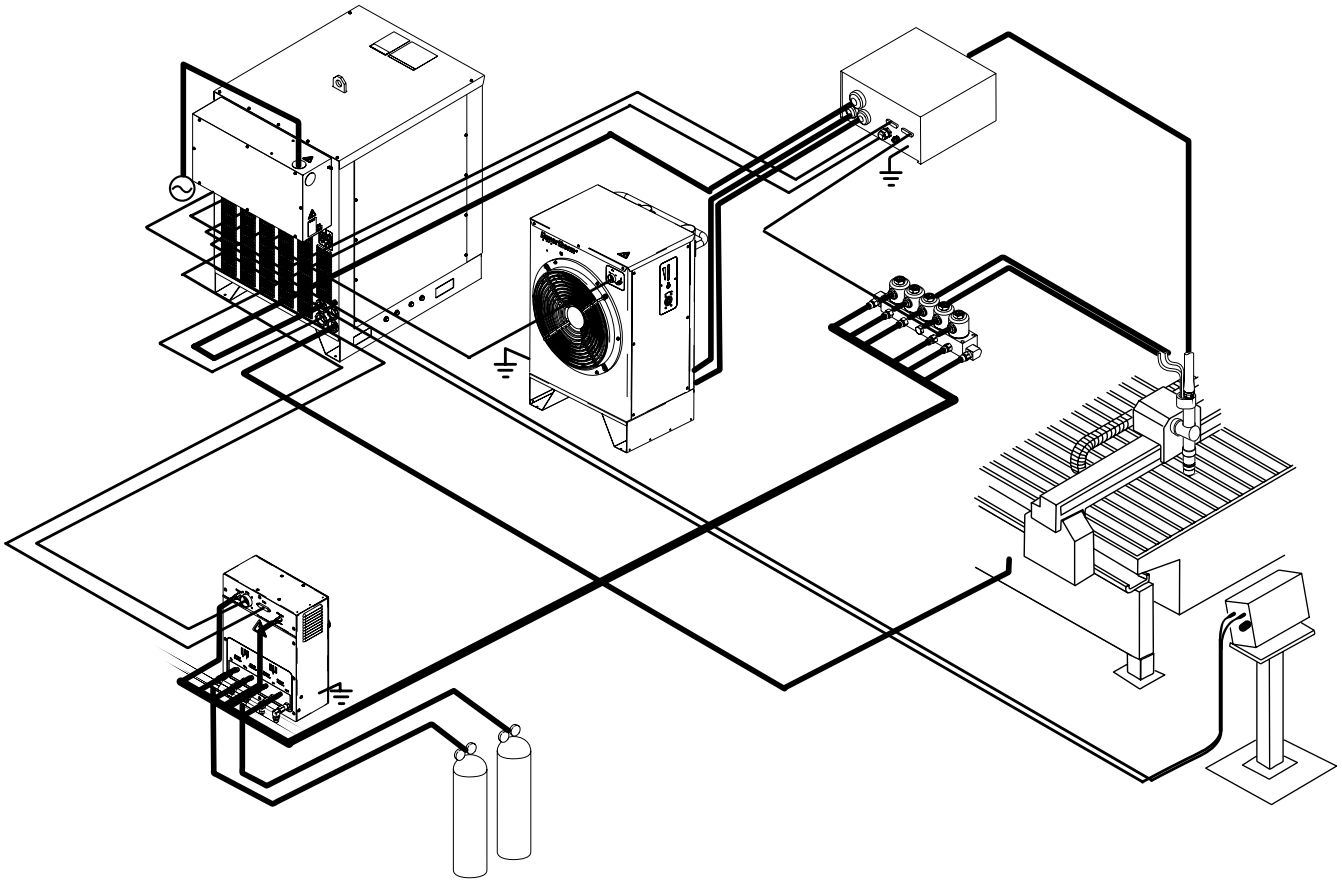
HySpeed™ HT4400®

Plasma Arc Cutting System

Instruction Manual
803580 - Revision 9



Hypertherm®

The world leader in plasma cutting technology™

Changed Page	Description of Change	IM358 Rev 8 to 9	3/28/05
4.15, 4.16, 6.11 and 6.12	Added part number and information for SilverPlus electrode.		

Changed Page	Description of Change	IM358 Rev 7 to 8	12/22/04
General	Coolant system upgrade. Changes pump, motor and some hoses in the coolant loop.		
3.3, 3.8, 3.19	Caution box text updated.		
4.22	Corrected English cut chart, cutting speed for 3/8". 4050 mm changed to 3050 mm.		
5.21 and 5.23	Corrected LED number for "Arc On". D24 changed to D26		
5.38-5.43	New preventive maintenance information added. Preventive maintenance protocal, master schedule, protocal checklist.		
6.8	Added item number 9, manifold and solenoids.		
6.9	Art updated to show Coolant System Upgrade. Part numbers changed. Item number 5 changed from 129906 (Kit: Pump Upgrade) to 128968 (Coolant System Upgrade). Pump item number (031138) added. Description changed for item number 9 from "Filter Assembly: 25 Micron" to " FIlter Housing.		
6.12	Corrected consumable parts kit items to match BOM in Oracle. Removed part numbers 120800 and 120804. Added electrode pit depth gauge (004630), Nozzle: 400A Oxygen CW (120934), Swirl ring: 400A Oxygen CW (120939). Changed Qty of consumables - 120777 from 3 to 2, 120785 from 3 to 2, 120787 from 3 to 2, 120793 from 3 to 2, 120794 from 6 to 4,120802 from 3 to 2, 120810 from 3 to 2, 120855 from 6 to 4 and 120856 from 3 to 2.		
6.14	Changed electrode pit depth gauge part number from 004147 to 004630.		
Wiring diagrams Section 7	013338 Diagrams went to Rev "K".		

Changed Page	Description of Change	IM358 Rev 6 to 7	4/26/04
General	Coolant pump changed. The coolant system must use Hypertherm coolant. If the system is run with water as coolant catostrphic pump failure will occur.		
iii, iv, v, vi, 2.1, 2.2, 2.7, 2.8, 3.1, 3.3, 3.11, 3.12, 3.18, 3.19, 3.29, 4.28, 5.1, 5.3, 5.4, 5.14, 5.34, 6.1, 6.9, 6.4	Water removed from cooler and or coolant description. Was "water cooler" now "cooler" or "water flow" changed to "coolant flow"		
3.3, 3.8, 3.19	Caution added.		
3.3	Information changed and added under "Torch Coolant Requirements"		
3.4	Information changed and added under "Water Purity Requirements"		
4.25	Water removed from bullet connector description. Was "water bullet connector" now "coolant bullet connector"		
5.3	Pump strainer cleaning deleted. The new pump has no strainer.		
6.9	Art updated to show new pump. Part numbers changed. Item number 9 changed from 129619 (Pump-Motor Assembly) to 229036 (Motor Sub-Assembly). Item number 10 changed from 129738 (Pump Sub-Assembly) to 128906 (Kit: Pump Upgrade).		
Wiring diagrams Section 7	013338 Diagrams went to Rev "J".		

Changed Page	Description of Change	IM358 Rev 4 to 6	7/11/03
2.3	Max gas flow rate for Air changed from 250 scfh to 200 (correction)		
3.7	Contactor light removed from art. TB "U,V,&W" labels rearranged. Warning changed to remove reference to "neon" light.		
5.16	Light on contactor removed from art. Warning changed to remove reference to "neon" light.		
6.4	Part number for start circuit changed from 129349 to 129851		
6.6	Contactor and contactreplacement kit numbers changed. Contactors from 003116 to 003217 and 003172 to 003218. Contact replacement kits from 129227 to 129972 and 129228 to 129973Contactor light removed from art.		
6.13	Contactor part number changed under recommended spare parts - power supply. 003116 to 003217 and 003172 to 003218.		

Changed Page	Description of Change	IM358 Rev 3 to 4	11/14/01
6.9	Updated parts to include lo-profile filter, P/Ns 128714 & 027927. Item #'s rearranged to fit new art.		

Changed Page	Description of Change	IM358 Rev 2 to 3	9/19/01
TOC pgs v & vi	Updated Section 5 to include added pages. Re-numbered pgs 5.17-end.		
2.5	Correction: Metric call out for 3.5" was 63mm changed to 89mm.		
5.1	Updated to include added pages. Re-numbered pgs 5.17-end.		
5.8 & 9	Updated information in cause column for PC, PP, SC & SP (display column).		
5.36	Added page for Pressure Switch Settings.		
6.4	Added part # 003021 120VAC Relay.		
6.9	Added part # 129738 Pump subassembly.		
6.10	Added part #s 128654, 058224 & 044030. Re-numbered items. Updated torch body art.		
6.11	Part # 129787 corrected, now 120787.		
Ap. c	Footer changed to HT4400 (was HD4070) Line art of 2-stage Reg changed to photo.		
Ap.d	Updated data in table.		
Ap.e	Correction of all mild steel cutchart s. O_2 Plasma/O2-N2 shield (was N2 Plasma).		

Rev	Changed Page	Description of Change IM358 Rev 1 to 2 11/16/00
2	Cover	Added system art
2	Title page	Changed Rev and date
2	TOC	Updated to match Rev change
2	Address page	updated format
2	2.3	Updated table to include Air
2.1	2.4 slip pg'd	Added 440V power supply part # & specs
2	2.5	Updated torch art
2.1	2.5 slip pg'd	Updated torch w/ dim art to include 2.5" length dimension
2	2.6	Updated gas console art
2	3.1	Updated to match rev changes
2	3.1	TB3 graphic updated. Added Plasma start... & Hold...
2	3.10-3.12	Graphics update
2	3.14-3.15	Graphics update
2	3.17	Added 10a hoses
2	3.21 & 3.22	TB3 graphic updated. Added Plasma start... & Hold...
2	3.23	Text added
2	3.25	Updated gas console art
2	4.1	Updated to match rev changes
2	4.2	Updated gas console art
2	4.9-4.11	Updated gas console art
2	4.13	Adde pressure and Kerf tables
2	4.14	Added page, updated table to include air
2	4.15-4.22	Cutchart format change and data change to reflect O2/Air process
2	4.23	added text
2	4.27	added text
2	5.1	Updated to match rev changes
2	5.2	Text change
2	5.3	Changed format and added Pump strainer cleaning
2	5.4-5.5	Text change
2	5.8	Text change
2	5.11-5.14	System troubleshooting added. All pages after 5.14 bumped
2	5.19	Updated graphic and changed text
2.1	5.31 slip pg'd	1Ω s/b 10kΩ
2	5.36	Moved preventative maintenance page from last in manual
2	6.1	Updated to match rev changes
2	6.1	Updated torch lead art to reflect change on back end.
2	6.2	Part # changed from 041644 to 041690
2	6.8	Graphics update
2	6.9	Updated Pump art to include strainer in picture
2	6.14	Text edit
2	7	Wiring diagrams up rev'd to G
2		Added appendix E & F. Original cutchart data, new format. Original gases at 120psi
2.1	6.11 Slip pg'd	Part # 129787 corrected, now 120787

Rev	Changed Page	Description of Change IM358 Rev 0 to 1 5/1/00
1	0.04	Added Fume Emissions to TOC
1	2.02	text edit
0	2.09	Changed p/n of remote current control to 077020
1	3.01	Added "Fume Emissions" to TOC
1	3.02	Referenced appendix C
1	3.04	Added Fume Emissions reference
1	3.05	Referenced appendix D
1	3.08	Added note to install water cooler etc. lower than torch
1	3.10	Changed TB3 & TB4 picture
1	3.15	Changed graphic of plasma and shield sense hoses
1	3.16	Added 60 ft hose lengths
1	3.19	Added note referencing Post Installation
1	3.21	Changed TB3 & TB4 picture
1	3.21	Added pierce complete and error counter signals to Machine interface cable
1	3.23	Added graphic showing correct mounting of torch to leads
1	3.24	text edit
1	3.24	bumped page
1	3.25	bumped page
1	3.26	bumped page
1	4.11	Changed range of pressure readings from +/- 2 psi to +/- 3psi
1	4.13	Changed p/n of 400A nozzle and swirl ring
1	4.13	Changed graphic and text to capabilities chart
1	4.14-4.21	Converted metric tables to more common thicknesses; changed p/n of 400A nozzle and swirl ring.
1	5.1	Changed 160 C to 160 F
1	5.3	New graphic of chopper
1	6.1	Changed graphic and part numbers for 400A nozzle and swirl ring
1	6.11	Changed graphic and part numbers for 400A nozzle and swirl ring
1	6.12	Changed part numbers for 400A nozzle and swirl ring cw and ccw
0	7.05	Changed p/n of remote current control to 077020
1	7.04-7.22	Uprevved wiring diagrams to E
1	c.0	Added appendix for gas regulators
1	d.0	Added appendix for noise levels

HT4400

Instruction Manual
(P/N 803580)

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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 affected 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 Powermax 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 sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the Products.

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 any 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 substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty.

Hypertherm

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, or 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

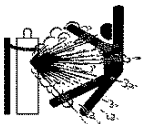
Work Cable Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

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

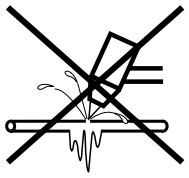
Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

- 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.

Hypertherm

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.

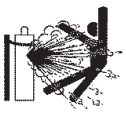
Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

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

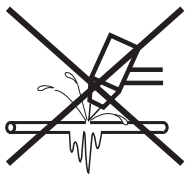
Les bouteilles de gaz contiennent du gaz à haute pression. Si une bouteille est endommagée, elle peut exploser.

- 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

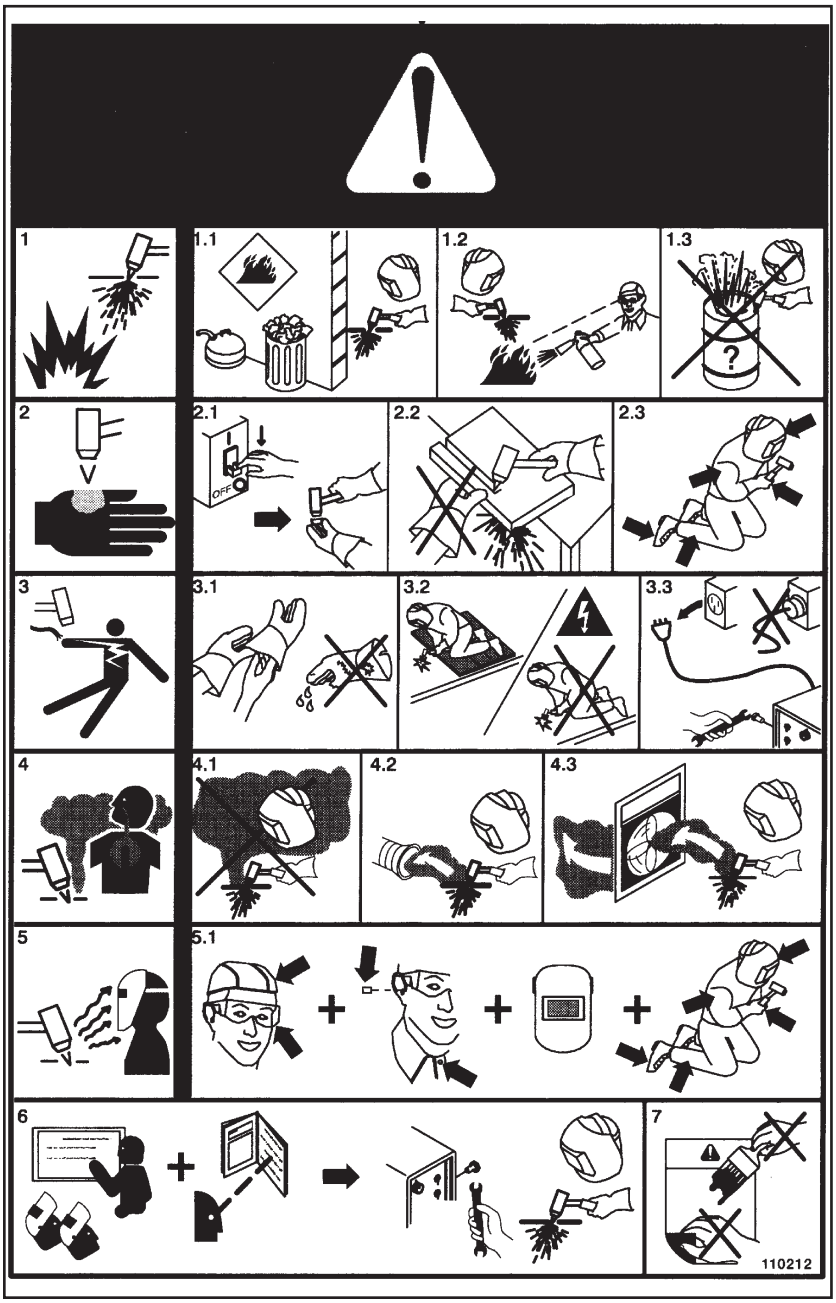
Les champs magnétiques produits par les courants à haute tension peuvent affecter le fonctionnement des prothèses auditives et des pacemakers. Les personnes portant ce type d'appareil doivent consulter un médecin avant de s'approcher d'un lieu où s'effectue le coupage ou le gougeage plasma.

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.

Hypertherm

Section 2

SPECIFICATIONS

In this section:

System Components

See Section 3 for details of the system interconnections.

Power Supply

The power supply houses four 100-amp, 15 kHz choppers to produce up to 400A of constant current DC output.

Machine Torch

The maximum production cutting capability of the torch is 1-1/4 inches (32 mm). **To achieve consumable long life, all cuts must begin and end on the plate surface**.

Valve Cluster

The valve cluster consists of 5 valves and interfaces with the machine torch, the ignition console and the gas console. The valve cluster must be located within 4 ft (1.2 m) of the torch and within 50 ft (15.3 m) of the gas console.

Gas Console

This unit houses metering and solenoid valves, pressure readout LEDs and gas selection switches to choose, set and monitor plasma and shield gases. The gas console must be located within 50 ft (15.3 m) of the valve cluster.

Ignition Console

The ignition console generates a high voltage, high frequency signal and couples it to the cathode lead and pilot arc lead. This ignition console must be located within 15 feet (4.6 m) of the torch.

Cooler

This unit circulates a coolant solution to the torch. The cooler interfaces with the ignition console and the power supply. For more information, see *Torch Coolant Requirements* in the Installation section of this manual.

Remote Current Control Console - Optional

The remote current control console contains a thumb-wheel switch to set the arc current. If a machine interface will provide current control for the plasma system, you will not need this console.

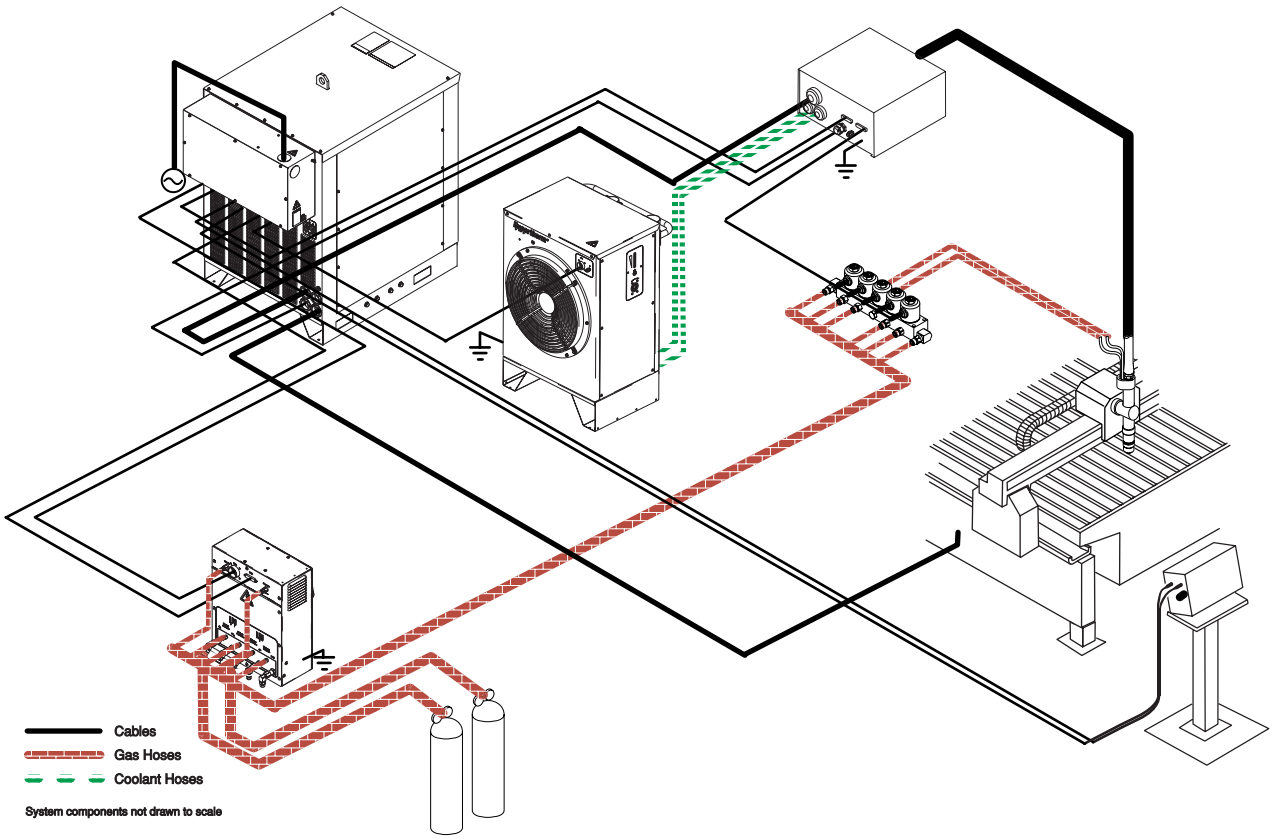
Command THC - Optional

The Command THC 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 Command THC instruction manual 802780 for more detailed information.

Specifications

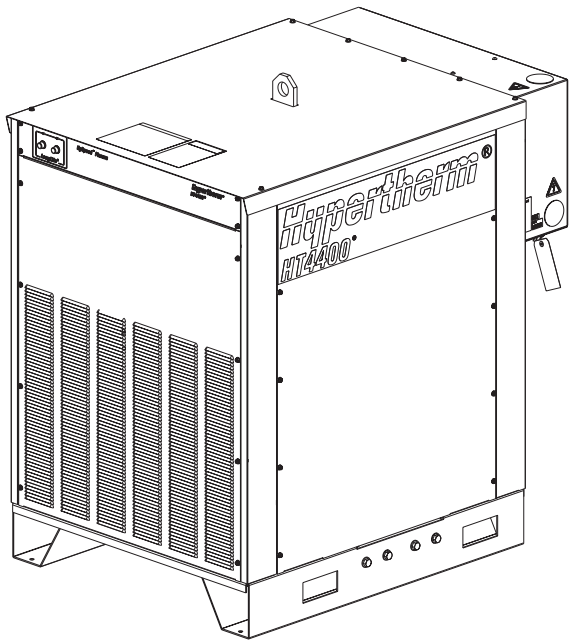
System Requirements

Gas Requirements:	
Plasma Gas Types	Oxygen, Nitrogen
Shield Gas Types	Air; Nitrogen
Gas Quality:	
Oxygen	99.5% pure (liquid gas recommended)
Nitrogen	99.995% pure (liquid gas recommended)
Air	99.995% pure (liquid gas recommended)
Maximum Gas Flow Rates and Inlet Pressures:	
Oxygen	140 scfh (3965 sclh) @ 120 psi +/- 10 psi (8.3 bar +/- 0.7 bar)
Nitrogen	250 scfh (7080 sclh) @ 120 psi +/- 10 psi (8.3 bar +/- 0.7 bar)
Air	200 scfh (5664 sclh) @ 120 psi +/- 10 psi (8.3 bar +/- 0.7 bar)



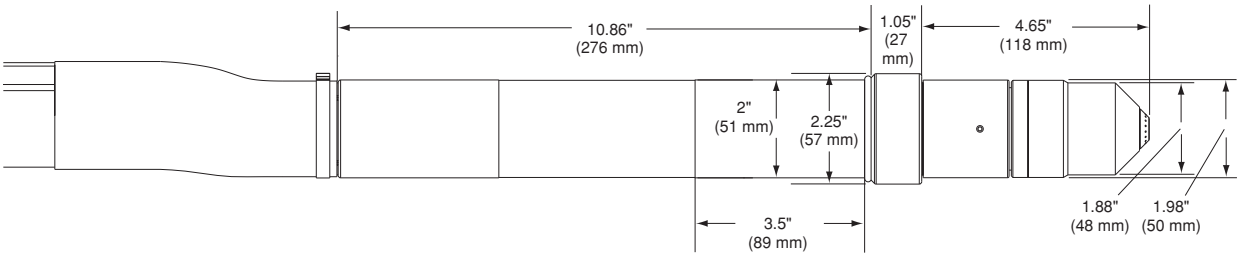
Power Supply

Maximum OCV (U_0)	361 VDC
Maximum Output Current (I_2)	400 Amps
Output Voltage (U_2)	80-200 VDC
Duty Cycle Rating (X)	100% @ 89 kVa, 104° F (40° C)
Temperature Rating	14° F (-10° C) to 104° F (40° C)
Power Factor (cosφ)	0.94
Cooling	Forced Air (Class F)
Input Power (Input Voltage [U_1 – Input Voltage; I_1 – Input Current])	
077036	200 VAC (U_1), 3 Phase, 50-60 Hz, 257A (I_1)
077037	400 VAC (U_1), 3 Phase, 50-60 Hz, 128A (I_1)
077046	440 VAC (U_1), 3 Phase, 50-60 Hz, 117A (I_1)
077033	480 VAC (U_1), 3 Phase, 60 Hz, 107A (I_1)
077038	600 VAC (U_1), 3 Phase, 60 Hz, 86A (I_1)
∗ In accordance with IEC 61000-3-12, the R_{sce} (short Circuit Ratio) for the 400 VAC power supply is 100.	
Dimensions and Weight	
Width	34" (863 mm)
Maximum Height	51" (1295 mm)
Maximum Depth	48-11/16" (1236 mm)
Weight	1800 lbs (817 kg)



Machine Torch – 128342 (with 15 ft (4.6 m) Leads) See Section 6 *Parts List* for other lead lengths

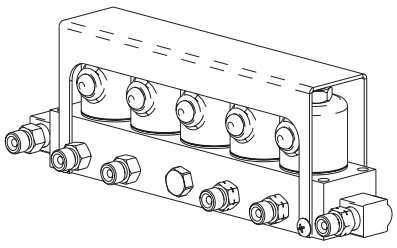
Maximum recommended production cutting thickness	1-1/4" (32 mm)
Maximum current at 100% duty cycle	400 Amp
Dimensions	See figure below
Weight - Torch only	2 lbs (0,9 kg)
Weight - Torch and 15 ft (4.6 m) leads w/o coolant	14.7 lbs (6,7 kg)

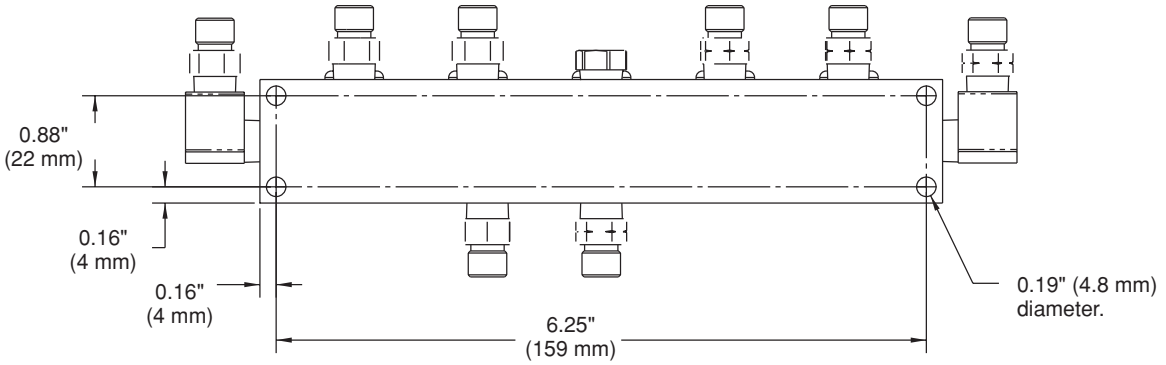


Torch with Dimensions

Valve Cluster – 077035

Dimensions and Weight	
Weight	6.6" (168 mm)
Height	2.5" (64 mm)
Depth	1.2" (30 mm)
Weight	2.5 lbs (1,1 kg)

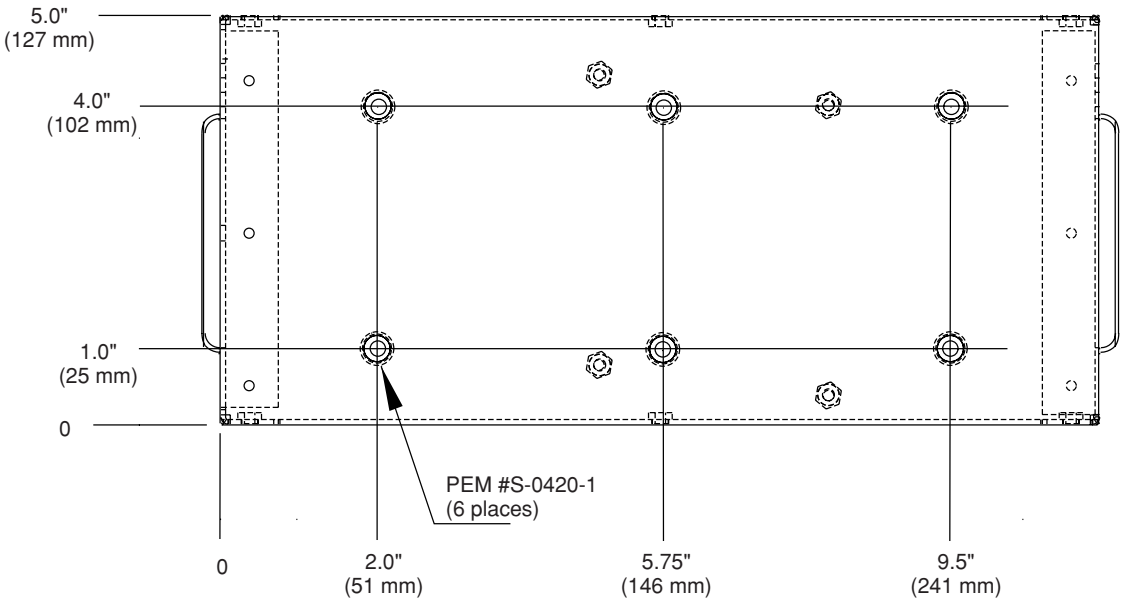




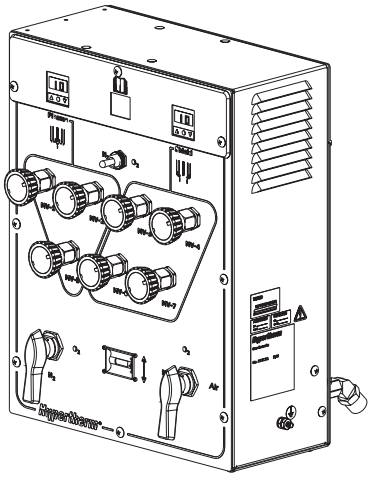
Valve Cluster Mounting Dimensions

Gas Console – 077032

Dimensions and Weight	
Width	11.5" (290 mm)
Height	14.5" (370 mm)
Depth	5.0" (127 mm)
Weight	28.7 lbs (13 kg)

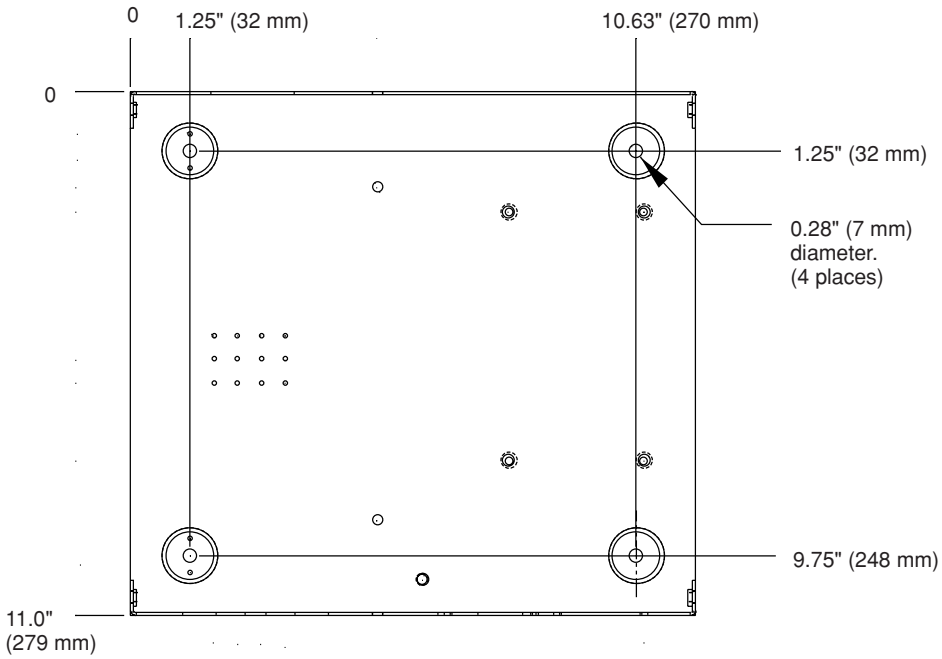


Gas Console Mounting Dimensions (bottom view)



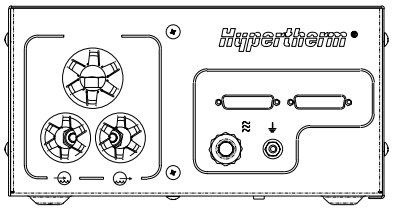
Ignition Console – 078088

Dimensions and Weight	
Width	12" (305 mm)
Height	6.25" (159 mm)
Depth	11.25" (286 mm)
Weight	20.5 lbs (9.3 kg)

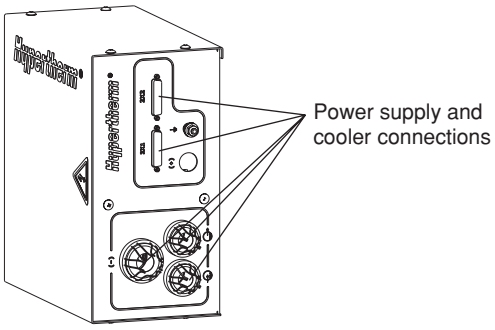


Ignition Console Mounting Dimensions (bottom view)

Hypertherm recommends mounting the ignition console either horizontally or in the vertical position with the power supply and cooler connections facing out as shown.



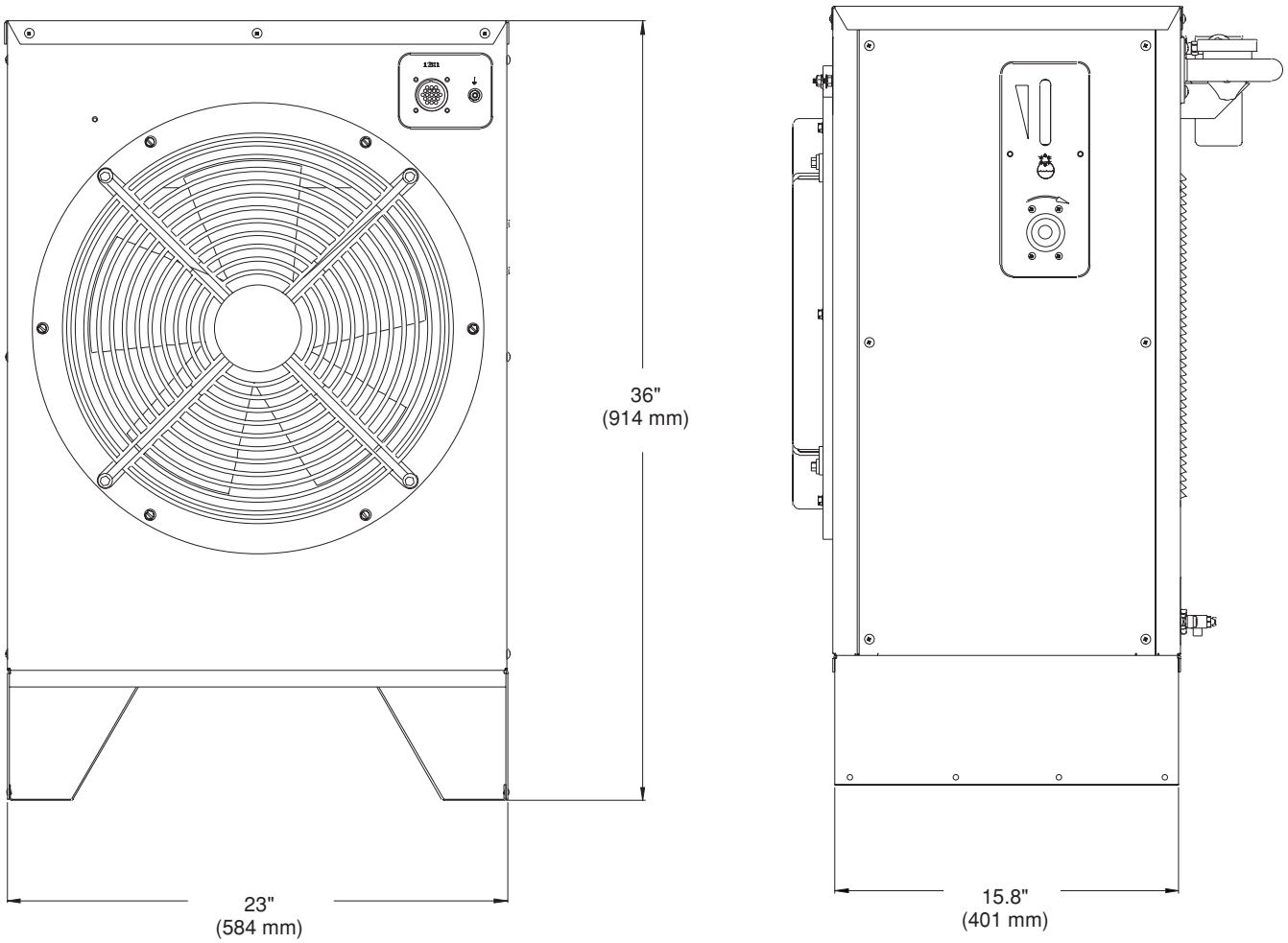
Horizontal Mounting



Vertical Mounting

Cooler– 077034

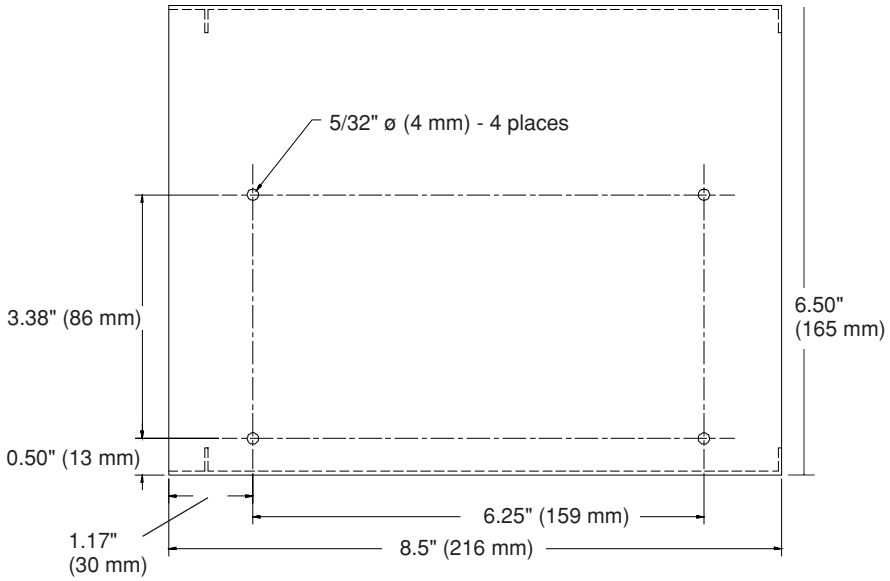
Dimensions and Weight	
Width	23" (584 mm)
Height	36" (914 mm)
Depth	15.8" (401 mm)
Weight	148 lbs (67,2 kg)
Coolant capacity	2.5 gal (9.5 l)
Maximum coolant flow	0.85 gpm (3.2 l/min)



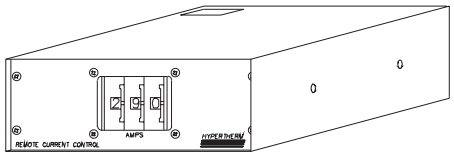
Cooler with Dimensions

Remote Current Control Console – Optional – 077020

Dimensions and Weight	
Width	6.5" (165 mm)
Height	2.5" (64 mm)
Depth	8.63" (219 mm)
Weight	3 lbs (1 kg)



Remote Current Control Mounting Dimensions (bottom view)



Command THC - Optional

Refer to the Command THC Instruction Manual 802780.

Hypertherm

Section 3

INSTALLATION

In this section:

Installation Requirements

All installation and service of the electrical and plumbing systems must conform to national or local 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 nearest authorized Hypertherm distributor.

Gas Requirements

The customer furnishes all gases and gas-supply regulators for the system. Use a high-quality, 2-stage pressure regulator located within 10 ft (3 m) of the gas console. See Appendix C for gas regulator recommendations. Refer to Section 2 for gas and flow 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 or contamination in the supply hoses or connections,

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

Gas Supply Plumbing

Rigid copper plumbing or suitable flexible hose may be used for all gas supplies. Do not use steel pipe. After installation, pressurize the entire system and check for leaks.

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

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 cutflow conditions.

WARNING
CUTTING WITH OXYGEN CAN CAUSE FIRE OR EXPLOSION

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 cooler is shipped to the customer without any coolant in the tank. Hypertherm recommends a mixture of 30% propylene glycol, 69.9% deionized water, and .1% benzotriazole. This mixture resists freezing to +10° F (-12° C) and contains a corrosion inhibitor (benzotriazole) to protect copper surfaces in the coolant loop. This mixture is available in one-gallon containers by ordering 028872. 100% propylene glycol is available by ordering 028873.

Caution: For operating temperatures colder than the temperature stated above, the percentage of propylene glycol must be increased. Failure to do so could result in a cracked torch head, hoses, or other damage to the torch coolant system due to the torch coolant freezing.

See Figure b-1 chart in Appendix B to determine if a stronger propylene glycol/purified water solution is needed for your particular application.

Observe the warning and cautions below. Refer to the Material Safety Data Sheets in Appendix B for data on safety, handling, and storage of propylene glycol and benzotriazole.


WARNING
COOLANT CAN BE IRRITATING TO SKIN AND EYES AND HARMFUL OR FATAL IF SWALLOWED

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.

Caution

Use Hypertherm coolant (028872) to reduce the risk of damage from freezing and to prevent long-term corrosion.

Caution: Always use propylene glycol in the coolant mixture. Do not use automotive antifreeze in place of propylene glycol. Antifreeze contains corrosion inhibitors that will damage the torch coolant system.

Caution: Always use purified water in the coolant mixture in order to prevent corrosion in the torch coolant system. See Water Purity Requirements for Coolant Mixture.

Water Purity Requirements for Coolant Mixture

Maintaining a low level of calcium carbonate is critical for proper performance of the torch and components in the cooling system. Water purity should meet the requirements defined in the table below. When mixing Hypertherm coolant (P/N 028873 - 100% propylene glycol) with water to create the appropriate coolant mixture.

Note: If water purity exceeds maximum levels, mineral deposits may occur throughout the system.
If water purity is below minimum levels, soluble materials may leach into the coolant.

	Water Purity Measurement Methods			
Water Purity	**Conductivity µS/cm at 77° F (25° C)**	**Resistivity M /cm at 77° F (25° C)**	**Dissolved Solids (ppm of NaCl)**	**Grains per Gallon (gpg of $CaCO_2$)**
Pure Water (ref. only)	0.055	18.3	0	0
Maximum Purity	**0.5**	**2**	**0.206**	**0.010**
Minimum Purity	**18**	**0.054**	**8.5**	**0.43**
Max. Potable Water (ref. only)	1000	0.001	495	25

Grounding Requirements

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

See Appendix A 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 3/4" (19 mm) diameter driven to a depth of at least 15 feet (4.5 m) into the earth, below the permanent moisture level. Ensure that all grounding connections are tight to avoid excessive heating. See also *Grounding* in the Safety section. For additional information, consult national or local electric codes.

Caution: All accessory modules in the HT4400 system must be grounded to earth. Use a minimum of 8 AWG (10 mm2) wire connected from the stud on the side of each module enclosure to the worktable ground.

Note: The customer must supply all grounding wire.

Fume Emissions

Contact Hypertherm to receive the publication, *Fume Emissions Testing for Plasma Arc Cutting*.

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 with the plasma system. See also *Noise Protection* in the Safety section of this manual. See also Appendix D for noise levels measured on the HT4400 system.

Power Requirements

All switches, slow-blow fuses and power cables are customer supplied and must be chosen as outlined by applicable national or local codes. Installation must be performed by qualified personnel. Use a separate primary line disconnect switch for the power supply. If slow-blow fuses are not available or not allowed by applicable codes, use a motor-start circuit breaker.

Input Voltage	Phase	Rated Input Current @ 89 kW Output	Recommended Slow-Burn Fuse Size	Recommended Cable Size (AWG) rated for 60° C (140° F)	Recommended Cable Size (AWG) rated for 90° C (194° F)
200 VAC	3	257 amps	350 amps	**See Note below*	4/0 AWG
400 VAC	3	128 amps	175 amps	2/0 AWG	2 AWG
440 VAC	3	117 amps	175 amps	2/0 AWG	2 AWG
480 VAC	3	107 amps	150 amps	1 AWG	3 AWG
600 VAC	3	86 amps	125 amps	2 AWG	4 AWG

***** Note: Use the smaller diameter **4/0 AWG** cable (1.6" / 40.6 mm) rated for **90° C (194° F)** rather than an equivalent larger diameter cable (350 MCM, 2.05" / 52 mm) rated for 60° C (140° F) to accommodate the bend radius necessary to connect incoming power cable to the power supply.

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 national or local 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 suggested wire sizes listed in the table above were taken from the U.S. National Electric Code 1990 handbook, table 310.16. Use a 4-conductor (3 conductor with ground) input power cable with a conductor temperature rating of 60° C (140° F) or 90° C (194° F). The cable should be installed only by a licensed electrician following national or local codes.

Positioning the Power Supply

WARNING
ELECTRICAL SHOCK CAN KILL

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. Provide at least 3 feet (1 m) of room on all sides of the power supply to allow for easy access when servicing, and to allow the cooling fans to function properly.
- Cooling air is drawn in through the front panel grating, and 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.

Positioning the Cooler

- Place the cooler in an area that is free of excessive moisture, has proper ventilation, and is relatively clean. Provide at least 3 feet (1 m) of room on all sides of the cooler to allow for easy access when servicing, and to allow the cooling fans to function properly.

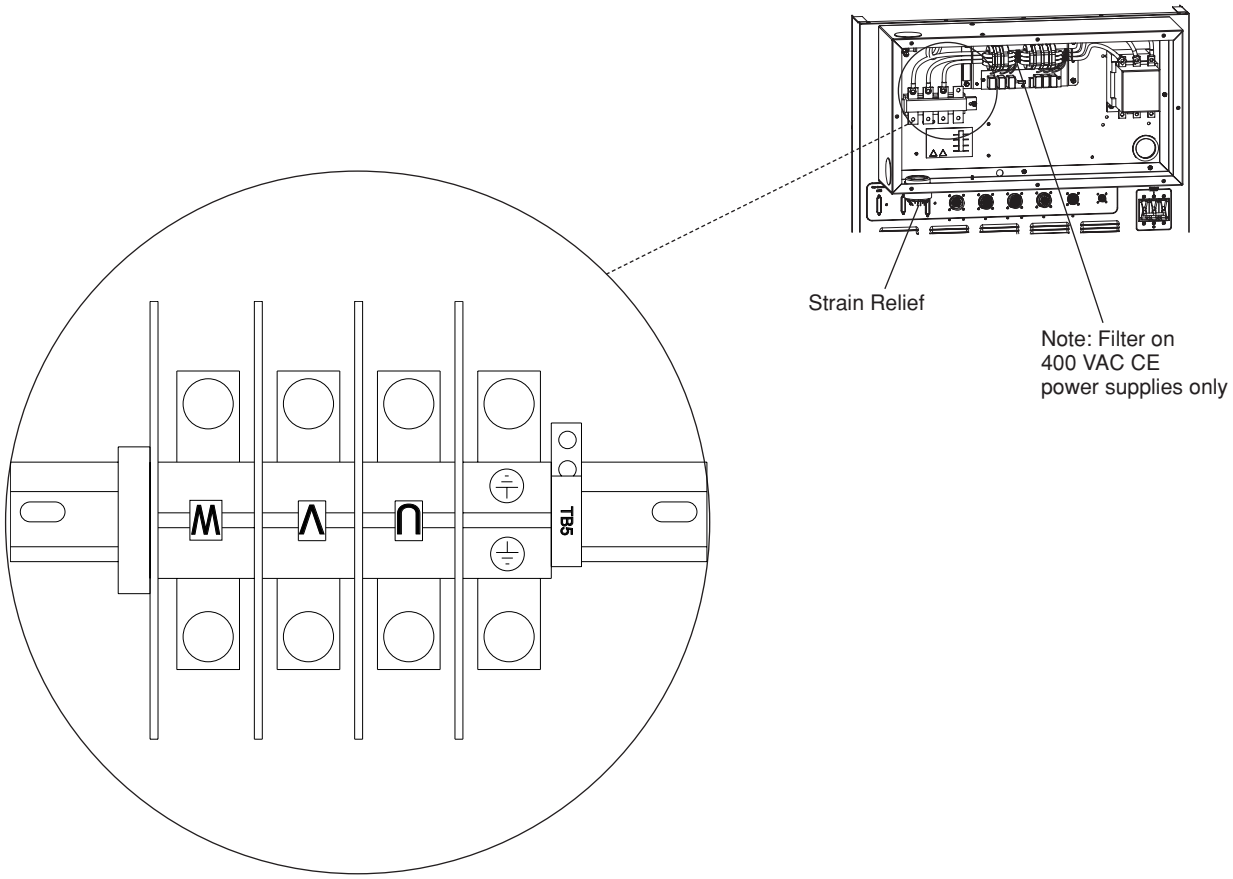
Connecting the Power

WARNING
ELECTRICAL SHOCK CAN KILL

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 - All Voltages

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 HT4400 system.**
2. Insert the power cable through the strain relief located in the rear of the power supply.
3. Connect the power leads to the W, V, and U terminals of TB5**.** See figure below.
4. Connect the ground lead (PE) to the stud marked ⏚ as shown below.
5. Connect the power cord leads to the line disconnect switch following national or local electrical codes..



WARNING
ELECTRICAL SHOCK CAN KILL

There is line voltage at the contactor if the line disconnect switch is in the ON position, even if the circuit breaker on the power supply is OFF. <u>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.</u>

Torch Lifter Requirement

The HT4400 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.

System Units Placement

- Position all required units prior to making electrical, gas and interface connections.
- Ground all external modules in the HT4400 system to earth.
- To prevent leaks in the system, tighten all gas and coolant connections to the following specifications:

Gas or Coolant Hose Size	Torque Specification		
	lbf-in	lbf-ft	kgf-cm
Up to 3/8" (9.5 mm)	75-85	6.25-7	86-98
1/2" (12 mm)	360-480	30-40	415-550

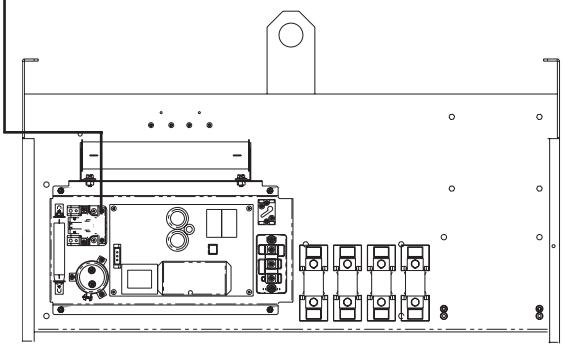
Use 2 wrenches when tightening to prevent damage to the mating component.

- Install the cooler, the ignition console and connecting coolant hoses at a lower height than the torch to prevent leaking when the torch body is disconnected from the torch leads.

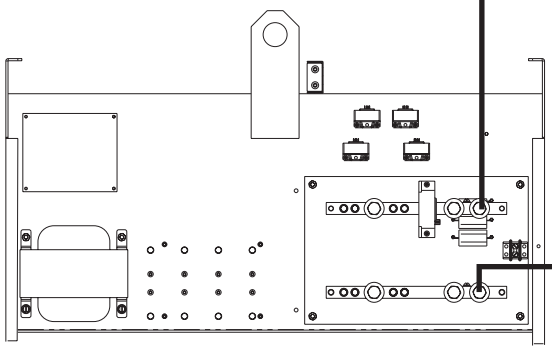
Use the *HT4400 System Connections* diagram later in this section to help make the system cable, torch and hose connections. Follow the number guide on the diagram to find out specific information on each cable, hose or connection. The numbered items are detailed on the pages following the diagram.

	Caution
	Use Hypertherm coolant (028872) to reduce the risk of damage from freezing and to prevent long-term corrosion.

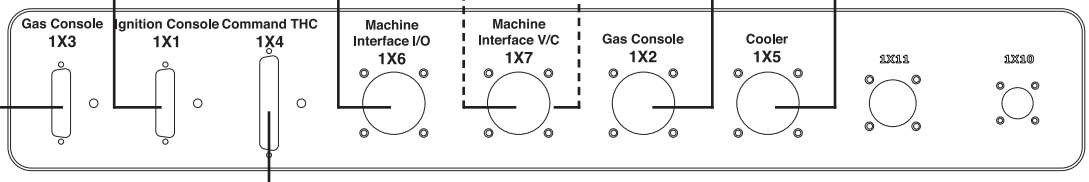
Notes



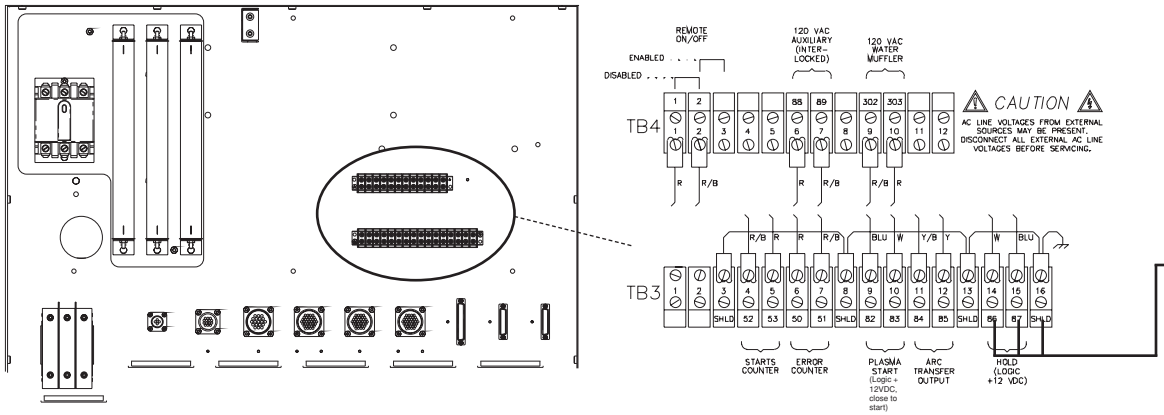
Power Supply
Center Bail Front



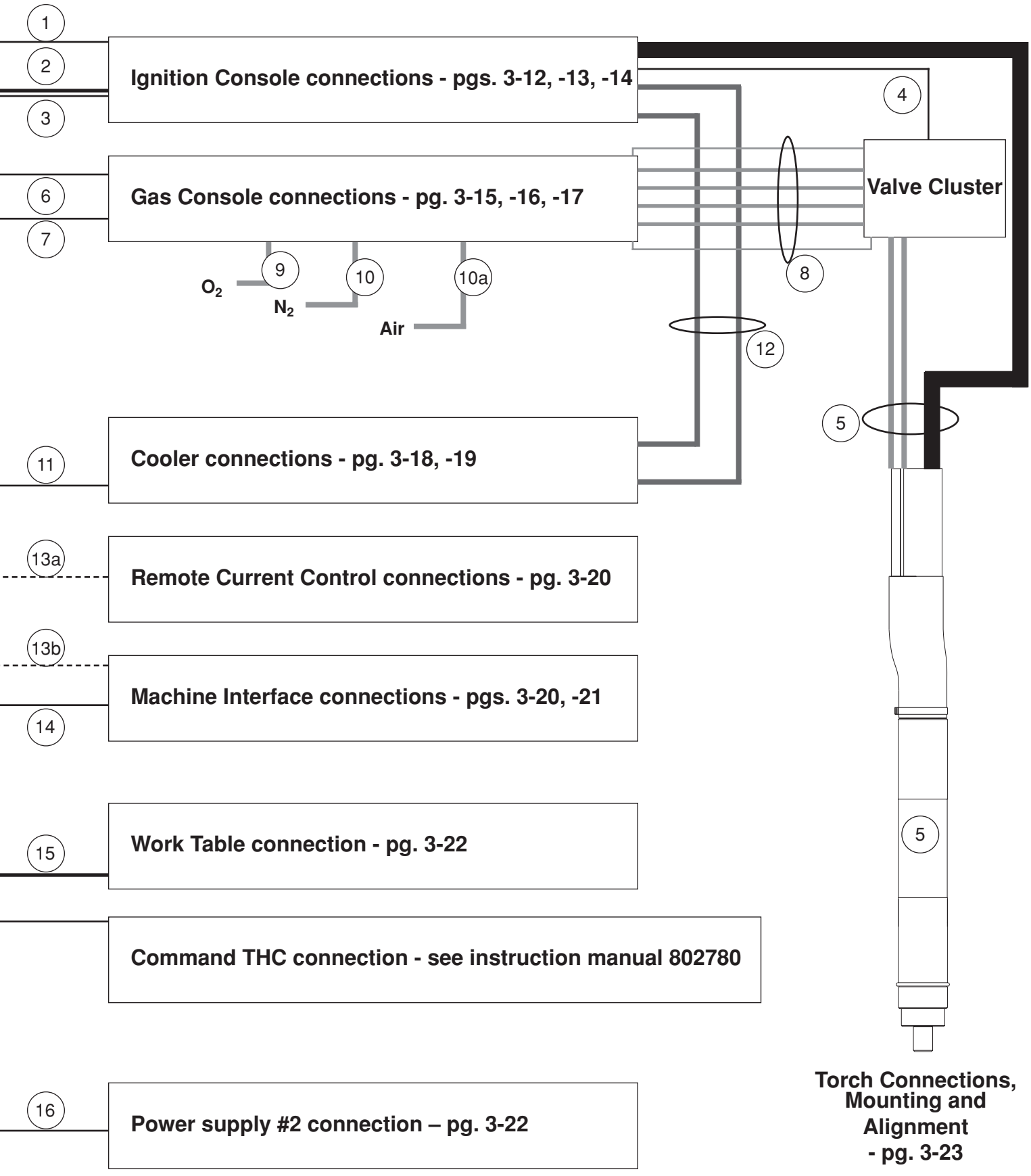
Power Supply
Center Bail Rear



Power Supply Rear Panel

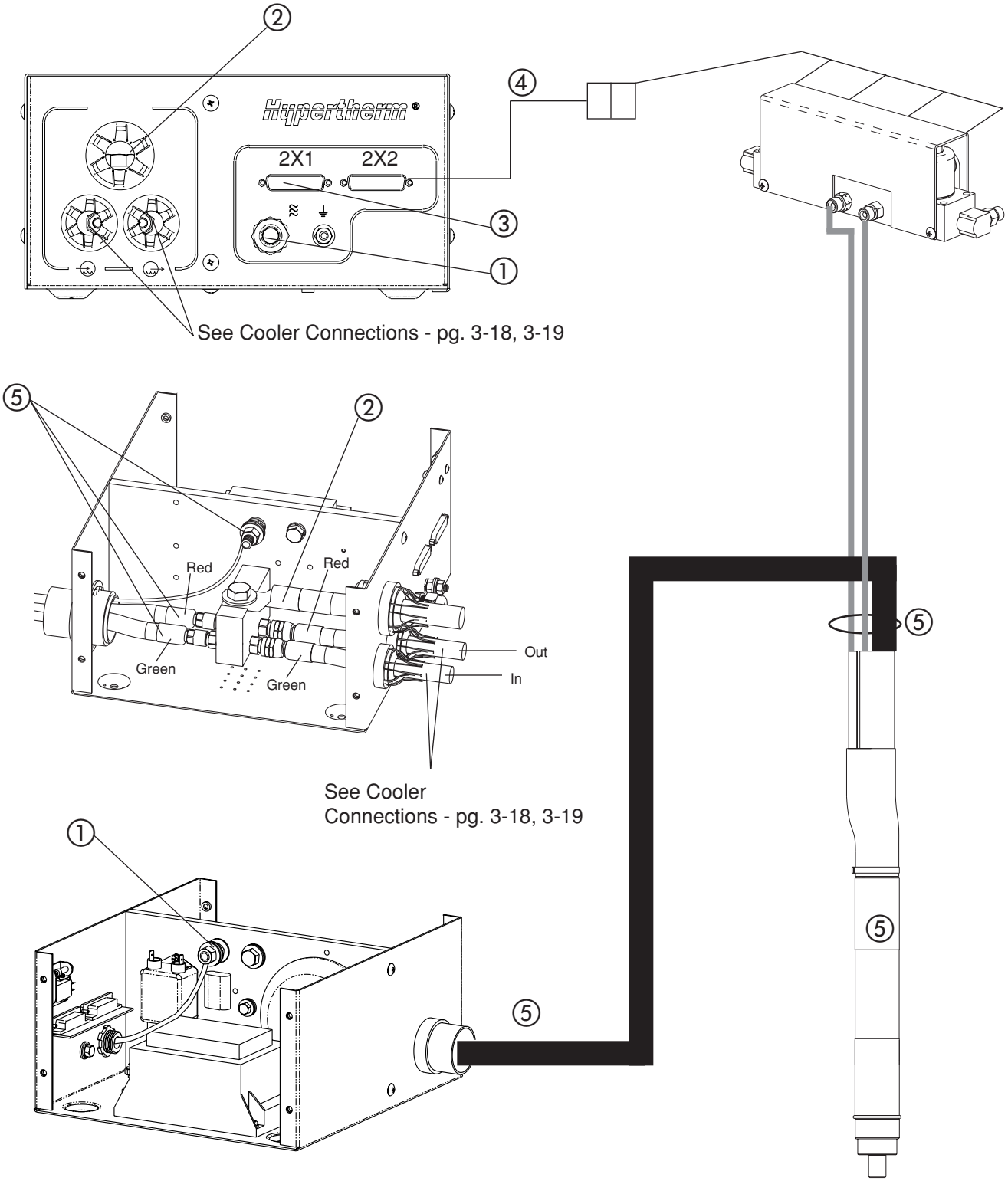


Power Supply
Rear Wall Inside



HT4400 System Interconnections

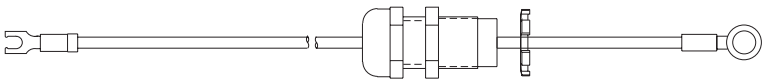
Ignition Console Connections – 1 of 3



See also *Torch Connections, Mounting and Alignment* later in this section.

Ignition Console Connections – 2 of 3

① Nozzle (Pilot Arc) Lead (+)

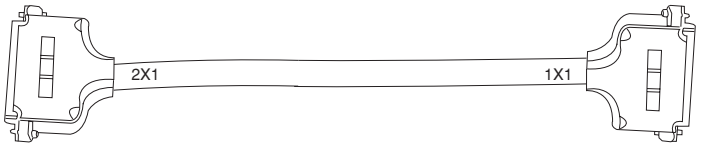


Part No.	Length	Part No.	Length
123552	10 ft (3 m)	123530	60 ft (18.3 m)
123553	15 ft (4.6 m)	123531	75 ft (22.9 m)
123554	20 ft (6.1 m)	123532	100 ft (30.5 m)
123528	25 ft (7.6 m)	123534	125 ft (38.1 m)
123555	30 ft (9.2 m)	123535	150 ft (45.8 m)
123556	40 ft (12.2 m)	123536	175 ft (53.4 m)
123529	50 ft (15.3 m)	123537	200 ft (61 m)

② Negative Lead (-)

Part No.	Length	Part No.	Length
123418	10 ft (3 m)	123316	60 ft (18.3 m)
023382	15 ft (4.6 m)	023124	75 ft (22.9 m)
023136	20 ft (6.1 m)	023080	100 ft (30.5 m)
023078	25 ft (7.6 m)	123084	125 ft (38.1 m)
023101	30 ft (9.2 m)	023081	150 ft (45.8 m)
023135	40 ft (12.2 m)	123097	175 ft (53.4 m)
023079	50 ft (15.3 m)	023188	200 ft (61 m)

③ Cable - Ignition Console to Power Supply



Part No.	Length	Part No.	Length
123446	10 ft (3 m)	123559	60 ft (18.3 m)
123557	15 ft (4.6 m)	123513	75 ft (22.9 m)
123447	20 ft (6.1 m)	123514	100 ft (30.5 m)
123448	25 ft (7.6 m)	123515	125 ft (38.1 m)
123449	30 ft (9.2 m)	123516	150 ft (45.8 m)
123450	40 ft (12.2 m)	123560	175 ft (53.4 m)
123512	50 ft (15.3 m)	123561	200 ft (61 m)

Installation Notes

①

Attach the ring terminal end of the nozzle lead to the bolt in the center panel of the ignition console as shown in the lower left figure on page 3-12. Secure the attached strain relief to the panel of the ignition console by tightening the nut in place.

Pass the fork terminal end of the nozzle lead through the small bushing in the lower rear of the power supply and connect to the start circuit assembly as shown on page 3-10.

②

Pass the negative lead through one of the 2" bushings in the lower rear of the power supply and connect to the lower bar (-) on the center bail rear as shown on page 3-10.

③

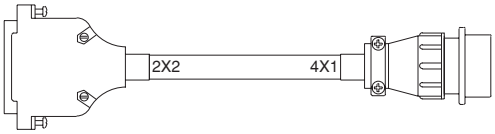
RUN LIST – Ignition Console to Power Supply Cable

Note: 2X1 and 1X1 are not labeled on the cable. Plug one cable end into the 2X1 Ignition Console receptacle and the other cable end into the 1X1 Power Supply receptacle.

SIGNAL	2X1	COLOR	1X1
S.S.I.	1	Black	1
S.S.I.	14	Red	14
SV8	7	Black	7
SV8	20	Orange	20
SV9	8	Red	8
SV9	21	White	21
SV10	9	Red	9
SV10	22	Green	22
SV11	10	Red	10
SV11	23	Blue	23
SV12	11	Red	11
SV12	24	Yellow	24
Gnd	6	Black	6
Gnd	12	Red	12
Gnd	19	Brown	19
Gnd	25	Brown	25

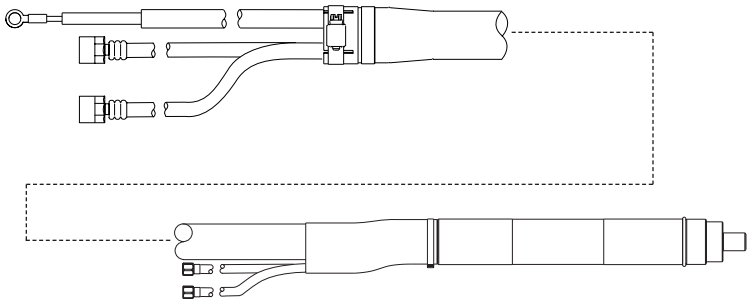
Ignition Console Connections – 3 of 3

④ Cable - Ignition Console to Valve Cluster



Part No.	Length	Part No.	Length
123509	6 ft (1.8 m)	123511	15 ft (4.6 m)
123510	10 ft (3 m)		

⑤ Torch Leads



Part No.	Length
128462	6 ft (1.8 m)
128463	10 ft (3 m)
128341	15 ft (4.6 m)

Installation Notes

④

RUN LIST – Ignition Console to Valve Cluster Cable

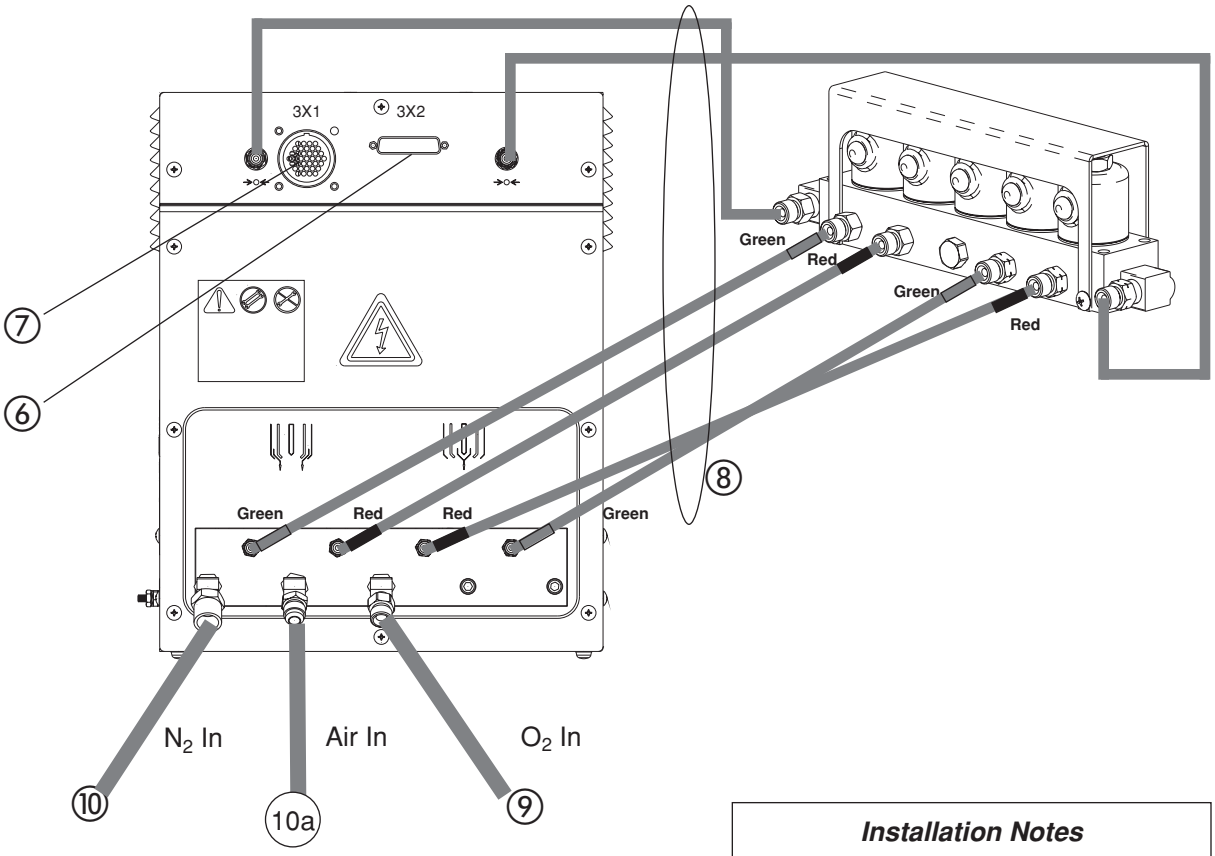
Note: 2X2 and 4X1 are not labeled on the cable. Plug one cable end into the 2X2 Ignition Console receptacle and the other cable end into the Valve Cluster cable receptacle.

SIGNAL	2X2	COLOR	4X1
SV8	7	White	1
SV8	20	Yellow	2
SV9	8	White	4
SV9	21	Orange	5
SV10	9	White	7
SV10	22	Brown	8
SV11	10	White	10
SV11	23	Black	11
SV12	11	White	13
SV12	24	Red	14
PE (Gnd)	6	White	12
PE (Gnd)	12	Green	3

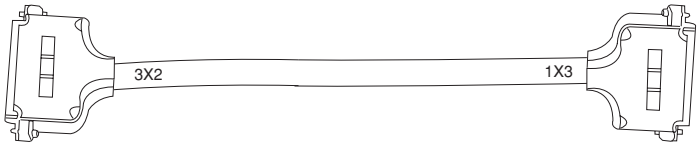
⑤

See also *Torch Connections, Mounting and Alignment* later in this section.

Gas Console Connections – 1 of 3



⑥ Cable 1 - Gas Console to Power Supply



Part No.	Length	Part No.	Length
123446	10 ft (3 m)	123559	60 ft (18.3 m)
123557	15 ft (4.6 m)	123513	75 ft (22.9 m)
123447	20 ft (6.1 m)	123514	100 ft (30.5 m)
123448	25 ft (7.6 m)	123515	125 ft (38.1 m)
123449	30 ft (9.2 m)	123516	150 ft (45.8 m)
123450	40 ft (12.2 m)	123560	175 ft (53.4 m)
123512	50 ft (15.3 m)	123561	200 ft (61 m)

Installation Notes

⑥

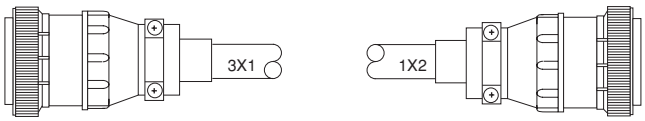
RUN LIST – Gas Console to Power Supply Cable -1

Note: 3X2 and 1X3 are not labeled on the cable. Plug one cable end into the 3X2 Gas Console receptacle and the other cable end into the 1X3 Power Supply receptacle.

SIGNAL	3X2	COLOR	1X3
28V	1	Black	1
Gnd	14	Red	14
28V Return	3	Black	3
Gnd	16	Blue	16
PS1	5	Black	5
Gnd	18	Brown	18
PS2	6	Black	6
Gnd	19	Orange	19
SOD+	8	Red	8
Gnd	21	Green	21
SOD–	9	Red	9
Gnd	22	Blue	21
Str2+	10	Red	10
Gnd	23	Yellow	23
Str2–	11	Red	11
Gnd	24	Brown	24
Clk2+	12	Red	12
Gnd	25	Orange	25
Clk2–	7	Red	7
Gnd	20	White	20

Gas Console Connections – 2 of 3

⑦ Cable 2 - Gas Console to Power Supply



Part No.	Length	Part No.	Length
123562	10 ft (3 m)	123568	60 ft (18.3 m)
123563	15 ft (4.6 m)	023497	75 ft (22.9 m)
123564	20 ft (6.1 m)	023498	100 ft (30.5 m)
123565	25 ft (7.6 m)	123087	125 ft (38.1 m)
123566	30 ft (9.2 m)	023499	150 ft (45.8 m)
123567	40 ft (12.2 m)	123031	175 ft (53.4 m)
023496	50 ft (15.3 m)	023500	200 ft (61 m)

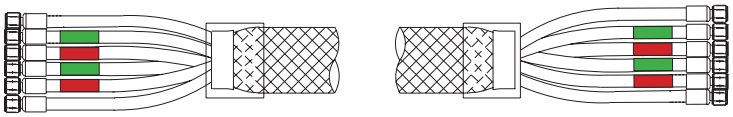
Installation Notes

⑦

RUN LIST – Gas Console to Power Supply Cable -2

SIGNAL	3X1	COLOR	1X2
Select O2/N2	1	Shield	1
Select O2/N2	5	Black	5
Select O2/N2	6	White	6
SV1	2	Black	2
SV1	3	Green	3
Gnd	7	Shield	7
SV2	8	Black	8
SV2	9	Blue	9
Gnd	4	Shield	4
BCD Common	10	Shield	10
BCD Bit 8	16	Black	16
BCD Bit 4	17	Yellow	17
BCD Bit 2	11	Black	11
BCD Bit 1	12	Brown	12
Gnd	18	Shield	18
SV6	19	Black	19
SV6	20	Orange	20
Gnd	13	Shield	13
SV3	23	Red	23
SV3	24	Yellow	24
Gnd	25	Shield	25
SV5	26	Red	26
SV5	27	Brown	27
Gnd	28	Shield	28
SV7	29	Black	29
SV7	30	Red	30
Gnd	34	Shield	34
SV Purge	32	Red	32
SV Purge	33	Blue	33
Gnd	37	Shield	37
SV4	35	Red	35
SV4	36	Green	36
Gnd	31	Shield	31

⑧ Hoses - Gas Console to Valve Cluster



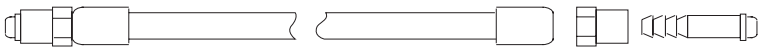
Hose Package – Gas Console to Valve Cluster:	Length	Plasma Preflow (green tape)	Plasma-Cutflow (red tape)	Shield-Preflow (green tape)	Shield Cutflow (red tape)	Plasma Sense	Shield Sense
128482	5 ft (1.5 m)	024620	024620	024628	024628	024591	024599
128483	10 ft (3 m)	024621	024621	024629	024629	024590	024598
128484	15 ft (4.6 m)	024622	024622	024630	024630	024589	024597
128485	20 ft (6.1 m)	024623	024623	024631	024631	024588	024596
128486	25 ft (7.6 m)	024624	024624	024632	024632	024587	024595
128487	30 ft (9.2 m)	024625	024625	024633	024633	024586	024594
128488	40 ft (12.2 m)	024626	024626	024634	024634	024585	024593
128489	50 ft (15.3 m)	024627	024627	024635	024635	024584	024592
128518	60 ft (18.3 m)	024653	024653	024652	024652	024650	024651

Gas Console Connections – 3 of 3

⑨ Oxygen Hose - Gas Console to Gas Supply

Part No.	Length	Part No.	Length
024607	10 ft (3 m)	024611	60 ft (18.3 m)
024204	15 ft (4.6 m)	024398	75 ft (22.9 m)
024608	20 ft (6.1 m)	024206	100 ft (30.5 m)
024205	25 ft (7.6 m)	024490	125 ft (38.1 m)
024609	30 ft (9.2 m)	024159	150 ft (45.8 m)
024610	40 ft (12.2 m)	024612	175 ft (53.4 m)
024155	50 ft (15.3 m)	024333	200 ft (61 m)

⑩ Nitrogen Hose - Gas Console to Gas Supply

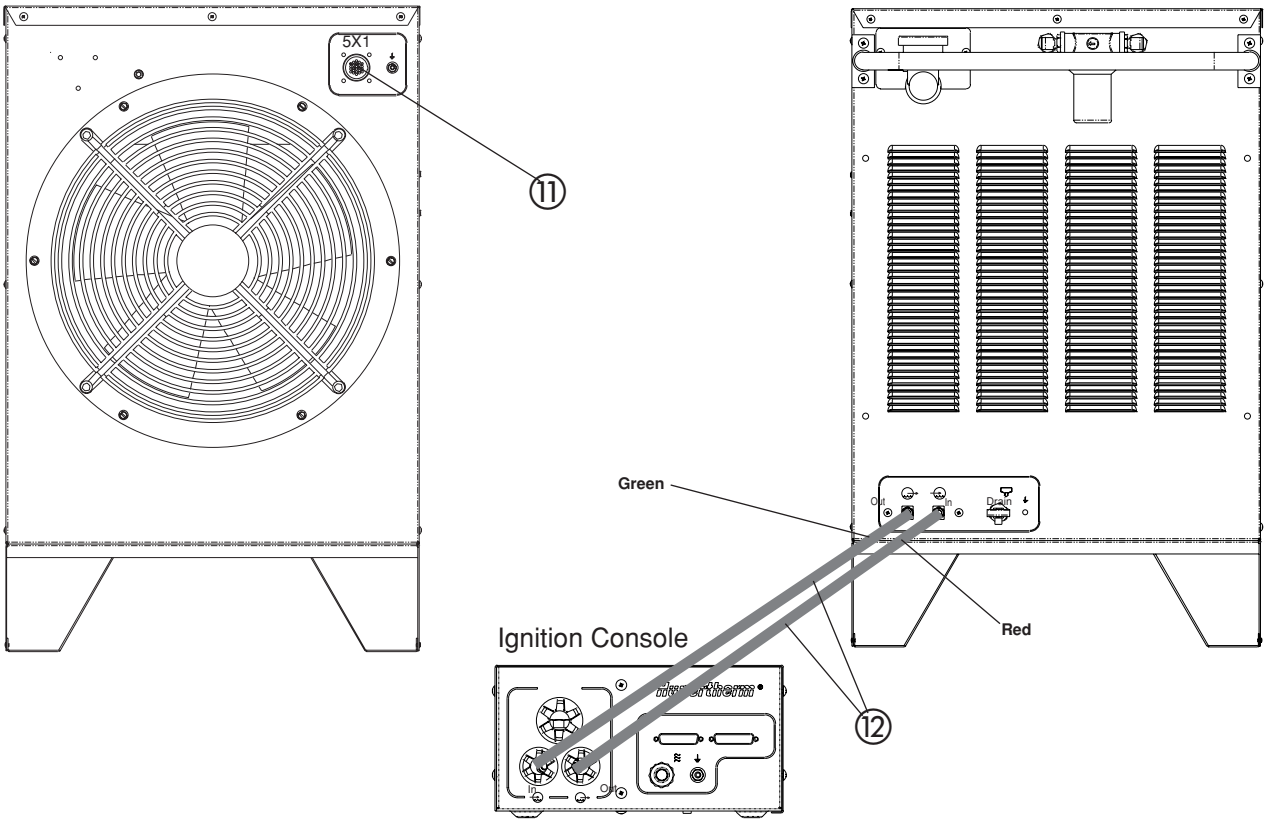


Part No.	Length	Part No.	Length
024210	10 ft (3 m)	024615	60 ft (18.3 m)
024203	15 ft (4.6 m)	024148	75 ft (22.9 m)
024232	20 ft (6.1 m)	024116	100 ft (30.5 m)
024134	25 ft (7.6 m)	024491	125 ft (38.1 m)
024613	30 ft (9.2 m)	024120	150 ft (45.8 m)
024614	40 ft (12.2 m)	024616	175 ft (53.4 m)
024112	50 ft (15.3 m)	024124	200 ft (61 m)

(10a) Air Hose - Gas Console to Gas Supply

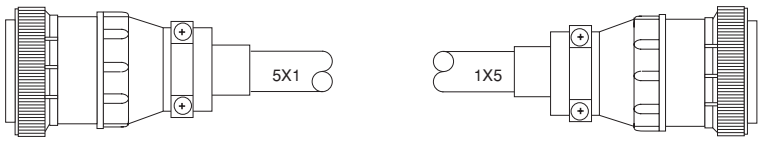
Part No.	Length	Part No.	Length
024671	10 ft (3 m)	024675	60 ft (18.3 m)
024658	15 ft (4.6 m)	024661	75 ft (22.9 m)
024672	20 ft (6.1 m)	024676	100 ft (30.5 m)
024659	25 ft (7.6 m)	024677	125 ft (38.1 m)
024673	30 ft (9.2 m)	024678	150 ft (45.8 m)
024674	40 ft (12.2 m)	024679	175 ft (53.4 m)
024660	50 ft (15.3 m)	024680	200 ft (61 m)

Cooler Connections – 1 of 2



Note:
Connect hose from **Out** of cooler to **In** of ignition console .
Connect hose from **In** of cooler to **Out** of ignition console.
See also Ignition Console connections on page 3-12.

⑪ Cable - Cooler to Power Supply



Part No.	Length
123517	5 ft (1.5 m)
123518	10 ft (3 m)
123519	15 ft (4.6 m)

Installation Notes

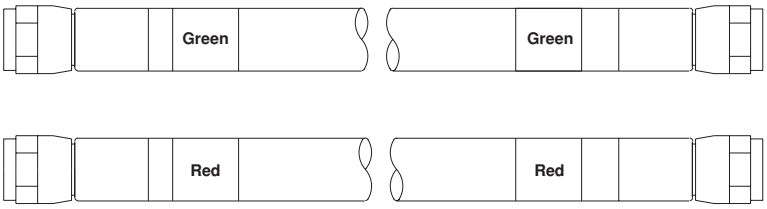
⑪

RUN LIST – Cooler to Power Supply Cable

SIGNAL	5X1	COLOR	1X5
Coolant Temp TS1 (Logic Level)	11	Black	11
Coolant Temp TS1 (Logic Level)	15	BLue	15
Shield	6	Shield	6
Flow Switch FS1 (120 VAC)	16	Yellow	16
Flow Switch FS1 (120 VAC)	12	Black	12
Shield	7	Shield	7
Pump (240 VAC)	17	Black	17
Pump (240 VAC)	18	Brown	18
Shield	19	Shield	19
Fan (120 VAC)	8	Black	8
Fan (120 VAC)	9	White	9
Shield	4	Shield	4
Solenoid V1 (120 VAC)	1	Black	1
Solenoid V1 (120 VAC)	2	Red	2
Shield	3	Shield	3

Cooler Connections – 2 of 2

⑫ Hoses - Cooler to Ignition Console

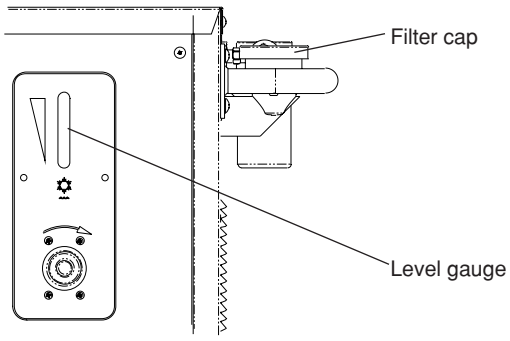


Part No.	Length	Part No.	Length
128499	5 ft (1.5 m)	128052	60 ft (18.3 m)
028652	10 ft (3.1 m)	028443	75 ft (22.9 m)
028440	15 ft (4.6 m)	028444	100 ft (30.5 m)
028653	20 ft (6.1 m)	028747	125 ft (38.1 m)
028441	25 ft (7.6 m)	028445	150 ft (45.8 m)
128495	30 ft (9.2 m)	128064	175 ft (53.4 m)
128496	40 ft (12.2 m)	028637	200 ft (61 m)
028442	50 ft (15.3 m)		

Note: There are 2 hoses contained in each hose set part number listed here.

	Caution
	Use Hypertherm coolant (028872) to reduce the risk of damage from freezing and to prevent long-term corrosion.

Adding Coolant to the Cooler

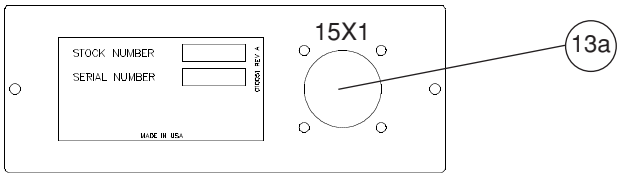


1. Install consumables in the torch: see *Changing Consumables* in Section 4.
2. Remove cooler filler cap.
3. Add coolant until level is full on the level gauge.
4. Turn the cooler on for 1 minute and add more coolant, if necessary.

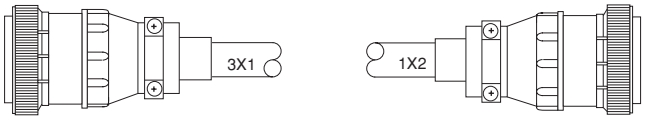
See *Post Installation* later in this section.

See also *Torch Coolant Requirements* earlier in this section.

Remote Current Control Connection



(13a) Cable - Remote Current Control to Power Supply



Part No.	Length	Part No.	Length
123150	10 ft (3 m)	123590	60 ft (18.3 m)
123586	15 ft (4.6 m)	023874	75 ft (22.9 m)
123587	20 ft (6.1 m)	023875	100 ft (30.5 m)
023871	25 ft (7.6 m)	123088	125 ft (38.1 m)
123588	30 ft (9.2 m)	023876	150 ft (45.8 m)
123589	40 ft (12.2 m)	123032	175 ft (53.4 m)
023873	50 ft (15.3 m)	023877	200 ft (61 m)

Installation Notes

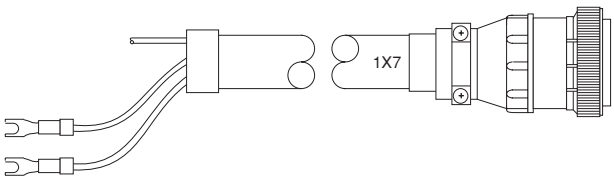
If a machine interface will provide current control, you will not need this cable. See Machine Interface Connections.

(13a) RUN LIST – Remote Current Control to Power Supply Cable

SIGNAL	15X1	COLOR	1X7
I 10	8	Black	2
I 20	7	White	3
I 40	10	Black	4
I 80	9	Green	5
I 100	15	Black	6
I 200	16	Red	7
I 400	14	Black	8
I Common	3	Shield	11

Machine Interface Connections - 1 of 2

(13b) Cable - Machine V/C Interface to Power Supply



Part No.	Length	Part No.	Length
123580	10 ft (3 m)	123584	60 ft (18.3 m)
023851	15 ft (4.6 m)	023855	75 ft (22.9 m)
123581	20 ft (6.1 m)	023856	100 ft (30.5 m)
023852	25 ft (7.6 m)	023903	125 ft (38.1 m)
123582	30 ft (9.2 m)	023857	150 ft (45.8 m)
123583	40 ft (12.2 m)	123585	175 ft (53.4 m)
023854	50 ft (15.3 m)	023858	200 ft (61 m)

Installation Notes

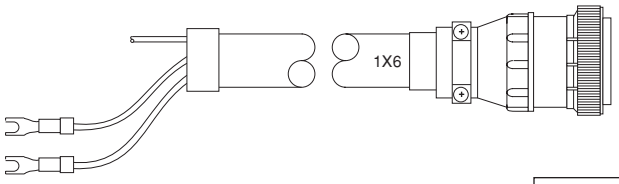
If the Remote Current Control console will provide current control, you will not need this cable.

(13b) RUN LIST – Machine V/C Interface to Power Supply Cable

SIGNAL	Terminal	COLOR	1X7
I 10		White	2
I 20		Red	3
I 40		Green	4
I 80		Orange	5
I 100		Blue	6
I 200		White/Black	7
I 400		Red/Black	8
I Common		Blue/Black	11
Shield		Shield	10

Machine Interface Connections - 2 of 2

⑭ Cable - Machine I/O Interface to Power Supply



Part No.	Length	Part No.	Length
123574	10 ft (3 m)	123579	60 ft (18.3 m)
123575	15 ft (4.6 m)	023894	75 ft (22.9 m)
123576	20 ft (6.1 m)	023895	100 ft (30.5 m)
023892	25 ft (7.6 m)	123089	125 ft (38.1 m)
123577	30 ft (9.2 m)	023896	150 ft (45.8 m)
123578	40 ft (12.2 m)	123033	175 ft (53.4 m)
023893	50 ft (15.3 m)	023897	200 ft (61 m)

Installation Notes

If using the Command THC, do not connect this cable.

⑭ RUN LIST – Machine I/O Interface t Power Supply Cable

SIGNAL	Terminal	COLOR	1X6
Remote OFF**	78	Green	32
Remote ON**	79	Red	37
Remote ON/OFF Shield**	Cut	Shield	26
Hold Signal (12VDC) Signal. Closed-ON;Open=OFF	87	White	1
Hold Common	86	Black	5
Hold Shield	Cut	Shield	10
Plasma Start (12VDC) Signal. Closed=Start	82	Blue	9
Plasma Start Signal	83	Black	15
Plasma Start Shield	Cut	Shield	14
Plasma Emergency Stop (24VAC) Signal. Closed=Stop	80	Yellow	28
Plasma Emergency Stop Signal	81	Red	33
Plasma Emergency Stop Shield	Cut	Shield	27
Arc Xfer Output - Signal. Dry contact relay†*	84	Red	36
Arc Transfer Output - Signal*	85	Blue	31
Arc Transfer Output - Shield*	Cut	Shield	25
Pierce Complete***	135	Orange	4
Pierce Complete***	136	Black	8
Pierce Complete Shield***	Cut	Shield	13
Error Counter	167	Green	35
Error Counter	168	Black	30
Error Counter Shield	Cut	Shield	24

Notes:

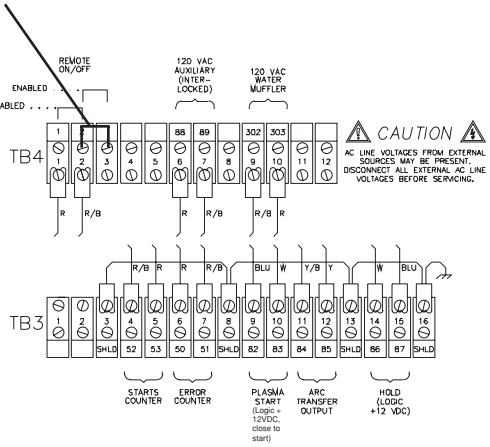
* Contact closes after arc transfer and time delay

** To enable a remote ON/OFF switch, the jumper on TB4 must be moved from terminals 1&2 to terminals 2&3 - see figure.

*** A contact closure will activate pierce complete and keeps shield in preflow mode. Open the contacts for shield cutflow mode.

Note on the µP PCB that resistor R150 and capacitor C78 are connected in series across the contacts. In some cases, one lead of R150 must be cut from the control PC board, as the R-C circuit may provide enough current flow to maintain machine motion input to the cutting machine.

****Move jumper to TB4 terminals 2&3 to enable a remote ON/OFF switch**



WARNING

When installing or servicing the HT4400, AC or DC line voltages may be present on the TRANSFER signals even if the power supply line disconnect switch is OFF. Make certain that all line disconnect switches relating to the HT4400 system are OFF during installation and when servicing.

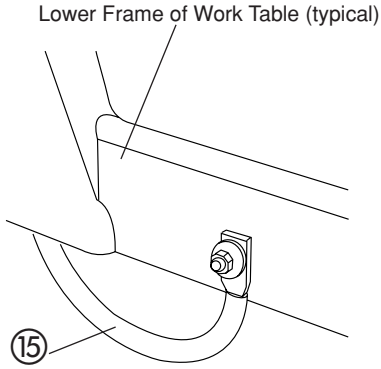
Work Table Connection

⑮ Cable - Power Supply to Work Table

Part No.	Length	Part No.	Length
123418	10 ft (3 m)	123316	60 ft (18.3 m)
023382	15 ft (4.6 m)	023124	75 ft (22.9 m)
023136	20 ft (6.1 m)	023080	100 ft (30.5 m)
023078	25 ft (7.6 m)	123084	125 ft (38.1 m)
023101	30 ft (9.2 m)	023081	150 ft (45.8 m)
023135	40 ft (12.2 m)	123097	175 ft (53.4 m)
023079	50 ft (15.3 m)	023188	200 ft (61 m)

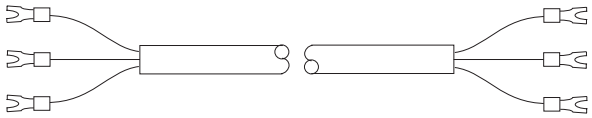
⑮ ***Installation Notes***

Pass the work cable through one of the 2" bushings in the lower rear of the power supply and connect to the upper bar (+) on the center wall rear as shown on page 3-10. Attach the other end to the work table.



Power Supply #2 Connection

⑯ Cable - Power Supply #1 to Power Supply #2



Part No.	Length	Part No.	Length
123591	10 ft (3 m)	123594	40 ft (12.2 m)
023340	15 ft (4.5 m)	023342	50 ft (15.3 m)
123592	20 ft (6.1 m)	023343	100 ft (30.5 m)
023341	25 ft (7.5 m)	023344	150 ft (45.8 m)
123593	30 ft (9.2 m)		

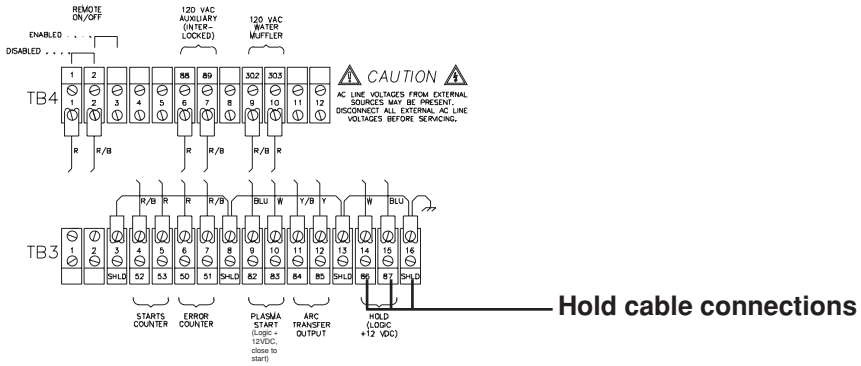
Installation Notes

When using a multi-torch system, the hold cable may be used to interface the two power supplies. Make connections at TB3 on both supplies. TB3 is located on the inside rear wall of the power supply. See figure below.

Note: This feature can also be directly controlled by the CNC.

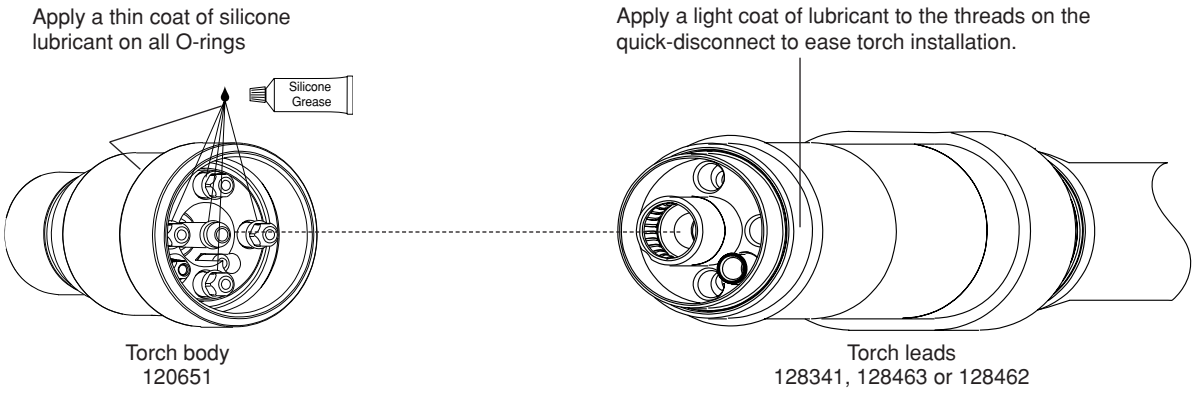
⑯ RUN LIST – Power Supply #1 to Power Supply #2

SIGNAL	PS#1	COLOR	PS#2
Hold Signal	86	Black	86
Hold Common	87	Red	87
Hold Shield	Gnd	Shield	Gnd



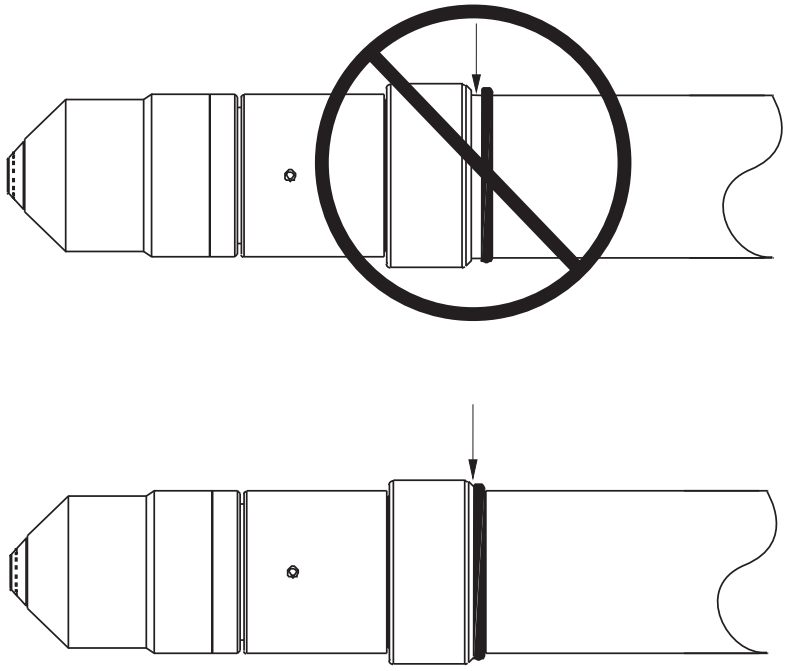
Torch Connections

Connecting the Torch to Torch Leads



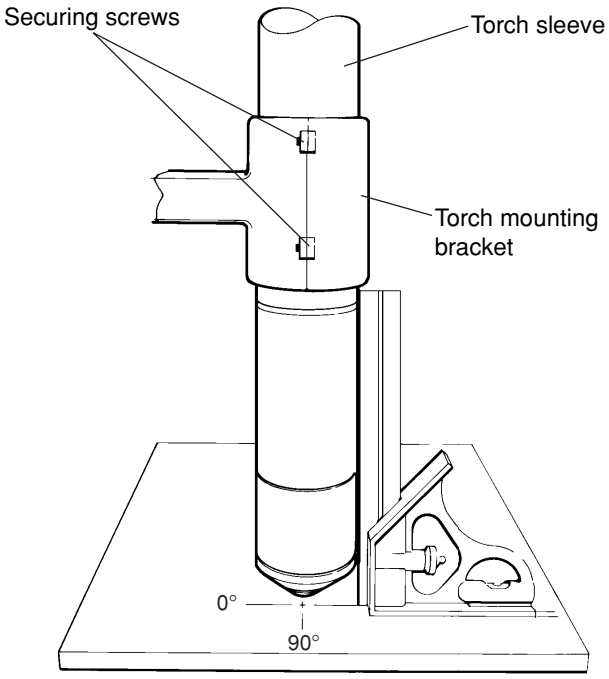
Installation Notes

Align the torch body to the torch leads and secure by screwing completely together. Be certain that there is no space between the torch body and the o-ring on the torch leads. See also *Ignition Console Connections* earlier in this section for torch lead connections to ignition console.



Torch Mounting and Alignment

Mounting the Torch



Installation Notes

1. Install the torch (with torch leads attached) in the torch mounting bracket.
2. Position the torch until the torch body extends all the way through the bracket, so that the bracket is now around the torch sleeve and not touching the torch body. Position the torch approximately 0.25" (6 mm) from the workpiece.
3. Tighten the securing screws.

Torch Alignment

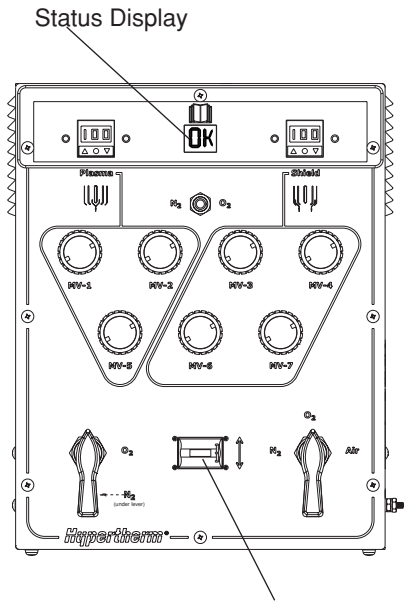
To align the torch at right angles to the workpiece, use a square at 0° and 90°. See figure above.

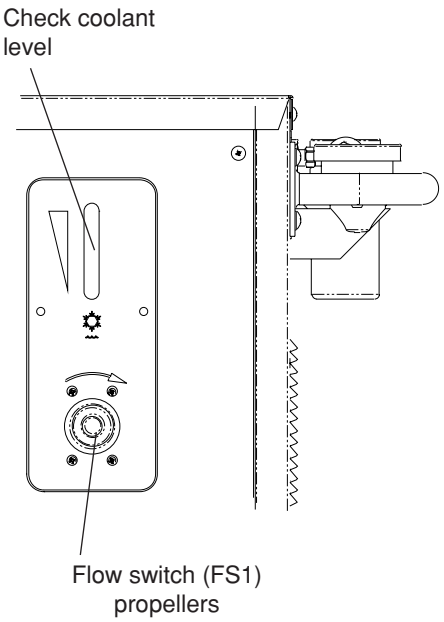
See also *Changing Consumables* in Section 4 to install consumables in the torch.

Post-Installation

HT4400 Initial Startup

After installation is complete, perform the following procedure to ensure the proper performance of the HT4400 system before moving on to the Operation section of this manual. The gas console will display error code **FS** (flow switch error) on initial startup until: all air is out of the torch coolant loop; the reservoir in the cooler has an adequate supply of coolant. Follow the procedure below to satisfy the flow switch.





1. Verify that all installation requirements are met and that all connections are made as outlined in this section.
2. Verify that consumables are installed properly in the torch (see *Daily Startup* in the Operation section, if necessary).
3. Verify that the torch coolant has been added to the cooler (see pages 3-3 and 3-19).
4. Position the valve select switch (S2) on the gas console to either Leak Test 1 or Leak Test 2.
5. Switch the Control Power switch on the power supply ON (I).
6. Allow coolant to flow through the system. If the coolant is flowing properly, propellers on the flow switch (FS1) will be spinning rapidly.

   Note: When propellers are spinning, the individual paddles cannot be seen.

   If coolant stops flowing and FS is still displayed on the gas console, turn valve select switch to RUN, and then back to Leak Test 1 or Leak Test 2. This action allows the pump to run for 30 seconds. Check coolant level.
7. After 5 minutes, switch the Control Power switch on the power supply OFF (O).
8. Position the valve select switch (S2) on the gas console to RUN.
9. Switch Control Power switch on the power supply ON (I).

   The coolant pump should continue to run and OK should be displayed on the gas console status display.

   If FS or any other error code is displayed on the gas console other than OK, the system has a problem that needs to be fixed before daily operations can begin. See the Maintenance section (Section 5) of this manual to troubleshoot.

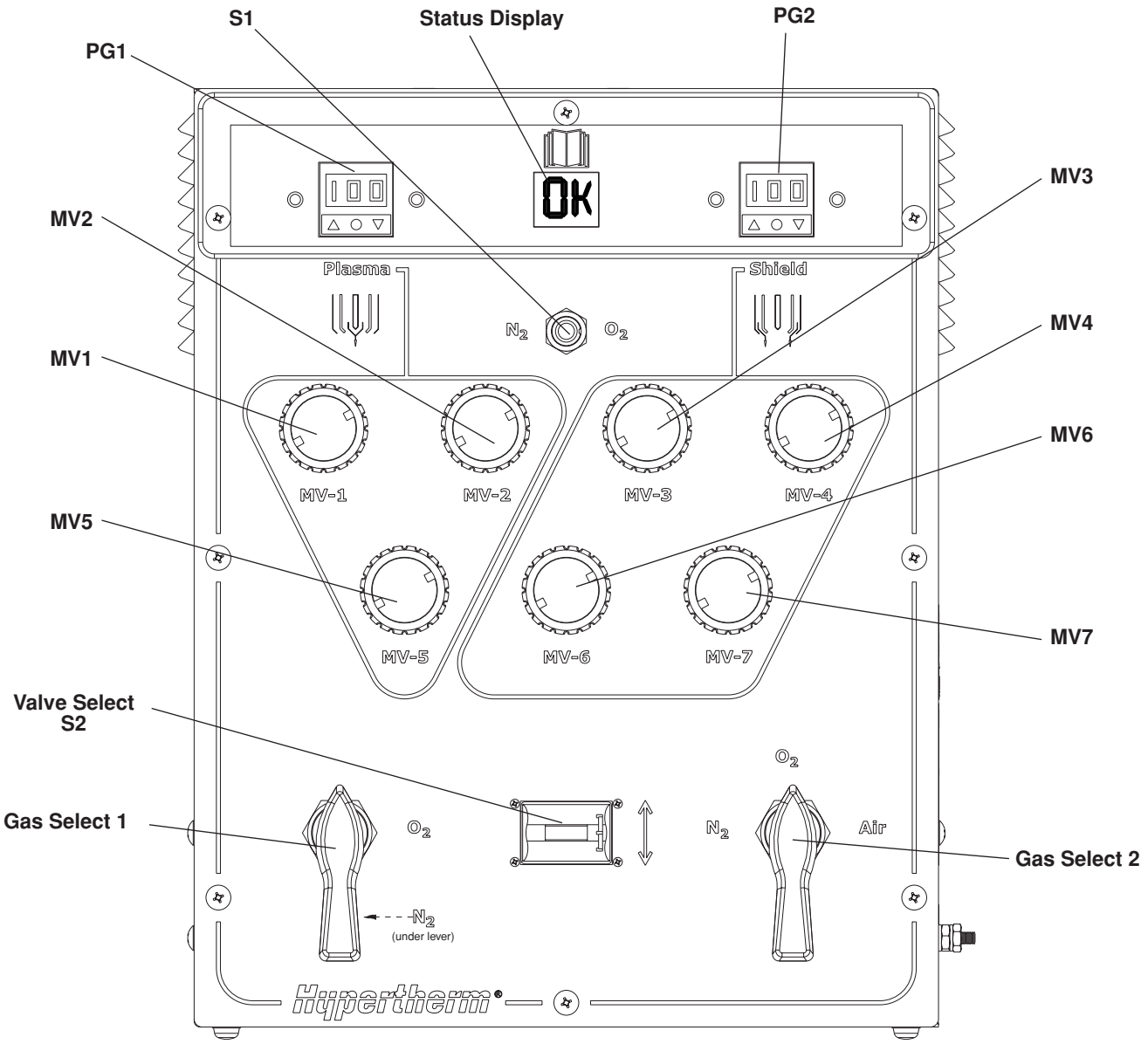
Section 4

OPERATION

In this section:

Controls and Indicators

Gas Console



Gas Console Controls and Indicators

PG1 Indicates the plasma gas pressure. Settings for the plasma gas pressures are specified in the *Cut Charts.*

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

Status Display Displays a 2 character code to report the condition of the HT4400 system. See *Status Display Messages on the Gas Console* later in this section. See also *Error Code Troubleshooting* in Section 5.

PG2 Indicates the shield gas pressure. Settings for the shield gas pressures are specified in the *Cut Charts*.

MV1 Adjusts the plasma gas cutflow pressure. MV1 and cutflow plasma pressures are specified in the *Cut Charts*.

MV2 Adjusts one of the plasma gas preflow pressures. MV2 and preflow plasma pressures are specified in the *Cut Charts*. .

MV3 Adjusts one of the shield gas cutflow pressures. MV3 and cutflow shield pressures are specified in the *Cut Charts*.

MV4 Adjusts one of the shield gas preflow pressures. MV4 and preflow shield pressures are specified in the *Cut Charts*. .

MV5 Adjusts one of the plasma gas preflow pressures. MV5 and preflow plasma pressures are specified in the *Cut Charts*. .

MV6 Adjusts one of the shield gas cutflow pressures. MV6 and cutflow shield pressures are specified in the *Cut Charts*.

MV7 Adjusts one of the shield gas preflow pressures. MV7 and preflow shield pressures are specified in the *Cut Charts*.

Gas Select 1 Selects the plasma cutting gas (Gas 1). When the shield gas is a mixture of 2 gases, this setting represents the plasma portion of the mixture.

Gas Select 2 Selects the shield gas (Gas 2). When the shield gas is a mixture of 2 gases, this setting represents the non-plasma portion of the mixture.

Valve Select S2 Chooses the active valve to adjust. Also selects Leak Test 1, Leak Test 2, Test Preflow, and Test Cutflow.

Leak Test 1 See *Gas Console Valve Select Detail* in Section 5.

Leak Test 2 See *Gas Console Valve Select Detail* in Section 5.

Test Preflow See *Gas Console Valve Select Detail* in Section 5.

Test Cutflow See *Gas Console Valve Select Detail* in Section 5.

Run In this mode, all valves are OFF initially. **The valve select switch must be positioned to RUN before sending the START command to the plasma system**.

Status Display Messages on the Gas Console

The list of error codes that may appear in the Status display are explained in Section 5, *Error Code Troubleshooting*.

The codes that will prevent the system from starting a cut are:

CT – Chopper temperature is too high
FS – Coolant flow error - See *Post-Installation* in Section 3
PC ,**PP**, **SC** or **SP** – Plasma cutflow, plasma preflow, shield cutflow or shield preflow gas pressures not within the proper range
TT – Main transformer temperature is too high
VO – Incoming voltage more than +/- 15% out of nominal range
VS – Valve select switch not in RUN position
WT – Coolant temperature is too high
SS – Start signal error

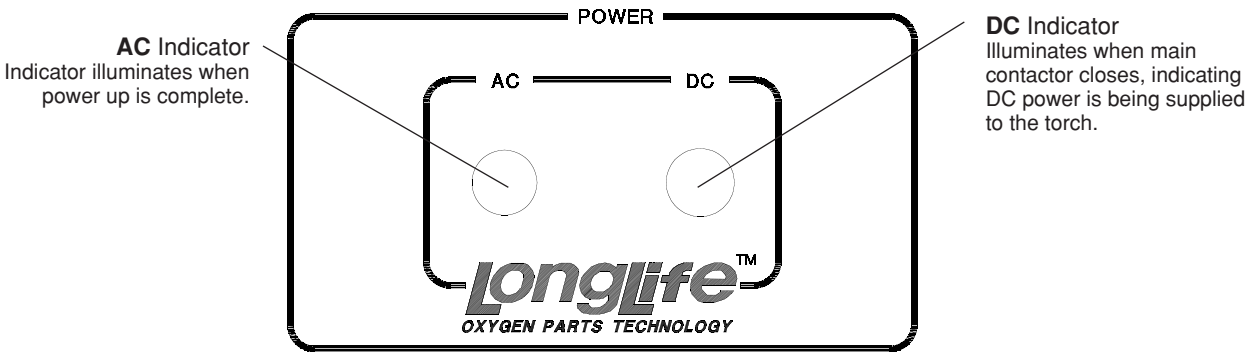
The above error conditions must be corrected before plasma cutting can begin. When the system is satisfied, the code **OK** will be displayed in the Status window after the START signal is given. See *Specifications, Installation*, and *Maintenance* sections of this manual to verify that the system is installed correctly, and that all operating requirements are met.

The codes that will stop the system while cutting are all of the above and:

CA – Lost current on chopper #1 and/or chopper #2
Cb – Lost current on chopper #3 and/or chopper #4
Hd – HOLD time-out
PL – Phase loss error
Rd – Ramp down error
RU – Ramp up error
XF – No arc transfer

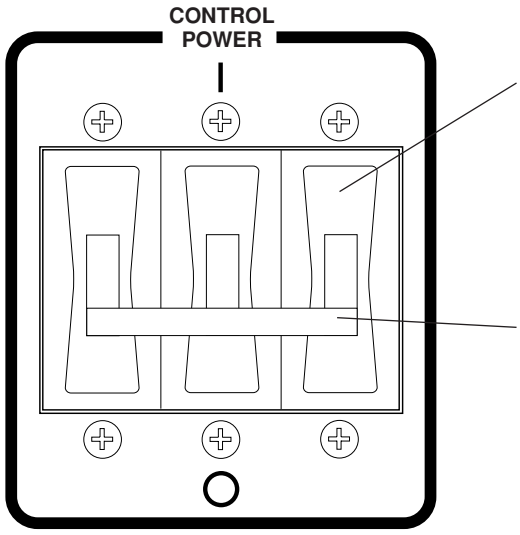
Power Supply

Front Panel



Power Supply

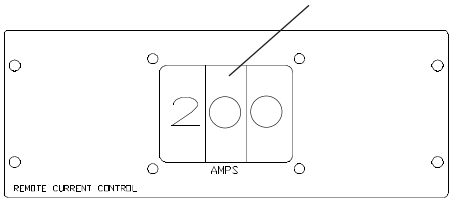
Rear Panel



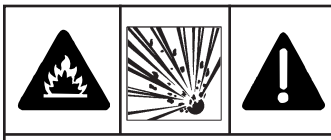
WARNING

The main contactor terminals remain energized in the DOWN position. If an EMI filter is installed, it also remains energized in the DOWN position.

Remote Current Control Console



Leak Tests



WARNING
CUTTING WITH OXYGEN CAN CAUSE FIRE OR EXPLOSION

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.

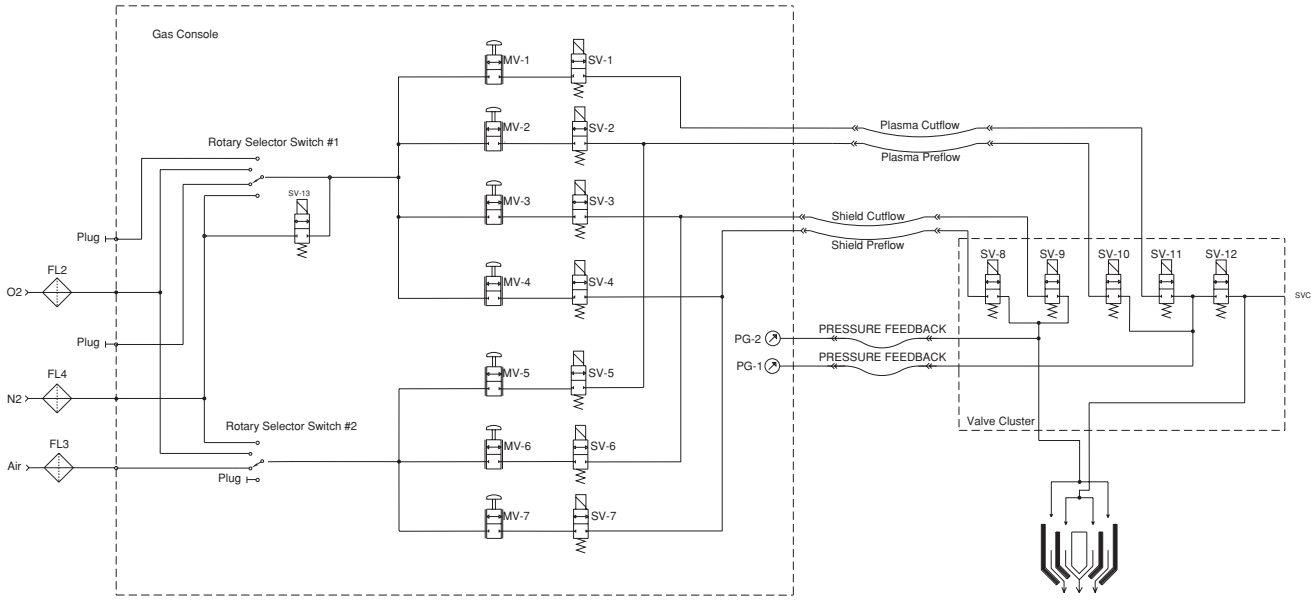
After installing the system and before adjusting plasma and shield gas levels, perform the following leak tests.

Leak Test 1

1. Open all gas console valves, MV1-MV7.
2. Set the Gas Select 1 lever on the gas console to the proper plasma gas.
3. Set the Gas Select 2 lever on the gas console to the proper shield gas.
   Note: If the shield gas is a mixture, set Gas Select 2 to the non-plasma portion of the mixture.
4. Choose Leak Test 1 on the valve select thumb-wheel switch.
5. Turn the supply gases on.
6. Turn on the power supply by positioning the CONTROL POWER circuit breaker on the rear of the power supply to the UP (I) position.
7. When the system is pressurized, turn off the supply gases and view the supply gas pressure gauge. If the system is losing pressure, troubleshoot by using the gas schematic on page 4-7.

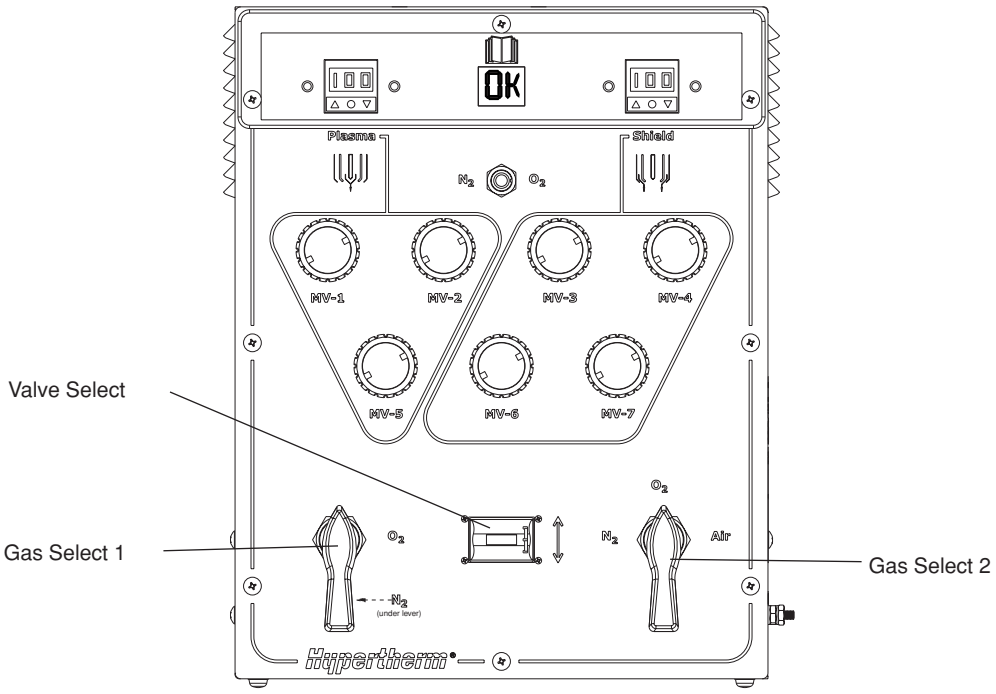
Leak Test 2

1. Open all gas console valves, MV1-MV7.
2. Set the Gas Select 1 lever on the gas console to the proper plasma gas.
3. Set the Gas Select 2 lever on the gas console to the proper shield gas.
   Note: If the shield gas is a mixture, set Gas Select 2 to the non-plasma portion of the mixture.
4. Choose Leak Test 2 from the valve select thumb-wheel switch.
5. Turn the supply gases on.
6. Turn on the power supply by positioning the POWER circuit breaker on the rear of the power supply to the UP (I) position.
7. When the system is pressurized, turn off the supply gases and view the supply gas pressure gauge. If the system is losing pressure, troubleshoot by using the gas schematic on page 4-7.



Note: In Leak Test 1, valves 1-7 are ON (open), and valves 8-12 are OFF (closed).
In Leak Test 2, valves 8-12 are ON (open), and valves 1-7 are OFF (closed).

Gas Schematic



Gas Console

Daily Startup

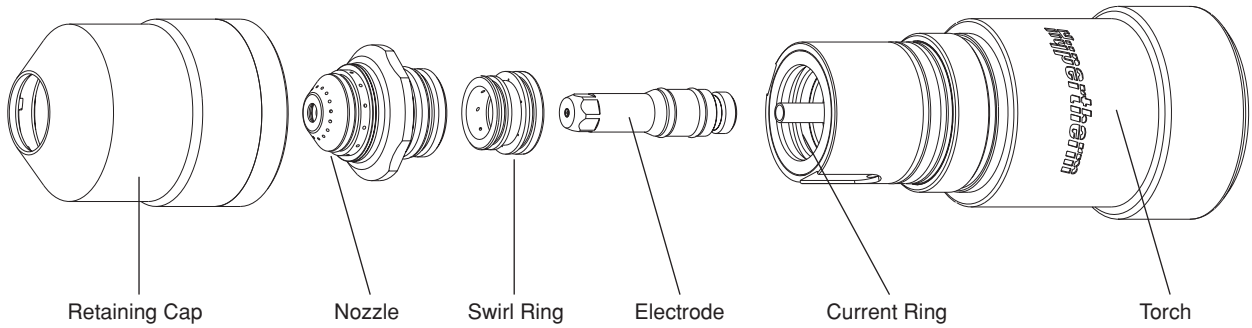
Prior to startup, ensure that your cutting environment and that your clothing meet the safety requirements outlined in the Safety section of this manual. See *Post-installation* in Section 3 if you are switching the power supply on for the first time.

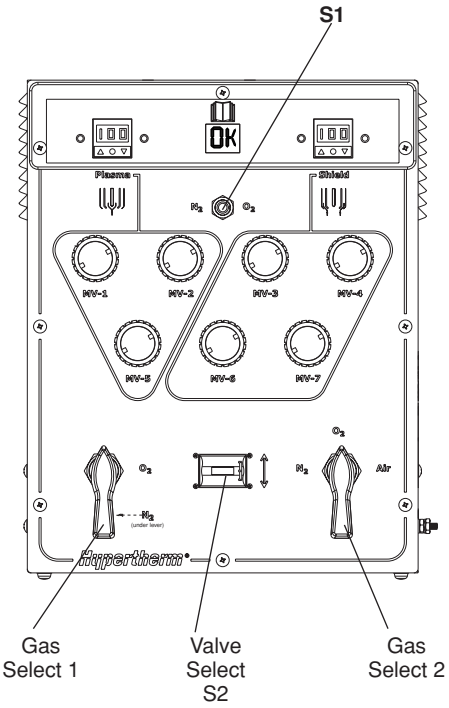
WARNING

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.

1. Check Torch and Consumables

1. Remove the consumables from the torch and check for worn or damaged parts. See *Changing Consumable Parts* later in this section. **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 .040 inch (1 mm). A gauge for measuring electrode pit depth can be purchased through Hypertherm. See Section 6 *Parts List* in this manual. See also *Inspect Electrode Pit Depth* later in this section.
   - Wipe the current ring in the torch with a clean paper towel or cotton swab.
   - 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.



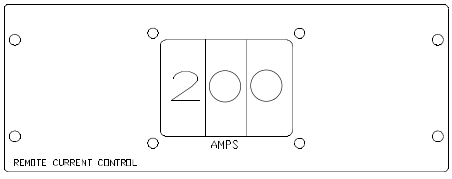


2. Turn Gases On

1. Turn the supply gases on.
2. Set S1 toggle switch on the gas console to plasma gas O_2, or N_2.
3. Set the Gas Select 1 lever on the gas console to the proper plasma gas.
4. Set the Gas Select 2 lever on the gas console to the proper shield gas. Note: If the shield gas is a mixture, set Gas Select 2 to the non-plasma portion of the mixture. (e.g., If the plasma gas is O_2 and the shield gas is Air, set Gas Select 2 switch to Air.)
5. Set the Valve Select thumb-wheel switch (S2) to Run.

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

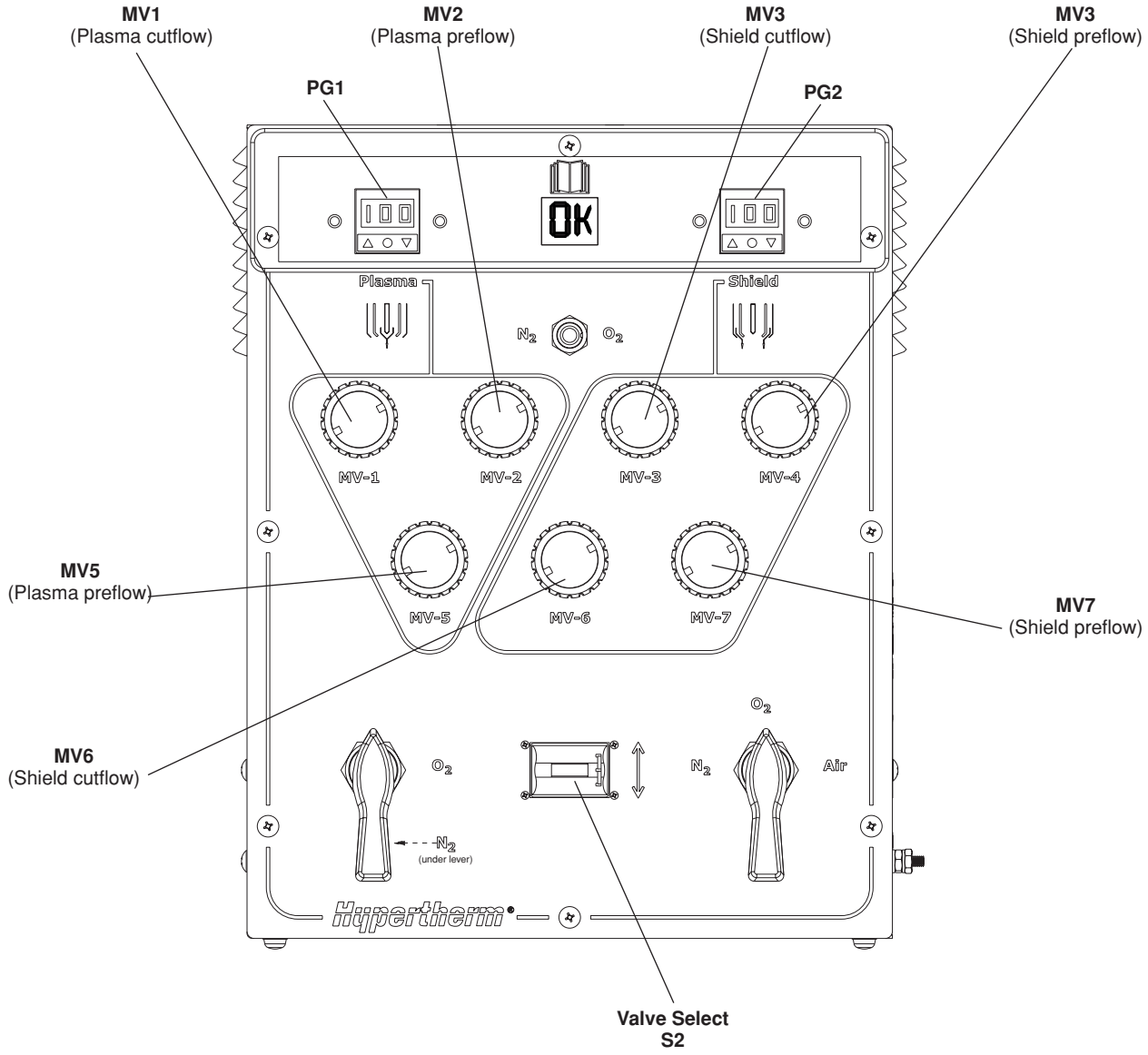
3. Turn Power Supply On and Adjust Current & Voltage

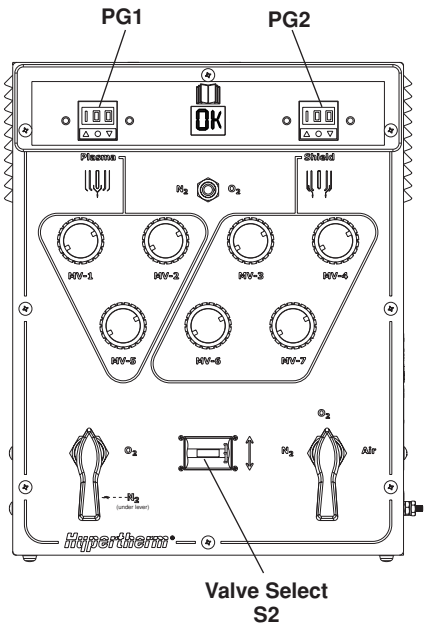


1. Turn the main disconnect switch ON.
2. Turn on the power supply by positioning the CONTROL POWER circuit breaker on the rear of the power supply to the UP position. The system will automatically purge gases and then display OK in the gas console status display window.
3. Set the current from the machine computer interface or the remote current control console. Set the voltage from the machine computer interface or torch-height control system. Select the arc current and arc voltage numbers from the *Cut Charts* for the type and thickness of metal to cut.

4. Adjust Cutflow and Preflow Gases

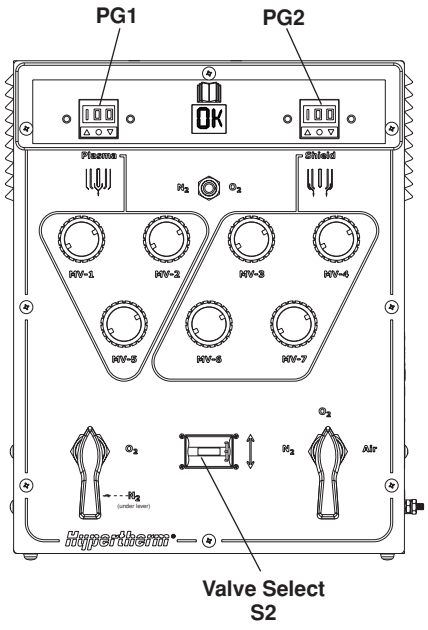
1. Set the Valve Select thumb-wheel switch (S2) to MV1.
2. Turn the MV1 valve to the plasma pressure detailed in the *Cut Charts*. The pressure reading appears in the gas console PG1 Plasma window.
3. Set the Valve Select thumb-wheel switch (S2) to MV2.
4. Turn the MV2 valve to the plasma pressure detailed in the *Cut Charts*. The pressure reading appears in the gas console PG1 Plasma window.
5. Repeat this procedure to set metering valves M3-M7. Note that the readings for shield gas adjustments appear in gas console PG2 Shield window.





5. Verify Test Preflow

1. Set the Valve Select thumb-wheel switch (S2) to Test Preflow.
2. Observe pressure readings on PG1 (plasma) and PG2 (shield). Verify that the readings are within +/- 3.0 psi (0.21 bar) of the PG1 and PG2 *Test Preflow Verify* rates specified in the *Cut Charts*.
3. If readings are not within +/- 3.0 psi (0.21 bar), repeat the preflow gas adjustments of steps 4.



6. Verify Test Cutflow

1. Set the Valve Select thumb-wheel switch (S2) to Test Cutflow.
2. Observe pressure readings on PG1 (plasma) and PG2 (shield). Verify that the readings are within +/- 3.0 psi (0.21 bar) of the PG1 and PG2 *Test Cutflow Verify* rates specified in the *Cut Charts*.
3. If readings are not within +/- 3.0 psi (0.21 bar), repeat the cutflow gas adjustments of steps 4.

7. Begin Cutting

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 Cutflow for one minute.

1. Set any additional cutting parameters as outlined in the *Cut Charts*.
2. Set Valve Select switch to Run after the test preflow and test cutflow rates have been verified.
3. The system is now ready to operate. Press the START command from the machine interface to begin the cutting sequence.

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 HT4400 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.

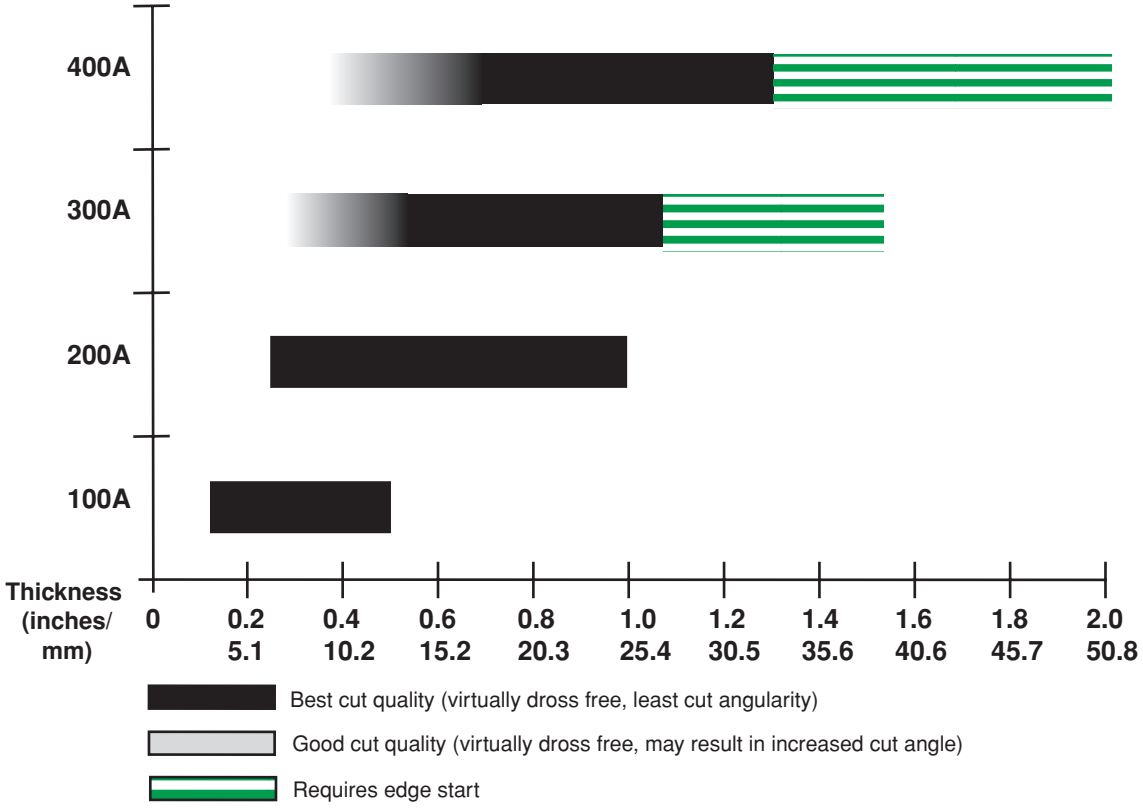
     High quality side is on the right with respect to the forward motion of the torch.
  2. Torch-to-work distance is not correct (check *Cut Chart* information).
  3. Cutting speed is not correct (check *Cut Chart* information).
  4. Arc current is not correct (check *Cut Chart* information).
  5. Damaged 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.

Performance and Process Data

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

Performance Summary for Cutting Mild Steel with Oxygen Plasma



Results will vary based on machine motion performance and material characteristics.

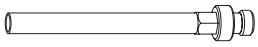
Approximate Pressures During Cutting		
Process	PG1	PG2
100A O_2/Air	76	17
200A O_2/Air	56	32
300A O_2/Air	72	35
400A O_2/Air	75	38
200A N_2/O_2-N_2	49	36
400A N_2/N_2	58	30

Kerf Width O_2 /Air Processes				
Thickness	100A	200A	300A	400A
3/16"	.055			
1/4"	.065	.095		
3/8"	.072	.110	.105	.130
1/2"		.120	.120	.135
3/4"		.125	.130	.150
1"			.140	.165

Cut Chart and Consumable Parts Index

The data listed in the charts is for making drop cuts with minimal dross.

*CUT CHART AND CONSUMABLE PARTS INDEX								
	Metal	Amps	Plasma Gas/ Shield Gas	Retaining Cap	Nozzle	Swirl Ring	Electrode	Page
 CUTTING	Mild Steel	400	O_2/Air	120786	120934	120939	120810	4-15
		300	O_2/Air	120786	120794	120913	120802	4-16
		200	O_2/Air	120786	120787	120791	120793	4-17
		100	O_2/Air	120786	120777	120783	120785	4-18
	Stainless Steel	400	N_2/N_2	120786	120856	120853	120855	4-19
		200	N_2/O_2-N_2	120786	120794	120853	120855	4-20
	Aluminum	400	N_2/N_2	120786	120856	120853	120855	4-21
		200	N_2/O_2-N_2	120786	120794	120853	120855	4-22
BEVEL-CUTTING	Mild Steel	400	O_2/Air	120786	120804	120800	120810	4-15

Water tube used for above processes: 120025 

Notes:

1. If using the Command THC with ohmic contact or other ohmic contact sensing device, use retaining cap with IHS tab, 120907.

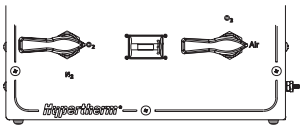
2. Counterclockwise consumables can be found in the parts list (Section 6) of this manual.

3. Underwater cutting can only be accomplished by using underwater retaining cap #120984. Using retaining cap #120796 will cause misfires.

*

See appendix F for 120psi inlet and O_2 / N_2 cutcharts.

See appendix E for 140psi inlet and O_2 / N_2 cutcharts.



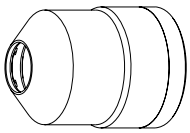
Mild Steel

O_2 Plasma / Air Shield

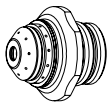
400 Amps

Straight and Bevel Cutting to 45°

Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	Air	O_2
Preflow	184.3 / 5220	58.8 / 1662
Cutflow	167.5 / 4740	92.2 / 2610

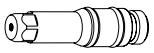


120786
Retaining Cap

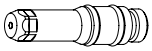


120934
Nozzle

120939
Swirl Ring



120810
(standard)
Electrode



220412+
(optional)
SilverPlus
electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
68	0	0	10	43		38	38	36	43	68	38	**3/8****	135	.125	3	195	4950	.250	6	0.4
												1/2**	138	.157	4	160	4060	.314	8	0.5
												5/8	140	.157	4	120	3050	.314	8	0.6
												3/4	142	.157	4	95	2413	.314	8	0.7
												7/8	145	.188	5	80	2032	.375	10	0.8
												1	145	.188	5	70	1778	.375	10	1
												1-1/8	145	.188	5	60	1520	.375	10	1.4
												1-1/4	148	.188	5	55	1400	.375	10	1.9
												1-1/2	150	.188	5	40	1020	*	*	*
												2	175	.250	6	15	381	*	*	*

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
68	0	0	10	43		38	38	36	43	68	38	**10****	135	3	.125	4718	186	6	.250	0.4
												12**	138	4	.157	4301	169	8	.314	0.5
												15	140	4	.157	3320	131	8	.314	0.6
												20	142	4	.157	2298	91	8	.314	0.7
												22	145	5	.188	2053	81	10	.375	0.8
												25	145	5	.188	1806	71	10	.375	1
												30	145	5	.188	1468	58	10	.375	1.2
												32	148	5	.188	1386	55	10	.375	1.4
												35	150	5	.188	1204	47	10	.375	1.9
												40	155	5	.188	929	37	*	*	*
												50	175	6	.250	421	17	*	*	*

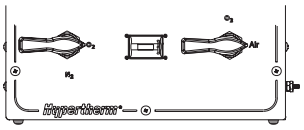
* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 75**
PG2 38

+ SilverPlus provides increased life in most applications. The hafnium wears to approximately twice the depth of an all copper electrode (120810 400VA and 120802 300A). Arc voltage may need to be increased by 5-15 volts throughout the electrode life to maintain proper cut height parameters.

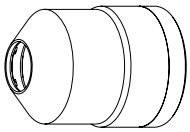


Mild Steel

O_2 Plasma / Air Shield

300 Amps

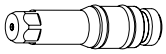
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	Air	O_2
Preflow	172.5 / 4860	57.2 / 1620
Cutflow	157.5 / 4440	84.3 / 2388



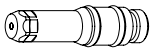
120786
Retaining Cap

120794
Nozzle

120913
Swirl Ring



120802
Electrode



220412+
(optional)
SilverPlus
electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
46	0	0	10	24		35	35	20	42	46	35	**1/4****	120	.062	2	190	4830	.125	3	0.3
												3/8**	125	.125	3	160	4060	.250	6	0.5
												1/2	130	.157	4	120	3050	.314	8	0.7
												5/8	135	.188	5	100	2540	.375	10	0.9
												3/4	140	.188	5	80	2030	.375	10	1.1
												7/8	145	.188	5	70	1780	.375	10	1.3
												1	145	.188	5	55	1400	.375	10	1.5
												1-1/8	150	.188	5	50	1270	*	*	*
												1-1/4	155	.250	6	45	1140	*	*	*
												1-1/2	155	.250	6	35	890	*	*	*

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
46	0	0	10	24		35	35	20	42	46	35	**6****	120	2	.062	5108	201	3	.125	0.3
												10**	125	3	.125	3871	153	6	.250	0.5
												12	130	4	.157	3226	127	8	.314	0.7
												15	135	5	.188	2681	106	10	.375	0.9
												20	140	5	.188	1935	76	10	.375	1.1
												22	145	5	.188	1796	71	10	.375	1.3
												25	145	5	.188	1419	56	10	.375	1.5
												30	150	5	.188	1213	48	*	*	*
												32	155	6	.250	1134	45	*	*	*
												35	155	6	.250	1014	40	*	*	*

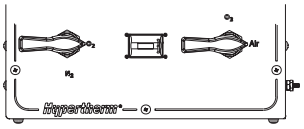
* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 72**
PG2 35

+ SilverPlus provides increased life in most applications. The hafnium wears to approximately twice the depth of an all copper electrode (120810 400VA and 120802 300A). Arc voltage may need to be increased by 5-15 volts throughout the electrode life to maintain proper cut height parameters.

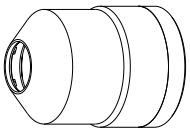


Mild Steel

O_2 Plasma / Air Shield

200 Amps

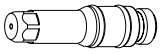
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	Air	O_2
Preflow	184.3 / 5220	55.7 / 1578
Cutflow	149.1 / 4224	78 / 2208



120786
Retaining Cap

120787
Nozzle

120791
Swirl Ring



120793
Electrode

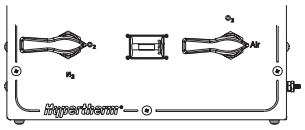
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
35	0	0	10	30		32	35	24	42	35	32	**1/4**	120	.125	3	160	4060	.250	6	0.5
												3/8	120	.125	3	100	2540	.250	6	0.5
												1/2	125	.157	4	80	2030	.314	8	0.7
												5/8	130	.157	4	70	1780	.314	8	0.9
												3/4	135	.188	5	55	1400	.375	10	1.2
												7/8	135	.25	6	45	1140	.500	13	1.5
												1	140	.25	6	35	889	.500	13	2.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
35	0	0	10	30		32	35	24	42	35	32	**6**	120	3	.125	4301	169	6	.250	0.5
												10	120	3	.125	2419	95	6	.250	0.5
												12	125	4	.157	2151	85	8	.314	0.7
												15	130	4	.157	1851	73	8	.314	0.9
												20	135	5	.188	1331	52	10	.375	1.2
												22	135	6	.25	1155	46	13	.500	1.5
												25	140	6	.25	903	36	13	.500	2.5

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 56**
PG2 32

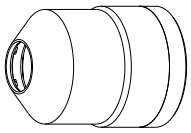


Mild Steel

O_2 Plasma / Air Shield

100 Amps

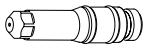
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	Air	O_2
Preflow	164.2 / 4620	0 / 0
Cutflow	97.2 / 2748	48 / 1356



120786
Retaining Cap

120777
Nozzle

120783
Swirl Ring



120785
Electrode

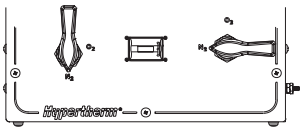
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
35	0	0	0	36		17	25	31	23	35	17	**1/8**	125	.094	2	240	6100	.188	5	0.3
												3/16	125	.125	3	180	4570	.250	6	0.5
												1/4	130	.125	3	120	3050	.250	6	0.7
												3/8	135	.157	4	85	2160	.314	8	0.9
												1/2	135	.157	4	60	1520	.314	8	1.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
35	0	0	0	36		17	25	31	23	35	17	**3**	125	2	.094	6462	255	5	.188	0.3
												5	125	3	.125	4355	172	6	.250	0.5
												6	130	3	.125	3226	127	6	.250	0.7
												10	135	4	.157	2056	81	8	.314	0.9
												12	135	4	.157	1613	64	8	.314	1.5

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 76**
PG2 17

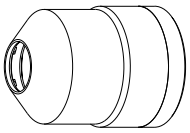


Stainless Steel

N_2 Plasma / N_2 Shield

400 Amps

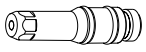
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)	
	N_2
Preflow	223.1 / 6318
Cutflow	226.5 / 6414



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
63	45	36	41	0		0	0	34	36	49	30	**1/4**	140	.125	3	195	4953	.250	6	0.3
												3/8	140	.125	3	170	4320	.250	6	0.5
												1/2	145	.157	4	140	3560	.314	8	0.7
												5/8	150	.157	4	95	2410	.314	8	1
												3/4	155	.188	5	70	1780	.375	10	1.5
												7/8	160	.188	5	55	1400	.375	10	2
												1	165	.188	5	40	1020	.375	10	2.5
												1-1/4	170	.250	6	30	760	*	*	*
												1-1/2	180	.250	6	25	630	*	*	*
												2	185	.250	6	13	330	*	*	*

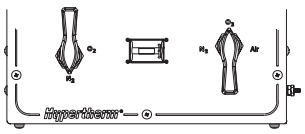
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
63	45	36	41	0		0	0	34	36	49	30	**6**	140	3	.125	5242	207	6	.250	0.3
												10	140	3	.125	4113	162	6	.250	0.5
												12	145	4	.157	3763	148	8	.314	0.7
												15	150	4	.157	2713	107	8	.314	1
												20	155	5	.188	1694	67	10	.375	1.5
												22	160	5	.188	1411	56	10	.375	2
												25	165	5	.188	1032	41	10	.375	2.5
												35	170	6	.250	697	27	*	*	*
												40	180	6	.250	585	23	*	*	*
												50	185	6	.250	349	14	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 58**
PG2 30

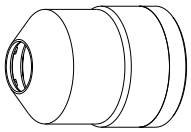


Stainless Steel

N_2 Plasma / O_2-N_2 Shield

200 Amps

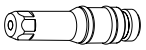
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	N_2	O_2
Preflow	199.4 / 5646	54.5 / 1542
Cutflow	191 / 5406	47.7 / 1350



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
44	35	30	40	0		5	8	28	44	37	36	**3/16**	130	.125	3	135	3430	.250	6	0.4
												1/4	135	.125	3	120	3050	.250	6	0.5
												3/8	135	.125	3	100	2540	.250	6	1
												1/2	140	.157	4	75	1900	.314	8	2
												5/8	140	.157	4	60	1520	.314	8	2
												3/4	145	.188	5	45	1140	.375	10	2.5
												7/8	145	.250	6	35	890	.500	12	3.0
												1	150	.250	6	20	510	*	*	*
												1-1/4	160	.250	6	15	380	*	*	*

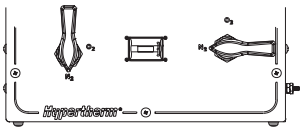
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
44	35	30	40	0		5	8	28	44	37	36	**5**	130	3	.125	3266	129	6	.250	0.4
												6	135	3	.125	3226	127	6	.250	0.5
												10	135	3	.125	2419	95	6	.250	1
												12	140	4	.157	2016	79	6	.314	2
												15	140	4	.157	1628	64	8	.314	2
												20	145	5	.188	1089	43	10	.375	2.5
												22	145	6	.250	898	35	12	.500	3.0
												25	150	6	.250	516	20	*	*	*
												30	160	6	.250	415	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thickness.

Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 36

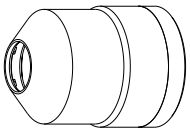


Aluminum

N_2 Plasma / N_2 Shield

400 Amps

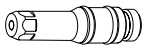
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)	
	N_2
Preflow	223.1 / 6318
Cutflow	226.5 / 6414



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
63	45	36	41	0		0	0	34	36	49	30	**1/4**	135	.125	3	220	5588	.250	6	0.3
												3/8	140	.125	3	195	4953	.250	6	0.5
												1/2	145	.157	4	150	3810	.314	8	0.7
												5/8	150	.157	4	105	2667	.314	8	1
												3/4	155	.188	5	80	2032	.375	10	1.5
												7/8	160	.188	5	65	1651	.375	10	2
												1	165	.188	5	50	1270	.375	10	2.5
												1-1/4	170	.250	6	40	1016	*	*	*
												1-1/2	180	.250	6	30	762	*	*	*
												2	185	.250	6	15	381	*	*	*

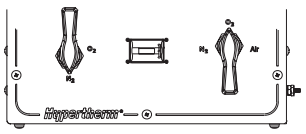
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
63	45	36	41	0		0	0	34	36	49	30	**6**	135	3	.125	5914	233	6	.250	0.3
												10	140	3	.125	4718	186	6	.250	0.5
												12	145	4	.157	4032	159	8	.314	0.7
												15	150	4	.157	2968	117	8	.314	1
												20	155	5	.188	1935	76	10	.375	1.5
												22	160	5	.188	1668	66	10	.375	2
												25	165	5	.188	1290	51	10	.375	2.5
												30	170	6	.250	1085	43	*	*	*
												40	180	6	.250	709	28	*	*	*
												50	185	6	.250	405	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 58**
PG2 30

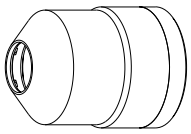


Aluminum

N_2 Plasma / O_2-N_2 Shield

200 Amps

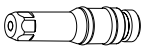
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	N_2	O_2
Preflow	199.4 / 5646	54.5 / 1542
Cutflow	191 / 5406	47.7 / 1350



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
44	35	30	40	0		5	8	28	44	37	36	**3/16**	130	.125	3	180	4570	.250	6	0.5
												1/4	135	.125	3	160	4060	.250	6	1
												3/8	135	.125	3	120	3050	.250	6	1.5
												1/2	140	.125	3	80	2030	.250	6	2
												5/8	140	.157	4	70	1780	.314	8	2
												3/4	150	.250	6	50	1270	.500	12	2.5
												7/8	160	.250	6	35	890	.500	12	2.5
												1	165	.250	6	25	630	*	*	*
												1-1/4	175	.250	6	20	510	*	*	*

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
44	35	30	40	0		5	8	28	44	37	36	**5**	130	3	.125	4355	172	6	.250	0.5
												6	135	3	.125	4301	169	6	.250	1
												10	135	3	.125	2903	114	6	.250	1.5
												12	140	4	.157	2151	85	6	.250	2
												15	140	4	.157	1851	73	8	.314	2
												20	145	5	.188	1210	48	12	.500	2.5
												22	145	6	.250	898	35	12	.500	2.5
												25	150	6	.250	645	25	*	*	*
												30	160	6	.250	543	21	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 36

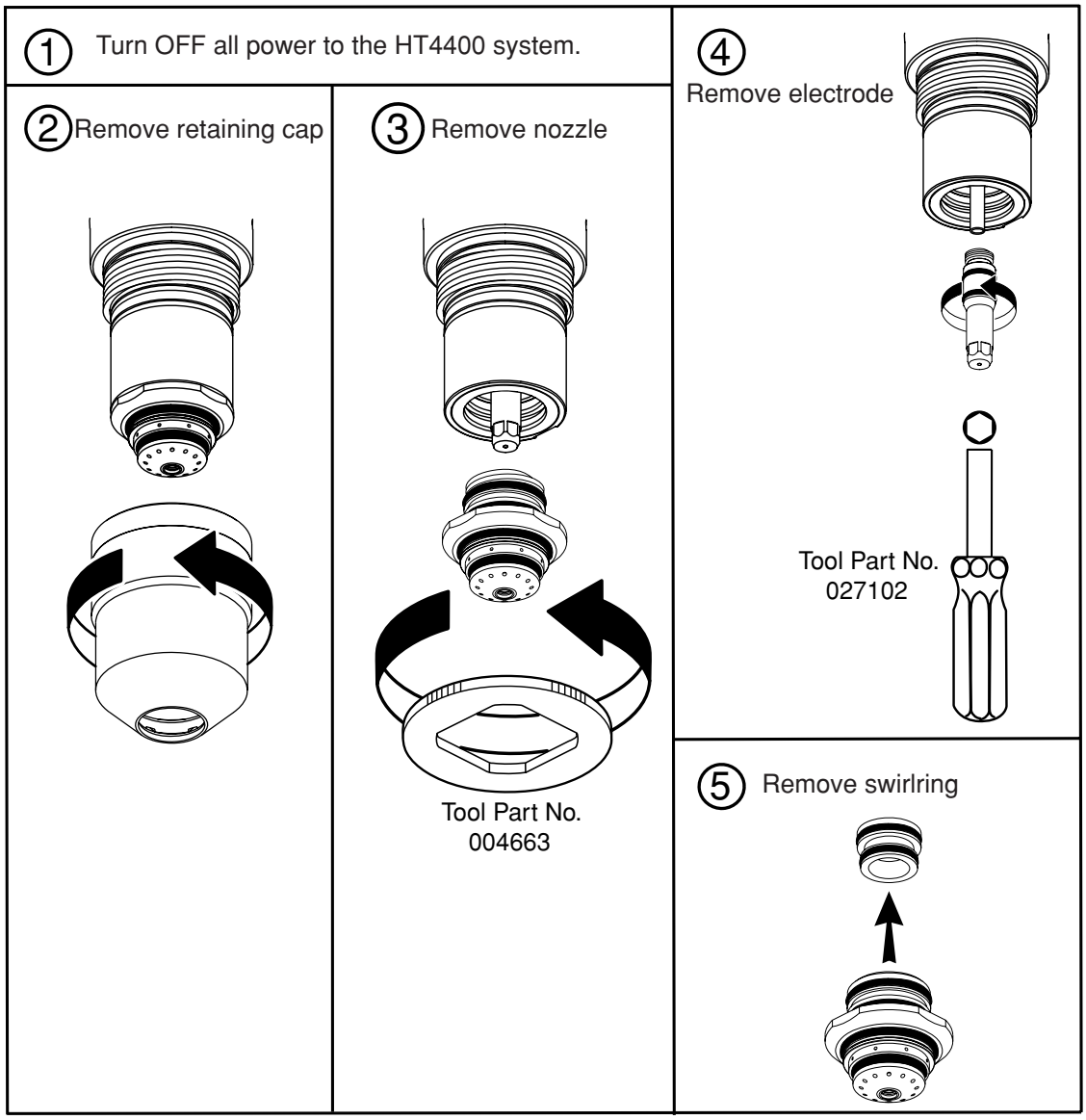
Changing Consumable Parts

WARNING

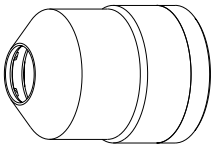
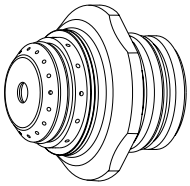
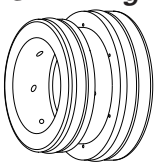
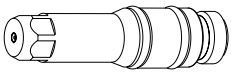
The HT4400 power supply is designed to go into an idle mode if the retaining cap is removed. However, DO NOT CHANGE CONSUMABLE PARTS WHILE IN THE IDLE MODE! Always disconnect power to the power supply before inspecting or changing torch consumable parts.

Remove Consumables

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

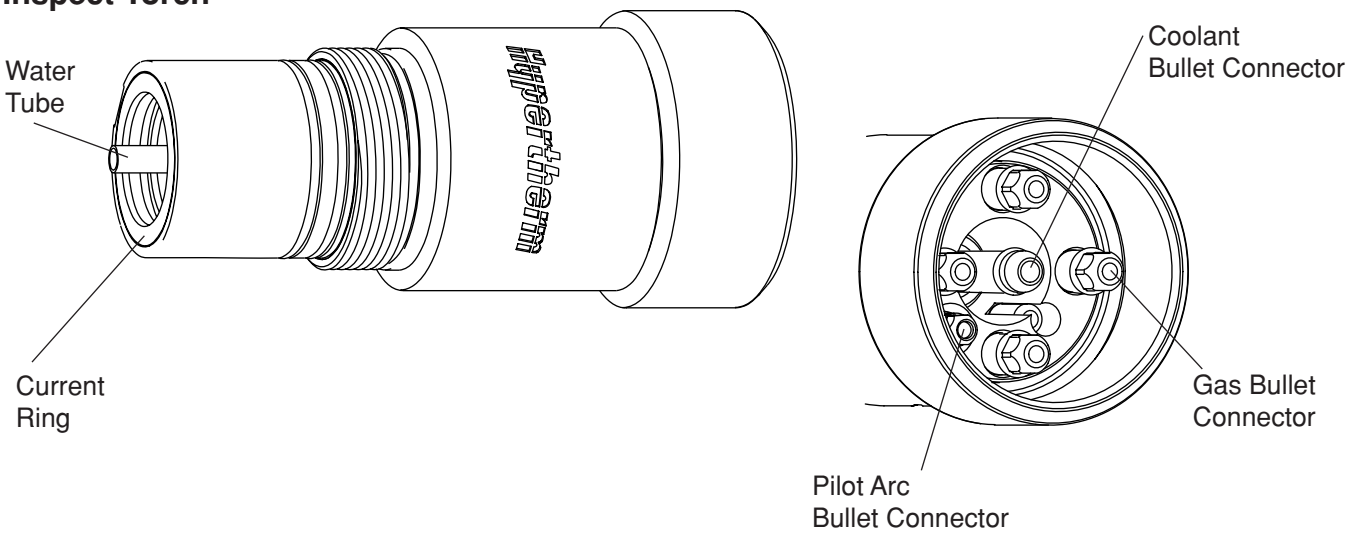


Inspect Consumables

Part	*Check For*	*Limit*	*Action*
Cap 	Erosion, missing material	None	Replace cap
	Cracks	None	Replace cap
	Burned	None	Replace cap
Nozzle 	Wear or missing material	None	Replace nozzle*
	Blocked gas holes	None	Replace nozzle*
Center hole	1. Round	Hole must be round	Replace nozzle*
	2. Signs of arcing	None	Replace nozzle*
O-rings	1. Damage	None	Replace nozzle*
	2. Lubricant	Not dry	Apply a thin coat of silicon lubricant
Swirl Ring 	Damage	None	Replace swirl ring
	Dirt or debris	Clean and no damage	Replace swirl ring
Gas holes	Blocked holes	None	Replace swirl ring
O-rings	1. Damage	None	Replace swirl ring
	2. Lubricant	Not dry	Apply a thin coat of silicon lubricant
Electrode 			
Center surface	Wear	See *Inspect Electrode Pit Depth* later in this section	
O-rings	1. Damage	None	Replace electrode*
	2. Lubricant	Not dry	Apply a thin coat of silicon lubricant

*NOTE: Always replace the nozzle and electrode as a set.

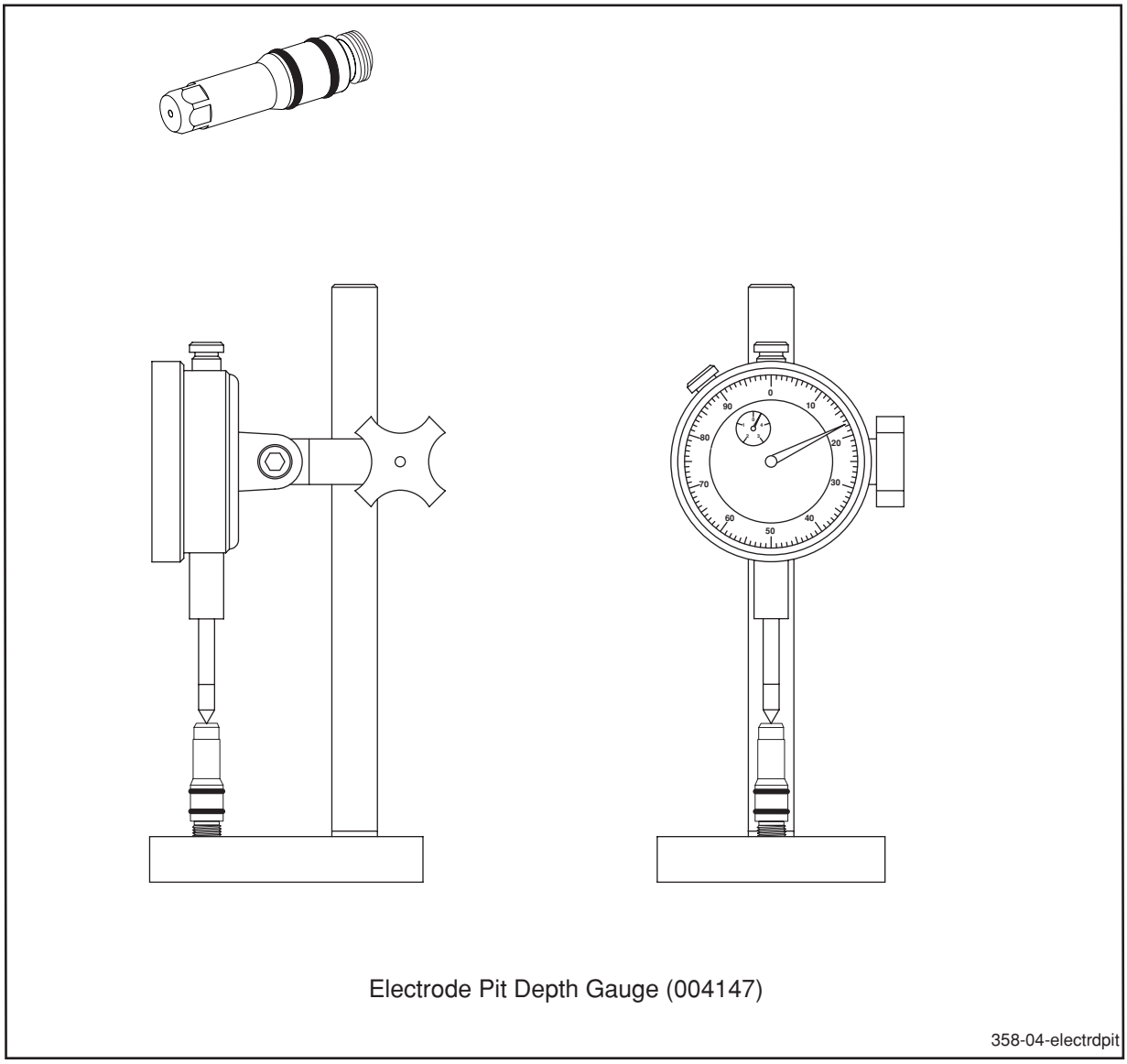
Inspect Torch



Inspect	*Check For*	*Limit*	*Action*
All Surfaces	Dirt or debris	None	Clean
	Erosion, missing material	None	Replace torch
	Cracks	None	Replace torch
	Internal burn or arcing marks	None	Replace torch
Current Ring	1. Dirt or debris	None	Clean
	2. Pitted or missing material	None	Replace torch
Threads	Wear or damage	None	Replace torch
Bullet Connectors	Damage	None	Replace torch
O-rings	1. Damage	None	Replace O-ring
	2. Lubricant	Not dry	Apply a thin coat of silicon lubricant
External O-rings	1. Damage	None	Replace O-ring
	2. Lubricant	Not dry	Apply a thin coat of silicon lubricant
Water Tube*	1. Tightness	Not loose	Tighten or replace tube*
	2. Pitted or missing material	None	Replace tube*

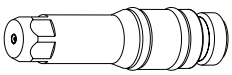
*NOTE: See *Replace Torch Water Tube* later in this section.

Inspect Electrode Pit Depth



Electrode Pit Depth Gauge (004147)

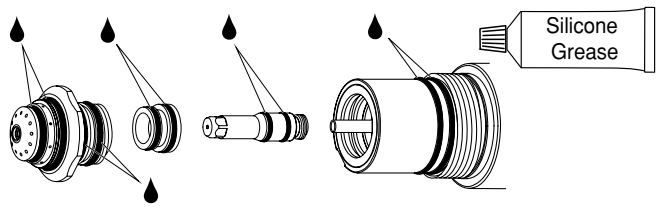
358-04-electrdpit

Part	*Check For*	*Limit*	*Action*
Electrode  Center surface	Wear	Pit not more than 0.040 inch (1 mm) deep	Replace Electrode*

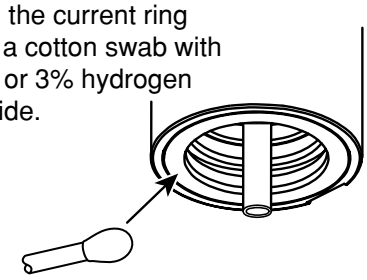
*NOTE: Always replace the nozzle and electrode as a set.

Install Consumables

① Apply a thin coat of silicone grease on all O-rings.

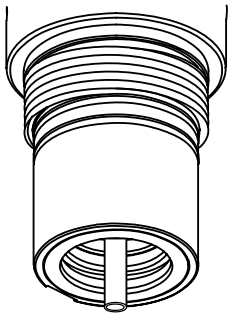


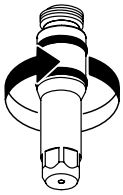
② Clean the current ring using a cotton swab with water or 3% hydrogen peroxide.



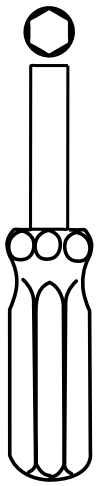
Do not over-tighten parts! Only tighten until mating parts are seated.

③ Install electrode

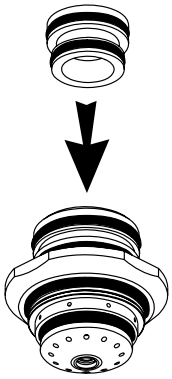




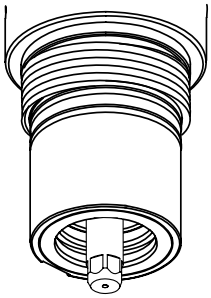
Tool Part No.
027102

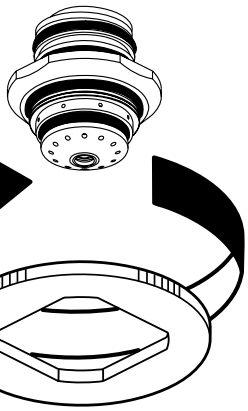


④ Insert swirl ring



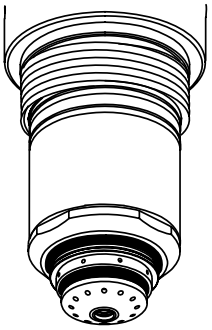
⑤ Install nozzle

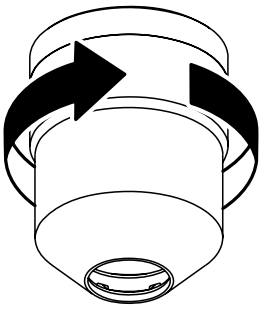




Tool Part No.
004663

⑥ Install retaining cap





Replace Torch Water Tube

Below are some problems and causes that you may find with a defective or improperly installed water tube.

Problem	Cause
Short electrode life	Water tube not screwed in tightly
Flow switch interlock shutting down the system	Coolant flow restricted because water tube is loose
Humming or rattling sound coming from the torch	Water tube bent or loose

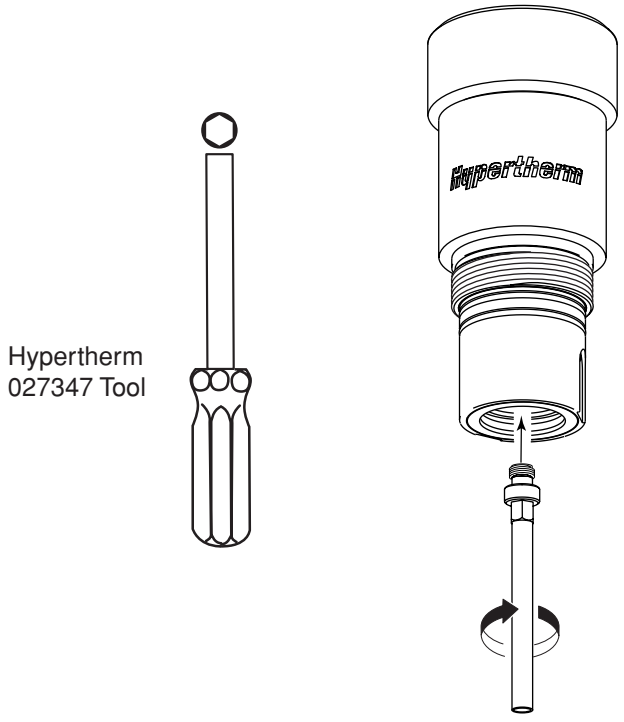
WARNING

The HT4400 power supply is designed to go into an idle mode if the retaining cap is removed. However, DO NOT REMOVE CONSUMABLE PARTS WHILE IN THE IDLE MODE! Always disconnect power to the power supply before removing torch consumable parts.

1. Turn OFF all power to the HT4400 system.
2. Remove consumables from torch.

Do not over-tighten parts! Only tighten until mating parts are seated.

3.



Cutting Techniques

How to Get Better Cut Quality

In order to get the best cut quality, ensure the HT4400 plasma system is set up according to the *Daily Start-Up* procedure in this section. The 3 major components of cut quality are: cut angle, dross, and shape (flatness) and smoothness of the cut surface.

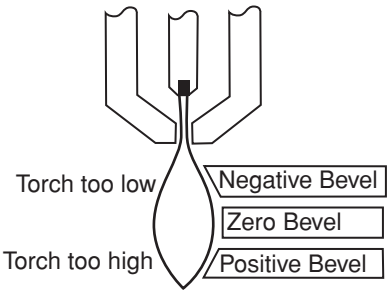
Cut Angle

Cut angle is defined as either positive or negative. A positive cut angle is when there is more material removed from the top of the kerf than at the bottom (V-shaped cut). A negative cut angle is when there is more material removed from the bottom of the cut than at the top (undercut).

The 2 most common cut angle faults are as follows:

1. The average cut angle of 4 sides is off by 3 to 4°. Angles greater than this can be caused by:

   - Torch-to-work distance. If cut angles are all positive or all negative, torch-to-work distance is most likely the problem. Vary the arc voltage to correct the cut angle.



   - Damaged consumable parts. If the nozzle orifice is worn uniformly, the cut angle will show positive. Change or check consumables by referring to *Changing Consumable Parts* in this section.

   - Machine travel is in the wrong direction. The square cut angle is on the right with respect to the forward motion of the torch.

2. Non-uniform cut angles (one side positive and the other negative), this is caused by:

   - Damaged or worn consumable parts, especially the nozzle and shield. Change or check consumables by referring to *Changing Consumable Parts* in this section.

   - Torch is out of vertical alignment to workpiece. Ensure that the torch is at right angles to the workpiece (0° and 90°) to get a clean, vertical cut. Use a square to align the torch.

Dross Conditions

Dross can occur in the following ways:

1. Low speed dross happens when the torch travel speed is too slow and the arc shoots ahead. It forms as a heavy, bubbly deposit at the bottom of the kerf and can be easily removed. Normally, increasing the speed will reduce the dross.

2. High speed dross occurs when the torch travel speed is too fast and the arc lags behind. It forms as a thin, linear bead of solid metal attached very close to the kerf. The dross appears to be a fused continuation of the kerf wall. It is welded to the bottom of the cut and is very difficult to remove. High speed dross can be reduced in the following ways:

   • Decreasing the travel speed will reduce the dross. If changing the speed does not remove the dross, varying the following parameters will help.

   • Lowering the torch-to-work distance by decreasing arc voltage will reduce the dross.
3. Dross may show at certain parts of the cut (the dross comes and goes), if the consumables are worn or damaged.

4. Dross formation is material dependent.

5. Dross formation is dependent upon metal temperature. Warm and hot metal is much more prone to dross accumulation than cool metal. For example, the first cut in a series of cuts will mostly likely have the least amount of dross. As the workpiece heats up, dross levels are likely to increase on the subsequent cuts.

Shape of Cut Surface

The ideal shape of the cut face is straight. Sometimes the cut face becomes either concave or convex. Maintaining the correct torch height and cut speed are required to keep the cut face straight.

1. A concave cut face (bevel on inside) is due to torch-to-work distance being too low. Increasing the arc voltage will increase the torch-to-work distance and straighten the cut face.

2. A convex cut face (top of cut rounded) is due to the torch-to-work distance being too high or cutting current being too high. First, try reducing the arc voltage, and then the cutting current. If there is overlap between different cutting currents for that thickness, try the lower current consumables.

Smoothness of Cut Surface

Both the plasma jet and the motion of X-Y table will affect the smoothness of the cut surface.

1. The plasma jet can cause random roughness. Change the shield gas O_2/N_2 ratio for cutting mild steel. A higher concentration of oxygen in the shield mixture will increase the potential cut speed, but at the expense of a rougher cutting edge.

2. A regular wavy surface is due to machine motion. Tuning the drives and cleaning the rails will help.

How to Get Longer Consumable Life

The HT4400 plasma system incorporates Hypertherm's patented LongLife® process to extend the life of consumable parts. Full compliance with the LongLife operating procedures that follow, as well as the gas purity requirements listed earlier in this section, is necessary in order to optimize the useful life of consumable parts.

Piercing Height

Piercing height should be higher than the cutting height to prevent pierce splatter from building up on the front of the nozzle and/or shield. An initial pierce height that is too high will increase the dwell time of the pilot arc on the nozzle. As a rule, the pierce height should be 1.5 to 2 times as much as the cutting height (torch-to-work distance).

Pierce Delay

The pierce delay function can be set externally from the CNC controller in the form of a pierce complete signal.

Ramp Down

At the end of a cut, the plasma (current and gas flows) must be allowed to ramp down to an off state before the torch is retracted from the workpiece. If the arc blows out without ramping down, life of the consumables is decreased.

This is particularly a problem when cutting smaller parts. When the torch reaches the end of the cut and the smaller or drop part (center) falls away from the workpiece, there is no metal under the torch to provide ramp down. However, in this situation arc blow out does not always occur. Sometimes the arc can stay attached to the edge of the hole long enough to ramp down, removing only a small divot from the workpiece.

If a ramp down error occurs, try modifying the lead-out at the end of the cut:

- Reduce the cutting speed and use no lead-out.
- Stop the cut before reaching the end of the part - the ramp down of the current and gases will complete the cut.

Running the torch off the edge of the plate will produce the same condition.

Note that in some cutting conditions, it may be difficult to achieve the full benefits of the LongLife process.

Electrode Life

1. To obtain maximum life from your consumable parts, program the lead-out of the cut so that the arc can remain attached to the plate until the ramp-down process is complete.

   - When cutting drop-parts (the part that drops away is production material and the plate remaining on the cutting table is scrap), program the lead-out into the scrap area.

   - When cutting a hole (the part that drops away is scrap), program the lead-out along the kerf so that the arc can remain attached to cut edge until ramp-down is complete.

2. Use a chain cut if possible.

3. Purge the gas lines before cutting.

Nozzle Life

1. Do not lead out to the drop part, which will cause the arc to stretch.

2. Purge the gas lines to clean the plasma chamber before cutting.

3. Make sure the torch does not dive to the plate during cutting.

Shield Adapter Life

1. Make sure the shield adapter does not touch the plate during cutting.

2. Set the pierce height between 1.5 to 2 times higher than the torch-to-work height. Keep the shield clean to prevent double arcing.

How to Get Better Pierces

1. Start the arc on the edge of the material with a pre-punched side, if possible.

2. Make the IHS setting constant. The initial pierce height should be between 1.5 to 2 times higher than the torch-to-work height.

3. Make sure the pierce delay is on long enough to allow the arc to pierce through the material before the machine moves.

4. Use a higher shield pre-flow to help pierce through and blow the molten metal away. This may affect starting reliability.

How to Increase Cutting Speed

1. Lower the torch-to-work distance. However, the shield can not touch the plate. The cutting surface will bevel inside when the torch-to-work distance is too low.

Hypertherm

Section 5

MAINTENANCE

In this section:

Introduction

Hypertherm assumes that the service personnel performing the troubleshooting testing are high-level electronic service technicians who 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 departments listed in the front of this manual.

WARNING
SHOCK HAZARD

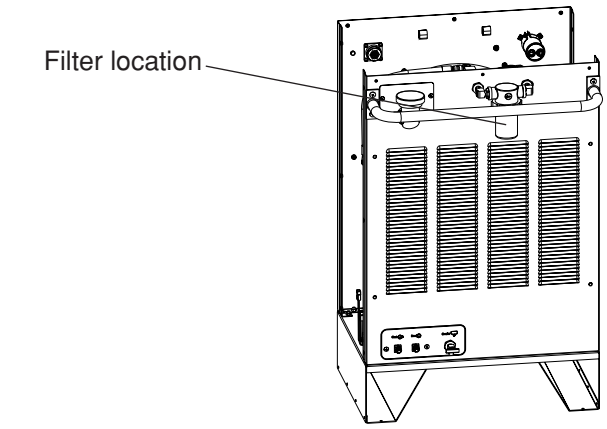
The large chopper capacitors store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge capacitors with a screwdriver or other implement...explosion, property damage and/or personal injury will result. Wait at least 5 minutes after turning the power supply off before touching the chopper or the capacitors.

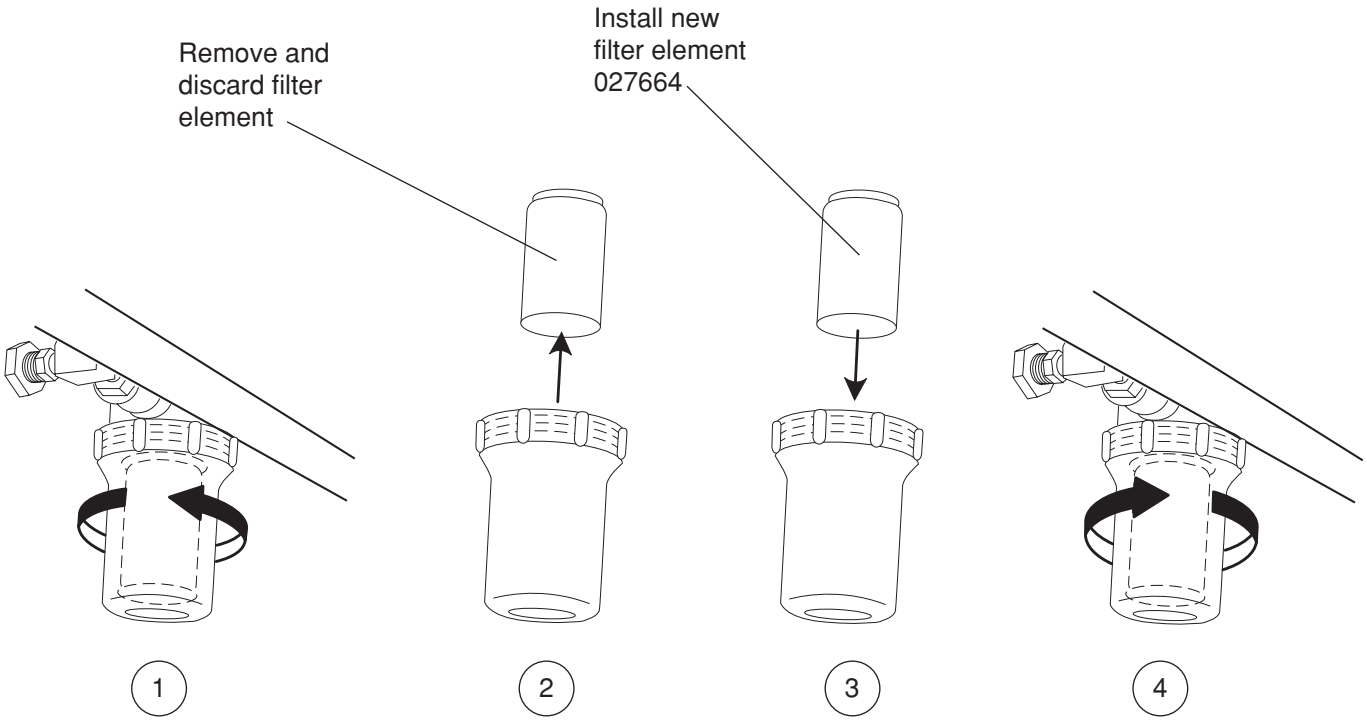
Routine Maintenance

For a complete list of routine maintenance recommendations, see the *Preventative Maintenance Schedule* sheet located at the rear of this section. Contact the Technical Services department listed at the front of this manual with any questions regarding the maintenance schedule or procedures.

Replacing the Cooler Filter

Replace the filter element as needed.





Torch Coolant Draining

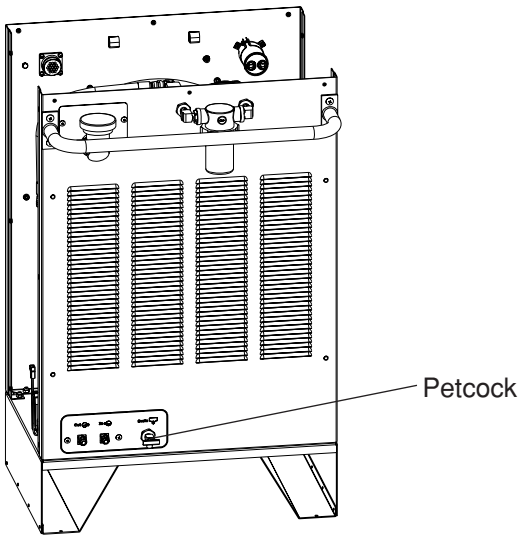
If the torch needs to be changed or transported, follow this procedure for draining the torch coolant from the torch and torch leads. Coolant should be drained from the system every 6 months. See *Preventative Maintenance Schedule* at the back of this section.

1. Disconnect all power to the HT4400 system.
2. Disconnect the torch leads from the ignition console and valve cluster.
3. Ensure that the consumables are installed in the torch.
4. Position the torch lead fittings over a drain or other suitable device to collect coolant.
5. Blow clean, dry, oil-free air at 80-120 psi (5.5-8.3 bar) into the hose with the green band. Coolant will flow out of hose with the red band.

Cooler Draining

If the cooler needs to be transported, follow this procedure to drain the coolant from the cooler. Coolant should be drained from the system every 6 months. See *Preventative Maintenance Schedule* at the back of this section.

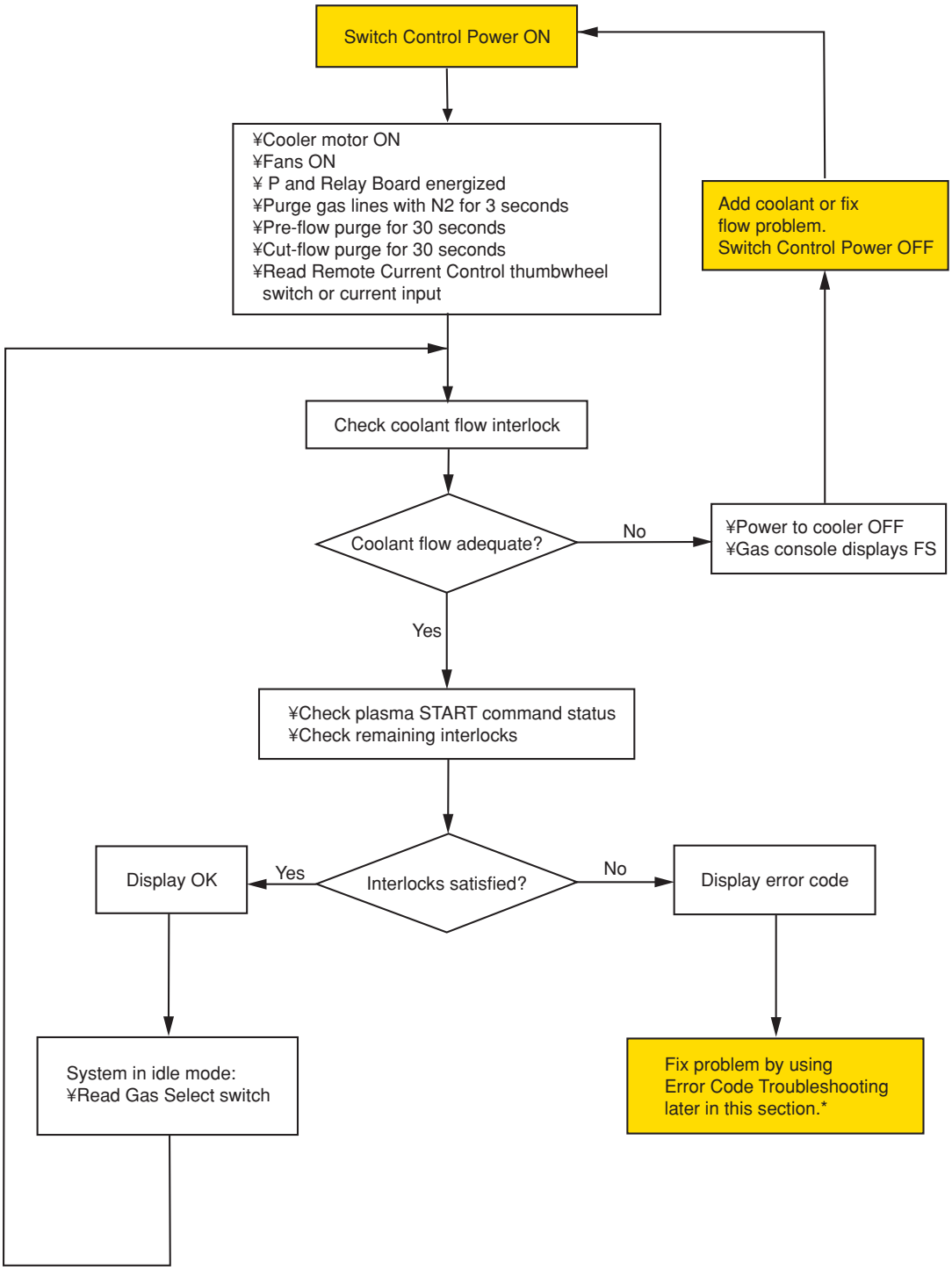
1. Disconnect all power to the HT4400 system.
2. Disconnect and drain the coolant from the hoses going between the cooler and the ignition console.
3. Place a suitable receptacle under the cooler's drain petcock.
4. Turn petcock counterclockwise to drain cooler.



Cooler Drain Location

HT4400 Startup Sequence

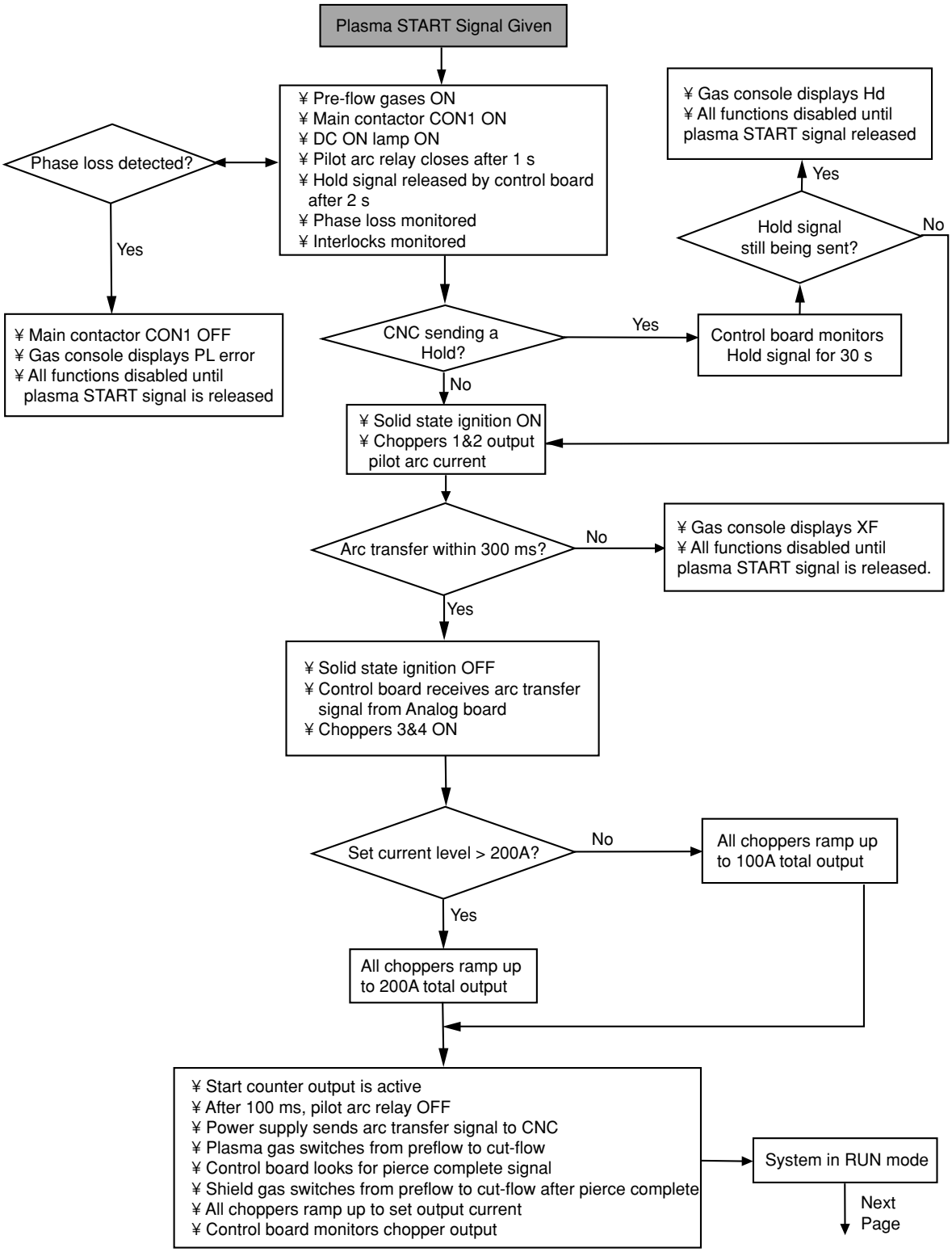
The following flowchart shows the startup sequence from when the control power circuit breaker is placed in the ON position to the power supply idle state before the plasma START command is given. Shaded boxes indicate action taken by the operator. See *Post-Installation* in Section 3 if you are switching on the power supply for the first time.



* PLASMA START command refreshes the status display

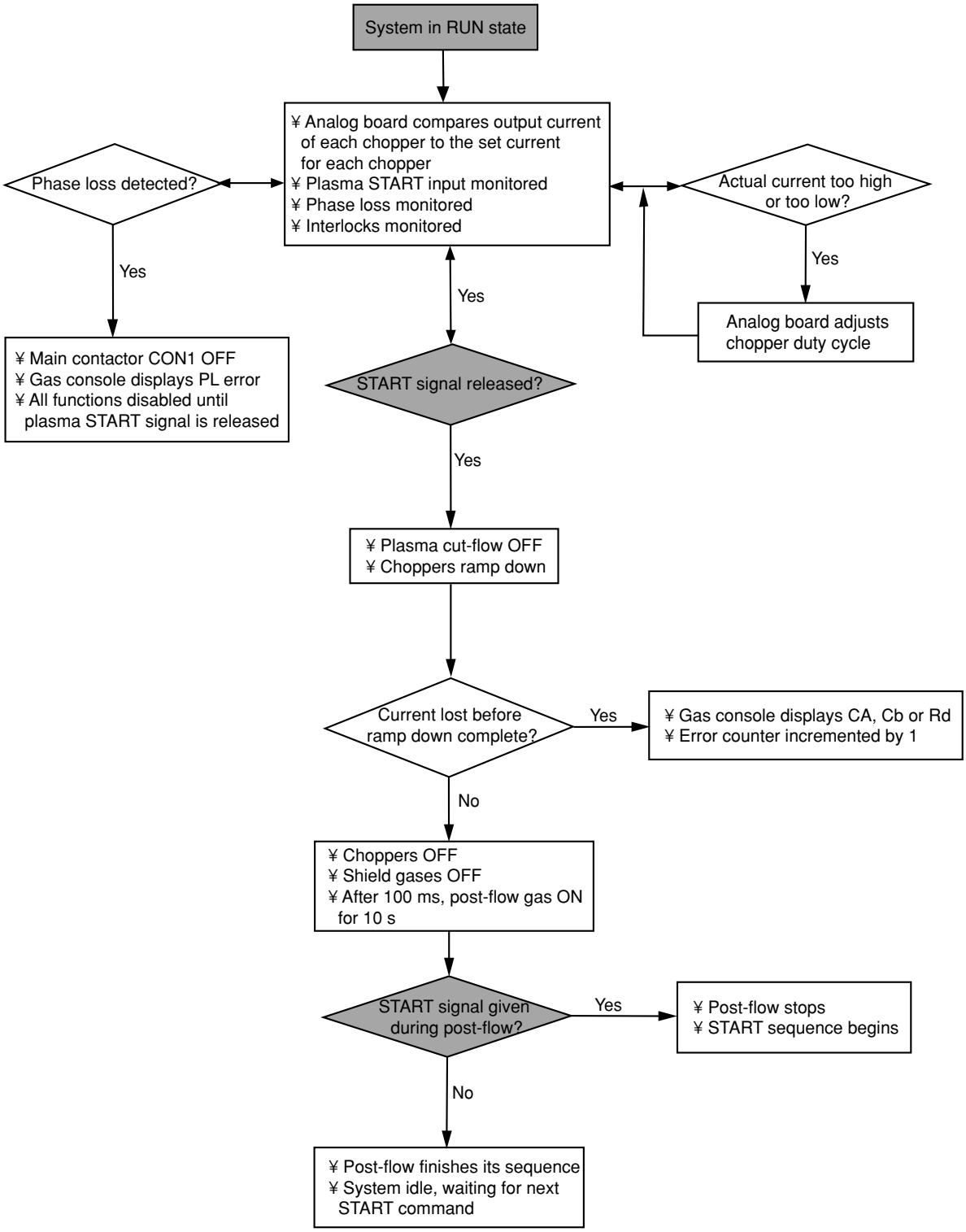
HT4400 Plasma START Sequence

The following flowchart shows the sequence from when the plasma START signal is given up to the RUN state. Shaded boxes indicate action taken by the operator.



HT4400 Plasma RUN Sequence

The following flowchart shows the sequence from RUN state through the end of a cut. Shaded boxes indicate action taken by the operator.



Error Code Troubleshooting - 1 of 3

All error code displays are cleared after error condition has been corrected and the valve select switch is set to MV1 and back to Run. The system is now ready for the plasma START signal. “FS” error is cleared by cycling the HT4400 power.

Display	Condition	Effect	Possible Cause	Fix
CA	Lost current on Chopper 1 and/or 2	Cutting error output active	Torch running off plate	Change programming to prevent arc from losing contact with plate.
			Current sensor failure	See Current Sense Test later in this section.
			Chopper failure	See Chopper Module Test Procedure later in this section.
Cb	Lost current on Chopper 3 and/or 4	Cutting error output active	Torch running off plate	Change programming to prevent arc from losing contact with plate.
			Current sensor failure	See Current Sense Test later in this section.
			Chopper failure	See Chopper Module Test Procedure later in this section.
CT	Temperature on 1 of the choppers is too high	Cutting stops	Cooling fan failure	Replace cooling fan. Ensure that there is voltage to the fan and that the fan is spinning freely.
FS	Coolant flow switch is not satisfied	Cutting stops, coolant pump motor turns off	Low coolant level	Fill cooler with coolant - See Section 3.
			System was turned on with HOLD signal active	Remove HOLD signal
			Coolant pump failure	Replace the pump
			Restriction in a hose	Remove restriction or replace hoses.
			Flow switch failure	Replace the flow switch
Hd	Hold timeout	Cutting is disabled. Main contactor closes, preflow gases flow, but cutting does not start.	HOLD input active for more than 30 seconds	Verify that the controller is not outputting a HOLD signal. See wiring diagrams for details.
			Paralleled system not releasing HOLD	Disconnect hold cable from other plasma power supplies. Check wiring of hold circuit.
			Shorted cable	Check for short in HOLD cable. See wiring diagrams for detail.
OK	No errors	Ready to cut	No errors detected	No fix is required
PC	Plasma cut pressure error	Cutting is disabled.	Plasma cut pressure is not between 30-140 psi / 2.07-9.65 bar (pressure switch setpoints) while cutting.	Check gas inlet pressure. Check valve pressure settings. Check for gas leaks or restrictions in hoses. See Leak Tests in Section 4.

Error Code Troubleshooting - 2 of 3

Display	Condition	Effect	Possible Cause	Fix
PL	Phase loss error	Main contactor closes, then opens. Cutting stops	Improper input power	Verify proper circuit breaker fuse size, input voltage, power cable wire size. Verify all connections are tight.
			Contactor failure	Replace contactor or contacts. Contactor contacts should not be severely pitted.
PP	Plasma preflow pressure error	Cutting is disabled.	Plasma preflow pressure is not between 10-140 psi / 0.69 - 9.65 bar (pressure switch setpoints) before cutting begins.	Check gas inlet pressure. Check valve pressure settings. Check for gas leaks or restrictions in hoses. See Leak Tests in Section 4.
Rd	Lost current on ramp down	Error output active	Torch running off the plate	Change programming to prevent arc from losing contact with the plate.
RU	Lost current on ramp up	Cutting stops - Error output active	Insufficient input power	Verify proper circuit breaker fuse size, input voltage, power cable wire size. Verify all connections are tight.
			Torch running off plate	Change programming to prevent arc from losing contact with the plate.
SC	Shield cut pressure error	Cutting is disabled.	Shield cut pressure is not between 10-140 psi / 0.69 - 9.65 bar (pressure switch setpoints) while cutting.	Check gas inlet pressure. Check valve pressure settings. Check for gas leaks or restrictions in hoses. See Leak Tests in Section 4.
SP	Shield preflow pressure error	Cutting is disabled.	Shield preflow pressure is not between 15-140 psi / 1.03 - 9.65 bar (pressure switch setpoints) before cutting begins.	Check gas inlet pressure. Check valve pressure settings. Check for gas leaks or restrictions in hoses. See Leak Tests in Section 4.
SS	Start signal error	Cutting is prevented	System was powered up while START command was coming from CNC.	Remove START signal. System will wait for next START command.

Error Code Troubleshooting - 3 of 3

Display	Condition	Effect	Possible Cause	Fix
TT	Main transformer temperature too high	Cutting stops	Cooling fan failure	Replace cooling fan. Verify voltage to the fan is correct and that the fan is spinning freely.
			Power supply exceeding duty cycle	Operate according to the specifications. Although the system has a 100% duty cycle, operating with reduced cooling air flow or excessive arc length will cause this problem.
VI	Line voltage between +10% and +15% or between -10% and -15% of nominal	In this condition, the power supply will continue to operate normally.	Supply voltage not within specifications	Verify for correct line voltages.
VO	Line voltage greater than +15% or less than -15% of nominal	In this condition, the power supply will not function. No cutting is possible until voltage falls within the VI or OK range.	Supply voltage not within specifications	Verify for correct line voltages.
VS	Valve select error	Cutting prevented	START activated with gas console valve selector not in RUN position	Set the gas console valve selector to RUN.
WT	Coolant temperature too high	Cutting stops	Coolant temperature exceeds 160¡ F (71¡ C) - caused by high ambient temperature and/or high duty-cycle cutting and/or water leak	Let power supply idle for 5 minutes. Check that the cooling fan in the water cooler operates. Check if the temerature sensor is working. Blow out the cooler with compressed air to clean.
XF	No arc transfer	Cutting stops - Error output active	Poor work cable connection	Verify that the work cable is connected to the cutting table and the cable is in good condition.
			Piercing distance too high	Verify that the torch is at the proper pierce height.
			Insufficient input power	Verify for proper circuit breaker fuse size, input voltage, power cable wire size. Verify that all connections are tight.
			Damaged torch leads	Replace the torch leads.
			Transfer sensor failure	Perform the Current Sense Test later in this section.
			Chopper failure	Perform the Chopper Module Test Procedure later in this section.

System Troubleshooting - 1 of 4

Condition	Result	Cause	Solution
System not Powering up	Circuit breaker on back of power supply (CB1) tripping	E-stop is being applied by CNC.	Release E-stop.
		Wire #80 and #81 of machine interface cable are tied together	Check continuity across wire #80 and #81. Continuity should be open unless an E-stop is being applied by CNC.
	Circuit breaker (CB1) is on, main disconnect is on, but fans and power light are off	Remote On/Off is not jumped at TB4 (for local On/Off)	Check that TB4 jumper is across positions 1 and 2. If a remote On/Off is being used, this jumper should be across positions 2 and 3.
		CNC is not giving a contact closure signal on the remote On/Off wires (Optional)	Check for continuity across TB4 position 1 and 2 when attempting to turn the power supply on from the CNC. This circuit should be closed for ON, and open for OFF.
		There is a blown fuse on the power distribution board (PCB1)	With power applied to power supply, all three LEDs should be illuminated on PCB1. If one of the three LEDs is extinguished, replace the fuse that is associated with the LED.
		K2 relay on PCB1 is faulty	After power up, there will be 120 VAC to the coil of K2 at pins 1 and 5. There should also be 0 VAC across pins 3 and 4.
No Arc at Torch	Torch not firing and no error being displayed at the Gas Console	Plasma start signal is not sensed	If an error is displayed at the gas console, refer to *Error Code Troubleshooting* in this section for possible causes.
			Remove the machine interface cable from 1X6 in the back of the power supply. Locate TB3 in the back right hand side of the power supply. Hook up a toggle switch across wires 82 and 83 on TB3. Power up the system and then close the switch. If torch fires, then the problem is with the machine interface cable or the CNC.
Loss of Arc/No Transfer	Torch fires, marks the plate or starts to cut, then the arc goes out. No error is displayed at the gas console	Plasma start signal is being released	If an error is displayed at the gas console, refer to *Error Code Troubleshooting* in this section for possible causes.
			Locate TB3 in the back right hand side of the power supply. Hook up a toggle switch across wires 82 and 83 on TB3. Perform a programmed cut. When the arc is established turn on the toggle switch. The switch will bypass the plasma start signal. If the torch continues to cut, then the problem is with the machine interface cable or the CNC.

Condition	Result	Cause	Solution
Poor Consumable Life	Nozzle orifice etched on one side, and/or electrode life is short, and/or electrode is black at the tip	The system may have a gas leak, a faulty pressure regulator or a gas restriction	Refer to *Leak Tests* in the Operation section of this manual and perform the test shown.
			Make sure the inlet pressure for both plasma and shield pressures are set to the book values. When cutting, monitor the pressure on each pressure gauge. Be sure that pressure is not dropping more than +/- 10 psi (+/- 0.7 bar). A good delivery system with a good regulator will not drop more than 5 psi (0.3 bar). Dips in pressure could be from a faulty regulator, an insufficient gas source, a leak in the delivery line before the regulator or a leak/restriction after the pressure regulator.
			With inlet pressures set to the book values and gas pressures set up according to the cut charts in the manual, the plasma preflow and cut-flow pressures should be as shown in the cut charts. There are pressure values at the bottom of each cut chart for PG1 and PG2 during cutting. All pressures should be within +/- 5 psi (+/- 0.3 bar) for preflow, cut-flow and run. If one of these pressures is high and all gas settings are correct, then there is a restriction in the gas system after the Off-Valve Assembly. If one of these pressures is low, then there is a leak in the system, an insufficient gas source or a restriction before the Off-Valve Assembly.
		There is an internal coolant leak within the torch	Purge preflow for 30 seconds, purge cut-flow gas for 30 seconds and then switch to run mode. Let system idle for about 15 minutes. Lower torch to 1/2" (12 mm) from the plate and place a mirror under the torch. Purge preflow for 30 seconds and purge cut-flow for 30 seconds. If moisture begins to deposit on the mirror, then there is a coolant leak within the torch. Check all o-rings on the torch body and on the bullet connectors on the back of the torch.
		Pierce height too close to plate or pierce thickness is above maximum	Refer to the cut charts in the operation section of the manual for correct pierce height and maximum pierce thickness.
	Outside orifice of nozzle is countersunk	Pilot arc lead is shorted to the work-piece	The resistance of the pilot arc lead to ground or the work lead should be 1 Kohms or higher.
		Pilot arc relay (CR1) contacts are welded shut	Locate the pilot arc relay on the center bail. When firing the torch over metal, this relay should open as soon as the arc is transferred to the plate.
		Faulty work lead connection	A faulty work lead and/or work lead connection increases the time the pilot arc is on and increases nozzle wear. To determine if the pilot arc is not transferring to the plate immediately, watch the green LED on the Start Circuit (PCB14) while firing over the plate. If the LED illuminates it should only blink quickly. If the LED illuminates for more than .5 seconds then the arc is not transferring to the plate immediately.
		Power supply output current is greater than the current setting	Check output current at CS5 on Analog Board (PCB3), refer to *Current Sense Test* in this section of manual. If the actual output current is higher than the set output current, check the output current of each chopper.
		Shorted torch head	Replace the torch.
		Piercing too high off plate	Refer to cut charts in the Operation section of this manual for proper pierce height.

System Troubleshooting - 3 of 4

Condition	Result	Cause	Solution
Poor Cut Quality	Positive and negative bevels on opposing sides of the cut	Torch is not square to the plate	Check alignment of torch to plate. See *Torch Mounting and Alignment* in the Installation section of this manual.
	Excessive positive bevel on all sides of the cut	Torch-to-work distance is too high	Lower arc voltage setting by 5 or 10 volts.
		Gas leak	See *Leak Tests* in the Operation section of this manual.
		Travel speed is too high	Check travel speed against cut charts in the Operation section of the manual. Travel speed should be +/- 10 ipm (+/- 254 mm/m) from the speed listed in the cut charts.
		Gas setting is incorrect, insufficient gas source or gas pressure is set to less than book value	Refer to cut charts in the Operation section of this manual and check the test preflow and test cut-flow gas pressures. If the pressures are not within +/- 5 psi (+/- 0.3 bar), then either a gas setting is incorrect, the inlet pressure is set too low, there is a faulty regulator or there is a leak/restriction.
	Excessive positive and/or negative bevel on one or two sides of the cut	Faulty torch	Rotate the torch and see if a bevel goes to a different cut edge. If the bevel moves to a different cut edge, replace the torch.
		Gas leak/restriction	Refer to the cut charts in the Operation section of the manual. On the bottom of the page are gas pressures for plasma and shield that will be displayed on the gas console while cutting. The actual cutting pressure should be +/- 5psi (+/- 0.3 bar) from the value listed in the cut chart. If the gas pressure is high, then there is either a pinched plasma gas line after the Off-Valve Assembly, a clogged gas port in the torch or a bad swirl ring.
	Excessive negative bevel on all sides of cut	Torch-to-work distance is too low	Increase arc voltage setting by 5 or 10 volts.
THC not functioning properly	Torch rising off plate when table starts moving	The system may have a gas leak, a faulty pressure regulator or a gas restriction before the off-valve assembly	See *Leak Tests* in the Operation section of this manual.
			Make sure the plasma and shield inlet pressures are set to book values. While cutting, monitor the pressure on each pressure gauge. Make sure that pressure is not dropping more than +/- 10 psi (+/- 0.7 bar). A good delivery system with a good regulator will normally drop less than 5 psi (0.3 bar). Dips in pressure could be from a faulty regulator, insufficient gas supply, a gas leak or a restriction before the Off-Valve Assembly.
			With inlet pressures set to book values, and gas pressures set up according to the cut charts, the plasma preflow and cut-flow pressures should be as shown in the cut charts. There are pressure values at the bottom of each cut chart for PG1 and PG2 during cutting. The actual cutting pressures should be within +/-5 psi (+/- 0.3 bar) of value listed in manual. If one of these pressures is low, then there is a leak in the system, insufficient gas source or restriction before the Off-Valve Assembly.

System Troubleshooting - 4 of 4

Condition	Result	Cause	Solution
THC not functioning properly (Continued)	Torch rising off plate when table starts moving (Continued)	Faulty voltage divider	Refer to the cut chart in the Operation section of the manual. Determine the torch-to-work distance for the material you are cutting. Perform a manual cut (AVC off) at the height and travel speed indicated in the manual. If using a Command THC, monitor the actual arc voltage on the pendant (if used) or measure the voltage on the terminal strip in the plasma interface box (from Electrode to Work). Voltage should be +/-10 VDC from setting shown in manual. If voltage is low check for gas leaks. If voltage is within +/-10 VDC from book setting, then perform another manual cut and measure the divided voltage across pins 16 and 35 on J7 in Plasma Interface Box. The voltage should be 1/40th of actual arc voltage. If using a THC system other than the Command THC, refer to manufacturer of the THC system to determine how to test their voltage divider.
	Torch moves down toward or into the plate when table starts moving	Gas restriction	With inlet pressures set to book values, and gas pressures set according to the cut charts, the plasma preflow and cut-flow should be as shown in the cut charts. There are pressure values at the bottom of each cut chart for PG1 and PG2 during cutting. All pressures should be within +/- 5 psi (+/- 0.3 bar). If one of these pressures is high and all gas settings are correct, then there is a restriction in the gas system after the Gas Console. If one of these pressures is low, then there is a leak in the system or insufficient flow from gas source.
		Faulty voltage divider	Refer to the cut chart in the Operation section of the manual. Determine the torch-to-work distance for the material you are cutting. Perform a manual cut (AVC off) at the height and travel speed indicated in the manual. If using a Command THC, monitor the actual arc voltage on the pendant (if used) or measure the voltage on the terminal strip in the plasma interface box (from Electrode to Work). Voltage should be +/-10 VDC from setting shown in the manual. If voltage is high, the problem could be a gas restriction after the Off-Valve or a faulty torch. If voltage is within +/-10 VDC from book setting, then perform another manual cut and measure the divided voltage across pins 16 and 35 on J7 in the Plasma Interface Box. The voltage should be 1/40th of actual arc voltage. If using a THC system other than the Command THC, refer to manufacturer of THC system to determine how to test their voltage divider.
Coolant Leaking out Torch Body	Torch not properly seated to torch receptacle	O-ring on the center shaft on the back of the torch is not properly seated	If the torch is not screwed completely onto the torch receptacle, the o-rings on the back of the torch body will not properly seal gases and coolant when power is applied. As a result, the force of the coolant leaking around the center shaft of the torch will cause the o-ring to become dislodged. Refer to the Installation section of this manual for proper installation of the quick-disconnect torch.
		One of the coolant connectors on the back of the torch is damaged	Inspect o-rings on back of the torch for damage. Refer to the Operation section of this manual to identify coolant connectors.

Initial Checks

Before tracking down specific problems, do a visual check and verify proper voltages are present at the power source, transformers and power distribution board.

WARNING

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

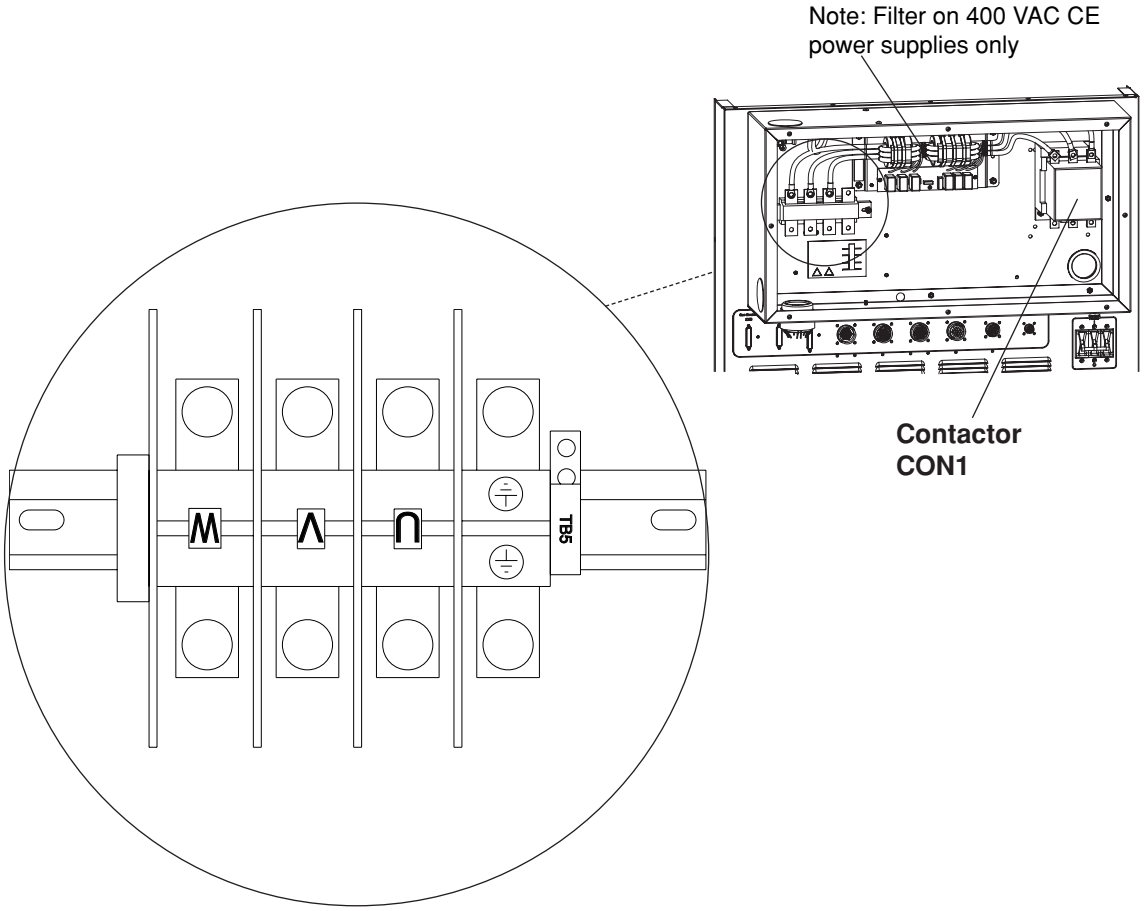
1. Disconnect line power by turning main disconnect switch off.

2. Remove top plate, two side plates, front plate, and rear plate of power unit.

3. Inspect interior of power unit 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 doing any testing. Refer to the *Parts List* section to identify parts and part numbers.

4. If no damage is apparent, plug in the power supply unit, and apply power by turning on the main disconnect switch.

Power Measurement Location - All Voltages

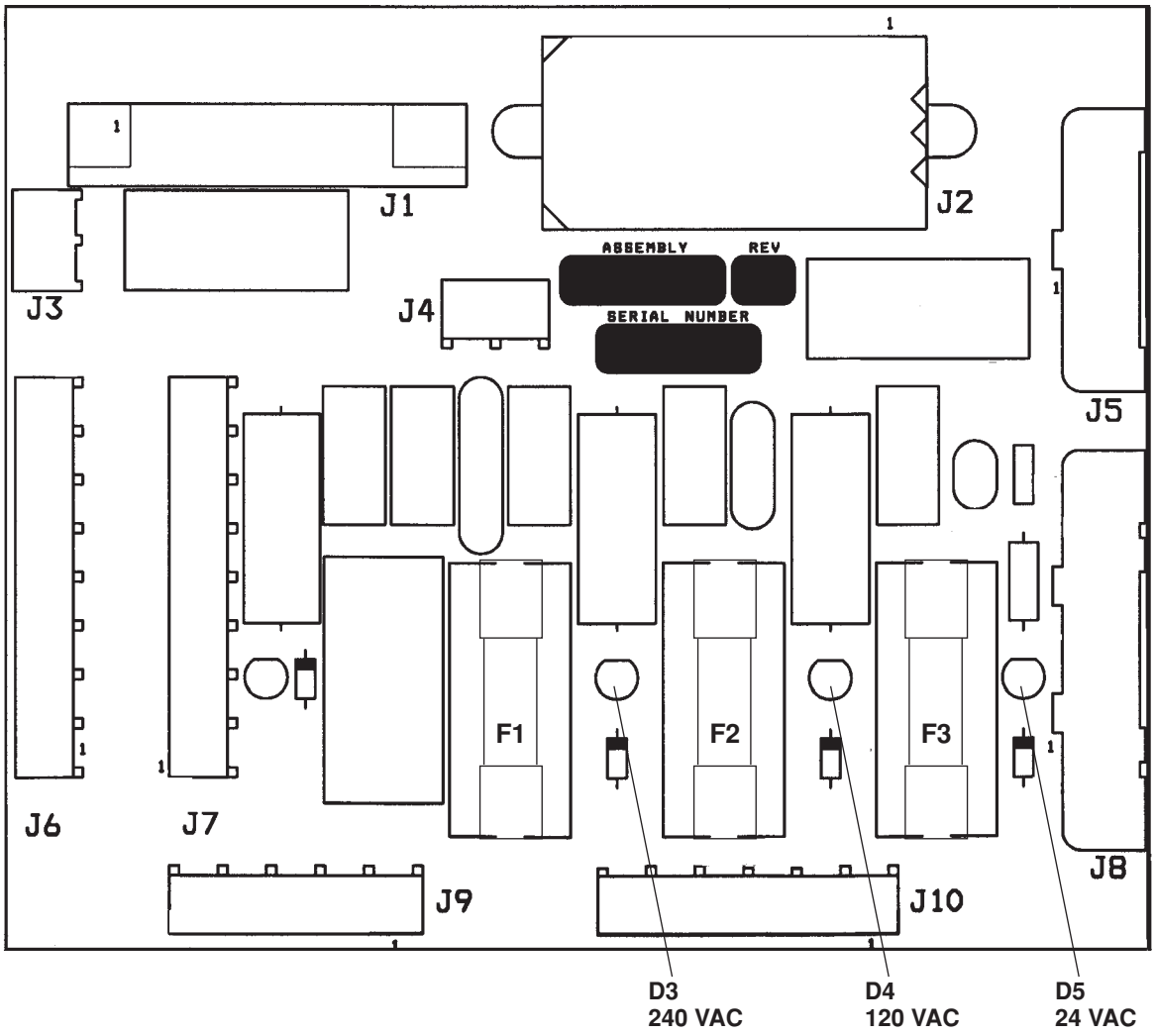


5. Measure the voltage between the W, V and U terminals of TB5 located in the rear of the power supply. See figure above. Also refer to the wiring diagram in Section 7, if required. The voltage between any 2 of the 3 terminals should be equal to the supply voltage. If there is a problem at this point, disconnect main power and check connections, power cable, and fuses at line disconnect switch. Repair and/or replace defective component(s) if necessary.

	WARNING
There is line voltage at the contactor if the line disconnect switch is in the ON position, even if the circuit breaker on the power supply is OFF.. Use extreme care when measuring primary power in these areas. Voltages present at the terminal block and contactors can cause injury or death!	

Power Distribution PCB1 - Status Indicators

See page 6-5 for location of Power Distribution Board.



Notes: When circuit breaker CB1 is switched ON, LEDs D3-D5 will illuminate and stay illuminated.

To measure voltages at the power distribution board, find fuses F1, F2 and F3. When the power supply is energized, take measurements from the top of each fuse to chassis ground, and then from the bottom of each fuse to chassis ground. Measurements should be as follows:

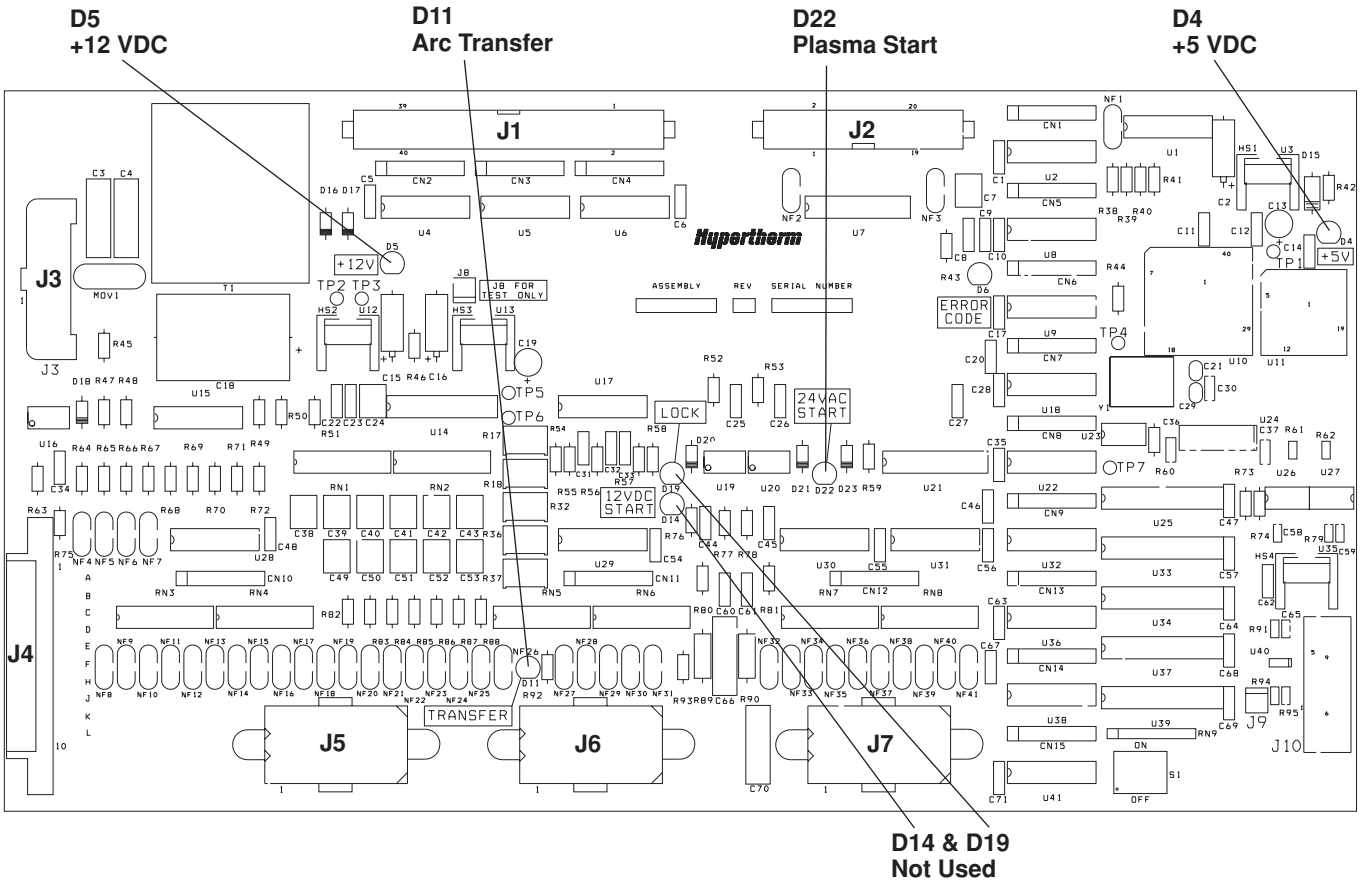
F1: 240 VAC
F2: 120 VAC
F3: 24 VAC

If voltages are not present, or incorrect at one or more of these points, disconnect power and troubleshoot fuses and associated pins, connectors and wiring between power distribution board connector J10 and control transformer secondary T1.

Also, check wiring and connections between T1, CB1, and CON1.

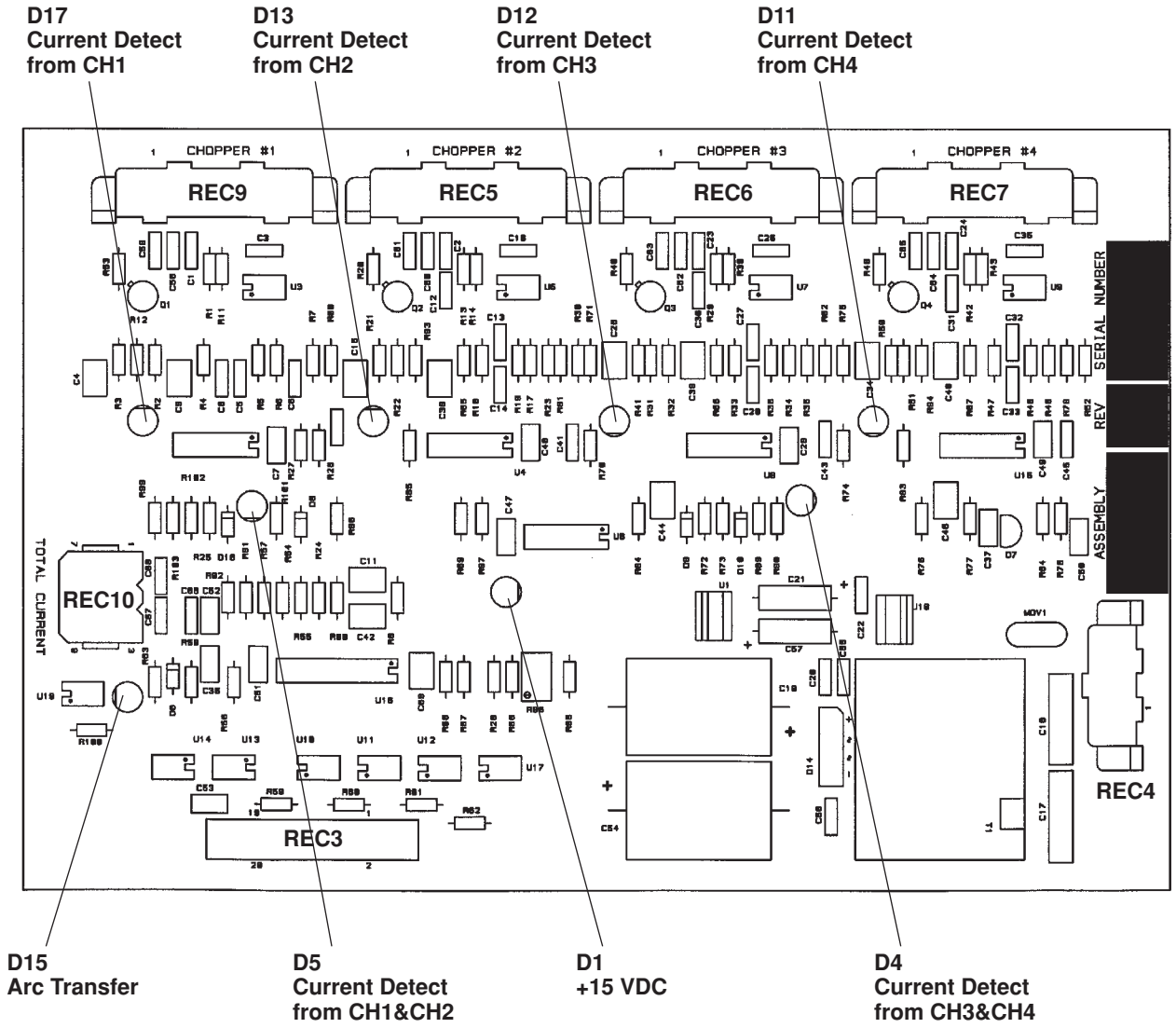
Microprocessor Control Board PCB2 - Status Indicators

See page 6-2 for location of Microprocessor Control Board.



Analog Board PCB3 - Status Indicators

See page 6-2 for location of Analog Board.



Note:
- D15 Arc transfer output - illuminates when total current sensor (CST) senses a current higher than 30 amps.
- D11, D12, D13, D17 Chopper outputs - illuminates when each chopper current sensor (CS1-CS4) senses a current higher than 7 amps.
- D5 Current Detect from CH1&CH2 - illuminates when both CH1&CH2 output more than 7 amps.
- D4 Current Detect from CH3&CH4 - illuminates when both CH3&CH4 output more than 7 amps.

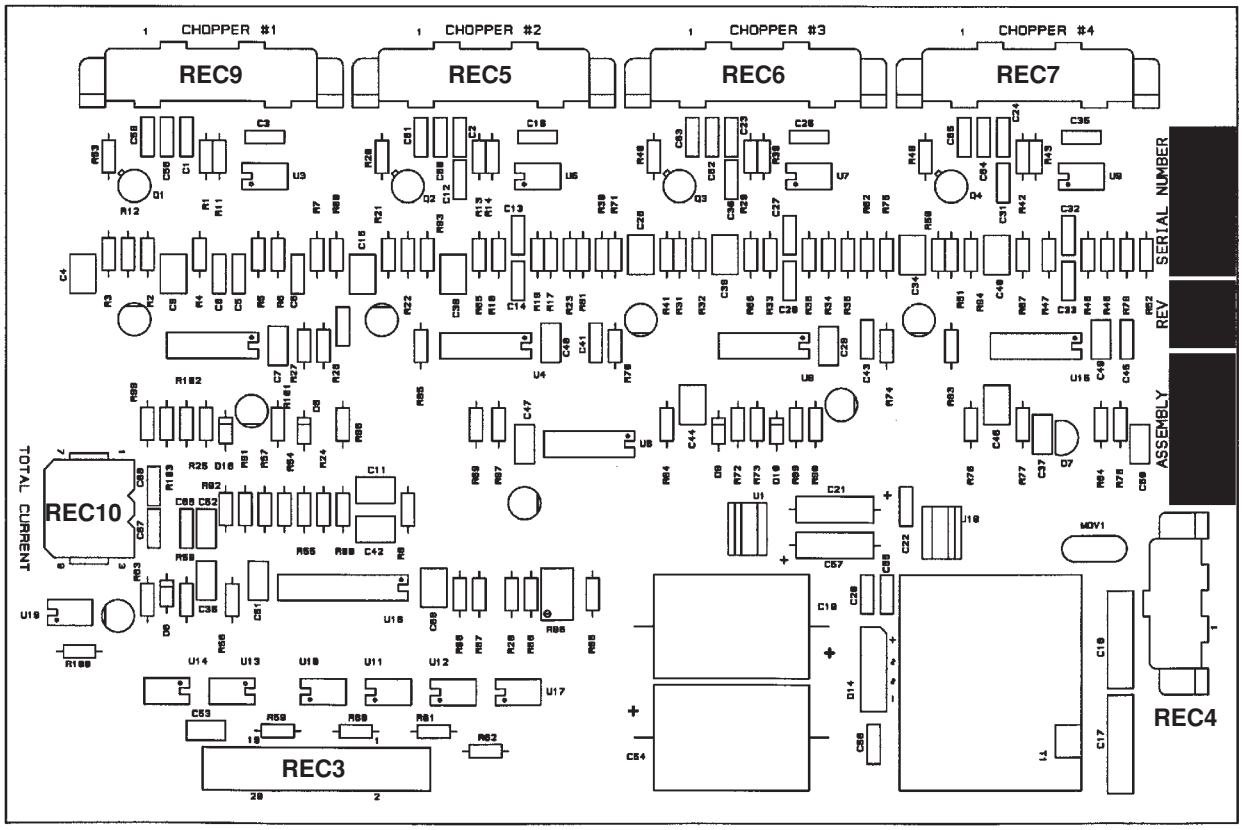
Current Sense Test

WARNING

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

The signals from the current sensors can be measured as voltages. Use the table and figure below to check for proper current levels when the power supply is ON and the torch is cutting.

Chopper	Measurement Point	Output Value
CH1	REC9 pins 3 & 4	4 V = 100 amps
CH2	REC5 pins 3 & 4	4 V = 100 amps
CH3	REC6 pins 3 & 4	4 V = 100 amps
CH4	REC7 pins 3 & 4	4 V = 100 amps
Total Current	REC10 pins 3 & 4	3.2 V = 400 amps

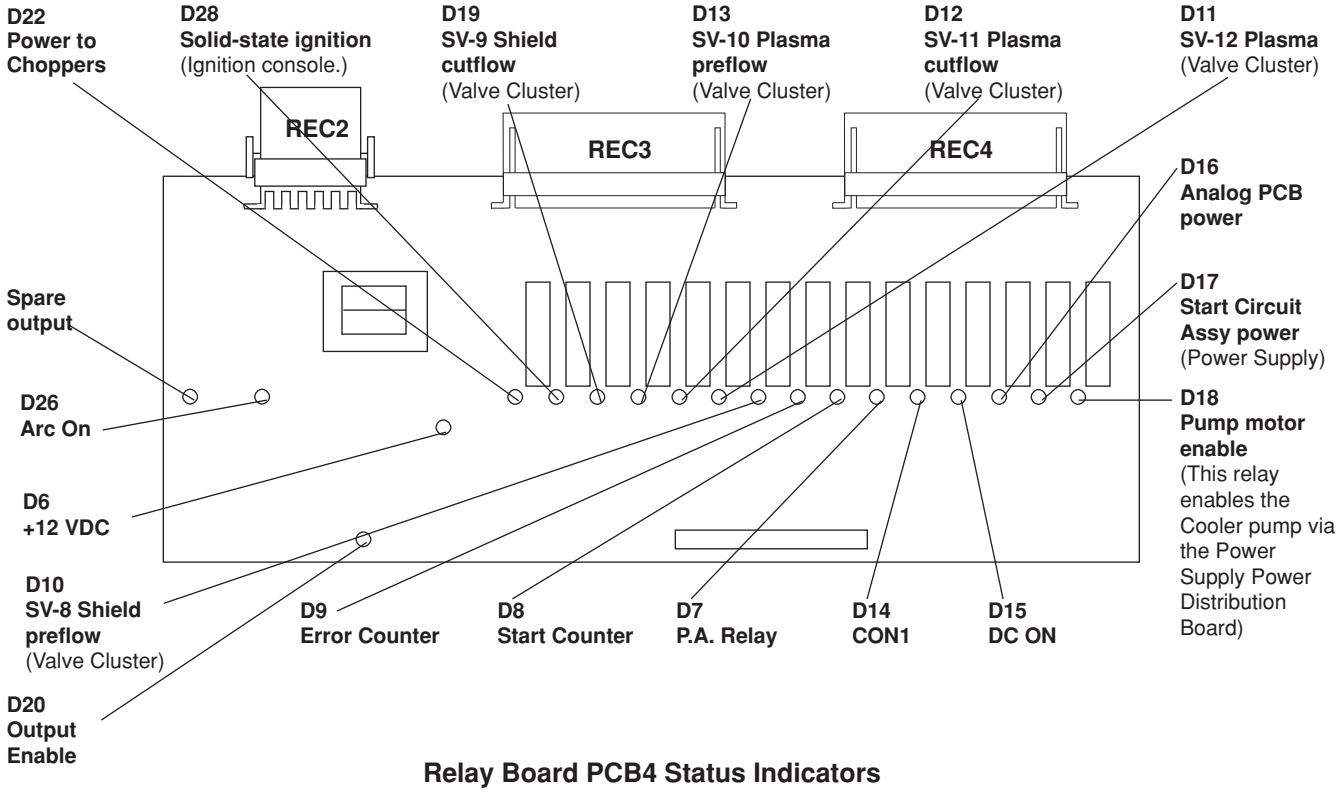


Relay Board PCB4 - Status Indicators

Relay board PCB4 interfaces certain controls in the power supply, ignition console and the valve cluster. The control board sends a command to the relay board, and the relay board responds by sending 120 VAC to the control (and also lighting an LED on the relay board). The control board also tells the relay board to shut off the 120 VAC to the particular control (which shuts off the LED). LEDs are located adjacent to the relay that switches the 120 VAC There are also 4 LEDs indicating on-board conditions.
See page 6-2 for location of Relay Board.

On the following pages are the LEDs that will illuminate under different modes of operation.

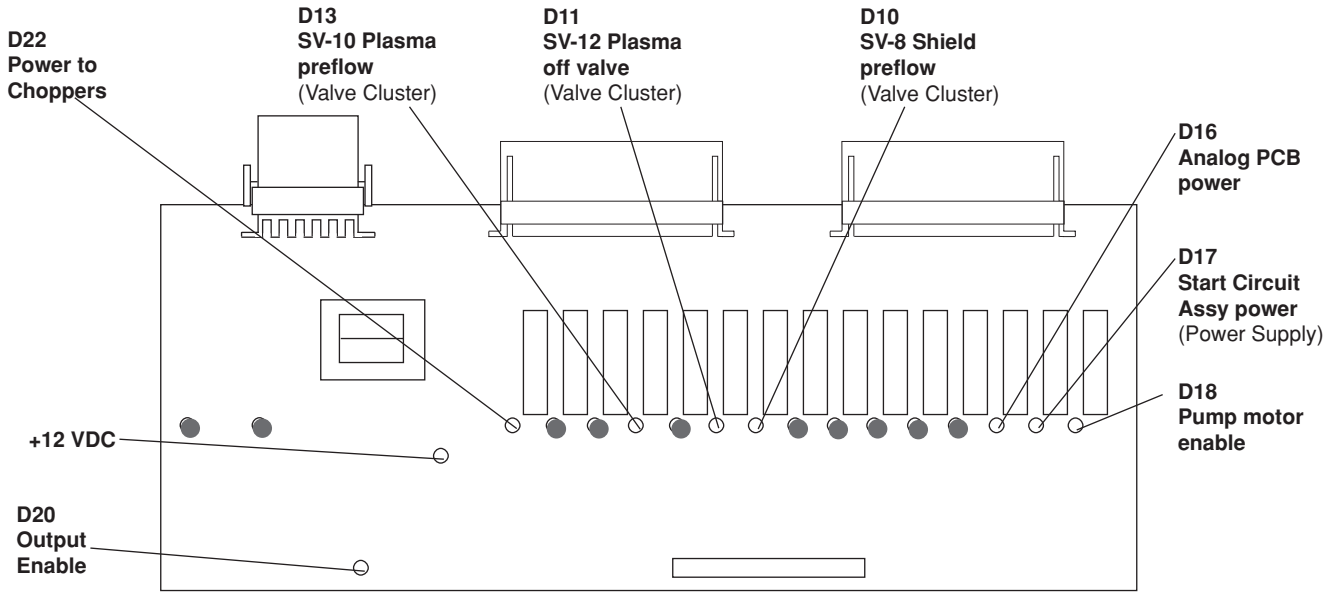
REC2 Pin#	Description	REC3 Pin#	Description	REC4 Pin#	Description
5&6	Arc Xfer	1&2	SV-8 on Valve Cluster	1&2	Pump motor in Cooler via Power Distribution PCB
		3&4	SV-12 on Valve Cluster	3&4	Power to Start Circuit Assy
		5&6	SV-11 on Valve Cluster	5&6	Power to Analog PCB
		7&8	SV-10 on Valve Cluster	7&8	DC On LT2
		9&10	SV-9 on Valve Cluster	9&10	CON1 CON2
		11&12	Solid-state ignition in Ignition Console	11&12	Pilot arc relay
		13&14	Choppers 1-4	13&14	Start counter
		15&16	Power to Relay Board	15&16	Error counter



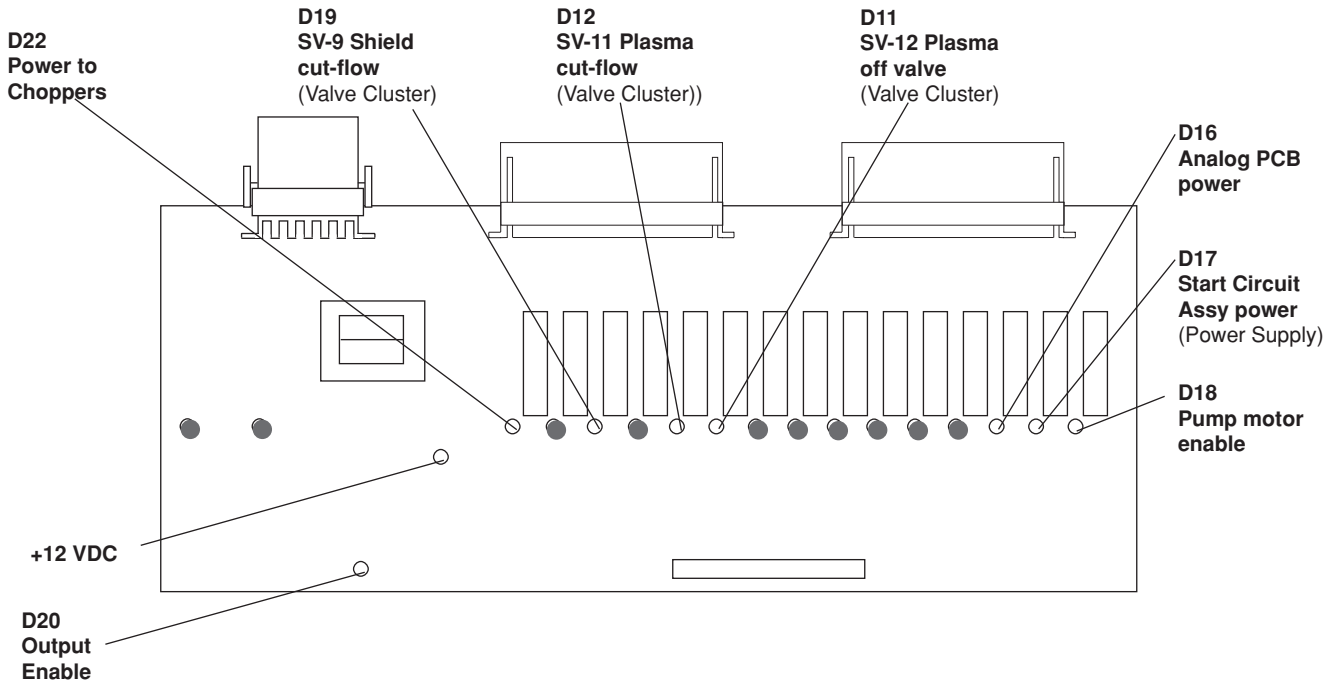
Relay Board PCB4 Status Indicators

Note: In all Relay Board Figures, LED ON = ○ LED OFF= ●

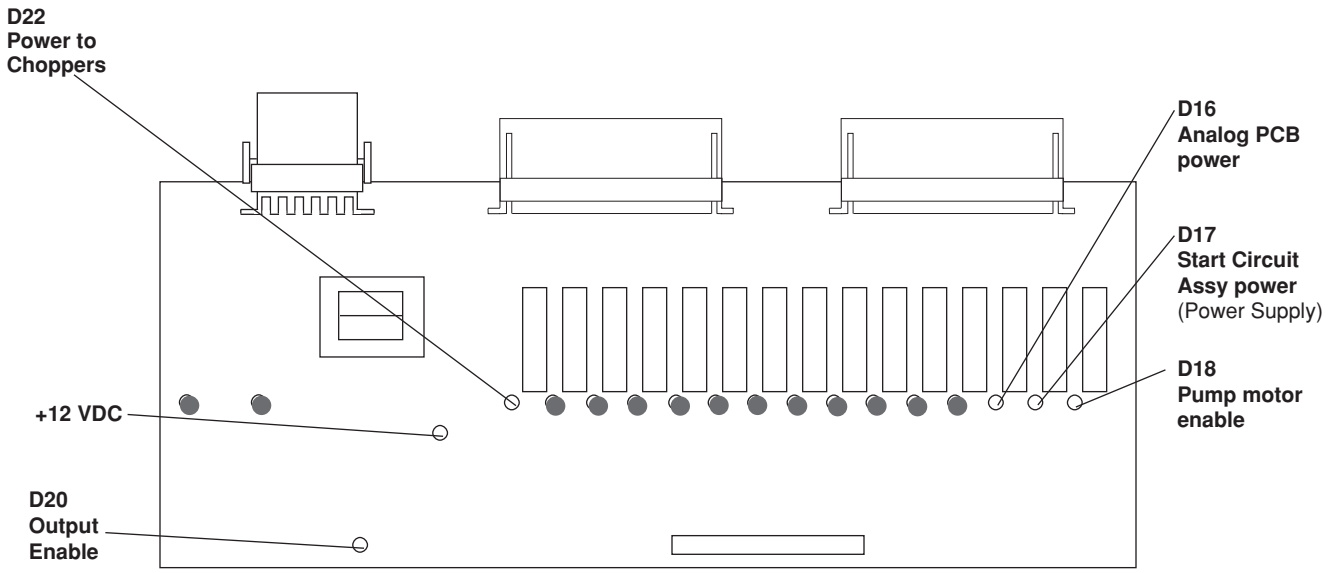
Relay Board LED Status
Test Preflow Mode



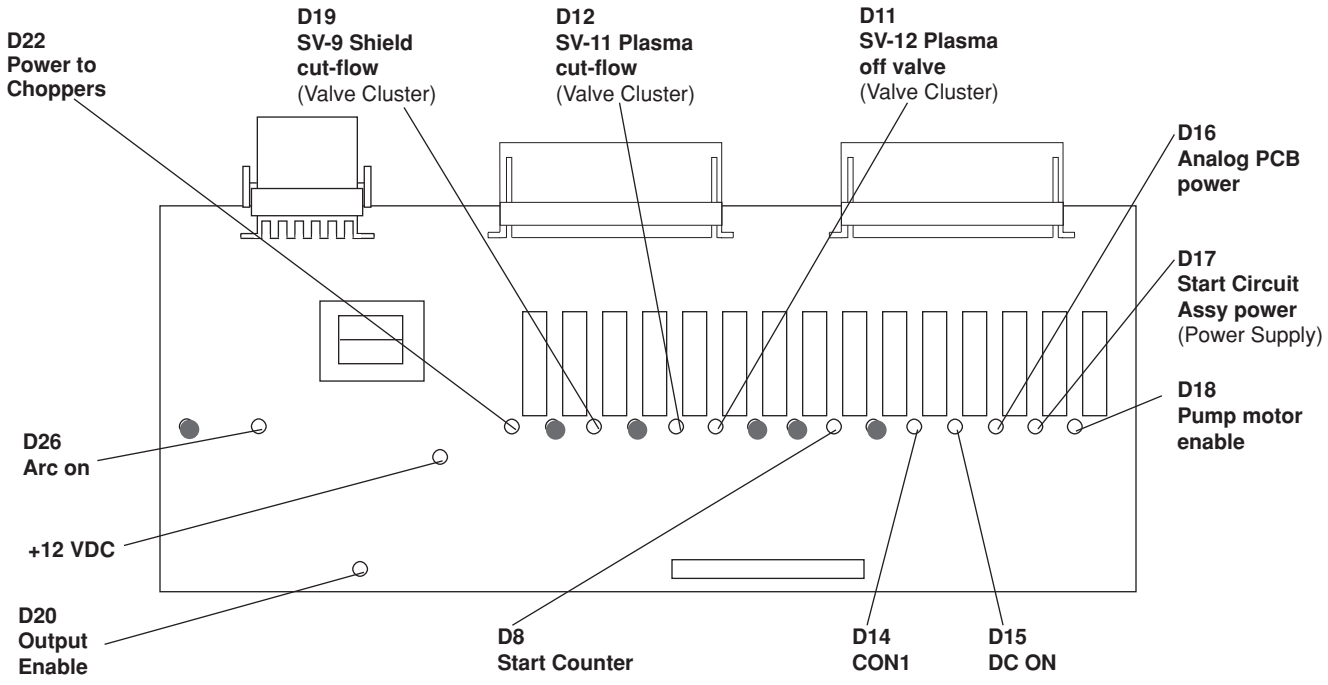
Relay Board LED Status
Test Cutflow Mode



Relay Board LED Status
RUN Mode - Idle

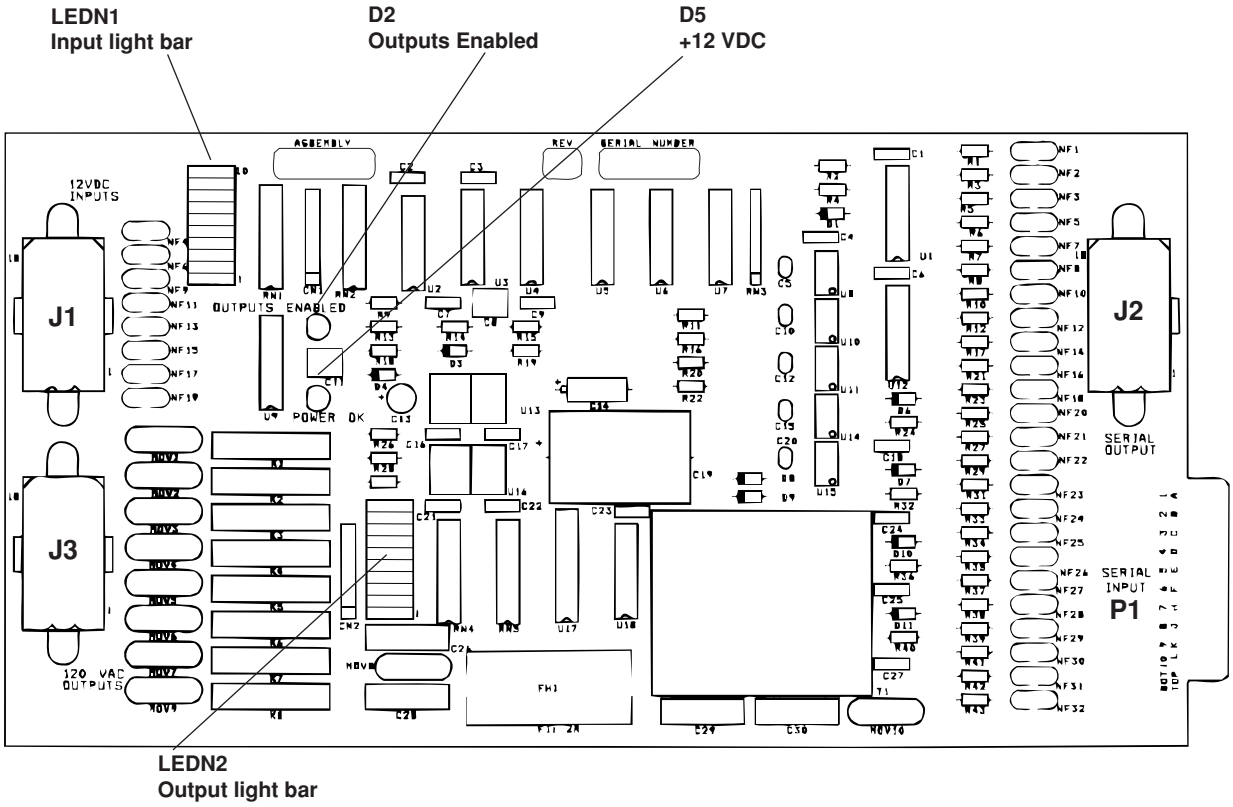


Relay Board LED Status
RUN Mode - Cutting



Serial I/O Board PCB5 - Status Indicators

The Serial I/O Board interfaces with the gas console and the microprocessor control board. The serial board controls all outputs for the gas console. When an LED on LEDN1 or LEDN2 is illuminated, the corresponding output or input is active. See page 6-2 for location of Serial I/O Board.



Note:
- D2 needs to be illuminated for the outputs to be active.
- If D5 is illuminated and D2 is not, then there is a communication problem between the microprocessor control board (PCB2) and the serial board (PCB5).
- LEDN1-5 through LEDN1-8 illuminate when in proper working conditions (no errors).

LEDN1-10	Not used
LEDN1-9	Not used
LEDN1-8	Shield cut-flow pressure switch (SC)
LEDN1-7	Plasma cut-flow pressure switch (PC)
LEDN1-6	Shield preflow pressure switch (SP)
LEDN1-5	Plasma preflow pressure switch (PP)
LEDN1-4	BCD1
LEDN1-3	BCD2
LEDN1-2	BCD4
LEDN1-1	BCD8

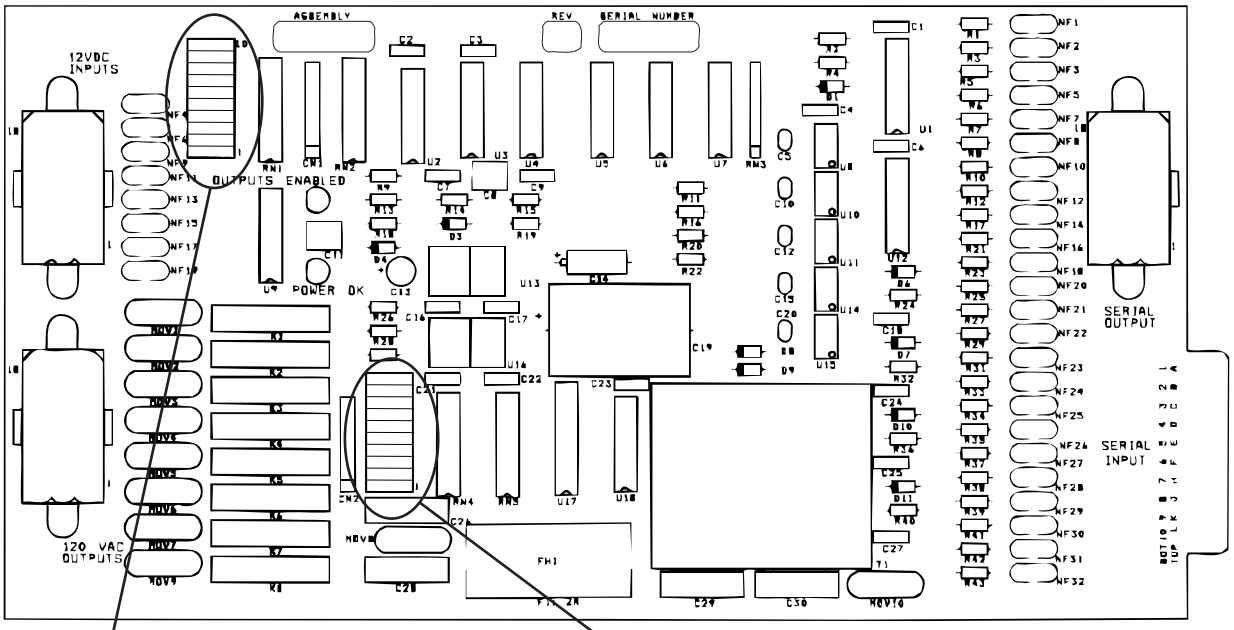
LEDN1

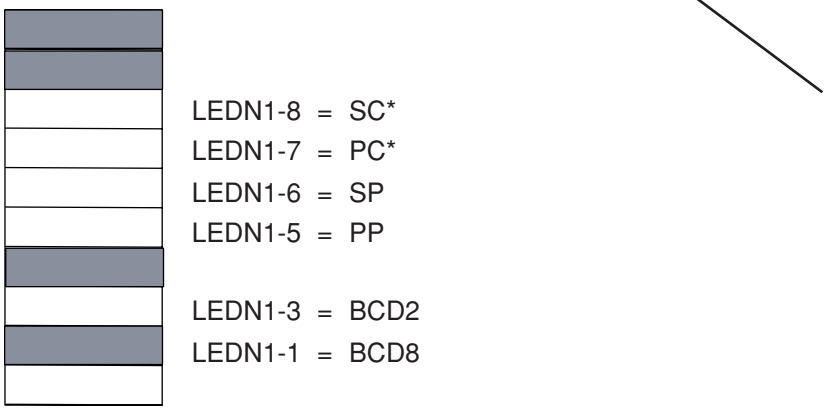
LEDN2-10	Not used
LEDN2-9	Not used
LEDN2-8	Nitrogen purge valve (SV-NP)
LEDN2-7	Secondary gas shield preflow (SV7)
LEDN2-6	Secondary gas shield cut-flow (SV6)
LEDN2-5	Secondary gas preflow (SV5)
LEDN2-4	Primary gas shield preflow (SV4)
LEDN2-3	Primary gas shield cut-flow (SV3)
LEDN2-2	Primary gas preflow (SV2)
LEDN2-1	Plasma cut-flow (SV1)

LEDN2

Note: In all Serial Board Figures, LED ON = ☐ LED OFF= ■

Serial Board LED Status
Test Preflow Mode





LEDN1-8 = SC*
LEDN1-7 = PC*
LEDN1-6 = SP
LEDN1-5 = PP

LEDN1-3 = BCD2
LEDN1-1 = BCD8

LEDN1

LEDN2-7 = SV7

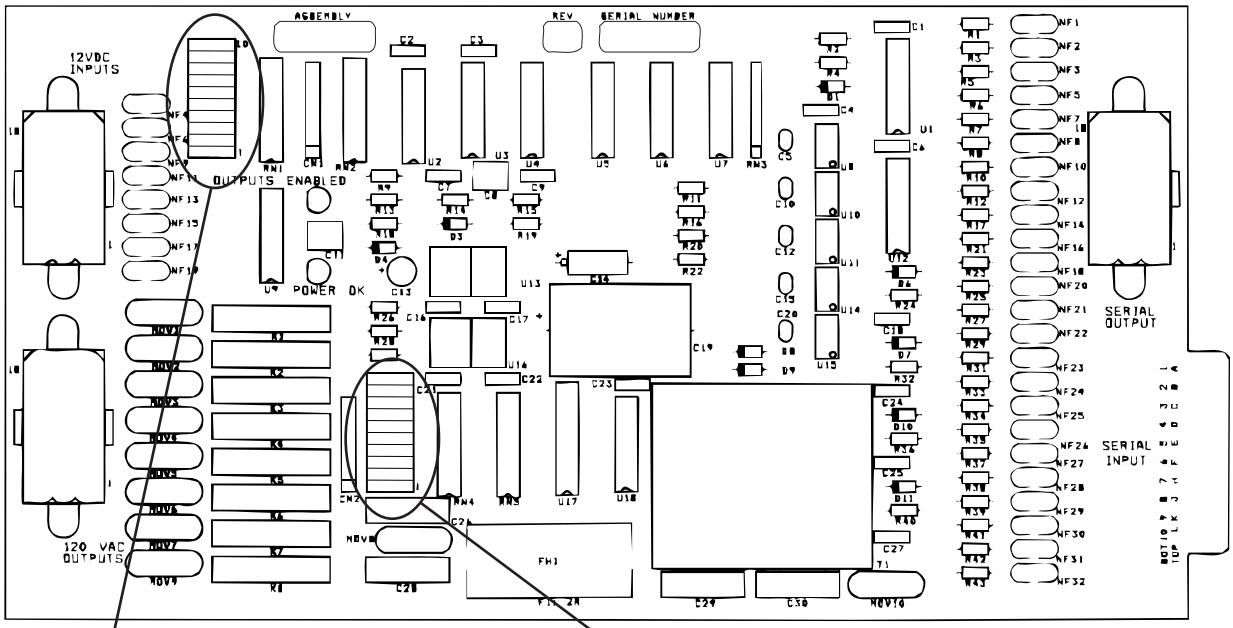
LEDN2-5 = SV5
LEDN2-4 = SV4

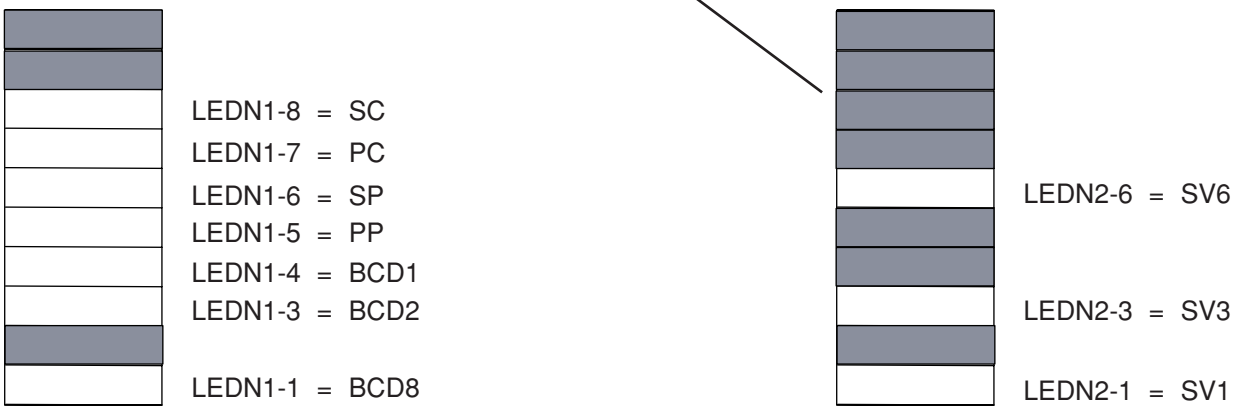
LEDN2-2 = SV2

LEDN2

* These cutflow LEDs may or may not be illuminated in Test Preflow Mode

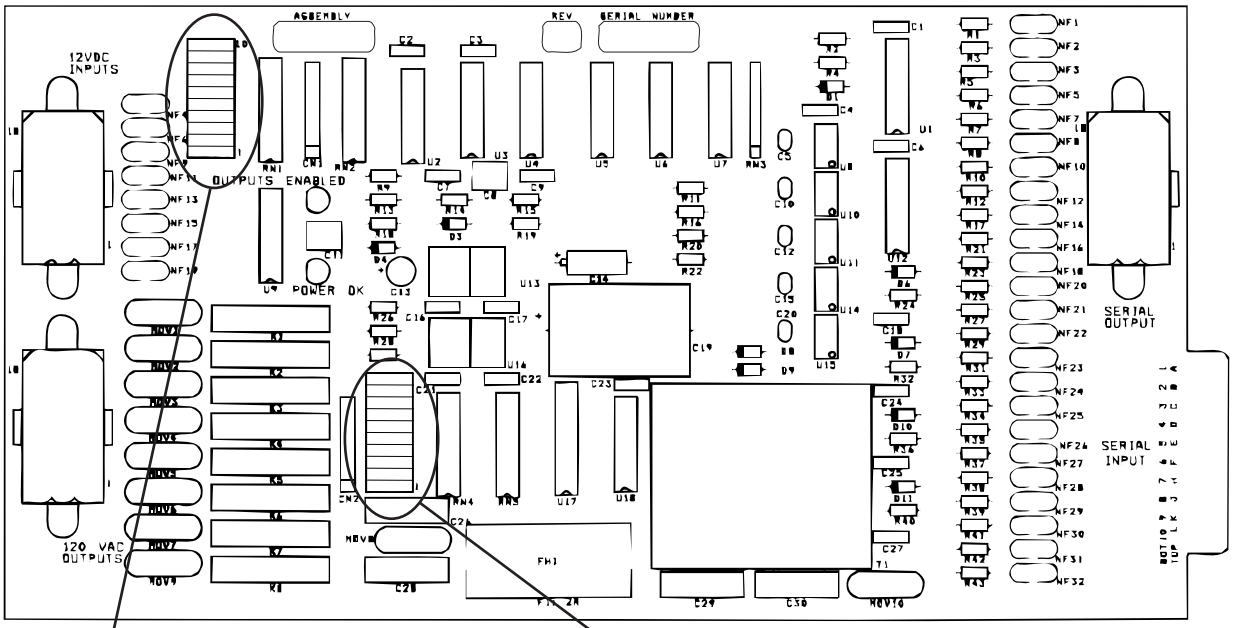
Serial Board LED Status
Test Cutflow Mode

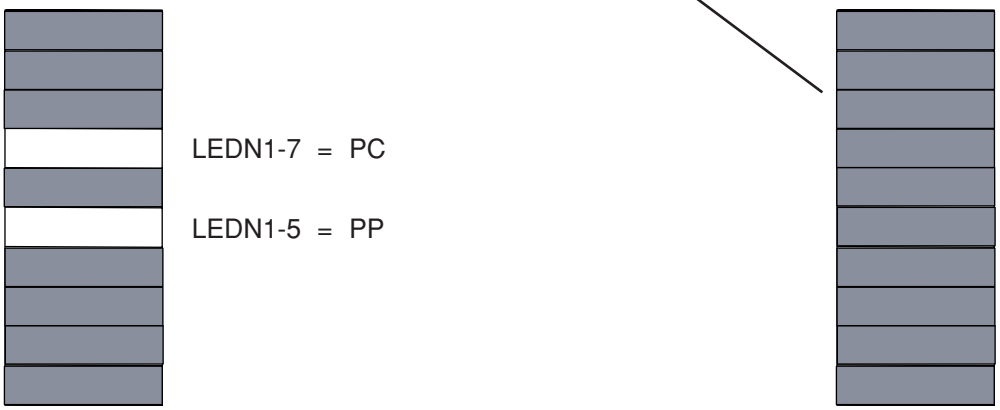




LEDN1 **LEDN2**

Serial Board LED Status
RUN Mode - Idle



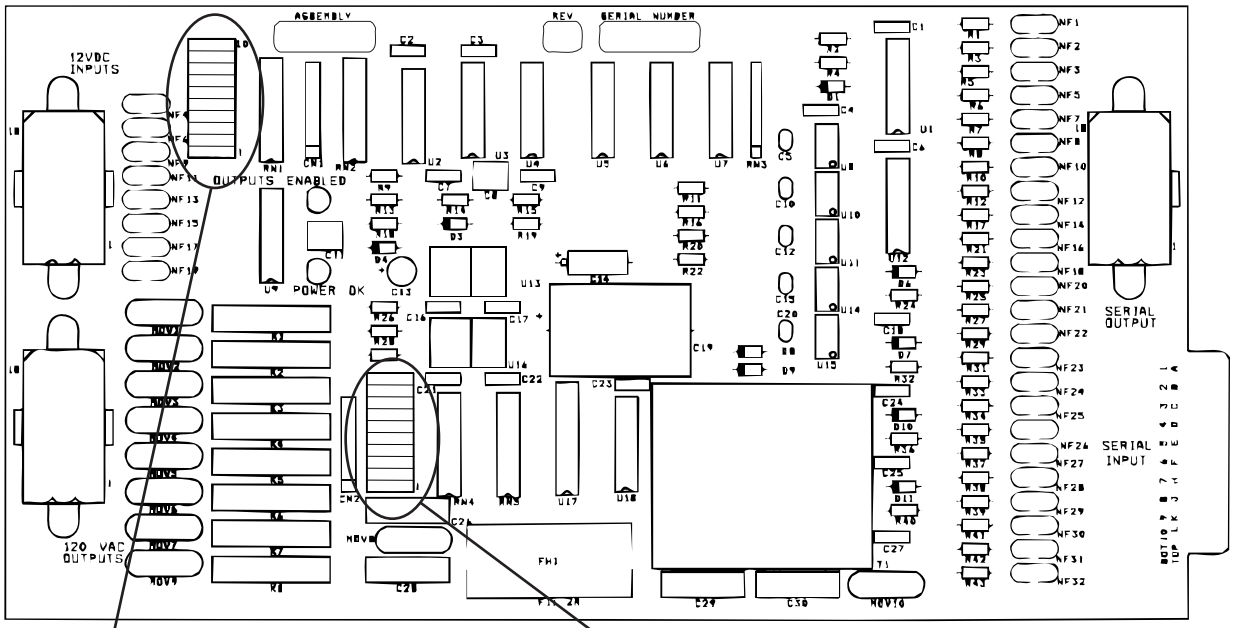


LEDN1-7 = PC

LEDN1-5 = PP

LEDN1 **LEDN2**

Serial Board LED Status
RUN Mode - Cutting



LEDN1-8 = SC
LEDN1-7 = PC
LEDN1-6 = SP
LEDN1-5 = PP

LEDN1

LEDN2-6 = SV6
LEDN2-3 = SV3
LEDN2-1 = SV1

LEDN2

Start Circuit Board PCB14 - Status Indicators and Operation

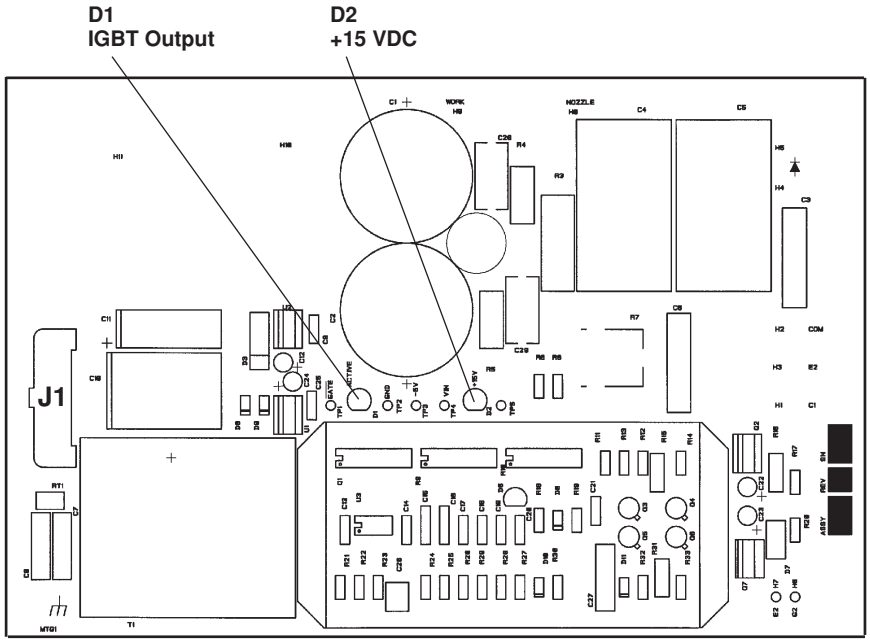
See page 6-4 for location of Start Circuit Board.

Operation

The start circuit is a high-speed switch that quickly transfers the pilot arc current from the pilot arc load to the work load. The start circuit performs 2 functions:

1. It allows the initial pilot arc current to flow through the pilot arc lead quickly, with little impedance.

2. After initial pilot arc current is established, the start circuit introduces impedance to the pilot arc load to aid in transferring the arc current to the workpiece. See schematic on following page.

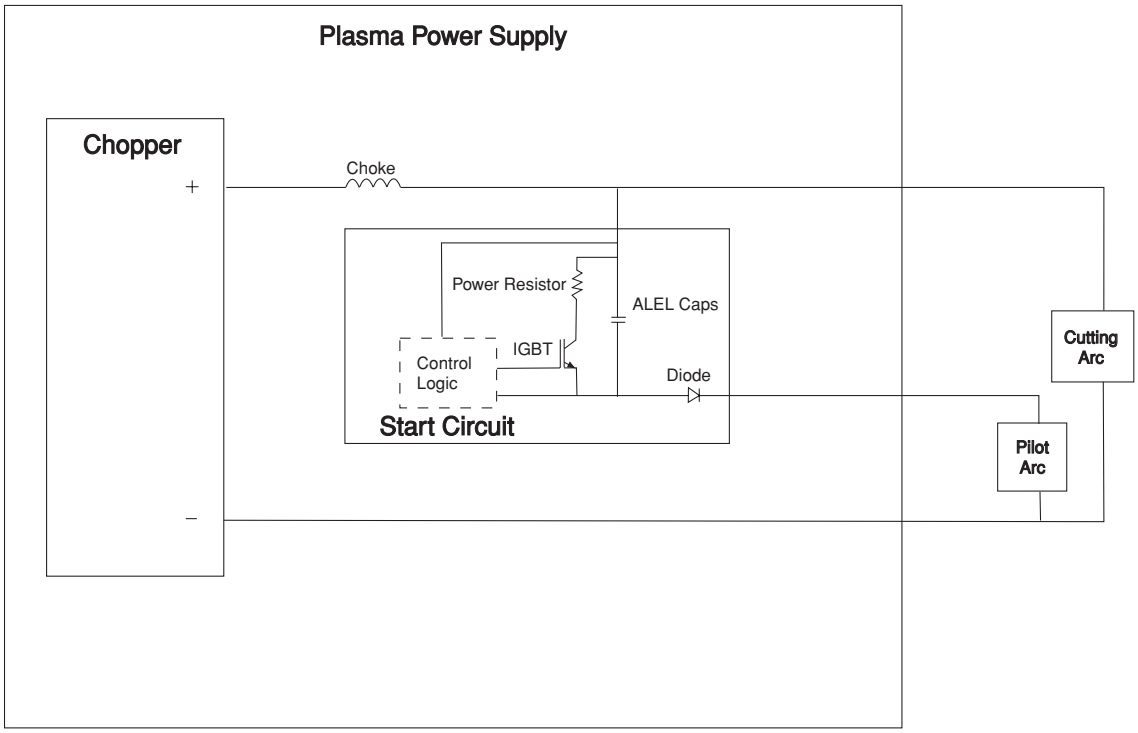


Pilot Arc Current Levels

The pilot arc current level will change depending on the chosen process and arc current level. See table below.

O2 as the Plasma Gas	Pilot Arc Current
100-amp current setting	30 amps
200-amp current setting	44 amps
300-amp and 400-amp current setting	60 amps
N2 as the Plasma Gas	**Pilot Arc Current**
200-amp current setting	44 amps
400-amp current setting	60 amps

Start Circuit Functional Schematic



Start Circuit Troubleshooting

WARNING

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

- D2 should always be ON.
- D1 illuminates as soon as the torch fires and then will extinguish as soon as the arc transfers to the plate. If arc transfer is immediate, the LED will not illuminate.
- If there is no arc at the torch or if the arc will not transfer:

  - Turn the power to the system OFF and check for a resistance of 15 kΩ from H8 to H1.
  - Check for a resistance of 5.5 kΩ across H10 and H4.
  - Refer to wiring diagrams. Note that the resistances will slowly increase to the above values due to capacitance in the circuit.
  - Check the junction of the D12 diode.
  - Work cable connection on the cutting table is not making good contact.
  - Check D2. It should be illuminated.
  - Fire the torch in the air and check to be sure that D1 illuminates.
  - Check the resistance across the R3 resistor. It should be 10 kΩ.

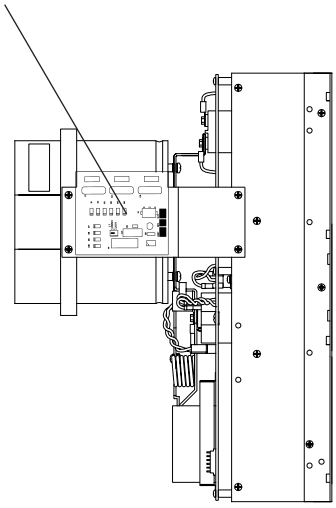
Phase Loss Detection Board PCB21 - Status Indicators and Operation

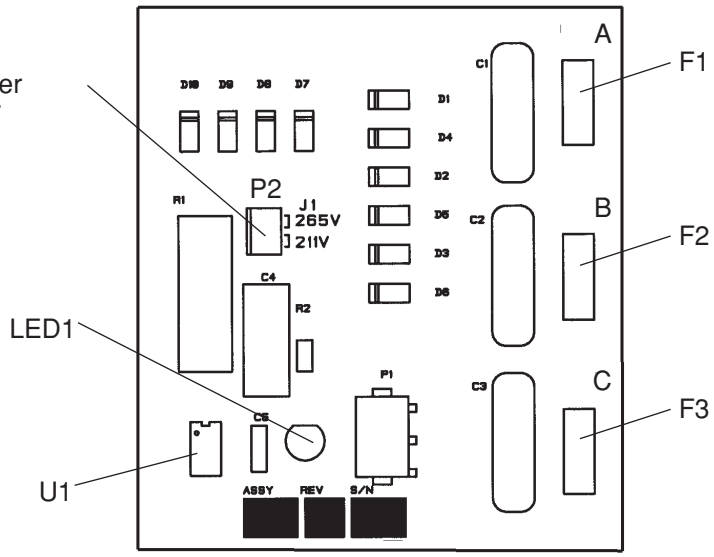
Operation

The phase loss detection circuit looks at the incoming voltage and verifies that the voltages between the 3-wire inputs are within +/- 15% of each other.

- After contactor CON1 closes, opto-coupler U1 on PCB21 is activated, shorting pins 1&2 of PL1 together and illuminating LED1.
- If LED1 does not illuminate:
  - Verify that voltages across points A B and C, phase-to-phase are approximately 255 VAC. If voltages are not within +/- 15%, LED1 will not illuminate. Check the incoming line voltage and the contacts on CON1.
  - Check PCB21 fuses F1-F3. If any of the fuses are open, then PCB21 is faulty.
  - Check jumper on P2 and verify that the jumper is set for 265V.

Phase Loss Board PCB21 location on chopper CH4 -
See page 6-3 for location of CH4





Chopper Module Test Procedure

WARNING

SHOCK HAZARD: Use extreme care when working near the chopper modules. The large electrolytic capacitor(s) (blue-cased cylinder(s)) 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 any capacitor with a screwdriver or other implement...explosion, property damage and/or personal injury will result.

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

1. Turn all power to the HT4400 system OFF.
   Disconnect 2 terminals on line filter FL1 in the ignition console to disable the solid-state ignition.

2. Remove large fuses F1, F2, F3 and F4. Check to see if any fuse is open.

3. Place the positive lead of the DVM to the **+** side of the bridge and the negative lead to the **–** side of the bridge. See figure on the facing page. Note that actual connection points are hidden by capacitor support bracket in figure.

4. Turn power to the HT4400 ON, and start up system. After the START command has been given, check voltage. The input to the chopper at these points should be about +360 VDC. If the input is OK and corresponding fuse F1, F2, F3 or F4 is blown, replace the chopper module. If there is no +360 VDC input, check the 3-phase AC input to the chopper. Also, check contactors (CON1, CON2), contacts, and connections and associated wiring to the contactor. Repair or replace any defective components.

5. If voltage from above step is +360 VDC and corresponding fuse is not blown, check output of choppers.

CH1:
- Place the positive lead of the DVM at point (+) WORK on the chopper module (wire #48A) and negative lead at point (-) TORCH (wire #39A). See the figure on following page.
- Turn the system on and give the START command. After the START command has been given, check the voltage. If the output from these points is +360 VDC, chopper is OK.
- An alternate method of testing is to keep fuses F1-F4 in place and take voltage as above. A low voltage reading with this method could mean a shorted torch.

CH2: To check the output of CH2, repeat the above procedure for CH1 but put the positive lead of the DVM at wire #48B and the negative lead at wire #39B.

Before checking output of choppers CH3 and CH4, switch connector PL3.6 with PL3.9 and also switch connector PL3.5 with PL3.7 on analog PCB3. See figure on the following page**.**

CH3: To check the output of CH3, repeat the above procedure for CH1 but put the positive lead of the DVM at wire #48C and the negative lead at wire #39C.

CH4: To check output of CH4, repeat the above procedure for CH1 but put the positive lead of the DVM at wire #48D and the negative lead at wire #39D.

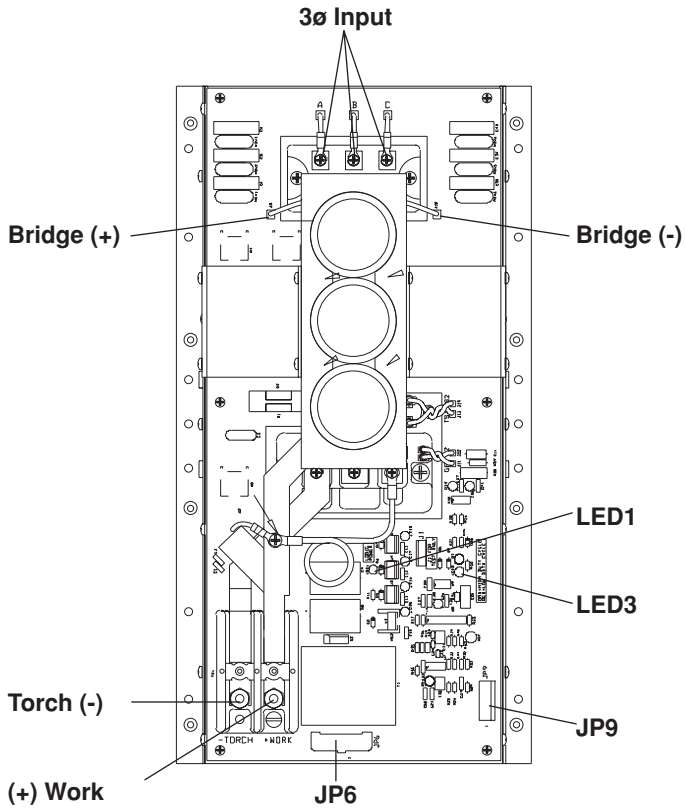
Return analog PCB3 connectors PL3.6, PL3.9, PL3.5 and PL3.7 to their original positions.

6. If a chopper does not output +360 VDC, check to see if 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 power distribution board. Repair or replace any defective components. Also check to see if LED3 is turning green when start command is given (normal condition). If LED1 is illuminated and LED3 is red when start command is given (fault condition), then make sure that JP9 is seated properly.

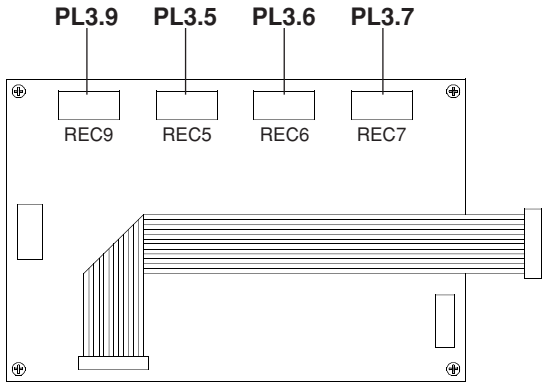
7. If a chopper still does not output +360 VDC after completing these instructions through step 6, there may be a problem with the control signal or the chopper module. The chopper drive signal comes through the analog board PCB3 as an analog level from 0 to +6.2 VDC, which varies the duty cycle and subsequent output current of the chopper. These analog signals are on PCB3 pins 5&6 PL3.9 for CH1, pins 5&6 PL3.5 for CH2, pins 5&6 PL3.6 for CH3, and pins 5&6 PL3.7 for CH4.

   To check choppers in non-transferred mode:

- Ensure that solid-state ignition is still disabled (see step 1).
- On analog board PCB3, disconnect PL3.9 from REC9 (to test CH1), or disconnect PL3.5 from REC5 (to test CH2), or disconnect PL3.6 (to test CH3), or disconnect PL3.7 (to test CH4). LED3 should be green.
- Place voltmeter across the output of the chopper in test and give the START command.
- If the voltmeter reads +360 VDC, then there is a problem with either control board PCB2 or analog board PCB3.
- If the voltmeter reads 0 volts, then replace the chopper module.



Chopper Module - Front View



Analog PCB3

Coolant Flow Test

1. Turn power off to the HT4400.
2. Remove the return coolant hose from the Cooler (hose with red tape).
3. Set the thumbwheel switch (S2) on the Gas Console to “Leak Test 1” or “Leak Test 2.”
4. Locate a 1-gallon container and place the return coolant hose inside the container.
5. Turn power to the HT4400 on.
6. Coolant will flow for 30 seconds and then shut off. In 30 seconds you should be able to get a minimum of 1/2 gallon of coolant.
7. Run the coolant test again by switching S2 to “Run” and then back to one of the leak test modes.
8. Again the coolant will flow for 30 seconds and then shut off. At this point the 1-gallon container should be more than full, worst case.
9. If the container is not full, than perform same test but at the torch.
10. To perform this test remove all the consumables from the torch. Running the coolant for 1 minute should result in approximately 1.5 gallons of coolant.

Pressure switch Settings

PG1 Plasma Pressure Switch

Output 1 - Plasma Cutflow (Green LED)
P1 = 30 psi
P2 = 140 psi

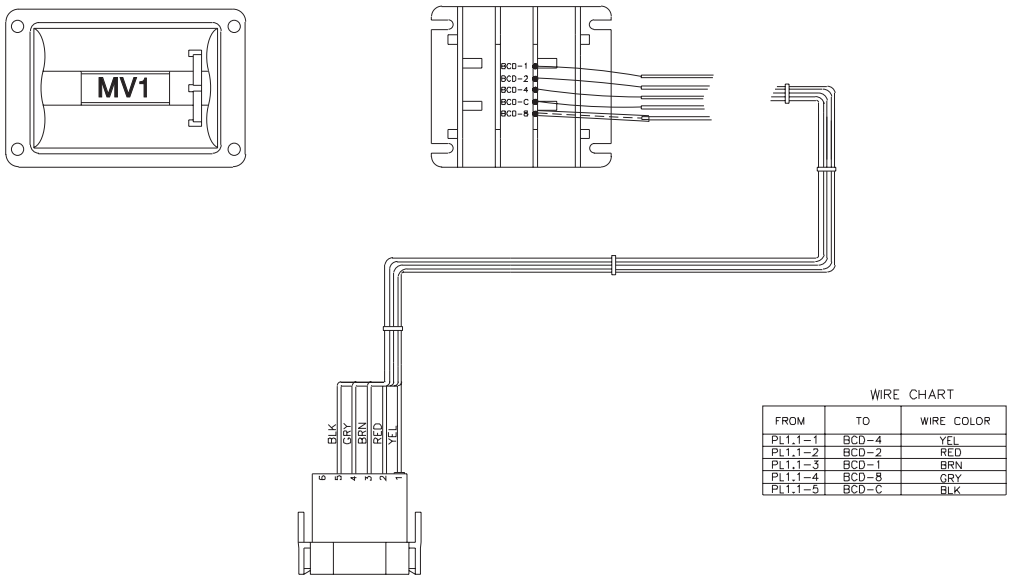
Output 2 - Plasma Preflow (Red LED)
P3 = 10 psi
P4 = 140 psi

PG2 Shield Pressure Switch

Output 1 - Shield Cutflow (Green LED)
P1 = 10 psi
P2 = 140 psi

Output 2 - Shield Preflow (Red LED)
P3 = 15 psi
P4 = 140 psi

Gas Console Valve Select Switch Detail



Valve Select Display	BCD Position	Outputs Activated
Run - Preflow	0	SV2, SV4, SV5, SV7, SV8, SV10, SV12
Run - Cutflow	0	SV1, SV3, SV6, SV9, SV11, SV12
MV1	1	SV1, SV11, SV12
MV2	2	SV2, SV10, SV12
MV3	3	SV3, SV9
MV4	4	SV4, SV8
MV5	5	SV5, SV10, SV12
MV6	6	SV6, SV9
MV7	7	SV7, SV8
Leak Test 1	8	SV1–SV7
Leak Test 2	9	SV8–SV12
Test Preflow	10	SV2, SV4, SV5, SV7, SV8, SV10, SV12
Test Cutflow	11	SV1, SV3, SV6, SV9, SV11, SV12

Preventive Maintenance

Introduction

Deteriorating consumable parts life is frequently one of the first symptoms to indicate that something is wrong with a plasma system. Reduced parts life dramatically increases operating costs for two reasons: first, and perhaps most obvious, shorter consumable life means that the end user will have to use more consumables to cut the same amount of metal. The second, and even more important factor, is that shorter consumable life means that the end user must shut down his cutting operation to change consumables more often. In an average cutting operation, labor and overhead can account for over 80% of the cost of cutting, so improved productivity, in the form of less downtime, can reduce cutting costs dramatically.

Proper maintenance often eliminates the problems that lead to shortened consumables life. Since the basic premise behind the purchase of a Hypertherm plasma system is reduced cutting costs and increased productivity, maintaining a system in proper operating condition is a key to ensuring customer satisfaction.

The Preventive Maintenance Protocol is intended to be simple to follow. After you have performed it a few times, you should expect to take approximately 3 hours to complete it for each individual plasma system involved.

Hypertherm wants to meet or exceed our customers' expectations. We hope that this booklet will help you meet or exceed those customers' expectations.

Preventive maintenance protocol

The following protocol covers the basic elements of a Hypertherm mechanized plasma system. These basic elements apply broadly to all our mechanized systems, although certain specific components, such as the high-frequency console or the coolant system, are not present in all mechanized systems. The protocol may therefore vary slightly from a MAX100 to an HT2000, for example, and as we move through the protocol, we have tried to note where certain steps would not be necessary for certain systems.

It is important to have available for reference a copy of the appropriate manual for the Hypertherm system to be maintained.

If inspection suggests that a component is worn and might require replacement, and you would like confirmation of your recommendation, please contact Hypertherm's Technical Service department.

The power supply

When performing preventive maintenance in any plasma system power supply, it is critical to turn off power to the power supply at the source. Extreme electrical hazard is present in the power supply and at the torch. Please consult the manual for a complete list of safety precautions.

1. With power to the power supply off, remove all side panels and inspect for accumulated dust. Using compressed air, blow out the inside of the power supply to remove dust and particulates.

2. Inspect wiring harnesses and connections for any wear or damage. Check for loose connections and look for any discoloration that might indicate overheating. If this condition is observed, contact Hypertherm Technical Service.

3. Inspect the main contactor for excessive pitting on the contacts, characterized by a blackened, rough surface on any of the contacts. If this condition exists, replacement should be recommended.

4. If the plasma system has an air filter in the front panel of the power supply, inspect the air filter and recommend replacement if dirty.

5. Inspect the pilot arc relay (CR1) for excessive pitting on the contacts, characterized by a roughened, black surface. Recommend replacement if necessary.

Coolant system

6. If the plasma equipment in question has a built-in coolant system, inspect the filter element of the coolant system which is located at the rear of the power supply. If the filter has begun to turn a brownish color, replacement should be recommended. For HyDefinition systems, a de-ionizing filter should be used. Refer to the manual for proper part numbers. If the system is a MAX200 or HT2000, a particle filter should be used.

7. Perform a coolant flow test on the system. For MAX200, HT2000, HD1070 and HD3070 systems, flow should be at least 0.75 gpm (2.8 l/min) on the return line. When testing systems with external water chillers, the required coolant flow varies according to different size pumps. Refer to appropriate manuals.

   Check for coolant leaks. Primary locations to inspect are: 1) the back of the power supply; 2) at the high-frequency console, if applicable; and, 3) at the torch main body. Check the holding tank for dirt and particulates. Verify that proper Hypertherm coolant is being used.

Torch main body

8. If the torch contains a water tube for electrode cooling, check the water tube to ensure that it is straight and has no pitting on the end.

9. Check the current ring inside the torch main body. The current ring should be smooth and not pitted. If slight pitting is seen, contact Hypertherm Technical Service to assess the likelihood that the torch could be repaired. If no pitting is observed, clean the current ring with a clean cotton swab and clean water. Do not use alcohol. Pitting on the current ring generally indicates improper maintenance (i.e. lack of regular cleaning).

10. Clean all threads on the front end of the torch head with clean water and a cotton swab, pipe cleaner or clean cloth. Do not use alcohol. Damage to the threads usually results from not properly cleaning the torch and retaining cap threads, so that dirt and particulates accumulate in the threads.

11. Inspect the torch insulator for cracks. Replacement of the torch should be recommended if cracks are found.

12. Inspect all o-rings on the torch body and consumables. Make sure that the correct amount of lubricant is being applied to these o-rings. Too much lubricant may obstruct gas flows.

13. Ensure that the retaining or shield cap is tightened securely to the torch main body.

14. Check all hose fittings at the rear of the torch for wear. Damage to the fitting threads may indicate that overtightening has occurred.

15. Ensure that all connections between the torch and torch leads are tight, but do not overtighten.

    When removing consumables, always place them on a clean, dry, oil-free surface, since dirty consumables may cause the torch to malfunction.

Gas flows

16. Check the plumbing from the gas supply source, as follows:

    A. Remove and plug the oxygen inlet gas fitting at the gas console.

    B. Pressurize the gas system at the source to 8.3 bar (120 psi).

    C. Close the gas supply valve at the source. Watch for a pressure drop. If the supply line from the source is a hose, there may be a 0.3 to 0.5 bar (5 to 7 psi) drop due to stretch.

    D. If the pressure continues to drop, find the leaks in the system.

E. Perform the same protocol for the nitrogen gas supply system, except that the gas system should be pressurized at the source to 10.3 bar (150 psi), 8.3 bar (120 psi) for the HD3070 and HD4070.

F. Perform the same protocol for the air, carbon dioxide or argon-hydrogen and methane supplies (as applicable) except that the gas system should be pressurized at the source to 6.2 bar (90 psi), 8.3 bar (120 psi) for the HD3070 and HD4070.

G. If the system is operating on compressed air, verify that a filtering system is in place to ensure that no oil or moisture is allowed to enter the plasma system. Inspect all filters and oil separators and recommend replacement if dirty.

17. Perform a system gas leak test, as follows:

A. Place the gas console in the Test Preflow mode.

Adjust gas flows to appropriate settings as outlined in the *Operation* section of the instruction manual.

B. Locate the off-valve solenoid and disconnect the control cable from the solenoid. The digital pressure indicator should slowly drop to zero. If it does not, a leak may be indicated.

C. Close the shut-off valves for the oxygen and nitrogen supply at the source.

D. The pressure gauges on the gas console should maintain their pressure. If either nitrogen or oxygen pressures drop more than 0.1 bar (2 psi) in 10 minutes, there is an unacceptable leak.

E. If a leak is indicated, check all gas connections, using a soapy water solution.

18. Check for hose restrictions, as follows:

A. Check the 3 hoses connected to the motor valve. Make sure that they are not bent, causing a possible restriction.

B. Check the gas hoses from the gas console to the motor valve, looking for any sharp bends that may cause restrictions.

C. Check the off-valve hose from the off-valve to the torch main body. Make sure that the hose is not bent, causing a restriction.

D. If the cutting table uses a power track system to support leads from the power supply to the gas console or torch, check the position of the leads in the power track to ensure the leads do not twist or kink, causing a possible restriction.

Cable connections

19. Cables should be checked for chafing or unusual wear. If the outside insulation has been cut, check the wires inside for damage:

A. For Initial Height Sensing (IHS) option, check the cables from the inductive probes to the IHS console.

B. Check the control cable from the off-valve to the motor valve console.

C. Check the cable from the motor valve console to the power supply.

D. Check control cables from the high-frequency console and the gas console to the power supply.

High-frequency console (if applicable)

20. Open the cover and inspect the interior for condensation or the accumulation of dust and particulates. If dust and particulates are present, blow out the unit with compressed air. If moisture is present, dry the inside of the console with a cloth and contact Hypertherm Technical Service for recommended action.

21. Inspect the spark gap subassembly. Inspect the 3 electrodes. Verify that the electrodes are 0.508 mm (0.020") apart and that they are clean and the ends are flat. File the electrodes clean with a diamond file if necessary. Ensure that the wiring connections to the spark gap subassembly are secure. Check that the console doors are properly closed.

22. Inspect the torch leads. Ensure that they are fastened tightly to the outside of the high-frequency console.

System grounding

23. Verify that all components of the system are individually grounded to a driven earth ground, as described in the instruction manual.

    A. All metal enclosures, such as the power supply, high-frequency console and gas console, should be connected individually to a ground point. These connections should be made with 10 mm^2 (#8 AWG) wire (USA), or equivalent-size wire.

24. Check the connection from the cutting table to the workpiece (+) lead. Particularly inspect where the positive (+) lead connects to the cutting table to ensure that it is a good, clean connection. A poor connection may cause arc transfer problems.

Preventive Maintenance Master Schedule

Daily:

- Verify proper inlet gas pressure.
- Verify proper gas flow settings. – Mandatory at every consumable change.
- Verify proper coolant pressures and temperatures. – Water chillers only.
- Inspect torch and replace consumables as needed.

Weekly:

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

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

- Complete systems check per the preventive maintenance protocol.

Bi-Annually:

Year	1st Service	2nd Service

- Complete systems check per the preventive maintenance protocol.

Annually:

Year									

- Complete systems check per the preventive maintenance protocol.

Preventive Maintenance Protocol Checklist

Customer: _____
Location: _____
Contact: _____
Date: _____

Hypertherm system: _____
System serial #: _____
System arc hours: _____
(if equipped with an hour meter)

Comments *P* – Performed *NP* – Not present on system

Power supply

- ☐*P* ☐*NP* 1. Inspect for particulates and blow out
- ☐*P* ☐*NP* 2. Inspect wiring harnesses
- ☐*P* ☐*NP* 3. Inspect main contactor
- ☐*P* ☐*NP* 4. Inspect air filter on front of system
- ☐*P* ☐*NP* 5. Inspect pilot arc relay

Coolant system

- ☐*P* ☐*NP* 6. Inspect filter element
- ☐*P* ☐*NP* 7. Perform coolant flow test
  - A. Coolant flow checked at _____ gallons per minute (_____ l/min)

Torch main body

- ☐*P* ☐*NP* 8. Inspect water tube
- ☐*P* ☐*NP* 9. Inspect current ring
- ☐*P* ☐*NP* 10. Clean threads on torch front end
- ☐*P* ☐*NP* 11. Inspect Vespel torch insulator
- ☐*P* ☐*NP* 12. Inspect torch and consumable o-rings
- ☐*P* ☐*NP* 13. Verify proper fit of retaining or shield cap
- ☐*P* ☐*NP* 14. Inspect hose fittings
- ☐*P* ☐*NP* 15. Inspect torch-to-torch-lead connections

Gas flows

- ☐*P* ☐*NP* 16. Inspect plumbing from gas supply
  - ☐*P* ☐*NP* A. Oxygen
  - ☐*P* ☐*NP* B. Nitrogen
  - ☐*P* ☐*NP* C. Air
  - ☐*P* ☐*NP* D. CO_2
  - ☐*P* ☐*NP* E. Argon-Hydrogen
  - ☐*P* ☐*NP* F. Methane
  - ☐*P* ☐*NP* G. Inspect compressed air filter system

Gas flows (cont.)

- ☐*P* ☐*NP* 17. Perform gas leak test
  - A. Oxygen pressure drop at _____ psi in 10 minutes (_____ bar)
  - B. Nitrogen pressure drop at _____ psi in 10 minutes (_____ bar)
- ☐*P* ☐*NP* 18. Inspect for hose restrictions
  - ☐*P* ☐*NP* A. Motor valve hoses
  - ☐*P* ☐*NP* B. Gas console to motor valve
  - ☐*P* ☐*NP* C. Off-valve to torch body
  - ☐*P* ☐*NP* D. Hoses in power track

Cable connections

- ☐*P* ☐*NP* 19. Inspect cables
  - ☐*P* ☐*NP* A. From IHS probes to IHS console
  - ☐*P* ☐*NP* B. Control cable from off-valve to motor valve console
  - ☐*P* ☐*NP* C. From motor valve console to power supply
  - ☐*P* ☐*NP* D. From high-frequency console and gas console to power supply

High-frequency console

- ☐*P* ☐*NP* 20. Inspect for moisture, dust and particulates
- ☐*P* ☐*NP* 21. Inspect spark gap subassembly
  - ☐*P* ☐*NP* A. Electrode gap range _____ to _____
- ☐*P* ☐*NP* 22. Inspect torch leads

System grounding

- ☐*P* ☐*NP* 23. Inspect for proper system component grounding
- ☐*P* ☐*NP* 24. Inspect connection from cutting table to workpiece (+) lead

General comments and recommendations:

_____

_____

_____

_____

_____

Preventive maintenance performed by: _____ **Date:** _____

Hypertherm

Section 6

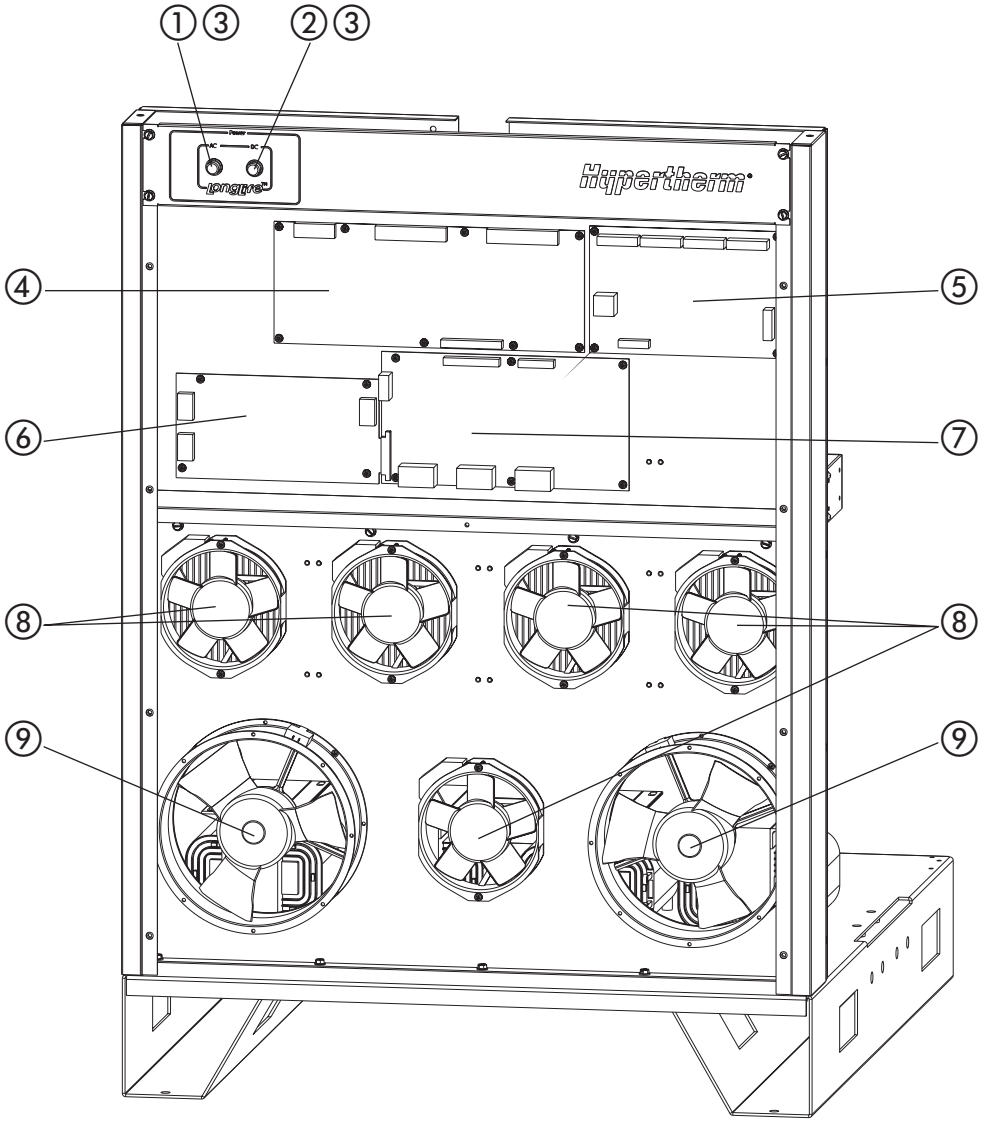
PARTS LIST

See Section 3 *Installation* for part numbers of hoses and interconnecting cables.

In this section:

Power Supply

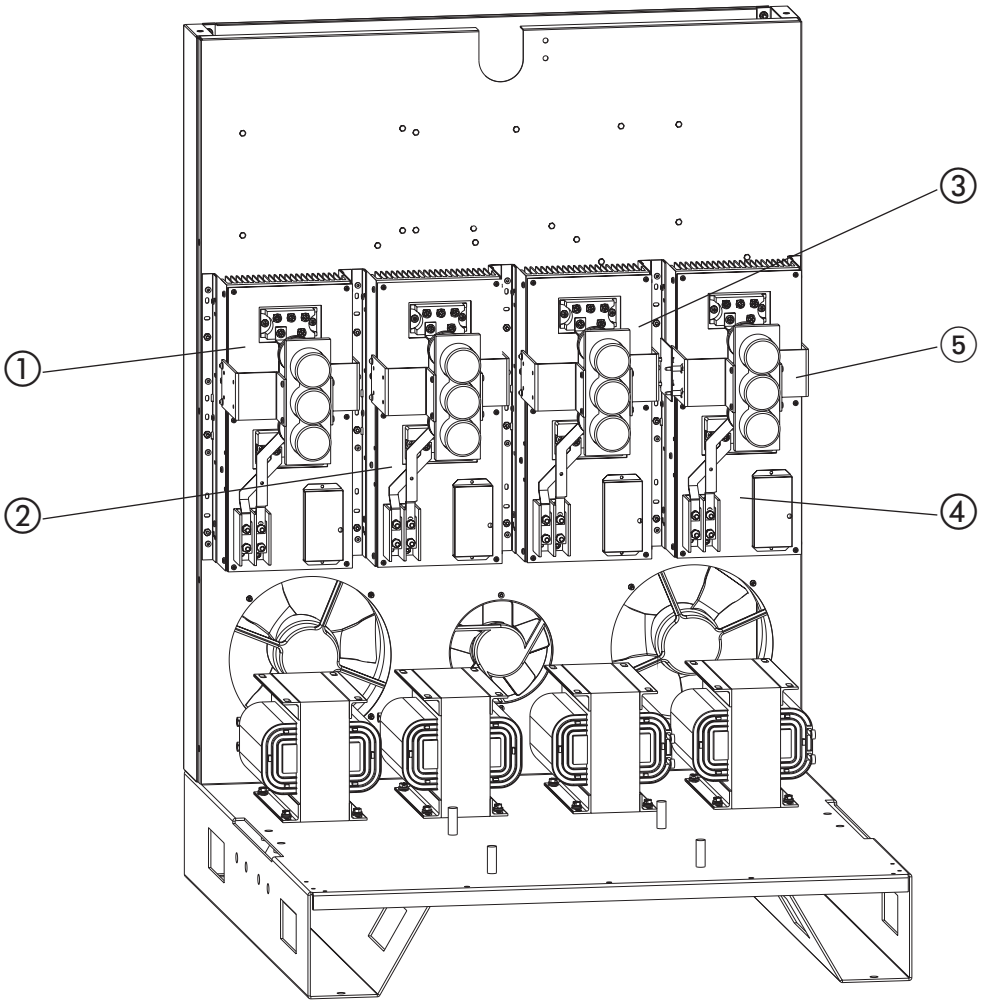
Front Panel Outside



Item	Part Number	Description	Designator	Qty.
1	005177	Lens, Green	**LT1**	1
2	005089	Lens, White	**LT2**	1
3	005149	Light Bulb, 120 VAC		2
4	041589	PCB Assy: Relay	**PCB4**	1
5	041282	PCB Assy: Analog	**PCB3**	1
6	041635	PCB Assy:Serial	**PCB5**	1
7	041690	PCB Assy: µP Control	**PCB2**	1
8	027080	Fan 225 cfm, 120 VAC, 50-60 Hz	**M1-4,M6**	5
9	027079	Fan: 450-550 cfm, 120 VAC, 50-60 Hz	**M5, M7**	2

Power Supply

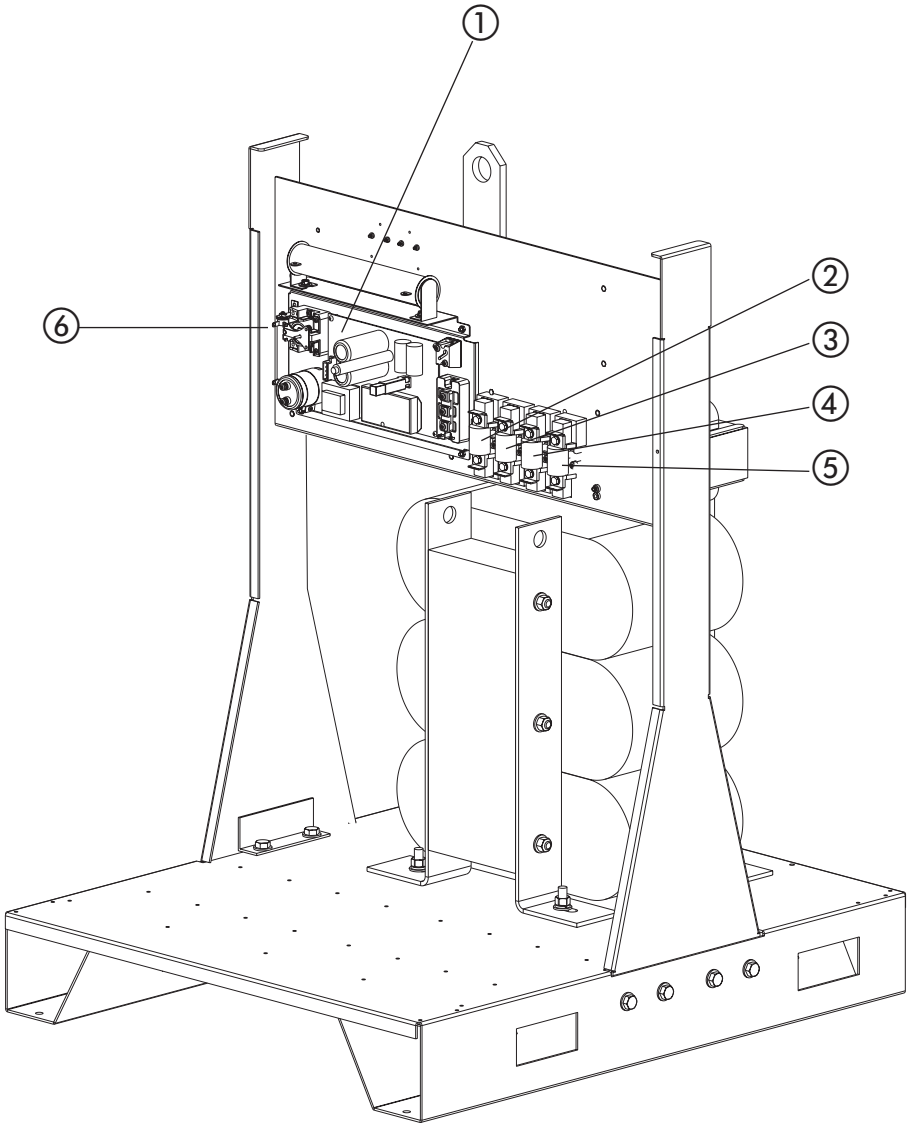
Front Panel Inside



Item	Part Number	Description	Designator	Qty.
1	129160	CH100-CE/LVD Chopper Assembly	**CH1**	1
2	129160	CH100-CE/LVD Chopper Assembly	**CH2**	1
3	129160	CH100-CE/LVD Chopper Assembly	**CH3**	1
4	129160	CH100-CE/LVD Chopper Assembly	**CH4**	1
5	041564	PCB: Phase Loss Detection	**PCB21**	1

Power Supply

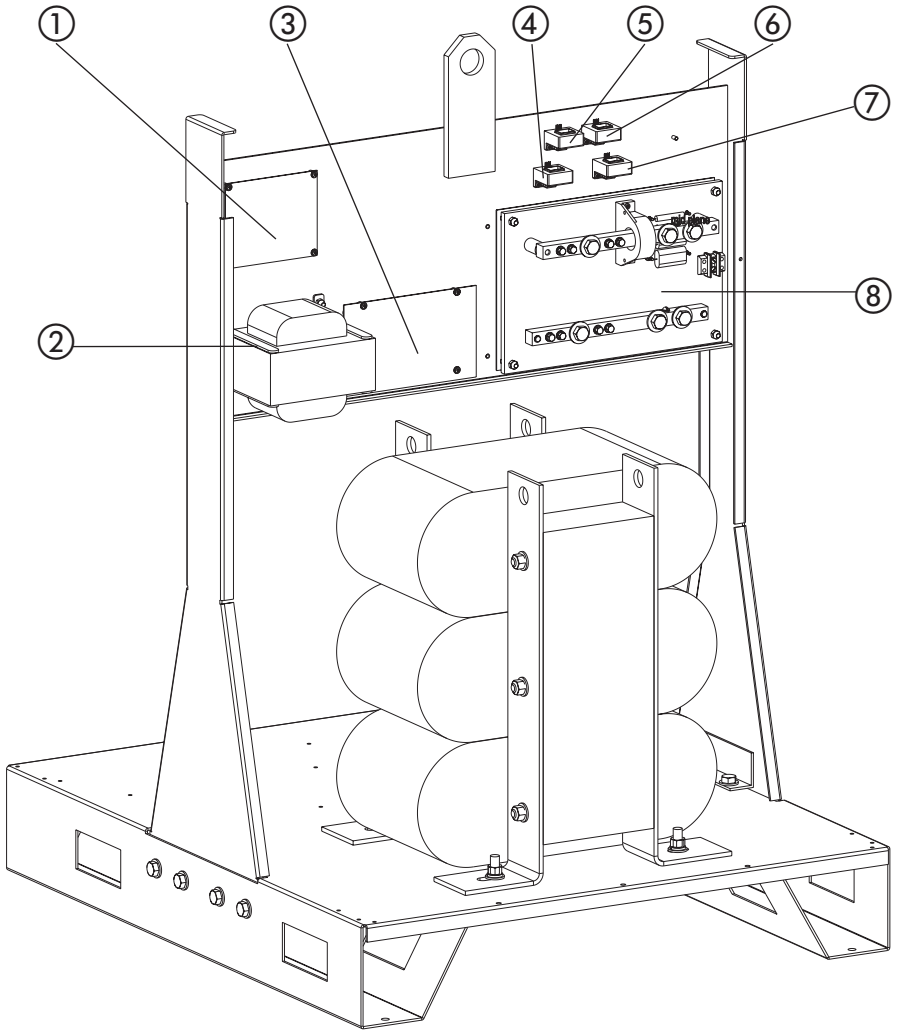
Front Bail (Wall)



Item	Part Number	Description	Designator	Qty.
1	129851	Start Circuit Assembly	**PCB14**	1
2	008317	Fuse: 125A 250V	**F4**	1
3	008317	Fuse: 125A 250V	**F3**	1
4	008317	Fuse: 125A 250V	**F2**	1
5	008317	Fuse: 125A 250V	**F1**	1
6	003021	Relay: 120 VAC	**CR1**	1

Power Supply

Rear Bail (Wall)

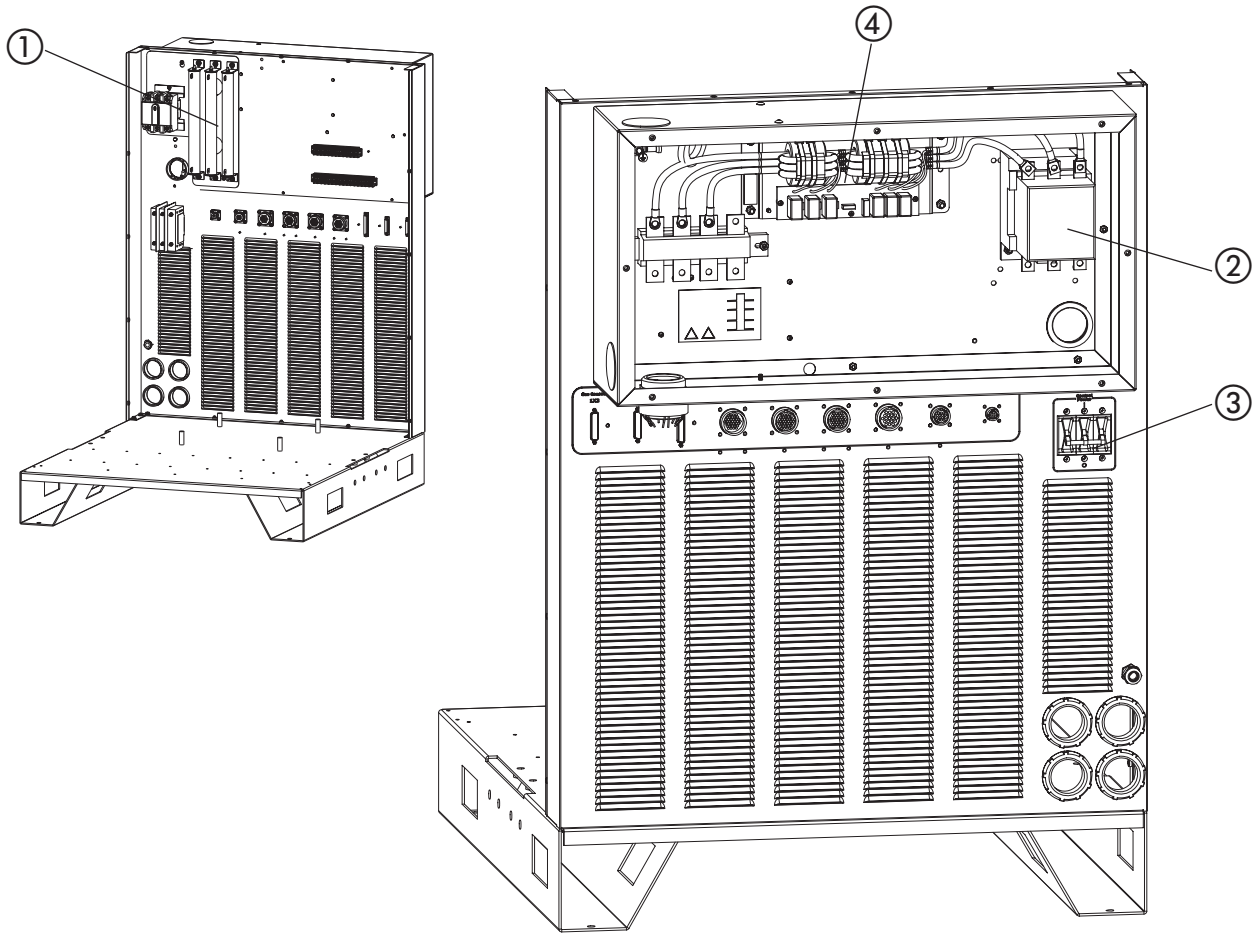


Item	Part Number	Description	Designator	Qty.
1	041610	PCB Assy: Power Distribution	**PCB1**	1
2	129603	Control Transformer: 200V/50-60HZ	**T1**	1
2	129604	Control Transformer: 400V/50 Hz	**T1**	1
2	129711	Control Transformer: 440V/50 Hz	**T1**	1
2	129606	Control Transformer: 480V/60 Hz	**T1**	1
2	129605	Control Transformer: 600V/60 Hz	**T1**	1
3	041671*	PCB Assy: THC Plasma Interface		1
4	109004	Current Sensor: Hall, 100A=4V	**CS1**	1
5	109004	Current Sensor: Hall, 100A=4V	**CS2**	1
6	109004	Current Sensor: Hall, 100A=4V	**CS3**	1
7	109004	Current Sensor: Hall, 100A=4V	**CS4**	1
8	129596	I/O Panel Assembly	**PCB10**	1

* Installed by customer when ordering the Command THC option. See Command THC instruction manual 802780 for more detailed information.

Power Supply

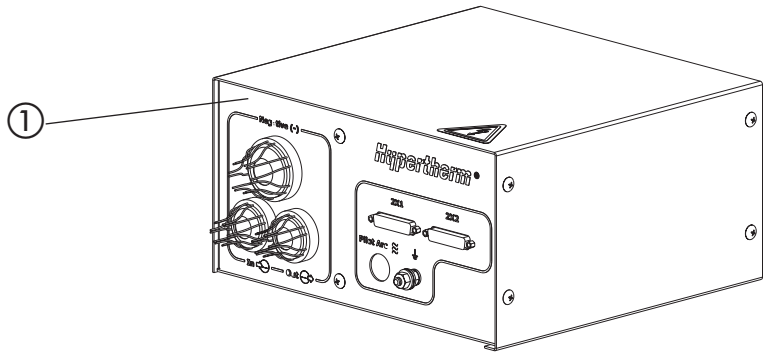
Rear Panel Inside and Outside

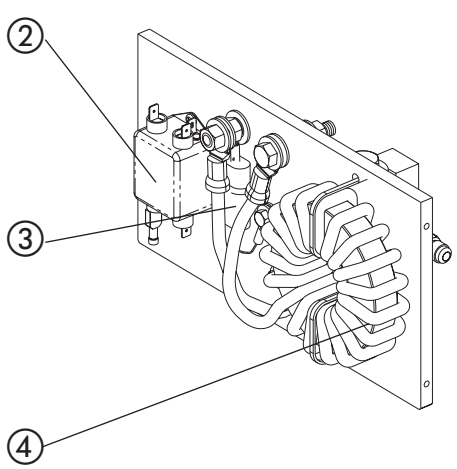


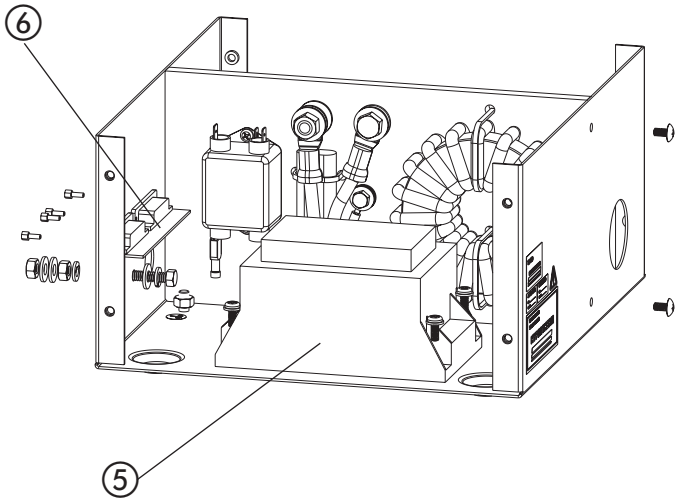
Item	Part Number	Description	Designator	Qty.
1	129328	Chassis Assembly, In-Rush		1
2	003217	Contactor: 185A, 3-Phase, 120 VAC	**CON1**	1
2	003218	Contactor: 265A, 3-Phase, 120 VAC	**CON1**	1
3	003152	Circuit Breaker: 3-Phase	**CB1**	1
	129972	Kit: 003217 Contactor Contacts Replacement		
	129973	Kit: 003218 Contactor Contacts Replacement		
4	129613 *	Filter: 140A 480V	**FL1A**	1

* Only used on 400 VAC CE power supplies

Ignition Console

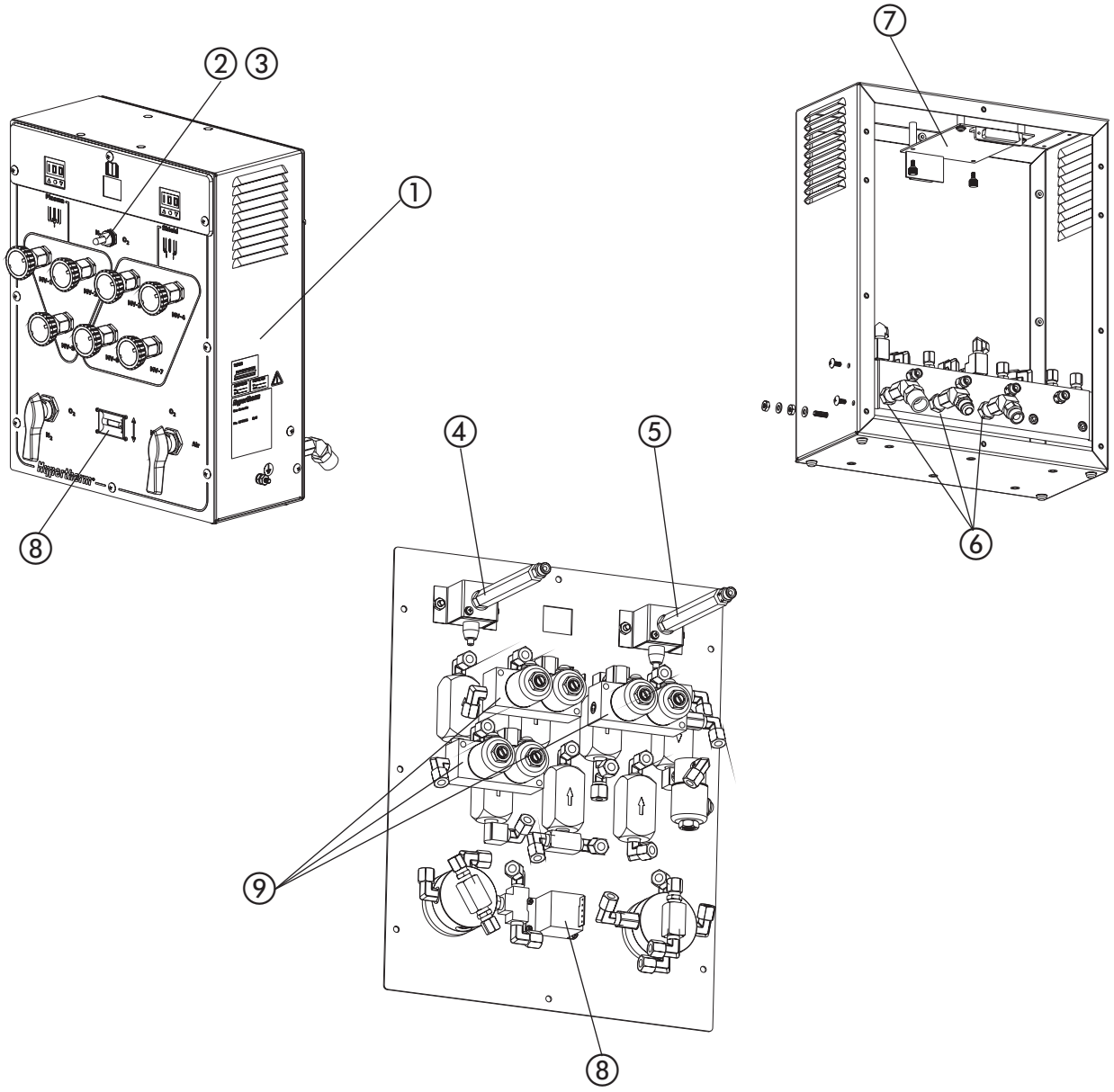






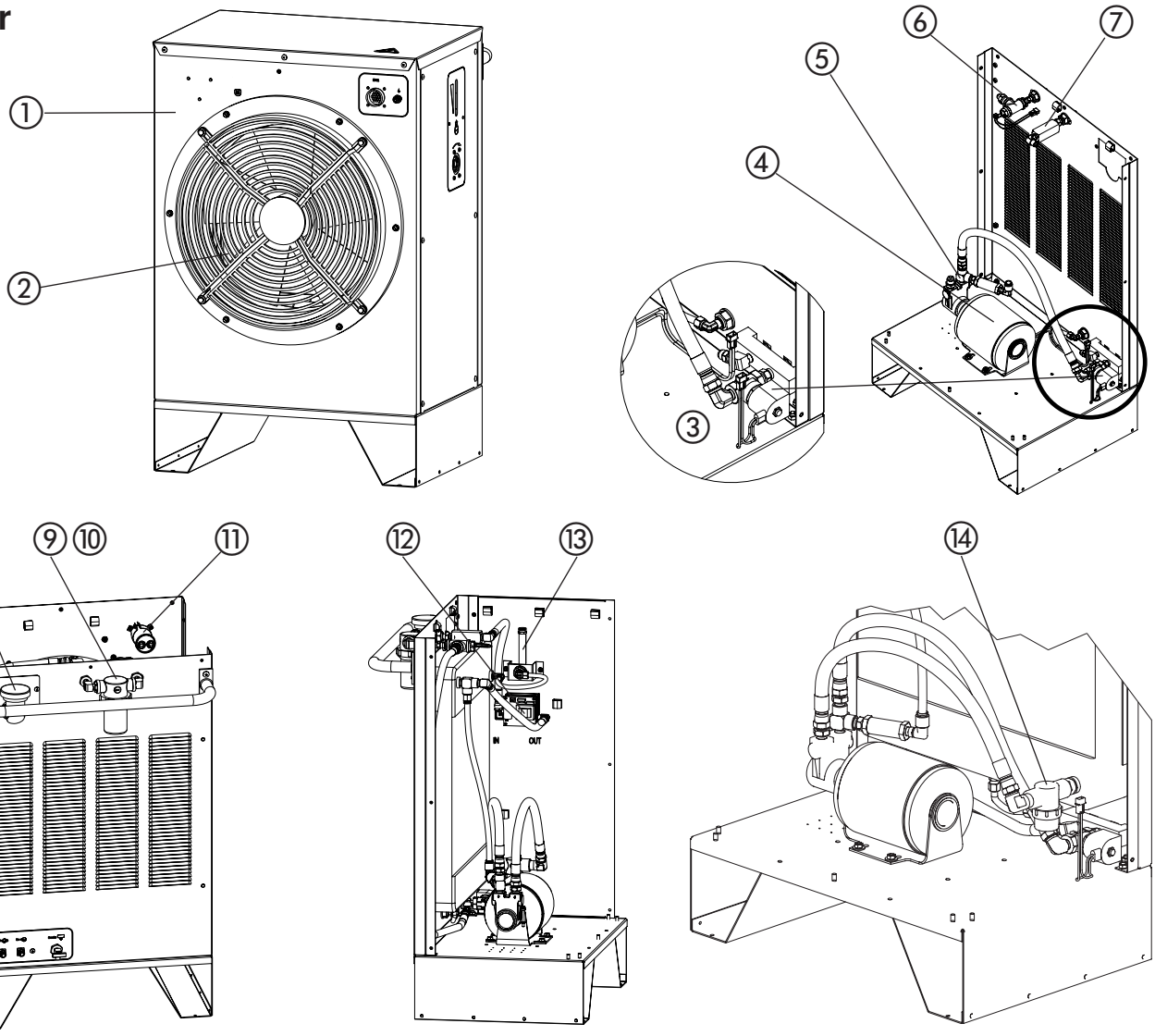
Item	Part Number	Description	Designator	Qty.
1	**078088**	HT4400 Ignition Console		
2	009040	FIlter: 3A, 3W	**FL1**	1
3	128510	Kit: Filter Capacitor Replacement	**C1**	1
4	129616	Inductor: Ignition Console	**L2**	1
5	027648	Ignition Module	**SSI1**	1
6	041619	PCB Assy: Ignition Console Interface		1

Gas Console



Item	Part Number	Description	Designator	Qty.
1	**077032**	**HT4400 Gas Console**		
2	005156	Toggle switch: SP 10A On/Off/On	**S1**	1
3	008106	Nut: Toggle Switch, Dress		1
4	128512	Kit: Pressure Switch Replacement	**PG2**	1
5	128511	Kit: Pressure Switch Replacement	**PG1**	1
6	015330	Filter: 10 Micron		2
7	041638	PCB Assy: LED Display Board	**PCB11**	1
8	129607	Thumb-wheel Assembly	**S2**	1
9	006118	Manifold and Solenoids		3

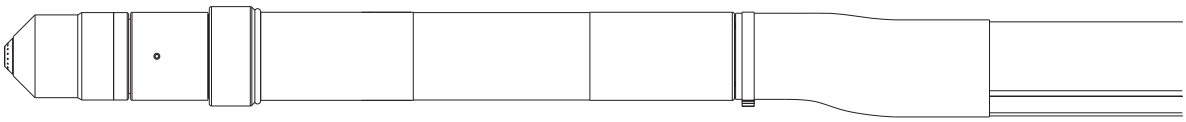
Cooler



Item	Part Number	Description	Designator	Qty.
1	**077034**	**Cooler**		
2	129634	Fan, 240V, 240W, 2910CFM	**M2**	1
3	128513	Kit: .Solenoid Valve Replacement	**SV1**	1
4	229036	Motor	**M1**	1
5	031138	Pump		1
	128968	Kit: Coolant System Upgrade		1
6	029323	Temp. Switch Assembly	**TS1**	1
7	006113	Check Valve: 3/8 FPT	**CHV3**	1
8	004598	Cap: Reservoir		1
9	027634	Filter Housing		1
10	027664	Filter Element		1
11	109207	Capacitor: 6µF 370 VAC		1
12	129489	Flowswitch Assembly		1
13	011084	Sight Glass: 1/4 NPT		1
14	128713	Kit: Lo Profile Filter		1
	027927	Filter Element		1

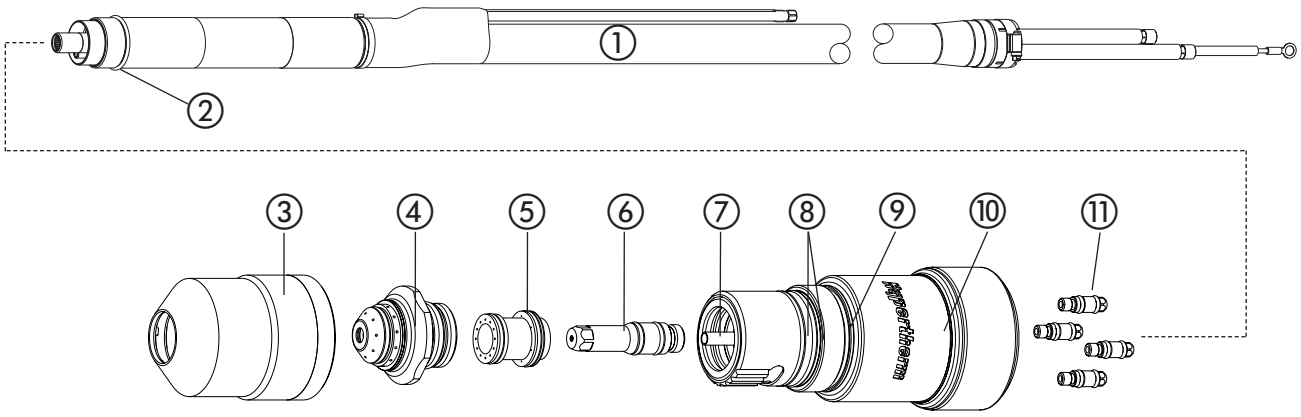
HT4400 Torch

Entire Torch Assemblies including Leads, Torch and Consumables



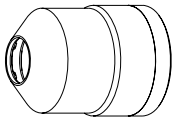
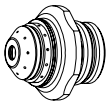
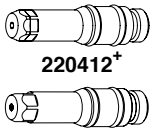
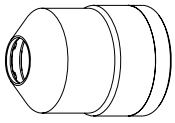
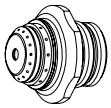
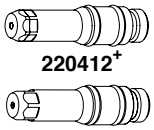
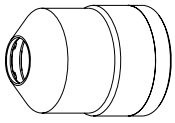
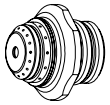
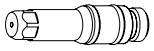
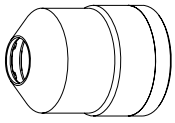
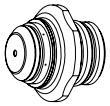
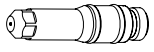
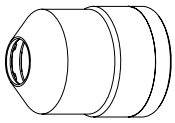
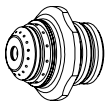
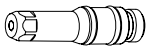
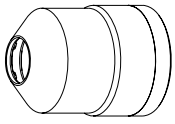
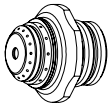
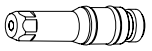
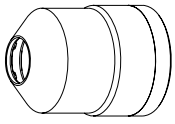
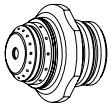
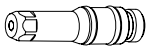
Part Number	Description
128342	**HT4400 Torch with 15' leads**
128431	**HT4400 Torch with 10' leads**
128430	**HT4400 Torch with 6' leads**

Lead Assemblies, Torch and Consumables



Item	Part Number	Description
1	**128341**	**Torch adapter with 15' leads**
1	**128463**	**Torch adapter with 10' leads**
1	**128462**	**Torch adapter with 6' leads**
2	058224	O-ring (part of torch adapter with leads assembly)
3	120786	Retaining Cap
4	120934	Nozzle
5	120939	Swirl Ring
6	120810	Electrode
7	120025	Water Tube (part of 120651 torch body assembly)
8	044028	O-rings (part of 120651 torch body assembly)
9	044030	O-ring (part of 120651 torch body assembly)
10	120651	Torch body
11	128654	Bullet Connector Replacement Kit

Consumable Configurations

Oxygen Mild Steel – 400 A	 120786	 120934	 120939	 **220412+** 120810
Oxygen Mild Steel – 300 A	 120786	 120794	 120913	 **220412+** 120802
Oxygen Mild Steel – 200 A	 120786	 120787	 120791	 120793
Oxygen Mild Steel – 100 A	 120786	 120777	 120783	 120785
Nitrogen Stainless Steel – 400 A	 120786	 120856	 120853	 120855
Nitrogen Stainless Steel – 200 A	 120786	 120794	 120853	 120855
Nitrogen Aluminum – 200 A	 120786	 120794	 120853	 120855

+ SilverPlus provides increased life in most applications. The hafnium wears to approximately twice the depth of an all copper electrode (120810 400A and 120802 300A). Arc voltage may need to be increased by 5-15 volts throughout the electrode life to maintain proper cut height parameters.

Consumable Parts Kit

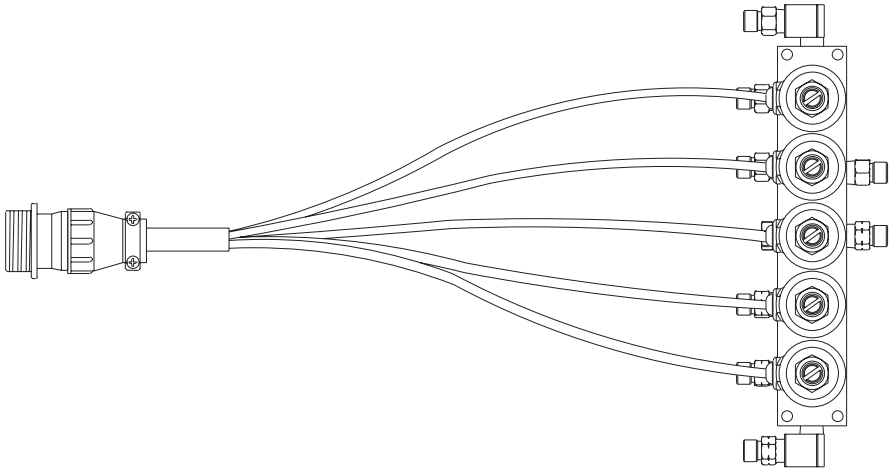
Part Number	Description	Qty.
128497	**Consumable Parts Kit**	
001067	Box:Gray Plastic	1
004630	Electrode Pit Depth Gauge Assembly	1
004663	Nozzle Wrench	1
026009	O-ring, .208 x .070	5
027012	Lubricant:Silicon 2-Oz Tube	1
027102	Electrode Wrench	1
027347	Tool: Water Tube Replacement	1
044028	O-ring, 1.364 x .070	2
120025	Water Tube	1
120777	Nozzle Assy:100A Oxygen cw	2
120783	Swirl Ring:100A Oxygen cw	1
120785	Electrode:100A Oxygen	2
120786	Cap:Nozzle Retaining	1
120787	Nozzle Assy:200A Oxygen cw	2
120791	Swirl Ring:200A Oxygen cw	1
120793	Electrode:200A Oxygen	2
120794	Nozzle Assy:300A Oxygen cw	2
120802	Electrode:300A Oxygen	1
120810	Electrode:400A Oxygen	2
120853	Swirl Ring:200A/400A Nitrogen cw	2
120855	Electrode:200A/400A Nitrogen	4
120856	Nozzle Assy:400A Nitrogen cw	2
120913	Swirl Ring:300A Oxygen cw	1
120934	Nozzle Assy: 400A Oxygen cw	4
120939	Swirl Ring:400A Oxygen cw	1
220412	Electrode: SilverPlus, 300A/400A Oxygen	3

See *Consumable Configurations* earlier in this section for graphics and proper combinations of consumables.

Counterclockwise Consumables

Oxygen	**400 amp**	**300 amp**	**200 amp**	**100 amp**
Swirl Ring	120940	120914	120792	120784
Nozzle	120935	120795	120788	120788
Nitrogen	**400 amp**	**300 amp**	**200 amp**	**100 amp**
Swirl Ring	120854		120854	
Nozzle	120857		120795	

Valve Cluster Assembly – 077035



Recommended Spare Parts

Power Supply

Part Number	Description	Designator	Qty.	Page (Ref.) Showing Item
005149	Light Bulb, 120 VAC	LT1, LT2	2	6-2
027080	Fan: 225 cfm, 120 VAC, 50-60 Hz	M1-M4, M6	1	6-2
027079	Fan: 450-550 cfm, 120 VAC, 50-60 Hz	M5, M7	1	6-2
041589	PCB Assy: Relay	PCB4	1	6-2
041644	PCB Assy: µP Control	PCB2	1	6-2
129160	CH100-CE/LVD Chopper Assembly	CH1-CH4	1	6-3
008317	Fuse: 125A 250V	F1-F4	4	6-4
041610	PCB Assy: Power Distribution	PCB1	1	6-5
109004	Current Sensor: Hall, 100A=4V	CS1-CS4	2	6-5
003217	Contactor: 185A, 3-Phase, 120 VAC	CON1	1	6-6
003218*	Contactor: 265A, 3-Phase, 120 VAC	CON1	1	6-6
003152	Circuit Breaker: 3-Phase	CB1	1	6-6

* Only used on 200V power supplies

Ignition Console

Part Number	Description	Designator	Qty.	Page (Ref.) Showing Item
128510	Kit: Filter Capacitor Replacement	C1	1	6-7
027648	Ignition Module	SSI1	1	6-7

Gas Console

Part Number	Description	Designator	Qty.	Page (Ref.) Showing Item
128511	Kit: Pressure Switch Replacement	PG1	1	6-8
128512	Kit: Pressure Switch Replacement	PG2	1	6-8
041638	PCB Assy: LED Display Board	PCB11	1	6-8

Cooler

Part Number	Description	Designator	Qty.	Page (Ref.) Showing Item
128513	Kit: Solenoid Valve Replacement	SV1	1	6-9
029323	Temp. Switch Assembly	TS1	1	6-9
027664	Filter Element		2	6-9
129489	Flowswitch Assembly	FS1	1	6-9

Electrode Pit Depth Gauge Assembly - 004630

To accurately measure the electrode pit depth, order the electrode pit depth gauge assembly. See *Inspect Electrode Pit Depth* in Section 4 for graphic and procedure.

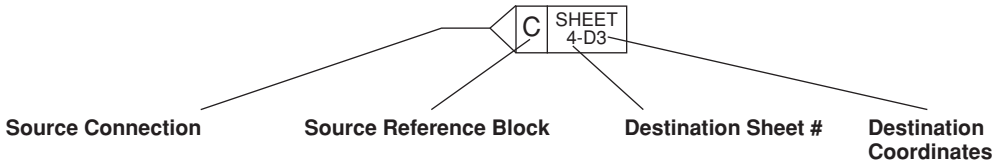
Section 7

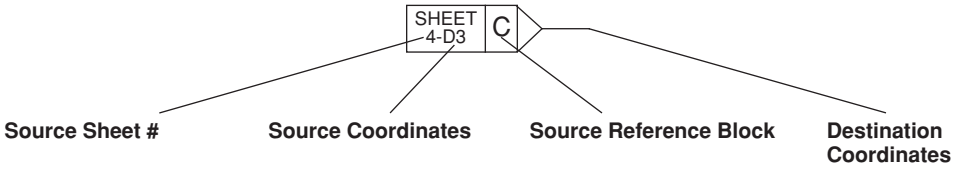
WIRING DIAGRAMS

Introduction

This section contains the wiring diagrams for the HT4400 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:

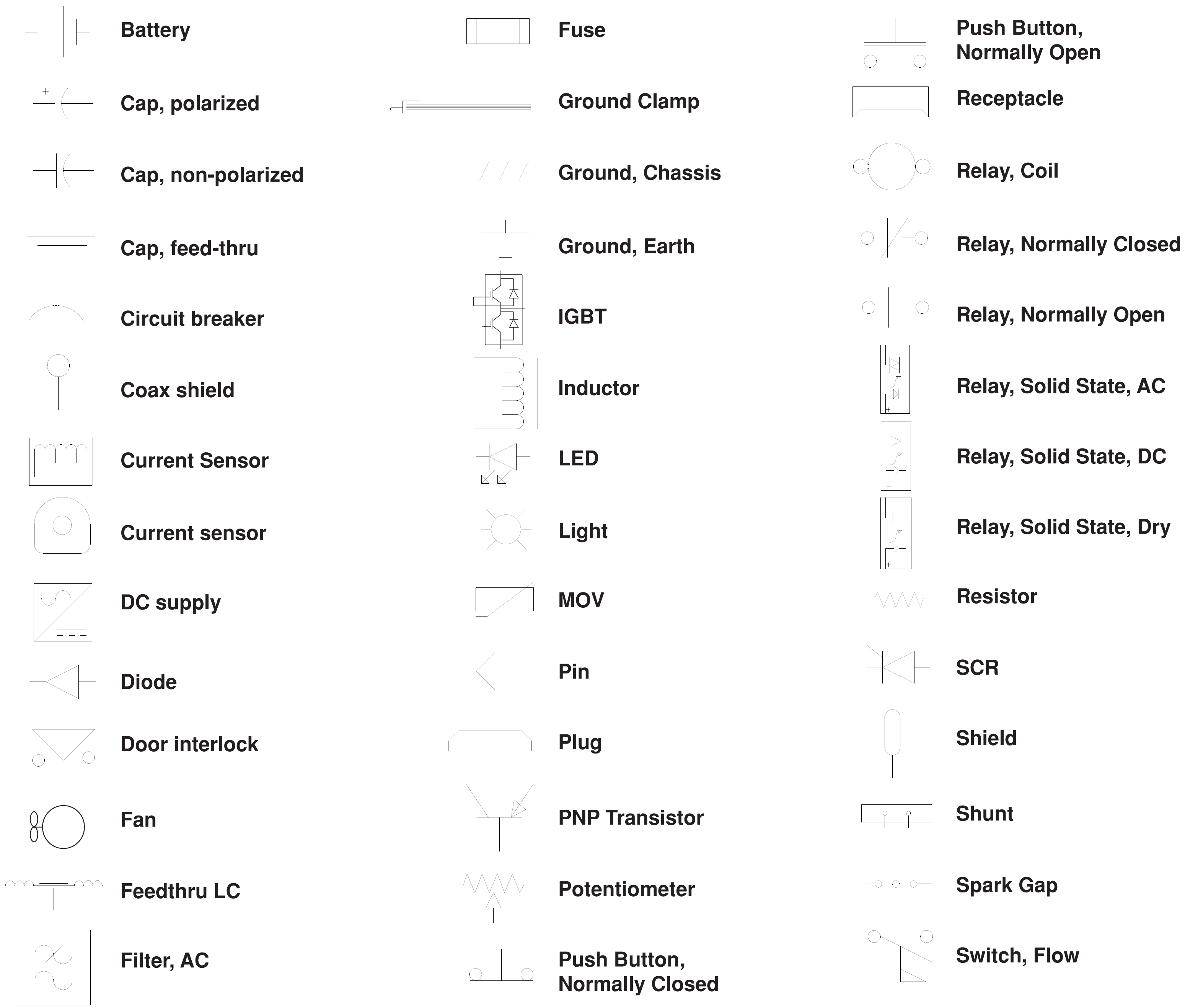


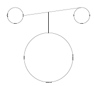


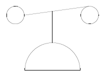
Destination and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).

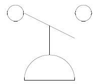
Wiring Diagram Symbols

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

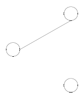

Battery
Cap, polarized
Cap, non-polarized
Cap, feed-thru
Circuit breaker
Coax shield
Current Sensor
Current sensor
DC supply
Diode
Door interlock
Fan
Feedthru LC
Filter, AC
Fuse
Ground Clamp
Ground, Chassis
Ground, Earth
IGBT
Inductor
LED
Light
MOV
Pin
Plug
PNP Transistor
Potentiometer
Push Button, Normally 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

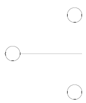

Switch, Level, Normally Closed

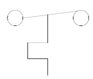

Switch, Pressure, Normally Closed

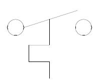

Switch, Pressure, Normally Open

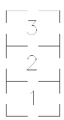

Switch, 1 Pole, 1 Throw


Switch, 1 Pole, 2 Throw

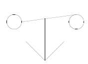

Switch, 1 Pole, 1 Throw, Center Off

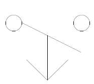

Switch, Temperature, Normally Closed

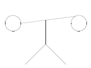

Switch, Temperature, Normally Open

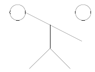


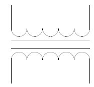
Terminal Block

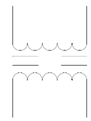

Time Delay Closed, NC/Off

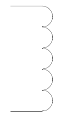

Time Delay Open, NO/Off

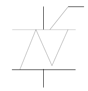

Time Delay Open, NC/On

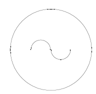

Time Delay Closed, NO/Off

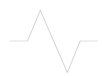

Transformer

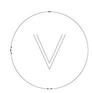

Transformer, Air Core

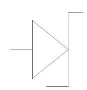

Transformer Coil


Triac

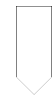

VAC Source

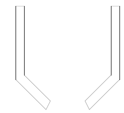

Valve, Solenoid

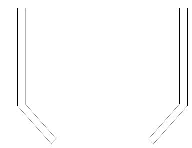

Voltage Source

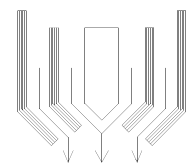

Zener Diode

Torch Symbols


Electrode


Nozzle


Shield


Torch

3 Phase
Power
w/ Ground

Unit 1
Master

400A PAC
Dry Cutting System

200 V 50 Hz 077036
400 V 50 Hz 077037
440 V 50 Hz 077046
480 V 60 Hz 077033
600 V 60 Hz 077038

Parts Kit 028xx1

1X5

PS/Cooler Cable
123517

5X1

Unit 5
Cooler
077034

Coolant
028440

Pilot Arc
123009

1X1

HF/PS Cable
123446

2X1

Negative Lead 023382

Unit 2
Ignition Console
078088

3X1

2X2

Shielded Torch Leads
128341

Ignition/Valve Cable
123509

4X1

Oxygen
Nitrogen
Air

Unit 3
Gas
Console
077032

3X1

3X2

Plasma Preflow
Shield Preflow
Plasma Cutflow
Shield Cutflow
Plasma Pressure
Shield Pressure

Hose Package
128482

Unit 4
Valve Assy
077035

Plasma
Shield

Unit 6
Torch & QD Load Set
128342

Torch Lifter 128050
Breakaway 128281
(Optional Unit)

THC Lifter Cable

1X2

PS/Gas1 Cable
023496

1X3

PS/Gas2 Cable
123446

Positive Lead 023382

Torch 120651

Workpiece

1X6

Machine Interface I/O Cable
023892

1X7

Machine Interface V/C Cable
023851

Machine I/O Cable
123022

Unit 6
CNC
Interface
(Customer Supplied)

1X7

PS/RCC Cable
023871

7X1

or

Unit 7
Remote Current
Control
(Optional Unit)
073045

1X4

Command I/O Cable
123022

Unit 8
Command
THC
(Optional Unit)
053018

THC Lifter Cable
123022 (Qty 2)

Pendant Ext. Cable
123018

Operator
Pendant
073019
(Optional Unit)

HT4400 BLOCK DIAGRAM
013338
SHEET 1 OF 13

K

HT4400
Power Supply
400 Amps

L3
L2
L1
PE
Handle
E-Stop
Fuse
Customer Supplied Fused Disconnect Sheet 3

CON2 Sheet 3
R1
R2
R3
CON1 Sheet 3

T2 Sheet 3

Chopper Assy 1 Sheet 3
Chopper Assy 2 Sheet 3
Chopper Assy 3 Sheet 3
Chopper Assy 4 Sheet 3
JP9 Control
JP6 VAC
F1
F2
F3
F4
L1
L2
L3
L4
CS1
CS2
CS3
CS4
A
B
C

CB1 with Power Off Sheet 3
T1 Sheet 3
041564 SHEET 3
PHASE LOSS DETECTION PCB PCB21 P1 SHEET 3
PL21

REC9 CH1
REC5 CH2
REC6 CH3
REC7 CH4
REC4 VAC
4 Channel Analog PCB Sheet 6
Total Current
REC10
REC3
REC7
REC5
REC6
REC1
REC2
REC3
REC4

J10 Supply
Power Board Sheet 4
J3
J4
24VAC J8
120VAC J2
240VAC J1

uP Control PCB Sheet 5
P4
J1
J2

Relay PCB Sheet 6

Serial Board Sheet 9
P1
J2
J3

I/O Panel Sheet 3
Work(+)
CST

Start Circuit Assy Sheet 3
Surge Injection
Pilot Arc Controller
J1
PAR

Plasma Interface PCB Sheet 10
J2
J3
J4

TB3
Sheet 10
TB4

RHF Console Sheet 8
2X1
2X2
Torch
1X1
4X1
Off Valve Sheet 8

1X2
3X1
1X3
3X2
Gas Console Sheet 7

1X4
2X1
Command THC Sheet

1X5
12X1
Cooler Sheet 12

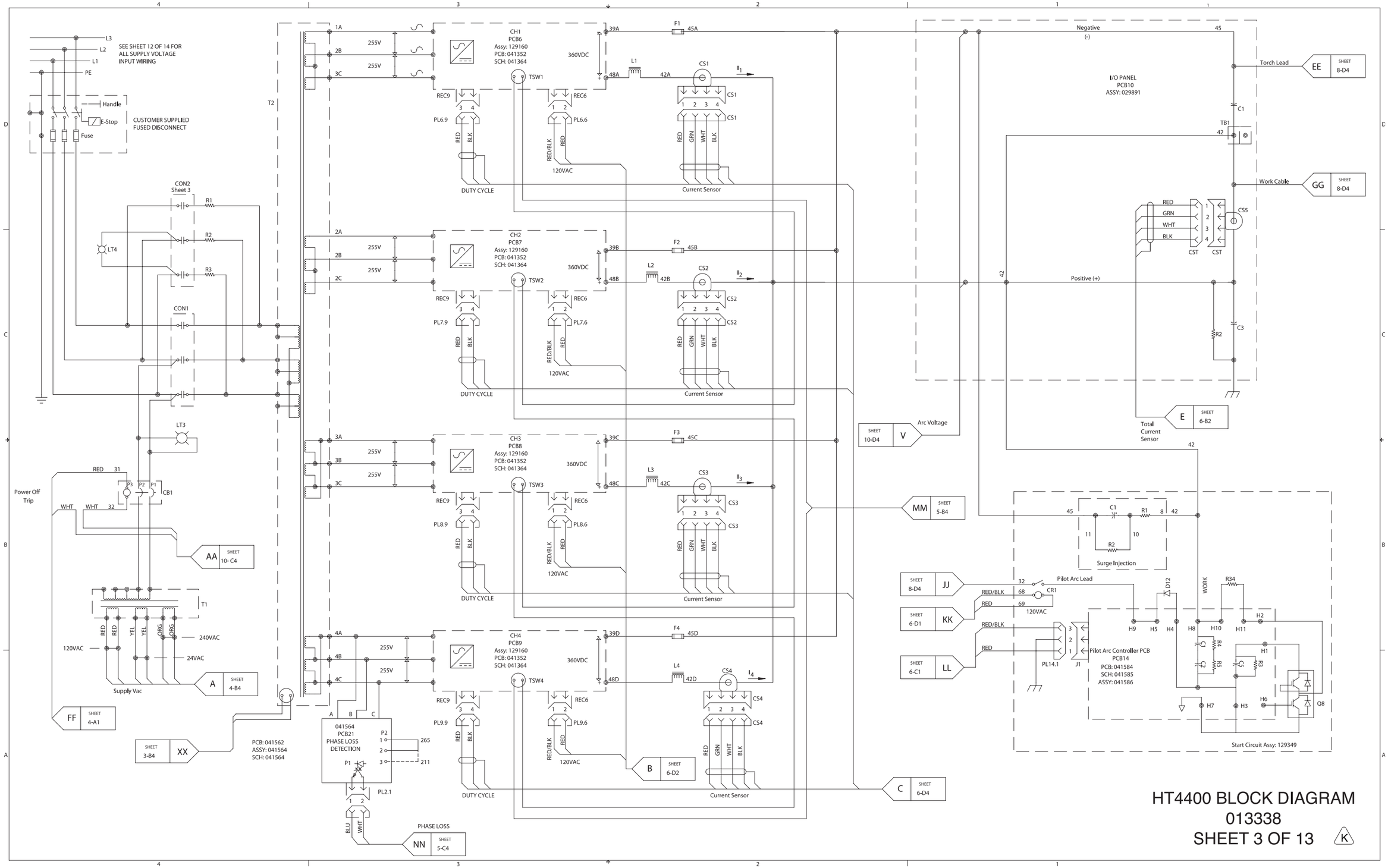
1X6
1X7
Machine I/O Sheet 10

1X11
10X1
W-M Air Control Sheet 10

1X10
W-M Supply Contactor Sheet 10

KEY
= POWER WIRING
= CONTROL WIRING
= COMPONENTS

HT4400 BLOCK DIAGRAM
013338
SHEET 2 OF 13
K



HT4400 BLOCK DIAGRAM
013338
SHEET 3 OF 13

K

Pump Motor Control

SHEET 6-C1 PP

RED
RED/BLK

PL1.3 J3 (2 1)

PL1.4 J4 (1 2)

BLK
YEL
BLK
YEL

Pump Motor
Fan

HH SHEET 12-C4

Pump Motor M1

F1
FUSE: 6A SLO
108075

FH1
FUSEHOLDER
008321

240VAC OUT

MOV1
250VAC
009353

C2
0.1uF
250VAC
009283

C3
0.1uF
250VAC
009283

R2
10K
5W
009864

D3
GRN
009399

D6
1N4001
009064

K1
G2R-14-120VAC
003151

240 VAC Outputs

J1 PL1.1

J7 (8 7 6 5 4 3 2 1)

J9 (5 4 3 2 1)

J5 PL1.5 (3 2 1)

RED
RED/BLK

F2
FUSE: 6A SLO
108075

FH2
FUSEHOLDER
008321

120VAC OUT

120 VAC Outputs

RED/BLK
RED

Remote On/Off

T SHEET 10-B3

Supply VAC

ORG
ORG
RED
RED
YLW
YLW

SHEET 3-A4 A

24 VAC
120 VAC
240 VAC

PL1.10 J10 (6 5 4 3 2 1)

MOV2
150VAC
009354

C4
0.1uF
250VAC
009283

C5
0.1uF
250VAC
009283

R3
10K
5W
009864

D4
GRN
009399

D7
1N4001
009064

M5 M6 M7 (3 3 3 / 4 4 4)

Transformer Fans

M1 M2 M3 M4 (5 5 5 5 / 6 6 6 6)

Chopper Fans

RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED
RED/BLK
RED

J6 (8 7 6 5 4 3 2 1)

J2
008530

K2
G2R-14-120VAC
003151

POWER DISTRIBUTION BOARD
PCB1

ASSY: 041610
PCB: 041608
SCH: 041610

uP PCB

H SHEET 5-D4

LT1

S1-AUX
301 CON1 302

W-M Start

Relay PCB

SS SHEET 6-D2

120V Auxilliary

M SHEET 10-B3

Solonoid V1

Flow Switch FS1

D SHEET 12-B4

J2 PL1.2 (36 rows)

F3
FUSE: 6A SLO
108075

FH3
FUSEHOLDER
008321

24VAC OUT

MOV3
82VAC
009355

C6
0.1uF
63V
009505

R4
3.9K
1/2W
009454

D5
GRN
009399

D8
1N4001
009064

24 VAC Outputs

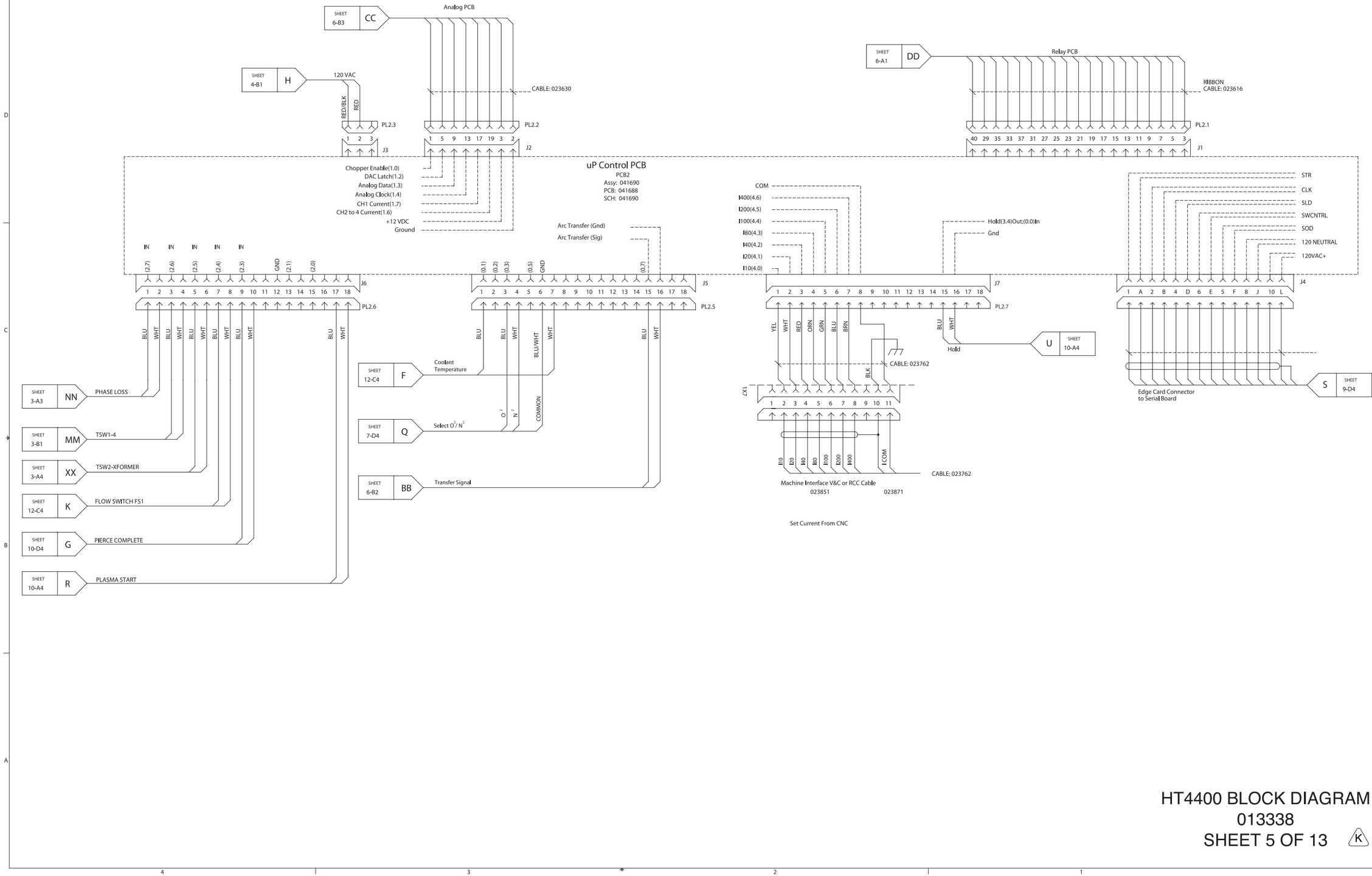
RED
WHT

Circuit Breaker Trip

FF SHEET 3-A4

J8 PL1.8 (1 2 3 4 5 6)

HT4400 BLOCK DIAGRAM
013338
SHEET 4 OF 13 K



HT4400 BLOCK DIAGRAM
013338
SHEET 5 OF 13 K

HT4400 BLOCK DIAGRAM
013338
SHEET 6 OF 13 (K)

Analog Brd Power
RED/BLK
RED
PL3.4
1 2
REC4
120 VAC

4 Channel Analog PCB
PCB3
Assy: 041282
PCB: 041281
SCH: 041282

SHEET 3-A1 C

PL3.9 REC9
RED 1 +15
GRN 2 -15
WHT 3 Signal
BLK&SHLD 4 GND
RED 5
BLK&SHLD 6
CH1: Current Sensor, 4V=100Amps; Duty Cycle

PL3.5 REC5
CH2: Current Sensor, 4V=100Amps; Duty Cycle

PL3.6 REC6
CH3: Current Sensor, 4V=100Amps; Duty Cycle

PL3.7 REC7
CH4: Current Sensor, 4V=100Amps; Duty Cycle

4V=500Amps
Total Detect
U4 12 13 14
U19 1 2 4 5

Chopper Enable
DAC Latch
Analog Data
Analog Clock
CH1 Current
CH2 to 4 Current
+12 VDC
Ground
REC3
1 5 9 13 17 19 3 2
PL3.3
CABLE: 023630
CC SHEET 5-D3

REC10 PL3.10
+15 1 RED
-15 2 GRN
Signal 3 WHT
GND 4 BLK
Signal 5
GND 6
8 BLU
9 WHT
7 Unused

Total Current Sensor
E SHEET 3-C1

Transfer Signal
BB SHEET 5-C3

(5.2) HV Trans
SV-9 SV-10 SV-11 SV-12 SV-8
O SHEET 8-C4

SHEET 3-A2 B Chopper 1-4

(6.0) Error Counter
(6.1) Start Counter
P SHEET 10-A4

SHEET 4-B1 SS Relay Brd Power

(6.2) Pilot Arc Relay
KK SHEET 3-B1

SHEET 10-A4 N
(5.1) Arc Transfer Output
YEL YEL/BLK

(6.3) CON2/SW1
40 41 A2 A1 CON1 R/B
CON2 42 43
DC On LT2
8 7

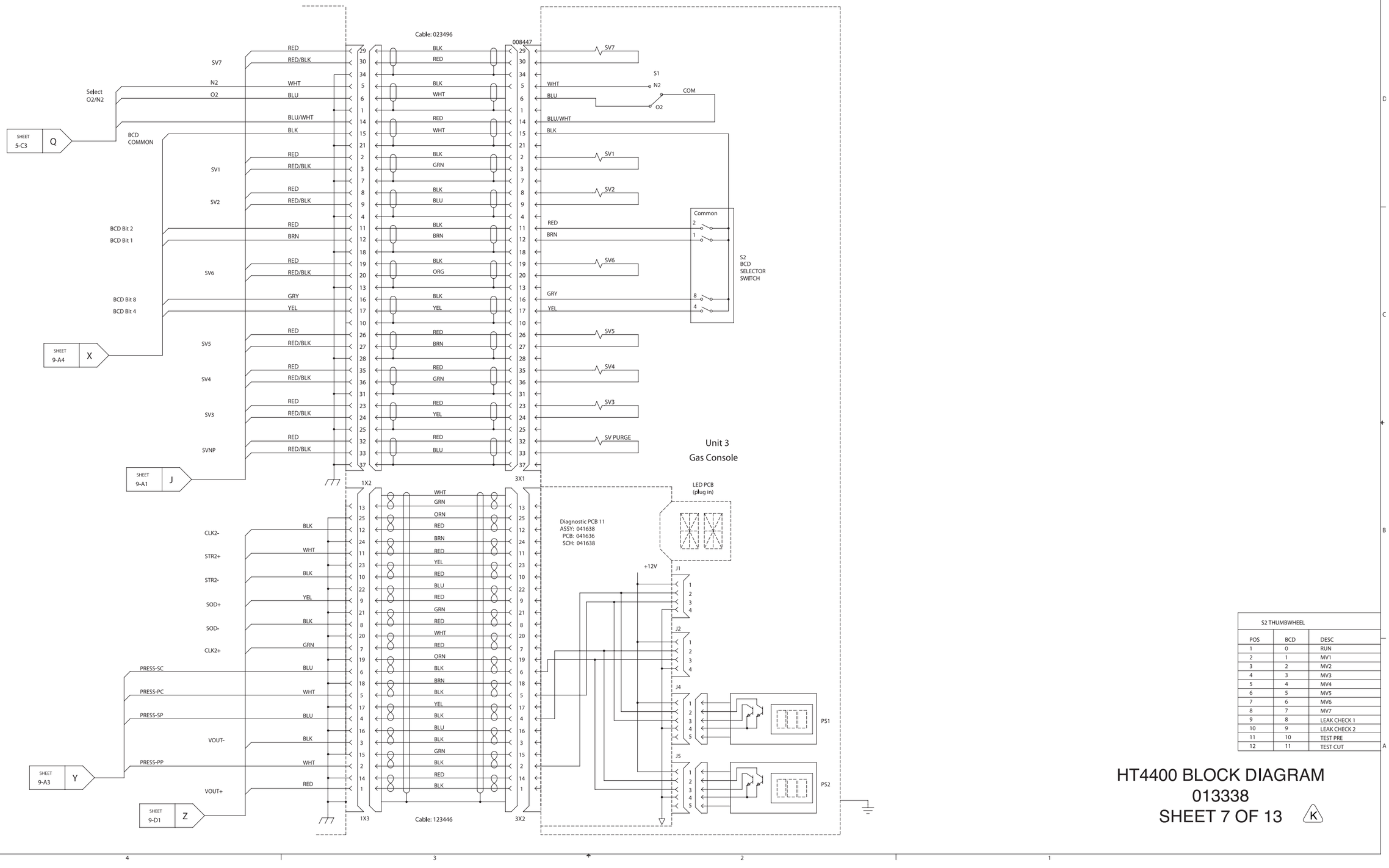
Analog Board Power
Start Circuit Board Power
LL SHEET 3-A1
Pump Motor Control
PP SHEET 4 D-3

PL4.2 1 2 5 6
PL4.3 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
PL4.4 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
REC2 REC3 REC4

R107 C70 R106 C69
CR17 CR16
F1 5 Amps
CR15 CR18 CR13 CR7 CR6 CR5 CR4 CR3 CR2 CR1 CR8 CR9 CR10 CR11 CR12
CR14 Enable (D28) D20
D27 D25 D22 D28 D19 D13 D12 D11 D10 D9 D8 D7 D14 D15 D16 D17 D18

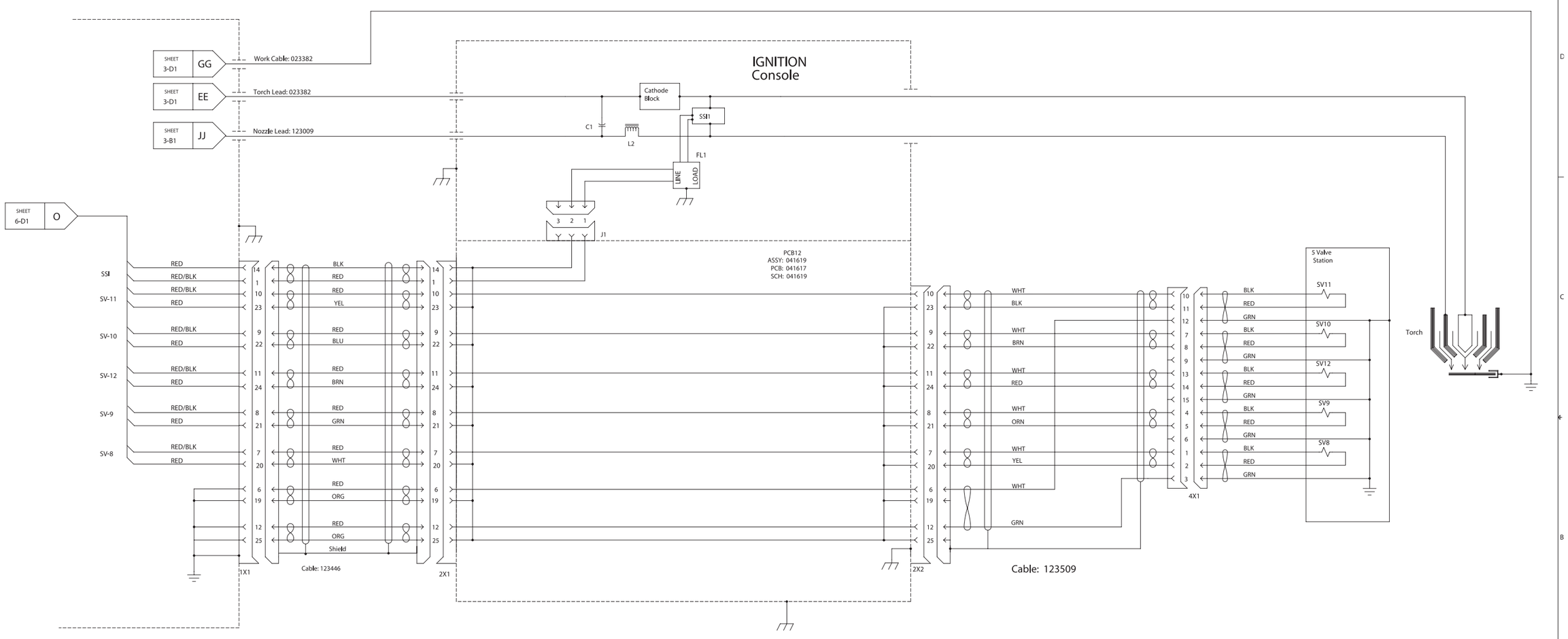
Relay PCB
PCB4
Assy: 041404
PCB: 041245
SCH: 041246
(Elemental Schematic)

REC1
40 29 35 33 37 31 27 25 23 21 19 17 15 13 11 9 7 5 3
PL4.1
CABLE: 023616
Signals for Relay PCB Triacs
DD SHEET 5-D2

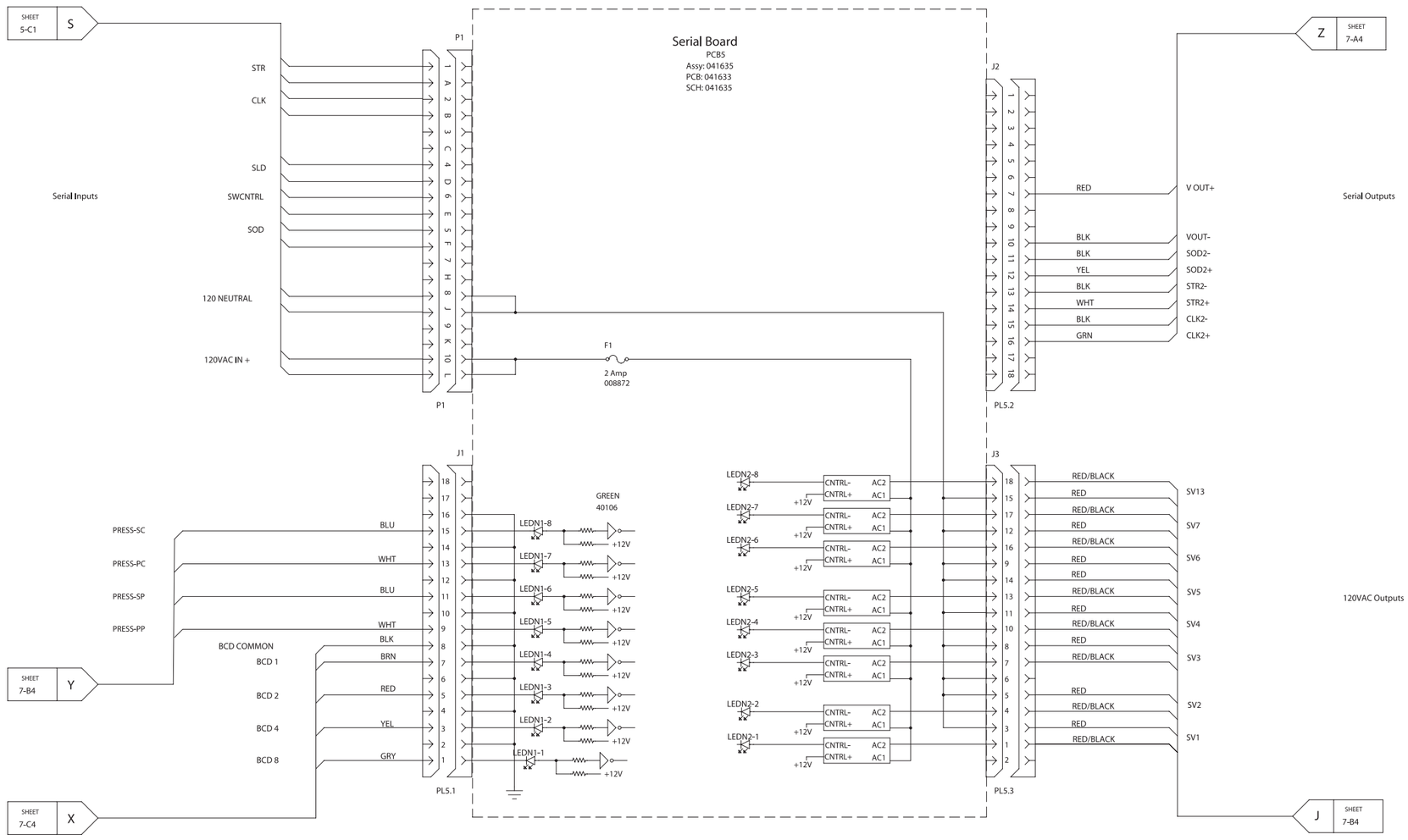


S2 THUMBWHEEL		
POS	BCD	DESC
1	0	RUN
2	1	MV1
3	2	MV2
4	3	MV3
5	4	MV4
6	5	MV5
7	6	MV6
8	7	MV7
9	8	LEAK CHECK 1
10	9	LEAK CHECK 2
11	10	TEST PRE
12	11	TEST CUT

HT4400 BLOCK DIAGRAM
013338
SHEET 7 OF 13 K



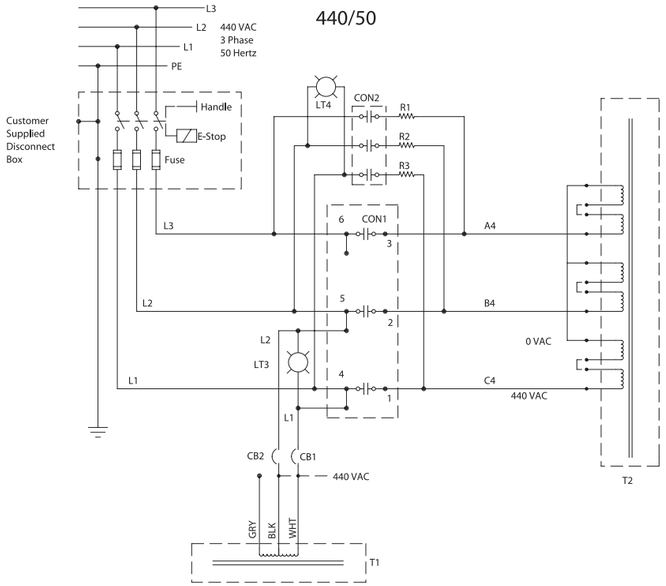
HT4400 BLOCK DIAGRAM
013338
SHEET 8 OF 13 K

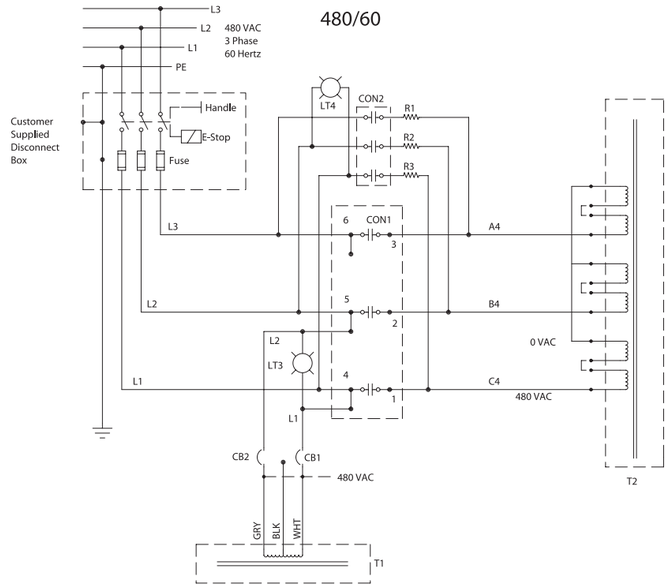


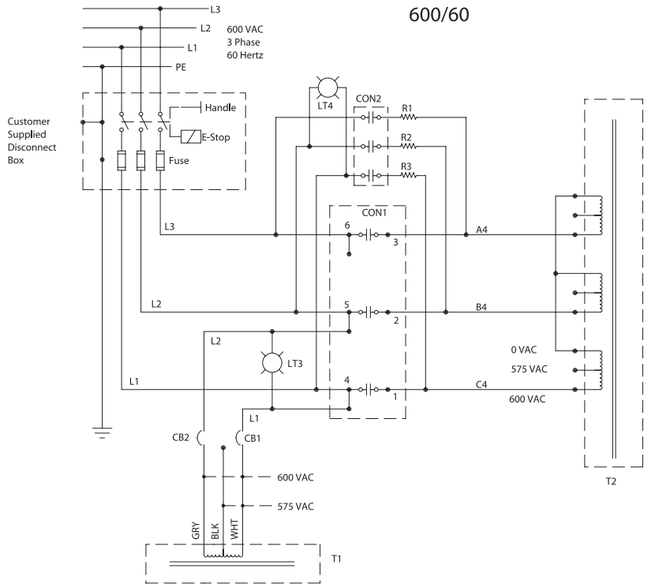
HT4400 BLOCK DIAGRAM
013338
SHEET 9 OF 13 K

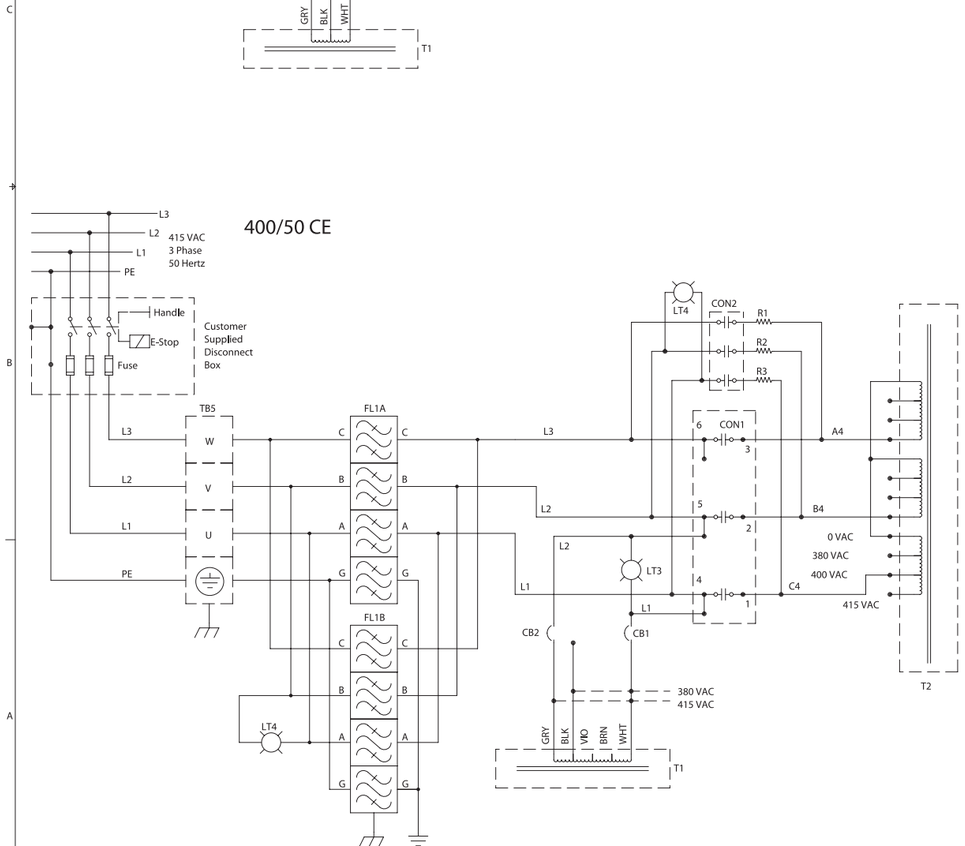
HT4400 BLOCK DIAGRAM
013338
SHEET 10 OF 13 (K)

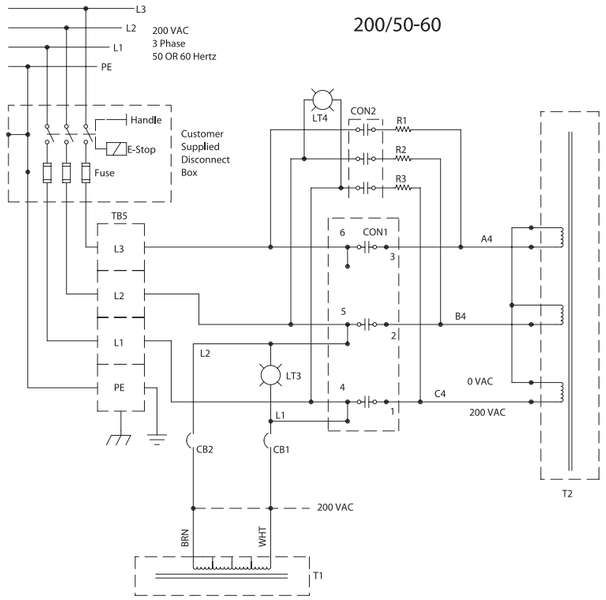
Arc Voltage — SHEET 3-C2 V
Arc Voltage
YEL 85
YEL/BLK 84
From Plasma System
J3
Shield
Work
Electrode
EM GND
PLASMA INTERFACE
PCB10
BRD: 041699
ASSY: 041671
Transfer in
+24V
PL10.3
J2
1X4
To THC
PLASMA START
HOLD
PIERCE COMPLETE
SHEET 5-B4 G
VAC
Motor
ARC TRANSFER OUTPUT
+24V
R13
D5
+24V
K1
3,6
4,5
SHEET 3 B-4 AA
Circuit Breaker Trip
SHEET 4-C1 T
Remote On/Off
SHEET 4-A1 M
PL10.2
J4
PL10.4
To Plasma System
BLU
WHT
BLU
WHT
BLU
WHT
Plasma Start
Hold
Pierce Complete
Cable: 023892
1X6
RED
RED/BLK
WHT
BLU
RED/BLK
RED/BLK
YEL/BLK
YEL
BLU
WHT
WHT
BLU
WHT
WHT
Arc Transfer Output
Hold
Plasma START
168
167
ERROR COUNTER
136
135
PIERCE COMPLETE
78
79
REMOTE ON/OFF
84
85
VAC
Motor
ARC TRANSFER OUTPUT
87
86
PLASMA HOLD INPUT/OUTPUT
to HOLD Power Supply #3
to HOLD Power Supply #2
to HOLD Power Supply #4
83
82
Plasma START
INPUT
81
80
Circuit Breaker Trip (N.0.)
TB4
Local On
Local Off
120V Power Select
120V Auxilliary
W-M
Start
RED
RED/BLK
RED/BLK
RED
88
89
RED
RED/BLK
RED/BLK
RED
1X11
AIR CONTROL BOX
Cable: 023903
10X1
SET
OFF
ON
Water Muffler not available at this time
WATER MUFFLER WATER SUPPLY
Cable: 023866
1X10
RED/BLK
TB3
Plasma START
Plasma HOLD
Arc Transfer Output
Error Counter
Start Counter
SHEET 5-C3 R
SHEET 5-C1 U
SHEET 6-D2 N
SHEET 6-D1 P
BLU
WHT
WHT
BLU
YEL
YEL/BLK
RED/BLK
RED
RED
RED/BLK
82
83
86
87
85
84
51
50
53
52
Plasma START
Plasma HOLD
Arc Transfer Output
Error Counter
Start Counter



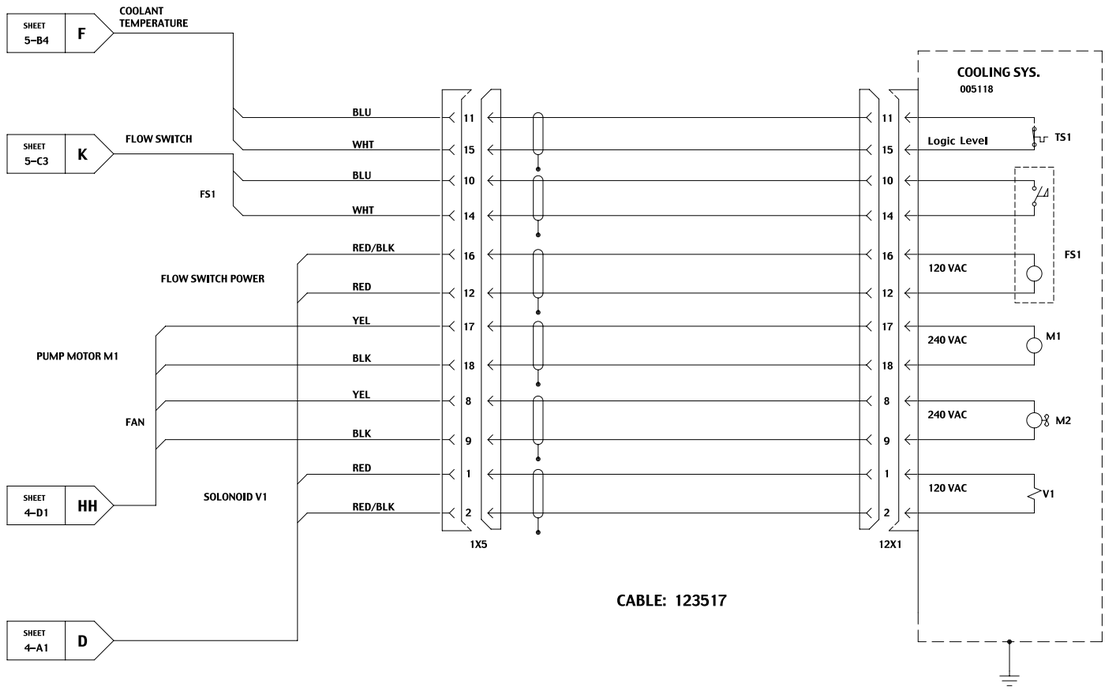




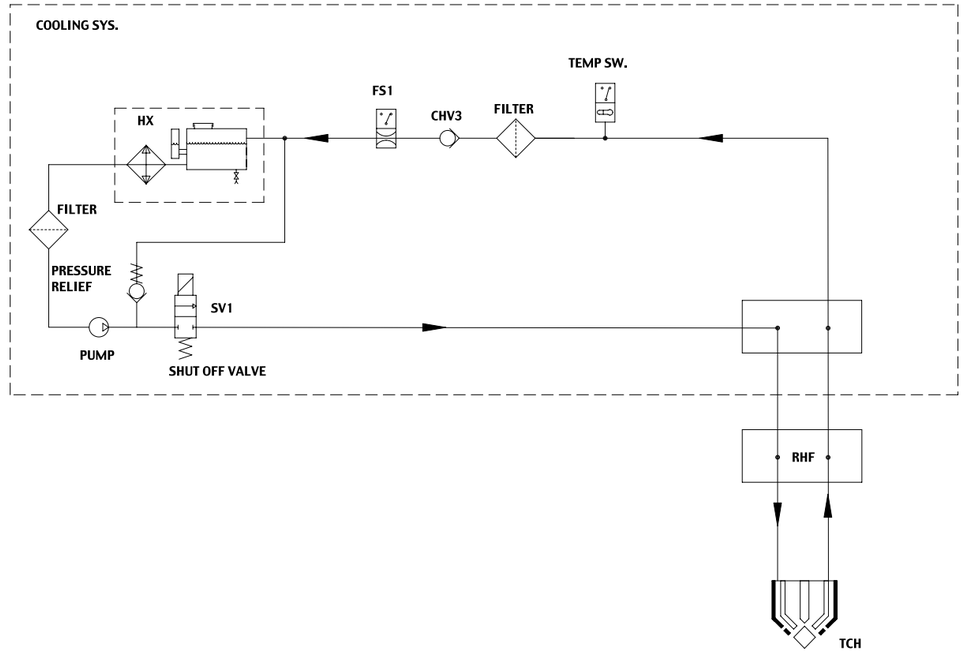




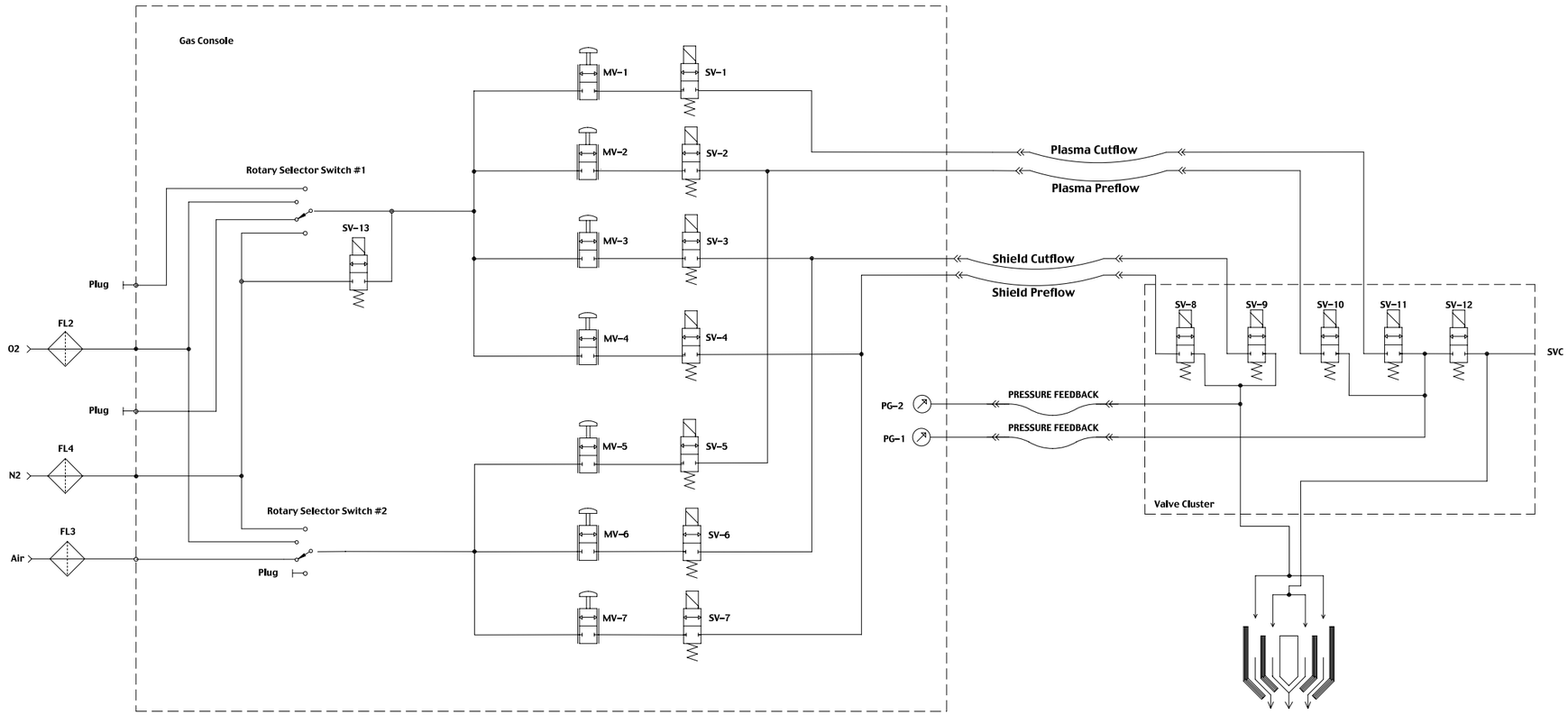
HT4400 BLOCK DIAGRAM
013338
SHEET 11 OF 13 K



CABLE: 123517



HT4400 BLOCK DIAGRAM
013338
SHEET 12 OF 13 (K)



HT4400 BLOCK DIAGRAM
013338
SHEET 13 OF 13 K

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Appendix A

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 or local codes.

- *EMI Suppression* If allowed by national or 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 and stray currents. 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 a-1 and a-2.

The ignition 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 a-1).

All modules may also be installed near the work table, and grounded directly to it (Figure a-2). Do not ground the ignition 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.

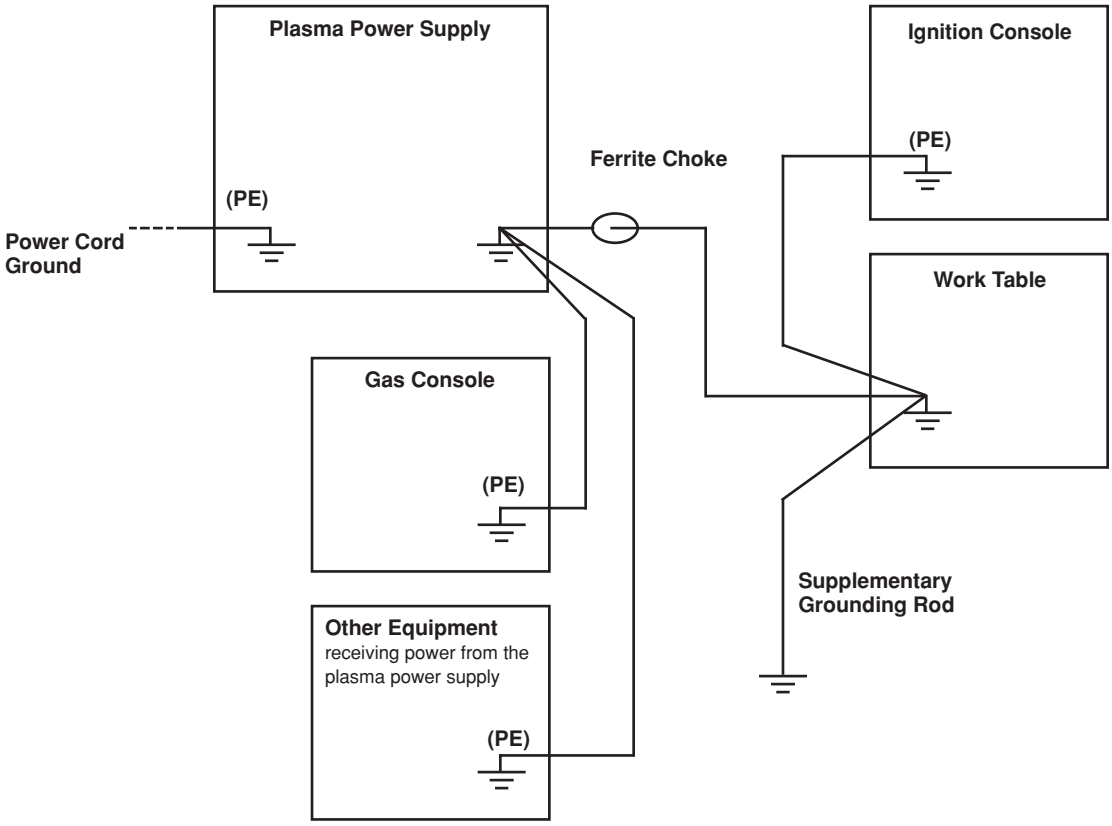

Figure a-1 Recommended Ground Connection Configuration

Note: Configuration may vary for each installation and may require a different ground scheme.

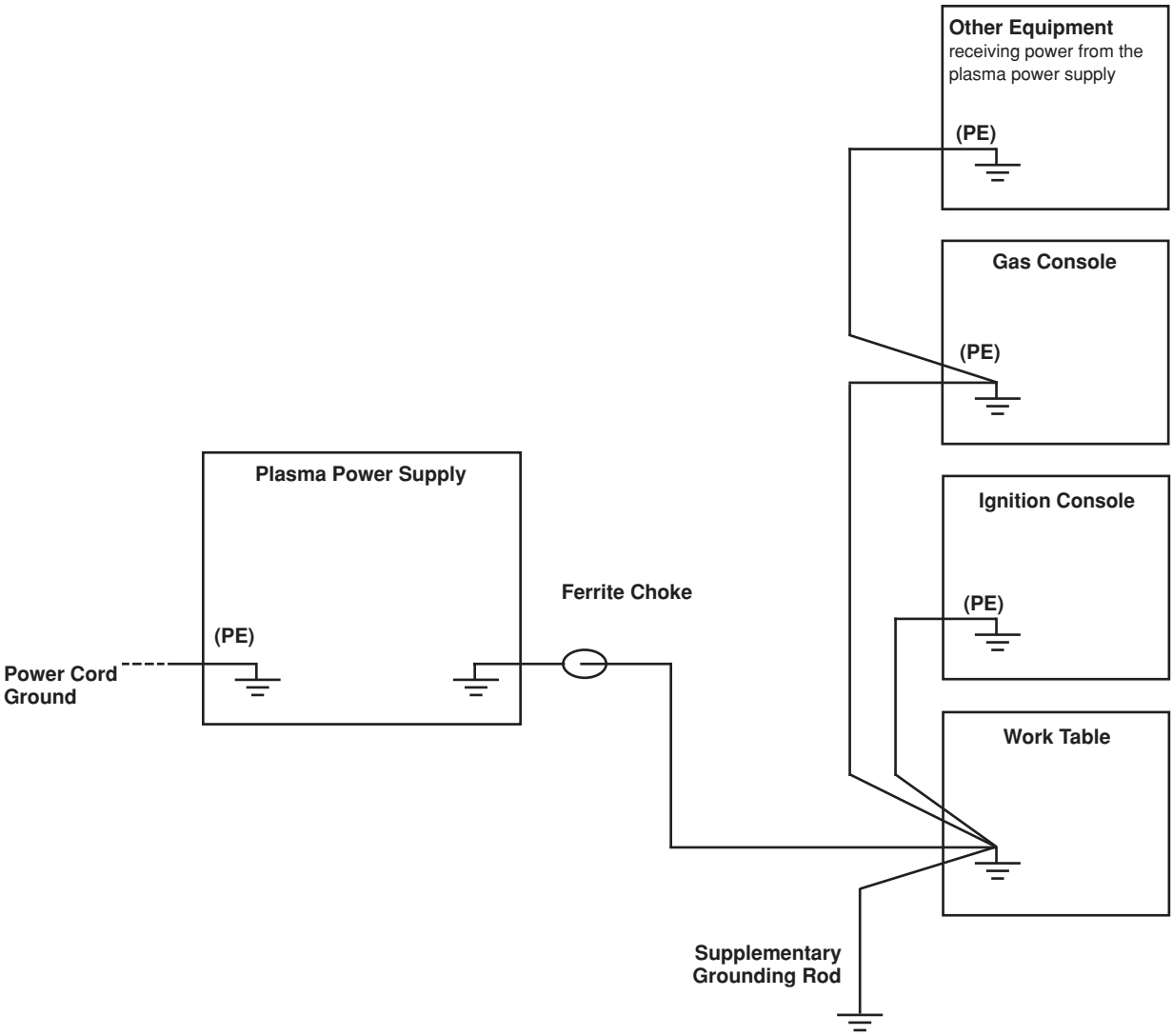

Figure a-2 Alternate Ground Connection Configuration

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.

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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.

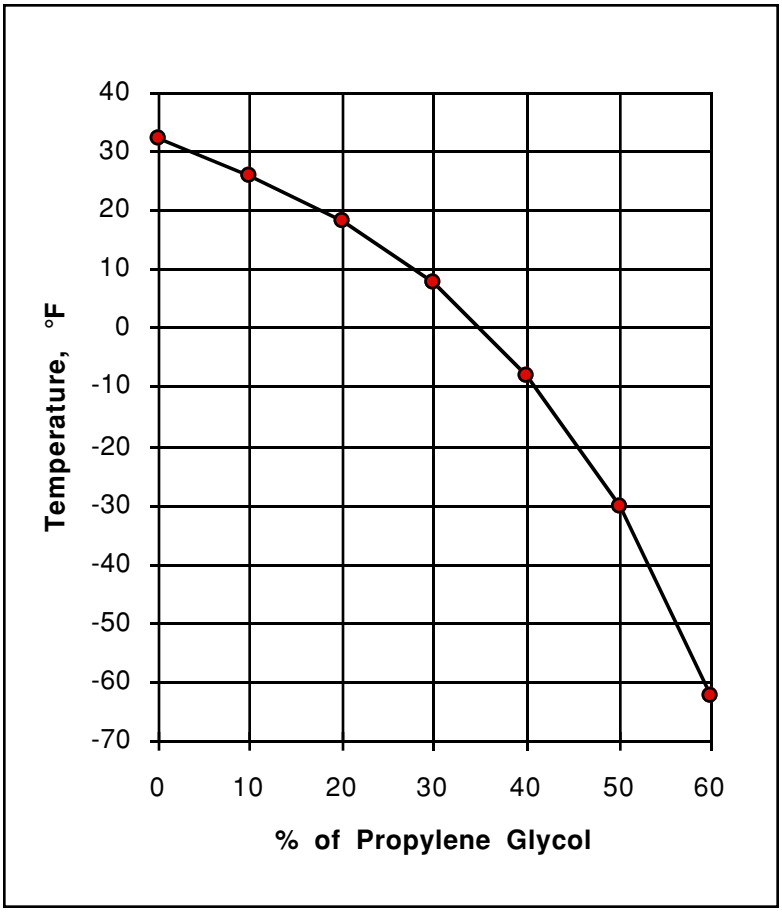

Figure b-1 Freezing Point of Propylene Glycol Solution

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.

08/28/95

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

The information contained herein is based on the data available to us and is believed to be correct as of the date prepared; however, PMC SPECIALTIES GROUP, INC. makes no warranty, expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Appendix C

GAS REGULATORS

In this section:

Gas Regulators

Low-quality gas regulators do not provide consistent supply pressures and can result in poor cut quality and system operation problems. Use a high-quality, 1-stage, gas regulator to maintain consistent gas supply pressure, if using liquid cryogenic or bulk storage. Use a high-quality, 2-stage, gas regulator to maintain consistent gas supply pressure from high pressure gas cylinders.

The high-quality gas regulators listed below are available from Hypertherm and meet U.S. Compressed Gas Association (CGA) specifications.

In other countries, select gas regulators that conform to national or local codes.

2-Stage Regulator

1-Stage Regulator

Part Number	Description	Qty.
128544	**Kit: Oxygen, 2-Stage ***	**1**
128545	**Kit: Inert Gas, 2-Stage**	**1**
128546	**Kit: Hydrogen (H5, H35 and Methane) 2-Stage**	**1**
128547	**Kit: Air, 2 Stage**	**1**
128548	**Kit: 1 Stage (For use with cryogenic liquid Nitrogen or Oxygen)**	**1**
022037	Oxygen, 2-Stage	1
022038	Inert Gas, 2-Stage	1
022039	Hydrogen/Methane, 2-Stage	3
022040	Air, 2-Stage	1
022041	Line Regulator, 1-Stage	1

***** Kits include appropriate fittings

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Appendix D

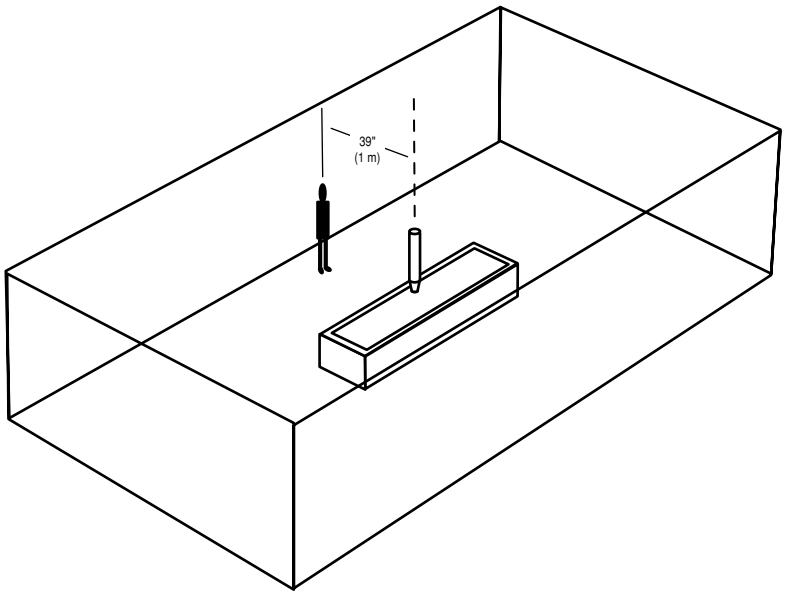
NOISE LEVELS

In this section:

Noise Levels

Noise level measurements listed below for the HT4400 plasma system were taken from a distance of 39" (1 m), at a height of 46" (1.2 m) from the torch. Sound levels may vary due to room acoustics, room size, material being cut, cutting amps being used and other factors.

Torch Position	Amps/Plasma	Maximum dB
2.5” (63.5 mm) Above Water	100 A/O2	111
	200 A/O2	120
	300 A/O2	121
	400 A/O2	124
3.0” (76 mm) Under Water	400 A/O2	106
2.5” (63.5 mm) Above Water	200 A/N2	124
	400 A/N2	121



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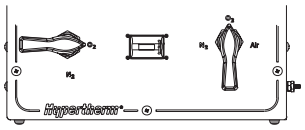
Appendix E

O_2 N_2 CUT CHARTS @ 140 PSI

In this section:



Mild Steel

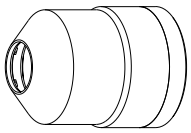
O_2 Plasma / O_2-N_2 Shield

400 Amps

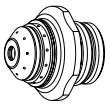
Straight and Bevel Cutting to 45°

Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	192.4 / 5448	61.2 / 1733
Cutflow	152.5/ 4318	125.8 / 3562

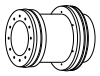
Note: Cut charts display straight cutting (90°) parameters



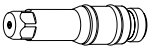
120786
Retaining Cap



120934
Nozzle



120939
Swirl Ring



120810
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
68	4	6	8	25		34	40	33	48	64	43	**3/8****	135	.125	3	195	4950	.250	6	0.4
												1/2**	138	.157	4	160	4060	.314	8	0.5
												5/8	140	.157	4	120	3050	.314	8	0.6
												3/4	142	.157	4	95	2413	.314	8	0.7
												7/8	145	.188	5	80	2032	.375	10	0.8
												1	145	.188	5	70	1778	.375	10	1
												1-1/8	145	.188	5	60	1520	.375	10	1.4
												1-1/4	148	.188	5	55	1400	.375	10	1.9
												1-1/2	150	.188	5	40	1020	*	*	*
												2	175	.250	6	15	381	*	*	*

Metric

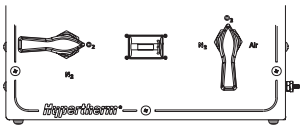
Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
68	4	6	8	25		34	40	33	48	64	43	**10****	135	3	.125	4718	186	6	.250	0.4
												12**	138	4	.157	4301	169	8	.314	0.5
												15	140	4	.157	3320	131	8	.314	0.6
												20	142	4	.157	2298	91	8	.314	0.7
												22	145	5	.188	2053	81	10	.375	0.8
												25	145	5	.188	1806	71	10	.375	1
												30	145	5	.188	1468	58	10	.375	1.2
												32	148	5	.188	1386	55	10	.375	1.4
												35	150	5	.188	1204	47	10	.375	1.9
												40	155	5	.188	929	37	*	*	*
												50	175	6	.250	421	17	*	*	*

* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 74**
PG2 43

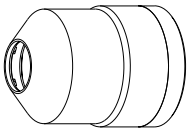


Mild Steel

O_2 Plasma / O_2-N_2 Shield

300 Amps

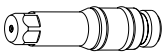
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	194.2 / 5499	56.9 / 1611
Cutflow	173.4 / 4910	115.6 / 3273



120786
Retaining Cap

120794
Nozzle

120913
Swirl Ring



120802
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
47	2	8	8	13		40	40	17	47	45	47	**1/4****	120	.062	2	190	4830	.125	3	0.3
												3/8**	125	.125	3	160	4060	.250	6	0.5
												1/2	130	.157	4	120	3050	.314	8	0.7
												5/8	135	.188	5	100	2540	.375	10	0.9
												3/4	140	.188	5	80	2030	.375	10	1.1
												7/8	145	.188	5	70	1780	.375	10	1.3
												1	145	.188	5	55	1400	.375	10	1.5
												1-1/8	150	.188	5	50	1270	*	*	*
												1-1/4	155	.250	6	45	1140	*	*	*
												1-1/2	155	.250	6	35	890	*	*	*

Metric

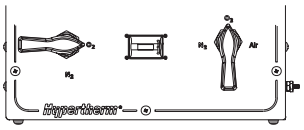
Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
47	2	8	8	13		40	40	17	47	45	47	**6****	120	2	.062	5108	201	3	.125	0.3
												10**	125	3	.125	3871	153	6	.250	0.5
												12	130	4	.157	3226	127	8	.314	0.7
												15	135	5	.188	2681	106	10	.375	0.9
												20	140	5	.188	1935	76	10	.375	1.1
												22	145	5	.188	1796	71	10	.375	1.3
												25	145	5	.188	1419	56	10	.375	1.5
												30	150	5	.188	1213	48	*	*	*
												32	155	6	.250	1134	45	*	*	*
												35	155	6	.250	1014	40	*	*	*

* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 72**
PG2 43

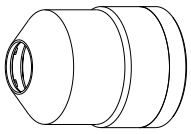


Mild Steel

O_2 Plasma / O_2-N_2 Shield

200 Amps

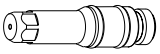
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	202.4 / 5731	60.4 / 1710
Cutflow	140.6 / 3981	111.4 / 3154



120786
Retaining Cap

120787
Nozzle

120791
Swirl Ring



120793
Electrode

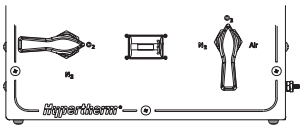
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
37	3	5	7	18		27	38	23	44	35	37	**1/4**	120	.125	3	160	4060	.250	6	0.5
												3/8	120	.125	3	100	2540	.250	6	0.5
												1/2	125	.157	4	80	2030	.314	8	0.7
												5/8	130	.157	4	70	1780	.314	8	0.9
												3/4	135	.188	5	55	1400	.375	10	1.2
												7/8	135	.25	6	45	1140	.500	13	1.5
												1	140	.25	6	35	889	.500	13	2.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
37	3	5	7	18		27	38	23	44	35	37	**6**	120	3	.125	4301	169	6	.250	0.5
												10	120	3	.125	2419	95	6	.250	0.5
												12	125	4	.157	2151	85	8	.314	0.7
												15	130	4	.157	1851	73	8	.314	0.9
												20	135	5	.188	1331	52	10	.375	1.2
												22	135	6	.25	1155	46	13	.500	1.5
												25	140	6	.25	903	36	13	.500	2.5

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 59**
PG2 33

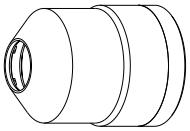


Mild Steel

O_2 Plasma / O_2-N_2 Shield

100 Amps

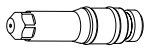
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	134.3 / 3803	35.7 / 1011
Cutflow	87.1 / 2466	68.9 / 1951



120786
Retaining Cap

120777
Nozzle

120783
Swirl Ring



120785
Electrode

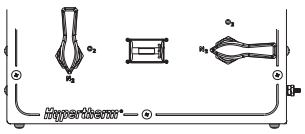
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
43	4	2	3	24		13	17	31	23	43	17	**1/8**	125	.094	2	240	6100	.188	5	0.3
												3/16	125	.125	3	180	4570	.250	6	0.5
												1/4	130	.125	3	120	3050	.250	6	0.7
												3/8	135	.157	4	85	2160	.314	8	0.9
												1/2	135	.157	4	60	1520	.314	8	1.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
43	4	2	3	24		13	17	31	23	43	17	**3**	125	2	.094	6462	255	5	.188	0.3
												5	125	3	.125	4355	172	6	.250	0.5
												6	130	3	.125	3226	127	6	.250	0.7
												10	135	4	.157	2056	81	8	.314	0.9
												12	135	4	.157	1613	64	8	.314	1.5

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 88**
PG2 16

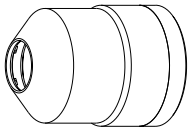


Stainless Steel

N_2 Plasma / N_2 Shield

400 Amps

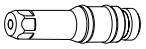
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)	
	N_2
Preflow	235.9 / 6680
Cutflow	237.7 / 6731



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
60	43	35	40	0		0	0	34	36	49	30	**1/4**	140	.125	3	195	4953	.250	6	0.3
												3/8	140	.125	3	170	4320	.250	6	0.5
												1/2	145	.157	4	140	3560	.314	8	0.7
												5/8	150	.157	4	95	2410	.314	8	1
												3/4	155	.188	5	70	1780	.375	10	1.5
												7/8	160	.188	5	55	1400	.375	10	2
												1	165	.188	5	40	1020	.375	10	2.5
												1-1/4	170	.250	6	30	760	*	*	*
												1-1/2	180	.250	6	25	630	*	*	*
												2	185	.250	6	13	330	*	*	*

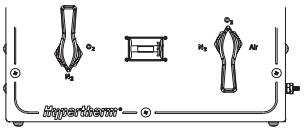
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
60	43	35	40	0		0	0	34	36	49	30	**6**	140	3	.125	5242	207	6	.250	0.3
												10	140	3	.125	4113	162	6	.250	0.5
												12	145	4	.157	3763	148	8	.314	0.7
												15	150	4	.157	2713	107	8	.314	1
												20	155	5	.188	1694	67	10	.375	1.5
												22	160	5	.188	1411	56	10	.375	2
												25	165	5	.188	1032	41	10	.375	2.5
												35	170	6	.250	697	27	*	*	*
												40	180	6	.250	585	23	*	*	*
												50	185	6	.250	349	14	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 59**
PG2 28

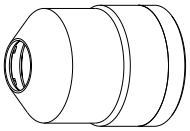


Stainless Steel

N_2 Plasma / O_2-N_2 Shield

200 Amps

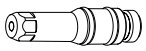
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	211.4 / 5986	56.1 / 1589
Cutflow	200.6 / 5680	36.6 / 1036



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
43	34	30	40	0		5	8	27	45	37	36	**3/16**	130	.125	3	135	3430	.250	6	0.4
												1/4	135	.125	3	120	3050	.250	6	0.5
												3/8	135	.125	3	100	2540	.250	6	1
												1/2	140	.157	4	75	1900	.314	8	2
												5/8	140	.157	4	60	1520	.314	8	2
												3/4	145	.188	5	45	1140	.375	10	2.5
												7/8	145	.250	6	35	890	.500	12	3.0
												1	150	.250	6	20	510	*	*	*
												1-1/4	160	.250	6	15	380	*	*	*

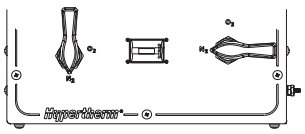
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
43	34	30	40	0		5	8	27	45	37	36	**5**	130	3	.125	3266	129	6	.250	0.4
												6	135	3	.125	3226	127	6	.250	0.5
												10	135	3	.125	2419	95	6	.250	1
												12	140	4	.157	2016	79	6	.314	2
												15	140	4	.157	1628	64	8	.314	2
												20	145	5	.188	1089	43	10	.375	2.5
												22	145	6	.250	898	35	12	.500	3.0
												25	150	6	.250	516	20	*	*	*
												30	160	6	.250	415	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thickness.

Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 33

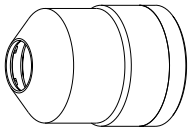


Aluminum

N_2 Plasma / N_2 Shield

400 Amps

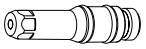
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)	
	N_2
Preflow	235.9 / 6680
Cutflow	237.7 / 6731



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
60	43	35	40	0		0	0	34	36	49	30	**1/4**	135	.125	3	220	5588	.250	6	0.3
												3/8	140	.125	3	195	4953	.250	6	0.5
												1/2	145	.157	4	150	3810	.314	8	0.7
												5/8	150	.157	4	105	2667	.314	8	1
												3/4	155	.188	5	80	2032	.375	10	1.5
												7/8	160	.188	5	65	1651	.375	10	2
												1	165	.188	5	50	1270	.375	10	2.5
												1-1/4	170	.250	6	40	1016	*	*	*
												1-1/2	180	.250	6	30	762	*	*	*
												2	185	.250	6	15	381	*	*	*

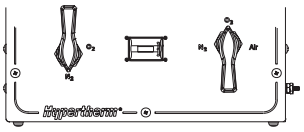
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
60	43	35	40	0		0	0	34	36	49	30	**6**	135	3	.125	5914	233	6	.250	0.3
												10	140	3	.125	4718	186	6	.250	0.5
												12	145	4	.157	4032	159	8	.314	0.7
												15	150	4	.157	2968	117	8	.314	1
												20	155	5	.188	1935	76	10	.375	1.5
												22	160	5	.188	1668	66	10	.375	2
												25	165	5	.188	1290	51	10	.375	2.5
												30	170	6	.250	1085	43	*	*	*
												40	180	6	.250	709	28	*	*	*
												50	185	6	.250	405	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 59**
PG2 28

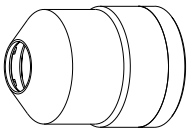


Aluminum

N_2 Plasma / O_2-N_2 Shield

200 Amps

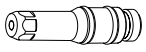
Flow Rates @ 140 psi / 9.6 bar (scfh / slh)		
	N_2	O_2
Preflow	211.4 / 5986	56.1 / 1589
Cutflow	200.6 / 5680	36.1 / 1036



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
43	34	30	40	0		5	8	27	45	37	36	**3/16**	130	.125	3	180	4570	.250	6	0.5
												1/4	135	.125	3	160	4060	.250	6	1
												3/8	135	.125	3	120	4050	.250	6	1.5
												1/2	140	.125	3	80	2030	.250	6	2
												5/8	140	.157	4	70	1780	.314	8	2
												3/4	150	.250	6	50	1270	.500	12	2.5
												7/8	160	.250	6	35	890	.500	12	2.5
												1	165	.250	6	25	630	*	*	*
												1-1/4	175	.250	6	20	510	*	*	*

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
43	34	30	40	0		5	8	27	45	37	36	**5**	130	3	.125	4355	172	6	.250	0.5
												6	135	3	.125	4301	169	6	.250	1
												10	135	3	.125	2903	114	6	.250	1.5
												12	140	4	.157	2151	85	6	.250	2
												15	140	4	.157	1851	73	8	.314	2
												20	145	5	.188	1210	48	12	.500	2.5
												22	145	6	.250	898	35	12	.500	2.5
												25	150	6	.250	645	25	*	*	*
												30	160	6	.250	543	21	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 140 psi (9.6 bar) for all material thicknesses.

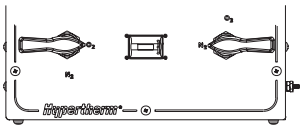
Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 33

Hypertherm

Appendix F

O_2 N_2 CUT CHARTS @ 120 PSI

In this section:



Mild Steel

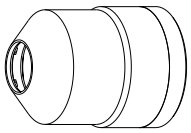
O_2 Plasma / O_2-N_2 Shield

400 Amps

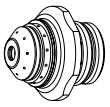
Straight and Bevel Cutting to 45°

Flow Rates @ 120 psi (8.3 bar) (scfh / slh)		
	N_2	O_2
Preflow	180.8 / 5118	60.4 / 1710
Cutflow	138.6 / 3924	133.6 / 3780

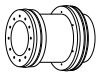
Note: Cut charts display straight cutting (90°) parameters



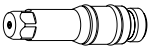
120786
Retaining Cap



120934
Nozzle



120939
Swirl Ring



120810
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
72	4	6	8	28		35	40	34	46	70	43	**3/8****	135	.125	3	195	4950	.250	6	0.4
												1/2**	138	.157	4	160	4060	.314	8	0.5
												5/8	140	.157	4	120	3050	.314	8	0.6
												3/4	142	.157	4	95	2413	.314	8	0.7
												7/8	145	.188	5	80	2032	.375	10	0.8
												1	145	.188	5	70	1778	.375	10	1
												1-1/8	145	.188	5	60	1520	.375	10	1.4
												1-1/4	148	.188	5	55	1400	.375	10	1.9
												1-1/2	150	.188	5	40	1020	*	*	*
												2	175	.250	6	15	381	*	*	*

Metric

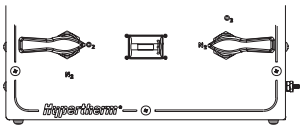
Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
72	4	6	8	28		35	40	34	46	70	43	**10****	135	3	.125	4718	186	6	.250	0.4
												12**	138	4	.157	4301	169	8	.314	0.5
												15	140	4	.157	3320	131	8	.314	0.6
												20	142	4	.157	2298	91	8	.314	0.7
												22	145	5	.188	2053	81	10	.375	0.8
												25	145	5	.188	1806	71	10	.375	1
												30	145	5	.188	1468	58	10	.375	1.2
												32	148	5	.188	1386	55	10	.375	1.4
												35	150	5	.188	1204	47	10	.375	1.9
												40	155	5	.188	929	37	*	*	*
												50	175	6	.250	421	17	*	*	*

* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 76**
PG2 42

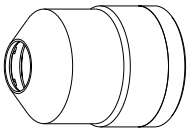


Mild Steel

O_2 Plasma / O_2-N_2 Shield

300 Amps

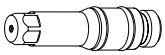
Flow Rates @ 120 psi / 8.3 bar (scfh / slh)		
	N_2	O_2
Preflow	175.8 / 4980	63.6 / 1800
Cutflow	143.7 / 4068	111.3 / 3150



120786
Retaining Cap

120794
Nozzle

120913
Swirl Ring



120802
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
48	4	5	8	13		32	40	20	45	46	39	**1/4****	120	.062	2	190	4830	.125	3	0.3
												3/8**	125	.125	3	160	4060	.250	6	0.5
												1/2	130	.157	4	120	3050	.314	8	0.7
												5/8	135	.188	5	100	2540	.375	10	0.9
												3/4	140	.188	5	80	2030	.375	10	1.1
												7/8	145	.188	5	70	1780	.375	10	1.3
												1	145	.188	5	55	1400	.375	10	1.5
												1-1/8	150	.188	5	50	1270	*	*	*
												1-1/4	155	.250	6	45	1140	*	*	*
												1-1/2	155	.250	6	35	890	*	*	*

Metric

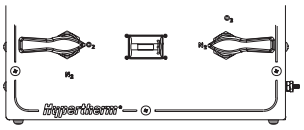
Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
48	4	5	8	13		32	40	20	45	46	39	**6****	120	2	.062	5108	201	3	.125	0.3
												10**	125	3	.125	3871	153	6	.250	0.5
												12	130	4	.157	3226	127	8	.314	0.7
												15	135	5	.188	2681	106	10	.375	0.9
												20	140	5	.188	1935	76	10	.375	1.1
												22	145	5	.188	1796	71	10	.375	1.3
												25	145	5	.188	1419	56	10	.375	1.5
												30	150	5	.188	1213	48	*	*	*
												32	155	6	.250	1134	45	*	*	*
												35	155	6	.250	1014	40	*	*	*

* Piercing not recommended

** Cuts on these thicknesses may result in increased cut angle variation and surface roughness. Reduce cut speed by 5%-10% for improvement with some materials.

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 70**
PG2 38

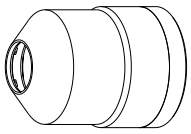


Mild Steel

O_2 Plasma / O_2-N_2 Shield

200 Amps

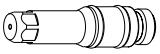
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)		
	N_2	O_2
Preflow	180.8 / 5118	57.2 / 1620
Cutflow	123.4 / 3492	111.3 / 3150



120786
Retaining Cap

120787
Nozzle

120791
Swirl Ring



120793
Electrode

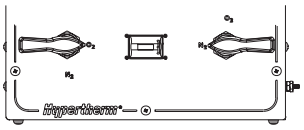
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
37	3	5	7	18		27	38	23	43	35	36	**1/4**	120	.125	3	160	4060	.250	6	0.5
												3/8	120	.125	3	100	2540	.250	6	0.5
												1/2	125	.157	4	80	2030	.314	8	0.7
												5/8	130	.157	4	70	1780	.314	8	0.9
												3/4	135	.188	5	55	1400	.375	10	1.2
												7/8	135	.25	6	45	1140	.500	13	1.5
												1	140	.25	6	35	889	.500	13	2.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
37	3	5	7	18		27	38	23	43	35	36	**6**	120	3	.125	4301	169	6	.250	0.5
												10	120	3	.125	2419	95	6	.250	0.5
												12	125	4	.157	2151	85	8	.314	0.7
												15	130	4	.157	1851	73	8	.314	0.9
												20	135	5	.188	1331	52	10	.375	1.2
												22	135	6	.25	1155	46	13	.500	1.5
												25	140	6	.25	903	36	13	.500	2.5

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 56**
PG2 36

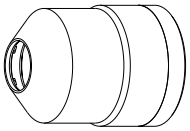


Mild Steel

O_2 Plasma / O_2-N_2 Shield

100 Amps

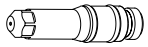
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)		
	N_2	O_2
Preflow	123.4 / 3492	38.2 / 1080
Cutflow	76.1 / 2154	68.4 / 1932



120786
Retaining Cap

120777
Nozzle

120783
Swirl Ring



120785
Electrode

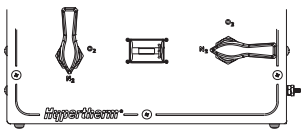
English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
36	4	2	3	24		13	17	31	24	35	17	**1/8**	125	.094	2	240	6100	.188	5	0.3
												3/16	125	.125	3	180	4570	.250	6	0.5
												1/4	130	.125	3	120	3050	.250	6	0.7
												3/8	135	.157	4	85	2160	.314	8	0.9
												1/2	135	.157	4	60	1520	.314	8	1.5

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
36	4	2	3	24		13	17	31	24	35	17	**3**	125	2	.094	6462	255	5	.188	0.3
												5	125	3	.125	4355	172	6	.250	0.5
												6	130	3	.125	3226	127	6	.250	0.7
												10	135	4	.157	2056	81	8	.314	0.9
												12	135	4	.157	1613	64	8	.314	1.5

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.
Approximate pressures while cutting in RUN mode: **PG1 77**
PG2 17

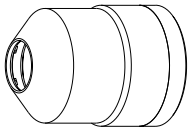


Stainless Steel

N_2 Plasma / N_2 Shield

400 Amps

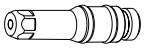
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)	
	N_2
Preflow	223.1 / 6318
Cutflow	226.5 / 6414



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
63	45	36	41	0		0	0	34	36	49	30	**1/4**	140	.125	3	195	4953	.250	6	0.3
												3/8	140	.125	3	170	4320	.250	6	0.5
												1/2	145	.157	4	140	3560	.314	8	0.7
												5/8	150	.157	4	95	2410	.314	8	1
												3/4	155	.188	5	70	1780	.375	10	1.5
												7/8	160	.188	5	55	1400	.375	10	2
												1	165	.188	5	40	1020	.375	10	2.5
												1-1/4	170	.250	6	30	760	*	*	*
												1-1/2	180	.250	6	25	630	*	*	*
												2	185	.250	6	13	330	*	*	*

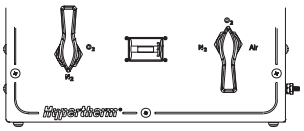
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
63	45	36	41	0		0	0	34	36	49	30	**6**	140	3	.125	5242	207	6	.250	0.3
												10	140	3	.125	4113	162	6	.250	0.5
												12	145	4	.157	3763	148	8	.314	0.7
												15	150	4	.157	2713	107	8	.314	1
												20	155	5	.188	1694	67	10	.375	1.5
												22	160	5	.188	1411	56	10	.375	2
												25	165	5	.188	1032	41	10	.375	2.5
												35	170	6	.250	697	27	*	*	*
												40	180	6	.250	585	23	*	*	*
												50	185	6	.250	349	14	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 58**
PG2 30

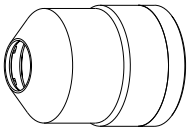


Stainless Steel

N_2 Plasma / O_2-N_2 Shield

200 Amps

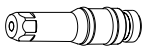
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)		
	N_2	O_2
Preflow	199.4 / 5646	54.5 / 1542
Cutflow	191 / 5406	47.7 / 1350



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
44	35	30	40	0		5	8	28	44	37	36	**3/16**	130	.125	3	135	3430	.250	6	0.4
												1/4	135	.125	3	120	3050	.250	6	0.5
												3/8	135	.125	3	100	2540	.250	6	1
												1/2	140	.157	4	75	1900	.314	8	2
												5/8	140	.157	4	60	1520	.314	8	2
												3/4	145	.188	5	45	1140	.375	10	2.5
												7/8	145	.250	6	35	890	.500	12	3.0
												1	150	.250	6	20	510	*	*	*
												1-1/4	160	.250	6	15	380	*	*	*

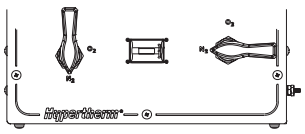
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
44	35	30	40	0		5	8	28	44	37	36	**5**	130	3	.125	3266	129	6	.250	0.4
												6	135	3	.125	3226	127	6	.250	0.5
												10	135	3	.125	2419	95	6	.250	1
												12	140	4	.157	2016	79	6	.314	2
												15	140	4	.157	1628	64	8	.314	2
												20	145	5	.188	1089	43	10	.375	2.5
												22	145	6	.250	898	35	12	.500	3.0
												25	150	6	.250	516	20	*	*	*
												30	160	6	.250	415	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thickness.

Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 36

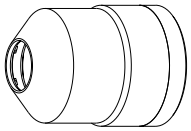


Aluminum

N_2 Plasma / N_2 Shield

400 Amps

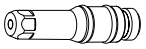
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)	
	N_2
Preflow	223.1 / 6318
Cutflow	226.5 / 6414



120786
Retaining Cap

120856
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
63	45	36	41	0		0	0	34	36	49	30	**1/4**	135	.125	3	220	5588	.250	6	0.3
												3/8	140	.125	3	195	4953	.250	6	0.5
												1/2	145	.157	4	150	3810	.314	8	0.7
												5/8	150	.157	4	105	2667	.314	8	1
												3/4	155	.188	5	80	2032	.375	10	1.5
												7/8	160	.188	5	65	1651	.375	10	2
												1	165	.188	5	50	1270	.375	10	2.5
												1-1/4	170	.250	6	40	1016	*	*	*
												1-1/2	180	.250	6	30	762	*	*	*
												2	185	.250	6	15	381	*	*	*

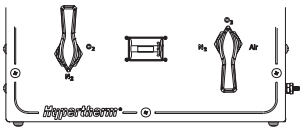
Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
63	45	36	41	0		0	0	34	36	49	30	**6**	135	3	.125	5914	233	6	.250	0.3
												10	140	3	.125	4718	186	6	.250	0.5
												12	145	4	.157	4032	159	8	.314	0.7
												15	150	4	.157	2968	117	8	.314	1
												20	155	5	.188	1935	76	10	.375	1.5
												22	160	5	.188	1668	66	10	.375	2
												25	165	5	.188	1290	51	10	.375	2.5
												30	170	6	.250	1085	43	*	*	*
												40	180	6	.250	709	28	*	*	*
												50	185	6	.250	405	16	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 58**
PG2 30

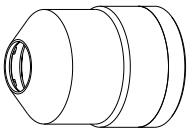


Aluminum

N_2 Plasma / O_2-N_2 Shield

200 Amps

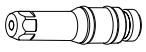
Flow Rates @ 120 psi (8.3 bar) (scfh / slh)		
	N_2	O_2
Preflow	199.4 / 5646	54.5 / 1542
Cutflow	191 / 5406	47.7 / 1350



120786
Retaining Cap

120794
Nozzle

120853
Swirl Ring



120855
Electrode

English

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**Inches**	Volts	in.	mm	ipm	mm/m	in.	mm	seconds
44	35	30	40	0		5	8	28	44	37	36	**3/16**	130	.125	3	180	4570	.250	6	0.5
												1/4	135	.125	3	160	4060	.250	6	1
												3/8	135	.125	3	120	4050	.250	6	1.5
												1/2	140	.125	3	80	2030	.250	6	2
												5/8	140	.157	4	70	1780	.314	8	2
												3/4	150	.250	6	50	1270	.500	12	2.5
												7/8	160	.250	6	35	890	.500	12	2.5
												1	165	.250	6	25	630	*	*	*
												1-1/4	175	.250	6	20	510	*	*	*

Metric

Test Preflow and Cutflow Adjust (psi)								Test Preflow Verify (psi)		Test Cutflow Verify (psi)		**Material Thickness**	Arc Voltage	Torch-to-Work Distance		Cutting Speed		Initial Pierce Height		Pierce Delay Time
Plasma		Shield		Plasma		Shield														
MV1	MV2	MV3	MV4	MV5		MV6	MV7	PG1	PG2	PG1	PG2	**mm**	Volts	mm	in.	mm/m	ipm	mm	in.	seconds
44	35	30	40	0		5	8	28	44	37	36	**5**	130	3	.125	4355	172	6	.250	0.5
												6	135	3	.125	4301	169	6	.250	1
												10	135	3	.125	2903	114	6	.250	1.5
												12	140	4	.157	2151	85	6	.250	2
												15	140	4	.157	1851	73	8	.314	2
												20	145	5	.188	1210	48	12	.500	2.5
												22	145	6	.250	898	35	12	.500	2.5
												25	150	6	.250	645	25	*	*	*
												30	160	6	.250	543	21	*	*	*

* Piercing not recommended

Minimum inlet pressures remain at one setting of 120 psi (8.3 bar) for all material thicknesses.

Approximate pressures while cutting in RUN mode: **PG1 49**
PG2 36