



# ***HyPerformance Plasma*** ***HPR400XD<sup>®</sup>***

***Auto gas***

***Instruction manual***

***806160 – Revision 3***

***Hypertherm<sup>®</sup>***

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Purchase date: \_\_\_\_\_

Distributor: \_\_\_\_\_

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Maintenance notes:

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***HyPerformance Plasma***  
***HPR400XD Auto Gas***

**Instruction Manual**

**(P/N 806160)**

**Revision 3 – November, 2011**

**Hypertherm, Inc.**  
**Hanover, NH USA**  
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# ELECTROMAGNETIC COMPATIBILITY (EMC)

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## Introduction

Hypertherm's CE-marked equipment is built in compliance with standard EN60974-10. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN60974-10 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 cutting 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 the work piece*. 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, signaling 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 as set forth in and in accordance with the manufacturer's written instructions. For example, 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 (nozzle for laser heads) at the same time.

The operator should be insulated from all such bonded metallic components.

### **Earthing of the 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 steel work, 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 provided in IEC 60974-9, Arc Welding Equipment, Part 9: 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.

## Attention

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage or injury caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty, and will constitute misuse of the Hypertherm Product.

You are solely 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 for the specific periods of time set forth herein and as follows: 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 brand 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, and with respect to torch lifter assemblies within a period of one (1) year from its date of delivery to you, and with respect to laser heads within a period of one (1) year from its date of delivery to you, and with respect to Automation products one (1) year from its date of delivery to you, with the exception of the EDGE Pro and MicroEDGE Pro CNCs and ArcGlide THC, which shall be within a period of two (2) years from the date of delivery to you.

This warranty shall not apply to any Powermax brand power supplies that have been used with phase converters. In addition, Hypertherm does not warranty systems that have been damaged as a result of poor power quality, whether from phase converters or incoming line power. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged.

Hypertherm provides repair, replacement or adjustment of the Product as the sole and exclusive remedy, if and only if the warranty set forth herein properly is invoked and applies. 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 pre paid by the customer. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph and with Hypertherm's prior written consent.

The warranty set forth 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 have the right to 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 in any event no longer than fourteen (14) days after learning of any action or threat of action), and Hypertherm's obligation to defend 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 direct, indirect, punitive or exemplary damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranty, failure of essential purpose, or otherwise, and even if advised of the possibility of such damages.**

### National and local codes

National and local codes governing plumbing and electrical installation shall take precedence 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.

### Liability cap

**In no event shall Hypertherm's liability, if any, 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 (whether in court, arbitration, regulatory proceeding or otherwise) 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.

### 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. Within thirty (30) days before any such transfer occurs, you agree to notify in writing Hypertherm, which reserves the right of approval. Should you fail timely to notify Hypertherm and seek its approval as set forth herein, the Warranty set forth herein shall be null and void and you will have no further recourse against Hypertherm under the Warranty or otherwise.

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## Section 1

### SAFETY

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### 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

Hypertherm uses American National Standards Institute guidelines for safety signal words and symbols. 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.
- DANGER safety messages precede related instructions in the manual that will result in serious injury or death if not followed correctly.
- 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 minor injury or damage to equipment if not followed correctly.

## ELECTRICAL HAZARDS

- Only trained and authorized personnel may open this equipment.
- If the equipment is permanently connected, turn it off, and lock out/tag out power before the enclosure is opened.
- If power is supplied to the equipment with a cord, unplug the unit before the enclosure is opened.
- Lockable disconnects or lockable plug covers must be provided by others.
- Wait 5 minutes after removal of power before entering the enclosure to allow stored energy to discharge.
- If the equipment must have power when the enclosure is open for servicing, arc flash explosion hazards may exist. Follow ALL local requirements (NFPA 70E in the USA) for safe work practices and for Personal Protective Equipment when servicing energized equipment.
- The enclosure shall be closed and the proper earth ground continuity to the enclosure verified prior to operating the equipment after moving, opening, or servicing.
- Always follow these instructions for disconnecting power before inspecting or changing torch consumable parts.



## 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 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

Explosion Hazard  
Underwater Cutting with Fuel Gases

- Do not cut aluminum underwater or with water touching the underside of the aluminum.
- Cutting aluminum underwater or with the water touching the underside of the aluminum can result in an explosive condition that can detonate during plasma cutting operations.



### WARNING

Hydrogen Detonation with  
Aluminum Cutting

- Do not cut under water with fuel gases containing hydrogen.
- Cutting under water with fuel gases containing hydrogen can result in an explosive condition that can detonate during plasma cutting operations.



## TOXIC FUMES CAN CAUSE INJURY OR DEATH

The plasma arc by itself is the heat source used for cutting. Accordingly, although the plasma arc has not been identified as a source of toxic fumes, the material being cut can be a source of toxic fumes or gases that deplete oxygen.

Fumes produced vary depending on the metal that is cut. Metals that may release toxic fumes include, but are not limited to, stainless steel, carbon steel, zinc (galvanized), and copper.

In some cases, the metal may be coated with a substance that could release toxic fumes. Toxic coatings include, but are not limited to, lead (in some paints), cadmium (in some paints and fillers), and beryllium.

Gases produced by plasma cutting vary based on the material to be cut and the method of cutting, but may include ozone, oxides of nitrogen, hexavalent chromium, hydrogen, and other substances if such are contained in or released by the material being cut.

Caution should be taken to minimize exposure to fumes produced by any industrial process. Depending upon the chemical composition and concentration of the fumes (as well as other factors, such as ventilation), there may be a risk of physical illness, such as birth defects or cancer.

It is the responsibility of the equipment and site owner to test the air quality in the area where the equipment is used and to ensure that the air quality in the workplace meets all local and national standards and regulations.

The air quality level in any relevant workplace depends on site-specific variables such as:

- Table design (wet, dry, underwater).
- Material composition, surface finish, and composition of coatings.
- Volume of material removed.

- Duration of cutting or gouging.
- Size, air volume, ventilation and filtration of the work area.
- Personal protective equipment.
- Number of welding and cutting systems in operation.
- Other site processes that may produce fumes.

If the workplace must conform to national or local regulations, only monitoring or testing done at the site can determine whether the site is above or below allowable levels.

To reduce the risk of exposure to fumes:

- Remove all coatings and solvents from the metal before cutting.
- Use local exhaust ventilation to remove fumes from the air.
- Do not inhale fumes. Wear an air-supplied respirator when cutting any metal coated with, containing, or suspected to contain toxic elements.
- Assure that those using welding or cutting equipment, as well as air-supplied respiration devices, are qualified and trained in the proper use of such equipment.
- Never cut containers with potentially toxic materials inside. Empty and properly clean the container first.
- Monitor or test the air quality at the site as needed.
- Consult with a local expert to implement a site plan to ensure safe air quality.



### 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 and 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.



### STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS

Use proper precautions when handling printed circuit boards:

- Store PC boards in anti-static containers.
- Wear a grounded wrist strap when handling PC boards.

### 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 and local codes.

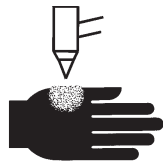


### GAS CYLINDERS CAN EXPLODE IF DAMAGED

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

- Handle and use compressed gas cylinders in accordance with applicable national and 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.





## 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 and local codes.
- Wear eye protection (safety glasses or goggles with side shields, and a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.

**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.

Arc current (amps)	Minimum protective shade number (ANSI Z49.1:2005)	Suggested shade number for comfort (ANSI Z49.1:2005)	OSHA 29CFR 1910.133(a)(5)	Europe EN168:2002
Less than 40 A	5	5	8	9
41 to 60 A	6	6	8	9
61 to 80 A	8	8	8	9
81 to 125 A	8	9	8	9
126 to 150 A	8	9	8	10
151 to 175 A	8	9	8	11
176 to 250 A	8	9	8	12
251 to 300 A	8	9	8	13
301 to 400 A	9	12	9	13
401 to 800 A	10	14	10	N/A



## **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.



## **NOISE CAN DAMAGE HEARING**

Cutting with a plasma arc can exceed acceptable noise levels as defined by local codes in many applications. Prolonged exposure to excessive noise can damage hearing. Always wear proper ear protection when cutting or gouging, unless sound pressure level measurements taken at the installed site have verified personal hearing protection is not necessary per relevant international, regional, and local codes.

Significant noise reduction can be obtained by adding simple engineering controls to cutting tables such as barriers or curtains positioned between the plasma arc and the workstation; and/or locating the workstation away from the plasma arc. Implement administrative controls in the workplace to restrict access, limit operator exposure time, screen off noisy working areas and/or take measures to reduce reverberation in working areas by putting up noise absorbers.

Use ear protectors if the noise is disruptive or if there is a risk of hearing damage after all other engineering and administrative controls have been implemented. If hearing protection is required, wear only approved personal protective devices such as ear muffs or ear plugs with a noise reduction rating appropriate for the situation. Warn others in the area of possible noise hazards. In addition, ear protection can prevent hot splatter from entering the ear.



## **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.

## DRY DUST COLLECTION INFORMATION

At some sites, dry dust can represent a potential explosion hazard.

The U.S. National Fire Protection Association's 2007 edition of NFPA standard 68, "Explosion Protection by Deflagration Venting," provides requirements for the design, location, installation, maintenance, and use of devices and systems to vent combustion gases and pressures after any deflagration event. Consult with the manufacturer or installer of any dry dust collection system for applicable requirements before you install a new dry dust collection system or make significant changes in the process or materials used with an existing dry dust collection system.

Consult your local "Authority Having Jurisdiction" (AHJ) to determine whether any edition of NFPA 68 has been "adopted by reference" in your local building codes.

Refer to NFPA68 for definitions and explanations of regulatory terms such as deflagration, AHJ, adopted by reference, the Kst value, deflagration index, and other terms.

Note 1 – Hypertherm's interpretation of these new requirements is that unless a site-specific evaluation has been completed to determine that all dust generated is not combustible, the 2007 edition of NFPA 68 requires the use of explosion vents designed to the worst-case Kst value (see annex F) that could be generated from dust so that the explosion vent size and type can be designed. NFPA 68 does not specifically identify plasma cutting or other thermal cutting processes as requiring deflagration venting systems, but it does apply these new requirements to all dry dust collection systems.

Note 2 – Users of Hypertherm manuals should consult and comply with all applicable federal, state, and local laws and regulations. Hypertherm does not, by the publication of any Hypertherm manual, intend to urge action that is not in compliance with all applicable regulations and standards, and this manual may never be construed as doing so.

## LASER RADIATION

**Exposure to the laser output can result in serious eye injury. Avoid direct eye exposure.**

For your convenience and safety, on Hypertherm products that use a laser, one of the following laser radiation labels has been applied on the product near where the laser beam exits the enclosure. The maximum output (mV), wavelength emitted (nM) and, if appropriate, the pulse duration is also provided.



Additional laser safety instructions:

- Consult with an expert on local laser regulations. Laser safety training may be required.
- Do not allow untrained persons to operate the laser. Lasers can be dangerous in the hands of untrained users.
- Do not look into the laser aperture or beam at any time.
- Position the laser as instructed to avoid unintentional eye contact.
- Do not use the laser on reflective workpieces.
- Do not use optical tools to view or reflect the laser beam.
- Do not disassemble or remove the laser or aperture cover.
- Modifying the laser or product in any way can increase the risk of laser radiation.
- Use of adjustments or performance of procedures other than those specified in this manual may result in hazardous laser radiation exposure.
- Do not operate in explosive atmospheres, such as in the presence of flammable liquids, gases, or dust.
- Use only laser parts and accessories that are recommended or provided by the manufacturer for your model.
- Repairs and servicing **MUST** be performed by qualified personnel.
- Do not remove or deface the laser safety label.

## SYMBOLS AND MARKS

Your Hypertherm product may have one or more of the following markings on or near the data plate. Due to differences and conflicts in national regulations, not all marks are applied to every version of a product.



### S mark symbol

The S mark symbol indicates that the power supply and torch are suitable for operations carried out in environments with increased hazard of electrical shock per IEC 60974-1.



### CSA mark

Hypertherm products with a CSA mark meet the United States and Canadian regulations for product safety. The products were evaluated, tested, and certified by CSA-International. Alternatively the product may have a mark by one of the other Nationally Recognized Testing Laboratories (NRTL) accredited in both the United States and Canada, such as Underwriters Laboratories, Incorporated (UL) or TÜV.



### CE marking

The CE marking signifies the manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of Hypertherm products with a CE marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European Electromagnetic Compatibility (EMC) Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the product with a CE marking.



### GOST-R mark

CE versions of Hypertherm products that include a GOST-R mark of conformity meet the product safety and EMC requirements for export to the Russian Federation.



### c-Tick mark

CE versions of Hypertherm products with a c-Tick mark comply with the EMC regulations required for sale in Australia and New Zealand.



### CCC mark


























The China Compulsory Certification (CCC) mark indicates that the product has been tested and found compliant with product safety regulations required for sale in China.

## ADDITIONAL SAFETY INFORMATION

- ANSI Standard Z49.1, *Safety in Welding and Cutting*, American Welding Society, 550 LeJeune Road  
P.O. Box 351020, Miami, FL 33135
- ANSI Standard Z49.2, *Fire Prevention in the Use of Cutting and Welding Processes*, American National Standards Institute  
1430 Broadway, New York, NY 10018
- ANSI Standard Z87.1, *Safe Practices for Occupation and Educational Eye and Face Protection*, American National Standards Institute, 1430 Broadway, New York, NY 10018
- 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
- AWS F5.2, *Recommended Safe Practices for Plasma Arc Cutting*, American Welding Society  
550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
- CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders*, Compressed Gas Association  
1235 Jefferson Davis Highway, Arlington, VA 22202
- CSA Standard W117.2, *Code for Safety in Welding and Cutting*, Canadian Standards Association Standard Sales  
178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada
- NFPA Standard 51B, *Cutting and Welding Processes*, National Fire Protection Association  
470 Atlantic Avenue, Boston, MA 02210
- NFPA Standard 70-1978, *National Electrical Code*, National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
- OSHA, *Safety and Health Standards*, 29FR 1910  
U.S. Government Printing Office, Washington, D.C. 20402
- AWS Safety and Health Fact Sheets, American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135  
[www.aws.org/technical/facts/](http://www.aws.org/technical/facts/)

**WARNING LABELS**

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.

 Read and follow these instructions, employer safety practices, and material safety data sheets. Refer to ANS Z49.1, "Safety in Welding, Cutting and Allied Processes" from American Welding Society ( <a href="http://www.aws.org">http://www.aws.org</a> ) and OSHA Safety and Health Standards, 29 CFR 1910 ( <a href="http://www.osha.gov">http://www.osha.gov</a> ).		 <b>WARNING</b>		 <b>AVERTISSEMENT</b>	
		Plasma cutting can be injurious to operator and persons in the work area. Consult manual before operating. Failure to follow all these safety instructions can result in death.		Le coupage plasma peut être préjudiciable pour l'opérateur et les personnes qui se trouvent sur les lieux de travail. Consulter le manuel avant de faire fonctionner. Le non respect des ces instructions de sécurité peut entraîner la mort.	
	  	<b>1. Cutting sparks can cause explosion or fire.</b> 1.1 Do not cut near flammables. 1.2 Have a fire extinguisher nearby and ready to use. 1.3 Do not use a drum or other closed container as a cutting table.	<b>1. Les étincelles de coupage peuvent provoquer une explosion ou un incendie.</b> 1.1 Ne pas couper près des matières inflammables. 1.2 Un extincteur doit être à proximité et prêt à être utilisé. 1.3 Ne pas utiliser un fût ou un autre contenant fermé comme table de coupage.		
	  	<b>2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.</b> 2.1 Turn off power before disassembling torch. 2.2 Do not grip the workpiece near the cutting path. 2.3 Wear complete body protection.	<b>2. L'arc plasma peut blesser et brûler; éloigner la buse de soi. Il s'allume instantanément quand on l'amorce;</b> 2.1 Couper l'alimentation avant de démonter la torche. 2.2 Ne pas saisir la pièce à couper de la trajectoire de coupage. 2.3 Se protéger entièrement le corps.		
	  	<b>3. Hazardous voltage. Risk of electric shock or burn.</b> 3.1 Wear insulating gloves. Replace gloves when wet or damaged. 3.2 Protect from shock by insulating yourself from work and ground. 3.3 Disconnect power before servicing. Do not touch live parts.	<b>3. Tension dangereuse. Risque de choc électrique ou de brûlure.</b> 3.1 Porter des gants isolants. Remplacer les gants quand ils sont humides ou endommagés. 3.2 Se protéger contre les chocs en s'isolant de la pièce et de la terre. 3.3 Couper l'alimentation avant l'entretien. Ne pas toucher les pièces sous tension.		
	  	<b>4. Plasma fumes can be hazardous.</b> 4.1 Do not inhale fumes. 4.2 Use forced ventilation or local exhaust to remove the fumes. 4.3 Do not operate in closed spaces. Remove fumes with ventilation.	<b>4. Les fumées plasma peuvent être dangereuses.</b> 4.1 Ne pas inhaler les fumées 4.2 Utiliser une ventilation forcée ou un extracteur local pour dissiper les fumées. 4.3 Ne pas couper dans des espaces clos. Chasser les fumées par ventilation.		
	  	<b>5. Arc rays can burn eyes and injure skin.</b> 5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.	<b>5. Les rayons d'arc peuvent brûler les yeux et blesser la peau.</b> 5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser un masque de soudeur avec un filtre de nuance appropriée.		
		<b>6. Become trained.</b> Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away. <b>7. Do not remove, destroy, or cover this label.</b> Replace if it is missing, damaged, or worn (PN 110584 Rev C).	<b>6. Suivre une formation.</b> Seul le personnel qualifié a le droit de faire fonctionner cet équipement. Utiliser exclusivement les torches indiquées dans le manuel. Le personnel non qualifié et les enfants doivent se tenir à l'écart. <b>7. Ne pas enlever, détruire ni couvrir cette étiquette.</b> La remplacer si elle est absente, endommagée ou usée (PN 110584 Rev C).		

## WARNING LABELS

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 Do not cut near flammables.
  - 1.2 Have a fire extinguisher nearby and ready to use.
  - 1.3 Do not use a drum or other closed container as a cutting table.
2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.
  - 2.1 Turn off power before disassembling torch.
  - 2.2 Do not grip the workpiece near the cutting path.
  - 2.3 Wear complete body protection.
3. Hazardous voltage. Risk of electric shock or burn.
  - 3.1 Wear insulating gloves. Replace gloves when wet or damaged.
  - 3.2 Protect from shock by insulating yourself from work and ground.
  - 3.3 Disconnect power before servicing. Do not touch live parts.
4. Plasma fumes can be hazardous.
  - 4.1 Do not inhale fumes.
  - 4.2 Use forced ventilation or local exhaust to remove the fumes.
  - 4.3 Do not operate in closed spaces. Remove fumes with ventilation.
5. Arc rays can burn eyes and injure skin.
  - 5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.
6. Become trained. Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away.
7. Do not remove, destroy, or cover this label. Replace if it is missing, damaged, or worn.





## Section 1a

# SÉCURITÉ

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### 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

le présent manuel et sur les étiquettes de sécurité se trouvant sur l'équipement.

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

### DANGER AVERTISSEMENT ATTENTION

Hypertherm adopte les lignes directrices de l'American National Standards Institute relativement aux termes et aux symboles de la signalisation de sécurité. Les signaux DANGER ou AVERTISSEMENT sont utilisés avec un symbole de sécurité. DANGER correspond aux risques les plus sérieux.

- Les étiquettes de sécurité DANGER et AVERTISSEMENT sont placées sur l'équipement pour situer certains dangers spécifiques.
- Les messages de sécurité DANGER précèdent les directives correspondantes dans le manuel qui, si elles ne sont pas suivies scrupuleusement, entraînent des blessures graves, voire mortelles.
- Les messages d'AVERTISSEMENT précèdent les instructions d'utilisation présentées dans ce manuel qui, si elles ne sont pas suivies scrupuleusement, peuvent entraîner des blessures graves, voire mortelles.
- Les messages de sécurité ATTENTION précèdent les directives associées dans le manuel qui, si elles ne sont pas suivies scrupuleusement, peuvent entraîner des blessures mineures ou endommager l'équipement.

### RISQUES ÉLECTRIQUES

- Seul le personnel formé et autorisé peut ouvrir cet équipement.
- Si l'équipement est branché en permanence, mettez-le hors tension, puis coupez l'alimentation avant d'ouvrir le boîtier.
- Si l'équipement est mis sous tension à l'aide d'un cordon, débranchez-le avant d'ouvrir le boîtier.
- Dans un cas autre, des raccords ou des capots d'obturateurs verrouillables doivent être fournis.
- Attendre ensuite 5 minutes après la coupure de l'alimentation électrique avant l'ouverture du capot pour que l'énergie stockée se décharge.
- Si l'équipement doit être sous tension lorsque le capot est ouvert pour l'entretien, le coup d'arc peut se produire. Respecter TOUTES les exigences locales (NFPA 70E aux États-Unis) relatives aux pratiques de travail sécuritaires et à l'équipement de protection individuelle lors de l'entretien de l'équipement électrique.
- Vérifier que le boîtier est bien fermé et que la mise à la terre est bien effectuée avant de faire fonctionner l'équipement après l'avoir déplacé, ouvert ou après avoir effectué un entretien.
- Toujours suivre ces instructions concernant le débranchement de la source de courant avant d'inspecter ou de remplacer des consommables de la torche.



## LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE FATALS

Le contact avec les pièces électriques sous tension peut entraîner une électrocution ou de brûlures graves, voire la mort.

- L'utilisation d'un système plasma complète un circuit électrique entre la torche et la pièce à couper. La pièce ainsi que tout autre élément la touchant 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 lorsque le système plasma fonctionne.

### Prévention des chocs électriques

**Tous les systèmes plasma Hypertherm fonctionnent à haute tension pour le coupage (souvent de 200 à 400 V c.c.). Prendre les précautions suivantes lors de l'utilisation du système :**

- 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 pendant l'utilisation du système plasma.
- S'isoler de la surface de travail et du sol en utilisant des tapis isolants ou des couvertures assez grandes pour éviter tout contact physique avec le matériel de travail ou le sol. S'il s'avère nécessaire de travailler dans ou près d'un endroit humide, procéder avec extrême prudence.
- Installer un sectionneur avec fusibles appropriés, à proximité de la source de courant. Ce sectionneur permet à l'opérateur d'éteindre 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 locaux et nationaux.
- Inspecter fréquemment le cordon de puissance d'entrée pour vérifier qu'il n'est pas endommagé ni fendu. Remplacer immédiatement un cordon d'alimentation endommagé. **Un câble dénudé peut causer la mort.**
- Inspecter et remplacer les câbles de la torche qui sont usés ou endommagés.
- Ne pas saisir la pièce à couper, ni les débris lors du coupage. Laisser la pièce à couper en place ou sur la table de travail et 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 source de courant.
- Ne jamais contourner ou court-circuiter les verrous de sécurité.
- Avant d'enlever le capot du système ou de la source de courant, couper la puissance d'entrée 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 PROVOQUER UN INCENDIE OU UNE EXPLOSION

### Prévention des incendies

- Avant de commencer, vérifier 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 de commencer le coupage.
- Lors de l'utilisation d'oxygène comme gaz plasma, un système de ventilation par extraction est nécessaire.

### Prévention des explosions

- Ne pas utiliser le système plasma en présence possible de poussière ou de vapeurs.
- Ne pas couper de bouteilles, de tuyaux ou autres récipients fermés et pressurisés.
- Ne pas couper de récipients qui ont servi à contenir 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

Risque d'explosion  
Sous l'eau lors du coupage  
avec gaz combustibles

- Ne pas couper l'aluminium sous l'eau ou lorsque celle-ci touche la partie inférieure de la pièce d'aluminium.
- Le coupage de l'aluminium sous l'eau, ou l'eau qui touche la partie inférieure de la pièce d'aluminium peut rassembler les conditions propices à une explosion causant une détonation lors du coupage plasma.



### AVERTISSEMENT

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

- Ne pas couper la pièce sous l'eau avec des gaz combustibles contenant de l'hydrogène.
- Cela peut entraîner une explosion suivie d'une détonation lors du coupage plasma.



## LES VAPEURS TOXIQUES PEUVENT PROVOQUER DES BLESSURES OU LA MORT

L'arc plasma constitue la source de chaleur utilisée pour le coupage. Par conséquent, bien que l'arc plasma n'ait pas été reconnu comme une source de vapeurs toxiques, le matériau coupé peut être une source de vapeurs ou de gaz toxiques qui épuisent l'oxygène.

Les vapeurs produites varient selon le métal coupé. Les métaux qui peuvent dégager des vapeurs toxiques comprennent, entre autres, l'acier inoxydable, l'acier au carbone, le zinc (galvanisé) et le cuivre.

Dans certains cas, le métal peut être revêtu d'une substance susceptible de dégager des vapeurs toxiques. Les revêtements toxiques comprennent entre autres, le plomb (dans certaines peintures), le cadmium (dans certaines peintures et enduits) et le béryllium.

Les gaz produits par le coupage plasma varient selon le matériau à couper et la méthode de coupage, mais ils peuvent comprendre l'ozone, les oxydes d'azote, le chrome hexavalent, l'hydrogène et autres substances présentes dans le matériau coupé ou en émanant.

Certaines précautions s'imposent pour réduire au minimum l'exposition aux vapeurs produites par tout processus industriel. Selon la composition chimique et la concentration des vapeurs (ainsi que d'autres facteurs comme la ventilation), celles-ci risquent de causer une maladie physique, comme des déficiences de naissance ou le cancer.

Il incombe au propriétaire du matériel et du site de vérifier la qualité de l'air dans le secteur où le matériel est utilisé et de s'assurer que la qualité de l'air sur les lieux de travail répond aux normes et réglementations locales et nationales.

Le niveau de qualité de l'air dans tout lieu de travail dépend des variables propres au site comme :

- Type de table (humide, sèche, sous l'eau).
- Composition du matériau, fini de la surface et composition des revêtements.
- Volume de matériau enlevé.
- Durée du coupage ou du gougeage.

- Dimensions, volume d'air, ventilation et filtration de la zone de travail.
- Équipement de protection individuelle.
- Nombre de systèmes de soudage et de coupage en fonctionnement.
- Autres procédés du site qui peuvent produire des vapeurs.

Si les lieux de travail doivent être conformes aux réglementations nationales ou locales, seuls les contrôles ou les essais effectués au site peuvent déterminer si celui-ci se situe au-dessus ou au-dessous des niveaux admissibles.

Pour réduire le risque d'exposition aux vapeurs :

- Éliminer tout revêtement et solvant du métal avant le coupage.
- Utiliser la ventilation par extraction locale pour éliminer les vapeurs de l'air.
- Ne pas inhaler les vapeurs. Porter un respirateur à adduction d'air lors du coupage des métaux revêtus d'éléments toxiques ou qui en contiennent ou sont susceptibles d'en contenir.
- S'assurer que les personnes qui utilisent un équipement de soudage ou de coupage ainsi que les dispositifs de respiration par adduction d'air sont qualifiées et formées pour utiliser adéquatement cet équipement.
- Ne jamais couper les contenants dans lesquels il peut y avoir des matériaux toxiques. En premier lieu, vider et nettoyer correctement le contenant.
- Contrôler ou éprouver la qualité de l'air du site au besoin.
- Consulter un expert local pour mettre en œuvre un plan du site afin d'assurer la qualité de l'air.



### 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 à 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.

#### Puissance d'entrée

- 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, vérifier 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.
- Vérifier que toutes les connexions sont bien serrées pour éviter une surchauffe.



### L'ÉLECTRICITÉ STATIQUE PEUT ENDOMMAGER LES CARTES DE CIRCUITS IMPRIMÉS

Les précautions qui s'imposent doivent être respectées lors de la manipulation des circuits imprimés :

- Les cartes de circuits imprimés doivent être rangées dans des contenants antistatiques.
- L'utilisateur doit porter un bracelet antistatique lors de la manipulation des cartes de circuits imprimés.

### SÉCURITÉ DES BOUTEILLES DE GAZ COMPRIMÉ

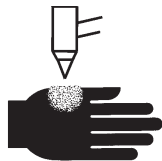
- Ne jamais lubrifier les robinets des bouteilles ou les régulateurs avec de l'huile ou de la graisse.
- Utiliser uniquement les bouteilles, régulateurs, tuyaux et accessoires appropriés et conçus pour chaque application spécifique.
- Entretien l'équipement et les pièces d'équipement à gaz comprimé afin 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. Consulter les 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.



## L'ARC PLASMA PEUT PROVOQUER DES BLESSURES OU DES BRÛLURES

### Torches à allumage instantané

L'arc plasma s'allume immédiatement après que la torche est activée.

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 et 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 (des lunettes ou masque muni d'écrans latéraux et un masque de soudure) avec des verres teintés appropriés pour protéger les yeux des rayons ultraviolets et infrarouges de l'arc.

**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 d'une 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.

Courant de l'arc (A)	Indice de protection minimum (ANSI Z49.1:2005)	Indice de protection suggéré pour assurer le confort (ANSI Z49.1:2005)	OSHA 29CFR 1910.133(a)(5)	Europe EN168:2002
Moins de 40 A	5	5	8	9
41 à 60 A	6	6	8	9
61 à 80 A	8	8	8	9
81 à 125 A	8	9	8	9
126 à 150 A	8	9	8	10
151 à 175 A	8	9	8	11
176 à 250 A	8	9	8	12
251 à 300 A	8	9	8	13
301 à 400 A	9	12	9	13
401 à 800 A	10	14	10	



### 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 d'arc 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 torche.
- Faire passer le faisceau de torche le plus près possible du câble de retour.
- Ne pas s'enrouler le faisceau de torche ou le câble de retour autour du corps.
- Se tenir le plus loin possible de la source de courant.



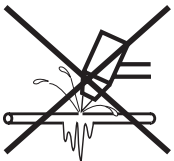
### LE BRUIT PEUT PROVOQUER DES PROBLÈMES AUDITIFS

Le coupage avec l'arc plasma peut dépasser les niveaux de bruits acceptables conformément aux codes locaux relatifs à de nombreuses applications. Une exposition prolongée à un bruit excessif peut provoquer des problèmes auditifs. Toujours porter un dispositif de protection antibruit adéquat lors du coupage ou du gougeage, sauf si les mesures de niveau de bruits prises sur le site d'installation certifient que les prothèses auditives ne sont pas nécessaires, telles que spécifiées par les codes internationaux, régionaux et locaux.

Les bruits peuvent être considérablement réduits en ajoutant de simples dispositifs de sécurité intégrés aux tables de coupe, telles que des barrières ou des rideaux placés entre l'arc plasma et le poste de travail; et/ou en éloignant le poste de travail de l'arc plasma. Mettre sur pied des mesures administratives sur le site de travail afin de limiter l'accès et la durée d'exposition

de l'opérateur, délimiter les zones bruyantes à l'aide d'une paroi et/ou instaurer des mesures préventives visant à réduire la réverbération sur le lieu de travail en installant des dispositifs antibruits.

Utiliser des protecteurs d'oreille si le bruit est toujours dérangeant ou si des problèmes auditifs peuvent survenir après l'installation des dispositifs de sécurité intégrés et l'instauration des mesures préventives. Si des protecteurs d'oreilles s'avèrent être nécessaires, porter uniquement des articles de protection personnelle approuvés, tels que des oreillères ou des bouchons d'oreille avec un coefficient de réduction de bruits approprié pour la situation sur le lieu de travail. Prévenir les personnes aux alentours des risques encourus en cas d'exposition au bruit. En outre, la protection des oreilles sert également de munition contre les projections chaudes.



### UN ARC PLASMA PEUT ENDOMMAGER LES TUYAUX GELÉS

Tenter de dégeler les tuyaux gelés avec une torche plasma peut les endommager ou les faire éclater.



## INFORMATION SUR LE DÉPOUSSIÈRAGE

À certains endroits, la poussière peut représenter un risque d'explosion potentiel.

La norme NFPA 68 de la National Fire Protection Association des É.-U. (édition 2007) « Explosion Protection by Deflagration Venting » établit les exigences relatives à la conception, à l'emplacement, à l'installation, à l'entretien et à l'utilisation de dispositifs et de systèmes pour évacuer à l'air libre les gaz de combustion et les pressions après une déflagration. Communiquer avec le fabricant ou avec l'installateur de tout système de dépoussiérage afin de connaître les exigences applicables avant d'installer un tel système neuf ou d'apporter des modifications importantes aux procédés ou aux matériaux utilisés par un système de dépoussiérage existant.

Consultez l'autorité compétente locale pour déterminer si une édition de la NFPA 68 a été adoptée en référence dans vos codes du bâtiment locaux.

Voir le document NFPA 68 pour obtenir des définitions et des explications des termes réglementaires tels que « déflagration, autorité compétente, adopté en référence, indice Kst, indice de déflagration » et autres termes.

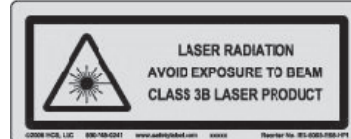
Note 1 – L'interprétation d'Hypertherm de ces nouvelles exigences est que, sauf évaluation particulière du site, pour déterminer que toute la poussière produite n'est pas combustible, l'édition 2007 de la NFPA 68 exige l'utilisation d'événements d'explosion conçus pour l'indice Kst dans le pire des cas (voir annexe F) qui pourrait provenir de la poussière de sorte que l'on puisse concevoir la dimension et le type d'événement d'explosion. La NFPA 68 ne stipule pas particulièrement le procédé de coupage plasma ou d'autres procédés de coupage thermique, mais elle prescrit ces nouveaux règlements à tous les systèmes de dépoussiérage.

Note 2 – Les utilisateurs des manuels d'Hypertherm doivent consulter tous les règlements et lois fédéraux et locaux applicables et s'y conformer. Hypertherm n'a pas l'intention, en publiant un manuel d'Hypertherm, de demander des mesures qui ne sont pas conformes aux règlements et normes applicables et ce manuel ne peut jamais être interprété dans ce sens.

## RADIATION AU LASER

**L'exposition à une sortie laser peut provoquer des problèmes visuels graves. Éviter un contact direct avec les yeux.**

Pour votre aisance et votre sécurité, l'une des étiquettes de radiation au laser suivantes a été installée sur les produits Hypertherm près de la sortie du faisceau laser du boîtier. Ont également été fournies la sortie maximale (mV), la longueur d'onde émise (nm) et au besoin, la durée d'impulsion.



Autres consignes de sécurité relatives au laser :

- Consulter un expert local pour les réglementations locales sur le laser. Une formation sur la sécurité relative au laser peut être nécessaire.
- Ne pas autoriser le personnel non formé à faire fonctionner le laser. Il peut s'avérer dangereux pour ce personnel.
- Ne jamais regarder l'intérieur ou le faisceau du laser.
- Positionner le laser selon les instructions afin d'éviter un éventuel contact avec les yeux.
- Ne pas utiliser le laser sur des pièces à couper réfléchives.
- Ne pas utiliser des outils optiques pour visualiser le faisceau du laser.
- Ne pas démonter ou retirer le laser ou son capot.
- Toute modification du laser ou du produit peut accroître le risque de radiation au laser.
- L'utilisation des réglages ou le suivi des procédures autres que celles spécifiées dans ce manuel peut entraîner un risque de radiation au laser.
- Ne pas faire fonctionner l'appareil en présence d'explosifs tels que des liquides et des gaz inflammables ou la poussière.
- Utiliser uniquement les pièces et accessoires laser recommandés ou fournis par le fabricant pour votre modèle.
- Les travaux de réparation et d'entretien **DOIVENT** être effectués par un personnel qualifié.
- Ne pas retirer ou détruire l'étiquette de sécurité du laser.

## SYMBOLES ET MARQUAGE

Votre produit Hypertherm peut comporter une ou plusieurs des marques suivantes sur sa plaque signalétique ou à proximité. En raison des différends et des conflits relatifs aux règlements nationaux, toutes les marques ne sont pas appliquées à chaque version d'un produit.



### Symbole de marque S

Le symbole de marque S indique que la source de courant et la torche conviennent pour les travaux effectués dans les milieux à risque accru de choc électrique selon l'IEC 60974-1.



### Marque CSA

Les produits Hypertherm portant la marque CSA sont conformes aux réglementations des États-Unis et du Canada pour la sécurité des produits. Les produits ont été évalués, testés et certifiés par CSA-International. Le produit peut autrement porter la marque d'autres laboratoires d'essais reconnus à l'échelle nationale (NRTL) agréés à la fois aux États-Unis et au Canada, par exemple : Underwriters Laboratories, Incorporated (UL) ou TÜV.



### Marque CE

Le marquage CE signifie : déclaration de conformité du fabricant aux directives et normes européennes applicables. Seules les versions des produits Hypertherm portant la marque CE située sur ou à proximité de la plaque signalétique ont été testées pour conformité à la directive européenne « basse tension » et la directive européenne « compatibilité électromagnétique » (CEM). Les filtres CEM devant être en conformité avec la directive européenne CEM sont intégrés dans les produits portant la marque CE.



### Marque GOST-R

Les versions CE des produits Hypertherm qui portent la marque de conformité GOST-R répondent aux exigences de sécurité du produit et de CEM en vue de l'exportation à la Fédération russe.



### Marque c-Tick

Les versions CE des produits Hypertherm portant la marque c-Tick sont conformes aux règlements CEM prescrits pour la vente en Australie et en Nouvelle-Zélande.






























### Marque CCC

La marque de certification obligatoire en Chine (CCC) indique que le produit a été mis à l'essai et déclaré conforme aux règlements de sécurité du produit prescrits pour la vente en Chine.

## ÉTIQUETTES DE SÉCURITÉ

Cette étiquette est affichée sur certaines sources de courant. Il est important que l'opérateur et le technicien d'entretien comprennent la signification des symboles de sécurité.

	<p>Read and follow these instructions, employer safety practices, and material safety data sheets. Refer to ANS Z49.1, "Safety in Welding, Cutting and Allied Processes" from American Welding Society (<a href="http://www.aws.org">http://www.aws.org</a>) and OSHA Safety and Health Standards, 29 CFR 1910 (<a href="http://www.osha.gov">http://www.osha.gov</a>).</p>	 <b>WARNING</b>	 <b>AVERTISSEMENT</b>
	  	<p><b>1. Cutting sparks can cause explosion or fire.</b>            1.1 Do not cut near flammables.            1.2 Have a fire extinguisher nearby and ready to use.            1.3 Do not use a drum or other closed container as a cutting table.</p>	<p><b>1. Les étincelles de coupage peuvent provoquer une explosion ou un incendie.</b>            1.1 Ne pas couper près des matières inflammables.            1.2 Un extincteur doit être à proximité et prêt à être utilisé.            1.3 Ne pas utiliser un fût ou un autre contenant fermé comme table de coupage.</p>
	  	<p><b>2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.</b>            2.1 Turn off power before disassembling torch.            2.2 Do not grip the workpiece near the cutting path.            2.3 Wear complete body protection.</p>	<p><b>2. L'arc plasma peut blesser et brûler; éloigner la buse de soi. Il s'allume instantanément quand on l'amorce;</b>            2.1 Couper l'alimentation avant de démonter la torche.            2.2 Ne pas saisir la pièce à couper de la trajectoire de coupage.            2.3 Se protéger entièrement le corps.</p>
	  	<p><b>3. Hazardous voltage. Risk of electric shock or burn.</b>            3.1 Wear insulating gloves. Replace gloves when wet or damaged.            3.2 Protect from shock by insulating yourself from work and ground.            3.3 Disconnect power before servicing. Do not touch live parts.</p>	<p><b>3. Tension dangereuse. Risque de choc électrique ou de brûlure.</b>            3.1 Porter des gants isolants. Remplacer les gants quand ils sont humides ou endommagés.            3.2 Se protéger contre les chocs en s'isolant de la pièce et de la terre.            3.3 Couper l'alimentation avant l'entretien. Ne pas toucher les pièces sous tension.</p>
	  	<p><b>4. Plasma fumes can be hazardous.</b>            4.1 Do not inhale fumes.            4.2 Use forced ventilation or local exhaust to remove the fumes.            4.3 Do not operate in closed spaces. Remove fumes with ventilation.</p>	<p><b>4. Les fumées plasma peuvent être dangereuses.</b>            4.1 Ne pas inhaler les fumées.            4.2 Utiliser une ventilation forcée ou un extracteur local pour dissiper les fumées.            4.3 Ne pas couper dans des espaces clos. Chasser les fumées par ventilation.</p>
	  	<p><b>5. Arc rays can burn eyes and injure skin.</b>            5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.</p>	<p><b>5. Les rayons d'arc peuvent brûler les yeux et blesser la peau.</b>            5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser un masque de soudeur avec un filtre de nuance appropriée.</p>
	  	<p><b>6. Become trained.</b> Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away.  <b>7. Do not remove, destroy, or cover this label.</b>            Replace if it is missing, damaged, or worn (PN 110584 Rev C).</p>	<p><b>6. Suivre une formation.</b> Seul le personnel qualifié a le droit de faire fonctionner cet équipement. Utiliser exclusivement les torches indiquées dans le manuel. Le personnel non qualifié et les enfants doivent se tenir à l'écart.  <b>7. Ne pas enlever, détruire ni couvrir cette étiquette.</b>            La remplacer si elle est absente, endommagée ou usée (PN 110584 Rev C).</p>

## ÉTIQUETTE DE SÉCURITÉ

Cette étiquette est affichée sur certaines sources de courant. Il est important que l'opérateur et le technicien d'entretien comprennent la signification des symboles de sécurité. Les numéros de la liste correspondent aux numéros des images.



1. Les étincelles de coupage peuvent provoquer une explosion ou un incendie.
  - 1.1 Ne pas couper près des matières inflammables.
  - 1.2 Un extincteur doit se trouver sur les lieux et être prêt à être utilisé.
  - 1.3 Ne pas utiliser un fût ou un autre contenant fermé comme table de coupe.
2. L'arc plasma peut blesser et brûler; ne jamais pointer la buse vers soi. L'arc s'amorce instantanément quand on appuie sur la gâchette.
  - 2.1 Couper l'alimentation avant de démonter la torche.
  - 2.2 Ne pas saisir la pièce à couper près de la trajectoire de coupage.
  - 2.3 Se protéger entièrement le corps.
3. Tension dangereuse. Risque de choc électrique ou de brûlure.
  - 3.1 Porter des gants isolants. Remplacer les gants s'ils sont humides ou endommagés.
  - 3.2 Se protéger contre les chocs en s'isolant de la pièce et de la terre.
  - 3.3 Couper l'alimentation avant de procéder à l'entretien. Ne pas toucher les pièces sous tension.
4. Les fumées du plasma peuvent être dangereuses.
  - 4.1 Ne pas inhaler les fumées.
  - 4.2 Utiliser une ventilation forcée ou par extraction locale pour éliminer les fumées.
  - 4.3 Ne pas utiliser dans des espaces clos. Éliminer les fumées avec la ventilation.
5. Les rayons d'arc peuvent brûler les yeux et blesser la peau.
  - 5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser le masque de soudage avec le filtre ayant le bon indice de protection.
6. Suivre une formation. Seul le personnel qualifié doit faire fonctionner cet équipement. Utiliser les torches prescrites dans le manuel. Tenir le personnel non qualifié et les enfants à l'écart.
7. Ne pas enlever, détruire ou couvrir cette étiquette. La remplacer si elle est manquante, endommagée ou usée.



## Sección 1b

### SEGURIDAD

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### RECONOCIMIENTO DE INFORMACIÓN DE SEGURIDAD

Los símbolos incluidos en esta sección se usan para identificar posibles peligros. Cuando vea un símbolo de seguridad en este manual o en la máquina, debe tomar conciencia del riesgo de lesiones personales y seguir las instrucciones relacionadas para evitar ese riesgo.



### CUMPLIMIENTO DE INSTRUCCIONES DE SEGURIDAD

Lea cuidadosamente todos los mensajes de seguridad de este manual y todas las etiquetas de seguridad de la máquina.

- Mantenga las etiquetas de seguridad de la máquina en buen estado. Reponga de inmediato las etiquetas dañadas o faltantes.
- Aprenda a operar la máquina y usar los controles de manera adecuada. No permita que nadie la opere sin las instrucciones correspondientes.
- Asegúrese de que la máquina esté en buenas condiciones operativas. Las modificaciones no autorizadas pueden afectar la seguridad y la vida útil de la máquina.

### PELIGRO ADVERTENCIA PRECAUCIÓN

Hypertherm utiliza las pautas del American National Standards Institute en relación con los símbolos y las palabras de aviso de seguridad. Junto a los símbolos de seguridad, aparecen palabras de aviso como PELIGRO o ADVERTENCIA. La palabra PELIGRO identifica a los riesgos más graves.

- Las etiquetas de seguridad de PELIGRO y ADVERTENCIA están colocadas cerca de los riesgos específicos que presenta la máquina.
- Los mensajes de seguridad de PELIGRO aparecen en este manual antes de las instrucciones relacionadas a procesos que pueden producir lesiones o la muerte si no se siguen correctamente.
- Los mensajes de seguridad de ADVERTENCIA aparecen en este manual antes de las instrucciones relacionadas a procesos que pueden producir lesiones o la muerte si no se siguen correctamente.
- Los mensajes de seguridad de PRECAUCIÓN aparecen en este manual antes de las instrucciones relacionadas a procesos que pueden producir lesiones menores o daños en los equipos si no se siguen correctamente.

### RIESGOS DE ELECTROCUCIÓN

- Sólo el personal capacitado y autorizado puede abrir este equipo.
- Si el equipo está conectado en forma permanente, apáguelo e implemente un cierre "con llave y etiqueta" de la energía antes de abrir el armazón.
- Si el suministro de energía se realiza a través de un cable, desenchufe la unidad antes de abrir el armazón.
- Otras personas deberán suministrar las cubiertas para enchufes bloqueables y los elementos de desconexión bloqueables.
- Espere 5 minutos luego de cortar la energía y antes de ingresar en el armazón, a fin de permitir que la energía almacenada se descargue.
- Si no se puede cortar el suministro de energía del equipo mientras se abre el armazón para realizar reparaciones, es posible que se produzcan peligros de explosión de arco eléctrico. Siga TODOS los requisitos locales (NFPA 70E en los EE. UU.) en relación con las prácticas de trabajo seguro y con el equipo de protección personal al realizar reparaciones en equipos energizados.
- El armazón debe permanecer cerrado y se debe verificar que la continuidad a tierra física al armazón sea la adecuada antes de operar el equipo y luego de moverlo, abrirlo o realizarle reparaciones.
- Siempre siga estas instrucciones para desconectar la energía antes de inspeccionar o cambiar las piezas consumibles de la antorcha.





## LAS DESCARGAS ELÉCTRICAS PUEDEN MATAR

El contacto con piezas eléctricas con corriente puede causar una descarga mortal o quemaduras graves.

- Cuando el sistema de plasma está en funcionamiento, se completa un circuito eléctrico entre la antorcha y la pieza a cortar. La pieza a cortar y cualquier objeto que la esté tocando pasan a formar parte de este circuito.
- Nunca toque el cuerpo de antorcha, la pieza a cortar ni el agua de la mesa de agua cuando el sistema de plasma esté en funcionamiento.

### Prevención de descargas eléctricas

**Todos los sistemas de plasma Hypertherm usan voltajes altos en el proceso de corte (suelen ser de 200 a 400 VCD). Tome las siguientes precauciones al operar el sistema:**

- Use botas y guantes aislados, y mantenga su cuerpo y su vestimenta secos.
- Asegúrese de que ninguna parte de su cuerpo esté en contacto con una superficie mojada mientras usa el sistema de plasma.
- Aíslese de la pieza de trabajo y la tierra con una alfombra o cubierta aislante de tamaño suficiente para prevenir cualquier contacto físico con la pieza de trabajo o la tierra. Tenga mucha precaución si el lugar de trabajo o los alrededores están húmedos.
- Instale un interruptor de desconexión con fusibles de tamaño apropiado cerca de la fuente de energía. Este interruptor permitirá al operador cortar la fuente de energía rápidamente ante una emergencia.
- Al usar una mesa de agua, asegúrese de que esté bien puesta a tierra.

- Instale y ponga a tierra el equipo respetando el manual de instrucciones y los códigos nacionales y locales.
- Inspeccione con frecuencia el cable de potencia de alimentación para detectar daños o rajaduras en la cubierta. Reemplace los cables dañados de inmediato. **Los cables pelados pueden ser mortales.**
- Inspeccione las mangueras de la antorcha y reemplace las que estén dañadas.
- No levante la pieza a cortar ni los residuos de corte durante la tarea. Deje la pieza a cortar en su lugar o en la mesa de trabajo con el cable de trabajo colocado durante el proceso de corte.
- Antes de controlar, limpiar o reemplazar piezas de la antorcha, desconecte la alimentación principal o desenchufe la fuente de energía.
- Nunca anule ni puentee los bloqueos de seguridad.
- Antes de quitarle la cubierta a una fuente de energía o recinto del sistema, desconecte la potencia de alimentación eléctrica. Espere 5 minutos antes de desconectar la alimentación principal, para permitir la descarga de los condensadores.
- Nunca opere el sistema de plasma sin las cubiertas de la fuente de energía en su lugar. Si las conexiones de la fuente de energía están expuestas, presentan un alto riesgo de electrocución.
- Al hacer las conexiones de entrada, una primero el conductor de puesta a tierra correspondiente.
- Cada sistema de plasma Hypertherm está diseñado para usarse únicamente con antorchas Hypertherm específicas. No utilice otras antorchas, ya que podrían sobrecalentarse y presentar un riesgo para la seguridad.



## LOS CORTES PUEDEN PRODUCIR INCENDIOS O EXPLOSIONES

### Prevención de incendios

- Compruebe la seguridad del lugar antes de realizar cortes. Tenga disponible un extintor de incendios cerca del lugar.
- Mantenga todas las sustancias inflamables a 10 m de distancia del área de corte.
- Temple o deje enfriar el metal caliente antes de manipularlo o que entre en contacto con materiales combustibles.
- Nunca corte envases que contengan materiales potencialmente inflamables; primero deben vaciarse y limpiarse bien.
- Ventile las atmósferas que puedan ser inflamables antes de realizar cortes.
- Al cortar con oxígeno como gas plasma, es obligatorio el uso de un sistema de ventilación de escape.

### Prevención de explosiones

- No use el sistema de plasma si puede haber polvo o vapores explosivos.
- No corte cilindros presurizados, tuberías ni envases cerrados.
- No corte envases que tenían materiales combustibles.



### ADVERTENCIA

Peligro de explosión  
Argón-hidrógeno y metano

El hidrógeno y el metano son gases inflamables que presentan un riesgo de explosión. Mantenga las llamas alejadas de los cilindros y las mangueras con metano o mezclas de hidrógeno. Evite que las llamas y las chispas se acerquen a la antorcha cuando use plasma de metano o argón-hidrógeno.



### ADVERTENCIA

Peligro de explosión  
Cortes bajo el agua con  
gases combustibles

- No corte aluminio bajo el agua o cuando el agua esté en contacto con la parte inferior del aluminio.
- Cortar aluminio bajo el agua o cuando el agua esté en contacto con la parte inferior del aluminio puede provocar una situación explosiva que podría detonarse durante las operaciones de corte por plasma.



### ADVERTENCIA

Explosión de hidrógeno  
al cortar aluminio

- No realice cortes bajo el agua con gases combustibles que contengan hidrógeno.
- Realizar cortes bajo el agua con gases combustibles que contienen hidrógeno puede provocar una situación explosiva que podría detonarse durante operaciones de corte por plasma.



## LOS VAPORES TÓXICOS PUEDEN PRODUCIR LESIONES O LA MUERTE

El arco de plasma es la fuente de calor usada para el corte. Por lo tanto, aunque el arco de plasma mismo no sea fuente de vapores tóxicos, el material que se corta puede producir estos vapores o gases que agotan el oxígeno.

Los vapores producidos varían según el metal que se corte. Algunos de los metales que pueden producir vapores tóxicos son, entre otros, el acero inoxidable, el acero al carbono, el zinc (galvanizado) y el cobre.

En algunos casos, el metal puede estar recubierto por una sustancia que podría producir vapores tóxicos. Los revestimientos tóxicos incluyen, entre otros, el plomo (de algunas pinturas), el cadmio (de algunas pinturas y tapaporos) y el berilio.

Los gases producidos por el corte por plasma varían según el material y el método de corte, pero pueden incluir ozono, óxidos de nitrógeno, cromo hexavalente, hidrógeno y otras sustancias contenidas o liberadas por el material de corte.

Se deben tomar precauciones para minimizar la exposición a los vapores producidos en cualquier proceso industrial. Según la composición química y la concentración de los vapores (junto con otros factores, como la ventilación), puede haber riesgo de contraer enfermedades físicas, como defectos congénitos o cáncer.

El propietario del equipo y las instalaciones debe analizar la calidad del aire del lugar donde se usa el equipo, para asegurarse de que cumpla con todas las normas y reglamentaciones locales y nacionales.

La calidad del aire de cualquier lugar de trabajo depende de variables específicas del lugar, como:

- Diseño de la mesa (con agua, en seco, bajo el agua).
- Composición del material, acabado de la superficie y composición de los revestimientos.
- Volumen de material descartado.
- Duración del corte o ranurado.

- Tamaño, volumen de aire, ventilación y filtración del área de trabajo.
- Equipos de protección personal.
- Cantidad de sistemas de soldadura y corte en funcionamiento.
- Otros procesos del lugar que pueden producir vapores.

Si el lugar de trabajo debe cumplir con reglamentaciones nacionales o locales, sólo los controles o pruebas realizados en el lugar pueden determinar si los niveles se encuentran dentro de lo permitido.

Para reducir el riesgo de exposición a vapores:

- Quite todos los revestimientos y solventes del metal antes de cortar.
- Use la ventilación de escape local para eliminar los vapores del aire.
- No inhale los vapores. Use un respirador con suministro de aire al cortar metales que contienen o pueden contener elementos tóxicos, o están recubiertos con estos elementos.
- Asegúrese de que las personas que usen equipos de soldadura o corte, y respiradores con suministro de aire estén calificadas y capacitadas en el uso adecuado de estos equipos.
- Nunca corte envases que contengan materiales potencialmente tóxicos. Vacíe y limpie bien el envase antes de cortarlo.
- Realice controles o pruebas de la calidad del aire del lugar, según sea necesario.
- Consulte a un experto local sobre la implementación de un plan para asegurarse de que la calidad del aire sea segura.



### SEGURIDAD DE TOMA A TIERRA

**Cable de trabajo** Sujete el cable de trabajo firmemente a la pieza a cortar o la mesa de trabajo, estableciendo un buen contacto metal con metal. No lo conecte a la pieza que se caerá cuando se termine el corte.

**Mesa de trabajo** Ponga a tierra la mesa de trabajo, en cumplimiento con los códigos eléctricos locales y nacionales.

#### Potencia de alimentación (entrada)

- Asegúrese de conectar el conductor de puesta a tierra del cable de alimentación con la puesta a tierra de la caja de desconexión.
- Si la instalación del sistema de plasma implica la conexión del cable de alimentación a la fuente de energía, asegúrese de conectar adecuadamente el conductor de puesta a tierra del cable de alimentación.
- Coloque el conductor de puesta a tierra del cable de alimentación en el borne antes que los demás; los otros conductores de puesta a tierra deben ir encima del conductor del cable de alimentación. Ajuste bien la tuerca de retención.
- Ajuste todas las conexiones eléctricas para evitar el calentamiento excesivo.



### LA ELECTRICIDAD ESTÁTICA PUEDE DAÑAR LAS PLACAS DE CIRCUITOS

Tome las precauciones necesarias para manipular placas de circuito impreso:

- Guarde las placas de PC en recipientes antiestáticos.
- Use una cinta de muñeca puesta a tierra para manipular las placas de PC.

### SEGURIDAD DE EQUIPOS DE GAS COMPRIMIDO

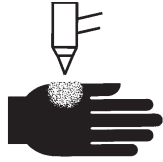
- Nunca lubrique los reguladores o las válvulas de cilindros con aceite o grasa.
- Use únicamente los cilindros de gas, los reguladores, las mangueras y los accesorios diseñados específicamente para esa aplicación.
- Mantenga todos los equipos de gas comprimido y las piezas relacionadas en buen estado.
- Etiquete e identifique con colores todas las mangueras de gas, para saber el tipo de gas que transporta cada manguera. Consulte los códigos nacionales y locales correspondientes.



### LOS CILINDROS DE GAS PUEDEN EXPLOTAR SI ESTÁN DAÑADOS

Los cilindros de gas tienen gas bajo alta presión. Si se dañan, pueden explotar.

- Los cilindros de gas comprimido deben manipularse y usarse respetando los códigos nacionales y locales.
- Use únicamente cilindros que estén en posición vertical y bien sujetos en su lugar.
- Mantenga la tapa protectora colocada en la válvula, a menos que el cilindro esté conectado o en uso.
- Nunca permita que haya contacto eléctrico entre el arco de plasma y un cilindro.
- Nunca exponga los cilindros al calor excesivo, las chispas, la escoria ni la llama directa.
- Nunca use un martillo, llave ni otra herramienta para abrir una válvula de cilindro atascada.



## EL ARCO DE PLASMA PUEDE PRODUCIR LESIONES Y QUEMADURAS

### Antorchas de encendido inmediato

El arco de plasma se enciende de inmediato al activar el interruptor de la antorcha.

El arco de plasma puede cortar los guantes y la piel rápidamente.

- Evite el contacto con la punta de la antorcha.
- No ponga piezas de metal cerca de la ruta de corte.
- Nunca apunte la antorcha en dirección a usted o a otras personas.



## LOS RAYOS DEL ARCO PUEDEN QUEMAR LOS OJOS Y LA PIEL

**Protección ocular** El arco de plasma produce rayos visibles e invisibles (ultravioletas e infrarrojos) que pueden quemar los ojos y la piel.

- Use la protección ocular que exigen los códigos nacionales y locales.
- Las lentes de la protección ocular (anteojos o gafas de seguridad con protección lateral, y careta de soldador) deben contar con el sombreado adecuado para proteger los ojos de los rayos ultravioletas e infrarrojos del arco.

**Protección cutánea** Use vestimenta de protección para evitar las quemaduras producidas por la luz ultravioleta, las chispas y el metal caliente.

- Guantes de seguridad, calzado de seguridad y casco.
- Vestimenta ignífuga para cubrir todas las áreas expuestas.
- Pantalones sin dobladillo, para evitar el ingreso de chispas y escoria.
- Antes del corte, sáquese de los bolsillos todo material combustible, como los encendedores con butano o los fósforos.

**Área de corte** Prepare el área de corte para reducir el reflejo y la emisión de luz ultravioleta:

- Pinte las paredes y otras superficies de colores oscuros, para reducir el reflejo.
- Use pantallas o barreras protectoras para resguardar a los demás del centelleo y el resplandor.
- Advierta a las demás personas que no deben mirar el arco. Coloque carteles o anuncios.

Corriente del arco (amperios)	Número mínimo de sombra de protección (ANSI Z49.1:2005)	Número de sombra sugerido para confort (ANSI Z49.1:2005)	OSHA 29CFR 1910.133(a)(5)	Europa EN168:2002
Inferior a 40 A	5	5	8	9
41 a 60 A	6	6	8	9
61 a 80 A	8	8	8	9
81 a 125 A	8	9	8	9
126 a 150 A	8	9	8	10
151 a 175 A	8	9	8	11
176 a 250 A	8	9	8	12
251 a 300 A	8	9	8	13
301 a 400 A	9	12	9	13
401 a 800 A	10	14	10	



### FUNCIONAMIENTO DE MARCAPASOS Y AUDÍFONOS

El funcionamiento de marcapasos y audífonos puede verse afectado por los campos magnéticos de las altas corrientes.

Las personas que usan marcapasos o audífonos deben consultar a un médico antes de acercarse a una operación de corte o ranurado por arco de plasma.

Para reducir el riesgo que presentan los campos magnéticos:

- Mantenga el cable de trabajo y los conductos de antorcha a un costado, alejados del cuerpo.

- Haga pasar las mangueras de la antorcha lo más cerca posible del cable de trabajo.
- No se enrosque ni apoye los conductos de antorcha ni el cable de trabajo en el cuerpo.
- Manténgase lo más alejado de la fuente de energía como sea posible.



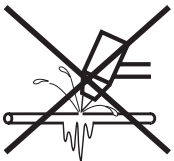
### LOS RUIDOS PUEDEN DAÑAR LA AUDICIÓN

Realizar cortes con un arco de plasma puede superar los niveles de ruido aceptables, según se definen en los códigos locales en muchas aplicaciones. La exposición prolongada a ruidos excesivos puede dañar la audición. Siempre use una protección apropiada para los oídos al realizar cortes o ranurados, a menos que se haya verificado que, en función de las mediciones de los niveles de presión de sonido tomadas en el sitio instalado, no sea necesario utilizar protección auditiva personal, de acuerdo con los códigos internacionales, regionales y locales correspondientes.

Se puede obtener una reducción significativa de los ruidos mediante la incorporación de controles de ingeniería simples a las mesas de corte, como barreras o cortinas ubicadas entre el arco de plasma y la estación de trabajo; además, se puede ubicar la estación de trabajo en un lugar alejado del arco de plasma. Se deben implementar controles

administrativos en el lugar de trabajo para restringir el acceso, limitar el tiempo de exposición del operador, cubrir áreas de trabajo ruidosas o tomar las medidas necesarias para reducir la reverberación en áreas de trabajo al colocar mecanismos de absorción de ruidos.

Se debe utilizar una protección auditiva si el ruido es perjudicial o si existe el riesgo de que se produzcan daños a la audición una vez implementados todos los demás controles administrativos y de ingeniería. Si es necesario utilizar una protección auditiva, utilice sólo los dispositivos de protección personal aprobados, como protectores para las orejas o tapones para los oídos con una calificación de reducción de ruidos adecuada para la situación. Advierta a las demás personas que trabajan en el área sobre los posibles riesgos que presentan los ruidos. Además, la protección para los oídos puede evitar que salpicaduras calientes ingresen en la oreja.



### EL ARCO DE PLASMA PUEDE DAÑAR LAS TUBERÍAS CONGELADAS

Las tuberías pueden dañarse o reventar si se intenta descongelarlas con una antorcha de plasma.

## INFORMACIÓN ACERCA DE LA RECOLECCIÓN DE POLVO SECO

En algunos sitios, el polvo seco puede presentar un posible riesgo de explosión.

La edición 2007 de la norma 68 NFPA de la U.S. National Fire Protection Association, "Explosion Protection by Deflagration Venting" (Protección contra explosiones mediante ventilación en caso de deflagración) proporciona los requisitos para el diseño, la ubicación, la instalación, el mantenimiento y el uso de dispositivos y sistemas para ventilar presiones y gases de combustión después de un evento de deflagración. Consulte al fabricante o instalador de sistemas de recolección de polvo seco acerca de los requisitos aplicables antes de instalar un nuevo sistema de recolección de polvo seco o de realizar cambios significativos en los materiales o procesos utilizados con un sistema de recolección de polvo seco existente.

Consulte la "Autoridad con jurisdicción" (AHJ, Authority Having Jurisdiction) para determinar si la edición de la norma 68 de la NFPA se ha "adoptado por referencia" en los códigos de construcción locales.

Consulte la norma NFPA68 para conocer las definiciones y explicaciones de los términos aprobados como deflagración, AHJ, adoptado por referencia, valor Kst, índice de deflagración y otros términos.

Nota 1 – La interpretación por parte de Hypertherm de estos nuevos requisitos implica que, a menos que se haya realizado una evaluación específica del lugar para determinar que el polvo generado no es combustible, la edición 2007 de NFPA 68 requiere el uso de ventilaciones de explosión diseñadas para el peor valor Kst (consulte el anexo F) que se podría generar a causa del polvo, de manera que se puedan diseñar el tipo y el tamaño de ventilación de explosión. La norma NFPA 68 no identifica específicamente que el corte por plasma ni otros procesos de corte térmico requieran sistemas de ventilación en caso de deflagración; sin embargo, sí aplica estos nuevos requisitos a todos los sistemas de recolección de polvo seco.

Nota 2 – Los usuarios de los manuales de Hypertherm deben consultar y cumplir todas las regulaciones y leyes federales, estatales y locales correspondientes. Mediante la publicación de sus manuales, Hypertherm no pretende instar la implementación de acciones que no cumplen los estándares y las regulaciones aplicables; asimismo, no se debe interpretar que este manual persigue dicho fin.



## RADIACIÓN LÁSER

**La exposición a la salida del láser puede provocar graves daños oculares. Evite la exposición ocular directa.**

Para su conveniencia y seguridad, en todos los productos Hypertherm que usan un láser, se ha aplicado una de las siguientes etiquetas de radiación láser en el producto, cerca de lugar donde el haz láser sale del bastidor. También se proporcionan los valores de salida máxima (mV), la longitud de onda emitida (nM) y, si corresponde, la duración de pulso.



Instrucciones de seguridad adicionales sobre la utilización de productos con láser:

- Consulte a un experto para conocer las regulaciones locales sobre la utilización de láser. Es posible que se exija una capacitación de seguridad para el uso de láser.
- No permita que el personal no capacitado opere el láser. El láser puede ser peligroso si es utilizado por personal no capacitado.
- No mire el haz o la apertura del láser en ningún momento.
- Ubique el láser como se indica, a fin de evitar contacto ocular no deseado.
- No utilice el láser en piezas a cortar reflectantes.
- No utilice herramientas ópticas para visualizar o reflejar el haz del láser.
- No desarme ni extraiga el láser ni la cubierta de apertura.
- Las modificaciones realizadas al láser o al producto pueden aumentar el riesgo de que se produzca radiación láser.
- El uso de ajustes o la implementación de procedimientos que no sean aquellos especificados en este manual pueden provocar una exposición peligrosa a la radiación láser.
- No opere el producto en atmósferas explosivas, como en presencia de polvo, gases o líquidos inflamables.
- Sólo utilice los accesorios y las piezas del láser que el fabricante suministra o recomienda para su modelo.
- Las reparaciones y el mantenimiento SE DEBEN llevar a cabo por personal calificado.
- No extraiga ni mutile la etiqueta de seguridad del láser.



## SÍMBOLOS Y MARCAS

Su producto Hypertherm puede contener alguna de las siguientes marcas en la placa de datos o cerca de ella. Debido a las diferencias y los conflictos con las regulaciones nacionales, no todas las marcas se aplican a todas las versiones de un producto.



### Marca símbolo S

La marca símbolo S indica que la fuente de energía y la antorcha son aptas para operaciones llevadas a cabo en entornos en los que existe un alto peligro de descargas eléctricas, de acuerdo con la norma IEC 60974-1.



### Marca CSA

Los productos de Hypertherm que tienen la marca CSA cumplen con los reglamentos de seguridad de los productos de los Estados Unidos y Canadá. Estos productos han sido evaluados, probados y certificados por CSA-International. De manera alternativa, es posible que el producto tenga una marca colocada por otro Laboratorio de pruebas reconocido a nivel nacional (NRTL, por sus siglas en inglés) autorizado en los Estados Unidos y en Canadá, por ejemplo, Underwriters Laboratories, Incorporated (UL) o TÜV.



### Marca CE

La marca CE indica la declaración de cumplimiento del fabricante con las normas y las directivas europeas aplicables. Sólo se considerarán probadas para cumplimiento con las Directivas europeas de baja tensión y con las Directivas europeas de compatibilidad electromagnética (EMC) aquellas versiones de los productos Hypertherm que tengan la marca CE colocada sobre la placa de datos o cerca de ésta. Aquellos filtros de EMC que deban cumplir con las Directivas europeas de EMC se han incorporado a las versiones de los productos con la marca CE.



### Marca GOST-R

Las versiones CE de los productos de Hypertherm que incluyen una marca de conformidad GOST-R cumplen los requisitos de compatibilidad electromagnética (EMC) y de seguridad del producto para exportación a la Federación Rusa.



### Marca c-Tick

Las versiones CE de los productos de Hypertherm que incluyen una marca c-Tick cumplen las regulaciones de EMC para la venta del producto en Australia y Nueva Zelanda.




























### Marca CCC

La marca China Compulsory Certification (CCC) indica que se ha evaluado el producto y que este cumple las regulaciones de seguridad del producto requeridas para su venta en China.

**ETIQUETAS DE ADVERTENCIA**

Esta etiqueta de advertencia se coloca en ciertas fuentes de energía. Es importante que el operador y el técnico de mantenimiento entiendan las ideas que transmiten estos símbolos de advertencia.

 Read and follow these instructions, employer safety practices, and material safety data sheets. Refer to ANS Z49.1, "Safety in Welding, Cutting and Allied Processes" from American Welding Society ( <a href="http://www.aws.org">http://www.aws.org</a> ) and OSHA Safety and Health Standards, 29 CFR 1910 ( <a href="http://www.osha.gov">http://www.osha.gov</a> ).		 <b>WARNING</b>	 <b>AVERTISSEMENT</b>
		Plasma cutting can be injurious to operator and persons in the work area. Consult manual before operating. Failure to follow all these safety instructions can result in death.	Le coupage plasma peut être préjudiciable pour l'opérateur et les personnes qui se trouvent sur les lieux de travail. Consulter le manuel avant de faire fonctionner. Le non respect des ces instructions de sécurité peut entraîner la mort.
	  	<b>1. Cutting sparks can cause explosion or fire.</b> 1.1 Do not cut near flammables. 1.2 Have a fire extinguisher nearby and ready to use. 1.3 Do not use a drum or other closed container as a cutting table.	<b>1. Les étincelles de coupage peuvent provoquer une explosion ou un incendie.</b> 1.1 Ne pas couper près des matières inflammables. 1.2 Un extincteur doit être à proximité et prêt à être utilisé. 1.3 Ne pas utiliser un fût ou un autre contenant fermé comme table de coupage.
	  	<b>2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.</b> 2.1 Turn off power before disassembling torch. 2.2 Do not grip the workpiece near the cutting path. 2.3 Wear complete body protection.	<b>2. L'arc plasma peut blesser et brûler; éloigner la buse de soi. Il s'allume instantanément quand on l'amorce;</b> 2.1 Couper l'alimentation avant de démonter la torche. 2.2 Ne pas saisir la pièce à couper de la trajectoire de coupage. 2.3 Se protéger entièrement le corps.
	  	<b>3. Hazardous voltage. Risk of electric shock or burn.</b> 3.1 Wear insulating gloves. Replace gloves when wet or damaged. 3.2 Protect from shock by insulating yourself from work and ground. 3.3 Disconnect power before servicing. Do not touch live parts.	<b>3. Tension dangereuse. Risque de choc électrique ou de brûlure.</b> 3.1 Porter des gants isolants. Remplacer les gants quand ils sont humides ou endommagés. 3.2 Se protéger contre les chocs en s'isolant de la pièce et de la terre. 3.3 Couper l'alimentation avant l'entretien. Ne pas toucher les pièces sous tension.
	  	<b>4. Plasma fumes can be hazardous.</b> 4.1 Do not inhale fumes. 4.2 Use forced ventilation or local exhaust to remove the fumes. 4.3 Do not operate in closed spaces. Remove fumes with ventilation.	<b>4. Les fumées plasma peuvent être dangereuses.</b> 4.1 Ne pas inhaler les fumées 4.2 Utiliser une ventilation forcée ou un extracteur local pour dissiper les fumées. 4.3 Ne pas couper dans des espaces clos. Chasser les fumées par ventilation.
	  	<b>5. Arc rays can burn eyes and injure skin.</b> 5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.	<b>5. Les rayons d'arc peuvent brûler les yeux et blesser la peau.</b> 5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser un masque de soudeur avec un filtre de nuance appropriée.
		<b>6. Become trained.</b> Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away. <b>7. Do not remove, destroy, or cover this label.</b> Replace if it is missing, damaged, or worn (PN 110584 Rev C).	<b>6. Suivre une formation.</b> Seul le personnel qualifié a le droit de faire fonctionner cet équipement. Utiliser exclusivement les torches indiquées dans le manuel. Le personnel non qualifié et les enfants doivent se tenir à l'écart. <b>7. Ne pas enlever, détruire ni couvrir cette étiquette.</b> La remplacer si elle est absente, endommagée ou usée (PN 110584 Rev C).

**ETIQUETAS DE ADVERTENCIA**

Esta etiqueta de advertencia se coloca en ciertas fuentes de energía. Es importante que el operador y el técnico de mantenimiento entiendan las ideas que transmiten estos símbolos de advertencia. Los textos numerados corresponden a los cuadros numerados de la etiqueta.



1. Las chispas de corte pueden producir explosiones o incendios.
  - 1.1 No corte cerca de sustancias inflamables.
  - 1.2 Tenga disponible un extintor de incendios cerca del lugar y listo para usar.
  - 1.3 No use tambores ni otros envases cerrados como mesa de corte.
2. El arco de plasma puede producir lesiones y quemaduras; mantenga la boquilla alejada del cuerpo. El arco arranca instantáneamente al apretar el gatillo.
  - 2.1 Corte la fuente de energía antes de desarmar la antorcha.
  - 2.2 No agarre la pieza a cortar cerca de la ruta de corte.
  - 2.3 Use protección corporal completa.
3. Voltaje peligroso. Riesgo de descargas o quemaduras eléctricas.
  - 3.1 Use guantes aislantes. Reemplácelos cuando estén húmedos o dañados.
  - 3.2 Protéjase de las descargas aislándose de la pieza de trabajo y la tierra.
  - 3.3 Desconecte la corriente antes de realizar reparaciones. No toque las piezas con corriente.
4. Los vapores de plasma pueden ser peligrosos.
  - 4.1 No inhale los vapores.
  - 4.2 Use ventilación forzada o la ventilación de escape local para eliminar los vapores.
  - 4.3 No opere el sistema en espacios cerrados. Elimine los vapores con ventilación.
5. Los rayos del arco pueden quemar los ojos y lesionar la piel.
  - 5.1 Use el equipo de protección correcto y adecuado para proteger la cabeza, los ojos, los oídos, las manos y el cuerpo. Abróchese el cuello de la camisa. Protéjase los oídos del ruido. Use una careta de soldador con el sombreado o filtro adecuado.
6. Capacítase. Sólo personal calificado debe operar este equipo. Use las antorchas especificadas en el manual. Mantenga al personal no calificado y a los niños alejados del área de trabajo.
7. No quite, destruya, ni cubra esta etiqueta. Reemplácela si falta o si está dañada o gastada.



## Section 2

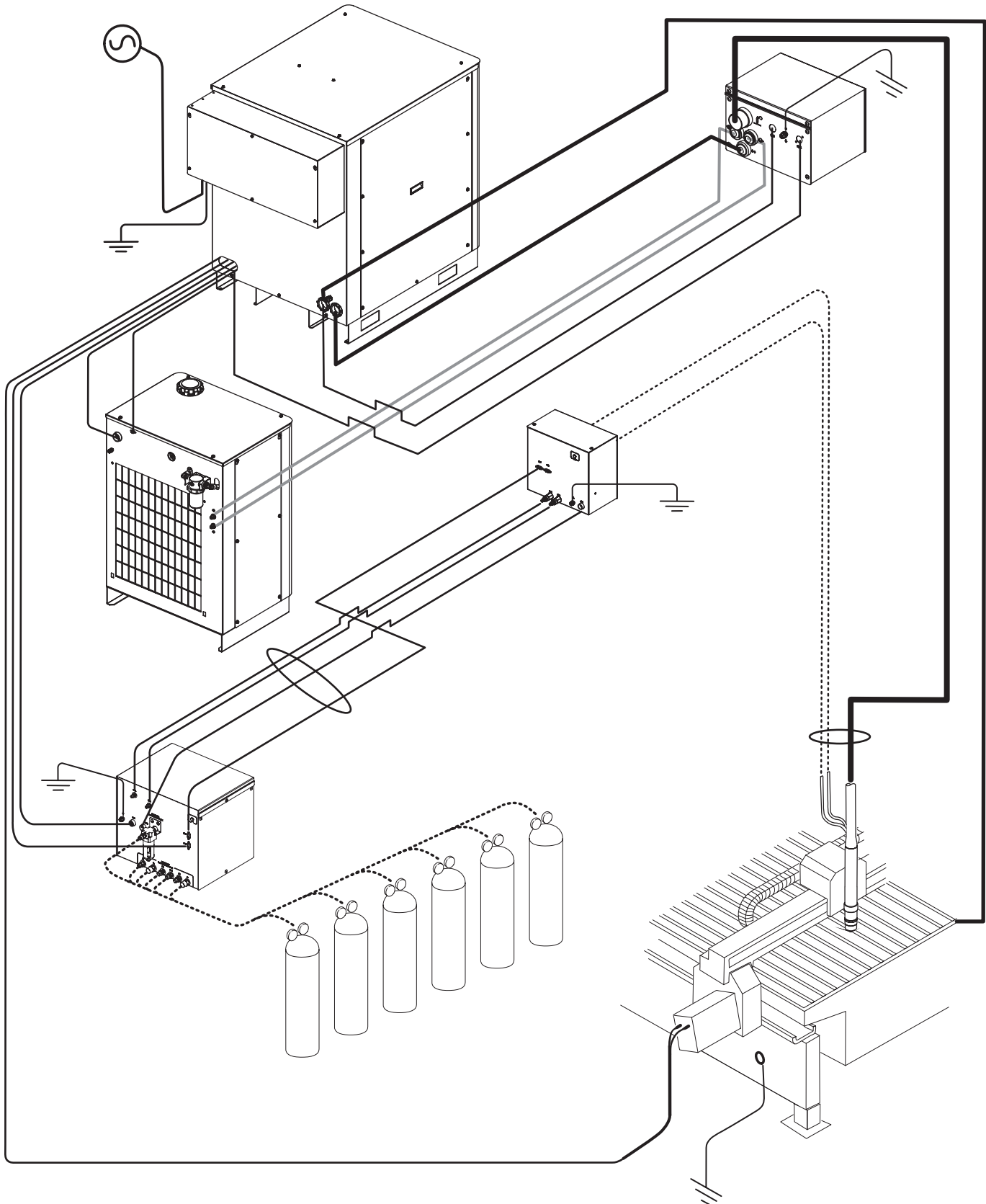
### SPECIFICATIONS

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# SPECIFICATIONS



## **System description**

### **General**

HyPerformance plasma systems are designed to cut a wide range of thicknesses of mild steel, stainless steel and aluminum.

### **Power supply**

The power supply is a 400-amp, 200-VDC constant-current supply. It contains the circuitry to ignite a torch. The power supply has a serial interface to provide communication with a CNC controller.

### **Cooler**

The cooler contains a heat exchanger and pump that reduces the temperature of the coolant that flows to the torch. It also contains flow and temperature sensors that ensure the cooling system is working properly.

### **Ignition console**

The ignition console uses a spark-gap assembly. The ignition console converts 120 VAC control voltage from the power supply into high-frequency and high-voltage pulses (9-10 kV) to break over the torch electrode-nozzle gap. The high-voltage, high-frequency signal is coupled to the cathode lead and pilot arc lead.

### **Selection console**

The selection console manages the selection and mixing of the plasma gases. It contains motor valves, solenoid valves and pressure transducers. It also contains a control board, an AC relay board and a power distribution board. The selection console has an LED lamp that illuminates when power is supplied to the system.

### **Metering console**

The metering console controls the flow rate of the gases to the torch in real time. It also controls the gas portion of the LongLife® process. The metering console contains proportional control valves, a PC control board and a power distribution board.

### **Torch**

The dross-free cutting capacity of the torch is 40 mm (1.5 in) for HyDefinition cutting. The production pierce capacity is 50 mm (2 in) for mild steel, 45 mm (1.75 in) for stainless steel, and 40 mm (1.5 in) for aluminum. The maximum cutting capability (edge start) is 80 mm (3 in) for mild steel, stainless steel, and aluminum.

# SPECIFICATIONS







## Specifications

### System gas requirements

Gas quality and pressure requirements			
Gas type	Quality	Pressure +/- 10%	Flow rate
O <sub>2</sub> oxygen	99.5% pure Clean, dry, oil-free	793 kPa / 8 bar 115 psi	4250 l/h 150 scfh
N <sub>2</sub> nitrogen	99.99% pure Clean, dry, oil-free	793 kPa / 8 bar 115 psi	11610 l/h 410 scfh
Air	* Clean, dry, oil-free per ISO 8573-1 Class 1.4.2	793 kPa / 8 bar 115 psi	11330 l/h 400 scfh
H35 argon-hydrogen	99.995% pure (H35 = 65% Argon, 35% Hydrogen)	793 kPa / 8 bar 115 psi	4250 l/h 150 scfh
F5 nitrogen-hydrogen	99.98% pure (F5 = 95% Nitrogen, 5% Hydrogen)	793 kPa / 8 bar 115 psi	4250 l/h 150 scfh
Ar argon	99.99% pure Clean, dry, oil-free	793 kPa / 8 bar 115 psi	4250 l/h 150 scfh

\* ISO standard 8573-1 Class 1.4.2 requirements are:

- Particulates – no more than 100 particles per cubic meter of air at a size of 0.1 to 0.5 microns in the largest dimension and 1 particle per cubic meter of air at a size of 0.5 to 5.0 microns in the largest dimension.
- Water – the pressure dewpoint of the humidity must be less than or equal to 3° C (37.4° F).
- Oil – the concentration of oil can be no more than 0.1 mg per cubic meter of air.

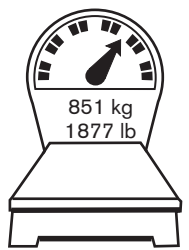
	Mild steel		Stainless steel		Aluminum	
						
Gas types	Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas
Cutting 30 to 50 A	O <sub>2</sub>	O <sub>2</sub>	N <sub>2</sub> & F5	N <sub>2</sub>	Air	Air
Cutting 80 A	O <sub>2</sub>	Air	F5	N <sub>2</sub>	–	–
Cutting 130 A	O <sub>2</sub>	Air	N <sub>2</sub> & H35	N <sub>2</sub>	H35 & Air	N <sub>2</sub> & Air
Cutting 200 A	O <sub>2</sub>	Air	N <sub>2</sub> & H35	N <sub>2</sub>	N <sub>2</sub> & H35	N <sub>2</sub>
Cutting 260 A	O <sub>2</sub>	Air	N <sub>2</sub> & H35	N <sub>2</sub>	N <sub>2</sub> & H35	N <sub>2</sub> & Air
Cutting 400 A	O <sub>2</sub>	Air	N <sub>2</sub> & H35	N <sub>2</sub> & Air	N <sub>2</sub> & H35	N <sub>2</sub> & Air



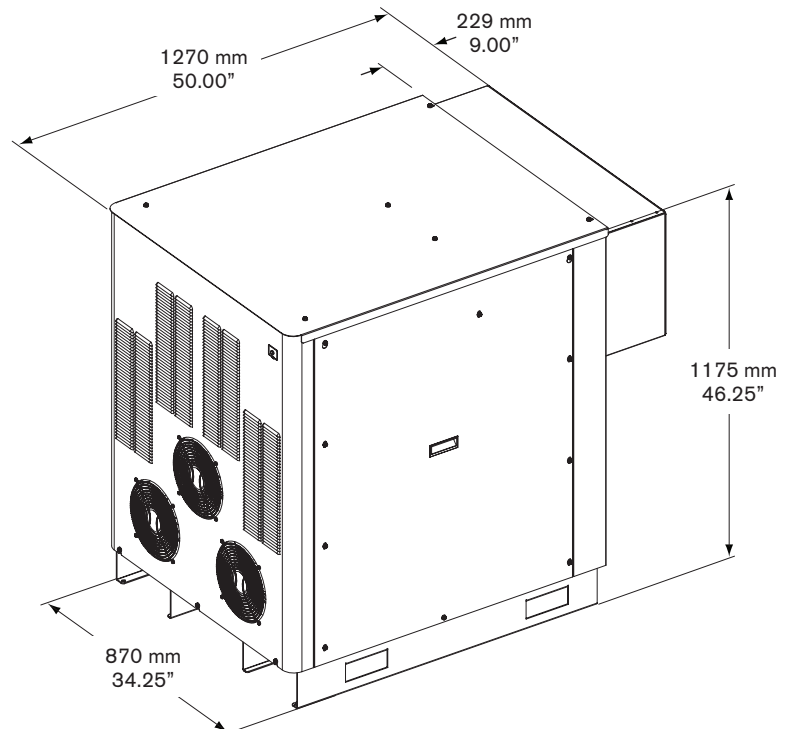
**Power supply**

<b>General</b>							
Maximum OCV ( $U_0$ )		360 VDC					
Maximum output current ( $I_2$ )		400 Amps					
Output voltage ( $U_2$ )		50 – 200 VDC					
Duty cycle rating (X)		100% @ 80 kw, 40° C (104° F)					
Ambient temperature/Duty cycle		Power supplies will operate between -10° C and +40° C (+14° and 104° F)					
Power factor (cosφ)		0.98 @ 400 ADC output					
Cooling		Forced air (Class F)					
Insulation		Class H					
Power supply part numbers		AC Voltage ( $U_1$ )	Phase	Frequency (Hz)	Amperage ( $I_1$ )	Regulatory approval	Power kVA (+/- 10%) ( $U_1 \times I_1 \times 1.73$ )
Without Hypernet	With Hypernet						
078523	078570	200/208	3	50/60	262/252	CSA	90.6
078524	078571	220	3	50/60	238	CSA	90.6
078525	078572	240	3	60	219	CSA	90.6
078526	078573	380*	3	50/60	138	CCC	90.6
078527	078574	400	3	50/60	131	CE/GOST-R	90.6
078528	078575	440	3	50/60	120	CSA	90.6
078529	078576	480	3	60	110	CSA	90.6
078530	078577	600	3	60	88	CSA	90.6

\* The 380 volt CCC regulatory approval only applies to 50 Hz operation



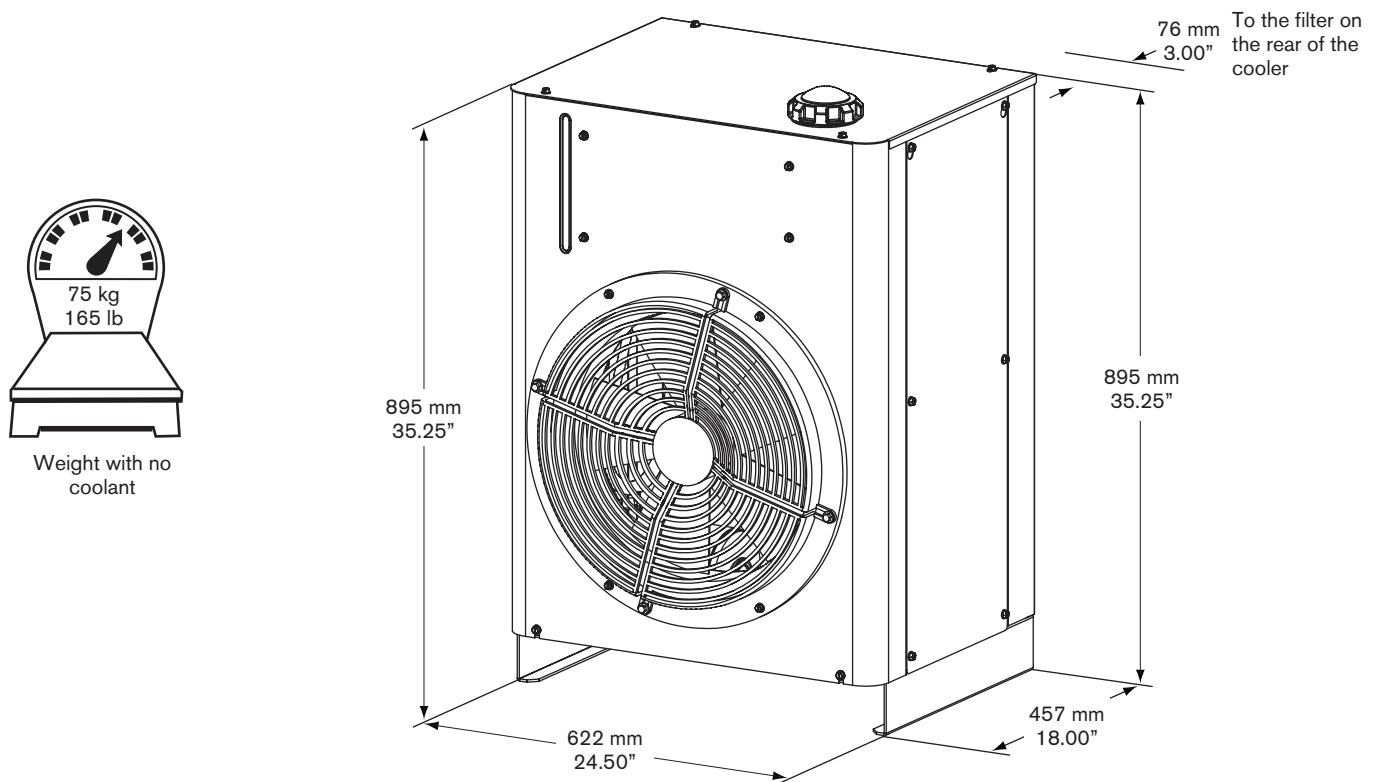
Approximate weight of the heaviest unit



## SPECIFICATIONS

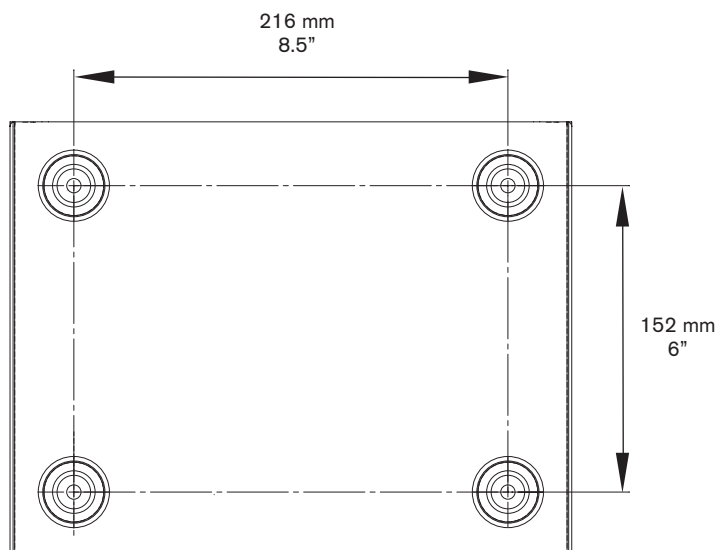
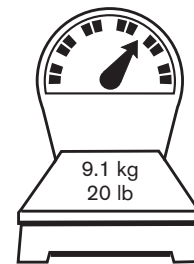
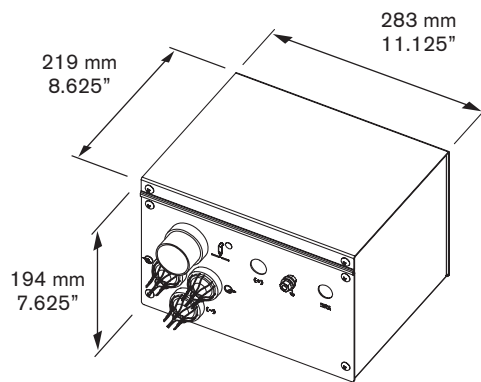
### Cooler – 078531

- The cooling system can contain up to 34.5 liters (9 gallons) of coolant.
- Maximum cable length from the cooler to the power supply is 4.57 meters (15 ft).
- Maximum hose length from the cooler to the ignition console is 76.2 meters (250 ft).
- Allow 1 m (3 ft) of space on all sides of the cooler for ventilation and service.



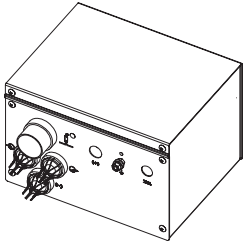
**Ignition console – 078172**

- The ignition console can be mounted remotely on the cutting table's bridge. See *Installation* section for details.
- Maximum cable length from the ignition console to the torch lifter station is 15 m (50 ft). Allow room to remove the top for servicing.
- The ignition console may be mounted horizontally or vertically.

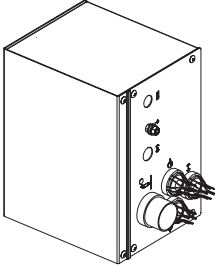


**SPECIFICATIONS**

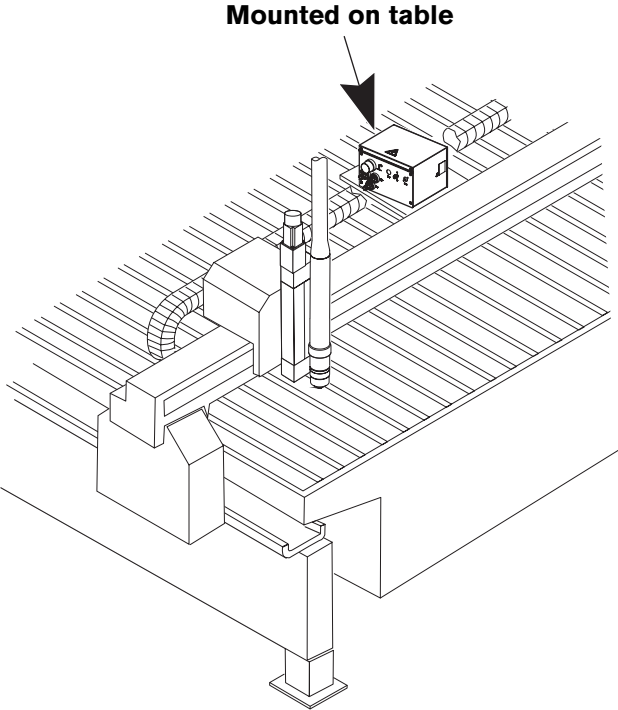
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**Horizontal mounting**



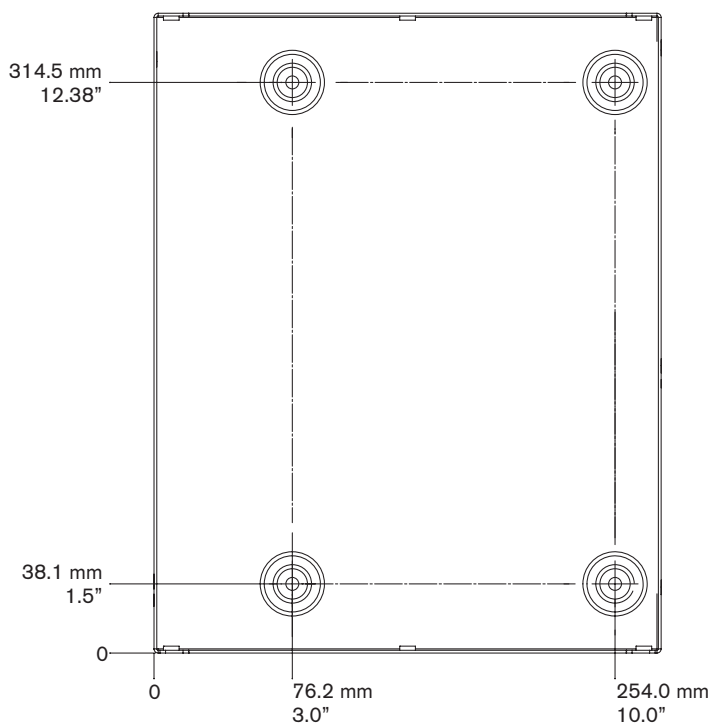
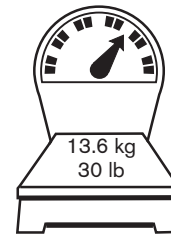
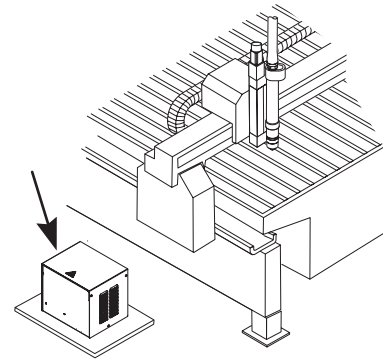
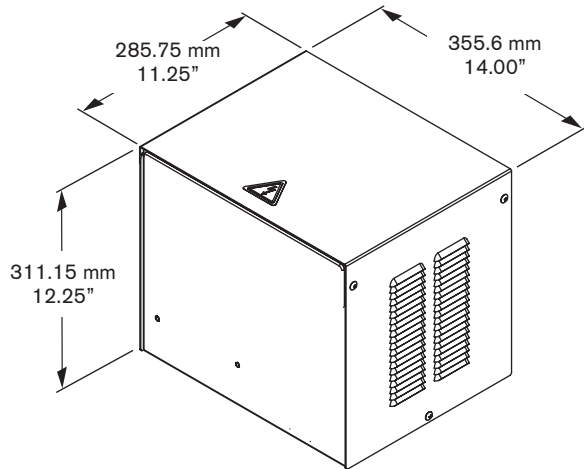
**Vertical mounting**



**Mounted on table**

**Selection console – 078533**

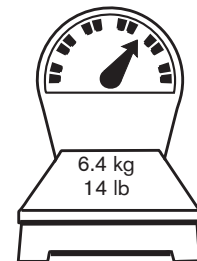
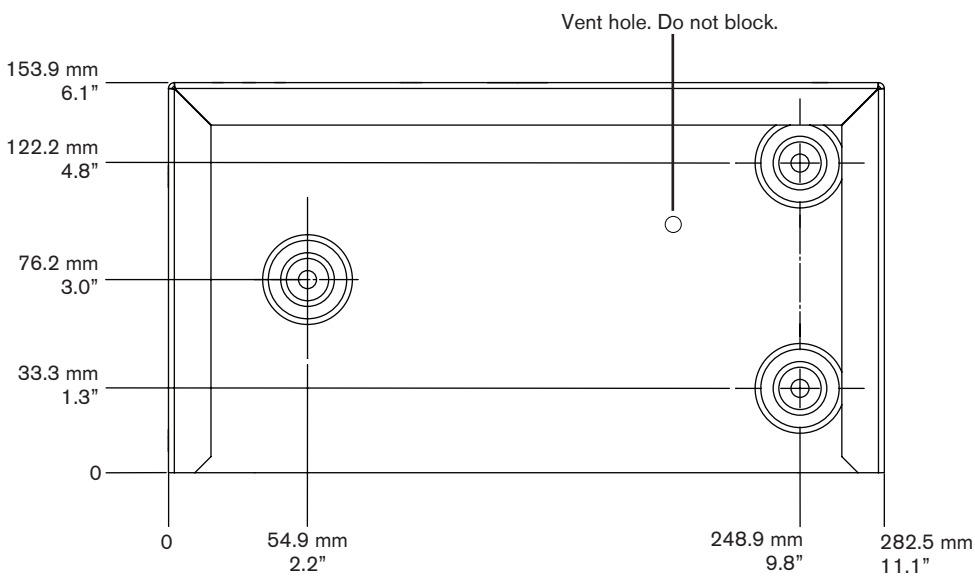
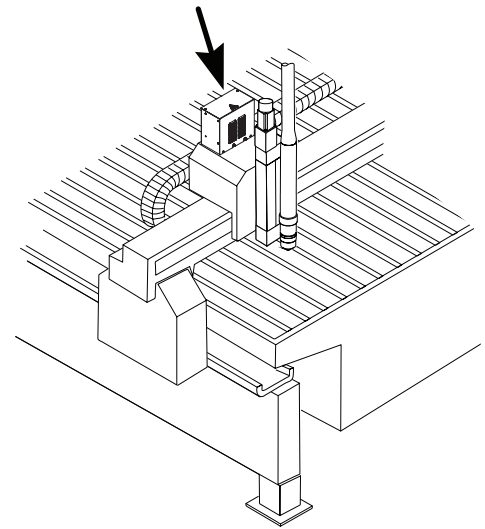
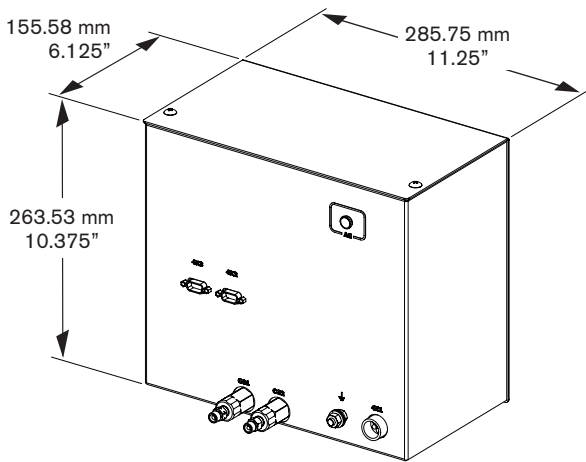
- Maximum cable length from the power supply to the selection console is 75 m (250 ft).
- Maximum cable length from the selection console to the metering console is 20 m (65 ft).
- Mount the selection console on top of the power supply or near the CNC on the cutting table. Allow room to open the top for servicing.



## SPECIFICATIONS

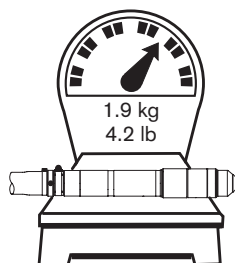
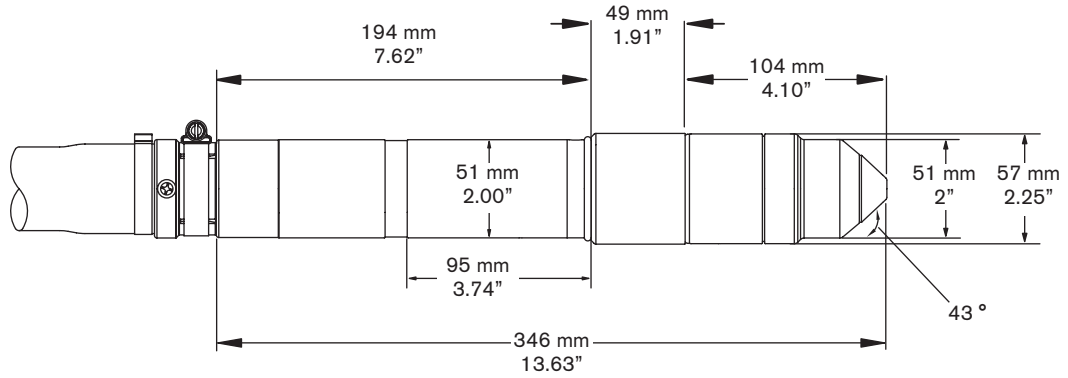
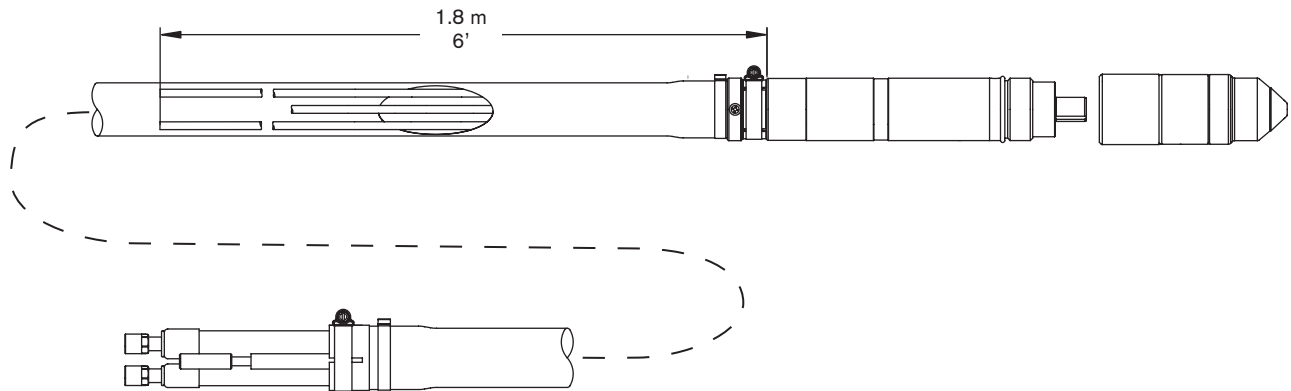
### Metering console – 078535

- Maximum cable length from the metering console to the torch lifter station is 1.8 m (6 ft).
- Mount the metering console to the torch carriage on larger tables. On smaller tables it can be mounted to a bracket just above the bridge.
- The vent hole on the console must be kept clear at all times.



**Torch – 228354**






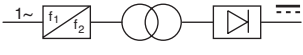

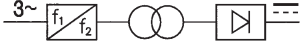










- The outside diameter of the torch mounting sleeve is 50.8 mm (2.0 in).
- The minimum bend radius for the torch leads is 152.4 mm (6.0 in).



# SPECIFICATIONS

## IEC symbols

The following symbols may appear on the power supply data plate, control labels, switches, LEDs, and LCD screen.

	Direct current (DC)		Power is ON
	Alternating current (AC)		Power is OFF
	Plasma torch cutting		An inverter-based power source, either 1-phase or 3-phase
	Plate metal cutting		
	Expanded metal cutting		Volt/amp curve, "drooping" characteristic
	Gouging		Power is ON (LED)
	AC input power connection		System fault (LED)
	The terminal for the external protective (earth) conductor		Inlet gas pressure fault (LCD)
			Missing or loose consumables (LCD)
			Power supply is out of temperature range (LCD)



## Section 3

# INSTALLATION

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## Upon receipt

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

## Claims

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

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

## Installation requirements

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

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

## Noise levels

Acceptable noise levels as defined by national and local codes may be exceeded by this plasma system. Always wear proper ear protection when cutting or gouging. Any noise measurements taken are dependant on the specific environment in which the system is used. See also *Noise can damage hearing* in the *Safety* section of this manual. Specific information by product can be found in the Hypertherm downloads library at:

<https://www.hypertherm.com/Xnet/library/DocumentLibrary.jsp>

Select the product you are looking for from the Product Type drop down menu, choose “Regulatory” from the Category drop down menu, and choose “Acoustical Noise Data Sheets” from the Sub Category drop down menu. Hit Submit.

## Placement of system components

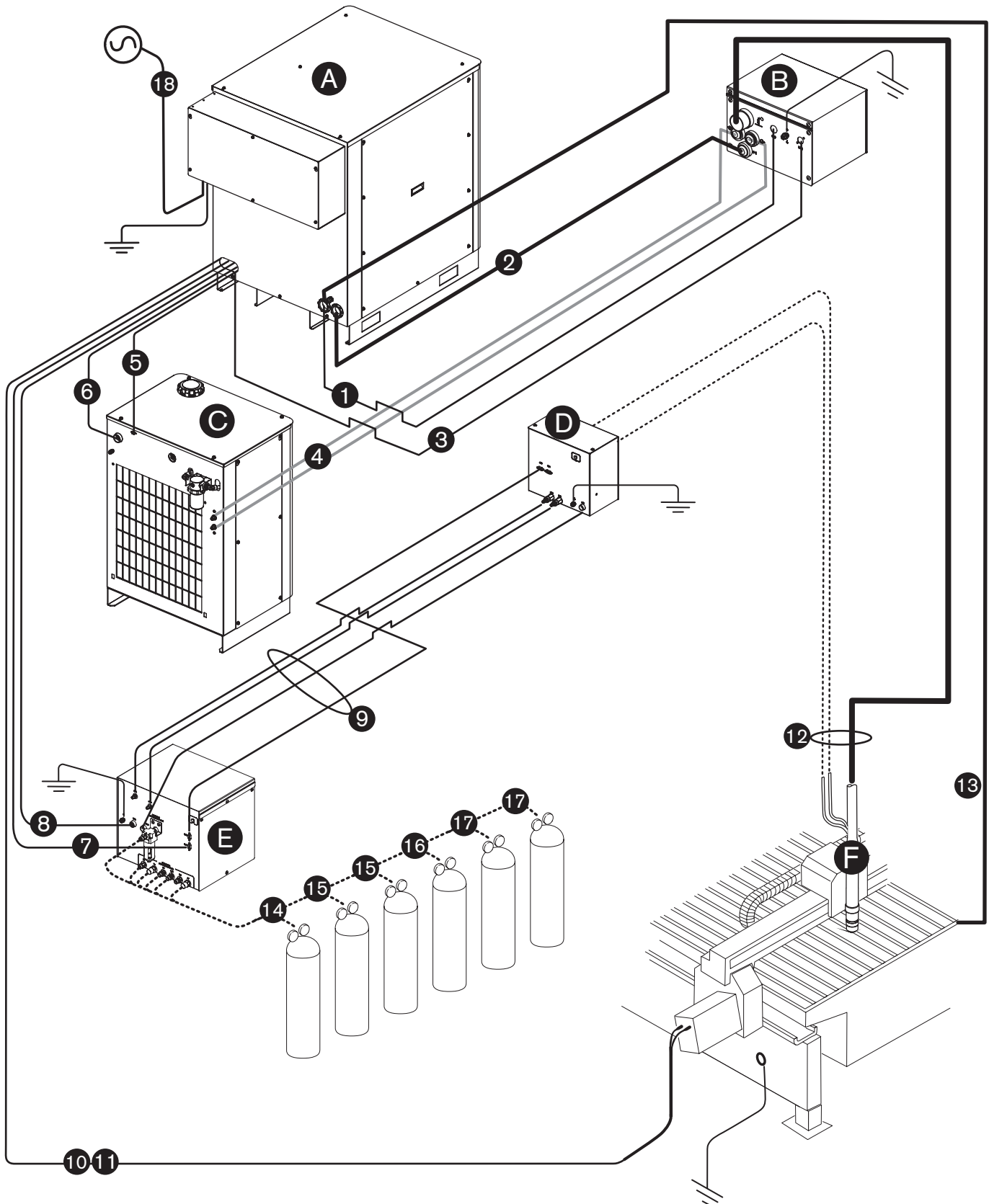
- Place all system components in position prior to making electrical, gas, and interface connections. Use the diagram in this section for component-placement guidelines.
- Ground all system components to earth. See *Recommended grounding and shielding practices* in this section for details.
- To prevent leaks in the system, tighten all gas and water connections as shown below:



<b>Torque specifications</b>			
<b>Gas or water hose size</b>	<b>kgf-cm</b>	<b>lbf-in</b>	<b>lbf-ft</b>
Up to 10 mm (3/8 in)	8.6-9.8	75-85	6.25-7
12 mm (1/2 in)	41.5-55	360-480	30-40

# INSTALLATION

## Installation requirements



**System components**

- A** Power supply
- B** Ignition console
- C** Cooler
- D** Metering console
- E** Selection console
- F** Torch

**Cables and hoses**

- 1** Pilot arc lead
- 2** Negative lead
- 3** Ignition console power cable
- 4** Coolant hoses
- 5** Cooler control cable
- 6** Cooler power cable
- 7** Selection console control cable
- 8** Selection console power cable
- 9** Selection console to metering console hose and lead assembly
- 10** CNC interface cable
- 11** Optional CNC interface cable for systems with multiple power supplies
- 12** Torch lead assembly
- 13** Work lead



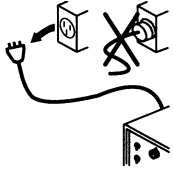
**Supply gas hoses**

- 14** Oxygen
- 15** Nitrogen or argon
- 16** Air
- 17** Argon-hydrogen (H35) or nitrogen-hydrogen (F5)

**Customer-supplied power cable**

- 18** Main power cable

### Recommended grounding and shielding practices

		<b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b>
	<b>Disconnect electrical power before performing any maintenance. All work requiring the removal of the power supply cover must be performed by a qualified technician.</b> <b>See Section 1 of the plasma system instruction manual for more safety precautions.</b>	

### Introduction

This document describes the grounding and shielding necessary to protect a plasma cutting system installation against radio frequency interference (RFI) and electromagnetic interference (EMI) noise. It addresses the three grounding systems described below. There is a diagram on page 3-4 for reference.

Note: These procedures and practices are not known to succeed in every case to eliminate RFI/EMI noise issues. The practices listed here have been used on many installations with excellent results, and we recommend that these practices be a routine part of the installation process. The actual methods used to implement these practices may vary from system to system, but should remain as consistent as possible across the product line.

### Types of grounding

- A. The safety (PE) or service ground. This is the grounding system that applies to the incoming line voltage. It prevents a shock hazard to any personnel from any of the equipment, or the work table. It includes the service ground coming into the plasma power supply and other systems such as the CNC controller and the motor drivers, as well as the supplemental ground rod connected to the work table. In the plasma circuits, the ground is carried from the plasma power supply chassis to the chassis of each separate console through the interconnecting cables.
- B. The DC power or cutting current ground. This is the grounding system that completes the path of the cutting current from the torch back to the power supply. It requires that the positive lead from the power supply be firmly connected to the work table ground bus with a properly sized cable. It also requires that the slats, on which the workpiece rests, make good contact with the table and the workpiece.
- C. RFI and EMI grounding and shielding. This is the grounding system that limits the amount of electrical “noise” emitted by the plasma and motor drive systems. It also limits the amount of noise that is received by the CNC and other control and measurement circuits. This grounding/shielding process is the main target of this document.

## Steps to take

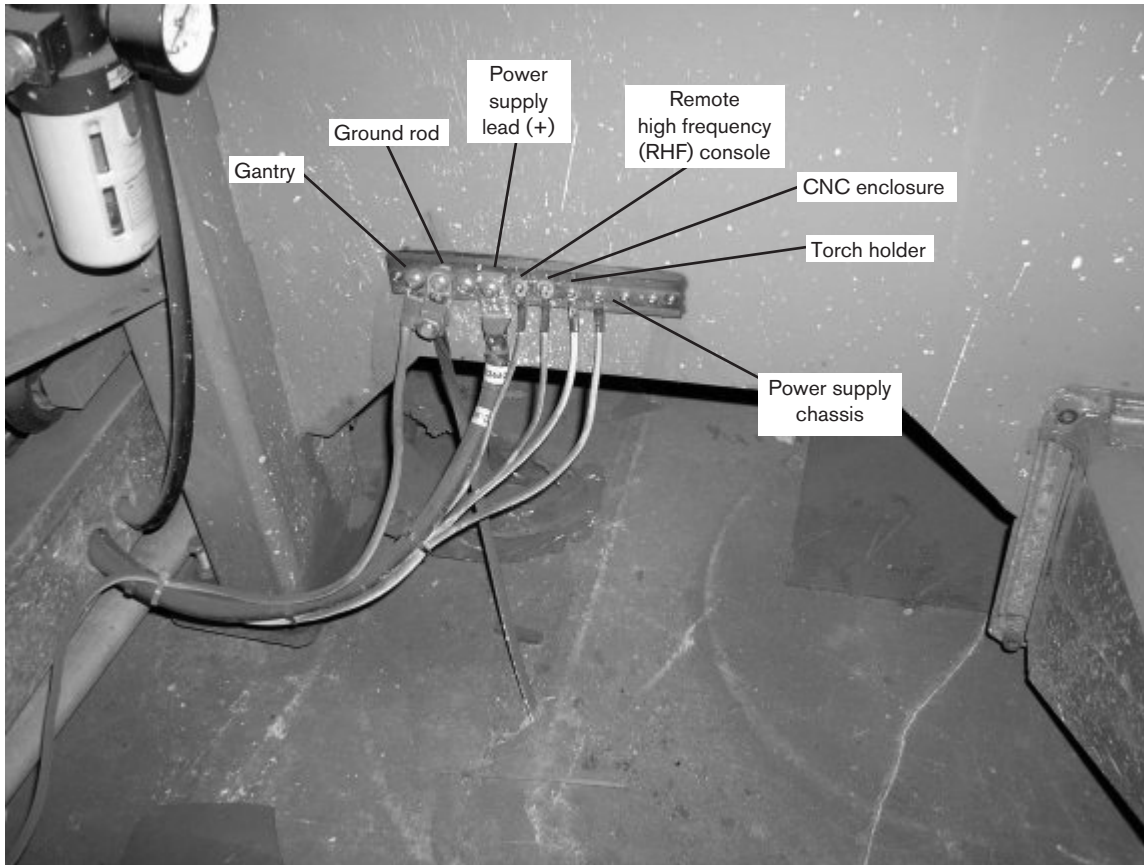
1. Unless noted, use only 6 AWG (16 mm<sup>2</sup>) welding cable (Hypertherm part no. 047040) for the EMI ground cables shown on the diagram.
2. The cutting table is used for the common, or star, EMI ground point and should have threaded studs welded to the table with a copper bus bar mounted on them. A separate bus bar should be mounted on the gantry as close to each drive motor as possible. If there are drive motors at each end of the gantry, run a separate EMI ground cable from the far drive motor to the gantry bus bar. The gantry bus bar should have a separate, heavy EMI ground cable (4 AWG (21,2 mm<sup>2</sup>) part no. 047031) to the table bus bar. The EMI ground cables for the torch lifter and the RHF console must each run separately to the table ground bus.
3. A ground rod that meets all applicable local and national electrical codes must be installed within 6 m (20 ft) of the table. This is a PE ground and should be connected to the ground bus on the cutting table with 6 AWG (16 mm<sup>2</sup>) green/yellow grounding cable (Hypertherm part number 047121) or equivalent. All PE grounds are shown on the diagram in green.
4. For the most effective shielding, use the Hypertherm CNC interface cables for I/O signals, serial communication signals, power supply-to-power supply multi-drop connections, and interconnections between all parts of the Hypertherm system.
5. All hardware used in the ground system must be brass or copper. The only exception is that the studs welded to the table for mounting the ground bus can be steel. Under no circumstances should aluminum or steel hardware be used.
6. AC power, PE, and service grounds must be connected to all equipment according to local and national codes.
7. \* The positive, negative, and pilot arc leads should be bundled together for as long a distance as possible. The torch lead, work lead, and the pilot arc (nozzle) leads may only be run parallel to other wires or cables if they are separated by at least 150 mm (6 in). If possible, run power and signal cables in separate cable tracks.
8. \* The ignition console should be mounted as close as possible to the torch, and must have a separate ground cable to the bus bar on the cutting table.
9. Each Hypertherm component, as well as any other CNC or motor-drive cabinet or enclosure, must have a separate ground cable to the common (star) point on the table. This includes the ignition console, even if it is bolted to the power supply or to the cutting machine.
10. The metal braided shield on the torch leads must be connected firmly to the ignition console and to the torch. It must be electrically insulated from any metal and from any contact with the floor or building. The leads can be run in a plastic cable tray (track) or covered with a plastic or leather sheath.
11. The torch holder and the torch breakaway mechanism – the part mounted to the lifter, not the part mounted on the torch – must be connected to the stationary part of the lifter with copper braid at least 12.7 mm (1/2 in) wide. A separate cable must run from the lifter to the bus bar on the gantry. The valve assembly should also have a separate ground connection to the gantry bus bar.

\* Applies to systems that use a remote high frequency (RHF) console

## INSTALLATION

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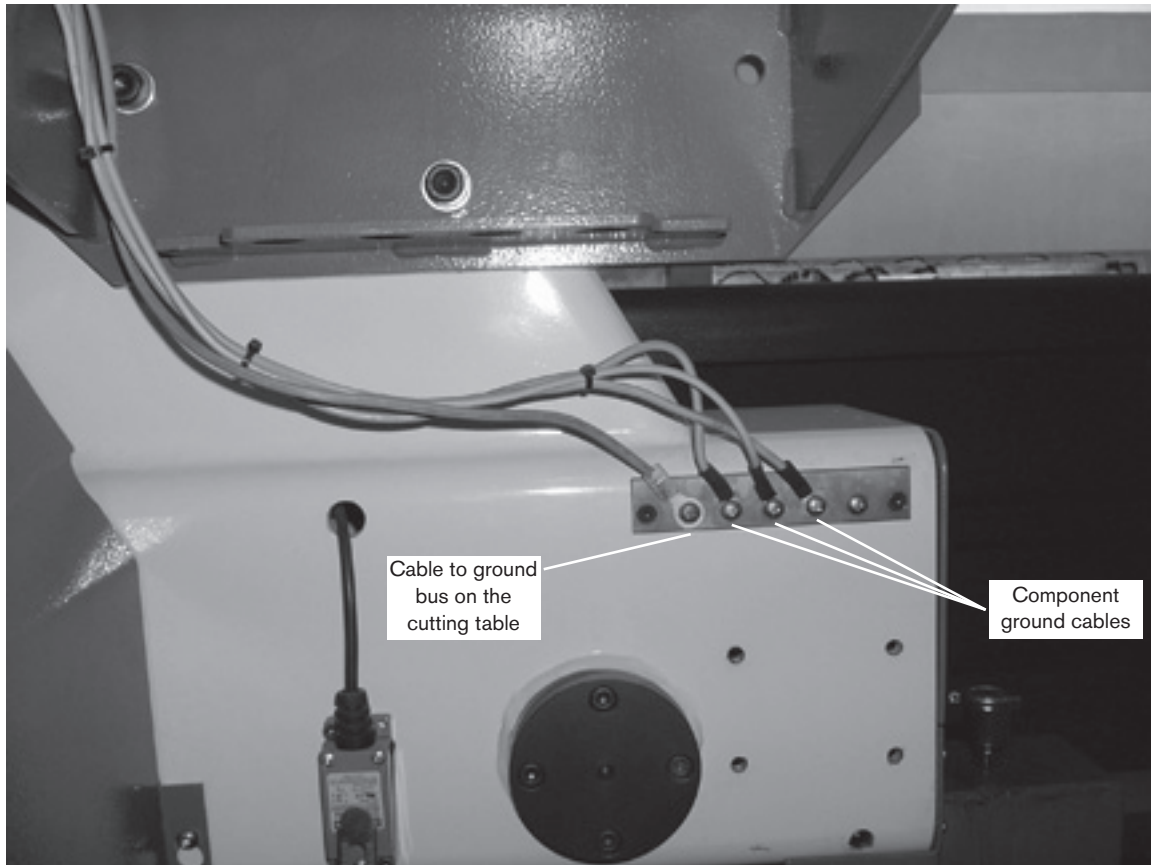
12. If the gantry runs on rails that are not welded to the table, then the rails need to be connected with a ground cable from each end of both rails to the table. These need not go to the common (star) point, but could take the shortest path to the table.
13. If the OEM is installing a voltage divider to process arc voltage for use in the control system, the voltage divider board should be mounted as close as possible to the point where the arc voltage is sampled. One acceptable location is inside the plasma power supply. If the Hypertherm voltage divider board is used, the output signal is isolated from all other circuits. The processed signal should be run in twisted, shielded cable (Belden type 1800F or equivalent). The cable used must have a braided shield, not a foil shield. The shield should be connected to the chassis of the power supply and left unconnected at the other end.
14. All other signals (analog, digital, serial, encoder) should run in twisted pairs inside a shielded cable. Connectors on these cables should have a metal housing and the shield, not the drain, should be connected to the metal housing of the connectors at each end of the cable. Never run the shield or the drain through the connector on any of the pins.



Example of a good cutting table ground bus. The picture above shows the connection from the gantry ground bus, the connection from the ground rod, the power supply positive lead, the RHF console\*, the CNC enclosure, the torch holder, and the power supply chassis.

\* Applies to systems that use a remote high frequency (RHF) console

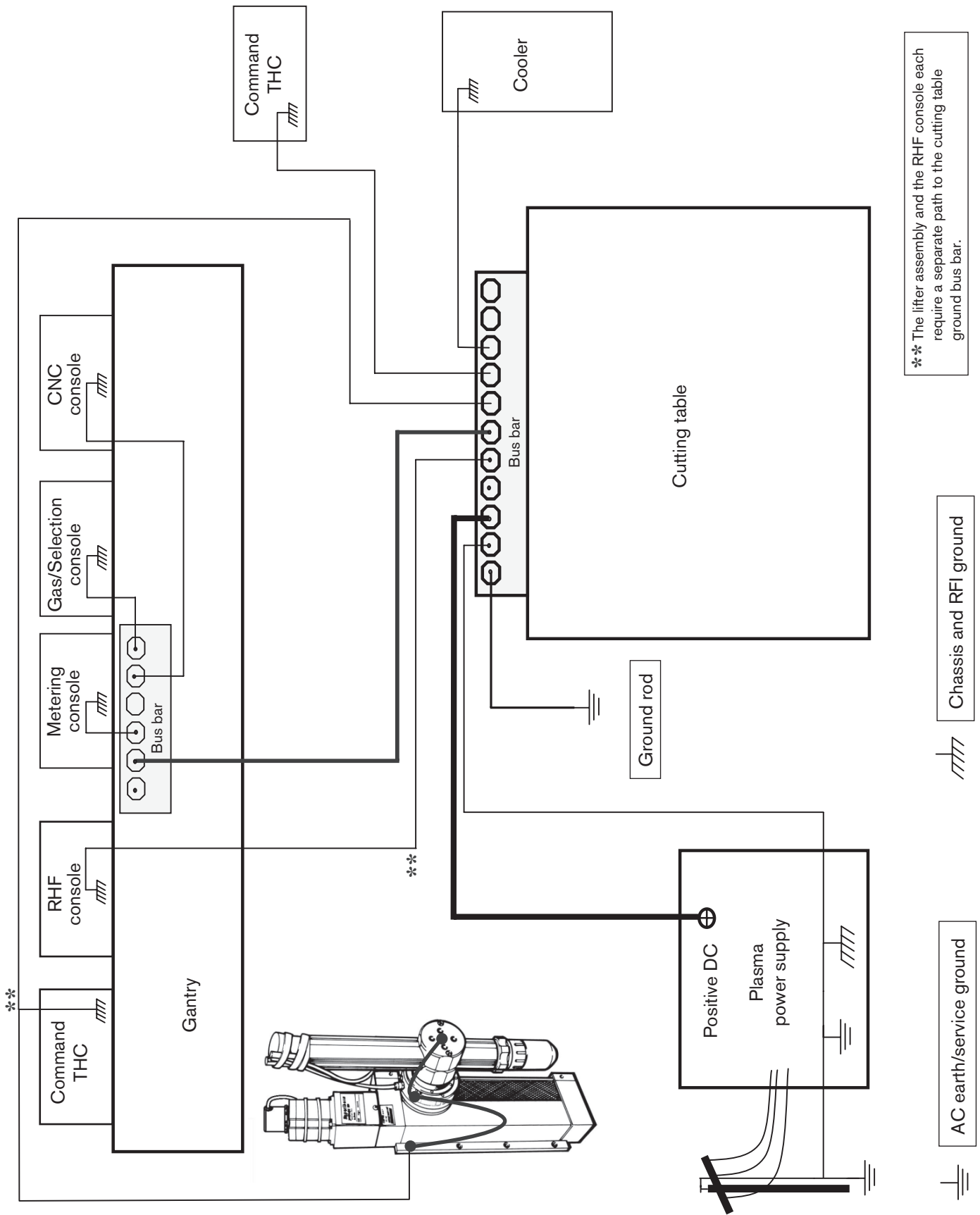




Example of a good gantry ground bus. It is bolted to the gantry, close to the motor. All of the individual ground cables from the components mounted on the gantry go to the bus except those from the RHF console\* and the torch holder. A single heavy cable then goes from the gantry ground bus to the ground bus bolted to the table.



\* Applies to systems that use a remote high frequency (RHF) console

# INSTALLATION



**Grounding diagram** (some systems will not include all the components shown)

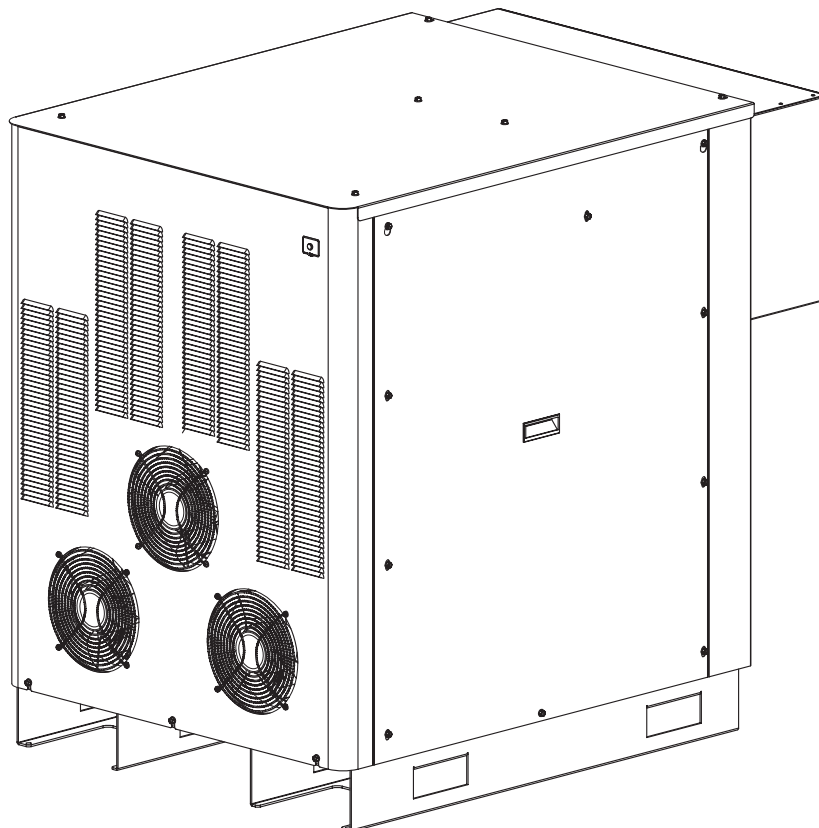
**A Placement of the power supply**

		<p><b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b></p>
<p><b>Remove all electrical connections to the power supply before moving or positioning. Transporting the unit can cause personal injury and equipment damage.</b></p>		

The power supply can be moved by forklift but the forks must be long enough to extend the entire length of the base. Take care when lifting so that the underside of the power supply is not damaged. The forks must also be centered front to back and side to side to prevent tipping while moving. Fork lift speeds should be kept to a minimum, especially when making a turn or going around a corner.

- Place the power supply in an area that is free of excessive moisture, has proper ventilation and is relatively clean. Allow 1 m (3 ft) of space on all sides of the power supply for ventilation and service.
- Cooling air is drawn in through the front panel and is exhausted through the rear of the unit by a cooling fan. Do not place any filter device over the air intake locations, which reduces cooling efficiency and **VOIDS THE WARRANTY.**
- Do not place the power supply on an incline greater than 10° to prevent it from toppling.

HPR400XD power supplies with serial number HPR400-000560 or later can be upgraded to a HPR800XD primary or secondary power supply.



## INSTALLATION

### Lifting the power supply

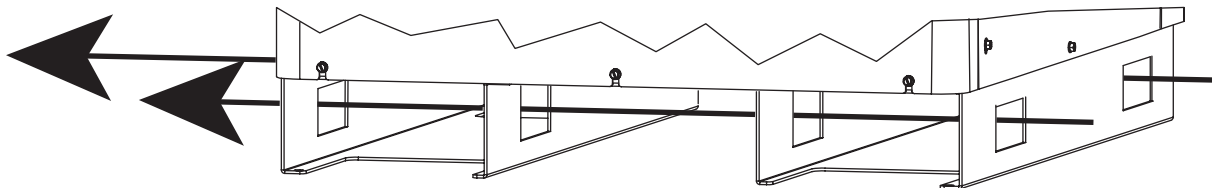


**DANGER**

**The HPR400XD power supply weighs approximately 746 kg (1645 lbs). 1 or 2 person manual pushing or lifting could cause injury. Use appropriate lifting aids and techniques when moving a power supply**

A strap kit (228336) for lifting the HPR400XD is available from Hypertherm. The strap kit should only be used to lift the HPR400 as outlined herein. Before using the strap kit, the customer understands and assumes exclusive responsibility for supplying personnel trained and qualified to operate forklifts, cranes, hoists and other lifting devices to lift or move the power supply. All movement of the power supply must be done in compliance with applicable local laws and regulations. All handling equipment must be evaluated for each application and inspected and tested before each use. The power supply can be moved by forklift, but the forks must be long enough to extend the entire length of the base. Take care when lifting so that the underside of the power supply is not damaged. The customer agrees to observe and ensure compliance with the following:

- The straps and other handling equipment must comply with applicable local standards, laws and regulations.
- The rated capacity, design factor, and efficiency rating of the lifting system, including the straps sold by Hypertherm, may be affected by wear, misuse, overloading, corrosion, deformation, intentional alteration, age, and other use conditions. An inspection of the straps by qualified personnel should be conducted before each use. Worn or damaged straps may not be used, nor may they be altered or modified in any way.
- All 4 loops at the ends of the straps must be securely and properly attached to the lifting mechanism.
- The power supply is a nonsymmetrical load; ensure that an analysis by a qualified person is performed properly to balance the load to prevent tipping and overloading of any one strap.
- All enclosure panels must be securely fastened before lifting the power supply.
- The lifting mechanism must be rated for the appropriate weight and be suitable for the strap size.
- Each strap should pass through all 4 holes in the base of the power supply and should not be twisted, constricted, bunched or pinched.



**Correct path for lifting straps**

- Straps shall not be shortened or lengthened by knotting, twisting, choker hitching, or other means.
- The power supply should be lifted slowly, not more than 203 mm (8 in.) above the floor, to insure that the weight is evenly distributed.
- The power supply should be moved slowly to prevent sudden acceleration and deceleration when moving.
- Access to the area should be restricted when moving or lifting to prevent injury of personnel if the power supply shifts or tips.

- Personnel should never be allowed to place themselves or any part of the body under the equipment, or between the equipment and walls or other solid objects.
- Store straps in a proper manner such that they are not subjected to mechanical, chemical, or ultraviolet damage, or to extreme temperatures.

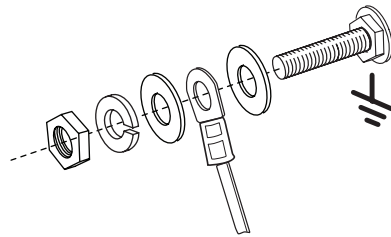
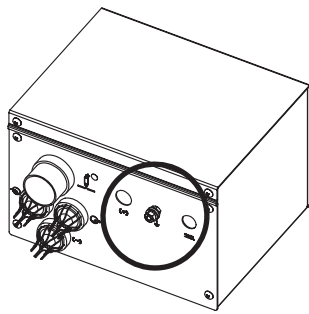
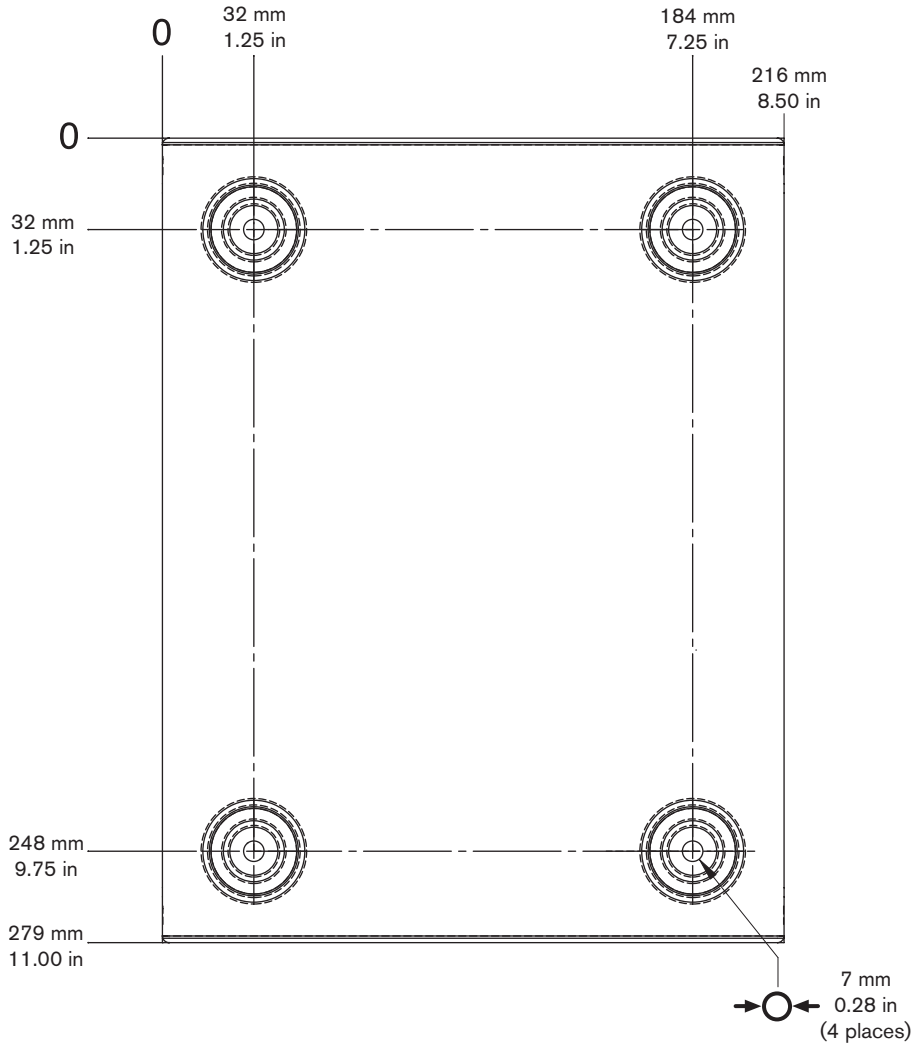
In the United States, OSHA regulates slings in 29 CFR 1910.184. This regulation covers general requirements, basic definitions, safe operating practices, inspections of the various types of slings. Read the OSHA regulations and OSHA sling guidelines carefully before moving the power supply, and observe all requirements and recommendations for safe handling in 29 CFR 1910.184 and other applicable sections. If there is any question respecting the interpretation or application of these or other OSHA regulations, you should consult appropriate legal counsel.

Hypertherm slings are not for sale In Europe, where locally purchased slings are required to have "CE Marking." In the UK the interpretation of the European Directives translated into the following UK Statutory Instruments (SI): SI 2306 PUWER, The Provision and Use of Work Equipment Regulations and SI 2307 LOLER, Lifting Operations Lifting Equipment Regulations. Reference to the European Directives may not be construed to mean that the strap kit may be used in other countries or jurisdictions.

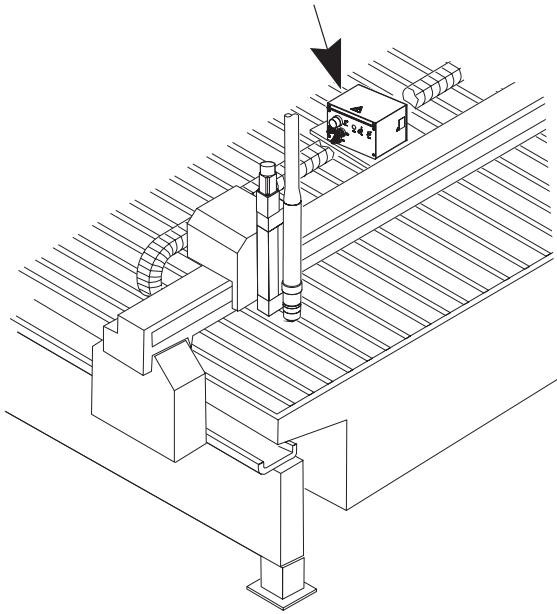
The body responsible for the workplace where the equipment is to be installed needs to ensure all applicable local regulations are followed, and Hypertherm assumes no responsibility or liability therefore. The customer assumes exclusive responsibility for ensuring that all local laws and regulations are followed, including those applicable to the use of equipment and work place conditions.

## B Install the ignition console

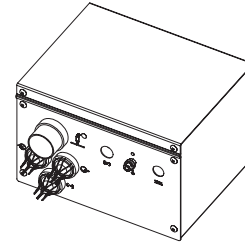
- Mount the ignition console in a vertical or horizontal position.
- Allow room to remove the top for servicing



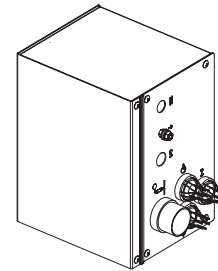
**Ignition console grounding**



**Horizontal RHF mounting**

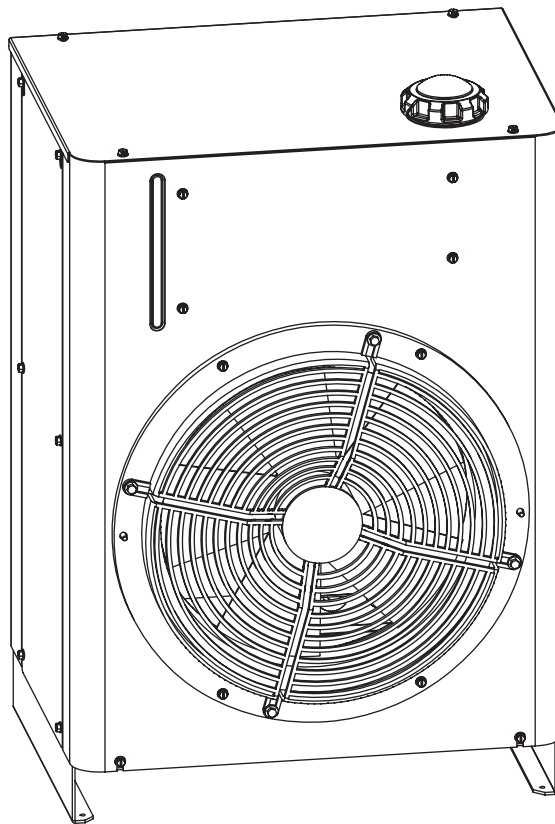


**Vertical RHF mounting**



### **C** Placement of the cooler

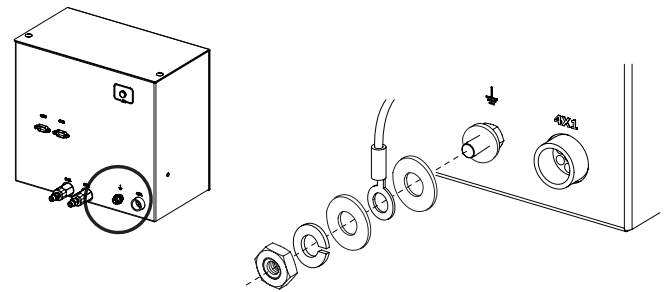
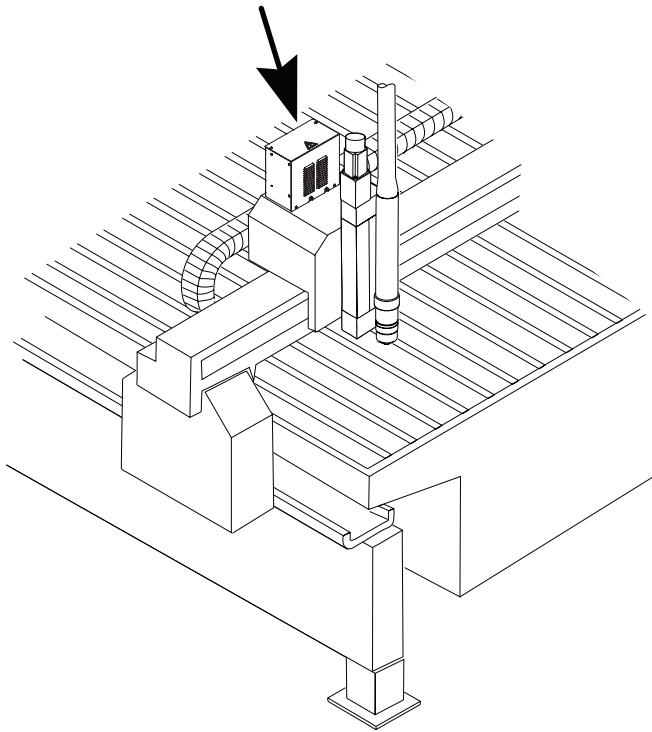
- Place the cooler in an area that is free of excessive moisture, has proper ventilation, and is relatively clean. Allow 1 m (3 ft) of space on all sides of the power supply for ventilation and service.
- Cooling air is drawn in through the front panel and is exhausted through the rear of the unit by a cooling fan. Do not place any filter device over the air intake locations, which reduces cooling efficiency and **VOIDS THE WARRANTY**.
- Do not place the cooler on an incline greater than 10° to prevent it from toppling.



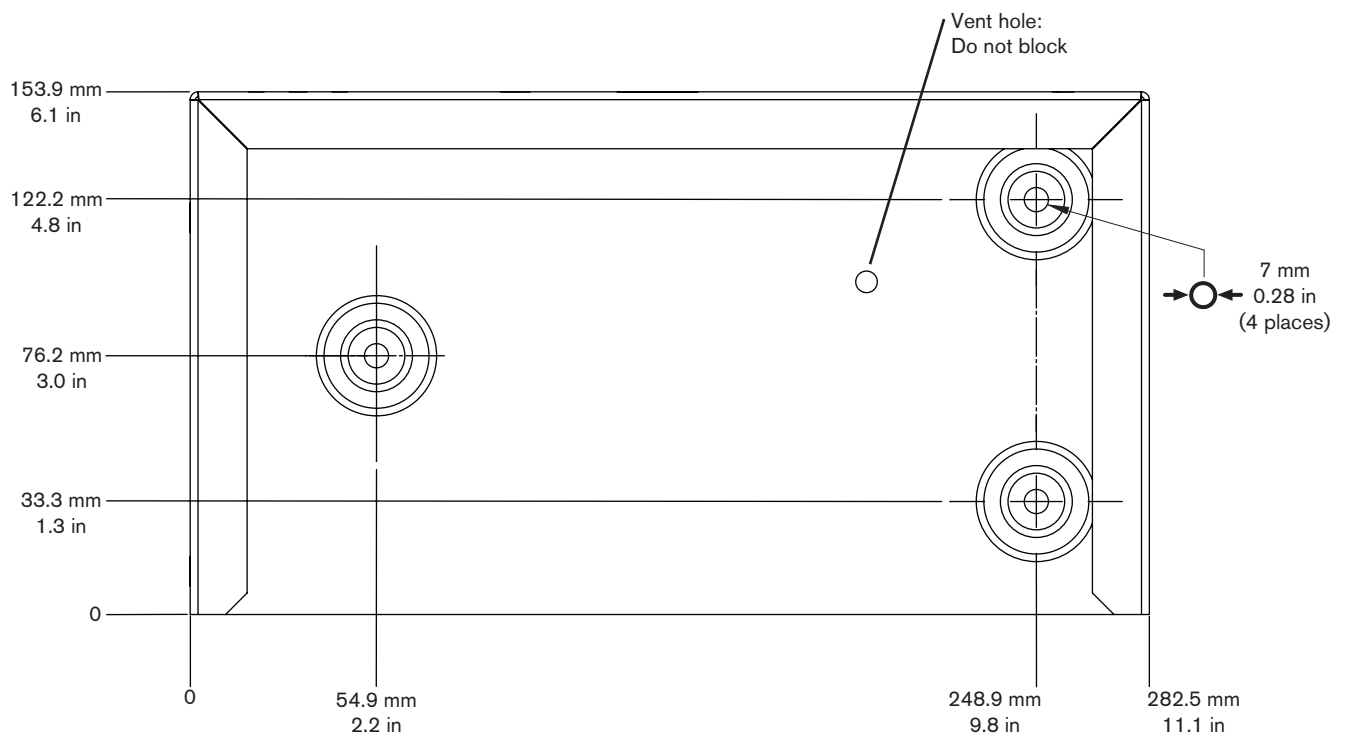


**D Install the metering console**

- Mount the metering console near the torch lifter station. The maximum length of the gas hoses between the metering console and the torch is 1.8 m (6 ft).

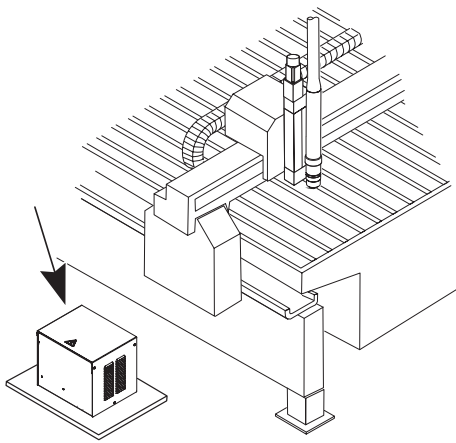


**Metering console grounding**

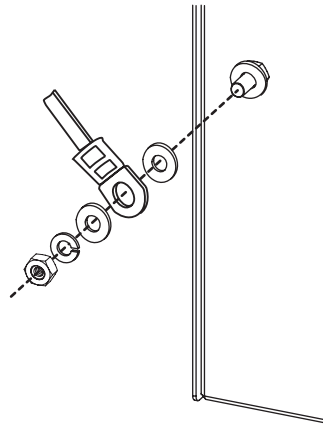


**E Placement of the selection console**

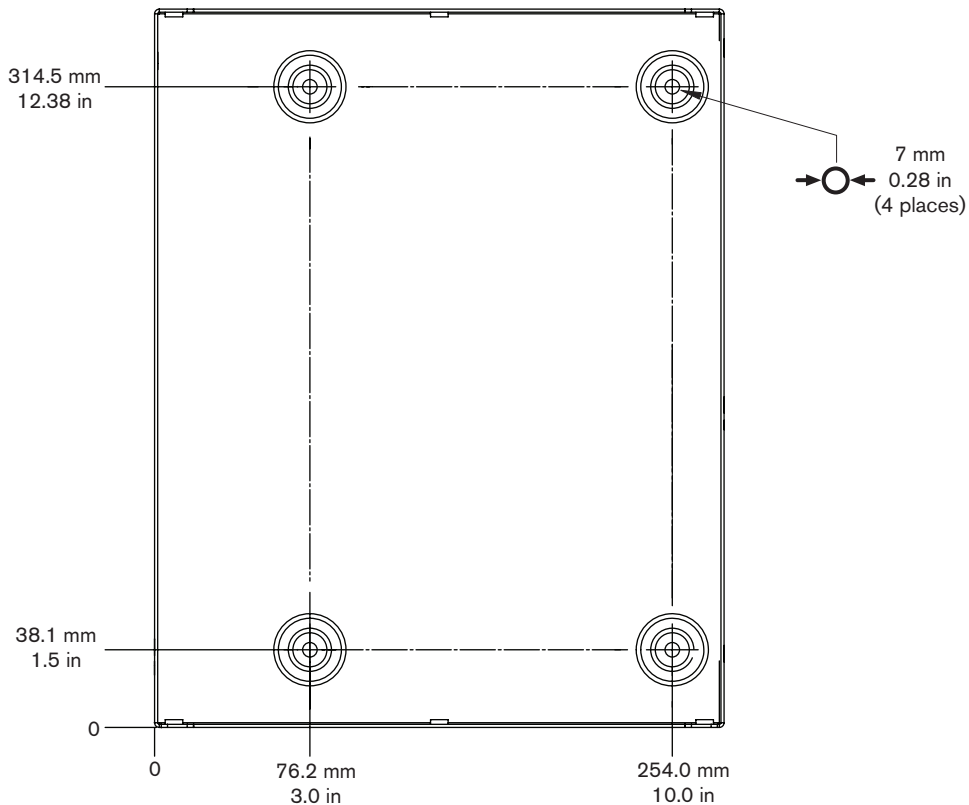
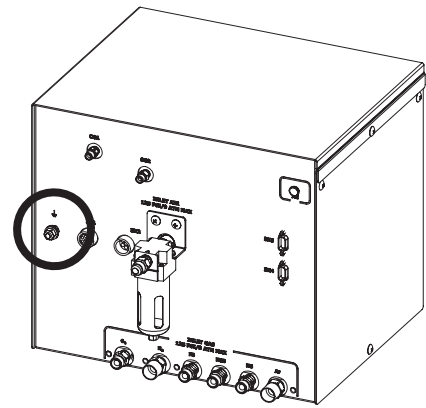
- Mount the selection console near the cutting table. Allow room to remove the top and right side cover for servicing. Preferred orientation is shown in the figure below. The maximum length of cables between the power supply and selection console is 75 m (250 ft). The maximum length of cables and hoses between the selection console and the metering console assembly is 20 m (65 ft).



**Preferred selection console orientation**



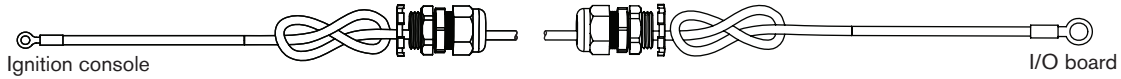
**Selection console grounding**



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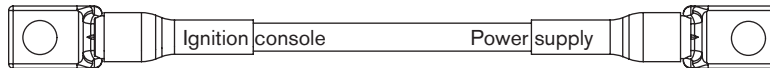
## Power supply to ignition console leads

### 1 Pilot arc lead

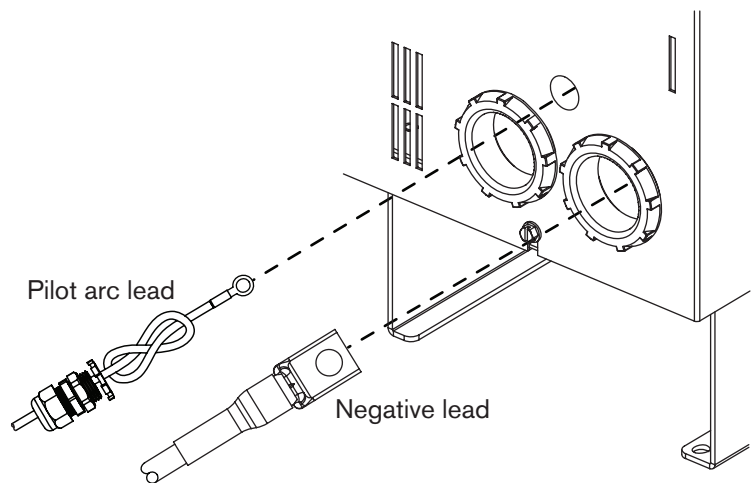
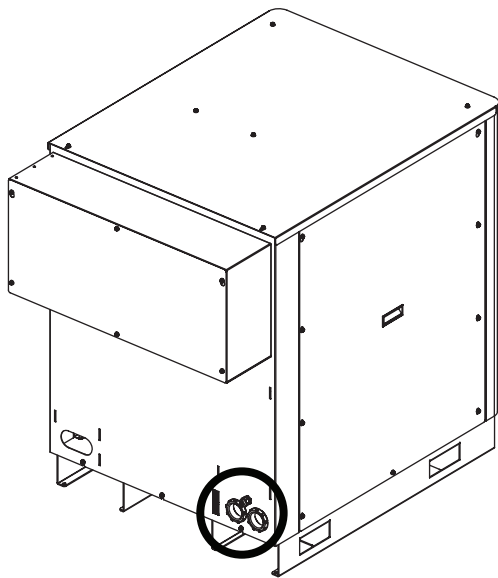


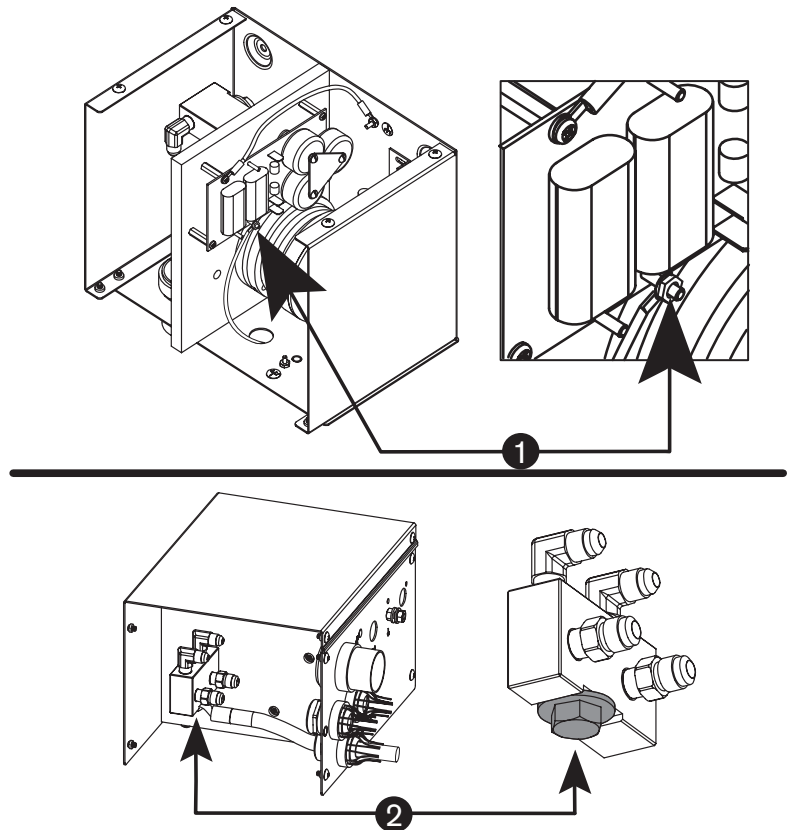
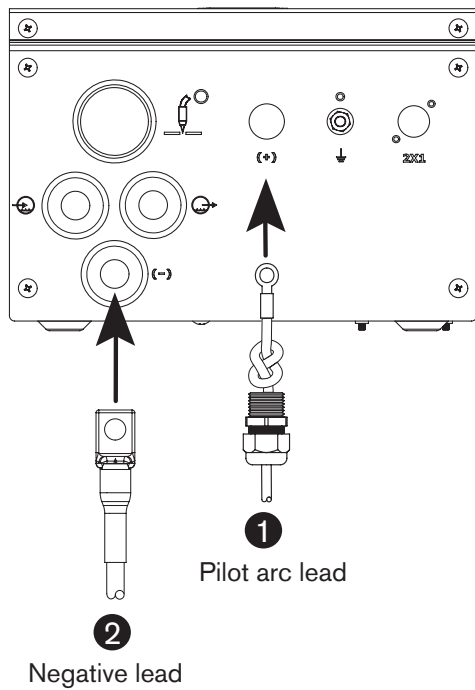
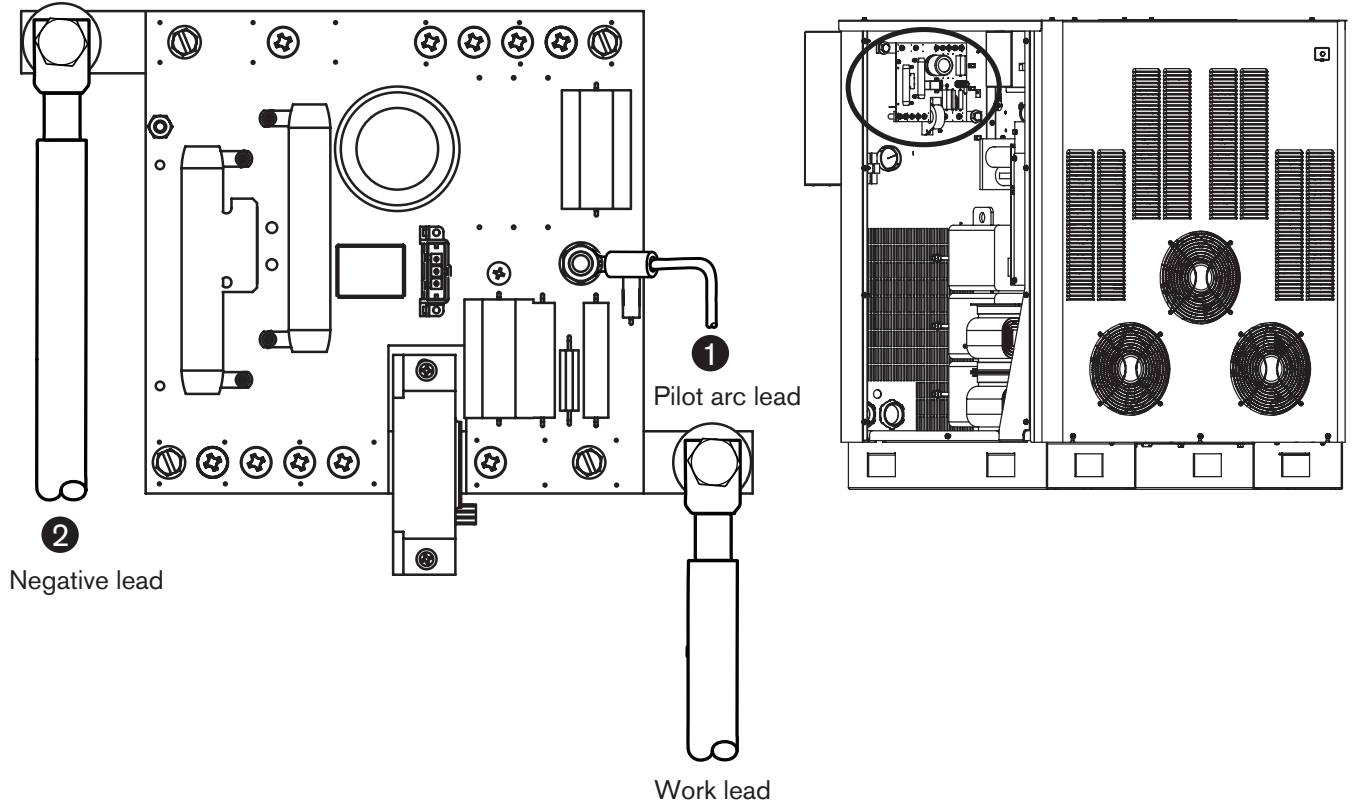
Part no.	Length	Part no.	Length
123820	3 m (10 ft)	123735	25 m (82 ft)
123821	4.5 m (15 ft)	123668	35 m (115 ft)
123666	7.5 m (25 ft)	123669	45 m (150 ft)
123822	10 m (35 ft)	123824	60 m (200 ft)
123667	15 m (50 ft)	123825	75 m (250 ft)
123823	20 m (65 ft)		

### 2 Negative lead



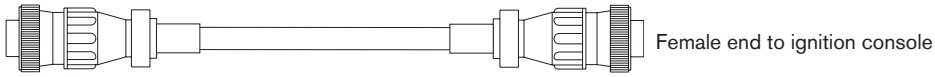
Part no.	Length	Part no.	Length
123418	3 m (10 ft)	123996	25 m (82 ft)
023382	4.5 m (15 ft)	123997	35 m (115 ft)
023078	7.5 m (25 ft)	023081	45 m (150 ft)
123994	10 m (35 ft)	023188	60 m (200 ft)
023079	15 m (50 ft)	023815	75 m (250 ft)
123995	20 m (65 ft)		





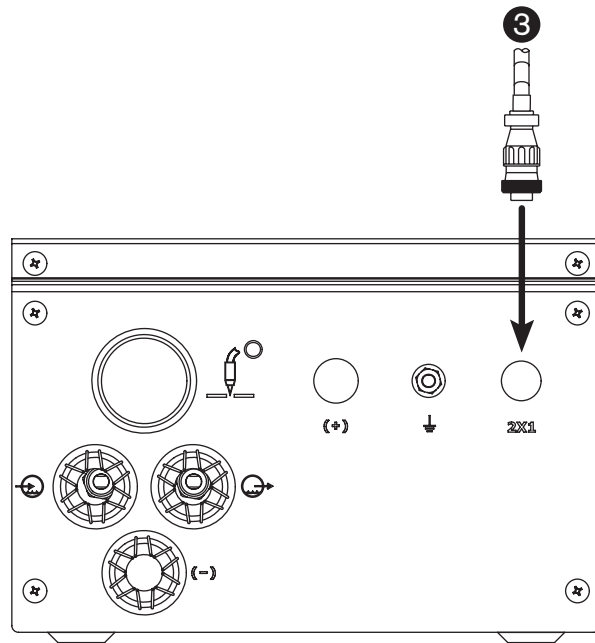
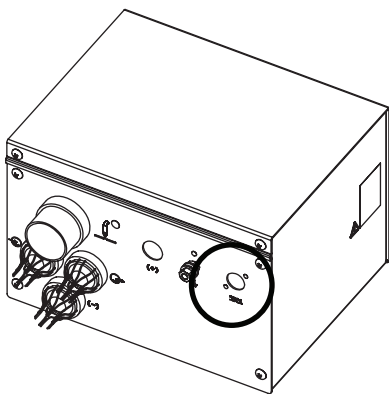
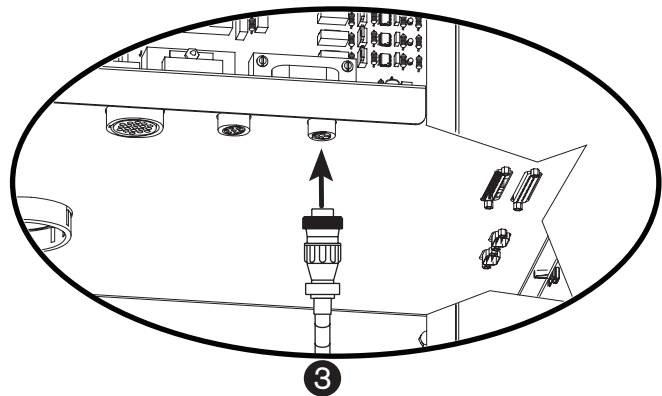
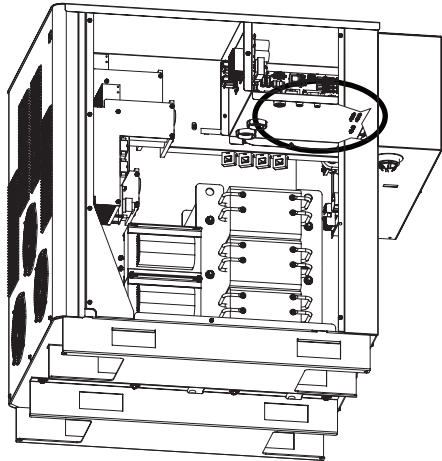
# INSTALLATION

## 3 Ignition console power cable



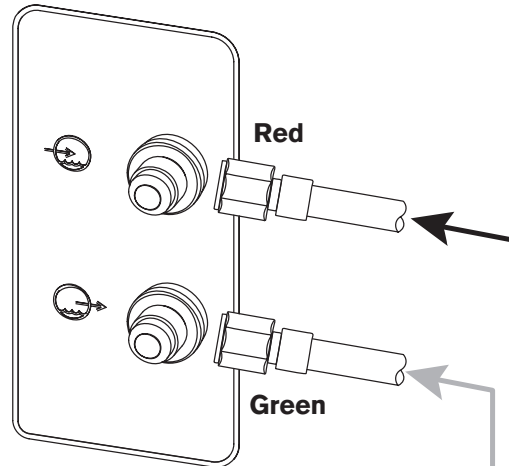
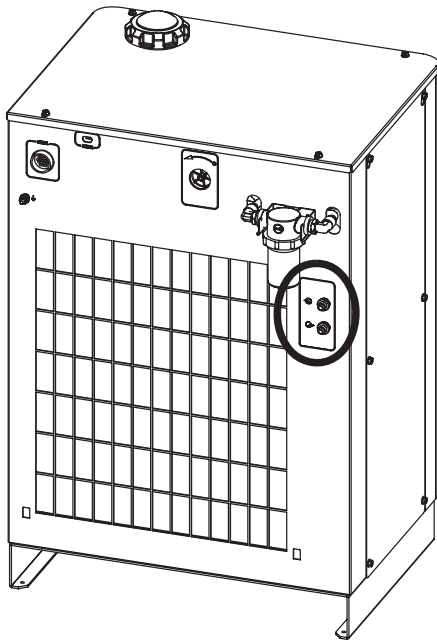
Part no.	Length	Part no.	Length
123419	3 m (10 ft)	123425	22.5 m (75 ft)
123834	4.5 m (15 ft)	123736	25 m (82 ft)
123420	6 m (20 ft)	123426	30 m (100 ft)
123670	7.5 m (25 ft)	123672	35 m (115 ft)
123422	9 m (30 ft)	123938	37.5 m (125 ft)
123835	10 m (35 ft)	123673	45 m (150 ft)
123423	12 m (40 ft)	123837	60 m (200 ft)
123671	15 m (50 ft)	123838	75 m (250 ft)
123836	20 m (65 ft)		

Cable signal list – power supply to ignition console		
Power supply end	Description	Ignition console end
Pin No.		Pin No.
1	120 VAC-Hot	1
2	120 VAC-Return	2
3	Ground	3
4	Not used	4

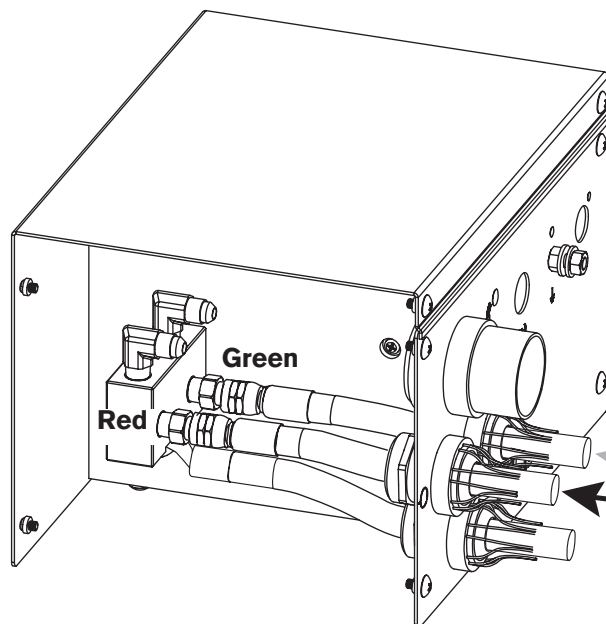


**4 Coolant hoses**

**Caution:** Never use teflon tape on any joint preparation.



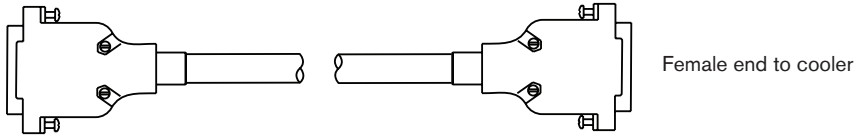
Part no.	Length	Part no.	Length
128499	1.5 m (5 ft)	128984	20 m (65 ft)
028652	3 m (10 ft)	128078	25 m (82 ft)
028440	4.5 m (15 ft)	028896	35 m (115 ft)
028441	7.5 m (25 ft)	028445	45 m (150 ft)
128173	10 m (35 ft)	028637	60 m (200 ft)
028442	15 m (50 ft)	128985	75 m (250 ft)



**4**

## Power supply to cooler cables

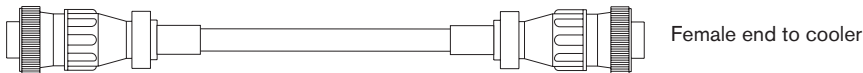
### 5 Control cable



Part no.	Length
123844	1.5 m (5 ft)
123784	3 m (10 ft)
123839	4.5 m (15 ft)

Cable signal list – power supply to cooler (9-pin DSUB connectors)						
Power supply end				Cooler end		
Pin No.	Wire color	Input/Output	Description	Pin No.	Input/Output	Function
2	Black	Input/Output	CAN L	2	Input/Output	CAN communication
3	Black	Input	CAN ground	3	Output	Power ground
7	Red	Input/Output	CAN H	7	Input/Output	CAN communication
9	Red	Input	Not used	9	Output	Not used

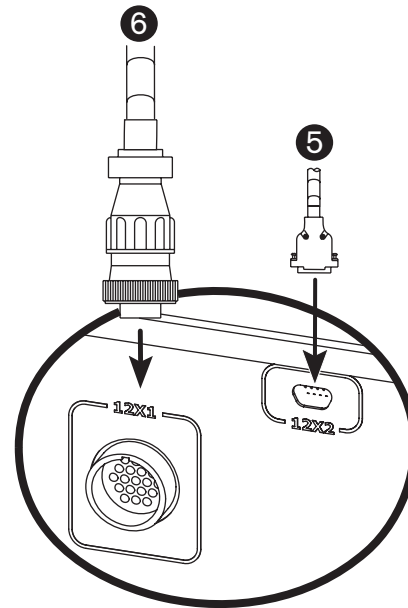
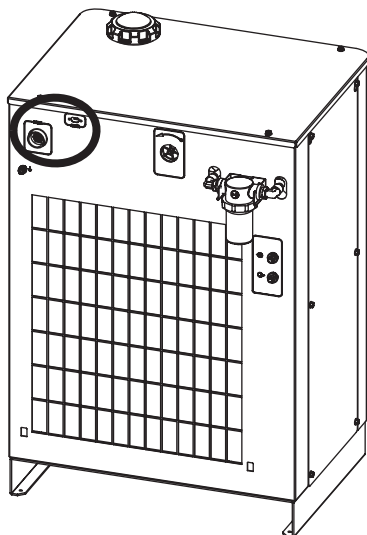
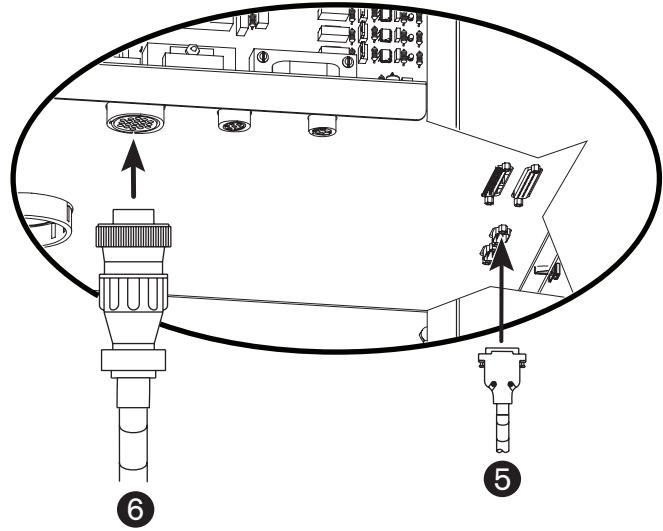
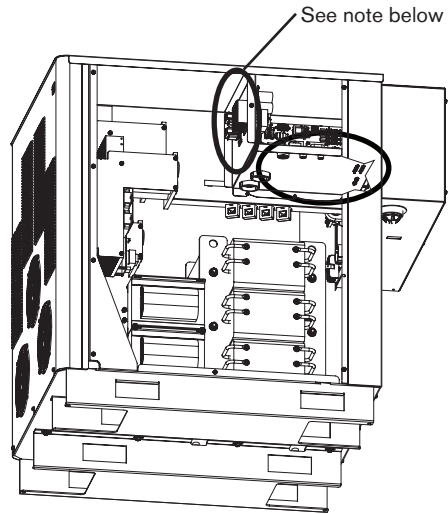
### 6 Power cable



Part no.	Length
123979	1.5 m (5 ft)
123980	3 m (10 ft)
123981	4.5 m (15 ft)

Cable signal list – power supply to cooler				
Power supply end			Cooler end	
Pin No.	Wire color	Description	Pin No.	Function
8	Black	120 VAC-Hot	8	Coolant solenoid (V1)
13	White	120 VAC-Return	13	Coolant solenoid (V1)
4		Shield	4	Ground
12	Black	240 VAC-Hot	12	Cooler fan
16	Yellow	240 VAC-Return	16	Cooler fan
7		Shield	7	Ground
11	Black	240 VAC-Hot	11	Pump motor
15	Blue	240 VAC-Return	15	Pump motor
6		Shield	6	Ground



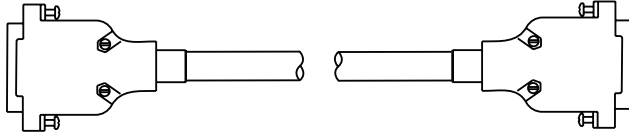


Note: The inductor on the pump motor drive board makes a noise during operation that has been described as a “hum”, “sing”, and “click”. This is normal and can be disregarded.

# INSTALLATION

## Power supply to selection console cables

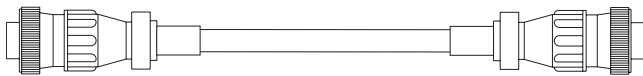
### 7 Control cable



Part no.	Length	Part no.	Length
123784*	3 m (10 ft)	123841	20 m (65 ft)
123839	4.5 m (15 ft)	123737	25 m (82 ft)
123963	6 m (20 ft)	123738	35 m (115 ft)
123691	7.5 m (25 ft)	123739	45 m (150 ft)
123840	10 m (35 ft)	123842	60 m (200 ft)
123711	15 m (50 ft)	123843	75 m (250 ft)

Cable signal list – power supply to selection console					
Power supply end			Gas console end		
Pin No.	Input/Output	Description	Pin No.	Input/Output	Function
1		Not used	1		Not used
6		Not used	6		Not used
2	Input/Output	CAN L	2	Input/Output	CAN serial communication
7	Input/Output	CAN H	7	Input/Output	CAN serial communication
3		CAN ground	3		CAN ground reference
9		Not used	9		Not used
8		Not used	8		Not used
4		Not used	4		Not used
5		Not used	5		Not used

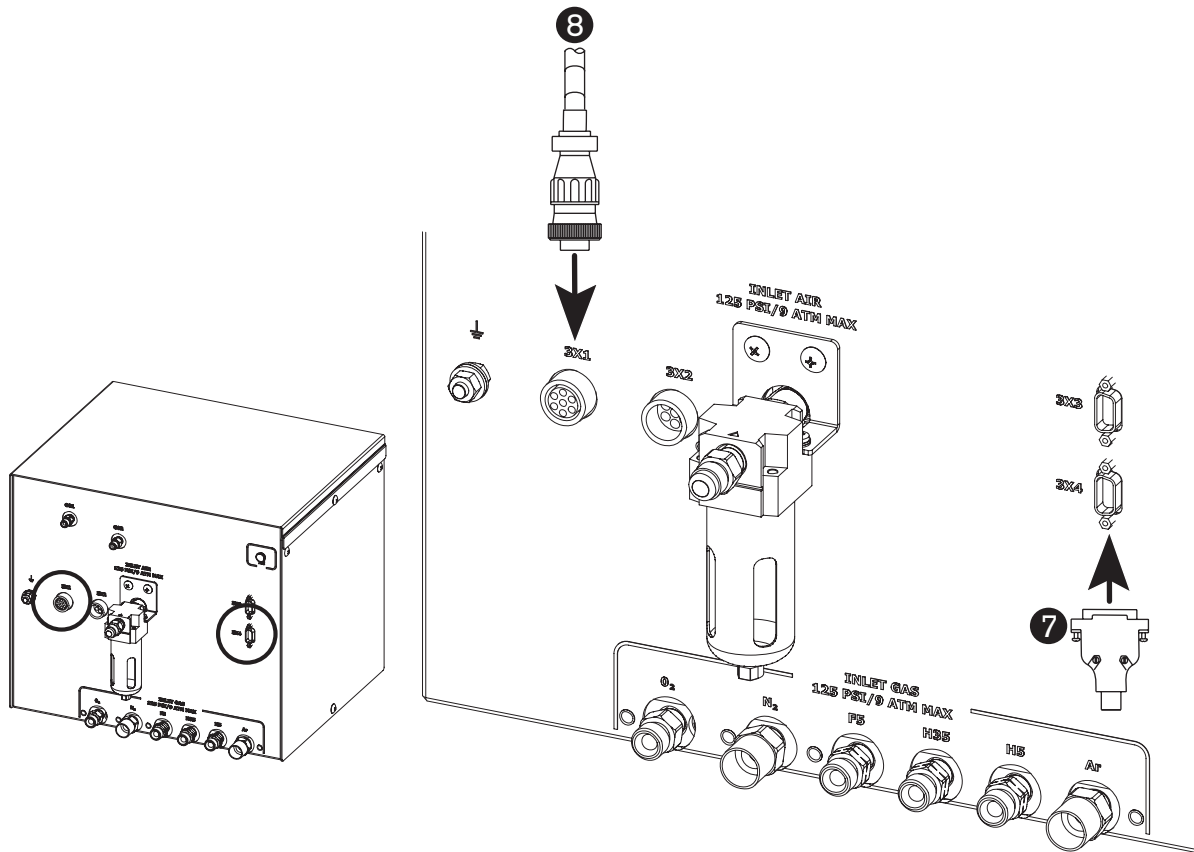
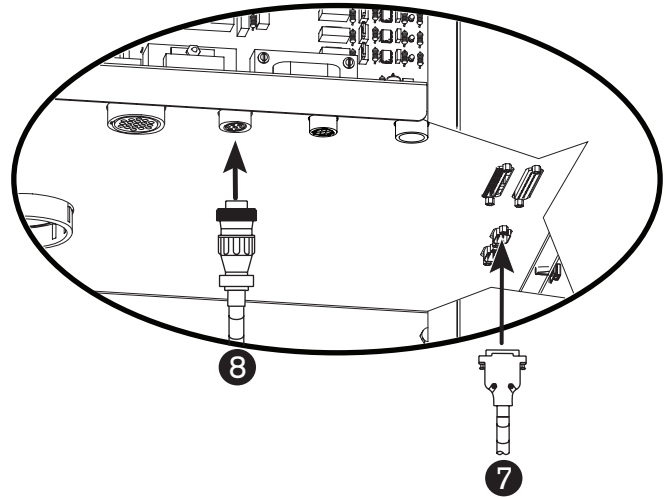
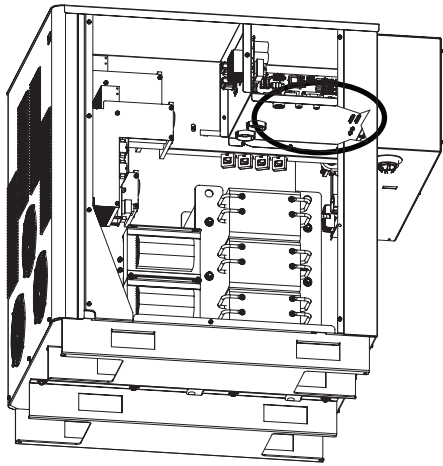
### 8 Power cable



Part no.	Length	Part no.	Length
123785*	3 m (10 ft)	123848	20 m (65 ft)
123846	4.5 m (15 ft)	123740	25 m (82 ft)
123964	6 m (20 ft)	123676	35 m (115 ft)
123674	7.5 m (25 ft)	123677	45 m (150 ft)
123847	10 m (35 ft)	123849	60 m (200 ft)
123675	15 m (50 ft)	123850	75 m (250 ft)

Cable signal list – power supply to selection console		
Power supply end	Description	Gas console end
Pin No.		Pin No.
1	120 VAC-Hot	1
2	120 VAC-Return	2
3	Ground	3
4	Not used	4
5	Not used	5
6	24 VAC-Hot	6
7	24 VAC-Return	7

\* Cable numbers 123784 and 123785 are for use with systems that have the gas console mounted on the power supply

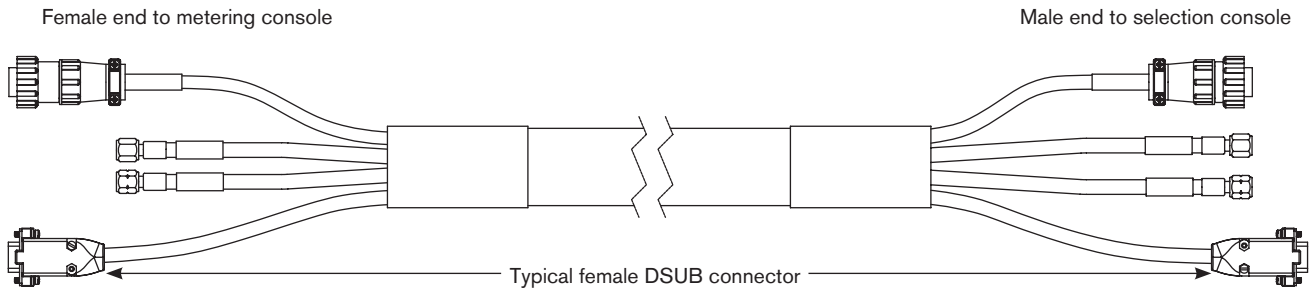


**Selection console to metering console connections**

**9 Cable and gas hose assembly**

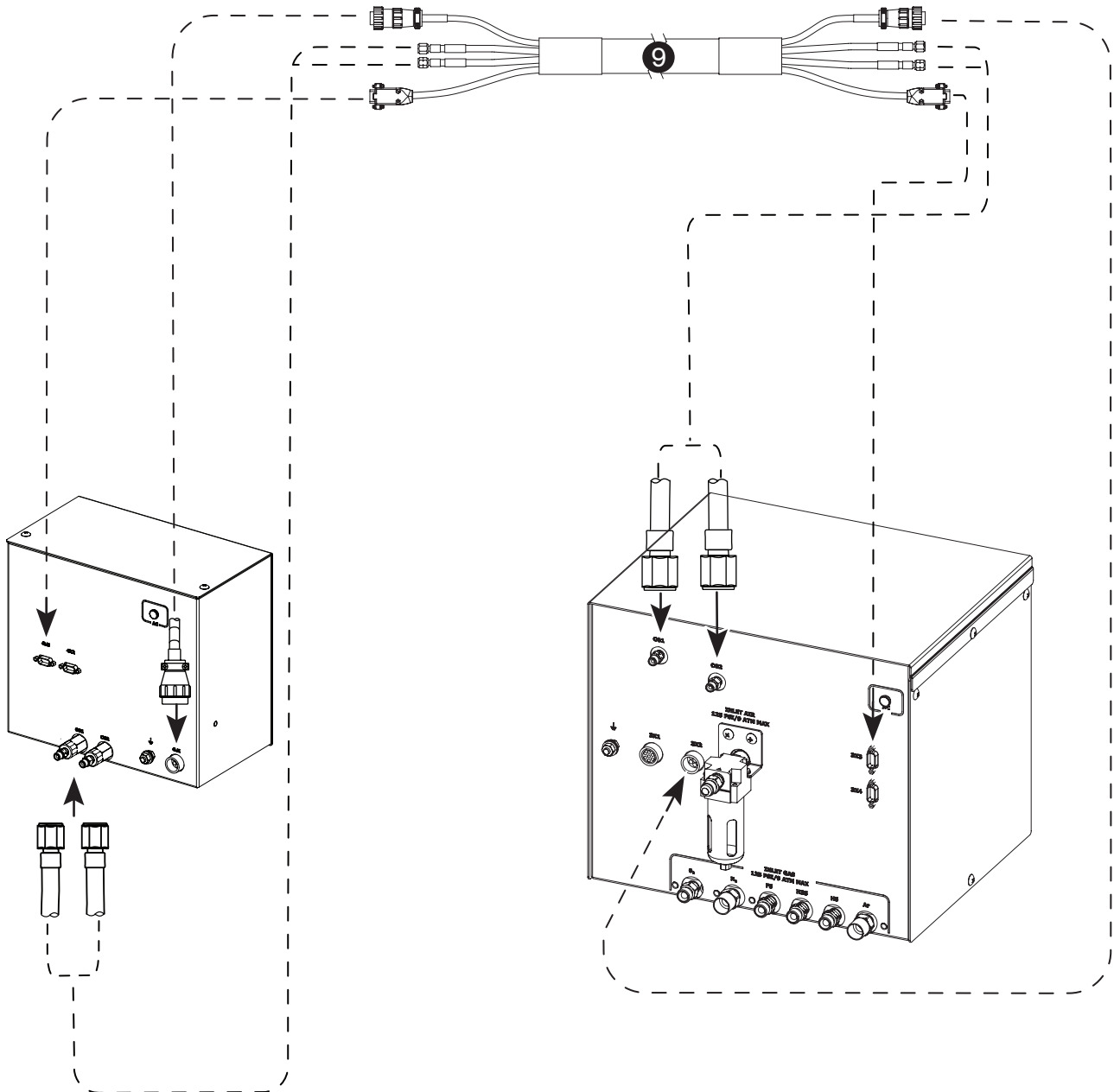
Part no.	Length
128992	3 m (10 ft)
128993	4.5 m (15 ft)
228338	6 m (20 ft)
128952	7.5 m (25 ft)
128994	10 m (35 ft)
128930	15 m (50 ft)
128995	20 m (65 ft)

Power cable signal list – 9-pin connectors					
Metering console end			Selection console end		
Pin No.	Input/Output	Description	Pin No.	Input/Output	Function
1	Input	120 VAC power	1	Output	AC in, return
2	Input	120 VAC power	2	Output	AC in, hot
3	Input	Chassis ground	3	Output	Chassis ground
4		Not used	4		Not used
5		Not used	5		Not used
6		Not used	6		Not used
7		Not used	7		Not used



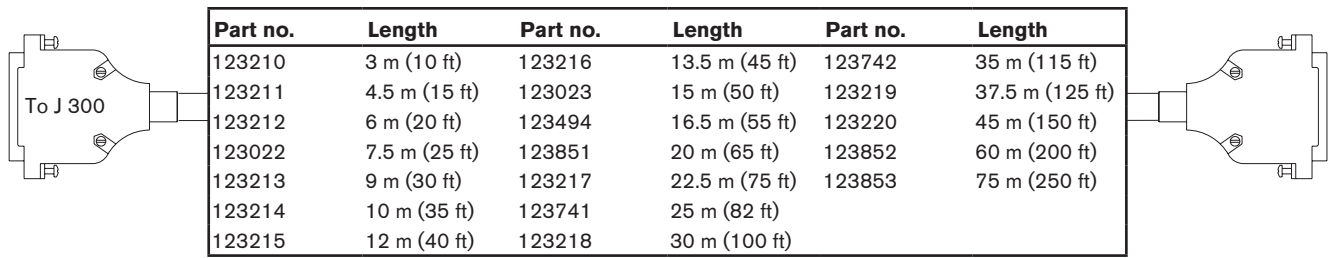
Communication cable signal list – 9-pin DSUB connectors					
Metering console end			Selection console end		
Pin No.	Input/Output	Description	Pin No.	Input/Output	Function
2	Input/Output	CAN L	2	Input/Output	CAN communication
3	Input	CAN ground	3	Output	Power ground
7	Input/Output	CAN H	7	Input/Output	CAN communication
9	Input	Not used	9	Output	Not used

**Caution:** Never use teflon tape on any joint preparation.



## INSTALLATION

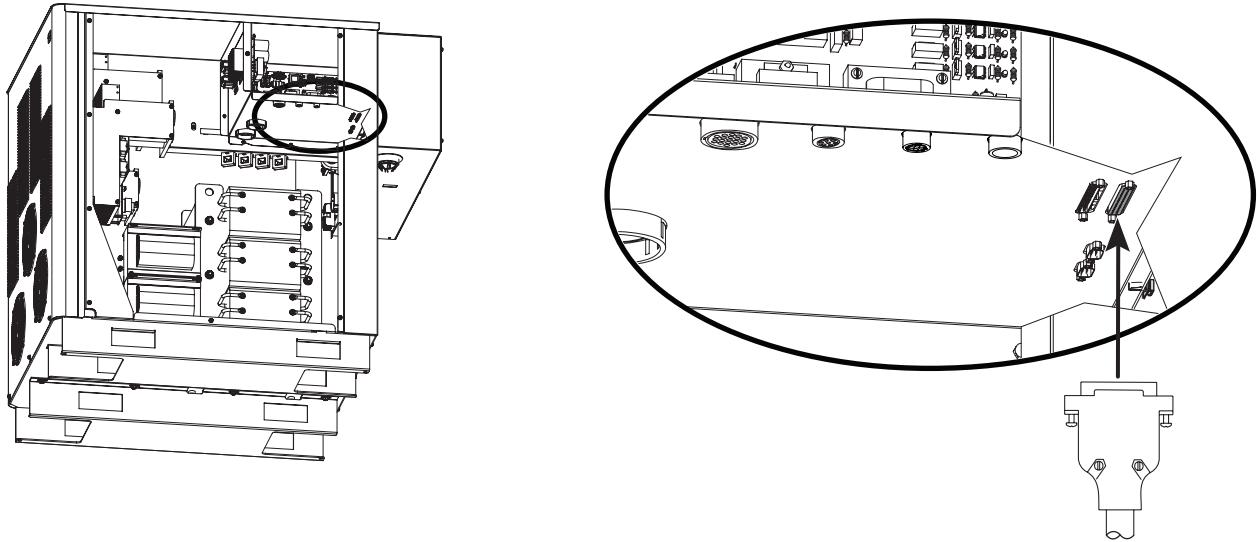
### 10 Power supply to CNC interface cable



Part no.	Length	Part no.	Length	Part no.	Length
123210	3 m (10 ft)	123216	13.5 m (45 ft)	123742	35 m (115 ft)
123211	4.5 m (15 ft)	123023	15 m (50 ft)	123219	37.5 m (125 ft)
123212	6 m (20 ft)	123494	16.5 m (55 ft)	123220	45 m (150 ft)
123022	7.5 m (25 ft)	123851	20 m (65 ft)	123852	60 m (200 ft)
123213	9 m (30 ft)	123217	22.5 m (75 ft)	123853	75 m (250 ft)
123214	10 m (35 ft)	123741	25 m (82 ft)		
123215	12 m (40 ft)	123218	30 m (100 ft)		

### 11 Optional multi-system CNC interface cable (see schematics for installation information)


Power supply end				CNC end		
Wire color	Pin no.	Input/ Output	Signal name	Function	Input/ Output	Notes
Black	1	Input	Rx -	RS-422 serial receiver	Output	
Red	20	Input	Rx +	RS-422 serial receiver	Output	
Black	2	Output	Tx -	RS-422 serial transmitter	Input	
Green	21	Output	Tx +	RS-422 serial transmitter	Input	
Black	3		RS-422 ground	RS-422 serial ground		
Blue	22		None	Not used		
Black	4	Output	Motion 1 E (-)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out	Input	2 & 3
Yellow	23	Output	Motion 1 C (+)		Input	
Black	5	Output	Error E (-)	Notifies the CNC that an error has occurred	Input	2
Brown	24	Output	Error C (+)		Input	
Black	6	Output	Rampdown error E (-)	Notifies the CNC that a rampdown error has occurred	Input	2
Orange	25	Output	Rampdown error C (+)			
Red	7	Output	Not ready E (-)	Notifies the CNC that the plasma system is not ready to fire an arc	Input	2
White	26	Output	Not ready C (+)			
Red	8	Output	Motion 2 E (-)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out	Input	2 & 3
Green	27	Output	Motion 2 C (+)		Input	
Red	9	Output	Motion 3 E (-)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out	Input	2 & 3
Blue	28	Output	Motion 3 C (+)		Input	
Red	10	Output	Motion 4 E (-)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out	Input	2 & 3
Yellow	29	Output	Motion 4 C (+)		Input	
Red	11		None	Not used		
Brown	30		None	Not used		
Red	12	Input	Corner (-)	The CNC Notifies the plasma system that a corner is approaching and to reduce cut current (Cut current is CNC selectable or defaults to 50% of cut current)	Output	1
Orange	31	Input	Corner (+)		Output	
Green	13	Input	Pierce (-)	The CNC Notifies the plasma system to maintain the shield preflow until the CNC releases the signal	Output	1
White	32	Input	Pierce (+)		Output	
Green	14	Input	Hold (-)	Not required without CommandTHC. CommandTHC requires a signal to preflow gases during IHS	Output	1
Blue	33	Input	Hold (+)		Output	
Green	15	Input	Start (-)	The CNC initiates the plasma arc	Output	1
Yellow	34	Input	Start (+)		Output	
Green	16		None	Not used		
Brown	35		None	Not used		
Green	17		None	Not used		
Orange	36		Power ground	Ground		
White	18		Power ground	Ground Available 24 VDC (200 milliamps maximum) see notes		4
Black	37		CNC +24 VDC			
	19		CNC +24 VDC	Not connected		



**Notes to CNC interface cable run list**

- Note 1. Inputs are optically isolated. They require 24 VDC at 7.3 mA, or dry-contact closure. The external relay's life may be improved by adding a metallized-polyester capacitor (0.022 $\mu$ F 100V or higher) in parallel with the relay contacts
- Note 2. Outputs are optically isolated, open collector, transistors. The maximum rating is 24 VDC at 10 mA.
- Note 3. Machine motion is selectable and is used for configurations with multiple plasma systems.
- Note 4.\* CNC +24 VDC provides 24 VDC at 200 mA maximum. A jumper is required on J304 to use 24 V power.

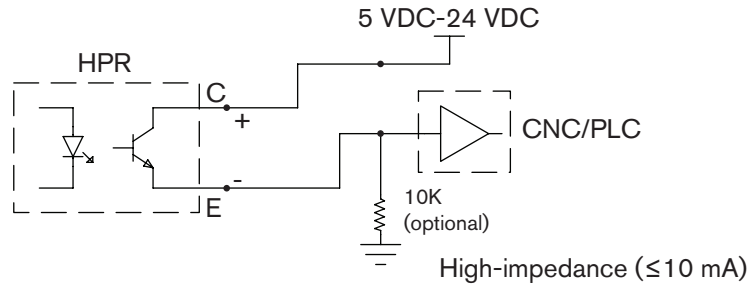
**Caution:** **The CNC cable must be constructed using cable with 360 degree shielding and metal housing connectors at each end. The shielding must be terminated to the metal housings at each end to ensure proper grounding and to provide the best shielding.**



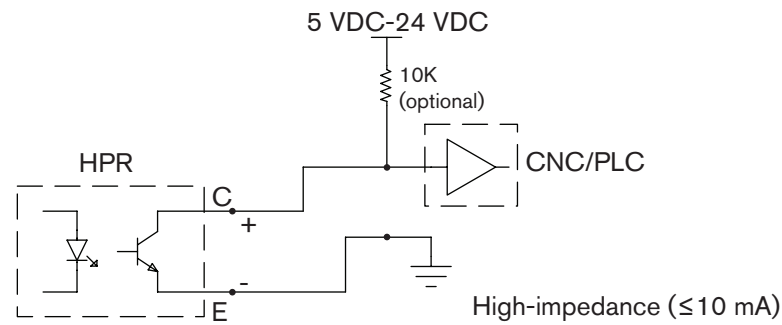
\* See example 1 on page 3-33

## Examples of output circuits

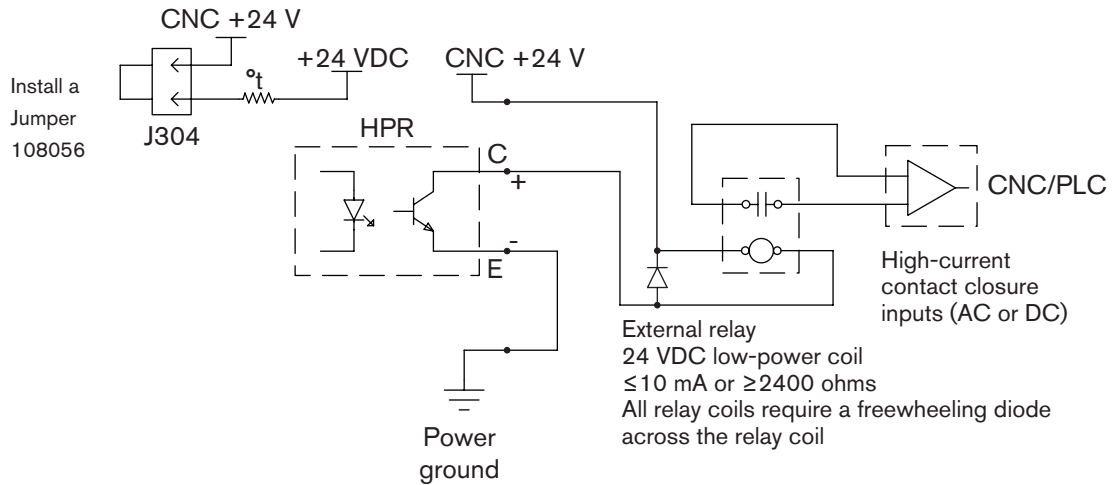
1. Logic interface, active-high



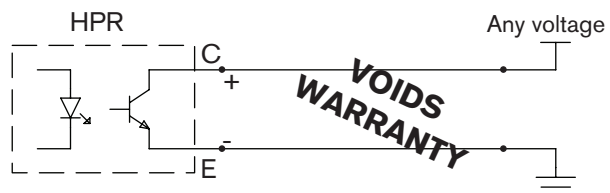
2. Logic interface, active-low



3. Relay interface



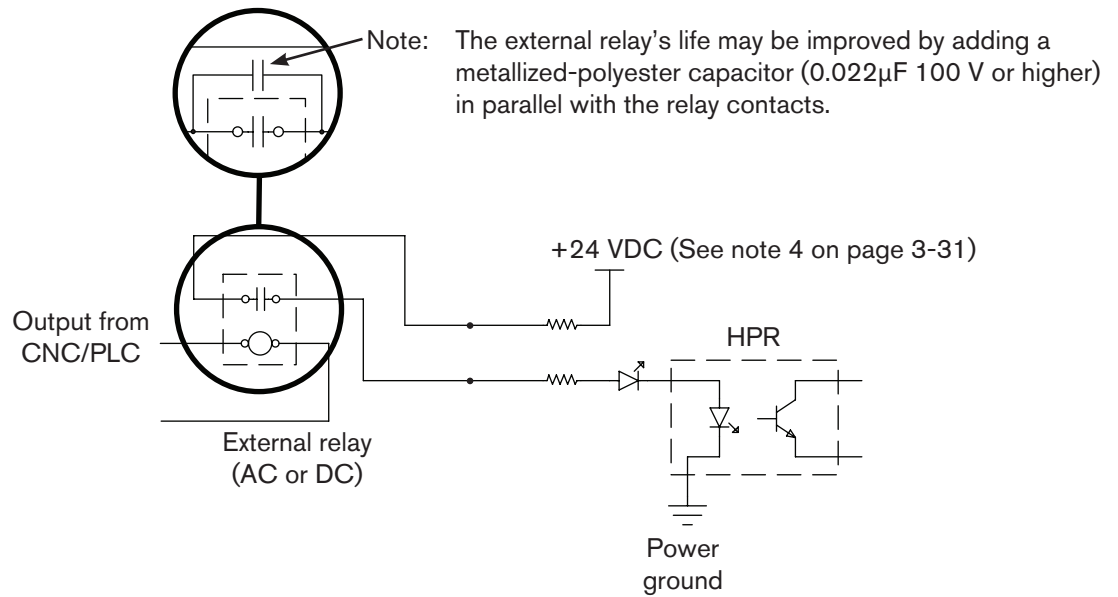
4. Do not use this configuration. Warranty will be void.



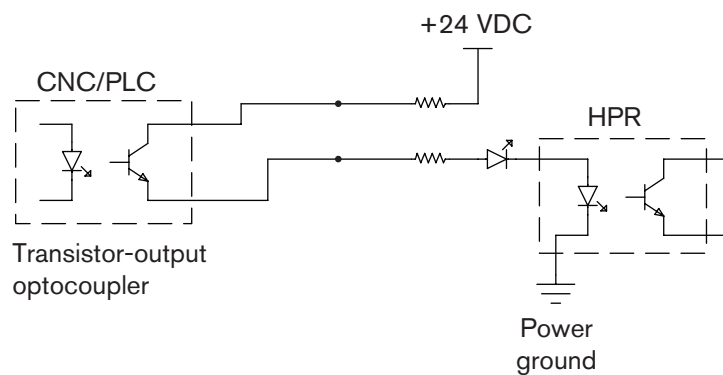


Examples of input circuits

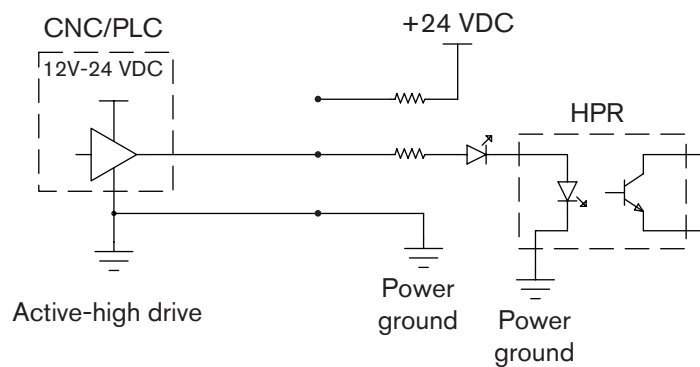
1. Relay interface



2. Optocoupler interface





3. Amplified-output interface

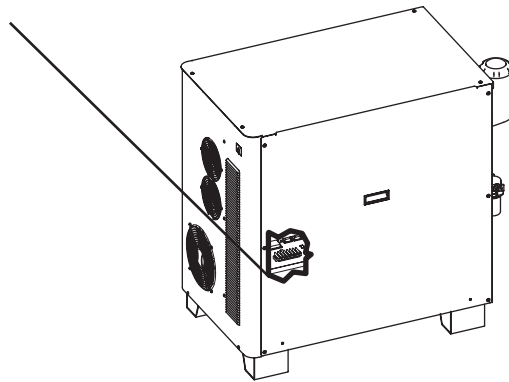


# INSTALLATION

## Remote ON/OFF switch (provided by customer)

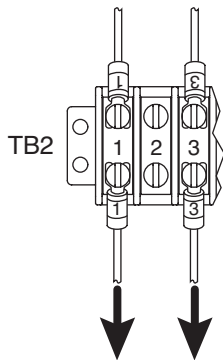
		<p style="text-align: center;"><b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b></p>
<p style="text-align: center;"><b>Disconnect electrical power before performing any maintenance.</b> <b>See the <i>Safety Section</i> in this Manual for more safety precautions.</b></p>		

1. Locate terminal block 2 (TB2) in the power supply.

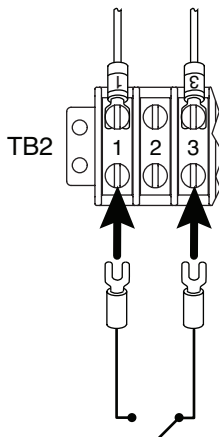


TB2 location

2. Remove wire 1 and wire 3 as shown. These wires do not need to be reconnected.



3. Connect switch to terminals 1 and 3 as shown.

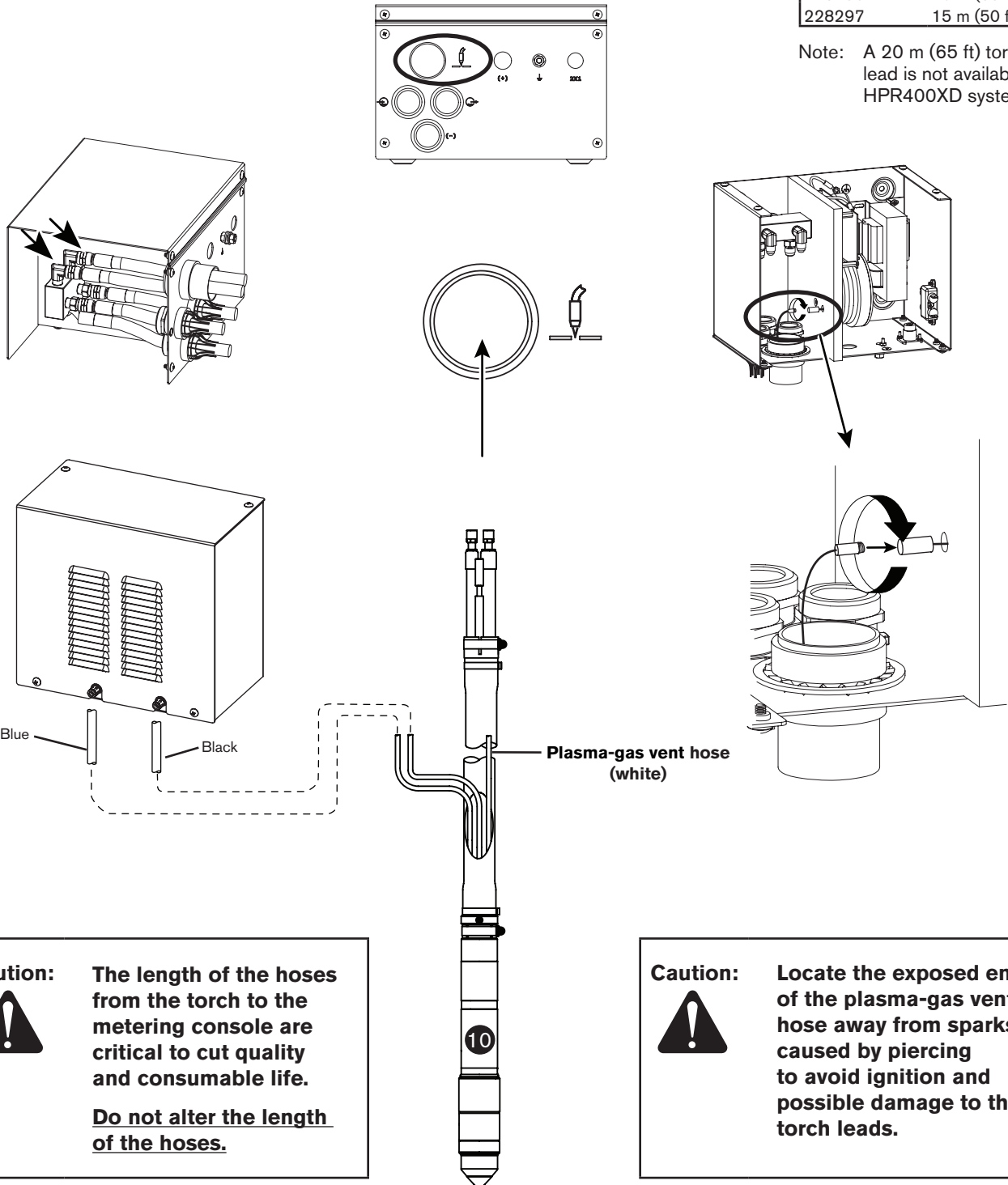


Note: Use a switch, relay or solid-state relay that is compatible with 24 VAC @ 100 mA. It must be a maintained contact switch, not a momentary contact switch.

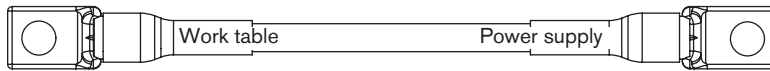
12 Torch lead assembly

Part no.	Length
228291	2 m (6 ft)
228292	3 m (10 ft)
228293	4.5 m (15 ft)
228294	6 m (20 ft)
228295	7.5 m (25 ft)
228296	10 m (35 ft)
228297	15 m (50 ft)

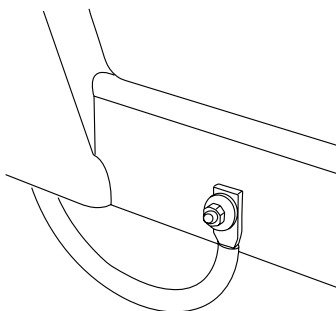
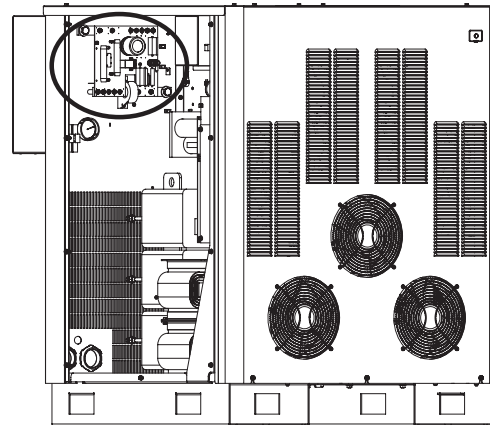
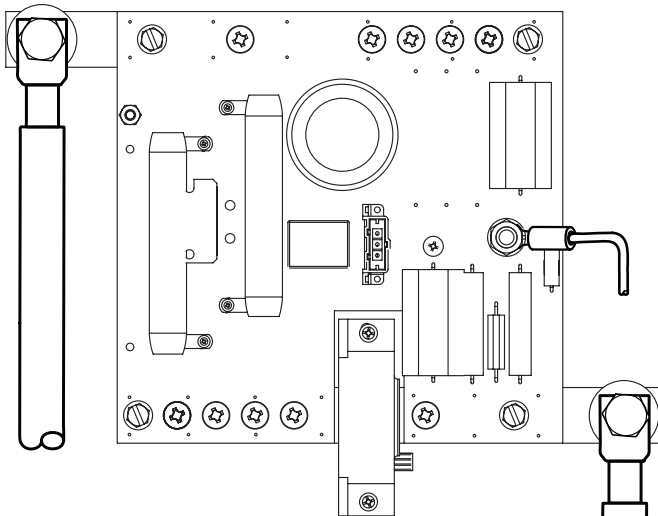
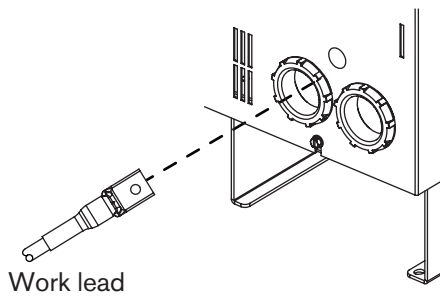
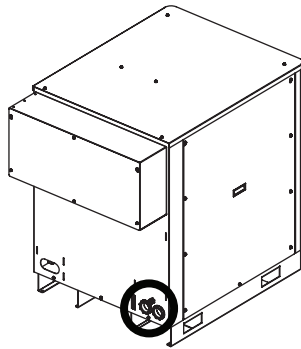
Note: A 20 m (65 ft) torch lead is not available for HPR400XD systems



## 13 Work lead



Part no.	Length	Part no.	Length
123418	3 m (10 ft)	123996	25 m (82 ft)
023382	4.5 m (15 ft)	123997	35 m (115 ft)
023078	7.5 m (25 ft)	023081	45 m (150 ft)
123994	10 m (35 ft)	023188	60 m (200 ft)
023079	15 m (50 ft)	023815	75 m (250 ft)
123995	20 m (65 ft)		



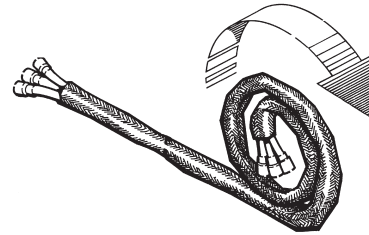
Work lead

Lower frame of work table (typical).

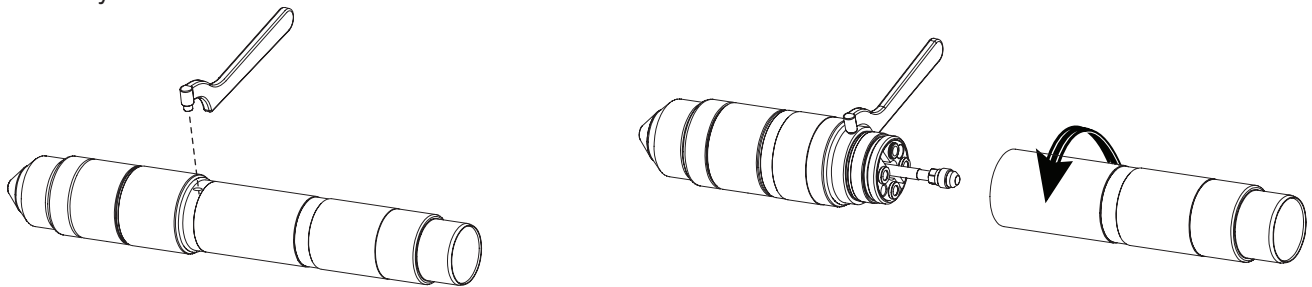
**F Torch connections**

**Connect the torch to the torch lead assembly**

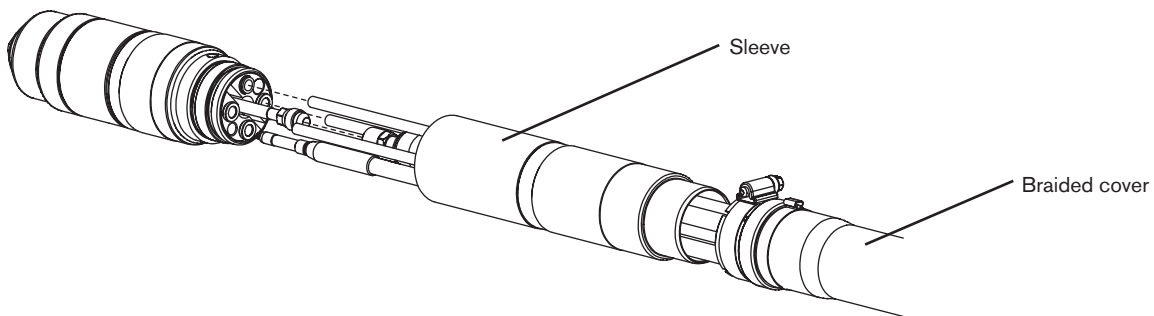
1. Uncoil the first 2 meters (6.5 ft) of the leads on a flat surface.



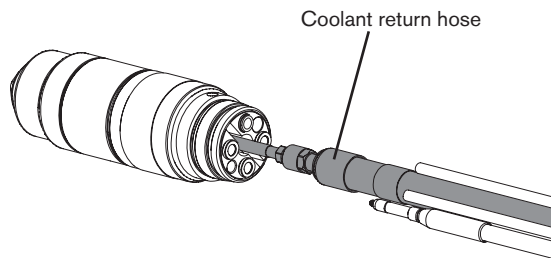
2. Hold the torch assembly in place with the spanner wrench (104269) and remove the mounting sleeve from the torch assembly.



3. Push back the braided cover and slide the sleeve over the leads. Align the torch with the hoses in the lead assembly. The hoses must not be twisted. They are taped together to help prevent twisting.



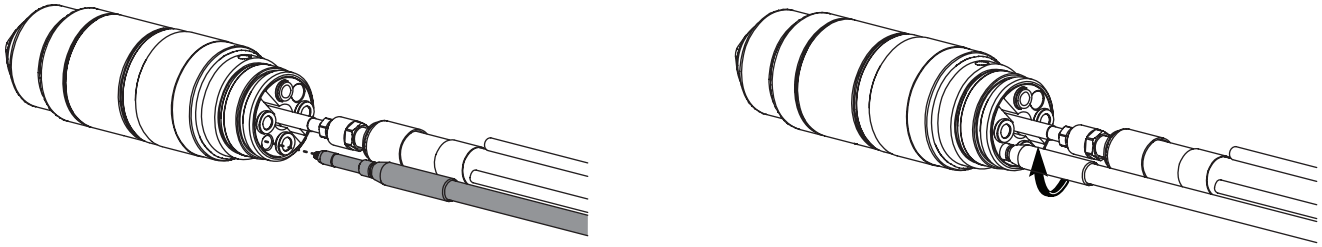
4. Connect the coolant return hose (red).



**Caution: Never use teflon tape on any joint preparation.**

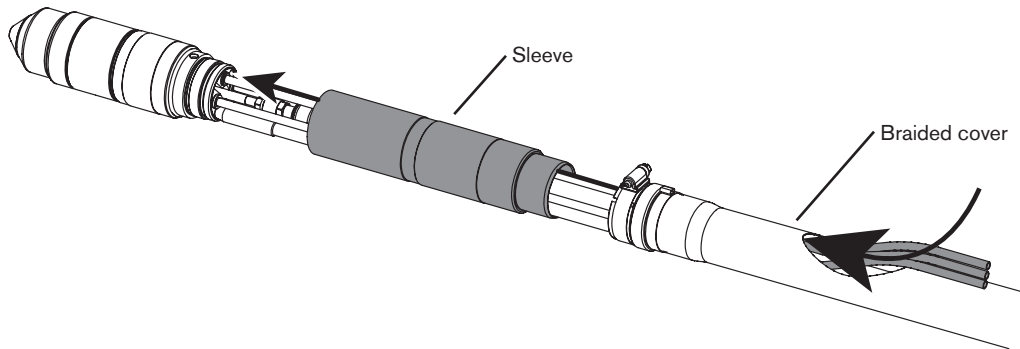
## INSTALLATION

5. Connect the pilot arc lead (yellow). Insert the connector into the torch receptacle and turn it by hand until it is tight.

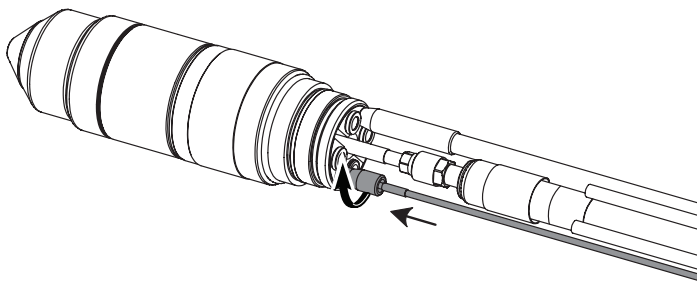


6. Connect the optional ohmic contact wire.

6a. Route the ohmic contact wire through the opening in the braided cover and the torch sleeve.

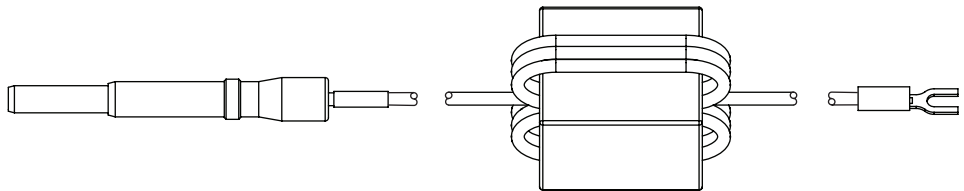


6b. Insert the connector into the torch receptacle and turn it by hand until it is tight.

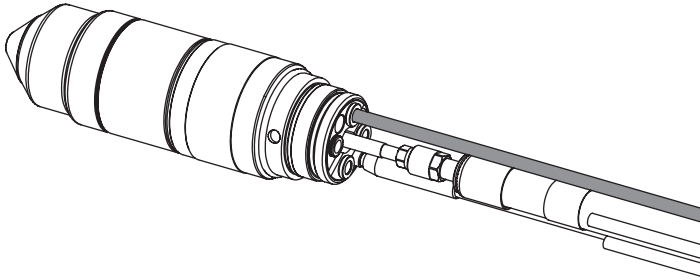


**Ohmic contact wire part numbers (Not part of the HPR400XD system. Shown for reference only)**

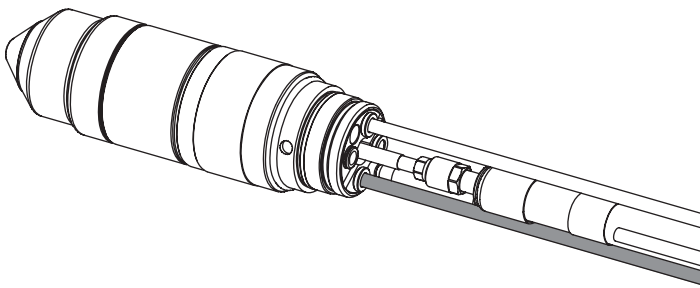
Part no.	Length
123983	3 m (10 ft)
123984	6 m (20 ft)
123985	7.5 m (25 ft)
123986	9 m (30 ft)
123987	12 m (40 ft)
123988	15 m (50 ft)
123989	23 m (75 ft)
123990	30 m (100 ft)
123991	45 m (150 ft)



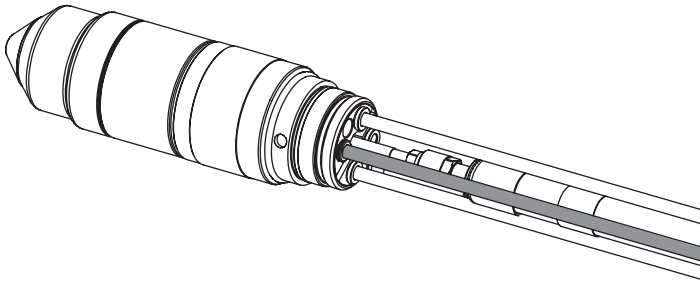
7. Connect the plasma-gas vent hose (white).



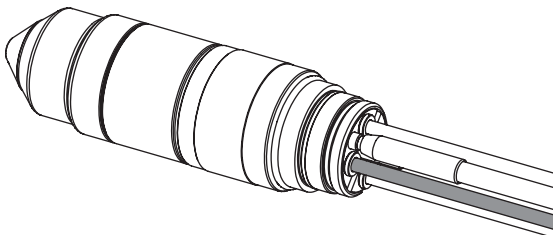
8. Connect the coolant supply hose (green).



9. Connect the plasma gas hose (black).

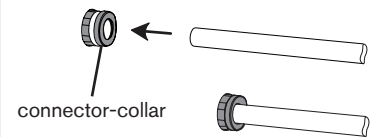


10. Connect the shield gas hose (blue).



Note: The connectors in steps 7–10 are push-to-connect fittings.

To make a connection, push the hose fitting into the appropriate connector until it stops, 13 mm (0.5 in.).



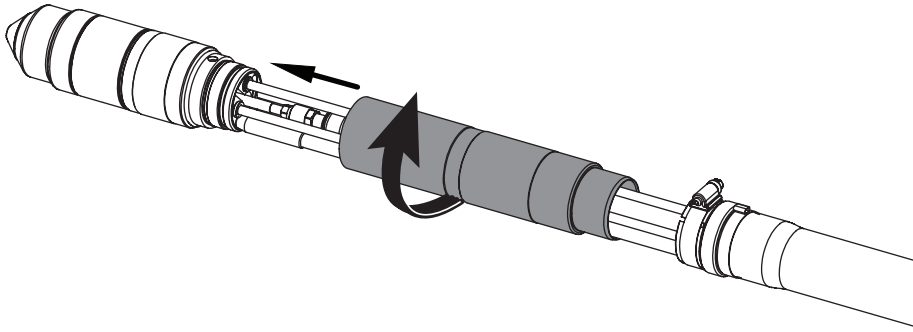
To disconnect a fitting, push the connector-collar toward the torch, and pull the hose away from the torch.



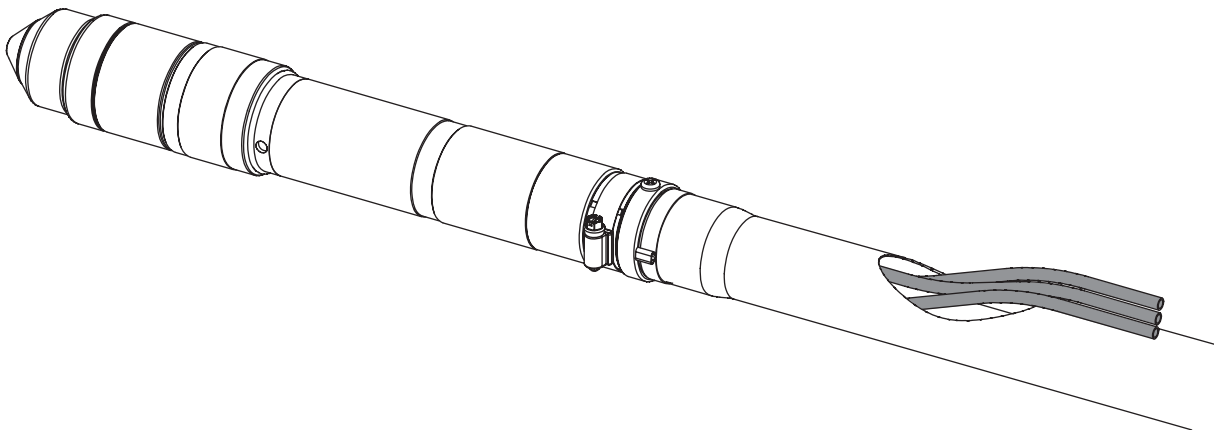
## INSTALLATION

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11. Slide the torch sleeve over the connections and screw it onto the torch assembly.

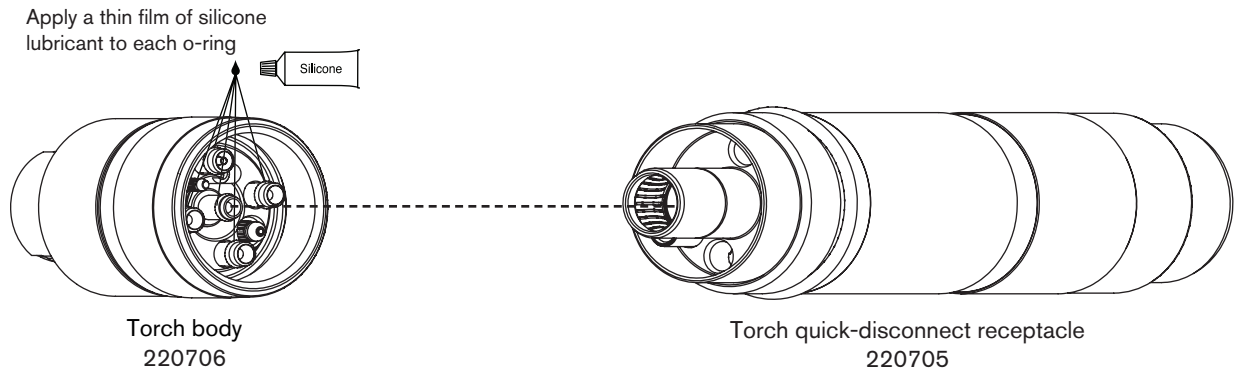


12. Slide the braided cover up to the torch sleeve. Make sure that the plasma, shield and vent hoses are routed through the hole in the braided cover. Loosen the hose clamp on the braided cover, slide the braided cover and clamp over the sleeve and tighten the clamp.



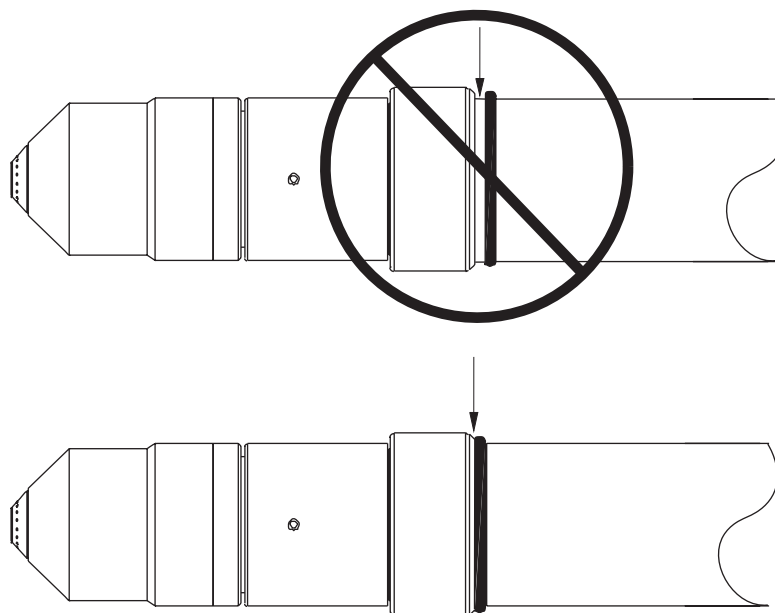


**Connect the torch to the quick-disconnect**



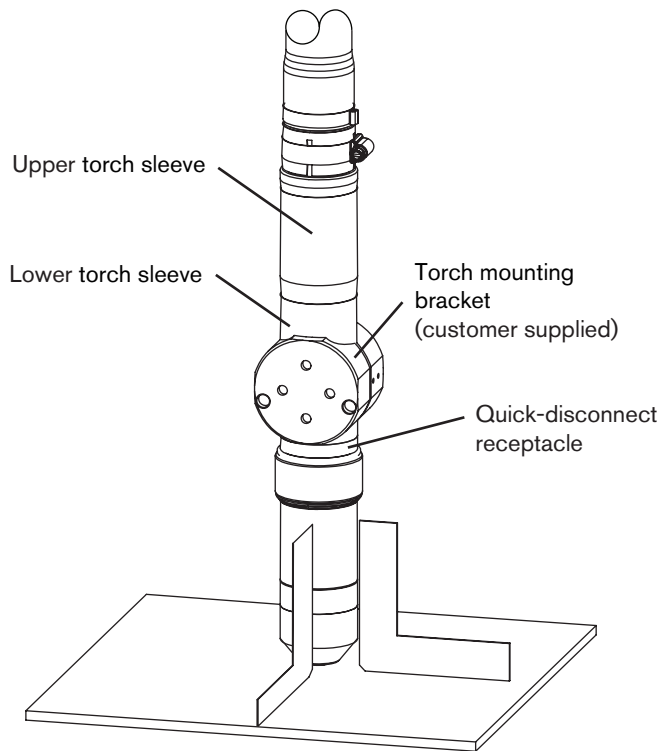
***Installation note***

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 *Torch connections* earlier in this section for torch lead connections to ignition console.



### Torch mounting and alignment

#### Mounting the torch



#### ***Installation***

1. Install the torch (with torch leads attached) in the torch mounting bracket.
2. Position the torch below the mounting bracket, so that the bracket is around the lower portion of the torch sleeve but not touching the torch quick-disconnect.
3. Tighten the securing screws.

Note: The bracket should be as low on the torch sleeve as possible to minimize vibration at the tip of the torch.

#### Torch alignment

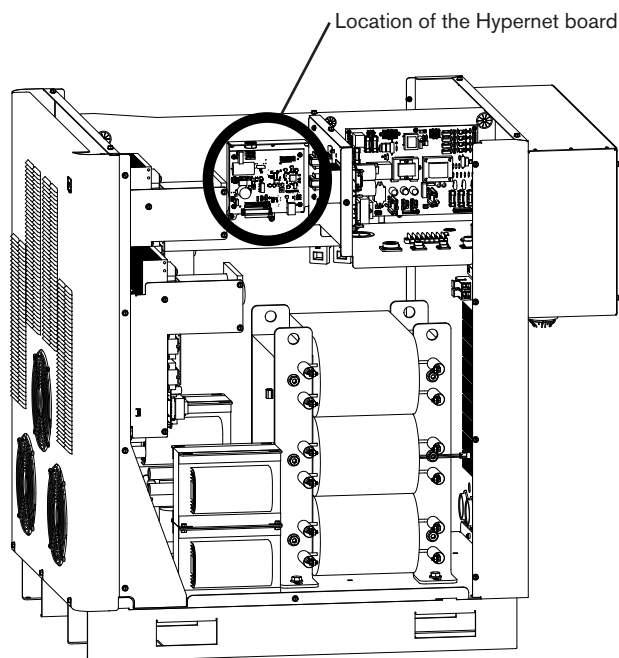
To align the torch at right angles to the workpiece, use a square. See figure above.

## Torch lifter requirement

The system requires a high-quality, motorized torch lifter with sufficient travel to cover all cutting thickness requirements. The lifter must provide 203 mm (8 in) of vertical travel. The unit should have the capability of maintaining a constant speed of up to 5080 mm/min (200 ipm) with positive braking. A unit which drifts through the stop point is not acceptable.

## HyperNet

HyperNet is only used to connect certain Hypertherm components to each other. An HPRXD system can be connected to the ArcGlide® torch height control, and an EDGE® Pro or MicroEDGE® Pro CNC using an ethernet hub and cable. The HyperNet PCB provides communication between components and is the source for the arc voltage needed for the torch height control. See the ArcGlide instruction manual (806450), the EDGE Pro instruction manual (806360) or the MicroEDGE Pro CNC instruction manual (807290) for more information.



## Power requirements

### General

All switches, slow-blow fuses and power cables are customer-supplied and must be chosen as outlined by applicable national and local electrical codes. Installation must be performed by a licensed electrician. Use a separate, primary, line disconnect switch for the power supply. Recommendations on fuse and circuit breaker sizing are listed below, however actual sizes required will vary based on individual site electrical line conditions (including but not limited to: source impedance, line impedance, and line voltage fluctuation), product inrush characteristics, and regulatory requirements.

The main feed protection device (circuit breaker or fuse) must be sized to handle all branch-feed loads for both inrush and steady-state current. The power supply must be wired into one of the branch-feed circuits. The power supply has a steady-state current listed in the table below.

Use a motor-start circuit breaker or equivalent if time delay high inrush fuses are not permitted by local and national codes. Time delay fuses and circuit breakers must be capable of withstanding inrush current that is up to 30 times the rated input current (FLA) for 0.01 seconds and up to 12 times the rated input current (FLA) for 0.1 seconds.

Input voltage	Phase	Rated input current (FLA) @ 80 kW output	Recommended time delay, high inrush fuse size	Recommended cable size for 15 m (50 ft) maximum length
				Rated for 90°C (194°F)
<b>200/208 VAC</b>	3	262/252 amps	325 amps	235 mm <sup>2</sup> (350 MCM)
<b>220 VAC</b>	3	238 amps	300 amps	201.1 mm <sup>2</sup> (300 MCM)
<b>240 VAC</b>	3	219 amps	275 amps	167.5 mm <sup>2</sup> (250 MCM)
<b>380 VAC</b>	3	138 amps	175 amps	67.5 mm <sup>2</sup> (2/0 AWG)
<b>400 VAC</b>	3	131 amps	175 amps	67.5 mm <sup>2</sup> (2/0 AWG)
<b>440 VAC</b>	3	120 amps	150 amps	53.5 mm <sup>2</sup> (1 AWG)
<b>480 VAC</b>	3	110 amps	150 amps	53.5 mm <sup>2</sup> (1 AWG)
<b>600 VAC</b>	3	88 amps	110 amps	26.7 mm <sup>2</sup> (3 AWG)

Note: Cable AWG recommendations taken from table 310-16 of the National Electric Code handbook (USA).

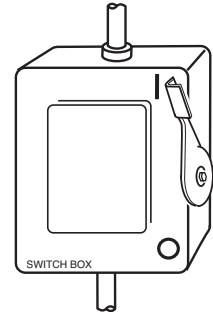
## Line disconnect switch

The line disconnect switch serves as the supply-voltage disconnecting (isolating) device. Install this switch near the power supply for easy access by the operator.

Installation must be performed by a licensed electrician and according to applicable national and 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 “O” (OFF) and “I” (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).




## 18 Main power cable

Wire sizes vary based on the distance of the receptacle from the main box. The wire sizes listed in the table above were taken from the National Electric Code 1990 handbook, table 310.16 (USA). Use a 4-conductor Type SO input power cable with a conductor temperature rating of 90° C (194° F). Installation must be performed by a licensed electrician.

## INSTALLATION

### Connect the power

	<p style="text-align: center;"><b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b></p>
<p><b>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 national and local safety procedures.</b></p>	

1. Insert the power cable through the strain relief at the rear of the power supply.
2. Connect the ground lead (PE) to the GROUND terminal ( $\oplus$ ) of TB1 as shown below.
3. Connect the power leads to the terminals of TB1 as shown below.
4. Verify that the line disconnect switch is in the OFF position and remains in the OFF position for the remainder of the installation of the system.
5. Connect the power cord leads to the line disconnect switch following national and local electrical codes.

#### North American wire colors

**U = Black**

**V = White**

**W = Red**

**(PE) Earth ground = Green/Yellow**

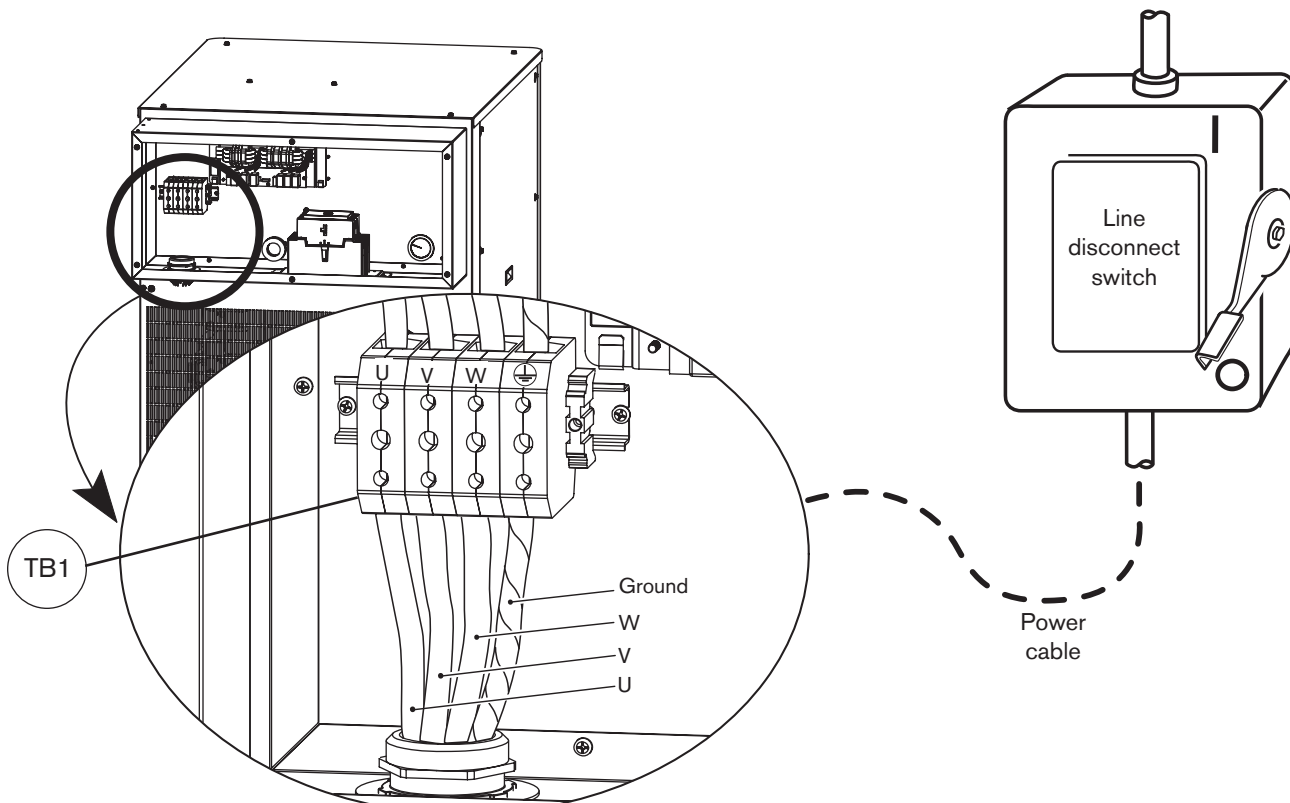
#### European wire colors

**U = Black**

**V = Blue**

**W = Brown**



**(PE) Earth ground = Green/Yellow**




## Torch coolant requirements

The system is shipped without any coolant in the tank. Before filling the coolant system, determine what coolant mix is correct for your operating conditions.

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

		<p><b>DANGER</b>  <b>COOLANT CAN BE IRRITATING TO SKIN AND EYES AND HARMFUL OR FATAL IF SWALLOWED</b></p>
<p><b>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, seek immediate medical attention.</b></p>		

	<p><b>Caution: Never use automotive anti-freeze in place of propylene glycol. Antifreeze contains corrosion inhibitors that will damage the torch coolant system.</b></p> <p><b>Always use purified water in the coolant mixture in order to prevent damage to the pump and corrosion in the torch coolant system.</b></p>
--	--

## Premixed coolant for standard operating temperatures

Use Hypertherm premixed coolant (028872) when operating in a temperature range of -12° C to 40° C (10° F to 104° F). Refer to the custom coolant mix recommendations, if temperatures during operation are ever outside of this range.

Hypertherm premixed coolant consists of 69.8% water, 30% propylene glycol, and 0.2% benzotriazole.

# INSTALLATION

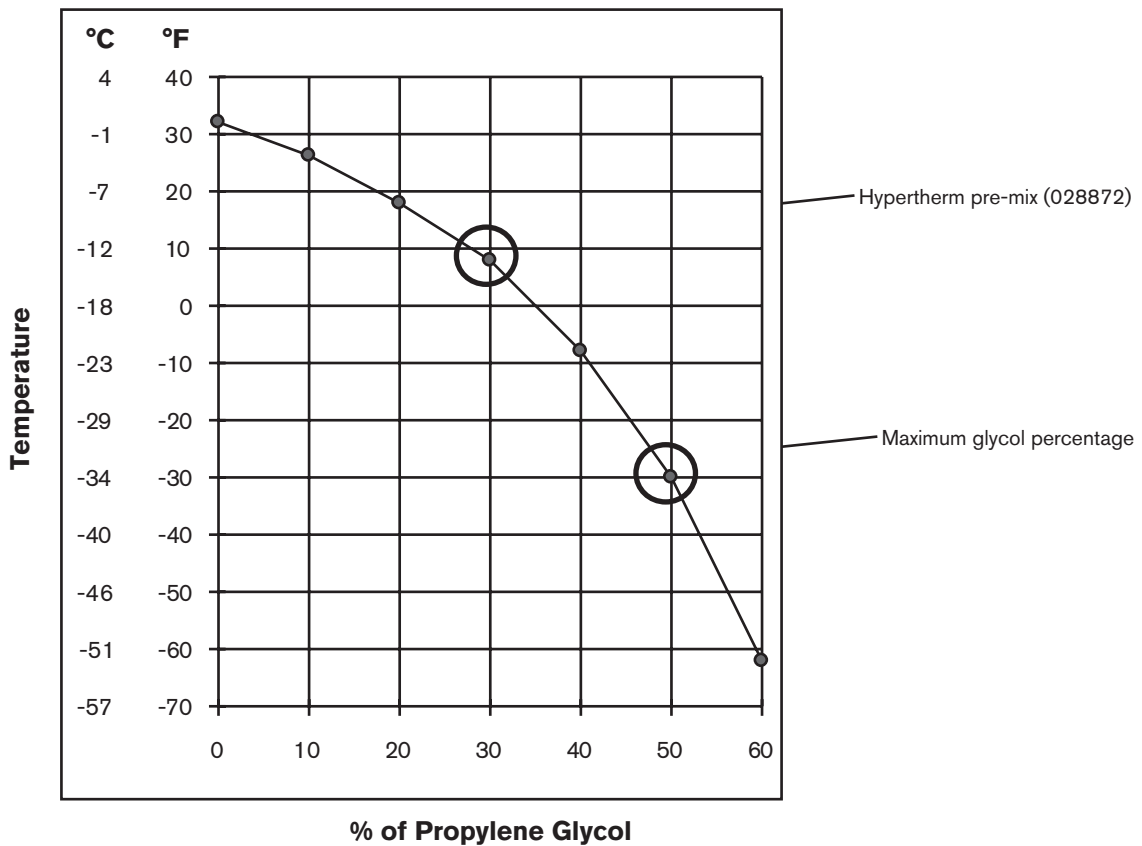
## Custom Coolant mix for cold operating temperatures (below -12° C / 10° F)

**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 freezing.

Use the chart below to determine what percentage of propylene glycol to use in the mixture.

Mix 100% glycol (028873) with the premixed Hypertherm coolant (028872) to increase the percentage of glycol. The 100% glycol solution can also be mixed with purified water (see next page for water purity requirements) to achieve the required protection from freezing.

Note: Maximum percentage of glycol should never exceed 50%.



Freezing Point of Propylene Glycol Solution



**Custom Coolant mix for hot operating temperatures (above 38° C / 100° F)**

Treated water (with no propylene glycol) can only be used as coolant when operating temperatures are **never** below 0° C (32° F). For operations in very warm temperatures treated water will provide the best cooling properties.

Treated water refers to a mixture of purified water, that meets the specifications below, and 1 part benzotriazole (BZT) to 300 parts of water. BZT (128020) acts as a corrosion inhibitor for the copper based coolant system contained in the plasma system.

**Water purity requirements**

It is critical to maintain a low level of calcium carbonate in the coolant to avoid reduced performance of the torch or cooling system.

Always use water that meets the minimum and maximum specifications in the table below when using a custom coolant mix.

Water that does not meet the minimum purity specifications below can cause excessive deposits on the nozzle that will alter the water flow and produce an unstable arc.

Water that does not meet the maximum purity specifications below can also cause problems. Deionized water that is too pure will cause leaching problems with the coolant system plumbing.

Use water purified by any method (deionization, reverse osmosis, sand filters, water softeners, etc.) as long as the water purity meets the specifications in the table below. Contact a water specialist for advice in choosing a water filtration system.

Water purity	Water purity measurement method			
	Conductivity μS/cm at 25° C (77° F)	Resistivity mΩ-cm at 25° C (77° F)	Dissolved solids (ppm of NaCl)	Grains per gallon (gpg of CaCO <sub>2</sub> )
Pure water (for reference 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
Maximum potable water (for reference only)	1000	0.001	495	25

### Fill the cooler with coolant

The cooling system's capacity is 15.5 to 34.5 liters (4 to 9 gallons) of coolant, depending on the length of the torch leads and coolant hoses.

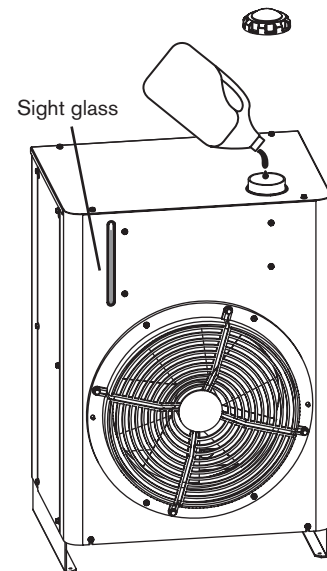
**Caution:**



**Using the wrong coolant can cause damage to the system. Refer to *Torch Coolant Requirements* in this section for more information.**

**Do not over fill the coolant tank.**

1. Remove the filler cap and add coolant until the level in the sight glass reaches full.
2. Turn ON the power supply using the remote ON/OFF switch or the CNC. The coolant level in the tank will drop as the coolant circulates through the system, and an error code (060 or 093) may occur.
3. Turn OFF the power.
4. Add coolant to the cooler until the level in the sight glass reaches full, and turn ON the power.
5. Repeat this process as many times as necessary, until the pump can be run continuously. This will allow coolant to completely fill the coolant loop and purge any air from the system.
6. Replace the filler cap.



## Gas requirements

The customer must furnish all gases and gas-supply regulators for the system. Use a high-quality, 2-stage pressure regulator located within 3 m (10 ft) of the selection console. See *gas regulators* in this section for recommendations. See the *Specification* section for gas and flow specifications. See *Supply gas hoses* at the end of this section for recommendations.

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

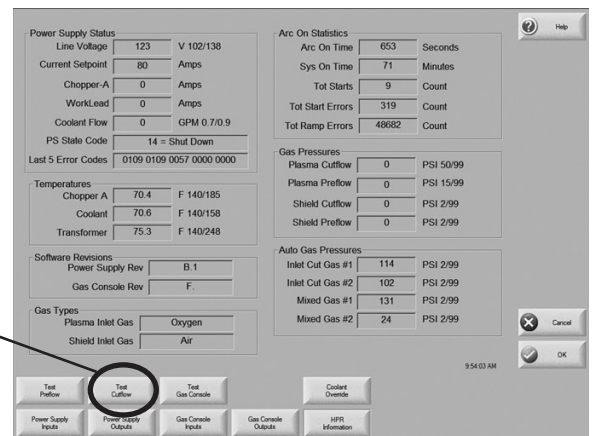


If the purity level of the gas is too low or if there are leaks in the supply hoses or connections,

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

## Setting the supply regulators

1. Turn OFF the power to the system. Set all gas regulator pressures to 8 bar (115 psi).
2. Turn ON the power to the system using the remote ON/OFF switch or the CNC.
3. Set to Test Prewflow.
4. While gas is flowing adjust the supply regulator for the shield gas to 8 bar (115 psi).
5. Turn OFF Test Prewflow.
6. Set system to Test Cutflow.
7. While gas is flowing adjust the supply regulator for the plasma gas to 8 bar (115 psi).
8. Turn OFF Test Cutflow.



## INSTALLATION

### 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 and local codes.

2-stage regulator



Single stage regulator



<b>Part Number</b>	<b>Description</b>	<b>Qty.</b>
128544	<b>Kit: Oxygen, 2-stage *</b>	<b>1</b>
128545	<b>Kit: Inert Gas, 2-stage</b>	<b>1</b>
128546	<b>Kit: Hydrogen (H5, H35 and methane) 2-stage</b>	<b>1</b>
128547	<b>Kit: Air, 2-stage</b>	<b>1</b>
128548	<b>Kit: 1-stage (for use with cryogenic liquid nitrogen or oxygen)</b>	<b>1</b>
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

## Supply gas plumbing

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

Recommended hose diameters are 9.5 mm (3/8 in) for lengths < 23 m (75 ft) and 12.5 mm (1/2 in) for lengths > 23 m (75 ft).

For flexible-hose systems, use a hose designed for inert gas to carry air, nitrogen or argon-hydrogen. See the last page of this section for hose part numbers.

**Caution: Never use teflon tape on any joint preparation.**



**Caution: When connecting the selection console to the supply gases, make sure that all hoses, hose connections and fittings are acceptable for use with oxygen and argon-hydrogen. Installation must be made in accordance with national and local codes.**



Note: When cutting with oxygen as the plasma gas, air must also be connected to the selection console to achieve the proper mixtures in the preflow and cutflow modes.



**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.**

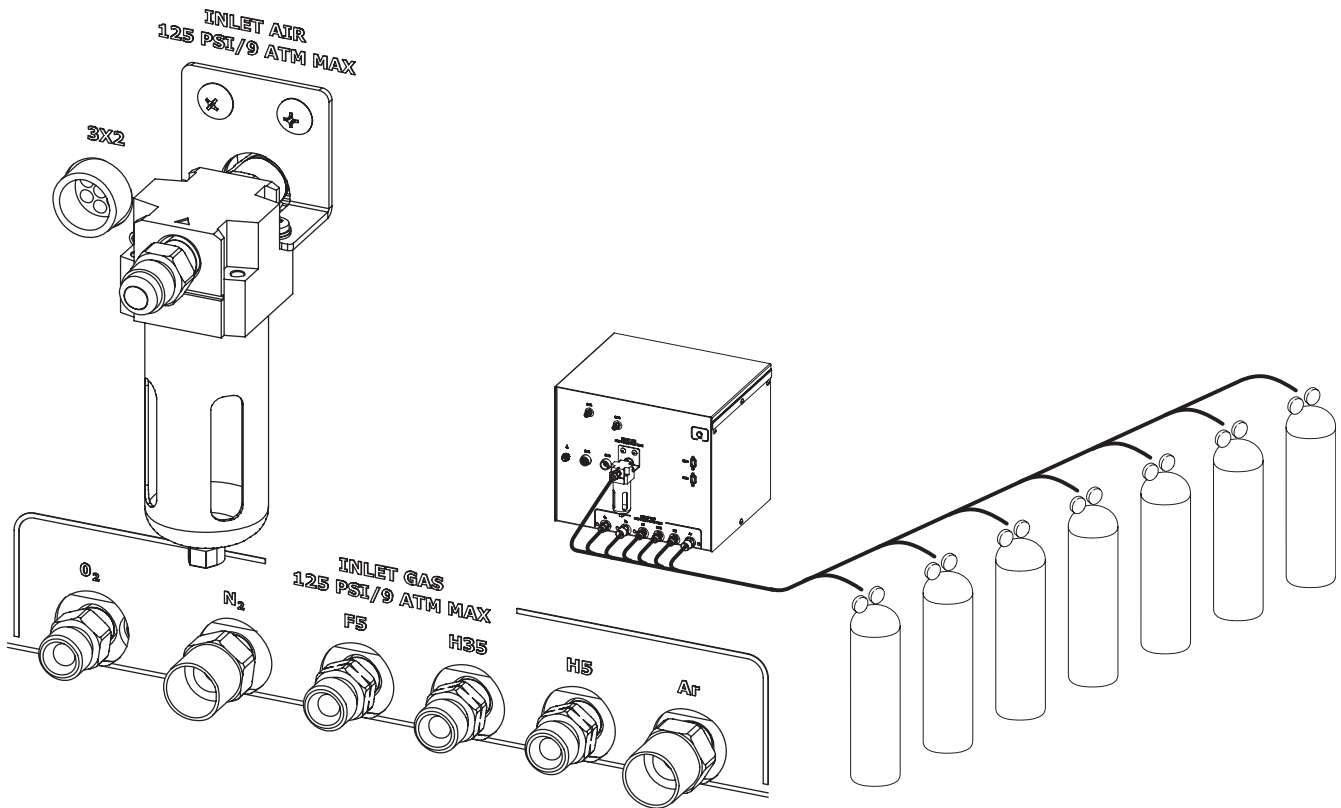
**Flashback arrestors are required (unless not available for specific gases or required pressures) to prevent fire from propagating back to supply gas.**

# INSTALLATION

## Connect the supply gases

Connect the supply gases to the selection console. Torch leads must be purged between gas changes.

Fitting	Size
N <sub>2</sub> / Ar	5/8 – 18, RH, internal (inert gas) "B"
Air	9/16 – 18, JIC, No. 6
H35 / F5 / H5	9/16 – 18, LH, (fuel gas) "B"
O <sub>2</sub>	9/16 – 18, RH, (oxygen) "B"



**Caution:** Replacing the fittings on the selection console may cause the internal valves to malfunction, because particulates can migrate into the valves.



## Supply gas hoses

### 14 Oxygen hose



**Caution:** Never use teflon tape on any joint preparation.

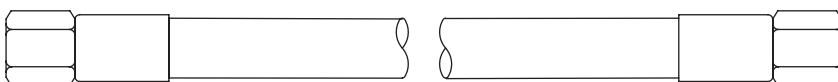
Part no.	Length	Part no.	Length
024607	3 m (10 ft)	024738	25 m (82 ft)
024204	4.5 m (15 ft)	024450	35 m (115 ft)
024205	7.5 m (25 ft)	024159	45 m (150 ft)
024760	10 m (35 ft)	024333	60 m (200 ft)
024155	15 m (50 ft)	024762	75 m (250 ft)
024761	20 m (65 ft)		

### 15 Nitrogen or argon hose



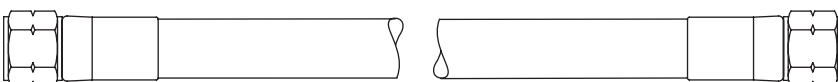
Part no.	Length	Part no.	Length
024210	3 m (10 ft)	024739	25 m (82 ft)
024203	4.5 m (15 ft)	024451	35 m (115 ft)
024134	7.5 m (25 ft)	024120	45 m (150 ft)
024211	10 m (35 ft)	024124	60 m (200 ft)
024112	15 m (50 ft)	024764	75 m (250 ft)
024763	20 m (65 ft)		

### 16 Air hose



Part no.	Length	Part no.	Length
024671	3 m (10 ft)	024740	25 m (82 ft)
024658	4.5 m (15 ft)	024744	35 m (115 ft)
024659	7.5 m (25 ft)	024678	45 m (150 ft)
024765	10 m (35 ft)	024680	60 m (200 ft)
024660	15 m (50 ft)	024767	75 m (250 ft)
024766	20 m (65 ft)		

### 17 Argon-hydrogen (H35) or nitrogen-hydrogen (F5)



Part no.	Length	Part no.	Length
024768	3 m (10 ft)	024741	25 m (82 ft)
024655	4.5 m (15 ft)	024742	35 m (115 ft)
024384	7.5 m (25 ft)	024743	45 m (150 ft)
024769	10 m (35 ft)	024771	60 m (200 ft)
024656	15 m (50 ft)	024772	75 m (250 ft)
024770	20 m (65 ft)		





## Section 4

### OPERATION

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*In this section:*

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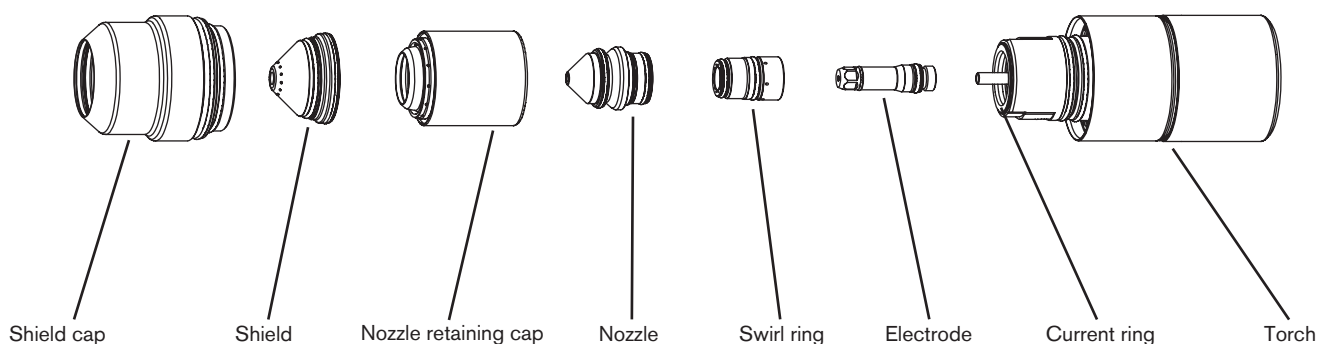
## Daily start-up

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

### Check torch

		<p><b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b></p>
<p><b>Before operating this system, you must read the <i>Safety</i> section thoroughly. Turn OFF the power supply's main disconnect switch before proceeding with the following steps.</b></p>		

1. Turn main disconnect switch to the power supply OFF.
2. Remove the consumables from the torch and check for worn or damaged parts. **Always place the consumables on a clean, dry, oil-free surface after removing. Dirty consumables can cause the torch to malfunction.**
  - Refer to *Install and inspect consumables* later in this section for details and for parts inspection tables.
  - Refer to the *Cut charts* to choose the correct consumables for your cutting needs.
3. Replace consumable parts. Refer to *Install and inspect consumables* later in this section for details.
4. Ensure that the torch is perpendicular to the workpiece.

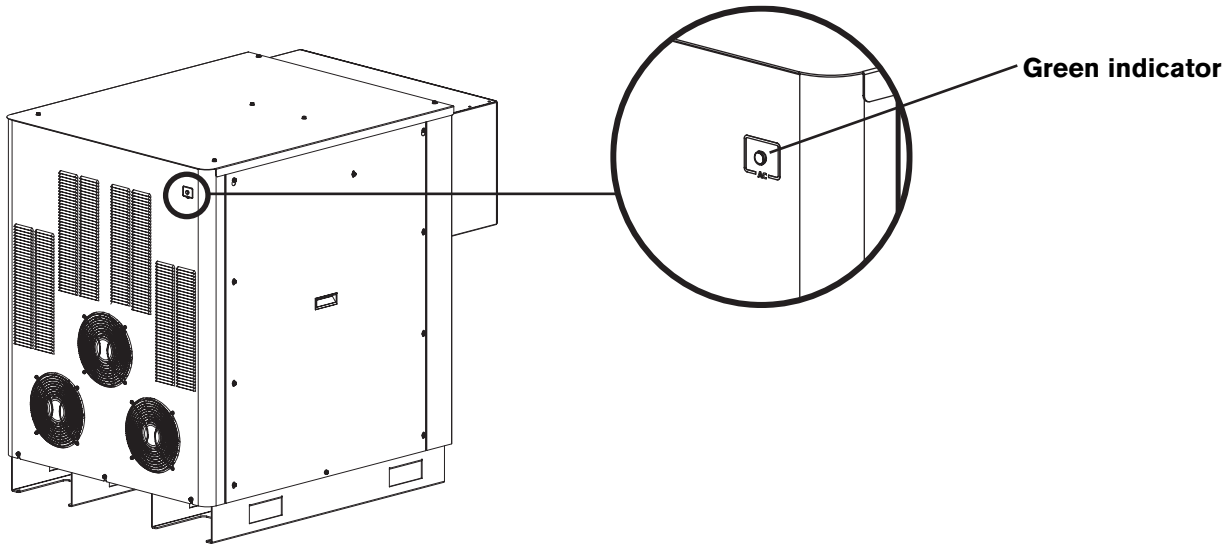


## Power indicators

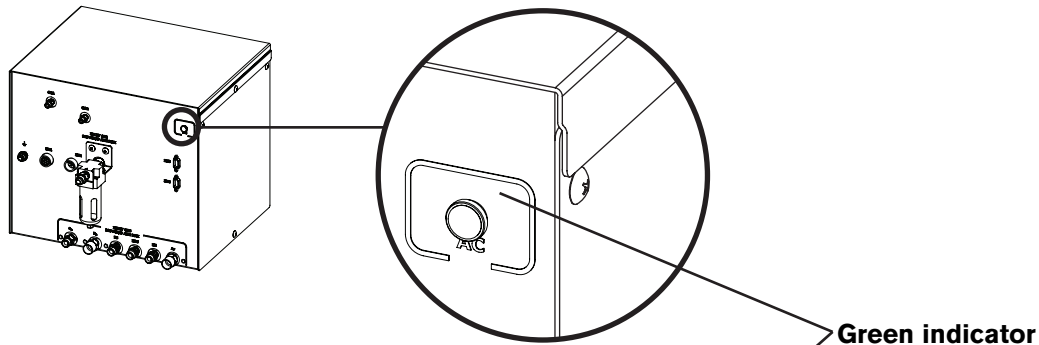
### General

Power for the system is controlled by the CNC. The power supply, selection console and metering console each have an LED lamp that illuminates when power is supplied to the component.

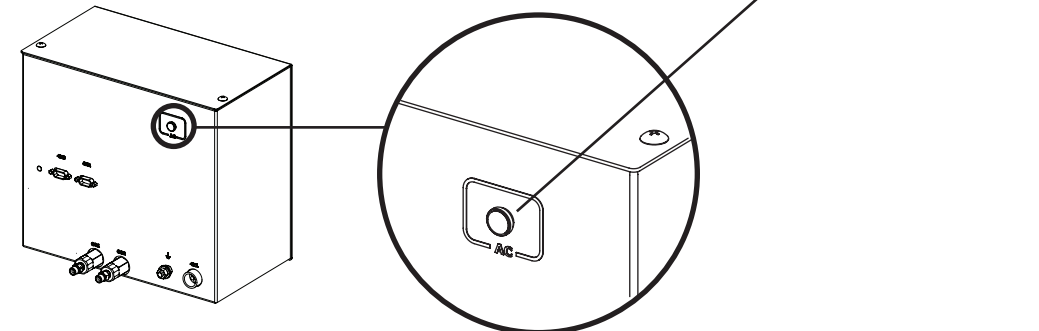
### Power supply



### Selection console



### Metering console



## CNC controller requirements

Note: See appendix B, *CNC interface protocol*, for more detailed information.

### Base required elements

The following elements should be able to be displayed and adjusted on the CNC for setup and basic system information. The plasma system needs this group for basic setup and operation capability.

1. Remote ON/OFF
2. Ability to display and adjust the basic plasma process set-points (command ID No. 95)
  - a. Current set point
  - b. Plasma preflow
  - c. Plasma cutflow
  - d. Shield preflow
  - e. Shield cutflow
  - f. Plasma gas type
  - g. Shield gas type
  - h. Gas mixing set-points
3. Display basic system information
  - a. System error code
  - b. Gas and PS firmware version
4. Manual pump control

### Required real time elements

The following elements should be able to be displayed in real time while cutting. This is necessary for troubleshooting and diagnostic purposes.

5. Display line voltage
6. Display chopper current
7. Display work lead current
8. Display system status code
9. Display chopper temperature
10. Display transformer temperature
11. Display coolant temperature
12. Display coolant flow
13. Display pressure transducers

### Required diagnostic elements

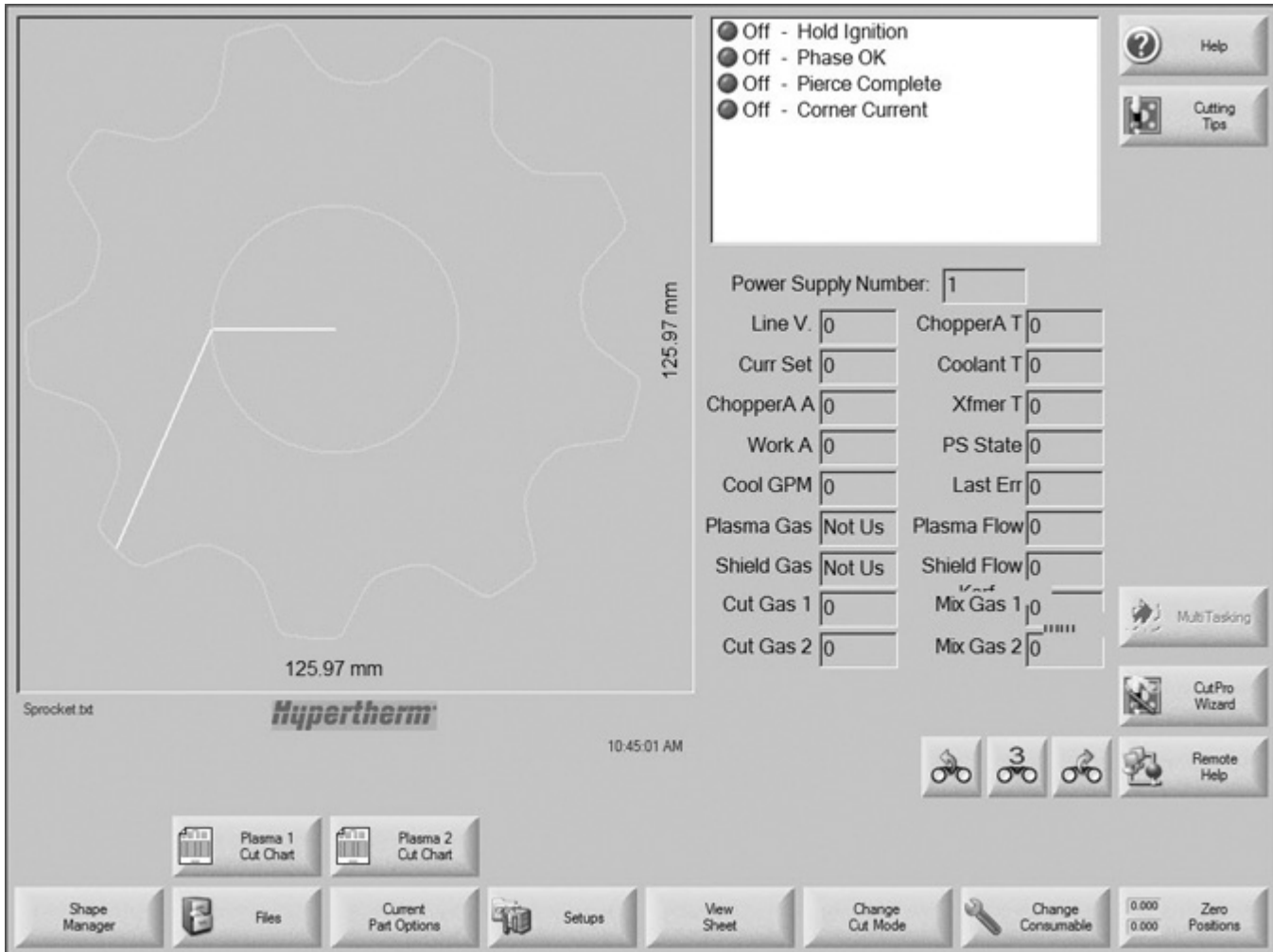
These elements provide additional diagnostic capability to the system for troubleshooting gas-delivery problems. The CNC should be capable of executing these commands and displaying the relevant information for the respective test according to the serial protocol guidelines.

14. Test preflow gases
15. Test cutflow gases
16. Inlet leak test
17. System leak test
18. System flow test


## CNC screen examples

The screens shown are for reference. The screens you work with may be different, but should include the functions listed on the previous page.

### Main (control) screen



Diagnostic screen

<b>Power Supply Status</b> Line Voltage <input type="text" value="123"/> V 102/138 Current Setpoint <input type="text" value="80"/> Amps Chopper-A <input type="text" value="0"/> Amps WorkLead <input type="text" value="0"/> Amps Coolant Flow <input type="text" value="0"/> GPM 0.7/0.9 PS State Code <input type="text" value="14 = Shut Down"/> Last 5 Error Codes <input type="text" value="0109 0109 0057 0000 0000"/>		<b>Arc On Statistics</b> Arc On Time <input type="text" value="653"/> Seconds Sys On Time <input type="text" value="71"/> Minutes Tot Starts <input type="text" value="9"/> Count Tot Start Errors <input type="text" value="319"/> Count Tot Ramp Errors <input type="text" value="48682"/> Count		 Help
<b>Temperatures</b> Chopper A <input type="text" value="70.4"/> F 140/185 Coolant <input type="text" value="70.6"/> F 140/158 Transformer <input type="text" value="75.3"/> F 140/248		<b>Gas Pressures</b> Plasma Cutflow <input type="text" value="0"/> PSI 50/99 Plasma Prewflow <input type="text" value="0"/> PSI 15/99 Shield Cutflow <input type="text" value="0"/> PSI 2/99 Shield Prewflow <input type="text" value="0"/> PSI 2/99		 Cancel  OK
<b>Software Revisions</b> Power Supply Rev <input type="text" value="B.1"/> Gas Console Rev <input type="text" value="F."/>		<b>Auto Gas Pressures</b> Inlet Cut Gas #1 <input type="text" value="114"/> PSI 2/99 Inlet Cut Gas #2 <input type="text" value="102"/> PSI 2/99 Mixed Gas #1 <input type="text" value="131"/> PSI 2/99 Mixed Gas #2 <input type="text" value="24"/> PSI 2/99		
<b>Gas Types</b> Plasma Inlet Gas <input type="text" value="Oxygen"/> Shield Inlet Gas <input type="text" value="Air"/>		9:54:03 AM		
<input type="button" value="Test Prewflow"/>	<input type="button" value="Test Cutflow"/>	<input type="button" value="Test Gas Console"/>	<input type="button" value="Coolant Override"/>	
<input type="button" value="Power Supply Inputs"/>	<input type="button" value="Power Supply Outputs"/>	<input type="button" value="Gas Console Inputs"/>	<input type="button" value="Gas Console Outputs"/>	<input type="button" value="HPR Information"/>

Test screen

Station 1

Power Supply Status

Line Voltage	0	Volts
Current Setpoint	0	Amps
ChopperA	0	Amps
WorkLead	0	Amps
Coolant Flow	0	GPM
PS State Code	0 = Idle	
Last Error Code	C	

Arc On Statistics

Arc On Time	0	Seconds
Sys On Time	0	Minutes
Tot Starts	0	Count
Tot Start Errors	0	Count
Tot Ramp Errors	0	Count

Temperatures

ChopperA	0
Coolant	0
Transformer	0

Software Revisions

Power Supply Rev	
Gas Console Rev	

Gas Types

Plasma Inlet Gas	Not Used
Shield Inlet Gas	Not Used

EDGE Pro

HPR Gas System Tests

- Inlet Leak Check ( 1 minute )
- System Leak Check ( 1 minute )

OK Cancel

10:47:22 AM

Cancel

OK

Test Prewlow Test Cutflow Test Gas Console Coolant Override

Power Supply Inputs Power Supply Outputs Gas Console Inputs Gas Console Outputs HPR Information



Cut chart screen

Plasma 1 Cut Chart - Rev 80006N

HPR - Cut Process Selection

Torch Type **HPR XD**

Material Type **Mild Steel**

Specific Material **None**

Process Current **260A**

Plasma / Shield Gases **O2 / Air**

Material Thickness **10mm**

	Plasma		Shield		
	Auto	Manual	Auto	Manual	
Preflow Setting	<input type="text" value="22"/>	<input type="text" value="24"/>	<input type="text" value="49"/>	<input type="text" value="75"/>	%
Cutflow Setting	<input type="text" value="76"/>	<input type="text" value="70"/>	<input type="text" value="46"/>	<input type="text" value="70"/>	%
	Gas 1		Gas 2		
Mixed Gas	<input type="text" value="0"/>	<input type="text" value="0"/>			%
Cut Speed	<input type="text" value="4572"/>				mmpm
Kerf	<input type="text" value="2.5"/>				mm
Pierce Time	<input type="text" value="0.3"/>				sec
Cut Height Delay	<input type="text" value="0"/>				sec
Creep Time	<input type="text" value="0"/>				sec
Cut Height	<input type="text" value="2.7"/>				mm
Transfer Height	<input type="text" value="300"/>	%	<input type="text" value="8.1"/>	mm	
Pierce Height	<input type="text" value="300"/>	%	<input type="text" value="8.1"/>	mm	
Set Arc Voltage	<input type="text" value="150"/>				volts
Set Arc Current	<input type="text" value="260"/>				amps

10:48:19 AM

### Consumable selection

#### Standard cutting (0°)

Most of the consumables on the following pages are designed for standard (straight) cutting, when the torch is perpendicular to the workpiece.

#### Bevel cutting (0° to 45°)

Consumables for 130 amp and 260 amp bevel cutting are specifically designed for bevel cutting. 400 amp consumables can be used for standard cutting and bevel cutting, but bevel-specific, 400 amp cut charts are provided for convenience.

#### Marking

Any of the consumable sets can also be used for marking with argon or nitrogen. Marking parameters are shown at the bottom of each cut chart. The quality of the marks will vary depending on the marking process, cut process, material type, material thickness, and material surface finish. For best mark quality, use the argon marking process settings. For all marking processes the depth of the mark can be increased by reducing the marking speed, or the depth can be decreased by increasing the marking speed. Argon marking currents can be increased by up to 30% to increase the depth of the mark. When marking with an argon process at 25 amps or greater, the process will start with air before changing to argon, and a thicker, darker mark will be seen at the start of the mark. When using the argon marking processes, mark and cut individual parts. Marking the entire nest prior to cutting may lead to reduced consumable life. For better results intersperse cuts and marks. Poor quality marking or burn-through may occur with material less than 1.5 mm (0.06 in. or 16 gauge).

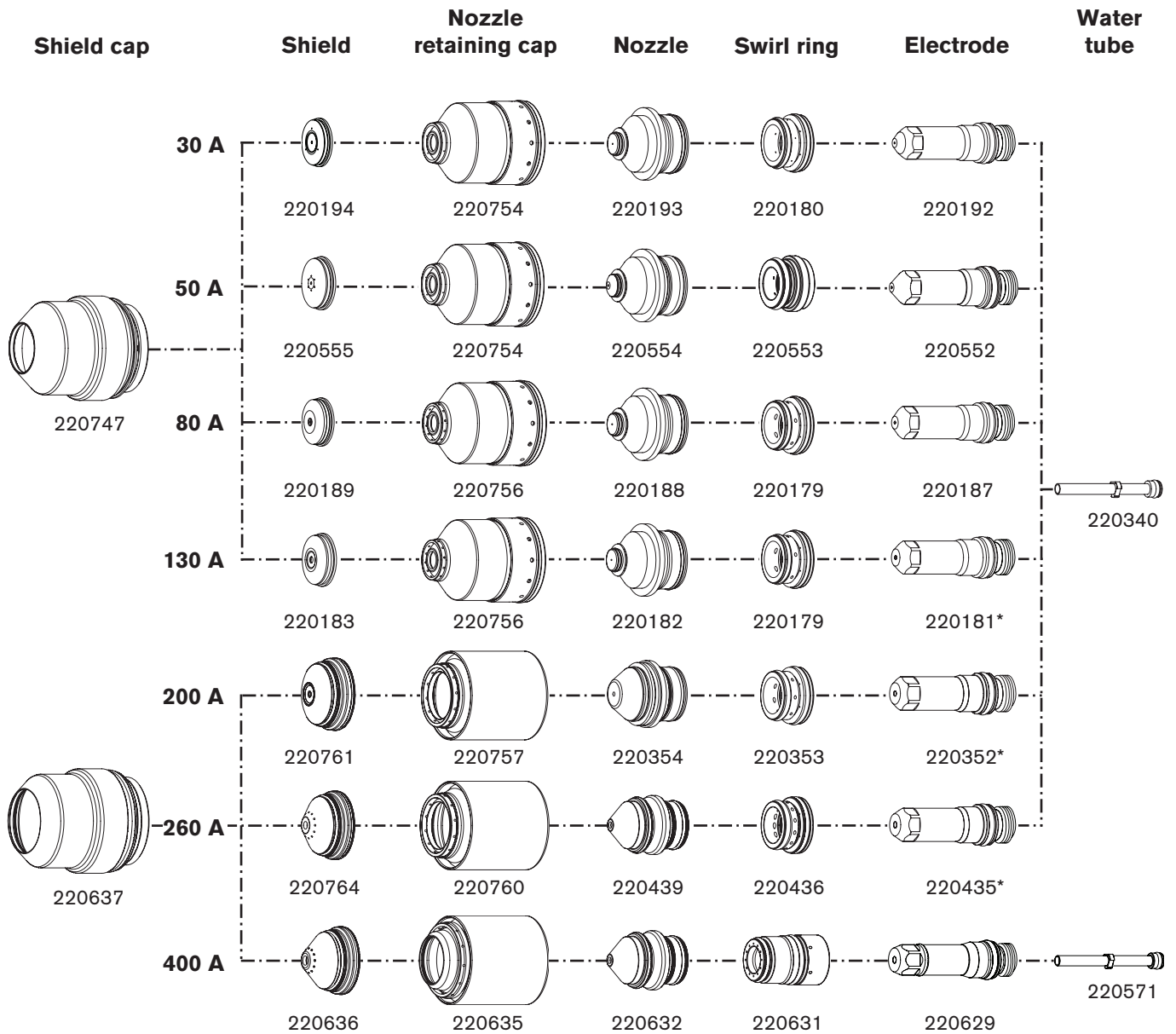
#### Consumables for mirror-image cutting

See the *Parts List* section in this manual for part numbers.

#### SilverPlus electrodes

SilverPlus electrodes provide increased life when the average cut duration is short (< 60 seconds), and cut quality is not the most critical requirement. SilverPlus electrodes are available for 130 amp, 200 amp, and 260 amp mild steel O<sub>2</sub> / Air cutting. Part numbers can be found on the following page.

Mild steel



\* SilverPlus electrodes are available for these processes.

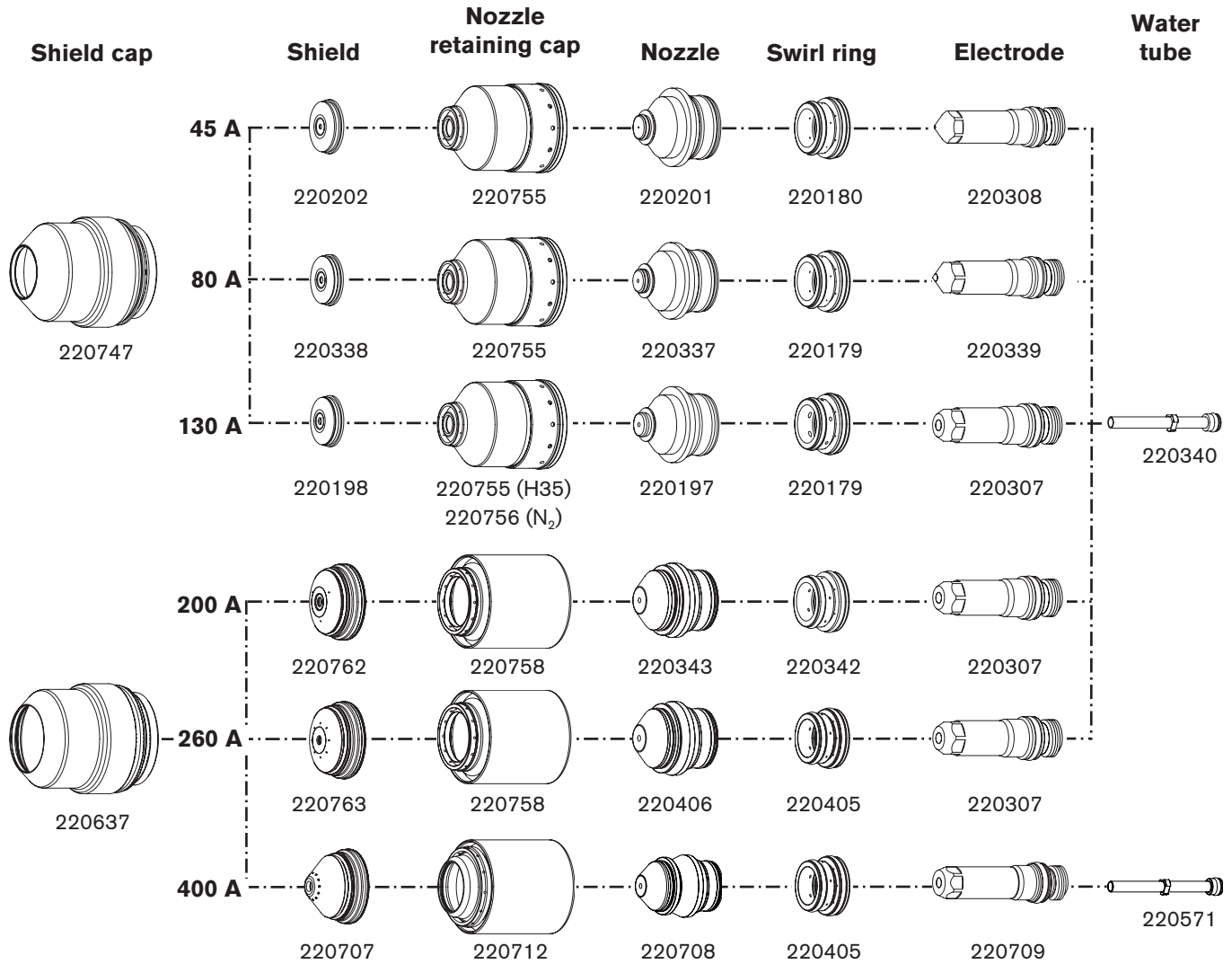
Mild steel, 130 amp, O<sub>2</sub> / Air – 220665

Mild steel, 200 amp, O<sub>2</sub> / Air – 220666

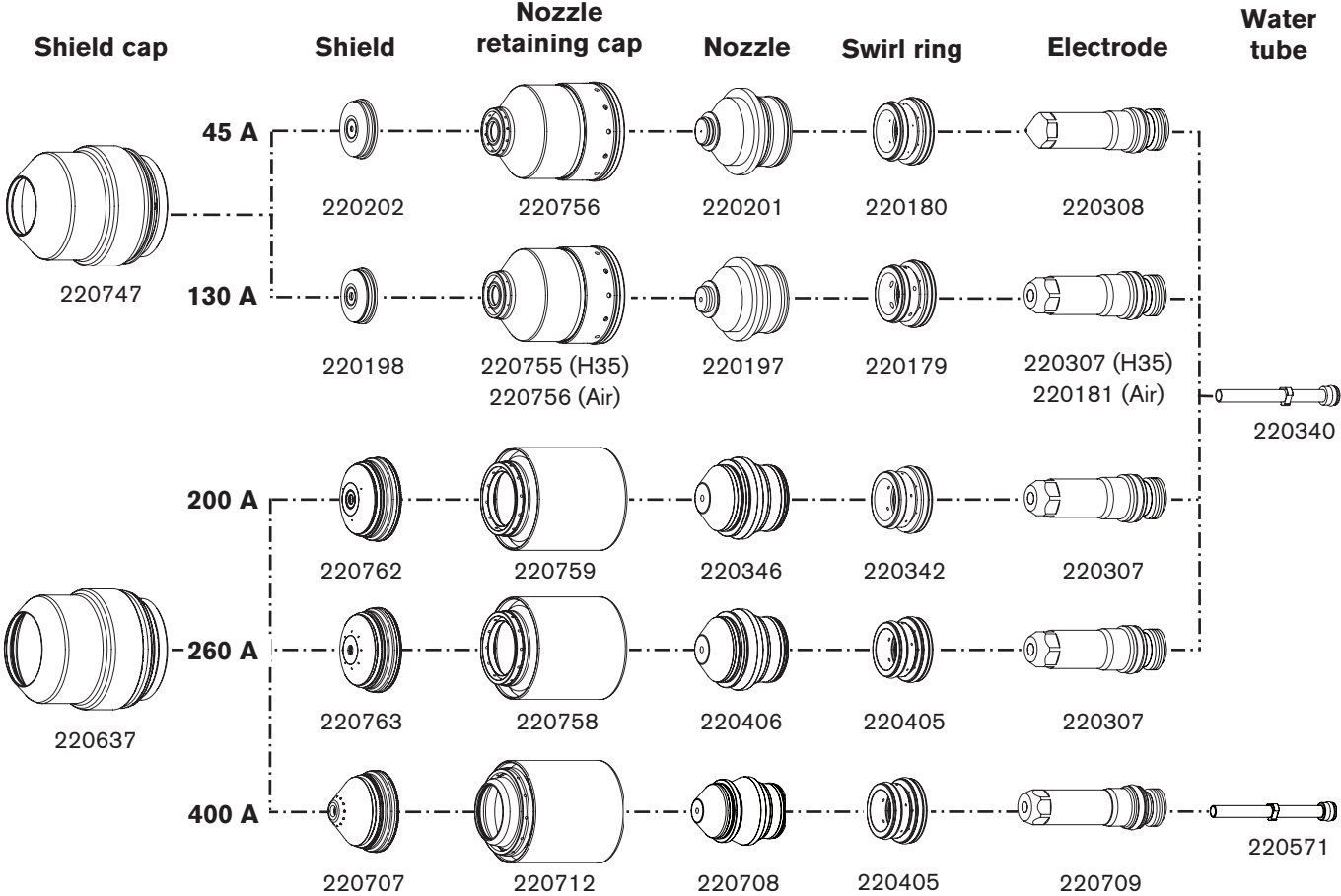
Mild steel, 260 amp, O<sub>2</sub> / Air – 220668

# OPERATION

## Stainless steel

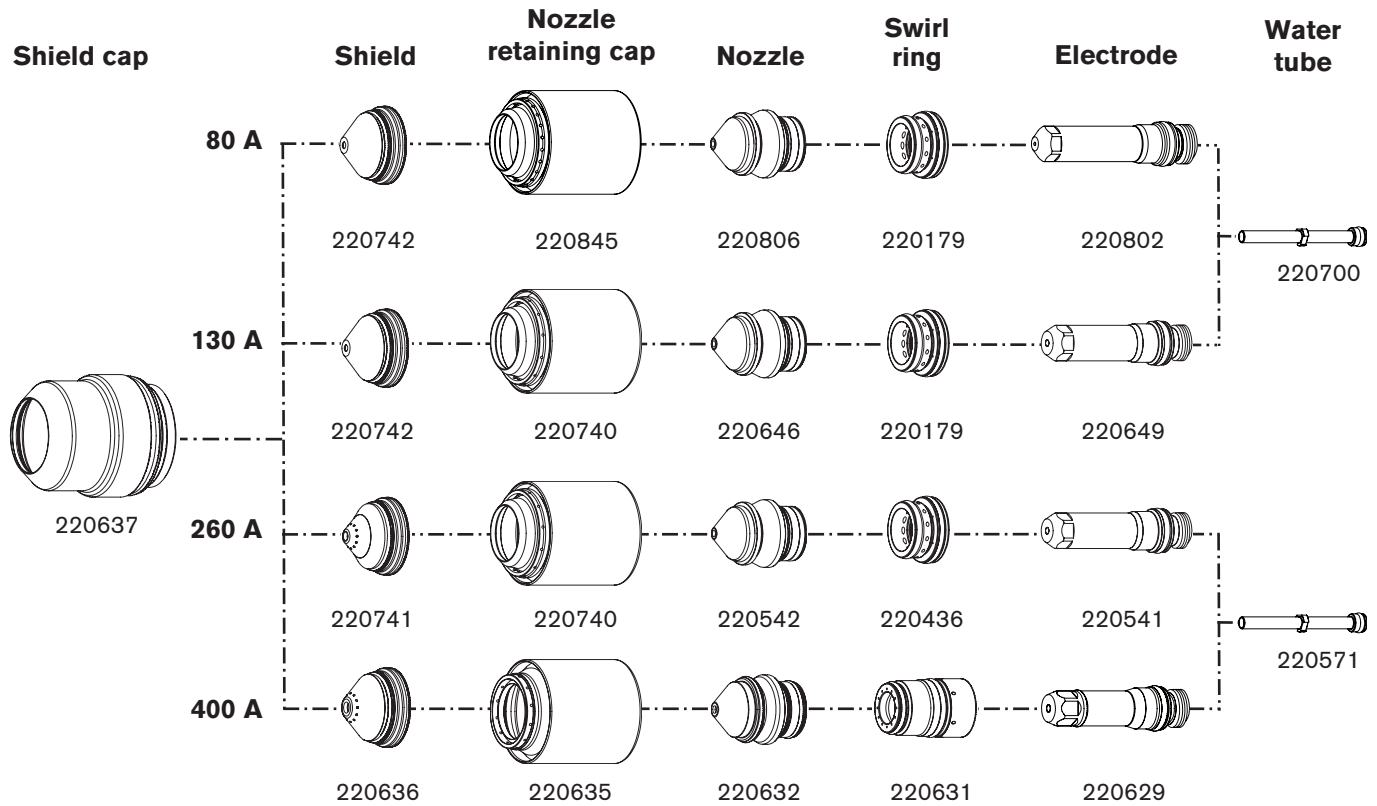


Aluminum

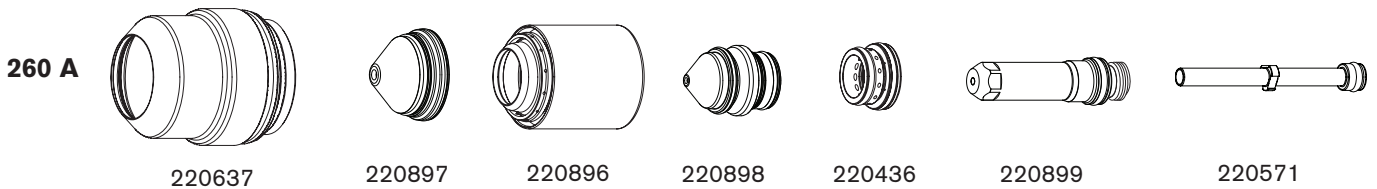


# OPERATION

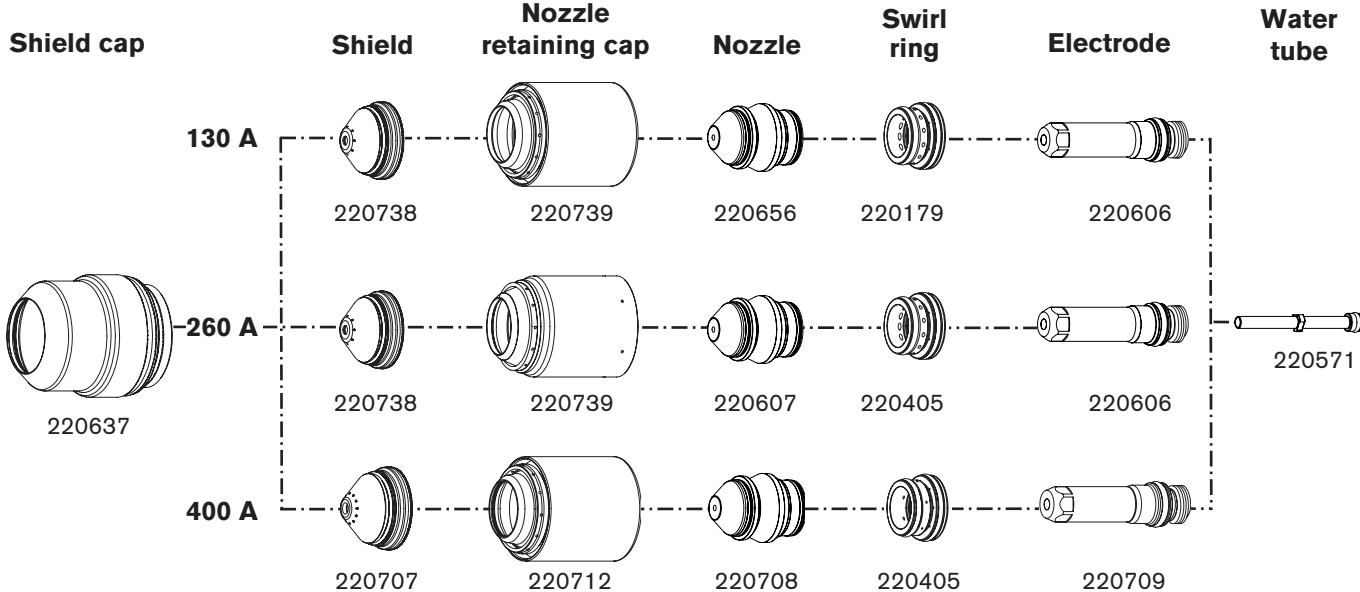
## Mild steel bevel cutting





## Mild steel, thick piercing, bevel cutting



Stainless steel bevel cutting



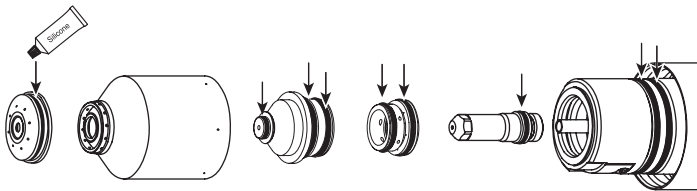
**Install and Inspect consumables**

		<p><b>WARNING</b></p>
<p>The system is designed to go into an idle mode if the retaining cap is removed. However, <b>DO NOT CHANGE CONSUMABLE PARTS WHILE IN THE IDLE MODE.</b> <u>Always</u> disconnect power to the power supply before inspecting or changing torch consumable parts. Use gloves when removing consumables. The torch might be hot.</p>		

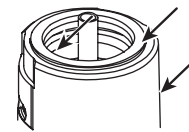
**Install consumables**

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.

**Note: Do not overtighten parts! Only tighten until mating parts are seated.**

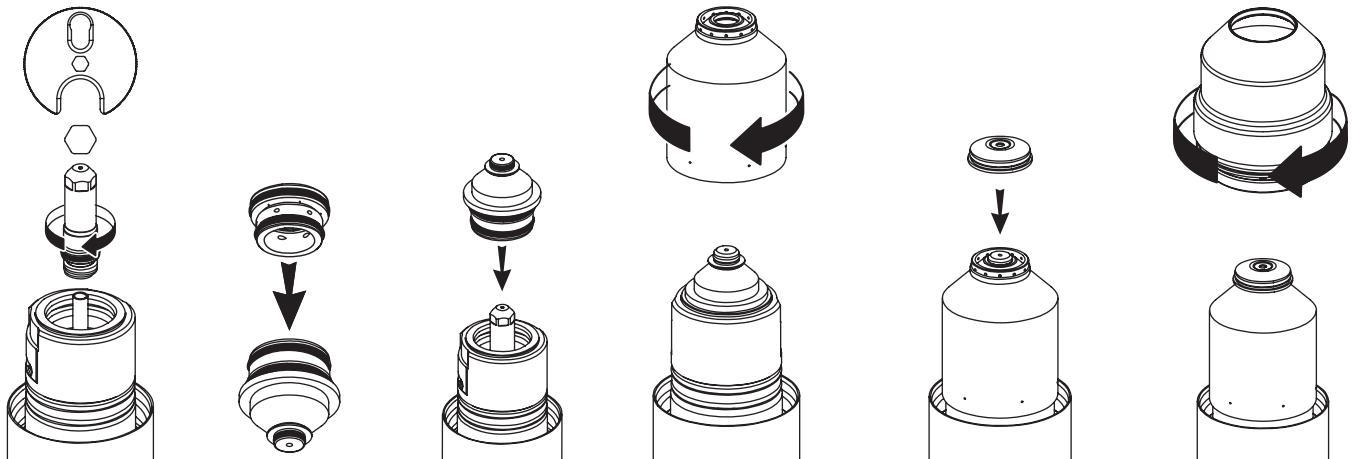


Apply a thin film of silicone lubricant on each o-ring. The o-ring should look shiny, but there should not be any excess or built-up grease.



Wipe the internal and external surfaces of the torch with a clean cloth or paper towel.

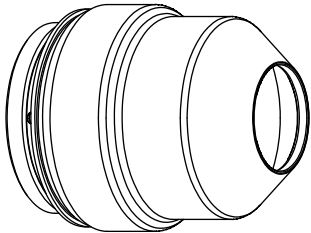
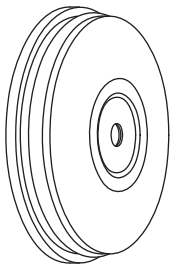
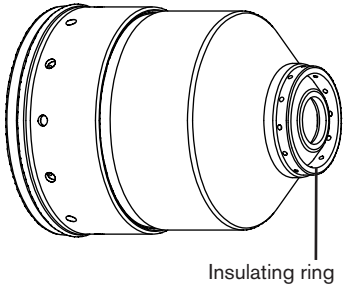
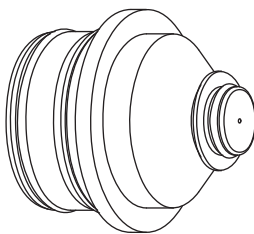
Tool: 104119



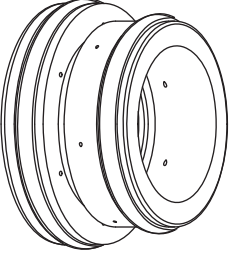
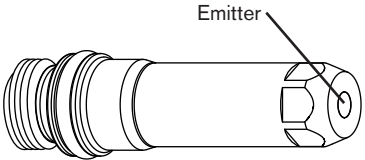
1. Install the electrode
2. Install the swirl ring
3. Install the nozzle and swirl ring
4. Install the nozzle retaining cap
5. Install the shield
6. Install the shield cap



Inspect consumables

Inspect	Look for	Action
<p><b>Shield cap</b></p> 	<p>Erosion, missing material</p> <p>Cracks</p> <p>Burned surface</p>	<p>Replace shield cap</p> <p>Replace shield cap</p> <p>Replace shield cap</p>
<p><b>Shield</b></p> 	<p><b>General:</b> Erosion or missing material</p> <p>Molten material attached</p> <p>Blocked gas holes</p> <p><b>Center hole:</b> Must be round</p> <p><b>O-rings:</b> Damage</p> <p>Lubricant</p>	<p>Replace shield</p> <p>Replace shield</p> <p>Replace shield</p> <p>Replace the shield when the hole is no longer round</p> <p>Replace shield</p> <p>Apply a thin film of silicone lubricant if the o-rings are dry</p>
<p><b>Nozzle retaining cap</b></p>  <p>Insulating ring</p>	<p><b>General:</b> Damage to insulating ring</p> <p>Poor cut quality after replacing other consumables</p>	<p>Replace nozzle retaining cap</p> <p>Replace nozzle retaining cap</p>
<p><b>Nozzle</b> Always replace the nozzle and electrode as a set.</p> 	<p><b>General:</b> Erosion or missing material</p> <p>Blocked gas holes</p> <p><b>Center hole:</b> Must be round</p> <p>Signs of arcing</p> <p><b>O-rings:</b> Damage</p> <p>Lubricant</p>	<p>Replace nozzle</p> <p>Replace nozzle</p> <p>Replace the nozzle when the hole is no longer round</p> <p>Replace nozzle</p> <p>Replace nozzle</p> <p>Apply a thin film of silicone lubricant if the o-rings are dry</p>

## OPERATION

Inspect	Look for	Action
<p><b>Swirl ring</b></p> 	<p><b>General:</b>            Chips or cracks            Blocked gas holes            Dirt or debris</p> <p><b>O-rings:</b>            Damage            Lubricant</p>	<p>Replace swirl ring</p> <p>Replace swirl ring</p> <p>Clean and check for damage; replace when damaged</p> <p>Replace swirl ring</p> <p>Apply a thin film of silicone lubricant if the o-rings are dry</p>
<p><b>Electrode</b>            Always replace the nozzle and electrode as a set.</p> 	<p><b>Center surface:</b>            Emitter wear – a pit forms as the emitter wears.</p> <p><b>O-rings:</b>            Damage</p> <p>Lubricant</p>	<p>In general, replace the electrode when the pit depth is 1 mm (0.04 in.) or greater. For the 400 amp mild steel electrode and all SilverPlus electrodes, replace the electrode when the pit depth is 1.5 mm (0.06 in.) or greater.</p> <p>Replace electrode</p> <p>Apply a thin film of silicone lubricant if the o-rings are dry</p>

## Torch maintenance

Poor cut quality and premature failure may occur if the HPR torch is not maintained properly.

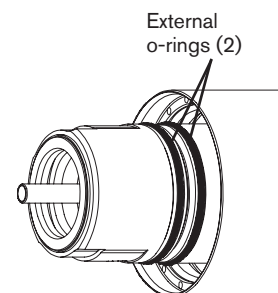
The torch is manufactured to very tight tolerances to maximize cut quality. The torch should not be subjected to hard impacts that can cause critical features to become misaligned.

The torch should be stored in a clean location when not in use, to avoid contamination of critical surfaces and passages.

## Routine maintenance

The following steps should be completed each time consumables are changed:

1. Use a clean cloth to wipe off the torch inside and outside. A cotton swab can be used to access hard-to-reach internal surfaces.
2. Use compressed air to blow away any remaining dirt and debris from internal and external surfaces.
3. Apply a thin film of silicone lubricant on each external o-ring. The o-rings should look shiny, but there should not be any excess or built-up grease.
4. If consumables will be reused, use a clean cloth to wipe them off, and use compressed air to blow them off before they are installed again. This is especially critical for the nozzle retaining cap.

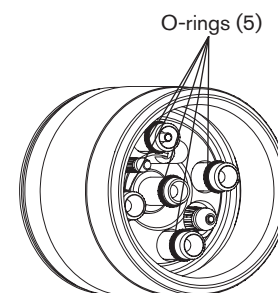
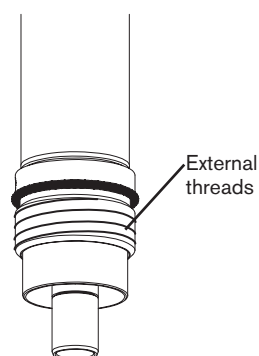


Front view of the torch

## Quick-disconnect maintenance

The following steps should be completed every 5-10 times consumables are changed:

1. Remove the torch from the quick-disconnect assembly.
2. Use compressed air to blow off all internal surfaces and the external threads.
3. Use compressed air to blow off all internal surfaces at the rear of the torch.
4. Inspect each of the 5 o-rings at the rear of the torch for nicks or cuts. Replace any damaged o-rings. If they are not damaged, apply a thin film of silicone lubricant on each o-ring. The o-rings should look shiny, but there should not be any excess or built-up grease.

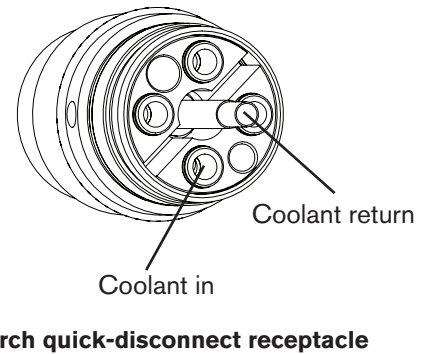
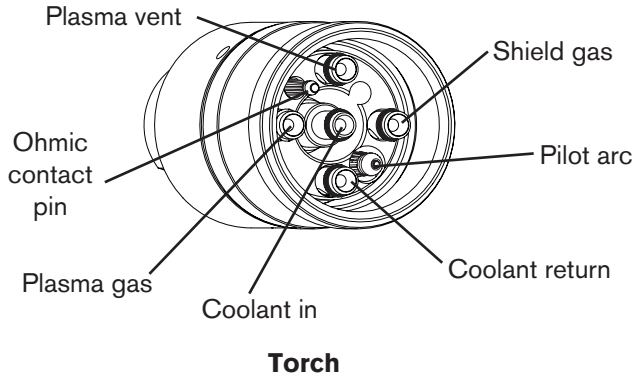


Rear view of the torch

## Maintenance kit

Even with proper care, the o-rings at the rear of the torch will need to be replaced periodically. Hypertherm provides a kit (128879) of replacement parts. Kits should be kept in stock and be used as part of your routine maintenance schedule.

## Torch connections



## Replace torch water tube

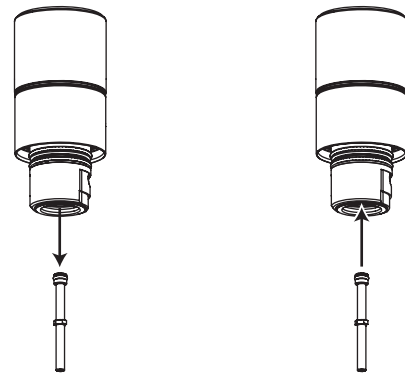


### WARNING

The system 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. Use gloves when removing consumables. The torch might be hot.

Note: The water tube may seem loose when correctly inserted, but any side-to-side looseness will disappear after the electrode is installed.

1. Turn OFF all power to the system.
2. Remove consumables from torch. See *Install and inspect consumables* in this section.
3. Remove the old water tube.
4. Apply a thin film of silicone lubricant on the o-ring, and install a new water tube. The o-ring should look shiny, but there should not be any excess or built-up grease.
5. Replace consumables. See *Install and inspect consumables* in this section.



## Common cutting faults

- Torch pilot arc will initiate, but will not transfer. Causes can be:
  1. Work cable connection on the cutting table is not making good contact.
  2. Malfunction in the system. See Section 5.
  3. Torch-to-work distance is too high.
- 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 *Install and inspect consumables*).
  4. Metal being cut is too thick.
- Dross forms on the bottom of the cut. Causes can be:
  1. Cutting speed is not correct (check *Cut chart* information).
  2. Arc current is set too low (check *Cut chart* information).
  3. Torch parts are worn (see *Install and inspect consumables*).
- 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 *Install and inspect consumables*).
- 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, 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. Beginning or ending the cut off the plate surface. **To achieve consumable long life, all cuts must begin and end on the plate surface.**

### Dross

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

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

- Decrease the cutting speed.
- Decrease arc voltage, to decrease the torch-to-work distance.

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

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

Worn or damaged consumables may produce intermittent dross.

### Straightness of the cut surface



A typical plasma cut surface is slightly concave.

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



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



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

**Additional factors of cut quality**

**Cut angle**

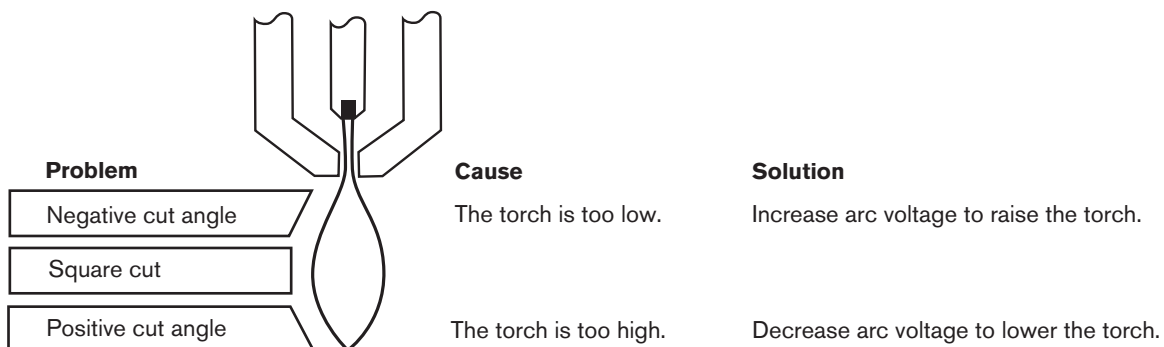
A cut part whose 4 sides average less than 4° of cut angle is considered acceptable.

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

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

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

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

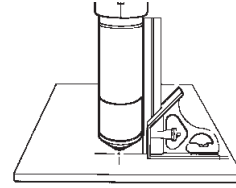


### How to optimize cut quality

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

#### Tips for table and torch

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



#### Plasma set-up tips

Follow carefully each step in the *Daily start-up* procedure described earlier in this section.

Purge the gas lines before cutting.

#### Maximize the life of consumable parts

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

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

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

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



## **Additional improvements**

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

### **Piercing**

The pierce delay should allow sufficient time to penetrate the full thickness of the material, but not so long that it allows the arc to “wander” while trying to find the edge of a large pierce hole. As consumables wear, this delay time may need to be increased. Pierce delay times given in the cut charts are based on average delay times throughout the life of the consumables.

Using the “pierce complete” signal during piercing maintains the shield-gas pressure at the higher preflow pressure, which provides additional protection for the consumables (for example: 30 amp O<sub>2</sub>/O<sub>2</sub> and 50 amp O<sub>2</sub>/O<sub>2</sub> processes). The pierce complete signal must be turned off for processes with shield gas preflow pressures that are lower than the outflow pressures (for example: 600 amp and 800 amp processes).

When piercing materials close to the maximum thickness for a specific process, there are several important factors to consider:

- Allow a lead-in distance that is about the same as the thickness of the material being pierced. 50 mm (2 in) material requires a 50 mm lead-in.
- To avoid damage to the shield from the build up of molten material created by the pierce, do not allow the torch to descend to cut height until it has cleared the puddle of molten material.
- When pre-piercing with the 400 amp O<sub>2</sub>/air process, the arc should be on for a minimum of 4 seconds or the electrode may experience rapid wear. This 4 seconds allows the current to properly ramp-up and ramp-down which is required for the long life process. A small torch movement may be necessary if the pierce time is less than 4 seconds to keep the arc transferred to the plate.
- Different material chemistries can have an adverse effect on the pierce capability of the system. In particular, high-strength steel and steel with a high manganese or silicon content can reduce the maximum pierce capability. Hypertherm calculates mild steel pierce parameters with certified A-36 plate.
- If the system has difficulty piercing a specific material or thickness, increasing the shield preflow pressure can help in some cases.  
Trade-off: This may reduce starting reliability.
- Using a “moving pierce” or “flying pierce” (starting torch motion immediately after transfer and during the pierce process) can extend the piercing capability of the system in some cases. Because this can be a complex process that can damage the torch, lifter, or other components, an edge start is recommended unless the operator is experienced with this technique.

### **How to increase cutting speed**

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

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

### Cut charts

The following *Cut charts* show the consumable parts, cutting speeds and the gas and torch settings required for each process.

The numbers shown in the *Cut charts* are recommended to provide high-quality cuts with minimal dross. Because of differences between installations and material composition, adjustments may be required to obtain desired results.

### Bevel cut charts

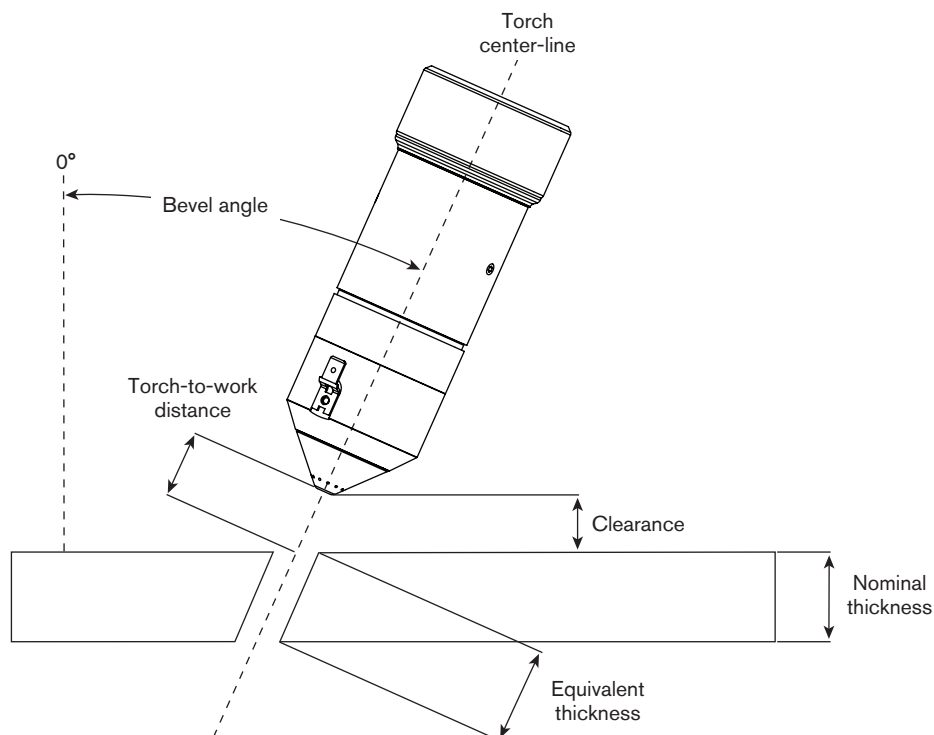
The bevel cut charts are slightly different from the standard cut charts. The torch-to-work distance is a range rather than a single value, material thickness is given as an equivalent value, a column for minimum clearance has been added, and there is no column for arc voltage.

Equivalent thicknesses and the arc voltages will vary depending on the angle of the cut. The angle for bevel cutting can range from 0° to 45°.

See *Bevel cutting definitions* on the next page for more detailed information.

## Bevel cutting definitions

Bevel angle	The angle between the center line of the torch and a line that is perpendicular to the workpiece. If the torch is perpendicular to the workpiece, the bevel angle is zero. The maximum bevel angle is 45°.
Nominal thickness	The vertical thickness of the workpiece.
Equivalent thickness	The length of the cut edge, or the distance the arc travels through the material while cutting. Equivalent thickness is equal to the nominal thickness divided by the cosine of the bevel angle. Equivalent thicknesses are listed in the cut chart.
Clearance	The vertical distance from the lowest point of the torch to the surface of the workpiece.
Torch-to-work distance	The linear distance from the center of the torch outlet to the workpiece surface along the torch center-line. A range of torch-to-work distances are listed in the cut chart. The smallest number is for a straight cut (bevel angle = 0°). The largest number is for a 45° bevel cut with a clearance of 3 mm (0.120 in).
Arc voltage	The arc voltage setting is dependent on the bevel angle and the setup of the cutting system. The arc voltage setting on one system may be different from a second system even if the workpiece is the same thickness. The arc voltages for bevel cutting are not supplied in the bevel cut charts.



## OPERATION

### Estimated kerf-width compensation

The widths in the chart below are for reference. Differences between installations and material composition may cause actual results to vary from those shown in the table. N/A = data not available.

#### Metric

Process	Thickness (mm)																	
	1.5	3	5	6	8	10	12	15	20	25	30	32	38	40	50	60	70	80
<b>Mild steel</b>																		
400A O <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	N/A	3.40	3.50	3.68	3.76	4.06	N/A	N/A	4.88	5.94	6.60	7.80	9.10
260A O <sub>2</sub> / Air	N/A	N/A	N/A	2.54	2.54	2.54	2.79	3.43	3.56	3.91	N/A	4.32	4.45	N/A	5.72	N/A	N/A	N/A
200A O <sub>2</sub> / Air	N/A	N/A	1.93	1.98	2.09	2.20	2.26	2.61	2.95	3.16	N/A	4.19	4.87	N/A	5.45	N/A	N/A	N/A
130A O <sub>2</sub> / Air	N/A	1.64	1.77	1.81	1.92	2.04	2.11	2.22	2.65	3.43	N/A	4.26	4.59	N/A	N/A	N/A	N/A	N/A
80A O <sub>2</sub> / Air	N/A	1.37	1.53	1.73	1.79	1.91	2.00	2.11	2.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50A O <sub>2</sub> / O <sub>2</sub>	1.52	1.74	1.86	1.86	2.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30A O <sub>2</sub> / O <sub>2</sub>	1.35	1.45	1.54	1.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Stainless steel</b>																		
400A N <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	N/A	3.00	2.90	2.80	3.10	3.30	N/A	N/A	5.00	N/A	N/A	N/A	N/A
400A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.10	5.30	5.45	N/A	N/A	5.50	5.80	6.35	N/A	N/A
400A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	3.90	4.00	4.20	4.45	4.65	N/A	N/A	5.15	5.65	5.90	6.35	6.95
260A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	2.34	3.02	3.71	3.80	3.82	4.32	4.34	N/A	4.58	4.77	N/A	5.63	N/A	N/A	N/A
260A N <sub>2</sub> / Air	N/A	N/A	N/A	2.31	2.39	2.46	2.54	2.76	3.08	3.30	N/A	3.64	4.43	N/A	4.16	N/A	N/A	N/A
260A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	3.84	3.83	3.81	3.81	4.06	4.32	N/A	4.53	4.70	N/A	7.46	N/A	N/A	N/A
200A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	2.10	2.16	2.29	2.47	2.92	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	3.66	3.68	3.81	3.68	3.94	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	3.05	3.05	3.05	2.88	3.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	2.69	2.72	2.77	3.03	2.90	3.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	1.83	1.89	1.88	2.42	2.51	3.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	1.78	2.25	2.73	2.76	3.03	2.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80A F5 / N <sub>2</sub>	N/A	N/A	1.02	1.20	1.05	0.96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45A F5 / N <sub>2</sub>	0.59	0.38	0.52	0.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45A N <sub>2</sub> / N <sub>2</sub>	0.49	0.23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**Metric**

Process	Thickness (mm)																		
	1.5	3	5	6	8	10	12	15	20	25	30	32	38	40	50	60	70	80	
<b>Aluminum</b>																			
400A N <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.50	3.60	3.70	3.90	4.00	N/A	N/A	4.00	7.60	N/A	N/A	N/A
400A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.20	4.30	4.30	N/A	N/A	4.45	5.40	7.05	8.00	8.15
400A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.55	3.65	3.80	3.80	4.20	N/A	N/A	4.45	4.55	6.15	6.85	7.10
260A N <sub>2</sub> / Air	N/A	N/A	N/A	2.49	2.73	2.97	3.05	2.91	3.05	3.30	N/A	2.87	3.99	N/A	5.66	N/A	N/A	N/A	
260A H35 / N <sub>2</sub>	N/A	N/A	N/A	2.64	2.64	2.62	2.79	3.09	3.30	3.56	N/A	3.29	3.60	N/A	5.37	N/A	N/A	N/A	
200A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	1.78	2.03	2.58	2.54	3.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
200A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	2.44	2.67	2.92	3.18	3.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
200A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	2.79	2.92	3.05	3.30	3.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
130A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	2.70	2.72	2.77	2.36	2.90	1.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
130A Air / Air	N/A	N/A	N/A	2.09	2.09	2.10	2.19	1.91	1.87	2.23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
130A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	2.06	2.39	2.73	2.76	2.00	2.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
45A Air / Air	1.07	1.10	1.25	1.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

# OPERATION

## English

Process	Thickness (in)															
	0.060	0.135	1/4	5/16	3/8	1/2	5/8	3/4	1.0	1-1/4	1-1/2	1-3/4	2.0	2-1/4	2-1/2	3.0
<b>Mild steel</b>																
400A O <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	0.135	0.140	0.145	0.148	0.164	0.183	0.215	0.237	0.250	0.275	0.340
260A O <sub>2</sub> / Air	N/A	N/A	0.100	0.100	0.100	0.110	0.115	0.135	0.150	0.170	0.175	0.220	0.225	0.240	0.260	N/A
200A O <sub>2</sub> / Air	N/A	N/A	0.078	0.082	0.086	0.089	0.108	0.116	0.125	0.164	0.192	N/A	0.216	N/A	N/A	N/A
130A O <sub>2</sub> / Air	N/A	0.066	0.071	0.076	0.080	0.083	0.089	0.104	0.135	0.167	0.181	N/A	N/A	N/A	N/A	N/A
80A O <sub>2</sub> / Air	N/A	0.054	0.068	0.070	0.075	0.080	0.084	0.102	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50A O <sub>2</sub> / O <sub>2</sub>	0.060	0.063	0.073	0.082	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30A O <sub>2</sub> / O <sub>2</sub>	0.053	0.057	0.067	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Stainless steel</b>																
400A N <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	0.118	0.116	0.112	0.122	0.132	0.198	0.235	N/A	N/A	N/A	N/A
400A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.200	0.210	0.215	0.218	0.220	0.230	0.245	0.255	N/A
400A H35& N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	0.135	0.160	0.165	0.175	0.185	0.200	0.210	0.225	0.230	0.235	0.265
260A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	0.092	0.119	0.145	0.151	0.151	0.170	0.171	0.180	0.188	0.197	0.225	N/A	N/A	N/A
260A N <sub>2</sub> / Air	N/A	N/A	0.091	0.094	0.100	0.100	0.120	0.120	0.130	0.142	0.175	0.223	0.155	N/A	N/A	N/A
260A H35 / N <sub>2</sub>	N/A	N/A	N/A	0.150	0.151	0.165	0.170	0.177	0.182	0.184	0.185	0.202	0.307	N/A	N/A	N/A
200A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	0.083	0.085	0.090	0.100	0.115	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 / N <sub>2</sub>	N/A	N/A	N/A	0.144	0.145	0.150	0.152	0.155	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	0.120	0.120	0.120	0.111	0.130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 / N <sub>2</sub>	N/A	N/A	N/A	0.115	0.121	0.123	0.124	0.125	0.129	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	0.072	0.074	0.083	0.095	0.100	0.118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	0.070	0.089	0.107	0.109	0.123	0.114	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80A F5 / N <sub>2</sub>	N/A	0.032	0.047	0.050	0.052	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45A F5 / N <sub>2</sub>	0.023	0.015	0.021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45A N <sub>2</sub> / N <sub>2</sub>	0.019	0.009	0.006	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Aluminum</b>																
400A N <sub>2</sub> / Air	N/A	N/A	N/A	N/A	N/A	0.140	0.143	0.145	0.155	0.160	0.160	0.230	0.300	N/A	N/A	N/A
400A H35 / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.164	0.170	0.170	0.170	0.190	0.215	0.250	0.310	0.318
400A H35& N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	N/A	0.140	0.145	0.150	0.150	0.170	0.175	0.175	0.180	0.225	0.263	0.276
260A N <sub>2</sub> / Air	N/A	N/A	0.098	0.107	0.120	0.120	0.120	0.120	0.130	0.145	0.158	0.193	0.227	N/A	N/A	N/A
260A H35 / N <sub>2</sub>	N/A	N/A	0.104	0.104	0.105	0.110	0.126	0.130	0.140	0.141	0.142	0.222	0.210	N/A	N/A	N/A
200A N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	0.070	0.080	0.090	0.100	0.105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 / N <sub>2</sub>	N/A	N/A	N/A	0.096	0.105	0.115	0.125	0.130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	N/A	N/A	0.115	0.120	0.130	0.150	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 / N <sub>2</sub>	N/A	N/A	N/A	0.106	0.107	0.109	0.112	0.114	0.120	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A Air / Air	N/A	N/A	0.082	0.082	0.082	0.086	0.071	0.071	0.089	N/A	N/A	N/A	N/A	N/A	N/A	N/A
130A H35 and N <sub>2</sub> / N <sub>2</sub>	N/A	N/A	0.081	0.094	0.107	0.109	0.067	0.114	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45A Air / Air	0.042	0.043	0.049	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

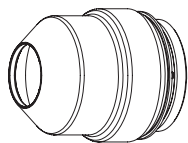
**Mild steel**

O<sub>2</sub> Plasma / O<sub>2</sub> Shield

30 A

Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	43 / 90
Cutflow	25 / 52	0 / 0

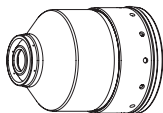
Note: Air must be connected to use this process. It is used as the preflow gas.



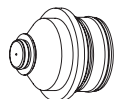
220747



220194



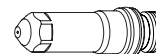
220754



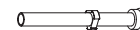
220193



220180



220192



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm
O <sub>2</sub>	O <sub>2</sub>	78	17	94	17	0.5	114	1.3	5355	2.3	180	0.1	
						0.8	115		4225			0.2	
						1	116		3615			0.3	
						1.2	117		2865				
						1.5	119		2210				
			35		7	2	120	1.5	1490			2.7	0.4
						2.5	122		1325				
						3*	123		1160				0.5
						4*	125		905				0.7
						6*	128		665				1.0

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time		
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in	ipm
O <sub>2</sub>	O <sub>2</sub>	78	17	94	17	0.018	114	0.05	215	0.09	180	0.1		
						0.024			200				0.2	
						0.030			115					170
						0.036			116					155
						0.048			117					110
			35		7	0.060	119	0.06	85			0.11	0.4	
						0.075	120		60					
						0.105	122		50					
						0.135*	123		40					0.5
						3/16*	128		30					0.7
1/4*	25	1.0												

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	105
Ar	Air	90	10	90	10	9	2.5	0.10	2540	100	80

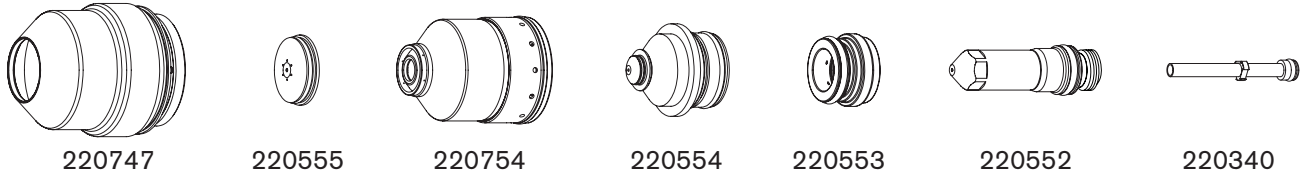
\* Pierce complete is recommended for these thicknesses.

## OPERATION

### Mild steel O<sub>2</sub> Plasma / O<sub>2</sub> Shield 50 A

Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	43 / 90
Cutflow	25 / 52	0 / 0

Note: Air must be connected to use this process. It is used as the preflow gas.



### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	Volts	mm	mm/m	mm	Factor %	Seconds	
O <sub>2</sub>	O <sub>2</sub>	70	30	81	14	0.8	110	1.0	6500	2.0	200	0.0	
						1	111		5000				
						1.2	112		4150				
						1.5	114	1.3	3200	2.6			
						2	115		2700				
						2.5	117		2200				
						3	119	1.5	1800	3.0			0.1
						4	121		1400				
						5	122		1200				
						6	126		950				
						7	128	2.0	780	4.0			0.2
8	130	630											

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	Volts	in	ipm	in	Factor %	Seconds	
O <sub>2</sub>	O <sub>2</sub>	70	30	81	14	0.030	110	0.04	270	0.08	200	0.0	
						0.036			210				
						0.048			160				
						0.060	114	0.05	125	0.10			
						0.075	115		110				
						0.105	118		80				
						0.135	120	0.06	60	0.12			0.1
						3/16	121		50				
						1/4	125	0.08	35	0.16			0.2
						5/16	130		25				

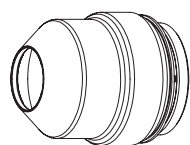
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	118
Ar	Air	90	10	90	10	9	2.5	0.10	2540	100	77



**Mild steel**  
O<sub>2</sub> Plasma / Air Shield  
80 A

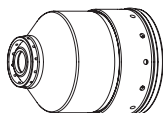
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	76 / 161
Cutflow	23 / 48	41 / 87



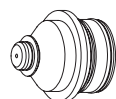
220747



220189



220756



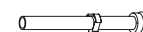
220188



220179



220187



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
O <sub>2</sub>	Air	48	23	78	23	2	112	2.5	9810	3.8	150	0.1
						2.5	115		7980			
						3	117		6145			
						4	120	2.0	4300	4.0	200	0.2
						5	121		3670			
						6	123		3045			
						8	125		2430			
					10	127	1810	5.0	250	0.3		
					12	130	1410					
					15	133	1030					
					20	135	2.5	545	6.3	0.4		
					20	135	2.5	545	6.3	0.5		
					20	135	2.5	545	6.3	0.7		
20	135	2.5	545	6.3	0.8							
20	135	2.5	545	6.3	0.9							

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
O <sub>2</sub>	Air	48	23	78	23	0.075	112	0.10	400	0.15	150	0.1
						0.105	115		290			
						0.135	117		180			
						3/16	120	0.08	155	0.16	200	0.2
						1/4	123		110			
						5/16	125		96			
						3/8	127		75			
					1/2	130	10	50	0.20	250	0.3	
					5/8	133		37				
					3/4	135		25				
					3/4	135	0.10	25	0.25	0.4		
					3/4	135	0.10	25	0.25	0.5		
					3/4	135	0.10	25	0.25	0.7		
3/4	135	0.10	25	0.25	0.8							
3/4	135	0.10	25	0.25	0.9							

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	130
Ar	Air	50	10	50	10	15	3.0	0.12	2540	100	78

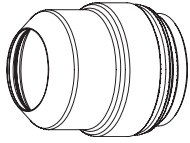
# OPERATION

## Mild steel bevel cutting

O<sub>2</sub> Plasma / Air Shield

80 A

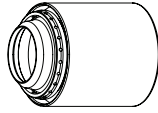
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	47 / 100
Cutflow	23 / 48	47 / 100



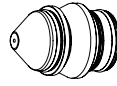
220637



220742



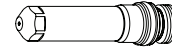
220845



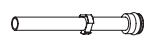
220806



220179



220802



220700

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	mm	
O <sub>2</sub>	Air	48	39	78	39	2.0	2	2.5 – 8.6	9810	3.8	150	0.1
							2.5					
							3					
							4					
							5					
							6					
					17		2.0 – 8.6	4300	4.0	200	0.2	
												8
												10
												12
												15
												20
17	2.5 – 8.6	545	6.3	250	0.3							
						3045						
						2430						
						1810						
						1410						
						1030						
17	2.5 – 8.6	545	6.3	250	0.4							
						3045						
						2430						
						1810						
						1410						
						1030						
17	2.5 – 8.6	545	6.3	250	0.5							
						3045						
						2430						
						1810						
						1410						
						1030						
17	2.5 – 8.6	545	6.3	250	0.7							
						3045						
						2430						
						1810						
						1410						
						1030						
17	2.5 – 8.6	545	6.3	250	0.8							
						3045						
						2430						
						1810						
						1410						
						1030						
17	2.5 – 8.6	545	6.3	250	0.9							
						3045						
						2430						
						1810						
						1410						
						1030						

### English

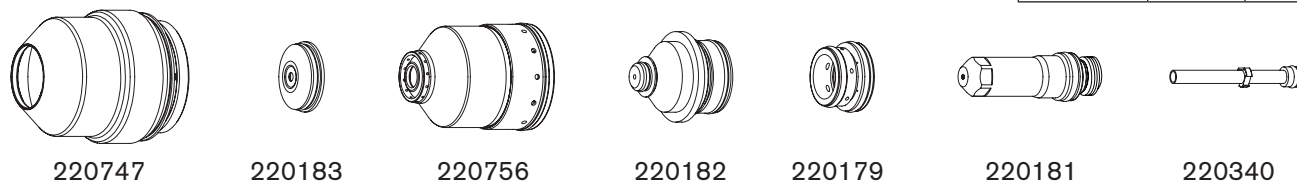
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	in	
O <sub>2</sub>	Air	48	39	78	39	0.08	0.075	0.1 – 0.34	400	0.15	150	0.1
							0.105					
							0.135					
							3/16					
							1/4					
							5/16					
					17		0.08 – 0.34	155	0.16	200	0.2	
												1/2
												3/8
												1/2
												5/8
												3/4
17	0.1 – 0.34	25	0.25	250	0.3							
						110						
						96						
						75						
						50						
						37						
17	0.1 – 0.34	25	0.25	250	0.4							
						110						
						96						
						75						
						50						
						37						
17	0.1 – 0.34	25	0.25	250	0.5							
						110						
						96						
						75						
						50						
						37						
17	0.1 – 0.34	25	0.25	250	0.7							
						110						
						96						
						75						
						50						
						37						
17	0.1 – 0.34	25	0.25	250	0.8							
						110						
						96						
						75						
						50						
						37						
17	0.1 – 0.34	25	0.25	250	0.9							
						110						
						96						
						75						
						50						
						37						

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		Amps	mm	in	mm/m	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	130
Ar	Air	50	10	50	10	15	3.0	0.12	2540	100	78

**Mild steel**  
O<sub>2</sub> Plasma / Air Shield  
130 A

Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	102 / 215
Cutflow	33 / 70	45 / 96



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	Volts	mm	mm/m	mm	factor %	seconds
O <sub>2</sub>	Air	32	32	84	28	3	124	2.5	6505	5.0	200	0.1
						4	126	2.8	5550			0.2
						5			4795			
					6	127	3.0	4035	5.6	0.3		
					8	129		3360				
					10	130	3.8	2680	6.0			
			12	132	2200							
			15	135	4.0	1665	7.6	190	0.5			
			20	138		1050			0.7			
			25	141	4.5	550	Edge start	1.8				
			32	160		375						
			38	167	255							

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	Volts	in	ipm	in	factor %	seconds
O <sub>2</sub>	Air	32	32	84	28	0.135	124	0.10	240	0.20	200	0.1
						3/16	126	0.11	190			0.2
						1/4			127			150
					5/16	129	0.12	132	0.24	0.3		
					3/8	130		110				
					1/2	132	0.13	80	0.26	0.5		
			5/8	135	0.15	60		0.30			0.7	
			3/4	138		0.16	45		190	1.0		
			1	141	0.18		20	Edge start			1.8	
			1-1/4	160		15						
			1-1/2	167	10							

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	130
Ar	Air	50	10	50	10	15	3.0	0.12	2540	100	75

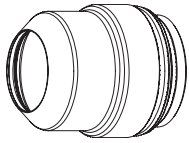
# OPERATION

## Mild steel bevel cutting

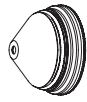
O<sub>2</sub> Plasma / Air Shield

130 A

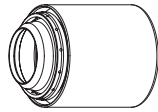
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	64 / 135
Cutflow	33 / 70	45 / 96



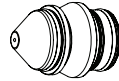
220637



220742



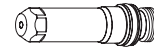
220740



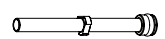
220646



220179



220649



220700

Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time		
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	factor %	seconds		
O <sub>2</sub>	Air	15	23	84	21	2.0	3	2.5 – 8.6	6505	5.0	200	0.1		
							4	2.8 – 8.6	5550				0.2	
							5		4795					
							6		4035					
							8		3.0 – 8.6					3360
							10							2680
			12		2200									
			15		3.8 – 8.6		1665	6.0	0.3					
			20				1050							
			25				550							
			32*				375							
			38		4.5 – 8.6		255	7.6	6.6	0.5				
										0.7				
					1.0									
					1.8									
					4.0									
					Edge start									

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time		
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	factor %	seconds		
O <sub>2</sub>	Air	15	23	84	21	0.08	0.135	0.10 – 0.34	240	0.20	200	0.1		
							3/16	0.11 – 0.34	190				0.2	
							1/4		150					
							5/16		0.12 – 0.34					132
							3/8							110
							1/2							80
			5/8		0.13 – 0.34		60	0.26	0.3					
			3/4				45							
			1				0.15 – 0.34			20				
			1-1/4*				0.16 – 0.34			15				
			1-1/2		0.18 – 0.34		10	0.30	1.0					
										1.8				
										4.0				
					Edge start									

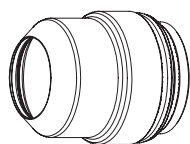
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	130
Ar	Air	50	10	50	10	15	3.0	0.12	2540	100	75

\* Suggestions for piercing 32 mm (1-1/4 in) mild steel: 1. Turn preflow on during IHS, 2. Use ohmic contact during IHS, 3. Use pierce complete when piercing.

**Mild steel**  
O<sub>2</sub> Plasma / Air Shield  
200 A

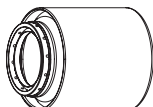
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	128 / 270
Cutflow	39 / 82	48 / 101



220637



220761



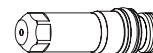
220757



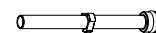
220354



220353



220352



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
O <sub>2</sub>	Air	23	42	74	18	5	123	3.3	5700	6.6	200	0.2
						6	124		5250			
						8	125		4355			
						10	126		3460			
						12	128	4.1	2275	8.2		0.6
						15	131		1575			
						20	133	5.1	1165	10.2		1.0
						25	143		750			
						32	145		510			
						38	152		255			
						50	163					Edge start

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
O <sub>2</sub>	Air	23	42	74	18	3/16	124	0.13	230	0.26	200	0.2
						1/4			200			
						5/16			171			
						3/8			140			
						1/2	128	0.16	115	0.32		0.5
						5/8	131		80			
						3/4	133	0.20	65	0.40		1.0
						1	143		45			
						1-1/4	145		30			
						1-1/2	152		20			
						2	163		10			Edge start

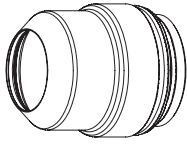
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	130
Ar	Air	30	10	30	10	20	3.0	0.12	2540	100	63

# OPERATION

## Mild steel O<sub>2</sub> Plasma / Air Shield 260 A

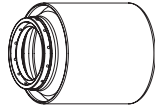
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220



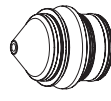
220637



220764



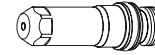
220760



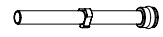
220439



220436



220435



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness mm	Arc Voltage Volts	Torch-to-Work Distance mm	Cutting Speed mm/m	Initial Pierce Height		Pierce Delay Time seconds		
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	factor %			
O <sub>2</sub>	Air	22	49	76	46	6	150	2.8	6500	8.5	300	0.3		
						8			5470					
						10			4440					
						12			3850					
				80	49	15	155	3.6	3130	9.0	250	0.5		
													20	2170
													22	1930
													25	1685
				84	49	28	170	4.8	1445	9.5	200	0.8		
													32	172
													38	174
													44	185
													50	188
													58	193
													64	202
													Edge start	

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness in	Arc Voltage Volts	Torch-to-Work Distance in	Cutting Speed ipm	Initial Pierce Height		Pierce Delay Time seconds		
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	factor %			
O <sub>2</sub>	Air	22	49	76	46	1/4	150	0.11	245	0.33	300	0.3		
						5/16			215					
						3/8			180					
						1/2			145					
				80	49	5/8	155	0.14	115	0.35	250	0.5		
													3/4	90
													7/8	75
													1	65
				84	49	1-1/8	170	0.19	55	0.38	200	0.8		
													1-1/4	45
													1-1/2	35
													1-3/4	22
													2	15
													2-1/4	12
													2-1/2	8
													Edge start	

### Marking

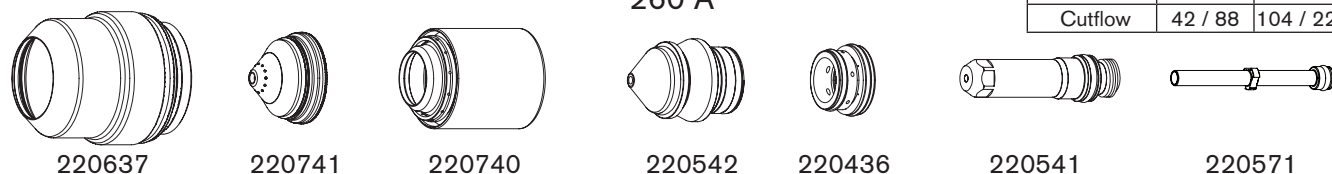
Select Gases		Set Preflow		Set Cutflow		Amperage Amps	Torch-to-Work Distance		Marking Speed		Arc Voltage Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	135
Ar	Air	30	20	30	20	24	3.0	0.12	2540	100	68

**Mild steel bevel cutting (standard)**

O<sub>2</sub> Plasma / Air Shield

260 A

Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220



**Metric**

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	factor %	seconds
O <sub>2</sub>	Air	22	49	76	46	2.0	6	2.8 – 7.6	6500	8.5	300	0.3
							8		5470			
							10		4440			
							12		3850			
							15		3130			
							20		2170			
				22	3.6 – 7.6		1930	9.0	250			
				25			1685					
				28			1445					
				32			1135					
				38*			895					
				44			580					
				50	4.8 – 7.6		405	9.5	200			
				58			290					
				64			195					
				Edge start								
Edge start												
Edge start												

**English**

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	factor %	seconds
O <sub>2</sub>	Air	22	49	76	46	0.08	1/4	0.11 – 0.30	245	0.33	300	0.3
							5/16		215			
							3/8		180			
							1/2		145			
							5/8		115			
							3/4		90			
				7/8	0.14 – 0.30		75	0.35	250			
				1			65					
				1-1/8			55					
				1-1/4			45					
				1-1/2*			35					
				1-3/4			22					
				2	0.19 – 0.30		15	0.38	200			
				2-1/4			12					
				2-1/2			8					
				Edge start								
Edge start												
Edge start												

**Marking**

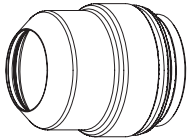
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	135
Ar	Air	30	20	30	20	24	3.0	0.12	2540	100	68

\* See the alternate, thick metal piercing, cut chart if you have a problem with excessive slag on the shield or problems with the torch misfiring.

## OPERATION

### Mild steel bevel cutting (alternate) thick metal piercing O<sub>2</sub> Plasma / Air Shield 260 A

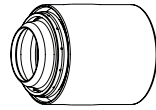
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	85 / 180
Cutflow	47 / 99	54 / 115



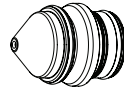
220637



220897



220896



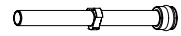
220898



220436



220899



220571

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	factor %	seconds
O <sub>2</sub>	Air	22	20	74	19	2.0	25	3.6 – 7.6	1685	9.0	250	0.8
							28		1445			
							32	4.8 – 7.6	1135	Edge start		
							38*		895			
							44		580			
							50		405			
							58		290			
64	195											

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	factor %	seconds
O <sub>2</sub>	Air	22	20	74	19	0.08	1	0.14 – 0.30	65	0.38	200	0.8
							1-1/8		55			
							1-1/4	0.19 – 0.30	45	Edge start		
							1-1/2*		35			
							1-3/4		22			
							2		15			
							2-1/4		12			
2-1/2	8											

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	122
Ar	Air	30	10	30	10	24	3.0	0.12	2540	100	62

The consumables on this page are designed for thick metal piercing. They are only recommended for use if you have a problem with excessive slag on the shield, or problems with the torch misfiring, when using the standard bevel consumables.

Using the thick metal piercing process may result in a 20% decrease in the life of the consumables.

\* Suggestions for piercing 38 mm (1-1/2 in) mild steel:

1. Turn preflow on during IHS
2. Use stall force during IHS
3. Use pierce complete when piercing



**Mild steel**  
O<sub>2</sub> Plasma / Air Shield  
400 A

Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	190 / 400
Cutflow	66 / 140	137 / 290



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time						
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm	mm/m	mm	Factor %	Seconds	
O <sub>2</sub>	Air	24	50	60	50	12	139	3.6	4430	7.2	200	0.4						
						15	142		3950			0.5						
						20	146		2805			0.7						
												22	148	3.8	2540	7.6	0.8	
												25	150	4.0	2210	8.0	0.9	
												30	153	4.6	1790	9.2	1.1	
												40	158		1160	11.5	250	1.9
												50	167	5.3	795	19.1	360	5.2
												60	173	6.4	580	Edge start		
												70	183		380			
						80	197	7.9	180									

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time						
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in	ipm	in	Factor %	Seconds	
O <sub>2</sub>	Air	24	50	60	50	1/2	140	0.14	170	200	200	0.4						
						5/8	143		150			0.5						
						3/4	145		115			0.6						
												7/8	148	0.15	100	0.30	0.8	
												1	151	0.16	85	0.32	0.9	
												1-1/4	153	0.18	65	0.36	1.2	
												1-1/2	157		48	0.45	250	1.6
												1-3/4	160		40		2.5	
												2	168	0.21	30	0.75	360	5.5
												2-1/4	171	0.25	25	Edge start		
						2-1/2	175	20										
						3	193	0.31	10									

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
N <sub>2</sub>	N <sub>2</sub>						mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	123
Ar	Air	20	10	30	10	25	3.0	0.12	1270	50	55

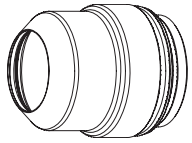
# OPERATION

## Mild steel bevel cutting

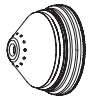
O<sub>2</sub> Plasma / Air Shield

400 A

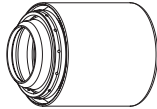
Flow rates – lpm/scfh		
	O <sub>2</sub>	Air
Preflow	0 / 0	190 / 400
Cutflow	66 / 140	137 / 290



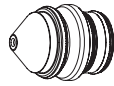
220637



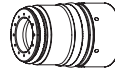
220636



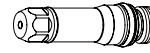
220635



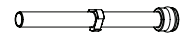
220632



220631



220629



220571

Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	Factor %	Seconds
O <sub>2</sub>	Air	24	50	60	50	2.0	12	3.6 – 9.4	4430	7.2	200	0.4
							15		3950			0.5
							20		2805			0.7
							22	3.8 – 9.4	2540	7.6	0.8	
							25	4.0 – 9.4	2210	8.0	0.9	
							30	4.6 – 9.4	1790	9.2	1.1	
							40		1160	11.5	250	1.9
							50	5.3 – 9.4	795	19.1	360	5.2
							60	6.4 – 9.4	580	Edge start		
							70		380			
80	180											

### English

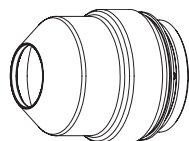
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	Factor %	Seconds
O <sub>2</sub>	Air	24	50	60	50	0.08	1/2	0.14 – 0.37	170	0.28	200	0.4
							5/8		150			0.5
							3/4		115			0.6
							7/8	0.15 – 0.37	100	0.30	0.8	
							1	0.16 – 0.37	85	0.32	0.9	
							1-1/4	0.18 – 0.37	65	0.36	1.2	
							1-1/2		48	0.45	250	1.6
							1-3/4	40	2.5			
							2	0.21 – 0.37	30	0.75	360	5.5
							2-1/4	0.25 – 0.37	25	Edge start		
2-1/2	20											
3	0.31 – 0.37	10										

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	123
Ar	Air	20	10	30	10	25	3.0	0.12	1270	50	55

**Stainless steel**  
N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
45 A

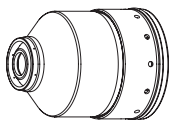
Flow rates – lpm/scfh	
N <sub>2</sub>	
Preflow	24 / 51
Cutflow	75 / 159



220747



220202



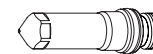
220755



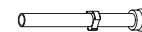
220201



220180



220308



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
N <sub>2</sub>	N <sub>2</sub>	35	5	62	49	0.8	94	2.5	6380	3.8	150	0.0
						1			5880			0.1
						1.2			5380			0.2
						1.5	4630					
						2	3935					
						2.5	3270					
						3	2550					
						4	1580		0.3			

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
N <sub>2</sub>	N <sub>2</sub>	35	5	62	49	0.036	94	0.10	240	0.15	150	0.0
						0.048			210			0.1
						0.060	95		180			0.2
						0.075	97		160			
						0.105	101		120			
						0.135	103		75			

**Marking**

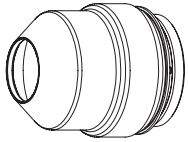
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	85
Ar	N <sub>2</sub>	90	10	90	10	12	2.5	0.10	2540	100	65

Note: This process produces a darker cut edge than the 45 A, F5/N<sub>2</sub> stainless steel process.

## OPERATION

### Stainless steel F5 Plasma / N<sub>2</sub> Shield 45 A

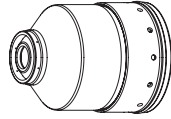
Flow rates – lpm/scfh		
	F5	N <sub>2</sub>
Preflow	0 / 0	43 / 91
Cutflow	8 / 17	65 / 138



220747



220202



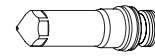
220755



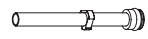
220201



220180



220308



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	Volts	mm	mm/m	mm	Factor %	Seconds
F5	N <sub>2</sub>	35	18	62	49	0.8	99	2.5	6570	3.8	150	0.2
						1			5740			
						1.2			4905			
						1.5			3890			
						2			3175			
						2.5			2510			
						3			2010			
					4	1435						
				11	6	110	2.0	845		190	0.5	

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	Volts	in	ipm	in	Factor %	Seconds
F5	N <sub>2</sub>	35	18	62	49	0.036	99	0.10	240	0.15	150	0.2
						0.048			190			
						0.060			150			
						0.075			130			
						0.105			90			
						0.135			65			
						3/16			45			
					1/4	30						
				11	3/16	108	0.08	45		190	0.4	
					1/4	110		30			0.5	

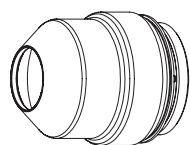
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	85
Ar	N <sub>2</sub>	90	10	90	10	12	2.5	0.10	2540	100	65

Note: This process produces a shinier cut edge than the 45 A, N<sub>2</sub>/N<sub>2</sub> stainless steel process.

**Stainless steel**  
F5 Plasma / N<sub>2</sub> Shield  
80 A

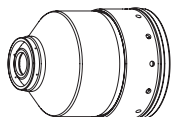
Flow rates – lpm/scfh		
	F5	N <sub>2</sub>
Preflow	0 / 0	67 / 142
Cutflow	31 / 65	87 / 185



220747



220338



220755



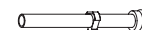
220337



220179



220339



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
F5	N <sub>2</sub>	33	23	65	60	4	108	3.0	2180	4.5	150	0.2
						5	110	2.7	1700	4.1		0.3
						6	112	2.5	1225	3.8		0.4
						8	116	3.0	895	4.5		0.5
						10	120		560			

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
F5	N <sub>2</sub>	33	23	65	60	0.135	108	0.12	105	0.18	150	0.2
						3/16	110	0.11	60	0.17		0.3
						1/4	112	0.10	45	0.15		0.4
						5/16	116	0.12	35	0.18		0.5
									25			

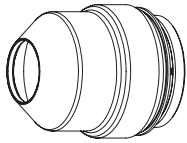
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	95
Ar	N <sub>2</sub>	50	10	50	10	12	3.0	0.12	2540	100	60

## OPERATION

### Stainless steel N<sub>2</sub> Plasma / N<sub>2</sub> Shield 130 A

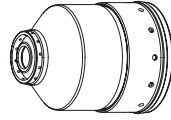
Flow rates – lpm/scfh	
N <sub>2</sub>	
Preflow	97 / 205
Cutflow	79 / 168



220747



220198



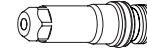
220756



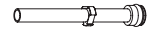
220197



220179



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time					
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm	mm/m	mm	factor %	seconds
N <sub>2</sub>	N <sub>2</sub>	19	51	75	23	6	153	3.0	1960	6.0	200	0.3					
						8	155		1630			0.4					
						10	156		1300			0.5					
												12	162	3.5	900	7.0	0.8
												15	167	3.8	670	Edge start	
												20	176	4.3	305	Edge start	

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time					
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in	ipm	in	factor %	seconds
N <sub>2</sub>	N <sub>2</sub>	19	51	75	23	1/4	153	0.12	75	0.24	200	0.3					
						5/16	155		64			0.4					
						3/8	156		55			0.5					
												1/2	162	0.14	30	0.28	0.8
												5/8	167	0.15	25	Edge start	
												3/4	176	0.17	15	Edge start	

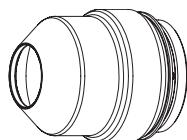
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

Note: This process produces a rougher, darker cut edge with more dross, and the cut edges are closer to perpendicular than the 130 A, H35/N<sub>2</sub> process.

**Stainless steel**  
H35 Plasma / N<sub>2</sub> Shield  
130 A

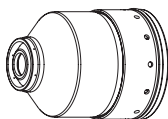
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144



220747



220198



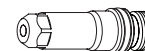
220755



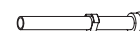
220197



220179



220307



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield					mm	Volts	
H35	N <sub>2</sub>	19	32	75	49	8	150	4.5	1140	7.7	170	0.3
						10	154		980			
						12	158		820			
						15	162		580			
						20	165		360			1.3
				16	25	172		260			Edge start	

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
H35	N <sub>2</sub>	19	32	75	49	5/16	150	0.18	45	0.31	170	0.3
						3/8	154		40			
						1/2	158		30			
						5/8	162		20			
						3/4	165		15			1.3
				16	1	172		10			Edge start	

**Marking**

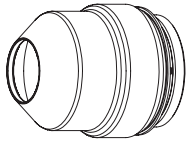
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

Note: This process produces a smoother, shinier cut edge with less dross, and the cut edges are less perpendicular than the 130 A, N<sub>2</sub>/N<sub>2</sub> process.

## OPERATION

### Stainless steel H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield 130 A

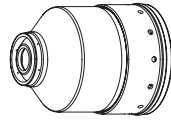
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150



220747



220198



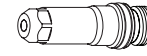
220755



220197



220179



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	Volts	mm	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	19	51	75	38	32	18	6	150	3.0	1835	6.0	200	0.3
					8			152	1515					
					10			153	1195					
					12			160	3.5	875	7.0	0.5		
					15			168	3.8	670	7.6	0.8		
20	176	4.3	305	7.7	180	1.3								

### English

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	Volts	in	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	19	51	75	38	32	18	1/4	150	0.12	70	0.24	200	0.3
					5/16			152	60					
					3/8			153	50					
					1/2			160	0.14	30	0.28	0.5		
					5/8			168	0.15	25	0.30	0.8		
3/4	176	0.17	15	0.31	180	1.3								

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

Note: This process produces a smoother, shinier cut edge with less dross, and the cut edges are less perpendicular than the 130 A, N<sub>2</sub>/N<sub>2</sub> process. Edge color is more silver than the H35/N<sub>2</sub> process.



## Stainless steel bevel cutting

N<sub>2</sub> Plasma / N<sub>2</sub> Shield

130 A

Flow rates – lpm/scfh	
N <sub>2</sub>	
Prewflow	97 / 205
Cutflow	125 / 260



Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Prewflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm		mm	Range (mm)	mm/m	mm	factor %
N <sub>2</sub>	N <sub>2</sub>	19	51	75	63	2.0	<b>6</b>	3.0 – 10.0	1960	6.0	200	0.3
							<b>8</b>		1630			0.4
							<b>10</b>		1300			0.5
							<b>12</b>	3.5 – 10.0	900	7.0	0.8	
							<b>15</b>	3.8 – 10.0	670	Edge start		
							<b>20</b>	4.3 – 10.0	305	Edge start		

### English

Select Gases		Set Prewflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in		in	Range (in)	ipm	in	factor %
N <sub>2</sub>	N <sub>2</sub>	19	51	75	63	0.08	<b>1/4</b>	0.12 – 0.40	75	0.24	200	0.3
							<b>5/16</b>		64			0.4
							<b>3/8</b>		55			0.5
							<b>1/2</b>	0.14 – 0.40	30	0.28	0.8	
							<b>5/8</b>	0.15 – 0.40	25	Edge start		
							<b>3/4</b>	0.17 – 0.40	15	Edge start		

### Marking

Select Gases		Set Prewflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		Amps	mm	in	mm/m	ipm
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	<b>18</b>	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	50	10	50	10	<b>15</b>	3.0	0.12	2540	100	75

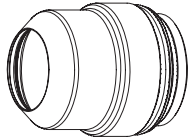
## OPERATION

### Stainless steel bevel cutting

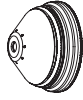
H35 Plasma / N<sub>2</sub> Shield

130 A

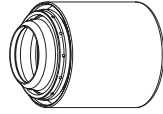
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	90 / 190
Cutflow	26 / 54	114 / 240



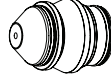
220637



220738



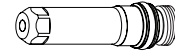
220739



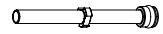
220656



220179



220606



220571

Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	mm	
H35	N <sub>2</sub>	19	32	75	63	2.0	8	4.5 – 10.0	1140	7.7	170	0.3
							10		980			
							12		820			
							15		580			
							20		360			
							25		260			Edge start

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	in	
H35	N <sub>2</sub>	19	32	75	63	0.08	5/16	0.18 – 0.40	45	0.31	170	0.3
							3/8		40			
							1/2		30			
							5/8		20			
							3/4		15			
							1		10			Edge start

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

## Stainless steel bevel cutting

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield

130 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	120 / 250



Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time								
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	mm	Range (mm)	mm/m	mm	Factor %	Seconds								
H35	N <sub>2</sub>	19	51	75	80	32	18	2.0	6	3.0 – 10.0	1835	6.0	200	0.3								
									8		1515											
									10		1195											
																		3.5 – 10.0	875	7.0		0.5
																		3.8 – 10.0	670	7.6		0.8
									3.0 – 10.0	305	7.7	180	1.3									

### English

Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time								
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	in	Range (in)	ipm	in	Factor %	Seconds								
H35	N <sub>2</sub>	19	51	75	80	32	18	0.080	1/4	0.12 – 0.40	70	0.24	200	0.3								
									5/16		60											
									3/8		50											
																		0.14 – 0.40	30	0.28		0.5
																		0.15 – 0.40	25	0.30		0.8
									0.17 – 0.40	15	0.31	180	1.3									

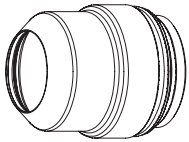
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

# OPERATION

## Stainless steel N<sub>2</sub> Plasma / N<sub>2</sub> Shield 200 A

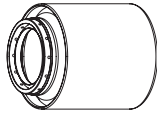
Flow rates – lpm/scfh	
N <sub>2</sub>	
Preflow	111 / 235
Cutflow	137 / 290



220637



220762



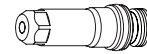
220758



220343



220342



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
N <sub>2</sub>	N <sub>2</sub>	17	42	84	42	8	159	3.8	3000	7.6	200	0.4
						10	160		2700			0.5
						12	161		2400			0.6
						15	163		1800			0.8
						20	167		1000			1.0

### English

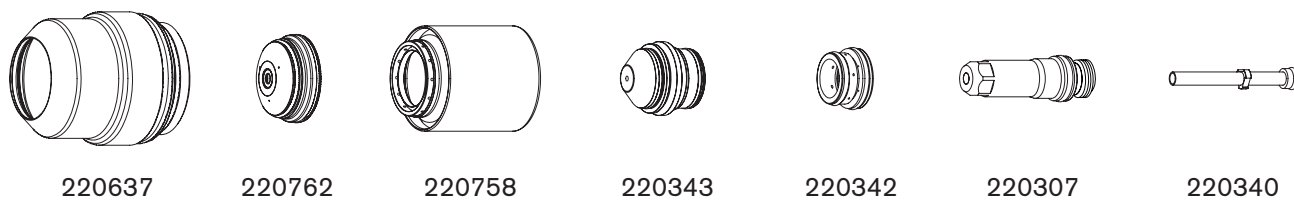
Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
N <sub>2</sub>	N <sub>2</sub>	17	42	84	42	5/16	159	0.15	118	0.3	200	0.4
						3/8	160		110			0.5
						1/2	161		90			0.6
						5/8	163		65			0.8
						3/4	167		45			1.0

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		Amps	mm	in	mm/m	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	66

**Stainless steel**  
H35 Plasma / N<sub>2</sub> Shield  
200 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	116 / 245
Cutflow	30 / 63	104 / 220



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
H35	N <sub>2</sub>	17	43	88	52	8	175	9.0	1790	9.0	100	0.4
						10						1620
						12	170	7.5	1450	0.6		
						15	173		1200	0.7		
						20	177		820	0.8		

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
H35	N <sub>2</sub>	17	43	88	52	5/16	175	0.35	70	0.35	100	0.4
						3/8						65
						1/2	170	0.30	55	0.30		0.6
						5/8	173		45			0.7
						3/4	177		35			0.8

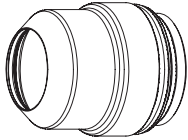
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	66

# OPERATION

## Stainless steel H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield 200 A

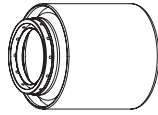
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	116 / 245
Cutflow	11 / 24	118 / 250



220637



220762



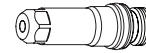
220758



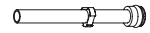
220343



220342



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time								
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					mm	Volts		mm	mm/m	mm	Factor %	Seconds			
H35	N <sub>2</sub>	17	41	87	41	42	20	8	160	4.0	2000	8.0	200	0.4								
								10	161		1900			0.5								
								12	162		1800			0.6								
																15	167	4.6	1600	7.0	150	0.8
																20	171	5.1	1000	7.5	150	1.0

### English

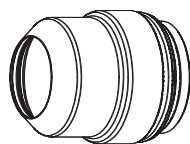
Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time								
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					in	Volts		in	ipm	in	Factor %	Seconds			
H35	N <sub>2</sub>	17	41	87	41	42	20	5/16	160	0.16	79	0.320	200	0.4								
								3/8	161		75			0.5								
								1/2	162		70			0.6								
																5/8	167	0.18	60	0.270	150	0.8
																3/4	171	0.20	45	0.300	150	1.0

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	66

**Stainless steel**  
N<sub>2</sub> Plasma / Air Shield  
260 A

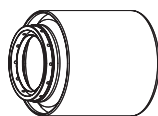
Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



220637



220763



220758



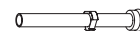
220406



220405



220307



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
N <sub>2</sub>	Air	12	47	79	56	6	160	3.8	6375	7.5	200	0.3
						8	158		4910			
						10	157		3440			
						12	161		2960			
						15	163		2520			
						20	164		1590			
						25	168		1300			
						32	171		875			
						38	179		515			
						44	190		365			Edge start
						50	195		180			

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
N <sub>2</sub>	Air	12	47	79	56	1/4	160	0.15	240	0.3	200	0.3
						5/16	158		193			
						3/8	157		140			
						1/2	161		110			
						5/8	163		95			
						3/4	164		70			
						1	168		50			
						1-1/4	171		35			
						1-1/2	179		20			
						1-3/4	190		14			Edge start
						2	200		6			

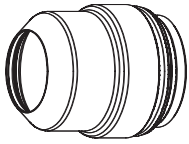
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

# OPERATION

## Stainless steel H35 Plasma / N<sub>2</sub> Shield 260 A

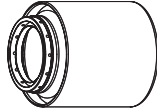
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



220637



220763



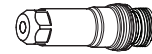
220758



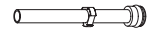
220406



220405



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness mm	Arc Voltage Volts	Torch-to-Work Distance mm	Cutting Speed mm/m	Initial Pierce Height		Pierce Delay Time seconds
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	factor %	
H35	N <sub>2</sub>	12	49	85	60	8	188	11.0	2030	11.0	100	0.3
						10			1870			
						12	173	9.0	1710	9.0	120	0.4
						15	171		1465			
						20	175	7.5	1085	7.5	120	0.6
						25	180		785			
						32	185	7.5	630	7.5	120	0.7
						38	186		510			
						44	189	7.5	390	7.5	120	1.0
						50	200		270			
Edge start												

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness in	Arc Voltage Volts	Torch-to-Work Distance in	Cutting Speed ipm	Initial Pierce Height		Pierce Delay Time seconds
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	factor %	
H35	N <sub>2</sub>	12	49	85	60	5/16	188	0.45	80	0.45	100	0.3
						3/8			75			
						1/2	173	0.35	65	0.35	120	0.4
						5/8	171		55			
						3/4	175	0.30	45	0.30	120	0.6
						1	180		30			
						1-1/4	185	0.30	25	0.30	120	0.7
						1-1/2	186		20			
						1-3/4	189	0.30	15	0.30	120	1.0
						2	200		10			
Edge start												

### Marking

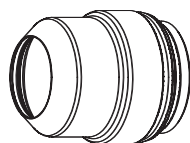
Select Gases		Set Preflow		Set Cutflow		Amperage Amps	Torch-to-Work Distance		Marking Speed		Arc Voltage Volts
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63



**Stainless steel**

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
260 A

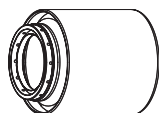
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	132 / 280
Cutflow	13 / 27	163 / 345



220637



220763



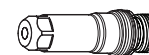
220758



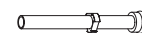
220406



220405



220307



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	Volts	mm	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	12	49	87	60	60	21	6	170	4.0	3980	8.0	200	0.3
								8	173		3085			
								10	175		2190			
								12	176		1790			
								15	177		1650			
								20	179		1320			
								25	182		920			
						40	26	32	186		755			Edge start
								38	189		510			
								44	195		390			
								50	202		270			

**English**

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	Volts	in	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	12	49	87	60	60	21	1/4	170	0.16	150	0.32	200	0.3
								5/16	173		121			
								3/8	175		90			
								1/2	176		65			
								5/8	177		55			
								3/4	179		35			
								1	182		30			
						40	26	1-1/4	186		20			Edge start
								1-1/2	189		15			
								1-3/4	187		10			
								2	202					

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

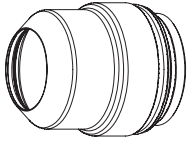
# OPERATION

## Stainless steel bevel cutting

H35 Plasma / N<sub>2</sub> Shield

260 A

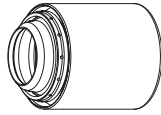
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



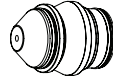
220637



220738



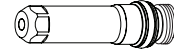
220739



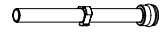
220607



220405



220606



220571

Notes: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	mm	
H35	N <sub>2</sub>	12	49	85	60	2.0	8	11.0	2030	11.0	100	0.3
							10					
							12	9.0 – 10.0	1710	9.0	120	0.4
							15					
							20	7.5 – 10.0	630	Edge start	1.0	
							25					1085
							25					785
							32					510
							38					390
							50					270

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	in	
H35	N <sub>2</sub>	12	49	85	60	0.08	5/16	0.45 – 0.40	80	0.45	100	0.3
							3/8					
							1/2	0.35 – 0.40	65	0.35	120	0.4
							5/8					
							3/4	0.30 – 0.40	25	Edge start	1.0	
							1					45
							1					30
							1-1/4					20
							1-1/2					15
							1-3/4					10

### Marking

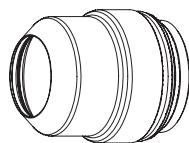
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		Amps	mm	in	mm/m	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

## Stainless steel bevel cutting

N<sub>2</sub> Plasma / Air Shield

260 A

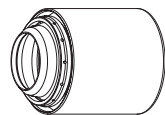
Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



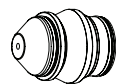
220637



220738



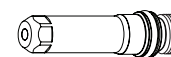
220739



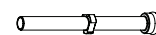
220607



220405



220606



220571

Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	factor %	seconds
N <sub>2</sub>	Air	12	47	79	56	2.0	6	3.8 – 10.0	6375	7.5	200	0.3
							8		4910			
							10		3440			
							12		2960			
							15		2520			
							20		1590			
							25		1300			
							32		875			
							38		515			
							44		365			
							50		180			

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	factor %	seconds
N <sub>2</sub>	Air	12	47	79	56	0.08	1/4	0.15 – 0.40	240	0.3	200	0.3
							5/16		193			
							3/8		140			
							1/2		110			
							5/8		95			
							3/4		70			
							1		50			
							1-1/4		35			
							1-1/2		20			
							1-3/4		14			
							2		6			

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

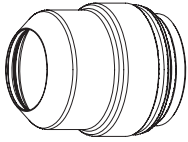
# OPERATION

## Stainless steel bevel cutting

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield

260 A

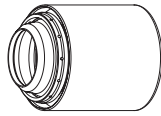
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	132 / 280
Cutflow	13 / 27	163 / 345



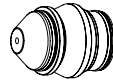
220637



220738



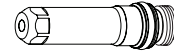
220739



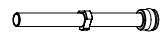
220607



220405



220606



220571

Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	mm	Range (mm)	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	12	49	87	60	60	21	2.0	6	4.0 – 10.0	3980	8.0	200	0.3
									8		3085			
									10		2190			
									12		1790			
									15		1650			
									20		1320			
									25		920			
						32	755		Edge start					
						38	510							
						44	390							
						50	270							

### English

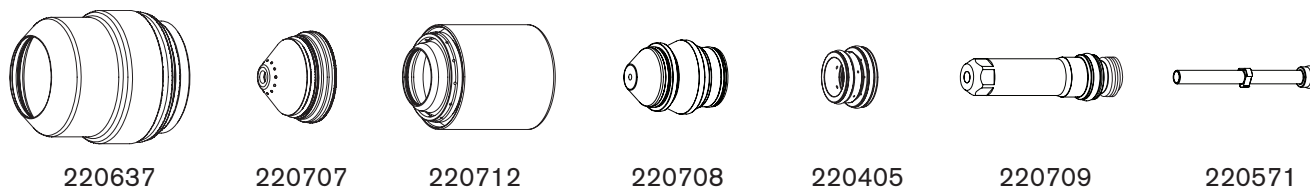
Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	in	Range (in)	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	12	49	87	60	60	21	0.08	1/4	0.16 – 0.40	150	0.32	200	0.3
									5/16		121			
									3/8		90			
									1/2		65			
									5/8		55			
									3/4		35			
									1		30			
						1-1/4	20		Edge start					
						1-1/2	15							
						1-3/4	10							
						2								

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

**Stainless steel**  
N<sub>2</sub> Plasma / Air Shield  
400 A

Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	42 / 90	146 / 310
Cutflow	86 / 182	102 / 217



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
N <sub>2</sub>	Air	30	50	85	31	12	158	3.8	3300	9.9	260	0.3
						15	159		2800			0.4
						20	162	4.6	2340	13.8	300	0.5
						25	164		1940			0.6
						30	176	6.4	1450	19.2	Edge start	0.8
						40	177	4.6	570	430		
						45	187					

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
N <sub>2</sub>	Air	30	50	85	31	1/2	158	0.15	125	0.39	260	0.3
						5/8	159		105			0.4
						3/4	162	0.18	95	0.54	300	0.5
						1	164		75			0.6
						1-1/4	176	0.25	50	0.75	Edge start	0.8
						1-1/2	177	0.18	25	17		
						1-3/4	187					

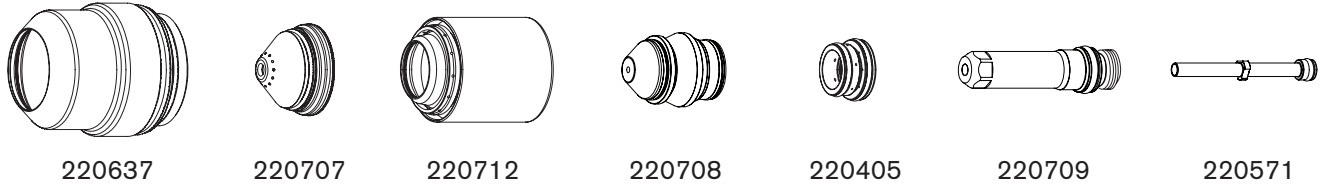
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

# OPERATION

## Stainless steel H35 Plasma / N<sub>2</sub> Shield 400 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	189 / 400
Cutflow	86 / 182	123 / 260



### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm
H35	N <sub>2</sub>	30	45	86	45	20	180	9.0	1100	14.5	150	0.7	
						25	181		905				
						30	184		800	19.0	210		1.0
						40	186		600				
						50	192		400	Edge start			
						60	198		280				

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in
H35	N <sub>2</sub>	30	45	86	45	3/4	180	0.35	45	0.53	150	0.7	
						1	181		35				
						1-1/4	184		30	0.75	210		1.5
						1-1/2	186		25				
						1-3/4	189		20	Edge start			
						2	192		15				
						2-1/4	198		12				
						2-1/2	202		10				

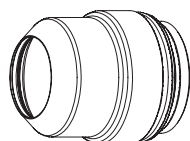
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

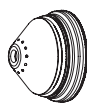
**Stainless steel**

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
400 A

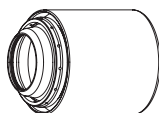
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	194 / 410
Cutflow	36 / 77	194 / 410



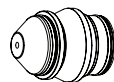
220637



220707



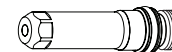
220712



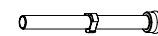
220708



220405



220709



220571

**Metric**

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	Volts	mm	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	30	45	88	45	60	40	12	157	4.6	2750	14	300	0.4
								15	159		2390			0.5
								20	166		1810			0.7
								25	172		1310			1.0
							60	30	186	5.3	1080	16	2.0	
								40	187	6.4	720	19	3.0	
								45	190		635			
								50	192		520	Edge start		
								60	192		410			
								70	194		310			
								80	210		180			

**English**

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	Volts	in	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	30	45	88	45	60	40	1/2	157	0.18	105	0.5	300	0.4
								5/8	159		90			0.5
								3/4	166		75			0.7
								1	172		50			1.0
							60	1-1/4	182	0.21	40	0.6	1.5	
								1-1/2	186	0.25	30	0.8	2.0	
								1-3/4	187		25		3.0	
								2	190		20	Edge start		
								2-1/4	192		17			
								2-1/2	194		15			
								3	202		10			

**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

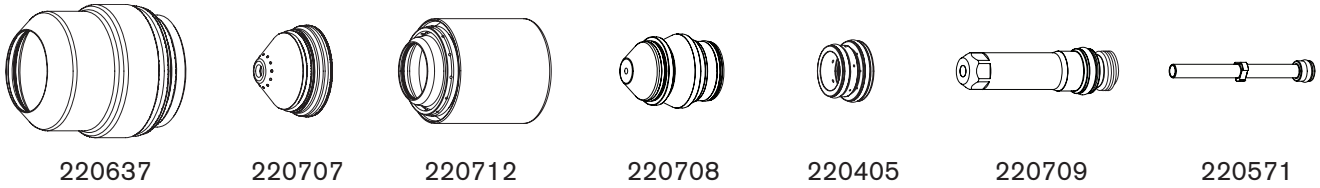
## OPERATION

### Stainless steel bevel cutting

N<sub>2</sub> Plasma / Air Shield

400 A

Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	42 / 90	146 / 310
Cutflow	86 / 182	102 / 217



Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	Factor %	Seconds
N <sub>2</sub>	Air	30	50	85	31	2.0	12	3.8 – 11.6	3300	9.9	260	0.3
							15		2800			0.4
							20	4.6 – 11.6	2340	13.8	300	0.5
							25		1940			0.6
							30	6.4 – 11.6	1450	19.2	Edge start	0.8
							40	4.6 – 11.6	570	430		
							45					

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	Factor %	Seconds
N <sub>2</sub>	Air	30	50	85	31	0.08	1/2	0.15 – 0.46	125	0.39	260	0.3
							5/8		105			0.4
							3/4	0.18 – 0.46	95	0.54	300	0.5
							1		75			0.6
							1-1/4	0.25 – 0.46	50	0.75	Edge start	0.8
							1-1/2	0.18 – 0.46	25			
							1-3/4		17			

### Marking

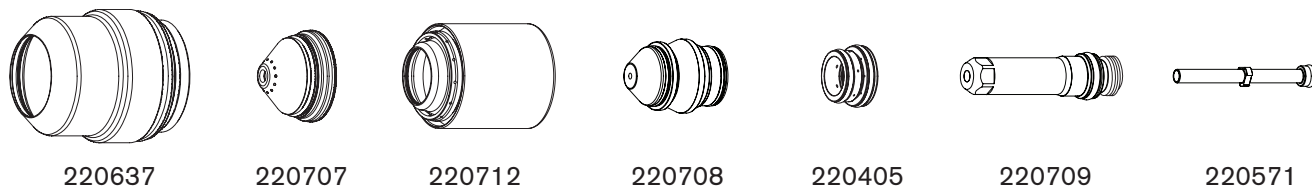
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50



## Stainless steel bevel cutting

H35 Plasma / N<sub>2</sub> Shield  
400 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	189 / 400
Cutflow	86 / 182	123 / 260



Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	mm	mm	Range (mm)	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	30	45	86	45	2.0	20	9.0 – 11.6	1100	19.0	150	0.7
							25		905			1.0
							30		800			1.5
							40		600			2.0
							50		400	Edge start		
							60		280			

### English

Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	in	in	Range (in)	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	30	45	86	45	0.08	3/4	0.35 – 0.46	45	0.75	150	0.7
							1		35			1.0
							1-1/4		30			1.5
							1-1/2		25			2.0
							1-3/4		20	Edge start		
							2		15			
							2-1/4		12			
							2-1/2		10			

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

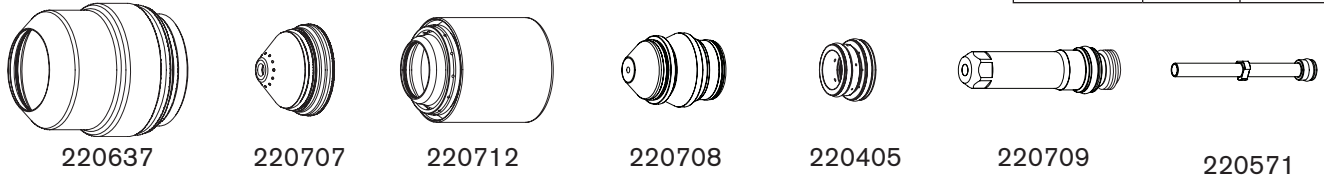
# OPERATION

## Stainless steel bevel cutting

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield

400 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	194 / 410
Cutflow	36 / 77	194 / 410



Note: Bevel angle range is 0° to 45°.

### Metric

Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					mm	mm	
H35	N <sub>2</sub>	30	45	88	45	60	40	2.0	12	4.6 – 11.6	2750	14	300	0.4
									15					0.5
									20					0.7
									25					1.0
							30		5.3 – 11.6	1080	16	2.0		
							40					6.4 – 11.6	720	19
							50		Edge start					
							60							
							70							
							80		180					

### English

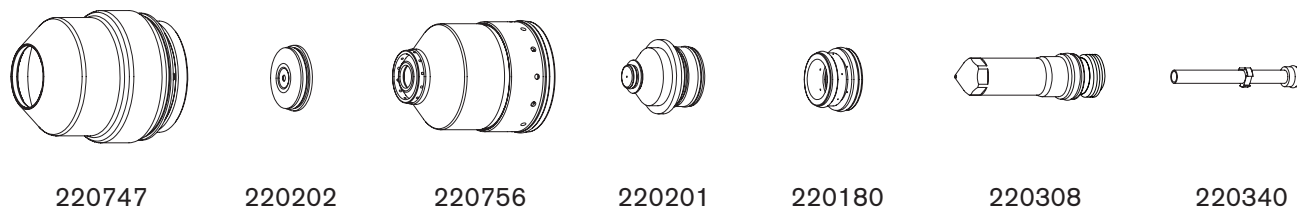
Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					in	in	
H35	N <sub>2</sub>	30	45	88	45	60	40	0.08	1/2	0.18 – 0.46	105	0.5	300	0.4
									5/8					0.5
									3/4					0.7
									1					1.0
							1-1/4		0.21 – 0.46	40	0.6	1.5		
							1-1/2					0.25 – 0.46	30	0.8
							1-3/4		Edge start					
							2							
							2-1/4							
							2-1/2		15					
3	10													

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

**Aluminum**  
Air Plasma / Air Shield  
45 A

Flow rates – lpm/scfh	
Air	
Preflow	45 / 95
Cutflow	78 / 165



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time			
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm	mm	Factor %
Air	Air	35	19	62	49	1.2	130	2.5	4750	3.8	150	0.2			
						1.5	115		4160						
						2	113		3865						
						2.5	110		3675						
						3	107		2850						
					33	4	102	1.8	2660				2.7	0.3	
						6	117	3.0	1695				4.5		0.6

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time			
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in	ipm	in
Air	Air	35	19	62	49	0.040	130	0.10	220	150	150	0.2			
						0.051	115		170						
						0.064	113		160						
						0.102	110		140						
						0.125	102		0.07				110	0.11	0.3
					33	3/16	114	0.12	90				0.18	0.4	
						1/4	117		60						

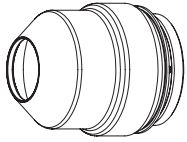
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	15	2.5	0.10	6350	250	85
Ar	Air	90	10	90	10	12	2.5	0.10	2540	100	75

## OPERATION

### Aluminum Air Plasma / Air Shield 130 A

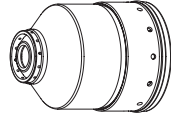
Flow rates – lpm/scfh	
Air	
Preflow	73 / 154
Cutflow	78 / 165



220747



220198



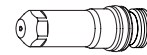
220756



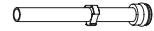
220197



220179



220181



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
Air	Air	19	31	75	23	6	153	2.8	2370	5.6	200	0.2
						8	154	3.0	1920	0.3		
						10			1465	0.5		
						12	156	3.3	1050	6.6		0.8
						15	158	3.5	725	7.0		1.3
						20	162	4.0	525	Edge start		
						25	172	4.0	525	Edge start		

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
Air	Air	19	31	75	23	1/4	153	0.11	90	0.22	200	0.2
						5/16	154	0.12	76	0.3		
						3/8			60	0.5		
						1/2	156	0.13	40	0.26		0.8
						5/8	158	0.14	30	0.28		1.3
						3/4	162	0.16	20	Edge start		
						1	172	0.16	20	Edge start		

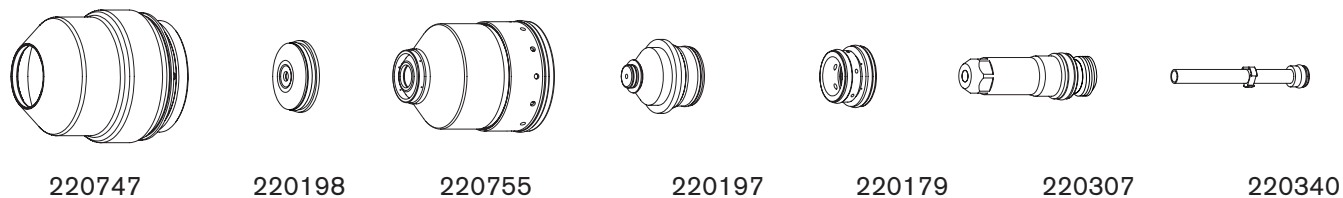
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	Air	50	10	50	10	15	3.0	0.12	2540	100	82

Note: This process produces a rougher cut edge that is less perpendicular than the 130 A, H35/N<sub>2</sub> process.

**Aluminum**  
H35 Plasma / N<sub>2</sub> Shield  
130 A

Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
H35	N <sub>2</sub>	19	32	75	49	8	158	5.0	1775	6.5	130	0.3
						10			1615			
					37	12	156	4.5	1455	7.7	170	0.5
					24	15			1305			0.8
					16	25	176	540	Edge start		1.3	

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
H35	N <sub>2</sub>	19	32	75	49	5/16	158	0.20	70	0.26	130	0.3
						3/8			65			
					37	1/2	156	0.18	55	0.31	170	0.5
					24	5/8			50			0.8
					16	3/4	157	40	1.3			
	1	176	20	Edge start								

**Marking**

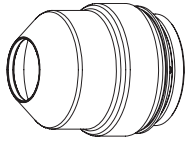
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

# OPERATION

## Aluminum

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
130 A

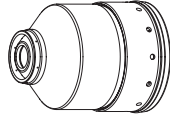
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150



220747



220198



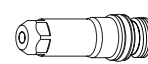
220755



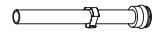
220197



220179



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	Volts	mm	mm/m	mm	Factor %	Seconds	
H35	N <sub>2</sub>	19	51	75	27	32	18	6	156	3.5	2215	7.0	200	0.3	
								8	157		1915				
								10	158		1615				
								12	159	3.0	1455	6.0			0.5
								15	160		1215				0.8
20	163	815	1.3												

### English

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	Volts	in	ipm	in	Factor %	Seconds	
H35	N <sub>2</sub>	19	51	75	27	32	18	1/4	156	0.14	85	0.28	200	0.3	
								5/16	157		75				
								3/8	158		65				
								1/2	159	0.12	55	0.24			0.5
								5/8	160		45				0.8
3/4	163	35	1.3												

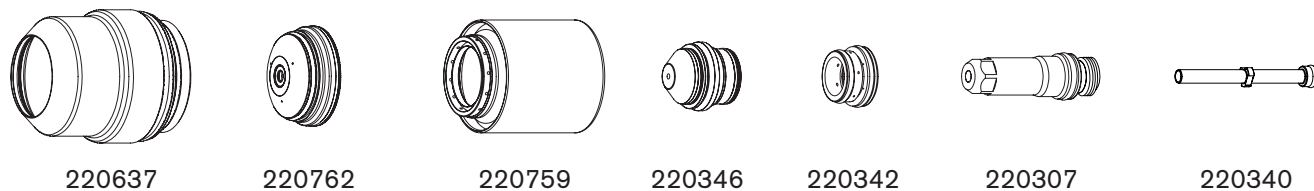
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	130
Ar	N <sub>2</sub>	50	10	50	10	15	3.0	0.12	2540	100	75

## Aluminum

N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
200 A

Flow rates – lpm/scfh	
N <sub>2</sub>	
Preflow	113 / 240
Cutflow	135 / 287



### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
N <sub>2</sub>	N <sub>2</sub>	17	43	73	43	8	158	6.4	6000	9.0	140	0.3
						10			4750			0.4
						12			3500			0.5
						15	2350		0.6			
						20	1000		0.8			

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
N <sub>2</sub>	N <sub>2</sub>	17	43	73	43	5/16	158	0.25	236	0.35	140	0.3
						3/8			200			0.4
						1/2			120			0.5
						5/8	80		0.6			
						3/4	50		0.8			

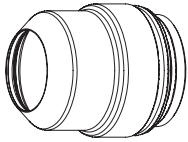
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	66

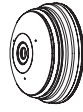
# OPERATION

## Aluminum H35 Plasma / N<sub>2</sub> Shield 200 A

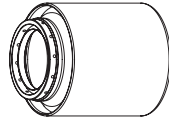
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	113 / 240
Cutflow	34 / 72	90 / 190



220637



220762



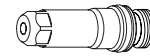
220759



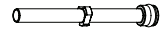
220346



220342



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
H35	N <sub>2</sub>	17	43	73	43	8	152	6.4	5000	9.0	140	0.3
						10			4400			
						12	150		3800			
						15			3000			
						20	159		1450			
												0.6

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
H35	N <sub>2</sub>	17	43	73	43	5/16	152	0.25	197	0.35	140	0.3
						3/8			180			
						1/2	150		140			
						5/8			110			
						3/4	159		70			
												0.6

### Marking

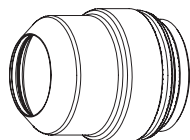
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	66



## Aluminum

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
200 A

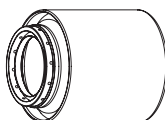
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Prewflow	0 / 0	121 / 256
Cutflow	13 / 27	126 / 267



220637



220762



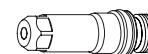
220759



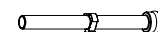
220346



220342



220307



220340

### Metric

Select Gases		Set Prewflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	mm	Volts	mm	mm/m	mm	Factor %	Seconds
H35	N <sub>2</sub>	17	44	73	44	42	20	8	158	6.4	4350	9.0	140	0.3
								10			4000			0.4
								12			3650			0.5
								15			2450			0.6
								20			1050			

### English

Select Gases		Set Prewflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2	in	Volts	in	ipm	in	Factor %	Seconds
H35	N <sub>2</sub>	17	44	73	44	42	20	5/16	158	0.25	171	0.35	140	0.3
								3/8			160			0.4
								1/2			140			0.5
								5/8			80			0.6
								3/4			50			

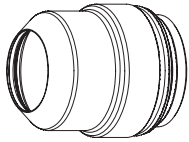
### Marking

Select Gases		Set Prewflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/m	ipm	Volts
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	<b>18</b>	2.5	0.10	6350	250	140
Ar	N <sub>2</sub>	30	10	30	10	<b>20</b>	3.0	0.12	2540	100	66

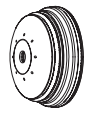
# OPERATION

## Aluminum N<sub>2</sub> Plasma / Air Shield 260 A

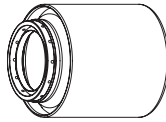
Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	125 / 265	0 / 0
Cutflow	50 / 105	113 / 240



220637



220763



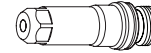
220758



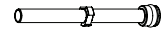
220406



220405



220307



220340

### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm
N <sub>2</sub>	Air	12	49	74	56	6	172	6.4	7900	9.0	140	0.2	
						8			6415			0.3	
						10			4930			0.4	
						12	164	4.0	4290	8.0	200	0.5	
						15	165		3330			0.6	
						20	171		1940	Edge start			
						25	177		1440		11.0	260	0.8
						32	191		940				
						38	195		520				
						44	202	320					
						50	205	215					

### English

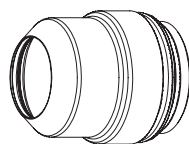
Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in
N <sub>2</sub>	Air	12	49	74	56	1/4	172	0.25	300	0.35	140	0.2	
						5/16			253			0.3	
						3/8			200			0.4	
						1/2	164	0.16	160	0.32	200	0.5	
						5/8	165		120			0.6	
						3/4	171		80	Edge start			
						1	177		55		0.42	260	0.8
						1-1/4	190		40				
						1-1/2	195		20				
						1-3/4	202	12					
						2	205	8					

### Marking

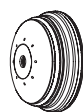
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		Amps	mm	in	mm/m	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

**Aluminum**  
H35 Plasma / N<sub>2</sub> Shield  
260 A

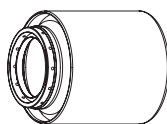
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	127 / 270
Cutflow	33 / 70	118 / 250



220637



220763



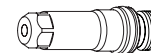
220758



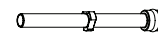
220406



220405



220307



220340

**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time						
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm	mm/m	mm	Factor %	Seconds	
H35	N <sub>2</sub>	12	49	76	58	6	170	11.0	7200	11.0	100	0.2						
						8			6660			0.3						
						10			6120			10.0	0.4					
												12	162	7.6	5160	8.5	110	0.5
												15	163		3720			0.6
												20	166		2230	11.0	150	0.8
												25	174		1930			
												32	175		1510			
												38	176		1150			
												44	183		670			
												50	190		390	Edge start		

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time						
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in	ipm	in	Factor %	Seconds	
H35	N <sub>2</sub>	12	49	76	58	1/4	170	0.45	280	0.45	100	0.2						
						5/16			262			0.3						
						3/8			250			0.40	0.4					
												1/2	162	0.30	190	0.33	110	0.5
												5/8	163		130			0.6
												3/4	166		90	0.45	150	0.8
												1	174		75			
												1-1/4	175		60			
												1-1/2	176		45			
												1-3/4	183		25			
												2	190		14	Edge start		

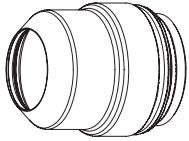
**Marking**

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	18	2.5	0.10	6350	250	120
Ar	N <sub>2</sub>	30	10	30	10	20	3.0	0.12	2540	100	63

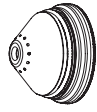
# OPERATION

## Aluminum N<sub>2</sub> Plasma / Air Shield 400 A

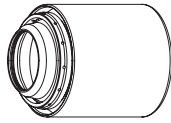
Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	42 / 90	146 / 310
Cutflow	68 / 144	103 / 219



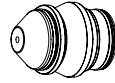
220637



220707



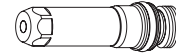
220712



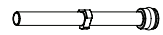
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220709



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### Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts		mm
N <sub>2</sub>	Air	30	50	70	31	12	155	3.8	4480	12.5	330	0.4	
						15	159		3770			0.5	
						20	163	4.1	2740	18.0	440	0.6	
						25	169		1850			0.7	
						30	175		1410			Edge start	
						40	188		810				
						50	206		410				

### English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts		in
N <sub>2</sub>	Air	30	50	70	31	1/2	155	0.15	170	0.5	330	0.4	
						5/8	159		140			0.5	
						3/4	163	0.16	115	0.7	440	0.6	
						1	169		70			0.7	
						1-1/4	177		50			Edge start	
						1-1/2	178		35				
						1-3/4	198		25				
						2	206		16				

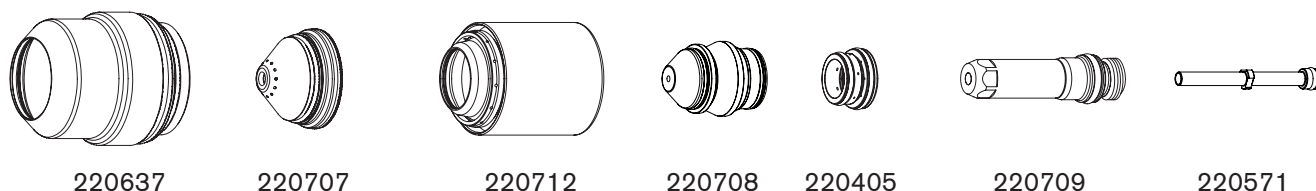
### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

**Aluminum**

H35 Plasma / N<sub>2</sub> Shield  
400 A

Flow rates – lpm/scfh		
	N <sub>2</sub>	Air
Preflow	0 / 0	189 / 400
Cutflow	86 / 182	123 / 260



**Metric**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					mm	Volts	
H35	N <sub>2</sub>	30	45	86	45	20	170	9.0	2420	18.9	150	0.7
						25	175		1820			1.0
						30	177		1590			1.5
						40	180		1190			2.0
						50	188		790	Edge start		
						60	200		450			
						70	208		310			
						80	210		210			

**English**

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas					in	Volts	
H35	N <sub>2</sub>	30	45	86	45	3/4	170	0.35	100	0.74	150	0.7
						1	175		70			1.0
						1-1/4	177		60			1.5
						1-1/2	180		50			2.0
						1-3/4	184		40	Edge start		
						2	188		30			
						2-1/4	200		20			
						2-1/2	208		15			
3	210	10										

**Marking**

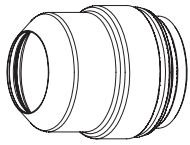
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas		mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

# OPERATION

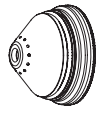
## Aluminum

H35 and N<sub>2</sub> Plasma / N<sub>2</sub> Shield  
400 A

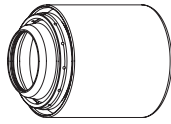
Flow rates – lpm/scfh		
	H35	N <sub>2</sub>
Preflow	0 / 0	194 / 410
Cutflow	36 / 77	194 / 410



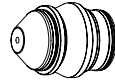
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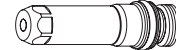
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### Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					mm	Volts	
H35	N <sub>2</sub>	30	45	88	45	60	40	12	155	4.6	5190	14	300	0.4
								15	157					0.5
								20	159					0.7
								25	166					1.0
							60	30	171	5.3	2170	16	1.5	
								40	175	6.4	1440	19	2.0	
								50	185		Edge start			
								60	195					
								70	200					
								80	208	210				

### English

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma gas	Shield gas	Plasma gas	Shield gas	Plasma gas	Shield gas	Mix Gas 1	Mix Gas 2					in	Volts	
H35	N <sub>2</sub>	30	45	88	45	60	40	1/2	155	0.18	200	0.5	300	0.4
								5/8	157					0.5
								3/4	159					0.7
								1	166					1.0
							60	1-1/4	171	0.21	80	0.6	1.5	
								1-1/2	175	0.25	60	0.8	2.0	
								1-3/4	180		Edge start			
								2	185					
								2-1/4	195					
								2-1/2	200					
								3	208	10				

### Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
							mm	in	mm/m	ipm	
N <sub>2</sub>	N <sub>2</sub>	10	10	10	10	22	2.5	0.10	1270	50	94
Ar	N <sub>2</sub>	30	10	30	10	24	3.0	0.12	2540	100	50

## Section 5

# MAINTENANCE

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## MAINTENANCE

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## 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.

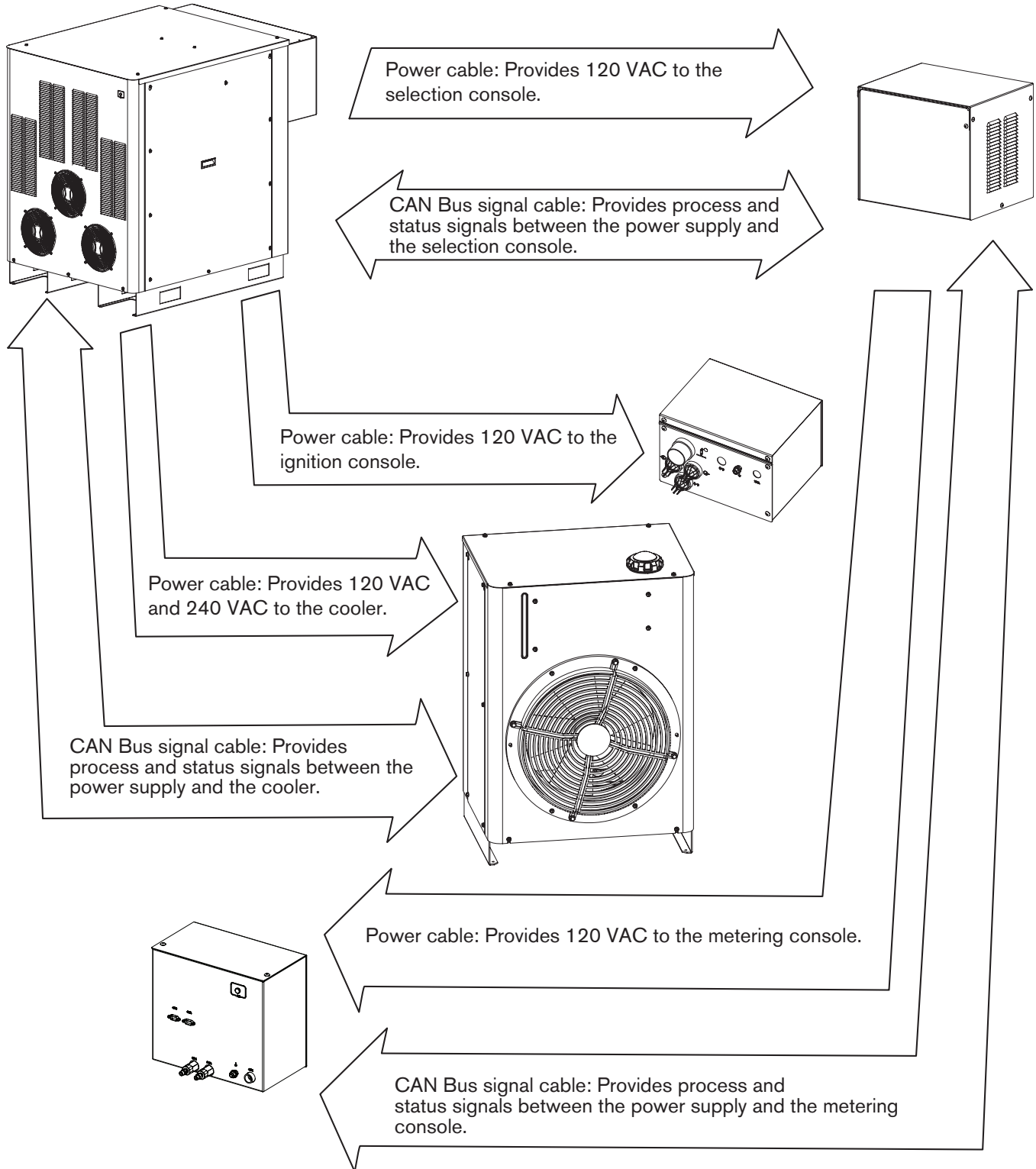
		<b>WARNING SHOCK HAZARD</b>
<p>Use extreme care when working near the chopper modules. Each large electrolytic capacitor (blue-cased cylinder) stores large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge any capacitor with a screwdriver or other implement... explosion, property damage and/or personal injury will result.</p>		

## Routine maintenance

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

## System description

### Power and signal cables



## Sequence of operation

1. Power-up – The system verifies that all of these signals are off at power-up
  - Coolant flow off
  - Chopper current off
  - Transfer off
  - Phase-loss off
  - Chopper 1 overtemp off
  - Magnetics overtemp off
  - Coolant overtemp off
  - Plasma start off
2. Purge – Air or N<sub>2</sub> gas flows through torch for 20 seconds
  - Contactor closes and the chopper performs a chopper test and a current sensor test
  - Plasma start off
  - Contactor remains closed when the purge cycle ends
3. Idle
  - Gas pressure ok
  - Coolant flow on
  - Chopper current off
  - Line voltage ok
4. Preflow – 2-second flow of gas
5. Pilot arc – Current flows between electrode and nozzle
  - Chopper, main contactor and pilot arc relay are on
  - High frequency present
  - Chopper current sensor = pilot arc current
6. Transfer – Pilot arc current sensed on the worklead
7. Ramp-up – Chopper current increases to its setpoint and gas changes to cutflow
  - Coolant flow on
  - Gas pressure ok
  - Phase-loss on
  - Line voltage ok
8. Steady state – normal operating parameters
  - Coolant flow on
  - Gas pressure ok
  - Phase loss on
  - Chopper 1 overtemp off
  - Magnetics overtemp off
  - Coolant overtemp off
9. Ramp-down – Current and gas flow decrease after plasma start has been removed
  - Cutflow gas off
10. Auto Off – 10-second postflow
  - Main contactors off
  - Choppers off

## MAINTENANCE

### Gas system purge cycle

When the system is turned on, or the operator changes from one cut process to another, the system automatically goes through a purge cycle. The purge cycle has 2 stages; a preflow purge and a cutflow purge.

The preflow purge gas flows for 8 seconds with an auto gas console, or 12 seconds with a manual gas console.

The cutflow purge gas flows for 8 seconds with an auto gas console, or 12 seconds with a manual gas console.

There are 2 exceptions to the cycle described above.

Exception 1 – if the operator changes from a non-fuel gas process (O<sub>2</sub>/Air, Air/Air, or N<sub>2</sub>/Air) to a fuel gas process (H35/N<sub>2</sub>, or F5/N<sub>2</sub>) or the reverse, there will be 3 stages to the purge process. Nitrogen will purge the gas system first, for 12 seconds. The preflow and cutflow purges will follow the nitrogen purge.

Note: Error code 42 (low nitrogen gas pressure) will be displayed, if nitrogen is not connected to the gas system. If error code 42 is not resolved in 3 minutes, it will be replaced by error code 139 (purge time-out error).

Exception 2 – no purge cycle will occur if the operator changes from any cut process to a nitrogen or argon marking process.

### Gas system valve usage

The following tables show which valves are active for each cutting process.

O <sub>2</sub> /O <sub>2</sub> process	Metering console control board				Selection console control board															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4		B2		SV1		SV3					SV8		SV10						
Cutflow		B3		B1	SV1		SV3					SV8		SV10						

O <sub>2</sub> /Air process	Metering console control board				Selection console control board															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4		B2		SV1		SV3					SV8		SV10						
Cutflow		B3	B2		SV1		SV3					SV8		SV10						

N <sub>2</sub> /N <sub>2</sub> process	Metering console control board				Selection console control board															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4			B1									SV9		SV11					
Cutflow	B4			B1									SV9		SV11					

F5/N <sub>2</sub> process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3		B1						SV6			SV9							
Cutflow	B4			B1						SV6			SV9					SV14		

H35/N <sub>2</sub> process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3		B1					SV5				SV9							
Cutflow	B4			B1					SV5				SV9					SV14		

H35 & N <sub>2</sub> /N <sub>2</sub> process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3		B1					SV5				SV9							
Cutflow	B4			B1					SV5				SV9			SV12	SV13			

N <sub>2</sub> /Air process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3	B2				SV3						SV9	SV10						
Cutflow		B3	B2				SV3						SV9	SV10						

Air/Air process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3	B2			SV2	SV3						SV9	SV10						
Cutflow		B3	B2			SV2	SV3						SV9	SV10						

# MAINTENANCE

## Marking process

The valves that are active when marking are represented by the tables below. The active valves in the metering console will differ depending on what process was used before marking.

Valves active when changing from a process that **does not** use a fuel gas

N <sub>2</sub> /N <sub>2</sub>	Metering console control board				Selection console control board																
	LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4		B2													SV11					
Cutflow	B4		B2													SV11					

Valves active when changing from a process that **does** use a fuel gas

N <sub>2</sub> /N <sub>2</sub>	Metering console control board				Selection console control board																
	LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3		B1										SV9							
Cutflow		B3		B1										SV9							

Ar/N <sub>2</sub>	Metering console control board				Selection console control board																
	LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4			B1										SV9							SV15
Cutflow	B4			B1										SV9							SV15

Ar/Air 25 to 35 amps	Metering console control board				Selection console control board																
	LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow	B4		B2					SV3				SV7			SV10						
Cutflow	B4		B2					SV3				SV7			SV10						

Ar/Air < 25 or > 35 amps	Metering console control board				Selection console control board																
	LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3	B2					SV3				SV7			SV10						
Cutflow		B3	B2					SV3				SV7			SV10						

## Error codes

Error codes are displayed on the CNC screen. The diagnostic screen shown below is for reference. The screens you work with may be different, but should include the functions described in the Operation section of this manual.

The screenshot displays a diagnostic interface with the following sections:

- Power Supply Status:**
  - Line Voltage: 123 V 102/138
  - Current Setpoint: 80 Amps
  - Chopper-A: 0 Amps
  - WorkLead: 0 Amps
  - Coolant Flow: 0 GPM 0.7/0.9
  - PS State Code: 14 = Shut Down
  - Last 5 Error Codes: 0109 0109 0057 0000 0000
- Arc On Statistics:**
  - Arc On Time: 653 Seconds
  - Sys On Time: 71 Minutes
  - Tot Starts: 9 Count
  - Tot Start Errors: 319 Count
  - Tot Ramp Errors: 48682 Count
- Gas Pressures:**
  - Plasma Cutflow: 0 PSI 50/99
  - Plasma Preflow: 0 PSI 15/99
  - Shield Cutflow: 0 PSI 2/99
  - Shield Preflow: 0 PSI 2/99
- Auto Gas Pressures:**
  - Inlet Cut Gas #1: 114 PSI 2/99
  - Inlet Cut Gas #2: 102 PSI 2/99
  - Mixed Gas #1: 131 PSI 2/99
  - Mixed Gas #2: 24 PSI 2/99
- Temperatures:**
  - Chopper A: 70.4 F 140/185
  - Coolant: 70.6 F 140/158
  - Transformer: 75.3 F 140/248
- Software Revisions:**
  - Power Supply Rev: B.1
  - Gas Console Rev: F.
- Gas Types:**
  - Plasma Inlet Gas: Oxygen
  - Shield Inlet Gas: Air

At the bottom of the screen, there are several control buttons: Test Preflow, Test Outflow, Test Gas Console, Coolant Override, Power Supply Inputs, Power Supply Outputs, Gas Console Inputs, Gas Console Outputs, and HPR Information. A 'Help' button is located in the top right corner, and 'Cancel' and 'OK' buttons are in the bottom right corner. The time 9:54:03 AM is displayed in the bottom right area.

### Error code troubleshooting – error codes 000 to 018

Error code number	Name	Description	Corrective action
000	No error	System is ready to run.	None needed.
009	Flow switch test	The flow switch is tested when the pump restarts after a pump timeout (30 minutes without a start signal). The test ensures that the coolant flow is correct before firing the torch.	Wait 10 seconds for the flow rate to stabilize.
011	No active process <b>HPR400XD HPR800XD Only</b>	The current setting is greater than the capability of the selected process. When this error code occurs, the power supply will ignore the start signal until a correct process is chosen.	<ol style="list-style-type: none"> <li>1. Verify that the secondary power supply is turned ON.</li> <li>2. Verify that the current for the selected process is within the range of the power supply capability (up to 400A for 400XD, and up to 800A for 800XD).</li> </ol>
012	Test in progress	One of the gas test modes is running.	Wait for the test to finish.
013	Test passed	The test was successful.	No action required.
014	Cut gas channel 1 fail	The gas pressure in channel 1 is decreasing, which indicates a leak.	Look for leaks and loose connections between the selection console and the metering console.
015	Cut gas channel 2 fail	The gas pressure in channel 2 is decreasing, which indicates a leak.	Look for leaks and loose connections between the selection console and the metering console.
016	Plasma rampdown fail	Plasma pressure did not decrease in the time allowed.	Verify that there is no obstruction in the plasma vent hose.
017	Shield rampdown fail	Shield pressure did not decrease in the time allowed.	Inspect the holes in the shield for obstructions. Replace the shield if the holes are blocked.



**Error code troubleshooting – error codes 020 to 028, 224 to 228**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
020	No pilot arc	No current detected from chopper at ignition and before 1-second timeout.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper preflow and cut-flow settings.</li> <li>3. Perform gas leak tests (see <i>Maintenance</i> section).</li> <li>4. Verify spark across spark gap.</li> <li>5. Inspect CON1 and pilot arc relay for excessive wear.</li> <li>6. Perform gas flow test (see <i>Maintenance</i> section).</li> <li>7. Perform torch lead test (see <i>Maintenance</i> section).</li> <li>8. Perform start circuit test (see <i>Maintenance</i> section).</li> </ol>
021	No arc transfer	No current detected on work lead 500 milliseconds after pilot arc current was established.	<ol style="list-style-type: none"> <li>1. Verify proper pierce height.</li> <li>2. Verify proper preflow and cut-flow settings.</li> <li>3. Inspect work lead for damage or loose connections.</li> </ol>
024 Primary 224 Secondary	Lost current Chopper 1	Lost the current signal from Chopper 1 after transfer.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper cut-flow gas settings.</li> <li>3. Verify pierce delay time.</li> <li>4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc).</li> </ol>
025 Primary 225 Secondary	Lost current Chopper 2 <b>HPR260XD HPR400XD Only</b>	Lost the current signal from Chopper 2 after transfer.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper cut-flow gas settings.</li> <li>3. Verify pierce delay time.</li> <li>4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc).</li> </ol>
026 Primary 226 Secondary	Lost transfer	Lost the transfer signal after transfer completed.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper cut-flow gas settings.</li> <li>3. Verify pierce delay time.</li> <li>4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc).</li> <li>5. Inspect work lead for damage or loose connections.</li> <li>6. Try connecting work lead directly to the plate.</li> </ol>
027 Primary 227 Secondary	Lost phase	Phase imbalance to chopper after contactor engaged or while cutting.	<ol style="list-style-type: none"> <li>1. Verify phase-to-phase voltage to power supply.</li> <li>2. Disconnect power to power supply, remove cover on contactor and inspect contacts for excessive wear.</li> <li>3. Inspect power cord, contactor, and input to chopper for loose connections.</li> <li>4. Inspect phase loss fuses on Power Distribution board. Replace board if fuses are blown.</li> <li>5. Perform phase loss test (see <i>Maintenance</i> section).</li> </ol>
028 Primary 228 Secondary	Lost current Chopper 3 <b>HPR400XD Only</b>	Lost the current signal from Chopper 3 after transfer.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper cut-flow gas settings.</li> <li>3. Verify pierce delay time.</li> <li>4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc).</li> </ol>

## Error code troubleshooting – error codes 030 to 042, 231 to 234

Error code number	Name	Description	Corrective action
030	Gas system error <b>Auto Gas Only</b>	A failure has occurred in the gas system.	<ol style="list-style-type: none"> <li>1. Verify that cable number 5 (power supply-to-gas console control cable) is not damaged and is properly connected to PCB3 and to the rear of the gas console.</li> <li>2. Verify that cable number 6 (power supply-to-gas console power cable) is not damaged and is properly connected inside the power supply and to the rear of the gas console.</li> <li>3. Verify that D1 (+5 VDC) and D2 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2.</li> <li>4. If power is present at PCB2 and PCB3 and both gas console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> </ol>
031 Primary 231 Secondary	Start lost	Start signal was received and then lost before an arc was established.	<ol style="list-style-type: none"> <li>1. If a mechanical relay is being used to provide the HPR with a start signal, this relay is either bouncing when activated or the contacts are faulty. Replace the relay.</li> <li>2. Inspect interface cable for damage; faulty crimps, or poor electrical connections.</li> <li>3. If interface cable is good and a relay is not driving the start input, the CNC is dropping the start signal before a steady state arc has been established.</li> </ol>
032	Hold timeout	Hold signal was active for longer than 60 seconds.	<ol style="list-style-type: none"> <li>1. Check the interface cable for damage. The hold wires may be short-circuiting inside.</li> <li>2. The CNC is maintaining this input, it could be waiting for an IHS complete input from another torch.</li> <li>3. If CNC interface cable is good and it is a 1-torch system, change PCB3.</li> </ol>
033	Precharge time-out <b>Auto Gas Only</b>	Selection console was not able to charge the lines to the correct value.	This is a warning for a possible gas restriction in the leads. Verify that there are no restrictions in the plasma and shield hoses, or low inlet-gas pressure.
034 Primary 234 Secondary	Lost current Chopper 4 <b>HPR400XD Only</b>	Lost the current signal from Chopper 4 after transfer.	<ol style="list-style-type: none"> <li>1. Verify that the consumable parts are in good condition.</li> <li>2. Verify proper cut-flow gas settings.</li> <li>3. Verify pierce delay time.</li> <li>4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc).</li> </ol>
042	Low nitrogen (N <sub>2</sub> ) gas pressure	Nitrogen gas pressure under lower limit of: 2.07 bar (30 psi) – cutting 0.34 bar (5 psi) – marking During N <sub>2</sub> purge, when changing between a fuel gas process and an oxidizer process.	<ol style="list-style-type: none"> <li>1. Verify that the nitrogen supply is turned on and inspect gas supply pressure and volume of gas remaining in supply tanks.</li> <li>2. Verify that the gas regulator is set to 8.27 bar (120 psi). See <i>Setting the supply regulators (Installation section)</i>.</li> </ol>

**Error code troubleshooting – error codes 044 to 046**

Error code number	Name	Description	Corrective action
044	Low plasma gas pressure	Plasma gas pressure under lower limit of 0.34 bar (5 psi) – preflow 3.45 bar (50 psi) – cutflow (cutting) 0.34 bar (5 psi) – cutflow (marking)	<ol style="list-style-type: none"> <li>1. Inspect gas supply pressure and volume of gas remaining in supply tanks.</li> <li>2. Verify the gas regulator settings on gas console with the parameters in the cut charts.</li> <li>3. See <i>Setting the supply regulators (Installation section)</i>.</li> <li>4. Perform gas leak tests (<i>Maintenance section</i>).</li> </ol>
045	High plasma gas pressure	Plasma gas pressure over upper limit of: 7.58 bar (110 psi) – manual 9.65 bar (140 psi) – auto	<ol style="list-style-type: none"> <li>1. Verify gas supply pressure settings.</li> <li>2. Verify gas regulator settings on gas console with cut chart.</li> <li>3. See <i>Setting the supply regulators (Installation section)</i>.</li> <li>4. Solenoid at off-valve is not opening. Verify power to valves, disconnect plasma and shield hoses exiting off-valve. If pressures decrease a valve is not functioning or no power to the valve.</li> </ol>
046	Low line voltage	Line voltage is close to or less than the lower limit of 102 VAC (120 VAC -15%). The normal lower limit for operation is 108 VAC (120 VAC -10%).	<ol style="list-style-type: none"> <li>1. Verify input-line voltage at PCB2 in the power supply (also PCB1 in the cooler for HPR400XD systems). Voltage needs to be within 10% of nominal (120 VAC).</li> <li>2. Verify fuses on PCB2 in the power supply.</li> <li>3. Verify 120 VAC voltage on plug J2.4, pins 3 and 4 on PCB2 in the power supply.</li> <li>4. For HPR400XD systems, verify the voltage on PCB1 in the cooler with a DC volt meter. It should be about 0.415 VDC between TP23 and TP2 on PCB1.</li> <li>5. If AC voltage on PCB2, J2.4, pins 3 and 4, is greater than 108 VAC and DC voltage between TP23 and TP2 on PCB1 is less than 0.38 VDC, verify minimum 108 VAC voltage on plug J4, pins 1 and 2 on PCB1. Verify the wiring between PCB2 in the power supply and J4 on PCB1. If the voltage on plug J4 is greater than 108 VAC, but the DC voltage on TP23 and TP2 is less than 0.38, replace PCB1.</li> <li>6. If the AC voltage on PCB2 in the power supply at J2.4, pins 3 and 4, is greater than 108 VAC and the DC voltage between TP23 and TP2 on PCB1 in the cooler (HPR400XD only) is also greater than 0.38 VDC, verify the CAN link between PCB3 in the power supply and PCB1 in the cooler.</li> </ol>

## Error code troubleshooting – error codes 047 to 053, 248 to 250

Error code number	Name	Description	Corrective action
047	High line voltage	Line voltage is close to or greater than the upper limit of 138 VAC (120 VAC +15%). The normal upper limit for operation is 132 VAC (120 VAC +10%).	<ol style="list-style-type: none"> <li>1. Verify input–line voltage at PCB2 in the power supply and PCB1 in the cooler (HPR400XD only). Voltage needs to be within 10% of nominal (120 VAC).</li> <li>2. Verify fuses on PCB2 in the power supply.</li> <li>3. Verify 120 VAC voltage on plug J2.4, pins 3 and 4 on PCB2 in the power supply.</li> <li>4. Verify the voltage on PCB1 in the cooler (HPR400XD only) with a DC volt meter. It should be about 0.415 VDC between TP23 and TP2 on PCB1.</li> <li>5. If AC voltage on PCB2, J2.4, pins 3 and 4, is less than 132 VAC and DC voltage between TP23 and TP2 on PCB1 is greater than 0.44 VDC, verify maximum 132 VAC voltage on plug J4, pins 1 and 2 on PCB1. Verify wiring between PCB2 in the power supply and J4 on PCB1. If the voltage on plug J4 is less than 132 VAC, but the DC voltage on TP23 and TP2 is greater than 0.44, replace PCB1.</li> <li>6. If the AC voltage on PCB2 in the power supply on plug J2.4, pins 3 and 4, is less than 132 VAC and the DC voltage between TP23 and TP2 on PCB1 in the cooler (HPR400XD only) is also less than 0.44 VDC, verify the CAN link between PCB3 in the power supply and PCB1 in the cooler.</li> </ol>
048 Primary 248 Secondary	CAN error	An error occurred with the CAN communications between the power supply and the gas console.	<ol style="list-style-type: none"> <li>1. Verify that cable number 5 (power supply-to-gas console control cable) is not damaged and is properly connected to PCB3 and to the rear of the gas console.</li> <li>2. Verify that cable number 6 (power supply-to-gas console power cable) is not damaged and is properly connected inside the power supply and to the rear of the gas console.</li> <li>3. Verify that D1 (+5 VDC) and D2 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2.</li> <li>4. If power is present at PCB2 and PCB3 and both gas console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> </ol>
050 Primary 250 Secondary	Start signal is on at power-up	Plasma start signal input is active during power-up of power supply.	<ol style="list-style-type: none"> <li>1. Stop or clear the cutting program. The plasma start signal to the plasma was not dropped after the last cut.</li> <li>2. Verify that the CNC interface cable is not damaged.</li> <li>3. Remove CNC interface cable from PCB3 and look for an open circuit between pins 15 and 34.</li> <li>4. If the circuit is closed either the CNC is issuing a plasma start or the CNC interface cable is damaged.</li> <li>5. If circuit is open, and LEDN300J is illuminated with CNC Interface cable removed from PCB3, replace PCB3.</li> </ol>
053	Low shield gas pressure	Shield pressure is below lower limit of 0.14 bar (2 psi).	<ol style="list-style-type: none"> <li>1. Verify gas supply pressure and that a sufficient volume of gas remains in your supply.</li> <li>2. Verify gas regulator settings on gas console with cut chart.</li> <li>3. See <i>Setting the supply regulators</i> (Installation section).</li> <li>4. Perform gas leak tests (Maintenance section).</li> </ol>

**Error code troubleshooting – error codes 054 to 061**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
054	High shield gas pressure	Shield gas pressure is over upper limit of: 7.58 bar (110 psi) – manual 9.65 bar (140 psi) – auto	<ol style="list-style-type: none"> <li>1. Verify gas supply regulator settings. See <i>Setting the supply regulators</i> (Installation section).</li> <li>2. Verify pressure settings on gas console with cut chart.</li> <li>3. Solenoid at off-valve is not opening. Verify power to valves, disconnect plasma and shield hoses exiting off-valve. If pressures decrease, a valve is not functioning or no power to the valve.</li> </ol>
055	MV1 inlet pressure <b>Auto Gas Only</b>	Motor valve 1 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).	<ol style="list-style-type: none"> <li>1. Verify that gas pressure transducer P1 is between 3.45 bar (50 psi) and 9.65 bar (140 psi). Increase or decrease the inlet gas pressure to correct the problem.</li> </ol>
056	MV2 inlet pressure <b>Auto Gas Only</b>	Motor valve 2 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).	<ol style="list-style-type: none"> <li>1. Verify that gas pressure transducer P2 is between 3.45 bar (50 psi) and 9.65 bar (140 psi). Increase or decrease the inlet gas pressure to correct the problem.</li> </ol>
057	Cut gas 1 pressure <b>Auto Gas Only</b>	Cut gas 1 outlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi) in the selection console.	<ol style="list-style-type: none"> <li>1. Verify that gas pressure transducer P3 is between 3.45 bar (50 psi) and 9.65 bar (140 psi). Increase or decrease the inlet gas pressure to correct the problem.</li> </ol>
058	Cut gas 2 pressure <b>Auto Gas Only</b>	Cut gas 2 outlet pressure is less than 3.45 bar (50 psi) for non-mixing, or less than 1.38 bar (20 psi) when mixing or greater than 9.65 bar (140 psi) for non-mixing and mixing.	<ol style="list-style-type: none"> <li>1. Verify that gas pressure transducer P4 is between 3.45 bar (50 psi) and 9.65 bar (140 psi). Increase or decrease the inlet gas pressure to correct the problem.</li> </ol>
060	Low coolant flow	Coolant flow is less than the required 2.3 lpm (0.6 gpm).	<ol style="list-style-type: none"> <li>1. Verify that the correct consumables are properly installed.</li> <li>2. Perform the coolant flow test procedure in the Maintenance section of the manual.</li> </ol>
061	No plasma gas type	Manual gas - The gas console control board is not receiving signals from the gas selector knob. Auto gas - The selection console is not receiving the plasma gas type signal.	<ol style="list-style-type: none"> <li>1. Auto gas - the process parameters may not have been downloaded. Verify that the process information can be viewed on the CNC screen.</li> <li>2. Manual gas - the selector knob (2) may be set between positions. Reset the knob.</li> <li>3. Verify that there is power to the console by looking to see if any LED on any board in the selection console (auto) or gas console (manual) is illuminated. If no LED is illuminated, verify that the fuse on the power distribution PCB is in proper working condition.</li> <li>4. If the problem still exists, replace the control board.</li> </ol>

## Error code troubleshooting – error codes 062 to 067, 265 to 267

Error code number	Name	Description	Corrective action
062	No shield gas type	Manual gas – The gas console control board is not receiving signals from the gas selector knob. Auto gas – The selection console is not receiving the shield gas type signal.	<ol style="list-style-type: none"> <li>1. Auto gas – The process parameters may not have been downloaded. Verify that the process information can be viewed on the CNC screen.</li> <li>2. Manual gas – The selector knob (2) may be set between positions. Reset the knob.</li> <li>3. Verify that there is power to the console by looking to see if any LED on any board in the selection console (auto) or gas console (manual) is illuminated. If no LEDs are illuminated, verify that the fuse on the power distribution PCB is in proper working condition.</li> <li>4. If the problem still exists, replace the control board.</li> </ol>
065 Primary 265 Secondary	Chopper 1 overtemp	Chopper 1 has overheated.	<ol style="list-style-type: none"> <li>1. Verify that all chopper fans are operating properly. Spinning fan blades should be difficult to see.</li> <li>2. Blow dust out of system, especially from fans and heat sink of chopper.</li> <li>3. Verify that the voltage on rear side of J3.202, pins 2 and 3 on PCB3, is less than or equal to 2.9 VDC.</li> <li>4. If the voltage is low, verify correct wiring between chopper temperature sensor and J3.202 pins 1 and 2.</li> <li>5. If wiring is good and overtemp error does not clear after 30 minutes of the power supply idling with the fans running, replace the chopper.</li> </ol>
066 Primary 266 Secondary	Chopper 2 overtemp <b>HPR260XD</b> <b>HPR400XD</b> <b>Only</b>	Chopper 2 has overheated.	<ol style="list-style-type: none"> <li>1. Verify that all chopper fans are operating properly. Spinning fan blades should be difficult to see.</li> <li>2. Blow dust out of system, especially from fans and heat sink of chopper.</li> <li>3. Verify that the voltage on rear side of J3.202, pins 5 and 6 on PCB3, is less than or equal to 2.9 VDC.</li> <li>4. If the voltage is low, verify correct wiring between chopper temperature sensor and J3.202 pins 4 and 5.</li> <li>5. If wiring is good and overtemp error does not clear after 30 minutes of the power supply idling with the fans running, replace the chopper.</li> </ol>
067 Primary 267 Secondary	Magnetics overtemp	Power transformer has overheated.	<ol style="list-style-type: none"> <li>1. Verify that all the large fans are operating properly. Spinning fan blades should be difficult to see.</li> <li>2. Blow dust out of system especially from fans and large power transformer.</li> <li>3. Verify that the voltage on the rear side of J3.202 pins 14 and 15, is equal to or less than 3.2 VDC.</li> <li>4. If voltage is low or near 0 VDC, inspect wiring between the transformer's temperature sensor and J3.202 pins 13 and 14. Look for shorts between wires or to ground.</li> <li>5. If wiring is good, the transformer has overheated. Allow the power supply to idle with the fans running for a minimum of 30 minutes to cool the large power transformer.</li> <li>6. Replace the transformer's temperature sensor if it is open or shorted. Replacement kit part number is 228309.</li> </ol>



**Error code troubleshooting – error codes 071 to 075, 273 to 275**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
071	Coolant overtemp	Torch coolant has overheated.	<ol style="list-style-type: none"> <li>1. Verify that the large fan in the cooler (HPR400XD only) is running.</li> <li>2. Blow dust out of the cooler (HPR400XD only), especially from the heat exchanger.</li> <li>3. Verify that the voltage on the rear side of J1.5 pins 6 and 8, is equal to or lower than 2.8 VDC.</li> <li>4. If voltage is low, inspect wiring between coolant temperature sensor and J1.5, pins 5 and 6, for shorts to wires or ground.</li> <li>5. If wiring is good, the coolant has overheated; let system idle with the fans running for 30 minutes to cool.</li> <li>6. Replace the coolant temperature sensor if it is open or shorted. Sensor part number is 229224.</li> </ol>
072	Auto gas, control board overtemp <b>Auto Gas Only</b>	Control board has exceeded 90° C (194° F).	Verify that the airflow to the gas console is not restricted.
073 Primary 273 Secondary	Chopper 3 overtemp <b>HPR400XD Only</b>	Chopper 3 has overheated.	<ol style="list-style-type: none"> <li>1. Verify that all chopper fans are operating properly. Spinning fan blades should be difficult to see.</li> <li>2. Blow dust out of system, especially from fans and heat sink of chopper.</li> <li>3. Verify that the voltage on rear side of J3.202, pins 8 and 9 on PCB3, is less than or equal to 2.9 VDC.</li> <li>4. If the voltage is low, verify correct wiring between chopper temperature sensor and J3.202 pins 7 and 8.</li> <li>5. If wiring is good and overtemp error does not clear after 30 minutes of the power supply idling with the fans running, replace the chopper.</li> </ol>
074 Primary 274 Secondary	Chopper 4 overtemp <b>HPR400XD Only</b>	Chopper 4 has overheated.	<ol style="list-style-type: none"> <li>1. Verify that all chopper fans are operating properly. Spinning fan blades should be difficult to see.</li> <li>2. Blow dust out of system, especially from fans and heat sink of chopper.</li> <li>3. Verify that the voltage on rear side of J3.202, pins 11 and 12 on PCB3, is less than or equal to 2.9 VDC.</li> <li>4. If the voltage is low, verify correct wiring between chopper temperature sensor and J3.202 pins 10 and 11.</li> <li>5. If wiring is good and overtemp error does not clear after 30 minutes of the power supply idling with the fans running, replace the chopper.</li> </ol>
075 Primary 275 Secondary	Low current on CS3 <b>HPR400XD Only</b>	A current less than 10 amps has been detected by current sensor 3.	See the chopper test later in this section.

## Error code troubleshooting – error codes 076 to 101, 276 to 301

Error code number	Name	Description	Corrective action
076 Primary 276 Secondary	Low current on CS4 <b>HPR400XD Only</b>	A current less than 10 amps has been detected by current sensor 4.	See the chopper test later in this section.
093	No coolant flow	Coolant flow signal was lost or never was satisfied.	<ol style="list-style-type: none"> <li>1. If this is a new system, follow start procedure.</li> <li>2. Verify that the coolant filter is in good condition.</li> <li>3. Perform coolant flow tests (<i>Maintenance</i> section).</li> <li>4. Verify that the CNC drives the plasma start signal for at least 10 seconds to allow the timed-out pump to turn on again.</li> </ol>
095 Primary 295 Secondary	High current on CS4 <b>HPR400XD Only</b>	A current greater than 35 amps has been detected by current sensor 4.	See the chopper test later in this section.
098	Phase loss at initialization <b>HPR400XD HPR800XD Only</b>	The system detected incoming line voltage during power-up, before the contactor was energized.	<ol style="list-style-type: none"> <li>1. Verify phase-to-phase voltage to power supply.</li> <li>2. Disconnect power to power supply, remove cover on contactor and inspect contacts for excessive wear.</li> <li>3. Inspect power cord, contactor, and input to chopper for loose connections.</li> <li>4. Inspect phase loss fuses on Power Distribution board. Replace board if fuses are blown.</li> <li>5. Perform phase loss test (see <i>Maintenance</i> section).</li> </ol>
099 Primary 299 Secondary	Chopper 1 overtemp at power-up	Chopper 1 is indicating an overtemp at power-up.	<ol style="list-style-type: none"> <li>1. Verify that the temperature sensor for the chopper has not been bypassed or that the wires to the temperature switch are shorted out in the harness, or that the sensor is open.</li> <li>2. If no jumper is present, the chopper is overheated and needs time to cool to 83° C (181.4° F).</li> </ol>
100 Primary 300 Secondary	Chopper 2 overtemp at power-up <b>HPR260XD HPR400XD Only</b>	Chopper 2 is indicating an overtemp at power-up.	<ol style="list-style-type: none"> <li>1. Verify that the temperature sensor for the chopper has not been bypassed or that the wires to the temperature switch are shorted out in the harness, or that the sensor is open.</li> <li>2. If no jumper is present, the chopper is overheated and needs time to cool to 83° C (181.4° F).</li> </ol>
101 Primary 301 Secondary	Magnetics overtemp at power-up	Main transformer is indicating an overtemp at power-up.	<ol style="list-style-type: none"> <li>1. Verify that the transformer temperature sensor has not been bypassed or the wires to the temperature sensor are not shorted out in the harness.</li> <li>2. Verify that the sensor is not open or shorted, if it is not open or shorted, the main transformer is overheated and needs time to cool to 150° C (302° F).</li> </ol>



**Error code troubleshooting – error codes 102 to 111, 302 to 308**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
102 Primary 302 Secondary	Chopper 1 current at power-up	Chopper 1 current signal is active at power-up.	See wiring diagrams in section 7  1. Verify that the voltage at CS1 is correct. 2. Verify that the wiring between CS1 and PCB3 is correct and not damaged. 3. Swap CS1 with CS2. If the error code changes to 156, replace the original CS1.
103 Primary 303 Secondary	High current on CS1	A current greater than 35 Amps has been detected by current sensor 1.	See the chopper test later in this section.
104 Primary 304 Secondary	High current on CS2 <b>HPR260XD HPR400XD Only</b>	A current greater than 35 amps has been detected by current sensor 2.	See the chopper test later in this section.
105 Primary 305 Secondary	Low current on CS1	A current less than 10 amps has been detected by current sensor 1.	See the chopper test later in this section.
106 Primary 306 Secondary	Low current on CS2 <b>HPR260XD HPR400XD Only</b>	A current less than 10 amps has been detected by current sensor 2.	See the chopper test later in this section.
107 Primary 307 Secondary	High current on CS3 <b>HPR400XD Only</b>	A current greater than 35 amps has been detected by current sensor 3.	See the chopper test later in this section.
108 Primary 308 Secondary	Transfer at power-up	The system has detected current on the work lead during power-up.	1. Verify that the electrical connections to current sensors CS1 and CS3 are correct and not damaged. 2. Replace PCB3 if connections are correct and not damaged. 3. Verify that the main contactor (CON1) is not welded closed, or closing at power-up.
109	Coolant flow at power-up	“Coolant flow OK” signal is active during power-up and before pump motor is activated.	Either the coolant flow sensor was bypassed or it is faulty. 1. Verify that there is power at the sensor. 2. Verify that all the connectors have good connections.
111	Coolant overtemp at power-up	Coolant is indicating an overtemp at power-up.	1. Verify that the coolant temperature sensor has not been bypassed or the wires to the sensor are not shorted out in the harness. 2. If not, the coolant temperature is over the set point and needs time to cool to 70° C (158° F).

**Error code troubleshooting – error codes 116 to 133, 316**

Error code number	Name	Description	Corrective action
<p>116 Primary 316 Secondary</p>	<p>Watchdog interlock</p>	<p>An error occurred with the CAN communication system.</p>	<ol style="list-style-type: none"> <li>1. Verify that cable number 5 (power supply-to-gas console control cable) is not damaged and is properly connected to PCB3 and the rear of the gas console.</li> <li>2. Verify that cable number 6 (power supply-to-gas console power cable) is not damaged and is properly connected inside the power supply and to the rear of the gas console.</li> <li>3a. <b>(Manual gas console)</b> Verify that D1 (+5 VDC) and D2 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2.</li> <li>3b. <b>(Auto gas console)</b> Verify that D17 (+5 VDC) and D18 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2.</li> <li>4. If power is present at PCB2 and PCB3 and both gas console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> <li>5. Verify that the gas console control PCB and power distribution PCBs are securely mounted to the chassis at all four corners.</li> </ol>
<p>123</p>	<p>MV1 error <b>Auto Gas Only</b></p>	<p>Motor valve 1 did not move into position within 60 seconds.</p>	<p>Verify that LED D17 or D18 illuminates on the AC valve driver PCB in the selection console. If either illuminates, replace the motor valve. If they do not illuminate, replace PCB3.</p>
<p>124</p>	<p>MV2 error <b>Auto Gas Only</b></p>	<p>Motor valve 2 did not move into position within 60 seconds.</p>	<p>Verify that LED D19 or D20 is illuminating on the AC valve driver PCB in the selection console. If either illuminates, replace the motor valve. If they do not illuminate, replace PCB3.</p>
<p>133</p>	<p>Unknown gas console type</p>	<p>The power supply control board does not recognize the gas console that is installed or has not received a CAN message.</p>	<ol style="list-style-type: none"> <li>1. Verify that the part numbers of PCB2 and PCB3 are correct.</li> <li>2. Verify that the power supply-to-gas console control cable is not damaged and is properly connected to PCB3 and the rear of the gas console.</li> <li>3. Verify that the power supply-to-gas console power cable is not damaged and is properly connected inside the power supply and to the rear of the gas console.</li> <li>4. Verify that D1 (+5 VDC) and D2 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2.</li> <li>5. If power is present at PCB2 and PCB3 and both gas console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> </ol>

**Error code troubleshooting – error codes 134 to 140, 334 and 338**

Error code number	Name	Description	Corrective action
134 Primary 334 Secondary	Chopper 1 overcurrent	Chopper 1 current feedback has exceeded 160 amps.	<ol style="list-style-type: none"> <li>1. Verify that the wiring between CS1 and PCB3 is correct and not damaged.</li> <li>2. Measure voltage across current sensor.                             <ol style="list-style-type: none"> <li>a) Red to black = +15 VDC, Green to black = -15 VDC, white to black = 0 VDC at idle and varies with current output (4 VDC = 100 amps).</li> <li>b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps.</li> <li>c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor.</li> </ol> </li> <li>3. Remove connector JA.1 from the chopper and verify that LED1 is extinguished.                             <ol style="list-style-type: none"> <li>a) If LED1 is extinguished with the connector removed, then reconnect JA.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper.</li> <li>b) If the chopper does not go into overcurrent, replace PCB3.</li> </ol> </li> </ol>
138 Primary 338 Secondary	Chopper 2 overcurrent <b>HPR260XD</b> <b>HPR400XD</b> <b>Only</b>	Chopper 2 current feedback has exceeded 160 amps.	<ol style="list-style-type: none"> <li>1. Verify that the wiring between CS2 and PCB3 is correct and not damaged.</li> <li>2. Measure voltage across current sensor.                             <ol style="list-style-type: none"> <li>a) Red to black = +15 VDC, Green to black = -15 VDC, white to black = 0 VDC at idle and varies with current output (4 VDC = 100 amps).</li> <li>b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps.</li> <li>c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor.</li> </ol> </li> <li>3. Remove connector JB.1 from the chopper and verify that LED1 is extinguished.                             <ol style="list-style-type: none"> <li>a) If LED1 is extinguished with the connector removed, then reconnect JB.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper.</li> <li>b) If the chopper does not go into overcurrent, replace PCB3.</li> </ol> </li> </ol>
139	Purge time-out error	The purge cycle did not complete within 3 minutes.	This is a warning for a possible gas restriction in the leads. <ol style="list-style-type: none"> <li>1. Verify that there are no restrictions in the plasma and shield hoses.</li> <li>2. Verify that the inlet gas pressures are set to the proper levels.</li> </ol>
140	Pressure transducer 1 or 8 error <b>Auto Gas</b> <b>Only</b>	Faulty transducer or control board in the metering console or the selection console.	<ol style="list-style-type: none"> <li>1. Verify that transducer P1 in the selection console is working properly. Replace if necessary.</li> <li>2. Verify that transducer P8 in the metering console is working properly. Replace if necessary.</li> <li>3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.</li> </ol>

### Error code troubleshooting – error codes 141 to 152, 346 to 351

Error code number	Name	Description	Corrective action
141	Pressure transducer 2 or 7 error <b>Auto Gas Only</b>	Faulty transducer or control board in the metering console or the selection console.	<ol style="list-style-type: none"> <li>1. Verify that transducer P2 in the selection console is working properly. Replace if necessary.</li> <li>2. Verify that transducer P7 in the metering console is working properly. Replace if necessary.</li> <li>3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.</li> </ol>
142	Pressure transducer 3 or 5 error <b>Auto Gas Only</b>	Faulty transducer or control board in the metering console or the selection console.	<ol style="list-style-type: none"> <li>1. Verify that transducer P3 in the selection console is working properly. Replace if necessary.</li> <li>2. Verify that transducer P5 in the metering console is working properly. Replace if necessary.</li> <li>3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.</li> </ol>
143	Pressure transducer 4 or 6 error <b>Auto Gas Only</b>	Faulty transducer or control board in the metering console or the selection console.	<ol style="list-style-type: none"> <li>1. Verify that transducer P4 in the selection console is working properly. Replace if necessary.</li> <li>2. Verify that transducer P6 in the metering console is working properly. Replace if necessary.</li> <li>3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.</li> </ol>
144	Internal flash error <b>Manual Gas Only</b>	Communication problem to the flash chip on the gas console control board.	Replace the control board.
145	Internal flash error <b>Auto Gas Only</b>	Communication problem to the flash chip on the selection console control board.	Replace the control board.
146 Primary 346 Secondary	Chopper 3 overtemp at power-up <b>HPR400XD Only</b>	Chopper 3 is indicating an overtemp at power-up.	<ol style="list-style-type: none"> <li>1. Verify that the temperature sensor for the chopper has not been bypassed or that the wires to the temperature switch are shorted out in the harness, or that the sensor is open.</li> <li>2. If no jumper is present, the chopper is overheated and needs time to cool to 83° C (181.4° F).</li> </ol>
147 Primary 347 Secondary	Chopper 4 overtemp at power-up <b>HPR400XD Only</b>	Chopper 4 is indicating an overtemp at power-up.	<ol style="list-style-type: none"> <li>1. Verify that the temperature sensor for the chopper has not been bypassed or that the wires to the temperature switch are shorted out in the harness, or that the sensor is open.</li> <li>2. If no jumper is present, the chopper is overheated and needs time to cool to 83° C (181.4° F).</li> </ol>
151 Primary 351 Secondary	Software fail	Software has detected an incorrect state or condition.	Replace power supply control board.
152	Internal flash error	Communication problem to the flash chip on the power supply control board.	Replace the control board.

**Error code troubleshooting – error codes 153 to 156, 354 to 356**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
153	PS EEPROM error	EEPROM memory on power supply control board not working.	Replace the control board.
154 Primary 354 Secondary	Chopper 3 overcurrent <b>HPR400XD Only</b>	Chopper 3 current feedback has exceeded 160 amps.	<ol style="list-style-type: none"> <li>1. Verify that the wiring between CS3 and PCB3 is correct and not damaged.</li> <li>2. Measure voltage across current sensor.               <ol style="list-style-type: none"> <li>a) Red to black = +15 VDC, Green to black = -15 VDC, white to black = 0 VDC at idle and varies with current output (4 VDC = 100 amps).</li> <li>b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps.</li> <li>c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor.</li> </ol> </li> <li>3. Remove connector JC.1 from the chopper and verify that LED1 is extinguished.               <ol style="list-style-type: none"> <li>a) If LED1 is extinguished with the connector removed, then reconnect JC.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper.</li> <li>b) If the chopper does not go into overcurrent, replace PCB3..</li> </ol> </li> </ol>
155 Primary 355 Secondary	Chopper 4 overcurrent <b>HPR400XD Only</b>	Chopper 4 current feedback has exceeded 160 amps.	<ol style="list-style-type: none"> <li>1. Verify that the wiring between CS4 and PCB3 is correct and not damaged.</li> <li>2. Measure voltage across current sensor.               <ol style="list-style-type: none"> <li>a) Red to black = +15 VDC, Green to black = -15 VDC, white to black = 0 VDC at idle and varies with current output (4 VDC = 100 amps).</li> <li>b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps.</li> <li>c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor.</li> </ol> </li> <li>3. Remove connector JD.1 from the chopper and verify that LED1 is extinguished.               <ol style="list-style-type: none"> <li>a) If LED1 is extinguished with the connector removed, then reconnect JD.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper.</li> <li>b) If the chopper does not go into overcurrent, replace PCB3.</li> </ol> </li> </ol>
156 Primary 356 Secondary	Chopper 2 current at power-up <b>HPR260XD HPR400XD Only</b>	Chopper 2 current signal is active at power-up.	<p>See wiring diagrams in section 7</p> <ol style="list-style-type: none"> <li>1. Verify that the voltage at CS2 is correct.</li> <li>2. Verify that the wiring between CS2 and PCB3 is correct and not damaged.</li> <li>3. Swap CS2 with CS3. If the error code changes to 157, replace the original CS2.</li> </ol>

**Error code troubleshooting – error codes 157 to 159, 357 to 359**

Error code number	Name	Description	Corrective action
<p>157 Primary 357 Secondary</p>	<p>Chopper 3 current at power-up <b>HPR400XD Only</b></p>	<p>Chopper 3 current signal is active at power-up.</p>	<p>See wiring diagrams in section 7</p> <ol style="list-style-type: none"> <li>1. Verify that the voltage at CS3 is correct.</li> <li>2. Verify that the wiring between CS3 and PCB3 is correct and not damaged.</li> <li>3. Swap CS3 with CS2. If the error code changes to 156, replace the original CS3.</li> </ol>
<p>158 Primary 358 Secondary</p>	<p>Chopper 4 current at power-up <b>HPR400XD Only</b></p>	<p>Chopper 4 current signal is active at power-up.</p>	<p>See wiring diagrams in section 7</p> <ol style="list-style-type: none"> <li>1. Verify that the voltage at CS4 is correct.</li> <li>2. Verify that the wiring between CS4 and PCB3 is correct and not damaged.</li> <li>3. Swap CS4 with CS2. If the error code changes to 156, replace the original CS4.</li> </ol>
<p>159 Primary 359 Secondary</p>	<p>Motor-drive fault <b>HPR400XD and HPR800XD</b></p>	<p>The pump-motor-drive board (PCB7) is indicating a drive fault.</p> <p>Note: The secondary error code (359) may display if the secondary power supply is turned off individually, or when the entire system is turned off. Customers with a manual gas console will not see this error code when the entire system is turned off.</p>	<ol style="list-style-type: none"> <li>1. Verify that the circuit breaker on PCB7 has not tripped. If it has tripped, reset the breaker by pressing the button until it is even with the top of the circuit breaker. If the circuit breaker is not tripped and there is no power to PCB7, verify that the fuse on PCB2 in the power supply is good.</li> <li>2. If D32 on PCB7 illuminates, the solenoid valve and motor are drawing too much current. D32 will only illuminate for a short time, and extinguishes after the outputs from the pump-motor-drive turn-off in response to the fault condition. Verify the wiring to the solenoid valve and the motor. Verify that the pump spins freely and is properly mounted to the motor. Look for obstructions in the torch, consumables, coolant lines, and in-line filter. Verify that the solenoid valve is operating. Any of these can cause the motor or solenoid valve to draw excessive current. Test for low coolant flow by using the coolant flow test in this section.</li> <li>3. If D32 on PCB7 illuminates immediately at power-up, and all the items above have been verified, replace PCB7.</li> <li>4. If D30 on PCB7 illuminates, the IGBT drive has encountered an over current condition. D30 will only illuminate for a short time, and extinguishes after the outputs from the pump motor-drive turn off. Follow the same steps for D32 above.</li> <li>5. If D31 on PCB7 illuminates, the heatsink thermistor is indicating that the heatsink is too hot. Wait 10 minutes for it to cool. If the error remains, verify that the wires from heatsink on PCB7 are properly connected to the J6 connector on PCB7. If the error still remains, turn OFF all power to the system and measure the resistance on the J6 connector between pins 1 and 2. At 25° C (77° F) the resistance should be 10k.</li> </ol>

**Error code troubleshooting – error codes 160 to 180**

<b>Error code number</b>	<b>Name</b>	<b>Description</b>	<b>Corrective action</b>
160	HPR cooler's CAN fault <b>HPR400XD Only</b>	Communication between the control board (PCB3 in the power supply) and the cooler sensor board (PCB1 in the cooler) was interrupted for more than 1 second.	<ol style="list-style-type: none"> <li>1. Verify that the cable connections from the power supply to the cooler are good.</li> <li>2. Verify that D1 (+ 5 VDC) and D2 (+3.3 VDC) are illuminated on PCB1 inside the cooler.</li> <li>3. Verify that the CAN bus LEDs, D7 and D8 are blinking.</li> </ol>
161	Maximum coolant flow has been exceeded	Coolant flow has exceeded 6.8 lpm (1.8 gpm) for a cooler, 8.52 lpm (2.25 gpm) for a chiller.	<ol style="list-style-type: none"> <li>1. Verify proper coolant flow.</li> <li>2. Look for air bubbles in the coolant.</li> <li>3. Verify that the coolant is mixed in the proper proportions.</li> </ol>
180	Selection console CAN time-out <b>Auto Gas Only</b>	The power supply did not receive a CAN message from the selection console within 1 second.	<ol style="list-style-type: none"> <li>1. Verify that the power supply-to-selection console CONTROL and POWER cables are not damaged and are properly connected to PCB3, and the rear of the selection console.</li> <li>2. Verify that D17 (+5 VDC) and D18 (+3.3 VDC) are illuminated on PCB2 inside the selection console. These LEDs indicate power to PCB2. Also verify that D26 (CAN – RX) and D27 (CAN – TX) are illuminated on PCB2 inside the selection console. These LEDs indicate communication between the selection console and the power supply.</li> <li>3. If power is present at PCB2 and PCB3 and both selection console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> <li>4. Verify that the gas console control PCB and power distribution PCBs are securely mounted to the chassis at all four corners.</li> </ol>



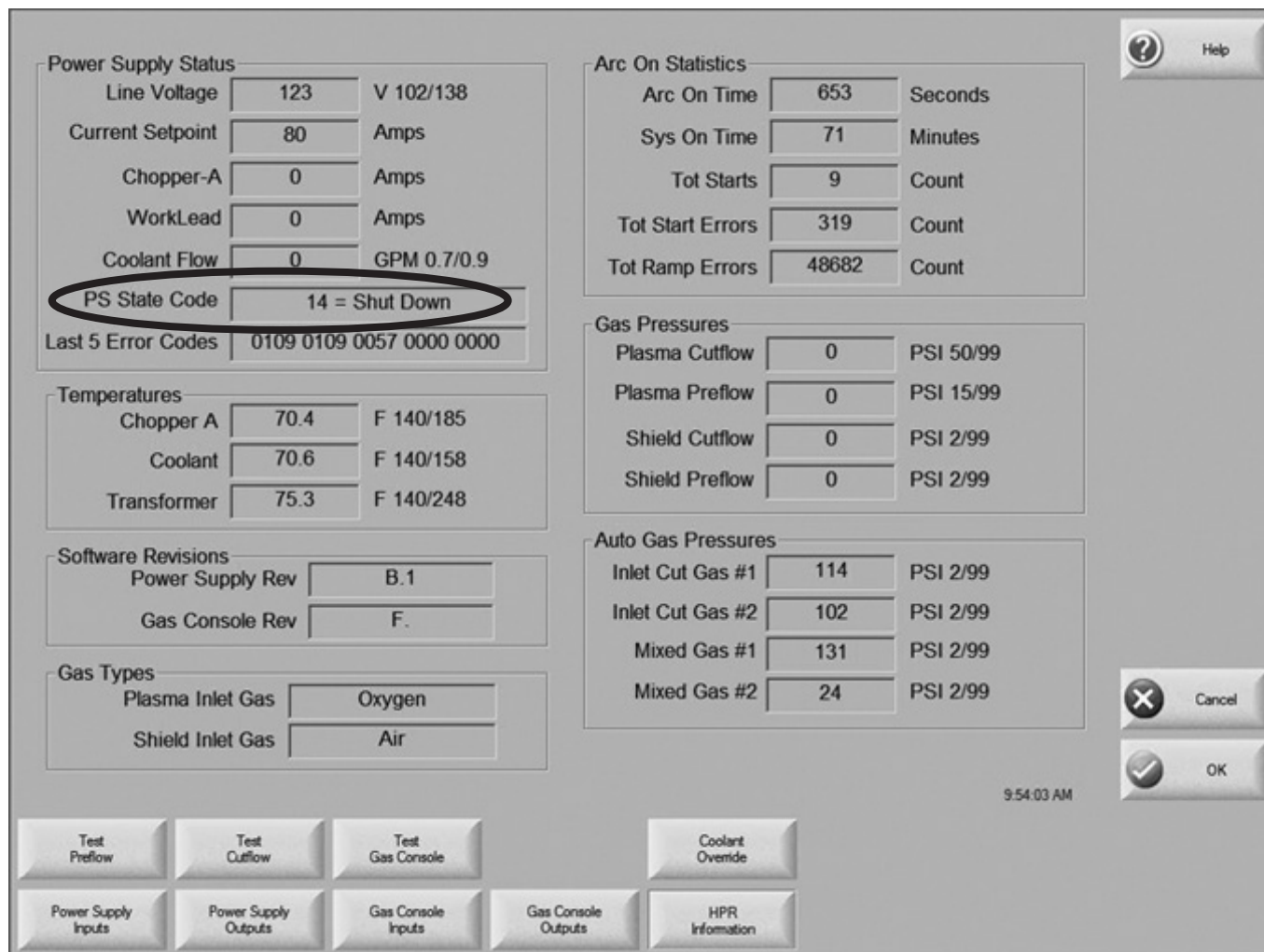
**Error code troubleshooting – error code 181, 182, and 383**

Error code number	Name	Description	Corrective action
181	Metering console CAN time-out <b>Auto Gas Only</b>	The power supply did not receive a CAN message from the metering console within 1 second.	<ol style="list-style-type: none"> <li>1. Verify that the power supply-to-metering console CONTROL and POWER cables are not damaged and are properly connected to PCB3, and the rear of the metering console.</li> <li>2. Verify that D17 (+5 VDC) and D18 (+3.3 VDC) are illuminated on PCB2 inside the metering console. These LEDs indicate power to PCB2. Also verify that D26 (CAN – RX) and D27 (CAN – TX) are illuminated on PCB2 inside the metering console. These LEDs indicate communication between the metering console and the power supply.</li> <li>3. If power is present at PCB2 and PCB3 and both metering console cables are good, then PCB2 or PCB3 has failed. Use the CAN tester to verify which board needs to be replaced.</li> <li>4. Verify that the gas console control PCB and power distribution PCBs are securely mounted to the chassis at all four corners.</li> </ol>
182	Secondary power supply time-out <b>HPR800XD Only</b>	The secondary power supply fails before transmitting the error to the primary power supply.	<ol style="list-style-type: none"> <li>1. The primary power supply to secondary power supply CAN communication cable was disconnected after power-up.</li> <li>2. The cable has electrical interference (noise) or the cable shielding has been compromised.</li> </ol>
383	No ramp-up message <b>HPR800XD Only</b>	The secondary power supply is ready to provide current output but does not receive the control signal from the primary power supply.	<ol style="list-style-type: none"> <li>1 Turn off the power to the system and then turn on the power again.</li> <li>2. The cable has electrical interference (noise) or the cable shielding has been compromised.</li> </ol>



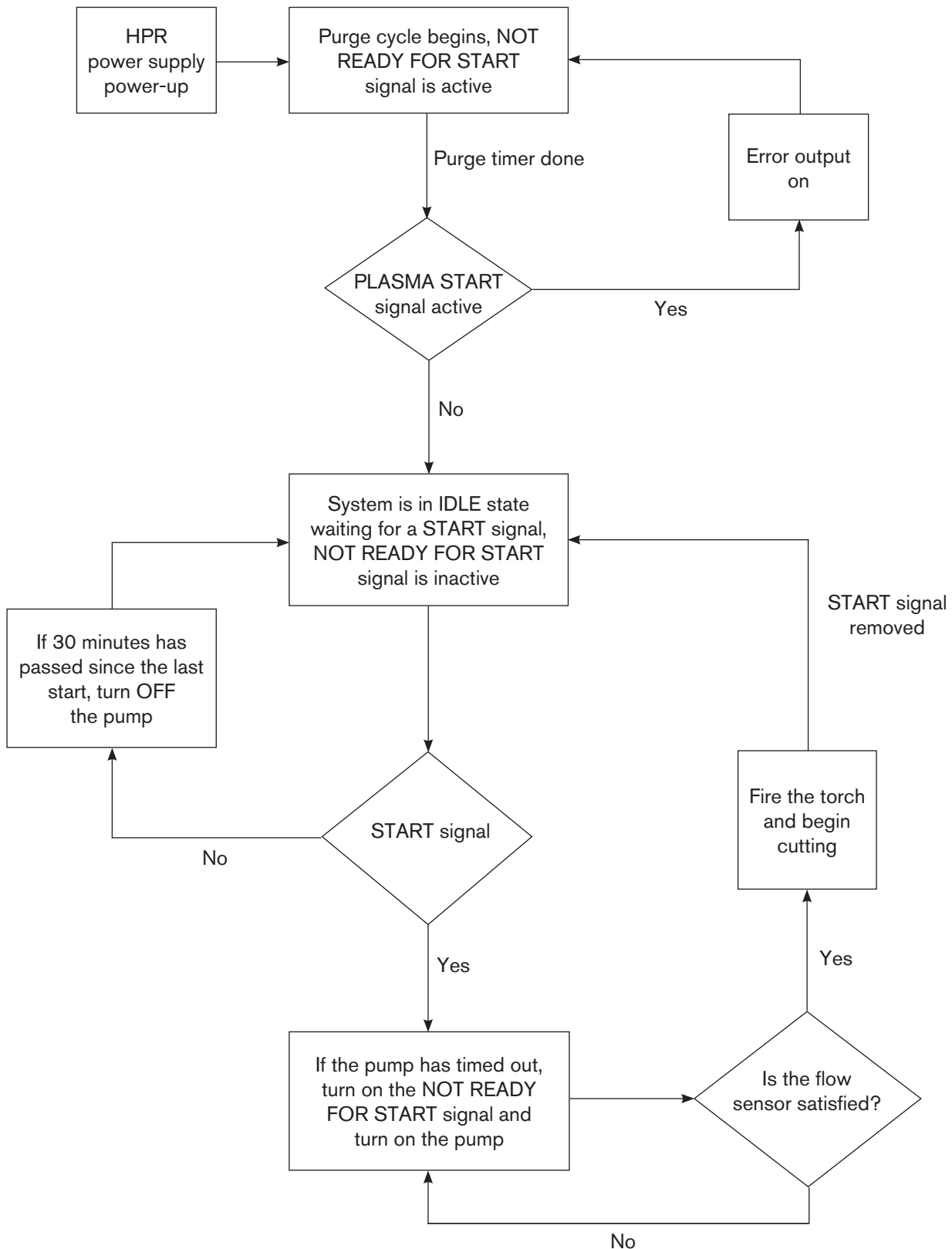
## Power supply states

Power supply states are displayed on the CNC screen. The diagnostic screen shown below is for reference.

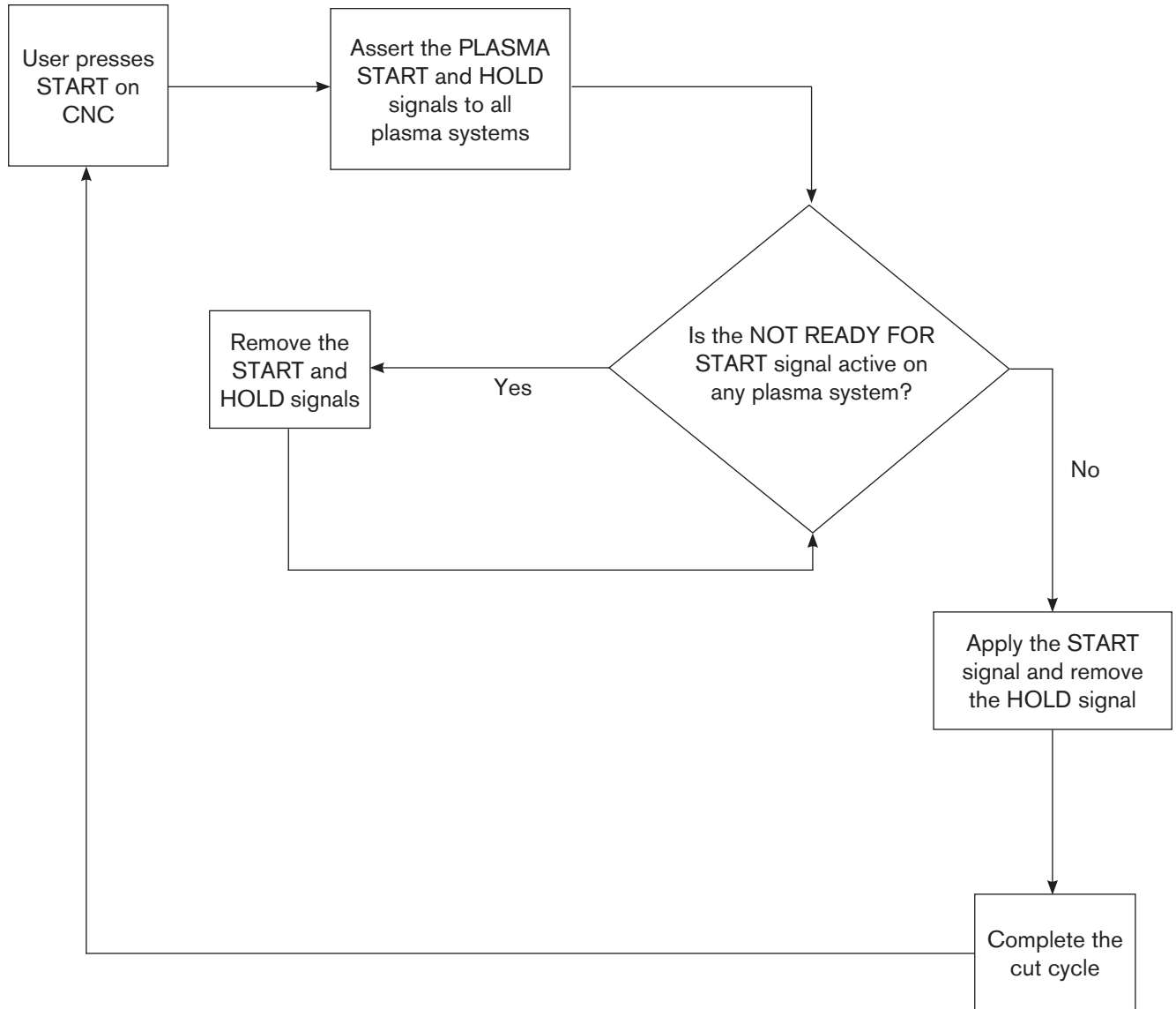


State code	Name	State code	Name
00	Power-up (idle)	11	Cycle complete (auto off)
02	Purge	12	Test outflow
03	Ready for start (idle2)	14	Shutdown
04	Preflow	15	Reset
05	Pilot arc	16	Maintenance
06	Transfer	20	Test preflow
07	Ramp-up	22	Manual pump control
08	Steady state	23	Inlet leak check
09	Ramp-down	24	System leak check
10	Final ramp-down	25	Burkert valve flow check

**Plasma system operation with pump time-out**





### CNC operation with pump time-out





### Initial checks

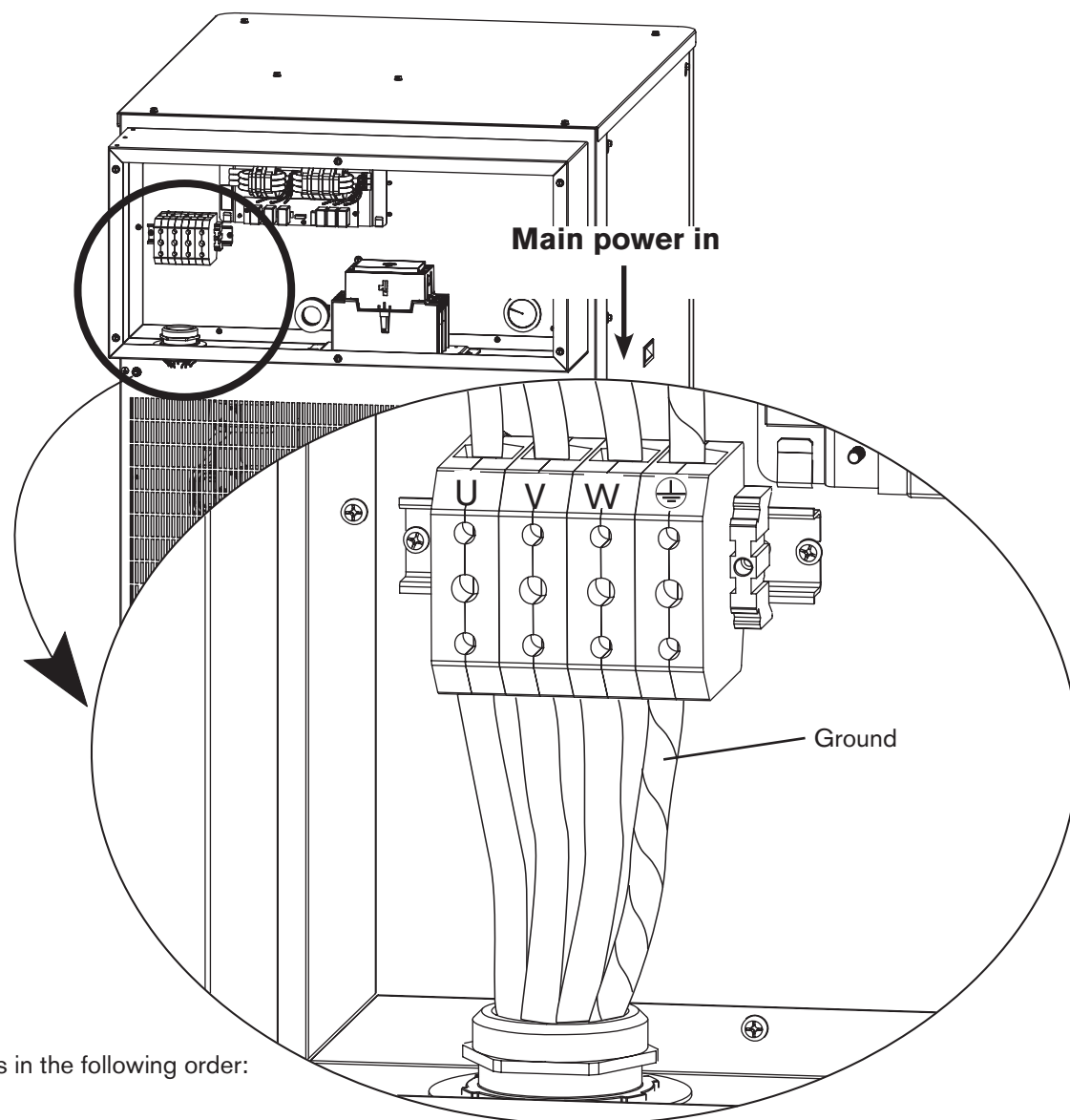
Before trouble-shooting, do a visual check and verify that proper voltages are present at the power source, transformers and power distribution board.

		<b>DANGER</b>
<b>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.</b>		

1. Disconnect line power by turning OFF the main disconnect switch.
2. Remove the power supply's top panel and 2 side panels.
3. Inspect interior of power supply for discoloration on PC boards, or other apparent damage. If a component or module is obviously defective, replace it before doing any testing. Refer to the *Parts List* section to identify parts and part numbers.
4. If no damage is apparent, connect power to the power supply, and turn ON the main disconnect switch.
5. Measure the voltage between the W, V and U terminals of TB1 located on the right side of the power supply. See figure on next page. 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 or replace any defective component.

## Power measurement

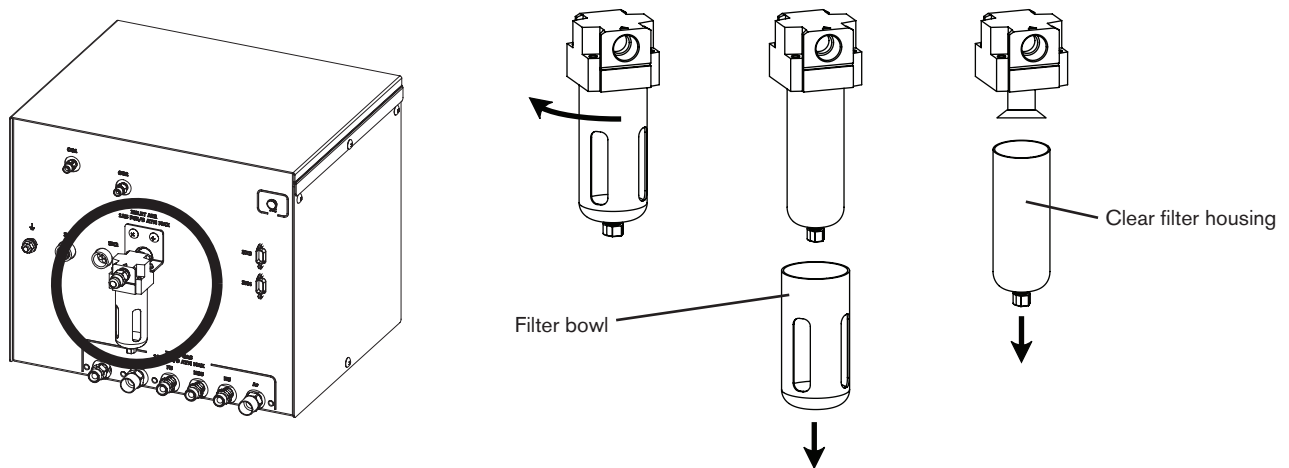
		<p><b>DANGER</b> <b>SHOCK HAZARD</b></p>
<p>There is line voltage at the contactor and the power distribution board (PCB2) when the line disconnect switch is on. <u>Use extreme care when measuring primary power in these areas. Voltages present at the terminal block and contactors can cause injury or death.</u></p>		



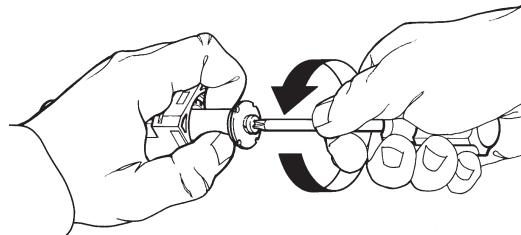
Note: Check lines in the following order:  
 U to V  
 U to W  
 V to W  
 Check each line to ground. If one line is 10% greater, or more, than the other 2, put that leg on U.

### Air filter element replacement

1. Turn OFF all electrical power and disconnect the air hose from the filter.
2. Remove the filter bowl by turning it counter clockwise until it releases.
3. Pull the clear filter housing down firmly to remove it. The filter housing has an o-ring around the top. Apply a thin film of silicone lubricant on the o-ring to extend it's life. The o-ring should look shiny, but there should not be any excess or built-up grease.



4. Use a screwdriver to remove the filter element from the filter housing. Then install the new filter element.  
Note: Do not allow the filter element to turn when loosening the screw.

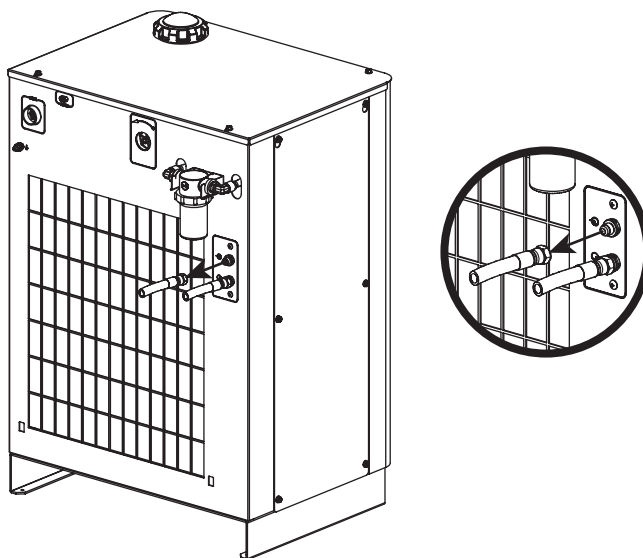


5. Reinstall the clear filter housing and the filter bowl.

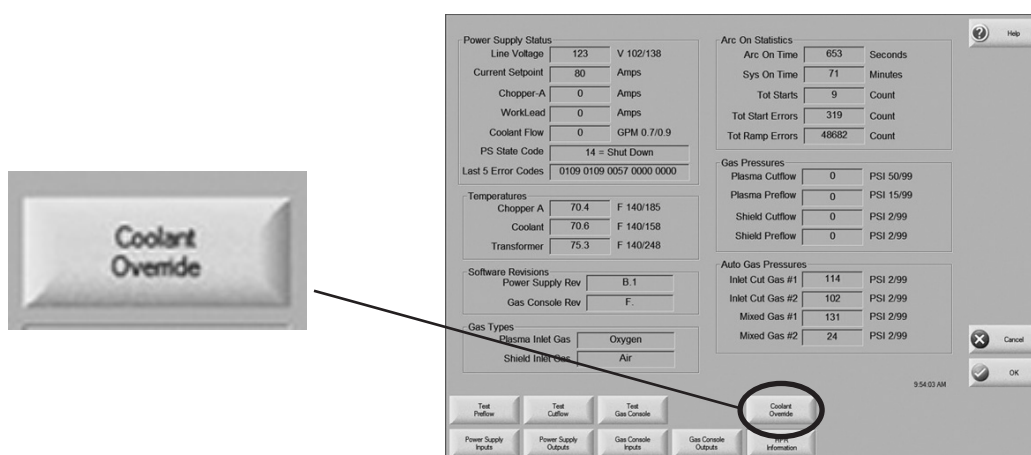
## Coolant system servicing

### Draining the coolant system

1. Turn OFF all power to the system.
2. Remove the return coolant hose (red washer on the cooler fitting) from the rear of the cooler and put it in a 20 liter (5 gallon) container.



3. Turn ON the pump manually, using the manual pump control button on your CNC screen.



4. Turn OFF the pump when the coolant stops flowing.

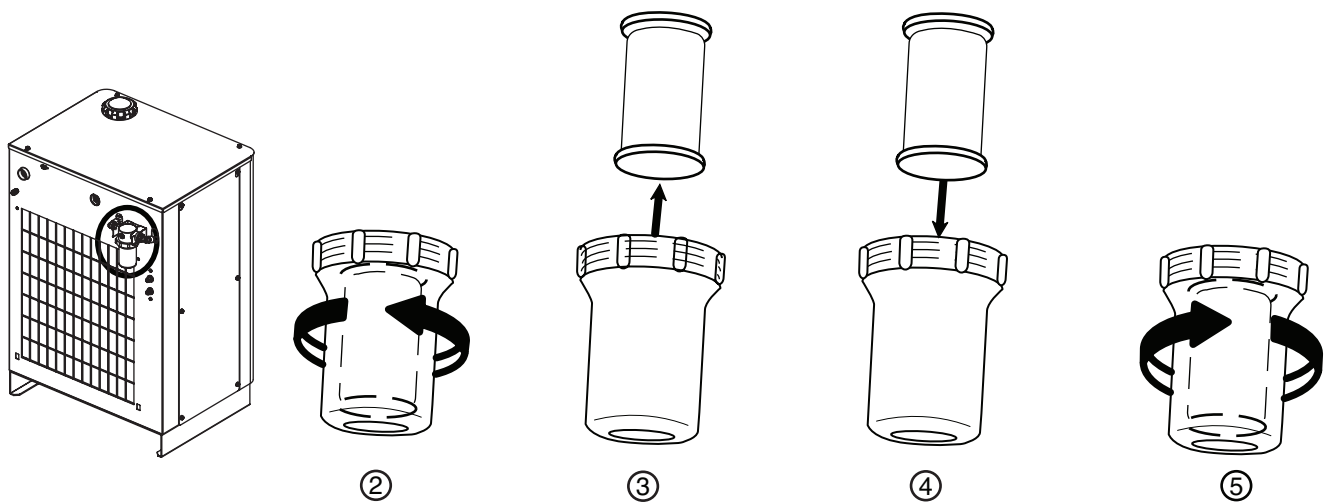
**Caution:** Coolant will flow from the filter when its housing is removed. Drain coolant before servicing the filter.



### Coolant system filter

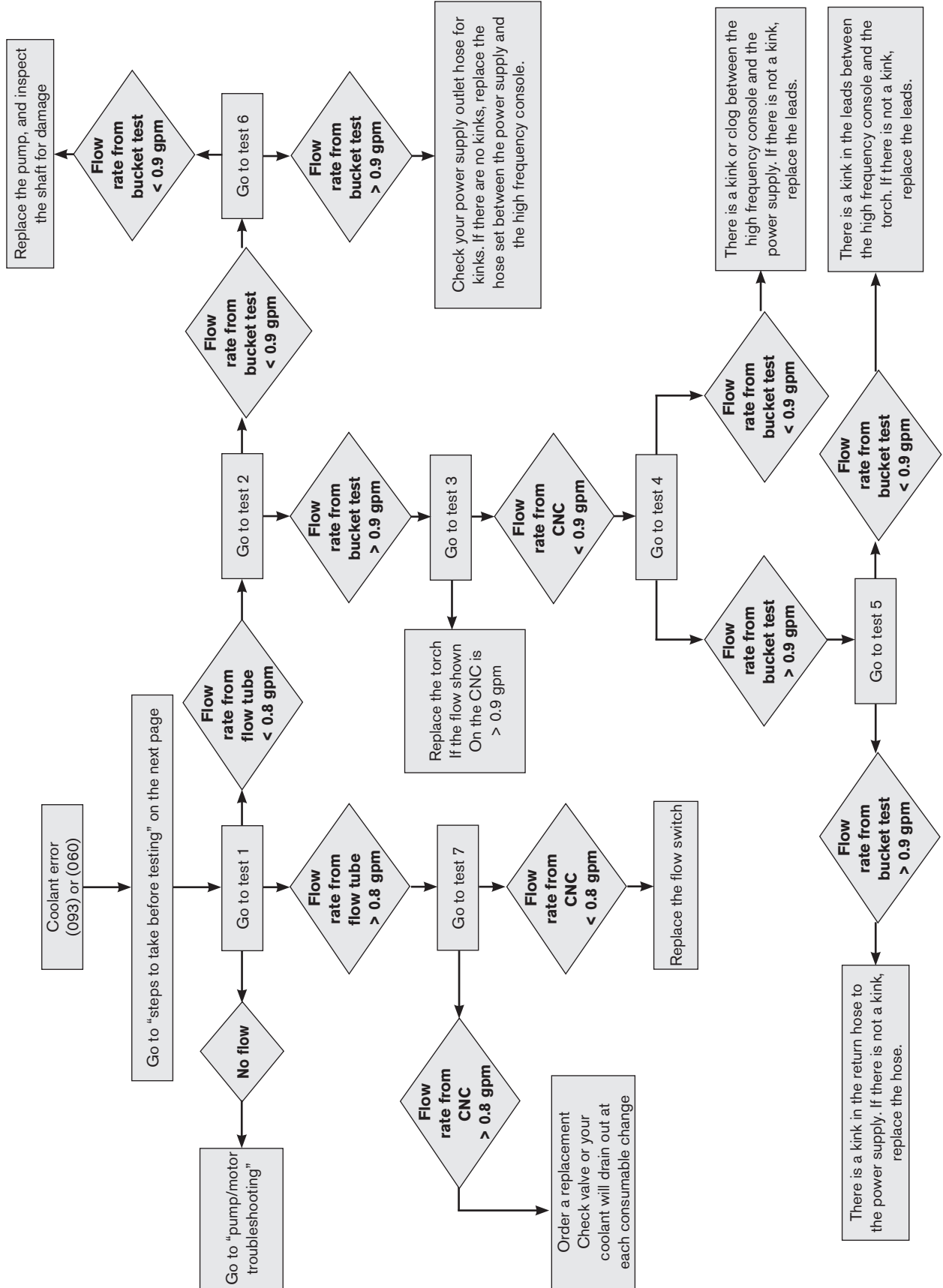
#### Filter replacement

1. Turn OFF all power to the system.
2. Remove housing.
3. Remove and discard filter element.
4. Install new filter element 027664.
5. Re-install housing.
6. Refill with new coolant.





# Coolant flow troubleshooting chart



### Coolant flow tests

If the CNC screen shows a coolant flow error (093 or 060), turn OFF the system and then ON again to clear the error. Then perform the following tests to find the cause of the problem.

An in-line flow meter is the most accurate way to measure the flow rate, but can not be used with all the tests described without custom fittings. An in-line flow meter (part number 128933) is available from Hypertherm. The following “bucket” tests give a good idea of the flow rate.

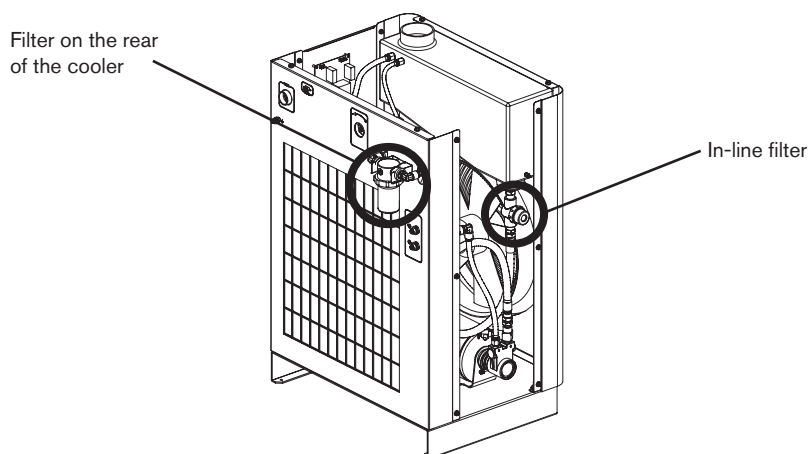
Note: The CNC screens shown here are for reference. The screens you work with may look different, but should have the same functions shown here.

### Before testing

Notes: It is important to follow the troubleshooting steps in the order in which they are shown in the flow chart on the previous page.

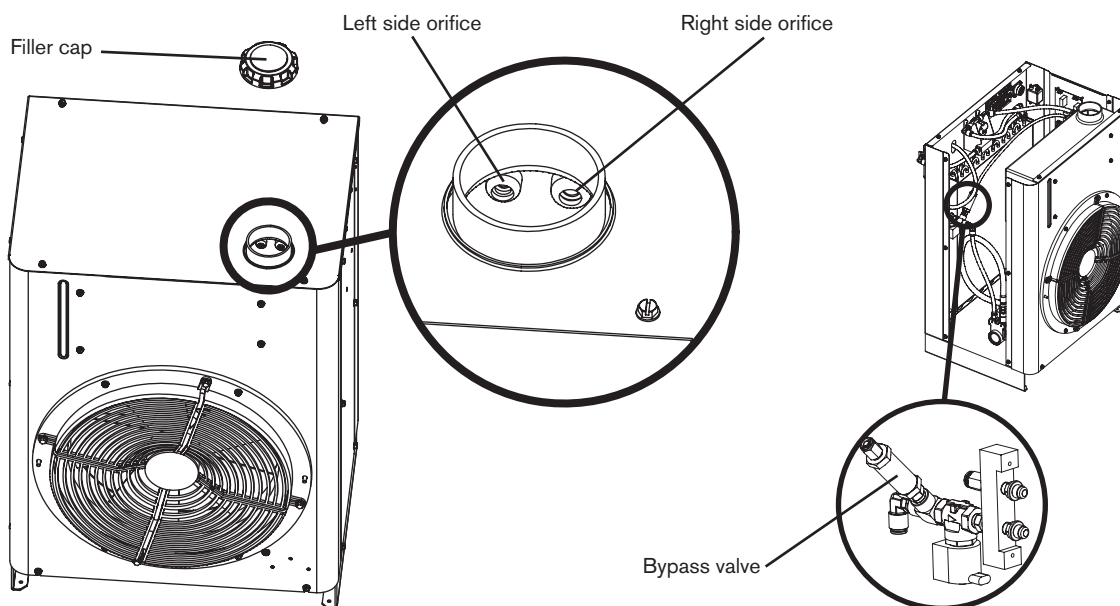
Coolant must be drained from the system before the in-line filter is cleaned (step 1 below). The coolant in the system will drain out as soon as the in-line filter is removed.

1. Clean the in-line filter.
2. Replace the filter element on the rear of the cooler.
3. Verify that the system has the correct level of coolant when refilling the system after completing steps 1 and 2. See fill the cooler with coolant in the *Installation* section.



**Bypass valve verification**

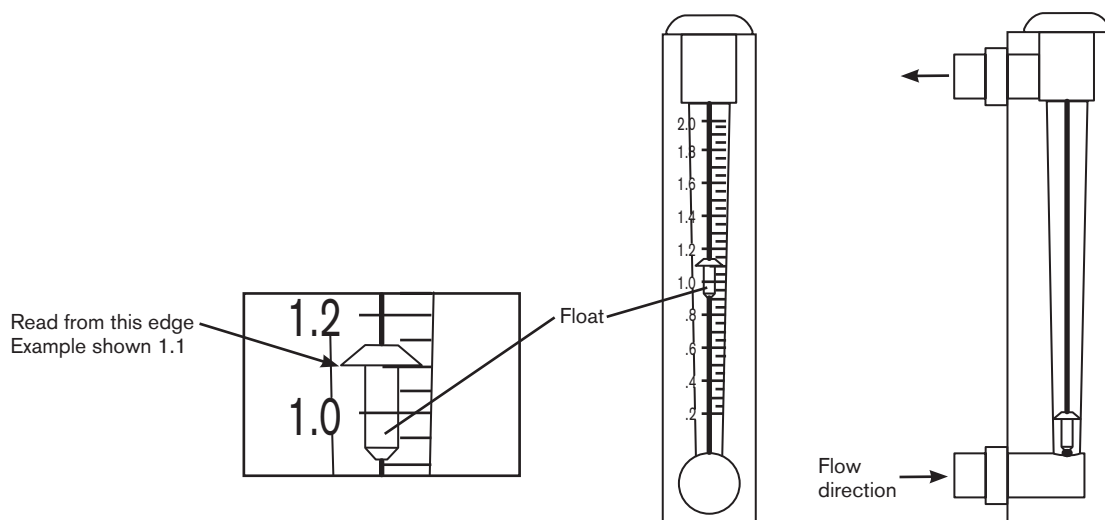
1. Remove the cooler's filler cap.
2. Stand in front of the cooler with the pump running, and look inside the coolant tank.
3. Coolant should be flowing from the orifice on the right. If coolant is flowing from the orifice on the left, look for a restriction in the coolant path. Install a new bypass valve if there is no obstruction.



**Using the Hypertherm flow meter (128933)**

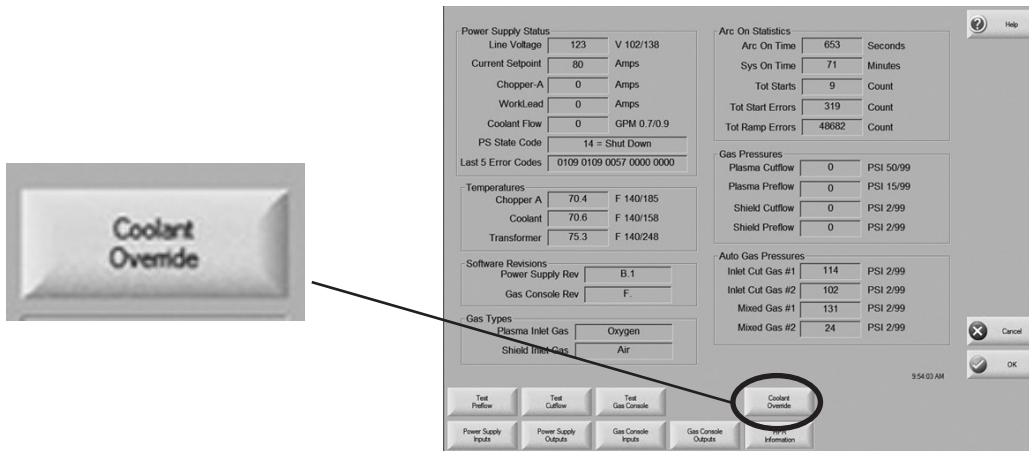
Use the steps below to get an accurate reading from the flow meter.

1. Hold the flow meter upright. Square in both axis.
2. Take your reading from the edge shown below.

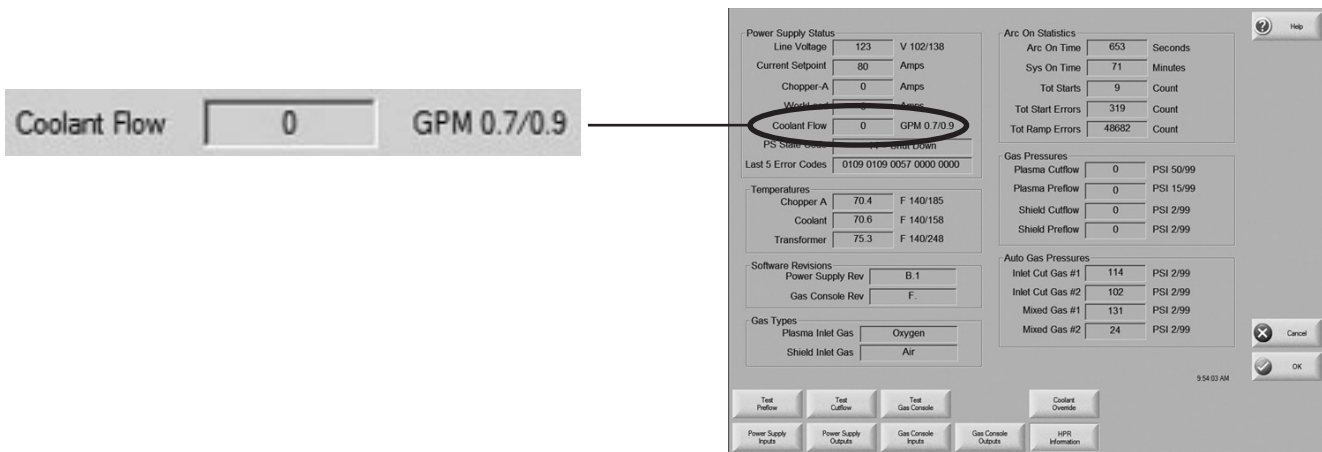


## Manual pump operation

1. Go to the CNC screen that turns on the pump manually (refer to the operation instructions for the CNC being used). If the selection console shows coolant flow error 093, the pump must be turned on manually within 8 seconds of turning on the power supply, or the power will have to be turned off and then on again.
2. Turn ON the power. Turn ON the pump manually, and allow the coolant to flow for 60 seconds.



3. Write down the coolant flow rate on the CNC screen. The recorded flow rate will be used for comparison during some of the tests. Coolant flow must be greater than 2.3 lpm (0.6 gpm) for the system to operate.



Note: A flow diagram can be found on schematic 013374, sheet 19 of 24

**Test 1 – return line**

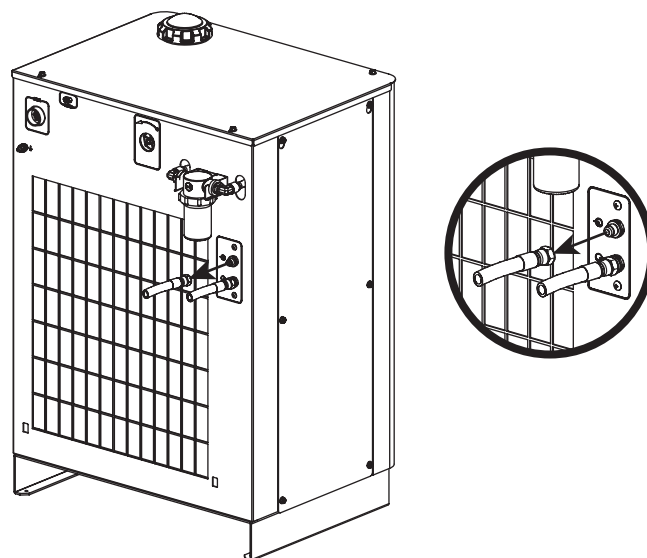
Note: An in-line flow meter is required to complete this test.

1. Turn OFF the power. Remove the return coolant line (red washer on the cooler fitting), and connect the flow meter to measure the flow rate.
2. Measure the flow rate on the flow meter. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down the flow rate from the flow meter.
3. Reconnect the return coolant line (red washer on the cooler fitting).

If the flow rate is 0.8 gpm or more, replace the flow switch.

If the flow rate is less than 0.8 gpm, Go to test 2.

If there is no flow, go to pump and motor troubleshooting.



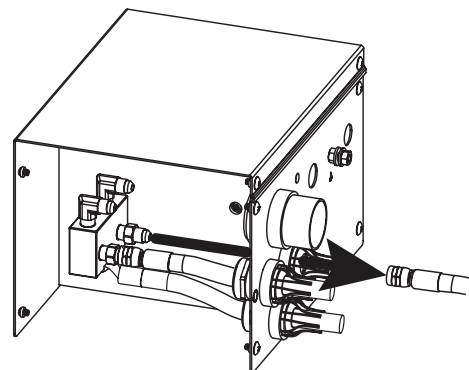
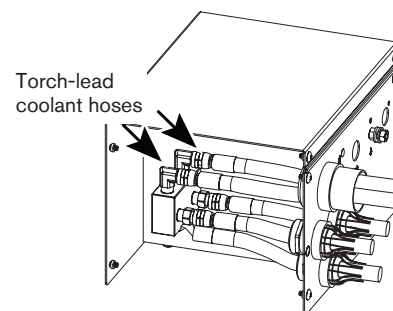
**Test 2 – supply line at ignition console**

Note: Remove the torch-lead coolant hoses to access the supply line.

1. Turn OFF the power. Remove the supply coolant line (blue hose with green tape) from the RHF/LHF console, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.
3. Reconnect the coolant lines.

If the container is full in 65 seconds or less, go to test 3.

If it takes more than 65 seconds to fill the container, go to test 6.



### Test 3 – change the torch

1. Replace the torch and consumables with a new torch and new consumables.
2. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”), let it run for 60 seconds, and look at the flow rate on the CNC screen.

If the flow rate on the CNC screen is 0.9 gpm or more, the torch is clogged.

If the flow rate is still less than 0.9 gpm, go to test 4.

### Test 4 – supply line to the torch receptacle

1. Turn OFF the power. Remove the coolant supply line at the torch receptacle, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.

**Caution: Coolant will flow from the hose very quickly.**



2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.
3. Reconnect the coolant supply line to the torch receptacle.

If it takes more than 65 seconds to fill the container, look for an obstruction or kink in the coolant hose between the torch and the LHF/RHF console. If there is no obstruction or kink, replace the torch leads.

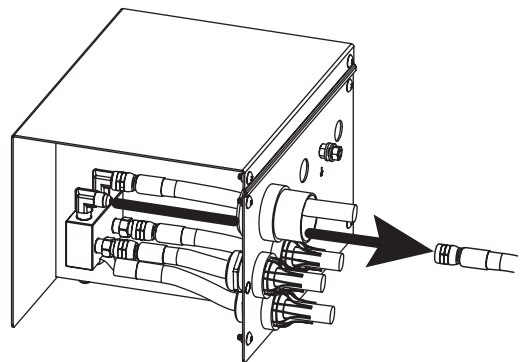
If the container is full in 65 seconds or less, go to test 5.

### Test 5 – return line from the torch receptacle (remove at the ignition console)

1. Turn OFF the power. Remove the return coolant line (blue hose with red tape) from the RHF/LHF console, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.
3. Reconnect the return coolant line.

If it takes more than 65 seconds to fill the container, there is an obstruction in the torch receptacle. Replace the torch receptacle.

If the container is full in 65 seconds or less, there is an obstruction in the return coolant line (from the RHF/LHF console to the power supply). Replace the return coolant line.

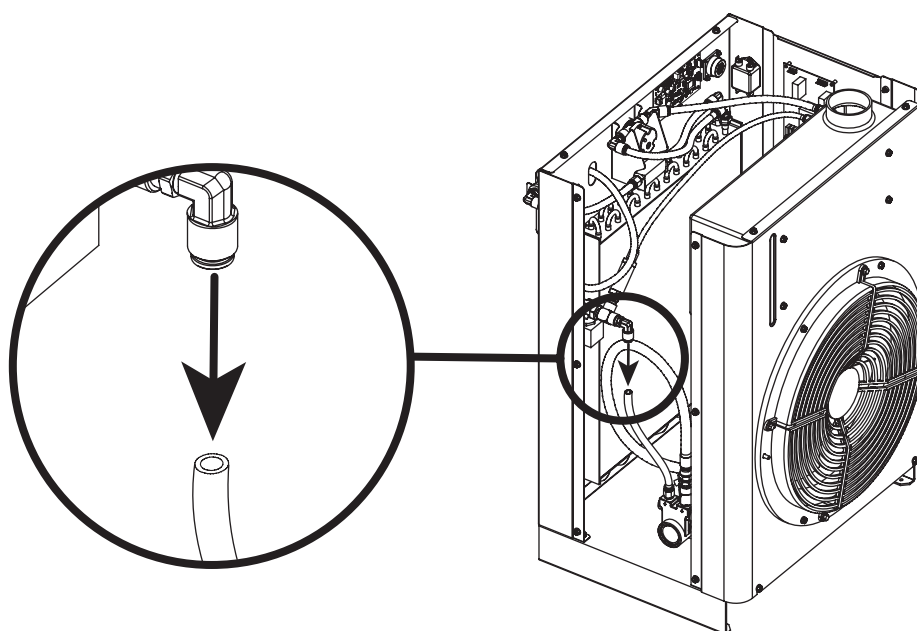


**Test 6 – bucket test at the pump**

1. Turn OFF the power. Remove the pump outlet, coolant line, and place it in a 3.8 liter (1 gallon) container.  
A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.

If it takes more than 65 seconds to fill the container, replace the pump and check the motor shaft for damage.

If it takes less than 65 seconds to fill the container, check the coolant supply line (from the power supply to the RHF/ LHF console) for kinks. If no kinks are found, replace the by-pass valve and perform this test again. If it still takes more than 65 seconds to fill the container, replace the hoses between the power supply and RHF/LHF console.



## Pump and motor troubleshooting

Is the motor LED illuminated on the control board?

Is the motor on?

If the LED is illuminated, but the pump is not running, turn the pump on manually.

If the motor will not turn on, verify that the fuse is OK, and make sure there is power to the motor.

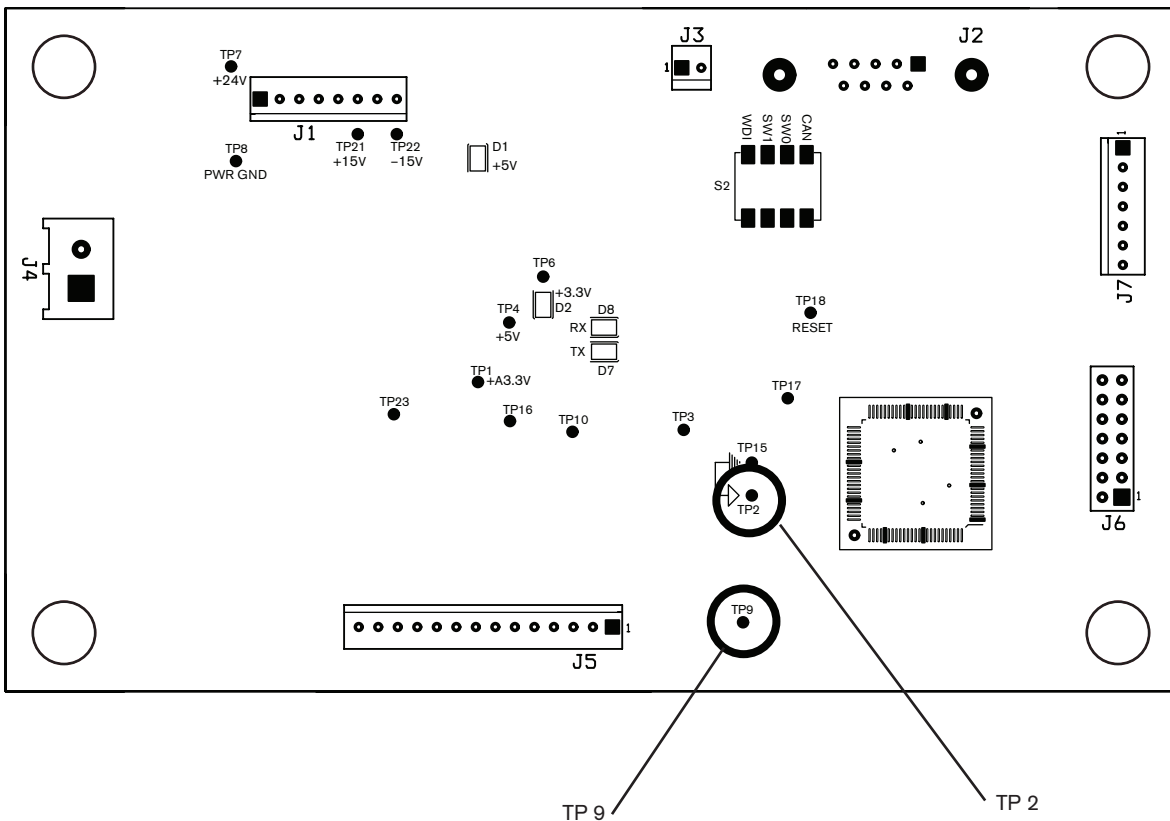
If you are still not getting flow from the pump, verify that the solenoid valve and relief valve are working correctly.

## Testing the flow sensor

1. Turn ON the power.

2. Measure the VDC between TP2 and TP9.

TP9 is 67% scaled voltage from the flow sensor. Normal flow is 3.8 lpm (1.0 gpm), which will equal 0.67 VDC at TP9.

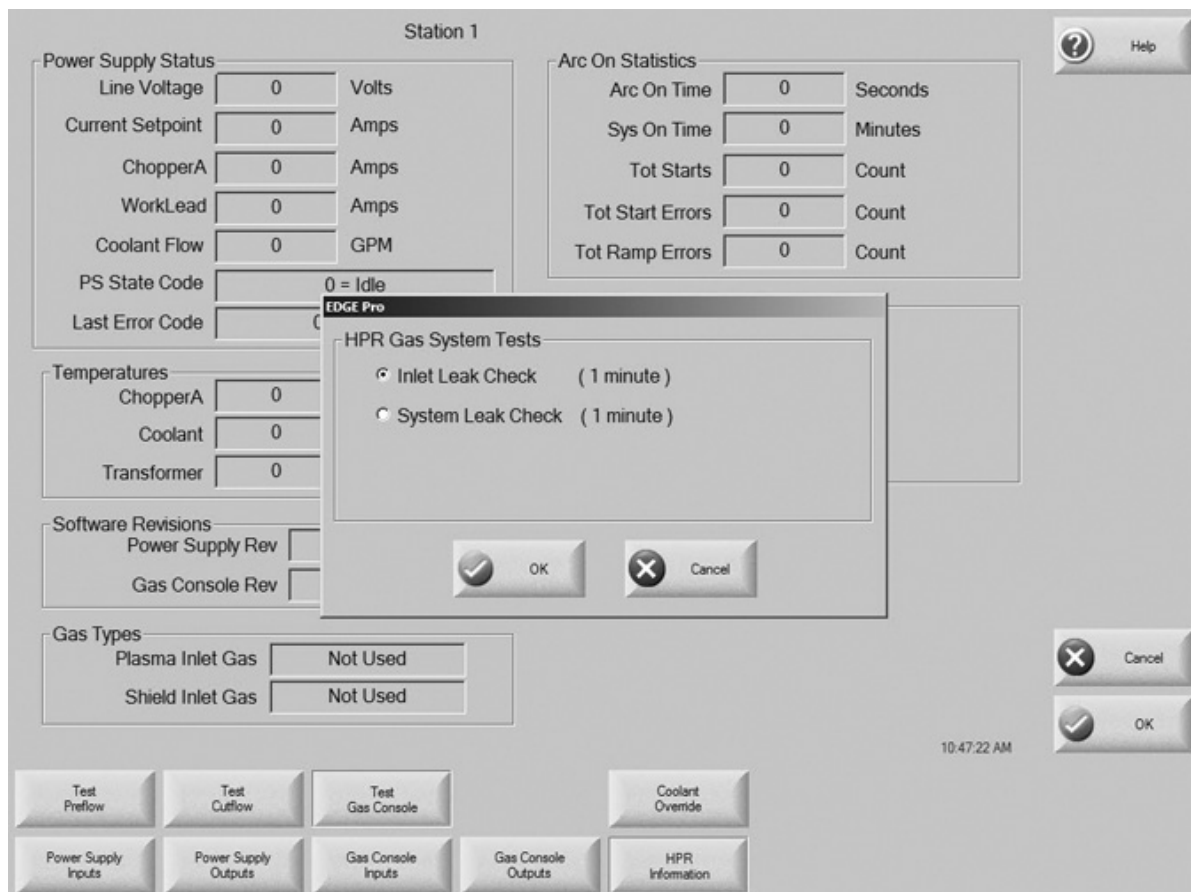




## Gas leak tests

Notes: The CNC screen shown below is from a Hypertherm Automation controller, using version 6 software, and is for reference only. Other controllers should have a test screen similar to the one shown. Contact the original equipment manufacturer for instructions on how to access the test screen needed.

See sheet 20 of 24 on schematic 013374, in this manual, for more details on the gas delivery system.



### Leak test 1 (inlet leak test)

Purpose: Tests the inlet-valve solenoids in the selection console for leaks.

Test description: The valves in the metering console (B1-B4) open to release all gas pressure to the atmosphere, then the valves close and pressure is monitored by P3 and P4 in the selection console. The pressure will increase if an inlet valve is leaking. Code number 14 (cut gas channel number 1 failed) or 15 (cut gas channel number 2 failed) will be displayed if there is a leak. Code number 13 (test passed) will be displayed if no leak is detected.

Procedure:

1. Turn ON power to the plasma system.
2. Perform Inlet Leak Check on the CNC controller.
3. Turn OFF power and then turn ON power. This will purge gases from the system.

### Leak test 2 (system leak test)

Purpose: Tests for leaks to the atmosphere from the gas system.

Test description: The gas for the process selected is purged through the gas system. The metering console valves (B1-B4), and the inlet valves (for the selected process) in the selection console are closed. Gas pressure is now trapped in the system. The trapped pressure is monitored. Code number 14 (cut gas channel number 1 failed) or 15 (cut gas channel number 2 failed) will be displayed if the pressure drops faster than 0.14 bar/minute (2 psi/minute). Code number 13 will be displayed if the pressure decreases within the acceptable limit of 0.14 bar/minute (2 psi/minute).

Procedure:

1. Perform System Leak Check on the CNC controller.
2. Turn OFF power and then turn ON power. This will purge gases from the system.

### Leak test 3 (proportional valve test in the metering console)

Purpose: Tests the Burkert valves (B1 and B3) in the metering console to ensure that they are working within the correct parameters.

Test description: 130-amp mild steel consumables, and the 30-amp O<sub>2</sub>/O<sub>2</sub> mild steel process are used for this test, because there is a known flow rate.

Gas flows from the torch, and the Burkert valve that controls the plasma gas channel (B3) attempts to maintain the set plasma gas pressure (monitored by P7 and P8) by adjusting the valve dynamically. The signal percentage to the valve is measured (example – 65% on), and the value is checked against the expected range (55% – 75%). The test is successful if the signal percentage is within the expected range. Code number 14 (shield gas channel failed) or 15 (plasma gas channel failed) will be displayed if the test fails. The same test is repeated for the Burkert valve that controls the shield gas channel (B1).

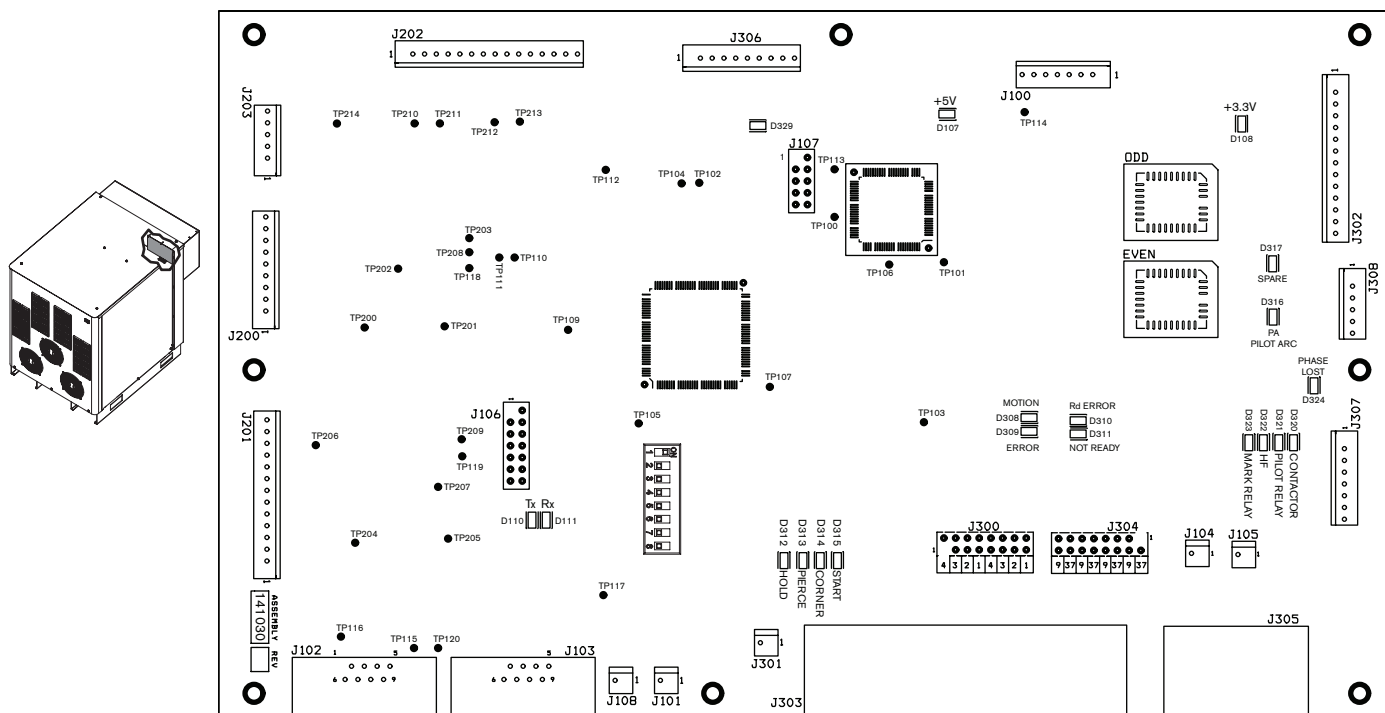
For the next part of the test, the Burkert valve that controls the plasma gas channel (B3) is closed, and the pressure is measured milliseconds later (pressure should decrease). The test is successful if the pressure is below a given limit (0.69 bar [10 psi]). The same test is repeated on the shield gas channel (B1).

Code number 16 (plasma ramp-down test failed) or 17 (shield rampdown test failed) will be displayed if the signal percentage is out of the expected range. Code number 13 (test passed) will be displayed if the signal percentage is within the expected range.

Procedure:

1. Install 130-amp mild steel consumables in the torch and select the 30-amp O<sub>2</sub>/O<sub>2</sub> mild steel process.
2. Perform Metering Valve Flow Check on the CNC controller (test 3).
3. Turn OFF the power and then turn ON the power. This will purge gases from the system.

## Power supply control board PCB3

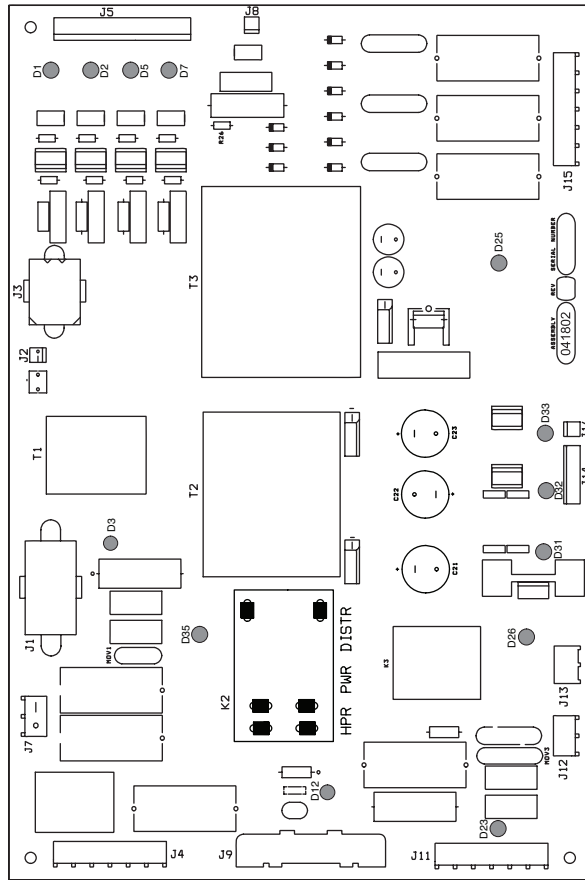
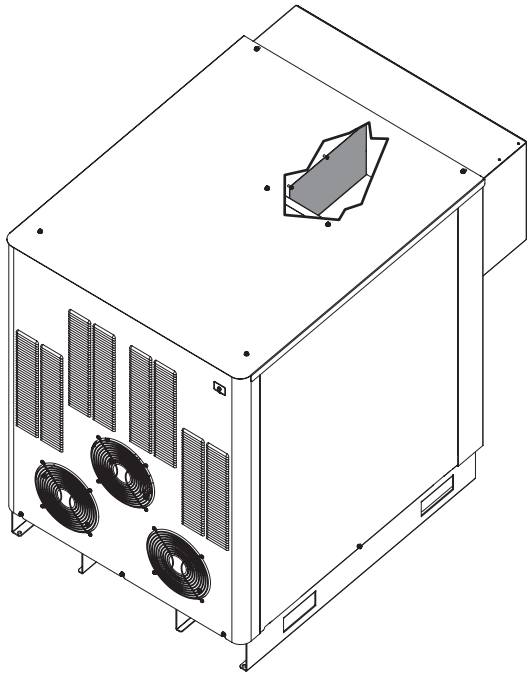


Control PCB LED list					
LED	Description	Status	LED	Description	Status
D107	+ 5 V OK	Steady	D312	Hold	
D108	+ 3.3 V OK	Steady	D313	Pierce	
D110	CAN transmit LED	Blinking	D314	Corner	
D111	CAN receive LED	Blinking	D315	Start redundant	
D308	Motion		D316	Pilot arc enable	
D309	Error		D317	Spare	
D310	Ramp-down error		D324	Phase loss	
D311	Not ready		D329	Pump motor-drive OK	Steady when OK

Firmware	
Item	Part number
U110	081135 EVEN
U109	081135 ODD

Control PCB test points					
Test point number	Description	Test point number	Description	Test point number	Description
TP105	WDI	TP117	CAN ground	TP206	Chopper 4 analog input
TP108	Reset	TP118	CCA+	TP207	Chopper control D
TP109	Reset	TP119	CCC+	TP208	DAC output A
TP110	Digital ground	TP120	CRXD (CANL)	TP209	DAC output B
TP111	Analog ground	TP200	Chopper 1 analog input	TP210	Chopper A temperature sensor
TP112	A + 3.3 V	TP201	Chopper control A	TP211	Chopper B temperature sensor
TP113	+ 3.3 V	TP202	Chopper 2 analog input	TP212	Chopper C temperature sensor
TP114	+ 5 V	TP203	Chopper control B	TP213	Chopper D temperature sensor
TP115	CANH	TP204	Chopper 3 analog input	TP214	Work lead analog input
TP116	CANL	TP205	Chopper control C		

**Power supply power distribution board PCB2**



Power distribution PC board LED list		
LED	Output	Color
D1	Contactor	Red
D2	Pilot arc relay	Red
D3	120 VAC (switched)	Green
D5	HF ignition	Red
D7	Surge select	Red
D12	24 VAC (switched)	Green
D23	240 VAC (switched)	Green
D25	+ 24 VDC	Red
D26	Pump motor	Green
D31	+ 5 VDC	Red
D32	- 15 VDC	Red
D33	+ 15 VDC	Red
D35	24 VAC	Green

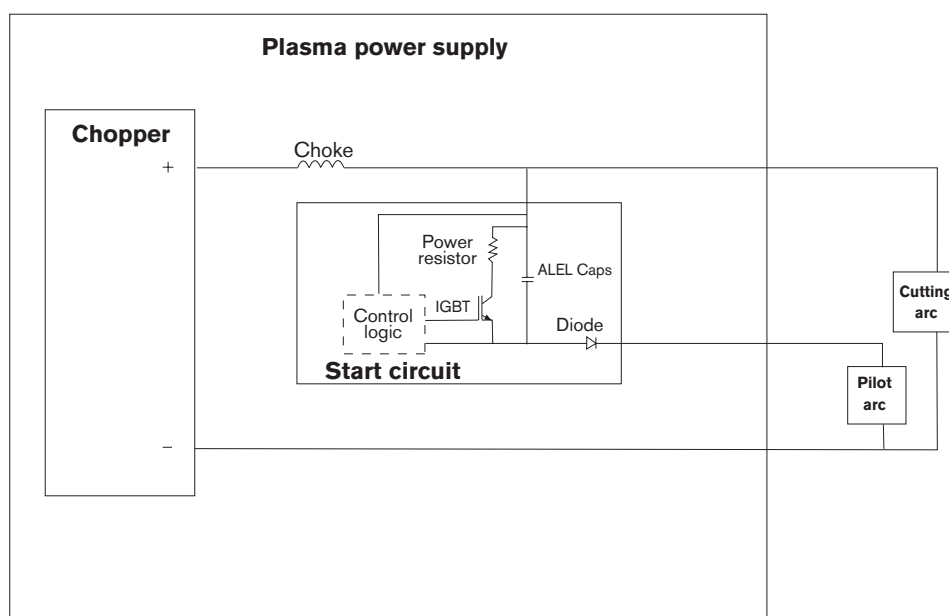
## Start-circuit PCB1

### Operation

The start circuit is a high-speed switch that quickly transfers the pilot arc current from the pilot arc lead to the work lead. 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 lead to aid in transferring the arc to the workpiece. See schematic below.

### Start circuit functional schematic



### Start circuit troubleshooting

		<p><b>DANGER</b> <b>SHOCK HAZARD</b></p>
<p>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.</p>		

## MAINTENANCE

D2 should always be illuminated.

D1 illuminates as soon as the torch fires and will extinguish as soon as the arc transfers to the workpiece. If arc transfer is immediate, the LED will not illuminate.

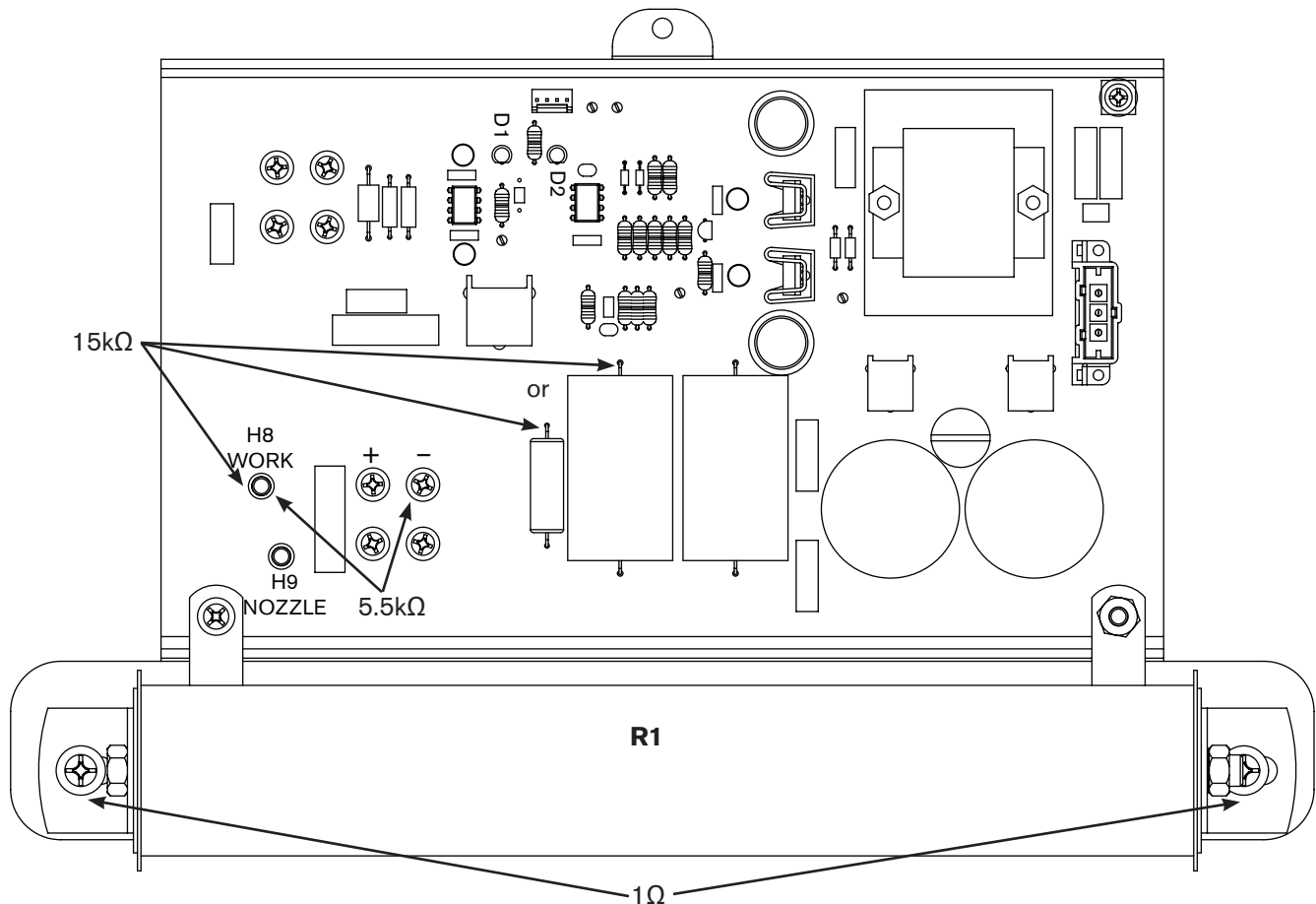
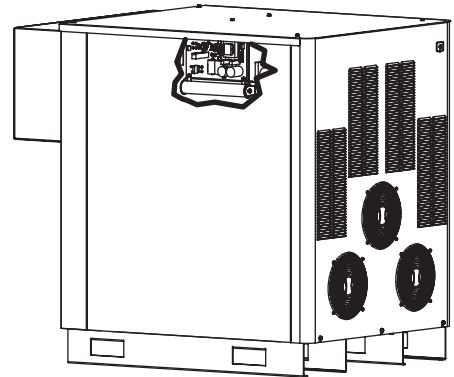
If there is no arc at the torch or if the arc will not transfer:

1. Turn OFF all power to the system.
2. Remove wires from H8 (WORK) and H9 (NOZZLE) studs on the board.
3. Verify a resistance of about ( $\approx$ ) 5.5 k $\Omega$  between H8 and D50 (-). If the resistance value is not correct, replace the board.

Note: Resistance value may slowly increase to the correct value due to the capacitance in the circuit.

4. Verify a resistance of about ( $\approx$ ) 15 k $\Omega$  between snubber and H8.

- The work lead should not have any cuts or breaks. Verify a resistance of 1  $\Omega$  or less. The work lead connection to the cutting table should be clean and have good contact to the table.
- Verify that LED-D2 is illuminated. If it is not illuminated, the board may need to be replaced or the board may not be receiving power.
- Fire the torch in the air and verify that D1 is illuminated. If it is not illuminated, but a pilot arc is established, the board may need to be replaced.
- Verify a resistance of about ( $\approx$ ) 1  $\Omega$  across the R1 resistor.



## Pilot arc current levels

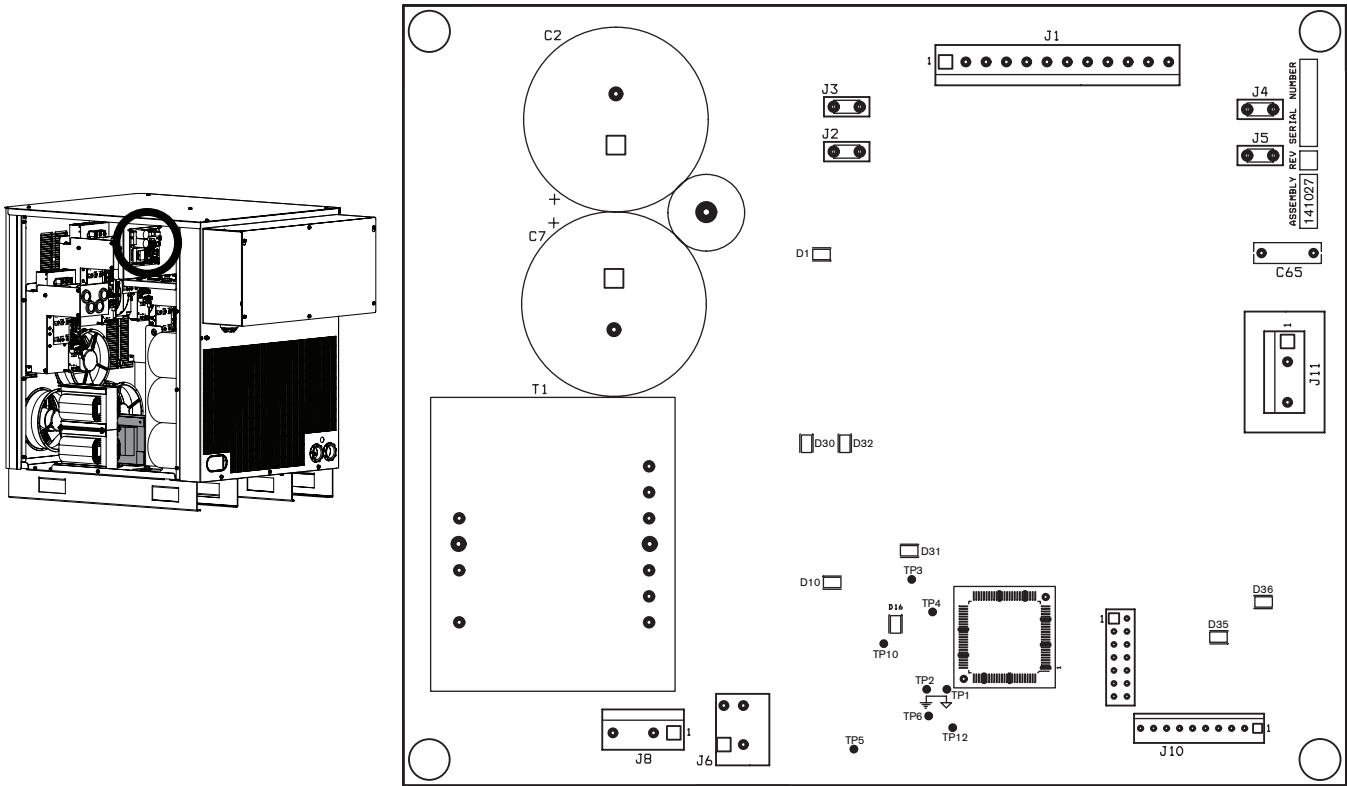
The pilot arc current level will vary according to the arc current selected, and the process. See table below.

<b>Pilot arc current</b>								
Plasma gas	30-amps	45-amps	50-amps	80-amps	130-amps	200-amps	260-amps	400-amps
O <sub>2</sub>	25	30	30	30	30	40	40	60
N <sub>2</sub>	25	30	30	30	35	40	40	60
H35	25	30	30	30	35	40	40	60
F5	25	30	30	30	35	40	40	60
Air	25	30	30	30	35	40	40	60

<b>Transfer current</b>								
Plasma gas	30-amps	45-amps	50-amps	80-amps	130-amps	200-amps	260-amps	400-amps
O <sub>2</sub>	10	10	10	10	15	20	20	30
N <sub>2</sub>	10	10	10	10	15	20	20	30
H35	10	10	10	10	15	20	20	30
F5	10	10	10	10	15	20	20	30
Air	10	10	10	10	15	20	20	30

**Pump motor drive board PCB7**

Note: The inductor on the pump motor-drive board makes a noise during operation that has been described as a “hum”, “sing”, and “click”. This is normal and can be disregarded.

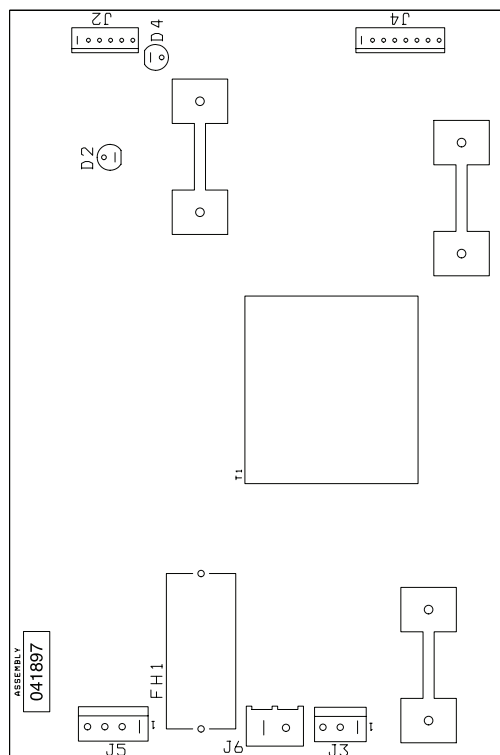
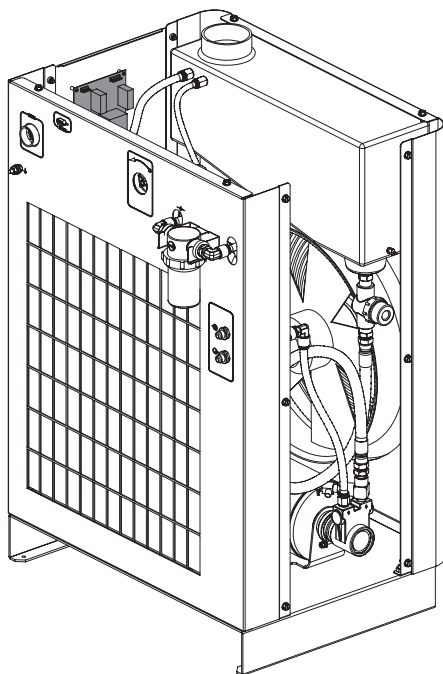


Control PCB LED list		
LED	Description	Status
D1	+ 15 V OK	On when +15 voltage is OK
D10	+ 5 V OK	On when +5 voltage is OK
D16	+ 3.3 V OK	On when +3.3 voltage is OK
D30	IPM temperature alarm output	Off when OK. On when there is a sustained over-current condition
D31	Temperature	Off when OK. On when there is a temperature fault
D32	IPM alarm output	Off when OK. On when there is an internal overtemp, over-current, or bad gate supply-drive voltage
D35	Pump motor drive OK	On when pump-motor-drive is OK
D36	Pump motor drive enable	On when enabled

Control PCB test points					
Test point number	Description	Test point number	Description	Test point number	Description
TP1	Analog ground	TP5	+ 5 V	TP9	Digital ground
TP2	Digital ground	TP6	A + 3.3 V	TP10	+ 3.3 V
TP3	Reset\	TP7	+ 3.3 V	TP11	SCIRXD
TP4	Reset	TP8	SCITXD	TP12	LINEFB +



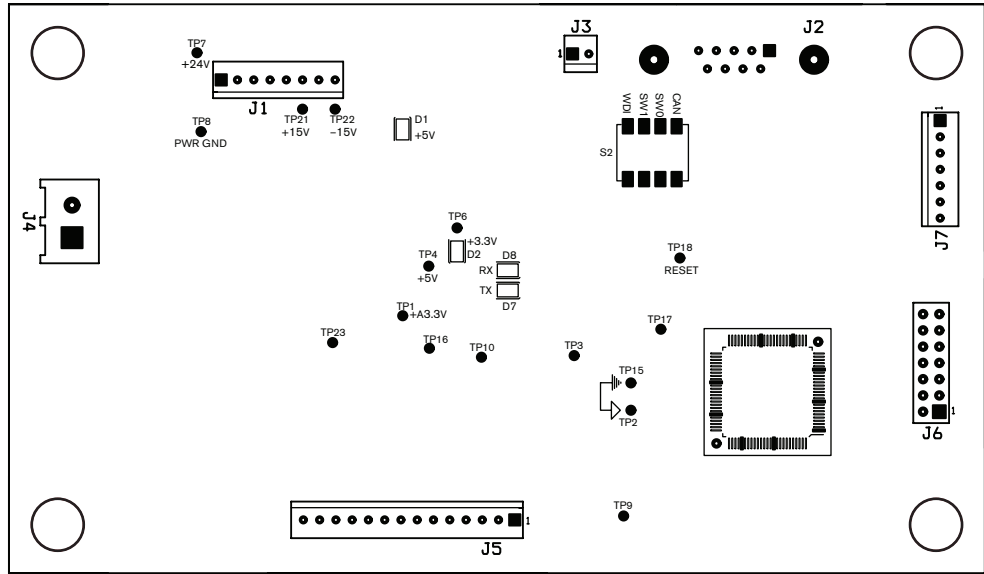
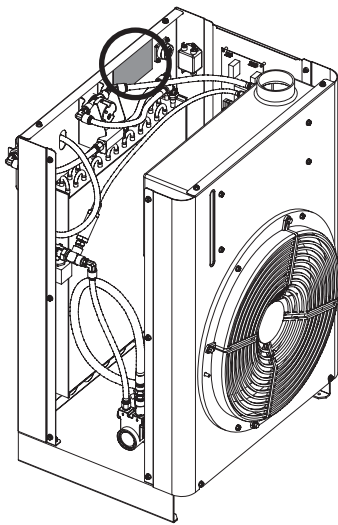
## Cooler power distribution board PCB1



### Gas console control board LED list

LED	Signal name	Color
D2	SV16	Red
D4	+ 5 VDC	Green

**Cooler sensor board PCB2**



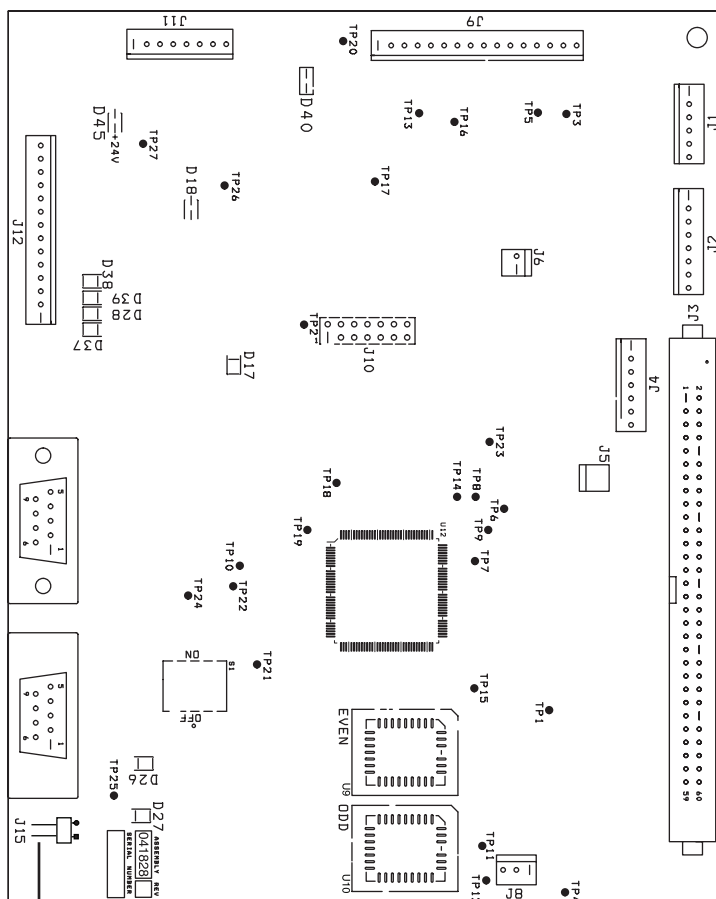
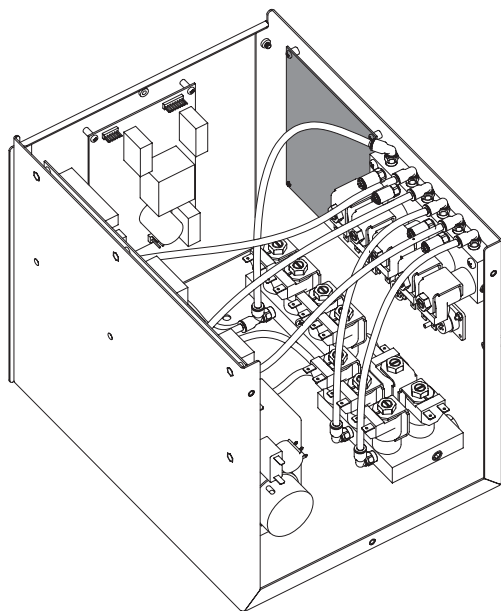
**Gas console control board LED list**

LED	Signal name	Color
D1	+ 5 VDC	red
D2	+ 3.3 VDC	Green
D7	CAN TX	
D8	CAN RX	

**Control PCB test points**

Test point number	Description	Test point number	Description
TP1	A + 3.3 V	TP12	Digital ground
TP2	Analog ground	TP13	+ 3.3 V
TP3	Pressure sensor (for use in the future)	TP14	SCIRXD (RS422 transmit)
TP4	+ 5 V	TP15	Digital ground
TP6	+ 3.3 V	TP16	Analog ground
TP7	+ 24 V	TP17	Reset\
TP8	Power ground	TP18	Reset
TP9	Coolant flow sensor input	TP21	+ 15 V
TP10	Chiller flow input (for use in the future)	TP22	- 15 V
TP11	SCIRXD (RS422 receive)	TP23	Line voltage input

## Selection console control board PCB2



Note: CAN termination resistor. The jumper must be removed.

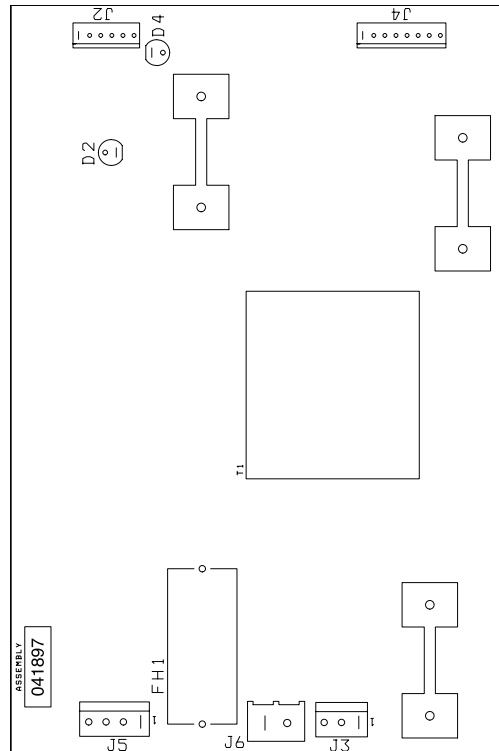
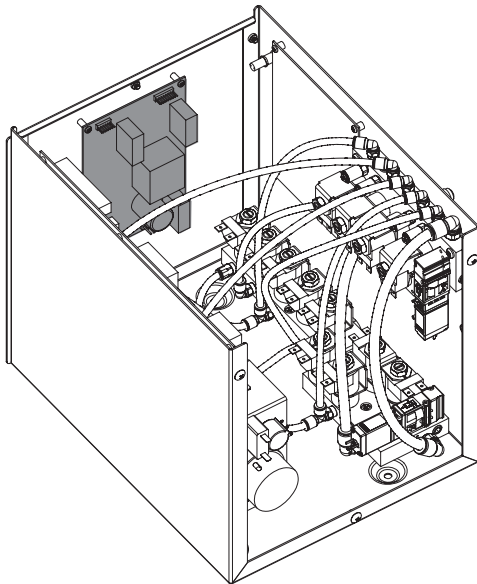
### Control PCB2 firmware list

Item	Part number
U9	081110 EVEN
U10	081110 ODD

### Gas console control board LED list

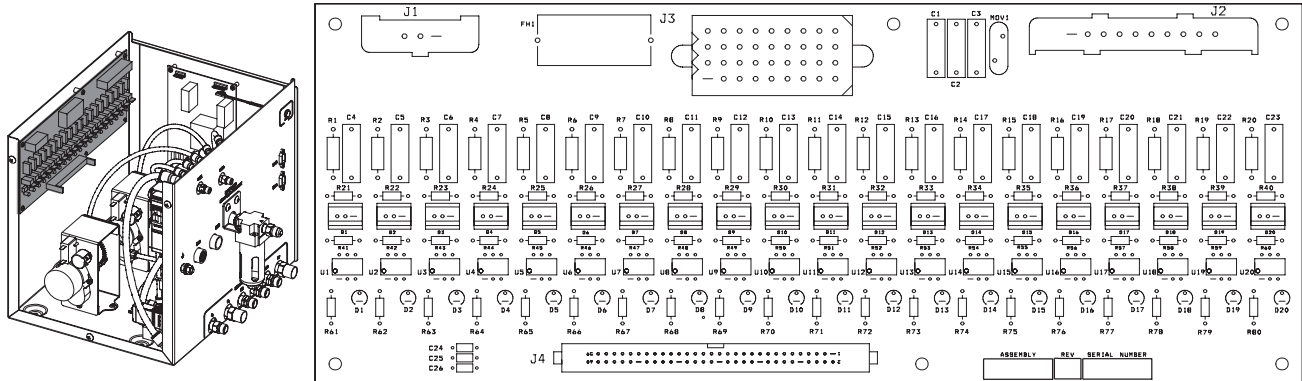
LED	Signal name	Color
D17	+ 3.3 VDC	Green
D18	+ 5 VDC	Green
D26	CAN – RX	Green
D27	CAN – TX	Green
D28	Not used	Red
D37	Not used	Red
D38	Not used	Red
D39	Not used	Red
D40	+ 15 VDC	Green
D45	+ 24 VDC	Green

**Selection console power distribution board PCB1**

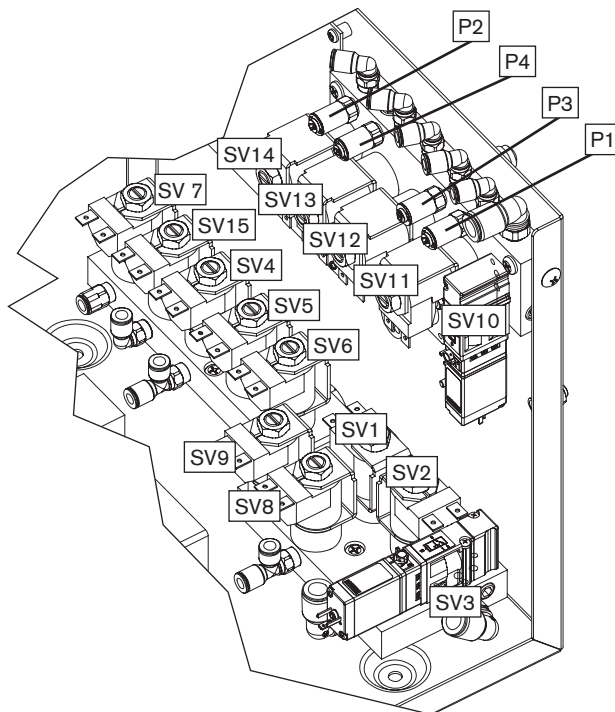


<b>Gas console control board LED list</b>		
LED	Signal name	Color
D2	SV16	Red
D4	+ 5 VDC	Green

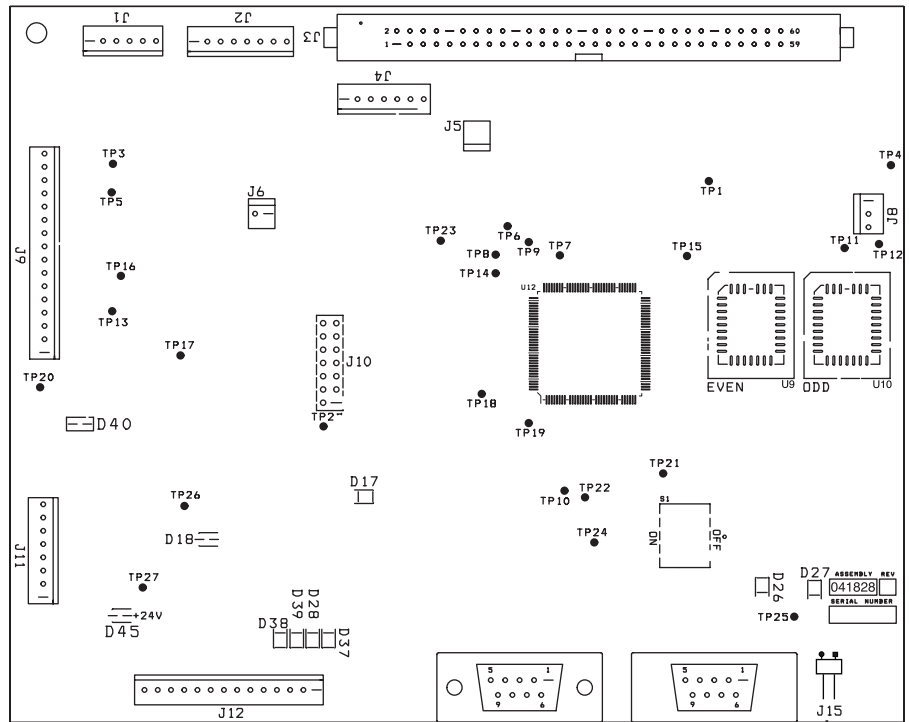
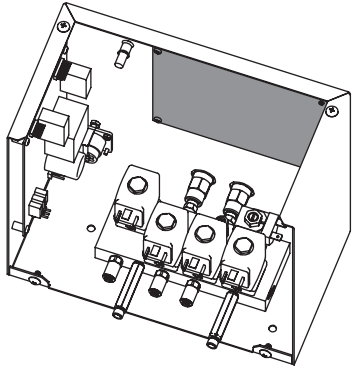
**Selection console, AC valve-driver board PCB3**



LED	Signal name	Color	LED	Signal name	Color
D1	SV1	Red	D11	SV11	Red
D2	SV2	Red	D12	SV12	Red
D3	SV3	Red	D13	SV13	Red
D4	SV4	Red	D14	SV14	Red
D5	SV5	Red	D15	(not used)	Red
D6	SV6	Red	D16	Metering console vent solenoid	Red
D7	SV7	Red	D17	MV1 close	Red
D8	SV8	Red	D18	MV1 open	Red
D9	SV9	Red	D19	MV2 close	Red
D10	SV10	Red	D20	MV2 open	Red



**Metering console control board PCB2**



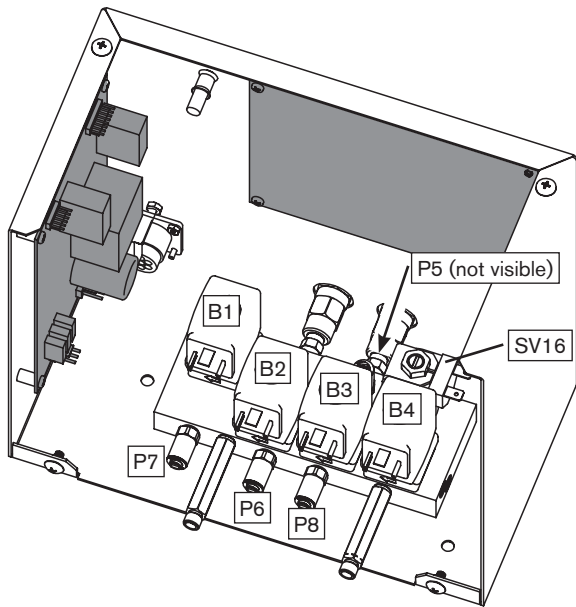
Note: CAN termination resistor. The jumper must be installed.

**Control PCB2 firmware list**

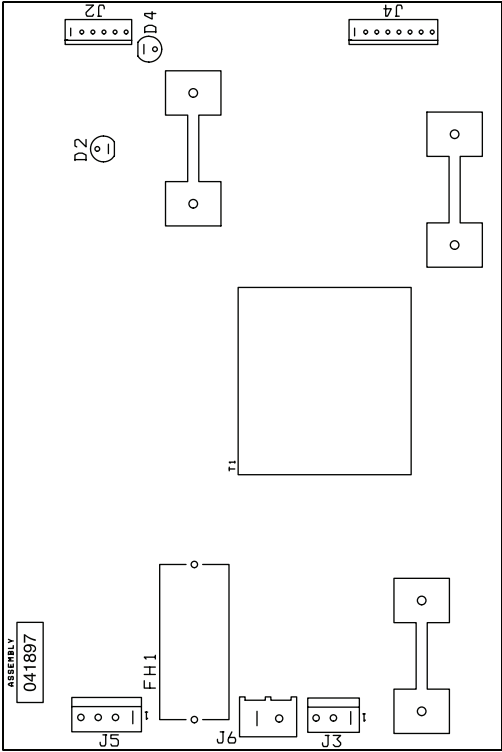
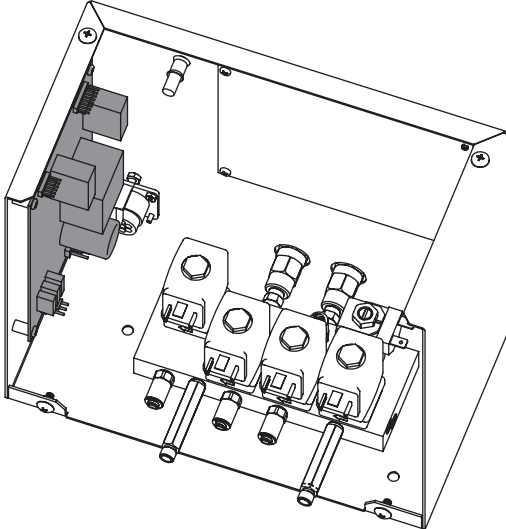
Item	Part number
U9	081110 EVEN
U10	081110 ODD

**Gas console control board LED list**

LED	Signal name	Color
D17	+ 3.3 VDC	Green
D18	+ 5 VDC	Green
D26	CAN – RX	Green
D27	CAN – TX	Green
D28	Burkert valve 2	Red
D37	Burkert valve 1	Red
D38	Burkert valve 4	Red
D39	Burkert valve 3	Red
D40	+ 15 VDC	Green
D45	+ 24 VDC	Green





### Metering console power distribution board PCB1



Gas console control board LED list		
LED	Signal name	Color
D2	SV16	Red
D4	+ 5 VDC	Green

## Chopper tests

		<b>WARNING SHOCK HAZARD</b>
<p><b>Use extreme care when working near the chopper modules. Each large electrolytic capacitor (blue-cased cylinder) stores 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.</b></p>		

### Automatic chopper tests during power-up

When the power is turned ON, the contactor will close and each chopper will automatically test in sequence (1, 3, 2, and 4). If the status changes to 3, all choppers passed the test. After the tests are complete the unit will advance to the purge cycle unless an error is detected on one of the choppers.

As each chopper is turned on, the current flows into the surge circuit and is measured for high and low limits. If the chopper passes the test, the next chopper is tested.

If chopper 1 passes the test and one of the other choppers fails, you can assume that the main contactor, the input power, and the surge circuit are OK.

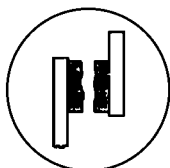
Error codes:

Chopper 1 – low-current error code 105  
Chopper 1 – high-current error code 103  
  
Chopper 3 – low-current error code 075  
Chopper 3 – high-current error code 107

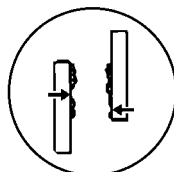
Chopper 2 – low-current error code 106  
Chopper 2 – high-current error code 104  
  
Chopper 4 – low-current error code 076  
Chopper 4 – high-current error code 095

### Chopper 1 failure

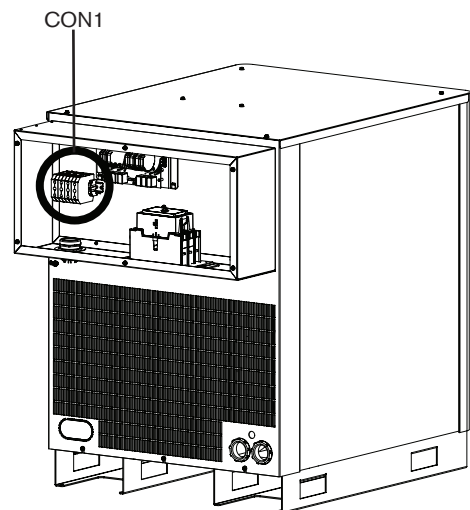
1. Turn OFF all power to the system.
2. Remove the cover over the main contactor (CON1) and inspect the contacts for arcing or damage.
  - If the contacts are damaged, replace the contactor.
  - If the contacts are OK, replace the cover, turn ON the power, and continue to step 3.



OK



Excessive wear





3. Locate dipswitch S301 on the control board (PCB3) and move switch 5 to the ON position. The switch must be returned to its original position before cutting.
4. Measure the open circuit voltage (OCV)  
Attach the test leads of a DC volt meter to the NEG terminal and the WORK terminal on the I/O board. Turn ON the power to start the chopper test. After the contactor (CON1) closes, read the OCV which should be about 360 VDC.
  - If the OCV is 0, the chopper is probably faulty. Swap chopper 1 with chopper 2 for verification. If chopper 1 is faulty, the error code should change to 106. Replace chopper 1.
  - If OCV is about 360 VDC, continue to step 5.
5. Swap current sensor 1 (CS1) with current sensor 2 (CS2). Move the sensor, but leave the power cable and the control wiring in place.
  - If the error remains on chopper 1, replace the I/O PCB.
  - If the error changes to chopper 2, replace CS1.

### **Chopper 2, 3, or 4 failure**

1. Swap the current sensor for the chopper that failed with the current sensor for the next chopper in sequence.
  - If the error moves to the next chopper in sequence, replace the current sensor for the chopper that failed.
  - If the error remains on the original chopper, continue to step 2.
2. Measure the OCV
  - The chopper outputs are connected in parallel at the I/O board, and the choppers are tested in sequence (1, 3, 2, and 4). This means that if you measure the OCV at the NEG and WORK terminals on a fully functional HPR400XD, the voltage will be 0 until the contactor (CON1) closes. Chopper 1 will turn on and you will measure 360 VDC. Chopper 1 will turn off and the voltage will decrease to 0. Chopper 3 (1, 3, 2, and 4) will turn on next, and the voltage will increase to 360 VDC and then decrease to 0 when chopper 3 turns off. This sequence repeats until all 4 choppers are tested.

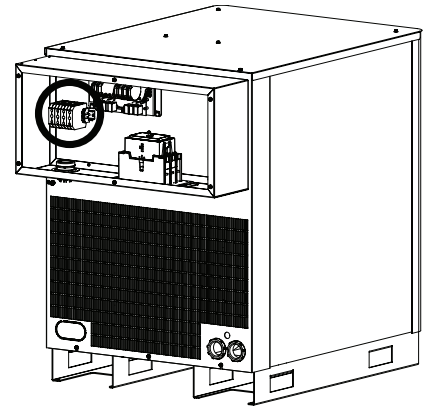
#### **Example:**

If you get error 075 or 107, you know chopper 3 failed the test. Because chopper 1 and chopper 2 passed the test, you know the incoming power and the I/O board are OK. If you measure the OCV at the NEG terminal and the WORK terminal on the I/O board, you will see the voltage cycle from 0 to 360, back to 0, and then to 360 again, because chopper 1 and chopper 2 are OK. If you do not get the third reading of 360 VDC from chopper 3, that means chopper 3 is faulty. You can swap chopper 3 with chopper 2 for verification. The error code will move to chopper 2, if chopper 3 is faulty. If the error does not move, or you measure an OCV of about 360 VDC for chopper 3, contact Hypertherm Technical Service at 800-643-9878.

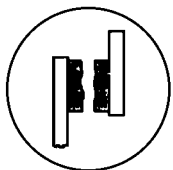
**Note:** Return switch 5 on S301 to the OFF position before returning to normal cutting operations.

## Phase-loss detection test

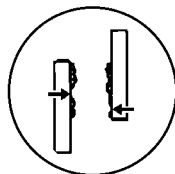
1. Turn OFF all power to the system and remove the cover from CON1.



2. Inspect the condition of the 3 contacts for excessive wear. If one or more of the contacts are worn excessively, replace CON1 and restart the system. If the error remains, perform the following steps.

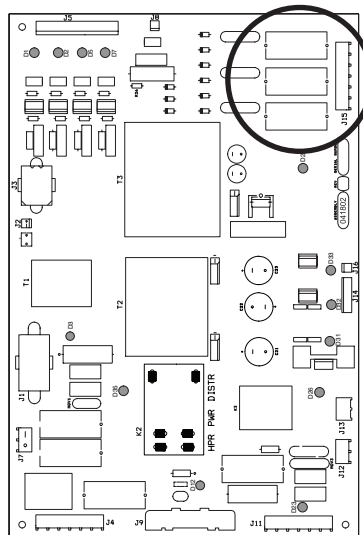


OK



Excessive wear

3. Test the fuses F5, F6, and F7 on the power distribution board (PCB2). If any of the fuses are blown, replace PCB2.



4. Remove J2.8 from PCB2 and place a jumper between pins 1 and 2 on the cable connector.

- a. Make a test cut. If the phase-loss error continues, verify wiring between J2.8 on PCB2 and J3.302 on PCB3 by verifying the continuity between
  - J2.8 pin1 to J3.302 pin14
  - J2.8 pin2 to J3.302 pin15.
- b. If the wiring is OK, replace PCB3. If any wiring is damaged, repair or replace any damaged wires.
- c. If the phase-loss error goes away while the jumper is on J2.8, make another cut and measure the phase-to-phase voltage across the fuses F5, F6, and F7. The voltage should be 220 VAC +/-15%. If 1 of the 3 voltage readings is less than 187 VAC, check the contacts to the contactor, and check for loose connections between the power cord, contactor, power transformer, and the chopper.

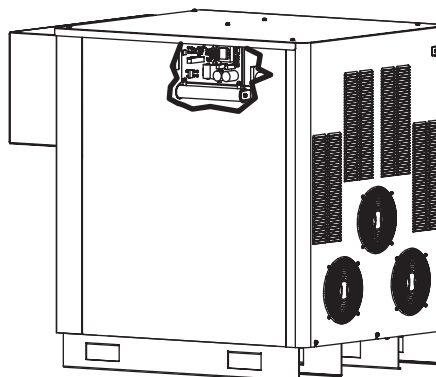


**WARNING  
SHOCK HAZARD**

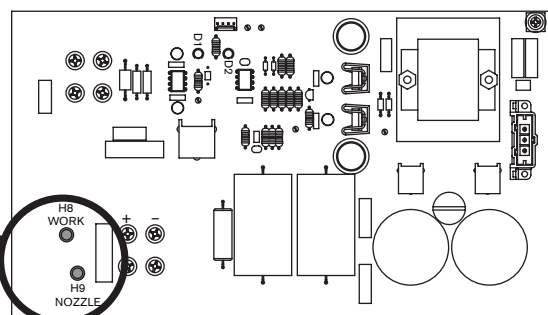
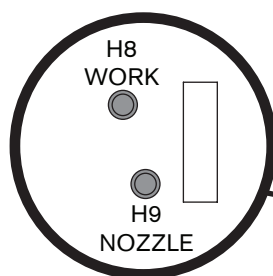
**Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.**

**Torch lead test**

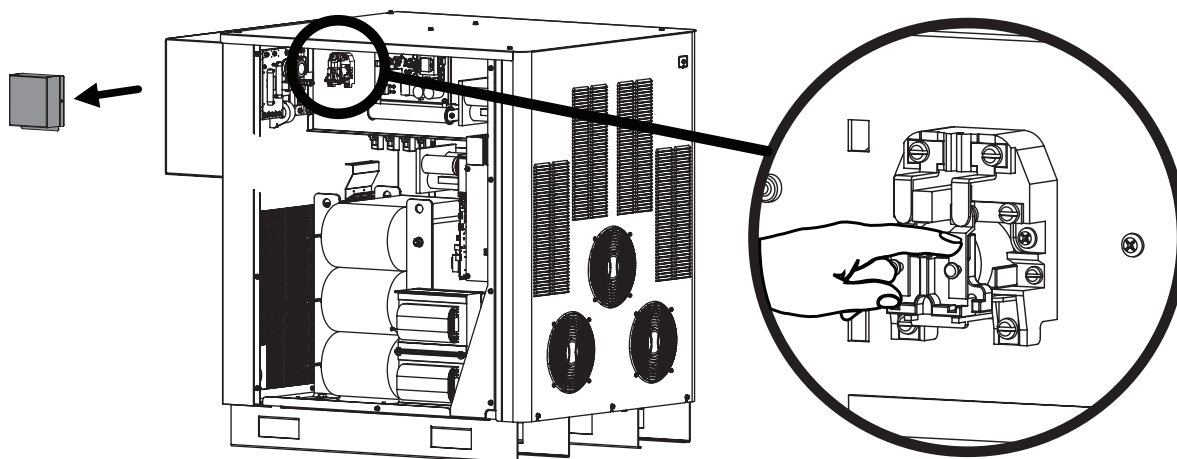
1. Turn OFF all power to the system.
2. Locate the start-circuit assembly.



3. Install a temporary jumper wire between H8 (work) and H9 (nozzle) on the start circuit PCB1.



4. Locate the pilot arc relay (CR1) and remove the dust cover. Have a second person close the contact.



5. Measure the ohm value between the nozzle and the plate. The reading should be less than 3 ohms. A measurement of greater than 3 ohms indicates a faulty connection between the torch and ignition console or between the ignition console and the power supply.
6. Verify that the pilot arc wire on the torch lead is not damaged. If it is damaged replace the lead. If it is not damaged, replace the torch head.

## Preventive maintenance

### Introduction

Deteriorating consumable parts life is one of the first indications that something is wrong with a plasma system. Reduced parts life increases operating costs in 2 ways: The operator must use more electrodes and nozzles to cut the same amount of metal, and the work of cutting must stop more often to change consumables.



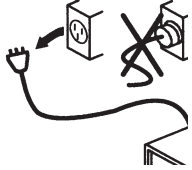
Proper maintenance often eliminates the problems that shorten the life of consumable parts. Since labor and overhead can account for 80% of the cost of cutting, improved productivity can reduce cutting costs dramatically.

### Preventive maintenance protocol

The following protocol covers the basic elements of all Hypertherm HyPerformance plasma systems.

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

### The power supply

		<b>DANGER</b> <b>ELECTRIC SHOCK CAN KILL</b>
		<b>Turn off all electrical power before removing the power supply cover and set the line disconnect switch to OFF. In the U.S., use a "lock-out and tag-out" procedure until the service or maintenance is complete. In other countries, follow appropriate local and national safety procedures.</b>

1. With power to the power supply turned off, remove all side panels. Use compressed air to blow out any accumulation of dust and particulates.
2. Inspect wiring harnesses and connections for wear, damage or loose connections. If you see any discoloration that might indicate overheating, 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 is recommended.
4. Inspect the pilot arc relay (CR1) for excessive pitting on the contacts, characterized by a roughened, black surface. Replace if necessary.

## Cooling system

5. Inspect the coolant-circulating system's filter element at the rear of the cooler. If the filter is a brownish color, replace it. Consult the *Parts List* in this manual for part numbers.
6. Perform a coolant flow test as described in this manual, then check for coolant leaks. Primary locations to inspect are these:
  - A. The rear of the cooler;
  - B. At the ignition console, and;
  - C. At the torch main body.

Also, check the coolant tank for dirt and particulates. Verify that proper Hypertherm coolant is being used. Proper Hypertherm coolant (028872) is a red liquid.

## Torch main body

7. Verify that the water tube is straight and has no pitting on the end.
8. Inspect the current ring inside the torch main body. The current ring should be smooth and not pitted. If no pitting is observed, clean the current ring with a clean cotton swab and hydrogen peroxide. Do not use alcohol. Pitting on the current ring generally indicates improper maintenance (i.e. lack of regular cleaning).
9. Clean all threads on the front end of the torch head with hydrogen peroxide and a cotton swab, pipe cleaner or clean cloth. Do not use alcohol. Damage to the threads usually results from not cleaning the torch and retaining cap threads properly, so that dirt and particulates accumulate in the threads.
10. Inspect the torch insulator for cracks. Replace the torch if you find cracks.
11. Inspect all o-rings on the torch body and consumables. Make sure that the correct amount of lubricant – a thin film – is applied to these o-rings. Too much lubricant may obstruct gas flows.
12. Check that the retaining or shield cap is tightened securely to the torch main body.
13. Inspect all hose fittings at the rear of the torch for wear. Damage to the fitting threads may indicate that overtightening has occurred.
14. Check that all connections between the torch and torch leads are tight, but do not overtighten. See torque specs in the *Installation* section of this manual.

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

## Gas flows

15. Check each gas line from the gas supply, as follows:
  - A. Remove and plug the inlet gas fitting at the gas console.
  - B. Pressurize the gas line to 8 bar (115 psi).
  - C. Close the gas supply valve at the source. Watch for a pressure drop. If the gas supply line is a hose, there may be a 0.3 to 0.5 bar (5 to 7 psi) drop due to hose-stretch.
  - D. Repeat for each line from a gas supply source. If any pressure continues to drop, find the leak within the system.

## MAINTENANCE

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16. If the gas line pressures hold steady, perform a system gas leak tests as specified in this manual.
17. Check for hose restrictions, as follows:
  - A. Check all hoses to verify that they have no kinks or sharp bends, which can restrict gas flow.
  - B. 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

18. All cables should be checked for chafing or unusual wear. If the outside insulation has been cut or otherwise damaged, replace the cable.

### Ignition console

19. Open the cover and use compressed air to blow out any accumulation of dust and particulates. If moisture is present, dry the inside of the console with a cloth and try to identify the source of the moisture.
20. Inspect the spark gap assembly. Ensure that the wiring connections to the spark gap assembly are secure. Check that the console doors close properly.
21. Inspect the torch leads. Ensure that they are fastened tightly to the outside of the ignition console.

### System grounding

22. Verify that all components of the system are individually grounded to a driven earth ground, as described in the *Installation* and *Grounding* sections of this manual.
  - A. All metal enclosures, such as the power supply, ignition console and selection console, should be connected individually to a ground point. These connections should be made with 10 mm<sup>2</sup> (No. 8 AWG) wire (USA), or equivalent-size wire.
23. Check the work lead (+) connection, particularly where the work lead (+) connects to the cutting table. This must be a good, clean connection because a poor connection may cause arc-transfer problems.
24. Complete the Preventive Maintenance worksheet on the next page, for future reference.

## Preventive Maintenance Master Schedule

**Daily:**

- Verify proper inlet gas pressure.
- Verify proper gas flow settings. – Mandatory at every consumable change.
- 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 the power supply with dry, oil-free compressed air, or a vacuum cleaner.
- Verify cooling fans are working properly.
- Clean torch threads and current ring.
- Verify proper coolant level.

**Semi-Annually:**

Year	1 <sup>st</sup> Service	2 <sup>nd</sup> Service

- Replace service parts per the Service Part Replacement Schedule.

**Annually:**

Year									

- Replace service parts per the Service Part Replacement Schedule.

# MAINTENANCE

## 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 pilot arc relay

### Coolant system

- P NP 5. Inspect filter element
- P NP 6. Perform coolant flow test
  - A. Coolant flow checked at \_\_\_\_\_ gallons per minute ( \_\_\_\_\_ l/min)

### Torch main body

- P NP 7. Inspect water tube
- P NP 8. Inspect current ring
- P NP 9. Clean threads on torch front end
- P NP 10. Inspect Vespel torch insulator
- P NP 11. Inspect torch and consumable o-rings
- P NP 12. Verify proper fit of retaining or shield cap
- P NP 13. Inspect hose fittings
- P NP 14. Inspect torch-to-torch-lead connections

### Gas flows

- P NP 15. Inspect plumbing from gas supply
  - P NP A. Oxygen
  - P NP B. Nitrogen
  - P NP C. Air
  - P NP D. Nitrogen-Hydrogen
  - P NP E. Argon-Hydrogen
  - P NP F. Inspect compressed air filter system

### Gas flows – continued

- P NP 16. 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 17. Inspect for hose restrictions
  - P NP A. metering console hoses
  - P NP B. Selection console to Metering console
  - P NP C. metering console to torch
  - P NP D. Hoses in power track

### Cable connections

- P NP 18. Inspect cables
  - P NP A. CommandTHC
  - P NP B. Control cable from metering console to selection console
  - P NP C. From metering console to power supply
  - P NP D. From ignition console and selection console to power supply

### Ignition console

- P NP 19. Inspect for moisture, dust and particulates
- P NP 20. Inspect spark gap subassembly
- P NP 21. Inspect torch leads

### System grounding

- P NP 22. Inspect for proper system component grounding
- P NP 23. Inspect connection from cutting table to workpiece (+) lead

### General comments and recommendations:

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Preventive maintenance performed by: \_\_\_\_\_ Date: \_\_\_\_\_



**Service parts replacement schedule – 1 of 2**

228369 – annual preventive maintenance parts kit (200-240 volt)

228370 – annual preventive maintenance parts kit (380-600 volt)

The kits include all the parts in the shaded boxes below

Timeline	Component	Part number	Qty.
6 months or 300 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1
1 Year or 600 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	Air filter element	011110	1
1.5 Years or 900 arc hours+	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1
2 Years or 1200 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	Coolant pump kit	228171	1
	Torch leads	System dependent	1
	Air filter element	011110	1
2.5 Years or 1500 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1
3 Years or 1800 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	Cooling fan 6 in.	127039	8
	Cooling fan 10 in.	027079	3
	Air filter element	011110	1
3.5 Years or 2100 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1

## MAINTENANCE

### Service parts replacement schedule – 2 of 2

Timeline	Component	Part number	Qty.
4 Years or 2400 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	Coolant pump kit	228171	1
	Torch leads	System dependent	1
	Coolant pump motor kit	128385	1
	Air filter element	011110	1
4.5 Years or 2700 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1
5 Years or 3000 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	High voltage transformer	129854	1
	Power distribution board	041802	1
	Metering console	078535	1
	Pilot arc lead	System dependent	1
	Gas leads	System dependent	1
Air filter element	011110	1	
5.5 Years or 3300 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
	Air filter element	011110	1
6 Years or 3600 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	6
	Main contactor (200 VAC-240 VAC)	003218	1
	Main contactor (380 VAC-600 VAC)	003233	1
	Torch main body	220706	1
	Pilot arc relay	003149	1
	Coolant pump kit	228171	1
	Torch leads	System dependent	1
	Cooling fan 6 in.	127039	8
	Cooling fan 10 in.	027079	3
Air filter element	011110	1	
6.5 Years or 3900 arc hours	Repeat schedule starting at 6 months or 300 arc hours		

## Section 6

### PARTS LIST

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*In this section:*

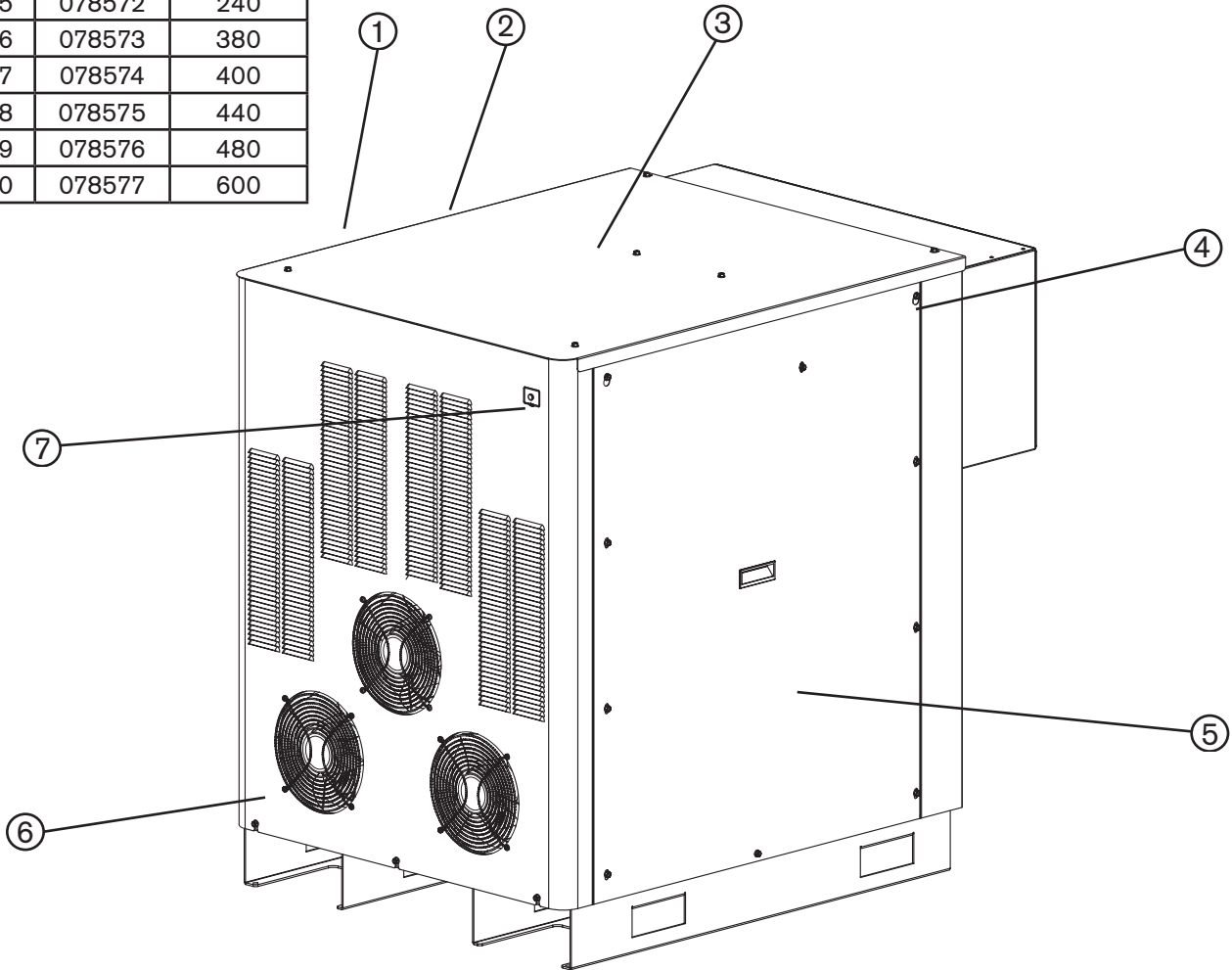
Power supply .....	6-2
Cooler .....	6-6
Ignition console .....	6-8
Selection console .....	6-9
Metering console .....	6-11
HyPerformance torch .....	6-12
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Ohmic contact wire .....	6-13
Consumable parts kits .....	6-14
Consumables for mirror-image cutting .....	6-16
Mild steel (straight cutting) .....	6-16
Mild steel (bevel cutting) .....	6-17
Recommended spare parts .....	6-18

# PARTS LIST

## Power supply

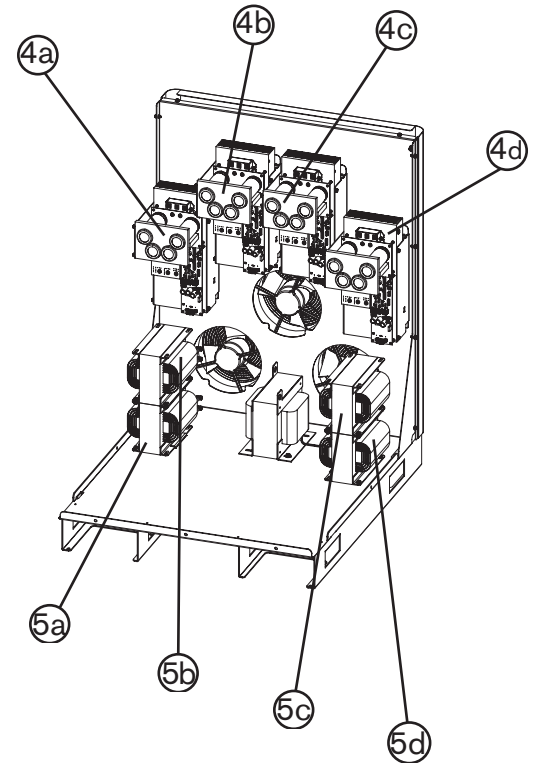
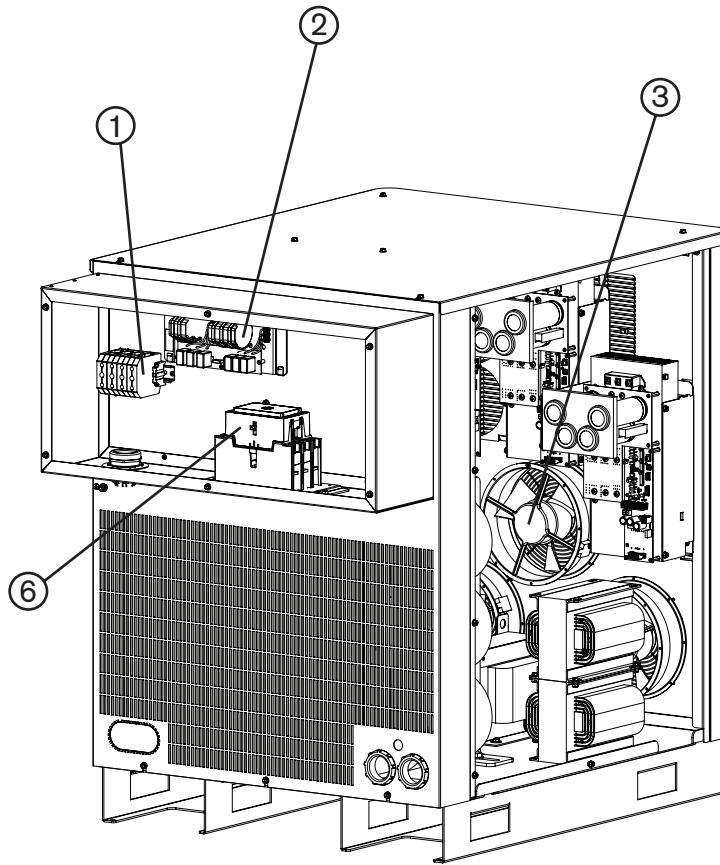
Power supplies		
Without Hypernet	With Hypernet	Voltage (AC)
078523	078570	200/208
078524	078571	220
078525	078572	240
078526	078573	380
078527	078574	400
078528	078575	440
078529	078576	480
078530	078577	600

Note: The Hypernet option is currently used with the ArcGlide® torch height control. See the ArcGlide instruction manual (806450) for more information.



Item	Part Number	Description	Designator	Qty.
1	See table above	Power supply		
2	228363	Panel: Left side, with labels and handles (not shown)		1
3	228362	Panel: Top, with labels		1
4	075241	Sheet metal screws		1
5	228395	Panel: Right side, with labels and handles		1
6	228361	Panel: Front, with labels		1
7	129633	Green power lamp assembly		
8	228604	Kit: Hypernet upgrade (not shown)		1

Power supply



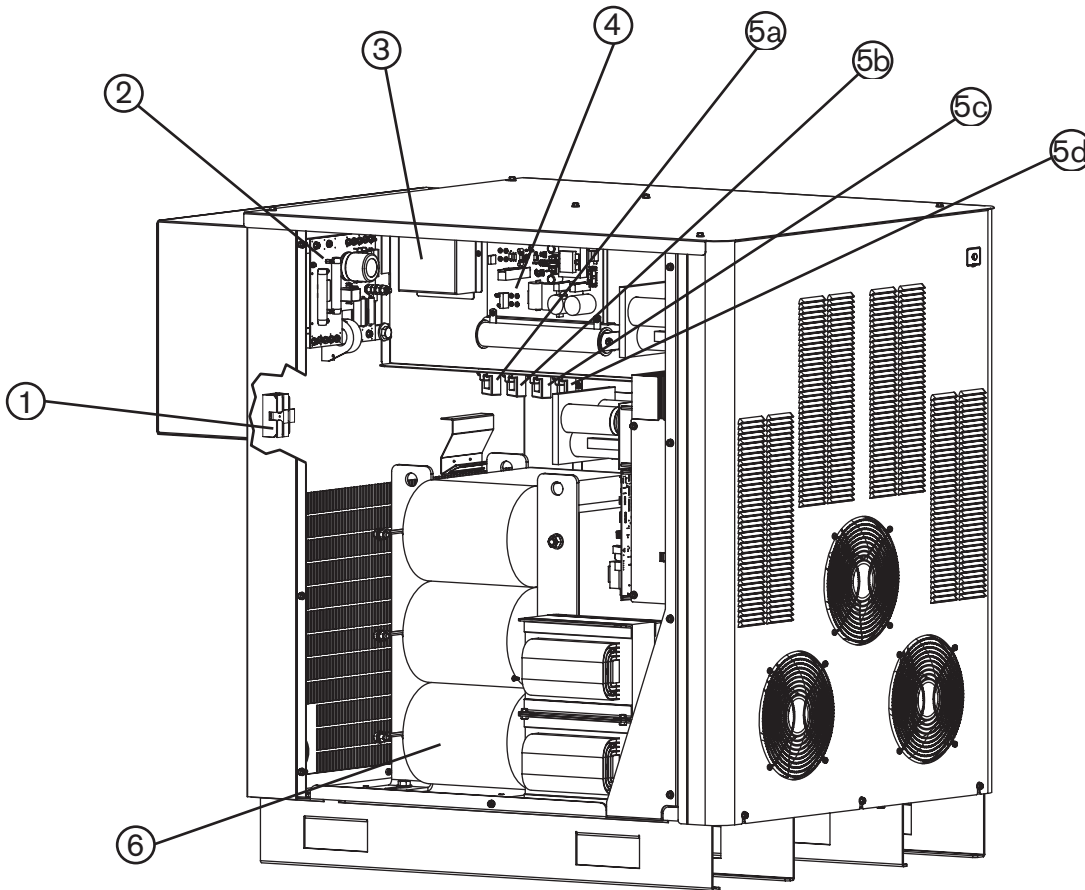
<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	229214*	Terminal block: Input power	TB1	1
	229033**	Terminal block: Input power	TB1	1
2	229195	EMI filter (400 volt power supply only)		1
3	027079	10" fan: 450-550 CFM, 120 VAC 50-60 HZ		3
4a	129792	Chopper assembly	CHA	1
4b	129792	Chopper assembly	CHB	1
4c	129792	Chopper assembly	CHC	1
4d	129792	Chopper assembly	CHD	1
	127039	6" fan: 230 CFM, 115 VAC 50-60 HZ		8
5a	014080	Inductor: 100 amp, 4 mH	L1	1
5b	014080	Inductor: 100 amp, 4 mH	L2	1
5c	014080	Inductor: 100 amp, 4 mH	L3	1
5d	014080	Inductor: 100 amp, 4 mH	L4	1
6	003218*	Contactora	CON1	1
	003233**	Contactorb	CON1	1

\* 200, 220, and 240 volt power supplies

\*\* 380, 400, 440, 480, and 600 volt power supplies

# PARTS LIST

## Power supply



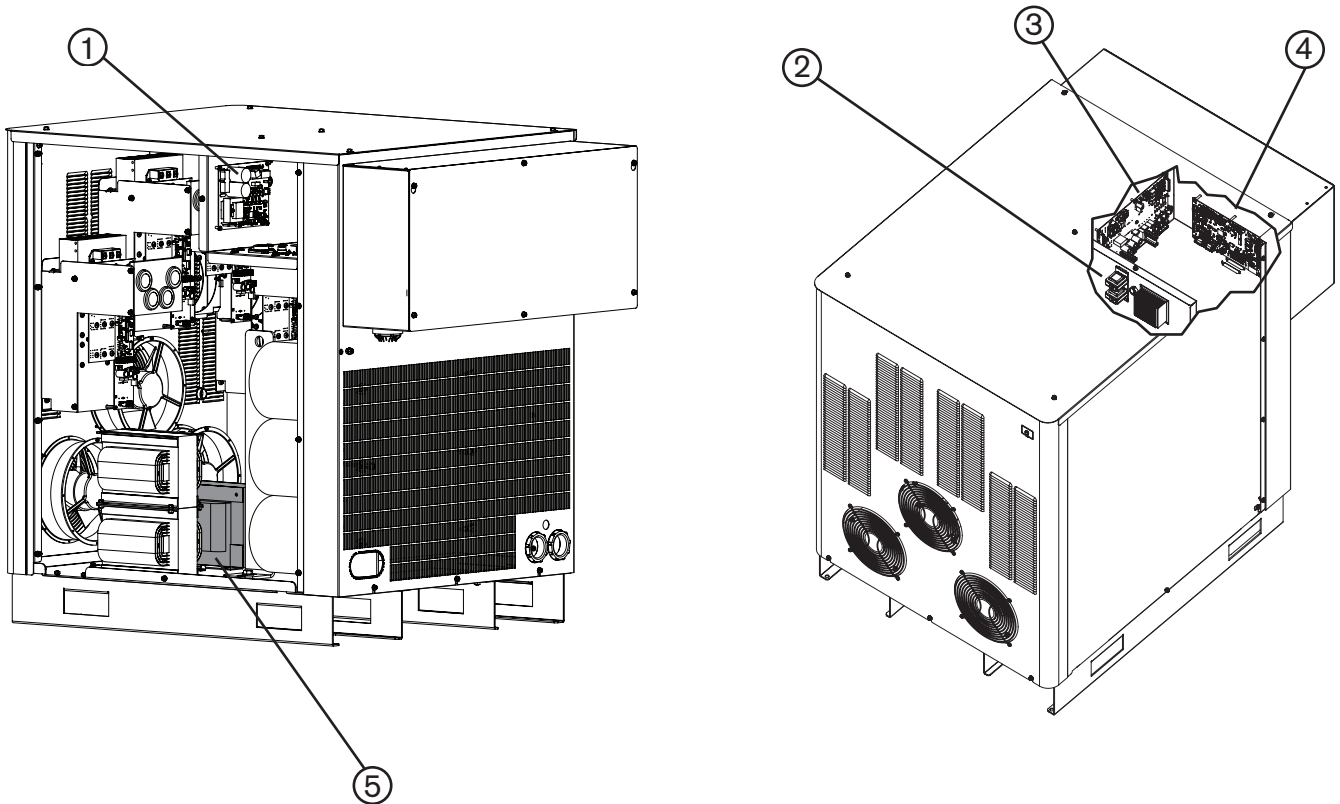
<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	108847*	Fuse: 7.5 amp, 600 volt, high surge	F1, F2	2
	008709**	Fuse: 20 amp, 500 volt, slow blow	F1, F2	2
2	229213	PCB: I/O		1
3	003149***	Relay: Pilot arc, 120 VAC	CR1	1
4	229238	Start circuit assembly	PCB1	1
5a	109004	Current sensor: Hall 100 amp, 4 volt	CS1	1
5b	109004	Current sensor: Hall 100 amp, 4 volt	CS2	1
5c	109004	Current sensor: Hall 100 amp, 4 volt	CS3	1
5d	109004	Current sensor: Hall 100 amp, 4 volt	CS4	1
6	014321	200 volt main transformer: 80KW, 3 ph, 50 HZ	T2	1
	014322	220 volt main transformer: 80KW, 3 ph, 50 HZ		1
	014323	240 volt main transformer: 80KW, 3 ph, 60 HZ		1
	014324	380 volt main transformer: 80KW, 3 ph, 50 HZ		1
	014325	400 volt main transformer: 80KW, 3 ph, 50 HZ		1
	014326	440 volt main transformer: 80KW, 3 ph, 50 HZ		1
	014327	480 volt main transformer: 80KW, 3 ph, 60 HZ		1
	014328	600 volt main transformer: 80KW, 3 ph, 60 HZ		1
	228309	Kit: Thermistor replacement for main transformer		1

\* 200, 220, and 240 volt power supplies

\*\* 380, 400, 440, 480, and 600 volt power supplies

\*\*\* CR1 is located under the cover

**Power supply**

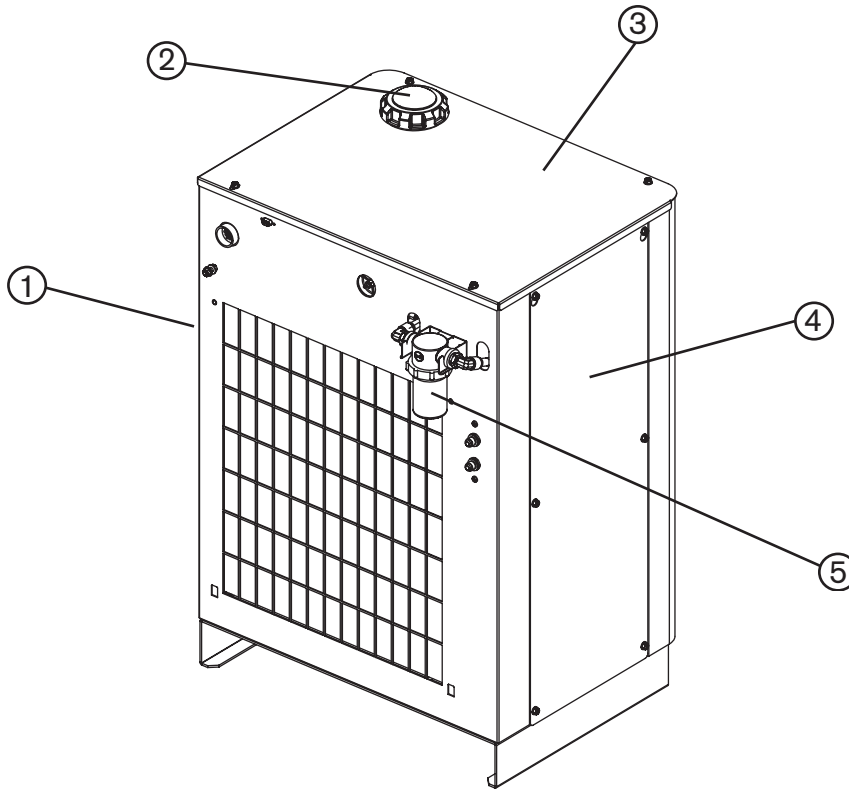


<b>Item</b>	<b>Part Number</b>	<b>Description</b>	<b>Designator</b>	<b>Qty.</b>
1	141027	PCB: Pump motor drive	PCB7	1
2	229212	Inductor: 5 amp, 1.4 mH		2
3	041802	PCB: Power distribution	PCB2	1
	108028	Fuse: 3 amp, 250 volt	F5, F6, F7	3
	108075	Fuse: 6.3 amp, 250 volt (slow-blow)	F1, F2, F3	3
	108709	Fuse: 10 amp, 250 volt	F4	1
4	141030	PCB: Control	PCB3	1
5	229225	Control transformer: 400 volt, 50-60 HZ	T2	1
	229226	Control transformer: 380 volt, 50-60 HZ		1
	229227	Control transformer: 480 volt, 60 HZ		1
	229228	Control transformer: 600 volt, 60 HZ		1
	229230	Control transformer: 240 volt, 60 HZ		1
	229231	Control transformer: 200 and 208 volt, 50-60 HZ		1
	229232	Control transformer: 440 volt, 50-60 HZ		1
	229233	Control transformer: 220 volt, 50-60 HZ		1

# PARTS LIST

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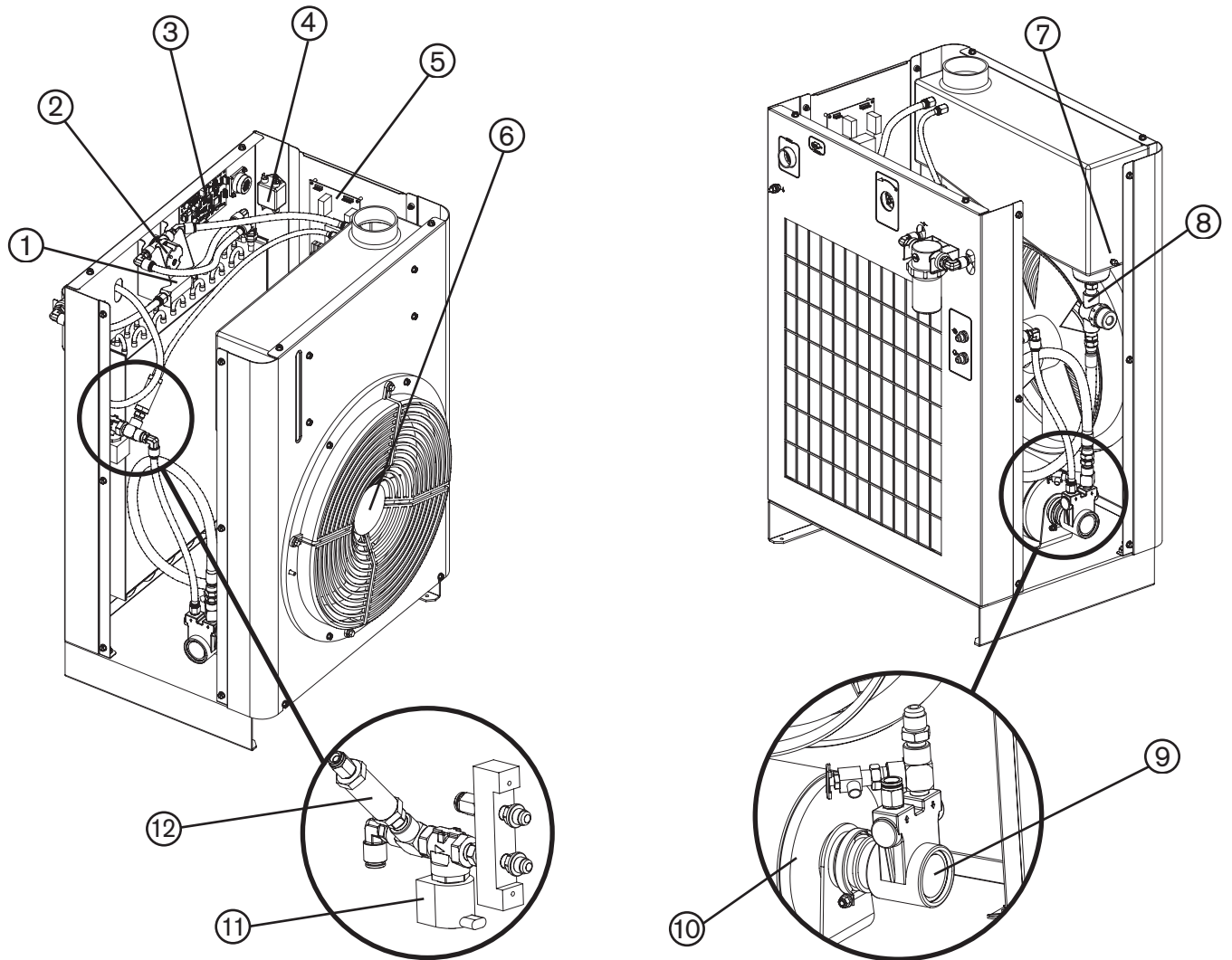
## Cooler



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	<b>078531</b>	<b>Cooler</b>		
1	101022	Panel: Right side		1
2	127014	Filler cap		1
3	228366	Panel: Top, with labels		1
4	110507	Panel: Left side		1
5	027634	Filter housing		1
	027664	Filter element		1



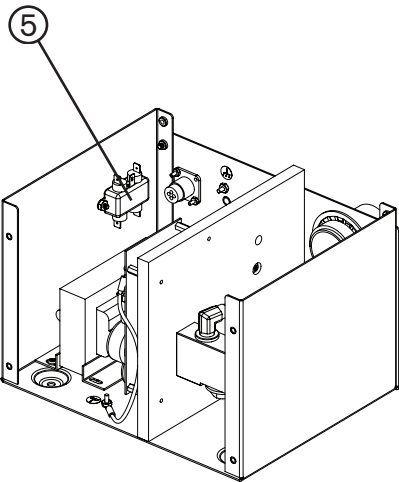
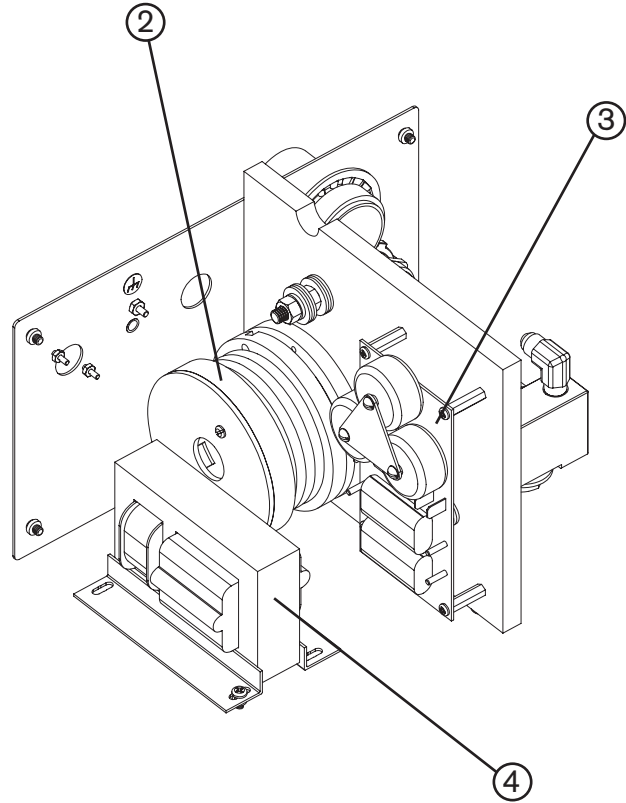
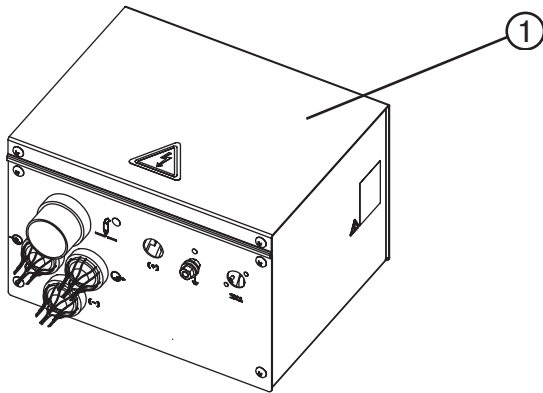
**Cooler**



<b>Item</b>	<b>Part Number</b>	<b>Description</b>	<b>Designator</b>	<b>Qty.</b>
1	006113	Check valve		1
2	229235	Flow sensor: 23 lpm (6 gpm)	FS1	1
3	141033	PCB: Cooler sensor		1
4	009040	EMI filter: 250 VAC, 2 amp, 1 phase		1
5	041897	PCB: Console power distribution		1
	008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
6	027658	Fan: 240 volt, 240 watt, 2910 cfm		1
7	229224	Temperature sensor	TS1	1
8	027926	Filter assembly: 1/2", NPT, low profile		1
9	228171	Kit: Pump with clamp		1
10	228230	Kit: Motor with clamp, 1/3 hp		1
11	229229	Solenoid valve		1
12	006132	Check valve (bypass valve): 1/4" NPT, 200 psi		1

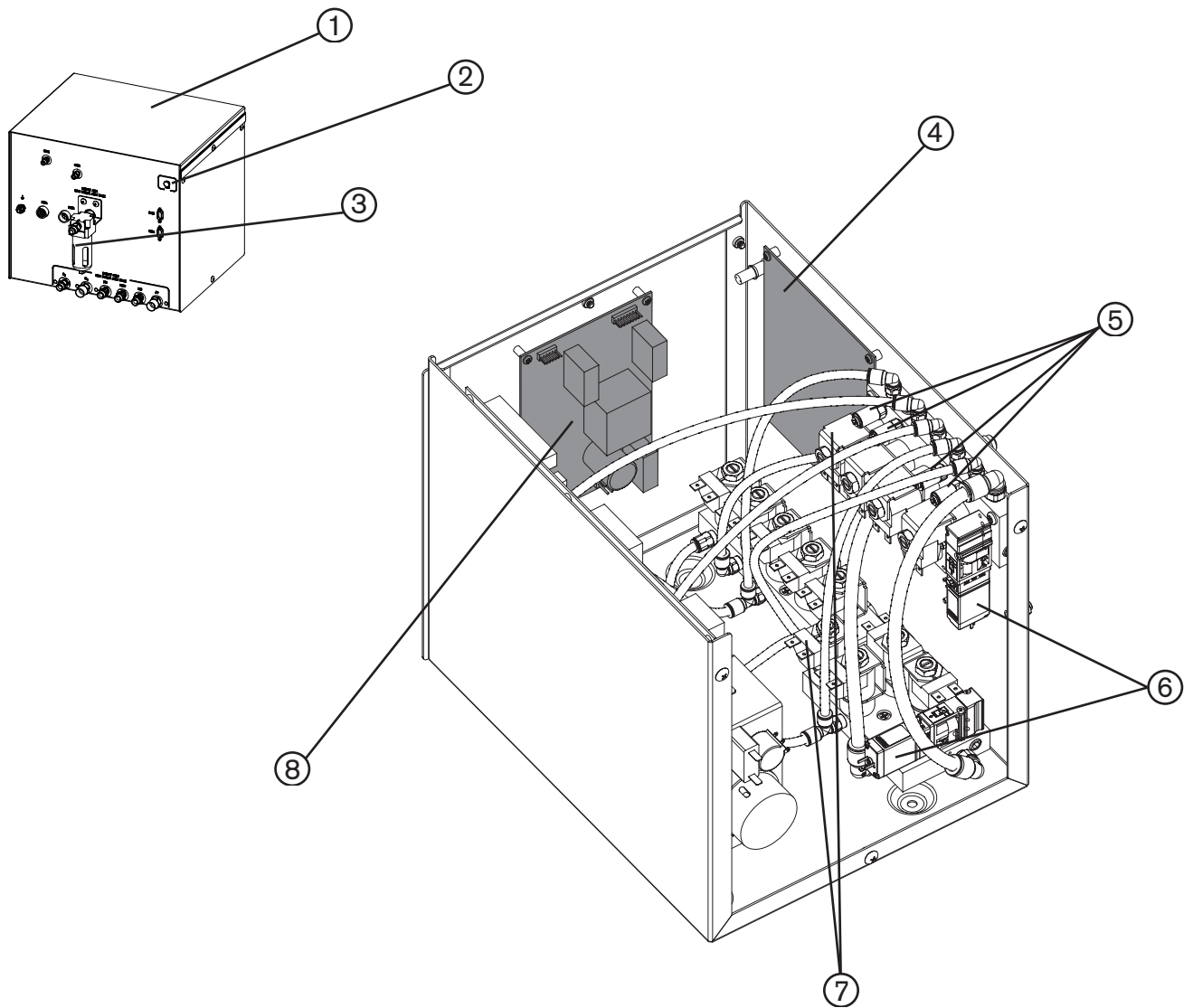
# PARTS LIST

## Ignition console



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	078172	Ignition Console		
2	129831	Coil assembly	T2	1
3	041817	HF/HV Ignition PCB	PCB IGN	1
4	129854	Transformer	T1	1
5	009045	EMI filter		1

Selection console

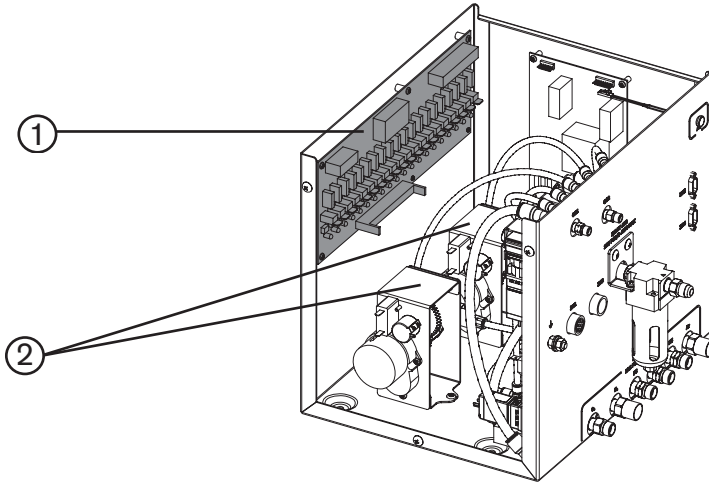


<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	078533	<b>Selection console</b>		
2	129633	Green power lamp		1
3	011109	Filter assembly: Auto drain, 1/4" NPT		1
	011110	Filter element		1
4	228069	Kit: Control PCB	PCB2	1
5	005263	Pressure sensor	P1-P4	4
6	006136	Solenoid valve	SV3 and SV10	2
7	006109	Solenoid valve	SV1, SV2, SV4-SV9, SV11-SV15	13
	006112	Replacement solenoid coil		
8	041897	Power distribution PCB	PCB1	1
	008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1

# PARTS LIST

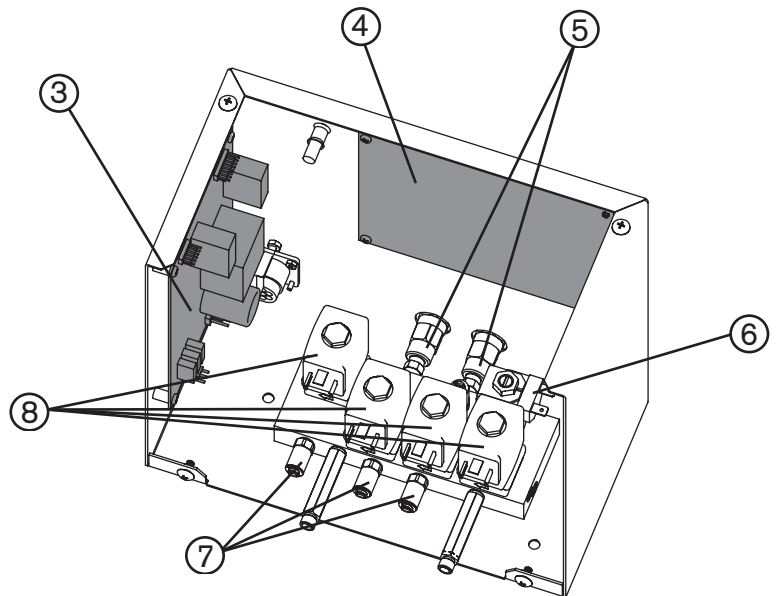
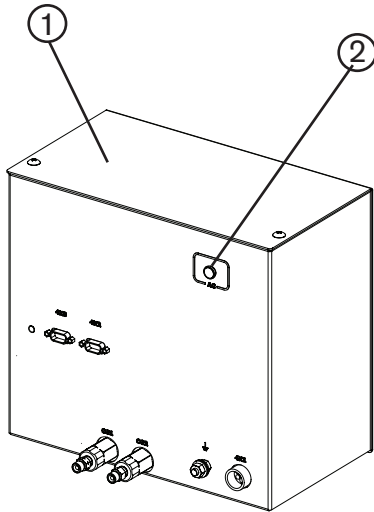
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## Selection console



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	041822	Valve driver PCB	PCB3	1
	008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
2	129999	Motor valve assembly	MV1, MV2	2

**Metering console**



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	<b>078535</b>	<b>Metering console</b>		<b>1</b>
2	129633	Green power lamp		1
3	041897	Power distribution PCB	PCB1	1
	008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
4	228069	Kit: Control PCB	PCB2	1
5	006077	Check valves		2
6	006109	Solenoid valve	SV16	1
	006112	Replacement solenoid coil		
7	005263	Pressure transducer (3 of 4 shown)	P5-P8	4
8	006128*	Proportional valve	B1-B4	4
	228023**	Kit: HPR gas metering manifold upgrade		1

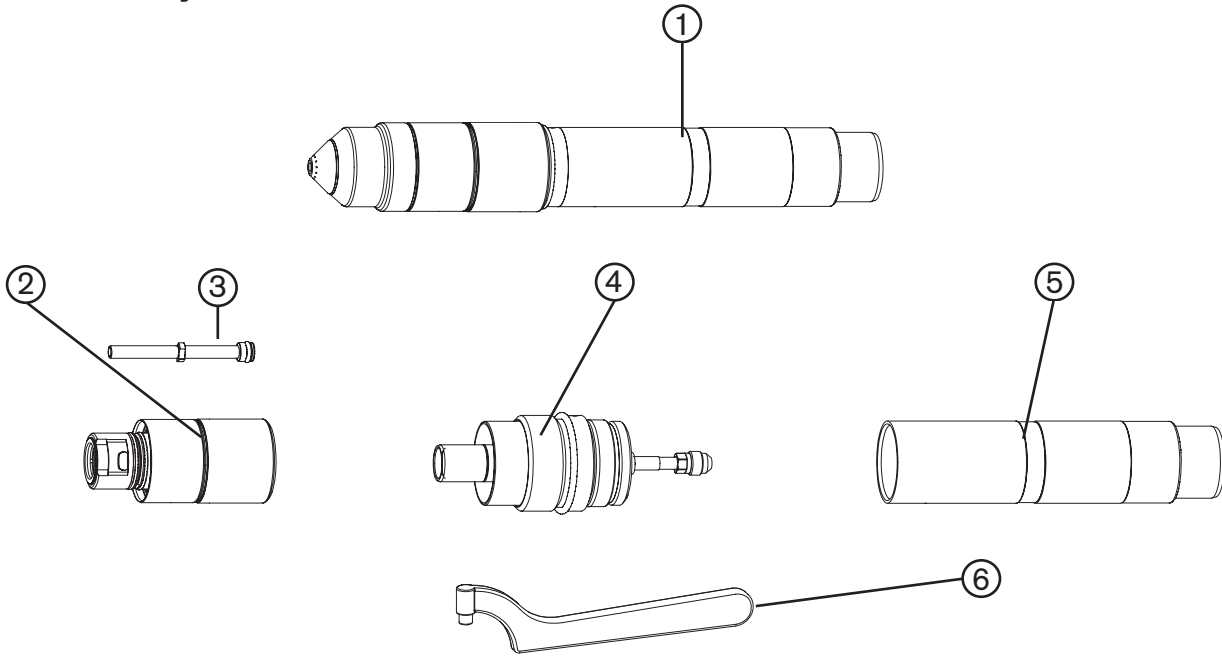
\* Gas consoles with a serial number of 500134 or later take this part number

\*\* Gas consoles with a serial number of 500133 or earlier must order this kit

# PARTS LIST

## HyPerformance torch

### Torch assembly



<u>Item</u>	<u>Part Number</u>	<u>Description</u>
1	228354	<b>HPR400XD machine torch assembly</b>
2	220706	Quick-disconnect torch
3	220571	Water tube
4	220705	Quick-disconnect receptacle
5	220789	Torch mounting sleeve assembly: Standard, 181 mm (7 in)
	220788	Torch mounting sleeve assembly: Short, 114 mm (4.5 in)
	220790	Torch mounting sleeve assembly: Long, 248 mm (9.75 in)
6	104269	2" spanner wrench
	128879	Torch kit: O-rings, water tube and seal
	128880	Quick disconnect kit: O-ring and connector

## Torch leads

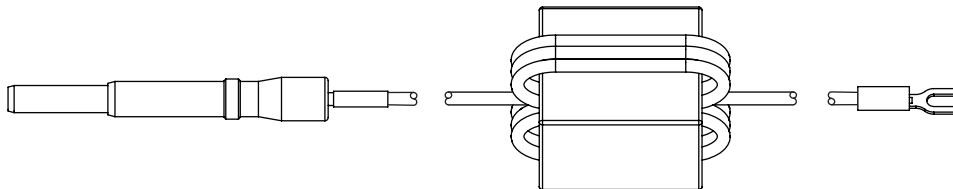


Part no.	Description
228291	2 m (6 ft)
228292	3 m (10 ft)
228293	4.5 m (15 ft)
228294	6 m (20 ft)
228295	7.5 m (25 ft)
228296	10 m (35 ft)
228297	15 m (50 ft)

Note: A 20 m (65 ft) torch lead is not available for HPR400XD systems

## Ohmic contact wire (Not part of the HPR400XD system. Shown for reference only.)

Note: The ohmic contact wire is not part of the HPR260XD system. Shown for reference only



Part no.	Length
123983	3 m (10 ft)
123984	6 m (20 ft)
123985	7.5 m (25 ft)
123986	9 m (30 ft)
123987	12 m (40 ft)
123988	15 m (50 ft)
123989	23 m (75 ft)
123990	30 m (100 ft)
123991	45 m (150 ft)

## PARTS LIST

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### Consumable parts kits

Note: See *Consumable selection* or *Cut charts* in section 4 for specific applications

#### Mild steel parts kit – 228367

<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
026009	O-ring: 0.208" X 0.070"	5
027055	Lubricant: Silicone 1/4-oz tube	1
044028	O-ring: 1.364" X 0.070"	2
104119	Tool: Consumable removal / replacement	1
104269	Wrench: Spanner	1
220747	Shield cap	1
220194	Shield	1
220754	Nozzle retaining cap	1
220193	Nozzle	2
220180	Swirl ring	1
220192	Electrode	2
220555	Shield	1
220554	Nozzle	2
220553	Swirl ring	1
220552	Electrode	2
220189	Shield	1
220756	Nozzle retaining cap	1
220188	Nozzle	2
220179	Swirl ring	1
220187	Electrode	2
220183	Shield	2
220182	Nozzle	3
220181	Electrode	2
220665	SilverPlus electrode	1
220340	Water tube with o-ring	1
220637	Shield cap	1
220761	Shield	2
220757	Nozzle retaining cap	1
220354	Nozzle	3
220353	Swirl ring	1
220352	Electrode	2
220666	SilverPlus electrode	1
220764	Shield	2
220760	Nozzle retaining cap	1
220439	Nozzle	3
220436	Swirl ring	1
220435	Electrode	2
220668	SilverPlus electrode	1
220636	Shield	2
220635	Nozzle retaining cap	1
220632	Nozzle	3
220631	Swirl ring	1
220629	Electrode	3
220571	Water tube with o-ring	1

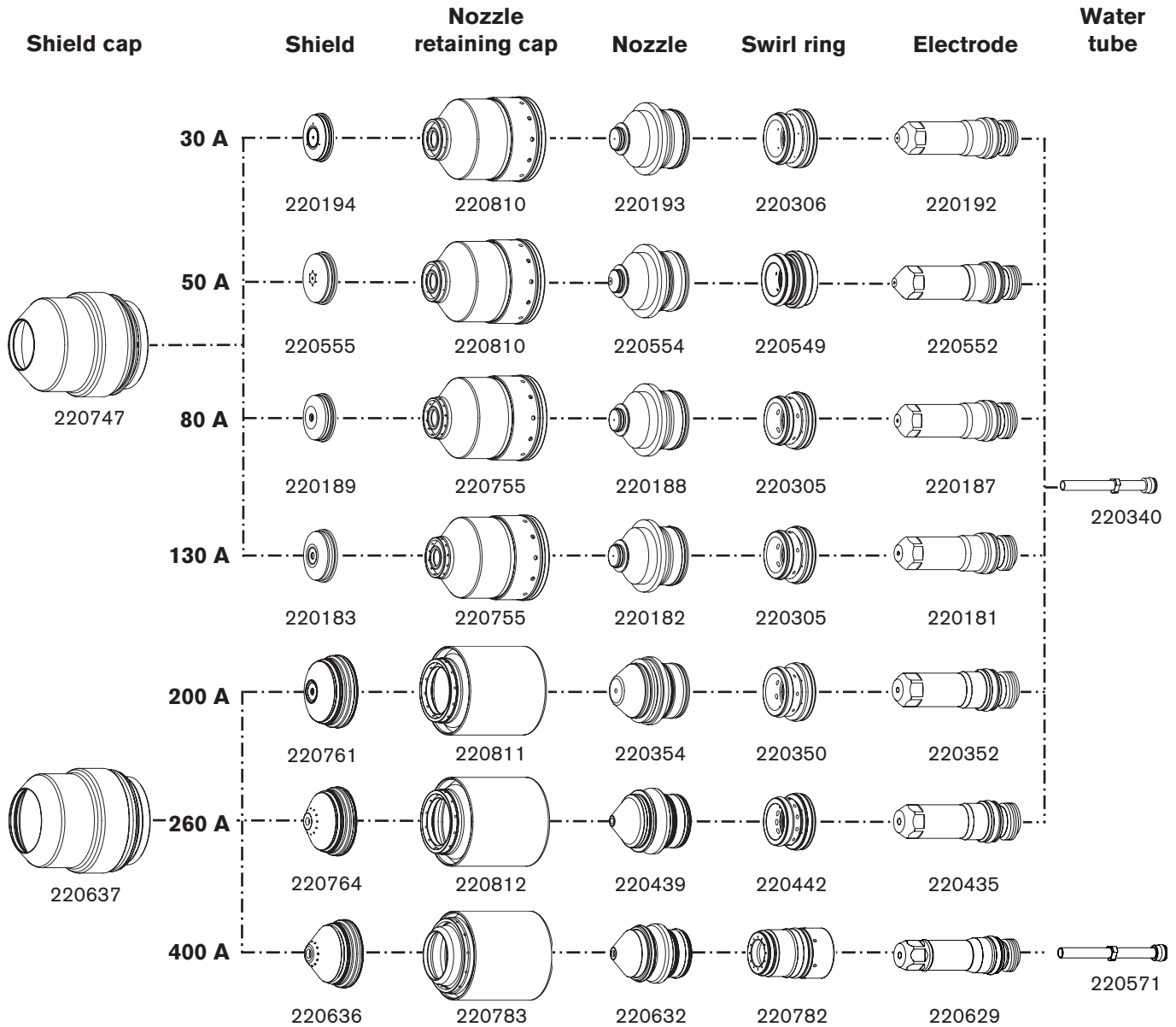


**Stainless steel and aluminum parts kit – 228368**

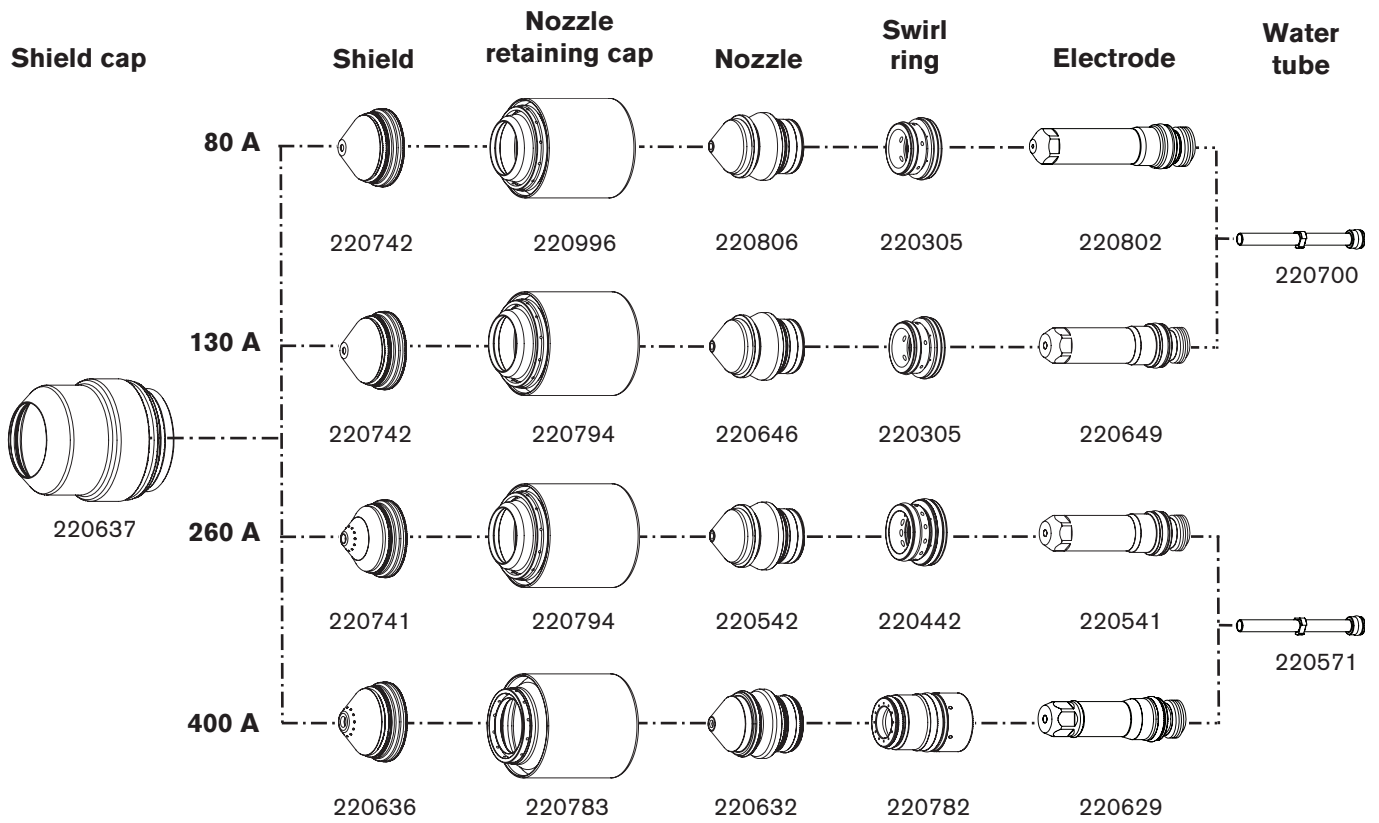
<b><u>Part Number</u></b>	<b><u>Description</u></b>	<b><u>Qty.</u></b>
026009	O-ring: 0.208" X 0.070"	5
027055	Lubricant: Silicone 1/4-oz tube	1
044028	O-ring: 1.364" X 0.070"	2
104119	Tool: Consumable removal / replacement	1
104269	Wrench: Spanner	1
220747	Shield cap	1
220202	Shield	1
220755	Nozzle retaining cap	1
220201	Nozzle	2
220180	Swirl ring	1
220308	Electrode	2
220338	Shield	1
220337	Nozzle	2
220179	Swirl ring	1
220339	Electrode	2
220340	Water tube with o-ring	1
220198	Shield	1
220756	Nozzle retaining cap	1
220197	Nozzle	2
220307	Electrode	4
220637	Shield cap	1
220762	Shield	1
220758	Nozzle retaining cap	1
220343	Nozzle	2
220342	Swirl ring	1
220763	Shield	1
220406	Nozzle	2
220405	Swirl ring	1
220707	Shield	2
220712	Nozzle retaining cap	1
220708	Nozzle	3
220709	Electrode	3
220571	Water tube with o-ring	1
220759	Nozzle retaining cap	1
220346	Nozzle	1
220181	Electrode	1

**Consumables for mirror-image cutting**

**Mild steel (straight cutting)**



**Mild steel (bevel cutting)**



## PARTS LIST

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### Recommended spare parts

#### Power supply

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
129633	Green power lamp assembly		1
129792	Chopper assembly	CH1, CH2, CH3, CH4	1
127039	6" fan: 230 CFM, 115 VAC 50-60 HZ		1
027079	10" fan: 450-550 CFM, 120 VAC 50-60 HZ		1
003149	Relay: Pilot arc, 120 VAC	CR1	1
229213	PCB: I/O		1
003232*	Contactactor	CON1	1
003228**	Contactactor	CON1	1
109004	Current sensor: Hall 100 amp, 4 volt	CS1, CS2, CS3, CS4	1
229238	Start circuit assembly	PCB1	1
008551	Fuse: 7.5 amp, 600 volt	F1, F2	2
141030	PCB: Control	PCB3	1
041802	PCB: Power distribution	PCB2	1
108028	Fuse: 3 amp, 250 volt	F5, F6, F7	3
108075	Fuse: 6.3 amp, 250 volt (slow-blow)	F1, F2, F3	3
108709	Fuse: 10 amp, 250 volt	F4	1
228171	Kit: Pump with clamp		1
228230	Kit: Motor with clamp		1
141027	PCB: Pump motor drive	PCB7	1

\* 200/208, 220 and 240 volt power supplies

\*\* 380, 400, 440, 480 and 600 volt power supplies

#### Cooler

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
041897	PCB: Console power distribution		1
008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
027634	Filter housing (on the rear panel of the cooler)		1
027664	Filter element		1
027926	Filter housing (under the coolant tank)		1
229235	Flow sensor	FS1	1
006113	Check valve: 3/8" FPT		1
229229	Solenoid valve		1
141033	PCB: Cooler sensor		1

#### Ignition console

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
041817	HFHV Ignition PCB		1
129854	Transformer	T1	1

**Selection and metering consoles**

<b><u>Part Number</u></b>	<b><u>Description</u></b>	<b><u>Designator</u></b>	<b><u>Qty.</u></b>
228069	Kit: Control PCB	PCB2	1
041897	Power distribution PCB	PCB1	1
008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
041822	Valve driver PCB	PCB3	1
008756	Fuse: 5 amp, 250 volt (slow-blow)	F1	1
006136	Solenoid valve	SV3 and SV10	2
006109	Solenoid valve	SV1, SV2, SV4-SV9, SV11-SV15	13
005263	Pressure sensor		1
011109	Air filter housing (on the rear panel of the selection console)		1
011110	Air filter element		1

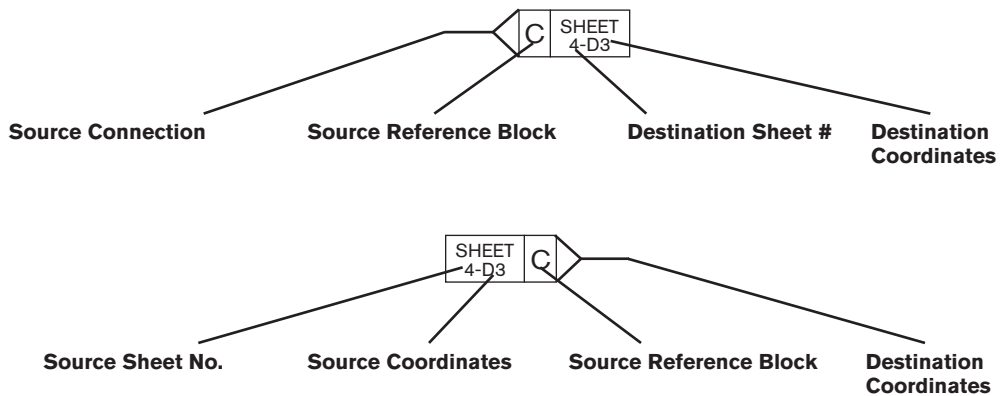


WIRING DIAGRAMS

**Introduction**

This section contains the wiring diagrams for the 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:









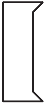


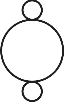

























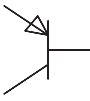


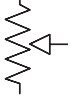



**Destination** and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).






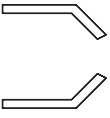




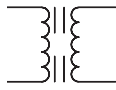
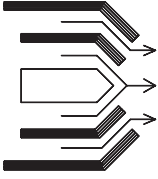

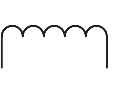
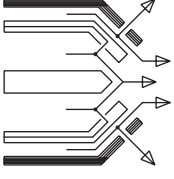








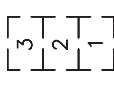



**Wiring diagram symbols**

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

# WIRING DIAGRAMS

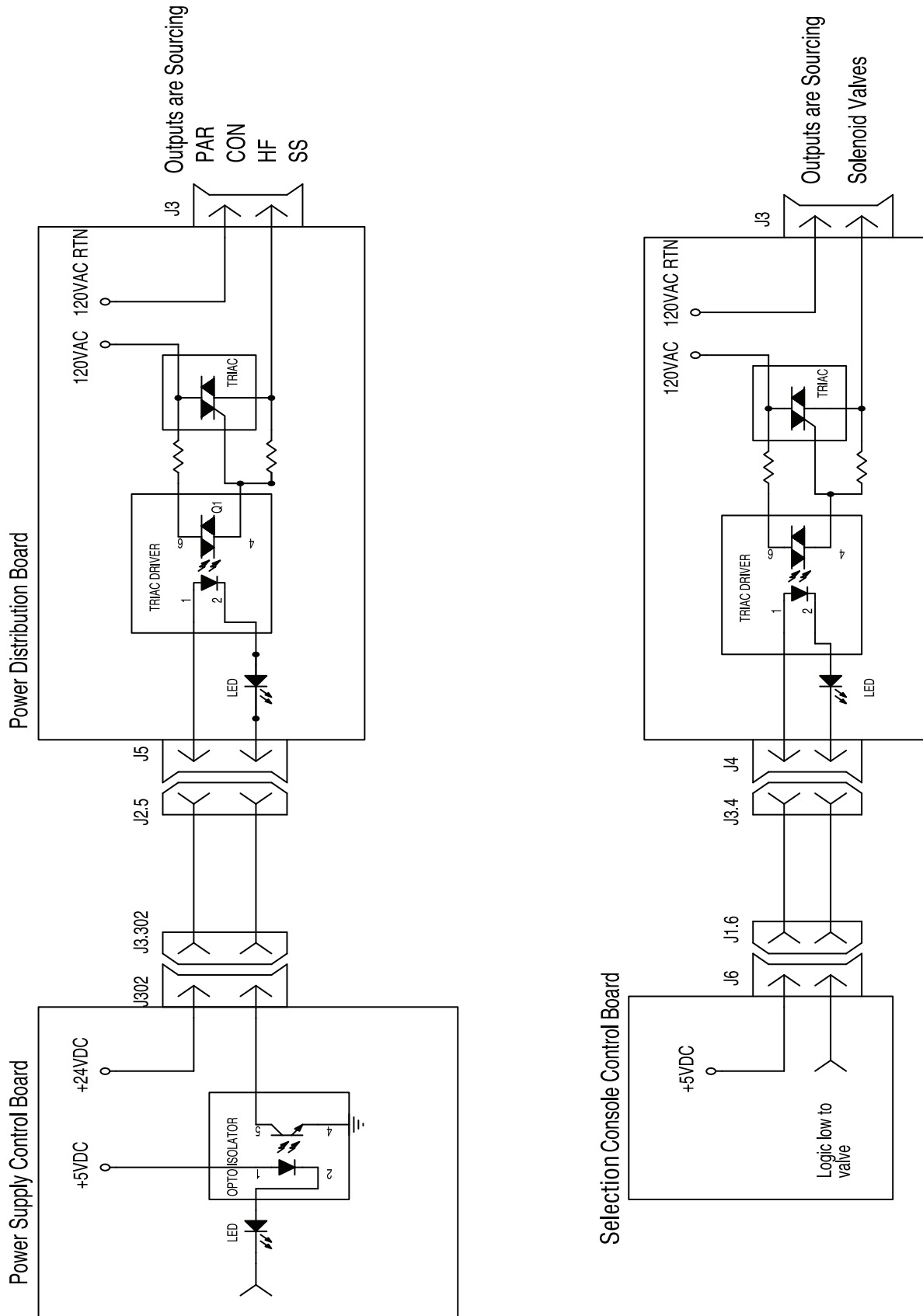
	<b>Battery</b>		<b>Fuse</b>		<b>Push Button, Normally Closed</b>
	<b>Cap, polarized</b>		<b>Ground Clamp</b>		<b>Push Button, Normally Open</b>
	<b>Cap, non-polarized</b>		<b>Ground, Chassis</b>		<b>Receptacle</b>
	<b>Cap, feed-thru</b>		<b>Ground, Earth</b>		<b>Relay, Coil</b>
	<b>Circuit breaker</b>		<b>IGBT</b>		<b>Relay, Normally Closed</b>
	<b>Coax shield</b>		<b>Inductor</b>		<b>Relay, Normally Open</b>
	<b>Current Sensor</b>		<b>LED</b>		<b>Relay, Solid State, AC</b>
	<b>Current sensor</b>		<b>Lamp</b>		<b>Relay, Solid State, DC</b>
	<b>DC supply</b>		<b>MOV</b>		<b>Relay, Solid State, Dry</b>
	<b>Diode</b>		<b>Pin</b>		<b>Resistor</b>
	<b>Door interlock</b>		<b>Socket</b>		<b>SCR</b>
	<b>Fan</b>		<b>Plug</b>		<b>Shield</b>
	<b>Feedthru LC</b>		<b>PNP Transistor</b>		<b>Shunt</b>
	<b>Filter, AC</b>		<b>Potentiometer</b>		<b>Spark Gap</b>



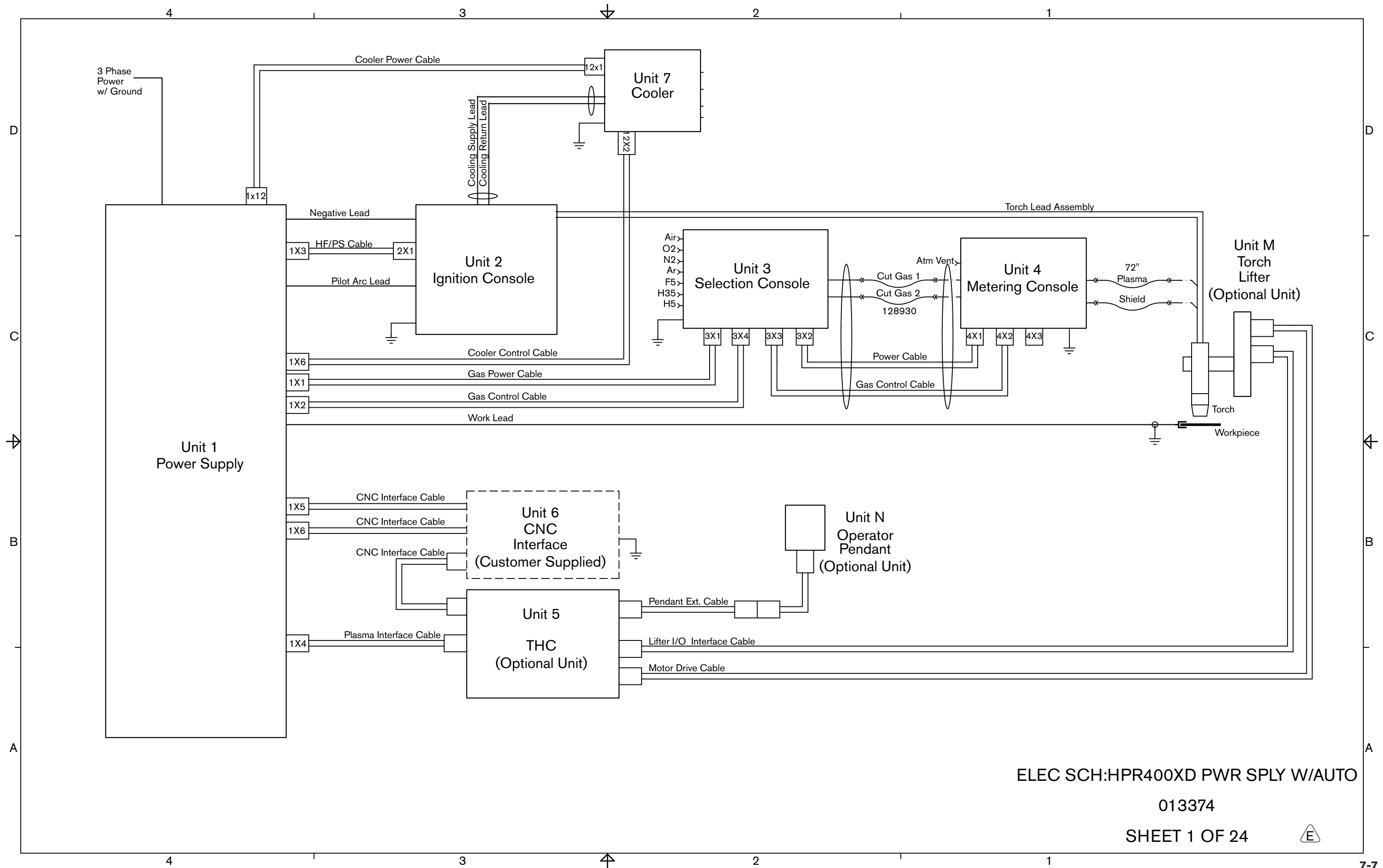
	<b>Switch, Flow</b>		<b>Time Delay Open, NC/On</b>		<b>Electrode</b>
	<b>Switch, Level, Normally Closed</b>		<b>Time Delay Closed, NO/Off</b>		<b>Nozzle</b>
	<b>Switch, Pressure, Normally Closed</b>		<b>Transformer</b>		<b>Shield</b>
	<b>Switch, Pressure, Normally Open</b>		<b>Transformer, Air Core</b>		<b>Torch</b>
	<b>Switch, 1 Pole, 1 Throw</b>		<b>Transformer Coil</b>		<b>Torch, HyDefinition™</b>
	<b>Switch, 1 Pole, 2 Throw</b>		<b>Triac</b>		
	<b>Switch, 1 Pole, 1 Throw, Center Off</b>		<b>VAC Source</b>		
	<b>Switch, Temperature, Normally Closed</b>		<b>Valve, Solenoid</b>		
	<b>Switch, Temperature, Normally Open</b>		<b>Voltage Source</b>		
	<b>Terminal Block</b>		<b>Zener Diode</b>		
	<b>Time Delay Closed, NC/Off</b>				
	<b>Time Delay Open, NO/Off</b>				



# Discrete output functionality





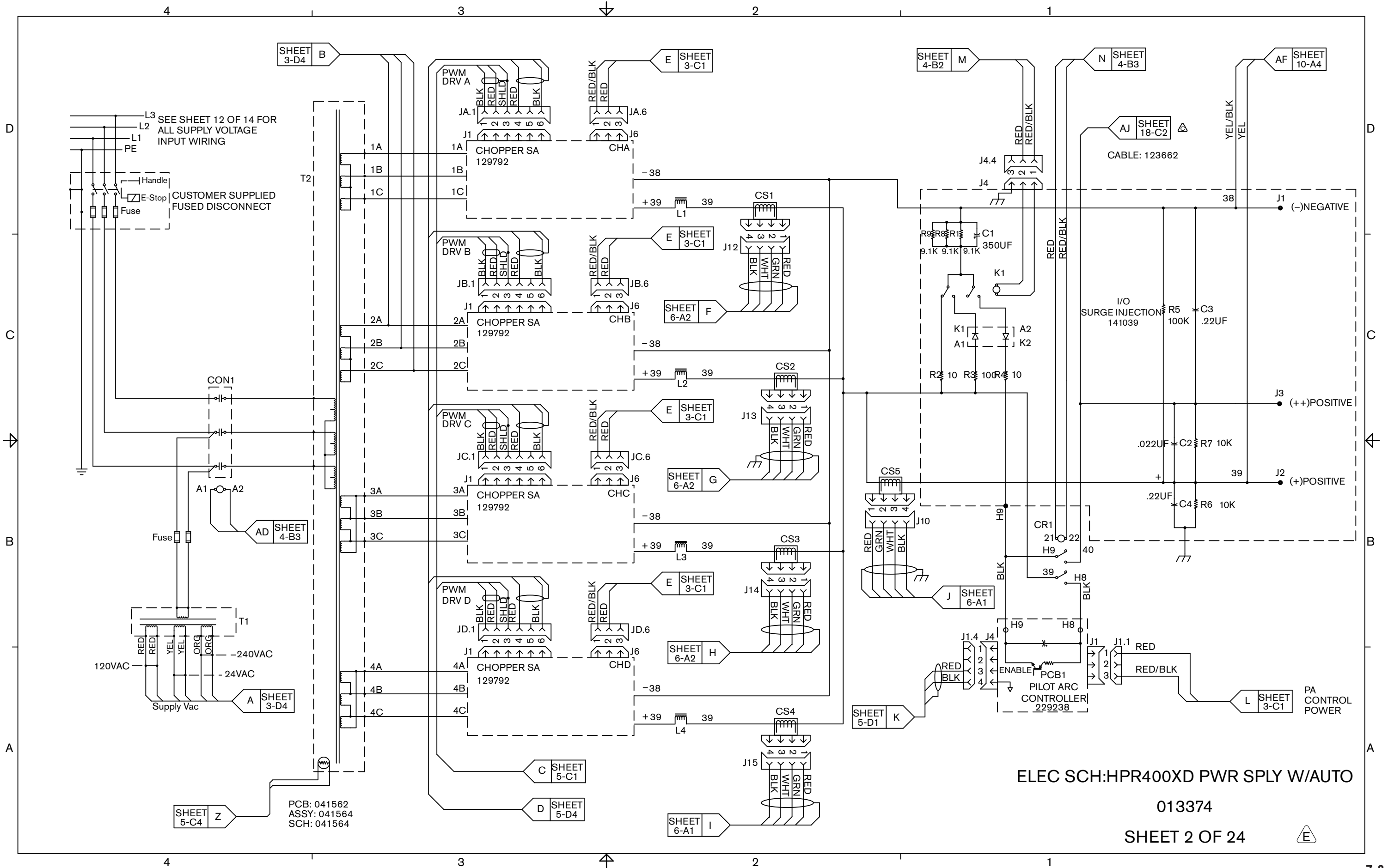


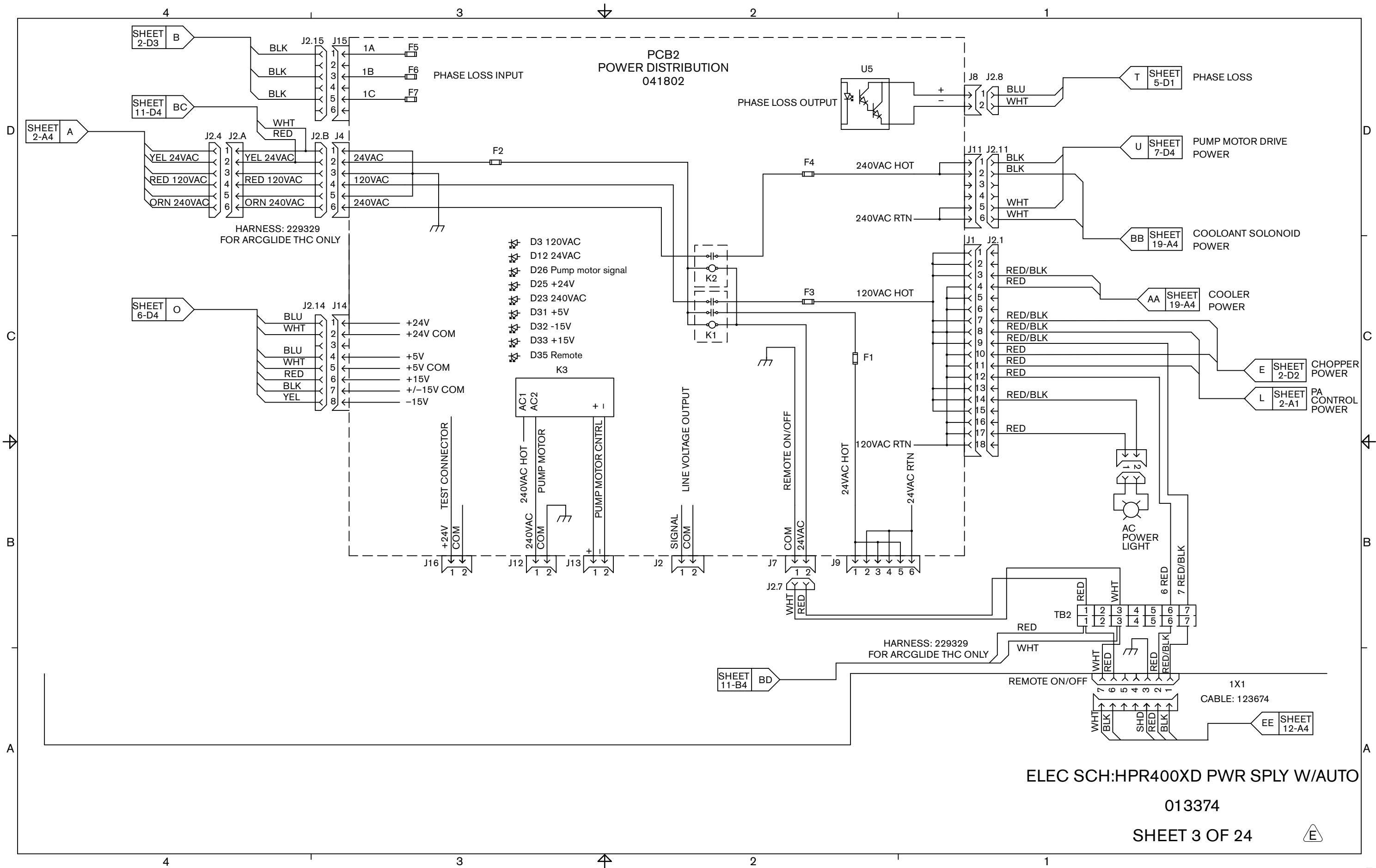
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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SHEET 1 OF 24







ELEC SCH:HPR400XD PWR SPLY W/AUTO

013374

SHEET 3 OF 24



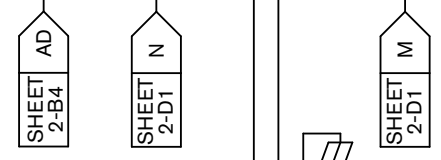
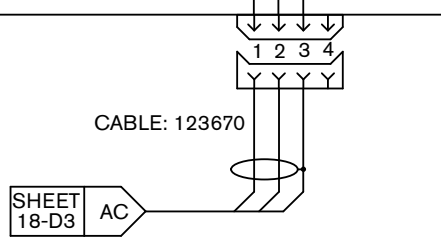
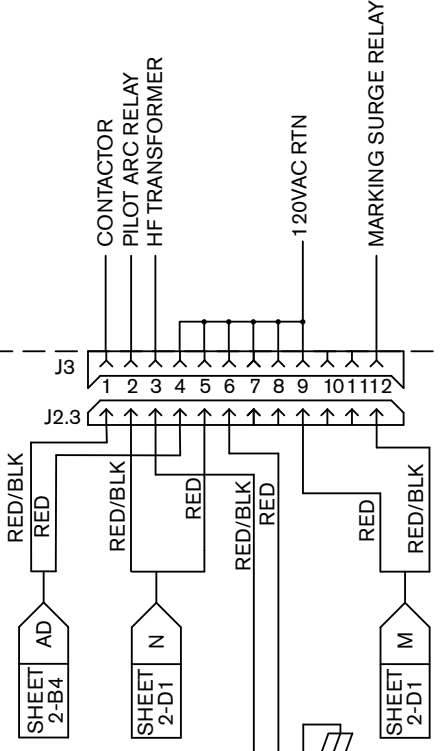
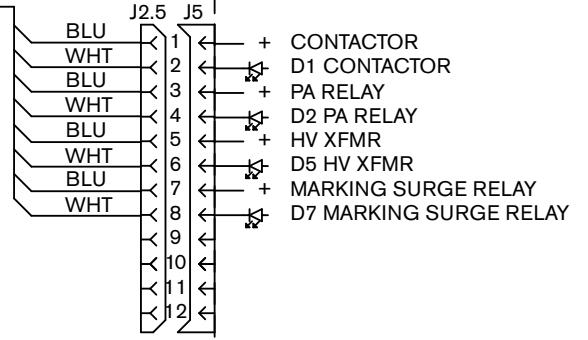
4 3 2 1

D  
C  
B  
A

D  
C  
B  
A

PCB2  
POWER DISTRIBUTION  
041802

SHEET 5-D1 Y



ELEC SCH:HPR400XD PWR SPLY W/AUTO

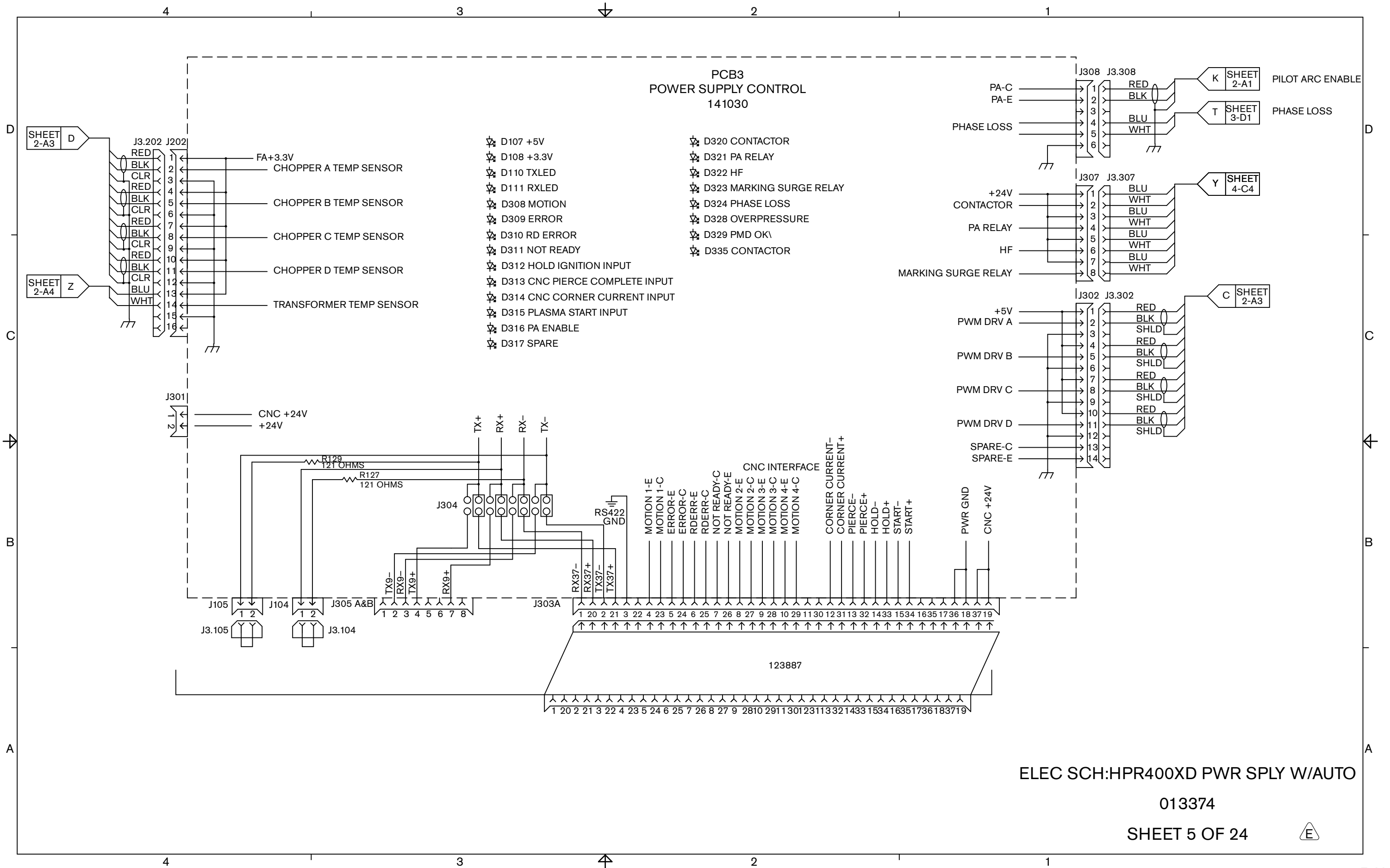
013374

SHEET 4 OF 24



4 3 2 1



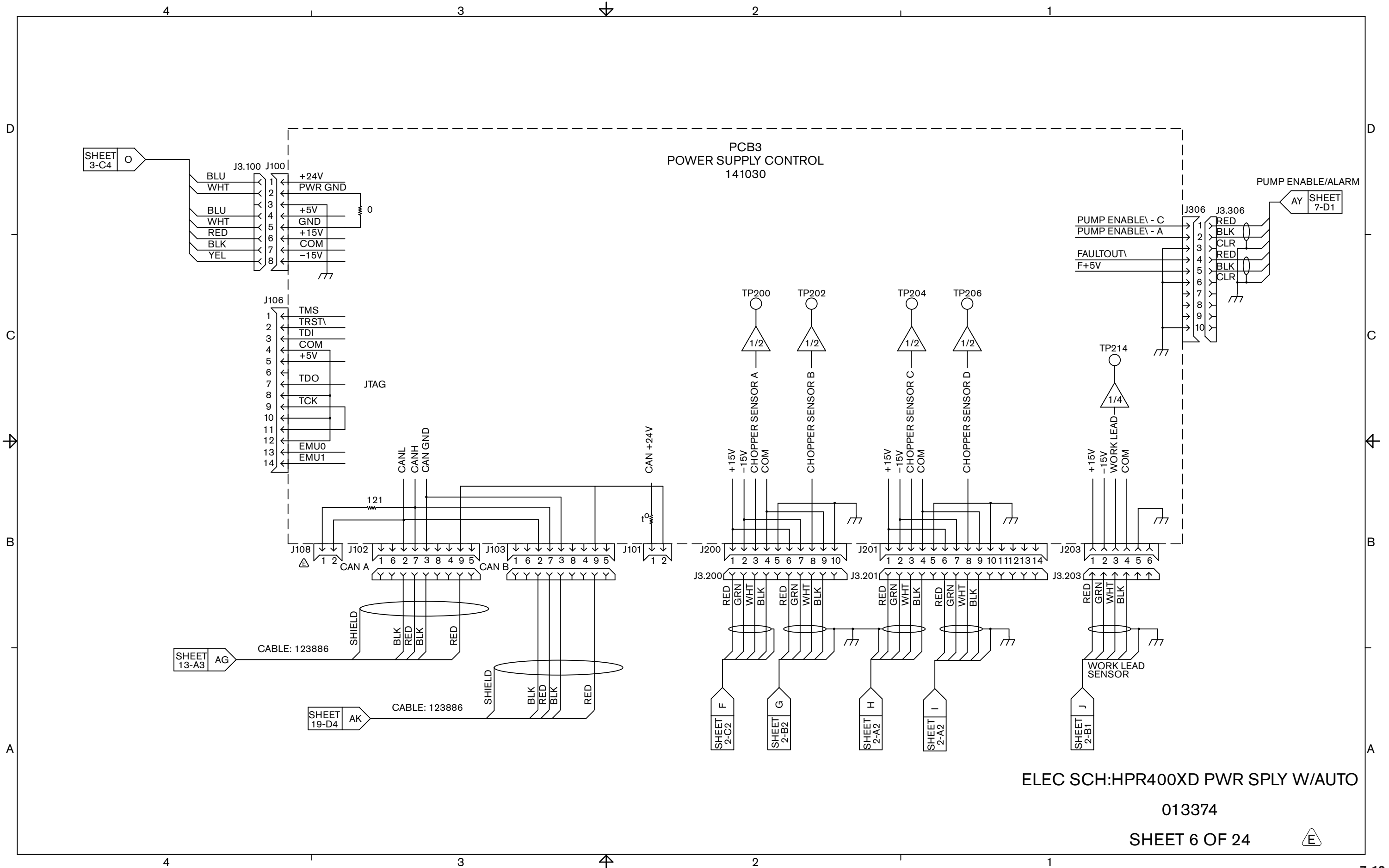


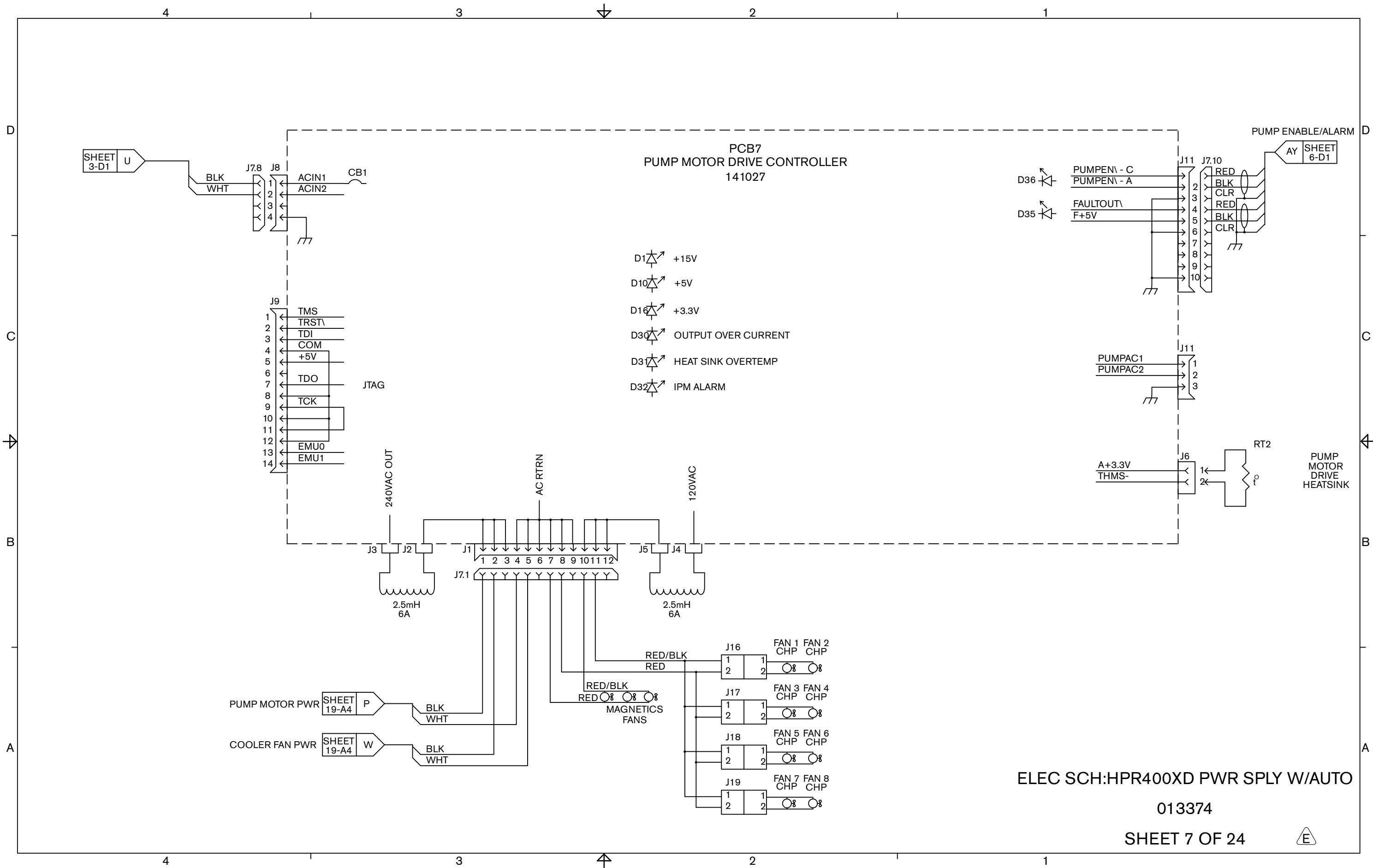
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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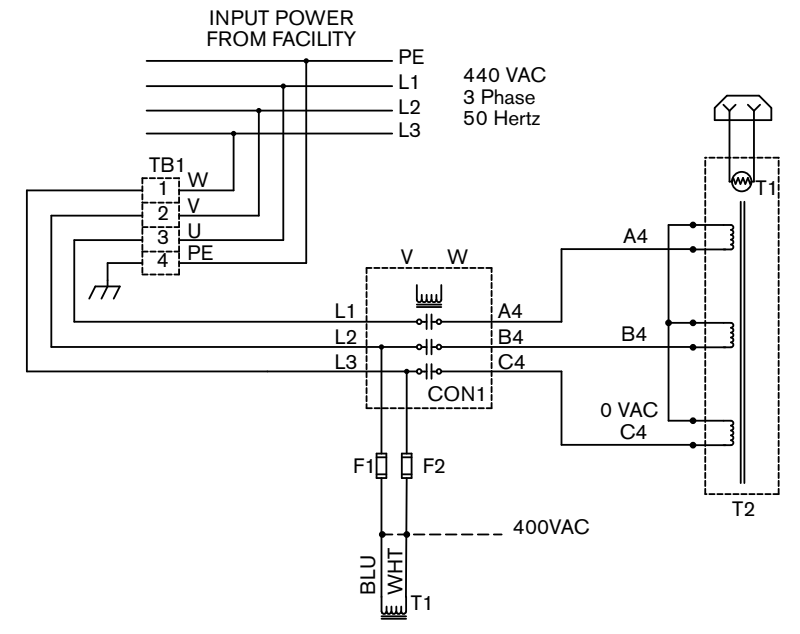




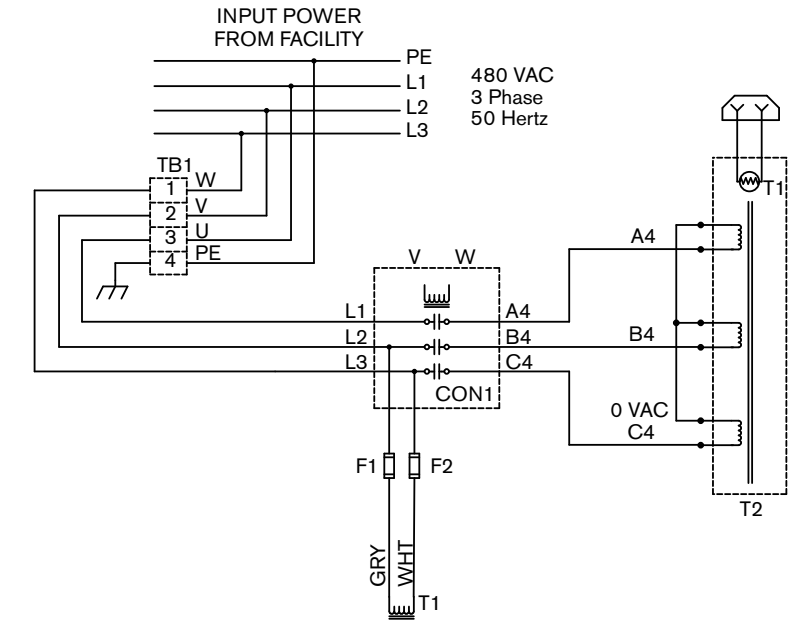


4 3 2 1

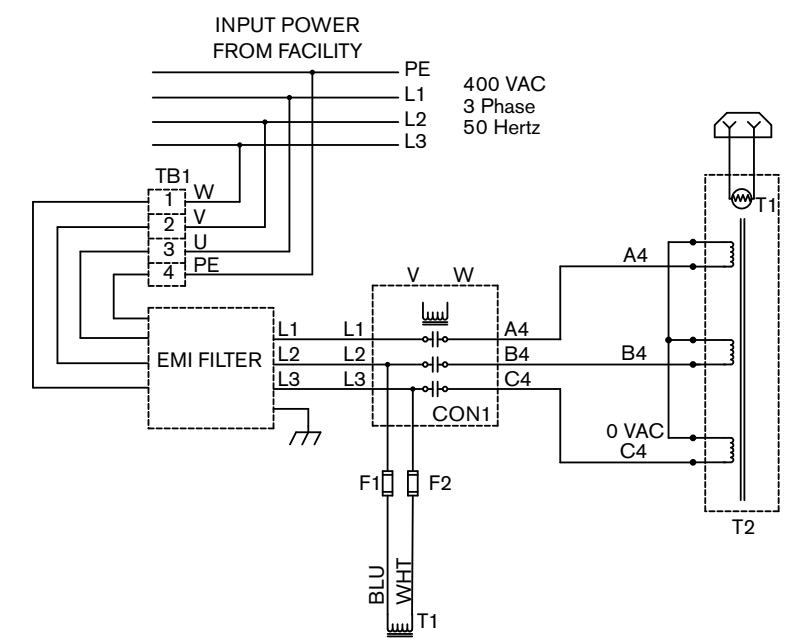
440/50



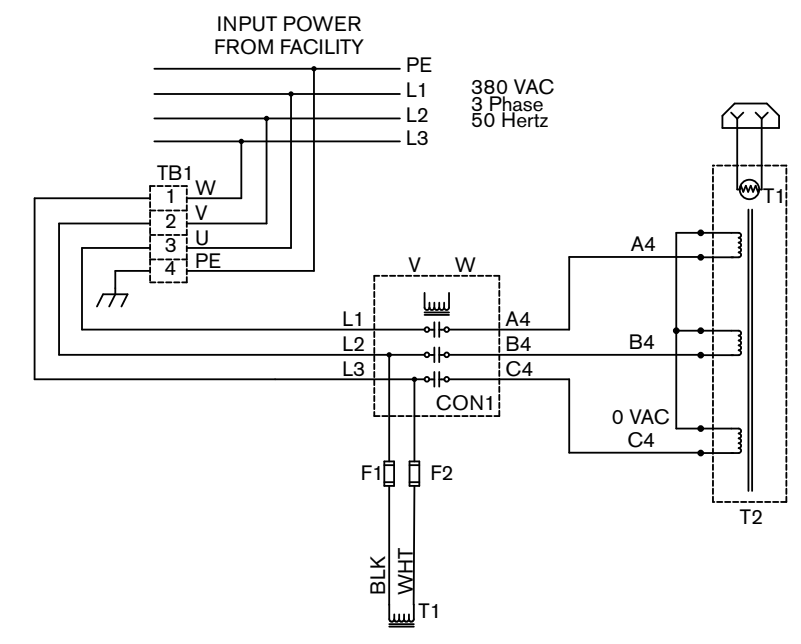
480/60



400/50 CE



380/50



ELEC SCH:HPR400XD PWR SPLY W/AUTO

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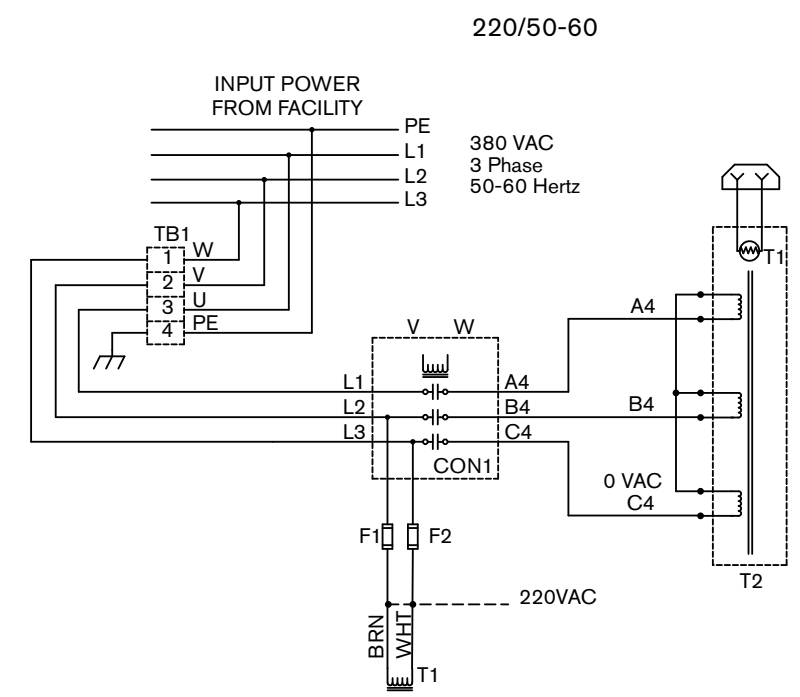
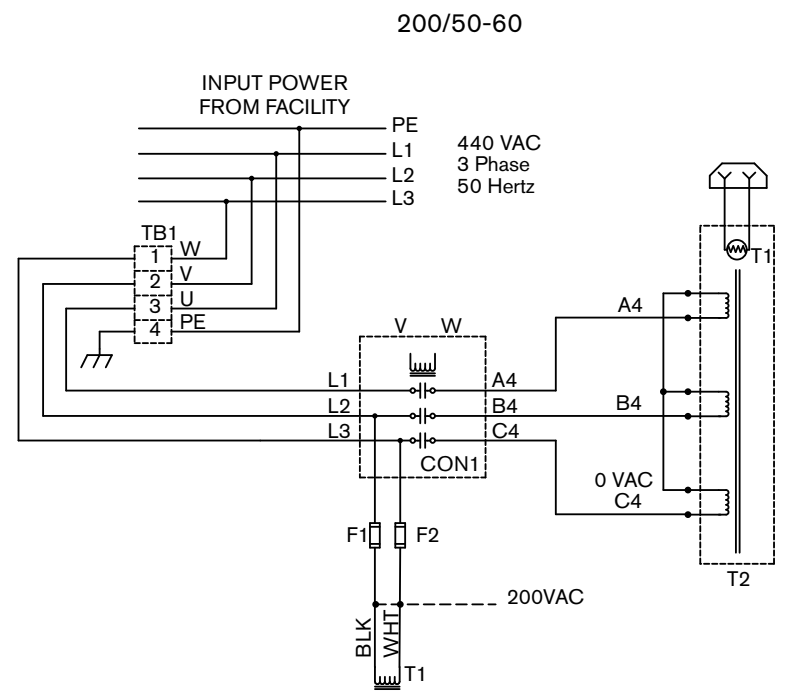
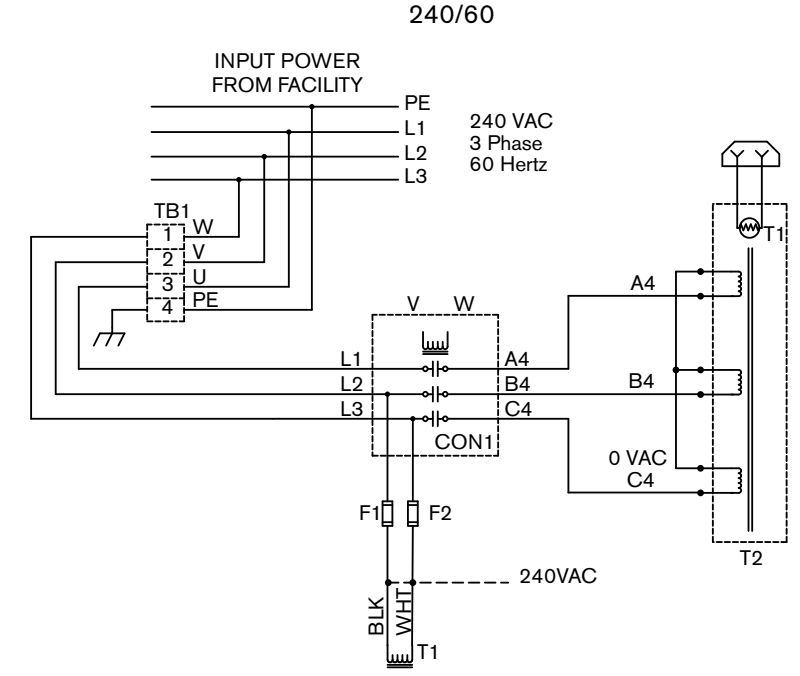
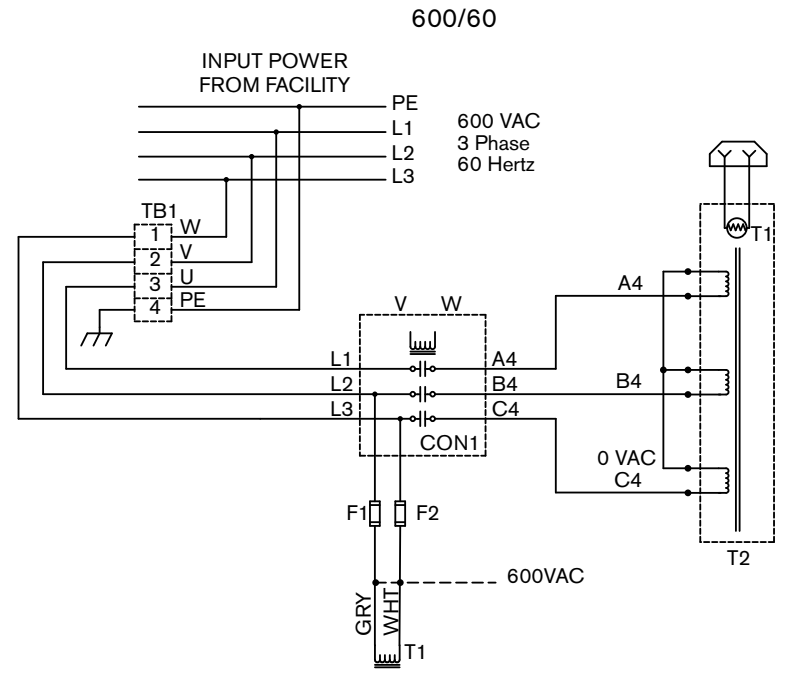


D  
C  
B  
A

D  
C  
B  
A

4 3 2 1

4 3 2 1



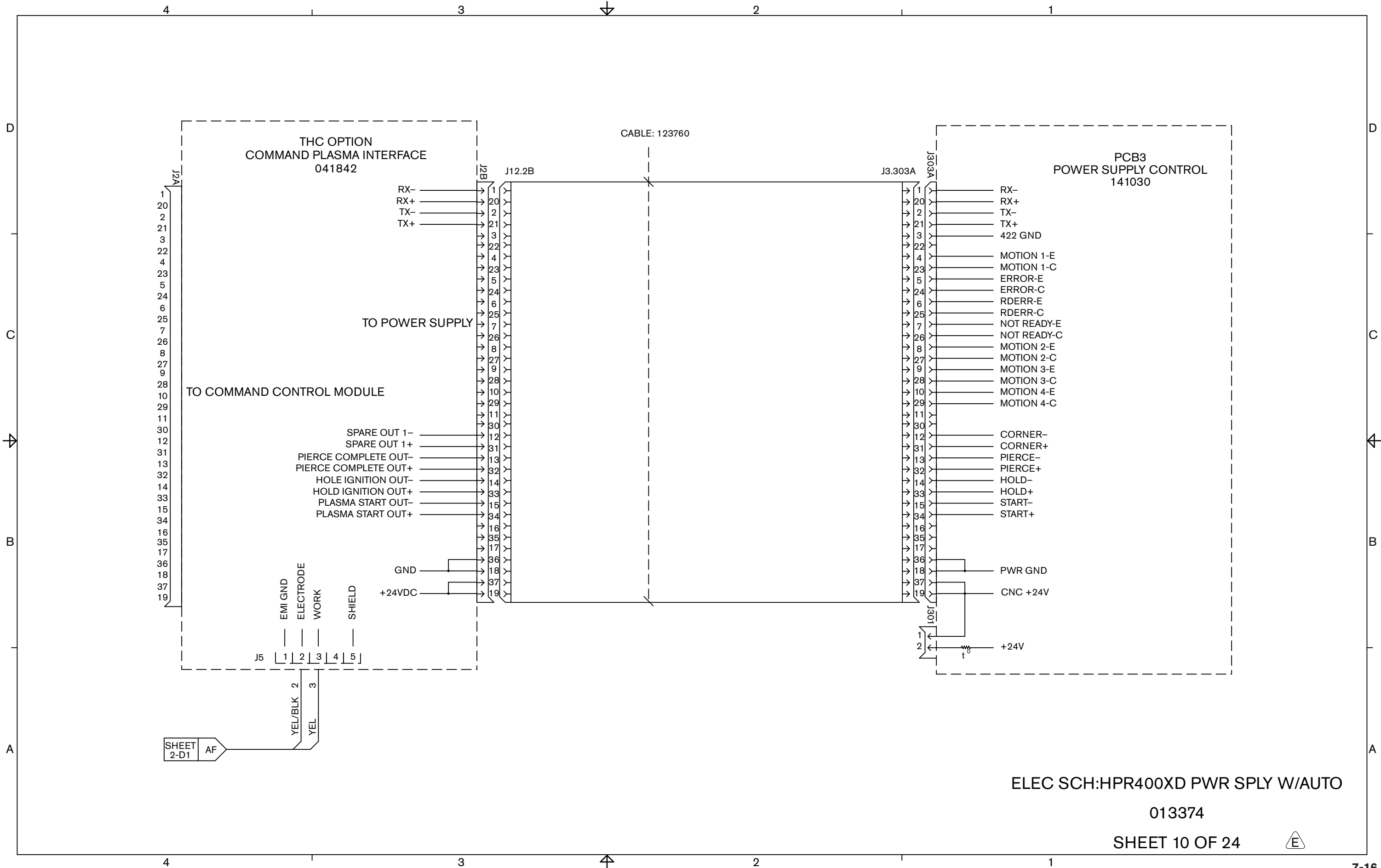
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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4 3 2 1

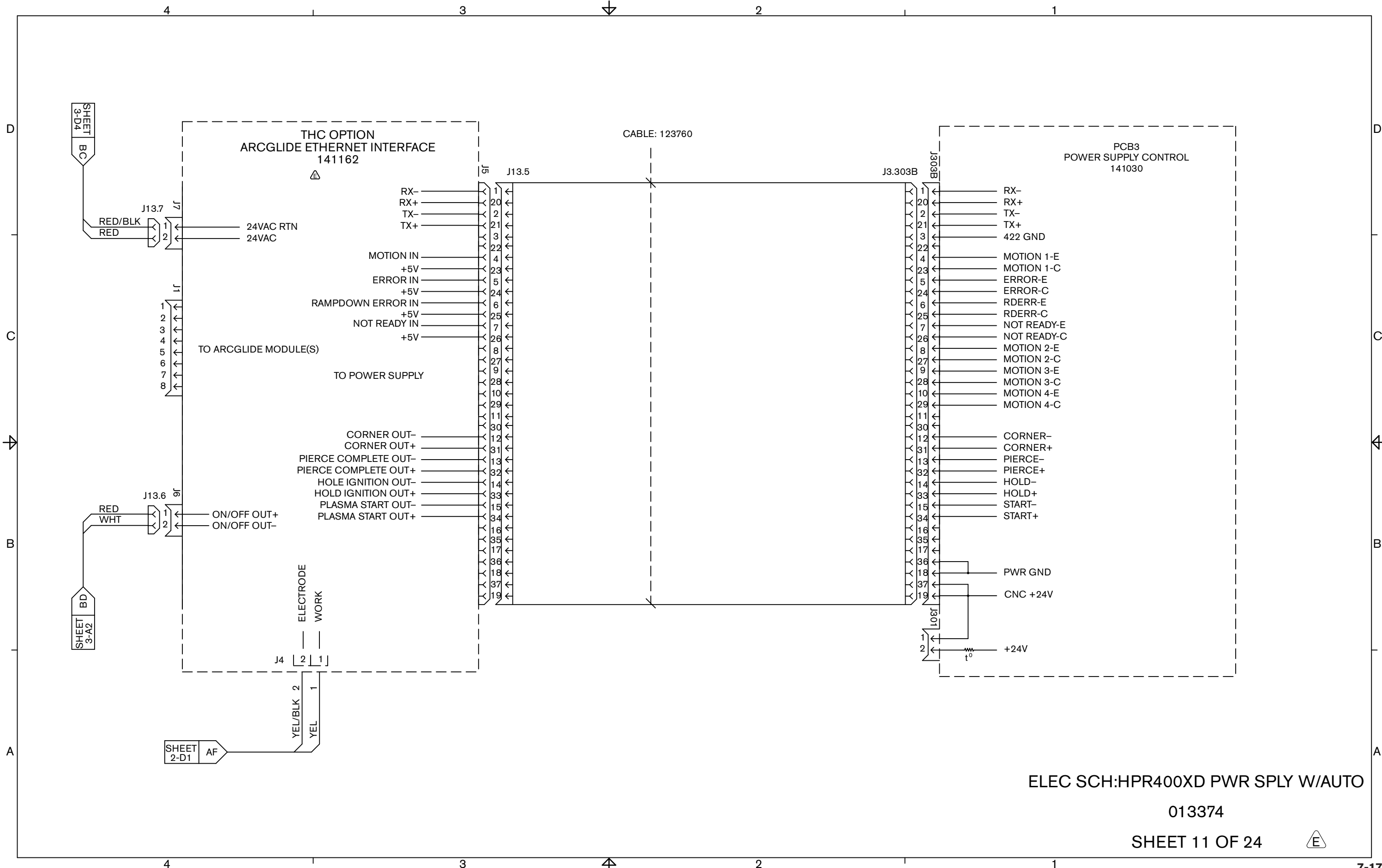


ELEC SCH:HPR400XD PWR SPLY W/AUTO

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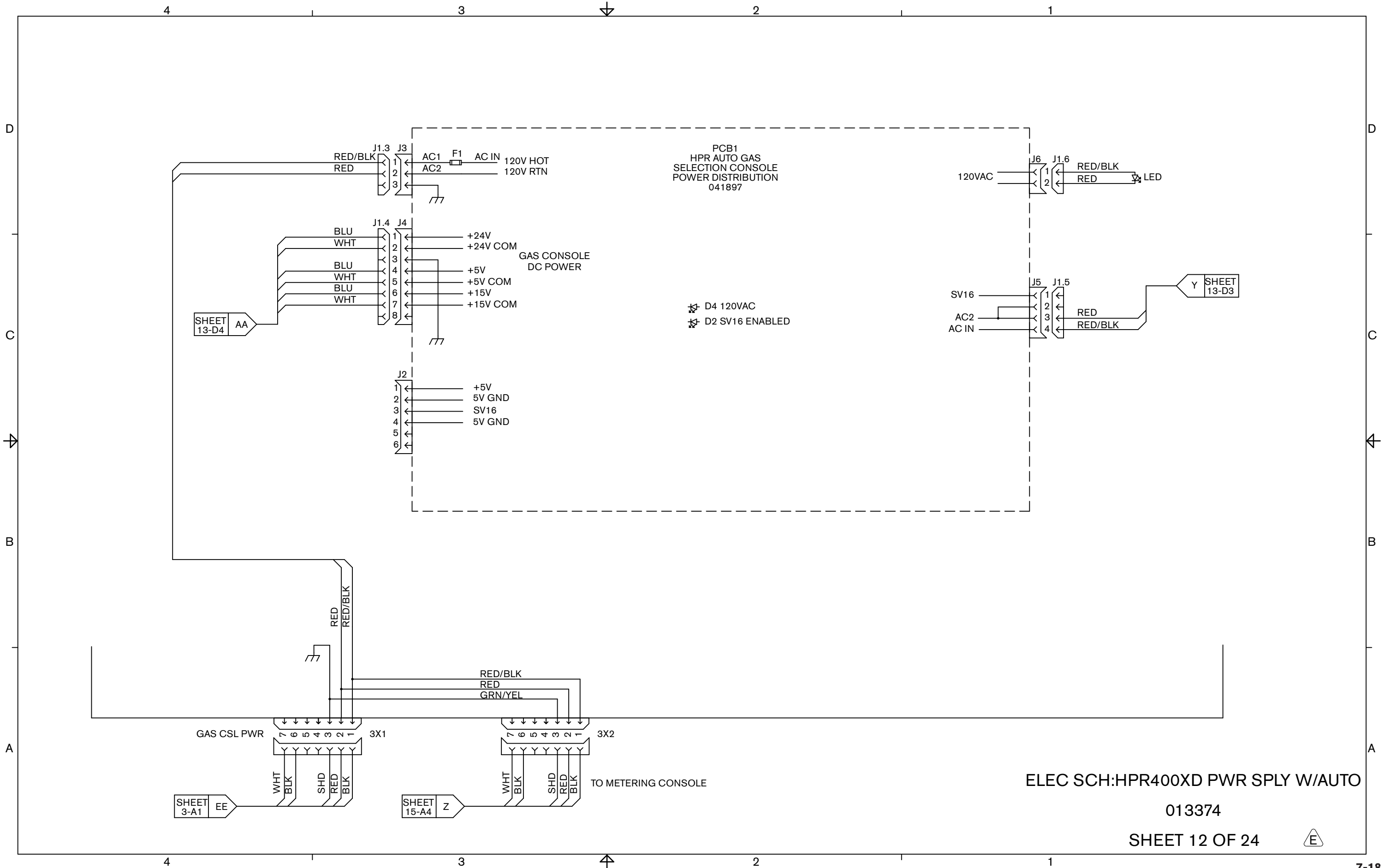


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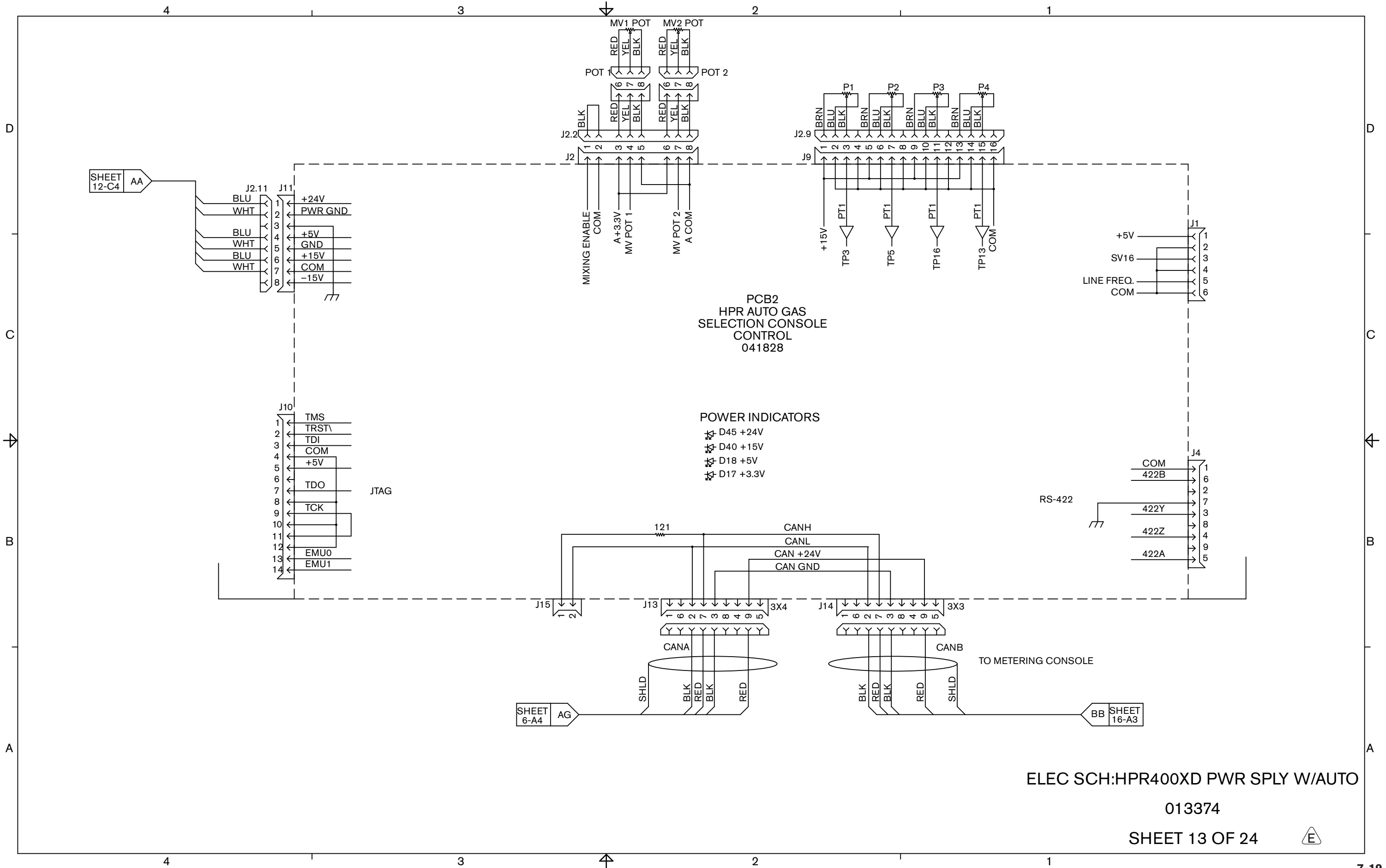
013374

SHEET 11 OF 24

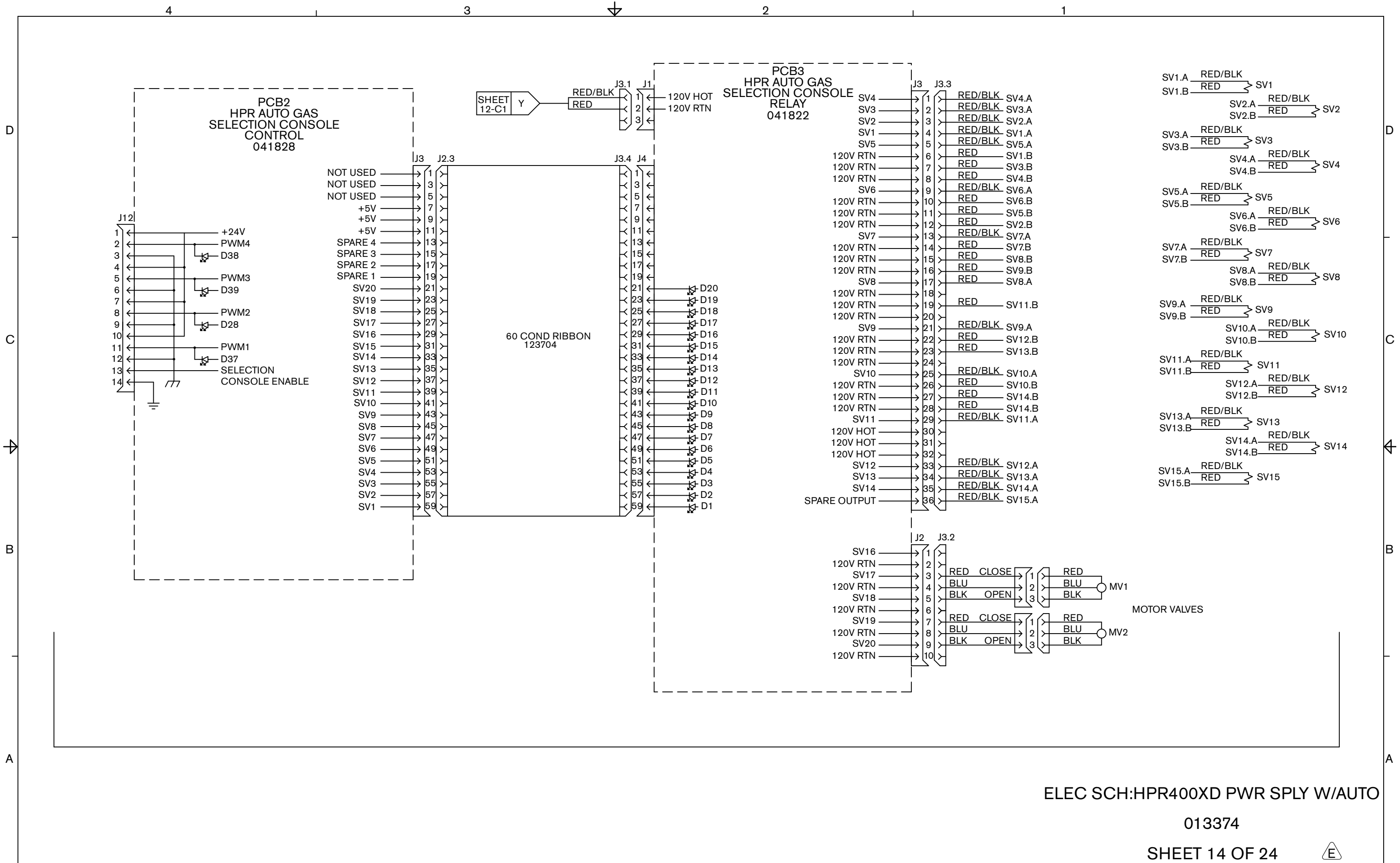








ELEC SCH:HPR400XD PWR SPLY W/AUTO  
 013374  
 SHEET 13 OF 24



ELEC SCH:HPR400XD PWR SPLY W/AUTO

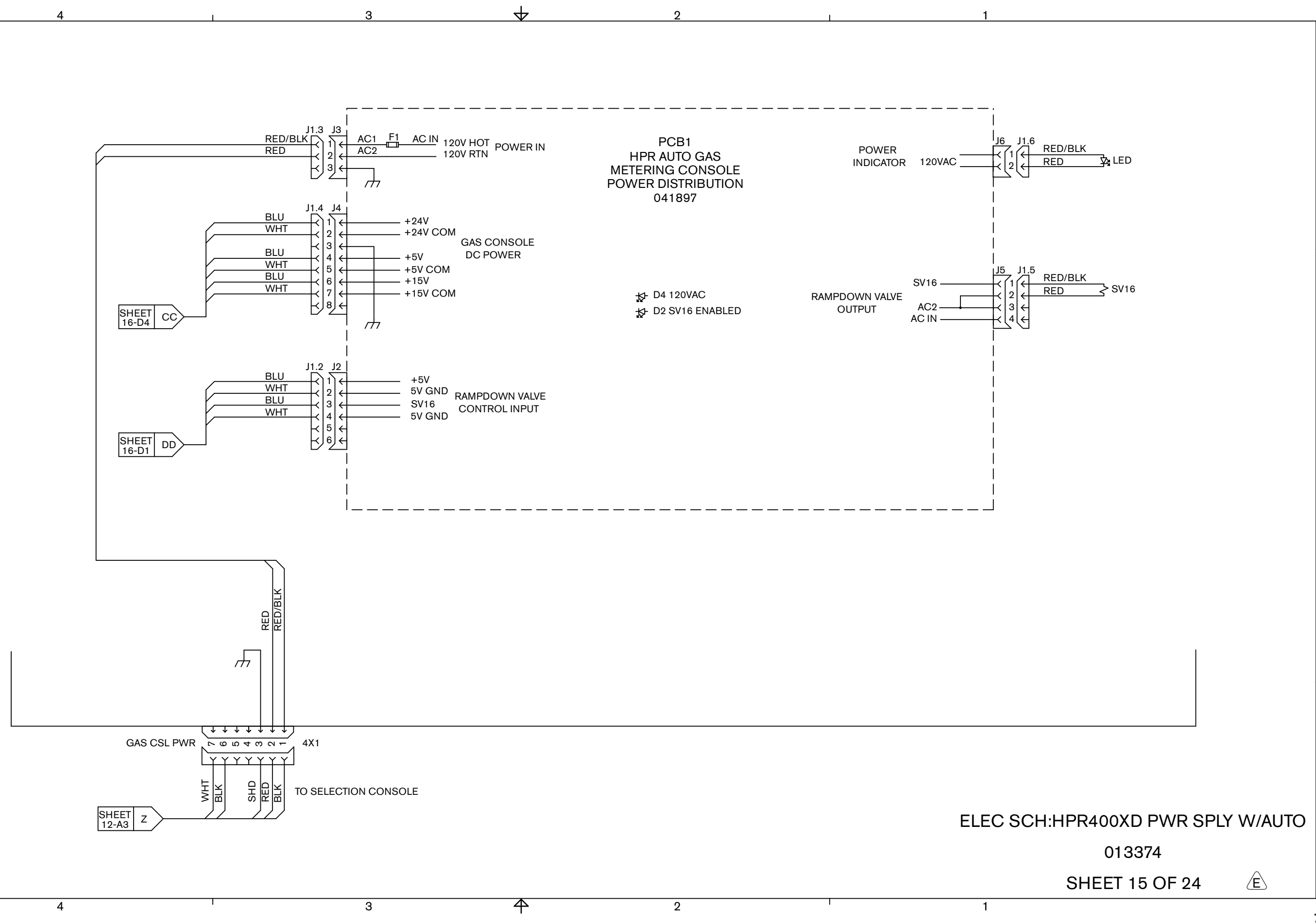
013374

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PCB1  
HPR AUTO GAS  
METERING CONSOLE  
POWER DISTRIBUTION  
041897

D4 120VAC  
D2 SV16 ENABLED

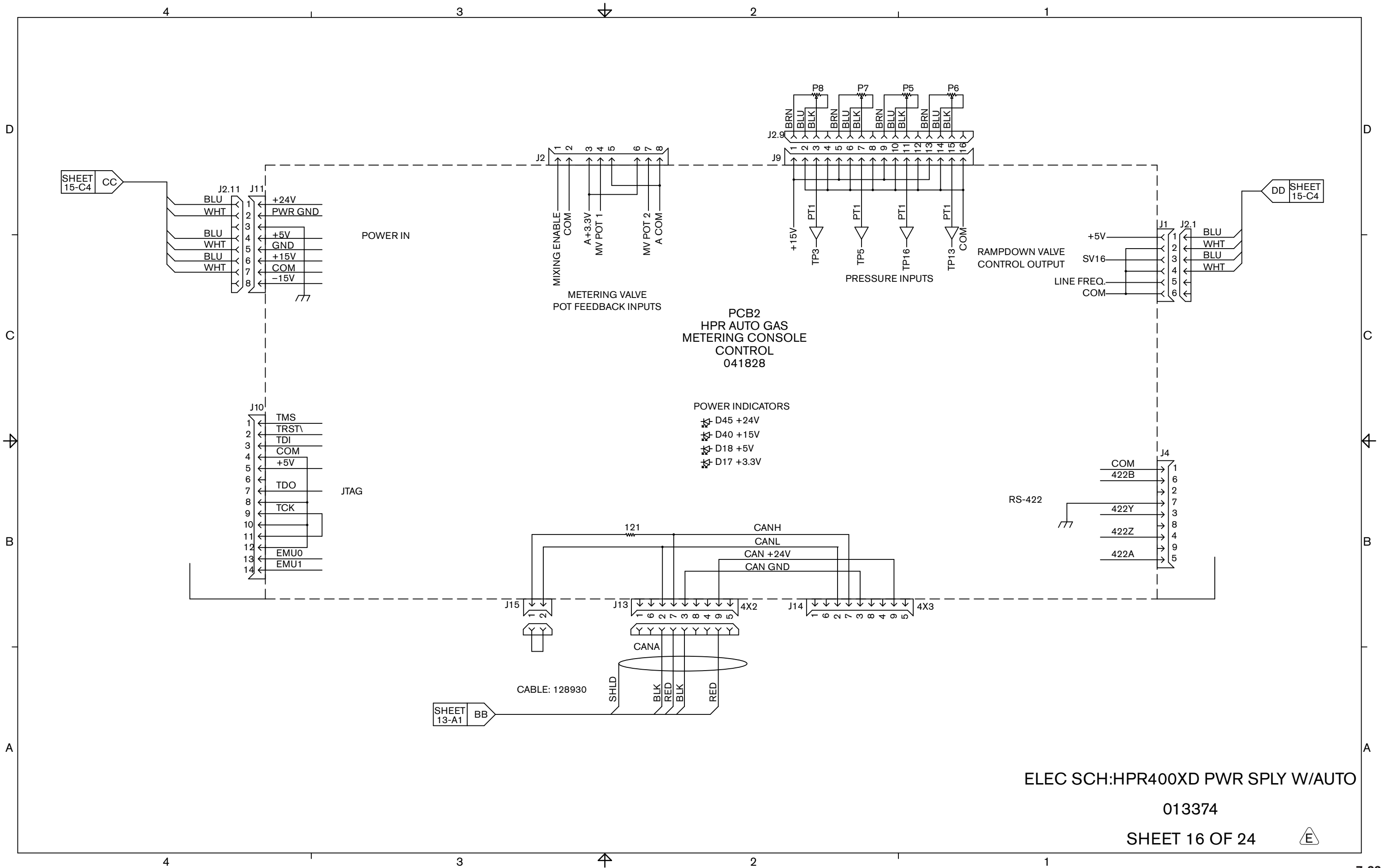


ELEC SCH:HPR400XD PWR SPLY W/AUTO

013374

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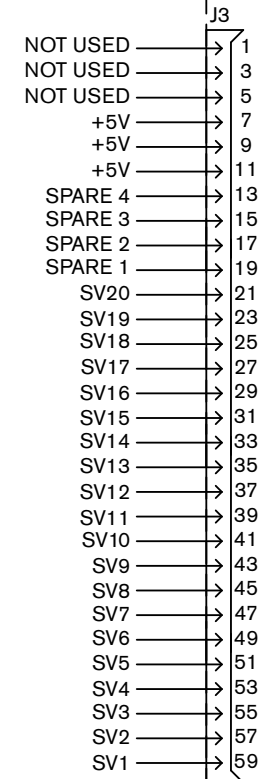
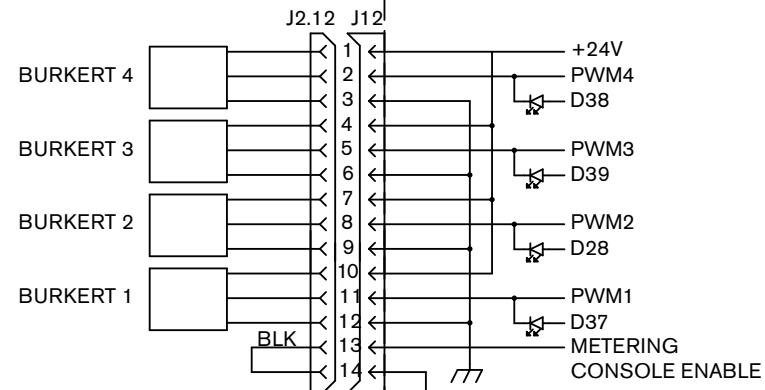
ELEC SCH:HPR400XD PWR SPLY W/AUTO

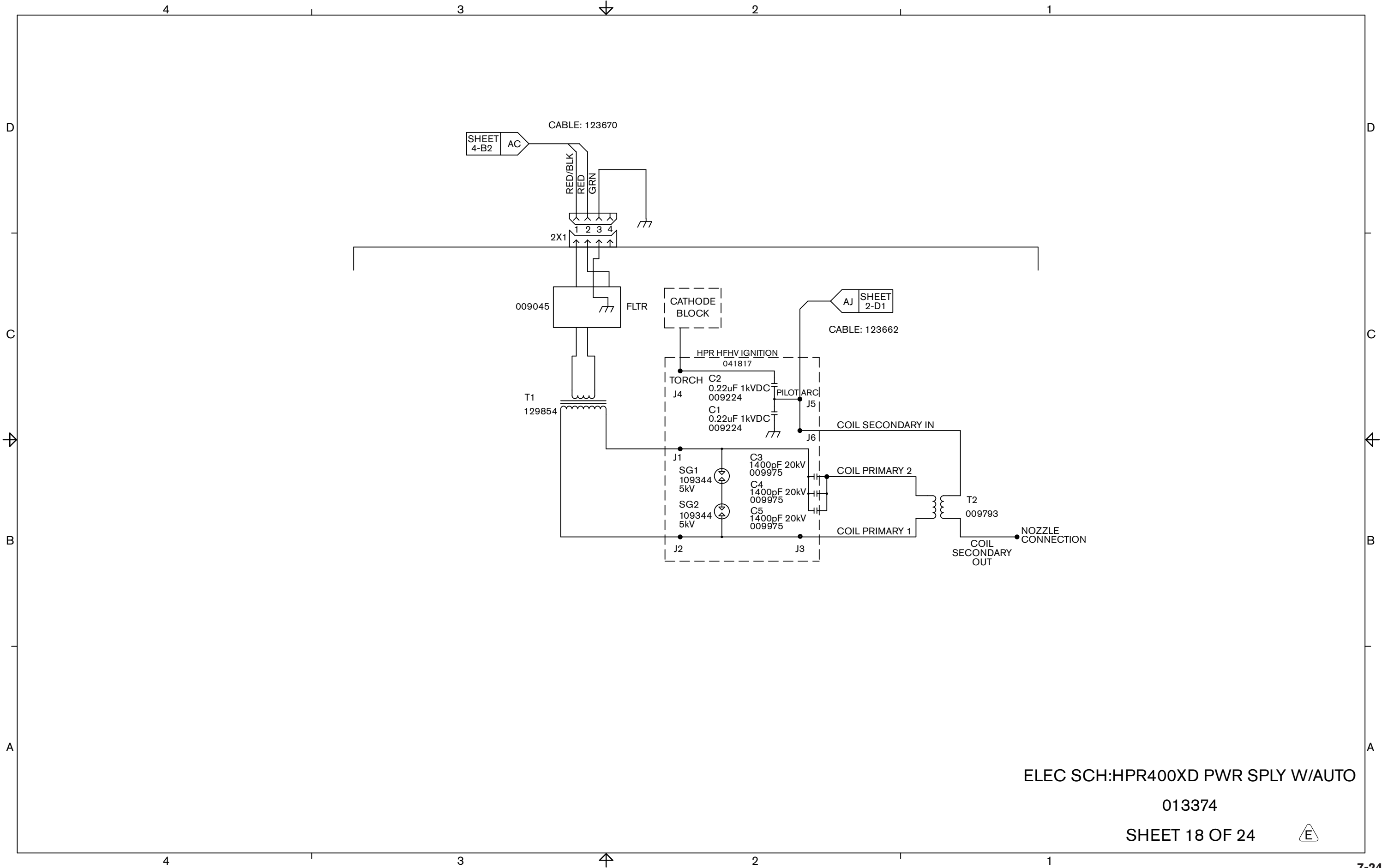
013374

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PCB2  
HPR AUTO GAS  
METERING CONSOLE  
CONTROL  
041828



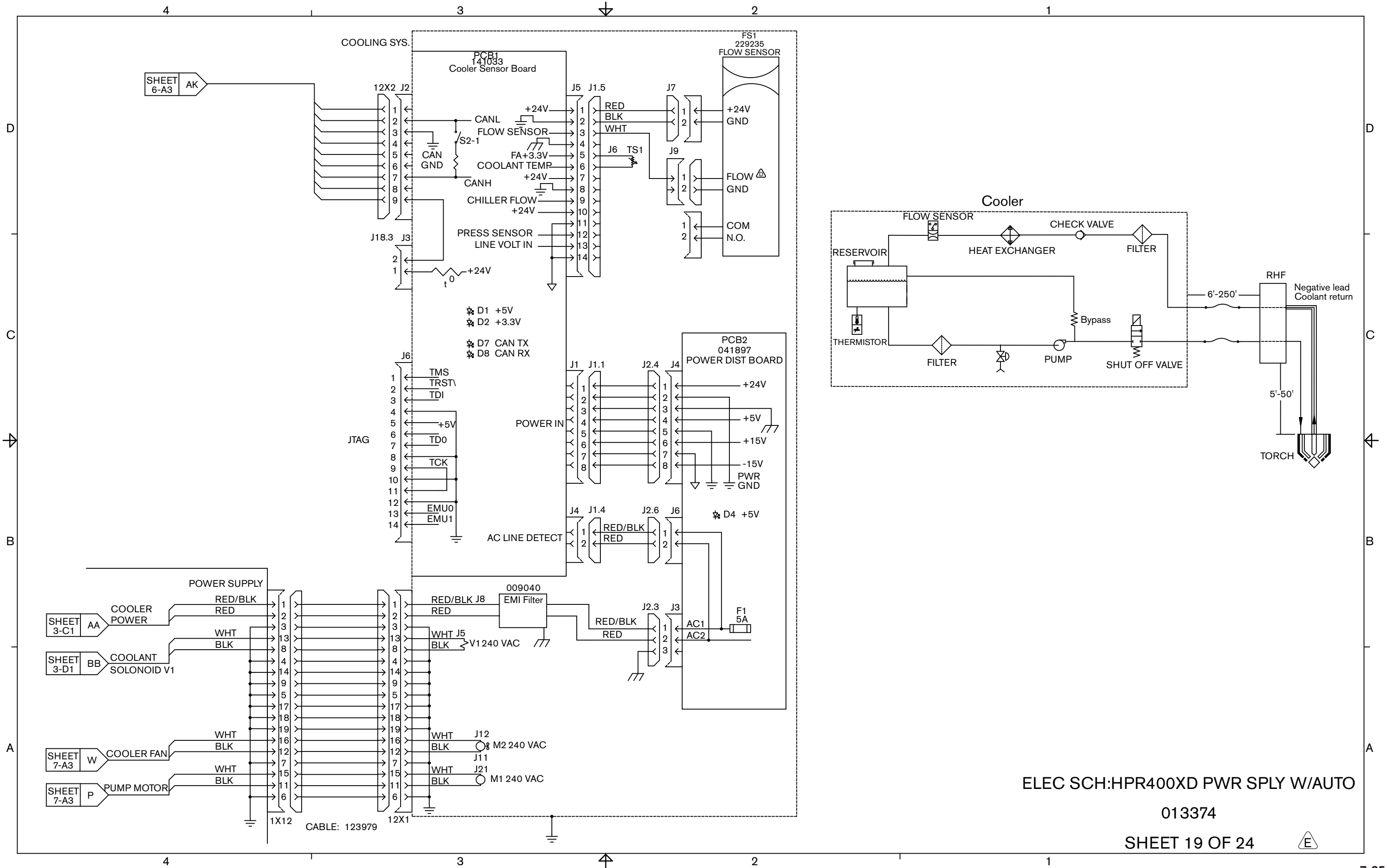


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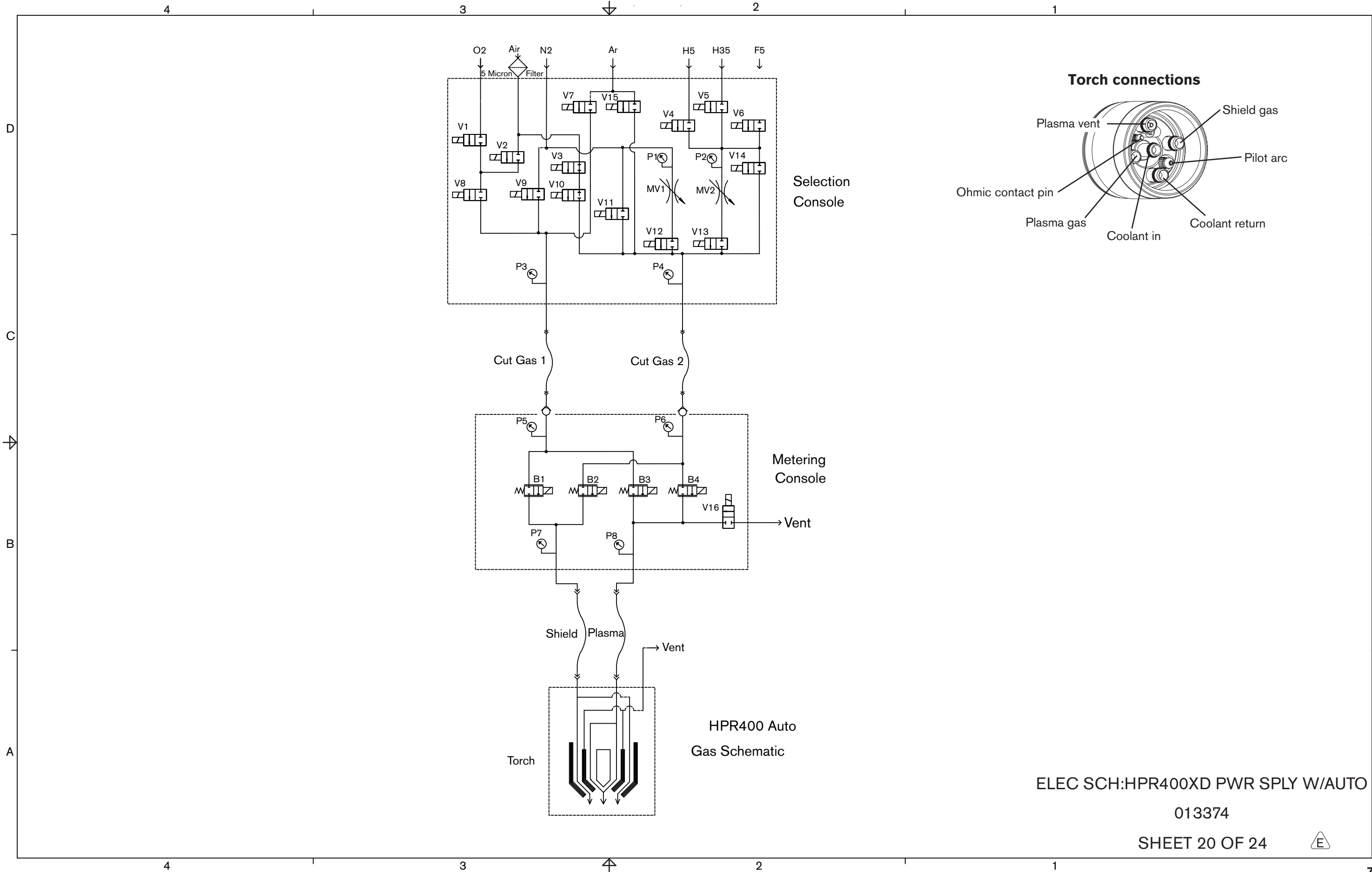


ELEC SCH:HPR400XD PWR SPLY W/AUTO

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SHEET 19 OF 24





ELEC SCH:HPR400XD PWR SPLY W/AUTO

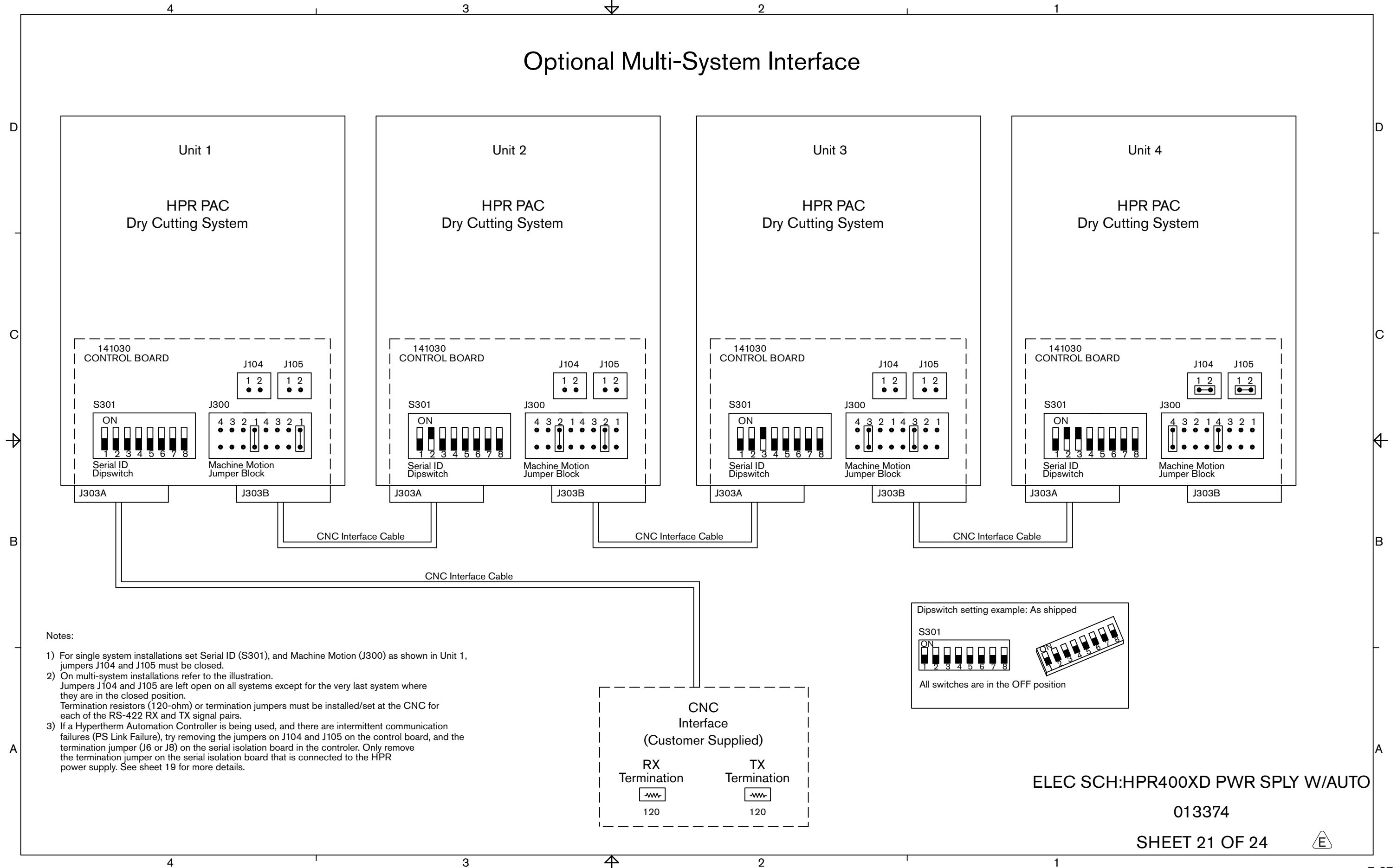
013374

SHEET 20 OF 24



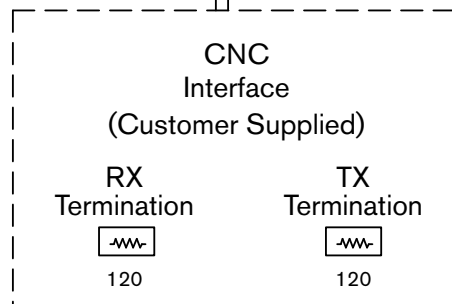
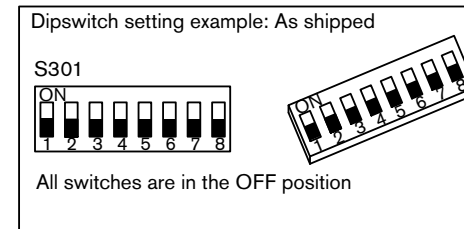


# Optional Multi-System Interface



**Notes:**

- 1) For single system installations set Serial ID (S301), and Machine Motion (J300) as shown in Unit 1, jumpers J104 and J105 must be closed.
- 2) On multi-system installations refer to the illustration. Jumpers J104 and J105 are left open on all systems except for the very last system where they are in the closed position. Termination resistors (120-ohm) or termination jumpers must be installed/set at the CNC for each of the RS-422 RX and TX signal pairs.
- 3) If a Hypertherm Automation Controller is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J104 and J105 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controller. Only remove the termination jumper on the serial isolation board that is connected to the HPR power supply. See sheet 19 for more details.



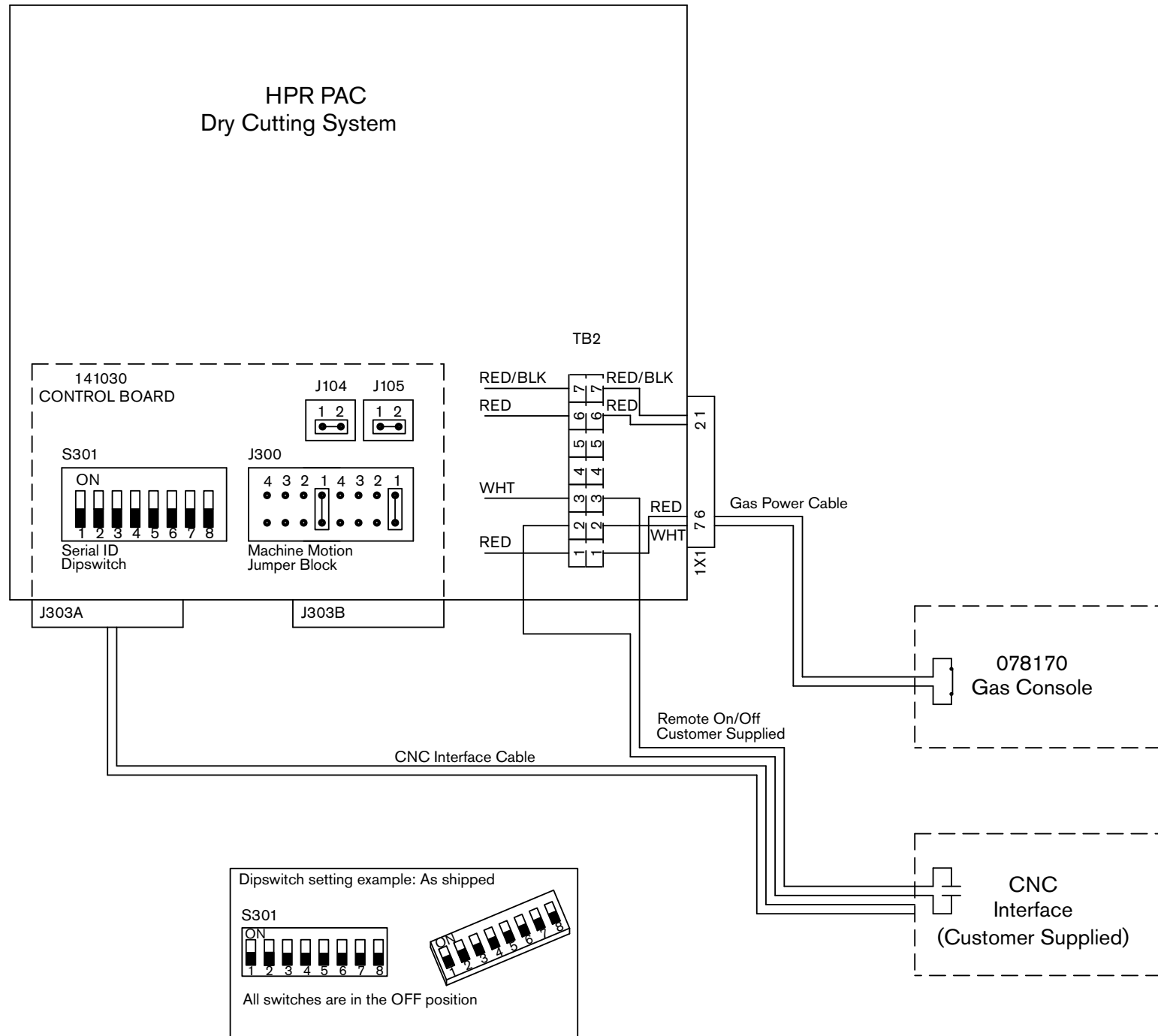
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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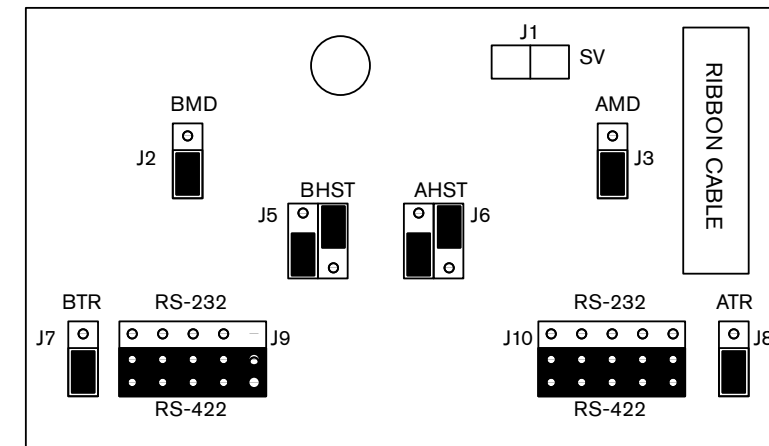
# Optional Remote On/Off



**Notes:**

- 1) For single system installation set Serial ID (S301), Machine Motion (J300), J104 & J105 as shown.  
  
Relocate the white wire on TB2 from position #3 to position #2. Connect customer supplied Remote On/Off cable in series with the power supply and the gas console power switch. Connect one terminal of the Remote On/Off cable to position #2 on TB2 and the other terminal to position #3.  
  
Refer to page 3 of the wiring diagram  
  
Depress the Gas Console Power switch to the closed position (on position).
- 2) For a multi-system installation set up as described above, set jumpers as shown on the multi-system interface page
- 3) The CNC will need a dedicated I/O for each system using the Remote On/Off feature (contact should be rated for min. 24Vac, 0.5 Amp)

\* If a Hypertherm Automation controller is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J104 and J105 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controller. Only remove the termination jumper on the serial isolation board that is connected to the HPR power supply. See figure below for details.



Serial isolation board in a Hypertherm Automation controller

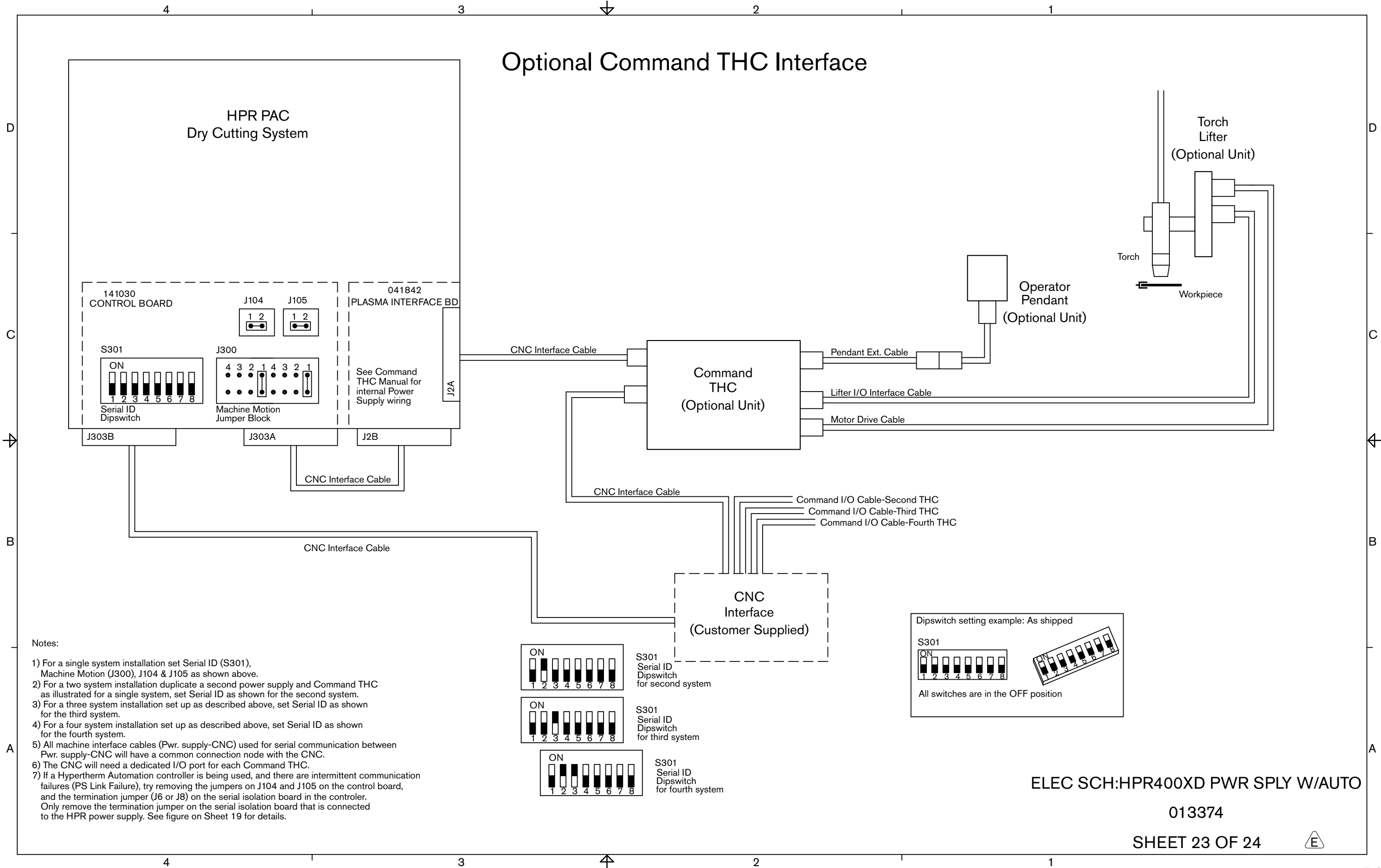
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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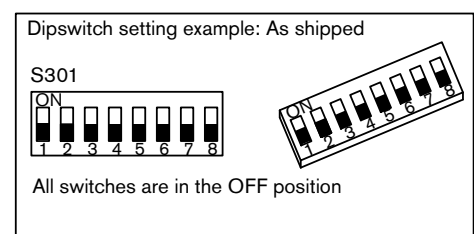
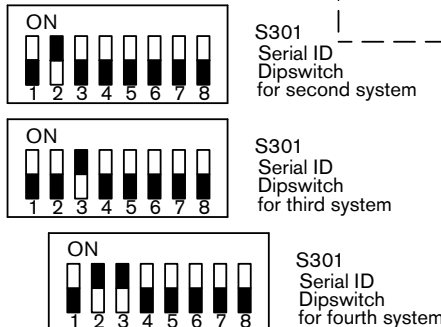


# Optional Command THC Interface



**Notes:**

- 1) For a single system installation set Serial ID (S301), Machine Motion (J300), J104 & J105 as shown above.
- 2) For a two system installation duplicate a second power supply and Command THC as illustrated for a single system, set Serial ID as shown for the second system.
- 3) For a three system installation set up as described above, set Serial ID as shown for the third system.
- 4) For a four system installation set up as described above, set Serial ID as shown for the fourth system.
- 5) All machine interface cables (Pwr. supply-CNC) used for serial communication between Pwr. supply-CNC will have a common connection node with the CNC.
- 6) The CNC will need a dedicated I/O port for each Command THC.
- 7) If a Hypertherm Automation controller is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J104 and J105 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controller. Only remove the termination jumper on the serial isolation board that is connected to the HPR power supply. See figure on Sheet 19 for details.



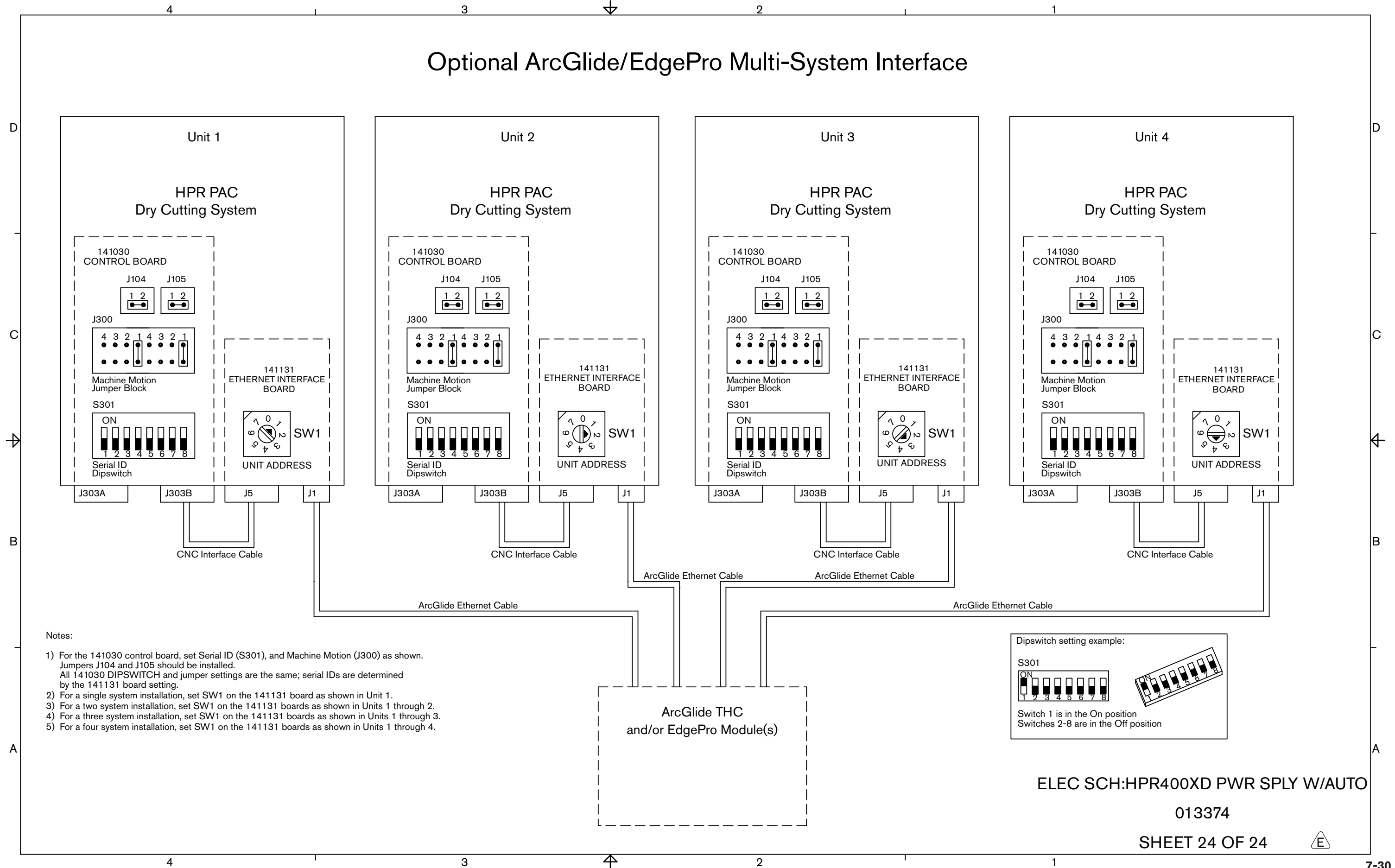
ELEC SCH:HPR400XD PWR SPLY W/AUTO

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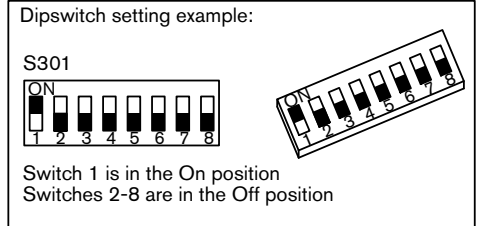


# Optional ArcGlide/EdgePro Multi-System Interface



**Notes:**

- 1) For the 141030 control board, set Serial ID (S301), and Machine Motion (J300) as shown. Jumpers J104 and J105 should be installed. All 141030 DIPSWITCH and jumper settings are the same; serial IDs are determined by the 141131 board setting.
- 2) For a single system installation, set SW1 on the 141131 board as shown in Unit 1.
- 3) For a two system installation, set SW1 on the 141131 boards as shown in Units 1 through 2.
- 4) For a three system installation, set SW1 on the 141131 boards as shown in Units 1 through 3.
- 5) For a four system installation, set SW1 on the 141131 boards as shown in Units 1 through 4.



ELEC SCH:HPR400XD PWR SPLY W/AUTO

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**HYPERTHERM TORCH COOLANT SAFETY DATA**

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*In this section:*

1 – Identification of the substance/mixture and of the company undertaking ..... a-2

2 – Hazards identification ..... a-2

3 – Composition/information on ingredients..... a-3

4 – First aid measures ..... a-3

5 – Fire-fighting measures..... a-3

6 – Accidental release measures..... a-3

7 – Handling and storage ..... a-4

8 – Exposure controls/personal protection ..... a-4

9 – Physical and chemical properties..... a-4

10 – Stability and reactivity ..... a-5

11 – Toxicological information..... a-5

12 – Ecological information..... a-5

13 – Disposal considerations ..... a-6

14 – Transport information ..... a-6

15 – Ecological information..... a-6

16 – Other information ..... a-7

Freezing Point of Propylene Glycol Solution ..... a-8

<b>Date</b>	<b>SAFETY DATA SHEET</b>	<b>Revision</b>
6 Dec 2010	Torch Coolant 30% PG Mixture	2.01CLP

## 1 – IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY UNDERTAKING

**Product identifier – Torch Coolant 30% PG Mixture**

GHS Product Identifier – **Not applicable.**

Chemical Name – **Not applicable.**

Trade name – Torch Coolant 30% PG Mixture

CAS No. – **Not applicable.**

EINECS No. – **Not applicable.**

REACH Registration No. – **Not available.**

**Relevant identified uses of the substance or mixture and uses advised against**

Identified use(s) – **Industrial use only.**

Uses advised against – **Not available.**

**Details of the supplier of the safety data sheet**

Company Identification – **Hypertherm**

Telephone – **+1 (603) 643-5638 (USA), +31 (0) 165 596 907 (Europe)**

E-Mail (competent person) – **technical.service@Hypertherm.com**

Address – **P.O. Box 5010, Hanover, NH 03755 USA (USA),  
Vaartveld 9, 4704 SE Roosendaal, Nederlands (Europe)**

Emergency telephone number – **(800) 255-3924 (USA), +1 (813) 248-0585 (International)** 

**Hypertherm®**

## 2 – HAZARDS IDENTIFICATION

<b>EC Classification</b>	<b>NONE</b>	<b>GHS Classification</b> Signal word(s)	<b>NONE</b>
<b>NONE</b>	<b>NONE</b>	<b>NONE</b>	<b>NONE</b>

**According to Regulation (EC) No. 1272/2008 (CLP) – NONE**

**According to Directive 67/548/EEC & Directive 1999/45/EC – NONE**

Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.

**Risk Phrases – NONE**



**Safety Phrases – NONE**

**Hazard statement(s) – NONE**

**Precautionary statement(s) – NONE**

<b>Date</b>	<b>SAFETY DATA SHEET</b>	<b>Revision</b>
6 Dec 2010	<b>Torch Coolant 30% PG Mixture</b>	2.01CLP

### 3 – COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENT 1	% W/W	CAS No.	EC No.	EC Classification
Propylene Glycol	30-50	57-55-6	200-338-0	<b>NONE</b>
<b>GHS Classification</b>				
Not classified				<b>NONE</b>
HAZARDOUS INGREDIENT 2	% W/W	CAS No.	EC No.	EC Classification
Benzotriazole	< 1.0	95-14-7	202-394-1	<b>Xn, F</b>
<b>GHS Classification</b>				
<b>WARNING</b>	 	<b>Acute Tox. 4 (Oral, Dermal, Inhalation) Eye Irrit. 2, Aquatic Chronic 3</b>		<b>H302, 312, 319, 332, 412</b>

For full text of R phrases see section 16. For full text of H/P phrases see section 16. Non-hazardous components are not listed.

### 4 – FIRST AID MEASURES

<b>Inhalation</b>	Unlikely to be hazardous by inhalation unless present as an aerosol. Remove patient from exposure.
<b>Skin Contact</b>	Wash skin with water
<b>Eye Contact</b>	If substance has gotten into the eyes, immediately wash out with plenty of water for several minutes
<b>Ingestion</b>	Laxative. Do not induce vomiting. If swallowed, seek medical advice immediately and show this container or label.
<b>Further Medical Treatment</b>	Unlikely to be required but if necessary treat symptomatically

### 5 – FIRE-FIGHTING MEASURES

Combustible but not readily ignited.

<b>Extinguishing media</b>	Extinguish preferably with dry chemical, foam or water spray
<b>Unsuitable Extinguishing Media</b>	None known
<b>Fire Fighting Protective Equipment</b>	A self contained breathing apparatus and suitable protective clothing should be worn in fire conditions

### 6 – ACCIDENTAL RELEASE MEASURES


<b>Personal Precautions</b>	Put on protective clothing
<b>Environmental Exposure Controls</b>	Absorb spillages onto sand, earth or any suitable adsorbent material
<b>Other</b>	None

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## 7 – HANDLING AND STORAGE

<b>Handling</b>	Unlikely to cause harmful effects under normal conditions of handling and use
<b>Storage</b>	Keep container tightly closed and dry. Keep away from heat. Keep out of the reach of children. Keep away from oxidizing agents.
Storage Temperature:	Ambient
Storage Life:	Stable at ambient temperatures
Specific Use:	Industrial use only

## 8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

	<b>Respirators</b>	Normally no personal respiratory protection is necessary. Wear suitable respiratory protective equipment if exposure to levels above the occupational exposure limit is likely. A suitable dust mask or dust respirator with filter type A/P may be appropriate.
	<b>Eye Protection</b>	Safety spectacles.
	<b>Gloves</b>	Wearing of chemical protective gloves is not necessary.
	<b>Body protection</b>	None.
	<b>Engineering Controls</b>	Ensure adequate ventilation to remove vapors, fumes, dust etc.
	<b>Other</b>	None.

## OCUPATIONAL EXPOSURE LIMITS

SUBSTANCE	CAS No.	LTEL (8 hr TWA ppm)	LTEL (8 hr TWA mg/m <sup>3</sup> )	STEL (ppm)	STEL (mg/m <sup>3</sup> )	Note:
<b>Propylene Glycol</b>	<b>57-55-6</b>	<b>NE</b>	<b>10 *</b>	<b>NE</b>	<b>NE</b>	<b>AIHA WEEL in the USA</b>
<b>Benzotriazole</b>	<b>95-14-7</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>None</b>

## 9 – PHYSICAL AND CHEMICAL PROPERTIES

### Information on basic physical and chemical properties

Appearance – <b>Liquid</b>	Vapor Pressure (mm Hg) – <b>Not available</b>
Color - <b>Pinkish – Reddish</b>	Vapor Density (Air=1) – <b>Not available</b>
Odor – <b>Slight</b>	Density (g/ml) – <b>1.0 ± 0.1 g/ml</b>
Odor Threshold (ppm) – <b>Not available</b>	Solubility (Water) – <b>Soluble</b>
pH (Value) – <b>5.5-7.0</b> (Concentrated)	Solubility (Other) – <b>Not established</b>
Melting Point (°C) / Freezing Point (°C) – <b>&lt; -0°C / (&lt; 32°F)</b>	Partition Coefficient (n-Octanol/water) – <b>Not available</b>
Boiling point/boiling range (°C): <b>&gt;100°C (&gt;212°F)</b>	Auto Ignition Temperature (°C) – <b>Not available</b>
Flash Point (°C) – <b>&gt;95°C (&gt;203°F)</b>	Decomposition Temperature (°C) – <b>Not available</b>
Evaporation rate – <b>Not available</b>	Viscosity (mPa.s) – <b>Not available</b>
Flammability (solid, gas) – <b>Non-flammable</b>	Explosive properties – <b>Not explosive</b>
Explosive limit ranges – <b>Not available</b>	Oxidizing properties – <b>Not oxidizing</b>
Other information – <b>None</b>	



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## 10 – STABILITY AND REACTIVITY

<b>Reactivity</b>	None
<b>Chemical stability</b>	Stable under normal conditions
<b>Possibility of hazardous reactions</b>	None
<b>Conditions to avoid</b>	None anticipated
<b>Incompatible materials</b>	Keep away from oxidizing agents
<b>Hazardous Decomposition Product(s)</b>	Carbon monoxide, Carbon dioxide, Nitrogen oxides

## 11 – TOXICOLOGICAL INFORMATION

### 11.1.1 – Substances

<b>Acute toxicity</b>	
Ingestion	Low oral toxicity, but ingestion may cause irritation of the gastrointestinal tract
Inhalation	Unlikely to be hazardous by inhalation
Skin Contact	Mild irritant to rabbit skin
Eye Contact	Mild irritant to the eye
<b>Hazard label(s)</b>	None
<b>Serious eye damage/irritation</b>	Mild irritant to the eye
<b>Respiratory or skin sensitization</b>	Mild irritant to rabbit skin
<b>Mutagenicity</b>	Not known
<b>Carcinogenicity</b>	IARC, NTP, OSHA, ACGIH do not list this product or any components thereof as known or suspected carcinogen
<b>Reproductive toxicity</b>	Not known
<b>STOT-single exposure</b>	Not known
<b>STOT-repeated exposure</b>	Not known
<b>Aspiration hazard</b>	Not known

## 12 – ECOLOGICAL INFORMATION

<b>Toxicity</b>	Do not let this chemical/product enter the environment.
<b>Persistence and degradability</b>	Biodegradable
<b>Bioaccumulative potential</b>	None anticipated
<b>Mobility in soil</b>	The product is predicted to have moderate mobility in soil
<b>Results of PBT and vPvB assessment</b>	None assigned
<b>Other adverse effects</b>	None anticipated

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### 13 – DISPOSAL CONSIDERATIONS

**Waste treatment methods** - Disposal should be in accordance with local, state or national legislation. No special measures are required. No specific waste water pretreatment required.

**Additional Information** – None

### 14 – TRANSPORT INFORMATION

Not classified as dangerous for transport.

**Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code.**

### 15 – ECOLOGICAL INFORMATION

#### USA

TSCA (Toxic Substance Control Act) – **Listed.**

SARA 302 - Extremely Hazardous Substances – **Not applicable.**

SARA 313 - Toxic Chemicals – **Not applicable.**

SARA 311/312 - Hazard Categories – **None.**

CERCLA (Comprehensive Environmental Response Compensation and Liability Act) – **Not applicable.**

CWA (Clean Water Act) - CWA 307 - Priority Pollutants – **None.**

CAA (Clean Air Act 1990) CAA 112 - Hazardous Air Pollutants (HAP) – **None.**

Proposition 65 (California) – **Not applicable.**

State Right to Know Lists – **CAS No. 95-14-7 Listed in MA, NJ, PA.**

#### Canada

WHMIS Classification (Canada) – **Not classified.**

CANADA INGREDIENT DISCLOSURE LIST – **Not applicable.**

Canada (DSL/NDSL) – **Listed.**

#### EU

EINECS (Europe) – **Listed.**

Wassergefährdungsklasse (Germany) – **None.**

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**16 – OTHER INFORMATION**

The following sections contain revisions or new statements: 1-16.

**Legend**

LTEL	Long Term Exposure Limit
STEL	Short Term Exposure Limit
STOT	Specific Target Organ Toxicity
DNEL	Derived No Effect Level
PNEL	Predicted No Effect Concentration

**References:**

**Risk Phrases and Safety Phrases**

None. Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.

**Hazard statement(s) and Precautionary statement(s).**

None. Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.

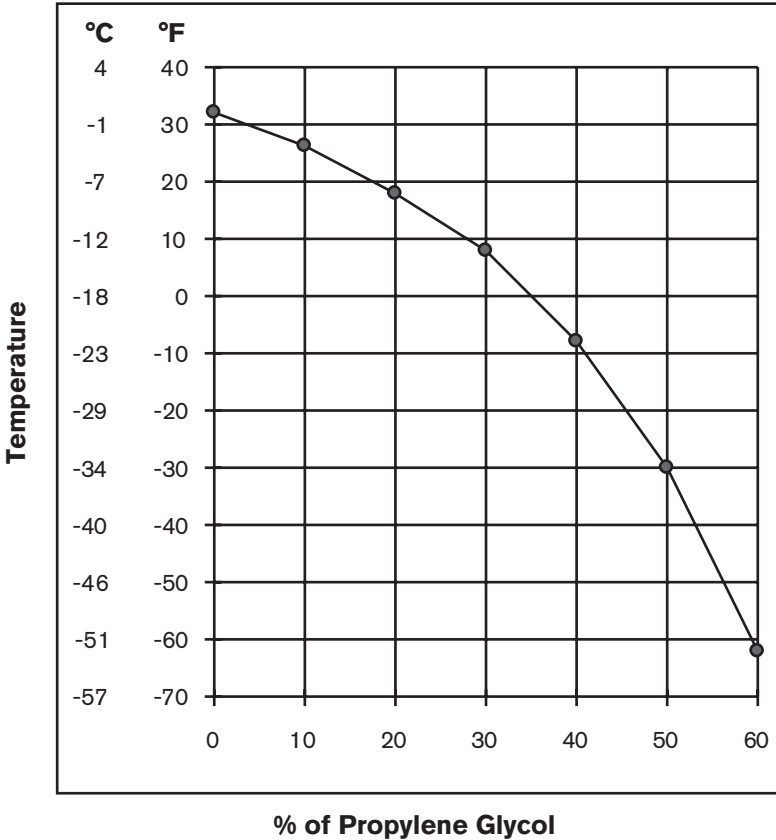
**Training advice** – None.

**Additional Information**

USA - NFPA (National Fire Protection Association) - NFPA Rating: **Flammability-1, Health-0, Instability/Reactivity – 0.**

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**Note:** Original safety data sheet authored in English



**Freezing Point of Propylene Glycol Solution**

**CNC INTERFACE PROTOCOL**

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### Interface hardware

- The interface will use a combination of discrete signals (5 inputs, 3 outputs, and 24 VDC active low) and an addressable RS422 interface.
- The hardware will provide 4 unique addresses, which allows 4 systems to be connected to one serial port on the CNC. The addressing mechanism will be inside the power supply, on a PC board (Note: A total of 32 I/O (20 Inputs, 12 Outputs) points will be required for 4 systems).
- The RS422 hardware will have tri-stateable transmitter to disconnect itself from the line when not communicating.
- Mounting holes for footprint of CommandTHC plasma interface board.
- Must have an interface compatible with the CommandTHC/HD4070.

### Signal list

#### Signals

Signal name	Type	Description
Plasma Start	Input	When active, the plasma system will fire an arc.
Machine Motion 1	Output	Indicates the arc has transferred to the plate. This signal is selected using jumper on power supply control board. Only 1 motion signal is needed per system. The remaining motion signals can be used to wire multiple systems in a daisy chain configuration.
Machine Motion 2	Output	Indicates the arc has transferred to the plate. This signal is selected using jumper on power supply control board. Only 1 motion signal is needed per system. The remaining motion signals can be used to wire multiple systems in a daisy chain configuration.
Machine Motion 3	Output	Indicates the arc has transferred to the plate. This signal is selected using jumper on power supply control board. Only 1 motion signal is needed per system. The remaining motion signals can be used to wire multiple systems in a daisy chain configuration.
Machine Motion 4	Output	Indicates the arc has transferred to the plate. This signal is selected using jumper on power supply control board. Only 1 motion signal is needed per system. The remaining motion signals can be used to wire multiple systems in a daisy chain configuration.
Hold Ignition	Input	When active, the system will stay in preflow and delay torch ignition. The signal should be applied at the same time the start signal is applied.
System Error	Output	Indicates that an error has occurred in the plasma system. Use the serial interface to query for the specific error code number.

**Signal list (continued)**

<b>Signal name</b>	<b>Type</b>	<b>Description</b>
Pierce Complete	Input	When active, the system will use shield preflow gases during piercing. When the signal is removed, the system will switch to shield cutflow gases. The signal should be applied at the same time the start signal is applied.
Corner Current	Input	When active, the system will switch to user specified corner current.
Remote Power	Input	Used to turn the power on or off
Not Ready for Start	Output	When on, this signal indicates that the plasma system is not ready for a plasma start signal. This could be because the system is purging or in test gas mode.
Ramp-down Error	Output	Indicates the arc did not ramp-down properly. Consumable life is shortened.
TX+	Serial	Transmitting from the system <b>Connect to CNC RX+</b>
TX-	Serial	Transmitting from the system <b>Connect to CNC RX-</b>
RX+	Serial	Receiving by the system <b>Connect to CNC TX+</b>
RX-	Serial	Receiving by the system <b>Connect to CNC TX-</b>

**Hardware**

Inputs – active low, dry contact, opto-isolated

Inactive: 24 V or open circuit, 0 mA

Active: 0 V or closed contact (0 ohm min, 6.5 mA; 200K ohm max, 0.1 mA)

Outputs – active low, open collector, opto-isolated

Inactive: Up to 40 V open circuit/open collector, 0 mA

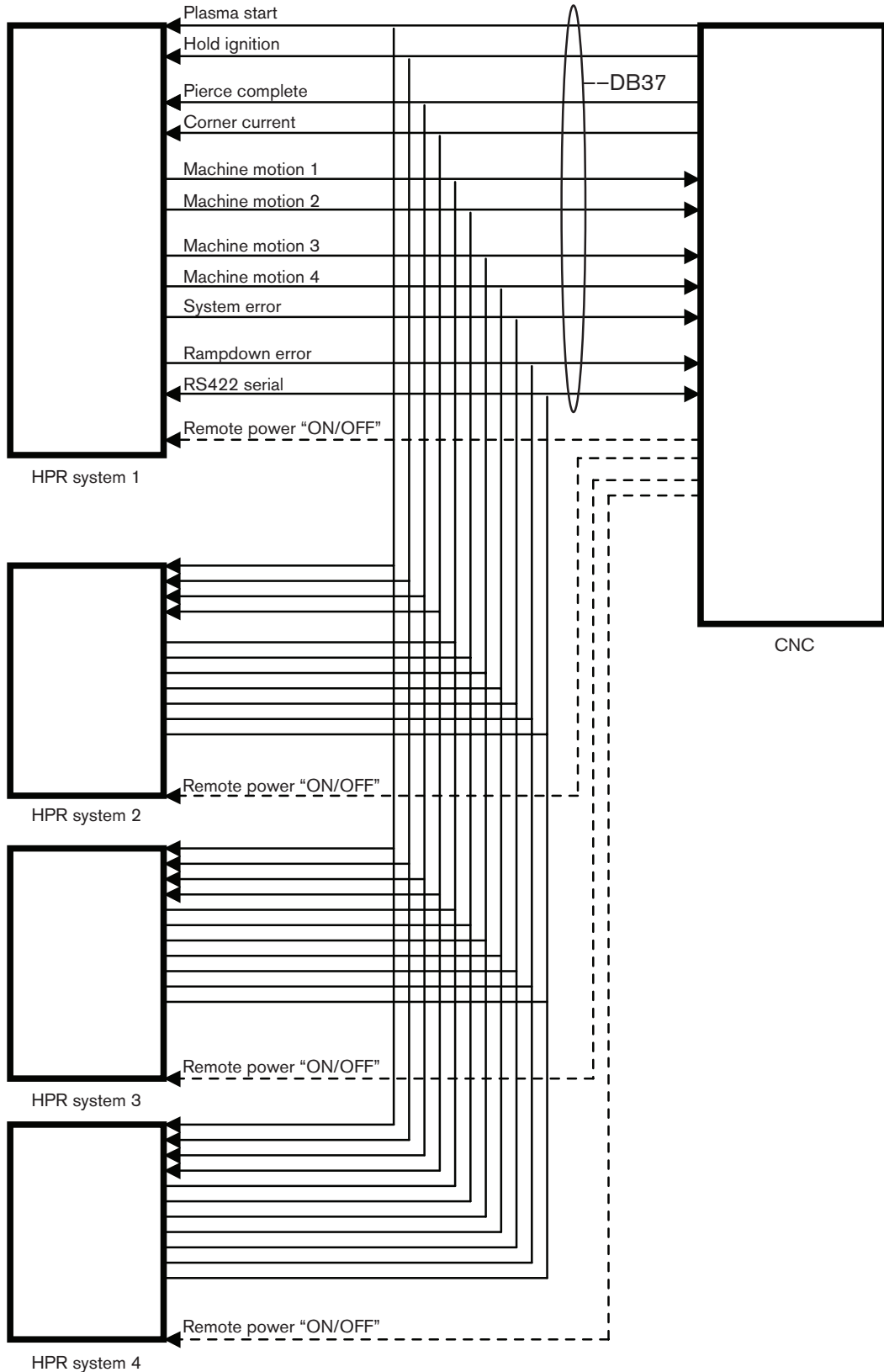
Recommended 24 V pull-up into high impedance load

Active: 0.3 V max output into high impedance load, sinking capacitor up to 5 mA

Or 2k ohm minimum load resistance

Serial – RS422 serial communications

Multi-drop wiring





## Multi-drop addressing

The power supply control has DIP switches to set the power supply ID. DIP switches 2, 3, 4 are used to set the ID.

<b>2</b>	<b>3</b>	<b>4</b>	<b>ID</b>
Off	Off	Off	0
On	Off	Off	1
Off	On	Off	2
On	On	Off	3
Off	Off	On	Reserved
On	Off	On	Reserved
Off	On	On	Reserved
On	On	On	Reserved

Systems with ID 0 power-up with the serial interface enabled. Systems with any other ID power-up with the serial interface disabled.

To implement the multi-drop interface, the CNC must send the SLEEP command (086) which will put all systems on the line into sleep mode. The WAKE command (085) with specific system ID will wake the system that the CNC wants to communicate with. Any command can now be sent to that power supply, while all other systems will ignore the communications. When the CNC is finished communicating with that power supply the SLEEP command must be sent, then the WAKE command is used to communicate with the next system.

## Serial commands

### Format

- ASCII-based protocol
- Baud 19200
- 8 Data bits
- 1 Stop bit
- No parity
- No flow control

### Framing

- > = Start of message
- 3 byte command ID
- Data
- 2 byte checksum
- < = End of message

Sample: >0011C2<

### Commands

Responses will echo the ID of the command, unless there is an error in the command.

**Command table (1 of 14)**

<b>ID</b>	<b>Command</b>	<b>System</b>	<b>Description</b>
000	HELLO	Manual gas system Auto gas system	Establish communications with the plasma system. Use this command to determine if the system is configured as an 800XD or 400XD. This command will return "HPR800XD" in place of "HPR400XD" when the secondary power supply is connected and the power is on.  <b>Data:</b> None <b>Return value:</b> String identifying the system <b>Sample:</b> >00090< >000HYPERFORMANCE130MANUALB5< or >000HYPERFORMANCE130AUTO30< or >000HYPERFORMANCE130AUTOMIX1E<
001	VERSION	Manual gas system Auto gas system	Get the version of the power supply firmware.  <b>Data:</b> None <b>Return value:</b> Power supply firmware then Gas console firmware, space-delimited <b>Sample:</b> >00191< >001A.0 A.25< (power supply rev A, gas rev A)
002	GET_STATE	Manual gas system Auto gas system	Get the current state of the plasma system.  <b>Data:</b> None <b>Return value:</b> Status code (see table V) <b>Sample:</b> >00292< >002000052< (status code 0)
003	LAST_ERROR	Manual gas system Auto gas system	Get the last error that occurred at the system.  <b>Data:</b> None <b>Return value:</b> Error code (see table IV) <b>Sample:</b> >00393< >00301165B< (error code 116)
004	REMOTE_MODE	Manual gas system Auto gas system	Switch system into remote mode, to allow remote control of the plasma system.  <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >00494< >0041C5<

Command table (2 of 14)

ID	Command	System	Description
028	READ_PLASMA_AMPS	Manual gas system Auto gas system	Read actual power supply current. <b>Data:</b> None <b>Return value:</b> Power supply current in amps <b>Sample:</b> >0289A< >02801305E< (130 amps)
058	SET_NOMINAL_AMPS	Auto gas system	Set the power supply current in amps. <b>Data:</b> 5-260 Amps (Limited to 130 amps on the HPR130) <b>Return value:</b> Actual current value set <b>Sample:</b> >05813031< >058013061< (set 130 amps)
064	GAS_PREFLOW_TEST_START	Manual gas system Auto gas system	Turn on the preflow gases. Not allowed when cutting. <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0649A< >0641CB<
065	GAS_PREFLOW_TEST_STOP	Manual gas system Auto gas system	Turn off the preflow gases. Not allowed when cutting. <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0659B< >0651CC<
066	GAS_CUTFLOW_TEST_START	Manual gas system Auto gas system	Turn on the cutflow gases. Not allowed when cutting. <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0669C< >0661CD<
067	GAS_CUTFLOW_TEST_STOP	Manual gas system Auto gas system	Turn off the cutflow gases. Not allowed when cutting. <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0679D< >0671CE<)

**Command table (3 of 14)**

<b>ID</b>	<b>Command</b>	<b>System</b>	<b>Description</b>
068	SYSTEM_RESET	Manual gas system Auto gas system	Clear error conditions and resume operation. Only accepted if system is in a shutdown error condition (Error code > 79 and State = 14). <b>Data:</b> None <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0689E< >0681CF<
070	SET_CORNER_CURRENT	Manual gas system Auto gas system	When CORNER CURRENT input is activated the power supply will switch to the current percentage specified. <b>Data:</b> % of cutting current (50-100%) 50=50% <b>Return value:</b> % achieved <b>Sample:</b> >0707503< >070007563< (set 75%)<
071	MANUAL_PUMP_CONTROL	Manual gas system Auto gas system	Used to override software control of the coolant pump. If the system has a fatal error, the pump cannot be overridden. <b>Data:</b> 1 = override software to force pump on, 0 = system software controls the pump, override off <b>Return value:</b> 1 = accepted, 0 = not accepted <b>Sample:</b> >0711C9< >0711C9<
072	GET_CONTROL_VOLTAGE	Manual gas system Auto gas system	Returns the internal control voltage of the power supply <b>Data:</b> None <b>Return value:</b> Voltage (1/10 V) 1200 = 120.0 V <b>Sample:</b> >07299< >07212005C< (120.0 volts)

Command table (4 of 14)

ID	Command	System	Description
074	GET_IO_STATUS	Manual gas system Auto gas system	<p>Read the status of the I/O ports of the DSP. Refer to I/O listing for description of each bit in Ports A-F.</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> PA00000000 PB00000000 PC00000000 PD00000000 PE00000000 PF00000000</p> <p>Ports A-F are returned space-delimited. The numbers are the decimal representation of the binary value of the port. 1 = on, 0 = off.</p> <p><b>Sample:</b> &gt;0749B&lt; &gt;074PA00000100 PB00000000 PC00010101 PD00100000 PE00010000 PF10000000B7&lt;</p>
078	SET_ALL_GAS_FLOWS	Auto gas system	<p>Set all gas flow rates.</p> <p>N<sub>2</sub> mix setpoint and Gas 2 mix setpoint are only applicable when using a mixed plasma gas such as H35 – N<sub>2</sub>. Otherwise, these 2 values should be set to 0.</p> <p>A value of 0 for N<sub>2</sub> mix setpoint will cause the system to close SV12, the solenoid valve for N<sub>2</sub> mixing. A value of 0 for Gas 2 Mix Setpoint will cause the system to close SV13 and open SV14. This will cause the inlet gas to bypass motor valve 2 and pass directly to the outlet of the mixing console.</p> <p><b>Data:</b> Space-delimited: Plasma cutflow (0 – 99 psi), Plasma preflow (0 – 99 psi), Shield cutflow (0 – 99 psi), Shield preflow (0 – 99 psi), N<sub>2</sub> mix setpoint (0 – 100 psi), Gas2 mix setpoint (0 – 100 psi).</p> <p><b>Return value:</b> 1 = accepted, 0 = not accepted</p> <p><b>Sample:</b> &gt;07855 45 35 25 50 50AB&lt; &gt;0781D0&lt;</p>

**Command table (5 of 14)**

ID	Command	System	Description
079	GET_PS_INFO	Manual gas system Auto gas system	<p>Returns pressures, system state, and system error, space-delimited</p> <p><b>Data:</b> None</p> <p><b>Return value:</b>                      Plasma cutflow pressure (0044 = 44 psi)                      Plasma preflow pressure (0044 = 44 psi)                      Shield cutflow pressure (0044 = 44 psi)                      Shield preflow pressure (0044 = 44 psi)                      Current setpoint (amps)                      System state (see table V) (0003 = state 3)                      System error (see table IV) (0000 = error 0)                      Cut gas 1 pressure (0044 = 44 psi)                      Cut gas 2 pressure (0044 = 44 psi)                      N<sub>2</sub> Mix inlet pressure (0044 = 44 psi)                      Gas2 Mix inlet pressure (0044 = 44 psi)</p> <p><b>Note:</b> Cut gas 1, Cut gas 2, N<sub>2</sub> mix inlet, and Gas 2 mix inlet are not measured in the manual gas console configuration.</p> <p><b>Sample:</b>                      &gt;079A0&lt;                      &gt;079PC0044 PP0042 SC0034 SP0035 CS0040 ST0003 ER0000 CG0000 CG0000 MV0000 MV0000DE&lt;</p>
084	DOWNLOAD_SOFTWARE  Not currently implemented on the HD4070 or the HPR systems	TBD	<p>Download new firmware to the plasma system.</p> <p><b>Data:</b> TBD</p> <p><b>Return value:</b> 1 = packet accepted, 0 = not accepted</p> <p><b>Sample:</b> TBD</p>
085	WAKE	Manual gas system Auto gas system	<p>This command is used to wake a system and enable its transmitter to communicate on a multi drop line.</p> <p><b>Data:</b> System ID, which is set by dipperswitches on PC board.</p> <p><b>Return value:</b> Echo of the command</p> <p><b>Sample:</b>                      &gt;0850CD&lt;                      &gt;0850CD&lt;</p>
086	SLEEP	Manual gas system Auto gas system	<p>Tell all systems on the line to disconnect their transmitters</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> None</p> <p><b>Sample:</b>                      &gt;0869E&lt;                      No response</p>

Command table (6 of 14)

ID	Command	System	Description
087	BROADCAST MODE	Manual gas system Auto gas system	Tell all systems to listen but not respond. <b>Data:</b> None <b>Return value:</b> None <b>Sample:</b> >0879F< no response
094	READ_GAS_PRESSESURES	Manual gas system Auto gas system	Read the gas pressures. <b>Data:</b> None <b>Return value:</b> Plasma cutflow pressure (psi), Plasma preflow pressure (psi), Shield cutflow pressure (psi), Shield preflow pressure (psi), Cut gas 1 pressure (psi), Cut gas 2 pressure (psi), N <sub>2</sub> Mix inlet pressure (psi), Gas2 Mix inlet pressure (psi) space-delimited Values are in psi (0007 = 7 psi) <b>Sample:</b> >0949D< >094PC0007 PP0036 SC0016 SP0003 CG0000 CG0000 MV0000 MV00005D<
095	SET_ALL_PARAMETERS	Auto gas system	Set all variables to run the plasma system. <b>If inlet gases change power supply will enter the purge state. Gas type changes are not allowed when the system is cutting (state 4 – state 10).</b> N <sub>2</sub> mix setpoint and Gas 2 mix setpoint are only applicable when using a mixed plasma gas such as H35 – N <sub>2</sub> otherwise these 2 values should be set to 0. A value of 0 for N <sub>2</sub> Mix setpoint will cause the system to close SV12, the solenoid valve for N <sub>2</sub> mixing. A value of 0 for Gas 2 Mix Setpoint will cause the system to close SV13 and open SV14. This will cause the inlet gas to bypass motor valve 2 and pass directly to the outlet of the mixing console. <b>Data:</b> Current setpoint (5 – 130/260/400 amps), Corner current percent (50 - 100%), Plasma gas type code (use table VI), Shield gas type code (use table VI), Plasma cutflow setpoint (0 – 99 psi), Plasma preflow setpoint (0 – 99 psi), Shield cutflow setpoint ( 0 – 99 psi), Shield preflow setpoint (0 – 99 psi), N <sub>2</sub> mix setpoint (0 – 100 psi), Gas 2 mix setpoint (0 – 100 psi), space-delimited. <b>Return value:</b> 1= accepted, 0 = not accepted <b>Sample:</b> >095100 75 1 6 55 45 35 25 00 0084< >0951CF<

**Command table (7 of 14)**

ID	Command	System	Description
096	SET_INLET_GASES	Auto gas system	<p>Set inlet gases for auto console. <b>If inlet gases change, the power supply will enter the purge state. Gas type changes are not allowed when the system is cutting (state 4 – state 10).</b></p> <p><b>Data:</b>                      Plasma gas type code (See table VI),                      Shield gas type code (See table VI),                      space-delimited.</p> <p><b>Return value:</b>                      1 = accepted, 0 = not accepted</p> <p><b>Sample:</b>                      &gt;0961 626&lt; (Set plasma gas = O<sub>2</sub> and set shield gas = N<sub>2</sub>)                      &gt;0961D0&lt;</p>
097	READ_CORNER_CURRENT	Manual gas system Auto gas system	<p>Read the corner-current percentage</p> <p><b>Data:</b>                      None</p> <p><b>Return value:</b>                      Percentage</p> <p><b>Sample:</b>                      &gt;097A0&lt;                      &gt;09700756C&lt; (75%)</p>
098	GET_INLET_GASES	Manual gas system Auto gas system	<p>Read the inlet gas types</p> <p><b>Data:</b>                      None</p> <p><b>Return value:</b>                      Plasma gas type code (See table VI),                      Shield gas type code (See table VI),                      space-delimited</p> <p><b>Sample:</b>                      &gt;098A1&lt;                      &gt;0980001 000648&lt; (Plasma gas = O<sub>2</sub> and shield gas = N<sub>2</sub>)</p>
099	GET_GAS_FLOWS	Auto gas system	<p>Read the gas setpoints</p> <p><b>Data:</b>                      None</p> <p><b>Return value:</b>                      Plasma cutflow setpoint (psi),                      Plasma preflow setpoint (psi),                      Shield cutflow setpoint (psi),                      Shield preflow setpoint (psi),                      N<sub>2</sub> Mix setpoint (psi),                      Gas 2 mix setpoint (psi)                      space-delimited.                      (55 = 55 psi)</p> <p><b>Sample:</b>                      &gt;099A2&lt;                      &gt;0990055 0045 0035 0025 0050 0050EE&lt;</p>



Command table (8 of 14)

ID	Command	System	Description
100	GET_CONTROL_DATA	Manual gas system Auto gas system	<p>Read internal control data: Chopper A used in HPR130/HPR260 Chopper B used in HPR260</p> <p>Return string is the same whether the system is an HPR130 or HPR260. Chopper B data can be ignored for HPR130.</p> <p>Chopper A temp (raw A/D, 0 - 1023), Chopper B temp (raw A/D, 0 - 1023), Line voltage (1/10 volts, 0 - 2400), 240.0 vac Coolant flow (1/100 gpm, 0 - 440), 4.40 gpm Coolant temp (raw A/D, 0 - 1023), Transformer temp (raw A/D, 0 - 1023), Chopper A current (0 – 130 amps), Chopper B current (0 – 130 amps), Work lead current (0 – 130/260 amps), Chopper A setpoint (5 – 130 amps), Chopper B setpoint (5 – 130 amps), PWM chopper A (100% = 1070), PWM chopper B (100% = 1070).</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> Above info is space-delimited.</p> <p><b>Sample:</b> &gt;10091&lt; &gt;100CAT0482 CBT0021 LVO0118 CFL0009 CTP0481 TTP0481 CAC0001 CBC0014 WLC0005 CAS0000 CBS0534 PWMA0000 PWMB00000B&lt;</p>
101	SET_IO_STATUS	Manual gas system Auto gas system	<p>This command will allow the user to turn on or off each output of the processor. After sending this command, the SYSTEM_RESET command must be issued to restore the processor state. The I/O are in the following order:</p> <p><b>Data:</b> 1 = On, 0 = Off for each I/O point</p> <p><b>Return value:</b> 1 = accepted, 0 = not accepted</p> <p><b>Power Supply</b> Pilot arc Relay Marking surge relay Pilot arc enable Coolant pump motor Soft-start enable CNC error CNC ramp-down error Igniter Contactor CNC machine motion CNC spare output Spare output</p> <p><b>Sample:</b> &gt;1011111111111111DD&lt; = All outputs on &gt;1011C3&lt;</p>

**Command table (9 of 14)**

ID	Command	System	Description
102	SET_GAS_IO_FROM_PS	Manual gas system Auto gas system	<p>This command will allow the user to turn on or off each output of the processor. After sending this command, the SYSTEM_RESET command must be issued to restore the processor state. The I/O are in the following order:</p> <p><b>Data:</b> 1 = On, 0 = Off for each I/O point</p> <p><b>Return value:</b> 1 = accepted, 0 = not accepted</p> <p><b>Manual Gas Console</b></p> <ul style="list-style-type: none"> <li>Shield cutflow (SV16)</li> <li>Calibrate bypass (SV13)</li> <li>Plasma cutflow 1 (SV14)</li> <li>Ramp-down valve (SV20)</li> <li>Shield preflow (SV17)</li> <li>Plasma preflow (SV18)</li> <li>Plasma cutflow 2 (SV19)</li> <li>H35 plasma cutflow 2 (SV12)</li> <li>Spare valve (SV15)</li> <li>O<sub>2</sub> shield cutflow (SV4)</li> <li>Air shield cutflow (SV5)</li> <li>N<sub>2</sub> shield cutflow (SV6)</li> <li>Air preflow (SV7)</li> <li>N<sub>2</sub> preflow (SV8)</li> <li>Air plasma cutflow 2 (SV9)</li> <li>Air plasma cutflow 1 (SV1)</li> <li>O<sub>2</sub> plasma cutflow 1 (SV2)</li> <li>H35 plasma cutflow 1 (SV3)</li> <li>O<sub>2</sub> plasma cutflow 2 (SV10)</li> <li>N<sub>2</sub> plasma cutflow (SV11)</li> </ul> <p><b>Auto Gas Console</b></p> <ul style="list-style-type: none"> <li>O<sub>2</sub> inlet (SV1)</li> <li>Air inlet (SV2)</li> <li>Air inlet 2 (SV3)</li> <li>H5 inlet (SV4)</li> <li>H35 inlet (SV5)</li> <li>F5 inlet (SV6)</li> <li>Spare out 1 (Spare)</li> <li>Ramp-down valve (SV16)</li> <li>Spare out 2 (Spare)</li> <li>Gas 2 no mix (SV14)</li> <li>Gas 2 mix (SV13)</li> <li>N<sub>2</sub> mix (SV12)</li> <li>N<sub>2</sub> inlet 2 (SV11)</li> <li>Air inlet 3 (SV10)</li> <li>N<sub>2</sub> inlet (SV9)</li> <li>O<sub>2</sub> air inlet (SV8)</li> <li>CH4 inlet (SV7)</li> </ul> <p><b>Sample:</b> &gt;10211111111111111111111111111111167&lt; &gt;1021C4&lt;</p>

Command table (10 of 14)

ID	Command	System	Description
114	READ_INPUTS	Manual gas system Auto gas system	<p>This command will return the status of inputs to the PC board.</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> 1 = on, 0 = off</p> <p><b>Power Supply</b> Serial program Plasma start Hold ignition Phase OK Arc detect Pierce complete Corner current Redundant start Serial ID0 Serial ID1 Serial ID2 Dipswitch #1 Dipswitch #5 Dipswitch #6 Dipswitch #7 Dipswitch #8 Chopper A overcurrent Chopper B overcurrent</p> <p><b>Sample:</b> &gt;11496&lt; &gt;11400000000000000000F6&lt;</p>
117	READ_GAS_INPUTS_FROM_PS	Manual gas system Auto gas system	<p>This command will allow the CNC to query the gas console I/O by sending the command to the serial port on the power supply control board.</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> 1 = on, 0 = off</p> <p><b>Manual Gas Console</b> Error select Status select Test preflow Test cutflow Serial ID bit 0 Serial ID bit 1 Serial ID bit 2</p> <p><b>Auto Gas Console</b> Metering dipswitch 2 Metering dipswitch 3 Metering dipswitch 4 Select dipswitch 1 Select dipswitch 2 Select dipswitch 3 Select dipswitch 4 Metering dipswitch 1</p> <p><b>Sample:</b> &gt;11799&lt; &gt;1170000000E9&lt;</p>

**Command table (11 of 14)**

ID	Command	System	Description
121	LEAK_CHECK_MODE	Manual gas system Auto gas system	<p>This command will put the system into leak mode. There are 3 modes, mode #1 is the inlet leak check mode. This is used to see if the inlet solenoids are allowing gas to pass through the valve even when they are closed.</p> <p>Mode #2 is the system leak check mode which will test for leaks to atmosphere within the system. Mode #3 is the Burkert valve flow test. For automatic gas consoles only.</p> <p>For the inlet leak test, the system should have 0 psi on all gas channels, and hold at this pressure.</p> <p>For the system leak test, the system should charge all gas lines, then hold the pressure.</p> <p>The Burkert flow test checks for an expected PWM value for a set pressure and does a gas ramp-down test.</p> <p><b>NOTE: This test is preformed using 130 amp O<sub>2</sub> / Air consumables and setting the 30 amp O<sub>2</sub> / O<sub>2</sub> process</b></p> <p>Each test takes about 40 seconds to complete.</p> <p>This command will only be accepted when the power supply is in the state IDLE2 (03).</p> <p>After leak checking is complete the system must be set to mode 0.</p> <p>An error code will reflect the state of the test. Using the GET_LAST_ERROR command, you can get the result of the test.</p> <p>12 = Test in progress            13 = Test passed            14 = Cut gas channel #1 failed            15 = Cut gas channel #2 failed            16 = Plasma ramp-down test failed (Burkert test only)            17 = Shield ramp-down test failed (Burkert test only)</p> <p><b>Data:</b>            Mode 0 = run                1 = Inlet leak check                2 = System leak check                3 = Burkert flow check</p> <p><b>Return value:</b>            Time for the test to run in seconds, 0 = not accepted</p> <p><b>Sample:</b>            &gt;1211C5&lt;            &gt;12140F8&lt; "40 second test"</p>

Command table (12 of 14)

ID	Command	System	Description
122	READ_GAS_SWITCH	Manual gas system	<p>This command will return data that shows the actual position of the rotary switches used to set the inlet gas type.</p> <p>The difference between this command and 098 is that this command returns the values set by the position of the switch. The 098 command returns values that the software decides are acceptable gas combinations. For example, H35 plasma and O<sub>2</sub> shield is not acceptable and is overridden by the software to be H35 plasma and N<sub>2</sub> shield regardless of the position of the shield gas knob. In this case, the 098 command would return H35 N<sub>2</sub>. This command will return H35 O<sub>2</sub>.</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> Plasma gas type code (See table VI), Shield gas type code (See table VI), space-delimited</p> <p><b>Sample:</b> &gt;12295&lt; &gt;1220001 00063C&lt;</p>
124	INDEX_MOTORVALVES	Auto gas system	<p>Move the motor valve by a fixed number of ADC counts</p> <p><b>Data:</b> Motor Valve number (1 or 2) Open/Clos (0 = Close, 1 = Open) Multiplier (move by x10 counts, 3 = move 30 counts)</p> <p><b>Return value:</b> 1 = accepted</p> <p><b>Sample:</b> Open Motor valve 1 by 30 counts &gt;1241 1 36C&lt; &gt;1241C8&lt;</p>
125	GET_TIMER_COUNTER	Manual gas system Auto gas system	<p>Read Timer/Counter data from the power supply</p> <p><b>Data:</b> None</p> <p><b>Return value:</b> Arc-on time (seconds) System on time (minutes) Total starts (# of arc transfers) Total starting errors (failed to transfer) Total ramp-down errors (failed to ramp-down current) Write counter (# of writes to the present memory block – for diagnostics only) Memory block (current memory location for timer counter data – for diagnostics only)</p> <p>All fields are a fixed width of 7 numbers followed by a space.</p> <p><b>Sample:</b> &gt;12598&lt; &gt;1250000000 0000000 0000000 0000000 0000000 0000000 0000000 58&lt;</p>

**Command table (13 of 14)**

<b>ID</b>	<b>Command</b>	<b>System</b>	<b>Description</b>
126	GET_INFO2	Auto gas control board only	See 079
127	GET_INFO3	Auto gas control board only	See 079
131	CLEAR WARNINGS	Manual gas system Auto gas system	This command will clear error codes less than #43. Sample: >13195< >1311C6<
132	READ COOLANT PRESSURE	HPR260 ONLY	This command returns the raw A/D value for coolant pressure. 83 counts = 225 psi 73 counts = 200 psi <b>Sample:</b> >13296< >13280FE<
133	GET CONTROL DATA3	HPR400XD ONLY	This command provides data for the 3rd and 4th choppers used in the HPR400 system. Chopper C temp (raw A/D) Chopper D temp (raw A/D) Chopper C current (amps) Chopper D current (amps) <b>Data:</b> None <b>Return value:</b> Above info space-delimited. <b>Sample:</b> >13397< >133CCT0482 CDT0021 CCC0000 CDC000050<
134	READ ERROR LOG	ALL HPR SYSTEMS	This command will return the last 4 error codes the system encountered. The log will only record errors (error code values greater than 0). It ignores error code 0, which indicates no error or that an error has been cleared. The error codes are listed space-delimited, most recent error first. <b>Data:</b> None <b>Return value:</b> Error – most recent (see table IV Error Codes) Error #2 Error #3 Error – oldest error <b>Sample:</b> >13498< >134020 020 024 0534A<

Command table (14 of 14)

ID	Command	System	Description
136	SERIAL_RESPONSE_DELAY	All HPR systems	<p>Used when a CNC serial port can only support a half-duplex connection. The HPR power supply will reduce its response speed.</p> <p><b>Data:</b></p> <p>None</p> <p><b>Return value:</b></p> <p>1 if successful</p> <p><b>Sample:</b></p> <p>Send &gt;1369A&lt;, response &gt;1361CB&lt;</p>
158	GET_SECONDARY_VERSION	HPR800XD ONLY	<p>Get the software version of the secondary power supply</p> <p><b>Data:</b></p> <p>None</p> <p><b>Return value:</b></p> <p>The Secondary Power Supply software version</p> <p>ex."D.0". "0.0" is returned if no secondary power supply is connected and the power is on.</p> <p><b>sample:</b></p> <p>&gt;1589E&lt;</p> <p>&gt;158D.040&lt;</p>

### Error responses

If there is a problem with the serial command, the module will return an error.

#### Bad checksum

Return ID: 500

Description: The serial command received does not have the correct checksum.

Sample: >00091< – checksum should be 90, not 91

>50095< – bad checksum

#### Bad command

Return ID: 501

Description: If the module does not recognize the command ID, it will return ID 501.

Sample >999AB< – unknown ID

>50196< – bad command

### Calculating checksums

Checksum is calculated on the command ID and command data only.

HELLO Command: >00090<

0 = 0x30 (ASCII value for number 0)

0 = 0x30

0 = 0x30

-----

Checksum = 0x30 + 0x30 + 0x30 = 90

READ INPUTS power supply response: >107000058<

1 = 0x31

0 = 0x30

7 = 0x37

0 = 0x30

0 = 0x30

0 = 0x30

0 = 0x30

-----

Checksum = 0x31 + 0x30 + 0x37 + 0x30 + 0x30 + 0x30 + 0x30 = 0x158

We only use the 2 least significant digits so the checksum = 58



**Error codes**

<b>ID</b>	<b>Name</b>	<b>Description</b>
000	NO ERROR	System is ready to run.
009	FLOW SWITCH TEST	When the pump is restarted after a pump timeout (30 minutes without a start signal) the system will test the flow switch to make sure there is sufficient flow before firing the torch.
011	NO_ACTIVE_PROCESS	The power supply receives an invalid current setting from a CNC.
012	TEST IN PROGRESS	One of the gas test modes is running.
013	TEST PASSED	The test completed successfully.
014	CUT GAS CHANNEL #1 FAIL	The gas pressure is dropping on channel #1, indicating a leak.
015	CUT GAS CHANNEL #2 FAIL	The gas pressure is dropping on channel #2, indicating a leak.
016	PLASMA RAMP-DOWN FAIL	Pump output has exceeded 200 psi.
017	SHIELD RAMP-DOWN FAIL	Shield pressure did not decrease in the allotted time.
018	PUMP OVER PRESSURE	Pump output has exceeded 13.79 bar (200 psi.)
020	NO PILOT ARC	No current detected from chopper at ignition and before 1-second timeout.
021	NO ARC TRANSFER	No transfer signal detected before 500-msec timeout.
024 Primary 224 Secondary	LOST CURRENT CH1	After transfer, lost the chopper current signal.
025 Primary 225 Secondary	LOST CURRENT CH2	After transfer, lost the chopper current signal.
026 Primary 226 Secondary	LOST TRANSFER	After transfer, lost the transfer signal.
027 Primary 227 Secondary	LOST PHASE	When main contactor is engaged, no "phase OK" input.
028 Primary 228 Secondary	LOST CURRENT CH3	After transfer, lost the chopper current signal.
030	GAS SYSTEM ERROR	A failure has occurred in the gas system.
031 Primary 231 Secondary	START LOST	Start signal was removed before steady-state operation.
032	HOLD TIMEOUT	Hold signal was applied for longer than 60 seconds.
033	PRE CHARGE TIMEOUT	Gas console was not able to charge the gas lines to the correct pressure.
034 Primary 234 Secondary	PRE CHARGE TIMEOUT	Gas console was not able to charge the gas lines to the correct pressure.
042	LOW NITROGEN PRESSURE	Nitrogen gas pressure under lower limit of 2.07 bar (30 psi) – cutting, 0.34 bar (5 psi) – marking
044	LOW PLASMA GAS PRESSURE	Gas pressure under lower limit of 0.34 bar (5 psi) – pre-flow 3.45 bar (50 psi) – cutflow (cutting) 0.34 bar (5 psi) – cutflow (marking).
045	HIGH PLASMA GAS PRESSURE	Gas pressure over upper limit of 7.58 bar (110 psi).
046	LOW LINE VOLTAGE	Line voltage is under lower limit of 102 VAC (120 VAC -15%).
047	HIGH LINE VOLTAGE	Line voltage is over upper limit of 138 VAC (120 VAC +15%).
048 Primary 248 Secondary	CAN ERROR	An error occurred with the CAN communication system.
050 Primary 250 Secondary	START ON AT INIT	Start signal input is active during power-up.
053	LOW SHIELD GAS PRESSURE	Gas pressure is under lower limit of 0.14 bar (2 psi).

## APPENDIX B – CNC INTERFACE PROTOCOL

ID	Name	Description
054	HIGH SHIELD GAS PRESSURE	Gas pressure is over upper limit of 7.58 bar (110 psi).
055	MV 1 INLET PRESSURE	Motor valve 1 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).
056	MV 2 INLET PRESSURE	Motor valve 2 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).
057	CUT GAS 1 PRESSURE	In the selection console, cut gas 1 outlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).
058	CUT GAS 2 PRESSURE	In the selection console, if cut gas 2 outlet pressure is less than 3.45 bar (50 psi) for non-mixing, or less than 1.38 bar (20 psi) when mixing or greater than 9.65 bar (140 psi) for non-mixing and mixing.
060	LOW COOLANT FLOW	Coolant flow is less than the required 2.3 lpm (0.6 gpm).
061	NO PLASMA GAS TYPE	Plasma gas has not been selected.
062	NO SHIELD GAS TYPE	Shield gas has not been selected, or system is in test mode.
065 Primary 265 Secondary	CHOPPER1 OVERTEMP	Chopper #1 overheated.
066 Primary 266 Secondary	CHOPPER2 OVERTEMP	Chopper #2 overheated.
067 Primary 267 Secondary	MAGNETICS OVERTEMP	Transformer has overheated.
071	COOLANT OVERTEMP	Torch coolant has overheated.
072	AUTOMATIC GAS CONTROL BOARD OVERTEMP	Control board has exceeded 90° C (194° F).
073 Primary 273 Secondary	CHOPPER3 OVERTEMP	Chopper #3 overheated
074 Primary 274 Secondary	CHOPPER4 OVERTEMP	Chopper #4 overheated
075 Primary 275 Secondary	CURRENT TOO LOW ON LEM #3	A current less than 10 amps has been detected by current sensor 3.
076 Primary 276 Secondary	CURRENT TOO LOW ON LEM #4	A current less than 10 amps has been detected by current sensor 4.
093	NO COOLANT FLOW	Coolant flow is less than 0.6 gpm.
095	CURRENT TOO HIGH ON LEM #4	Current has exceeded 35 amps during the chopper test
099 Primary 299 Secondary	CHOPPER1 OVERTEMP AT INIT	Chopper #1 is indicating overtemp during power-up.
100 Primary 300 Secondary	CHOPPER2 OVERTEMP AT INIT	Chopper #2 is indicating overtemp during power-up.
101 Primary 301 Secondary	MAGNETICS OVERTEMP AT INIT	Transformer is indicating overtemp during power-up.
102 Primary 302 Secondary	OUTPUT CURRENT AT INIT	Chopper current signal is active on power-up.
103 Primary 303 Secondary	CURRENT TOO HIGH ON LEM #1	A current greater than 35 amps has been detected by current sensor 1.
104 Primary 304 Secondary	CURRENT TOO HIGH ON LEM #2	A current greater than 35 amps has been detected by current sensor 2.
105 Primary 305 Secondary	CURRENT TOO LOW ON LEM #1	A current less than 10 amps has been detected by current sensor 1.

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ID	Name	Description
106 Primary 306 Secondary	CURRENT TOO LOW ON LEM #2	A current less than 10 amps has been detected by current sensor 2.
107 Primary 307 Secondary	CURRENT TOO HIGH ON LEM #3	A current greater than 35 amps has been detected by current sensor 3.
108 Primary 308 Secondary	TRANSFER AT INIT	The system has detected current on the work lead during power-up.
109	COOLANT FLOW AT INIT	Coolant flow is greater than 1.14 lpm (0.3 gpm) when pump is off.
111	COOLANT OVERTEMP AT INIT	Coolant is indicating overtemp during power-up.
116 Primary 316 Secondary	WATCHDOG INTERLOCK	CAN communication error.
123	MV 1 ERROR	Motor valve 1 did not move into position within 60 seconds.
124	MV 2 ERROR	Motor valve 2 did not move into position within 60 seconds.
133	UNKNOWN GAS CONSOLE TYPE	The power supply control board does not recognize the gas console installed or has not received a CAN message identifying the type of console installed.
134 Primary 334 Secondary	CHOPPER 1 OVERCURRENT	Chopper 1 current feedback has exceeded 160 amps.
138 Primary 338 Secondary	CHOPPER 2 OVERCURRENT	Chopper 2 current feedback has exceeded 160 amps.
139	PURGE TIMEOUT ERROR	The purge cycle did not complete within 3 minutes.
140	AUTO GAS PRESSURE TRANSDUCER #1 ERROR	Faulty transducer or auto gas control PCB
141	AUTO GAS PRESSURE TRANSDUCER #2 ERROR	Faulty transducer or auto gas control PCB
142	AUTO GAS PRESSURE TRANSDUCER #3 ERROR	Faulty transducer or auto gas control PCB
143	AUTO GAS PRESSURE TRANSDUCER #4 ERROR	Faulty transducer or auto gas control PCB
144	MANUAL GAS CONSOLE INTERNAL FLASH MEMORY ERROR	Replace manual gas console control PCB
145	AUTOMATIC GAS CONSOLE INTERNAL FLASH MEMORY ERROR	Replace auto gas console control PCB
146 Primary 346 Secondary	CHOPPER #3 OVERTEMP AT INIT	Chopper #3 is indicating over temp during power-up
147 Primary 347 Secondary	CHOPPER #4 OVERTEMP AT INIT	Chopper #4 is indicating over temp during power-up
151 Primary 351 Secondary	SOFTWARE FAIL	Software has detected an incorrect state or condition.
152	INTERNAL FLASH ERROR	DSP memory is not working properly.
153	PS EEPROM ERROR	EEPROM memory on power supply board not working.
154 Primary 354 Secondary	CHOPPER 3 OVER CURRENT	Chopper 3 current feedback has exceeded 160 amps
155 Primary 355 Secondary	CHOPPER 4 OVER CURRENT	Chopper 4 current feedback has exceeded 160 amps

## APPENDIX B – CNC INTERFACE PROTOCOL

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ID	Name	Description
156 Primary 356 Secondary	CHOPPER 2 CURRENT AT INIT	Chopper 2 current signal is active on power-up
157 Primary 357 Secondary	CHOPPER 3 CURRENT AT INIT	Chopper 3 current signal is active on power-up
158 Primary 358 Secondary	CHOPPER 4 CURRENT AT INIT	Chopper 4 current signal is active on power-up
159 Primary 359 Secondary	MOTOR DRIVE FAULT	Motor drive board power module is indicating an alarm – this can be comparable to “blowing a fuse” – does not necessarily indicate a problem with the board.
160	HPR COOLER CAN FAULT	Communications between the control board and the pump/motor drive board was interrupted for greater than 1 second.
161	MAXIMUM COOLANT FLOW EXCEEDED	Communications between the control board and the pump/motor drive board was interrupted for greater than 1 second.
180	SELECTION CONSOLE CAN TIMEOUT	Power supply has not received a CAN message from the selection console within 1 second
181	METERING CONSOLE CAN TIMEOUT	Power supply has not received a CAN message from the metering console within 1 second
182	SECONDARY POWER SUPPLY TIMEOUT	The secondary power supply fails before transmitting the error to the primary power supply.
383	SECONDARY POWER SUPPLY TIMEOUT	The secondary power supply is ready to provide current output but does not receive the control signal from the primary power supply.

## Status codes

ID	Name
00	IDLE
02	PURGE
03	IDLE2
04	PREFLOW
05	PILOT ARC
06	TRANSFER
07	RAMP-UP
08	STEADY STATE
09	RAMP-DOWN
10	FINAL RAMP-DOWN
11	AUTO OFF
12	TEST CUTFLOW
14	SHUTDOWN
15	RESET
16	MAINTENANCE
20	TEST PREFLOW
22	MANUAL PUMP CONTROL
23	INLET LEAK CHECK
24	SYSTEM LEAK CHECK
25	BURKERT FLOW CHECK

## Gas type codes

ID	Gas type
0	No gas
1	Oxygen
2	Methane (CH <sub>4</sub> ) not supported
3	H35 (argon – hydrogen)
4	H5 (not supported)
5	Air
6	Nitrogen
7	Argon
8	F5 (N95)

### CNC requirements

#### Auto gas console

Below is a list of functionality that CNCs must offer for the automatic gas console version of the HPR system. In this system configuration there is no local control of the plasma system. All settings and diagnostic information will be under CNC control.

1. Display and adjust the current setpoint – cutting current, see command ID No. 95
2. Display and adjust the plasma preflow setpoint – pressure setting, see command ID No. 95
3. Display and adjust the plasma cutflow setpoint – pressure setting, see command ID No. 95
4. Display and adjust the shield preflow setpoint – pressure setting, see command ID No. 95
5. Display and adjust the shield cutflow setpoint – pressure setting, see command ID No. 95
6. Display and adjust the plasma gas type – inlet gas selection, see command ID No. 95
7. Display and adjust the shield gas type – inlet gas selection, see command ID No. 95
8. Display and adjust the gas mixing setpoint – pressure setpoint, see command ID No. 95
9. Display the system error code – error code numbers, see command ID No. 3
10. Display the system status code – status code numbers, see command ID No. 2
11. Manual pump control – manually turn on/off the pump, see command ID No. 71
12. Display the firmware version – version of power supply and gas console firmware, see command ID No. 1
13. Test preflow gases – put the system in test gas mode, see command ID No. 64, 65
14. Test cutflow gases – put the system in test gas mode, see command ID No. 66, 67
15. Power on/off – turn on/off the plasma system, not a serial command (active low, dry contact, opto-isolated)
16. Display line voltage – see command ID No. 100
17. Display chopper current(s) – see command ID No. 100
18. Display work lead current – see command ID No. 100
19. Display chopper temperature(s) – see command ID No. 100
20. Display transformer temperature – see command ID No. 100
21. Display gas pressures – see command ID No. 79
22. Display coolant flow rate – see command ID No. 100

## **Serial interface guidelines**

### **Checksum**

The protocol used for the serial interface between the Hypertherm system and the CNC contains a checksum on the message being sent. The checksum should be validated for each message to ensure the information is not corrupted.

### **Message retries**

We recommend retrying a message if the original message was not acknowledged by the system. This is especially important when the high-frequency ignition is active. The high-frequency ignition can be active for up to 1 second and can corrupt serial communications. It is important to space the retries so that the system can handle an interruption in serial communications for up to 1 second.

Another alternative to handling the high frequency ignition is to poll for the power supply state, using the GET\_STATE command. If the state is (5 – Pilot arc) then stop serial communications until the state is no longer (5 – Pilot arc).

### **Cable shielding**

We have chosen to use metal shell DB style machine/serial interface cables on some on the newer systems. One of the reasons this type of cable was selected is for their EMI shielding capabilities. It is important that integrity of the shielding of this cable be maintained. The shielding provides protection from the high-frequency ignition system, if the cable shields are not properly terminated then the protection is not as effective. This is best achieved by ensuring the shield has a 360° termination provided on both end of the cables. Using a drain wire will not achieve the proper shielding. The cable should also be as short as possible with no coils.





## Appendix C

### ROBOTIC APPLICATIONS

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## Components for robotic applications

### Torch leads

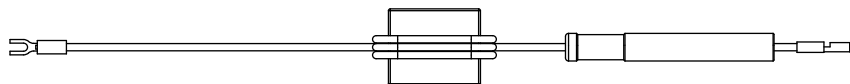
The torch leads listed below have been designed to withstand the added stresses found in robotic, or bevel, applications. They are available with 2 m (6 ft), or 2.5 m (8 ft) gas leads.

Note: Consumable life will be reduced if the 2.5 m (8 ft) gas leads are used.

Overall length	1.8 M (6 feet) gas lead	2.4 M (8 feet) gas lead
2 m (6 ft)	228514	228516
2.5 m (8 ft)	228515	228517
3 m (10 ft)	228475	228482
3.5 m (12 ft)	228476	228483
4.5 m (15 ft)	228477	228484
6 m (20 ft)	228478	228485
7.5 m (25 ft)	228479	228486
10 m (35 ft)	228480	228487
15 m (50 ft)	228481	228488

### Ohmic contact extension

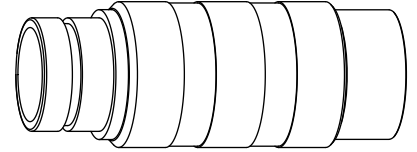
A 2.5 m (8 ft) Ohmic contact wire is part of the lead set. Extensions can be found in the table below.



Part number	Length	Part number	Length
223059	1.5 m (5 ft)	223064	12 m (40 ft)
223060	3 m (10 ft)	223065	15 m (50 ft)
223061	4.5 m (15 ft)	223066	22.5 m (75 ft)
223062	6 m (20 ft)	223067	30 m (100 ft)
223063	9 m (30 ft)	223068	45 m (150 ft)

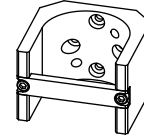
**Rotational mounting sleeve (optional) – 220864**

The rotational sleeve is designed for use in applications where the torch leads are twisted repeatedly. It is an optional component, and does not need to be used to use the torch leads listed above. The length of the rotational sleeve is 114.3 mm (4.5 in).



**Rotational mounting sleeve clamp – 220900**

The rotational sleeve has a larger diameter than standard sleeves (57 mm/2.25 in).

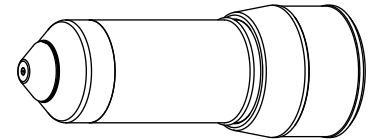


**Leather overwrap – 024866**

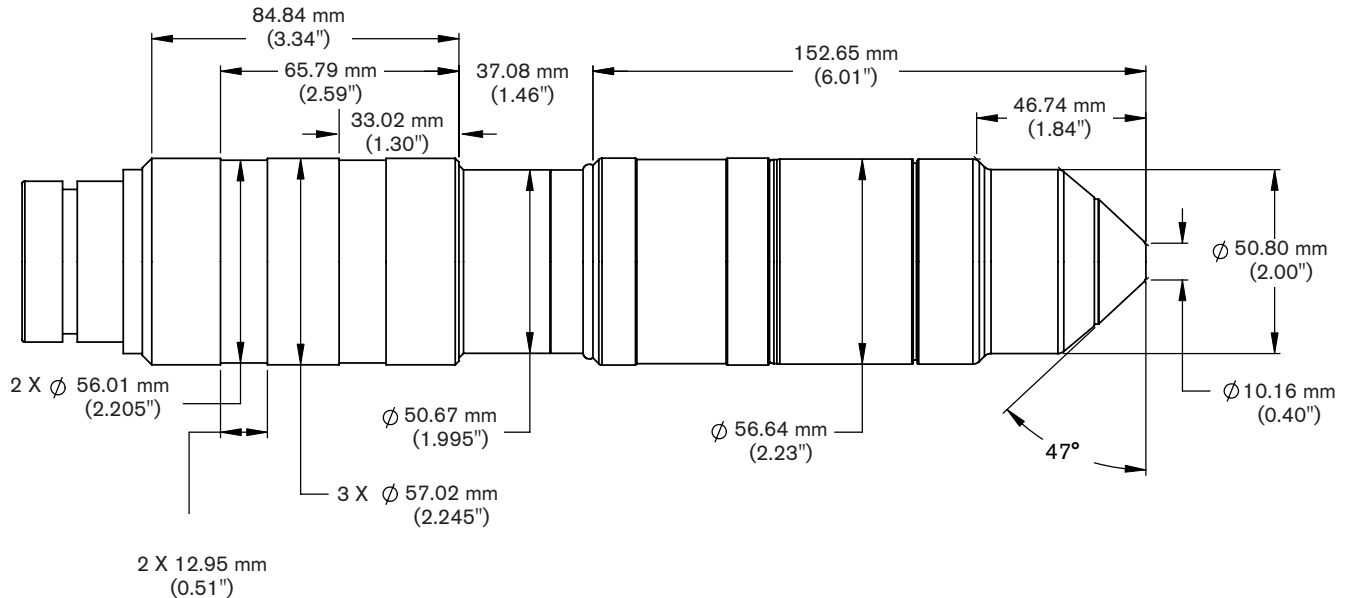
The leather overwrap is 3 m (10 ft) long, and is designed to be installed over the leads from where they attach to the torch. This adds protection in applications where molten metal will splash back on the leads.

**Robotic teaching torch (laser pointer) – 228394**

- Mount the laser pointer in the torch sleeve to provide accurate positioning and alignment of the torch.
- Use for online programming/teaching and robotic alignment systems.



**Torch and rotational mounting sleeve dimensions**





## HPR400XD auto gas instruction manual revision changes (806160)

Changed Page	Description of changes for revision 3 (date of revision - 9/2011)
Global	Inch marks (") have been replaced by the abbreviation (in).
EMC-1 through W-2	Updated the format and information for both the Electromagnetic compatibility and Warranty sections. Added Certification test marks, Differences in national standards, Higher-level systems, laser and Automation products, and Proper disposal of Hypertherm products information to the Warranty section.
Safety sections	Updated the format and content of the safety information. Added Dry dust collection and Laser radiation information.
2-4	Removed the note under the gas quality and pressure requirements table that said "Oxygen, nitrogen, and air are required for all systems. Nitrogen is used as a purge gas." The statement was inaccurate. Corrected the kPa pressure values from 827 kPa to 793 kPa.
2-5	Added power supply part numbers with Hypernet. Changed kW to kVA in the last column, "power".
2-11	Corrected the second bullet point to say "minimum" bend radius not maximum.
2-12	Added IEC symbol graphics and descriptions.
3-3	Updated information about noise levels. A generic statement pointing customers to information on the Hypertherm web site will be added to all Mechanized manuals over time.
3-11	Added a paragraph before the bullet points with some details about moving the power supply with a fork lift. Added "HPR400XD power supplies with serial number HPR400-000560 or later can be upgraded to a HPR800XD primary or secondary power supply." below the bullet points.
3-17 and 3-18	Added mounting hole call out.
3-23, 29, 37, 53 and 55	Added caution box about not using teflon tape.
3-26	Corrected the 2 cable signal list tables to say selection console instead of gas console.
3-42 and 3-43	Removed <i>changing consumables</i> note under torch alignment. Added a page and moved Torch lifter requirement to next page and added Hypernet information.
3-51	Removed the note "Oxygen, nitrogen, and air are required for all systems. Nitrogen is used as a purge gas." from under the first paragraph. The statement was inaccurate. Removed the reference to methane because it is not used.
3-53	Added "See <i>Supply gas hoses</i> at the end of this section for recommendations" to the first paragraph. Removed the note "Oxygen, nitrogen, and air are required for all systems. Nitrogen is used as a purge gas." from under the first paragraph. The statement was inaccurate. Removed the reference to methane because it is not used.
4-6 through 4-9	Updated CNC screen examples.
4-10	Added "When using the argon marking processes, mark and cut individual parts. Marking the entire nest prior to cutting may lead to reduced consumable life. For better results intersperse cuts and marks." under Marking.
4-14	Added Mild steel, thick piercing, bevel cutting consumables.
4-17 and 4-18	Expanded "Inspect consumables" from one page to 2. Increased size of graphics for clarity.

<b>Changed Page</b>	<b>Description of change for revision 2 (date of revision - 9/2011)</b>
4-20	Added Torch quick disconnect receptacle graphic.
4-25	Added "(for example: 30 amp O <sub>2</sub> /O <sub>2</sub> and 50 amp O <sub>2</sub> /O <sub>2</sub> processes). The pierce complete signal must be turned off for processes with shield gas preflow pressures that are lower than the cutflow pressures (for example: 600 amp and 800 amp processes)." to the second paragraph. Added third bullet point. Added "moving pierce", (800 amp SST piercing can be extended to 100 mm (4 in), and "an edge start is recommended unless the operator is experienced with this technique." to the last bullet point.
4-28 and 4-29	Updated kerf width compensation data. Added mixed gas processes to the table. Added 5 and 8 mm thicknesses. Populated empty boxes with N/A for not available. Added any new values that were available.
4-30	Updated kerf width compensation table data. Added mixed gas processes to the table. Added 5/16 in thickness. Populated empty boxes with N/A for not available. Added any new values that were available.
4-33 through 4-37 and 4-45,	Added 5 mm, 8 mm, and 5/16 in thicknesses to the cut charts.
4-39 and 4-40	Added "on the shield" to the note - They are only recommended for use if you have a problem with excessive slag on the shield, or problems with the torch misfiring, when using the standard bevel consumables.
4-45	Corrected the N <sub>2</sub> cutflow, flow rate.
4-38, 4-39, 4-46 through 4-60, 4-68 through 4-75	Added 8 mm, and 5/16 in thicknesses to the cut charts.
5-4	Changed heading from Control and signal cables to Power and signal cables.
5-5	Corrected the last line under number 2 to read "contactor remains closed" instead of contactor opens.
5-9, 27, 33 34, and 38	Updated the diagnostic screen and the Test Pump button (now the Coolant Override button)
5-10	Added error code number 11. Added XD after HPR130, 260, and 400 in the Name column (all instances). Added error code numbers for HPR800XD secondary power supply. Removed error code number 18. It is for the original HPR260 not the HPR260XD.
5-11, 5-12	Removed the "Perform chopper test" step from error code numbers 020, 024/224, 025/225, 026/226, 028/228, 034/234
5-13, 5-14, and 5-17	Added HPR400XD references to error code numbers 46, 47 steps 1, 4, and 6. Added HPR400XD references to code number 071 steps 1 and 2..
5-18	Added error code number 98 (Phase loss at initialization).
5-24	Added a note to the description of error code number 159/359. Added "on PCB7" after D30, D31, and D32 in the corrective action steps.
5-25	Added error code number 161
5-26	Added error code numbers 182 and 383
5-31	Added "Main power in" with an arrow. Rewrote the note about checking line to ground, for clarity.

<b>Changed Page</b>	<b>Description of change for revision 2 (date of revision - 9/2011)</b>
5-36	Added a second note about following the troubleshooting steps in order.
5-43	Updated the Gas Leak Test screen shot
5-67 and 5-68	Updated the Service Parts Replacement Schedule table. Corrected the part number for the annual preventive maintenance kit (it was 228015 and was changed to 228605). Corrected the part number for the torch main body (it was 220162 and was changed to 220706).
6-2	Added part numbers for power supplies with Hypernet and a note about Hypernet. Added the 415 volt power supply. Added Hypernet upgrade kit
6-5	Updated the part numbers for the control transformers.
6-17	Added part numbers to Consumables for mirror image cutting for 80 amp, 130 amp and 260 amp mild steel bevel cutting.
Schematics	All sheets updated from revision C to revision E.
Appendix A	Updated to the latest information and formatting for the Hypertherm torch coolant data (MSDS)
Appendix B	Added the secondary error code ID numbers after the primary error code ID number, for all applicable error codes.
b-6	Added information to the description of the "HELLO" command.
b-19	Added command numbers 136 and 158 to the command table.
b-21	Added error code number 11.
b-24	Added error code numbers 161, 182, and 383.
Appendix C	Updated TOC to include new items.
C-2	Added metric conversions for gas lead lengths. Added graphic of the ohmic contact extension.
C-3	Added graphics for the rotational mounting sleeve, the rotational mounting sleeve clamp, the leather over wrap, and the robotic teaching torch. Also added a dimensional drawing for the torch and rotational mounting sleeve.

