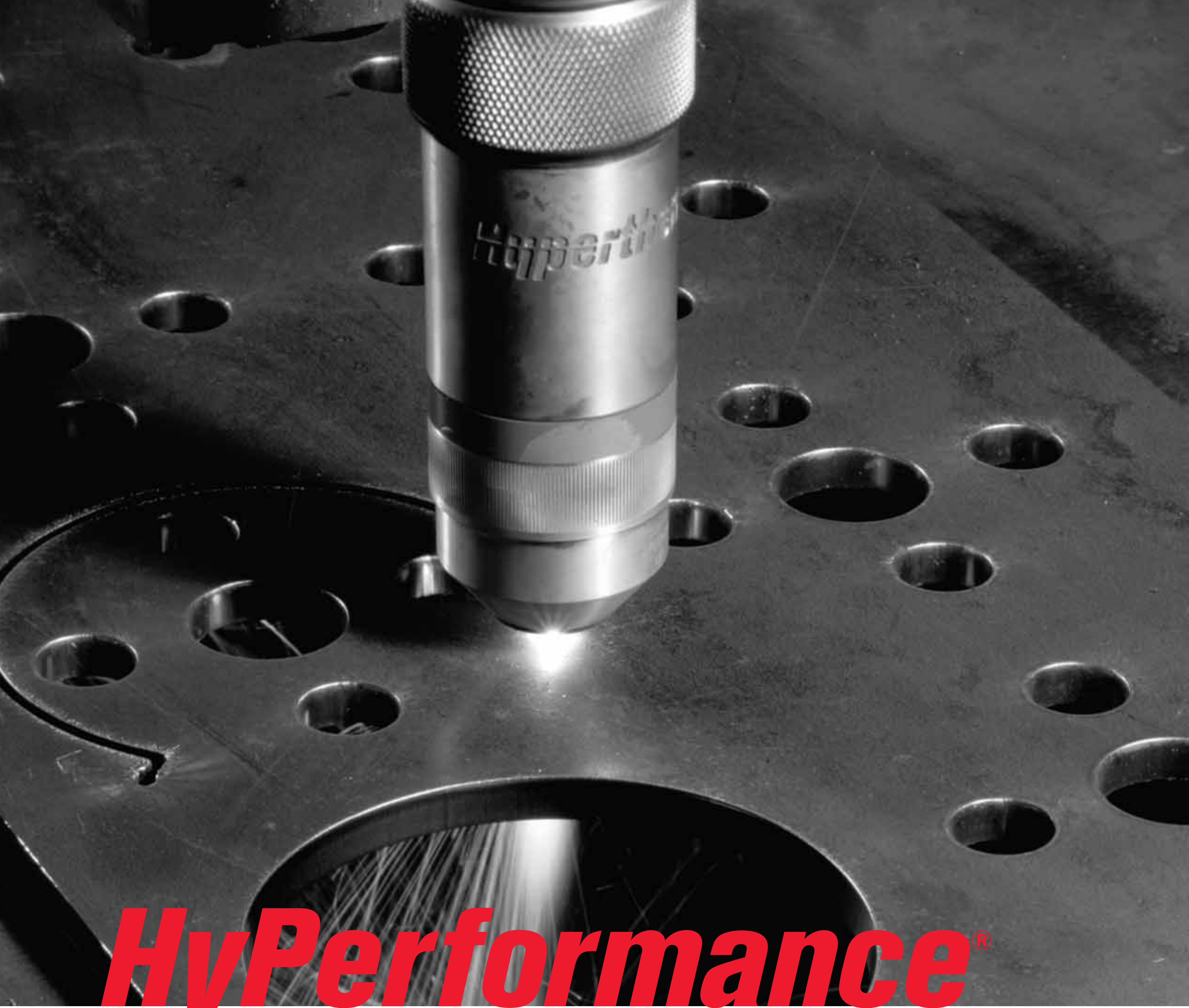

HyPerformance® Plasma HPR260®

Auto gas

Instruction manual

805000 – Revision 5

Hypertherm®

Register your new Hypertherm system

Register your product on-line at **www.hypertherm.com/registration** for easier technical and warranty support. You can also receive updates on new Hypertherm products and a free gift as a token of our appreciation.

For your records

Serial number: ______________________________

Purchase date: ______________________________

Distributor: ______________________________

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Maintenance notes:

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HyPerformance Plasma
HPR260 Auto Gas

Instruction Manual

(P/N 805000)

Revision 5 – April, 2008

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1/19/07

EMC 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 Workpiece*. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Assessment of area

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

a. Other supply cables, control cables, signalling and telephone cables; above, below and adjacent to the cutting equipment.

b. Radio and television transmitters and receivers.

c. Computer and other control equipment.

d. Safety critical equipment, for example guarding of industrial equipment.

e. Health of the people around, for example the use of pacemakers and hearing aids.

f. Equipment used for calibration or measurement.

g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.

h. Time of day that cutting or other activities are to be carried out.

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

Methods of reducing emissions

Mains supply

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

Maintenance of cutting equipment

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

Cutting cables

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

Equipotential bonding

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

Earthing of workpiece

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

Note: the cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is given in IEC/TS 62081 Arc Welding Equipment Installation and Use.

Screening and shielding

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

Attention

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

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

General

Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship, if Hypertherm is notified of a defect (i) with respect to the power supply within a period of two (2) years from the date of its delivery to you, with the exception of Powermax Series power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you, 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. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight prepaid. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with Hypertherm's prior written consent. **The warranty above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty**. Distributors/OEMs may offer different or additional warranties, but Distributors/ OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

Certification test marks

Certified products are identified by one or more certification test marks from accredited testing laboratories. The certification test marks are located on or near the data plate. Each certification test mark means that the product and its safety-critical components conform to the relevant national safety standards as reviewed by that testing laboratory. Hypertherm places a certification test mark on its products only after that product is manufactured with safety-critical components that have been authorized by the accredited testing laboratory.

Once the product has left the Hypertherm factory, the certification test marks are invalidated if any of the following occurs:

- The product is significantly modified in a manner that creates a hazard or non-conformance.
- Safety-critical components are replaced with unauthorized spare parts.
- Any unauthorized assembly or accessory that uses or generates a hazardous voltage is added.
- There is any tampering with a safety circuit or other feature that is designed into the product as part of the certification.

CE marking constitutes a 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 EMC Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the power supply with a CE Marking.

Patent indemnity

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

Limitation of liability

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

Liability cap

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

Insurance

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

National and Local codes

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

Transfer of rights

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

Proper disposal of Hypertherm products

Hypertherm plasma cutting systems, like all electronic products, may contain materials or components, such as printed circuit boards, that cannot be discarded with ordinary waste. It is your responsibility to dispose of any Hypertherm product or component part in an environmentally acceptable manner according to national and local codes.

- In the United States, check all federal, state, and local laws.
- In the European Union, check the EU directives, national, and local laws. For more information, visit www.hypertherm.com/weee.
- In other countries, check national and local laws.

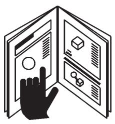
Section 1

SAFETY

In this section:

RECOGNIZE SAFETY INFORMATION

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



FOLLOW SAFETY INSTRUCTIONS

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

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

DANGER WARNING CAUTION

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

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

CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire prevention

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

Explosion prevention

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

WARNING

Explosion Hazard
Argon-Hydrogen and Methane

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

WARNING

Hydrogen Detonation
with Aluminum Cutting

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

ELECTRIC SHOCK CAN KILL

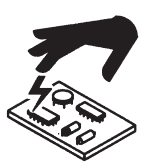
Touching live electrical parts can cause a fatal shock or severe burn.

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

Electric shock prevention

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

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



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.

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.

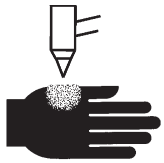
The air quality level in any relevant workplace depends on site-specific variables such as:

- 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.

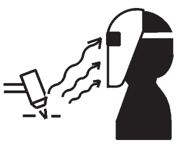


A PLASMA ARC CAN CAUSE INJURY AND BURNS

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

The plasma arc will cut quickly through gloves and skin.

- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.



ARC RAYS CAN BURN EYES AND SKIN

Eye protection Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

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

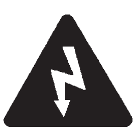
Arc current	Lens shade AWS (USA)	Lens shade ISO 4850
Up to 100 A	No. 8	No. 11
100-200 A	No. 10	No. 11-12
200-400 A	No. 12	No. 13
Over 400 A	No. 14	No. 14

Skin protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.

- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

Cutting area Prepare the cutting area to reduce reflection and transmission of ultraviolet light:

- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.



GROUNDING SAFETY

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

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

Input power

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

COMPRESSED GAS EQUIPMENT SAFETY

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

GAS CYLINDERS CAN EXPLODE IF DAMAGED

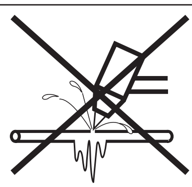
Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

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

NOISE CAN DAMAGE HEARING

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

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



A PLASMA ARC CAN DAMAGE FROZEN PIPES

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

PACEMAKER AND HEARING AID OPERATION

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

To reduce magnetic field hazards:

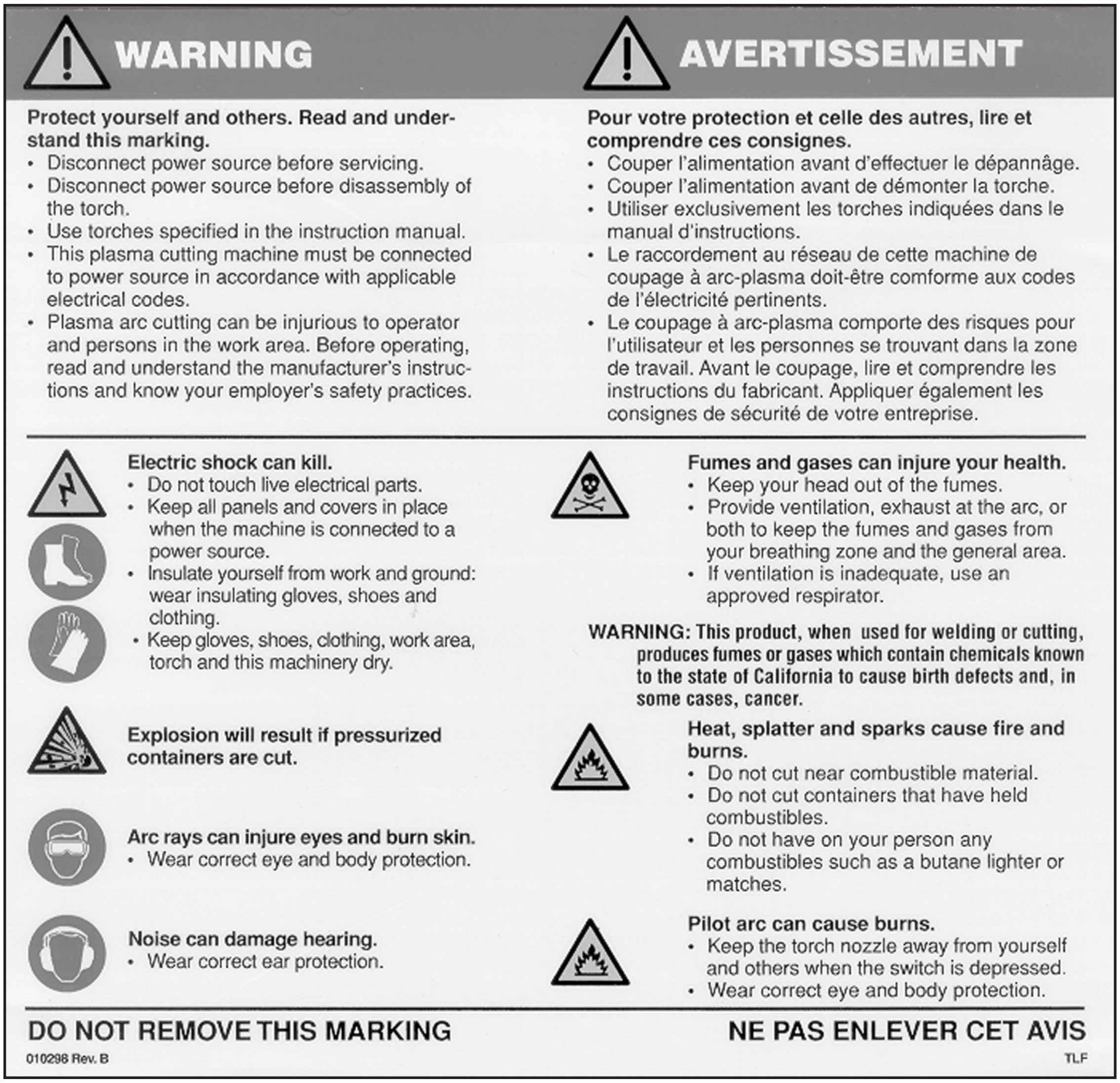
- Keep both the work cable and the torch lead to one side, away from your body.
- Route the torch leads as close as possible to the work cable.
- Do not wrap or drape the torch lead or work cable around your body.
- Keep as far away from the power supply as possible.

ADDITIONAL SAFETY INFORMATION

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

WARNING LABEL

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



WARNING | **AVERTISSEMENT**

Protect yourself and others. Read and understand this marking.

- Disconnect power source before servicing.
- Disconnect power source before disassembly of the torch.
- Use torches specified in the instruction manual.
- This plasma cutting machine must be connected to power source in accordance with applicable electrical codes.
- Plasma arc cutting can be injurious to operator and persons in the work area. Before operating, read and understand the manufacturer's instructions and know your employer's safety practices.

Pour votre protection et celle des autres, lire et comprendre ces consignes.

- Couper l'alimentation avant d'effectuer le dépannâge.
- Couper l'alimentation avant de démonter la torche.
- Utiliser exclusivement les torches indiquées dans le manual d'instructions.
- Le raccordement au réseau de cette machine de coupage à arc-plasma doit-être comforme aux codes de l'électricité pertinents.
- Le coupage à arc-plasma comporte des risques pour l'utilisateur et les personnes se trouvant dans la zone de travail. Avant le coupage, lire et comprendre les instructions du fabricant. Appliquer également les consignes de sécurité de votre entreprise.

Electric shock can kill.

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

Explosion will result if pressurized containers are cut.

Arc rays can injure eyes and burn skin.

- Wear correct eye and body protection.

Noise can damage hearing.

- Wear correct ear protection.

Fumes and gases can injure your health.

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

WARNING: This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the state of California to cause birth defects and, in some cases, cancer.

Heat, splatter and sparks cause fire and burns.

- Do not cut near combustible material.
- Do not cut containers that have held combustibles.
- Do not have on your person any combustibles such as a butane lighter or matches.

Pilot arc can cause burns.

- Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

DO NOT REMOVE THIS MARKING | **NE PAS ENLEVER CET AVIS**

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WARNING LABEL

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

1. Cutting sparks can cause explosion or fire.

1.1 Keep flammables away from cutting.

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

1.3 Do not cut on any closed containers.

2. The plasma arc can cause injury and burns.

2.1 Turn off power before disassembling torch.

2.2 Do not hold the material near cutting path.

2.3 Wear complete body protection.

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

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

3.2 Insulate yourself from work and ground.

3.3 Disconnect input plug or power before working on machine.

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

4.1 Keep your head out of the fumes.

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

4.3 Use ventilating fan to remove the fumes.

5. Arc rays can burn eyes and injure skin.

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

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

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

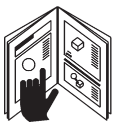
Section 1a

SÉCURITÉ

Dans cette section :

IDENTIFIER LES CONSIGNES DE SÉCURITÉ

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



SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

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

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

DANGER AVERTISSEMENT PRÉCAUTION

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

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

LE COUPAGE PEUT PROVOQUER UN INCENDIE OU UNE EXPLOSION

Prévention des incendies

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

Prévention des explosions

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

AVERTISSEMENT

Risque d'explosion
argon-hydrogène et méthane

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

AVERTISSEMENT

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

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

LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE FATALS

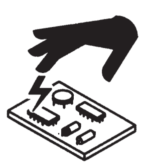
Toucher une pièce électrique sous tension peut provoquer un choc électrique fatal ou des brûlures graves.

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

Prévention des chocs électriques

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

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



L'ÉLECTRICITÉ STATIQUE PEUT ENDOMMAGER LES CARTES DE CIRCUITS IMPRIMÉS

On doit prendre les précautions qui s'imposent quand on manipule les circuits imprimés.

- On doit ranger les cartes de circuits imprimés dans des contenants antistatiques.
- On doit porter un bracelet antistatique quand on manipule les cartes de circuits imprimés.

LES VAPEURS TOXIQUES PEUVENT PROVOQUER DES BLESSURES OU LA MORT

L'arc plasma est lui-même 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 émanent.

On doit prendre les précautions qui 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), il peut y avoir un risque de maladie physique, comme des malformations ou le cancer.

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

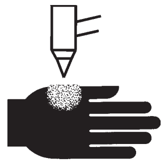
Le niveau de qualité de l'air dans tout lieu de travail dépend des variables propres au site comme :

- 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 règlements nationaux ou locaux, 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 d'extraction locale pour éliminer les vapeurs de l'air.
- Ne pas inhaler les vapeurs. Porter un respirateur à adduction d'air quand on coupe des métaux revêtus d'éléments toxiques ou qui en contiennent ou sont susceptibles d'en contenir.
- S'assurer que les personnes qui utilisent un matériel de soudage ou de coupage ainsi que les dispositifs de respiration par adduction d'air sont qualifiés et ont reçu la formation sur la bonne utilisation d'un tel matériel.
- 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 au site selon les besoins.
- Consulter un expert local pour mettre en œuvre un plan du site afin d'assurer une qualité de l'air sûre.



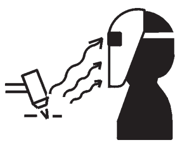
L'ARC PLASMA PEUT PROVOQUER DES BLESSURES OU DES BRÛLURES

Torches à allumage instantané

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

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

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



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

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

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

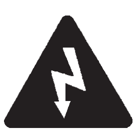
Courant de l'arc	Puissance des verres teintés AWS (É.-U.)	ISO 4850
Jusqu'à 100 A	Nº 8	Nº 11
100-200 A	Nº 10	Nº 11-12
200-400 A	Nº 12	Nº 13
Plus de 400 A	Nº 14	Nº 14

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

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

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

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



MISE À LA MASSE ET À LA TERRE

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

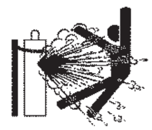
Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

Alimentation

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

SÉCURITÉ DES BOUTEILLES DE GAZ COMPRIMÉ

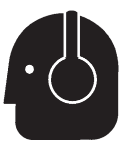
- Ne jamais lubrifier les robinets des bouteilles ou les régulateurs avec de l'huile ou de la graisse.
- Utiliser uniquement les bouteilles, régulateurs, tuyaux et accessoires appropriés et conçus pour chaque application spécifique.
- Entretenir l'équipement et les pièces d'équipement à gaz comprimé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



LES BOUTEILLES DE GAZ COMPRIMÉ PEUVENT EXPLOSER EN CAS DE DOMMAGES

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

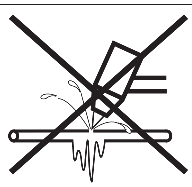
- Manipuler et utiliser les bouteilles de gaz comprimé conformément aux codes locaux ou nationaux.
- Ne jamais utiliser une bouteille qui n'est pas placée à la verticale et bien assujettie.
- Le capuchon de protection doit être placé sur le robinet sauf si la bouteille est en cours d'utilisation ou connectée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



LE BRUIT PEUT PROVOQUER DES PROBLÈMES AUDITIFS

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

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



UN ARC PLASMA PEUT ENDOMMAGER LES TUYAUX GELÉS

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

PACEMAKERS ET PROTHÈSES AUDITIVES

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

Pour réduire les risques associés aux champs magnétiques :

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

Étiquette de sécurité

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

WARNING

Protect yourself and others. Read and understand this marking.

- Disconnect power source before servicing.
- Disconnect power source before disassembly of the torch.
- Use torches specified in the instruction manual.
- This plasma cutting machine must be connected to power source in accordance with applicable electrical codes.
- Plasma arc cutting can be injurious to operator and persons in the work area. Before operating, read and understand the manufacturer's instructions and know your employer's safety practices.

AVERTISSEMENT

Pour votre protection et celle des autres, lire et comprendre ces consignes.

- Couper l'alimentation avant d'effectuer le dépannâge.
- Couper l'alimentation avant de démonter la torche.
- Utiliser exclusivement les torches indiquées dans le manual d'instructions.
- Le raccordement au réseau de cette machine de coupage à arc-plasma doit-être comforme aux codes de l'électricité pertinents.
- Le coupage à arc-plasma comporte des risques pour l'utilisateur et les personnes se trouvant dans la zone de travail. Avant le coupage, lire et comprendre les instructions du fabricant. Appliquer également les consignes de sécurité de votre entreprise.

Electric shock can kill.

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

Explosion will result if pressurized containers are cut.

Arc rays can injure eyes and burn skin.

- Wear correct eye and body protection.

Noise can damage hearing.

- Wear correct ear protection.

Fumes and gases can injure your health.

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

WARNING: This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the state of California to cause birth defects and, in some cases, cancer.

Heat, splatter and sparks cause fire and burns.

- Do not cut near combustible material.
- Do not cut containers that have held combustibles.
- Do not have on your person any combustibles such as a butane lighter or matches.

Pilot arc can cause burns.

- Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

DO NOT REMOVE THIS MARKING | **NE PAS ENLEVER CET AVIS**

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Étiquette de sécurité

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

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

1.1 Pendant le coupage, éloigner toute matière inflammable.

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

1.3 Ne jamais couper de récipients fermés.

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

2.1 Couper l'alimentation avant de démonter la torche.

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

2.3 Porter des vêtements de protection couvrant tout le corps.

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

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

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

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

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

4.1 Garder le visage à l'écart des vapeurs.

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

4.3 Utiliser un ventilateur pour dissiper les vapeurs.

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

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

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

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

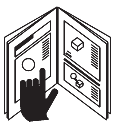
Seccíon 1b

SEGURIDAD

En esta sección:

RECONOCIMIENTO DE INFORMACIÓN DE SEGURIDAD

Los símbolos que se muestran en esta sección se utilizan para identificar los posibles peligros. Cuando vea un símbolo de seguridad en este manual o en su máquina, recuerde que existe la posibilidad de que se produzcan lesiones personales y siga las instrucciones correspondientes para evitar el peligro.



SIGA LAS INSTRUCCIONES DE SEGURIDAD

Lea atentamente todos los mensajes de seguridad de este manual y las etiquetas de seguridad en su máquina.

- Mantenga las etiquetas de seguridad de su máquina en buen estado. Reemplace las etiquetas que se pierdan o se dañen inmediatamente.
- Aprenda a utilizar la máquina y a utilizar los controles de la manera correcta. No permita que sea utilizada por alguien que no conozca su funcionamiento.
- Mantenga su máquina en buenas condiciones de funcionamiento. La realización de modificaciones no autorizadas a la máquina puede comprometer la seguridad y la vida útil de la máquina.

PELIGRO ADVERTENCIA PRECAUCIÓN

Las palabras PELIGRO y ADVERTENCIA se utilizan conjuntamente con un símbolo de seguridad. La palabra PELIGRO se utiliza para identificar los mayores peligros.

- Encontrará etiquetas de seguridad con las inscripciones PELIGRO y ADVERTENCIA en su máquina, junto a peligros específicos.
- En este manual, la palabra ADVERTENCIA va seguida de instrucciones que, si no se siguen correctamente, pueden provocar lesiones e inclusive la muerte.
- En este manual, la palabra PRECAUCIÓN va seguida de instrucciones que, si no se siguen correctamente, pueden provocar daños en el equipo.

LOS CORTES PUEDEN PROVOCAR INCENDIOS O EXPLOSIONES

Prevención ante el fuego

- Asegúrese de que el área sea segura antes de proceder a cortar. Tenga a mano un extinguidor de incendios.
- Retire todos los materiales inflamables, colocándolos a por lo menos 10 metros del área de corte.
- Remoje los metales calientes o permita que se enfríen antes de que entren en contacto con materiales combustibles.
- Nunca corte depósitos que contengan materiales inflamables – primero es necesario vaciarlos y limpiarlos debidamente.
- Antes de realizar cortes en atmósferas potencialmente inflamables, asegúrese de ventilar bien.
- Al realizar cortes utilizando oxígeno como gas plasma, se requiere tener un sistema de ventilación de escape.

Prevención ante explosiones

- No corte en atmósferas que contengan polvo o vapores explosivos.
- No corte depósitos o tubos a presión ni cualquier depósito cerrado.
- No corte depósitos que hayan contenido materiales combustibles.

ADVERTENCIA

Peligro de explosión
Argón-Hidrógeno y metano

El hidrógeno y el metano son gases inflamables que suponen un peligro de explosión. Mantenga el fuego lejos de los cilindros y las mangueras que contengan mezclas de hidrógeno o metano. Mantenga la llama y las chispas lejos de la antorcha al utilizar metano o argón-hidrógeno como plasma.

ADVERTENCIA

Detonación de hidrógeno con
el corte de aluminio

- Al cortar aluminio bajo agua o con agua en contacto con el lado inferior del aluminio, puede acumularse gas hidrógeno bajo la pieza a cortar y detonar durante la operación de corte por plasma.
- Instale un múltiple de aireación en el fondo de la mesa de agua para eliminar la posibilidad de la detonación del hidrógeno. Consulte la sección del apéndice de este manual para conocer detalles acerca del múltiple de aireación.

EL CHOQUE ELÉCTRICO PUEDE PROVOCAR LA MUERTE

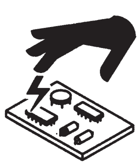
El contacto directo con piezas eléctricas conectadas puede provocar un electrochoque fatal o quemaduras graves.

- Al hacer funcionar el sistema de plasma, se completa un circuito eléctrico entre la antorcha y la pieza a cortar. La pieza a cortar es una parte del circuito eléctrico, como también cualquier cosa que se encuentre en contacto con ella.
- Nunca toque el cuerpo de la antorcha, la pieza a cortar o el agua en una mesa de agua cuando el sistema de plasma se encuentre en funcionamiento.

Prevención ante el electrochoque

Todos los sistemas por plasma de Hypertherm usan alto voltaje en el proceso de corte (son comunes los voltajes CD de 200 a 400). Tome las siguientes precauciones cuando se utiliza el equipo de plasma:

- Use guantes y botas aislantes y mantenga el cuerpo y la ropa secos.
- No se siente, se pare o se ponga sobre cualquier superficie húmeda cuando esté trabajando con el equipo.
- Aíslese eléctricamente de la pieza a cortar y de la tierra utilizando alfombrillas o cubiertas de aislamiento secas lo suficientemente grandes como para impedir todo contacto físico con la pieza a cortar o con la tierra. Si su única opción es trabajar en una área húmeda o cerca de ella, sea muy cauteloso.
- Instale un interruptor de corriente adecuado en cuanto a fusibles, en una pared cercana a la fuente de energía. Este interruptor permitirá al operador desconectar rápidamente la fuente de energía en caso de emergencia.
- Al utilizar una mesa de agua, asegúrese de que ésta se encuentre correctamente conectada a la toma a tierra.
- Instale este equipo y conéctelo a tierra según el manual de instrucciones y de conformidad con los códigos locales y nacionales.
- Inspeccione el cordón de alimentación primaria con frecuencia para asegurarse de que no esté dañado ni agrietado. Si el cordón de alimentación primaria está dañado, reemplácelo inmediatamente. **Un cable pelado puede provocar la muerte**.
- Inspeccione las mangueras de la antorcha y reemplácelas cuando se encuentren dañadas.
- No toque la pieza ni los recortes cuando se está cortando. Deje la pieza en su lugar o sobre la mesa de trabajo con el cable de trabajo conectado en todo momento.
- Antes de inspeccionar, limpiar o cambiar las piezas de la antorcha, desconecte la potencia primaria o desenchufe la fuente de energía.
- Nunca evite o descuide los bloqueos de seguridad.
- Antes de retirar la cubierta de una fuente de energía o del gabinete de un sistema, desconecte la potencia primaria de entrada. Espere 5 minutos después de desconectar la potencia primaria para permitir la descarga de los condensadores.
- Nunca opere el sistema de plasma sin que las tapas de la fuente de energía estén en su lugar. Las conexiones expuestas de la fuente de energía presentan un serio riesgo eléctrico.
- Al hacer conexiones de entrada, conecte el conductor de conexión a tierra en primer lugar.
- Cada sistema de plasma Hypertherm está diseñado para ser utilizado sólo con antorchas Hypertherm específicas. No utilice antorchas diferentes, que podrían recalentarse y ser peligrosas.



ELECTRICIDAD ESTÁTICA PUEDE DAÑAR TABLILLAS DE CIRCUITO

Use precauciones adecuadas cuando maneje tablillas impresas de circuito

- Almacene las tablillas PC en recipientes antiestáticos.
- Use la defensa de muñeca conectada a tierra cuando maneje tablillas PC.

HUMOS TÓXICOS PUEDEN CAUSAR LESIONES O MUERTE

El arco plasma es por si solo la fuente de calor que se usa para cortar. Según esto, aunque el arco de plasma no ha sido identificado como la fuente de humo tóxico, el material que se corta puede ser la fuente de humo o gases tóxicos que vacían el oxígeno.

El humo producido varía según el metal que está cortándose. Metales que pueden liberar humo tóxico incluyen, pero no están limitados a, acero inoxidable, acero al carbón, cinc (galvanizado), y cobre.

En algunos casos, el metal puede estar recubierto con una sustancia que podría liberar humos tóxicos. Los recubrimientos tóxicos incluyen, pero no están limitados a, plomo (en algunas pinturas), cadmio (en algunas pinturas y rellenos), y berilio.

Los gases producidos por el corte por plasma varían basándose en el material a cortarse y el método de cortar, pero pueden incluir ozono, óxidos de nitrógeno, cromo hexavalente, hidrógeno, y otras substancias, si están contenidas dentro o liberadas por el material que se corta.

Se debe tener cuidado de minimizar la exposición del humo producido por cualquier proceso industrial. Según la composición química y la concentración del humo (al igual que otros factores, tales como ventilación), puede haber el riesgo de enfermedad física, tal como defectos de natividad o cáncer.

Es la responsabilidad del dueño del equipo y instalación el comprobar la calidad de aire en el lugar donde se está usando el equipo para garantizar que la calidad del aire en el lugar de trabajo cumpla con todas las normas y reglamentos locales y nacionales.

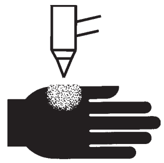
El nivel de la calidad del aire en cualquier lugar de trabajo relevante depende en variables específicas al sitio tales como:

- Diseño de mesa (mojada, seca, bajo agua).
- La composición del material, el acabado de la superficie, y la composición de los recubrimientos.
- Volumen que se quita del material.
- La duración del corte o ranura.
- Tamaño, volumen del aire, ventilación y filtración del lugar de trabajo.
- Equipo de protección personal.
- Número de sistemas de soldar y cortar en la operación.
- Otros procesos del lugar que pueden producir humo.

Si el lugar de trabajo debe cumplir reglamentos nacionales o locales, solamente el monitoreo o las pruebas que se hacen en el lugar pueden determinar si el sitio está encima o debajo de los niveles permitidos.

Para reducir el riesgo de exposición a humo:

- Quite todos los recubrimientos y solventes del metal antes de cortar.
- Use ventilación extractora local para quitar humo del aire.
- No inhale el humo. Use un respirador con fuente propia de aire cuando corte cualquier metal recubierto con, o sospechado de contener, elementos tóxicos.
- Garantice que aquéllos usando equipo de soldar o cortar, al igual que aparatos de respiración con aire propio de aire, estén capacitados y entrenados en el uso apropiado de tal equipo.
- Nunca corte recipientes con materiales potencialmente tóxicos adentro. Primero, vacíe y limpie el recipiente adecuadamente.
- Monitoree o compruebe la calidad del aire en el sitio como fuera necesario.
- Consulte con un experto local para realizar un plan al sitio para garantizar la calidad de aire seguro.



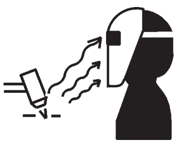
EL ARCO DE PLASMA PUEDE CAUSAR LESIONES Y QUEMADURAS

Antorchas de encendido instantáneo

El arco de plasma se enciende inmediatamente después de activarse el interruptor de la antorcha.

El arco de plasma puede cortar a través de guantes y de la piel con rapidez.

- Manténgase alejado de la punta de la antorcha.
- No sostenga el metal junto al trayecto de corte.
- Nunca apunte la antorcha hacia Ud. mismo o hacia otras personas.



LOS RAYOS DEL ARCO PUEDEN PRODUCIR QUEMADURAS EN LOS OJOS Y EN LA PIEL

Protección para los ojos Los rayos del arco de plasma producen rayos intensos visibles e invisibles (ultravioleta e infrarrojo) que pueden quemar los ojos y la piel.

- Utilice protección para los ojos de conformidad con los códigos locales o nacionales aplicables.
- Colóquese protectores para los ojos (gafas o anteojos protectores con protectores laterales, y bien un casco de soldar) con lentes con sombreado adecuado para proteger sus ojos de los rayos ultravioleta e infrarrojos del arco.

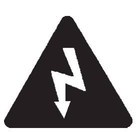
	Número del cristal	
Corriente del arco	**AWS (EE.UU.)**	**ISO 4850**
Hasta 100A	No. 8	No. 11
100-200 A	No. 10	No. 11-12
200-400 A	No. 12	No. 13
Más de 400 A	No. 14	No. 14

Protección para la piel Vista ropa de protección para proteger la piel contra quemaduras causadas por la radiación ultravioleta de alta intensidad, por las chispas y por el metal caliente:

- Guantes largos, zapatos de seguridad y gorro.
- Roipa de combustión retardada y que cubra todas las partes expuestas.
- Pantalones sin dobladillos para impedir que recojan chispas y escorias.
- Retire todo material combustible de los bolsillos, como encendedores a butano e inclusive cerillas, antes de comenzar a cortar.

Área de corte Prepare el área de corte para reducir la reflexión y la transmisión de la luz ultravioleta:

- Pinte las paredes y demás superficies con colores oscuros para reducir la reflexión.
- Utilice pantallas o barreras protectoras para proteger a los demás de los destellos.
- Advierta a los demás que no debe mirarse el arco. Utilice carteles o letreros.



SEGURIDAD DE TOMA A TIERRA

Cable de trabajo La pinza del cable de trabajo debe estar bien sujetada a la pieza y hacer un buen contacto de metal a metal con ella o bien con la mesa de trabajo. No conecte el cable con la parte que va a quedar separada por el corte.

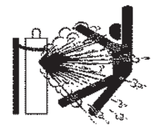
Mesa de trabajo Conecte la mesa de trabajo a una buena toma de tierra, de conformidad con los códigos eléctricos nacionales o locales apropiados.

Potencia primaria de entrada

- Asegúrese de que el alambre de toma a tierra del cordón de alimentación está conectado al terminal de tierra en la caja del interruptor de corriente.
- Si la instalación del sistema de plasma supone la conexión del cordón de alimentación primaria a la fuente de energía, asegúrese de conectar correctamente el alambre de toma a tierra del cordón de alimentación primaria.
- Coloque en primer lugar el alambre de toma a tierra del cordón de alimentación primaria en el espárrago luego coloque cualquier otro alambre de tierra sobre el conductor de tierra del cable. Ajuste firmemente la tuerca de retención.
- Asegúrese de que todas las conexiones eléctricas están firmemente realizadas para evitar sobrecalentamientos.

SEGURIDAD DE LOS EQUIPOS DE GAS COMPRIMIDO

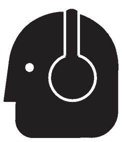
- Nunca lubrique reguladores o válvulas de cilindros con aceite o grasa.
- Utilice solamente cilindros, reguladores, mangueras y conectores de gas correctos que hayan sido diseñados para la aplicación específica.
- Mantenga todo el equipo de gas comprimido y las piezas relacionadas en buen estado.
- Coloque etiquetas y códigos de color en todas las mangueras de gas para identificar el tipo de gas que conduce cada una. Consulte los códigos locales o nacionales aplicables.



LOS CILINDROS DE GAS PUEDEN EXPLOTAR SI ESTÁN DAÑADOS

Los cilindros de gas contienen gas bajo alta presión. Un cilindro dañado puede explotar.

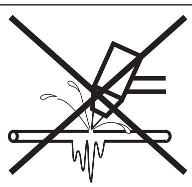
- Manipule y utilice los cilindros de gas comprimido de acuerdo con los códigos locales o nacionales aplicables.
- No use nunca un cilindro que no esté de pie y bien sujeto.
- Mantenga la tapa de protección en su lugar encima de la válvula, excepto cuando el cilindro se encuentre en uso o conectado para ser utilizado.
- No permita nunca el contacto eléctrico entre el arco de plasma y un cilindro.
- No exponga nunca los cilindros a calor excesivo, chispas, escorias o llamas.
- No emplee nunca martillos, llaves u otro tipo de herramientas para abrir de golpe la válvula del cilindro.



EL RUIDO PUEDE DETERIORAR LA AUDICIÓN

La exposición prolongada al ruido propio de las operaciones de corte y ranurado puede dañar la audición.

- Utilice un método de protección de los oídos aprobado al utilizar el sistema de plasma.
- Advierta a las demás personas que se encuentren en las cercanías acerca del peligro que supone el ruido excesivo.



UN ARCO PLASMA PUEDE DAÑAR TUBOS CONGELADOS

Se puede hacer daño a los tubos congelados, o se los puede reventar, si uno trata de descongelarlos con una antorcha por plasma.

OPERACIÓN DE MARCAPASOS Y DE AUDÍFONOS

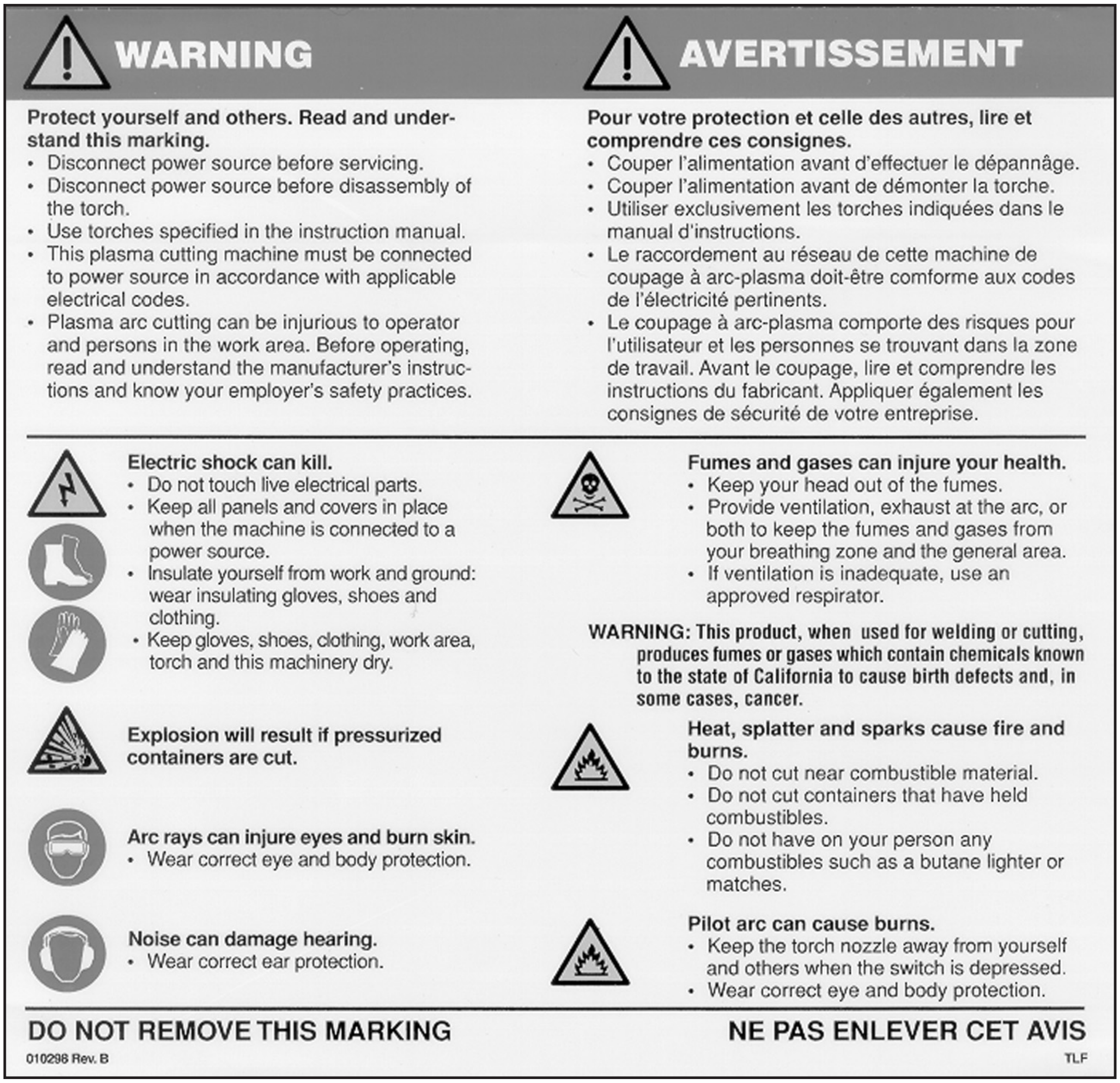
Los campos magnéticos producidos por las elevadas corrientes pueden afectar la operación de marcapasos y de audífonos. Las personas que lleven marcapasos y audífonos deberán consultar a un médico antes de acercarse a sitios donde se realizan operaciones de corte y ranurado por plasma.

Para reducir los peligros de los campos magnéticos:

- Mantenga el cable de trabajo y la manguera de la antorcha a un lado, lejos del cuerpo.
- Dirija la manguera antorcha lo más cerca posible del cable de trabajo.
- No envuelva el cable de trabajo ni la manguera de la antorcha en su cuerpo.
- Manténgase tan lejos de la fuente de energía como sea posible.

Etiqueta de advertencia

Esta etiqueta de advertencia se encuentra adherida a la fuente de energía. Es importante que el operador y el técnico de mantenimiento comprendan el sentido de estos símbolos de advertencia según se describen. El texto numerado corresponde a los cuadros numerados de la etiqueta.



WARNING

Protect yourself and others. Read and understand this marking.
- Disconnect power source before servicing.
- Disconnect power source before disassembly of the torch.
- Use torches specified in the instruction manual.
- This plasma cutting machine must be connected to power source in accordance with applicable electrical codes.
- Plasma arc cutting can be injurious to operator and persons in the work area. Before operating, read and understand the manufacturer's instructions and know your employer's safety practices.

AVERTISSEMENT

Pour votre protection et celle des autres, lire et comprendre ces consignes.
- Couper l'alimentation avant d'effectuer le dépannâge.
- Couper l'alimentation avant de démonter la torche.
- Utiliser exclusivement les torches indiquées dans le manual d'instructions.
- Le raccordement au réseau de cette machine de coupage à arc-plasma doit-être comforme aux codes de l'électricité pertinents.
- Le coupage à arc-plasma comporte des risques pour l'utilisateur et les personnes se trouvant dans la zone de travail. Avant le coupage, lire et comprendre les instructions du fabricant. Appliquer également les consignes de sécurité de votre entreprise.

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

Explosion will result if pressurized containers are cut.

Arc rays can injure eyes and burn skin.
- Wear correct eye and body protection.

Noise can damage hearing.
- Wear correct ear protection.

Fumes and gases can injure your health.
- Keep your head out of the fumes.
- Provide ventilation, exhaust at the arc, or both to keep the fumes and gases from your breathing zone and the general area.
- If ventilation is inadequate, use an approved respirator.

WARNING: This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the state of California to cause birth defects and, in some cases, cancer.

Heat, splatter and sparks cause fire and burns.
- Do not cut near combustible material.
- Do not cut containers that have held combustibles.
- Do not have on your person any combustibles such as a butane lighter or matches.

Pilot arc can cause burns.
- Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

DO NOT REMOVE THIS MARKING — **NE PAS ENLEVER CET AVIS**

010298 Rev. B — TLF

Etiqueta de advertencia

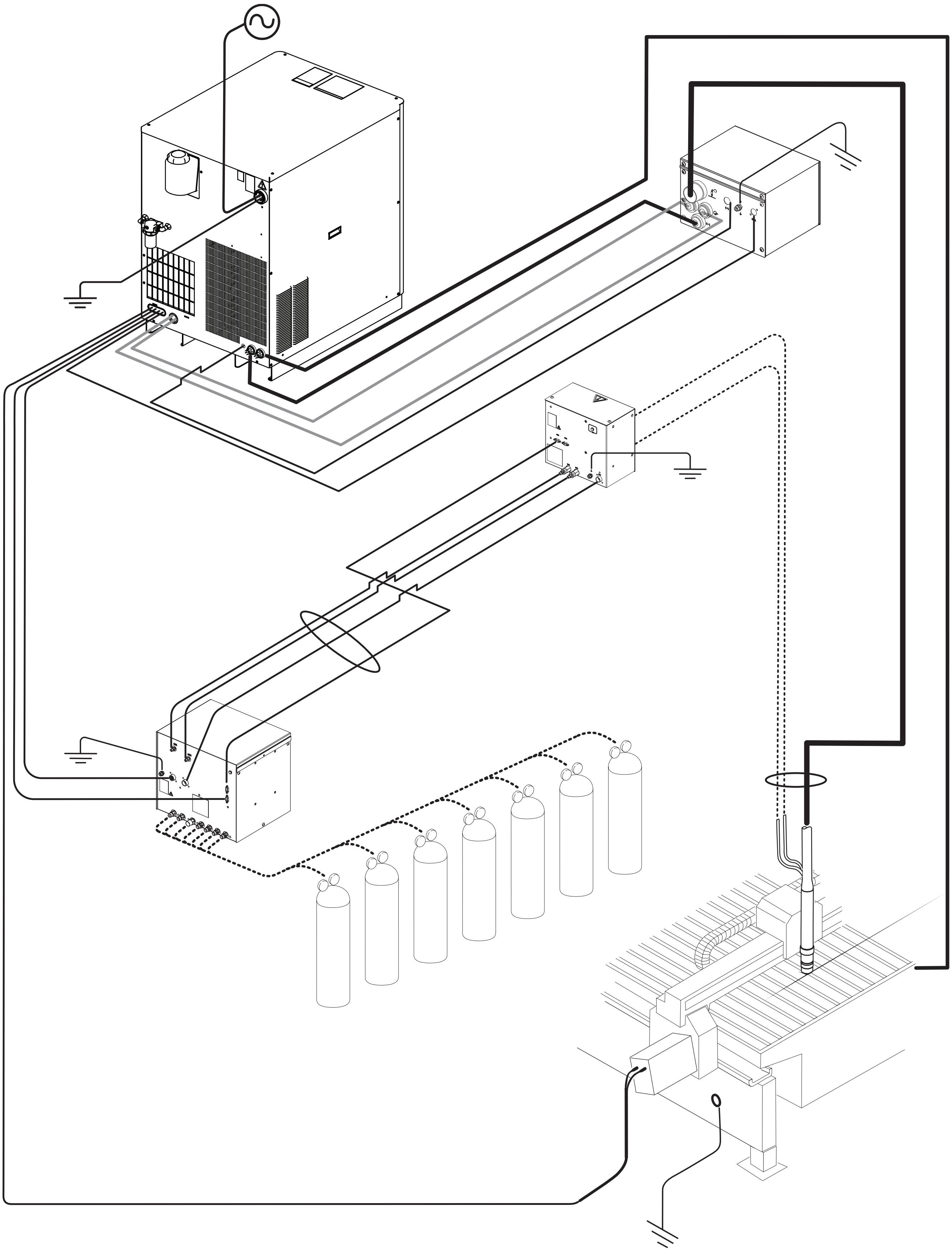
Esta etiqueta de advertencia se encuentra adherida a la fuente de energía. Es importante que el operador y el técnico de mantenimiento comprendan el sentido de estos símbolos de advertencia según se describen. El texto numerado corresponde a los cuadros numerados de la etiqueta.

1. Las chispas producidas por el corte pueden causar explosiones o incendios.
1.1 Mantenga los materiales inflamables lejos del lugar de corte.
1.2 Tenga a mano un extinguidor de incendios y asegúrese de que alguien esté preparado para utilizarlo.
1.3 No corte depósitos cerrados.
2. El arco de plasma puede causar quemaduras y lesiones.
2.1 Apague la fuente de energía antes de desarmar la antorcha.
2.2 No sostenga el material junto al trayecto de corte.
2.3 Proteja su cuerpo completamente.
3. Los electrochoques provocados por la antorcha o el cableado pueden ser fatales. Protéjase del electrochoque.
3.1 Colóquese guantes aislantes. No utilice guantes dañados o mojados.
3.2 Aíslese de la pieza de trabajo y de la tierra.
3.3 Antes de trabajar en una máquina, desconecte el enchufe de entrada o la potencia primaria.
4. La inhalación de los humos provenientes del área de corte puede ser nociva para la salud.
4.1 Mantenga la cabeza fuera de los gases tóxicos.
4.2 Utilice ventilación forzada o un sistema local de escape para eliminar los humos.
4.3 Utilice un ventilador para eliminar los humos.
5. Los rayos del arco pueden producir quemaduras en los ojos y en la piel.
5.1 Utilice un sombrero y gafas de seguridad. Utilice protección para los oídos y abróchese el botón del cuello de la camisa. Utilice un casco de soldar con el filtro de sombreado adecuado. Proteja su cuerpo completamente.
6. Antes de trabajar en la máquina o de proceder a cortar, capacítese y lea las instrucciones completamente.
7. No retire las etiquetas de advertencia ni las cubra con pintura.

Section 2

SPECIFICATIONS

In this section:



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 260-amp, 150-VDC constant-current supply. It contains the circuitry to ignite a torch, a heat exchanger and pump to cool the torch. The power supply has a serial interface to provide communication with a CNC controller.

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 PC 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 may be located up to 1.8 m (6 ft) away from the torch and 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 virtually dross-free cutting capacity of the torch is 32 mm (1.25 in) for HyDefinition cutting. The production pierce capacity is 32 mm (1.25 in) for mild steel and stainless steel and 25 mm (1 in) for aluminum. The maximum cutting capability (edge start) is 64 mm (2.5 in) for mild steel and stainless steel and 50 mm (2 in) for aluminum.

Specifications

System gas requirements

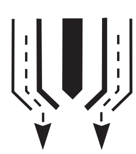
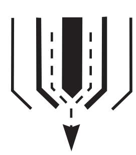
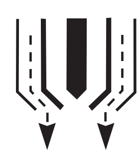
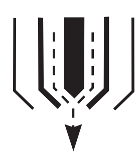
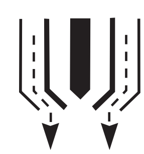
Gas quality and pressure requirements				
	Quality	**Grade****	**Pressure +/- 10%**	**Flow rate**
O_2 Oxygen*	99.5% pure Clean, dry, oil-free	G	827 kPa / 8.3 bar 115 psi	4250 l/h 150 scfh
N_2 Nitrogen*	99.99% pure Clean, dry, oil-free	E	827 kPa / 8.3 bar 115 psi	9910 l/h 350 scfh
Air*	*** Clean, dry, oil-free per ISO 8573-1 Class 1.2.2	K	827 kPa / 8.3 bar 115 psi	9910 l/h 350 scfh
H35 Argon-hydrogen	99.995% pure (H35 = 65% Argon, 35% Hydrogen)	Ar = A H_2 = A	827 kPa / 8.3 bar 115 psi	4250 l/h 150 scfh
F5 Nitrogen-hydrogen	99.98% pure (F5 = 95% Nitrogen, 5% Hydrogen)	N_2 = E H_2 = A	827 kPa / 8.3 bar 115 psi	4250 l/h 150 scfh

* Oxygen, nitrogen, and air are required for all systems. Nitrogen is used as a purge gas.

** This information can be found in the *Handbook of Compressed Gases*, 3rd edition, Compressed Gas Association, Van Nostrand Reinhold.

*** ISO standard 8573-1 Class 1.2.2 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 – there can not be more humidity in the air than in air at –40° C (–40° 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	Shield	Plasma	Shield	Plasma	Shield
Cutting 30 to 50 A	O_2	O_2	N_2 & F5	N_2	Air	Air
Cutting 80 A	O_2	Air	F5	N_2		
Cutting 130 A	O_2	Air	N_2 & H35	N_2	H35 & Air	N_2 & Air
Cutting 200 A	O_2	Air	N_2 & H35	N_2	N_2 & H35	N_2
Cutting 260 A	O_2	Air	N_2 & H35	N_2 & Air	N_2 & H35	N_2 & Air

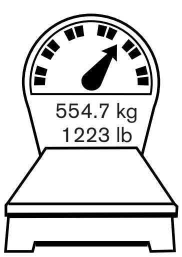
Power supply

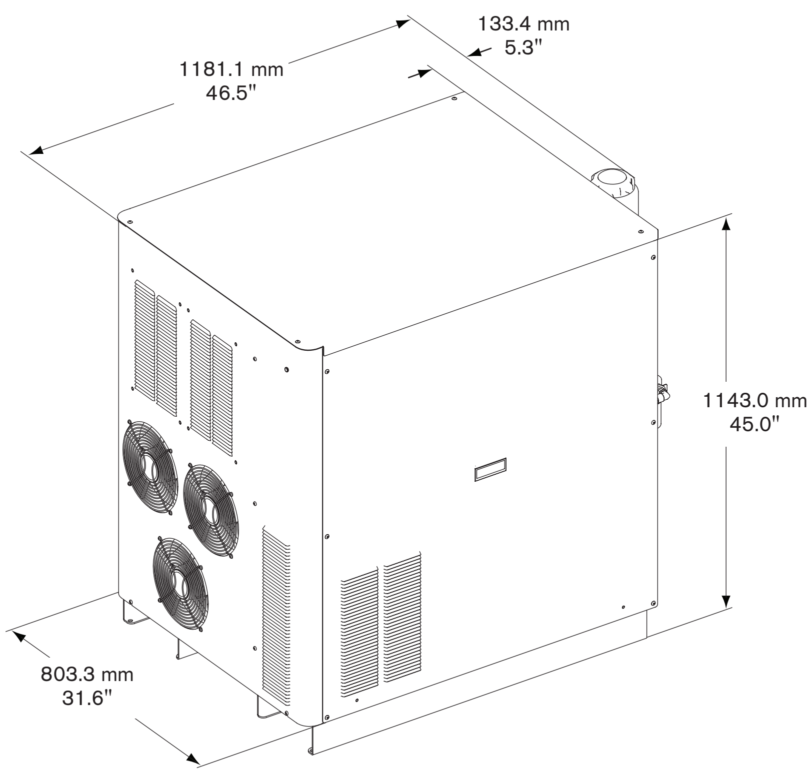
Caution: Revision "J" software, or later, is required for the safe operation of the automatic gas console.

Note: Software verification is needed for field upgrade units. New systems ship with revision J software or later.

General	
Maximum OCV (U_0)	311 VDC
Maximum output current (I_2)	260 Amps
Output voltage (U_2)	50 – 175 VDC
Duty cycle rating (X)	100% @ 45.5 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 @ 260 ADC output
Cooling	Forced air (Class F)
Insulation	Class H

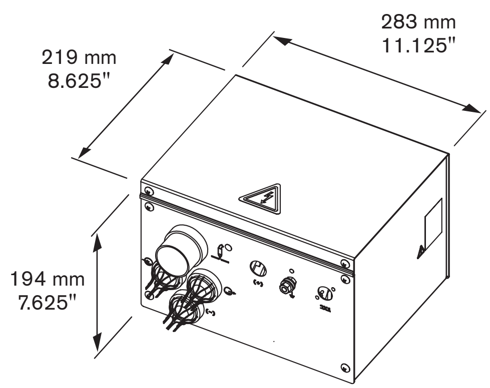
Part number	AC Voltage (U_1)	Phase	Frequency (Hz)	Amperage (I_1)	Regulatory approval	Power kW (+/- 10%) (U_1 x I_1 x 1.73)
078187	200/208	3	50/60	149/144	CSA	51.6
078202	220	3	50/60	136	CSA	51.6
078188	240	3	60	124	CSA	51.6
078192	380	3	50/60	79	CCC	51.6
078186	400	3	50/60	75	CE/GOST-R	51.6
078189	440	3	50/60	68	CSA	51.6
078190	480	3	60	62	CSA	51.6
078191	600	3	60	50	CSA	51.6

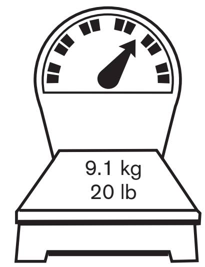


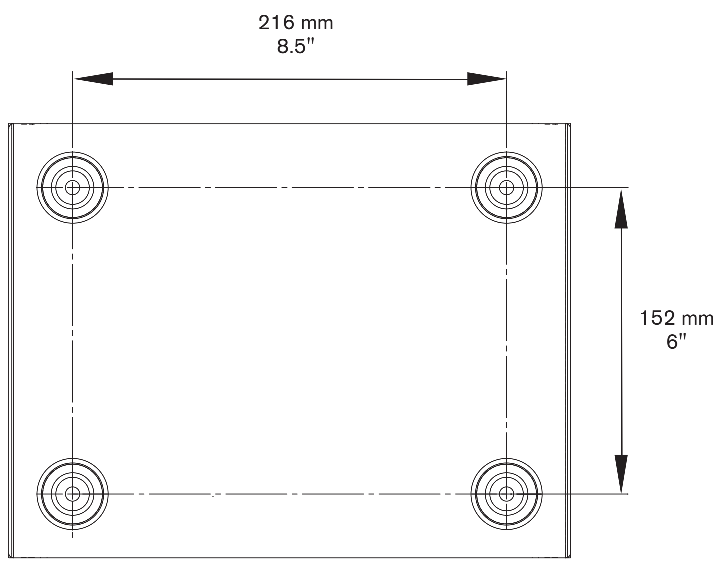


Ignition console – 078172

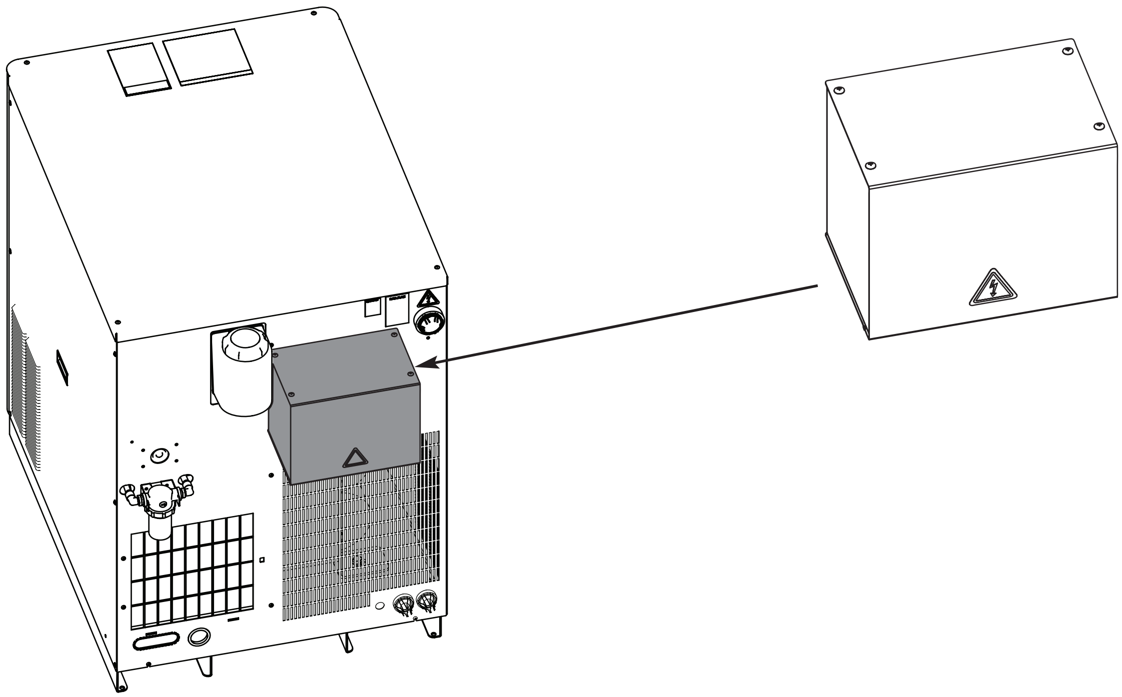
- The ignition console may be mounted locally on the power supply (LHF) or remotely on the cutting table's bridge (RHF). See *Installation* section for details.
- Maximum cable length from the ignition console to the torch lifter station is 20 m (65 ft). Allow room to remove the top for servicing.
- The ignition console may be mounted horizontally or vertically.



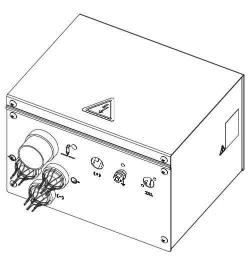


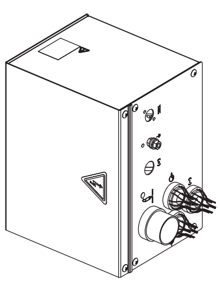


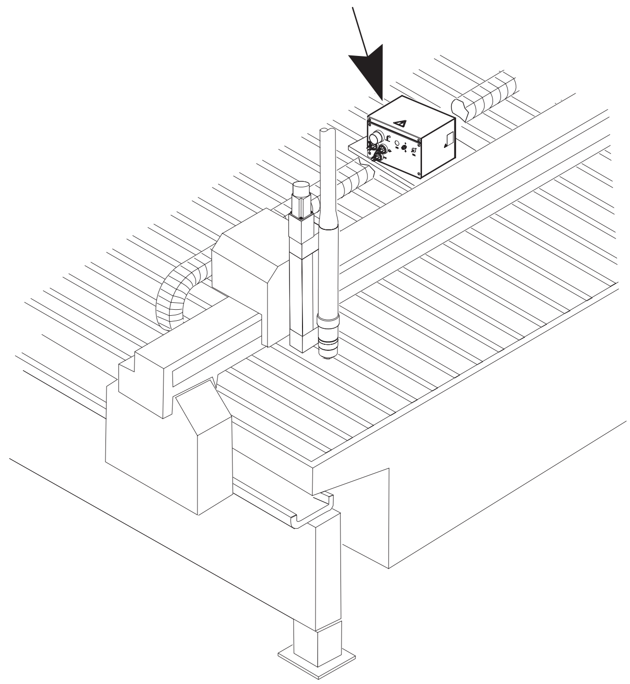
LHF mounting (local)



RHF mounting (remote)

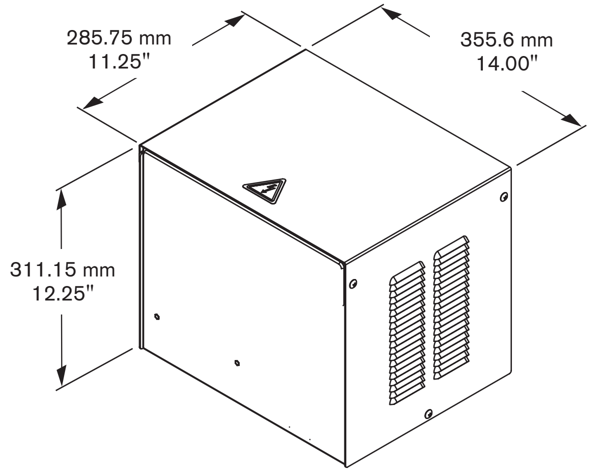


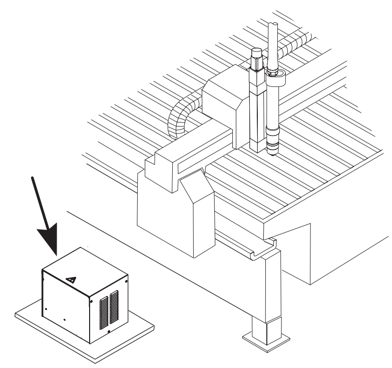


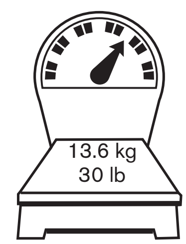


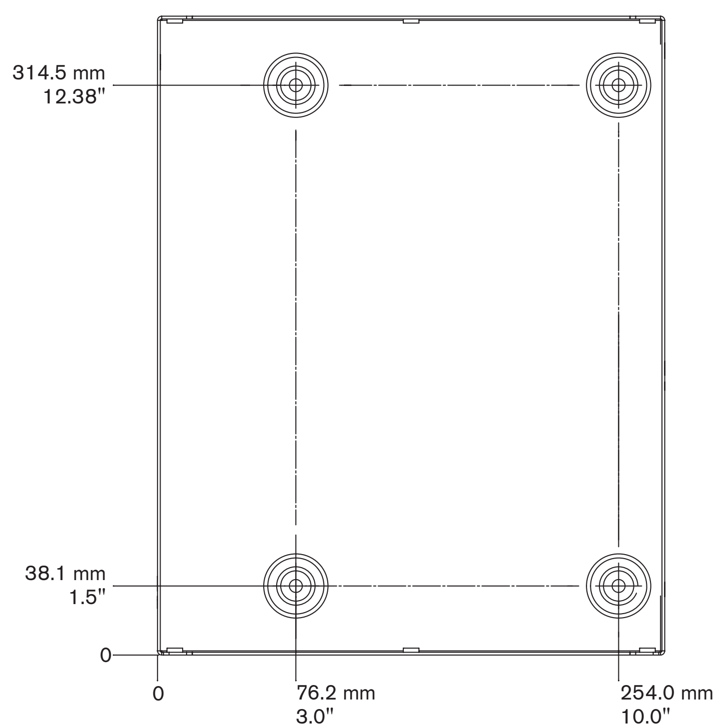
Selection console – 078185

- 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.



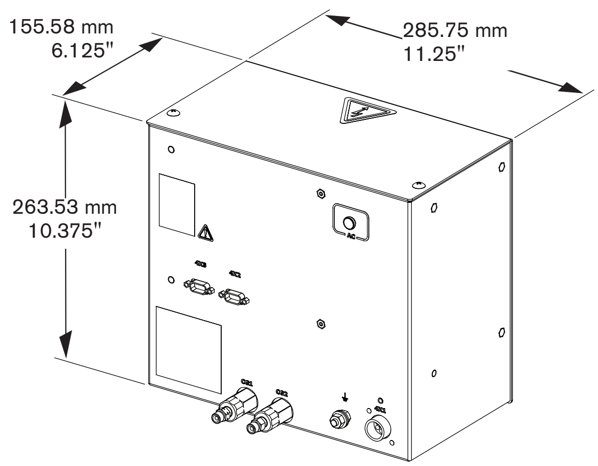


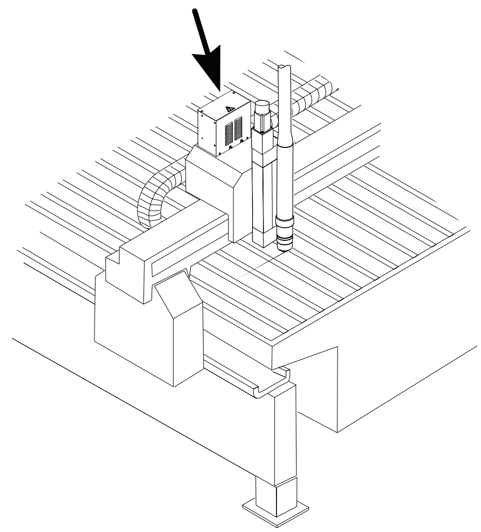


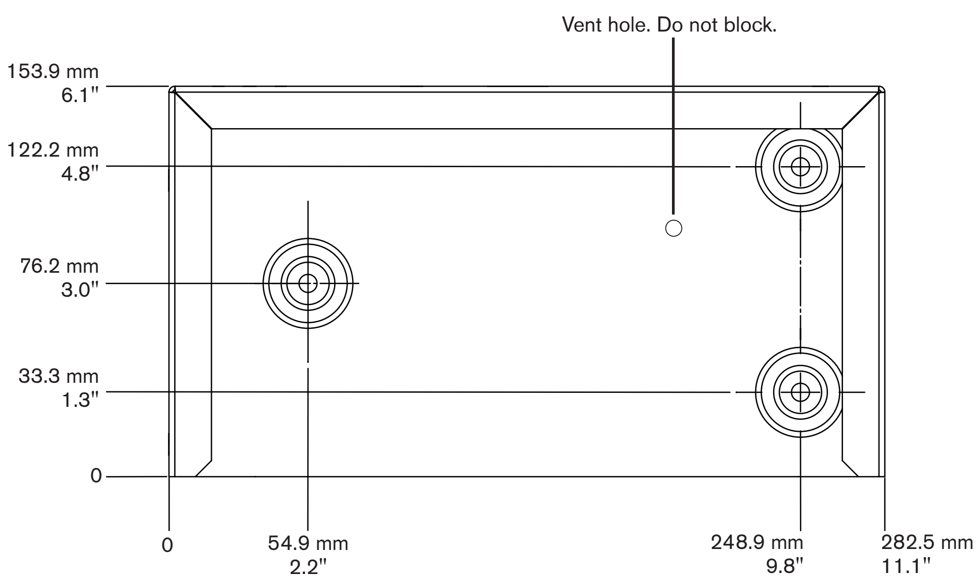


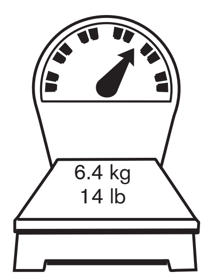
Metering console – 078184

- 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.



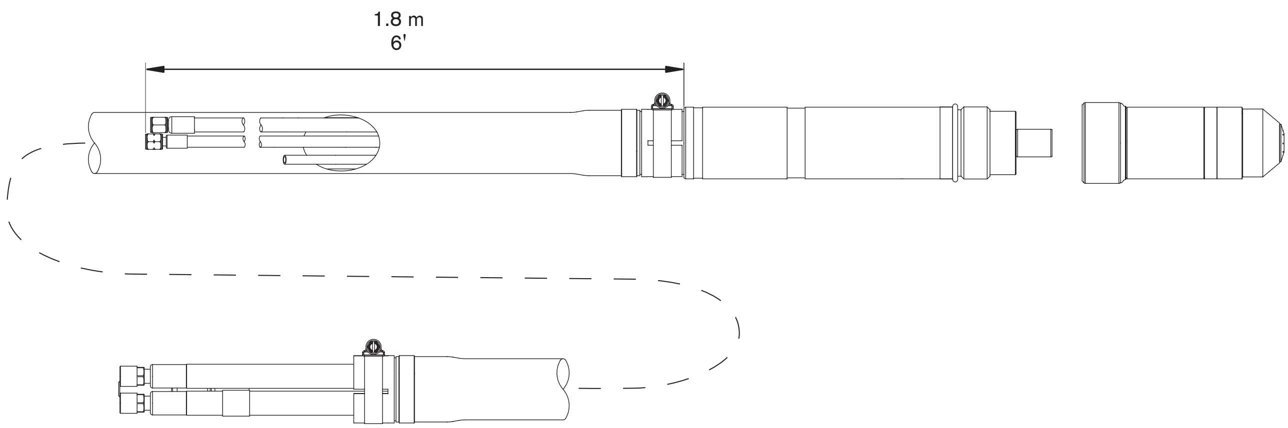


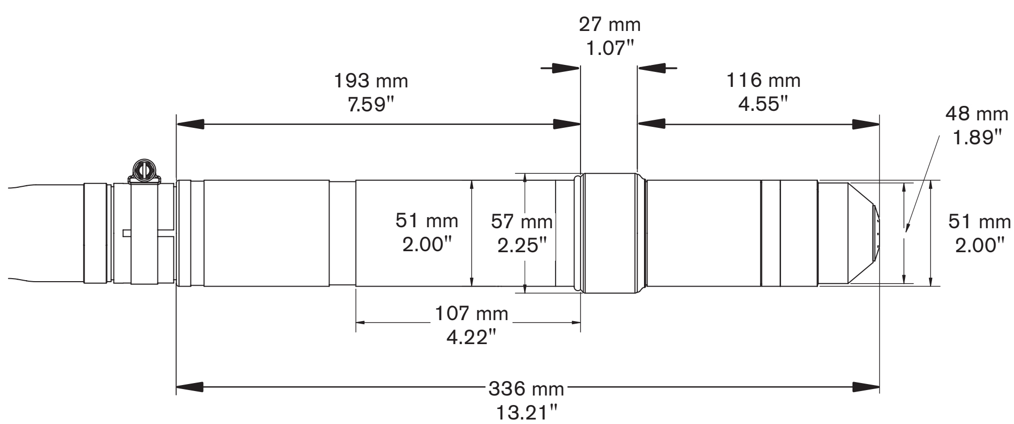


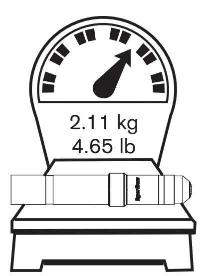


Torch – 128818

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







Section 3

INSTALLATION

In this section:

Upon receipt

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

Claims

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

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

Installation requirements

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

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

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. See also *Noise can damage hearing* in the *Safety* section of this manual.

Data was taken while cutting 12.7 mm (0.5 in) mild steel at 260A using an O_2 /Air process 76.2 mm (3 in) above water. The decibel readings at 914.4 mm (36 in) from the front of the torch and 330.2 mm (13 in) above the arc are: 120.7 Max Level, dBC (MaxP) and 98.6 Lav5, dBA.

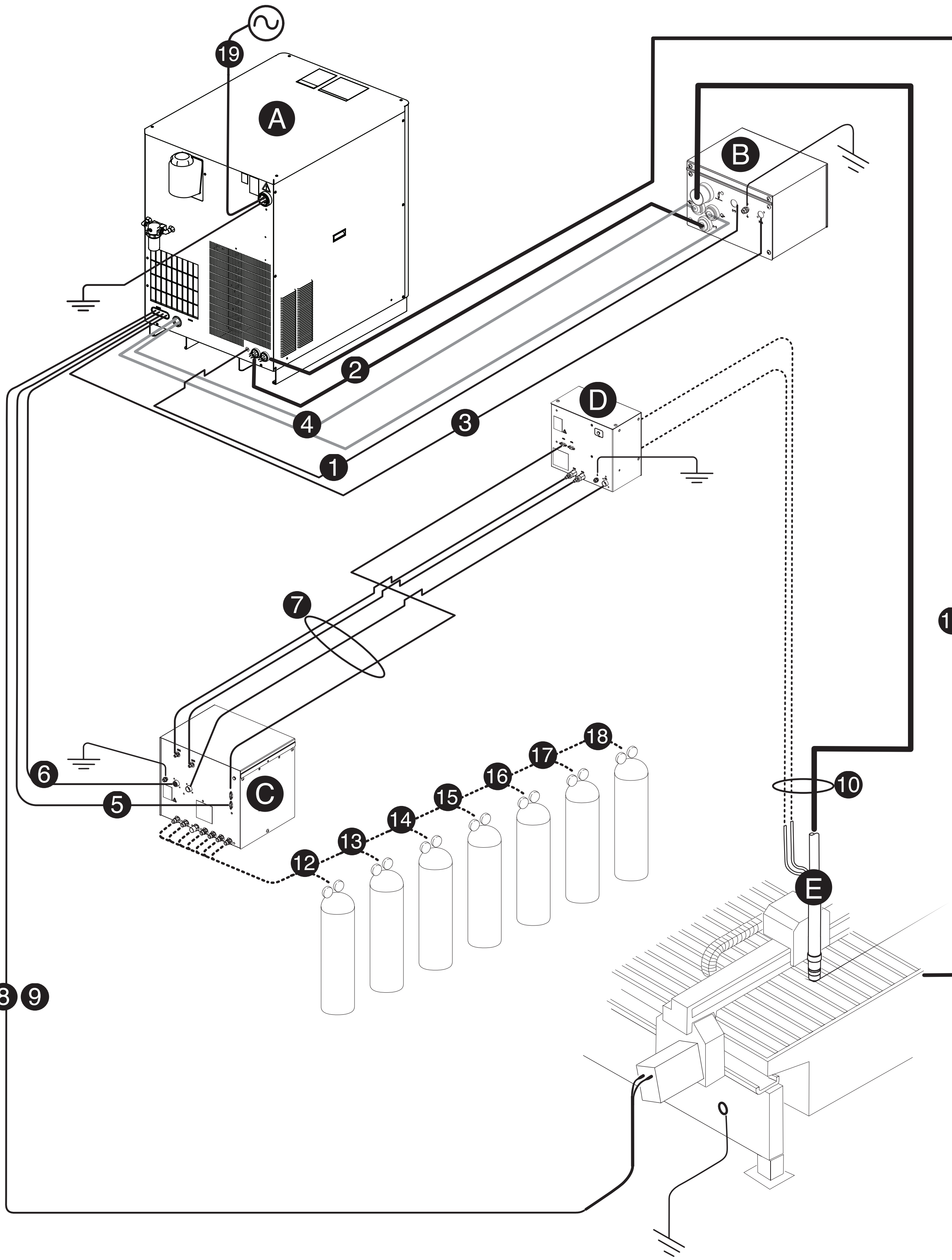
Placement of system components

- 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:

Torque specifications

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

Installation requirements



System components

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

Cables and hoses

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

Supply gas hoses

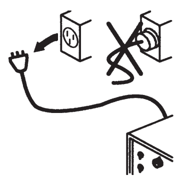
12. Oxygen
13. Nitrogen
14. Air
15. Argon-hydrogen (H5)
16. Argon-hydrogen (H35)
17. Nitrogen-hydrogen (F5)
18. Methane (CH_4)

Customer-supplied power cable

19. Main power cable

Recommended grounding and shielding practices


DANGER
ELECTRIC SHOCK CAN KILL



Disconnect electrical power before performing any maintenance. All work requiring the removal of the power supply cover must be performed by a qualified technician.

See *Section 1* of the plasma system instruction manual for more safety precautions.

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 3 grounding systems described below. There is diagram on page 5 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^2) welding cable (Hypertherm part no. 047040) for the EMI ground cables shown on the diagram (blue).

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 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 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.

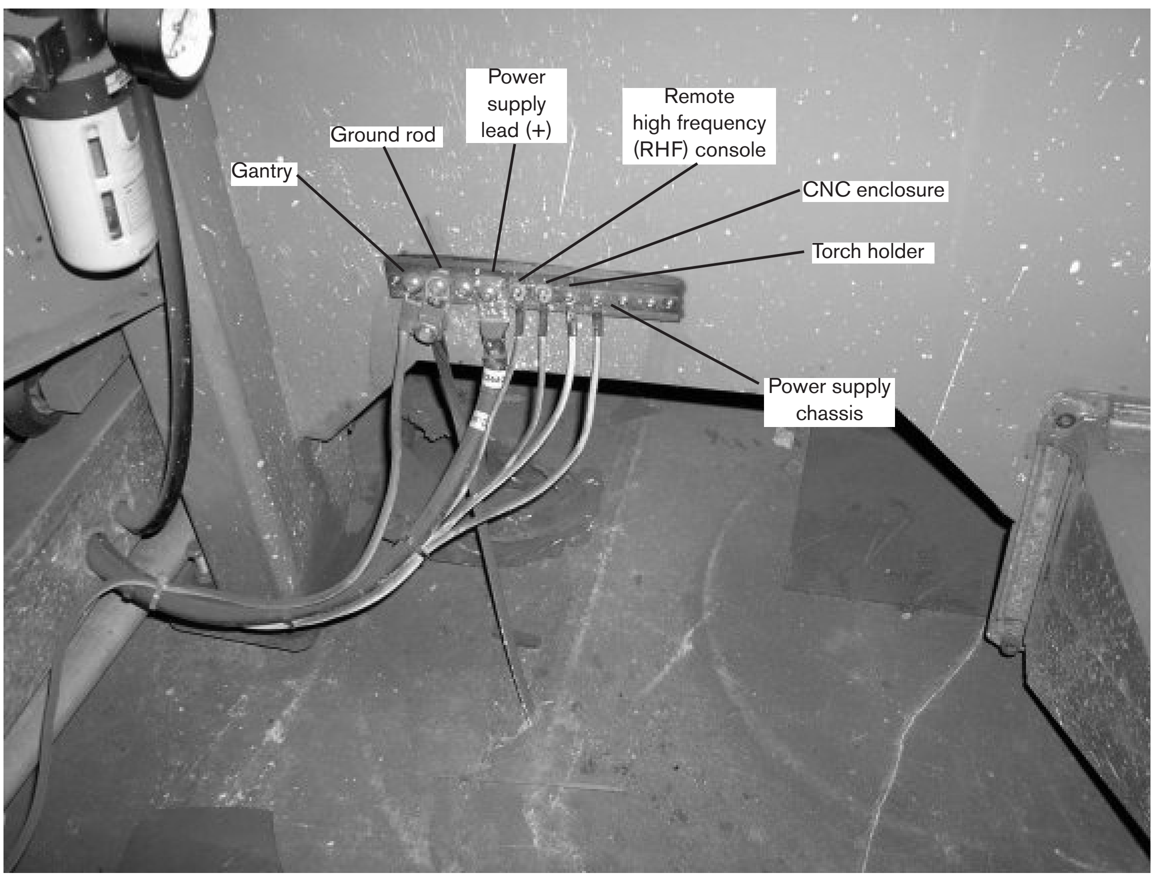
11. The torch holder and the torch breakaway mechanism – the part mounted to the lifter, not the part mounted on the torch – must be connected to the stationary part of the lifter with copper braid at least 12.7 mm (1/2 in) wide. A separate cable must run from the lifter to the bus bar on the gantry. 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

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.

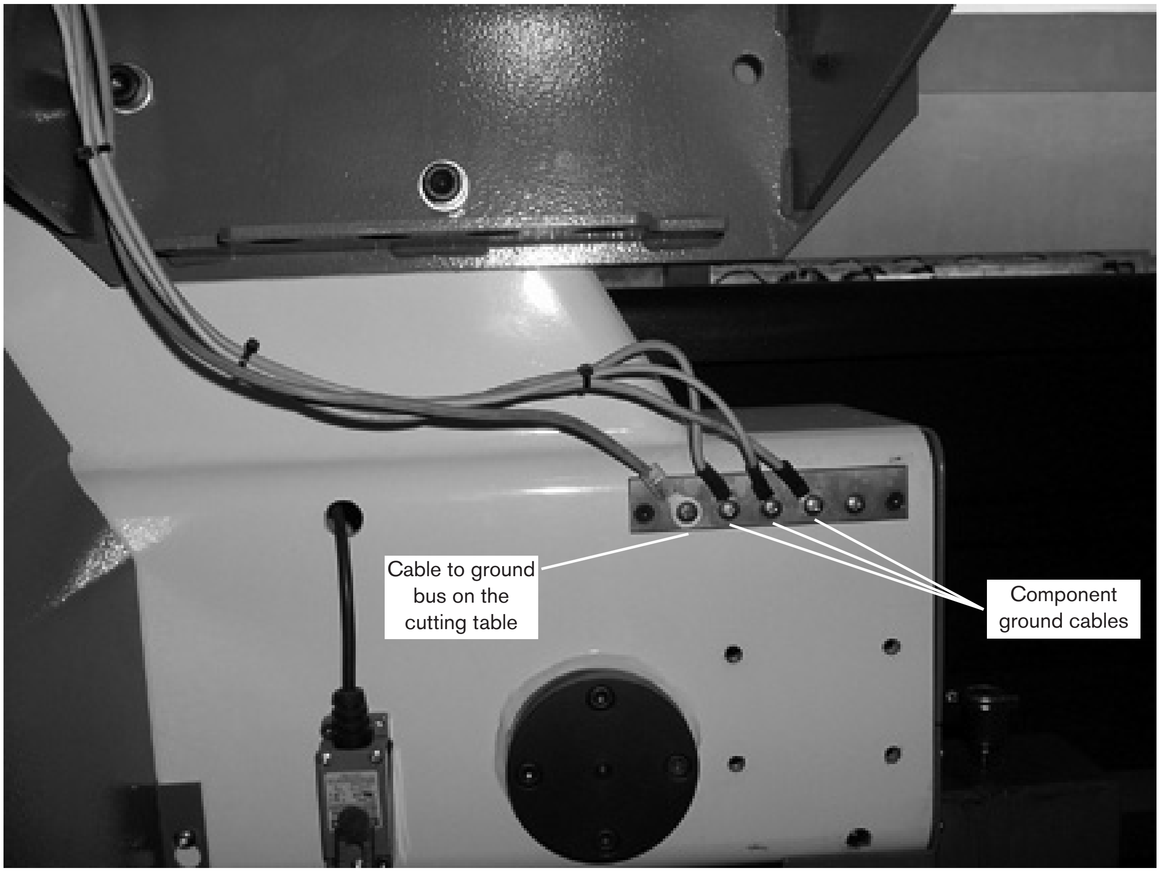
13. If the OEM is installing a voltage divider to process arc voltage for use in the control system, the voltage divider board should be mounted as close as possible to the point where the arc voltage is sampled. One acceptable location is inside the plasma power supply. If the Hypertherm voltage divider 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.



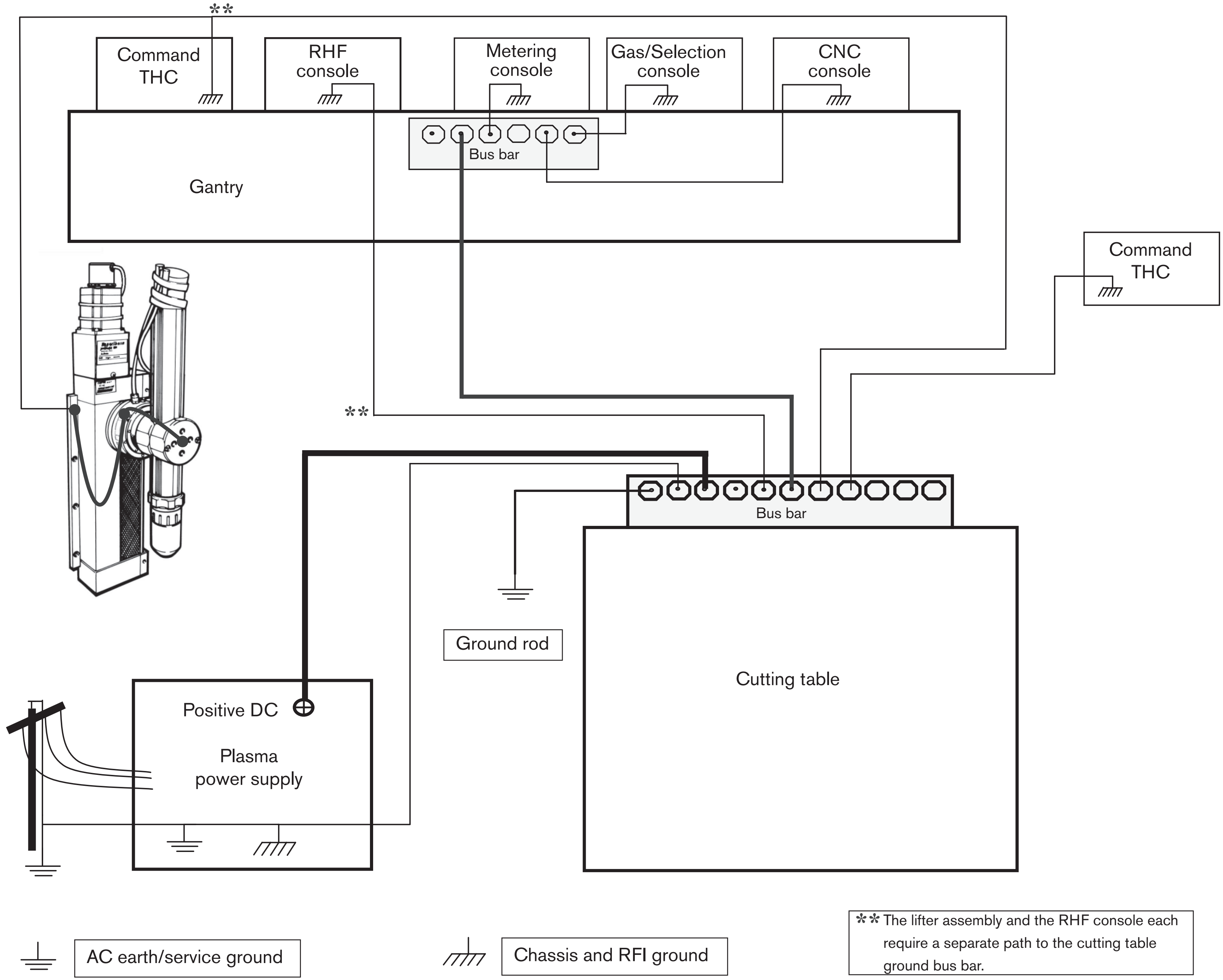
Example of a good cutting table ground bus. The picture above shows the connection from the gantry ground bus, the connection from the ground rod, the power supply positive lead, the RHF console*, the CNC enclosure, the torch holder, and the power supply chassis.

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



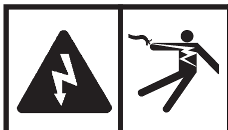
Example of a good gantry ground bus. It is bolted to the gantry, close to the motor. All of the individual ground cables from the components mounted on the gantry go to the bus except those from the RHF console* and the torch holder. A single heavy cable then goes from the gantry ground bus to the ground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

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



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

Ⓐ Placement of the power supply

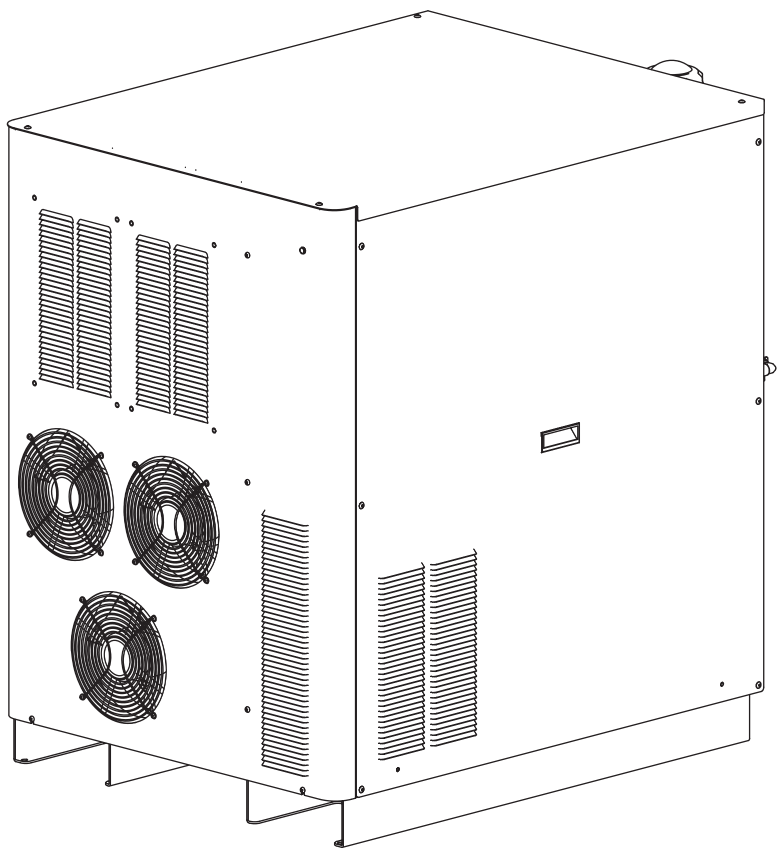


DANGER
ELECTRICAL SHOCK CAN KILL

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

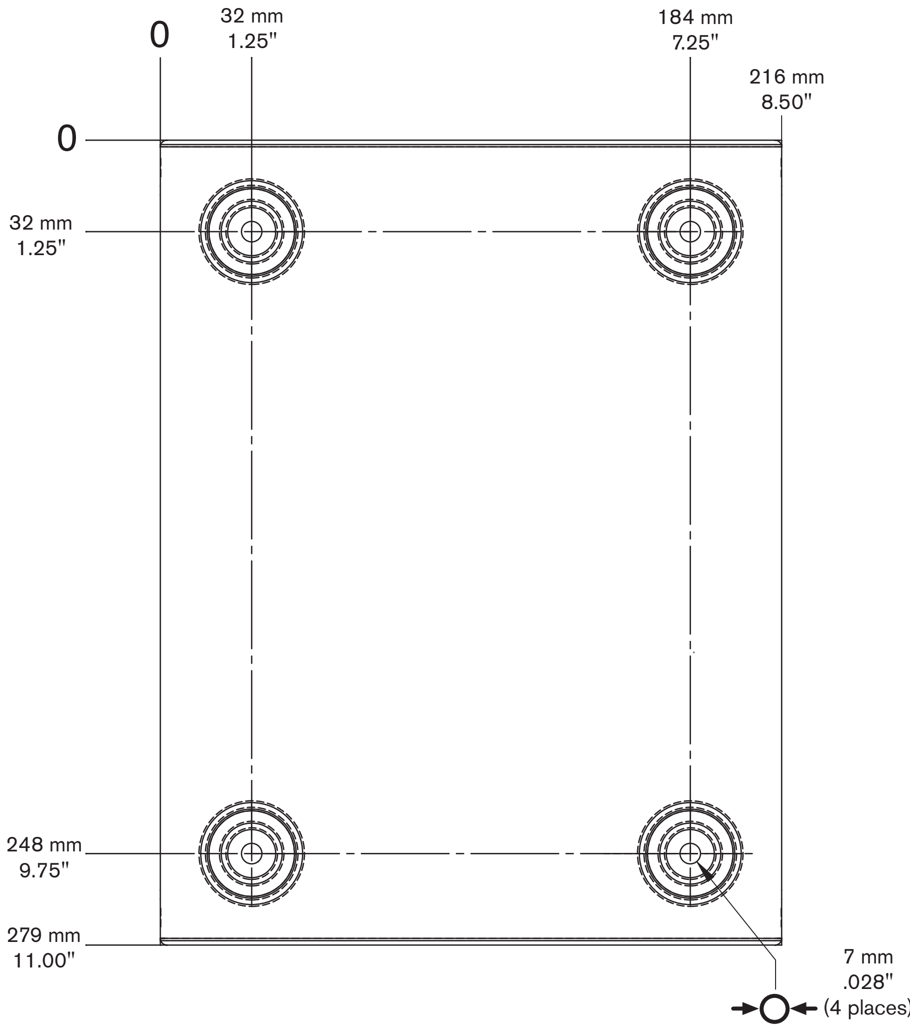
The power supply can be moved by forklift but the forks must be long enough to extend the entire length of the base. Take care when lifting so that the underside of the power supply is not damaged.

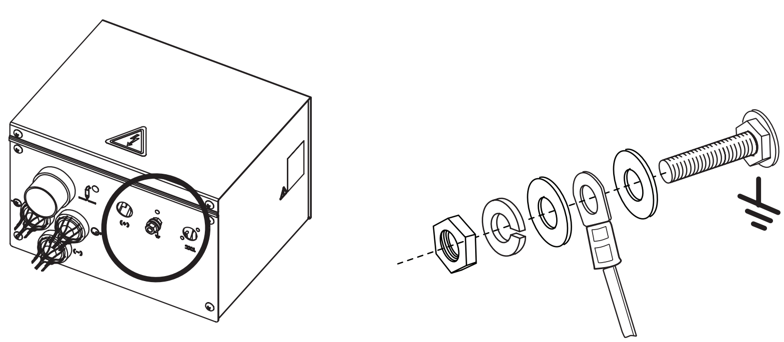
- Place the power supply in an area that is free of excessive moisture, has proper ventilation and is relatively clean. Allow 1 m (3 ft) of space on all sides of the power supply for ventilation and service.
- Cooling air is drawn in through the front panel and is exhausted through the rear of the unit 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.



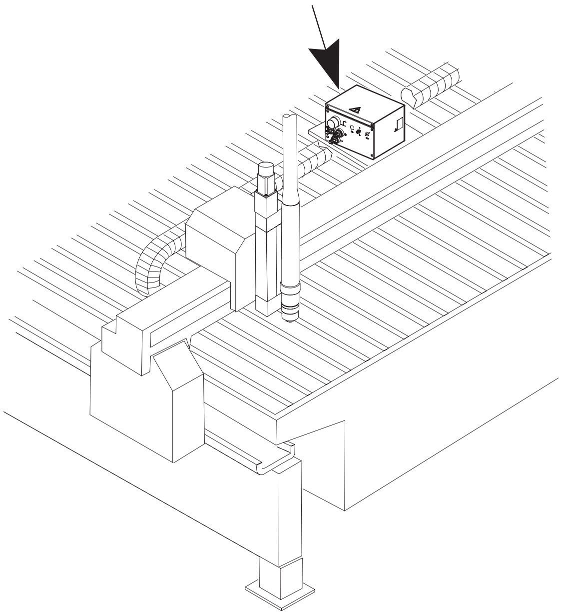
B Install the ignition console

- Mount the ignition console on the gantry (bridge) for the RHF configuration.
- Mount the ignition console on the power supply for the LHF configuration.
- Allow room to remove the top for servicing.

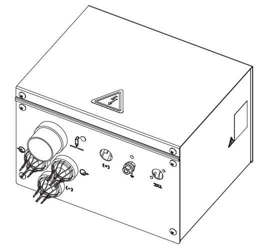




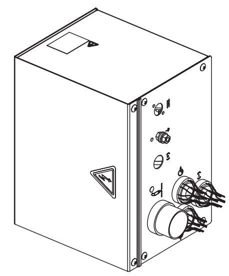
Ignition console grounding

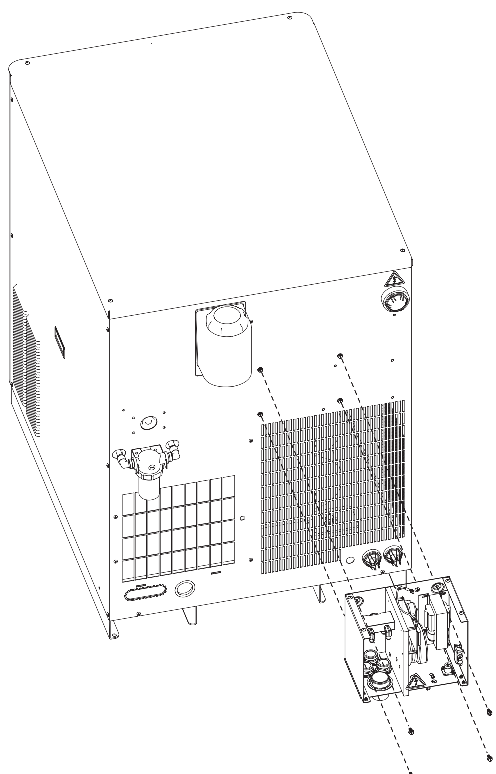


Horizontal RHF mounting

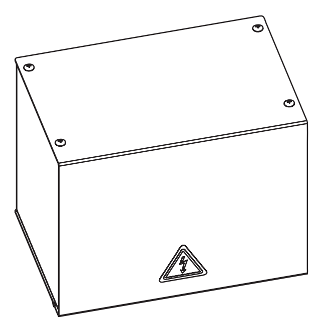


Vertical RHF mounting



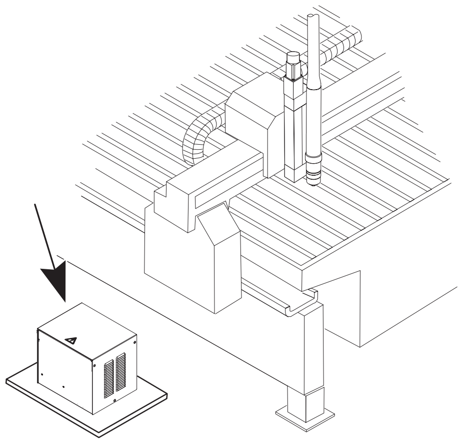


LHF mounting

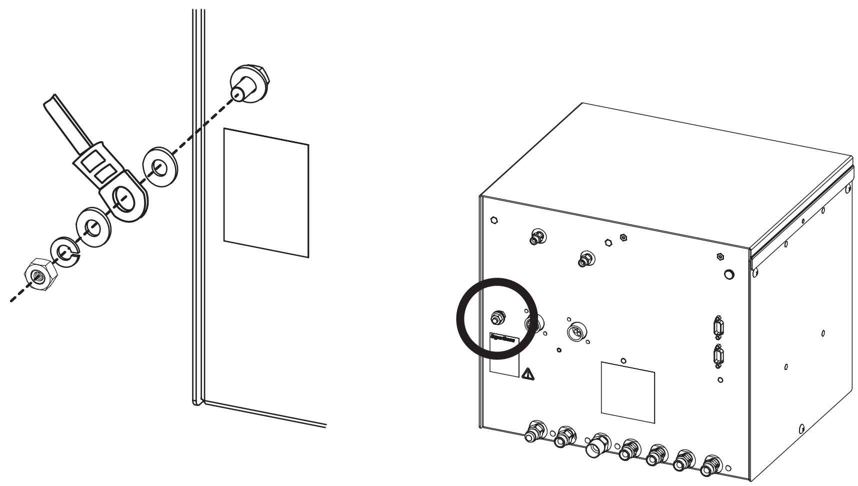


C Placement of the selection console

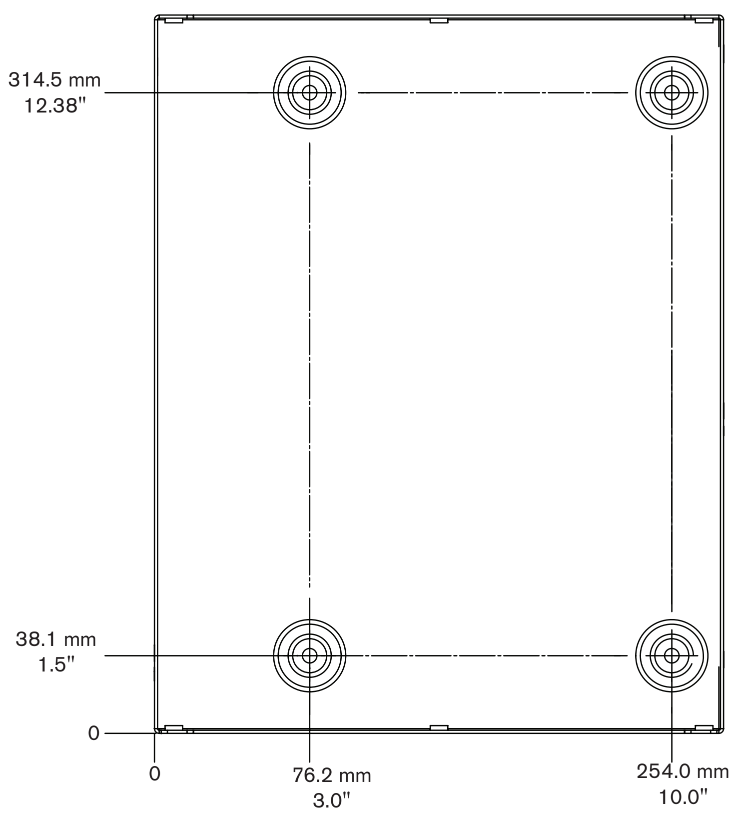
- Mount the selection console near the cutting table. Allow room to remove the top and right side cover for servicing. Preferred orientation is shown in the figure below. The maximum length of cables between the power supply and selection console is 75 m (250 ft). The maximum length of cables and hoses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



Preferred selection console orientation

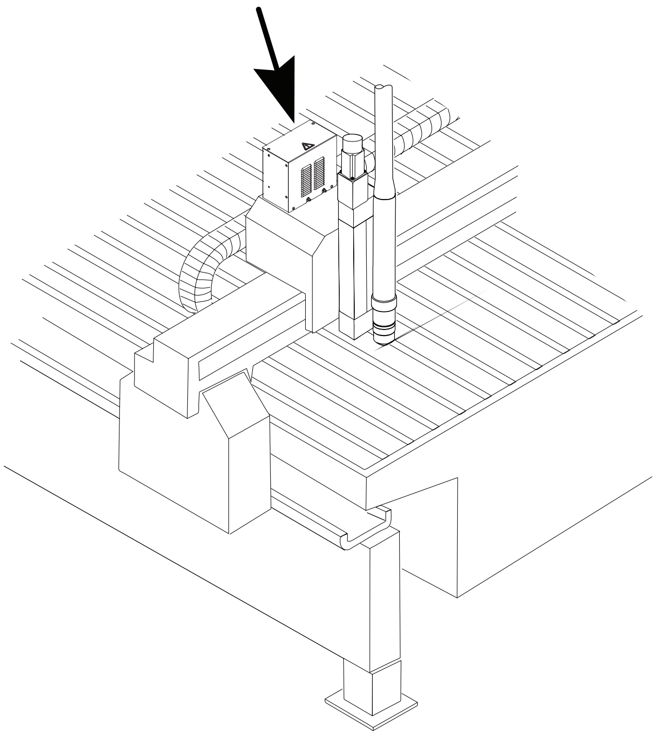


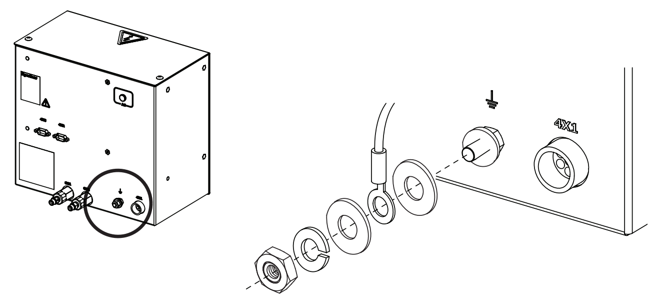
Selection console grounding



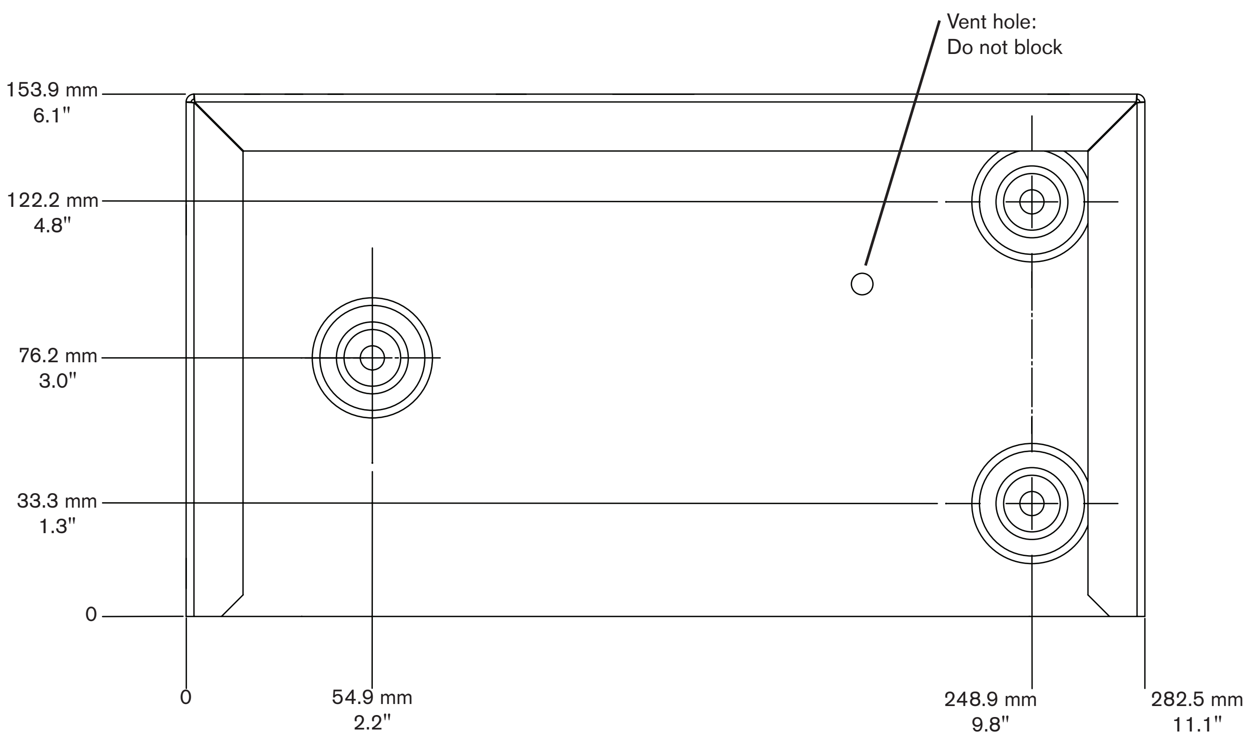
D Install the metering console

- 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).



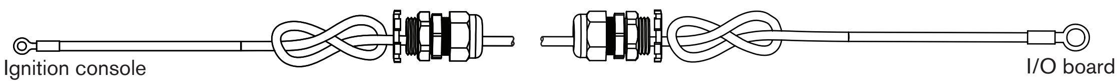


Metering console grounding



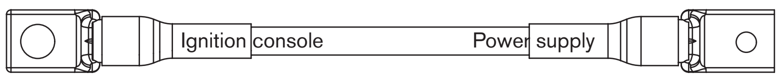
Power supply to ignition console leads

❶ Pilot arc lead



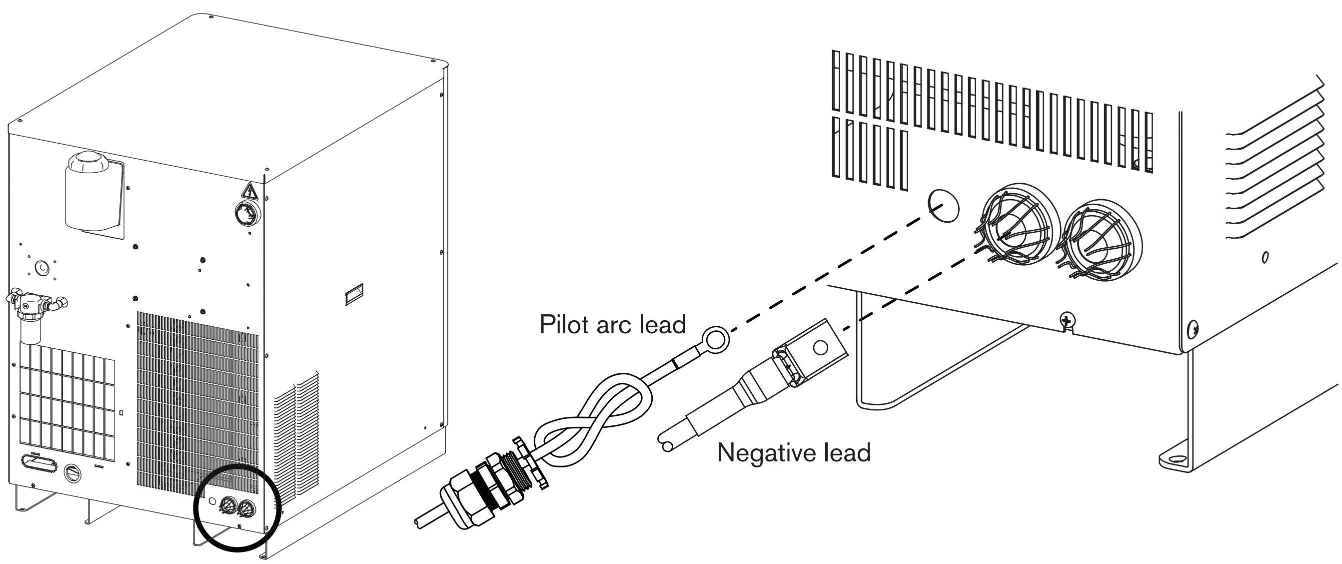
Part no.	Length	Part no.	Length
123683*	1.5 m (5 ft)	123823	20 m (65 ft)
123820	3 m (10 ft)	123735	25 m (82 ft)
123821	4.5 m (15 ft)	123668	35 m (115 ft)
123666	7.5 m (25 ft)	123669	45 m (150 ft)
123822	10 m (35 ft)	123824	60 m (200 ft)
123667	15 m (50 ft)	123825	75 m (250 ft)

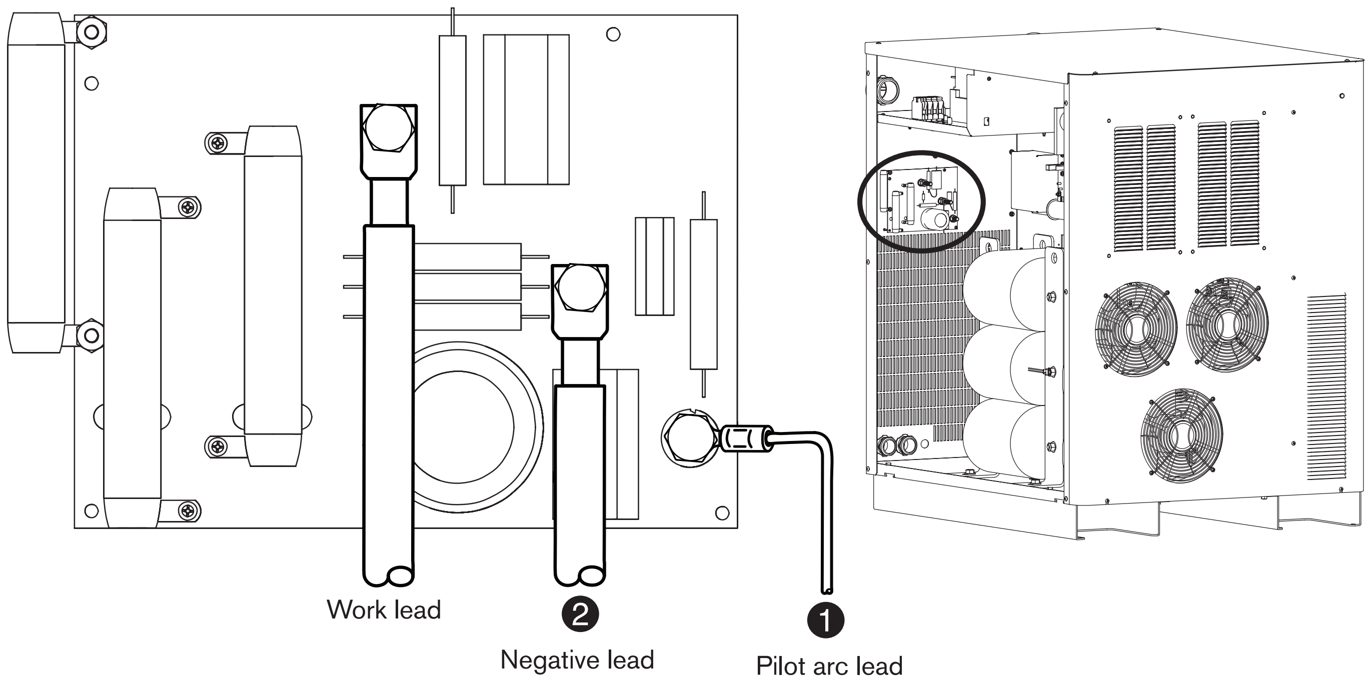
❷ Negative lead

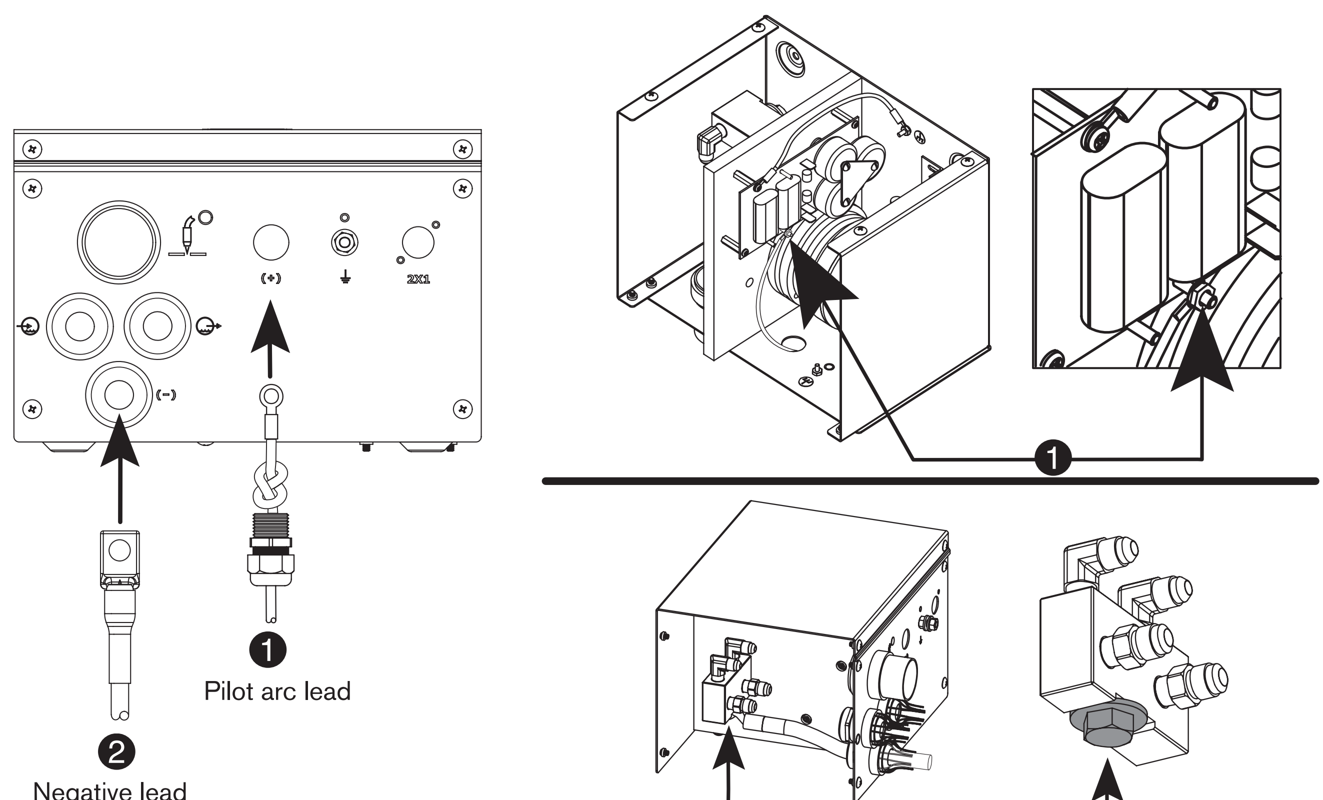


Part no.	Length	Part no.	Length
123829*	1.5 m (5 ft)	123819	20 m (65 ft)
123816	3 m (10 ft)	123775	25 m (82 ft)
123817	4.5 m (15 ft)	123776	35 m (115 ft)
123773	7.5 m (25 ft)	123777	45 m (150 ft)
123818	10 m (35 ft)	123778	60 m (200 ft)
123774	15 m (50 ft)	123779	75 m (250 ft)

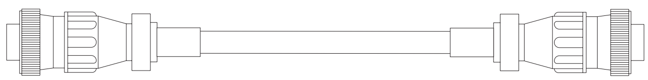
*Cable numbers 123683 and 123829 are for use with systems that have the ignition console mounted on the power supply




Work lead
2
Negative lead
1
Pilot arc lead


(+)
2X1
(–)
1
Pilot arc lead
2
Negative lead
1
2

❸ Ignition console power cable

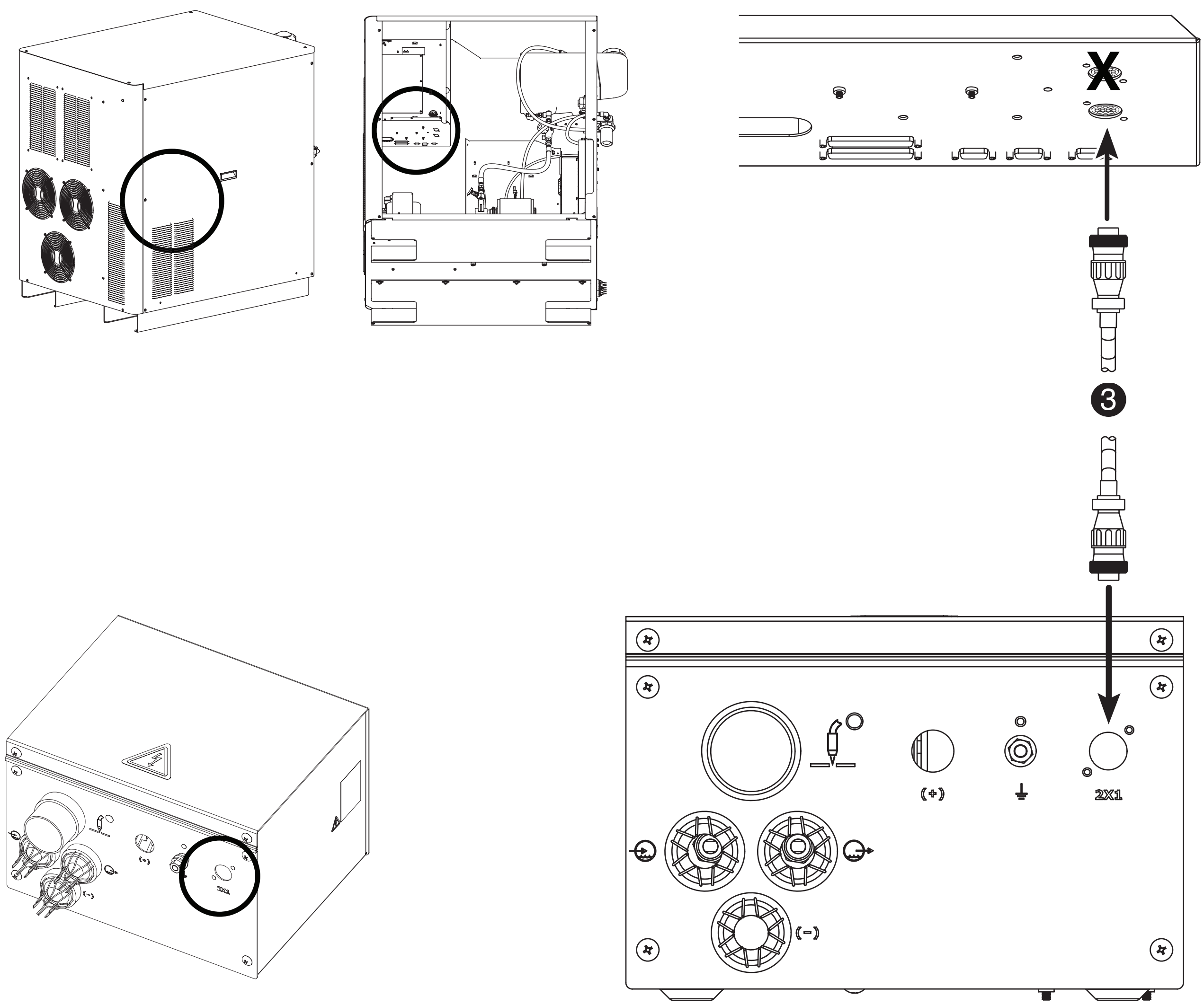


Part no.	Length	Part no.	Length
123865*	2.1 m (7 ft)	123836	20 m (65 ft)
123419	3 m (10 ft)	123736	25 m (82 ft)
123834	4.5 m (15 ft)	123672	35 m (115 ft)
123670	7.5 m (25 ft)	123673	45 m (150 ft)
123835	10 m (35 ft)	123837	60 m (200 ft)
123671	15 m (50 ft)	123838	75 m (250 ft)

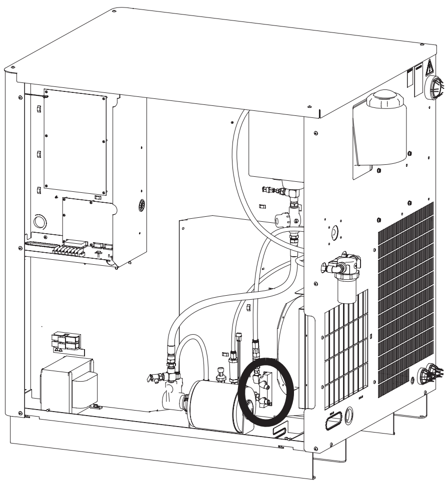
Cable signal list – power supply to ignition console

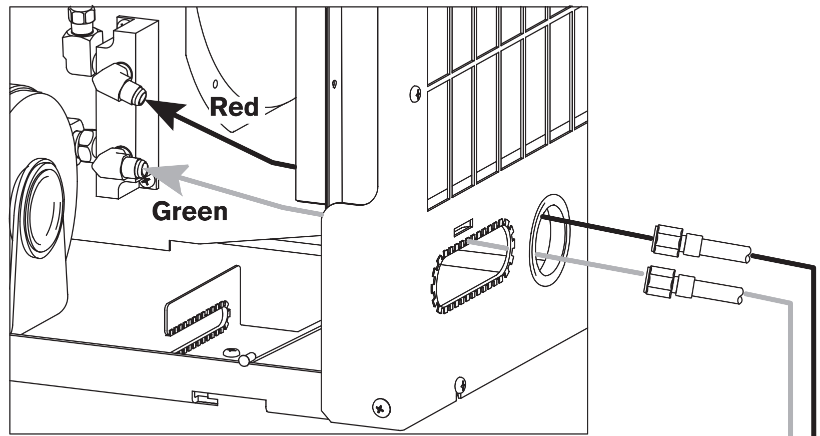
Power supply end			**Ignition console end**		
Pin #	I/O	Description	Pin #	I/O	Function
1		120 Vac Hot	1		
2		120 Vac Return	2		
3		Ground	3		
4		Not connected	4		

*Cable number 123865 is for use with systems that have the ignition console mounted on the power supply

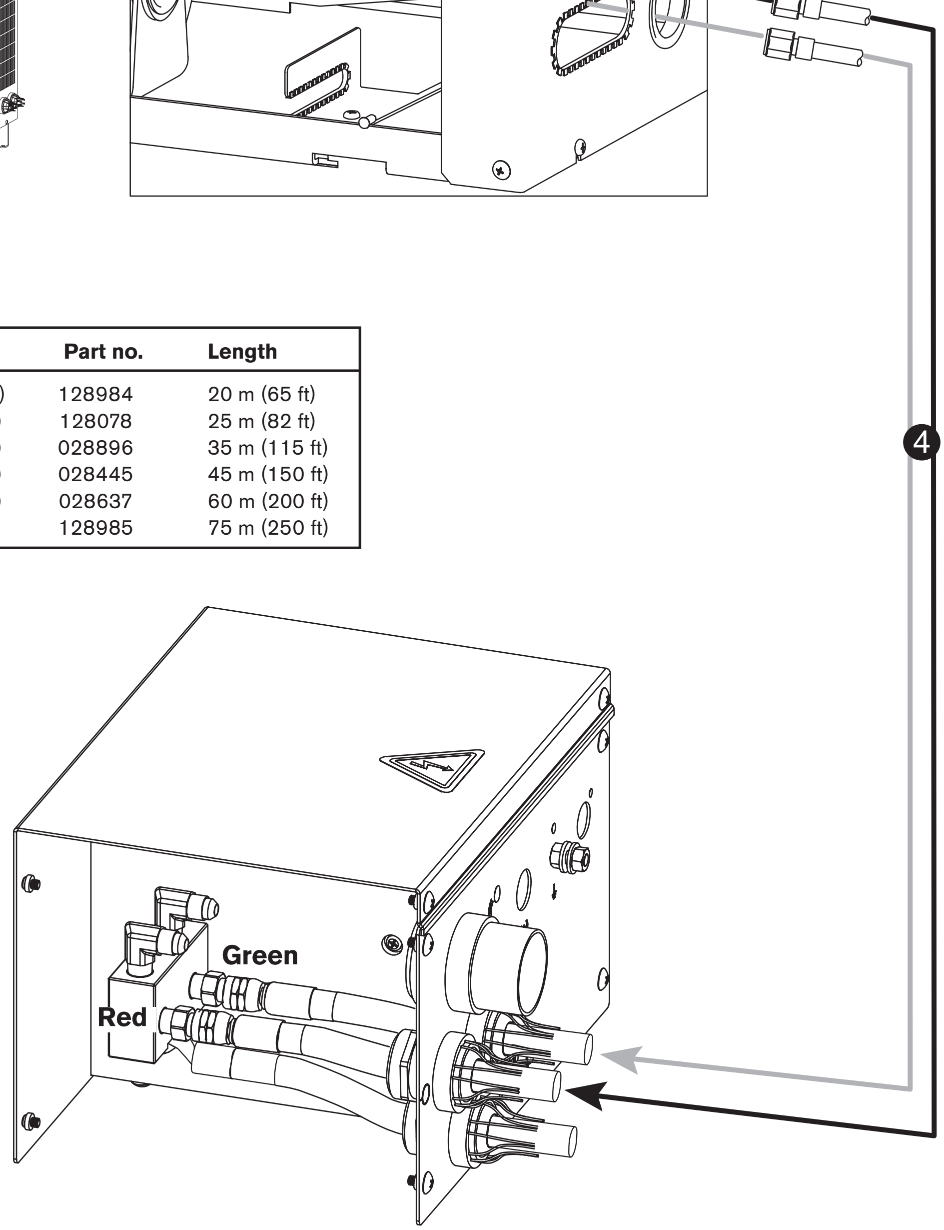


❹ Ignition console coolant hoses





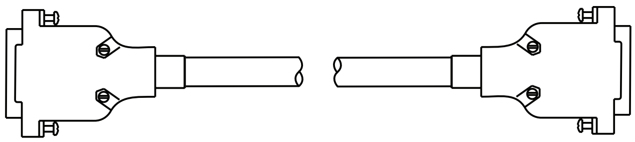
Part no.	Length	Part no.	Length
228031*	1.1 m (3.8 ft)	128984	20 m (65 ft)
028652	3 m (10 ft)	128078	25 m (82 ft)
028440	4.5 m (15 ft)	028896	35 m (115 ft)
028441	7.5 m (25 ft)	028445	45 m (150 ft)
128173	10 m (35 ft)	028637	60 m (200 ft)
028442	15 m (50 ft)	128985	75 m (250 ft)



*Hose set number 228031 is for use with systems that have the ignition console mounted on the power supply

Power supply to selection console cables

❺ Control cable

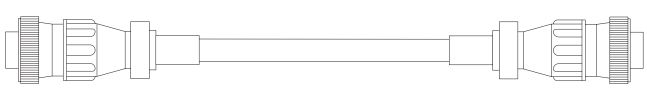


Part no.	Length	Part no.	Length
123784*	3 m (10 ft)	123737	25 m (82 ft)
123839	4.5 m (15 ft)	123738	35 m (115 ft)
123691	7.5 m (25 ft)	123739	45 m (150 ft)
123840	10 m (35 ft)	123842	60 m (200 ft)
123711	15 m (50 ft)	123843	75 m (250 ft)
123841	20 m (65 ft)		

Cable signal list – power supply to selection console

Power supply end			Selection console end		
Pin #	Input/Output	Description	Pin #	Input/Output	Function
1		unused	1		
6		unused	6		
2	Input/Output	CANL	2	Input/Output	CAN serial communication
7	Input/Output	CANH	7	Input/Output	CAN serial communication
3		CAN Ground	3		CAN ground reference
9		unused	9		unused
8		unused	8		
4		unused	4		
5		unused	5		

❻ Power cable

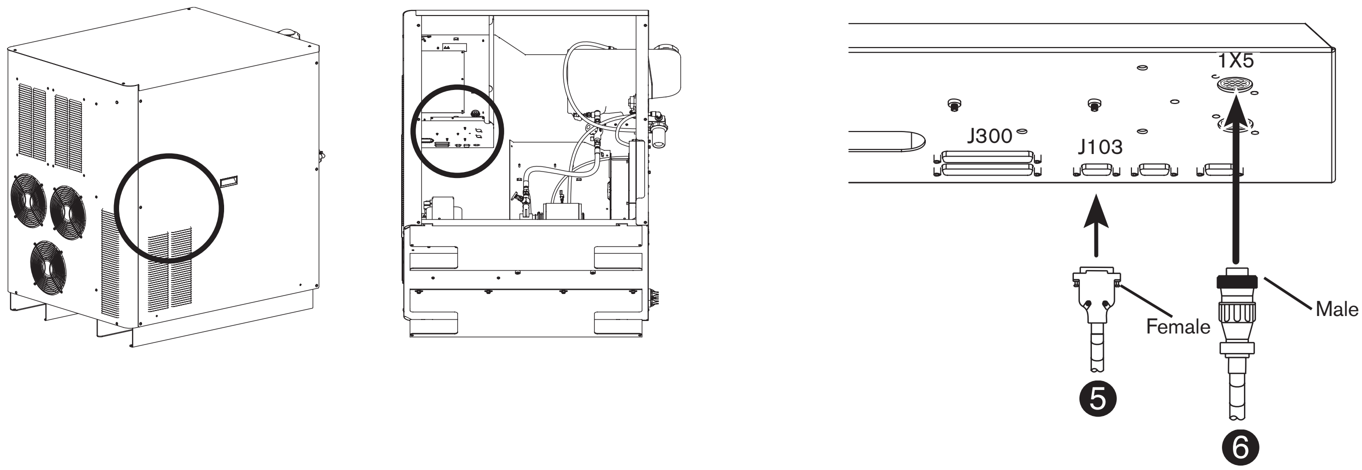


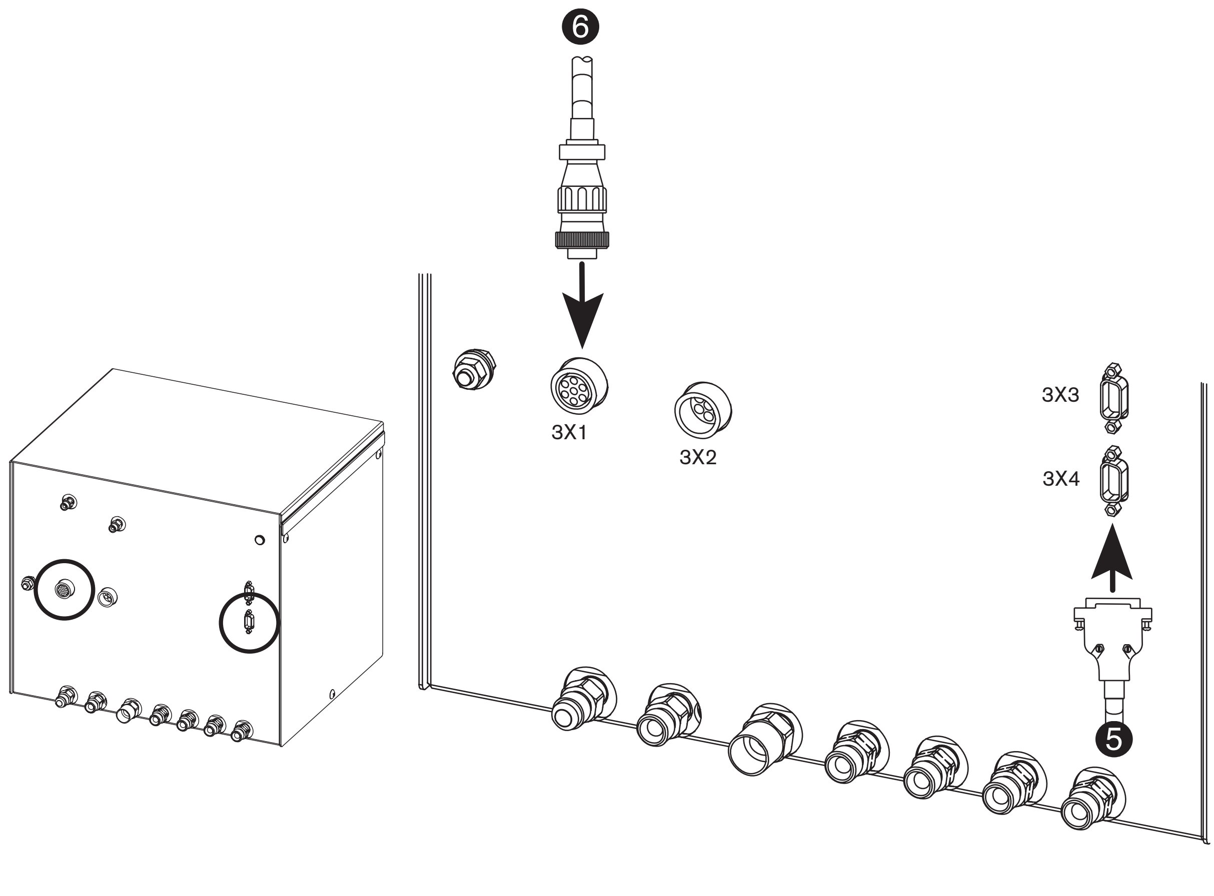
Part no.	Length	Part no.	Length
123785*	3 m (10 ft)	123740	25 m (82 ft)
123846	4.5 m (15 ft)	123676	35 m (115 ft)
123674	7.5 m (25 ft)	123677	45 m (150 ft)
123847	10 m (35 ft)	123849	60 m (200 ft)
123675	15 m (50 ft)	123850	75 m (250 ft)
123848	20 m (65 ft)		

Cable signal list – power supply to selection console

Power supply end			Selection console end		
Pin #	I/O	Description	Pin #	I/O	Function
1		120 VAC-Hot	1		
2		120 VAC-Return	2		
3		Ground	3		
4		unused	4		
5		unused	5		
6		24 VAC-Hot	6		
7		24 VAC-Return	7		

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


1X5
J300
J103
Female
Male
5
6


6
3X1
3X2
3X3
3X4
5

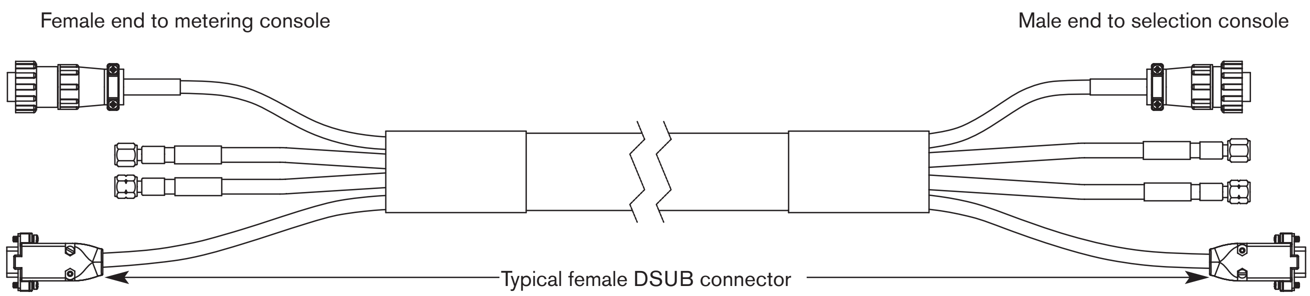
Selection console to metering console connections

❼ Cable and gas hose assembly

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

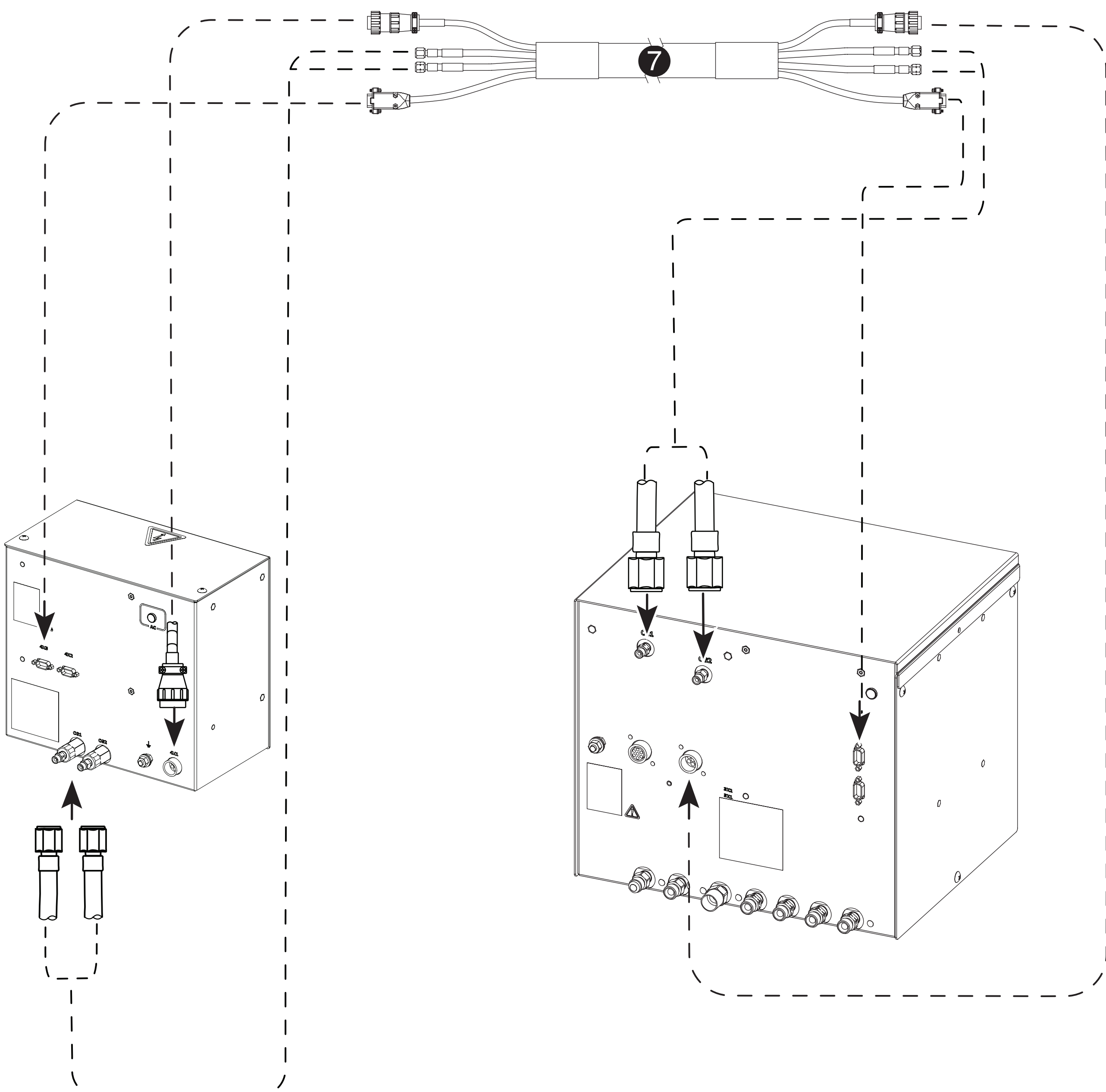
Power cable signal list – 9-pin connectors

Metering console end			**Selection console end**		
Pin #	Input/Output	Description	Pin #	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
6		unused	6		
7		unused	7		
4		unused	4		
5		unused	5		



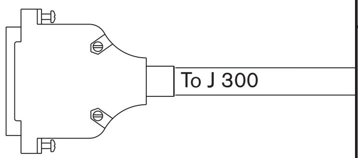
Communication cable signal list – 9-pin DSUB connectors

Metering console end			**Selection console end**		
Pin #	I/O	Description	Pin #	I/O	Function
9	I	unused	9	O	unused
3	I	CAN ground	3	O	Power ground
7	I/O	CAN H	7	I/O	CAN communication
2	I/O	CAN L	2	I/O	CAN communication

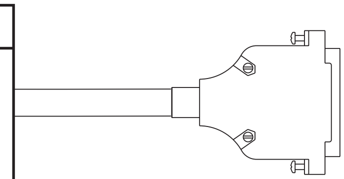


7

❽ Power supply to CNC interface cable



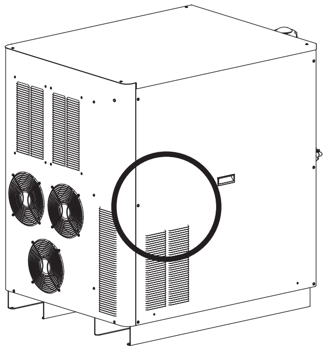
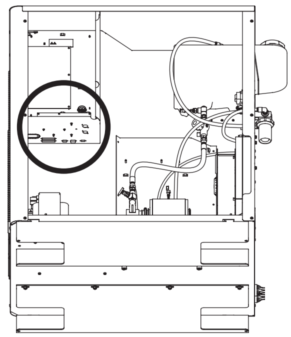
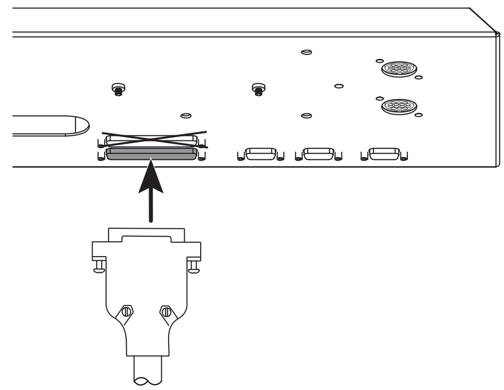
Part no.	Length	Part no.	Length
123210	3 m (10 ft)	123741	25 m (82 ft)
123211	4.5 m (15 ft)	123742	35 m (115 ft)
123022	7.5 m (25 ft)	123220	45 m (150 ft)
123214	10 m (35 ft)	123852	60 m (200 ft)
123023	15 m (50 ft)	123853	75 m (250 ft)
123851	20 m (65 ft)		



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

Power supply **CNC**

Wire color	Pin #	Input/ Output	Signal name	Function	Input/ Output	Notes
Black Red	1 20	Input Input	Rx - Rx +	RS-422 serial receiver RS-422 serial receiver	Output Output	
Black Green	2 21	Output Output	Tx - Tx +	RS-422 serial transmitter RS-422 serial transmitter	Input Input	
Black Blue	3 22		RS-422 ground None	RS-422 serial ground Not used		
Black Yellow	4 23	Output Output	Motion 1 E (-) Motion 1 C (+)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out.	Input Input	2 & 3
Black Brown	5 24	Output Output	Error E (-) Error C (+)	Notifies the CNC that an error has occurred.	Input Input	2
Black Orange	6 25	Output Output	Rampdown error E (-) Rampdown error C (+)	Notifies the CNC that a rampdown error has occurred	Input	2
Red White	7 26	Output Output	Not ready E (-) Not ready C (+)	Notifies the CNC that the plasma system is not ready to fire an arc	Input	2
Red Green	8 27	Output Output	Motion 2 E (-) Motion 2 C (+)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out.	Input Input	2 & 3
Red Blue	9 28	Output Output	Motion 3 E (-) Motion 3 C (+)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out.	Input Input	2 & 3
Red Yellow	10 29	Output Output	Motion 4 E (-) Motion 4 C (+)	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out.	Input Input	2 & 3
Red Brown	11 30		None None	Not used Not used		
Red Orange	12 31	Input Input	Corner - Corner +	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 Output	1
Green White	13 32	Input Input	Pierce - Pierce +	CNC Notifies the plasma system to maintain the shield preflow until the CNC releases the signal.	Output	1
Green Blue	14 33	Input Input	Hold - Hold +	Not required without CommandTHC. CommandTHC requires signal to preflow gases during IHS.	Output	1
Green Yellow	15 34	Input Input	Start - Start +	CNC initiates the plasma arc.	Output Output	1
Green Brown	16 35		None None	Not used Not used		
Green Orange	17 36		None Power ground	Not used Ground		
White Black	18 37		Power ground CNC +24 VDC	Ground Available 24 VDC (200 milliamps maximum) See notes		4
	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 (0.022µF 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.

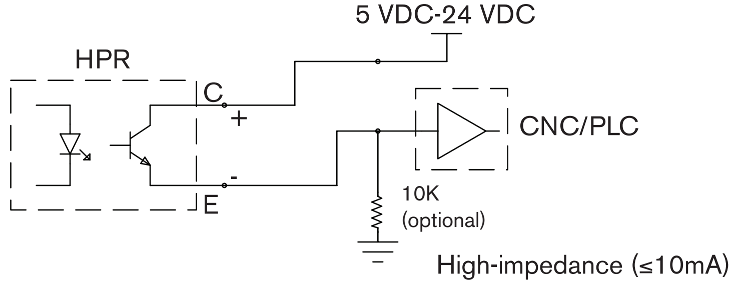
Note 3. Machine motion is selectable and is used for configurations with multiple plasma systems.

Note 4. CNC +24 VDC provides 24 VDC at 200 mA maximum. A jumper is required on J304 to use 24 V power.

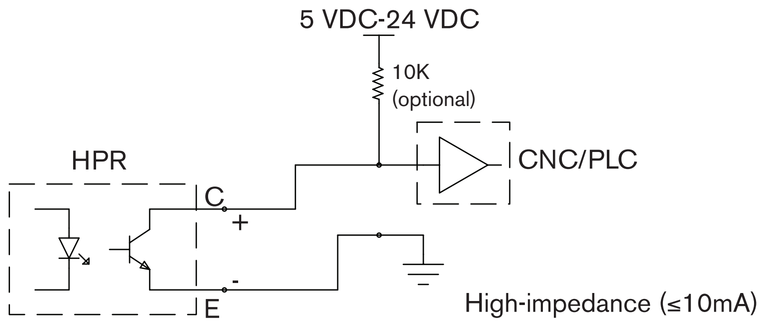
Caution: The CNC cable must be constructed using cable with 360-degree shield and metal housing connectors at each end. The shield must be terminated to the metal housings at each end to ensure proper grounding and to provide the best shield.

Examples of output circuits

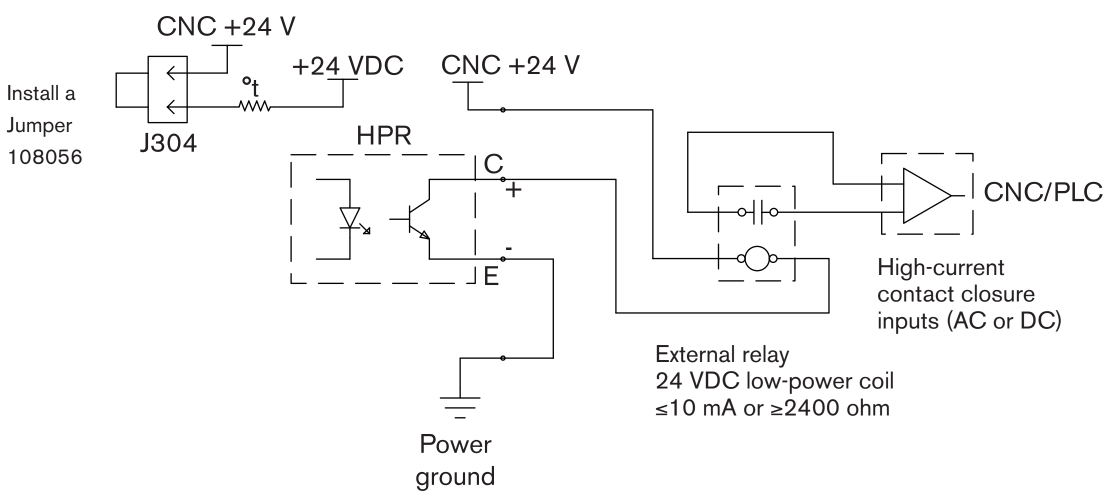
1. Logic interface, active-high



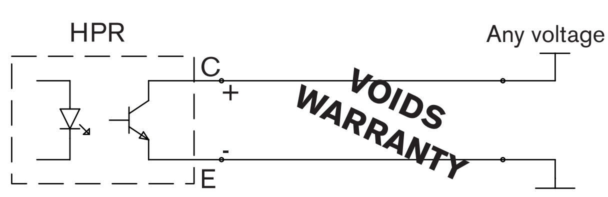
2. Logic interface, active-low



3. Relay interface

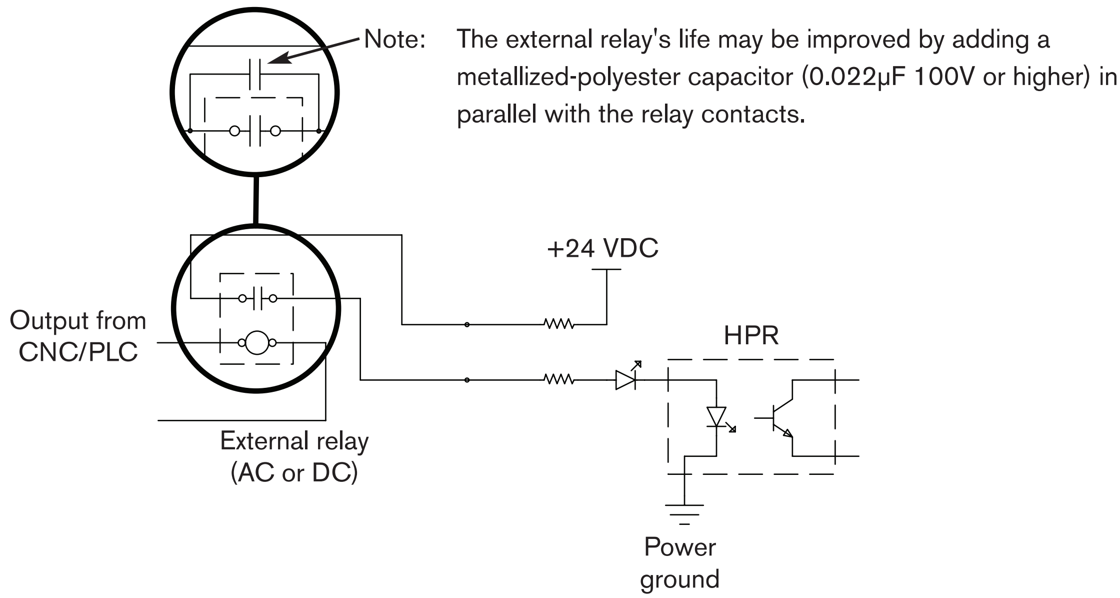


4. Do not use this configuration. Warranty will be void.

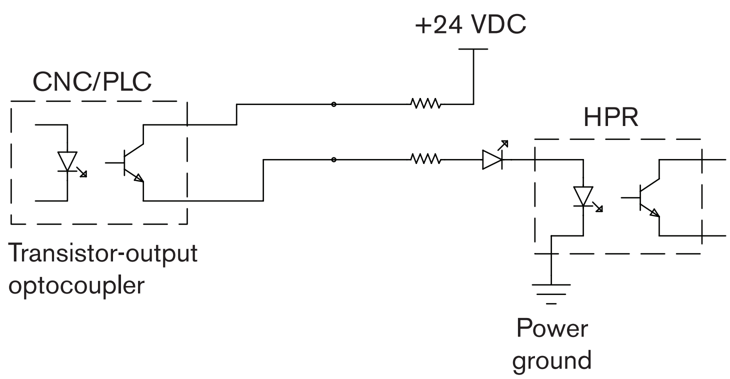


Examples of input circuits

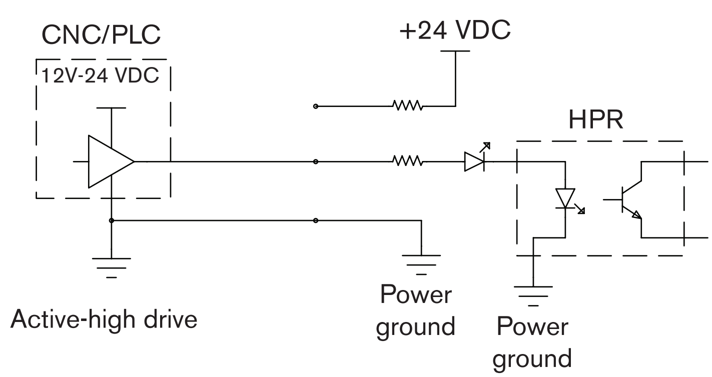
1. Relay interface



2. Optocoupler interface



3. Amplified-output interface

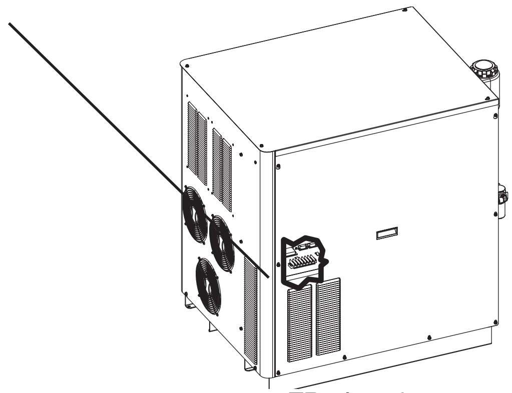


Remote ON/OFF switch (provided by customer)

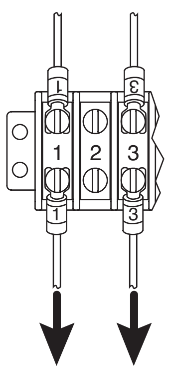
DANGER
ELECTRIC SHOCK CAN KILL

Disconnect electrical power before performing any maintenance.
See the *Safety* section in this manual for more safety precautions.

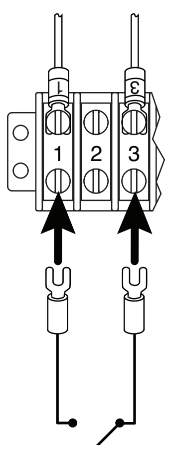
1. Locate terminal block 2 (TB2) in the power supply.



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



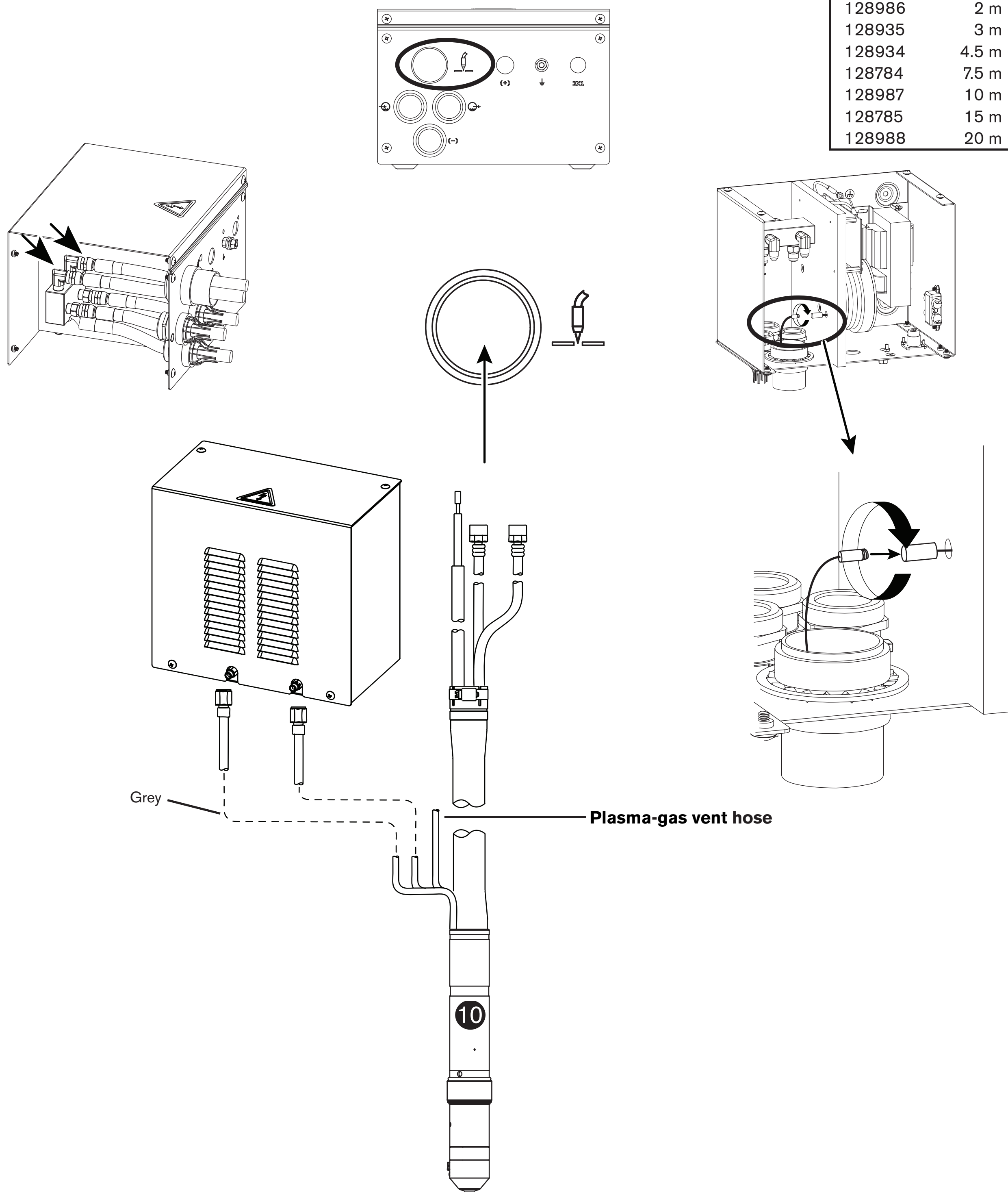
3. Connect switch to terminals 1 and 3 as shown.



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.

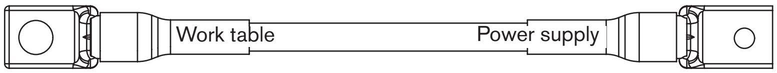
⑩ Torch lead assembly

Part no.	Length
128986	2 m (6 ft)
128935	3 m (10 ft)
128934	4.5 m (15 ft)
128784	7.5 m (25 ft)
128987	10 m (35 ft)
128785	15 m (50 ft)
128988	20 m (65 ft)

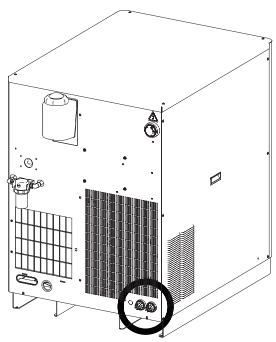


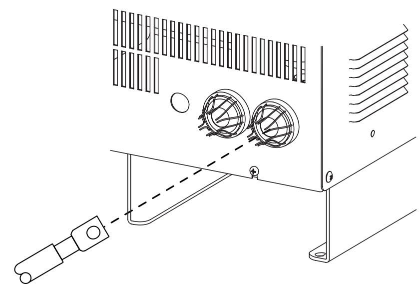
Caution: Locate the exposed end of the plasma-gas vent hose away from sparks caused by piercing to avoid ignition and possible damage to the torch leads.

⓫ Work lead

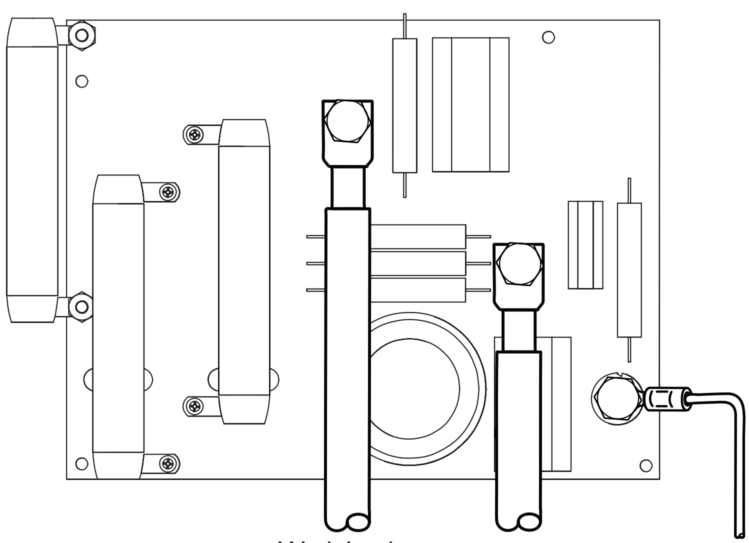


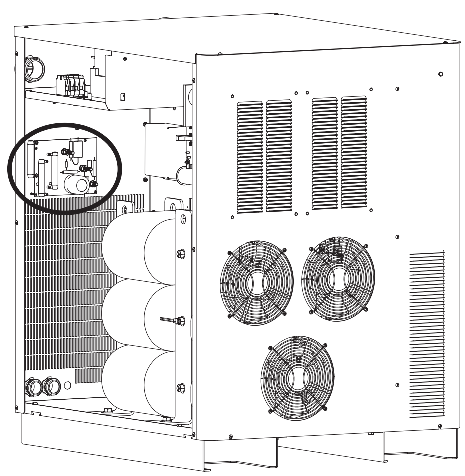
Part no.	Length	Part no.	Length
123816	3 m (10 ft)	123775	25 m (82 ft)
123817	4.5 m (15 ft)	123776	35 m (115 ft)
123773	7.5 m (25 ft)	123777	45 m (150 ft)
123818	10 m (35 ft)	123778	60 m (200 ft)
123774	15 m (50 ft)	123779	75 m (250 ft)
123819	20 m (65 ft)		



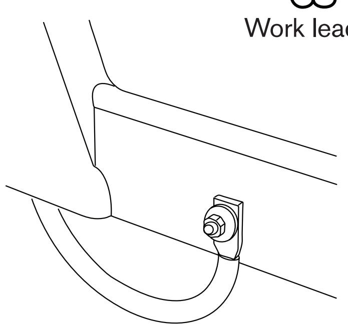


Work lead





Work lead

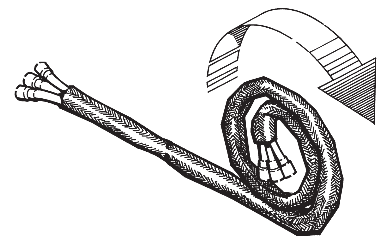


Lower frame of work table (typical).

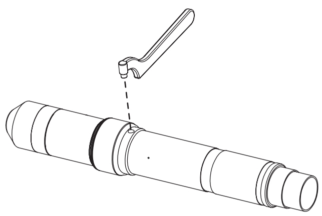
Torch connections

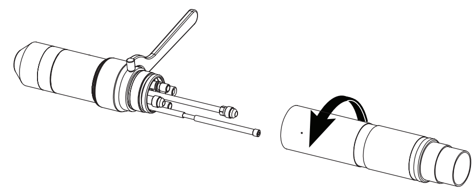
Connect the torch to the torch lead assembly

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

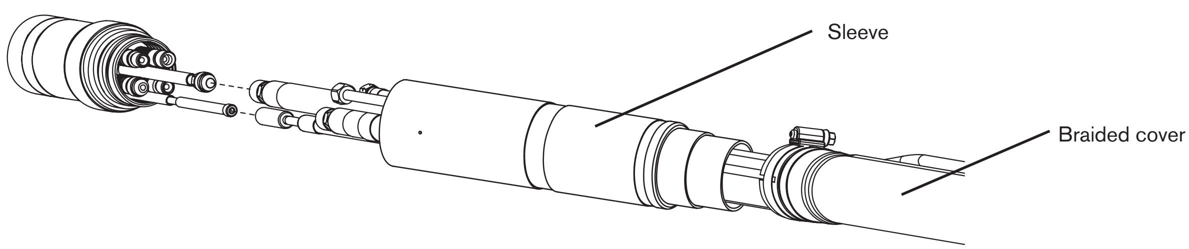


2. Hold the torch assembly in place with the spanner wrench (104269) and remove the mounting sleeve from the torch assembly.

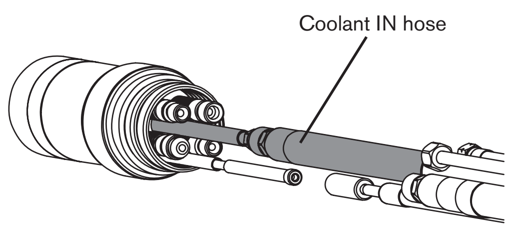




3. Push back the braided cover and slide the sleeve over the leads. Align the torch with the hoses in the lead assembly. The hoses must not be twisted. They are taped together to help prevent twisting.

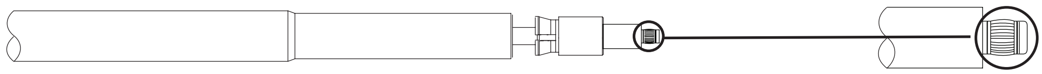


4. Connect the coolant IN hose (green) to the torch.

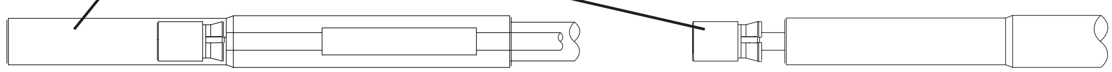


5. Connect the pilot arc lead.

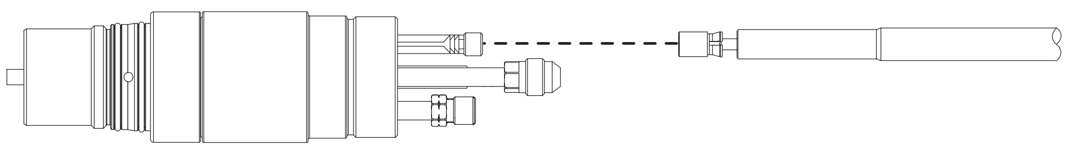
Note: Be careful not to damage or remove the small slotted metal band at the end of the pilot arc cable.



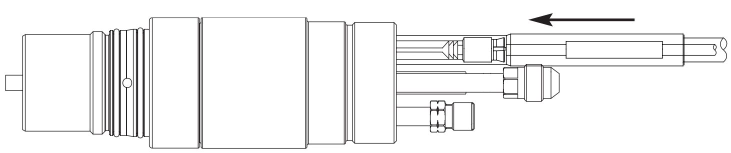
5a. Pull the sleeve back until the connector is exposed.



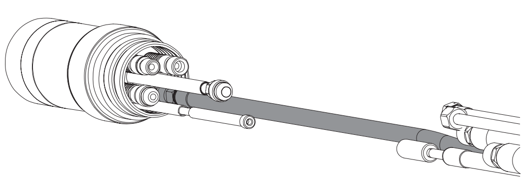
5b. Screw the connector onto the pilot arc connection from the torch. Tighten by hand until it is firmly seated.



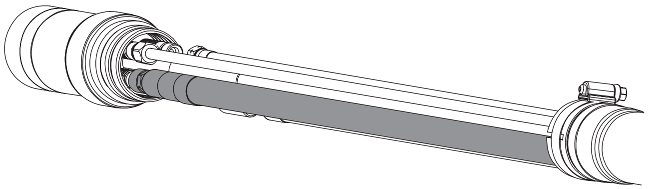
5c. Slide the sleeve forward until it clicks into place.



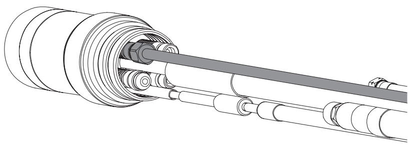
6. Connect the plasma-gas vent hose.



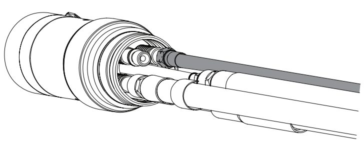
7. Connect the coolant return hose (red).



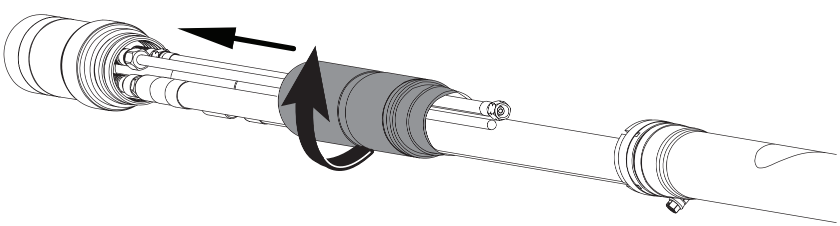
8. Connect the plasma gas hose.



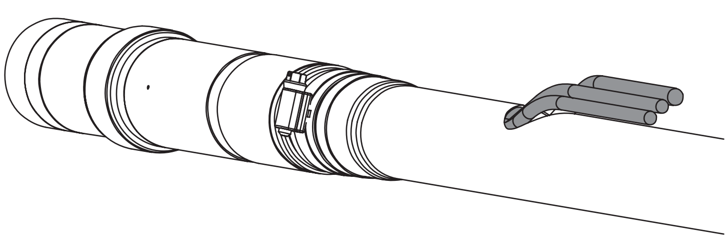
9. Connect the shield gas hose.



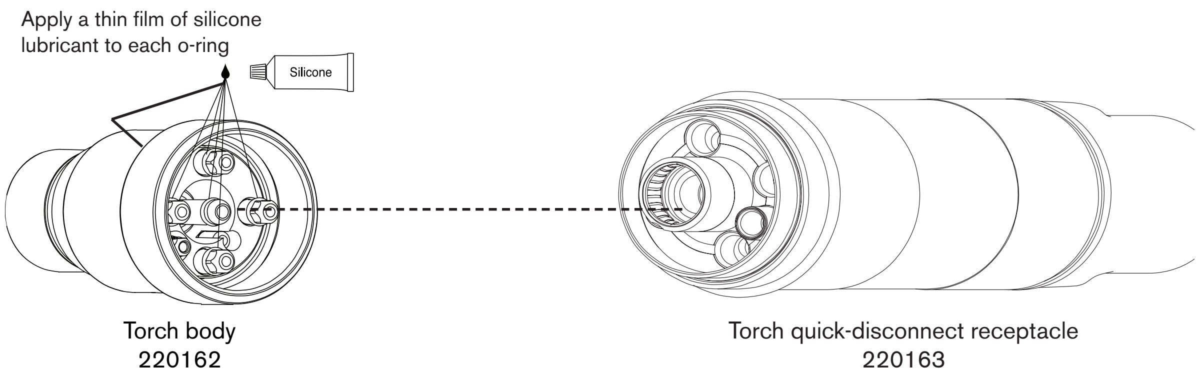
10. Slide the torch sleeve over connections and screw it onto the torch body.



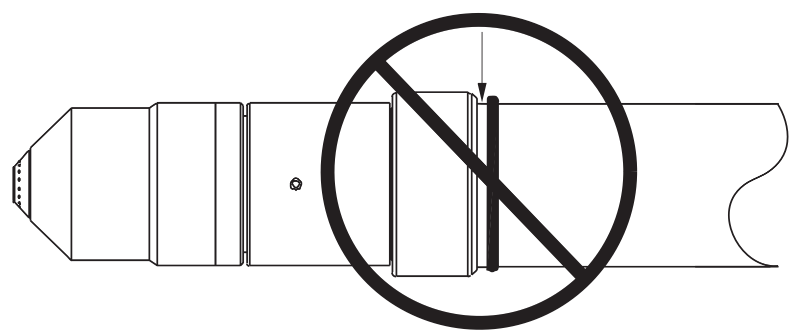
11. Slide the braided cover up to the torch sleeve. Make sure that the plasma, shield and vent hoses are routed through the hole in the braided cover. Loosen the hose clamp on the braided cover, slide the braided cover and clamp over the sleeve and tighten the clamp.

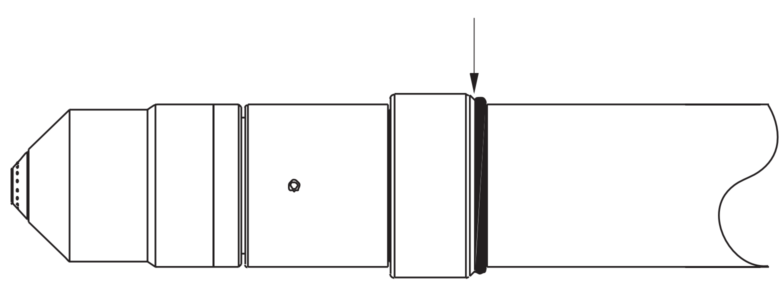


Connect the torch to the quick-disconnect



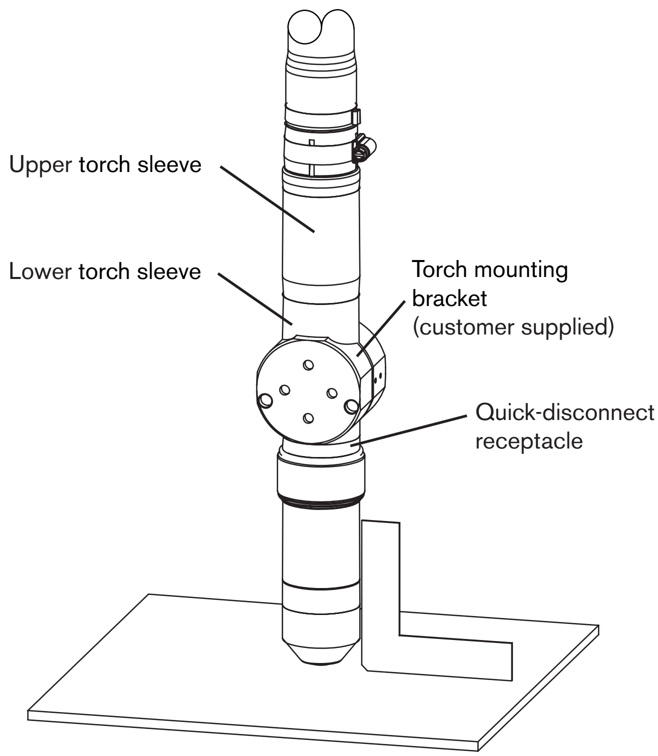
> ***Installation note***
>
> Align the torch body to the torch leads and secure by screwing completely together. Be certain that there is no space between the torch body and the o-ring on the torch leads. See also *Torch connections* earlier in this section for torch lead connections to ignition console.





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

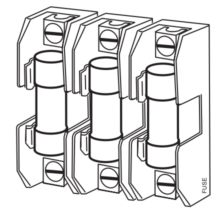
To align the torch at right angles to the workpiece, use a square. See figure above.

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

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.

Power requirements



General

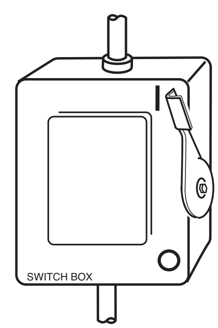
All switches, slow-blow fuses and power cables are customer-supplied and must be chosen as outlined by applicable national or local electrical codes. Installation must be performed by a licensed electrician. Use a separate primary line disconnect switch for the power supply.

Note: 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 and has an inrush current of 10 times the rated input current, which can last up to 0.20 seconds or 10 line cycles.

Input voltage	Phase	Rated input current @ 45.5 kW output	Recommended slow-blow fuse size	Recommended Cable size for 15 m (50 ft) maximum length	
				Rated for 60°C	Rated for 90°C
200/208 VAC	3	149/144 amps	175 amps	N/A	67.5 mm^2 (2/0 AWG)
220 VAC	3	136 amps	175 amps	N/A	67.5 mm^2 (2/0 AWG)
240 VAC	3	124 amps	150 amps	107.2 mm^2 (4/0 AWG)	53.5 mm^2 (1/0 AWG)
380 VAC	3	79 amps	95 amps	42.4 mm^2 (1 AWG)	26.7 mm^2 (3 AWG)
400 VAC	3	75 amps	90 amps	42.4 mm^2 (1 AWG)	26.7 mm^2 (3 AWG)
440 VAC	3	68 amps	80 amps	42.4 mm^2 (1 AWG)	21.2 mm^2 (4 AWG)
480 VAC	3	62 amps	75 amps	33.6 mm^2 (2 AWG)	21.2 mm^2 (4 AWG)
600 VAC	3	50 amps	60 amps	26.7 mm^2 (3 AWG)	13.3 mm^2 (6 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 or local codes.

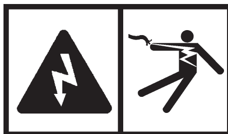
The switch should:

- Isolate the electrical equipment and disconnect all live conductors from the supply voltage when in the “OFF” position
- Have one “OFF” and one “ON” position clearly marked with “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).

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 60° C (140° F). Installation must be performed by a licensed electrician.

Connect the power



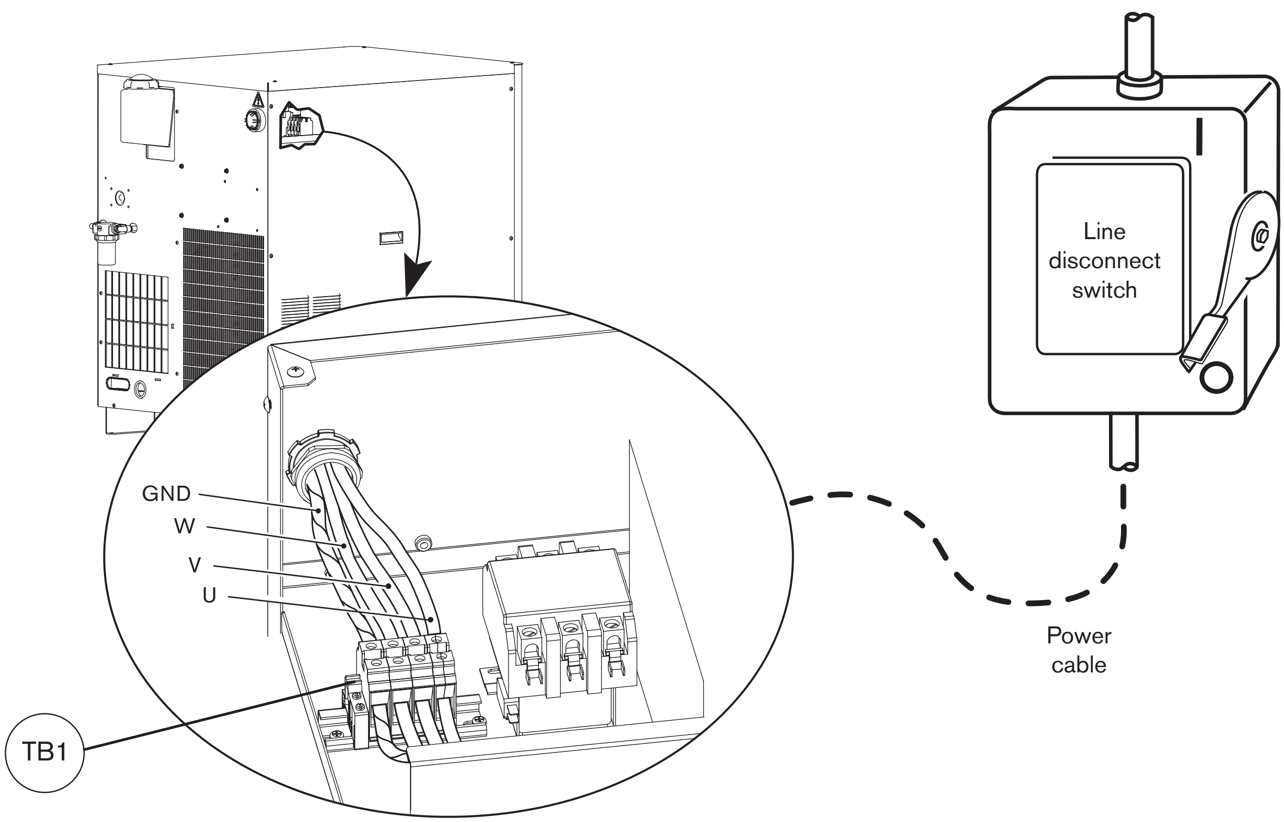
DANGER
ELECTRICAL SHOCK CAN KILL

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

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 of TB1 as shown below.
3. Connect the power leads to the terminals of TB1 as shown below.
4. **Check 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 or 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 power supply 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.

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

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

Caution: Never use automotive anti-freeze in place of propylene glycol. Antifreeze contains corrosion inhibitors that will damage the torch coolant system.

Always use purified water in the coolant mixture in order to prevent damage to the pump and corrosion in the torch coolant system.

Standard installation

Use Hypertherm premixed coolant (028872) when operating in a temperature range of 0° C to 40° C (32° F to 104° F). Refer to the non-standard installation recommendations, if temperatures during operation are ever outside of this range.

Hypertherm premixed coolant consists of 69.9% water, 30% propylene glycol, and 0.1% benzotriazole.

Coolant for cold operating temperatures (below 0° C / 32° F)

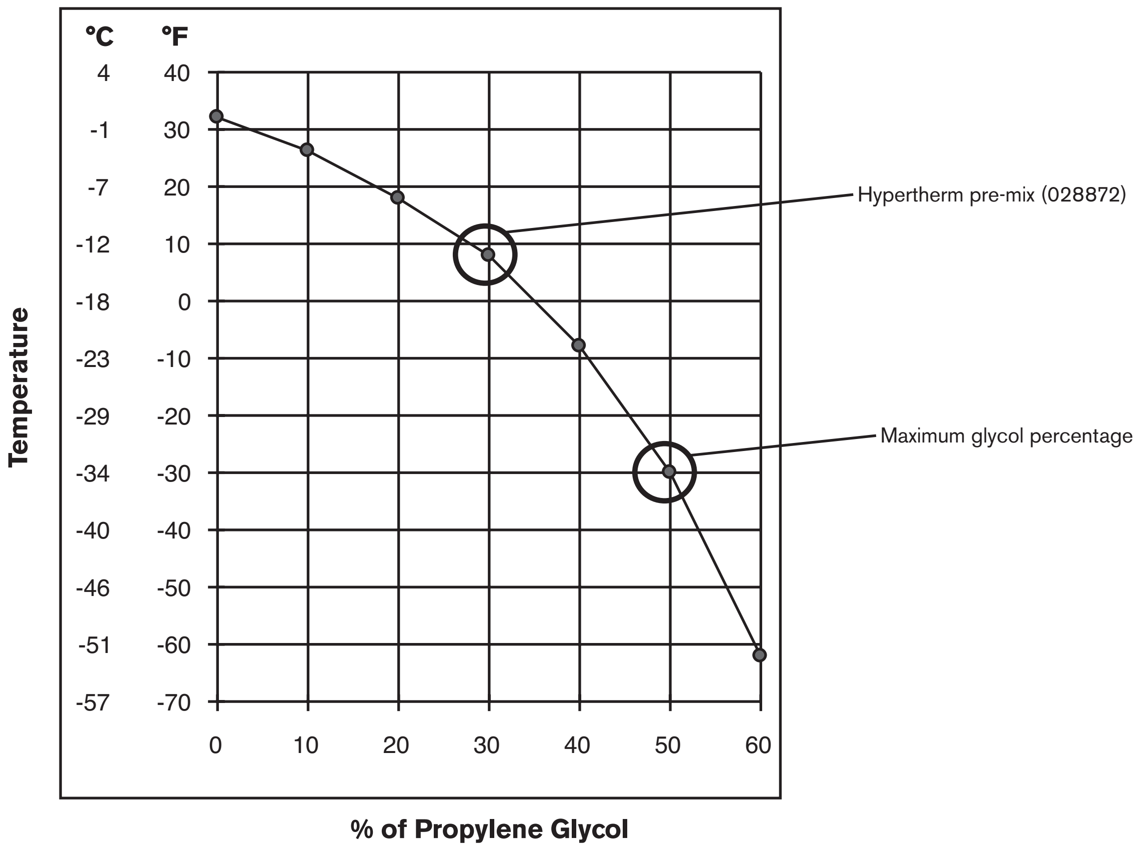
Use a custom coolant mix when operating in temperatures below 0° C (32° F).

> **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%.



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

Use a custom coolant mix when operating in 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 measurement method			
Water purity	Conductivity S/cm at 25° C	Resistivity mΩ-cm at 25° C	Dissolved solids (ppm of NaCl)	Grains per gallon (gpg of $CaCO_2$)
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

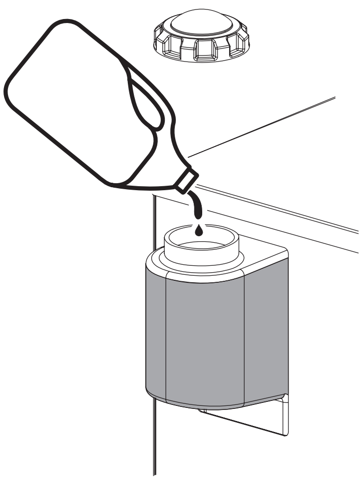
Fill the power supply with coolant

The system will take 11.4 – 15.1 liters (3 to 4 gallons) of coolant depending on the length of the torch leads and whether the system has a local or remote ignition console.

Caution: Using the wrong coolant can cause damage to the system. Refer to *torch coolant requirements* in this section for more information.

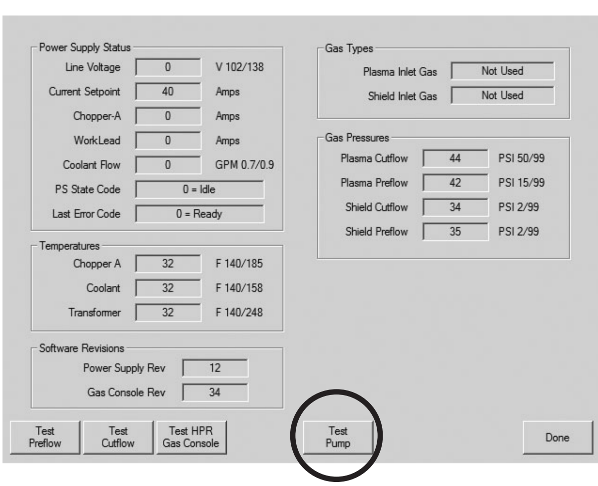
Do not over fill the coolant tank.

1. Add coolant to the power supply until the tank is full.

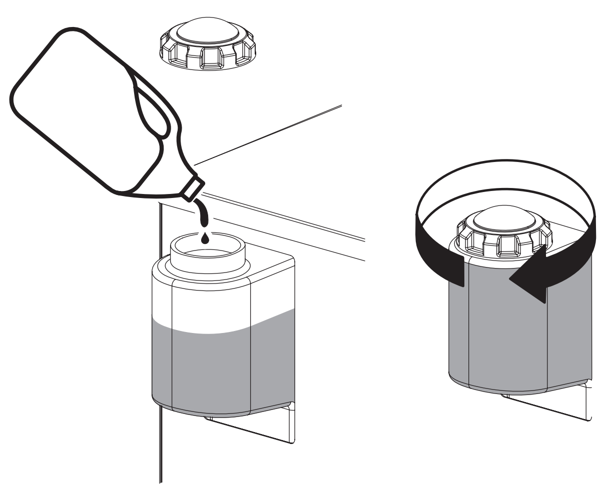


2. Turn ON the power supply using the remote ON/OFF switch or the CNC.

3. Locate the CNC screen for manual pump control. The pump needs to run to fill the leads.



4. Add coolant to the power supply until the tank is full and 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 Section 2 for gas and flow specifications.

Note: Oxygen, air and nitrogen are required for all systems. Nitrogen is used as a purge gas.

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 too high in the case of methane) or if there are leaks in the supply hoses or connections,

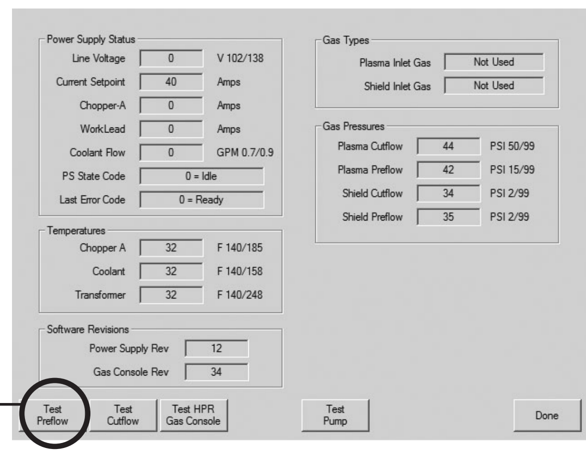
- **Cut speeds can decrease**
- **Cut quality can deteriorate**
- **Cutting thickness capability can decrease**
- **Parts life can shorten**

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.

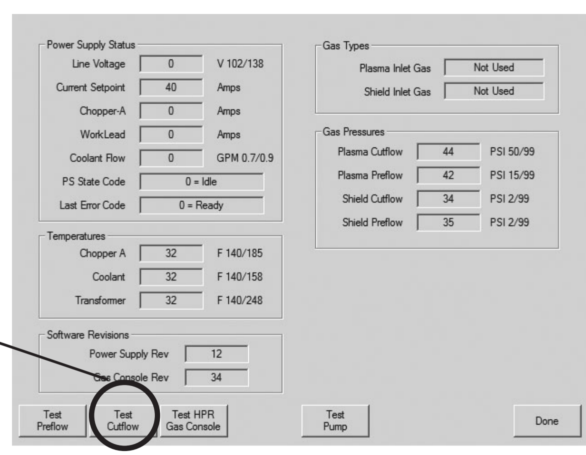
3. Set to Test Preflow.



4. While gas is flowing adjust the supply regulator for the shield gas pressure to 8 bar (115 psi).

5. Turn OFF Test Preflow.

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.

Gas regulators

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

The high-quality gas regulators listed below are available from Hypertherm and meet U.S. Compressed Gas Association (CGA) specifications. In other countries, select gas regulators that conform to national or local codes.

2-stage regulator

Single stage regulator

Part Number	Description	Qty.
128544	**Kit: Oxygen, 2-stage ***	**1**
128545	**Kit: Inert Gas, 2-stage**	**1**
128546	**Kit: Hydrogen (H5, H35 and methane) 2-stage**	**1**
128547	**Kit: Air, 2-stage**	**1**
128548	**Kit: 1-stage (for use with cryogenic liquid nitrogen or oxygen)**	**1**
022037	Oxygen, 2-stage	1
022038	Inert gas, 2-stage	1
022039	Hydrogen/methane, 2-stage	3
022040	Air, 2-stage	1
022041	Line regulator, 1-stage	1

***** Kits include appropriate fittings

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.

Caution: When configuring the selection console to the supply gases, make sure that all hoses, hose connections and fittings are acceptable for use with oxygen, argon-hydrogen and methane. 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.

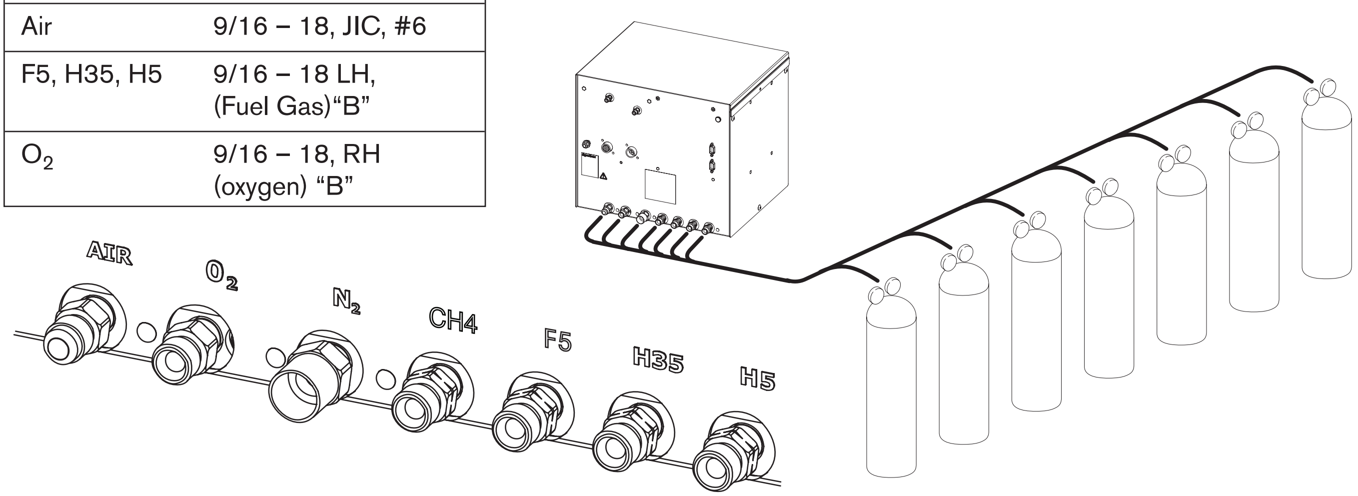
WARNING
CUTTING WITH OXYGEN CAN CAUSE FIRE OR EXPLOSION

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.

Connect the supply gases

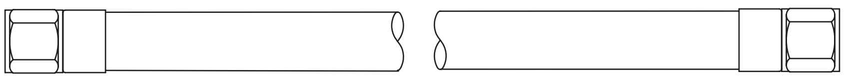
Connect the supply gases to the selection console. Torch leads must be purged between gas changes.

Fitting	Size
N_2	5/8 – 18, RH, internal (Inert Gas) "B"
Air	9/16 – 18, JIC, #6
F5, H35, H5	9/16 – 18 LH, (Fuel Gas)"B"
O_2	9/16 – 18, RH (oxygen) "B"



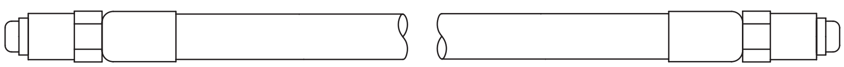
Supply gas hoses

12 Oxygen hose



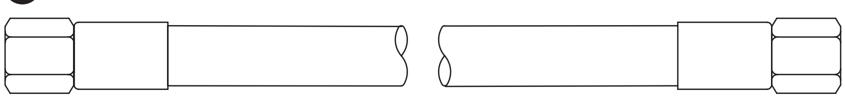
Part no.	Length	Part no.	Length
024607	3 m (10 ft)	024738	25 m (82 ft)
024204	4.5 m (15 ft)	024450	35 m (115 ft)
024205	7.5 m (25 ft)	024159	45 m (150 ft)
024760	10 m (35 ft)	024333	60 m (200 ft)
024155	15 m (50 ft)	024762	75 m (250 ft)
024761	20 m (65 ft)		

13 Nitrogen hose



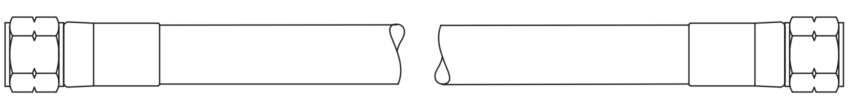
Part no.	Length	Part no.	Length
024210	3 m (10 ft)	024739	25 m (82 ft)
024203	4.5 m (15 ft)	024451	35 m (115 ft)
024134	7.5 m (25 ft)	024120	45 m (150 ft)
024211	10 m (35 ft)	024124	60 m (200 ft)
024112	15 m (50 ft)	024764	75 m (250 ft)
024763	20 m (65 ft)		

14 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)		

15 H35 or F5 hose



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

In this section:

Daily start-up

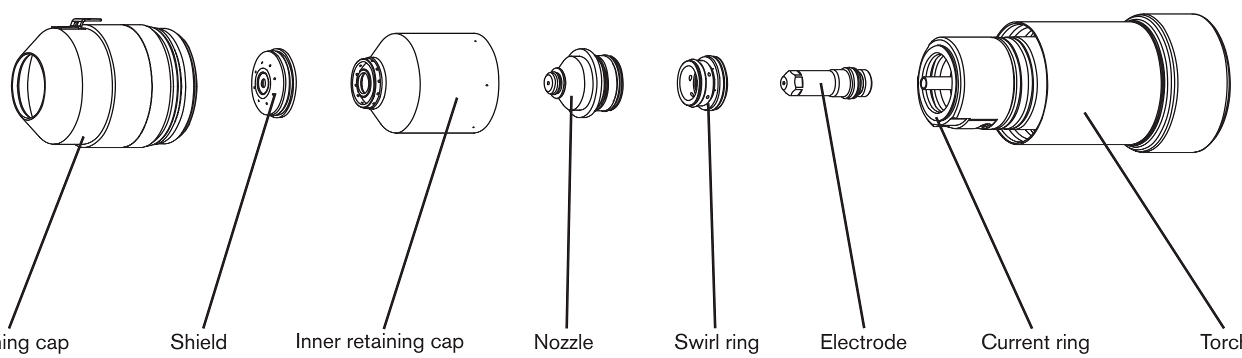
Prior to start-up, ensure that your cutting environment and that your clothing meet the safety requirements outlined in the *Safety* section of this manual.

Check torch

WARNING

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

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 *Changing consumable parts* 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 *Changing consumable parts* later in this section for details.
4. Ensure that the torch is perpendicular to the workpiece.

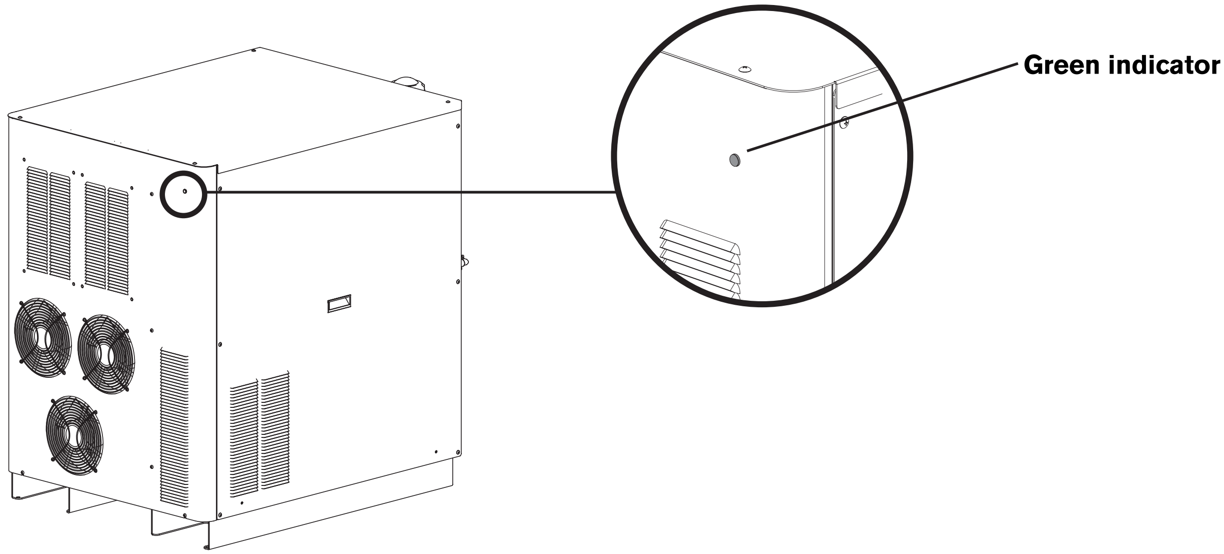


Power indicators

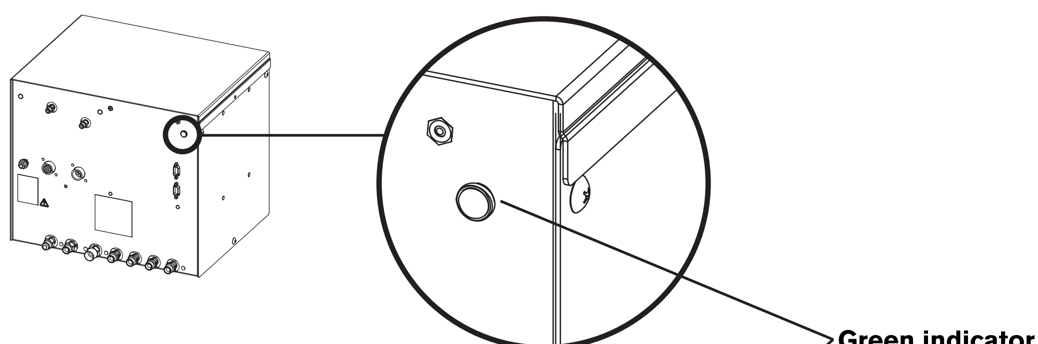
General

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.

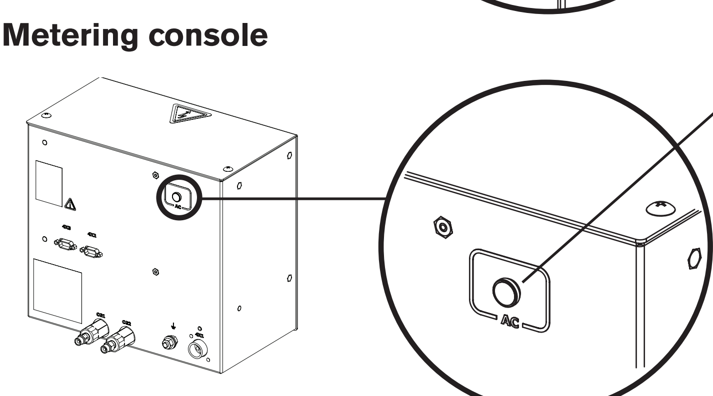
Power supply



Selection console



Metering console



CNC controller requirements

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 #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

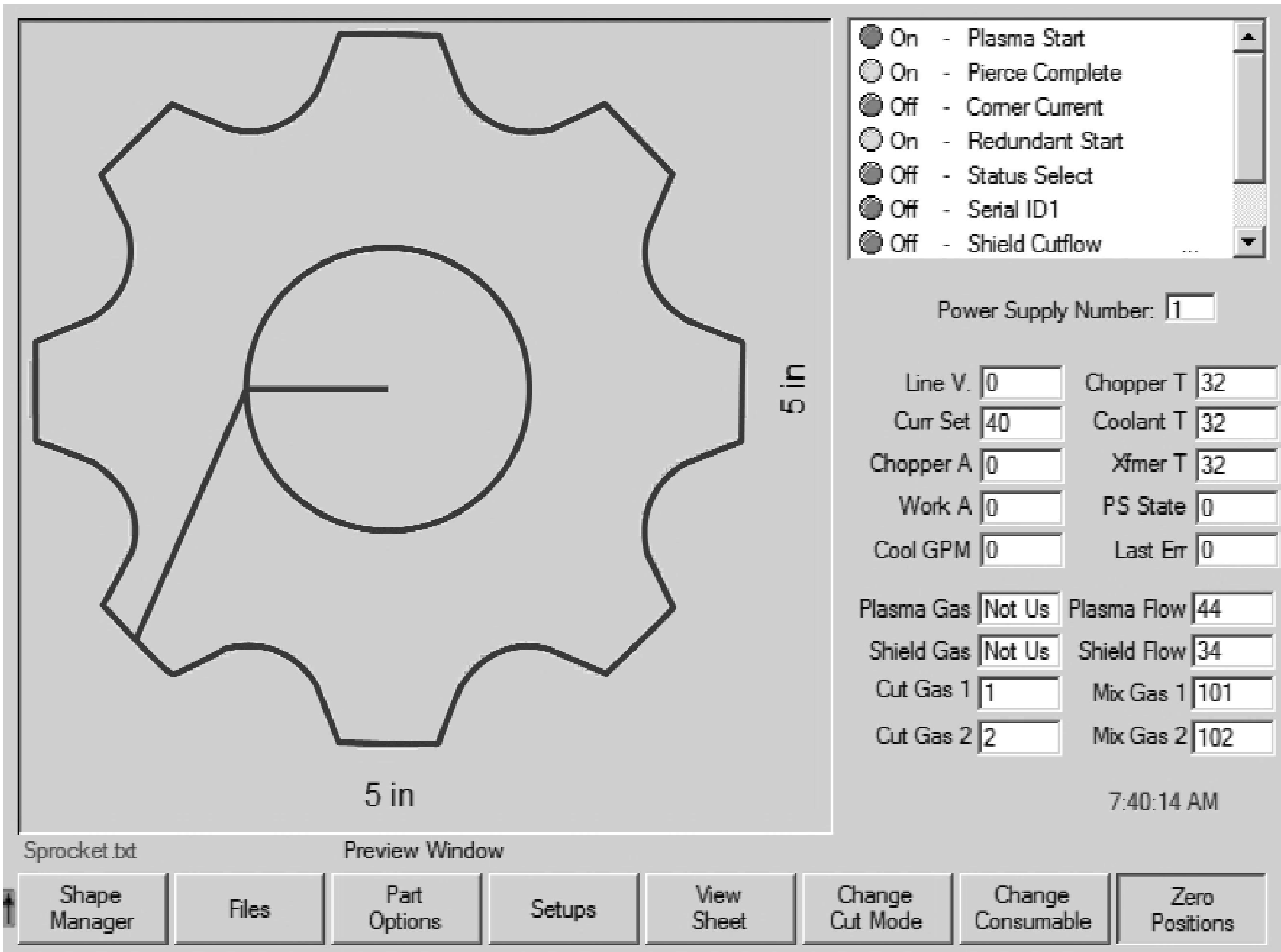
These elements provide additional diagnostic capability to the system for troubleshooting gas-delivery problems. The CNC should be capable of executing these commands and displaying the relevant information for the respective test according to the serial protocol guidelines.

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

CNC screen examples

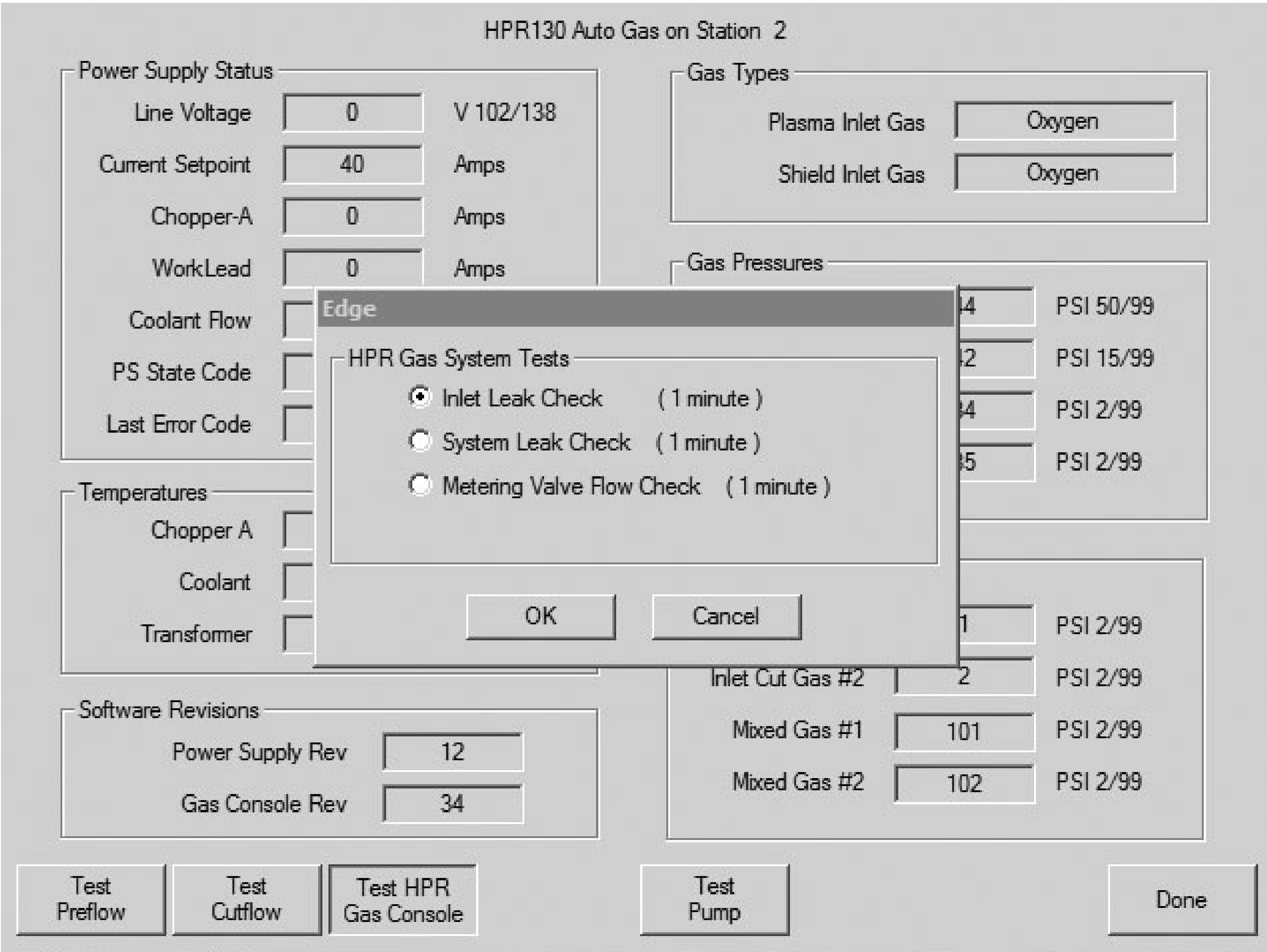
The screens shown are for reference. The screens you work with may be different, but should include the functions listed on the previous page.

Main (control) screen

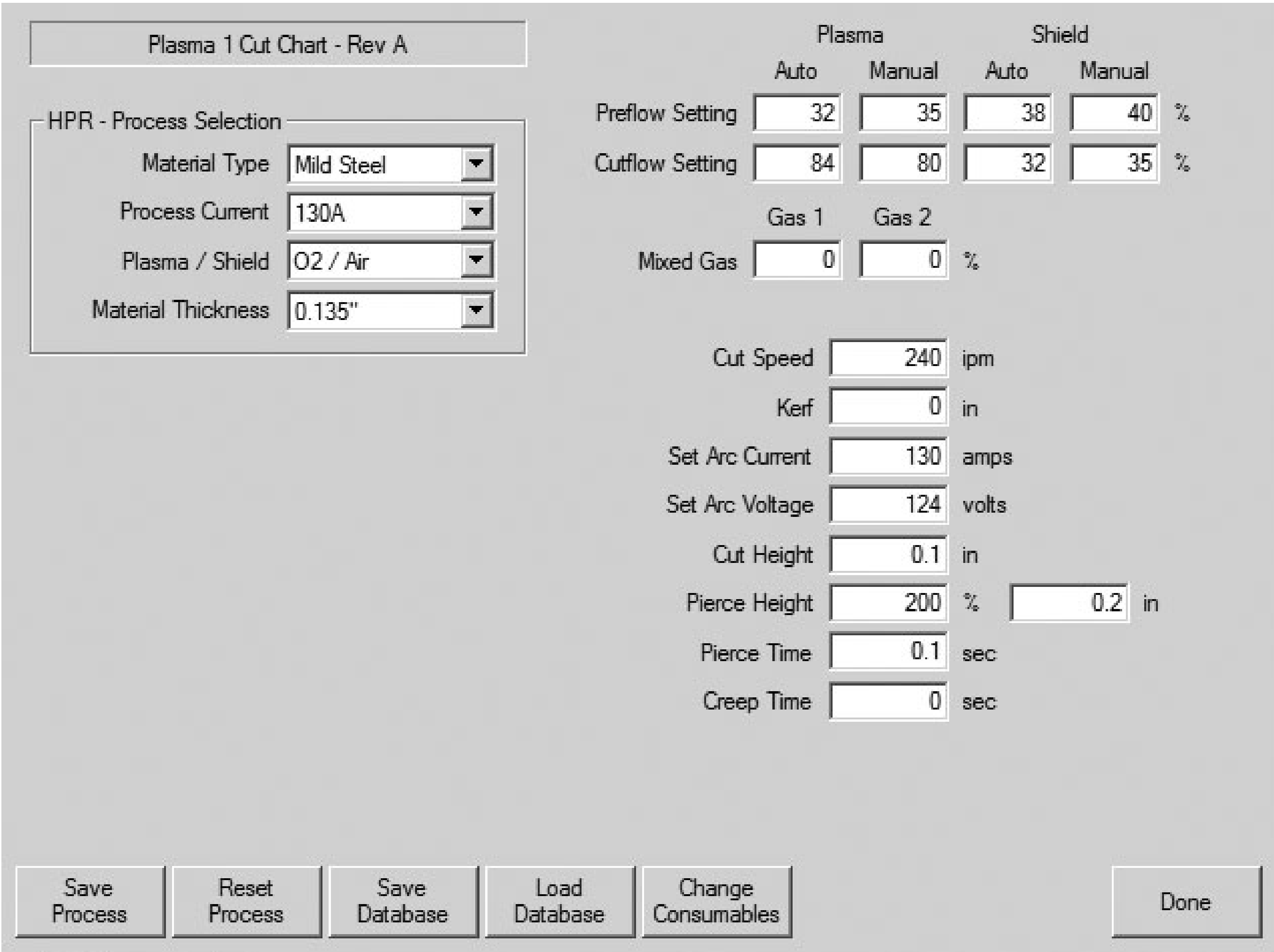


Diagnostic screen

Test screen

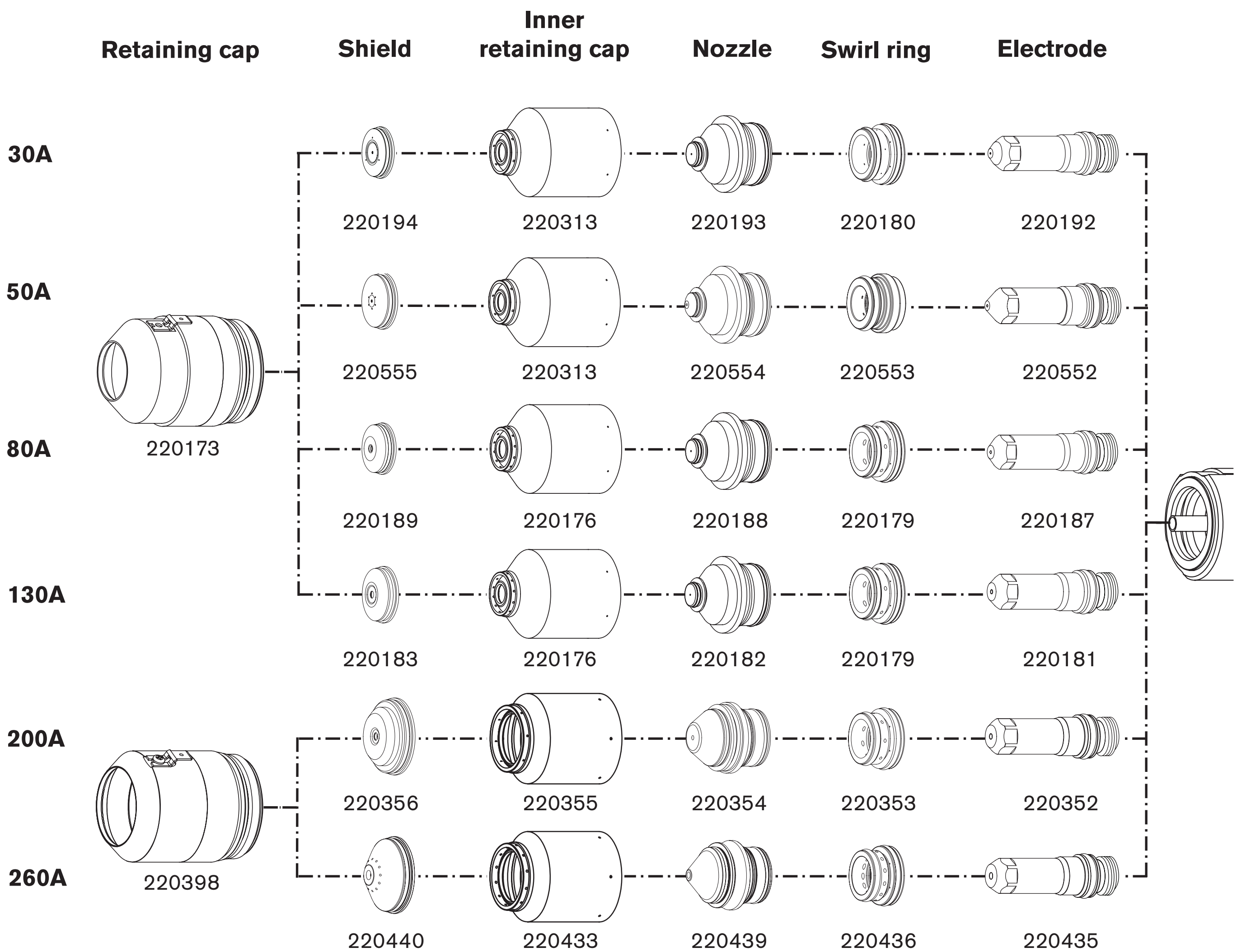

HPR130 Auto Gas on Station 2
Power Supply Status
Line Voltage 0 V 102/138
Current Setpoint 40 Amps
Chopper-A 0 Amps
WorkLead 0 Amps
Coolant Flow
PS State Code
Last Error Code
Temperatures
Chopper A
Coolant
Transformer
Software Revisions
Power Supply Rev 12
Gas Console Rev 34
Gas Types
Plasma Inlet Gas Oxygen
Shield Inlet Gas Oxygen
Gas Pressures
PSI 50/99
PSI 15/99
PSI 2/99
PSI 2/99
Edge
HPR Gas System Tests
Inlet Leak Check (1 minute)
System Leak Check (1 minute)
Metering Valve Flow Check (1 minute)
OK
Cancel
PSI 2/99
Inlet Cut Gas #2 2 PSI 2/99
Mixed Gas #1 101 PSI 2/99
Mixed Gas #2 102 PSI 2/99
Test Preflow
Test Cutflow
Test HPR Gas Console
Test Pump
Done

Cut chart screen

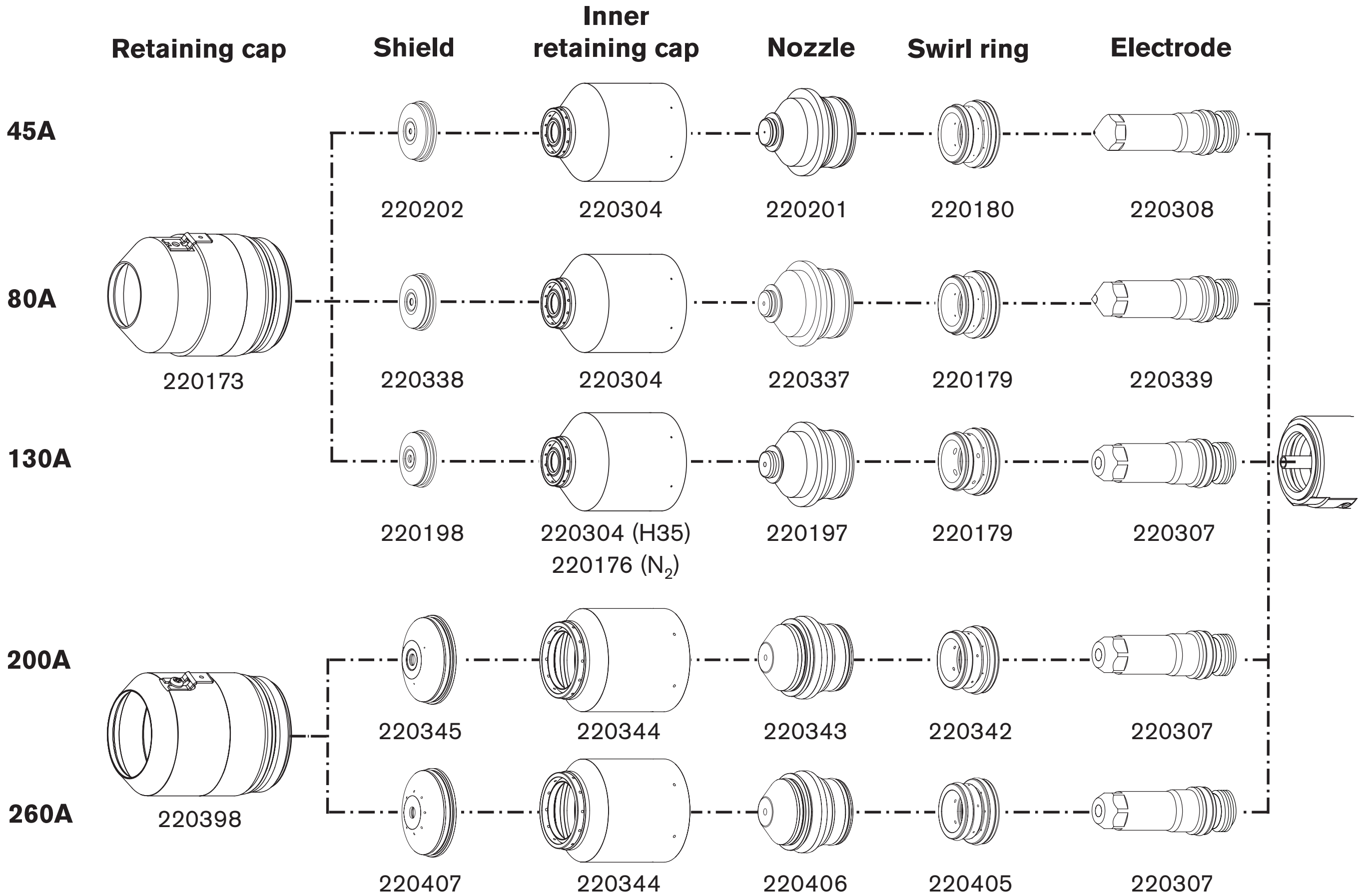


Consumable selection

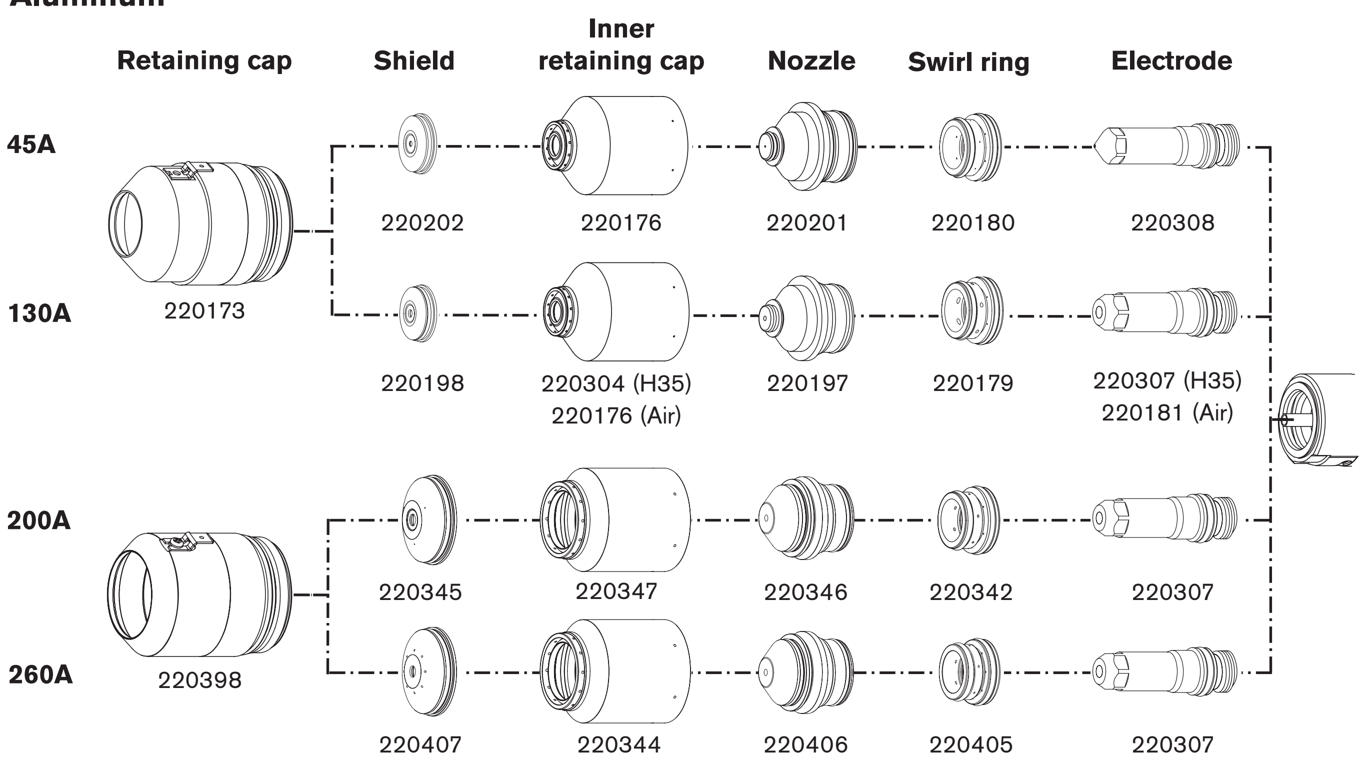
Mild steel



Stainless steel

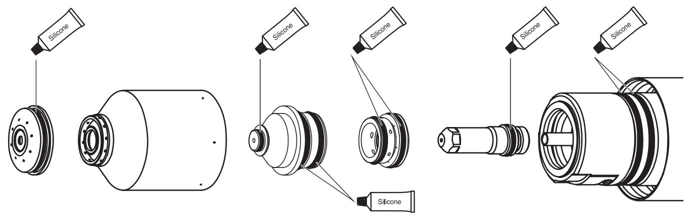


Aluminum

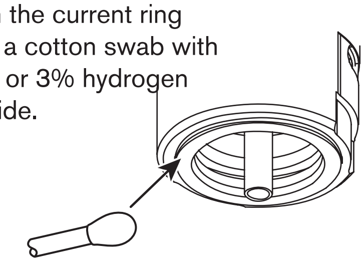


Install consumables

1 Apply a thin film of silicone lubricant on each o-ring.

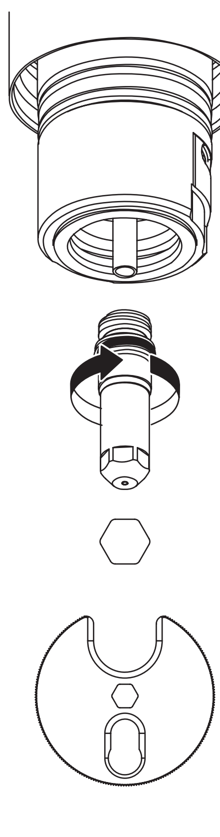


2 Clean the current ring using a cotton swab with water or 3% hydrogen peroxide.



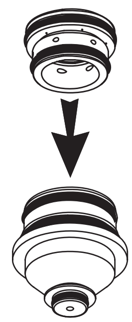
Do not overtighten parts! Only tighten until mating parts are seated.

3 Install the electrode

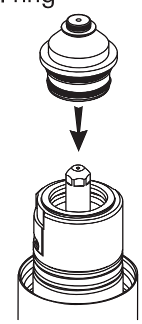


Tool part number 104119

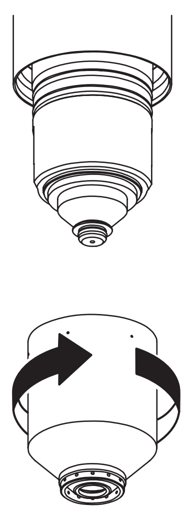
4 Install the swirl ring



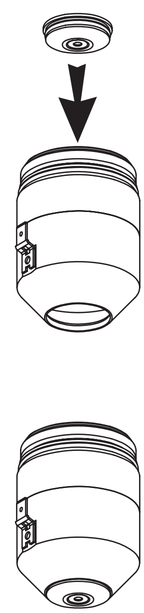
5 Install the nozzle and swirl ring



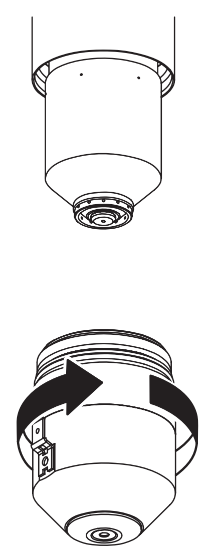
6 Install the inner retaining cap



7 Install the shield



8 Install the retaining cap



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 cutting

See *Appendix C* in this manual for cut charts and consumables.

Marking

Any of the consumable sets can also be used for marking. Marking parameters are shown at the bottom of each cut chart. The quality of the markings will vary depending on the cut process, material type, and material thickness combination. Marking is not possible for every combination (very thin materials). Poor quality marking or burn-through may occur with material less than 1.5 mm (0.060 in or 16 gauge).

Consumables for mirror-image cutting

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

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.

Metric

	Thickness (mm)								
Process	**1.5**	**3**	**6**	**10**	**12**	**20**	**25**	**32**	**38**
MS									
260A O_2 / Air				2.54	2.79	3.43	3.81	4.32	4.45
200A O_2 / Air				2.18	2.26	2.95			
130A O_2 / Air			1.803	2.032	2.108	2.642	3.429		
80A O_2 / Air		1.372	1.727	1.905					
50A O_2 / O_2	1.516	1.740	1.854						
30A O_2 / O_2	1.346	1.448							
SS									
260A N_2 / Air					2.54	3.08	3.30		
260A H35 / N_2					3.81	4.06	4.32		
200A N_2 / N_2				2.16	2.29	2.92			
200A H35 / N_2				3.68	3.81	3.94			
130A H35 / N_2				2.718	2.769	2.896			
130A N2 / N_2			1.829	1.879	2.413				
80A F5 / N_2			1.194						
45A F5 / N_2	0.584	0.381	0.533						
45A N_2 / N_2	0.483	0.229	0.152						
AL									
260A N_2 / Air					3.05	3.05	3.30		
260A H35 / N_2					2.79	3.30	3.56		
200A N_2 / N_2				2.03	2.58	3.01			
200A H35 / N_2				2.67	2.92	3.30			
130A H35 / N_2				2.718	2.769	2.896			
130A Air / Air			2.083	2.083	2.184				
45A Air / Air	1.067	1.092	1.245						

Estimated kerf-width compensation – continued

English

	Thickness (in)								
Process	**0.060"**	**0.135"**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1-1/4"**	**1-1/2"**
MS									
260A O_2 / Air				0.100	0.110	0.135	0.150	0.170	0.175
200A O_2 / Air				0.086	0.089	0.116			
130A O_2 / Air			0.071	0.080	0.083	0.104	0.135		
80A O_2 / Air		0.054	0.068	0.075					
50A O_2 / O_2	0.060	0.073	0.073						
30A O_2 / O_2	0.053	0.057							
SS									
260A N_2 / Air					0.100	0.120	0.130		
260A H35 / N_2					0.150	0.160	0.170		
200A N_2 / N_2				0.085	0.090	0.115			
200A H35 / N_2				0.145	0.150	0.155			
130A H35 / N_2				0.107	0.109	0.114			
130A N2 / N_2			0.072	0.074	0.095				
80A F5 / N_2			0.047						
45A F5 / N_2	0.023	0.015	0.021						
45A N_2 / N_2	0.019	0.009	0.006						
AL									
260A N_2 / Air					0.120	0.120	0.130		
260A H35 / N_2					0.110	0.130	0.140		
200A N_2 / N_2				0.080	0.090	0.105			
200A H35 / N_2				0.105	0.115	0.130			
130A H35 / N_2				0.107	0.109	0.114			
130A Air / Air			0.082	0.082	0.086				
45A Air / Air	0.042	0.043	0.049						

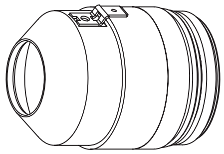
Mild steel

O_2 Plasma / O_2 Shield

30 A Cutting

Flow rates – lpm/scfh		
	O_2	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



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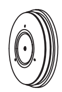

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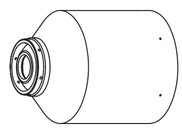

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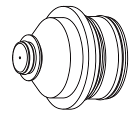

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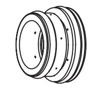

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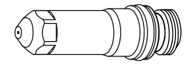

220192

Metric

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<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>mm</th><th>Volts</th><th>mm</th><th>mm/m</th><th>mm</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="10">O_2</td><td rowspan="10">O_2</td><td rowspan="10">78</td><td rowspan="5">17</td><td rowspan="10">94</td><td rowspan="5">17</td><td>0.5</td><td>114</td><td rowspan="5">1.3</td><td>5355</td><td rowspan="5">2.3</td><td rowspan="10">180</td><td>0.1</td></tr>
<tr><td>0.8</td><td>115</td><td>4225</td><td>0.2</td></tr>
<tr><td>1</td><td>116</td><td>3615</td><td rowspan="3">0.3</td></tr>
<tr><td>1.2</td><td>117</td><td>2865</td></tr>
<tr><td>1.5</td><td>119</td><td>2210</td></tr>
<tr><td rowspan="2">35</td><td rowspan="5">7</td><td>2</td><td>120</td><td rowspan="5">1.5</td><td>1490</td><td rowspan="5">2.7</td><td rowspan="2">0.4</td></tr>
<tr><td>2.5</td><td>122</td><td>1325</td></tr>
<tr><td rowspan="3">75</td><td>3*</td><td>123</td><td>1160</td><td>0.5</td></tr>
<tr><td>4*</td><td>125</td><td>905</td><td>0.7</td></tr>
<tr><td>6*</td><td>128</td><td>665</td><td>1.0</td></tr>
</table>

English

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>in</th><th>Volts</th><th>in</th><th>ipm</th><th>in</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="11">O_2</td><td rowspan="11">O_2</td><td rowspan="11">78</td><td rowspan="6">17</td><td rowspan="11">94</td><td rowspan="6">17</td><td>.018</td><td rowspan="2">114</td><td rowspan="6">0.050</td><td>215</td><td rowspan="6">0.090</td><td rowspan="11">180</td><td rowspan="2">0.1</td></tr>
<tr><td>.024</td><td>200</td></tr>
<tr><td>.030</td><td>115</td><td>170</td><td>0.2</td></tr>
<tr><td>.036</td><td>116</td><td>155</td><td rowspan="3">0.3</td></tr>
<tr><td>.048</td><td>117</td><td>110</td></tr>
<tr><td>.060</td><td>119</td><td>85</td></tr>
<tr><td rowspan="2">35</td><td rowspan="5">7</td><td>.075</td><td>120</td><td rowspan="5">0.060</td><td>60</td><td rowspan="5">0.110</td><td rowspan="2">0.4</td></tr>
<tr><td>.105</td><td>122</td><td>50</td></tr>
<tr><td rowspan="3">75</td><td>.135*</td><td>123</td><td>40</td><td>0.5</td></tr>
<tr><td>3/16*</td><td rowspan="2">128</td><td>30</td><td>0.7</td></tr>
<tr><td>1/4*</td><td>25</td><td>1.0</td></tr>
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Marking

<table>
<tr><th colspan="2" rowspan="2">Select Gases</th><th colspan="2" rowspan="2">Set Preflow</th><th colspan="2" rowspan="2">Set Cutflow</th><th>Amperage</th><th colspan="2">Torch-to-Work Distance</th><th colspan="2">Marking Speed</th><th>Arc Voltage</th></tr>
<tr><th>Amps</th><th>mm</th><th>in</th><th>mm/min</th><th>ipm</th><th>Volts</th></tr>
<tr><td>N_2</td><td>N_2</td><td>10</td><td>10</td><td>10</td><td>10</td><td>15</td><td>2.5</td><td>0.100</td><td>6350</td><td>250</td><td>105</td></tr>
</table>

*Pierce complete is recommended for these thicknesses

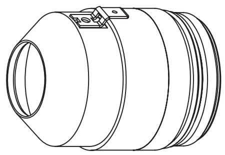
Mild steel

O_2 Plasma / O_2 Shield

50 A Cutting

Flow rates – lpm/scfh		
	O_2	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



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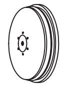

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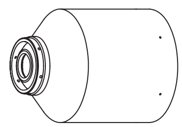

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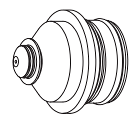

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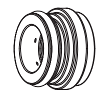

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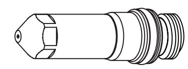


220552

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	O_2	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			0.1
						3	119	1.5	1800	3.0		0.2
						4	121		1400			0.3
						5	122		1200			0.4
						6	126	2.0	950	4.0		0.5
						7	128		780			
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O_2	O_2	70	30	81	14	**.030**	110	0.04	270	0.08	200	0.0
						.036			210			
						.048	112		160			
						.060	114	0.05	125	0.10		
						.075	115		110			
						.105	118		80			0.1
						.135	120	0.06	60	0.12		0.2
						3/16	121		50			0.3
						1/4	125	0.08	35	0.16		0.5
						5/16	130		25			

Marking

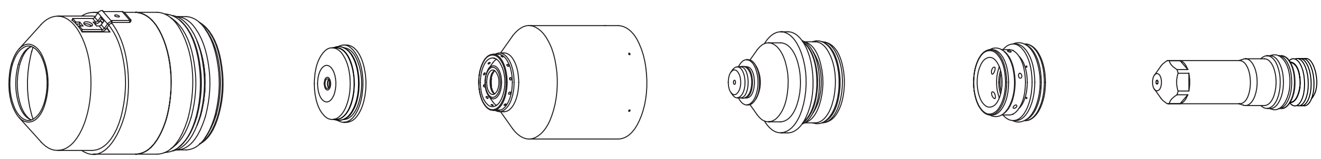
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	118

Mild steel

O_2 Plasma / Air Shield

80 A Cutting

Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	76 / 161
Cutflow	23 / 48	41 / 87



220173 220189 220176 220188 220179 220187

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	Air	48	23	78	23	**2**	112	2.5	9810	3.8	150	0.1
						2.5	115		7980			
						3	117		6145			0.2
						4	120	2.0	4300	4.0	200	
						6	123		3045			0.3
						10	127		1810			0.5
					10	**12**	130		1410	5.0	250	0.7
						15	133		1030			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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O_2	Air	48	23	78	23	**.075**	112	0.100	400	0.150	150	0.1
						.105	115		290			
						.135	117		180			0.2
						3/16	120	0.080	155	0.160	200	
						1/4	123		110			0.3
						3/8	127		75			0.5
					10	**1/2**	130		50	0.200	250	0.7
						5/8	133		37			0.8
						3/4	135	0.100	25	0.250		0.9

Marking

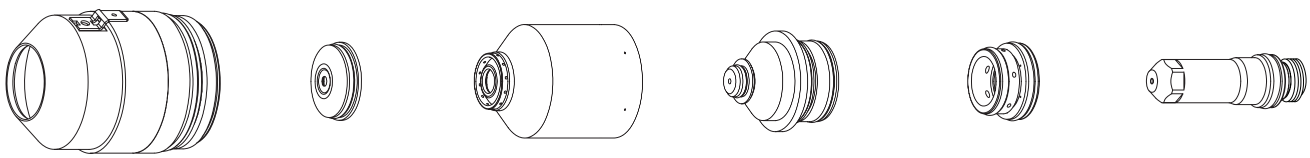
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	130

Mild steel

O_2 Plasma / Air Shield

130 A Cutting

<table>
<tr><th colspan="3">Flow rates – lpm/scfh</th></tr>
<tr><th></th><th>O_2</th><th>Air</th></tr>
<tr><td>Preflow</td><td>0 / 0</td><td>102 / 215</td></tr>
<tr><td>Cutflow</td><td>33 / 70</td><td>45 / 96</td></tr>
</table>



220173 220183 220176 220182 220179 220181

Metric

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>mm</th><th>Volts</th><th>mm</th><th>mm/m</th><th>mm</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="10">O_2</td><td rowspan="10">Air</td><td rowspan="10">32</td><td rowspan="7">32</td><td rowspan="10">84</td><td rowspan="3">28</td><td>3</td><td>124</td><td>2.5</td><td>6505</td><td>5.0</td><td rowspan="7">200</td><td>0.1</td></tr>
<tr><td>4</td><td>126</td><td rowspan="2">2.8</td><td>5550</td><td rowspan="2">5.6</td><td>0.2</td></tr>
<tr><td>6</td><td>127</td><td>4035</td><td rowspan="2">0.3</td></tr>
<tr><td rowspan="7">22</td><td>10</td><td>130</td><td>3.0</td><td>2680</td><td>6.0</td></tr>
<tr><td>12</td><td>132</td><td>3.3</td><td>2200</td><td>6.6</td><td>0.5</td></tr>
<tr><td>15</td><td>135</td><td rowspan="2">3.8</td><td>1665</td><td rowspan="3">7.6</td><td>0.7</td></tr>
<tr><td>20</td><td>138</td><td>1050</td><td>1.0</td></tr>
<tr><td rowspan="3">52</td><td>25</td><td>141</td><td>4.0</td><td>550</td><td>190</td><td>1.8</td></tr>
<tr><td>32</td><td>160</td><td rowspan="2">4.5</td><td>375</td><td colspan="3" rowspan="2">Edge start</td></tr>
<tr><td>38</td><td>167</td><td>255</td></tr>
</table>

English

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>in</th><th>Volts</th><th>in</th><th>ipm</th><th>in</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="10">O_2</td><td rowspan="10">Air</td><td rowspan="10">32</td><td rowspan="7">32</td><td rowspan="10">84</td><td rowspan="3">28</td><td>.135</td><td>124</td><td>0.100</td><td>240</td><td>0.200</td><td rowspan="7">200</td><td>0.1</td></tr>
<tr><td>3/16</td><td>126</td><td rowspan="2">0.110</td><td>190</td><td rowspan="2">0.220</td><td>0.2</td></tr>
<tr><td>1/4</td><td>127</td><td>150</td><td rowspan="2">0.3</td></tr>
<tr><td rowspan="7">22</td><td>3/8</td><td>130</td><td>0.120</td><td>110</td><td>0.240</td></tr>
<tr><td>1/2</td><td>132</td><td>0.130</td><td>80</td><td>0.260</td><td>0.5</td></tr>
<tr><td>5/8</td><td>135</td><td rowspan="2">0.150</td><td>60</td><td rowspan="3">0.300</td><td>0.7</td></tr>
<tr><td>3/4</td><td>138</td><td>45</td><td>1.0</td></tr>
<tr><td rowspan="3">52</td><td>1</td><td>141</td><td>0.160</td><td>20</td><td>190</td><td>1.8</td></tr>
<tr><td>1-1/4</td><td>160</td><td rowspan="2">0.180</td><td>15</td><td colspan="3" rowspan="2">Edge start</td></tr>
<tr><td>1-1/2</td><td>167</td><td>10</td></tr>
</table>

Marking

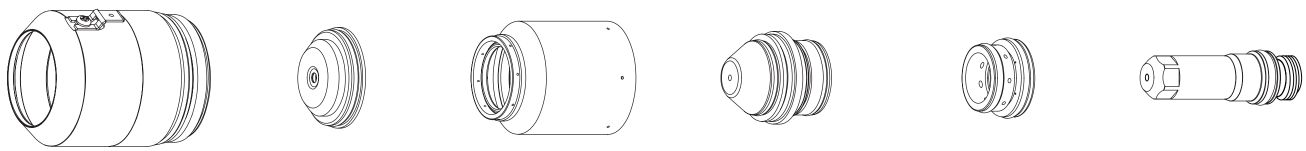
<table>
<tr><th colspan="2" rowspan="2">Select Gases</th><th colspan="2" rowspan="2">Set Preflow</th><th colspan="2" rowspan="2">Set Cutflow</th><th>Amperage</th><th colspan="2">Torch-to-Work Distance</th><th colspan="2">Marking Speed</th><th>Arc Voltage</th></tr>
<tr><th>Amps</th><th>mm</th><th>in</th><th>mm/min</th><th>ipm</th><th>Volts</th></tr>
<tr><td>N_2</td><td>N_2</td><td>10</td><td>10</td><td>10</td><td>10</td><td>15</td><td>2.5</td><td>0.100</td><td>6350</td><td>250</td><td>130</td></tr>
</table>

Mild steel

O_2 Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	128 / 270
Cutflow	39 / 82	48 / 101



220398 220356 220355 220354 220353 220352

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
						6	124		5250			0.2
						10	126	3.3	3460	6.6		0.3
						12	128		3060			0.5
						15	131	4.1	2275	8.2		0.6
O_2	Air	23	42	74	18	**20**	133		1575		200	0.8
						25	143		1165			1.0
						32	145	5.1	750	10.2		
						38	152		510			Edge start
						50	163		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
						3/16	124		230			0.2
						1/4		0.130	200	0.260		
						3/8	126		140			0.3
						1/2	128		115			0.5
O_2	Air	23	42	74	18	**5/8**	131	0.160	80	0.320	200	0.6
						3/4	133		65			0.8
						1	143		45			1.0
						1-1/4	145	0.200	30	0.400		
						1-1/2	152		20			Edge start
						2	163		10			

Marking

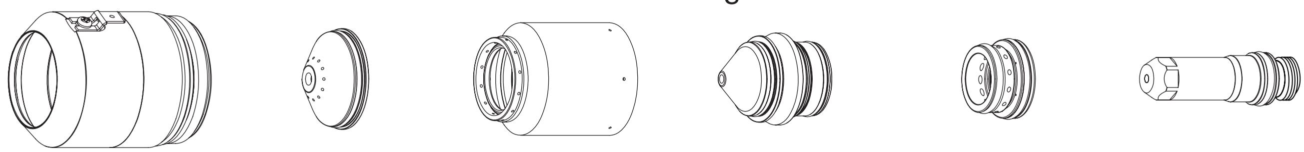
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	130

Flow rates – lpm/scfh @ 3/4" setting		
	O_2	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220

Mild steel

O_2 Plasma / Air Shield

260 A Cutting



220398 220440 220433 220439 220436 220435

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
						6			6500			0.3
				76	46	**10**	150	2.8	4440	8.5	300	
						12			3850			0.4
						15	155		3130			0.5
				80		**20**	159	3.6	2170	9.0	250	0.6
						22	166		1930			0.7
O_2	Air	22	49			**25**	171		1685			0.8
						28	170		1445			0.9
					49	**32**	172		1135	9.5	200	1.0
				84		**38**	174		895			1.2
						44	185	4.8	580			
						50	188		405	Edge start		
						58	193		290			
						64	202		195			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	mm/m	in	factor %	seconds
						1/4			250			0.3
				76	46	**3/8**	150	0.110	180	0.330	300	
						1/2			145			0.4
						5/8	155		115			0.5
				80		**3/4**	159	0.140	90	0.350	250	0.6
						7/8	166		75			0.7
O_2	Air	22	49			**1**	171		65			0.8
						1-1/8	170		55			0.9
					49	**1-1/4**	172		45	0.380	200	1.0
				84		**1-1/2**	174		35			1.2
						1-3/4	185	0.190	22			
						2	188		15	Edge start		
						2-1/4	193		12			
						2-1/2	202		8			

Marking

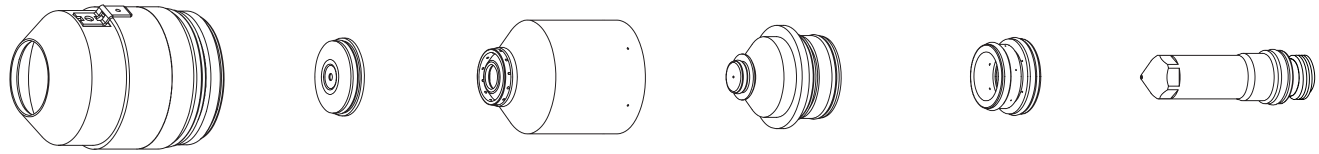
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	135

Stainless steel

N_2 Plasma / N_2 Shield

45 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	24 / 51
Cutflow	75 / 159



220173 220202 220304 220201 220180 220308

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	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	95		4630			
						2	97		3935			
						2.5	101		3270			
						3	103		2550			0.3
						4			1580			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	35	5	62	49	**.036**	94	0.100	240	0.150	150	0.0
						.048			210			0.1
						.060	95		180			0.2
						.075	97		160			
						.105	101		120			
						.135	103		75			0.3

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	85

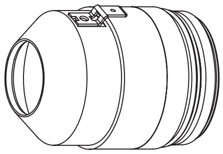
Note: This process produces a darker cut edge than the 45 A, F5/N_2 stainless steel process.

Stainless steel

F5 Plasma / N_2 Shield

45 A Cutting

<table>
<tr><th colspan="3">Flow rates – lpm/scfh</th></tr>
<tr><td></td><td>F5</td><td>N_2</td></tr>
<tr><td>Preflow</td><td>0 / 0</td><td>43 / 91</td></tr>
<tr><td>Cutflow</td><td>8 / 17</td><td>65 / 138</td></tr>
</table>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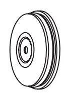
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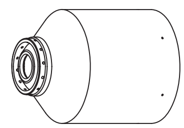
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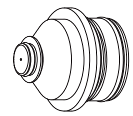
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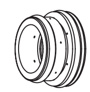
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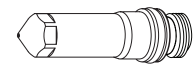

220308

Metric

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><td>Plasma</td><td>Shield</td><td>Plasma</td><td>Shield</td><td>Plasma</td><td>Shield</td><td>mm</td><td>Volts</td><td>mm</td><td>mm/m</td><td>mm</td><td>factor %</td><td>seconds</td></tr>
<tr><td rowspan="9">F5</td><td rowspan="9">N_2</td><td rowspan="9">35</td><td rowspan="9">18</td><td rowspan="9">62</td><td rowspan="8">49</td><td>0.8</td><td rowspan="4">99</td><td rowspan="8">2.5</td><td>6570</td><td rowspan="9">3.8</td><td rowspan="8">150</td><td rowspan="6">0.2</td></tr>
<tr><td>1</td><td>5740</td></tr>
<tr><td>1.2</td><td>4905</td></tr>
<tr><td>1.5</td><td>3890</td></tr>
<tr><td>2</td><td>101</td><td>3175</td></tr>
<tr><td>2.5</td><td>102</td><td>2510</td></tr>
<tr><td>3</td><td>103</td><td>2010</td><td rowspan="2">0.3</td></tr>
<tr><td>4</td><td>104</td><td>1435</td></tr>
<tr><td>11</td><td>6</td><td>110</td><td>2.0</td><td>845</td><td>190</td><td>0.5</td></tr>
</table>

English

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><td>Plasma</td><td>Shield</td><td>Plasma</td><td>Shield</td><td>Plasma</td><td>Shield</td><td>in</td><td>Volts</td><td>in</td><td>ipm</td><td>in</td><td>factor %</td><td>seconds</td></tr>
<tr><td rowspan="8">F5</td><td rowspan="8">N_2</td><td rowspan="8">35</td><td rowspan="8">18</td><td rowspan="8">62</td><td rowspan="6">49</td><td>.036</td><td rowspan="3">99</td><td rowspan="6">0.100</td><td>240</td><td rowspan="8">0.150</td><td rowspan="6">150</td><td rowspan="5">0.2</td></tr>
<tr><td>.048</td><td>190</td></tr>
<tr><td>.060</td><td>150</td></tr>
<tr><td>.075</td><td>100</td><td>130</td></tr>
<tr><td>.105</td><td>102</td><td>90</td></tr>
<tr><td>.135</td><td>104</td><td>65</td><td>0.3</td></tr>
<tr><td rowspan="2">11</td><td>3/16</td><td>108</td><td rowspan="2">0.080</td><td>45</td><td rowspan="2">190</td><td>0.4</td></tr>
<tr><td>1/4</td><td>110</td><td>30</td><td>0.5</td></tr>
</table>

Marking

<table>
<tr><th colspan="2" rowspan="2">Select Gases</th><th colspan="2" rowspan="2">Set Preflow</th><th colspan="2" rowspan="2">Set Cutflow</th><th>Amperage</th><th colspan="2">Torch-to-Work Distance</th><th colspan="2">Marking Speed</th><th>Arc Voltage</th></tr>
<tr><td>Amps</td><td>mm</td><td>in</td><td>mm/min</td><td>ipm</td><td>Volts</td></tr>
<tr><td>N_2</td><td>N_2</td><td>10</td><td>10</td><td>10</td><td>10</td><td>15</td><td>2.5</td><td>0.100</td><td>6350</td><td>250</td><td>85</td></tr>
</table>

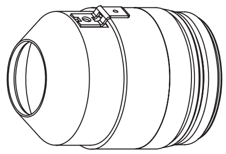
Note: This process produces a shinier cut edge than the 45 A, N_2/N_2 stainless steel process.

Stainless steel

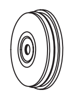
F5 Plasma / N_2 Shield

80 A Cutting

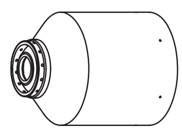
Flow rates – lpm/scfh		
	F5	N_2
Preflow	0 / 0	67 / 142
Cutflow	31 / 65	55 / 116



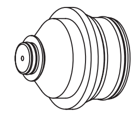
220173



220338



220304



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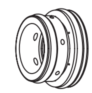

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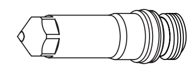


220339

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
F5	N_2	33	23	65	37	**4**	108	3.0	2180	4.5	150	0.2
						6	112	2.5	1225	3.8		0.3
						10	120	3.0	560	4.5		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
F5	N_2	33	23	65	37	**.135**	108	0.120	105	0.180	150	0.2
						3/16	110	0.110	60	0.170		0.3
						1/4	112	0.100	45	0.150		
						3/8	120	0.120	25	0.180		0.5

Marking

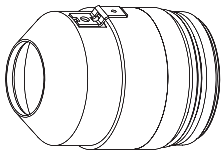
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	95

Stainless steel

N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	97 / 205
Cutflow	79 / 168



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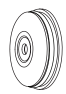

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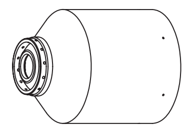
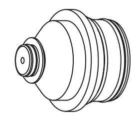
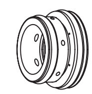


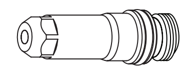
220176



220197



220179



220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	19	51	75	23	**6**	153	3.0	1960	6.0	200	0.3
						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			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	19	51	75	23	**1/4**	153	0.120	75	0.240	200	0.3
						3/8	156		55			0.5
						1/2	162	0.140	30	0.280		0.8
						5/8	167	0.150	25	Edge start		
						3/4	176	0.170	15			

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

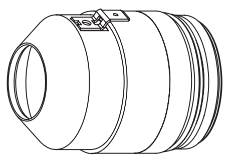
Note: This process produces a rougher, darker cut edge with more dross, and the cut edges are closer to perpendicular than the 130 A, H35/N_2 process.

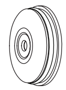
Stainless steel

H35 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144


220173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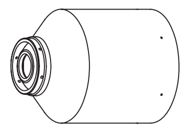
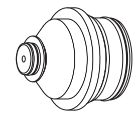

220304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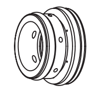
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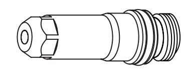

220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	32	75	49	**10**	154	4.5	980	7.7	170	0.3
					37	**12**	158		820			0.5
					24	**15**	162		580			0.8
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	32	75	49	**3/8**	154	0.180	40	0.310	170	0.3
					37	**1/2**	158		30			0.5
					24	**5/8**	162		20			0.8
						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
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

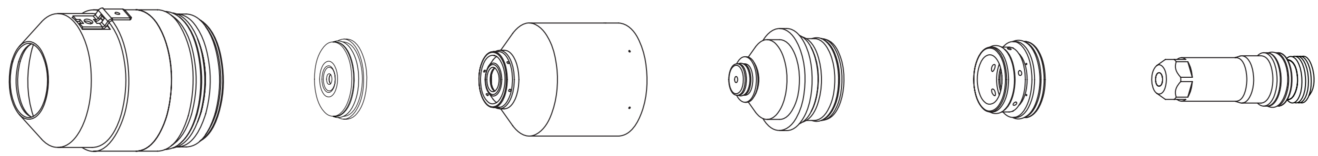
Note: This process produces a smoother, shinier cut edge with less dross, and the cut edges are less perpendicular than the 130 A, N_2/N_2 process.

Stainless steel

H35 and N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150



220173 220198 220304 220197 220179 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	51	75	38	32	18	**6**	150	3.0	1835	6.0	200	0.3
								10	153		1195			0.3
					27			**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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	51	75	38	32	18	**1/4**	150	0.120	70	0.240	200	0.3
								3/8	153		50			0.3
					27			**1/2**	160	0.140	30	0.280		0.5
								5/8	168	0.150	25	0.300		0.8
								3/4	176	0.170	15	0.310	180	1.3

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

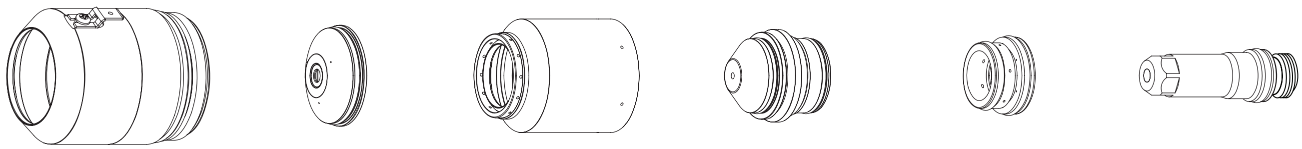
Note: This process produces a smoother, shinier cut edge with less dross, and the cut edges are less perpendicular than the 130 A, N_2/N_2 process. Edge color is more silver than the H35/N_2 process.

Stainless steel

H35 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	116 / 245
Cutflow	30 / 63	104 / 220



220398 220345 220344 220343 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	43	88	52	**10**	175	9.0	1620	9.0	100	0.5
						12	170	7.5	1450	7.5		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	43	88	52	**3/8**	175	0.350	65	0.350	100	0.5
						1/2	170	0.300	55	0.300		0.6
						5/8	173		45			0.7
						3/4	177		35			0.8

Marking

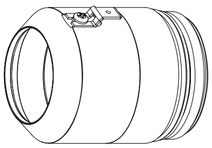
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

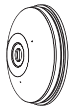
Stainless steel

N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	111 / 235
Cutflow	137 / 290


220398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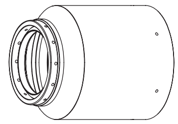
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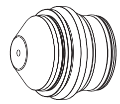
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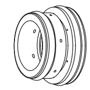
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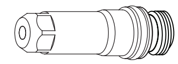

220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	20	42	84	42	**10**	160	3.8	2700	7.6	200	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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	20	42	84	42	**3/8**	160	0.150	110	0.300	200	0.5
						1/2	161		90			0.6
						5/8	163		65			0.8
						3/4	167		45			1.0

Marking

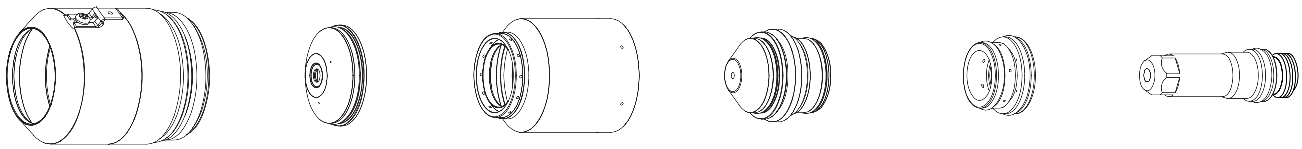
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Stainless steel

H35 and N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	116 / 245
Cutflow	11 / 24	118 / 250



220398 220345 220344 220343 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	23	41	87	41	42	20	**10**	161	4.0	1900	8.0	200	0.5
								12	162		1800			0.6
								15	167	4.6	1600	7.0	150	0.8
								20	171	5.1	1000	7.5		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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	23	41	87	41	42	20	**3/8**	161	0.160	75	0.320	200	0.5
								1/2	162		70			0.6
								5/8	167	0.180	60	0.270	150	0.8
								3/4	171	0.200	45	0.300		1.0

Marking

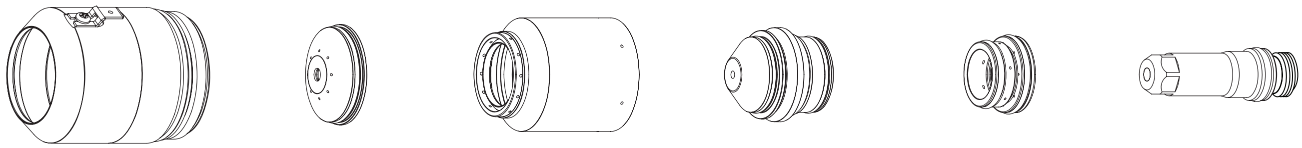
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Stainless steel

H35 Plasma / N_2 Shield

260 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



220398 220407 220344 220406 220405 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	12	49	85	60	**10**	188	11.0	1870	11.0	100	0.3
						12	173	9.0	1710	9.0		0.4
						15	171	7.5	1465		120	0.5
						20	175		1085			0.6
						25	180		785			0.7
						32	185		630			1.0
						38	186		510	Edge start		
						44	189		390			
						50	200		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	12	49	85	60	**3/8**	188	0.450	75	0.500	100	0.3
						1/2	173	0.350	65	0.350		0.4
						5/8	171	0.300	55	0.360	120	0.5
						3/4	175		45			0.6
						1	180		30			0.7
						1-1/4	185		25			1.0
						1-1/2	186		20	Edge start		
						1-3/4	189		15			
						2	200		10			

Marking

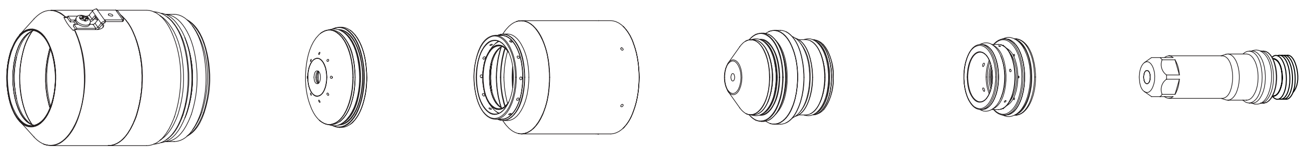
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Stainless steel

N$_2$ Plasma / Air Shield

260 A Cutting

Flow rates – lpm/scfh		
	N$_2$	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



220398 220407 220344 220406 220405 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N$_2$	Air	12	47	79	56	**6**	160	3.8	6375	7.5	200	0.3
						10	157		3440			
						12	161		2960			0.4
						15	163		2520			0.5
						20	164		1590			0.6
						25	168		1300			0.8
						32	171		875			1.0
						38	179		515	Edge start		
						44	190		365			
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N$_2$	Air	12	47	79	56	**1/4**	160	0.150	240	0.300	200	0.3
						3/8	157		140			
						1/2	161		110			0.4
						5/8	163		95			0.5
						3/4	164		70			0.6
						1	168		50			0.8
						1-1/4	171		35			1.0
						1-1/2	179		20	Edge start		
						1-3/4	190		14			
						2	200		6			

Marking

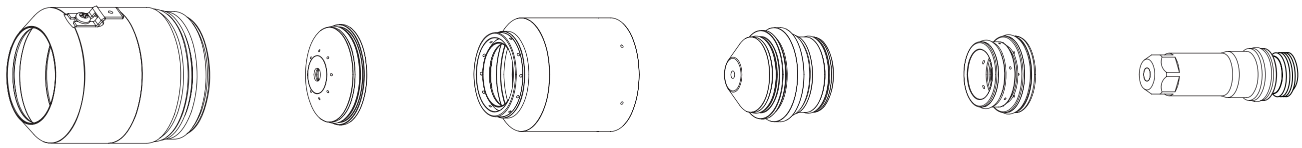
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N$_2$	N$_2$	10	10	10	10	**18**	2.5	0.100	6350	250	120

Stainless steel

H35 and N_2 Plasma / N_2 Shield

260 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	132 / 280
Cutflow	13 / 27	163 / 345



220398 220407 220344 220406 220405 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	12	49	87	60	60	21	**6**	170	4.0	3980	8.0	200	0.3
								10	175		2190			
								12	176		1790			0.5
								15	177		1650			0.7
								20	179		1320			0.8
						40	26	**25**	182		920			1.0
								32	186		755			1.2
								38	189		510	Edge start		
								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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	12	49	87	60	60	21	**1/4**	170	0.160	150	0.320	200	0.3
								3/8	175		90			
								1/2	176		65			0.5
								5/8	177					0.7
								3/4	179		55			0.8
						40	26	**1**	182		35			1.0
								1-1/4	186		30			1.2
								1-1/2	189		20	Edge start		
								1-3/4	187		15			
								2	202		10			

Marking

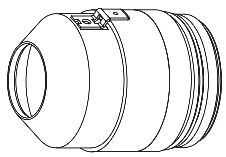
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Aluminum

Air Plasma / Air Shield

45 A Cutting

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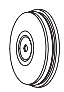
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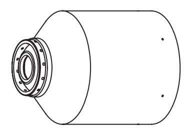
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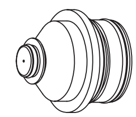
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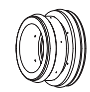
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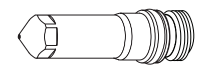

220308

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
Air	Air	35	19	62	49	**.040**	130	0.100	220	0.150	150	0.2
						.051	115		170			
						.064	113		160			
						.102	110		140			
					33	**.125**	102	0.070	110	0.110		0.3
						3/16	114	0.120	90	0.180		0.4
						1/4	117		60			0.6

Marking

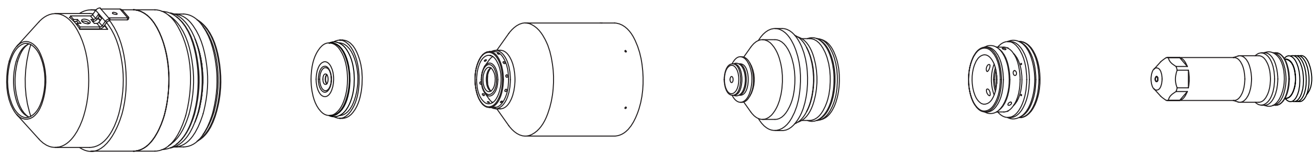
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	85

Aluminum

Air Plasma / Air Shield

130 A Cutting

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



220173 220198 220176 220197 220179 220181

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
Air	Air	19	31	75	23	**6**	153	2.8	2370	5.6	200	0.2
						10	154	3.0	1465	6.0		0.3
						12	156		1225			0.5
						15	158	3.3	1050	6.6		0.8
						20	162	3.5	725	7.0		1.3
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
Air	Air	19	31	75	23	**1/4**	153	0.110	90	0.220	200	0.2
						3/8	154	0.120	60	0.240		0.3
						1/2	156		45			0.5
						5/8	158	0.130	40	0.260		0.8
						3/4	162	0.140	30	0.280		1.3
						1	172	0.160	20	Edge start		

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

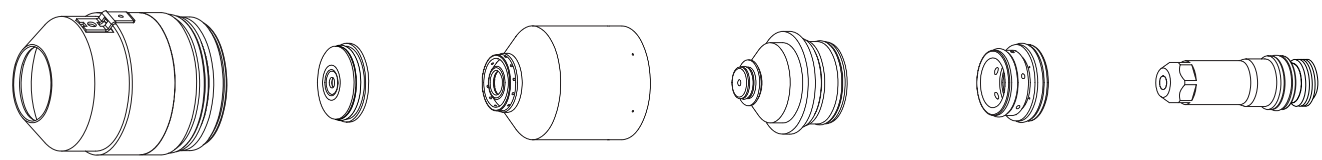
Note: This process produces a rougher cut edge that is less perpendicular than the 130 A, H35/N_2 process.

Aluminum

H35 Plasma / N_2 Shield

130 A Cutting

<table>
<tr><th colspan="3">Flow rates – lpm/scfh</th></tr>
<tr><th></th><th>H35</th><th>N_2</th></tr>
<tr><td>Preflow</td><td>0 / 0</td><td>76 / 160</td></tr>
<tr><td>Cutflow</td><td>26 / 54</td><td>68 / 144</td></tr>
</table>



220173 220198 220304 220197 220179 220307

Metric

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>mm</th><th>Volts</th><th>mm</th><th>mm/m</th><th>mm</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="5">H35</td><td rowspan="5">N_2</td><td rowspan="5">19</td><td rowspan="5">32</td><td rowspan="5">75</td><td>49</td><td>10</td><td>158</td><td>5.0</td><td>1615</td><td>6.5</td><td>130</td><td>0.3</td></tr>
<tr><td>37</td><td>12</td><td rowspan="2">156</td><td rowspan="4">4.5</td><td>1455</td><td rowspan="3">7.7</td><td rowspan="3">170</td><td>0.5</td></tr>
<tr><td rowspan="2">24</td><td>15</td><td>1305</td><td>0.8</td></tr>
<tr><td>20</td><td>157</td><td>940</td><td>1.3</td></tr>
<tr><td>16</td><td>25</td><td>176</td><td>540</td><td colspan="3">Edge start</td></tr>
</table>

English

<table>
<tr><th colspan="2">Select Gases</th><th colspan="2">Set Preflow</th><th colspan="2">Set Cutflow</th><th>Material Thickness</th><th>Arc Voltage</th><th>Torch-to-Work Distance</th><th>Cutting Speed</th><th colspan="2">Initial Pierce Height</th><th>Pierce Delay Time</th></tr>
<tr><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>Plasma</th><th>Shield</th><th>in</th><th>Volts</th><th>in</th><th>ipm</th><th>in</th><th>factor %</th><th>seconds</th></tr>
<tr><td rowspan="5">H35</td><td rowspan="5">N_2</td><td rowspan="5">19</td><td rowspan="5">32</td><td rowspan="5">75</td><td>49</td><td>3/8</td><td>158</td><td>0.200</td><td>65</td><td>0.260</td><td>130</td><td>0.3</td></tr>
<tr><td>37</td><td>1/2</td><td rowspan="2">156</td><td rowspan="4">0.180</td><td>55</td><td rowspan="3">0.310</td><td rowspan="3">170</td><td>0.5</td></tr>
<tr><td rowspan="2">24</td><td>5/8</td><td>50</td><td>0.8</td></tr>
<tr><td>3/4</td><td>157</td><td>40</td><td>1.3</td></tr>
<tr><td>16</td><td>1</td><td>176</td><td>20</td><td colspan="3">Edge start</td></tr>
</table>

Marking

<table>
<tr><th colspan="2" rowspan="2">Select Gases</th><th colspan="2" rowspan="2">Set Preflow</th><th colspan="2" rowspan="2">Set Cutflow</th><th>Amperage</th><th colspan="2">Torch-to-Work Distance</th><th colspan="2">Marking Speed</th><th>Arc Voltage</th></tr>
<tr><th>Amps</th><th>mm</th><th>in</th><th>mm/min</th><th>ipm</th><th>Volts</th></tr>
<tr><td>N_2</td><td>N_2</td><td>10</td><td>10</td><td>10</td><td>10</td><td>18</td><td>2.5</td><td>0.100</td><td>6350</td><td>250</td><td>130</td></tr>
</table>

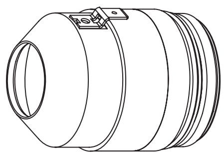
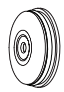
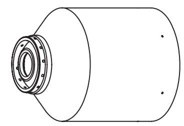
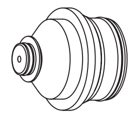
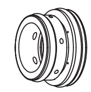
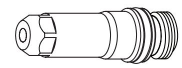
Note: This process produces a smoother cut edge that is more perpendicular than the 130 A, Air/Air process.

Aluminum

H35 and N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150

220173 220198 220304 220197 220179 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	51	75	27	32	18	**6**	156	3.5	2215	7.0	200	0.3
								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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	51	75	27	32	18	**1/4**	156	0.140	85	0.280	200	0.3
								3/8	158		65			
								1/2	159	0.120	55	0.240		0.5
								5/8	160		45			0.8
								3/4	163		35			1.3

Marking

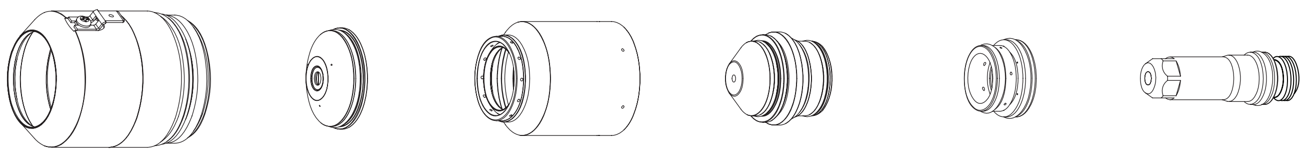
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

Aluminum

H35 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	113 / 240
Cutflow	34 / 72	90 / 190



220398 220345 220347 220346 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	43	73	43	**10**	152	6.4	4400	9.0	140	0.3
						12	150		3800			0.4
						15			3000			0.5
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	43	73	43	**3/8**	152	0.250	180	0.350	140	0.3
						1/2	150		140			0.4
						5/8			110			0.5
						3/4	159		70			0.6

Marking

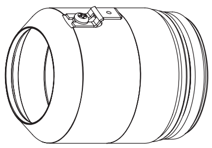
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	113 / 240
Cutflow	135 / 287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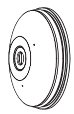
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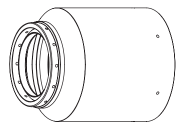
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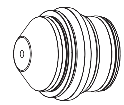
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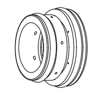
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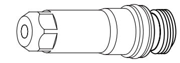

220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	22	43	73	43	**10**	158	6.4	4750	9.0	140	0.4
						12			3500			0.5
						15	166		2350			0.6
						20	165		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	22	43	73	43	**3/8**	158	0.250	200	0.350	140	0.4
						1/2			120			0.5
						5/8	166		80			0.6
						3/4	165		50			0.8

Marking

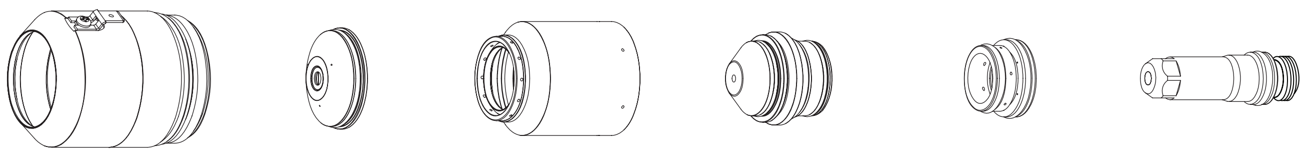
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

H35 and N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	121 / 256
Cutflow	13 / 27	126 / 267



220398 220345 220347 220346 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	44	73	44	42	20	**10**	158	6.4	4000	9.0	140	0.3
								12			3650			0.4
								15	162		2450			0.5
								20	170		1050			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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	44	73	44	42	20	**3/8**	158	0.250	160	0.350	140	0.3
								1/2			140			0.4
								5/8	162		80			0.5
								3/4	170		50			0.6

Marking

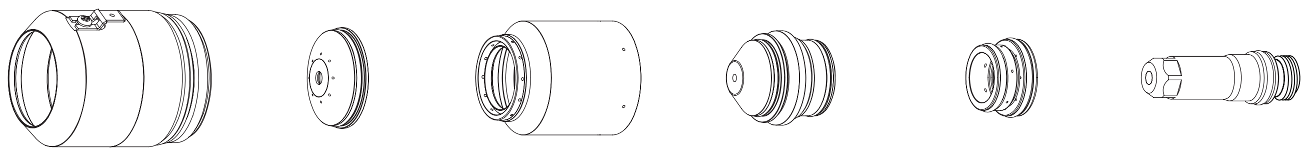
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

H35 Plasma / N_2 Shield

260 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	127 / 270
Cutflow	33 / 70	118 / 250



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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	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	12	49	76	58	**6**	170	11.0	7200	11.0	100	0.2
						10		10.0	6120	10.0		0.4
						12	162	7.6	5160	8.5	110	0.5
						15	163		3720			0.6
						20	166		2230			
						25	174		1930	11.0	150	0.8
						32	175		1510	Edge start		
						38	176		1150			
						44	183		670			
						50	190		390			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	12	49	76	58	**1/4**	170	0.450	280	0.450	100	0.2
						3/8		0.400	250	0.400		0.4
						1/2	162	0.300	190	0.330	110	0.5
						5/8	163		130			0.6
						3/4	166		90			
						1	174		75	0.450	150	0.8
						1-1/4	175		60	Edge start		
						1-1/2	176		45			
						1-3/4	183		25			
						2	190		14			

Marking

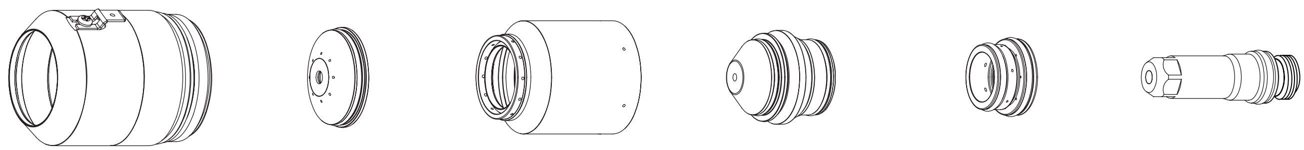
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Ar Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Aluminum

N_2 Plasma / Air Shield

260 A Cutting

Flow rates – lpm/scfh		
	N_2	Air
Preflow	125 / 265	0 / 0
Cutflow	50 / 105	113 / 240



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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	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	Air	12	49	74	56	**6**	172	6.4	7900	9.0	140	0.2
						10	171		4930			0.4
						12	164	4.0	4290	8.0	200	0.5
						15	165		3330			0.6
						20	171		1940			
						25	177		1440	11.0	260	0.8
						32	191		940	Edge start		
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	Air	12	49	74	56	**1/4**	172	0.250	300	0.350	140	0.2
						3/8	171		200			0.4
						1/2	164	0.160	160	0.320	200	0.5
						5/8	165		120			0.6
						3/4	171		80			
						1	177		55	0.420	260	0.8
						1-1/4	190		40	Edge start		
						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
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

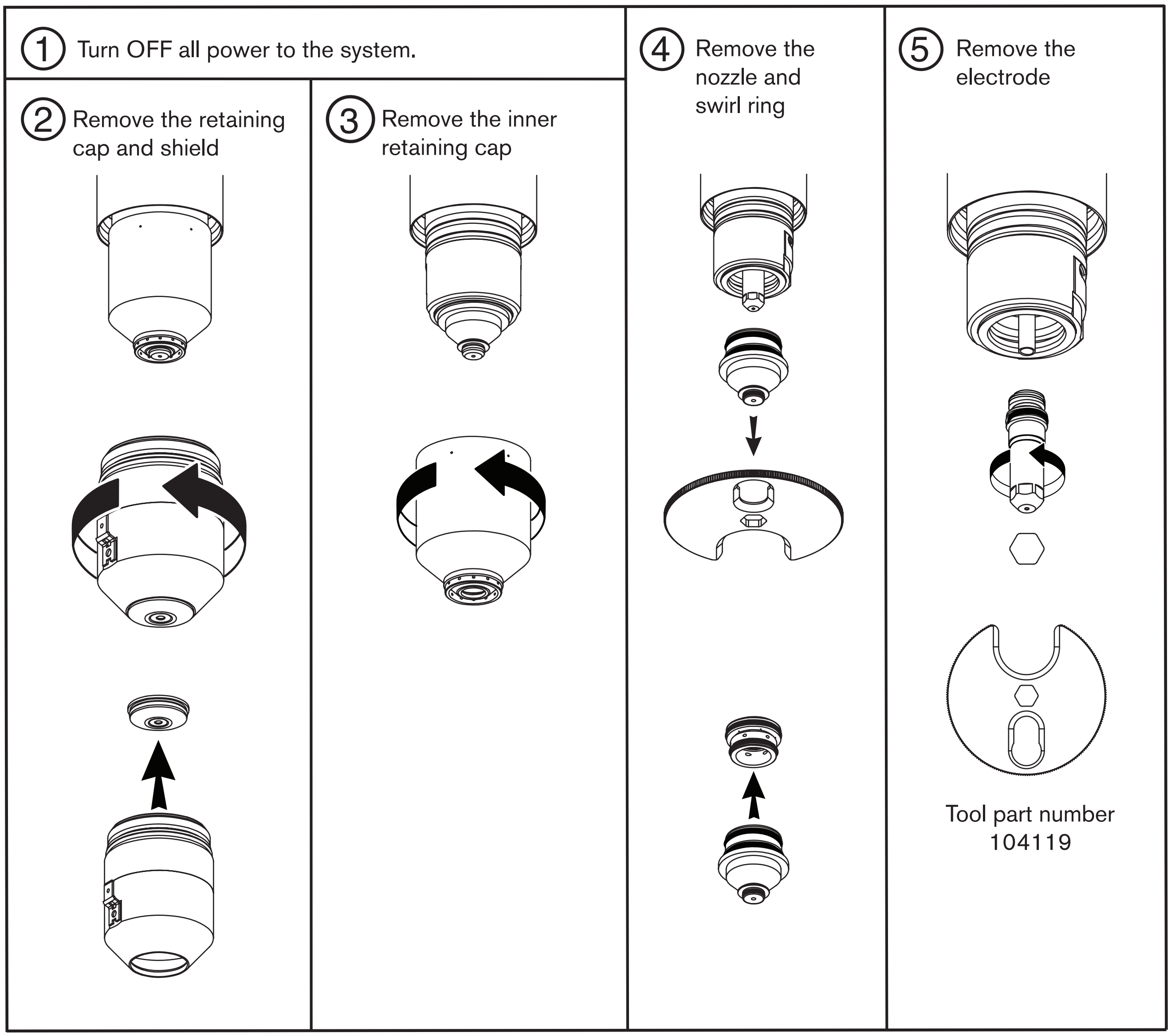
Changing consumable parts

WARNING

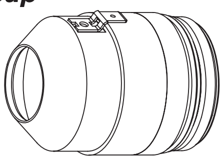
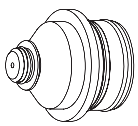
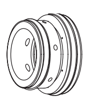
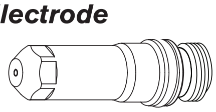
The system is designed to go into an idle mode if the retaining cap is removed. However, DO NOT CHANGE CONSUMABLE PARTS WHILE IN THE IDLE MODE. Always disconnect power to the power supply before inspecting or changing torch consumable parts. Use gloves when removing consumables. The torch might be hot.

Remove consumables

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

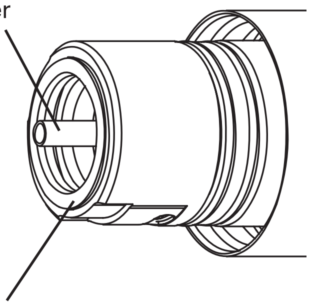


Inspect consumables

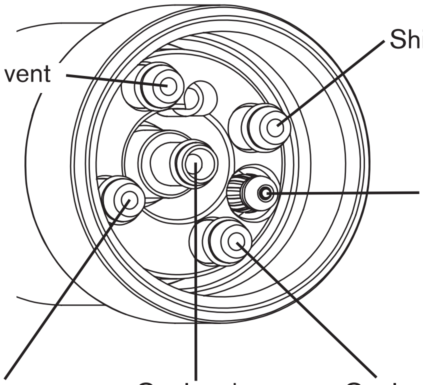
Part	***Check for***	***Action***
Cap 	Erosion, missing material	Replace cap
	Cracks	Replace cap
	Burned	Replace cap
Nozzle 	Erosion or missing material	Replace nozzle*
	Blocked gas holes	Replace nozzle*
Center hole	1. Must be round	Replace nozzle if hole is no longer round*
	2. Signs of arcing	Replace nozzle*
O-rings	1. Damage	Replace nozzle*
	2. Lubricant	Apply a thin film of silicone lubricant if dry
Swirl ring 	Damage	Replace swirl ring
	Dirt or debris	Clean and check for damage; replace if damaged
Gas holes	Blocked holes	Replace swirl ring
O-rings	1. Damage	Replace swirl ring
	2. Lubricant	Apply a thin film of silicone lubricant if dry
Electrode 		
Center surface	Wear	See *Inspect electrode pit depth* later in this section
O-rings	1. Damage	Replace electrode*
	2. Lubricant	Apply a thin film of silicone lubricant if dry

*Always replace the nozzle and electrode as a set.

Inspect torch



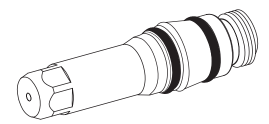
Bullet connectors

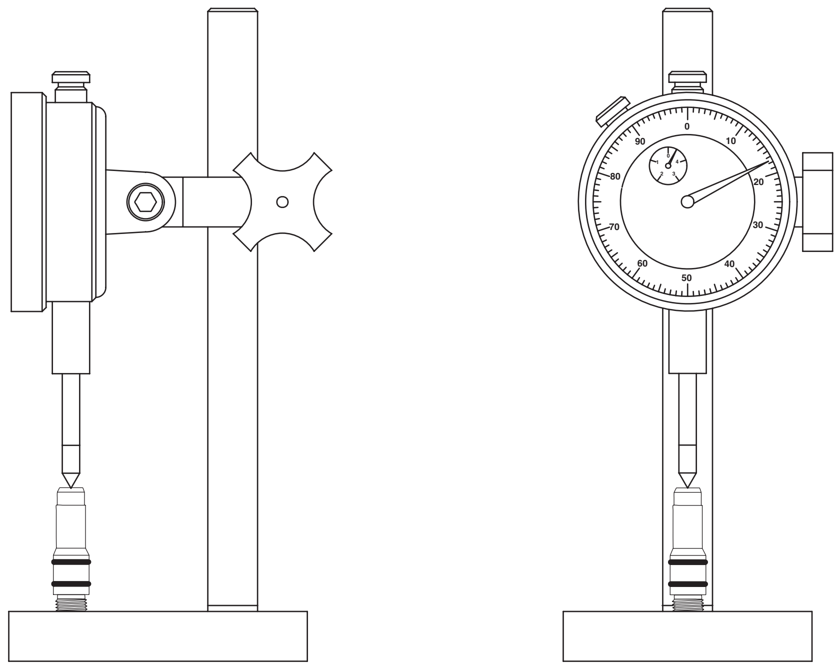


Inspect	***Check for***	***Action***
All surfaces	Dirt or debris	Clean surfaces
	Erosion, missing material	Replace torch
	Cracks	Replace torch
	Internal burn or arcing marks	Replace torch
Current ring	1. Dirt or debris	Clean
	2. Pitted or missing material	Replace torch
Threads	Wear or damage	Replace torch
Bullet connectors	Damage	Replace torch
O-rings	1. Damage	Replace o-ring
	2. Lubricant	Apply a thin film of silicone lubricant if dry
External o-rings	1. Damage	Replace o-ring
	2. Lubricant	Apply a thin film of silicone lubricant if dry
Water tube*	1. Tightness	Tighten or replace tube*
	2. Pitted or missing material	Replace tube*

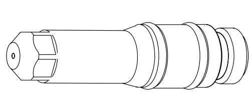
*See *Replace torch water tube* later in this section.

Inspect electrode pit depth





Electrode pit depth gauge (004630)

Part	*Check for*	*Action*
Electrode 		
Center surface	Wear	Replace electrode if pit is deeper than 1 mm (0.040 in.)*

*Always replace the nozzle and electrode as a set.

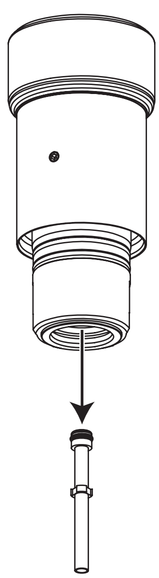
Replace torch water tube

WARNING

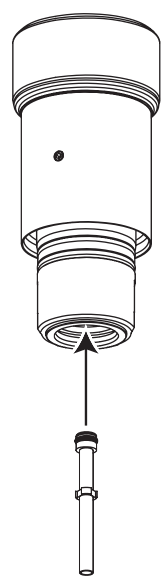
The system is designed to go into an idle mode if the retaining cap is removed. However, DO NOT REMOVE CONSUMABLE PARTS WHILE IN THE IDLE MODE. Always disconnect power to the power supply before removing torch consumable parts. Use gloves when removing consumables. The torch might be hot.

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 *Remove consumables* in this section.
3. Remove water tube



4. Install new water tube



5. Replace consumables. See *Install 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 *Changing consumable parts*).
  4. Metal being cut is too thick.

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

  1. Cutting speed is not correct (check *Cut chart* information).
  2. Arc current is set too low (check *Cut chart* information).
  3. Torch parts are worn (see *Changing consumable parts*).

- Cut angle is not square. Causes can be:

  1. Wrong direction of machine travel.
     High-quality side is on the right with respect to the forward motion of the torch.
  2. Torch-to-work distance is not correct (check *Cut chart* information).
  3. Cutting speed is not correct (check *Cut chart* information).
  4. Arc current is not correct (check *Cut chart* information).
  5. Damaged consumable parts (see *Changing consumable parts*).

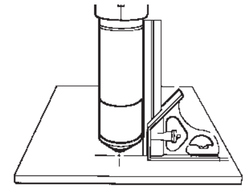
- Short consumable life. Causes can be:

  1. Arc current, arc voltage, travel speed, motion delay, gas flow rates, or initial torch height not set as specified in the *Cut charts*.
  2. Attempting to cut highly magnetic metal plate, 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**.

How to optimize cut quality

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

Tips for table and torch



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

Plasma set-up tips

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

Purge the gas lines before cutting.

Maximize the life of consumable parts

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

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

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

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

Additional factors of cut quality

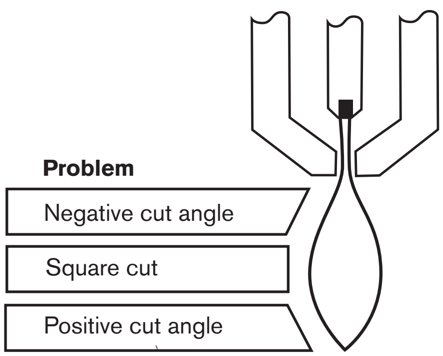
Cut angle

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

> Note: The squarest cut angle will be on the right side with respect to the forward motion of the torch.
>
> Note: To determine whether a cut-angle problem is being caused by the plasma system or the drive system, make a test cut and measure the angle of each side. Next, rotate the torch 90° in its holder and repeat the process. If the angles are the same in both tests, the problem is in the drive system.

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

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



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

Dross

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

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

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

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

Straightness of the cut surface

A typical plasma cut surface is slightly concave.

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

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

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

Additional improvements

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

Smoothness of cut surface (surface finish)

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

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

Piercing

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

When piercing maximum thicknesses, the ring of dross that forms during the pierce may become high enough to contact the torch when the torch begins to move after the pierce is complete.

- A "flying pierce," which makes the pierce while the torch is moving, may eliminate the torch vibration that follows contact between the torch and the ring of dross.

- In some Hypertherm systems, the shield gas pressure automatically increases during pierce delay.

- If the above steps do not solve the problem, increasing the setting of the shield gas pressure may help blow the molten metal away during piercing.
  Trade-off: This may reduce starting reliability.

How to increase cutting speed

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

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

Section 5

MAINTENANCE

In this section:

Introduction

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

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

WARNING

SHOCK HAZARD

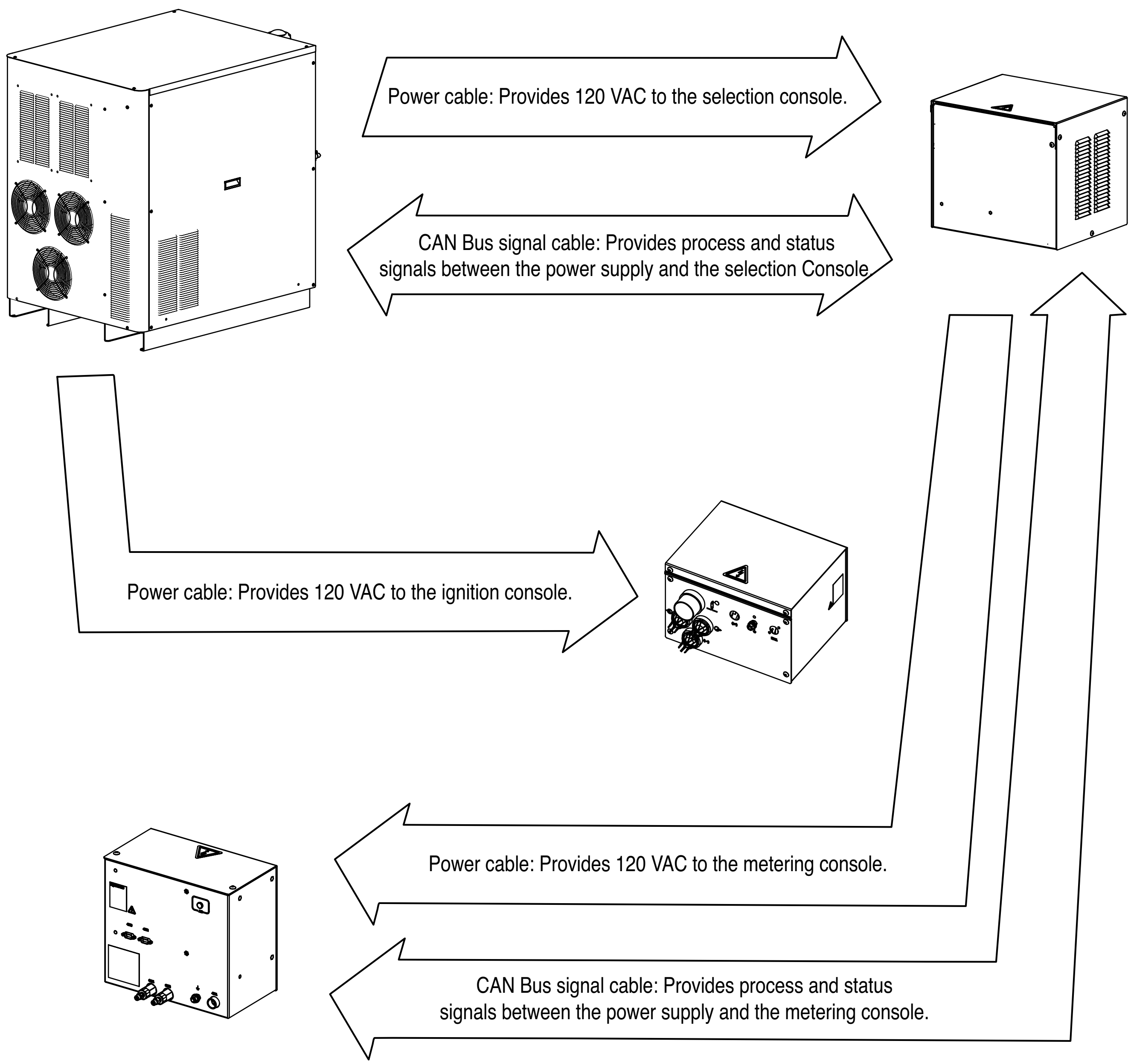
Use extreme care when working near the chopper modules. The large blue capacitors store high voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper and the heatsinks. Discharging any capacitor with a screwdriver or other implement may result in an explosion, property damage or personal injury. Wait at least 5 minutes after turning the power supply off before touching the chopper or the capacitors.

Routine maintenance

For a complete list of routine maintenance recommendations, see the *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

Control 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_2 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 opens 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

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

The cutflow 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_2/Air, Air/Air, or N_2/Air) to a fuel gas process (H35/N_2, or F5/N_2) 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 marking process.

Gas system valve usage

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

O_2/O_2 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	B4		B2		SV1		SV3					SV8		SV10						
Cutflow		B3		B1	SV1		SV3					SV8		SV10						

O_2/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	B4		B2		SV1		SV3					SV8		SV10						
Cutflow		B3	B2		SV1		SV3					SV8		SV10						

N_2/N_2 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	B4			B1									SV9		SV11					
Cutflow	B4			B1									SV9		SV11					

F5/N_2 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_2 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_2/N_2 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_2/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						

Marking process

The valves that are active when marking are represented by the 2 tables below. The active valves in the metering console will differ depending on what process was used before marking.

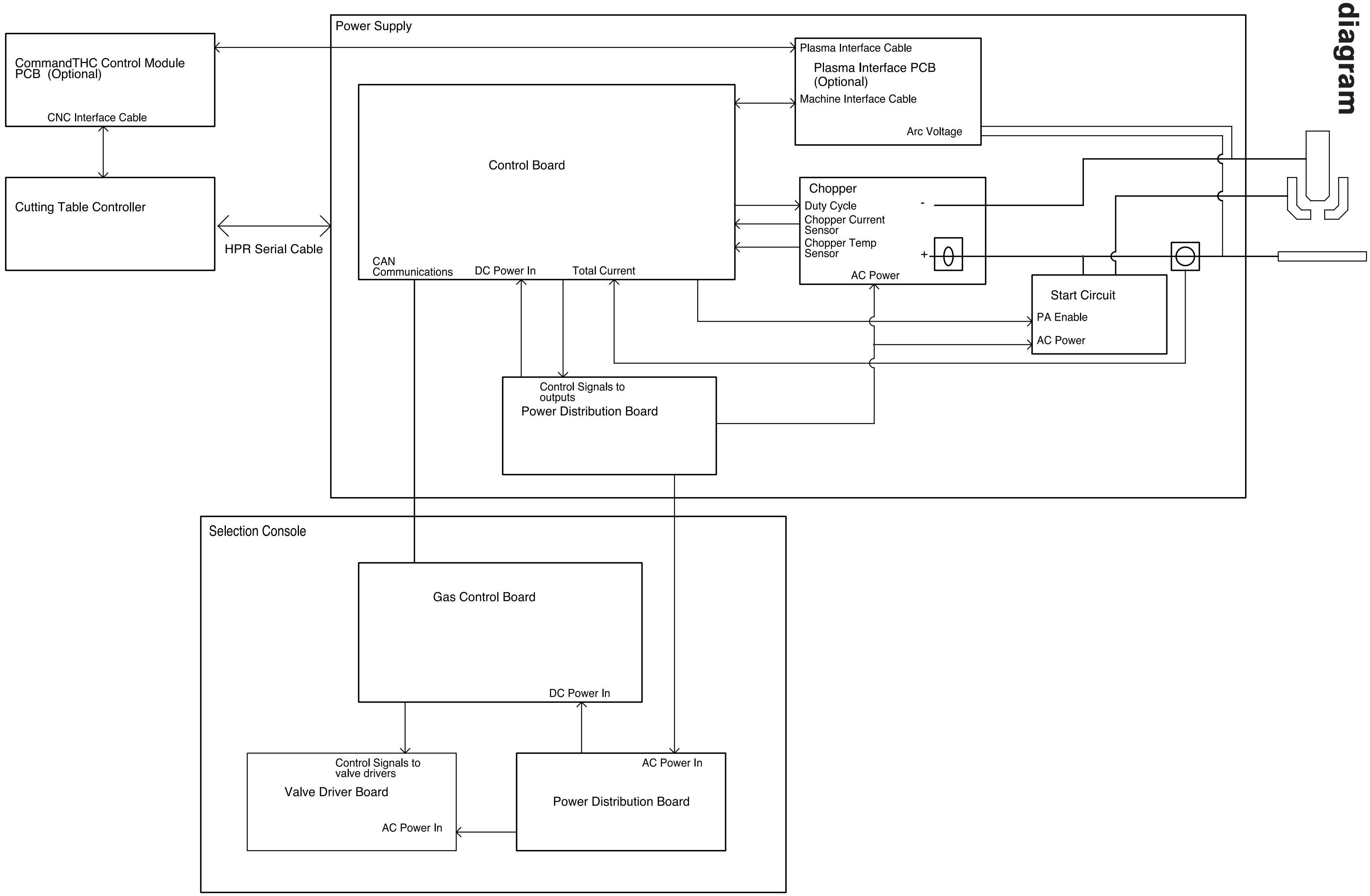
Valves active when changing from a non-fuel gas process

Marking 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	B4		B2												SV11					
Cutflow	B4		B2												SV11					

Valves active when changing from a fuel gas process

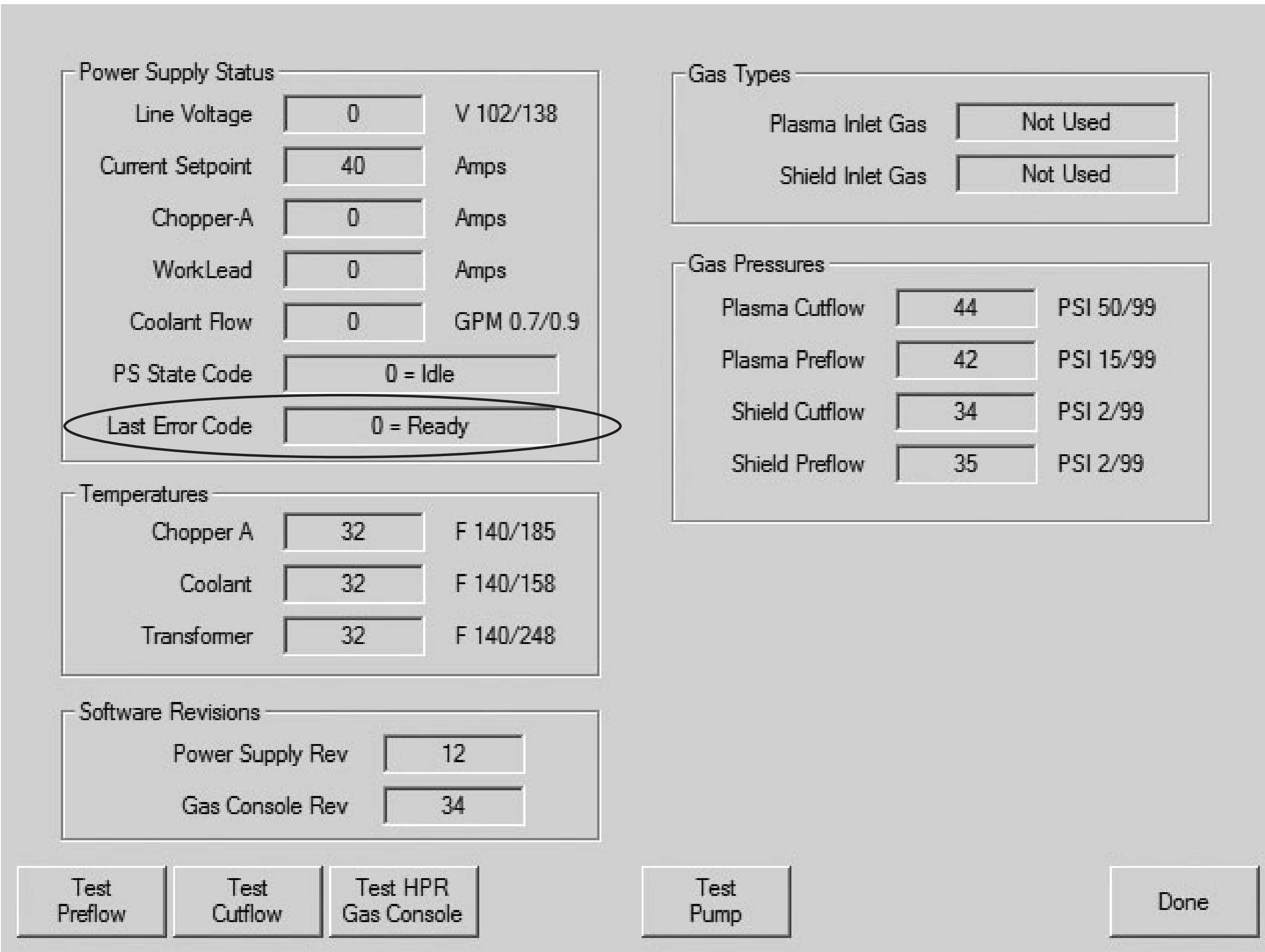
Marking process	Metering console control board				Selection console control board															
LED number	38	39	28	37	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preflow		B3		B1									SV9							
Cutflow		B3		B1									SV9							

PCB block diagram



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 *Operations* section of this manual.



Error code troubleshooting – 1 of 10

Error code number	Name	Description	Corrective action
000	No error	System is ready to run.	None needed.
018	Pump over pressure	Pump output has exceeded 13.79 bar (200 psi).	1. Verify that coolant filters are in good condition. 2. Verify that there are no restrictions in the coolant system.
020	No pilot arc	No current detected from chopper at ignition and before 1-second timeout.	1. Verify that the consumable parts are in good condition. 2. Verify proper preflow and cut-flow settings. 3. Perform gas leak tests (see *Maintenance* section). 4. Verify spark across spark gap. 5. Inspect CON1 and pilot arc relay for excessive wear. 6. Perform gas flow test (see *Maintenance* section). 7. Perform torch lead test (see *Maintenance* section). 8. Perform start circuit test (see *Maintenance* section). 9. Perform chopper test (see *Maintenance* section).
021	No arc transfer	No current detected on work lead 500 milli-seconds after pilot arc current was established.	1. Verify proper pierce height. 2. Verify proper preflow and cut-flow settings. 3. Inspect work lead for damage or loose connections. 4. Perform current test (see *Maintenance* section).
024	Lost current	Lost the current signal from the chopper after transfer.	1. Verify that the consumable parts are in good condition. 2. Verify proper cut-flow gas settings. 3. Verify pierce delay time. 4. Verify arc did not lose contact with plate while cutting (hole cutting, scrap cutting, etc). 5. Perform chopper test (see *Maintenance* section).
026	Lost transfer	Lost the transfer signal after transfer completed.	1. Verify that the consumable parts are in good condition. 2. Verify proper cut-flow gas settings. 3. Verify pierce delay time. 4. Verify arc did not loose contact with plate while cutting (hole cutting, scrap cutting, etc). 5. Inspect work lead for damage or loose connections. 6. Try connecting work lead directly to the plate. 7. Perform chopper test (see Maintenance section).
027	Lost phase	Phase imbalance to chopper after contactor engaged or while cutting.	1. Verify phase-to-phase voltage to power supply. 2. Disconnect power to power supply, remove cover on contactor and inspect contacts for excessive wear. 3. Inspect power cord, contactor, and input to chopper for loose connections. 4. Inspect phase loss fuses on Power Distribution board. Replace board if fuses are blown. 5. Perform phase loss test (see *Maintenance* section).

Error code troubleshooting – 2 of 10

Error code number	Name	Description	Corrective action
030	Gas system error **Auto Gas Only**	A failure has occurred in the gas system.	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. 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. 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. 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.
031	Start lost	Start signal was received and then lost before an arc was established.	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. 2. Inspect interface cable for damage; faulty crimps, or poor electrical connections. 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.
032	Hold timeout	Hold signal was active for longer than 60 seconds.	1. Check the interface cable for damage. The hold wires may be short-circuiting inside. 2. The CNC is maintaining this input, it could be waiting for an IHS complete input from another torch. 3. If CNC interface cable is good and it is a 1-torch system, change PCB3.
033	Precharge time-out **Auto Gas Only**	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.
042	Low nitrogen (N2) gas pressure	Nitrogen gas pressure under lower limit of 2.07 bar (30 psi) – cutting 0.34 bar (5 psi) – marking During N2 purge, when switching between a fuel gas process and an oxidizer process.	1.Verify that the nitrogen supply is turned on and inspect gas supply pressure and volume of gas remaining in supply tanks. 2. Verify that the gas regulator is set to 8.27 bar (120 psi). See *Setting the supply regulators* (*Installation* section).
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)	1. Inspect gas supply pressure and volume of gas remaining in supply tanks. 2. Verify the gas regulator settings on gas console with the parameters in the cut charts. 3. See *Setting the supply regulators* (*Installation* section). 4. Perform gas leak tests (*Maintenance* section).

Error code troubleshooting – 3 of 10

Error code number	Name	Description	Corrective action
045	High plasma gas pressure	Plasma gas pressure over upper limit of 7.58 bar (110 psi).	1. Verify gas supply pressure settings. 2. Verify gas regulator settings on gas console with cut chart. 3. See *Setting the supply regulators* (*Installation* section). 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.
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%).	1. Verify input-line voltage. Voltage needs to be within 10 % of nominal (120 VAC). 2. Verify fuses on PCB2. 3. Verify 120 VAC voltage on plug J2.4, pins 3 and 4 on PCB2. 4. Verify voltage on receptacle J2 on PCB2. Should be approximately 1.65 VDC between pins 1 and 2. 5. If AC voltage on J2.4, pins 3 and 4, is greater than 108 VAC and DC voltage on J2 is less than 1.485 VDC, replace PCB2. 6. If AC voltage on J2.4, pins 3 and 4, is greater than 108 VAC and DC voltage on J2 is also greater than 1.485 VDC, verify the DC voltage to J3.201 on PCB3. It should equal the voltage reading on J2. If the DC voltage readings are the same and the wiring passes continuity tests, replace PCB3.
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%).	1. Verify input-line voltage. Voltage needs to be within 10 % of nominal (120 VAC). 2. Verify fuses on PCB2. 3. Verify 120 VAC voltage on plug J2.4, pins 3 and 4 on PCB2. 4. Verify voltage on receptacle J2 on PCB2. Should be approximately 1.65 VDC between pins 1 and 2. 5. If AC voltage on J2.4, pins 3 and 4, is less than 132 VAC and DC voltage on J2 is greater than 1.815 VDC, replace PCB2. 6. If AC voltage on J2.4, pins 3 and 4, is less than 132 VAC and DC voltage on J2 is less than 1.815 VDC , verify the DC voltage to J3.201 on PCB3. It should equal the voltage reading on J2. If the DC voltage readings are the same and the wiring passes continuity tests, replace PCB3.
048	CAN error	An error occurred with the CAN communications between the power supply and the gas console.	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. 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. 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. 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.

Error code troubleshooting – 4 of 10

Error code number	Name	Description	Corrective action
050	Start signal is on at power-up	Plasma start signal input is active during power-up of power supply.	1. Stop or clear the cutting program. The plasma start signal to the plasma was not dropped after the last cut. 2. Verify that the CNC interface cable is not damaged. 3. Remove CNC interface cable from PCB3 and look for an open circuit between pins 15 and 34. 4. If the circuit is closed either the CNC is issuing a plasma start or the CNC interface cable is damaged. 5. If circuit is open, and LEDN300J is illuminated with CNC Interface cable removed from PCB3, replace PCB3.
053	Low shield gas pressure	Shield pressure is below lower limit of 0.14 bar (2 psi).	1. Verify gas supply pressure and that a sufficient volume of gas remains in your supply. 2. Verify gas regulator settings on gas console with cut chart. 3. See *Setting the supply regulators* (*Installation* section). 4. Perform gas leak tests (*Maintenance* section).
054	High shield gas pressure	Shield gas pressure is over upper limit of 7.58 bar (110 psi).	1. Verify gas supply regulator settings. See *Setting the supply regulators* (Installation section). 2. Verify pressure settings on gas console with cut chart. 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.
055	MV1 inlet pressure **Auto Gas Only**	Motor valve 1 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).	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.
056	MV2 inlet pressure **Auto Gas Only**	Motor valve 2 inlet pressure is less than 3.45 bar (50 psi) or greater than 9.65 bar (140 psi).	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.
057	Cut gas 1 pressure **Auto Gas Only**	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.	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.
058	Cut gas 2 pressure **Auto Gas Only**	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.	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.

Error code troubleshooting – 5 of 10

Error code number	Name	Description	Corrective action
060	Low coolant flow	Coolant flow is less than the required 2.3 lpm (0.6 gpm).	1. Verify that the correct consumables are properly installed. 2. Perform the coolant flow test procedure in the Maintenance section of the manual.
061	No plasma gas type	Gas console control board is not receiving signals from the gas selector knob.	1. Replace the gas console control board.
062	No shield gas type	Gas console control board is not receiving signals from the shield gas selector knob (2).	1. Replace the gas console control board.
065	Chopper 1 overtemp	Chopper has overheated.	1. Verify that both chopper fans are operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of system, especially from fans and heat sink of chopper. 3. Verify that the voltage on rear side of J3.201, pins 2 and 10 on PCB3, is less than or equal to 2.9 VDC. 4. If the voltage is low, verify correct wiring between chopper temp sensor and J3.201 pins 9 and 10. 5. If wiring is good and overtemp error does not clear after 30 minutes, replace chopper. 6. If voltage is higher than 2.9 VDC and overtemp LED does not clear after 30 minutes, replace PCB3.
066	Chopper 2 overtemp	Chopper has overheated.	1. Verify that both chopper fans are operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of system, especially from fans and heat sink of chopper. 3. Verify that the voltage on rear side of J3.201, pins 2 and 10 on PCB3, is less than or equal to 2.9 VDC. 4. If the voltage is low, verify correct wiring between chopper temp sensor and J3.201 pins 9 and 10. 5. If wiring is good and overtemp error does not clear after 30 minutes, replace chopper. 6. If voltage is higher than 2.9 VDC and overtemp LED does not clear after 30 minutes, replace PCB3.
067	Magnetics overtemp	Power transformer has overheated.	1. Verify that the large fan is operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of system especially from fans and large power transformer. 3. Verify that the voltage on the rear side of J3.201 pins 2 and 8, is equal to or less than 3.2 VDC. 4. If voltage is low, inspect wiring between the transformer's temp sensor and J3.201 pins 7 and 8. Look for shorts to wires or ground. 5. If wiring is good, the transformer has overheated. 6. If voltage is higher than 3.2 V and overtemp error does not clear after 30 minutes, replace PCB3.

Error code troubleshooting – 6 of 10

Error code number	Name	Description	Corrective action
071	Coolant overtemp	Torch coolant has overheated.	1. Verify that all 4 fans in the coolant heat exchanger are running. 2. Blow dust out of the system, especially from the heat exchanger. 3. Verify that the voltage on the rear side of J3.201 pins 2 and 6, is equal to or lower than 2.8 VDC. 4. If voltage is low, inspect wiring between coolant sensor and J3.201, pins 5 and 6, for shorts to wires or ground. 5. If wiring is good, the coolant has overheated; let system stand for 30 minutes to cool. 6. If voltage is higher than 2.8 VDC and the overtemp error does not clear after 30 minutes, replace PCB3.
072	Auto gas, control board overtemp **Auto Gas Only**	Control board has exceeded 90° C (194° F).	1. Verify that the airflow to the gas console is not restricted.
093	No coolant flow	Coolant flow signal was lost or never was satisfied.	1. If this is a new system, follow start procedure. 2. Verify that the coolant filter is in good condition. 3. Perform coolant flow tests (*Maintenance* section). 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.
099	Chopper 1 overtemp at power-up	Chopper 1 is indicating an overtemp at power-up.	1. Verify that the temperature sensor for the chopper has not been jumped out or the wires to the temp switch shorted out in the harness. 2. If no jumper is present, the chopper is overheated and needs time to cool to 83° C (181.4° F).
100	Chopper 2 overtemp at power-up	Chopper 2 is indicating an overtemp at power-up.	1. For 130 amp systems verify dipswitch number1 is in the OFF position. 2. For 260 amp systems repeat step 1 and 2 in error code 99.
101	Magnetics overtemp at power-up	Main transformer is indicating an overtemp at power-up.	1. Verify that the transformer temperature sensor for the chopper has not been jumped out or the wires to the temperature sensor are not shorted out in the harness. 2. If not, the main transformer is overheated and needs time to cool to 150° C (302° F).
102	Current detected at power-up	Current was detected by one of the current sensors at power-up.	1. Verify that the electrical connections to all current sensors and to J3.200 at PCB3 are good.
103	High current on CS1	A Current greater than 35 Amps has been detected by current sensor 1.	1. Verify that there is not a short on the I/O PCB, between the work lead and the negative lead. 2. Remove fuse F3 and check for a short on Chopper A from wire 38 to wire 39. 3. Verify fuse (F3).

Error code troubleshooting – 7 of 10

Error code number	Name	Description	Corrective action
104	High current on CS2	A current greater than 35 amps has been detected by current sensor 2.	1. Verify that there is not a short on the I/O PCB, between the work lead and the negative lead. 2. Remove fuse F4 and check for a short on Chopper B from wire 38 to wire 39. 3. Verify fuse (F4).
105	Low current on CS1	A current less than 10 amps has been detected by current sensor 1.	1. Verify the connections on CS1. 2. Verify that +/- 15 VDC is present at the CS1 connector. 3. Verify fuse (F3). 4. Verify that contactor CON1 is closing. 5. Remove fuse F3 and check the open circuit voltage (OCV) on wire 38 and wire 39 at chopper A when CON1 closes.
106	Low current on CS2	A current less than 10 amps has been detected by current sensor 2.	1. Verify the connections on CS2. 2. Verify that +/- 15 VDC is present at the CS2 connector. 3. Verify fuse (F4). 4. Verify that contactor CON1 is closing. 5. Remove fuse F4 and check the open circuit voltage (OCV) on wire 38 and wire 39 at chopper B when CON1 closes.
108	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 PCB 3 if connections are correct and not damaged.
109	Coolant flow at power-up	"Coolant flow OK" signal is active during power-up and before pump motor is activated.	1. Either coolant flow sensor was bypassed or the flow switch is faulty.
111	Coolant overtemp at power-up	Coolant is indicating an overtemp at power-up.	1. Verify that the coolant temperature sensor has not been jumped out 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).
116	Watchdog interlock	An error occurred with the CAN communication system.	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. 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. 3a. **(Manual gas console)** Verify that D1 (+5 VDC) and D2 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2. 3b. **(Auto gas console)** Verify that D17 (+5 VDC) and D18 (+3.3 VDC) are illuminated on PCB2 inside the gas console. These LEDs indicate power to PCB2. 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.

Error code troubleshooting – 8 of 10

Error code number	Name	Description	Corrective action
123	MV1 error **Auto Gas Only**	Motor valve 1 did not move into position within 60 seconds.	1. 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.
124	MV2 error **Auto Gas Only**	Motor valve 2 did not move into position within 60 seconds.	1. 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.
133	Unknown gas console type	The power supply control board does not recognize the gas console that is installed or has not received a CAN message.	1. Verify that the part numbers of PCB2 and PCB3 are correct. 2. 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. 3. 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. 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. 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.
134	Chopper 1 overcurrent	Chopper 1 current feedback has exceeded 160 amps.	1. Verify that the wiring between CS1 and PCB3 is correct and not damaged. 2. Measure voltage across current sensor. 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). b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps. c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor. 3. Remove connector J9.1 from the chopper and verify that LED1 is extinguished. a) If LED1 is extinguished with the connector removed, then reconnect J9.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper. b) If the chopper does not go into overcurrent, replace PCB3.

Error code troubleshooting – 9 of 10

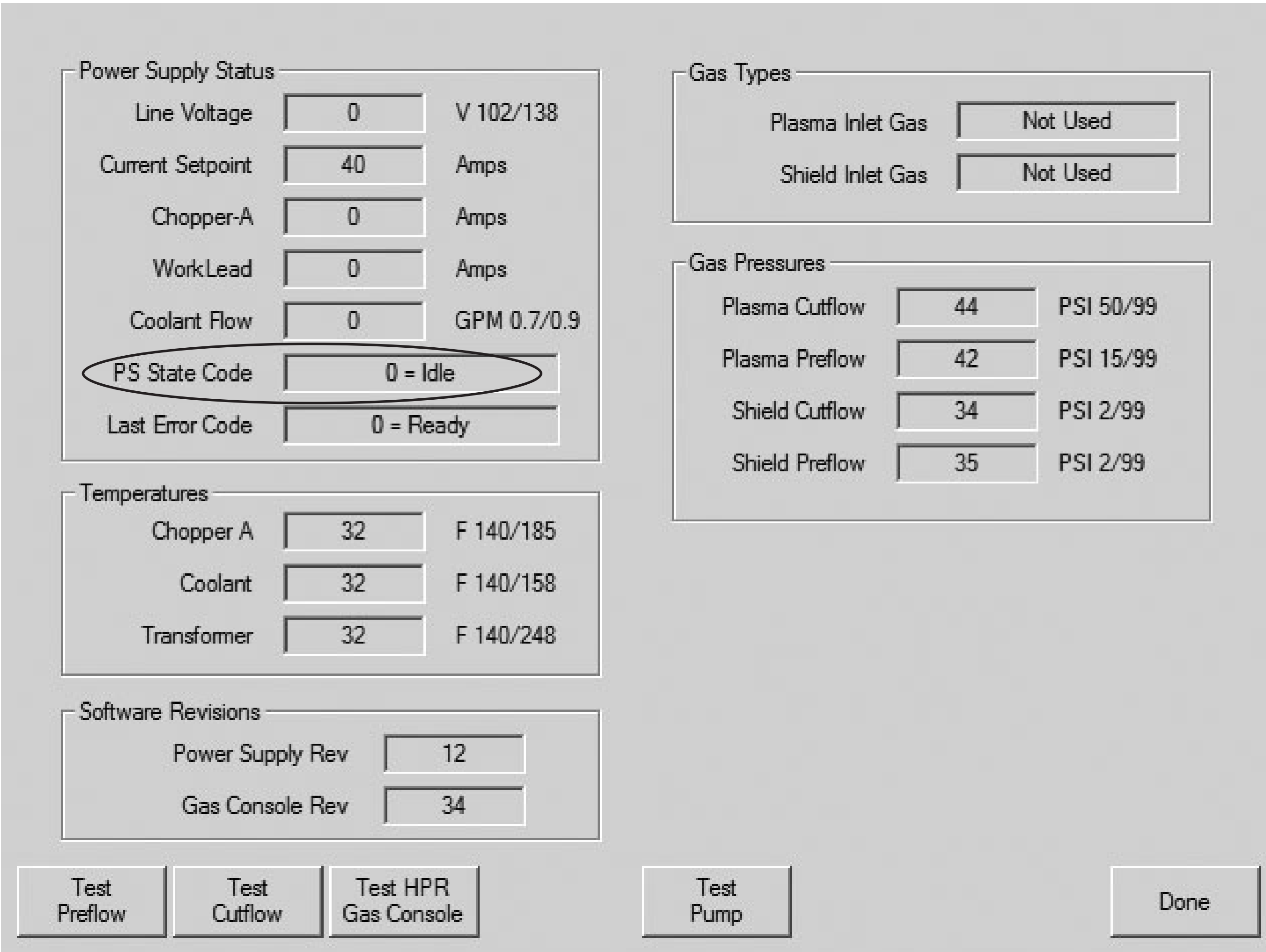
Error code number	Name	Description	Corrective action
138	Chopper 2 overcurrent **(HPR260 power supplies)**	Chopper 2 current feedback has exceeded 160 amps.	1. Verify that the wiring between CS2 and PCB3 is correct and not damaged. 2. Measure voltage across current sensor. a) Red to black = +15 VDC, Green to black = -15 VDC, white to black = 0 VDC at idle and varies with current output (4 VDC = 100 amps). b) If possible, take a voltage reading on current sensor while trying to cut. Ratio is 4 VDC = 100 amps. c) If the current sensor voltage is approximately 6.4 VDC or greater at idle, replace the current sensor. 3. Remove connector J9.1 from the chopper and verify that LED1 is extinguished. a) If LED1 is extinguished with the connector removed, then reconnect J9.1 and try to fire the torch. If the chopper still goes into overcurrent, replace the chopper. b) If the chopper does not go into overcurrent, replace PCB3.
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. Verify that there are no restrictions in the plasma and shield hoses.
140	Pressure transducer 1or 8 error **Auto Gas Only**	Faulty transducer or control board in the metering console or the selection console.	1. Verify that transducer P1 in the selection console is working properly. Replace if necessary. 2. Verify that transducer P8 in the metering console is working properly. Replace if necessary. 3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.
141	Pressure transducer 2 or 7 error **Auto Gas Only**	Faulty transducer or control board in the metering console or the selection console.	1. Verify that transducer P2 in the selection console is working properly. Replace if necessary. 2. Verify that transducer P7 in the metering console is working properly. Replace if necessary. 3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.
142	Pressure transducer 3 or 5 error **Auto Gas Only**	Faulty transducer or control board in the metering console or the selection console.	1. Verify that transducer P3 in the selection console is working properly. Replace if necessary. 2. Verify that transducer P5 in the metering console is working properly. Replace if necessary. 3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.
143	Pressure transducer 4 or 6 error **Auto Gas Only**	Faulty transducer or control board in the metering console or the selection console.	1. Verify that transducer P4 in the selection console is working properly. Replace if necessary. 2. Verify that transducer P6 in the metering console is working properly. Replace if necessary. 3. Verify that the control boards in the metering and selection consoles are working properly. Replace if necessary.

Error code troubleshooting – 10 of 10

Error code number	Name	Description	Corrective action
144	Internal flash error **Manual Gas Only**	Communication problem to the flash chip on the gas console control board.	1. Replace the control board.
145	Internal flash error **Auto Gas Only**	Communication problem to the flash chip on the selection console control board.	1. Replace the control board.
151	Software fail	Software has detected an incorrect state or condition.	1. Replace power supply control board.
152	Internal flash error	Communication problem to the flash chip on the power supply control board.	1. Replace the control board.
153	PS EEPROM error	EEPROM memory on power supply control board not working.	1. Replace the control board.
180	Selection console CAN timeout **Auto Gas Only**	The power supply did not receive a CAN message from the selection console within 1 second.	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. 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. 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.
181	Metering console CAN timeout **Auto Gas Only**	The power supply did not receive a CAN message from the metering console within 1 second.	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. 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. 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.

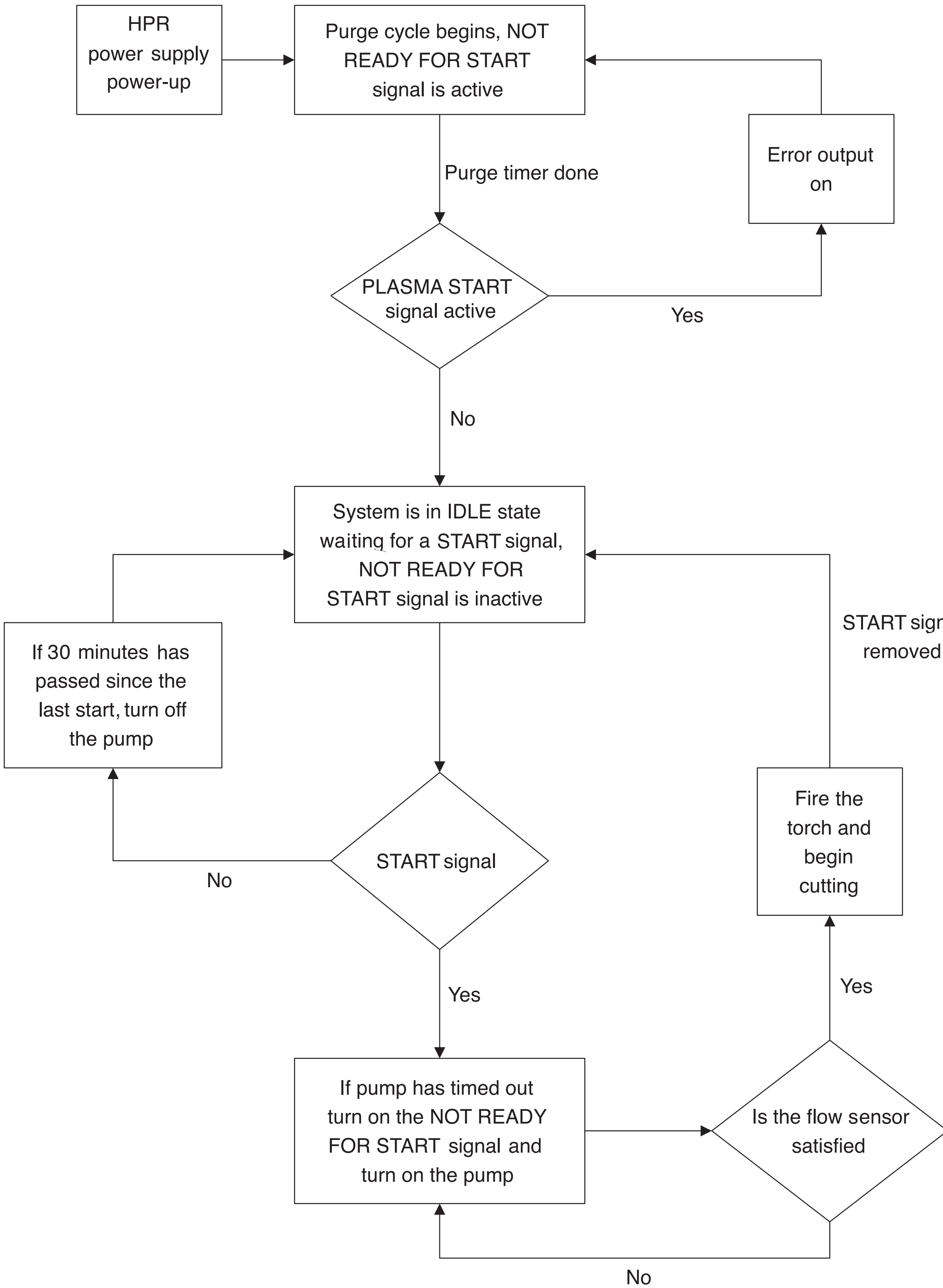
Power supply states

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

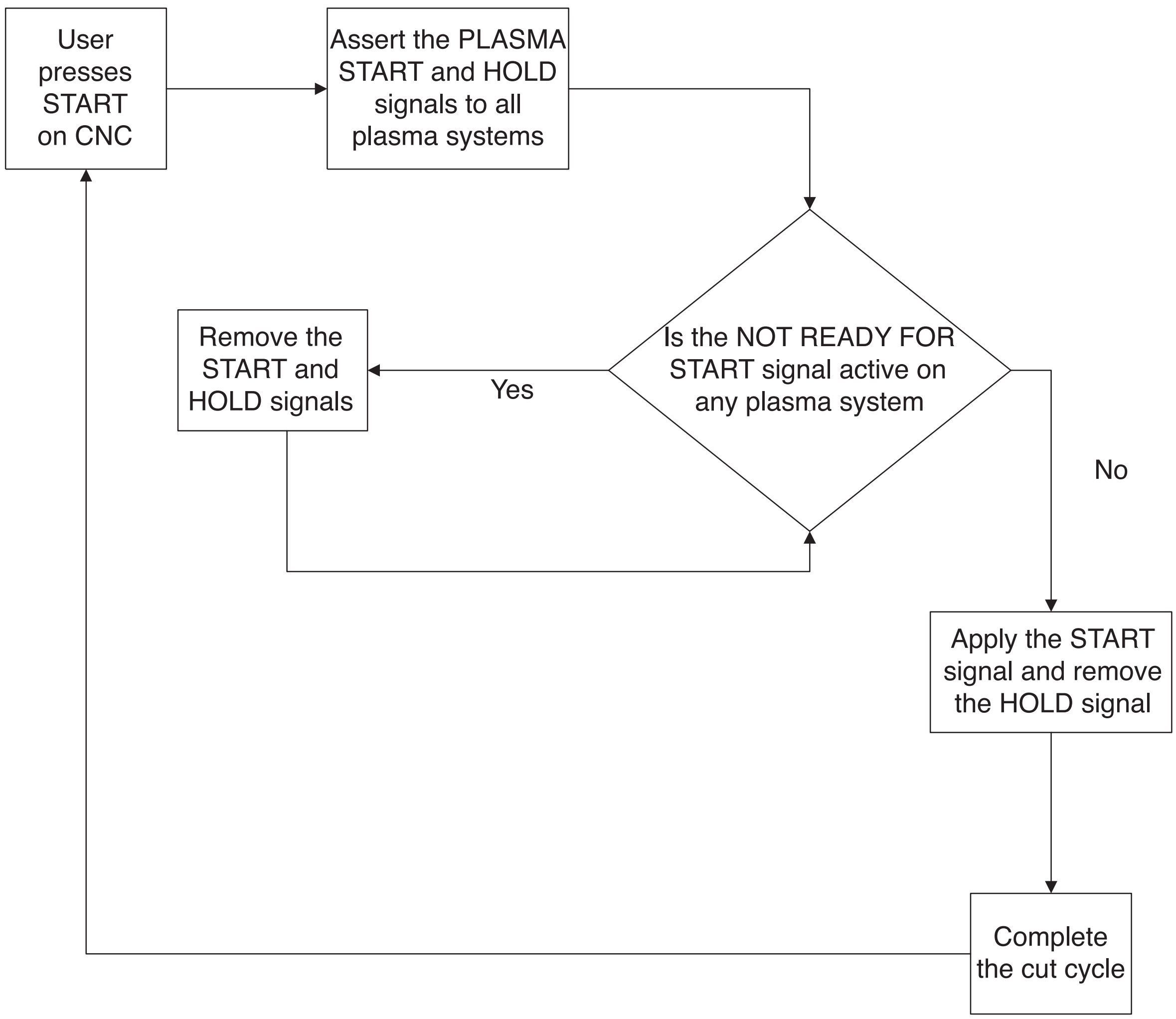


State code	Name	State code	Name
00	Idle	11	Auto off
02	Purge	12	Test cutflow
03	Idle 2	14	Shutdown
04	Preflow	15	Reset
05	Pilot arc	16	Maintenance
06	Transfer	20	Test preflow
07	Ramp-up	22	Manual pump control
08	Steady state	23	Inlet leak check
09	Ramp-down	24	System leak check
10	Final ramp-down		

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.

DANGER

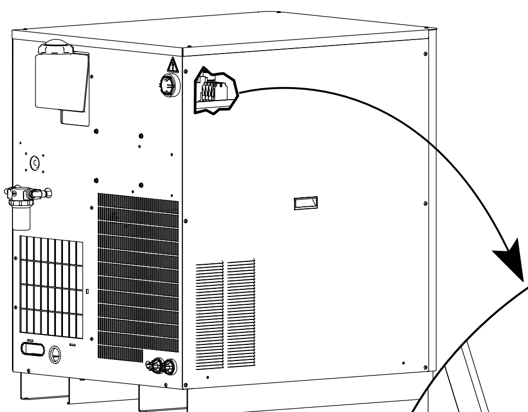
SHOCK HAZARD: Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

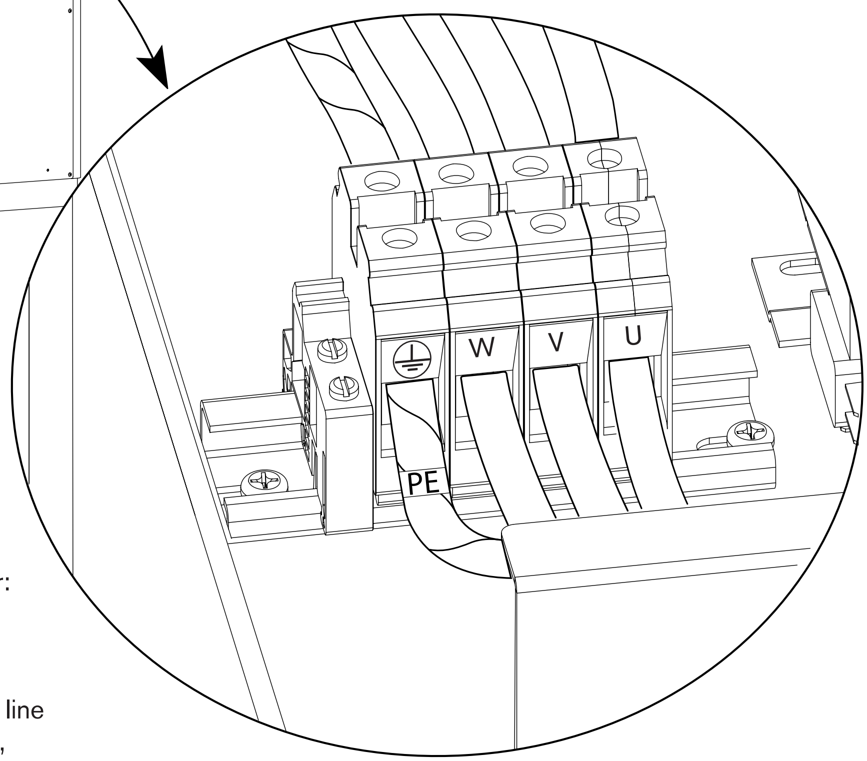
1. Disconnect line power by turning OFF the main disconnect switch.
2. Remove the power supply's top panel and 2 side panels.
3. Inspect interior of power supply for discoloration on PC boards, or other apparent damage. If a component or module is obviously defective, replace it before doing any testing. 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

DANGER

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



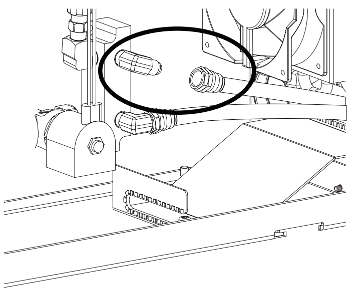


Note: Check lines in the following order:
U to V
U to W
V to W
Check each line to ground. If one line is 10% or higher than the other 2, put that leg on U.

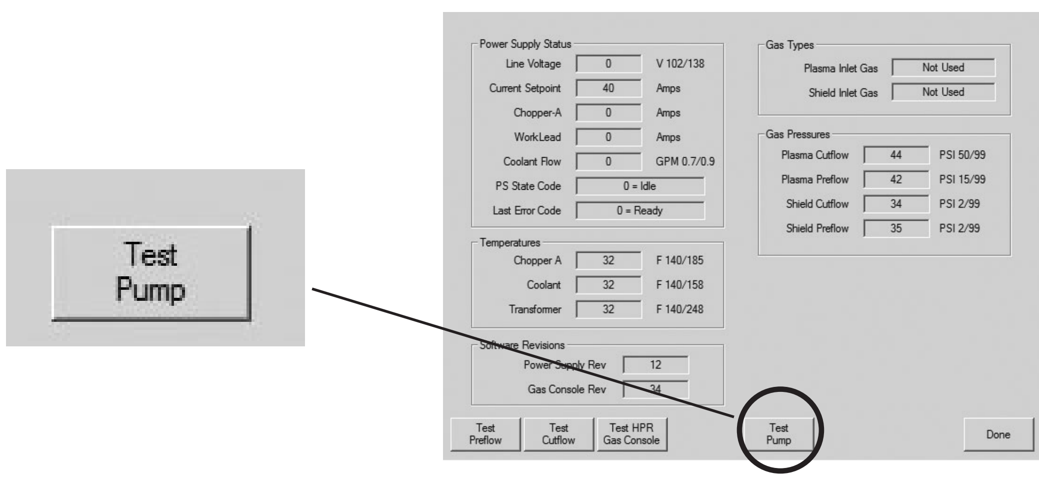
Power supply coolant system servicing

Draining the coolant system

1. Turn OFF the power, and remove the return coolant hose (red tape) from the pump and put it in a 20 liter (5 gallon) container.



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



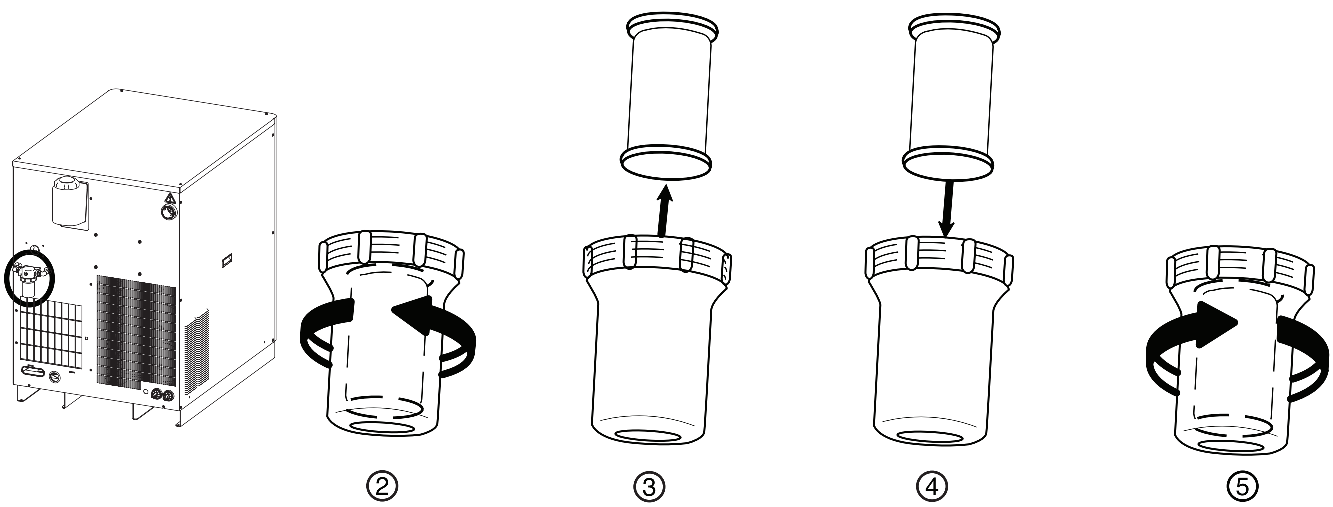
3. Turn OFF the pump when the coolant stops flowing.

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

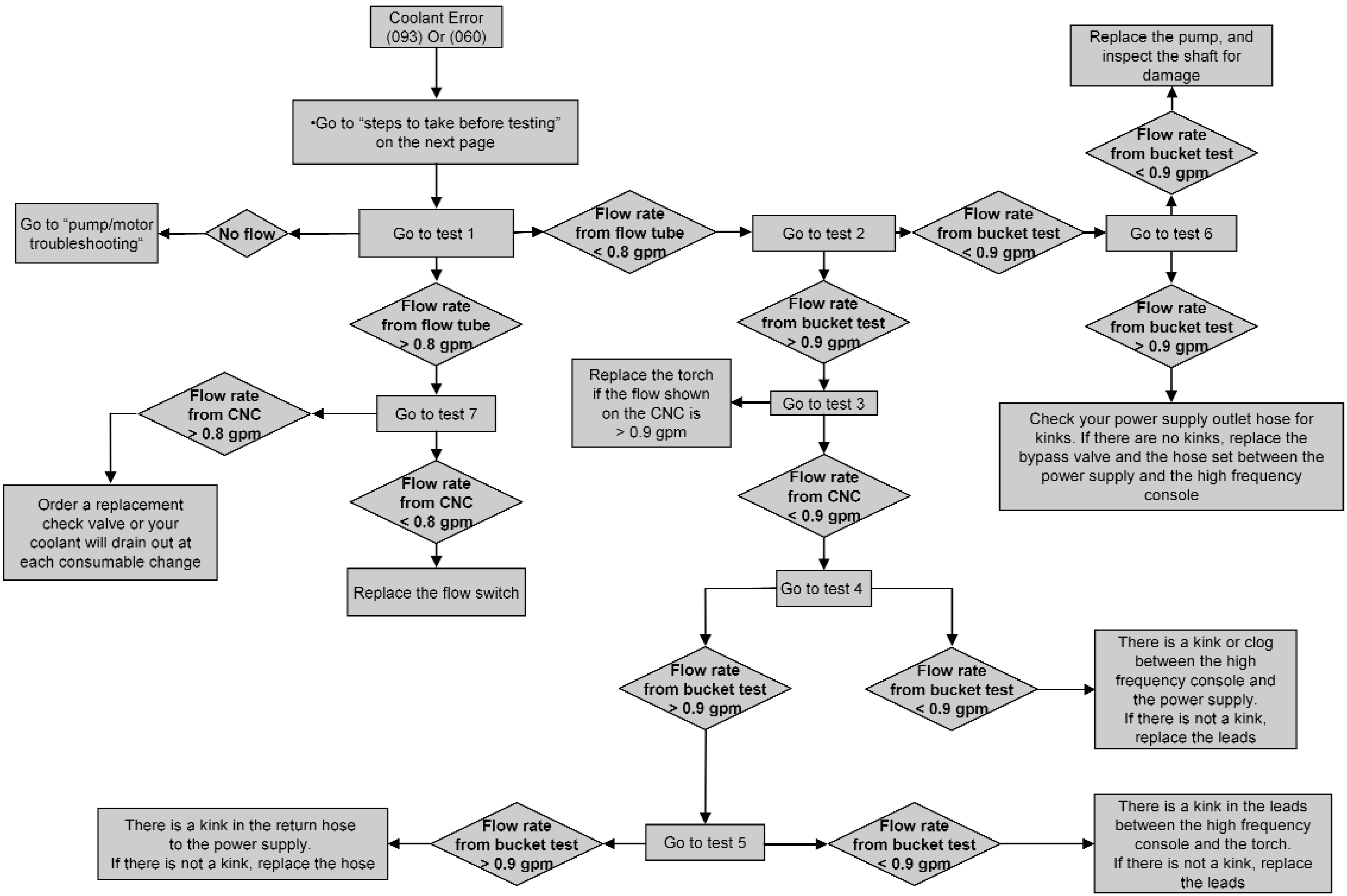
Coolant system filter

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.

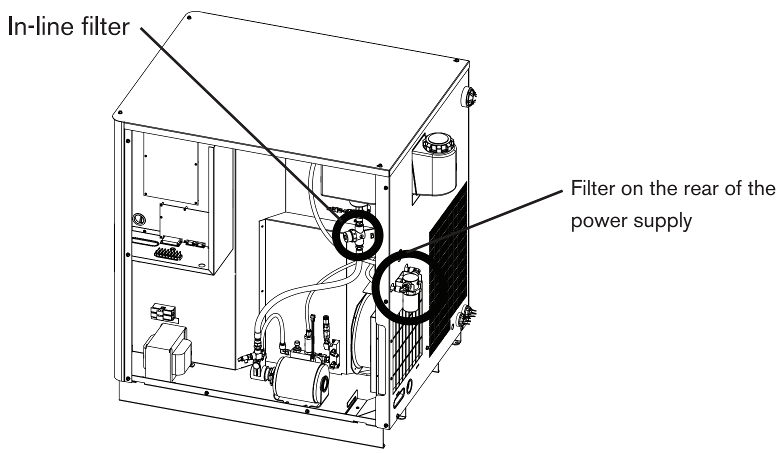
An in-line flow meter is the most accurate way to measure the flow rate, but can not be used with all the tests described without custom fittings. An in-line flow meter (part number 128933) is available from Hypertherm. The following "bucket" tests give a good idea of the flow rate.

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

Note: 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.

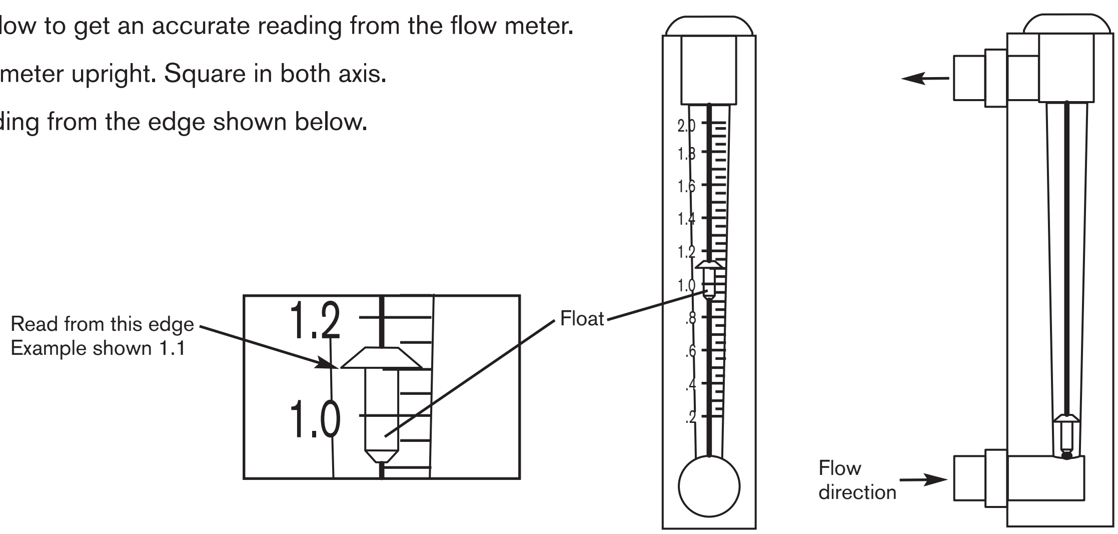
1. Clean the in-line filter.
2. Replace the filter on the back of the power supply.
3. Verify that the system has the correct level of coolant, when refilling the system after completing steps 1 and 2.



Using the Hypertherm flow meter (128933)

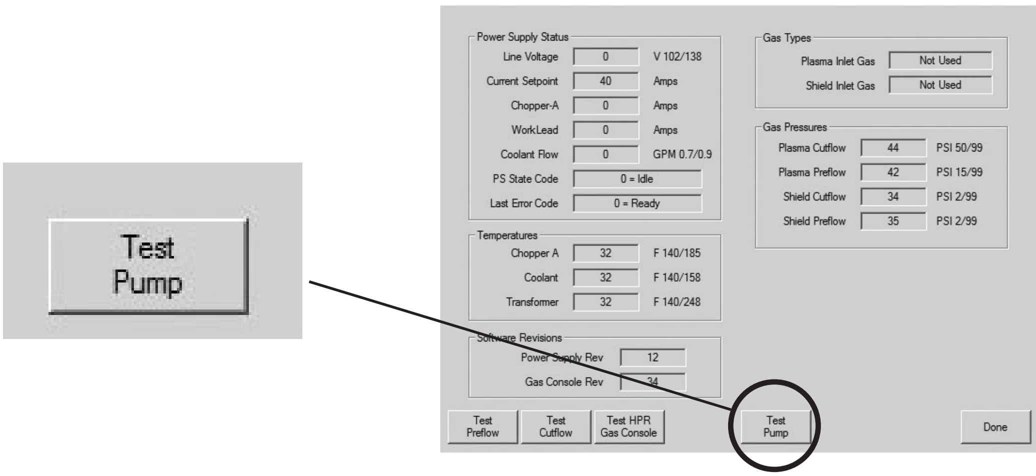
Use the steps below to get an accurate reading from the flow meter.

1. Hold the flow meter upright. Square in both axis.
2. Take your reading from the edge shown below.

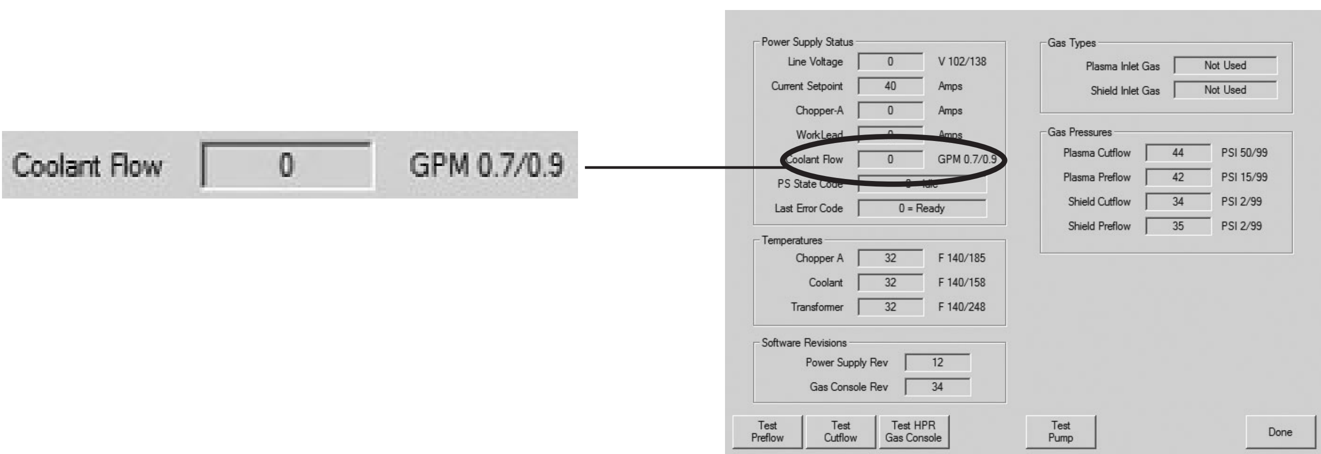


Manual pump operation

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.

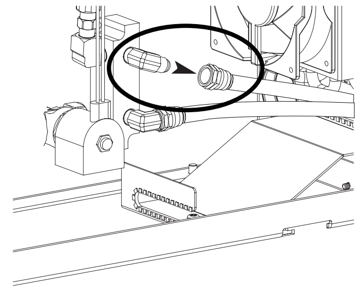


Note: a flow diagram can be found on schematic 013362, sheet 17 of 20

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 (blue hose with red tape), 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 (blue hose with red tape).

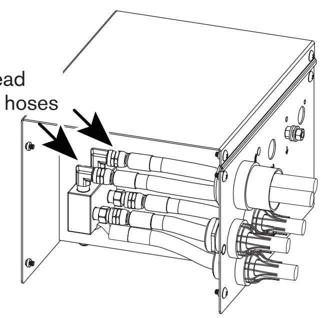
If the flow rate is 0.8 gpm or more, go to test 7.

If the flow rate is less than 0.8 gpm, Go to test 2.

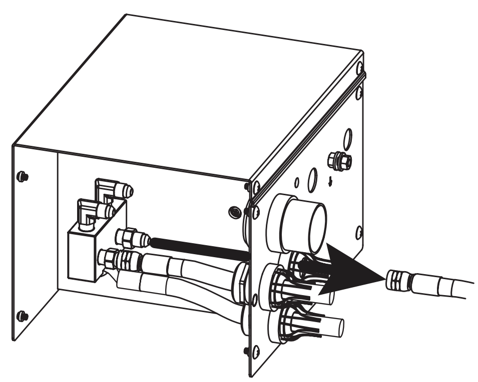
If there is no flow, go to pump and motor troubleshooting.

Test 2 – supply line at ignition console

Note: remove the torch-lead coolant hoses to acess 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, replace the torch.

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 from 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.

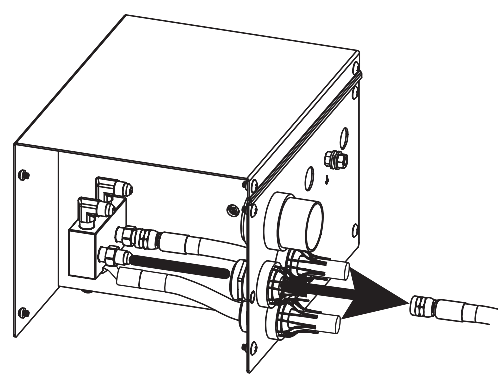
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under "Manual pump operation"). Write down how long it takes to fill the container.
3. Reconnect the coolant supply line to the torch receptacle.

If it takes more than 65 seconds to fill the container, look for an obstructionor 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)

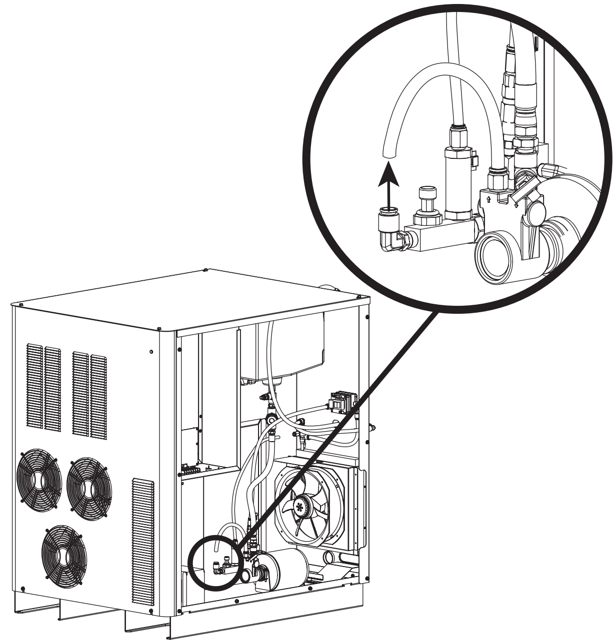
1. Turn OFF the power. Remove the return coolant line (blue hose with red tape) from the RHF/LHF console, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using 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

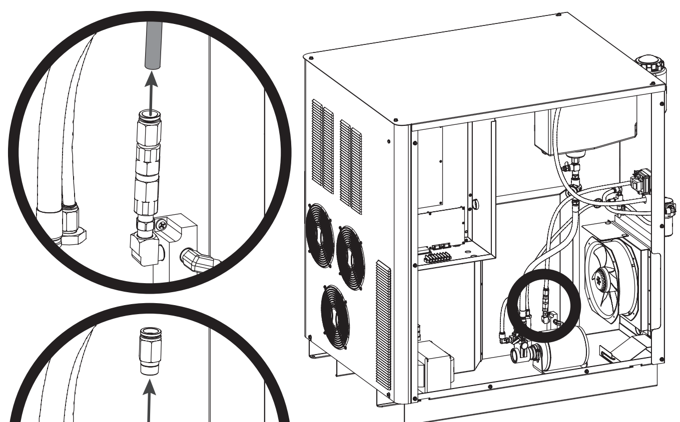


1. Turn OFF the power. Remove the pump outlet, coolant line, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually using the manual pump control button on your CNC screen (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.

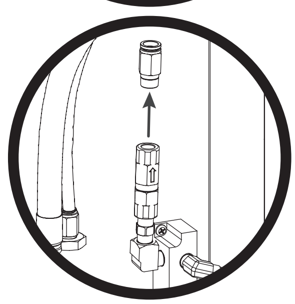
If it takes more than 65 seconds to fill the container, replace the pump and check the motor shaft for damage.

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 the hoses between the power supply and RHF/LHF console.

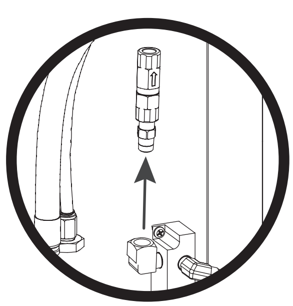
Test 7 – bypass the check valve



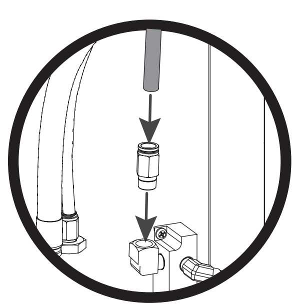
1. Turn OFF the power. Remove the hose from the relief valve.



2. Remove the push-to-connect fitting from the relief valve.



3. Remove the relief valve.



4. Install the push-to-connect fitting and connect the hose.

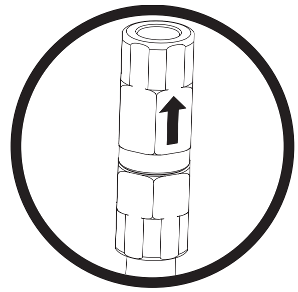
Test 7 – continued

5. Turn ON the power supply, and note the coolant flow rate shown on the CNC display.

If the flow shown on the CNC screen is more than 0.8 gpm, replace the check valve. Coolant will drain out of the torch during every consumable change if the check valve is bypassed.

If the flow shown on the CNC screen is less than 0.8 gpm, replace the flow switch.

Note: the check valve must be oriented correctly. The arrow points up, as shown.



Check valve orientation

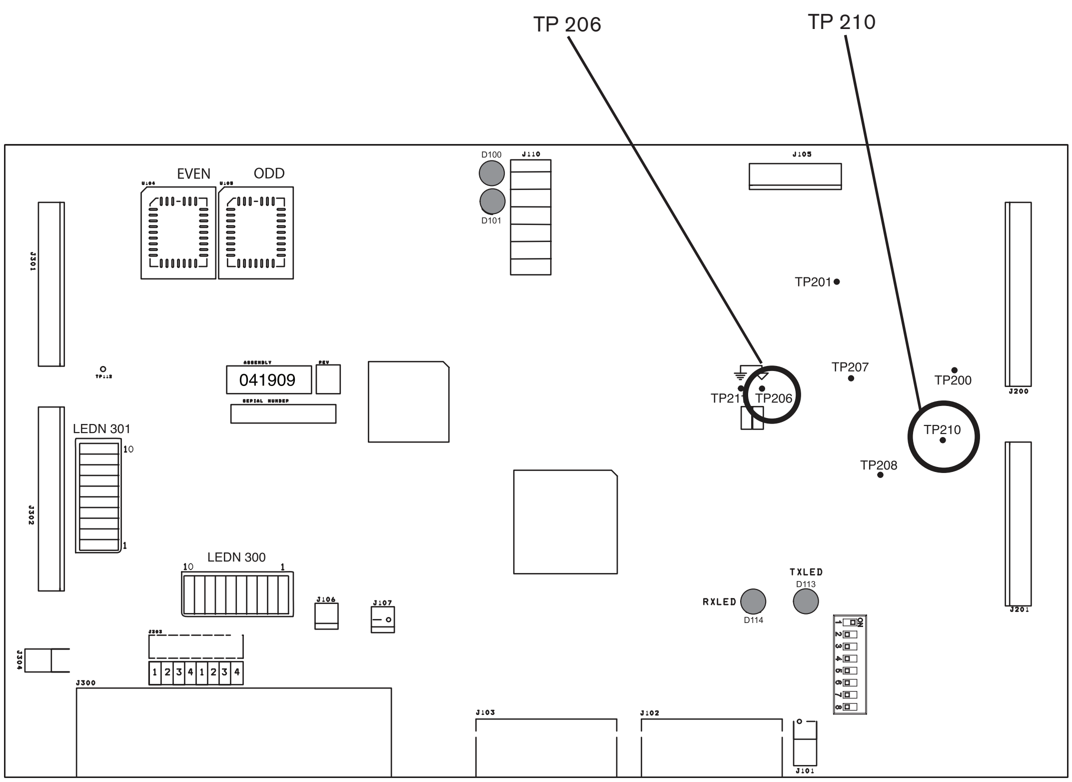
Pump and motor troubleshooting

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 switch

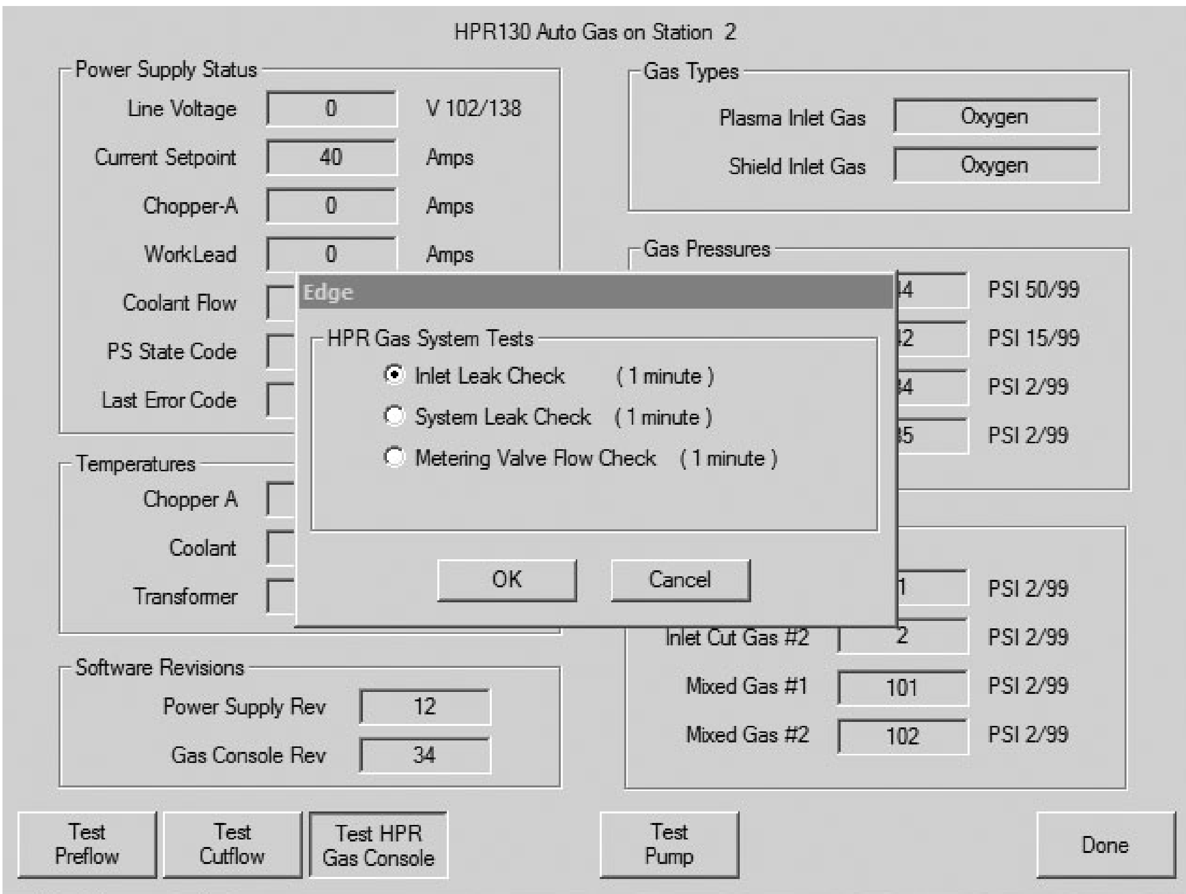
1. Turn ON the power.
2. Measure the VDC between TP210 and TP206.
   TP206 is common on PCB3. TP210 provides a filtered, 67% scaled, voltage from the flow switch. 0.45 VDC (0.67 VDC at the flow switch) equals 2.3 lpm (0.6 gpm). If the TP210 voltage reading is below 0.45 VDC and the flow is equal to or above 3.0 lpm (1 gpm), replace the flow switch.



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 16 of 20 on schematic 013362, 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 number1 failed) or 15 (cut gas channel number2 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 number1 failed) or 15 (cut gas channel number2 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 Burkett 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_2/O_2 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).

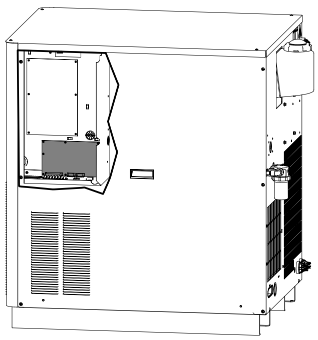
For the next part of the test, the Burkert valve that controls the plasma gas channel (B3) is closed, and the pressure is measured milliseconds later (pressure should decrease). The test is successful if the pressure is below a given limit (0.69 bar [10 psi]). The same test is repeated on the shield 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_2/O_2 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.

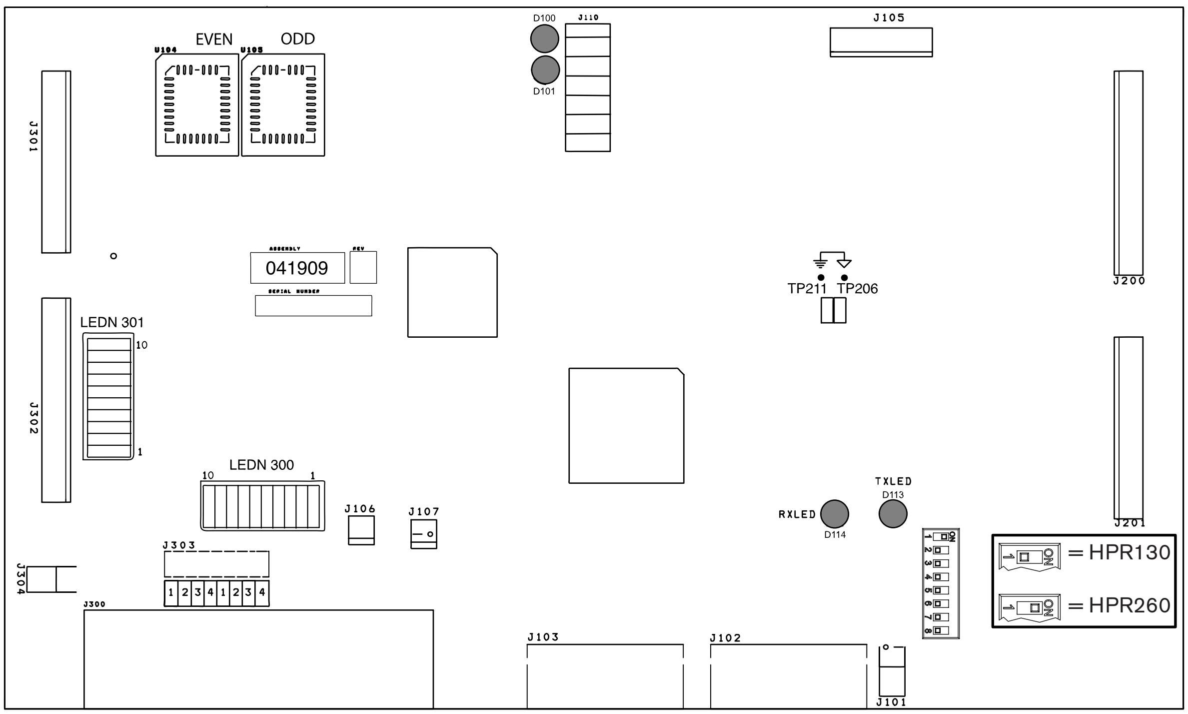
Power supply control board PCB3

Caution: Revision "J" software, or later, is required for the safe operation of the automatic gas console.



Control PC board LED list		
LED	Signal	Notes
D100	+5 VDC	
D101	+3.3 VDC	
D113	CAN TX	Constant blinking
D114	CAN RX	Constant blinking

Control PCB3 firmware list	
Item	Part number
U104	081107 EVEN
U105	081107 ODD

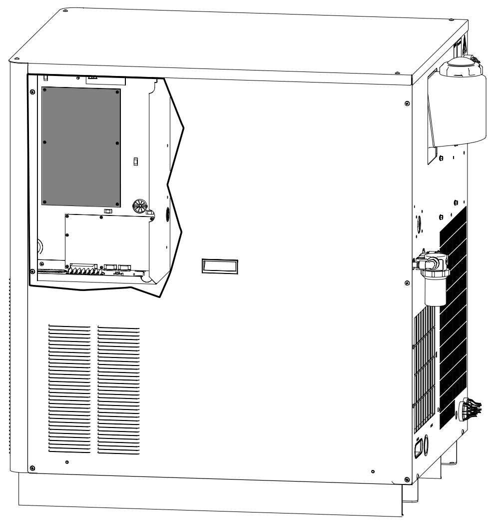


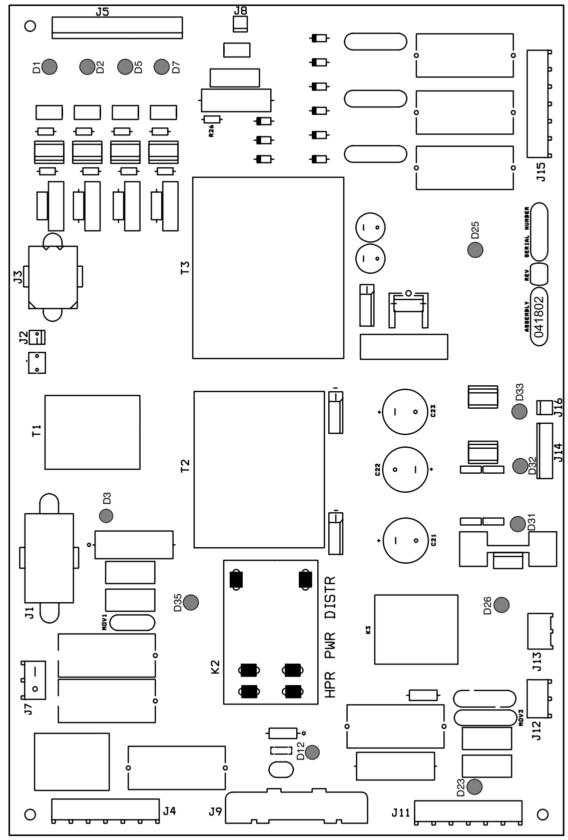
Note: see wiring diagrams for other dipswitch settings

Control PC Board LEDN300 List			
LEDN	Output	Input	Notes
LEDN1	Machine motion		
LEDN2	Error		
LEDN3	Ramp-down error		
LEDN4	Not ready		
LEDN5	Soft-start enable		Not used
LEDN6	Pilot arc enable		
LEDN7		Corner current	
LEDN8		Pierce	
LEDN9		Hold	
LEDN10		Plasma start	

Control PC Board LEDN301 List			
LEDN	Output	Input	Notes
LEDN1	HV transformer		
LEDN2	Pump motor enable		
LEDN3	Contactor		
LEDN4	Pilot arc relay		
LEDN5	Spare		
LEDN6	Surge select		
LEDN7			Not connected
LEDN8			Not connected
LEDN9			Not connected
LEDN10		Phase loss	

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

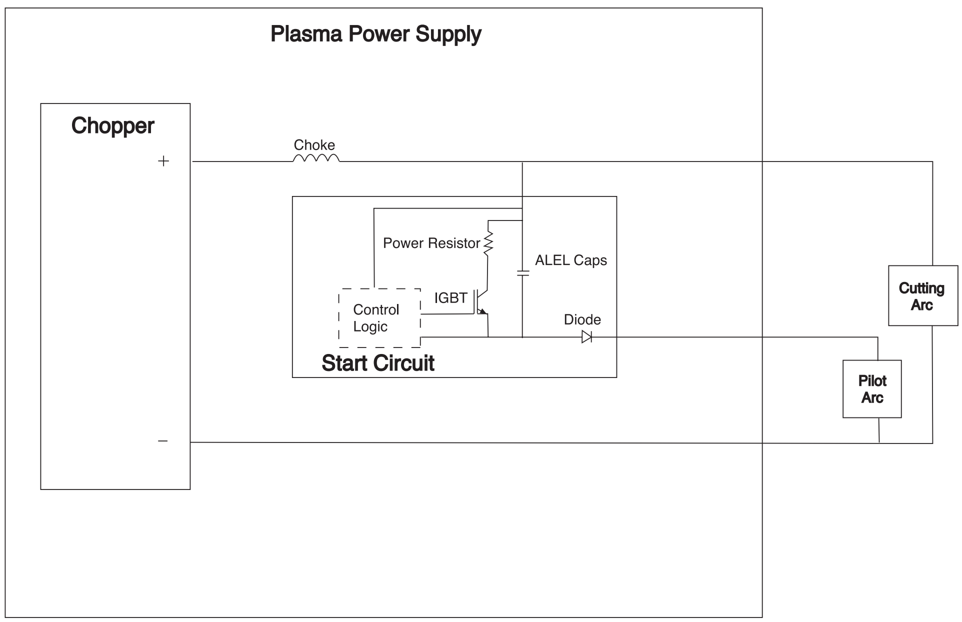
Operation

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.

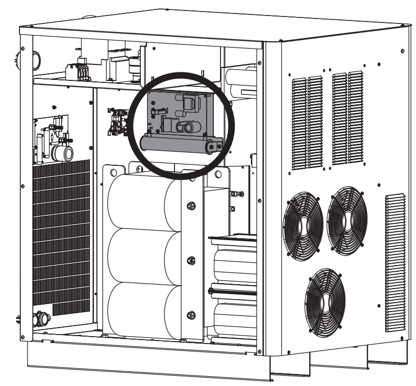
Start circuit functional schematic



Start circuit troubleshooting

DANGER

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

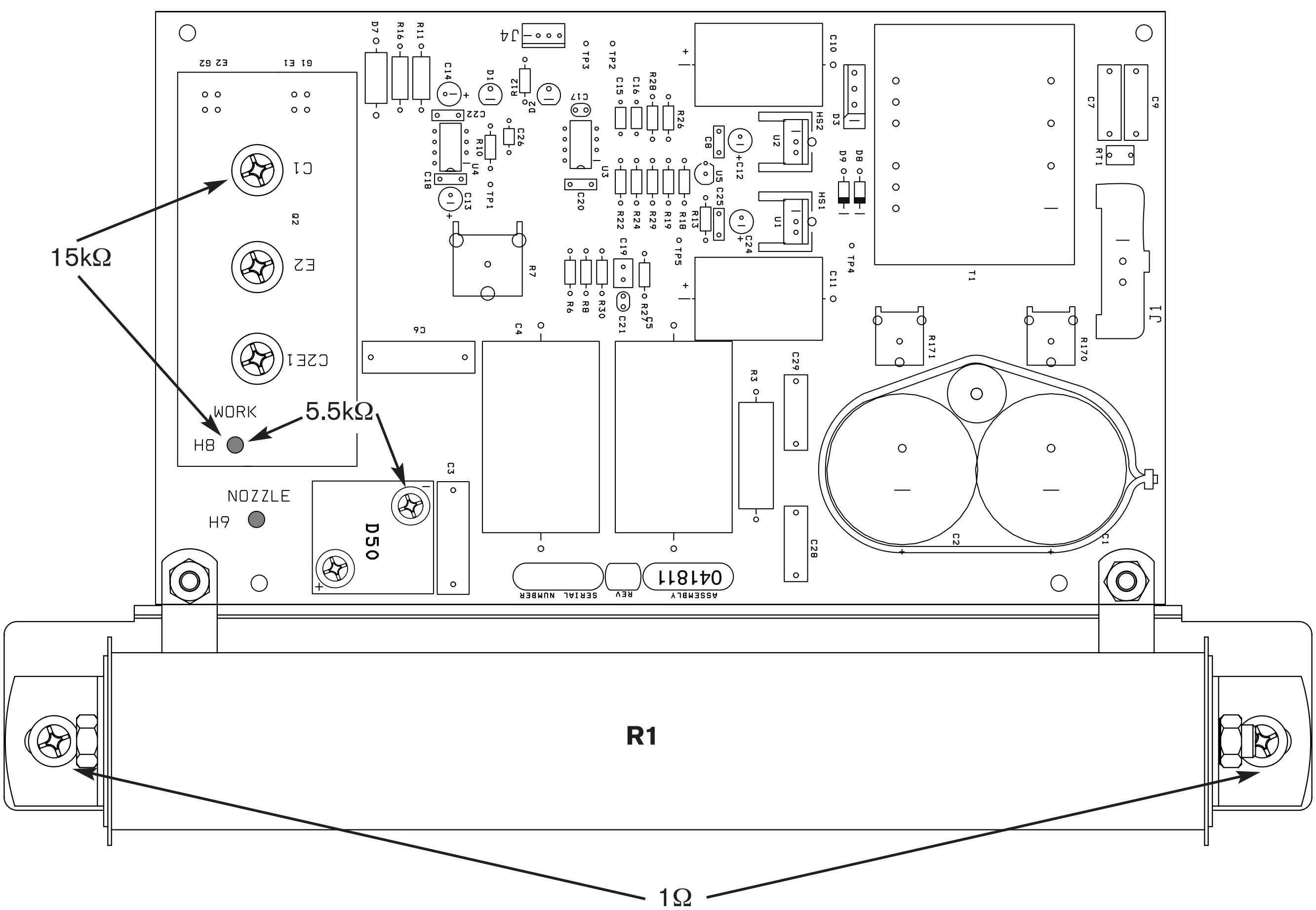


D2 should always be illuminated.

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 5.5 kΩ 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 15 kΩ between C1 and H8.
   - The work lead should not have any cuts or breaks. Verify a resistance of 1Ω 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 1 Ω across the R3 resistor.



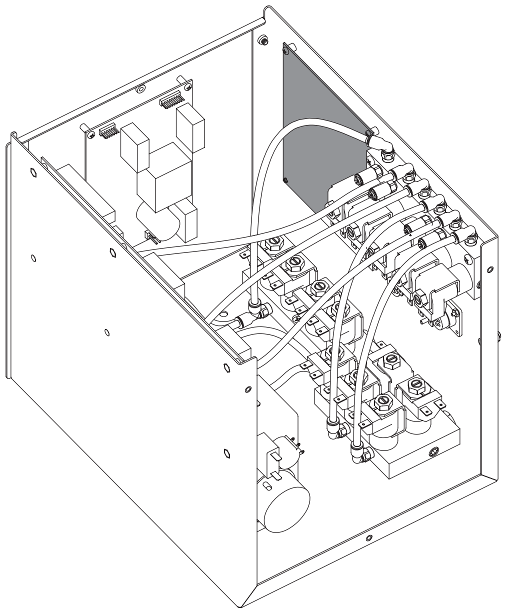
Pilot arc current levels

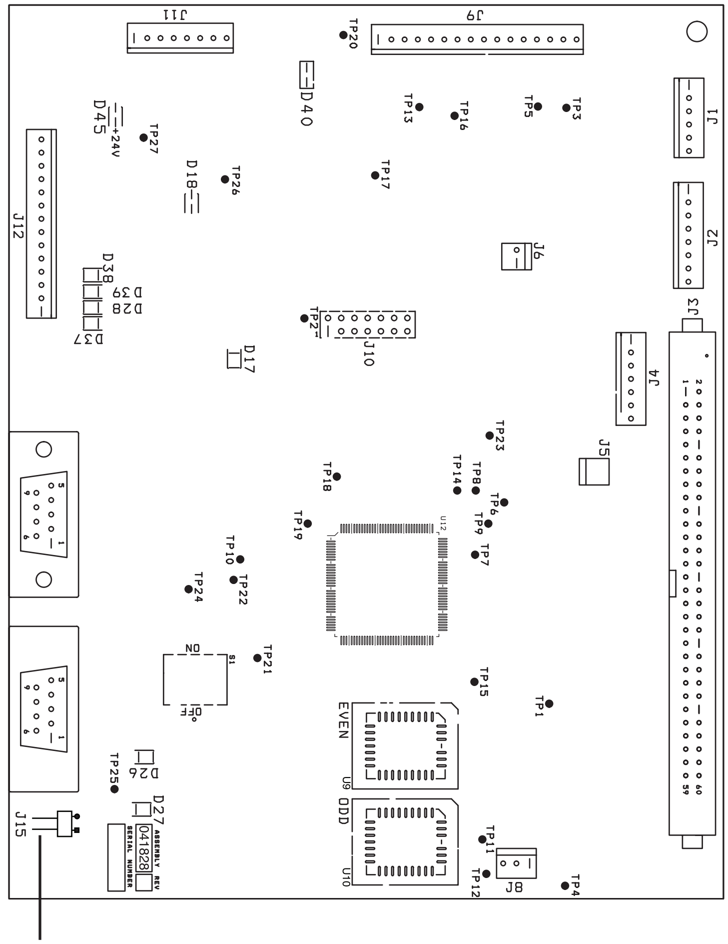
The pilot arc current level will vary according to the arc current selected, and the process. See table below.

Pilot arc current							
Plasma gas	30-amps	45-amps	50-amps	80-amps	130-amps	200-amps	260-amps
O_2	25	30	30	30	30	40	40
N_2	25	30	30	30	35	40	40
H35	25	30	30	30	35	40	40
F5	25	30	30	30	35	40	40
Air	25	30	30	30	35	40	40

Transfer current							
Plasma gas	30-amps	45-amps	50-amps	80-amps	130-amps	200-amps	260-amps
O_2	10	10	10	10	15	20	20
N_2	10	10	10	10	15	20	20
H35	10	10	10	10	15	20	20
F5	10	10	10	10	15	20	20
Air	10	10	10	10	15	20	20

Selection console control board PCB2



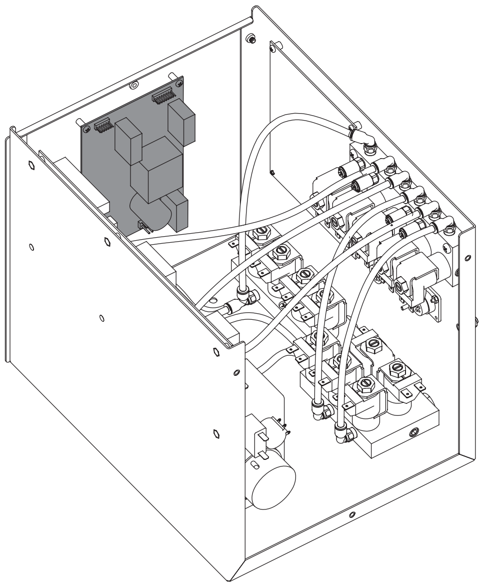


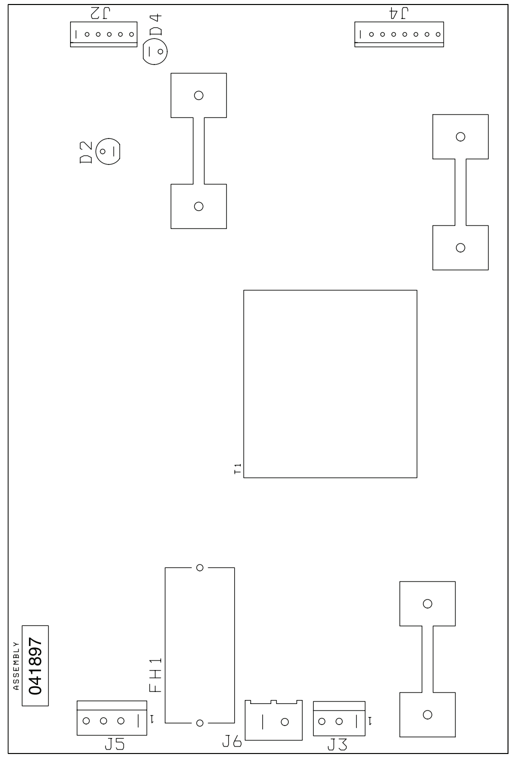
Note: CAN termination resistor. The jumper must be removed.

Control PCB2 firmware list	
Item	Part number
U9	081110 EVEN
U10	081110 ODD

Selection 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

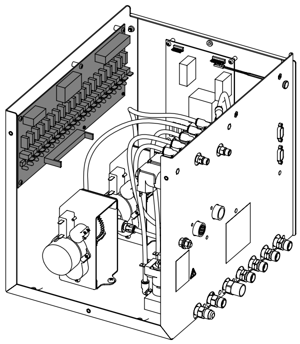
Selection console power distribution board PCB1

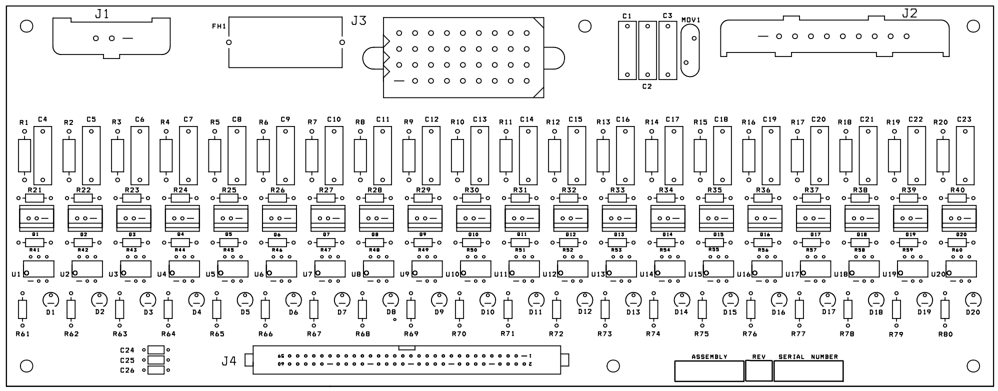




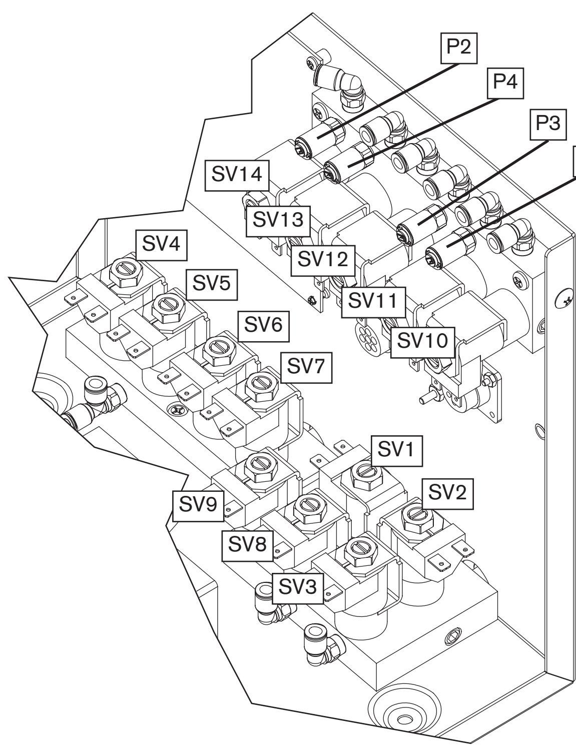
LED	Signal name	Color
D2	SV16	Red
D4	+ 5 VDC	Green

Selection console, AC valve-driver board PCB3

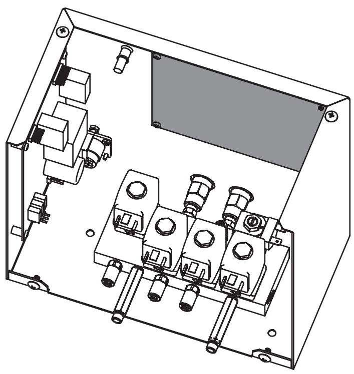


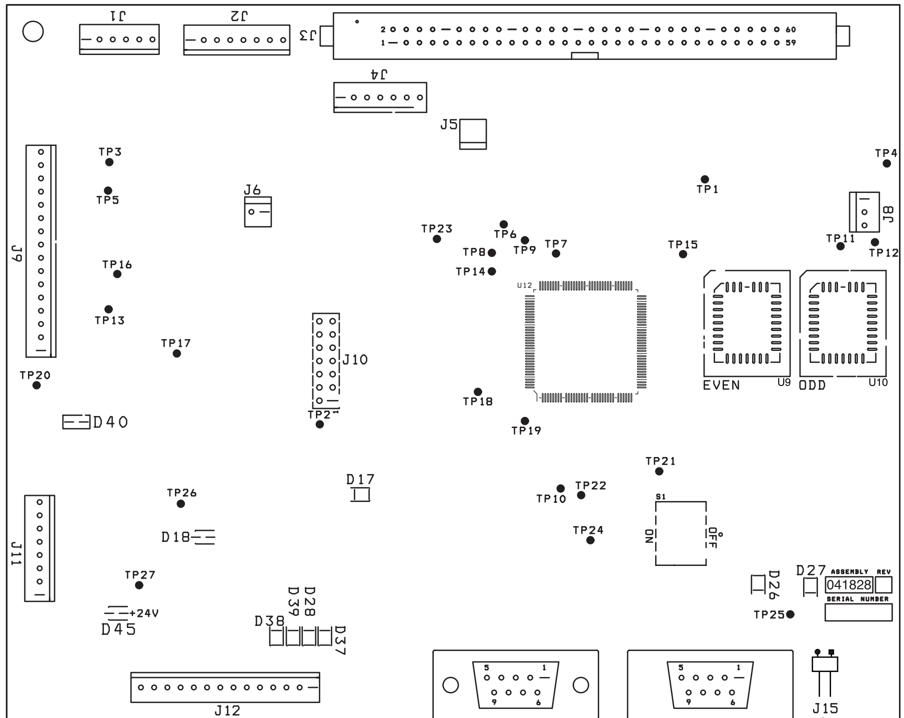


LED	Signal name	Color	LED	Signal name	Color
D1	SV1	Red	D11	SV11	Red
D2	SV2	Red	D12	SV12	Red
D3	SV3	Red	D13	SV13	Red
D4	SV4	Red	D14	SV14	Red
D5	SV5	Red	D15	Not used	Red
D6	SV6	Red	D16	Metering console vent solenoid	Red
D7	SV7	Red	D17	MV1 close	Red
D8	SV8	Red	D18	MV1 open	Red
D9	SV9	Red	D19	MV2 close	Red
D10	SV10	Red	D20	MV2 open	Red



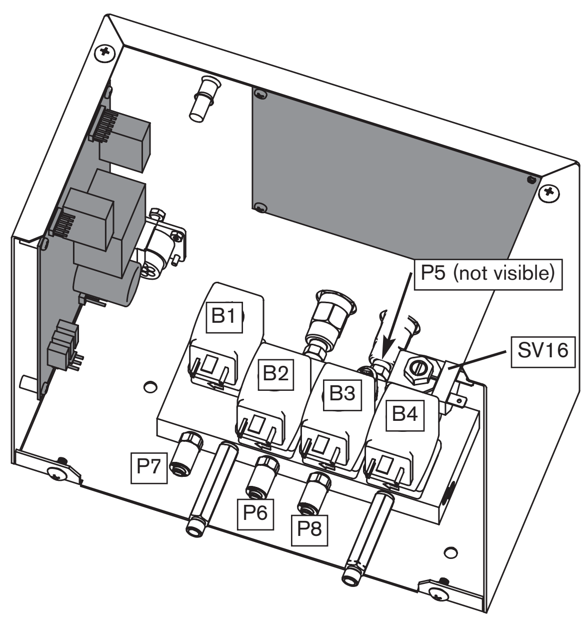
Metering console control board PCB2





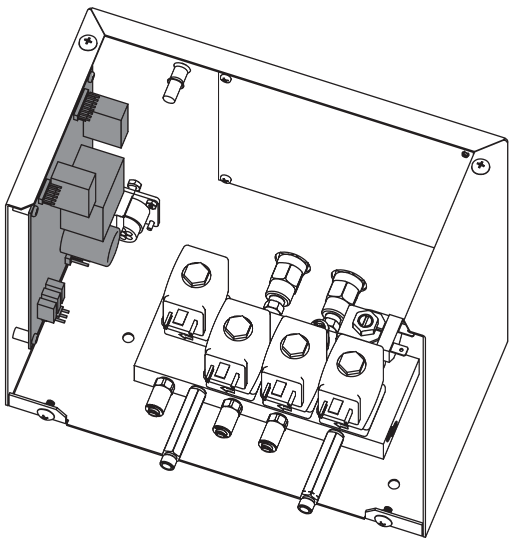
Note: CAN termination resistor. The jumper must be installed.

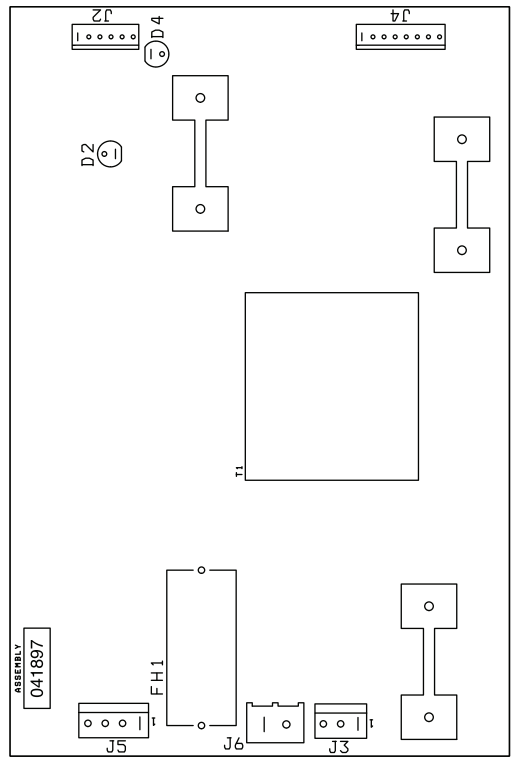
Control PCB2 firmware list	
Item	Part number
U9	081110 EVEN
U10	081110 ODD



Metering 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





LED	Signal name	Color
D2	SV16	Red
D4	+ 5 VDC	Green

Chopper tests

WARNING

SHOCK HAZARD: 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.

Automatic chopper and current sensor tests during power-up

Turn ON the system. When the preflow starts, the contactor will close and the system will automatically test the choppers and current sensors. The system closes the contactor and turns on chopper 1 at 90% duty cycle. The chopper will charge the surge capacitor on the I/O board (PCB 6). The current that charges the capacitor should be between 10 amps and 35 amps. Error code 105 will display on the CNC screen if the current is < 10 amps or there is no feedback on current sensor 1 (CS1). Error code 103 will display on the CNC screen if the current is > 35 amps.

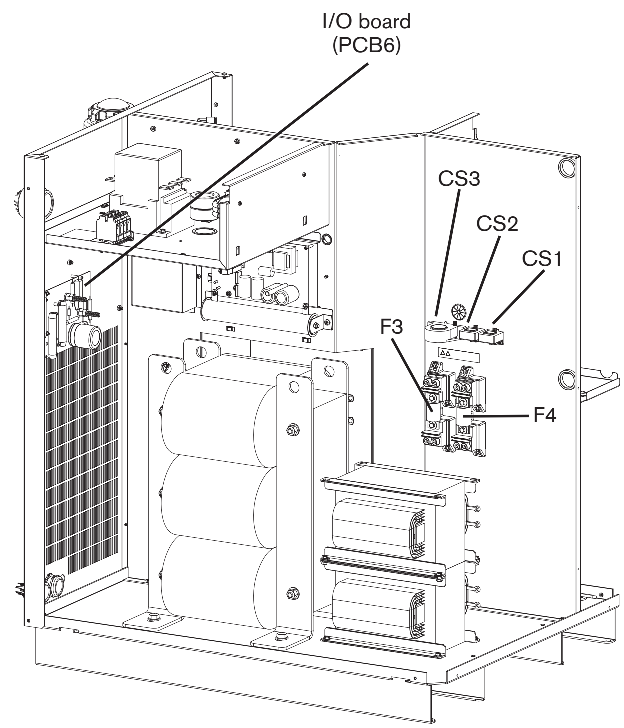
If chopper 1 passes the test, the system will repeat the test for chopper 2 and current sensor 2 (CS2). Error code 106 will display on the CNC screen if the current is < 10 amps. Error code 104 will display on the CNC screen if the current is > 35 amps.

Look at the error codes displayed on the CNC screen. If the error code shown is 003, the choppers and current sensors passed the test and no further tests are required.

If error code number 103, 104, 105, or 106 are displayed, continue with the tests below.

Troubleshooting low-current error code 105 and 106

1. Verify that the current sensors (CS1 and CS2) and cables are not damaged.
2. Exchange CS1 and CS2. Replace the faulty sensor if the error code is not displayed again.
3. Use a meter to measure the resistance between wire 38 and wire 39 on PCB6. The value should increase as the capacitor charges. Replace PCB6 if a constant value is seen.
4. Check for loose wires or shorts from the chopper to PCB6.
5. Check for 220 VAC to 1A, 1B, and 1C on the chopper when the contactor closes.
6. Verify that the fuses (F3 and F4) are in good working condition.



Troubleshooting high-current error codes 103 and 104

1. Verify that the current sensors (CS1 and CS2) and cables are not damaged.

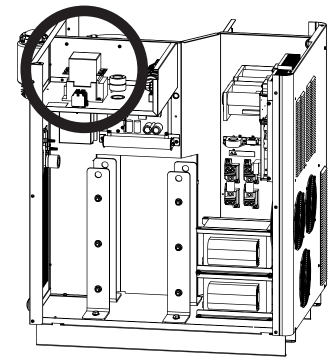
2. Exchange CS1 and CS2. Replace the faulty sensor if the error code is not displayed again.

3. Look at the surge capacitor to ensure that it is not short-circuited. Replace PCB6 if the surge capacitor is shorted.

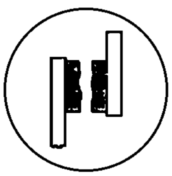
4. Check for short circuits from the work terminal to the negative terminal on PCB6. Resistance should be about 100K ohm from the work terminal to the negative terminal. Resistance will vary if you have a voltage divider for a height control system.

Phase-loss detection test

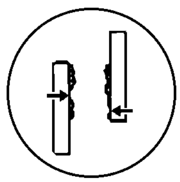
1. Turn OFF all power to the system and remove the cover from CON1.



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.

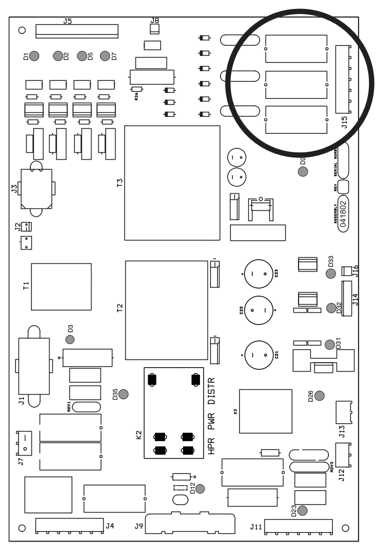


OK



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.



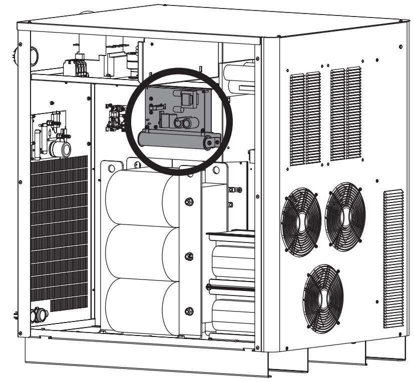
4. Remove J2.8 from PCB2 and place a jumper between pins 1 and 2 on the cable connector.
   a. Make a test cut. If the phase-loss error continues, verify wiring between J2.8 on PCB2 and J3.302 on PCB3 by verifying the continuity between
      – J2.8 pin1 to J3.302 pin14
      – J2.8 pin2 to J3.302 pin15.
   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.

DANGER

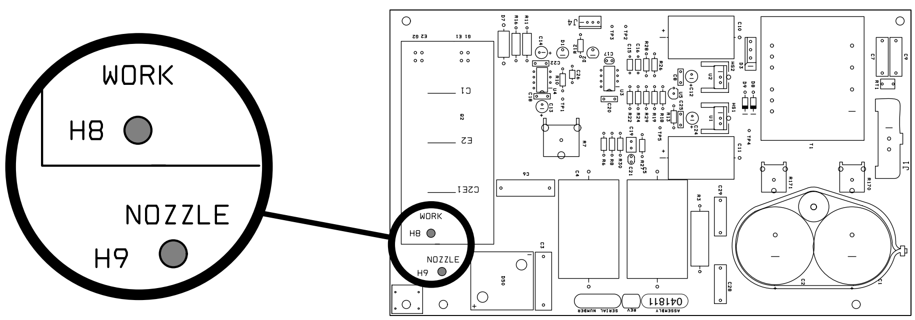
SHOCK HAZARD: Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

Torch lead test

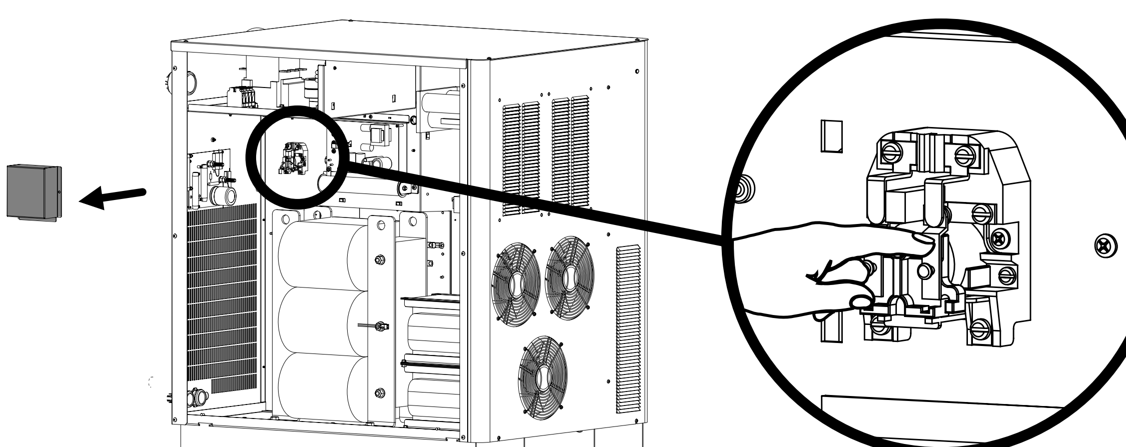
1. Turn OFF all power to the system.
2. Locate the start-circuit assembly.



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

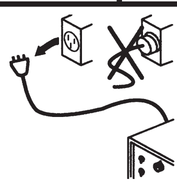
The following protocol covers the basic elements of all Hypertherm HyPerformance plasma systems.

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

DANGER

ELECTRIC SHOCK CAN KILL



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 or national safety procedures.

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 power supply. 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 power supply;

   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.

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^2 (#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	1st Service	2nd Service

- Replace service parts per the Service Part Replacement Schedule.

Annually:

Year									

- Replace service parts per the Service Part Replacement Schedule.

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 tests
  - 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:

____

____

____

____

____

Preventive maintenance performed by: ______________________________ **Date:** ______________

Service parts replacement schedule – 1 of 2

228016 – annual preventive maintenance parts kit
This kit includes all the parts in the shaded boxes below

Timeline	Component	Part number	Qty.
6 months or 300 arc hours	Coolant filter element Coolant solution 70/30 Torch kit Quick-disconnect kit	027664 028872 128879 128880	1 4 1 1
1 Year or 600 arc hours	Coolant filter element Coolant solution 70/30 Main contactor Torch main body Pilot arc relay	027664 028872 003217 220162 003149	1 4 1 1 1
1.5 Years or 900 arc hours+	Coolant filter element Coolant solution 70/30 Torch kit Quick-disconnect kit	027664 028872 128879 128880	1 4 1 1
2 Years or 1200 arc hours	Coolant filter element Coolant solution 70/30 Main contactor Torch main body Pilot arc relay Coolant pump kit Torch leads	027664 028872 003217 220162 003149 228171 System dependent	1 4 1 1 1 1 1
2.5 Years or 1500 arc hours	Coolant filter element Coolant solution 70/30 Torch kit Quick-disconnect kit	027664 028872 128879 128880	1 4 1 1
3 Years or 1800 arc hours	Coolant filter element Coolant solution 70/30 Main contactor Torch main body Pilot arc relay Cooling fan 6" Cooling fan 10"	027664 028872 003217 220162 003149 127039 027079	1 4 1 1 1 4 3
3.5 Years or 2100 arc hours	Coolant filter element Coolant solution 70/30 Torch kit Quick-disconnect kit	027664 028872 128879 128880	1 4 1 1
4 Years or 2400 arc hours	Coolant filter element Coolant solution 70/30 Main contactor Torch main body Pilot arc relay Coolant pump kit Torch leads Coolant pump motor kit	027664 028872 003217 220162 003149 228171 System dependent 128385	1 4 1 1 1 1 1 1
4.5 Years or 2700 arc hours	Coolant filter element Coolant solution 70/30 Torch kit Quick-disconnect kit	027664 028872 128879 128880	1 4 1 1

Service parts replacement schedule – 2 of 2

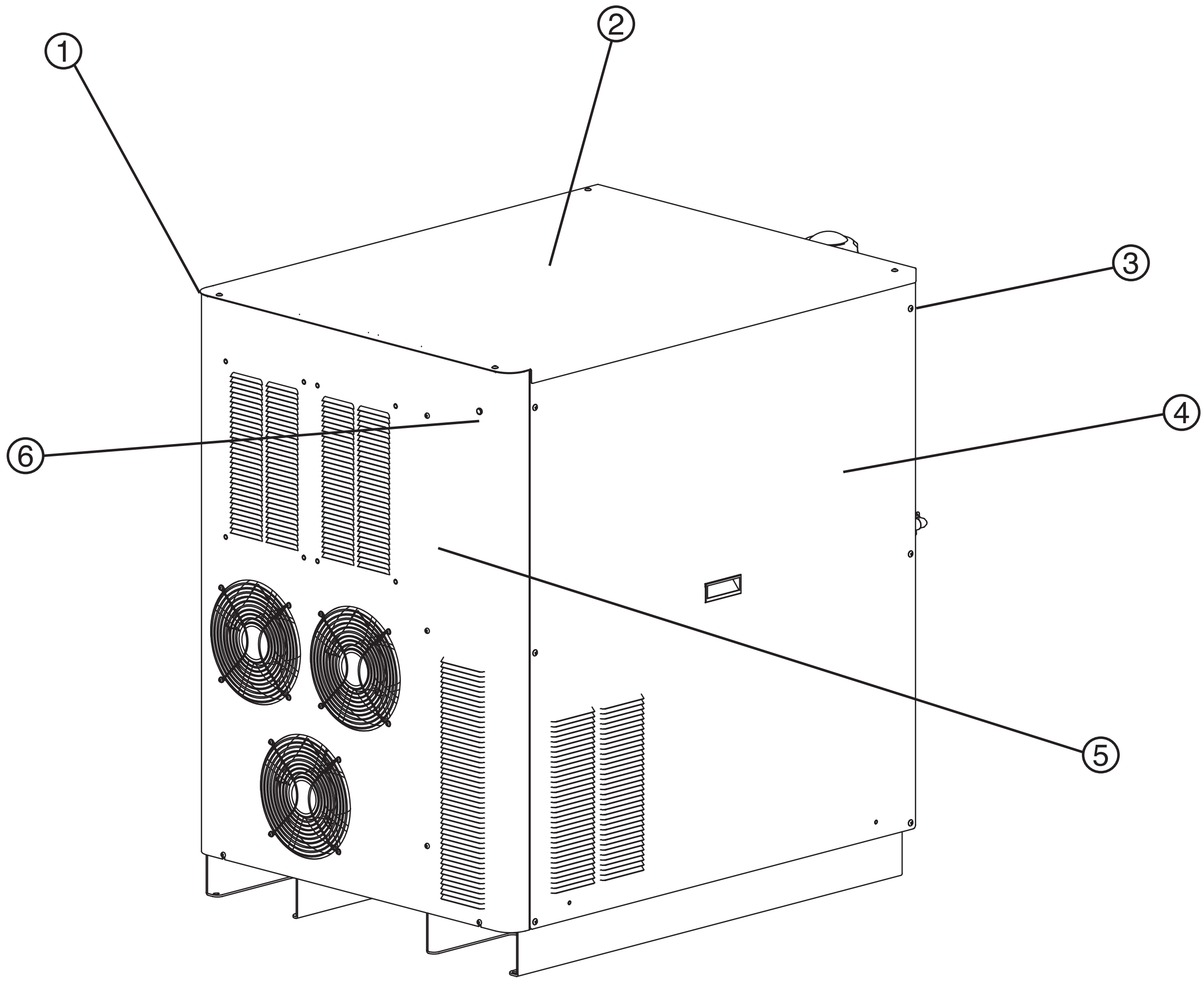
Timeline	Component	Part number	Qty.
5 Years or 3000 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Main contactor	003217	1
	Torch main body	220162	1
	Pilot arc relay	003149	1
	High voltage transformer	129854	1
	Power distribution board	041802	1
	Metering console	078184	1
	Pilot arc lead	System dependent	1
	Gas leads	System dependent	1
5.5 Years or 3300 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
6 Years or 3600 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Main contactor	003217	1
	Torch main body	220162	1
	Pilot arc relay	003149	1
	Coolant pump kit	228171	1
	Torch leads	System dependent	1
	Cooling fan 6"	127039	4
	Cooling fan 10"	027079	3
6.5 Years or 3900 arc hours	Repeat schedule starting at 6 months or 300 arc hours		

Section 6

PARTS LIST

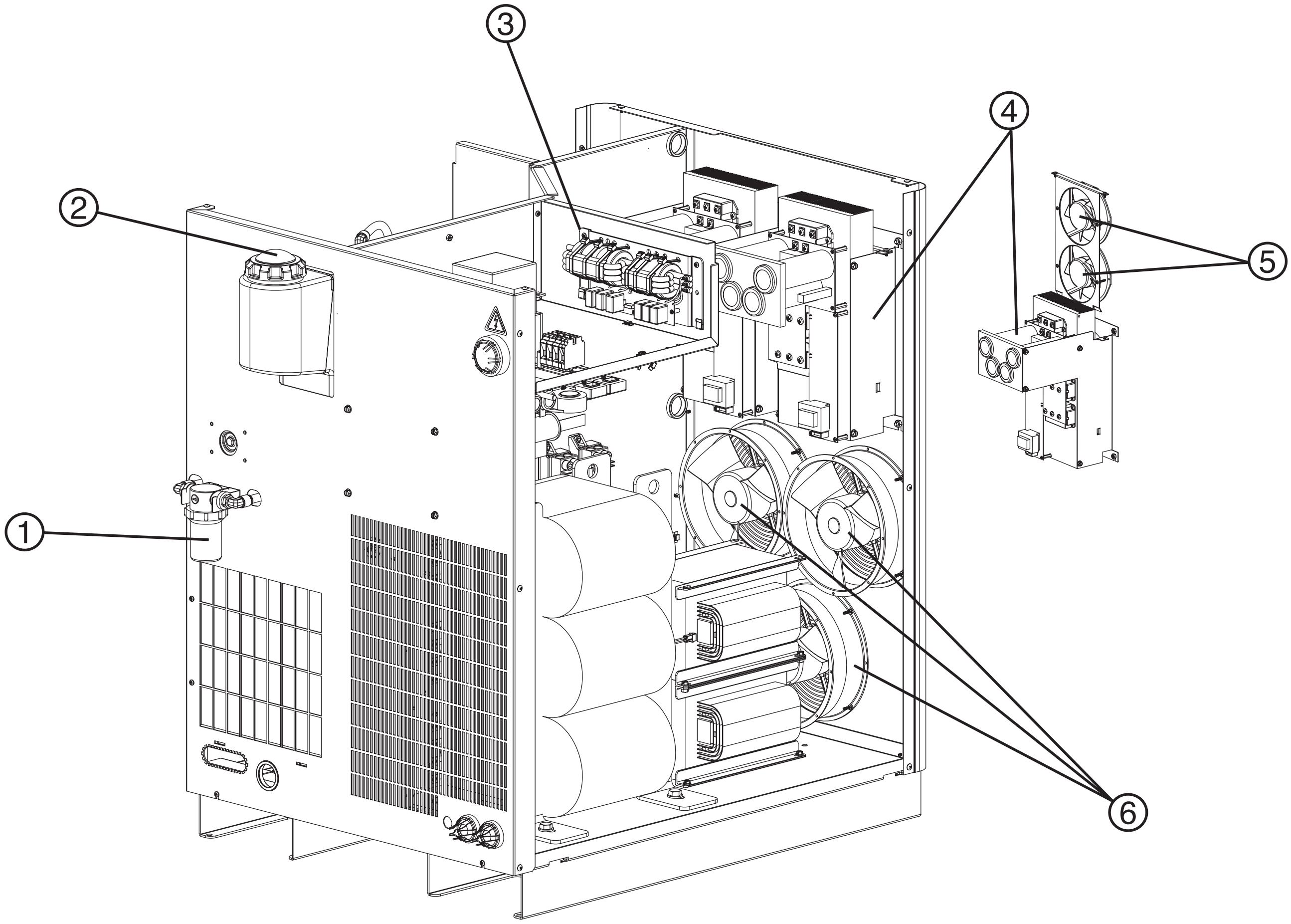
In this section:

Power supply



Item	Part Number	Description	Designator	Qty.
1	078187	HyPerformance Plasma power supply: 200/208 volt		
	078202	HyPerformance Plasma power supply: 220 volt		
	078188	HyPerformance Plasma power supply: 240 volt		
	078192	HyPerformance Plasma power supply: 380 volt		
	078186	HyPerformance Plasma power supply: 400 volt		
	078190	HyPerformance Plasma power supply: 480 volt		
	078189	HyPerformance Plasma power supply: 440 volt		
	078191	HyPerformance Plasma power supply: 600 volt		
2	228332	Panel: top, with lable		1
3	075241	Sheet metal screws		1
4	228334	Panel: right or left side, with lable		1
5	228333	Panel: front, with lable		1
6	129633	Green power lamp assembly		1

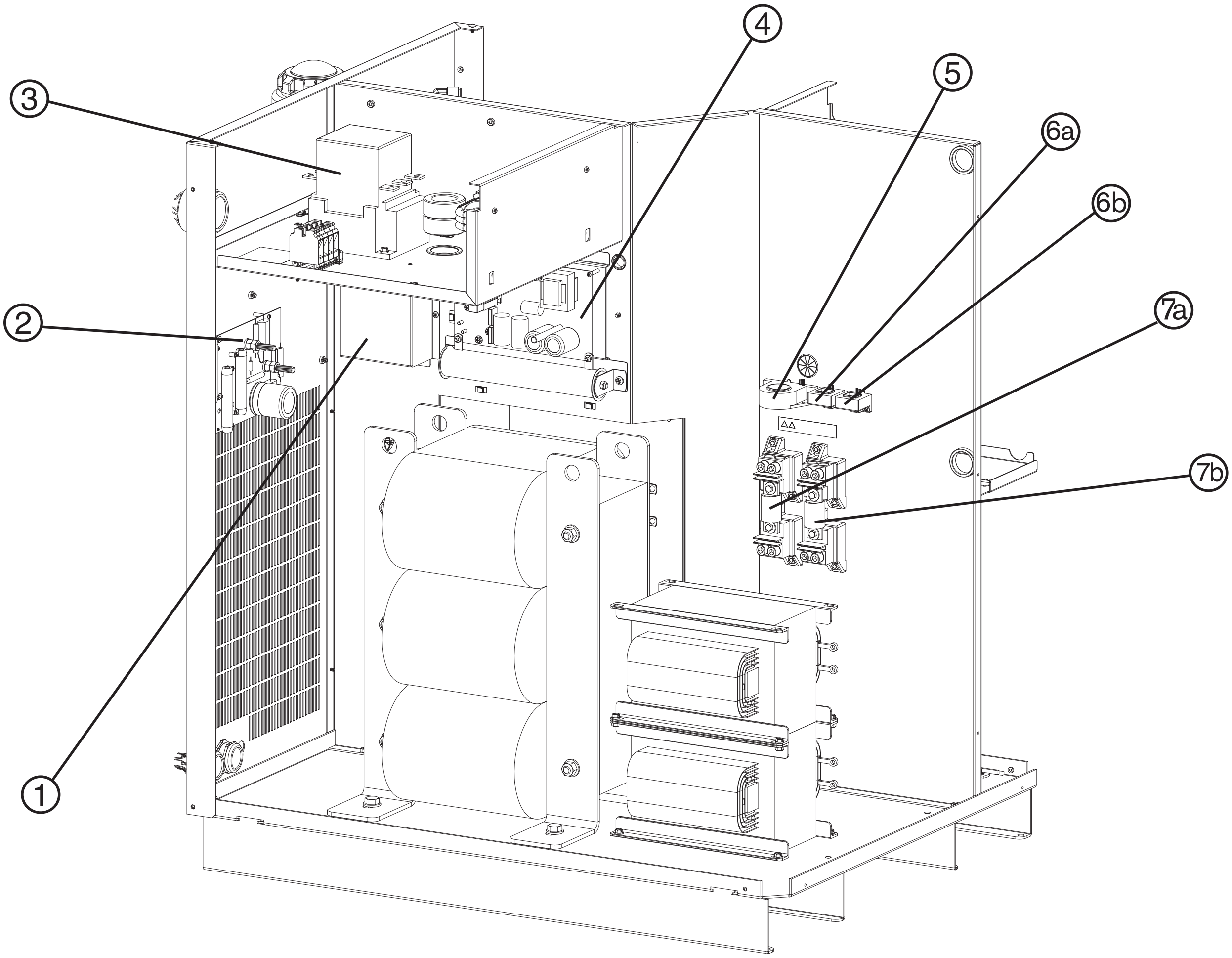
Power supply



Item	Part Number	Description	Designator	Qty.
1	027634	Filter housing		1
	027664	Filter element		1
2	127014	Cap: coolant reservoir		1
3	229034*	EMI filter: 80 amp, 50-60 HZ		1
4	129792	Chopper assembly	CH1, CH2	2
5	127039	6" fan :230 CFM, 115 VAC 50-60 HZ		2
6	027079	10" fan :450-550 CFM, 120 VAC 50-60 HZ		3

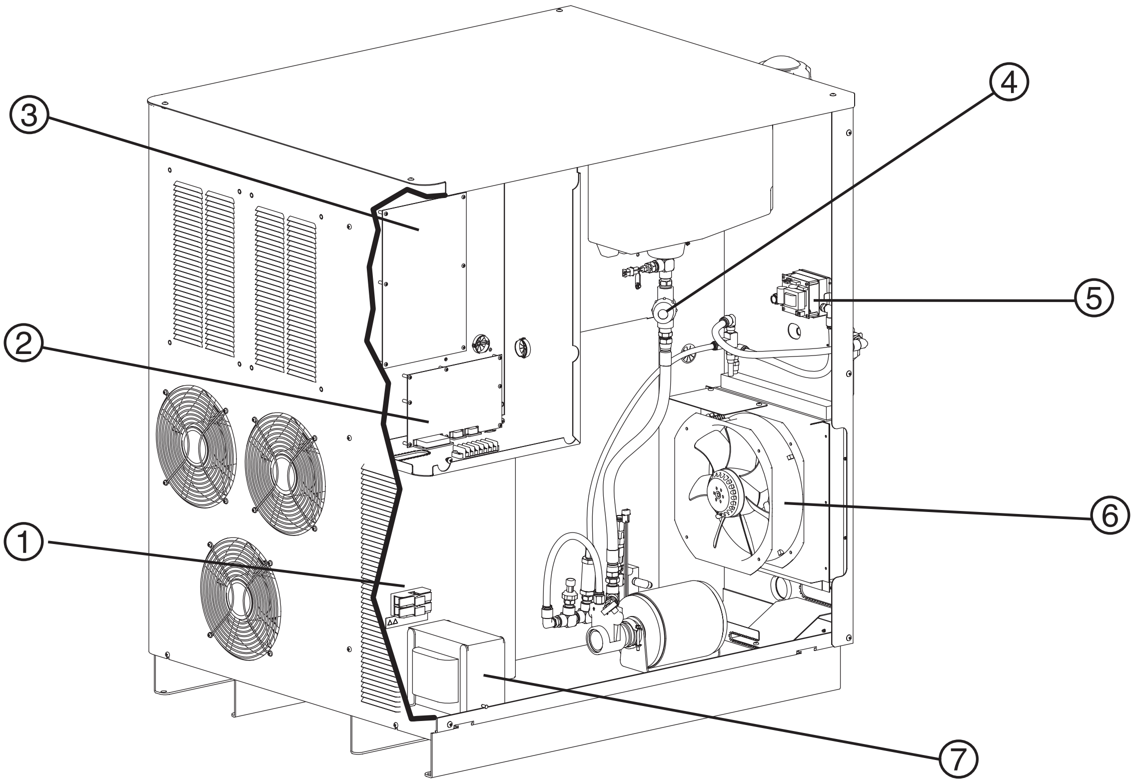
* 400 volt power supply only

Power supply



Item	Part Number	Description	Designator	Qty.
1	003149	Relay: pilot arc, 120 VAC	CR1	1
2	041837	PCB: I/O	PCB6	1
3	003217	Contactor	CON1	1
4	129791	Start circuit assembly	PCB1	1
5	109483	Current sensor: hall 200 amp, 4 volt	CS3	1
6a	109004	Current sensor: hall 100 amp, 4 volt	CS2	1
6b	109004	Current sensor: hall 100 amp, 4 volt	CS1	1
7a	108263	Fuse: 175 amp, 250 volt	F3	1
7b	108263	Fuse: 175 amp, 250 volt	F4	1

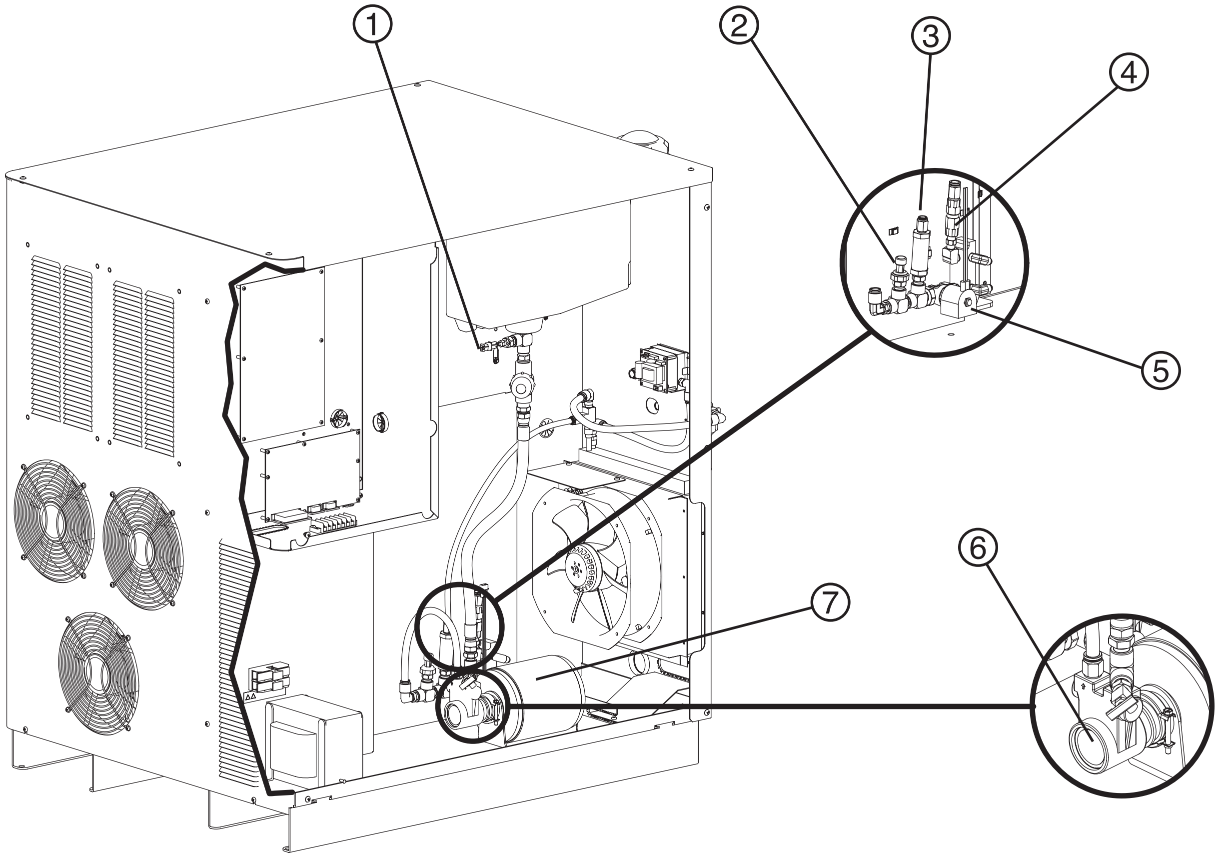
Power supply



Item	Part Number	Description	Designator	Qty.
1	008551*	Fuse: 7.5 amp, 600 volt	F1, F2	2
	008709**	Fuse: 20 amp, 500 volt	F1, F2	2
2	041909	Control PCB	PCB3	1
3	041802	Power distribution PCB	PCB2	1
4	027926	Filter assembly: 1/2" NPT low profile		1
5	129793	Flow switch assembly	FLS	1
6	229066	Heat exchanger assembly		1
7	129786	Control transformer: 200/208 volt, 50-60 HZ	T2	1
	229117	Control transformer: 220 volt, 50-60 HZ		1
	129966	Control transformer: 240 volt, 60 HZ		1
	129787	Control transformer: 380/400 volt, 50-60 HZ		1
	229013	Control transformer: 440 volt, 50-60 HZ		1
	129967	Control transformer: 480 volt, 50-60 HZ		1
	129989	Control transformer: 600 volt, 50-60 HZ		1

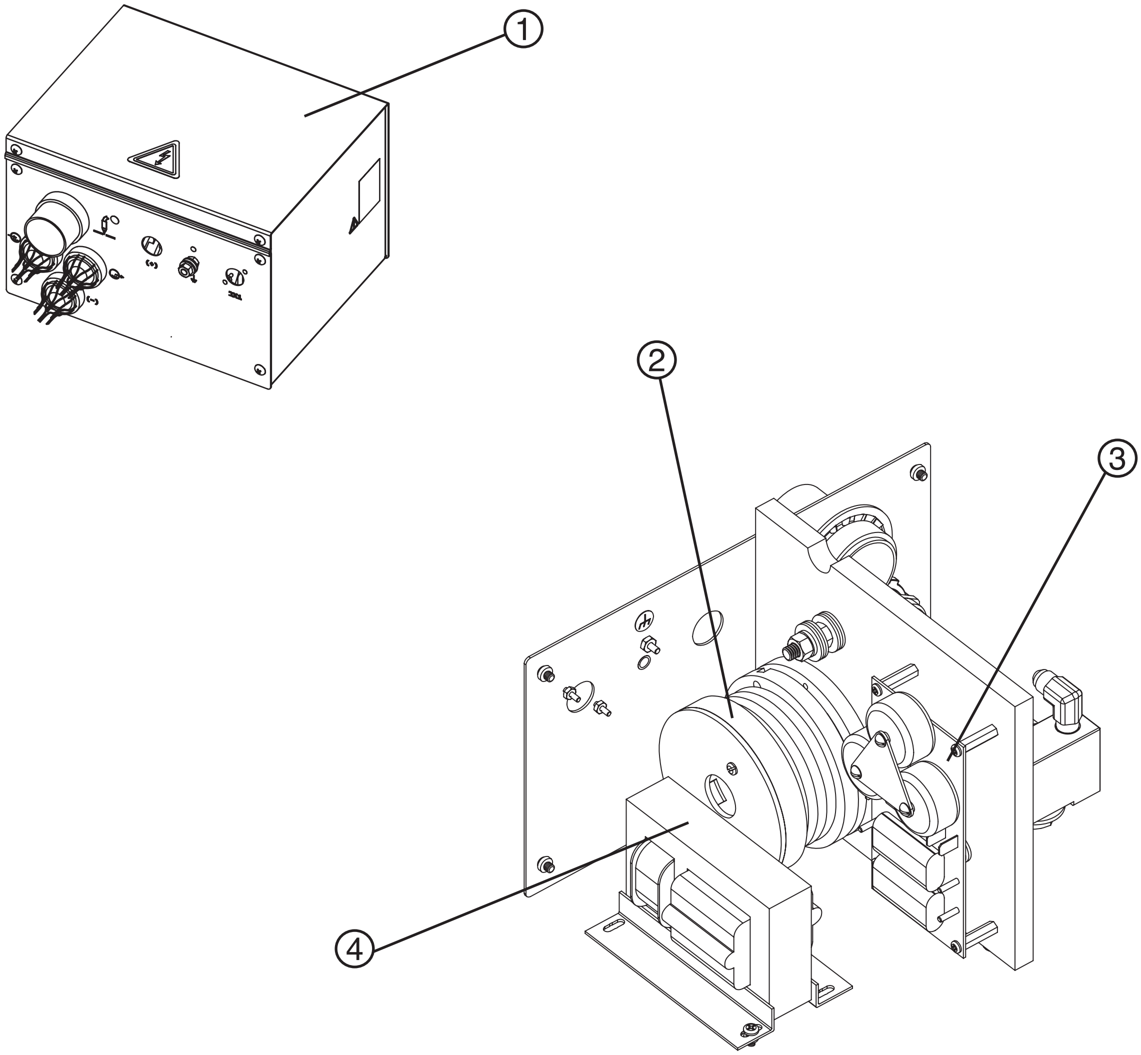
*380, 400, 440, 480 and 600 volt power supplies
**200/208, 220 and 240 volt power supplies

Power supply



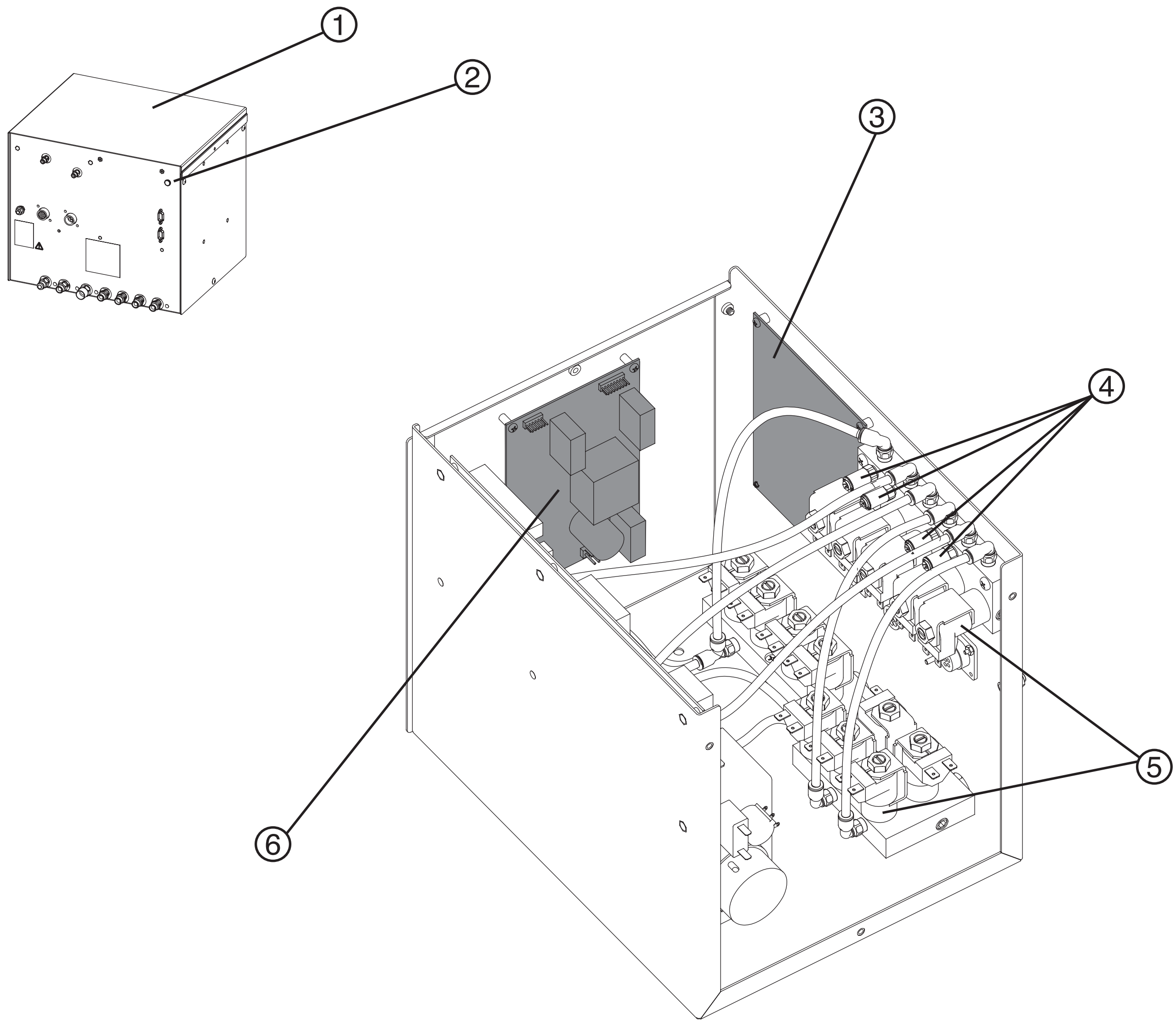
Item	Part Number	Description	Designator	Qty.
1	109393	Temperature sensor	T2	1
2	109524	Pressure transducer	PT1	1
3	006132	Check valve (relief valve): 1/4" NPT, 200 psi		1
4	006075	Check valve: 1/4" FPT		1
5	006046	Solenoid valve assembly: 3/8", 240 volt	CLT SOL	1
6	228171	Kit: Pump with clamp		1
7	228230	Kit: Motor with clamp		1

Ignition console



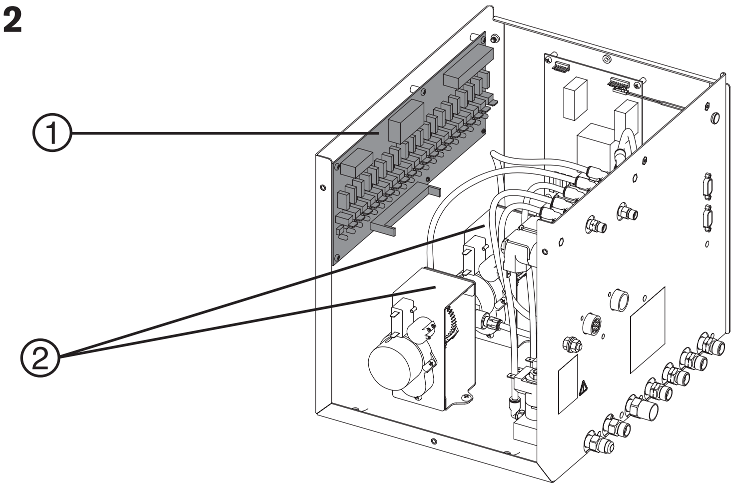
Item	Part Number	Description	Designator	Qty.
1	**078172**	**Ignition Console**		
2	129831	Coil assembly	T2	1
3	041817	HFHV Ignition PCB	PCB IGN	1
4	129854	Transformer	T1	1

Selection console – 1 of 2



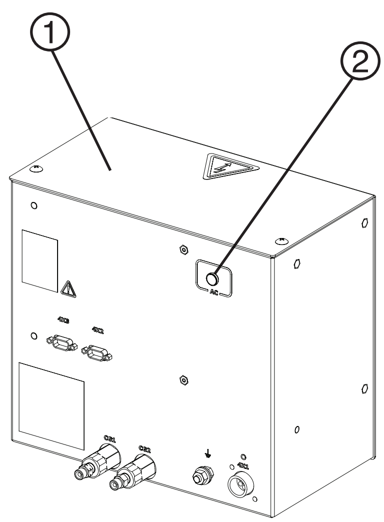
Item	Part Number	Description	Designator	Qty.
1	**078185**	**Selection console**		
2	129633	Green power lamp		1
3	228069	Kit: Control PCB	PCB2	1
4	005263	Pressure sensor	P1-P4	4
5	006109	Solenoid valve	SV1-SV14	14
	006112	Replacement solenoid coil		
6	041897	Power distribution PCB	PCB1	1

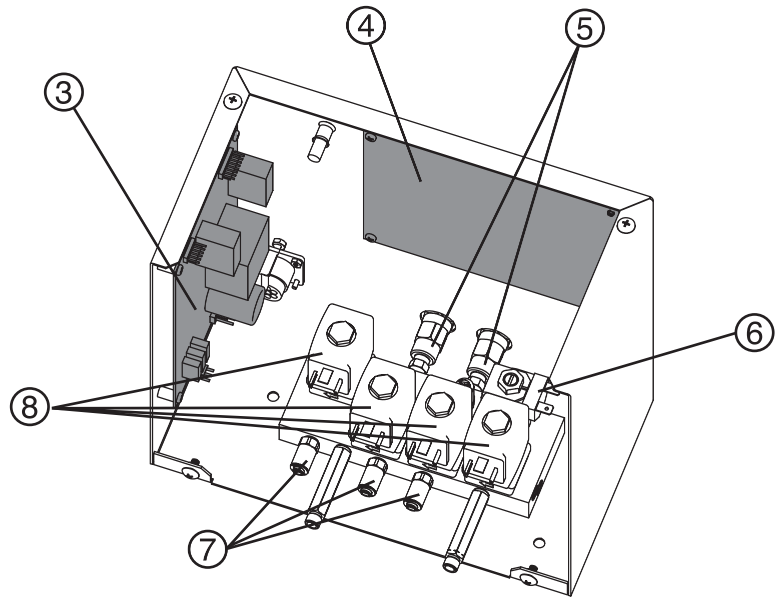
Selection console – 2 of 2



Item	Part Number	Description	Designator	Qty.
1	041822	Valve driver PCB	PCB3	1
2	129999	Motor valve assembly	MV1, MV2	2

Metering console



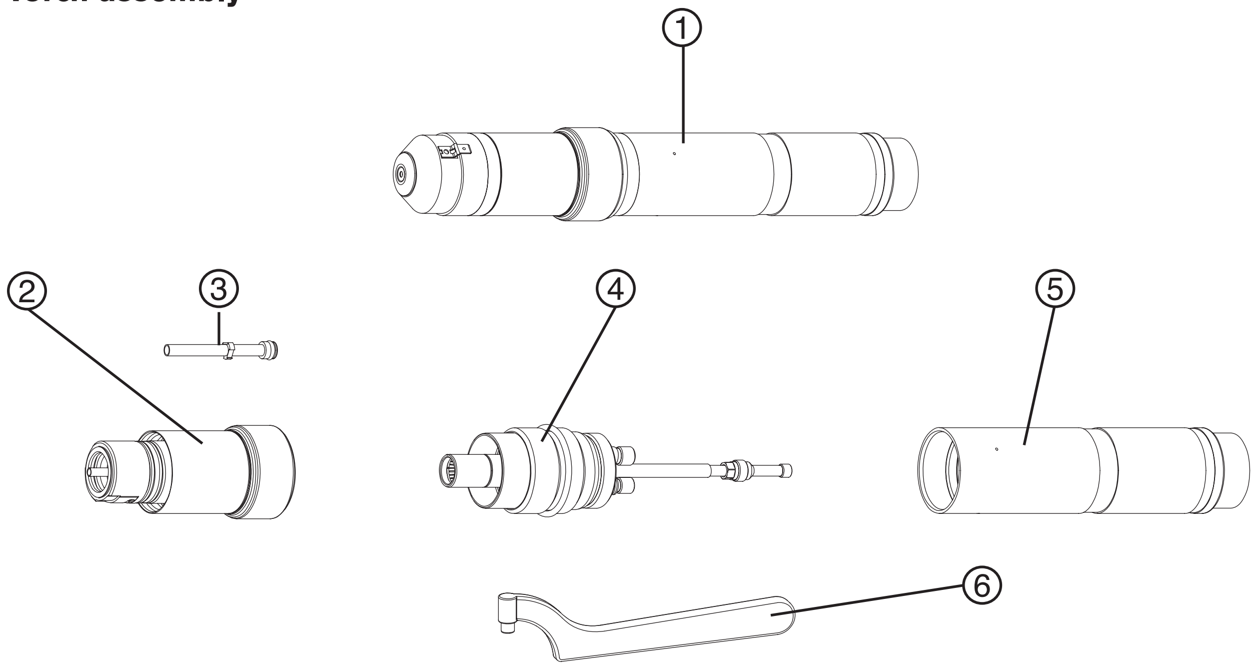


Item	Part Number	Description	Designator	Qty.
1	**078184**	**Metering console**		**1**
2	129633	Green power lamp		1
3	041897	Power distribution PCB	PCB1	1
4	228069	Kit: Control PCB	PCB2	1
5	006077	Check valves		2
6	006109	Solenoid valve	SV16	1
	006112	Replacement solenoid coil		
7	005263	Pressure transducer (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

HyPerformance torch

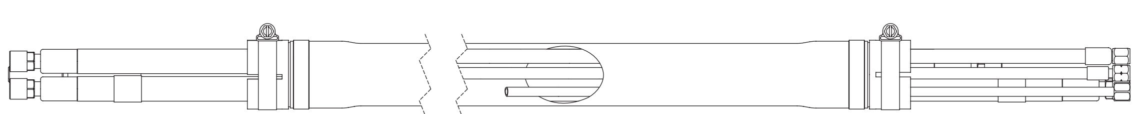
Torch assembly



Item	Part Number	Description
1	**128818**	**HPR machine torch assembly**
2	220162	Quick-disconnect torch
3	220340	Water tube
4	220163	Quick-disconnect receptacle
5	220232	Torch mounting sleeve assembly
6	104269	2” spanner wrench
	128879	Torch kit: bullet plugs, o-rings, water tube and seal
	128880	Quick disconnect kit: o-ring and connector

See *Appendix D* of this manual for bevel cutting part numbers.

Torch leads



Part Number	Description
128986	2 m (6 ft)
128935	3 m (10 ft)
128934	4.5 m (15 ft)
128784	7.5 m (25 ft)
128987	10 m (35 ft)
128785	15 m (50 ft)
128988	20 m (65 ft)

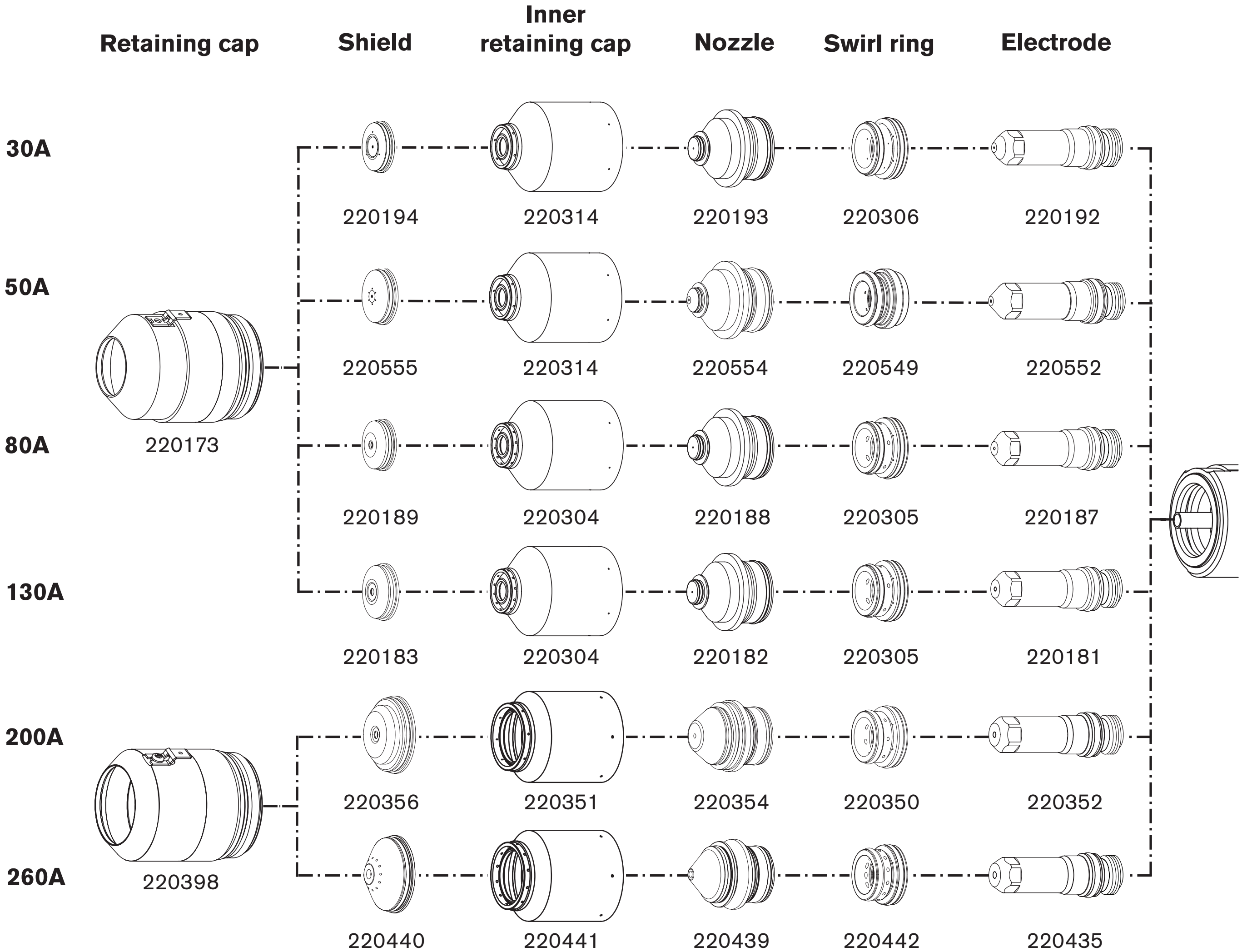
Consumable parts kit – 228027 (also includes HPR130 kit number 128878)

Note: See *Consumable selection* or *Cut charts* for specific applications

Part Number	Description	Qty.
220307	Electrode	4
220342	Swirl ring	2
220343	Nozzle	2
220344	Inner retaining cap	1
220345	Shield	2
220346	Nozzle	1
220347	Inner retaining cap	1
220352	Electrode	3
220353	Swirl ring	1
220354	Nozzle	3
220355	Inner retaining cap	1
220356	Shield	2
220398	Retaining cap with IHS tab	1
220405	Swirl ring	2
220406	Nozzle	4
220407	Shield	1
220433	Inner retaining cap	1
220435	Electrode	3
220436	Swirl ring	1
220439	Nozzle	3
220440	Shield	2
128878	**HPR130 consumable starter kit**	1
004630	Electrode gauge assembly	1
026009	O-ring: .208" X .070"	5
027055	Lubricant: silicone 1/4-oz tube	1
044028	O-ring: 1.364" X .070"	2
104119	Tool: consumable removal / replacement	1
104269	Wrench: spanner	1
220173	Retaining cap with IHS tab	1
220176	Inner retaining cap	2
220179	Swirl ring	1
220180	Swirl ring	1
220181	Electrode	3
220182	Nozzle	3
220183	Shield	2
220187	Electrode	3
220188	Nozzle	3
220189	Shield	2
220192	Electrode	2
220193	Nozzle	2
220194	Shield	1
220197	Nozzle	2
220198	Shield	1
220201	Nozzle	2
220202	Shield	1
220304	Inner retaining cap	1
220307	Electrode	2
220308	Electrode	2
220313	Inner retaining cap	1
220337	Nozzle	2
220338	Shield	1
220339	Electrode	2
220340	Water tube with o-ring	1

Consumables for mirror-image cutting

Mild steel



Recommended spare parts

Power supply

Part Number	Description	Designator	Qty.
129633	Green power lamp assembly		1
027634	Filter housing		1
027664	Filter element		1
129792	Chopper assembly	CH1	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
041837	PCB: I/O		1
003217	Contactor	CON1	1
109004	Current sensor: hall 100 amp, 4 volt		1
129791	Start circuit assembly	PCB1	1
108263	Fuse: 175 amp, 250 volt	F3, F4	2
008551*	Fuse: 7.5 amp, 600 volt	F1, F2	2
041909	Control PCB	PCB3	1
041802	Power distribution PCB	PCB2	1
129793	Flow switch assembly	FLS	1
006075	Check valve: 1/4" FPT		1
129995	Solenoid valve assembly	CLT SOL	1
129994	Pump assembly: 70 gpm, 200 psi		1
031113	Motor: 1/3 HP, 240 volt, 50-60 HZ		1

* 400, 480 and 600 volt power supplies

Ignition console

Part Number	Description	Designator	Qty.
041817	HFHV Ignition PCB		1
129854	Transformer	T1	1

Selection and metering consoles

Part Number	Description	Designator	Qty.
041828	Control PCB		1
041897	Power distribution PCB		1
041822	Valve driver PCB		1
006109	Solenoid valve		2
005263	Pressure sensor		1

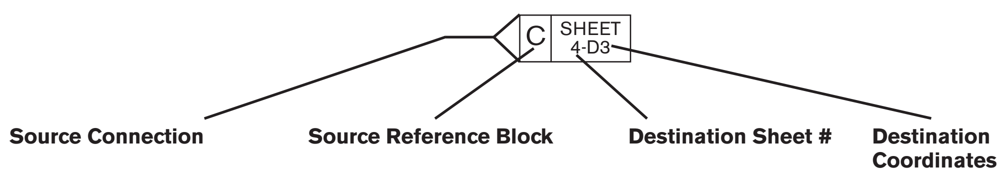
Section 7

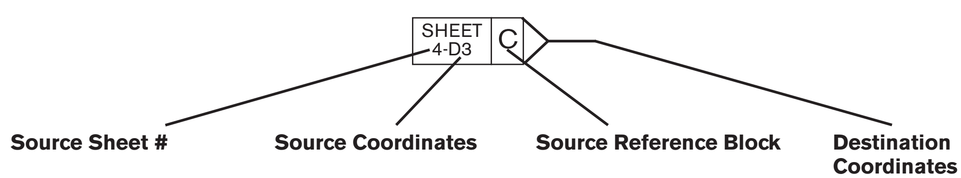
WIRING DIAGRAMS

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:

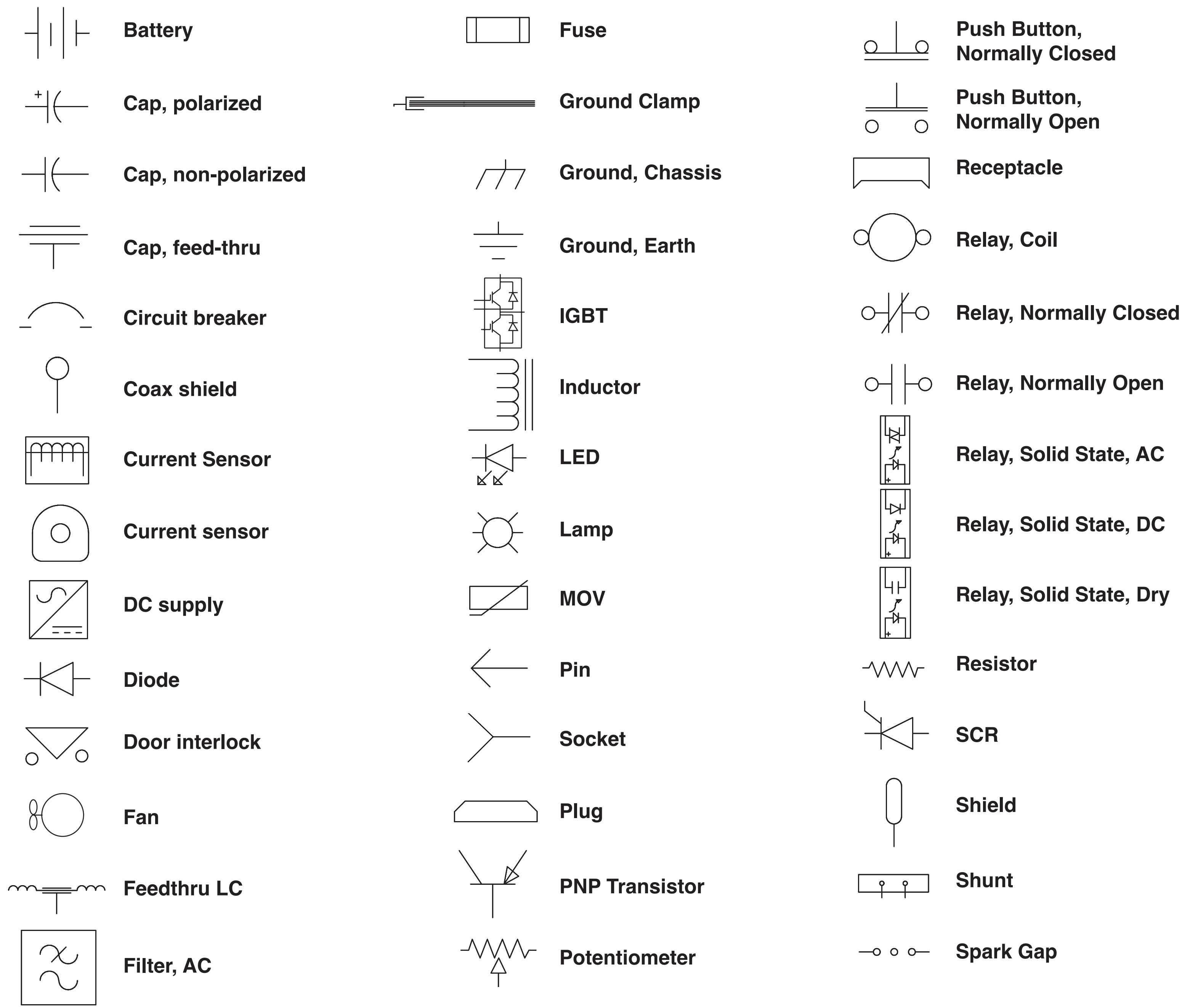


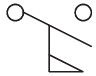


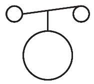
Destination and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).

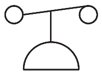
Wiring diagram symbols

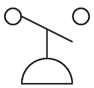
Wiring diagram symbols and their identification precede the system wiring diagrams in this section.


Battery
Cap, polarized
Cap, non-polarized
Cap, feed-thru
Circuit breaker
Coax shield
Current Sensor
Current sensor
DC supply
Diode
Door interlock
Fan
Feedthru LC
Filter, AC
Fuse
Ground Clamp
Ground, Chassis
Ground, Earth
IGBT
Inductor
LED
Lamp
MOV
Pin
Socket
Plug
PNP Transistor
Potentiometer
Push Button, Normally Closed
Push Button, Normally Open
Receptacle
Relay, Coil
Relay, Normally Closed
Relay, Normally Open
Relay, Solid State, AC
Relay, Solid State, DC
Relay, Solid State, Dry
Resistor
SCR
Shield
Shunt
Spark Gap

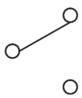

Switch, Flow

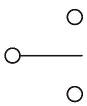

Switch, Level, Normally Closed

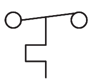

Switch, Pressure, Normally Closed

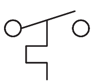

Switch, Pressure, Normally Open

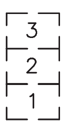

Switch, 1 Pole, 1 Throw


Switch, 1 Pole, 2 Throw

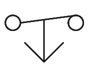

Switch, 1 Pole, 1 Throw, Center Off

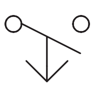

Switch, Temperature, Normally Closed

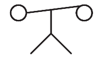

Switch, Temperature, Normally Open

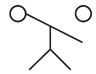


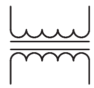
Terminal Block

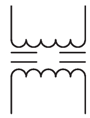

Time Delay Closed, NC/Off


Time Delay Open, NO/Off

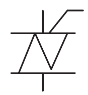

Time Delay Open, NC/On

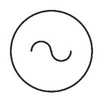

Time Delay Closed, NO/Off

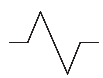

Transformer

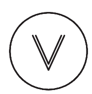

Transformer, Air Core

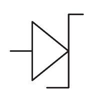

Transformer Coil


Triac

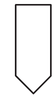

VAC Source

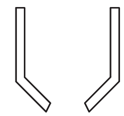

Valve, Solenoid

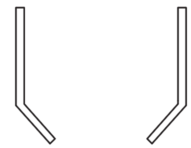

Voltage Source

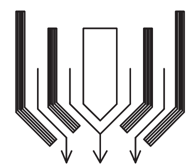

Zener Diode

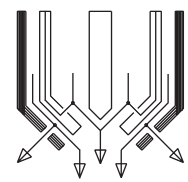
Torch Symbols


Electrode

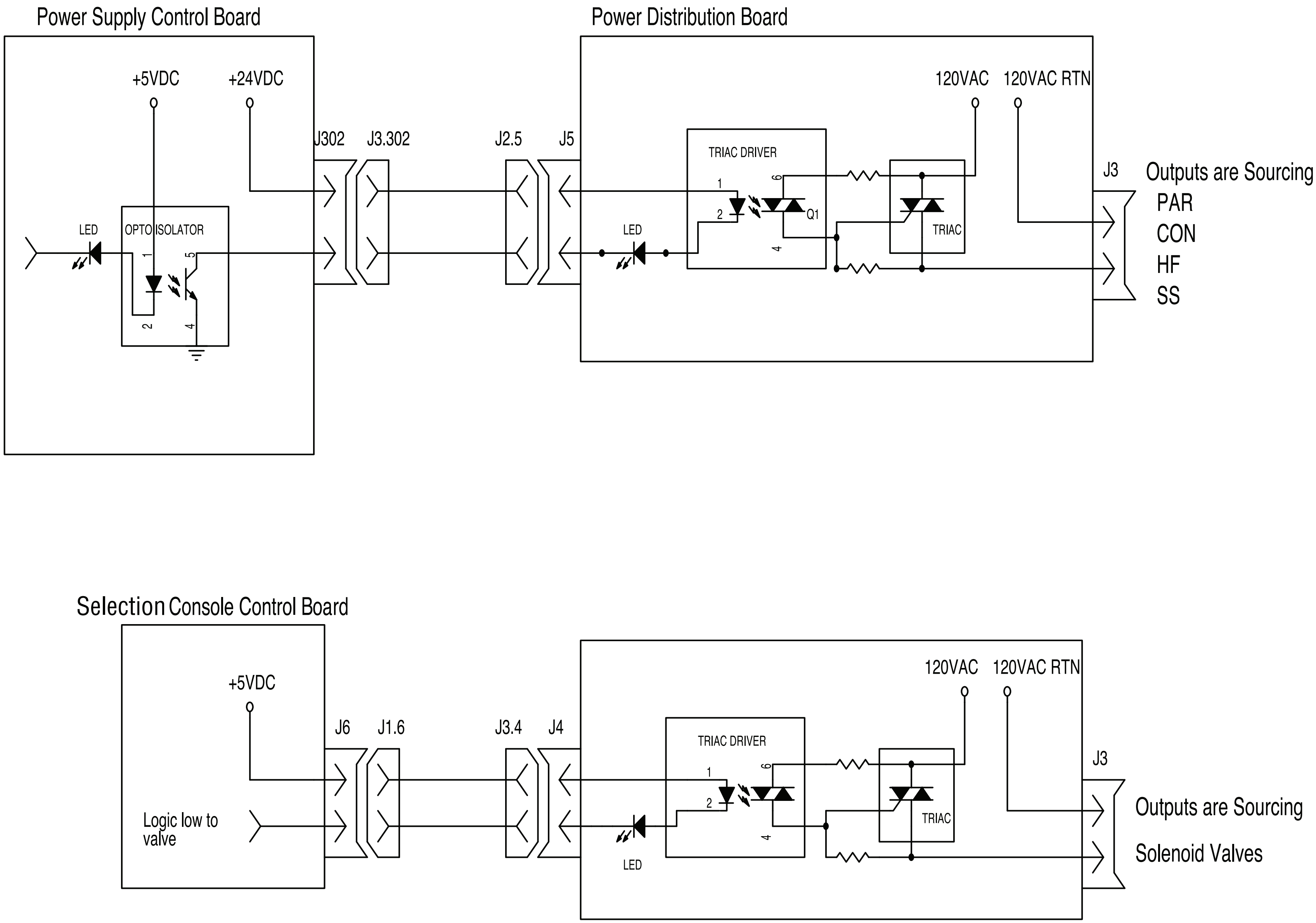

Nozzle

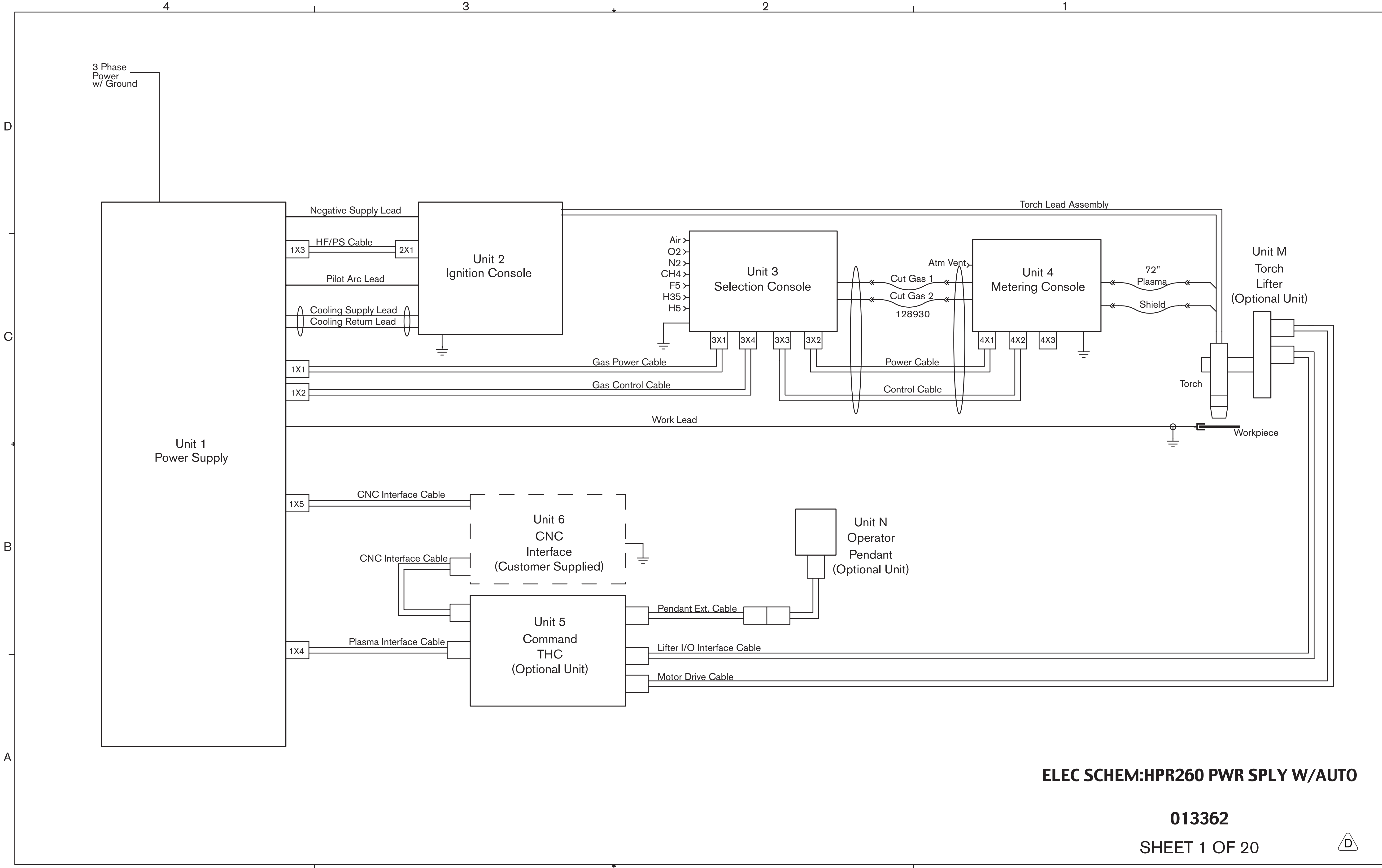

Shield


Torch


Torch, HyDefinition™

Discrete output functionality



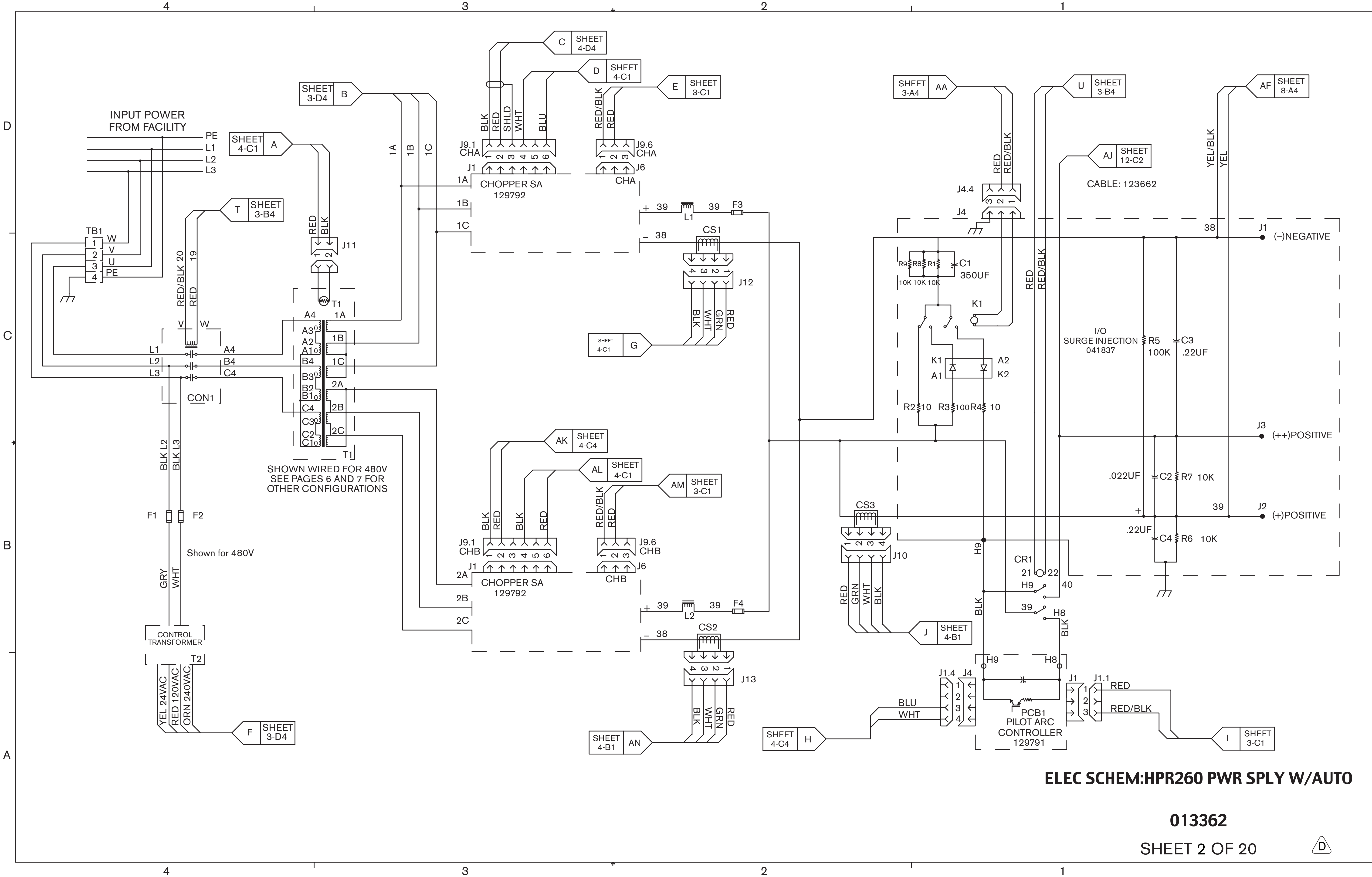


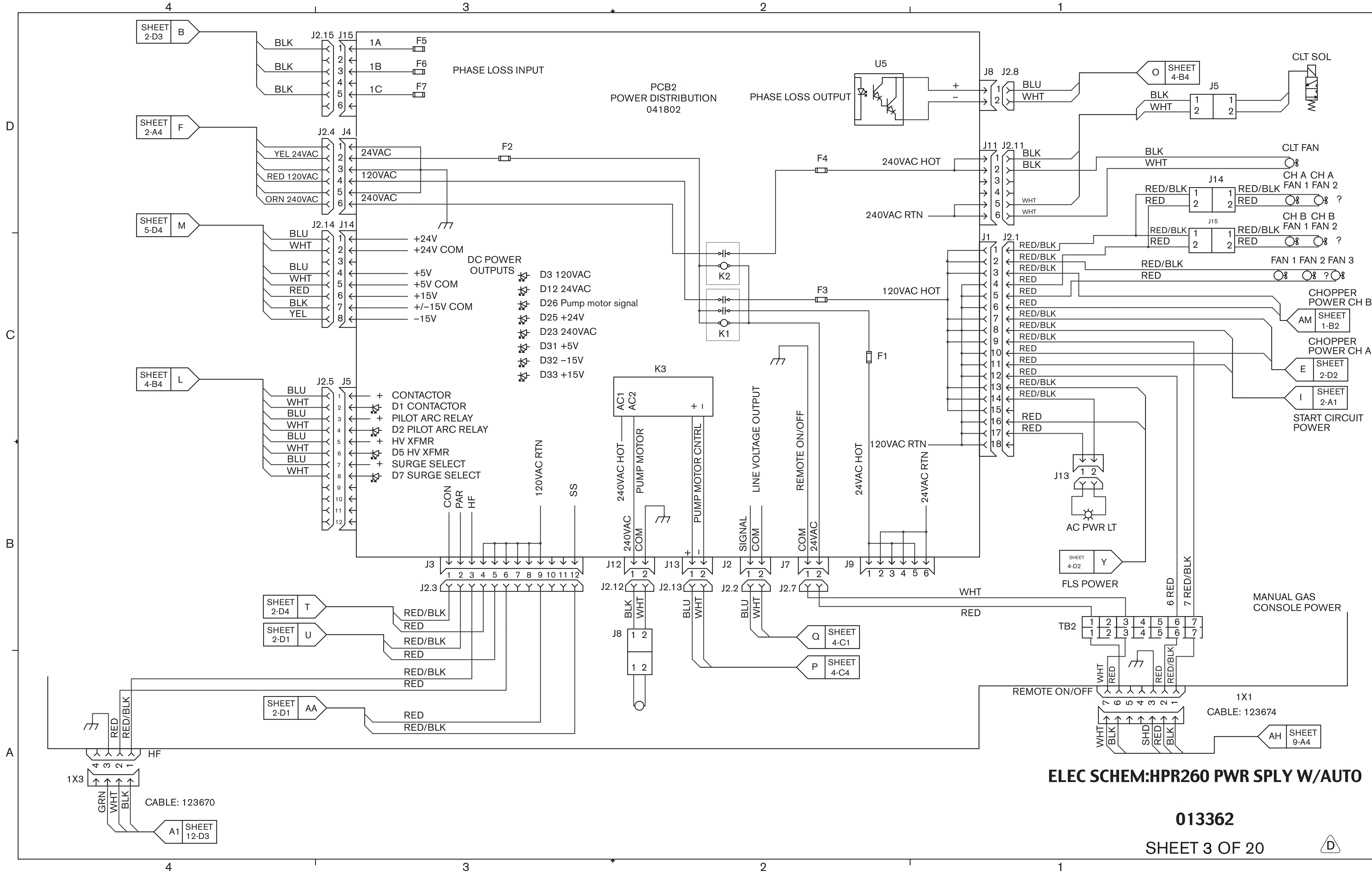
ELEC SCHEM:HPR260 PWR SPLY W/AUTO

013362

SHEET 1 OF 20

D


INPUT POWER
FROM FACILITY
PE
L1
L2
L3
TB1
W
V
U
PE
CON1
A4
B4
C4
BLK L2
BLK L3
F1
F2
Shown for 480V
GRY
WHT
CONTROL
TRANSFORMER
T2
YEL 24VAC
RED 120VAC
ORN 240VAC
SHEET 3-D4
SHEET 4-C1
SHEET 3-B4
RED/BLK 20
19
RED
RED
BLK
J11
T1
1A
1B
1C
2A
2B
2C
SHOWN WIRED FOR 480V
SEE PAGES 6 AND 7 FOR
OTHER CONFIGURATIONS
SHEET 4-D4
SHEET 4-C1
SHEET 3-C1
BLK
RED
SHLD
WHT
BLU
RED/BLK
J9.1
CHA
J9.6
CHA
J1
J6
CHOPPER SA
129792
L1
F3
CS1
J12
GRN
SHEET 4-C1
SHEET 4-C4
SHEET 4-C1
SHEET 3-C1
J9.1
CHB
J9.6
CHB
CHOPPER SA
129792
L2
F4
CS2
J13
SHEET 4-B1
SHEET 3-A4
SHEET 3-B4
SHEET 12-C2
SHEET 8-A4
CABLE: 123662
YEL/BLK
YEL
J4.4
J4
J1
(–)NEGATIVE
R9
R8
R1
10K 10K 10K
C1
350UF
K1
A2
K2
A1
R2 10
R3 100
R4 10
I/O
SURGE INJECTION
041837
R5
100K
C3
.22UF
J3
(++)POSITIVE
.022UF
C2
R7 10K
J2
(+)POSITIVE
.22UF
C4
R6 10K
CS3
J10
SHEET 4-B1
H9
CR1
21
22
40
H8
J1.4
J4
BLU
WHT
SHEET 4-C4
PCB1
PILOT ARC
CONTROLLER
129791
J1
J1.1
RED/BLK
SHEET 3-C1
ELEC SCHEM:HPR260 PWR SPLY W/AUTO
013362
SHEET 2 OF 20



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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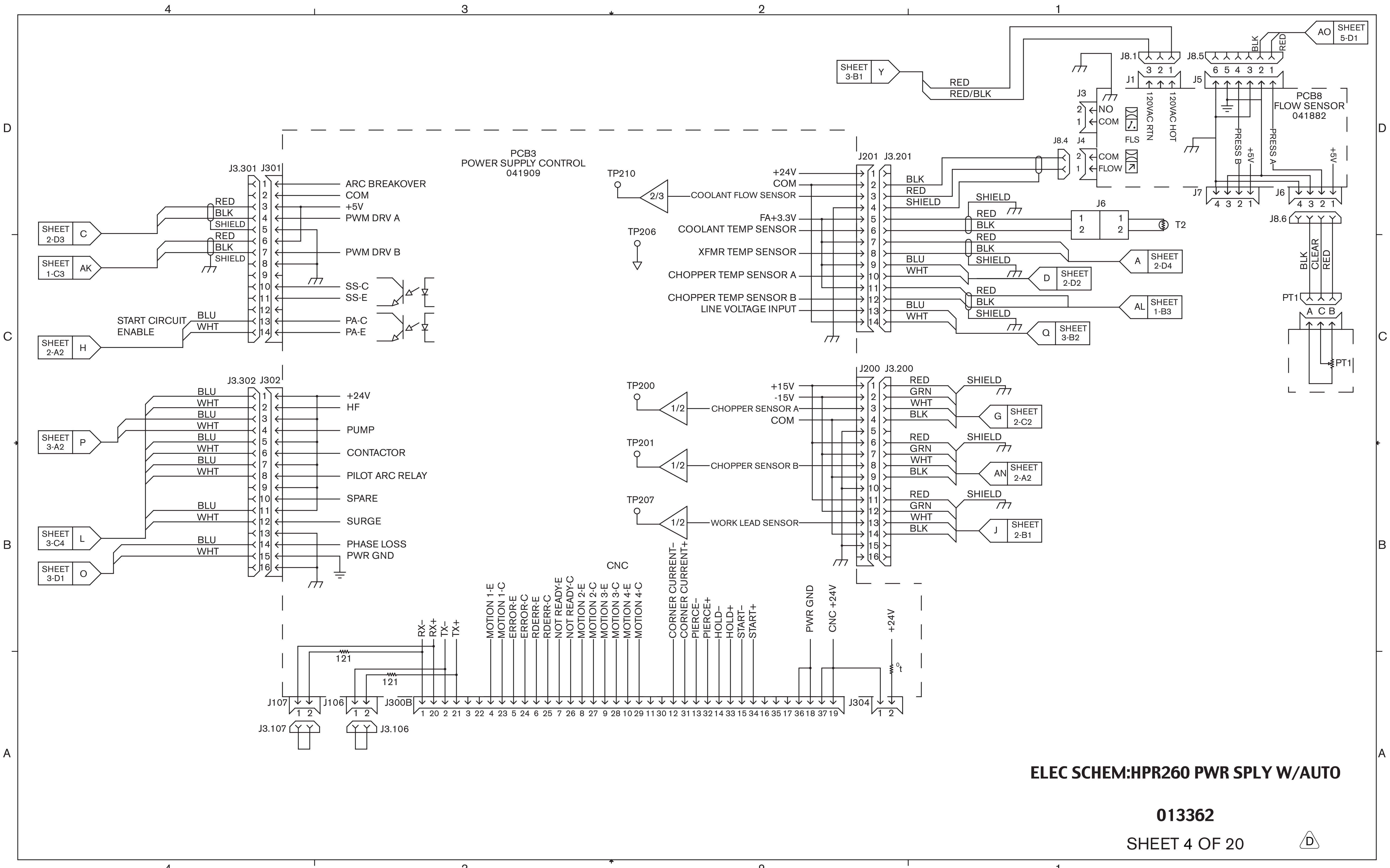
SHEET 3 OF 20



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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SHEET 4 OF 20

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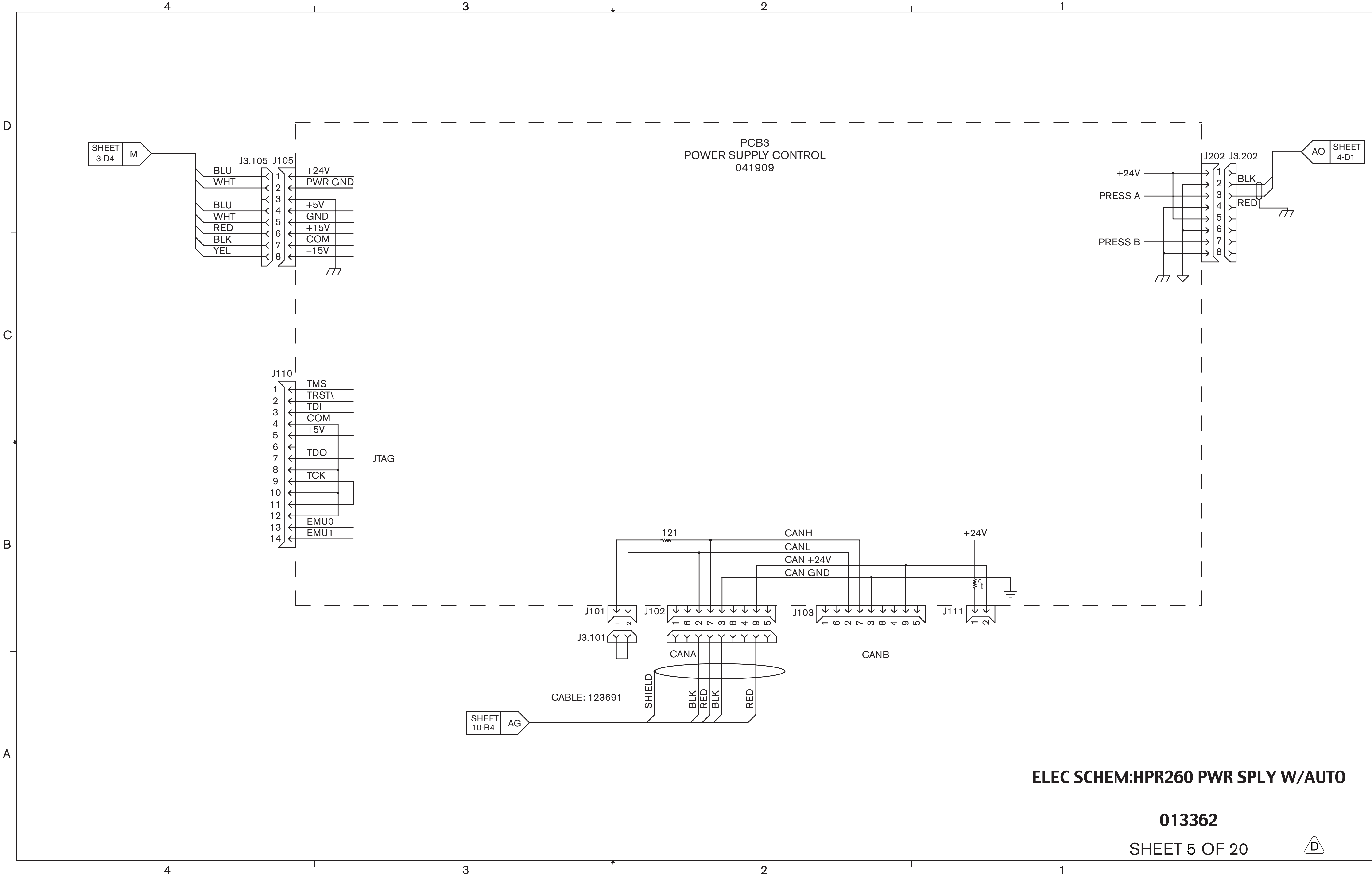

ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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SHEET 5 OF 20

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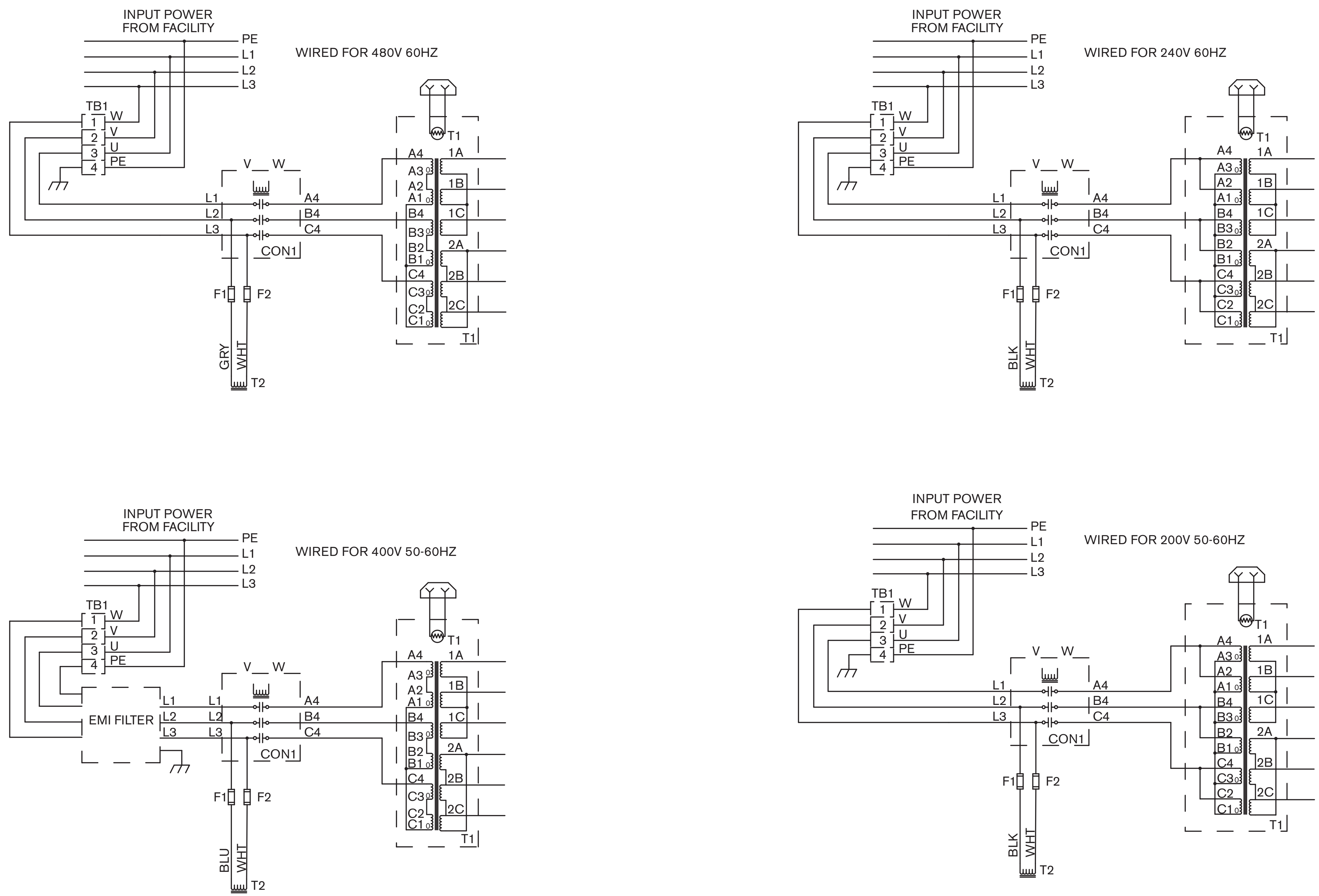

ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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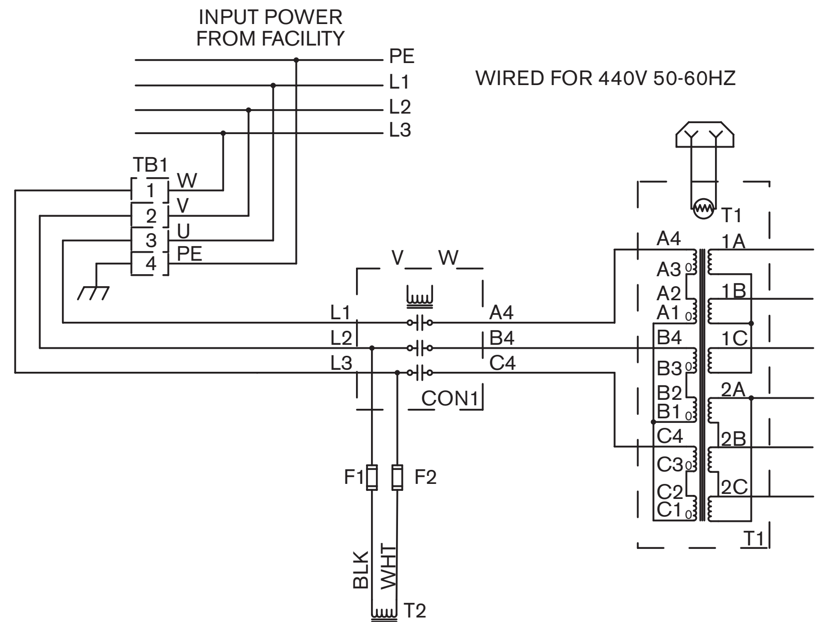
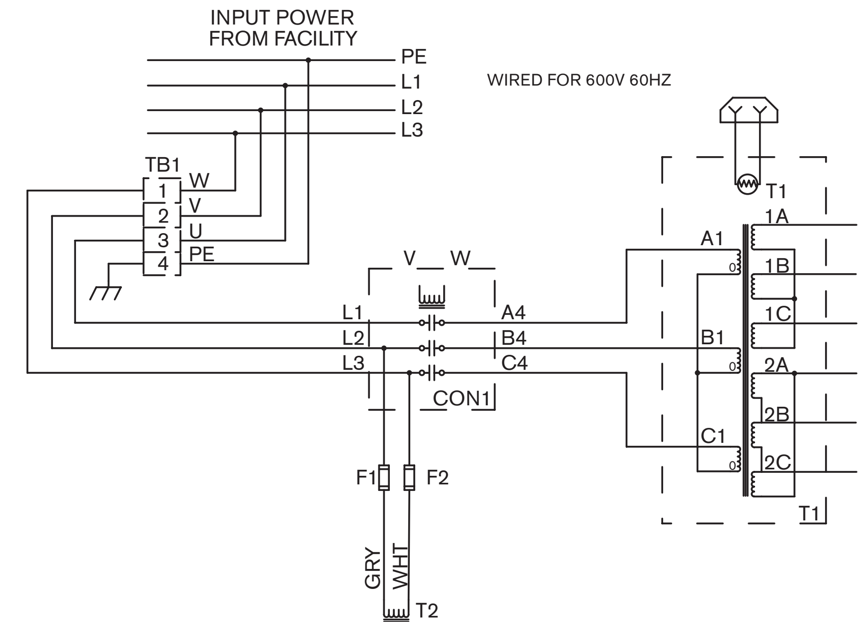
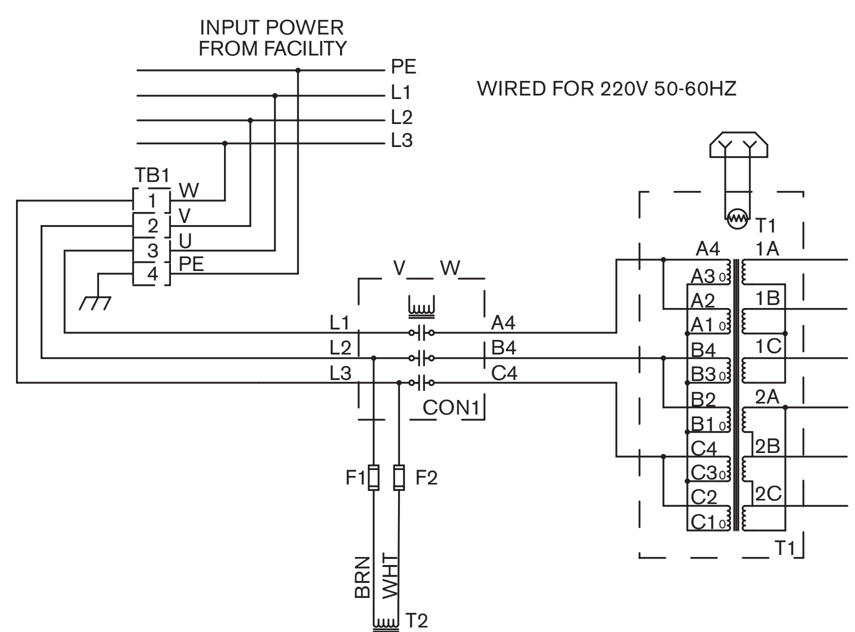
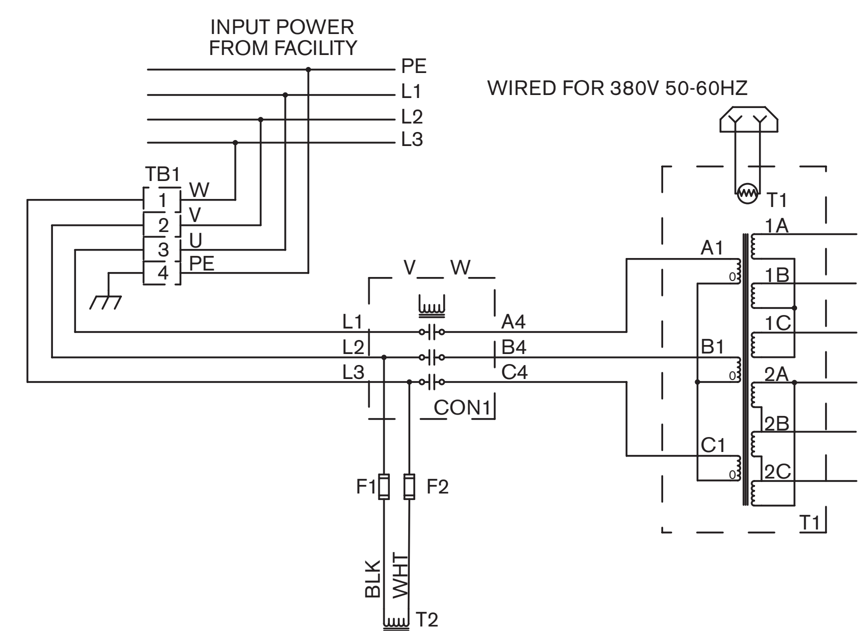
SHEET 6 OF 20 D









ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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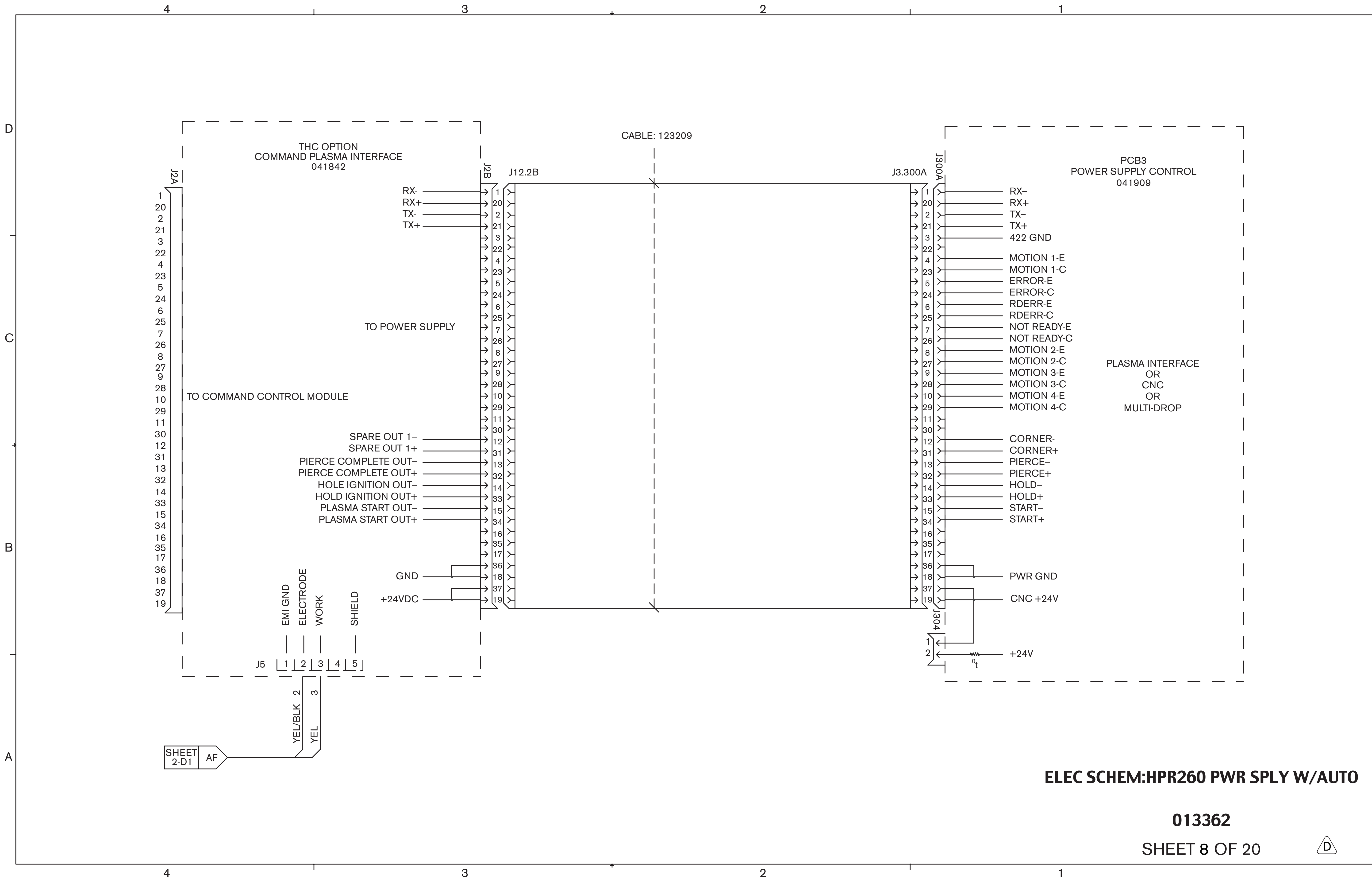
SHEET 7 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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SHEET 8 OF 20

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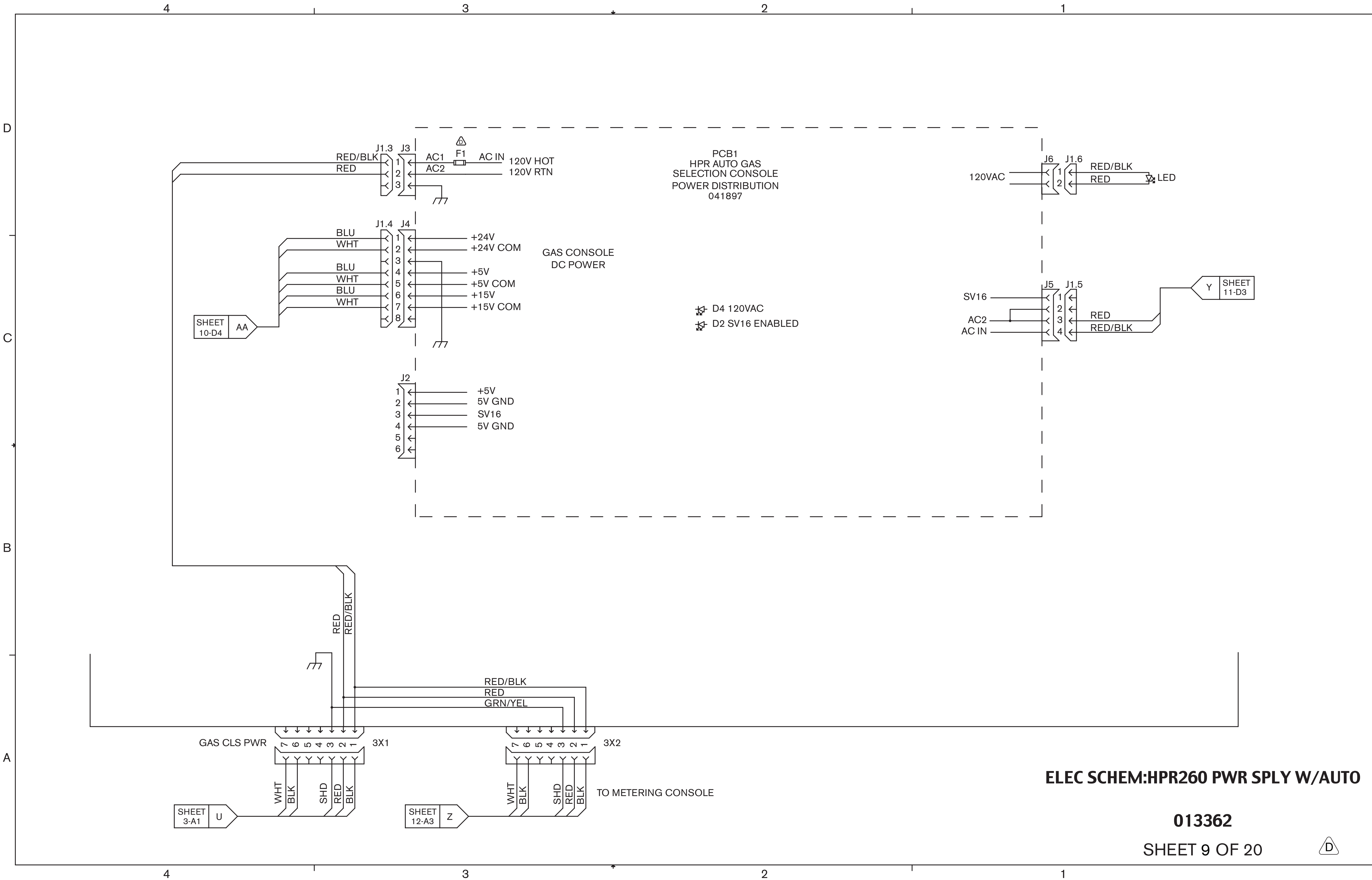

ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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SHEET 9 OF 20

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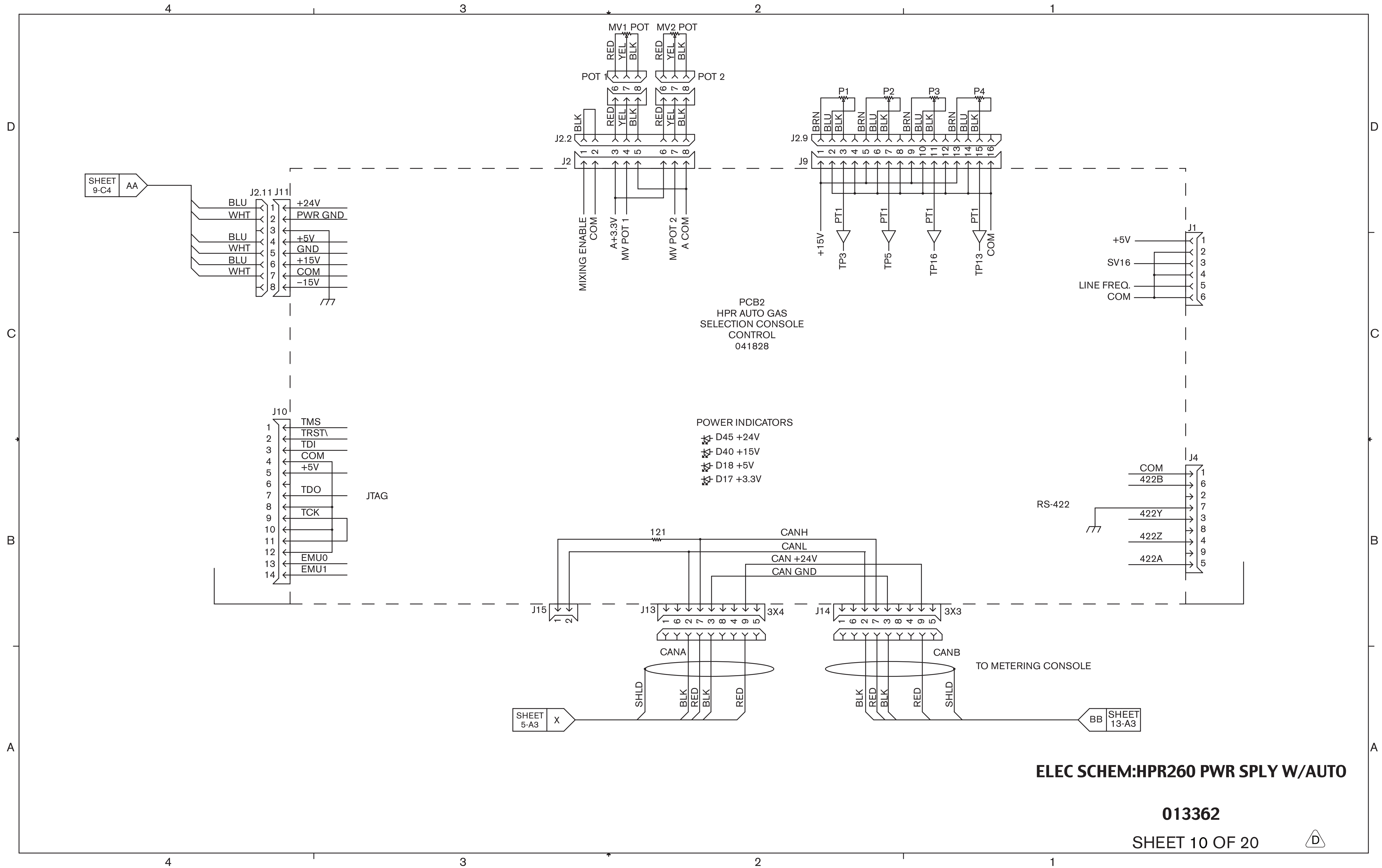

ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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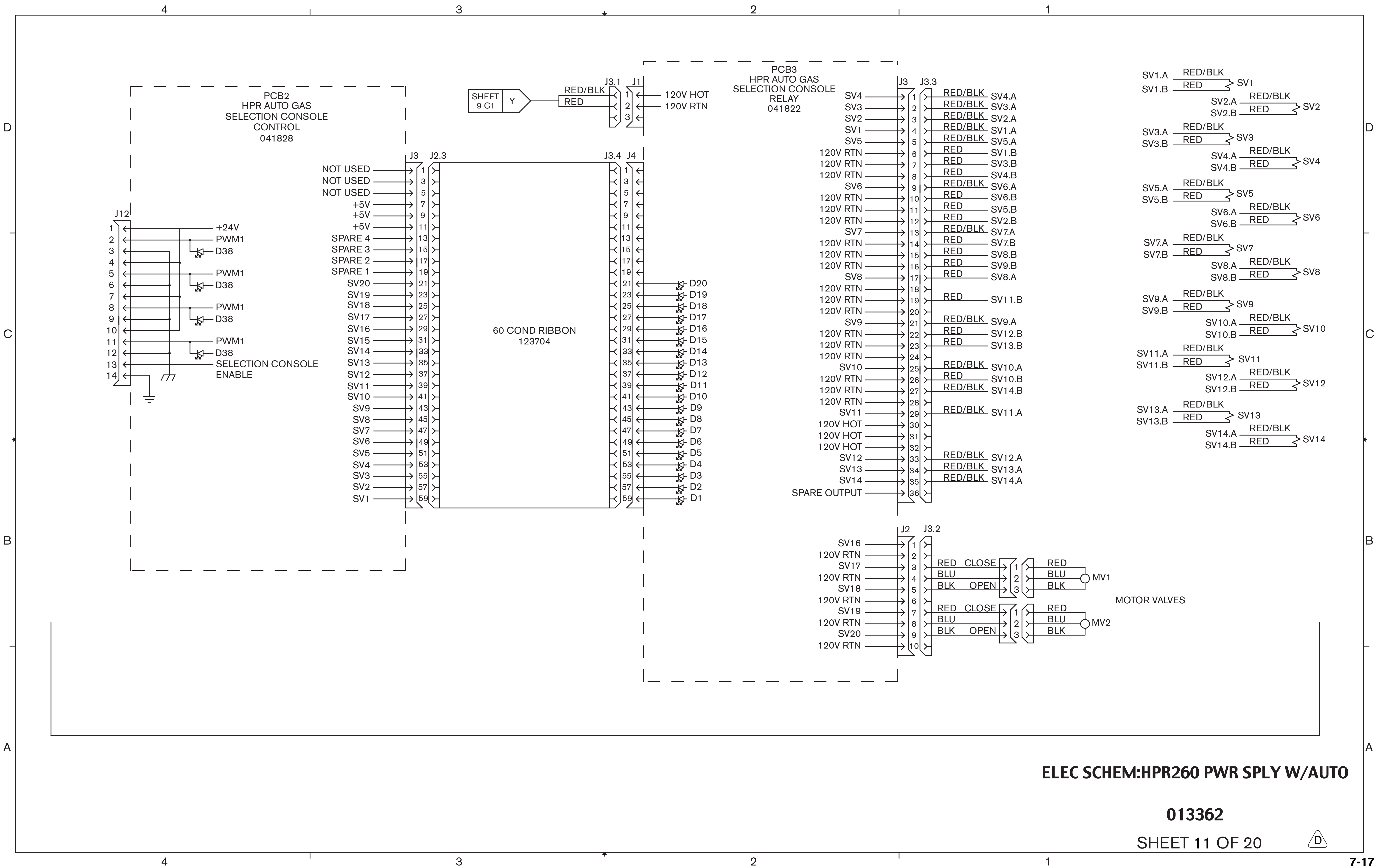
SHEET 10 OF 20



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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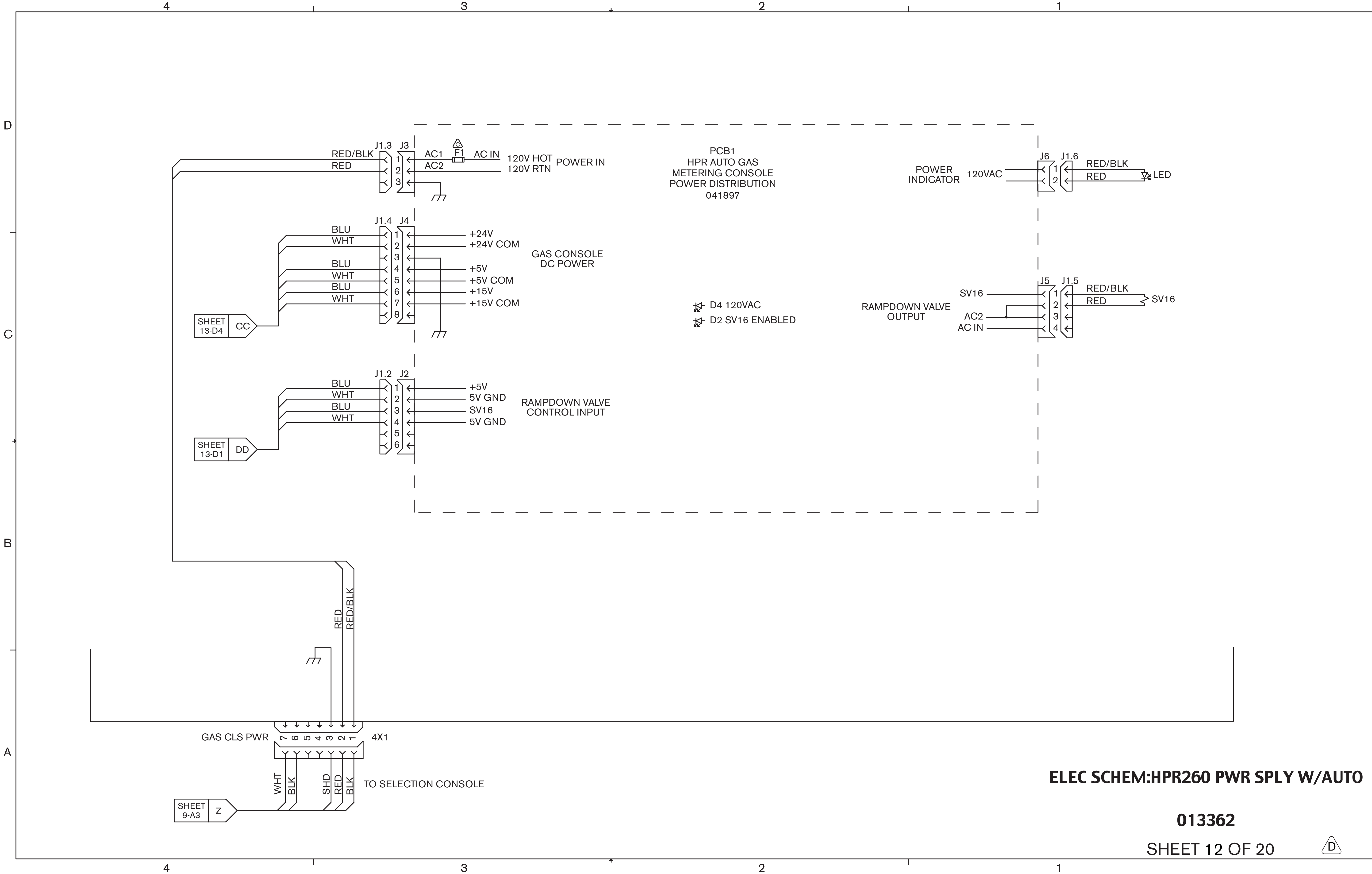
SHEET 11 OF 20



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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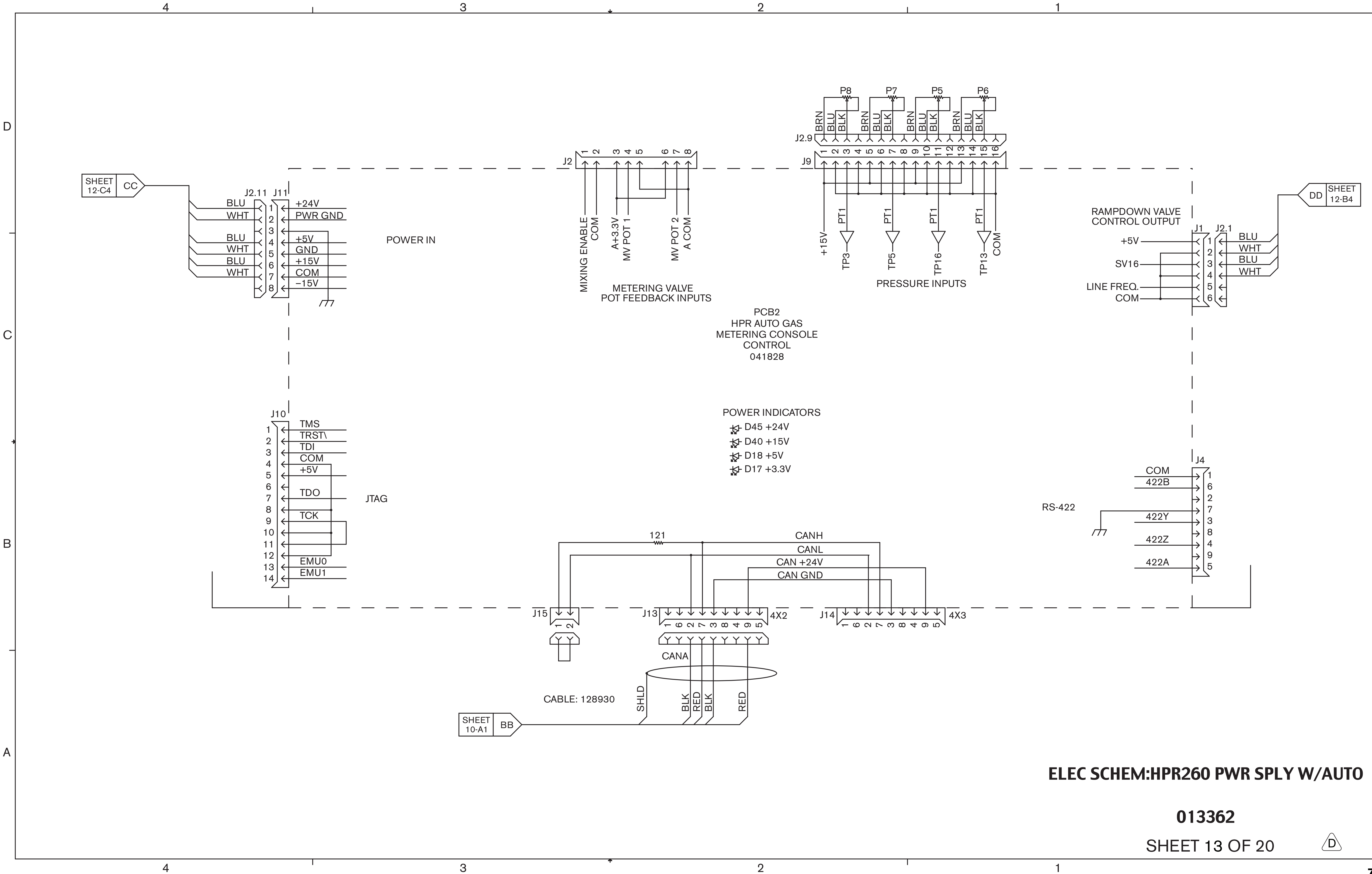
SHEET 12 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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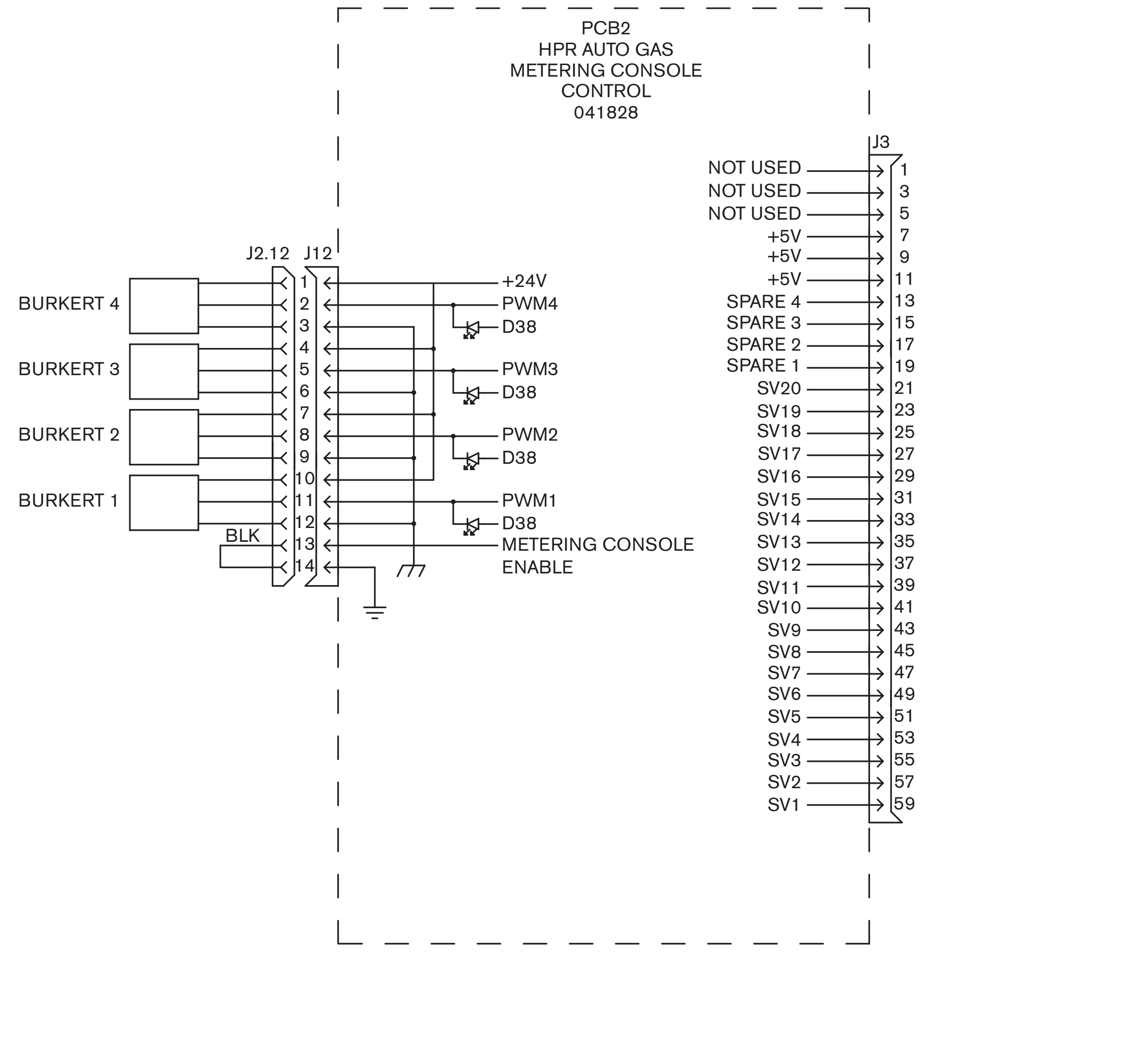
SHEET 13 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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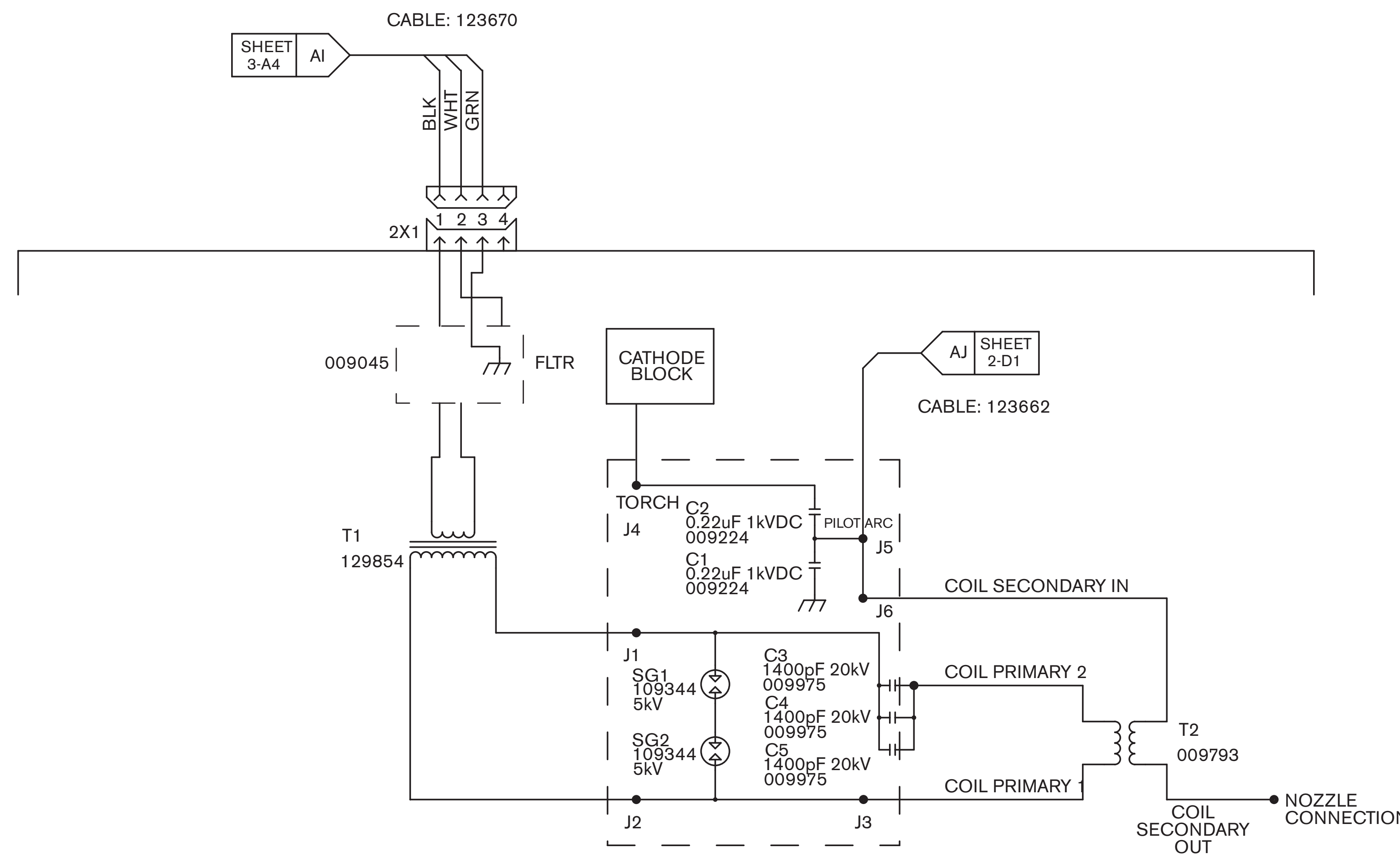
SHEET 14 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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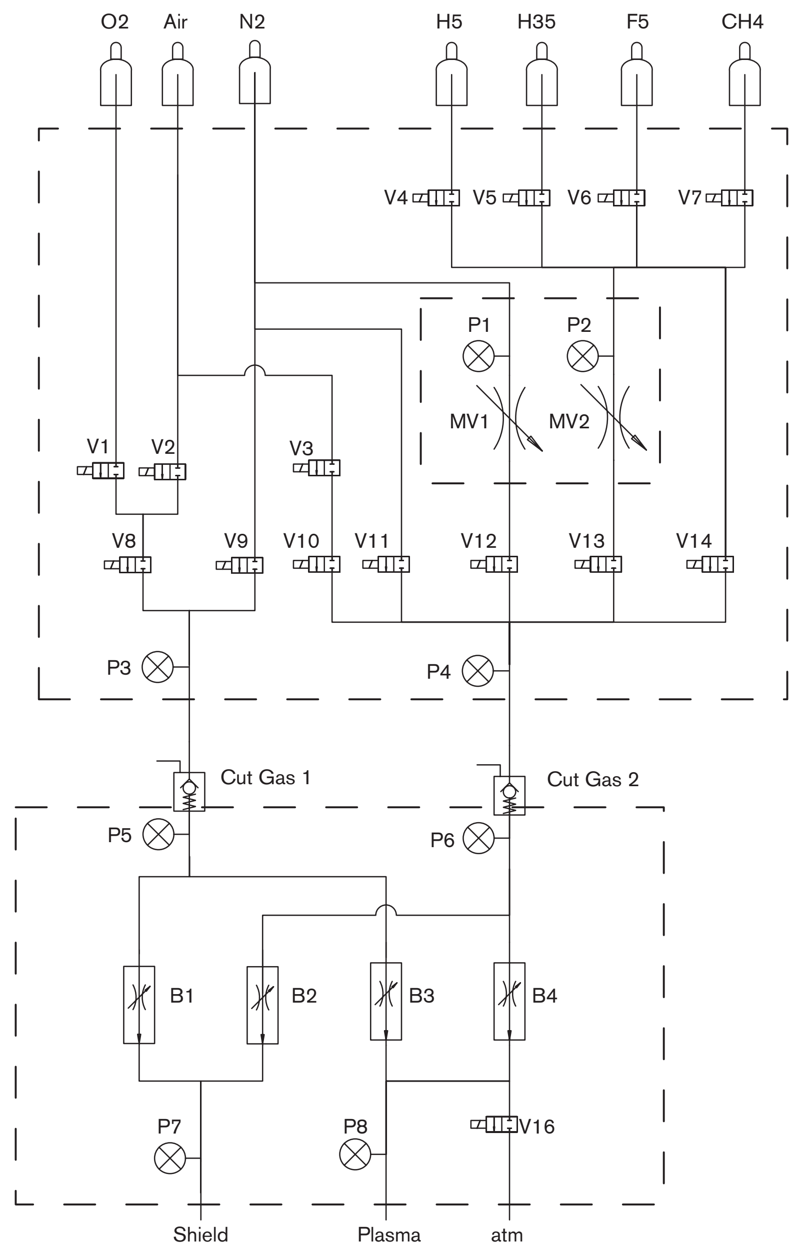
SHEET 15 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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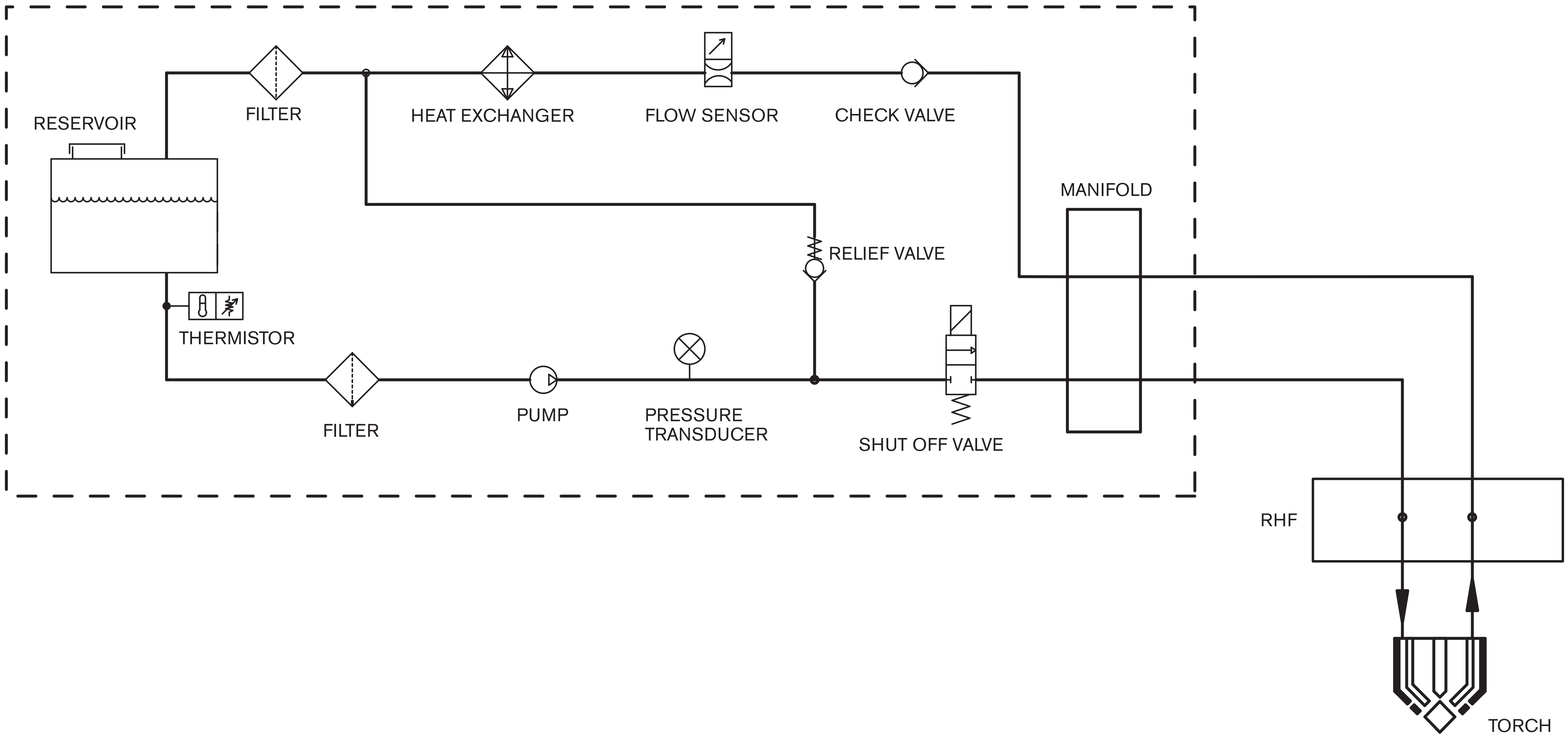
SHEET 16 OF 20 D



ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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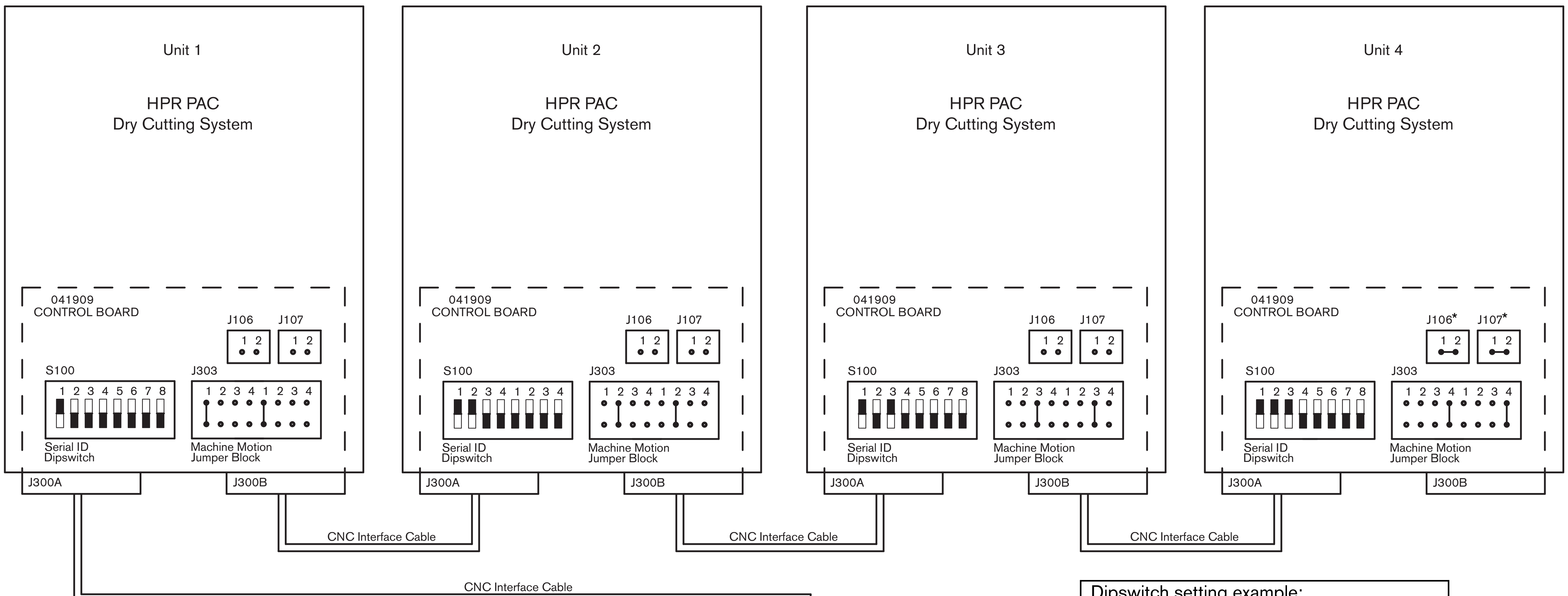
D

Optional Multi-System Interface



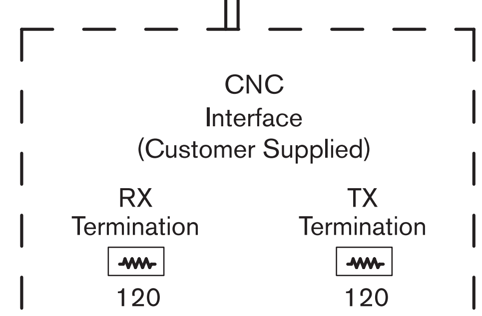
Notes:

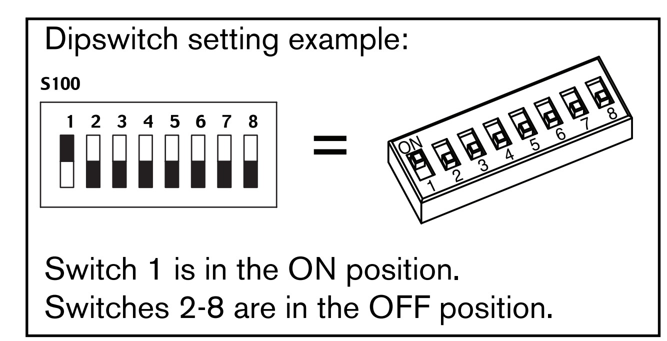
1) For single system installations set Serial ID (S100), and Machine Motion (J303) as shown in Unit 1, jumpers J106 and J107 must be closed

2) On multi-system installations refer to the illustration.
Jumpers J106 and J107 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) Use only the first four dipswitch settings, they are the same as on the 041808 control board

* If a Hypertherm Automation controler is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J106 and J107 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controler. Only remove the termination jumper on the serial isolation board that is connected to the HPR power supply. See sheet 19 of 20 for more details.





ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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D

Optional Remote On/Off

Notes:

1) For single system installation set Serial ID (S100), Machine Motion (J303), J106 & J107 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.

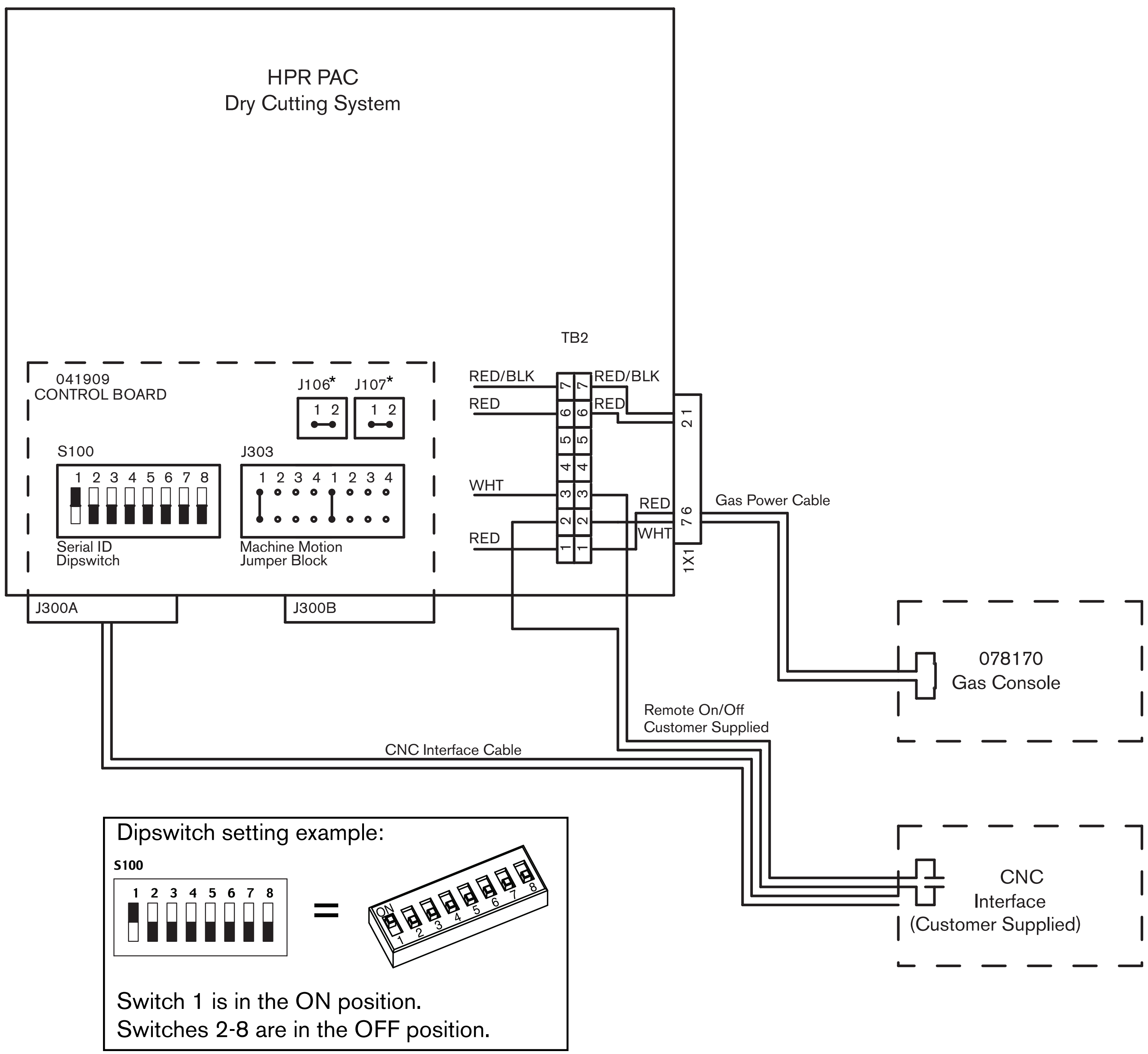
Refer to page 3 of the wiring diagram

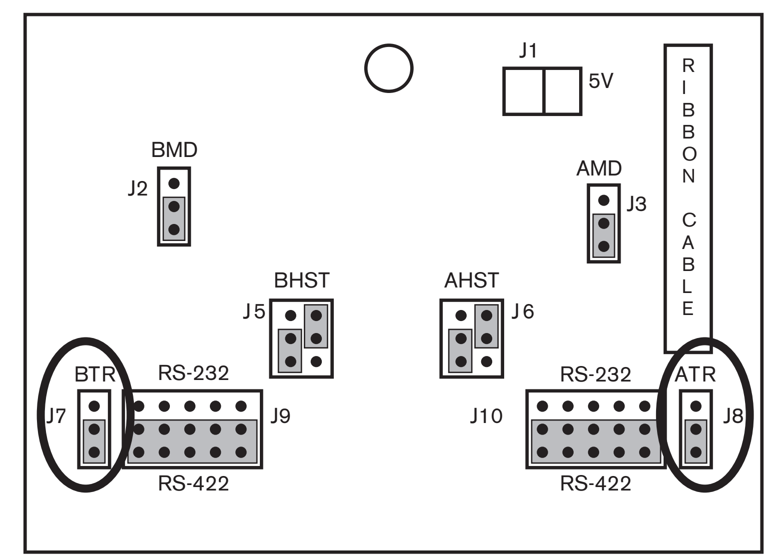
Depress the Gas Console Power switch to the closed position (on position).

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 controler is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J106 and J107 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controler. 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 SCHEM:HPR260 PWR SPLY W/AUTO

013362

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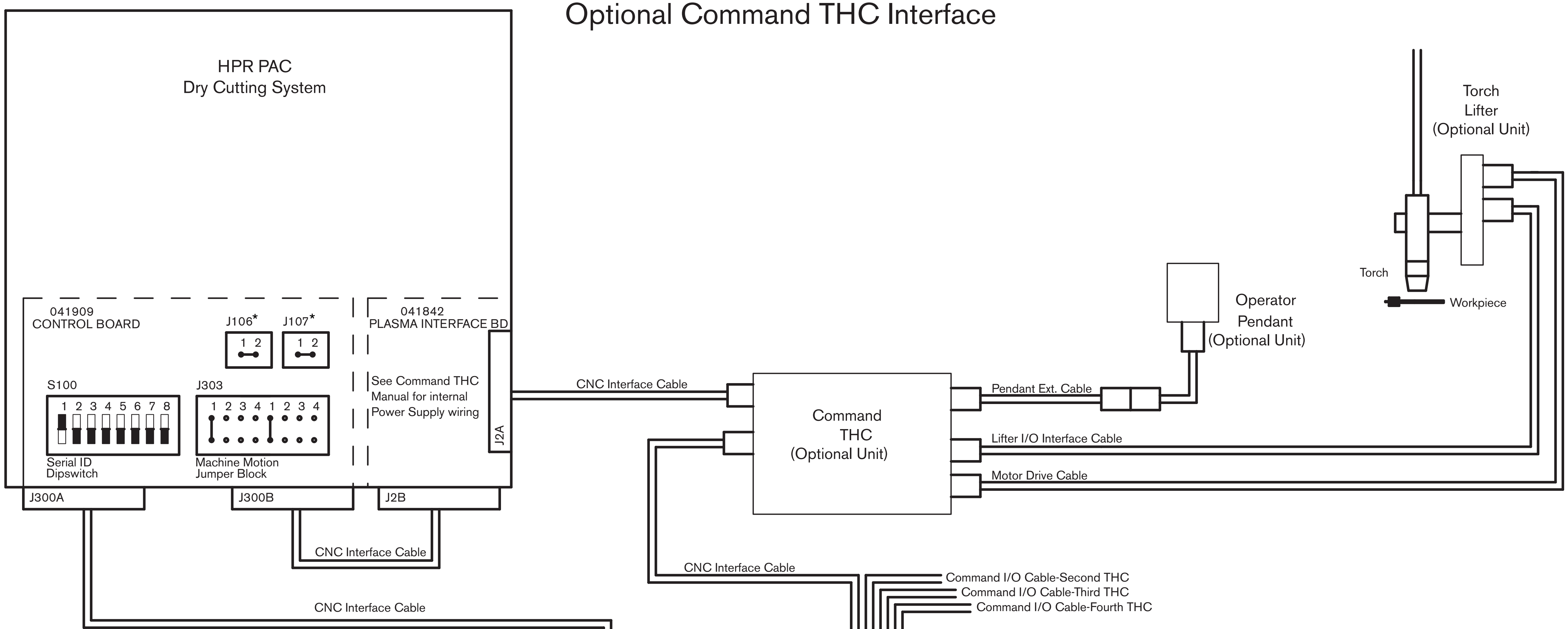
D

Optional Command THC Interface



Notes:

1) For a single system installation set Serial ID (S100), Machine Motion (J303), J106 & J107 as shown

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

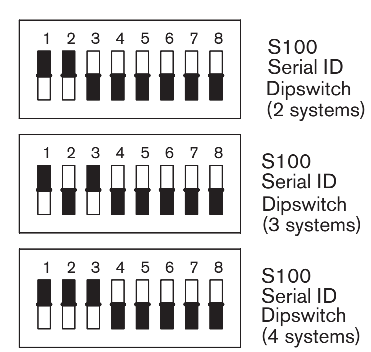
3) For a three system installation set up as described above, set Serial ID as shown for the third system

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

* If a Hypertherm Automation controler is being used, and there are intermittent communication failures (PS Link Failure), try removing the jumpers on J106 and J107 on the control board, and the termination jumper (J6 or J8) on the serial isolation board in the controler. Only remove the termination jumper on the serial isolation board that is connected to the HPR power supply. See sheet 19 of 20 for more details.



Dipswitch setting example:

Switch 1 is in the ON position.
Switches 2-8 are in the OFF position.

ELEC SCHEM:HPR260 PWR SPLY W/AUTO

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SHEET 20 OF 20

D

Appendix A

HYPERTHERM TORCH COOLANT SAFETY DATA

In this section:

MATERIAL SAFETY DATA SHEET

SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME	Hypertherm Torch Coolant

Latest Revision Date	09-02-2004

ISSUE DATE	03-10-2005

DISTRIBUTOR: **Hypertherm, Inc.**
Etna Road
Hanover, N.H. 03755

EMERGENCY TELEPHONE NUMBERS

Product Information: (603) 643-3441

SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Component	CAS No.	% by wt.	EXPOSURE LIMITS OSHA PEL	ACGIH TLV	R Phrases
Benzotriazole	95-14-7	<1,0	N.E.	N.E.	R22,36/37/38
Propylene Glycol	57-55-6	<50,0	N.E.	N.E.	R36/37/38

SECTION 3 – HAZARDS IDENTIFICATION

Emergency Overview	Causes eye irritation. May be harmful if swallowed. May cause skin irritation

Potential Health Effects	
Ingestion	Oral LD 50 (rat) as reported for 100% Benzotriazole is 560 mg./Kg.
Inhalation	Mists are harmful.
eye contact	Causes eye irritation.
skin contact	Can cause skin irritaion.

SECTION 4 – FIRST AID MEASURES

Ingestion	Never give anything by mouth to an unconscious person. Give several glasses of water. If vomiting is not spontaneous, induce vomiting. Keep airway clear. Get medical attention.
Inhalation	If affected, remove from exposure. Restore breathing. Keep warm and quiet. Get medical attention.
Eye Contact	Immediately flush eye with cool running water. Remove contact lenses if applicable. Continue flushing with water for at least 15 minutes. Get immediate medical attention.
Skin Contact	Wash with soap and water. If irritation develops or persists, get medical attention.
Note to Physician	Treatment based on judgment of the physician in response to reactions of the patient.

SECTION 5 – FIRE FIGHTING MEASURES

Flash Point / Method	None to boiling.	Flammable limits	Not Established
Extinguishing media	Product is an aqueous solution. Use Carbon Dioxide, Dry Chemical, Foam.		
special fire fighting procedures	Full protective equipment including self-contained breathing apparatus should be used. During emergency conditions overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Get medical attention.		
Fire and explosion hazards	Water base solution.		

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Response to spills	Small spills: Mop up residues and place in a covered waste disposal container. Large spills: Dike or dam spill. Pump to containers or soak up on inert absorbent. Place in covered waste dissposal container.

SECTION 7 – HANDLING AND STORAGE

Handling precautions	Keep container in upright position. Avoid breathing or creating airborne mists. Avoid contact with skin eyes, and clothing. Avoid inhalation of vapor or mists. DO NOT TAKE INTERNALLY. Clean up spills immediately.
Storage precautions	Store in a cool dry place. Keep from freezing. Keep containers tightly closed when not in use.

SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

Hygienic practices	Normal procedures for good hygiene.
Engineering controls	Good general ventilation. Eye wash station in immediate area of use. **M.E.L./O.E.S** Nil. **U.K HSE EH:40** Not listed

Personal protective equipment

X	**Respirator**	If exposed to mists.
X	**goggles / face shield**	Recommended
	APRON	
X	**Gloves**	Recommended; PVC, Neoprene or Nitrile acceptable
	Boots	

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear Pink/Red Liquid	Boiling point	100EC
ODOR	None	freezing point	Not established
pH of Concentrate	5,5-7,0	vapor pressure	Not applicable
Specific gravity	1,0	vapor density	Not applicable
solubility in water	Complete	evaporation rate	Not determined

SECTION 10 – STABILITY AND REACTIVITY

Chemical Stability		**Stable**	X		**Unstable**	
Conditions to avoid	None					
Incompatibility	None Known					
Hazardous products of decomposition	BY FIRE: Carbon Dioxide, Carbon Monoxide Nitrogen Oxides					
Polymerization		**Will not occur**	X		**May occur**	
Conditions to avoid	Not applicable					

SECTION 11 – TOXICOLOGICAL INFORMATION

Carcinogenicity

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

Other effects

Acute	Not determined
Chronic	Not determined

SECTION 12 – ECOLOGICAL INFORMATION

Biodegradability		**Considered biodegradable**			**Not biodegradable**	
BOD / COD Value	Not established					
Ecotoxicity	As reported for 100% Benzotriazole: Bluegill Sunfish (96 hr. Tlm):28mg/l; Minnow (96hr. Tlm):28mg/l; Trout (96 hr. LC 50): 39mg/l; Algae(96hr. EC 50): 15.4mg/l; Daphina magna (48 hr. LC 50): 141.6mg/l					

SECTION 13 – DISPOSAL CONSIDERATIONS

Waste disposal method	Waste material must be disposed of in accordance with national/local legislative requirements.							
RCRA Classification	Non Hazardous							
Recycle container		**Yes**	X		**CODE**	2 – HDPE		**No**

SECTION 14 – TRANSPORT INFORMATION

DOT Classification		**Hazardous**			**Not Hazardous**	X
Description	Not applicable					

SECTION 15 – REGULATORY INFORMATION

REGULATORY STATUS: Benzotriazole

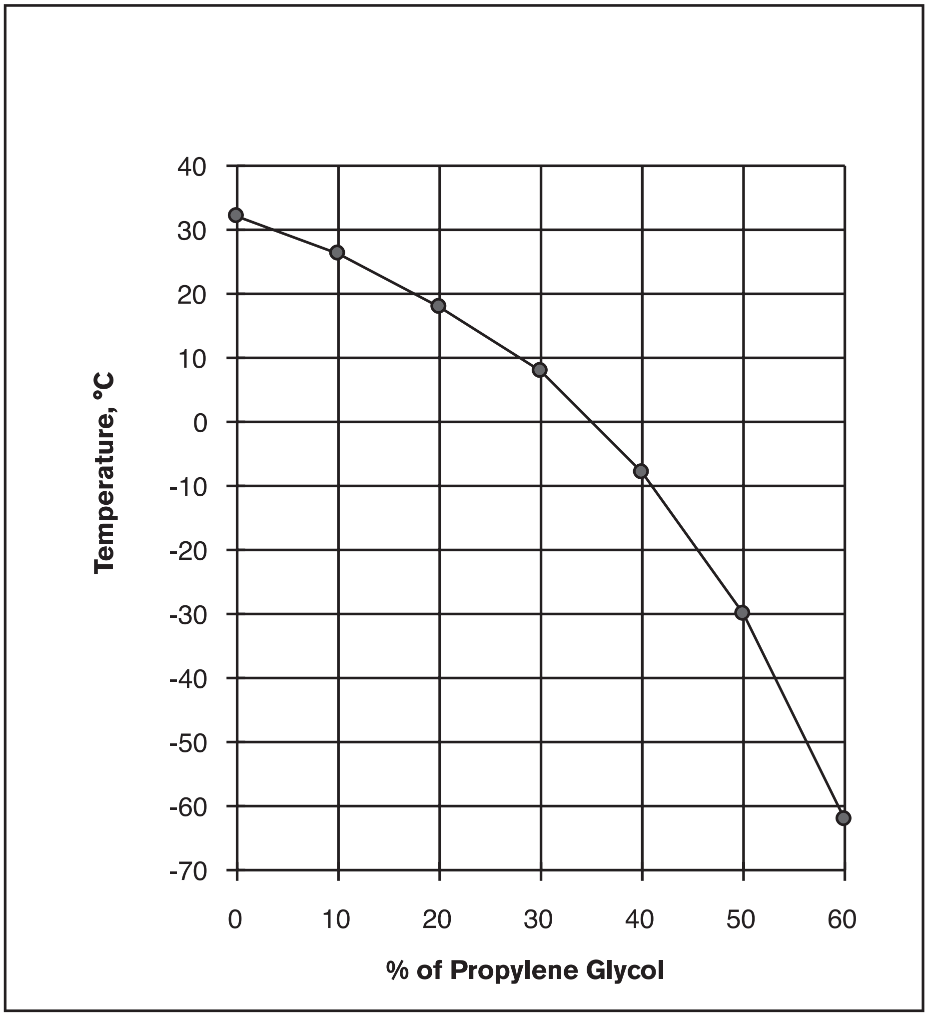
1.	Labeling Information	Irritant
2.	R Phrases	R 36/37/38, 22
3.	S Phrases	S 24/25, 26
4.	EI NECS No.	Not listed
5.	EC annex 1 Classification	Nil.
6.	German WGK	–

SECTION 16 – OTHER INFORMATION

NFPA Classification

1	**BLUE**	Health hazard
0	**RED**	Flammability
0	**YELLOW**	reactivity
–	**WHITE**	Special hazard

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



Freezing Point of Propylene Glycol Solution

Appendix B

CNC INTERFACE PROTOCOL

In this section:

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 the same CNC. 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 Command THC plasma interface board.
- Must have an interface compatible with the Command THC/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 system will stay in preflow and delay torch ignition.
System Error	Output	Indicates that an error has occurred in the plasma system

Signal list (continued)

Signal name	Type	Description
Pierce Complete	Input	When active, the system will use shield preflow gases during piercing. When the signal is removed, it will switch to shield cutflow gases
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 **Connect to CNC RX+**
TX-	Serial	Transmitting from the system **Connect to CNC RX-**
RX+	Serial	Receiving by the system **Connect to CNC TX+**
RX-	Serial	Receiving by the system **Connect to CNC TX-**

Hardware

Inputs – active low, dry contact, opto-isolated

Inactive: 24 V or open circuit, 0 mA

Active: 0v or closed contact (0 ohm min, 6.5 mA; 200K ohm max, 0.1 mA)

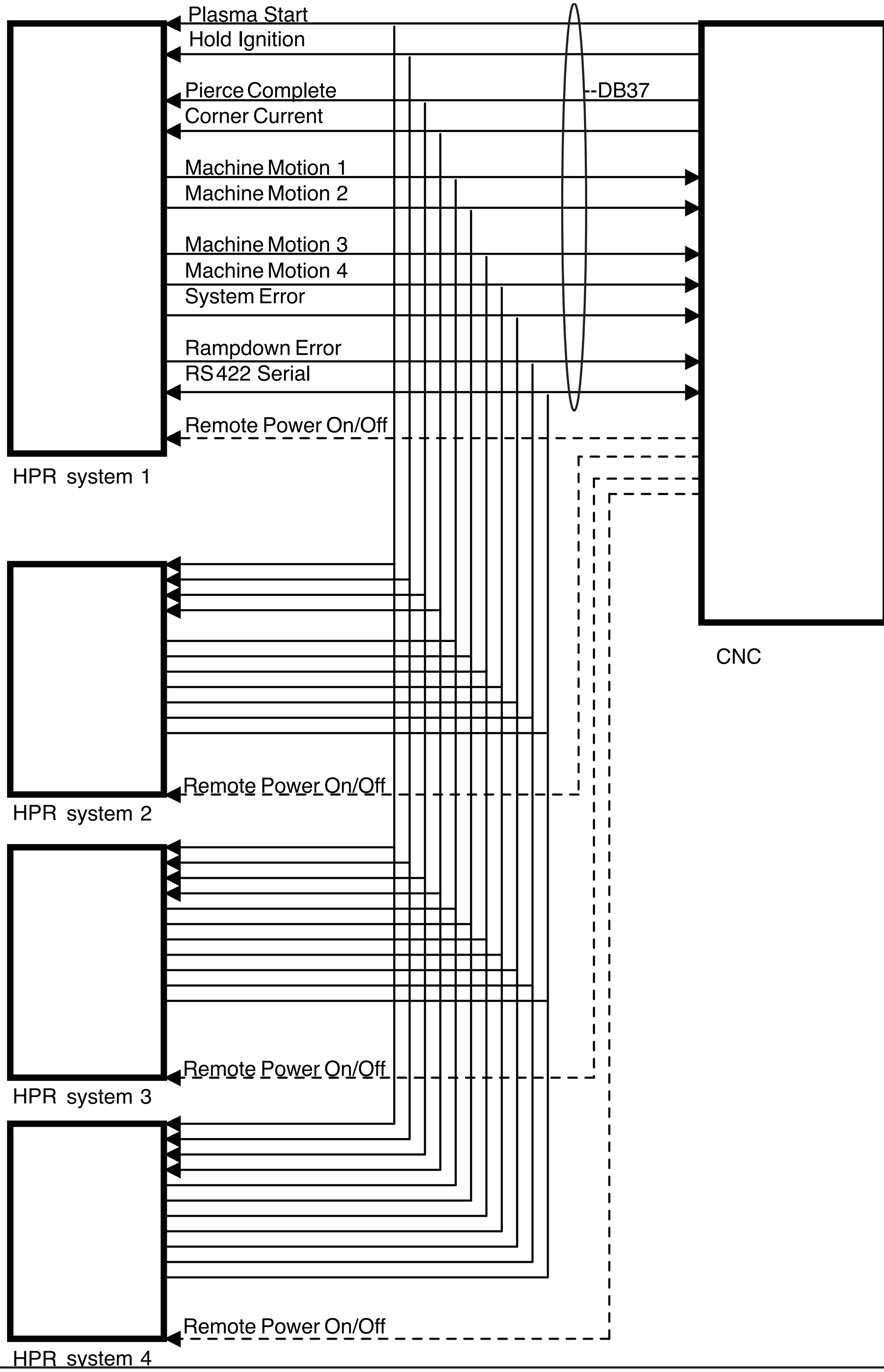
Outputs – active low, open collector, opto-isolated

Inactive: Up to 40 V open circuit/open collector, 0 mA
Recommended 24 V pull-up into high impedance load

Active: 0.3v max output into high impedance load, sinking cap up to 5 mA
Or 2k ohm min. load resistance

Serial – RS422 serial communications

Multi-drop wiring



Multi-drop addressing

The power supply control has dipswitches to set the power supply ID.
Dipswitches 2,3,4 are used to set the ID.

2	3	4	ID
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 13)

ID	Command	System	Description
000	HELLO	Manual gas system Auto gas system	Establish communications with the plasma system. Use this command to identify which system you are talking to. **Data:** None **Return value:** String identifying the system **Sample:** >00090< >000HYPERFORMANCE130MANUALB5< or >000HYPERFORMANCE130AUTO30< or >000HYPERFORMANCE130AUTOMIX1E<
001	VERSION	Manual gas system Auto gas system	Get the version of the power supply firmware **Data:** None **Return value:** Power supply firmware then Gas console firmware, space-delimited **Sample:** >00191< >001A.0 A.25< (power suppy rev A, gas rev A)
002	GET_STATE	Manual gas system Auto gas system	Get the current state of the plasma system. **Data:** None **Return value:** Status code (see table V) **Sample:** >00292< >002000052< (status code 0)
003	LAST_ERROR	Manual gas system Auto gas system	Get the last error that occurred at the system. **Data:** None **Return value:** Error code (see table IV) **Sample:** >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. **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >00494< >0041C5<

Command table (2 of 13)

ID	Command	System	Description
028	READ_PLASMA_AMPS	Manual gas system Auto gas system	Read actual power supply current **Data:** None **Return value:** Power supply current in amps **Sample:** >0289A< >02801305E< (130 amps)
058	SET_NOMINAL_AMPS	Auto gas system	Set the power supply current in amps. **Data:** 5-260 Amps (Limited to 130 amps on the HPR130) **Return value:** Actual current value set **Sample:** >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. **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >0649A< >0641CB<
065	GAS_PREFLOW_TEST_STOP	Manual gas system Auto gas system	Turn off the preflow gases. Not allowed when cutting. **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >0659B< >0651CC<
066	GAS_CUTFLOW_TEST_START	Manual gas system Auto gas system	Turn on the cutflow gases. Not allowed when cutting. **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >0669C< >0661CD<
067	GAS_CUTFLOW_TEST_STOP	Manual gas system Auto gas system	Turn off the cutflow gases. Not allowed when cutting. **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >0679D< >0671CE<)

Command table (3 of 13)

ID	Command	System	Description
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). **Data:** None **Return value:** 1 = accepted, 0 = not accepted **Sample:** >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. **Data:** % of cutting current (50-100%) 50=50% **Return value:** % achieved **Sample:** >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. **Data:** 1 = override software to force pump on, 0 = system software controls the pump, override off **Return value:** 1 = accepted, 0 = not accepted **Sample:** >0711C9< >0711C9<
072	GET_CONTROL_VOLTAGE	Manual gas system Auto gas system	Returns the internal control voltage of the power supply **Data:** None **Return value:** Voltage (1/10 V) 1200 = 120.0 V **Sample:** >07299< >07212005C< (120.0 volts)

Command table (4 of 13)

ID	Command	System	Description
074	GET_IO_STATUS	Manual gas system Auto gas system	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. **Data:** None **Return value:** PA00000000 PB00000000 PC00000000 PD00000000 PE00000000 PF00000000 Ports A-F are returned space-delimited. The numbers are the decimal representation of the binary value of the port. 1 = on, 0 = off. **Sample:** >0749B< >074PA00000100 PB00000000 PC00010101 PD00100000 PE00010000 PF10000000B7<
078	SET_ALL_GAS_FLOWS	Auto gas system	Set all gas flow rates. N2 mix setpoint and Gas 2 mix setpoint are only applicable when using a mixed plasma gas such as H35 – N2. Otherwise, these 2 values should be set to 0. A value of 0 for N2 mix setpoint will cause the system to close SV12, the solenoid valve for N2 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. **Data:** Space-delimited: Plasma cutflow (0 –99 psi), Plasma preflow (0 – 99 psi), Shield cutflow (0 – 99 psi), Shield preflow (0 – 99 psi), N2 mix setpoint (0 – 100 psi), Gas2 mix setpoint (0 – 100 psi). **Return value:** 1 = accepted, 0 = not accepted **Sample:** >07855 45 35 25 50 50AB< >0781D0<

Command table (5 of 13)

ID	Command	System	Description
079	GET_PS_INFO	Manual gas system Auto gas system	Returns pressures, system state, and system error, space delimited **Data:** None **Return value:** 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) N2 Mix inlet pressure (0044 = 44 psi) Gas2 Mix inlet pressure (0044 = 44 psi) **Note:** Cut gas 1, Cut gas 2, N2 mix inlet, and Gas 2 mix inlet are not measured in the manual gas console configuration. **Sample:** >079A0< >079PC0044 PP0042 SC0034 SP0035 CS0040 ST0003 ER0000 CG0000 CG0000 MV0000 MV0000DE<
084	DOWNLOAD_SOFTWARE Not currently implemented on the HD4070 or the HPR systems	TBD	Download new firmware to the plasma system. **Data:** TBD **Return value:** 1 = packet accepted, 0 = not accepted **Sample:** TBD
085	WAKE	Manual gas system Auto gas system	This command is used to wake a system and enable its transmitter to communicate on a multi drop line. **Data:** System ID, which is set by dipswitches on PC board. **Return value:** Echo of the command **Sample:** >0850CD< >0850CD<
086	SLEEP	Manual gas system Auto gas system	Tell all systems on the line to disconnect their transmitters **Data:** None **Return value:** None **Sample:** >0869E< No response

Command table (6 of 13)

ID	Command	System	Description
087	BROADCAST MODE	Manual gas system Auto gas system	Tell all systems to listen but not respond. **Data:** None **Return value:** None **Sample:** >0879F< no response
094	READ_GAS_PRESSURES	Manual gas system Auto gas system	Read the gas pressures. **Data:** None **Return value:** 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), N2 Mix inlet pressure (psi), Gas2 Mix inlet pressure (psi) Space delimited Values are in psi (0007 = 7 psi) **Sample:** >0949D< >094PC0007 PP0036 SC0016 SP0003 CG0000 CG0000 MV0000 MV00005D<
095	SET_ALL_PARAMETERS	Auto gas system	Set all variables to run the plasma system. **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).** N2 mix setpoint and Gas 2 mix setpoint are only applicable when using a mixed plasma gas such as H35 – N2 otherwise these 2 values should be set to 0. A value of 0 for N2 Mix setpoint will cause the system to close SV12, the solenoid valve for N2 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. **Data:** Current setpoint (5 – 130/260 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), N2 mix setpoint (0 – 100 psi), Gas 2 mix setpoint (0 – 100 psi), Space delimited. **Return value:** 1= accepted, 0 = not accepted **Sample:** >095100 75 1 6 55 45 35 25 00 0084< >0951CF<

Command table (7 of 13)

ID	Command	System	Description
096	SET_INLET_GASES	Auto gas system	Set inlet gases for auto console. **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).** **Data:** Plasma gas type code (See table VI), Shield gas type code (See table VI), Space delimited. **Return value:** 1= accepted, 0 = not accepted **Sample:** >0961 626< (Set plasma gas = O2 and set shield gas = N2) >0961D0<
097	READ_CORNER_CURRENT	Manual gas system Auto gas system	Read the corner-current percentage **Data:** None **Return value:** Percentage **Sample:** >097A0< >09700756C< (75%)
098	GET_INLET_GASES	Manual gas system Auto gas system	Read the inlet gas types **Data:** None **Return value:** Plasma gas type code (See table VI), Shield gas type code (See table VI), Space delimited **Sample:** >098A1< >0980001 000648< (Plasma gas = O2 and shield gas = N2)
099	GET_GAS_FLOWS	Auto gas system	Read the gas setpoints **Data:** None **Return value:** Plasma cutflow setpoint (psi), Plasma preflow setpoint (psi), Shield cutflow setpoint (psi), Shield preflow setpoint (psi), N2 Mix setpoint (psi), Gas 2 mix setpoint (psi) Space delimited. (55 = 55 psi) **Sample:** >099A2< >0990055 0045 0035 0025 0050 0050EE<

Command table (8 of 13)

ID	Command	System	Description
100	GET_CONTROL_DATA	Manual gas system Auto gas system	Read internal control data: Chopper A used in HPR130/HPR260 Chopper B used in HPR260 Return string is the same whether the system is an HPR130 or HPR260. Chopper B data can be ignored for HPR130. 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). **Data:** None **Return value:** Above info is space delimited. **Sample:** >10091< >100CAT0482 CBT0021 LVO0118 CFL0009 CTP0481 TTP0481 CAC0001 CBC0014 WLC0005 CAS0000 CBS0534 PWMA0000 PWMB00000B<
101	SET_IO_STATUS	Manual gas system Auto gas system	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: **Data:** 1 = On, 0 = Off for each I/O point **Return value:** 1 = accepted, 0 = not accepted **Power Supply** 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 **Sample:** >1011111111111111DD< = All outputs on >1011C3<

Command table (9 of 13)

ID	Command	System	Description
102	SET_GAS_IO_FROM_PS	Manual gas system Auto gas system	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: **Data:** 1 = On, 0 = Off for each I/O point **Return value:** 1 = accepted, 0 = not accepted **Manual Gas Console** Shield cutflow (SV16) Calibrate bypass (SV13) Plasma cutflow 1 (SV14) Ramp-down valve (SV20) Shield preflow (SV17) Plasma preflow (SV18) Plasma cutflow 2 (SV 19) H35 plasma cutflow 2 (SV12) Spare valve (SV15) O2 shield cutflow (SV4) Air shield cutflow (SV5) N2 shield cutflow (SV6) Air preflow (SV7) N2 preflow (SV8) Air plasma cutflow 2 (SV9) Air plasma cutflow 1 (SV1) O2 plasma cutflow 1 (SV2) H35 plasma cutflow 1 (SV3) O2 plasma cutflow 2 (SV10) N2 plasma cutflow (SV11) **Auto Gas Console** O2 inlet (SV1) Air inlet (SV2) Air inlet 2 (SV3) H5 inlet (SV4) H35 inlet (SV5) F5 inlet (SV6) Spare out 1 (Spare) Ramp-down valve (SV16) Spare out 2 (Spare) Gas 2 no mix (SV14) Gas 2 mix (SV13) N2 mix (SV12) N2 inlet 2 (SV11) Air inlet 3 (SV10) N2 inlet (SV9) O2 air inlet (SV8) CH4 inlet (SV7) **Sample:** >10211111111111111111111167< >1021C4<

Command table (10 of 13)

ID	Command	System	Description
114	READ_INPUTS	Manual gas system Auto gas system	This command will return the status of inputs to the PC board. **Data:** None **Return value:** 1 = on, 0 = off **Power Supply** 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 **Sample:** >11496< >11400000000000000000F6<
117	READ_GAS_INPUTS_FROM_PS	Manual gas system Auto gas system	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. **Data:** None **Return value:** 1 = on, 0 = off **Manual Gas Console** Error select Status select Test preflow Test cutflow Serial ID bit 0 Serial ID bit 1 Serial ID bit 2 **Auto Gas Console** Metering dipswitch 2 Metering dipswitch 3 Metering dipswitch 4 Select dipswitch 1 Select dipswitch 2 Select dipswitch 3 Select dipswitch 4 Metering dipswitch 1 **Sample:** >11799< >1170000000E9<

Command table (11 of 13)

ID	Command	System	Description
121	LEAK_CHECK_MODE	Manual gas system Auto gas system	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. 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. For the inlet leak test, the system should have 0 psi on all gas channels, and hold at this pressure. For the system leak test, the system should charge all gas lines, then hold the pressure. The Burkert flow test checks for an expected PWM value for a set pressure and does a gas ramp-down test. **NOTE: This test is preformed using 130 amp O2/Air consumables and setting the 30 amp O2/O2 process** Each test takes about 40 seconds to complete. This command will only be accepted when the power supply is in the state IDLE2 (03) After leak checking is complete the system must be set to mode 0. An error code will reflect the state of the test. Using the GET_LAST_ERROR command, you can get the result of the test. 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) **Data:** Mode 0 = run 1 = Inlet leak check 2 = System leak check 3 = Burkert flow check **Return value:** Time for the test to run in seconds, 0 = not accepted **Sample:** >1211C5< >12140F8< “40 second test”

Command table (12 of 13)

ID	Command	System	Description
122	READ_GAS_SWITCH	Manual gas system	This command will return data that shows the actual position of the rotary switches used to set the inlet gas type. 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 O2 shield is not acceptable and is overridden by the software to be H35 plasma and N2 shield regardless of the position of the shield gas knob. In this case, the 098 command would return H35 N2. This command will return H35 O2. **Data:** None **Return value:** Plasma gas type code (See table VI), Shield gas type code (See table VI), Space delimited **Sample:** >12295< >1220001 00063C<
124	INDEX_MOTORVALVES	Auto gas system	Move the motor valve by a fixed number of ADC counts **Data:** Motor Valve number (1 or 2) Open/Clos (0 = Close, 1 = Open) Multiplier (move by x10 counts, 3 = move 30 counts) **Return value:** 1 = accepted **Sample:** Open Motor valve 1 by 30 counts >1241 1 36C< >1241C8<
125	GET_TIMER_COUNTER	Manual gas system Auto gas system	Read Timer/Counter data from the power supply **Data:** None **Return value:** 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) All fields are a fixed width of 7 numbers followed by a space. Sample: >12598< >1250000000 0000000 0000000 0000000 0000000 0000000 0000000 58<

Command table (13 of 13)

ID	Command	System	Description
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 **Sample:** >13296< >13280FE<

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

ID	Name	Description
000	NO ERROR	System is ready to run.
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	LOST CURRENT	After transfer, lost the chopper current signal.
026	LOST TRANSFER	After transfer, lost the transfer signal.
027	LOST PHASE	When main contactor is engaged, no “phase OK” input.
030	GAS SYSTEM ERROR	A failure has occurred in the gas system.
031	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.
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	CAN ERROR	An error occurred with the CAN communication system.
050	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).
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	CHOPPER1 OVERTEMP	Chopper #1 overheated.
066	CHOPPER2 OVERTEMP	Chopper #2 overheated.
067	MAGNETICS OVERTEMP	Transformer has overheated.
071	COOLANT OVERTEMP	Torch coolant has overheated.

ID	Name	Description
072	AUTOMATIC GAS CONTROL BOARD OVERTEMP	Control board has exceeded 90° C (194° F).
093	NO COOLANT FLOW	Coolant flow is less than 0.6 gpm.
099	CHOPPER1 OVERTEMP AT INIT	Chopper #1 is indicating overtemp during power-up.
100	CHOPPER2 OVERTEMP AT INIT	Chopper #2 is indicating overtemp during power-up.
101	MAGNETICS OVERTEMP AT INIT	Transformer is indicating overtemp during power-up.
102	OUTPUT CURRRENT AT INIT	Chopper current signal is active on power-up.
103	CURRENT TOO HIGH ON LEM #1	A current greater than 35 amps has been detected by current sensor 1.
104	CURRENT TOO HIGH ON LEM #2	A current greater than 35 amps has been detected by current sensor 2.
105	CURRENT TOO LOW ON LEM #1	A current less than 10 amps has been detected by current sensor 1.
106	CURRENT TOO LOW ON LEM #2	A current less than 10 amps has been detected by current sensor 2.
108	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	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	CHOPPER 1 OVERCURRENT	Chopper 1 current feedback has exceeded 160 amps.
138	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
151	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.
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

Status codes

ID	Name
00	IDLE
02	PURGE
03	IDLE2
04	PREFLOW
05	PILOT ARC
06	TRANSFER
07	RAMPUP
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

Gas type codes

ID	Gas type
0	No gas
1	Oxygen
2	Methane (CH_4) not supported
3	H35 (argon – hydrogen)
4	H5 (not supported)
5	Air
6	Nitrogen
7	CO_2 (not supported)
8	F5

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#95
2. Display and adjust the plasma preflow setpoint – pressure setting, see command ID#95
3. Display and adjust the plasma cutflow setpoint – pressure setting, see command ID#95
4. Display and adjust the shield preflow setpoint – pressure setting, see command ID#95
5. Display and adjust the shield cutflow setpoint – pressure setting, see command ID#95
6. Display and adjust the plasma gas type – inlet gas selection, see command ID#95
7. Display and adjust the shield gas type – inlet gas selection, see command ID#95
8. Display and adjust the gas mixing setpoint – pressure setpoint, see command ID#95
9. Display the system error code – error code numbers, see command ID#3
10. Display the system status code – status code numbers, see command ID#2
11. Manual pump control – manually turn on/off the pump, see command ID#71
12. Display the firmware version – version of power supply and gas console firmware, see command ID#1
13. Test preflow gases – put the system in test gas mode, see command ID#64, 65
14. Test cutflow gases – put the system in test gas mode, see command ID#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#100
17. Display chopper current(s) – see command ID#100
18. Display work lead current – see command ID#100
19. Display chopper temperature(s) – see command ID#100
20. Display transformer temperature – see command ID#100
21. Display gas pressures – see command ID#79
22. Display coolant flow rate – see command ID#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.

Application Notes

Transmitting extra characters at the end of a message, or transmitting while the plasma system is responding.

The original control board 041808 and power supply control software revision H and prior can sometimes “lock up” when the power supply receives characters while it is transmitting. The reason for this is that the control system cannot process interrupts fast enough. In some cases, when a receive and transmit interrupt occur very close together, the system will miss one of the interrupts and will not process any more serial characters. Under normal conditions, this will not be an issue. As long as you wait for a response to every command before transmitting the next command, the problem will not occur. Also it is important not to include extra characters at the end of a command such as a carriage return or line feed. These are not required and can cause problems.

Power supply control software revision P improves the capability of the system and will reduce the likelihood of occurrence, but it can still happen. The new style control board 041909 has fixed the problem in hardware.

Appendix C

CUT CHARTS FOR PREVIOUS SYSTEM REVISIONS

The cut charts in this appendix are for use with systems that have:

Auto gas firmware earlier than revision “E”

Power supply firmware earlier than revision “P”

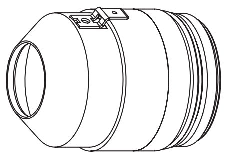
Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	46 / 97
Cutflow	22 / 46	0/0

Mild steel

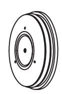
O_2 Plasma / O_2 Shield

30 A Cutting

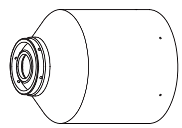
Note: Air must be connected to use this process. It is used as the preflow gas



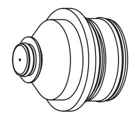
220173



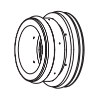
220194



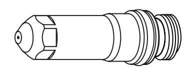
220313



220193



220180



220192

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	O_2	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			
			75			**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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O_2	O_2	78	17	94	17	**.018**	114	0.050	215	0.090	180	0.1
						.024			200			
						.030	115		170			0.2
						.036	116		155			0.3
						.048	117		110			
						.060	119		85			
			35		7	**.075**	120	0.060	60	0.110		0.4
						.105	122		50			
			75			**.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
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	105

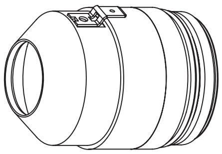
*Pierce complete is recommended for these thicknesses

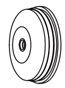
Mild steel

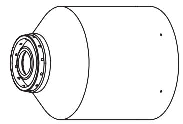
O_2 Plasma / Air Shield

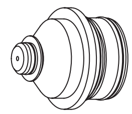
80 A Cutting

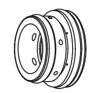
Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	76 / 161
Cutflow	23 / 48	41 / 87


220173


220189


220176


220188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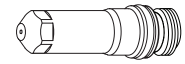

220187

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	Air	48	27	78	23	**2**	112	2.5	9810	3.8	150	0.1
						2.5	115		7980			
						3	117		6145			0.2
						4	120	2.0	4300	4.0	200	
						6	123		3045			0.3
						10	127		1810			0.5
					15	**12**	130		1410	5.0	250	0.7
						15	133		1030			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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O_2	Air	48	27	78	23	**.075**	112	0.100	400	0.150	150	0.1
						.105	115		290			
						.135	117		180			0.2
						3/16	120	0.080	155	0.160	200	
						1/4	123		110			0.3
						3/8	127		75			0.5
					15	**1/2**	130		50	0.200	250	0.7
						5/8	133		37			0.8
						3/4	135	0.100	25	0.250		0.9

Marking

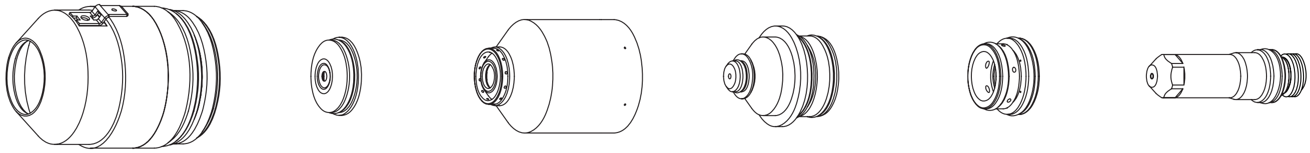
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	130

Mild steel

O_2 Plasma / Air Shield

130 A Cutting

Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	102 / 215
Cutflow	33 / 70	45 / 96



220173 220183 220176 220182 220179 220181

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	Air	32	38	84	32	**3**	124	2.5	6505	5.0	200	0.1
						4	126	2.8	5550	5.6		0.2
						6	127		4035			0.3
					27	**10**	130	3.0	2680	6.0		
						12	132	3.3	2200	6.6		0.5
						15	135	3.8	1665	7.6		0.7
			60			**20**	138		1050			1.0
						25	141	4.0	550		190	1.8
						32	160	4.5	375	N/A		
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O_2	Air	32	38	84	32	**.135**	124	0.100	240	0.200	200	0.1
						3/16	126	0.110	190	0.220		0.2
						1/4	127		150			0.3
					27	**3/8**	130	0.120	110	0.240		
						1/2	132	0.130	80	0.260		0.5
						5/8	135	0.150	60	0.300		0.7
			60			**3/4**	138		45			1.0
						1	141	0.160	20		190	1.8
						1-1/4	160	0.180	15	N/A		
						1-1/2	167		10			

Marking

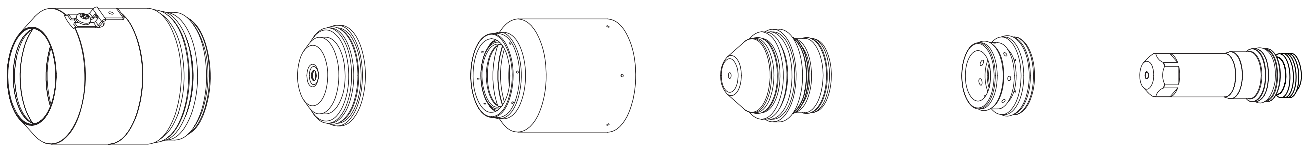
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	130

Mild steel

O_2 Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	128 / 270
Cutflow	39 / 82	48 / 101



220398 220356 220355 220354 220353 220352

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
O_2	Air	23	49	74	20	**6**	124	3.3	5250	6.6	200	0.2
						10	126		3460			0.3
						12	128		3060			0.5
						15	131	4.1	2275	8.2		0.6
						20	133		1575			0.8
						25	143	5.1	1165	10.2		1.0
						32	145		750			N/A
						38	152		510			N/A
						50	163		255			N/A

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
O2	Air	23	49	74	20	**3/16**	124	0.130	230	0.260	200	0.2
						1/4	124		200			0.2
						3/8	126		140			0.3
						1/2	128		115			0.5
						5/8	131	0.160	80	0.320		0.6
						3/4	133		65			0.8
						1	143	0.200	45	0.400		1.0
						1-1/4	145		30			N/A
						1-1/2	152		20			N/A
						2	163		10			N/A

Marking

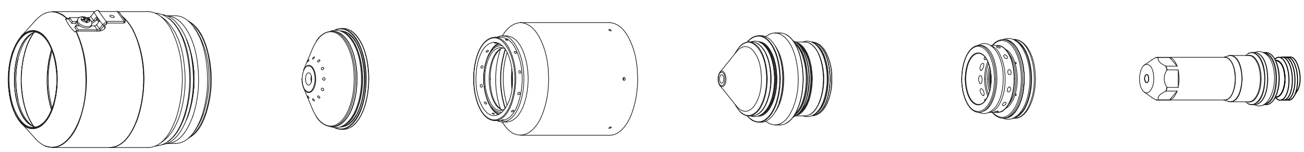
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
Plasma	Shield	Plasma	Shield	Plasma	Shield	**Amps**	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	130

Mild steel

O_2 Plasma / Air Shield

260 A Cutting

Flow rates – lpm/scfh @ 3/4" setting		
	O_2	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220



220398 220440 220433 220439 220436 220435

Metric

Select Gases Plasma	Select Gases Shield	Set Preflow Plasma	Set Preflow Shield	Set Cutflow Plasma	Set Cutflow Shield	**Material Thickness** mm	Arc Voltage Volts	Torch-to-Work Distance mm	Cutting Speed mm/m	Initial Pierce Height mm	Initial Pierce Height factor %	Pierce Delay Time seconds
O_2	Air	22	58	76	54	**6**	150	2.8	6500	8.5	300	0.3
						10	150		4440			
						12	150		3850			0.4
				80	58	**15**	155	3.6	3130	9.0	250	0.5
						20	159		2170			0.6
						22	166		1930			0.7
				84		**25**	171		1685			0.8
						28	170	4.8	1445	9.5	200	0.9
						32	172		1135			1.0
						38	174		895			1.2
						44	185		580	N/A		
						50	188		405			
						58	193		290			
						64	202		195			

English

Select Gases Plasma	Select Gases Shield	Set Preflow Plasma	Set Preflow Shield	Set Cutflow Plasma	Set Cutflow Shield	**Material Thickness** in	Arc Voltage Volts	Torch-to-Work Distance in	Cutting Speed ipm	Initial Pierce Height in	Initial Pierce Height factor %	Pierce Delay Time seconds
O_2	Air	22	58	76	54	**1/4**	150	0.110	250	0.330	300	0.3
						3/8	150		180			
						1/2	150		145			0.4
				80	58	**5/8**	155	0.140	115	0.350	250	0.5
						3/4	159		90			0.6
						7/8	166		75			0.7
				84		**1**	171		65			0.8
						1-1/8	170	0.190	55	0.380	200	0.9
						1-1/4	172		45			1.0
						1-1/2	174		35			1.2
						1-3/4	185		22	N/A		
						2	188		15			
						2-1/4	193		12			
						2-1/2	202		8			

Marking

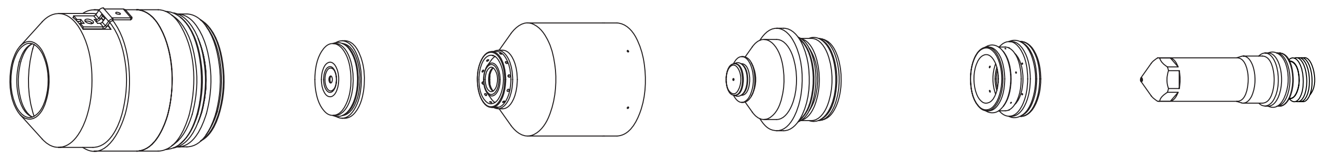
Select Gases		Set Preflow		Set Cutflow		**Amperage** **Amps**	Torch-to-Work Distance mm	Torch-to-Work Distance in	Marking Speed mm/min	Marking Speed ipm	Arc Voltage Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	135

Stainless steel

N_2 Plasma / N_2 Shield

45 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	24 / 51
Cutflow	75 / 159



220173 220202 220304 220201 220180 220308

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	35	5	62	55	**0.8**	94	2.5	6380	3.8	150	0.0
						1			5880			0.1
						1.2			5380			0.2
						1.5	95		4630			
						2	97		3935			
						2.5	101		3270			
						3	103		2550			0.3
						4			1580			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	35	5	62	55	**.036**	94	0.100	240	0.150	150	0.0
						.048			210			0.1
						.060	95		180			0.2
						.075	97		160			
						.105	101		120			
						.135	103		75			0.3

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	85

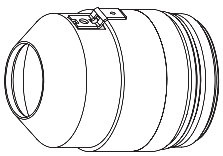
Note: This process produces a darker cut edge than the 45A, F5/N_2 stainless steel process

Stainless steel

F5 Plasma / N_2 Shield

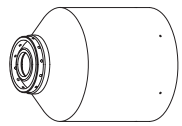
45 A Cutting

Flow rates – lpm/scfh		
	F5	N_2
Preflow	0 / 0	43 / 91
Cutflow	8 / 17	65 / 138

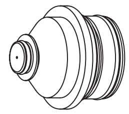


220173

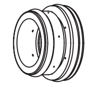
220202



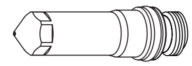
220304



220201



220180



220308

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
F5	N_2	35	25	62	55	**0.8**	99	2.5	6570	3.8	150	0.2
						1			5740			
						1.2			4905			
						1.5			3890			
						2	101		3175			
						2.5	102		2510			
						3	103		2010			0.3
						4	104		1435			
					15	**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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
F5	N_2	35	25	62	55	**.036**	99	0.100	240	0.150	150	0.2
						.048			190			
						.060			150			
						.075	100		130			
						.105	102		90			
						.135	104		65			0.3
					15	**3/16**	108	0.080	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/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	85

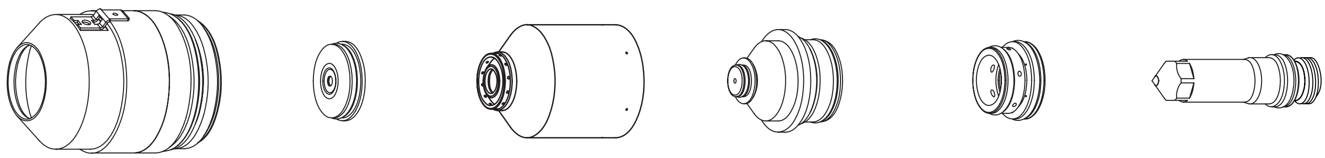
Note: This process produces a shinier cut edge than the 45A, N_2/N_2 stainless steel process

Stainless steel

F5 Plasma / N_2 Shield

80 A Cutting

Flow rates – lpm/scfh		
	F5	N_2
Preflow	0 / 0	67 / 142
Cutflow	31 / 65	55 / 116



220173 220338 220304 220337 220179 220339

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
F5	N_2	33	27	65	42	**4**	108	3.0	2180	4.5	150	0.2
						6	112	2.5	1225	3.8		0.3
						10	120	3.0	560	4.5		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
F5	N_2	33	27	65	42	**.135**	108	0.120	105	0.180	150	0.2
						3/16	110	0.110	60	0.170		0.3
						1/4	112	0.100	45	0.150		
						3/8	120	0.120	25	0.180		0.5

Marking

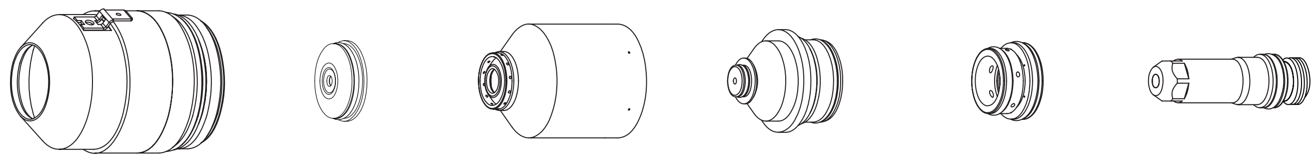
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	95

Stainless steel

N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	97 / 205
Cutflow	79 / 168



220173 220198 220176 220197 220179 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	19	60	75	27	**6**	153	3.0	1960	6.0	200	0.3
						10	156		1300			0.5
						12	162	3.5	900	7.0		0.8
						15	167	3.8	670	N/A		
						20	176	4.3	305			

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	19	60	75	27	**1/4**	153	0.120	75	0.240	200	0.3
						3/8	156		55			0.5
						1/2	162	0.140	30	0.280		0.8
						5/8	167	0.150	25	N/A		
						3/4	176	0.170	15			

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

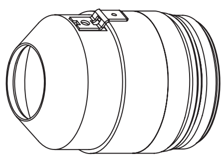
Note: This process produces a rougher, darker cut edge with more dross and less cut angle variation than the 130A, H35/N_2 process

Stainless steel

H35 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144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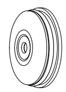
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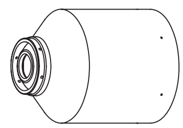
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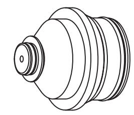
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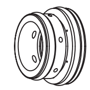
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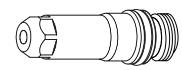

220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	38	75	54	**10**	154	4.5	980	7.7	170	0.3
					42	**12**	158		820			0.5
					27	**15**	162		580			0.8
						20	165		360			1.3
					20	**25**	172		260	N/A		

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	38	75	54	**3/8**	154	0.180	40	0.310	170	0.3
					42	**1/2**	158		30			0.5
					27	**5/8**	162		20			0.8
						3/4	165		15			1.3
					20	**1**	172		10	N/A		

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

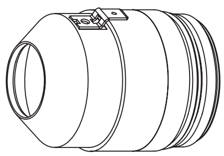
Note: This process produces a smoother, shinier cut edge with less dross and greater cut angle variation than the 130A, N_2/N_2 process

Stainless steel

H35 and N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150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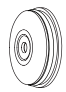
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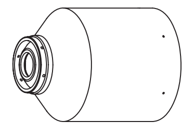
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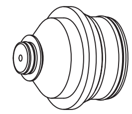
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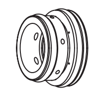
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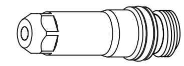

220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	60	75	38	32	18	**6**	150	3.0	1835	6.0	200	0.3
								10	153		1195			0.3
					27			**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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	60	75	38	32	18	**1/4**	150	0.120	70	0.240	200	0.3
								3/8	153		50			0.3
					27			**1/2**	160	0.140	30	0.280		0.5
								5/8	168	0.150	25	0.300		0.8
								3/4	176	0.170	15	0.310	180	1.3

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

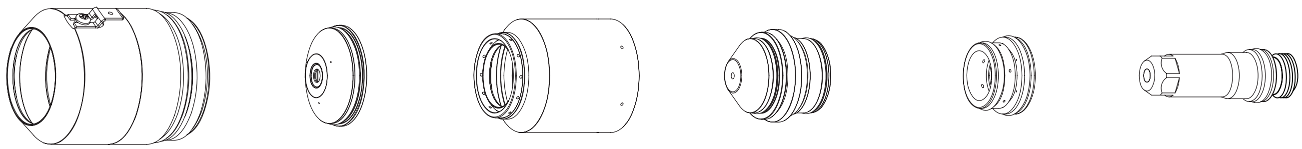
Note: This process produces a smoother, shinier cut edge with less dross and greater cut angle variation than the 130A, N_2/N_2 process. Edge color is more silver than the H35/N_2 process.

Stainless steel

H35 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	116 / 245
Cutflow	30 / 63	104 / 220



220398 220345 220344 220343 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	51	90	60	**10**	175	9.0	1620	9.0	100	0.5
						12	170	7.5	1450	7.5		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	51	90	60	**3/8"**	175	0.350	65	0.350	100	0.5
						1/2"	170	0.300	55	0.300		0.6
						5/8"	173		45			0.7
						3/4"	177		35			0.8

Marking

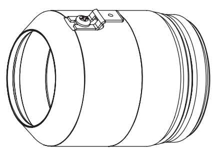
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Stainless steel

N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh	
	N_2
Preflow	111 / 235
Cutflow	137 / 290



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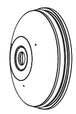

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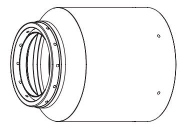

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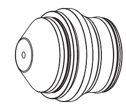

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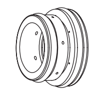

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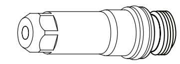


220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	23	49	85	49	**10**	160	3.8	2700	7.6	200	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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	23	49	85	49	**3/8**	160	0.150	110	0.300	200	0.5
						1/2	161		90			0.6
						5/8	163		65			0.8
						3/4	167		45			1.0

Marking

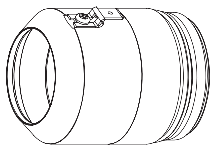
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Stainless steel

H35 and N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	116 / 245
Cutflow	11 / 24	118 / 250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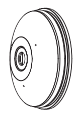
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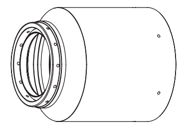
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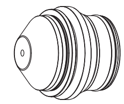
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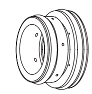
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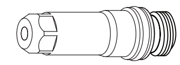

220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	23	49	87	49	42	20	**10**	161	4.0	1900	8.0	200	0.5
								12	162		1800			0.6
								15	167	4.6	1600	9.0	150	0.8
								20	171	5.1	1000	10.0		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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	23	49	87	49	42	20	**3/8**	161	0.160	75	0.320	200	0.5
								1/2	162		70			0.6
								5/8	167	0.180	60	0.27	150	0.8
								3/4	171	0.200	45	0.3		1.0

Marking

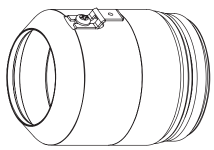
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Stainless steel

H35 Plasma / N_2 Shield

260 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



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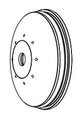

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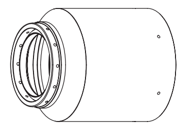

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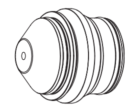

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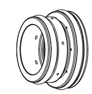

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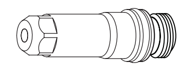


220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	12	59	85	71	**10**	188	11.0	1870	11.0	100	0.3
						12	173	9.0	1710	9.0		0.4
						15	171	7.5	1465		120	0.5
						20	175		1085			0.6
						25	180		785			0.7
						32	185		630			1.0
						38	186		510	N/A		
						44	189		390			
						50	200		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	12	59	85	71	**3/8**	188	0.450	75	0.500	100	0.3
						1/2	173	0.350	65	0.350		0.4
						5/8	171	0.300	55	0.360	120	0.5
						3/4	175		45			0.6
						1	180		30			0.7
						1-1/4	185		25			1.0
						1-1/2	186		20	N/A		
						1-3/4	189		15			
						2	200		10			

Marking

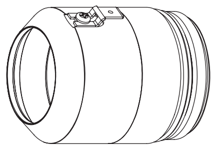
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Stainless steel

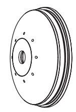
N_2 Plasma / Air Shield

260 A Cutting

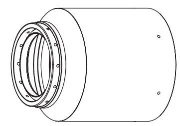
Flow rates – lpm/scfh		
	N_2	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



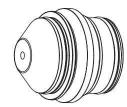
220398



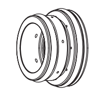
220407



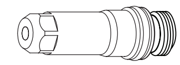
220344



220406



220405



220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	Air	12	60	79	69	**6**	160	3.8	6375	7.5	200	0.3
						10	157		3440			
						12	161		2960			0.4
						15	163		2520			0.5
						20	164		1590			0.6
						25	168		1300			0.8
						32	171		875			1.0
						38	179		515	N/A		
						44	190		365			
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	Air	12	60	79	69	**1/4**	160	0.150	240	0.300	200	0.3
						3/8	157		140			
						1/2	161		110			0.4
						5/8	163		95			0.5
						3/4	164		70			0.6
						1	168		50			0.8
						1-1/4	171		35			1.0
						1-1/2	179		20	N/A		
						1-3/4	190		14			
						2	200		6			

Marking

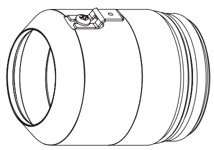
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Stainless steel

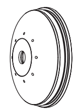
H35 and N_2 Plasma / N_2 Shield

260 A Cutting

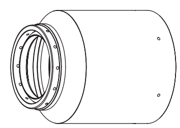
Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	132 / 280
Cutflow	13 / 27	163 / 345



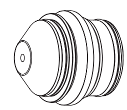
220398



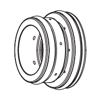
220407



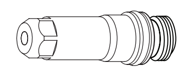
220344



220406



220405



220307

Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	12	59	87	71	60	21	**6**	170	4.0	3980	8.0	200	0.3
								10	175		2190			
								12	176		1790			0.5
								15	177		1650			0.7
								20	179		1320			0.8
						40	26	**25**	182		920			1.0
								32	186		755			1.2
								38	189		510	N/A		
								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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	12	59	87	71	60	21	**1/4**	170	0.160	150	0.320	200	0.3
								3/8	175		90			
								1/2	176		65			0.5
								5/8	177		65			0.7
								3/4	179		55			0.8
						40	26	**1**	182		35			1.0
								1-1/4	186		30			1.2
								1-1/2	189		20	N/A		
								1-3/4	187		15			
								2	202		10			

Marking

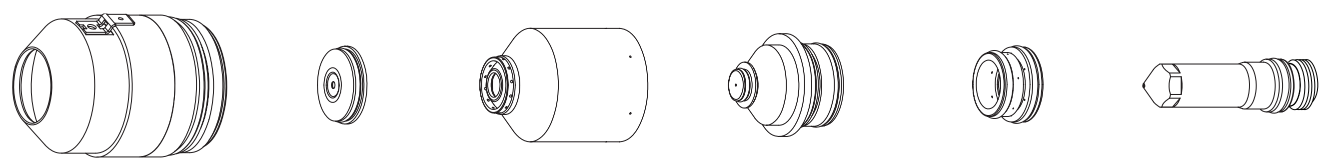
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Aluminum

Air Plasma / Air Shield

45 A Cutting

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



220173 220202 220176 220201 220180 220308

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
Air	Air	35	25	62	55	**1.2**	130	2.5	5670	3.8	150	0.2
						1.5	115		4420			
						2	113		4000			
						2.5	110		3665			
						3	107		3225			
					38	**4**	102	1.8	2575	2.7		0.3
						6	117	3.0	1690	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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
Air	Air	35	25	62	55	**.048**	130	0.100	220	0.150	150	0.2
						.060	115		170			
						.075	113		160			
						.105	110		140			
					38	**.135**	102	0.070	110	0.110		0.3
						3/16	114	0.120	90	0.180		0.4
						1/4	117		60			0.6

Marking

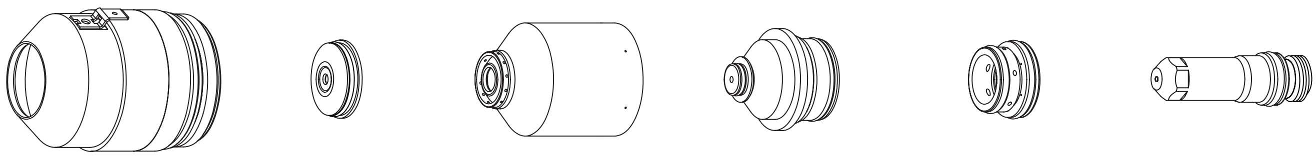
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**15**	2.5	0.100	6350	250	85

Aluminum

Air Plasma / Air Shield

130 A Cutting

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



220173 220198 220176 220197 220179 220181

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
Air	Air	19	38	75	27	**6**	153	2.8	2370	5.6	200	0.2
						10	154	3.0	1465	6.0		0.3
						12	156		1225			0.5
						15	158	3.3	1050	6.6		0.8
						20	162	3.5	725	7.0		1.3
						25	172	4.0	525	N/A		

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
Air	Air	19	38	75	27	**1/4**	153	0.110	90	0.220	200	0.2
						3/8	154	0.120	60	0.240		0.3
						1/2	156		45			0.5
						5/8	158	0.130	40	0.260		0.8
						3/4	162	0.140	30	0.280		1.3
						1	172	0.160	20	N/A		

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

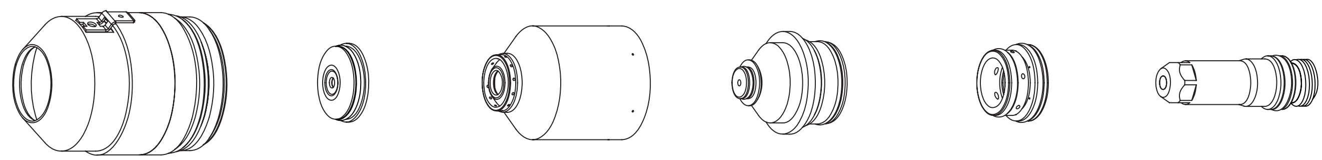
Note: This process produces a rougher cut edge with larger average angles than the 130A, $H35/N_2$ process

Aluminum

H35 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144



220173 220198 220304 220197 220179 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	38	75	54	**10**	158	5.0	1615	6.5	130	0.3
					42	**12**	156	4.5	1455	7.7	170	0.5
					27	**15**	156		1305			0.8
						20	157		940			1.3
					20	**25**	176		540	N/A		

English

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	38	75	54	**3/8**	158	0.200	65	0.260	130	0.3
					42	**1/2**	156	0.180	55	0.310	170	0.5
					27	**5/8**	156		50			0.8
						3/4	157		40			1.3
					20	**1**	176		20	N/A		

Marking

Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

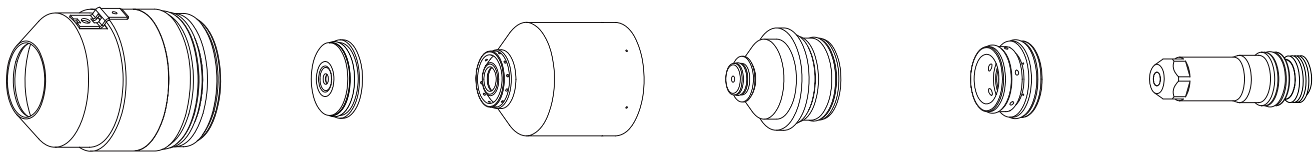
Note: This process produces a smoother cut edge with smaller average angles than the 130A, Air/Air process

Aluminum

H35 and N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	71 / 150



Metric

Select Gases		Set Preflow		Set Cutflow				Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	19	60	75	27	32	18	**6**	156	3.5	2215	7.0	200	0.3
								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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	19	60	75	27	32	18	**1/4**	156	0.140	85	0.280	200	0.3
								3/8	158		65			
								1/2	159	0.120	55	0.240		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/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	130

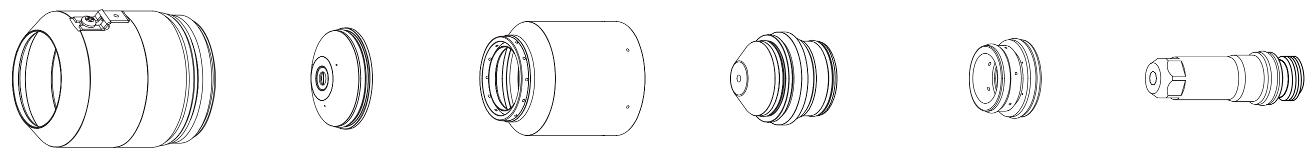
Note: This process produces a smoother cut edge with smaller average angles than the 130A, Air/Air process

Aluminum

H35 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	113 / 240
Cutflow	34 / 72	90 / 190



220398 220345 220347 220346 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	53	73	53	**10**	152	6.4	4400	9.0	140	0.3
						12	150		3800			0.4
						15	150		3000			0.5
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	53	73	53	**3/8**	152	0.250	180	0.350	140	0.3
						1/2	150		140			0.4
						5/8	150		110			0.5
						3/4	159		70			0.6

Marking

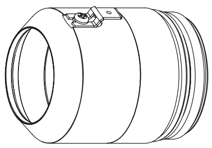
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

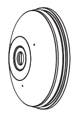
N_2 Plasma / N_2 Shield

200 A Cutting

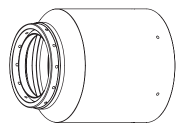
Flow rates – lpm/scfh	
	N_2
Preflow	113 / 240
Cutflow	135 / 287



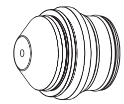
220398



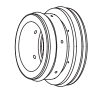
220345



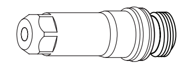
220347



220346



220342



220307

Metric

Select Gases		Set Preflow		Set Cutflow		**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	N_2	22	53	73	53	**10**	158	6.4	4750	9.0	140	0.4
						12	158		3500			0.5
						15	166		2350			0.6
						20	165		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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	N_2	22	53	73	53	**3/8**	158	0.250	200	0.350	140	0.4
						1/2	158		120			0.5
						5/8	166		80			0.6
						3/4	165		50			0.8

Marking

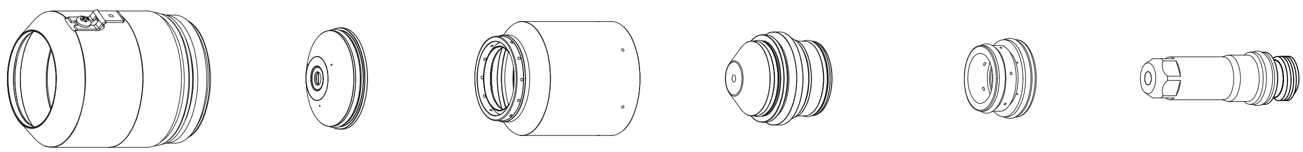
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

H35 and N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	121 / 256
Cutflow	13 / 27	126 / 267



220398 220345 220347 220346 220342 220307

Metric

Select Gases		Set Preflow		Set Cutflow				**Material Thickness**	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**mm**	Volts	mm	mm/m	mm	factor %	seconds
H35	N_2	22	53	73	53	42	20	**10**	158	6.4	4000	9.0	140	0.3
								12	158		3650			0.4
								15	162		2450			0.5
								20	170		1050			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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	**in**	Volts	in	ipm	in	factor %	seconds
H35	N_2	22	53	73	53	42	20	**3/8**	158	0.250	160	0.350	140	0.3
								1/2	158		140			0.4
								5/8	162		80			0.5
								3/4	170		50			0.6

Marking

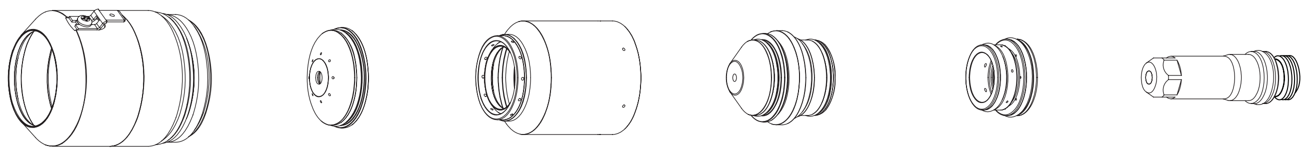
Select Gases		Set Preflow		Set Cutflow		**Amperage**	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	140

Aluminum

H35 Plasma / N_2 Shield

260 A Cutting

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	127 / 270
Cutflow	33 / 70	118 / 250



220398 220407 220344 220406 220405 220307

Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
						6	170	11.0	7200	11.0	100	0.2
						10	170	10.0	6120	10.0	100	0.4
						12	162		5160			0.5
						15	163		3720	8.5	110	0.6
H35	N_2	12	60	76	69	**20**	166		2230			0.6
						25	174	7.6	1930	11.0	150	0.8
						32	175		1510			
						38	176		1150	N/A		
						44	183		670			
						50	190		390			

English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
						1/4	170	0.450	280	0.450	100	0.2
						3/8	170	0.400	250	0.400	100	0.4
						1/2	162		190			0.5
						5/8	163		130	0.330	110	0.6
H35	N_2	12	60	76	69	**3/4**	166		90			0.6
						1	174	0.300	75	0.450	150	0.8
						1-1/4	175		60			
						1-1/2	176		45	N/A		
						1-3/4	183		25			
						2	190		14			

Marking

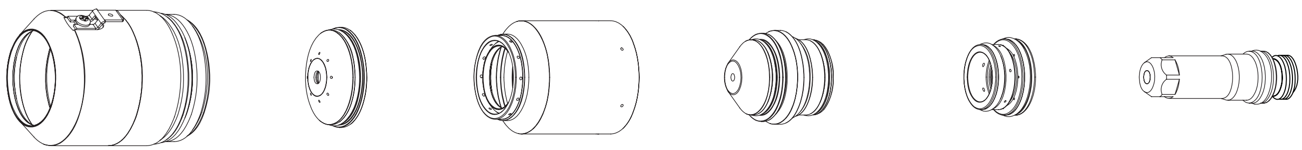
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Aluminum

N_2 Plasma / Air Shield

260 A Cutting

Flow rates – lpm/scfh		
	N_2	Air
Preflow	125 / 265	0 / 0
Cutflow	50 / 105	113 / 240



220398 220407 220344 220406 220405 220307

Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	**mm**	Volts	mm	mm/m	mm	factor %	seconds
N_2	Air	12	60	74	69	**6**	172	6.40	7900	9.0	140	0.2
						10	171		4930			0.4
						12	164	4.00	4290	8.0	200	0.5
						15	165		3330			0.6
						20	171		1940			
						25	177		1440	11.0	260	0.8
						32	191		940	N/A		
						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	Shield	Plasma	Shield	Plasma	Shield	**in**	Volts	in	ipm	in	factor %	seconds
N_2	Air	12	60	74	69	**1/4**	172	0.250	300	0.350	140	0.2
						3/8	171		200			0.4
						1/2	164	0.160	160	0.320	200	0.5
						5/8	165		120			0.6
						3/4	171		80			
						1	177		55	0.420	260	0.8
						1-1/4	191		40	N/A		
						1-1/2	195		20			
						1-3/4	202		12			
						2	205		8			

Marking

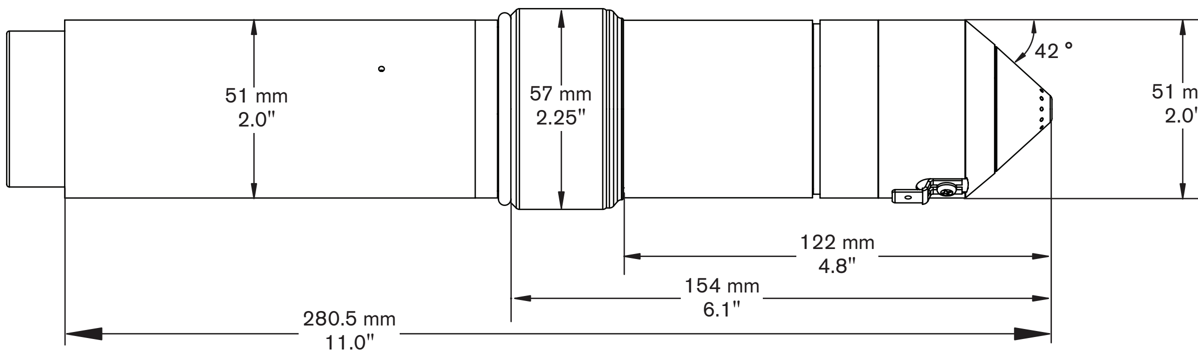
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	**18**	2.5	0.100	6350	250	120

Appendix D

BEVEL CUTTING

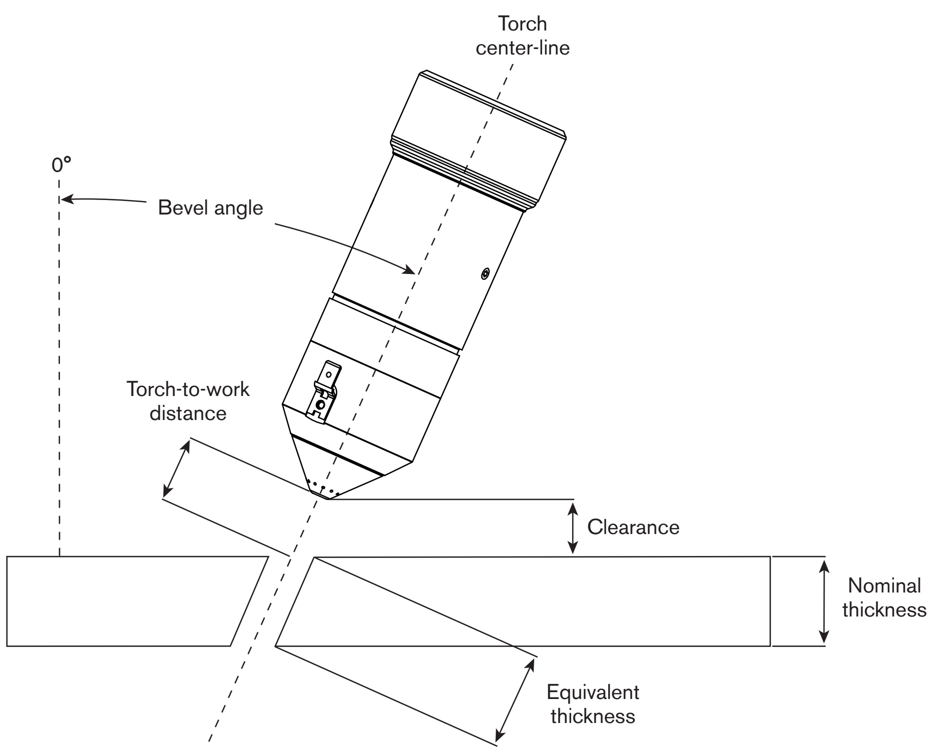
In this appendix:

Bevel torch dimensions



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.



Cut charts

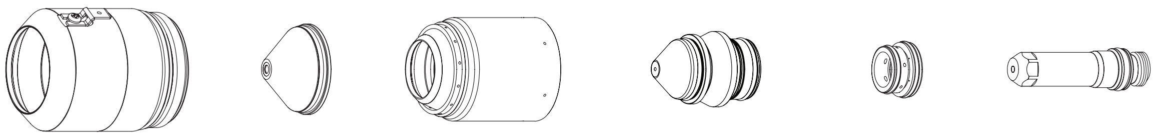
Initial pierce heights and pierce delay times listed in the cut charts are for straight cuts. Edge start indicates that the material thickness is outside the range that can be pierced. These thicknesses can only be cut by using an edge start.

Mild steel bevel cutting

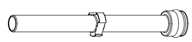
O_2 Plasma / Air Shield

130 A

Flow rates – lpm/scfh		
	O_2	Air
Preflow	0 / 0	64 / 135
Cutflow	33 / 70	45 / 96



220398 220645 220603 220646 220179 220649

Notes: Bevel angle range is 0° to 45°. Water tube 220700  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
O_2	Air	15	23	84	24	2.0	**3**	2.5 – 8.6	6505	5.0	200	0.1
							4	2.8 – 8.6	5550	5.6		0.2
							6		4035			0.3
					18		**10**	3.0 – 8.6	2680	6.0		
							12	3.3 – 8.6	2200	6.6		0.5
							15	3.8 – 8.6	1665	7.6		0.7
							20		1050			1.0
							25	4.0 – 8.6	550		190	1.8
							32	4.5 – 8.6	375	Edge start		
							38		255			

English

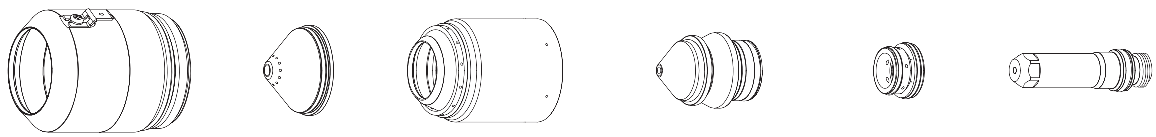
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
O_2	Air	15	23	84	24	0.080	**0.135**	0.100 – 0.340	240	0.200	200	0.1
							3/16	0.110 – 0.340	190	0.220		0.2
							1/4		150			0.3
					18		**3/8**	0.120 – 0.340	110	0.240		
							1/2	0.130 – 0.340	80	0.260		0.5
							5/8	0.150 – 0.340	60	0.300		0.7
							3/4		45			1.0
							1	0.160 – 0.340	20		190	1.8
							1-1/4	0.180 – 0.340	15	Edge start		
							1-1/2		10			

Mild steel bevel cutting

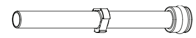
O_2 Plasma / Air Shield

260 A

Flow rates – lpm/scfh @ 3/4" setting		
	O_2	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220



220398 220545 220603 220542 220436 220541

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
O_2	Air	22	49	76	46	2.0	**6**	2.8 – 7.6	6500	8.5	300	0.3
							10		4440			
							12		3850			0.4
				80	49		**15**	3.6 – 7.6	3130	9.0	250	0.5
							20		2170			0.6
							22		1930			0.7
				84			**25**		1685			0.8
							28	4.8 – 7.6	1445	9.5	200	0.9
							32		1135			1.0
							38		895			1.2
							44		580	Edge start		
							50		405			
							58		290			
							64		195			

English

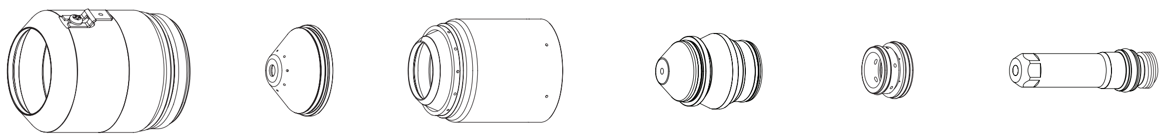
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
O_2	Air	22	75	70	70	0.080	**1/4**	0.110 – 0.300	245	0.330	300	0.3
							3/8		180			
							1/2		145			0.4
				75	75		**5/8**	0.140 – 0.300	115	0.350	250	0.5
							3/4		90			0.6
							7/8		75			0.7
				80			**1**		65			0.8
							1-1/8	0.190 – 0.300	55	0.380	200	0.9
							1-1/4		45			1.0
							1-1/2		35			1.2
							1-3/4		22	Edge start		
							2		15			
							2-1/4		12			
							2-1/2		8			

Stainless steel bevel cutting

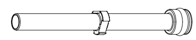
H35 Plasma / N_2 Shield

130 A

Flow rates – lpm/scfh		
	H35	N_2
Preflow	0 / 0	90 / 190
Cutflow	26 / 54	114 / 240



220398 220609 220608 220656 220179 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
H35	N_2	19	32	75	63	2.0	**10**	4.5 – 10.0	980	7.7	170	0.3
							12		820			0.5
							15		580			0.8
							20		360			1.3
							25		260	Edge start		

English

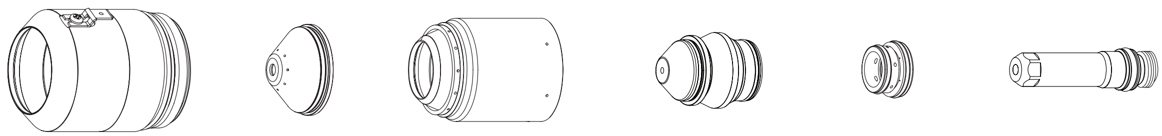
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
H35	N_2	19	32	75	63	0.080	**3/8**	0.180 – 0.400	40	0.310	170	0.3
							1/2		30			0.5
							5/8		20			0.8
							3/4		15			1.3
							1		10	Edge start		

Stainless steel bevel cutting

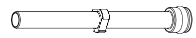
N_2 Plasma / N_2 Shield

130 A

Flow rates – lpm/scfh	
	N_2
Preflow	97 / 205
Cutflow	125 / 260



220398 220609 220608 220656 220179 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
N_2	N_2	19	51	75	63	2.0	**6**	3.0 – 10.0	1960	6.0	200	0.3
							10		1300			0.5
							12	3.5 – 10.0	900	7.0		0.8
							15	3.8 – 10.0	670	Edge start		
							20	4.3 – 10.0	305			

English

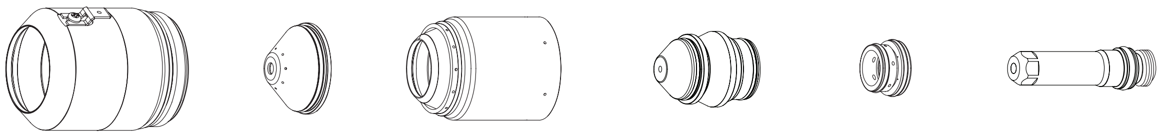
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
N_2	N_2	19	51	75	63	0.080	**1/4**	0.120 – 0.400	75	0.240	200	0.3
							3/8		55			0.5
							1/2	0.140 – 0.400	30	0.280		0.8
							5/8	0.150 – 0.400	25	Edge start		
							3/4	0.170 – 0.400	15			

Stainless steel bevel cutting

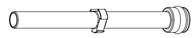
H35 and N_2 Plasma / N_2 Shield

130 A

Flow rates – lpm/scfh @ 3/4" setting		
	H35	N_2
Preflow	0 / 0	97 / 205
Cutflow	13 / 28	120 / 250



220398 220609 220608 220656 220179 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	mm	**mm**	mm	mm/m	mm	factor %	seconds
H35	N_2	19	51	75	80	32	18	2.0	**6**	3.0 – 10.0	1835	6.0	200	0.3
									10		1195			
									12	3.5 – 10.0	875	7.0		0.5
									15	3.8 – 10.0	670	7.6		0.8
									20	3.0 – 10.0	305	7.7	180	1.3

English

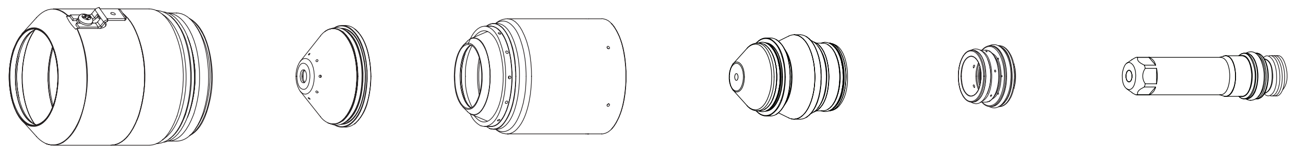
Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	in	**in**	in	ipm	in	factor %	seconds
H35	N_2	19	51	75	80	32	18	0.080	**1/4**	0.120 – 0.400	70	0.240	200	0.3
									3/8		50			
									1/2	0.140 – 0.400	30	0.280		0.5
									5/8	0.150 – 0.400	25	0.300		0.8
									3/4	0.170 – 0.400	15	0.310	180	1.3

Stainless steel bevel cutting

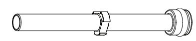
H35 Plasma / N_2 Shield

260 A

Flow rates – lpm/scfh @ 3/4" setting		
	H35	N_2
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



220398 220609 220608 220607 220405 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
H35	N_2	12	49	85	6088	2.0	**10**	11.0	1870	12.5	100	0.3
							12	9.0 – 10.0	1710	9.0		0.4
							15	7.5 – 10.0	1465		120	0.5
							20		1085			0.6
							25		785			0.7
							32		630			1.0
							38		510	Edge start		
							44		390			
							50		270			

English

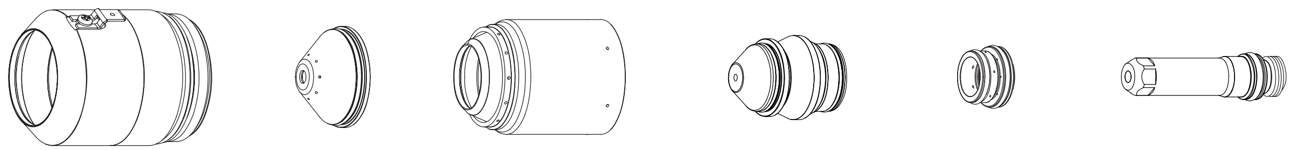
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
H35	N_2	12	49	85	60	0.080	**3/8**	0.450	75	0.500	100	0.3
							1/2	0.350 – 0.400	65	0.350		0.4
							5/8	0.300 – 0.400	55	0.360	120	0.5
							3/4		45			0.6
							1		30			0.7
							1-1/4		25			1.0
							1-1/2		20	Edge start		
							1-3/4		15			
							2		10			

Stainless steel bevel cutting

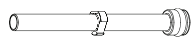
N_2 Plasma / Air Shield

260 A

Flow rates – lpm/scfh @ 3/4" setting		
	N_2	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



220398 220609 220608 220607 220405 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

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	Shield	Plasma	Shield	Plasma	Shield	mm	**mm**	mm	mm/m	mm	factor %	seconds
N_2	Air	12	47	79	56	2.0	**6**	3.8 – 10.0	6375	7.5	200	0.3
							10		3440			
							12		2960			0.4
							15		2520			0.5
							20		1590			0.6
							25		1300			0.8
							32		875			1.0
							38		515	Edge start		
							44		365			
							50		180			

English

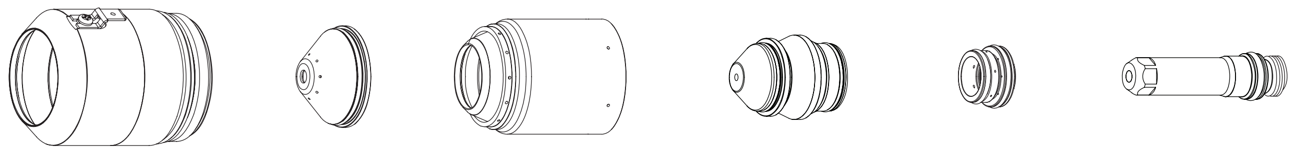
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	**in**	in	ipm	in	factor %	seconds
N_2	Air	12	47	79	56	0.080	**1/4**	0.150 – 0.400	240	0.300	200	0.3
							3/8		140			
							1/2		110			0.4
							5/8		95			0.5
							3/4		70			0.6
							1		50			0.8
							1-1/4		35			1.0
							1-1/2		20	Edge start		
							1-3/4		14			
							2		6			

Stainless steel bevel cutting

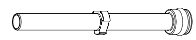
H35 and N_2 Plasma / N_2 Shield

260 A

Flow rates – lpm/scfh @ 3/4" setting		
	H35	N_2
Preflow	0 / 0	132 / 280
Cutflow	13 / 27	163 / 345



220398 220609 220608 220607 220405 220606

Notes: Bevel angle range is 0° to 45°. Water tube 220571  must be used with these consumables.

Metric

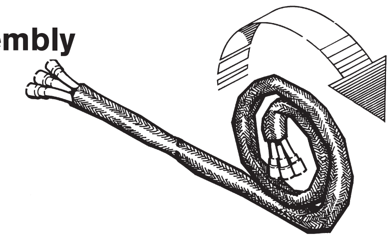
Select Gases		Set Preflow		Set Cutflow				Minimum Clearance	**Equivalent Material Thickness**	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	mm	**mm**	mm	mm/m	mm	factor %	seconds
H35	N_2	12	49	87	60	60	21	2.0	**6**	4.0 – 10.0	3980	8.0	200	0.3
									10		2190			
									12		1790			0.5
									15		1650			0.7
									20		1320			0.8
						40	26		**25**		920			1.0
									32		755			1.2
									38		510	Edge start		
									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	Shield	Plasma	Shield	Plasma	Shield	Mix Gas 1	Mix Gas 2	in	**in**	in	ipm	in	factor %	seconds
H35	N_2	12	49	87	60	60	21	0.08	**1/4**	0.16 – 0.40	150	0.320	200	0.3
									3/8		90			
									1/2		65			0.5
									5/8					0.7
									3/4		55			0.8
									1		35			1.0
						40	26		**1-1/4**		30			1.2
									1-1/2		20	Edge start		
									1-3/4		15			
									2		10			

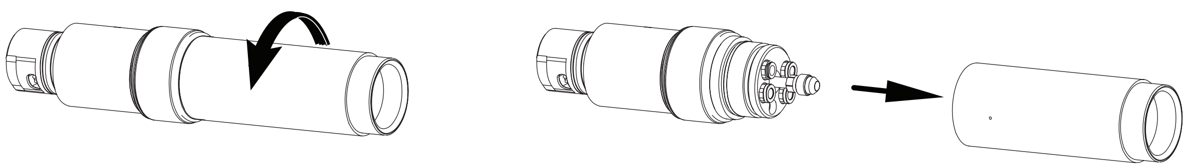
Torch connections

Connect the torch lead assembly to the quick-disconnect assembly

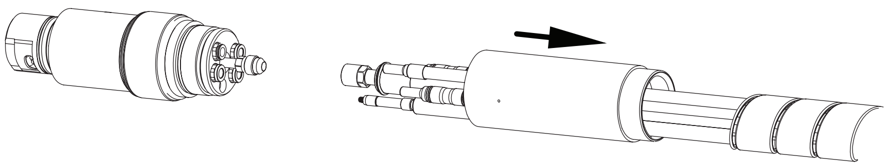


1. Uncoil the first 2 meters (6.5 feet) of lead assembly on a flat surface.

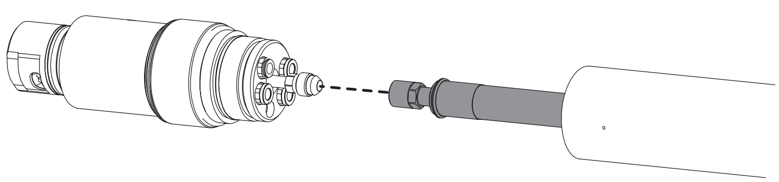
2. Hold the torch assembly and remove the mounting sleeve from the torch quick-disconnect assembly.



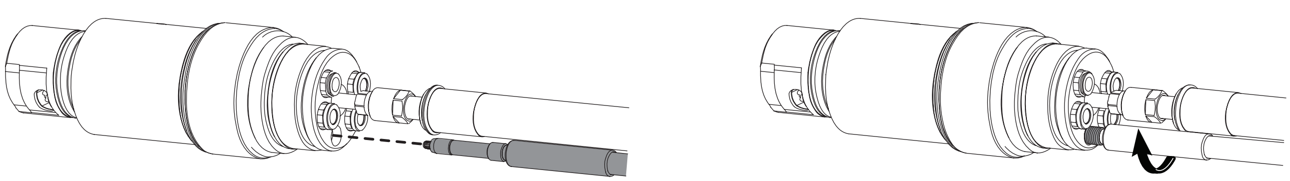
3. Slide the mounting sleeve over the leads and align the torch quick-disconnect fittings with the hoses in the lead assembly. The connections are color coded. The hoses must not be twisted and are taped together to help prevent twisting. Do not remove tape from leads.



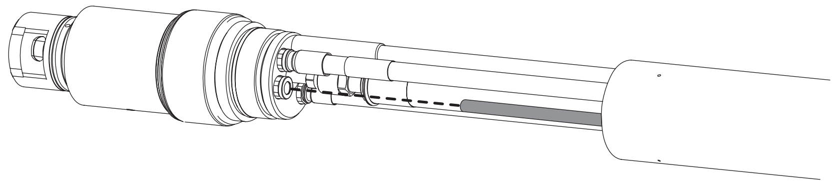
4. Connect the coolant inlet hose (green).



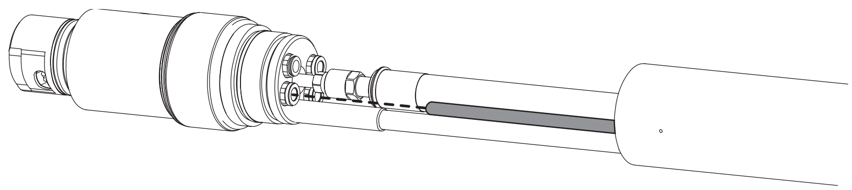
5. Connect the pilot arc lead (yellow).



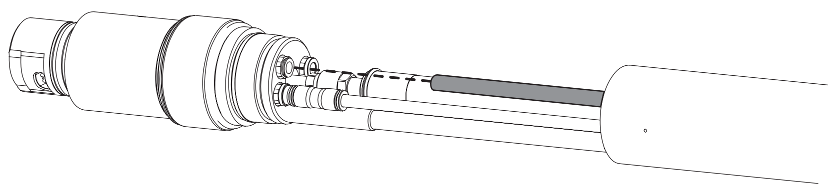
6. Connect the plasma vent hose (white).



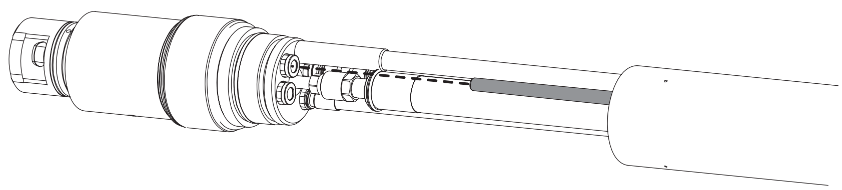
7. Connect the coolant return hose (red).



8. Connect the plasma gas hose (black).

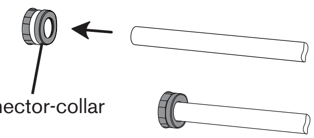


9. Connect the shield gas hose (blue).

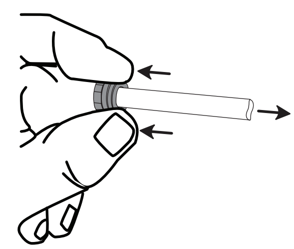


Note: The connectors in steps 6–9 are push-to-connect fittings.

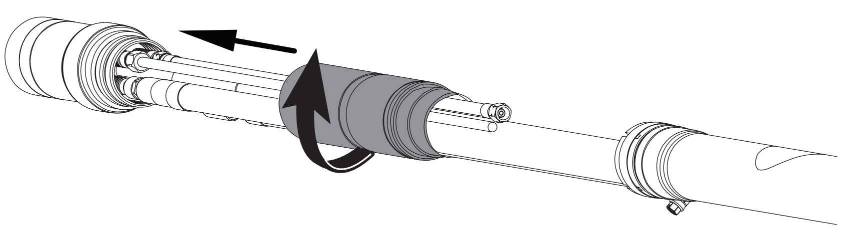
To make a connection, slide the hose fitting into the appropriate connector until it stops.



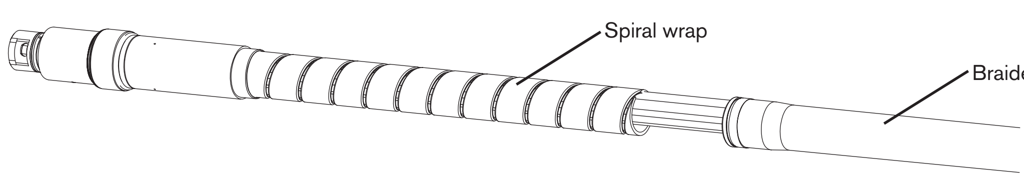
To disconnect a fitting, pull back on the connector-collar and pull out the hose fitting.



10. Slide the mounting sleeve over the connections and screw it onto the torch quick-disconnect.



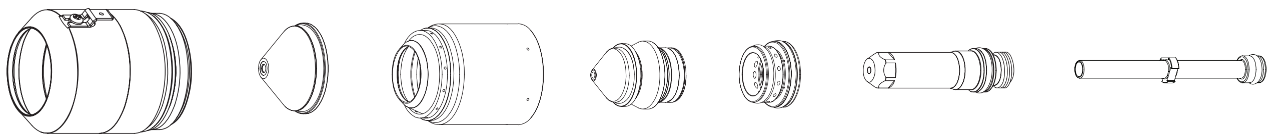
11. Slide the spiral wrap into the torch sleeve, about 50 mm (2 in). There will be a gap between the spiral wrap and the braided cover. The spiral wrap and braiding do not get clamped in place.

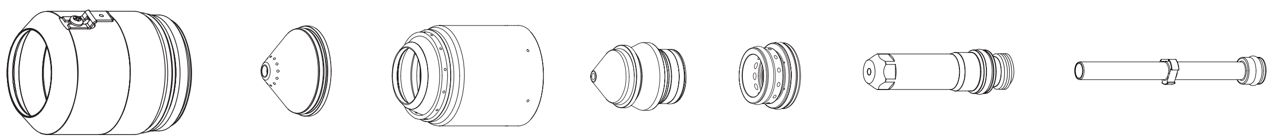


Parts list

Consumables

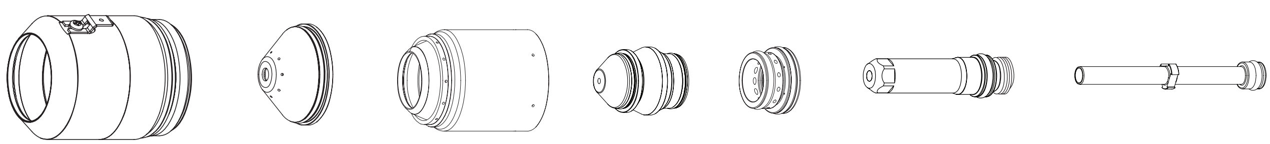
Mild steel

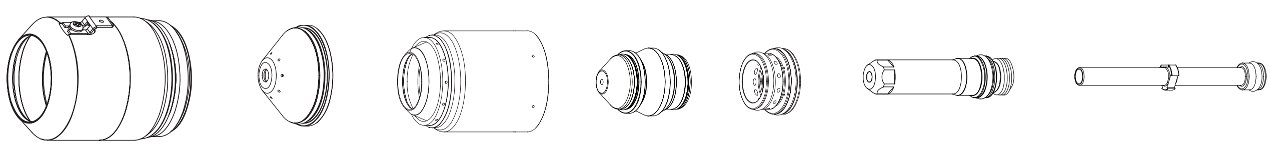




	Retaining cap	Shield	Inner retaining cap	Nozzle	Swirl ring	Electrode	Water tube
130A	220398	220645	220603	220646	220179	220649	220700
260A	220398	220545	220603	220542	220436	220541	220571

Stainless steel



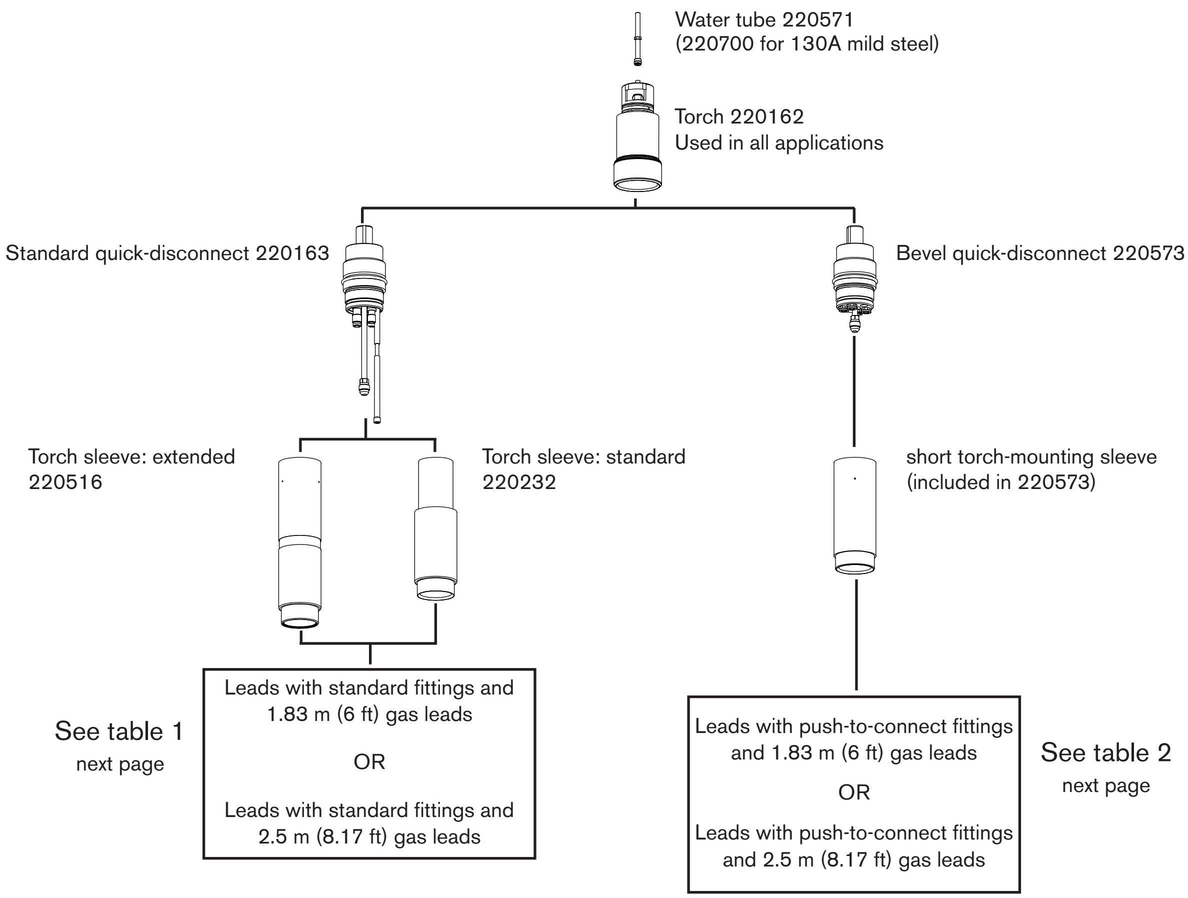


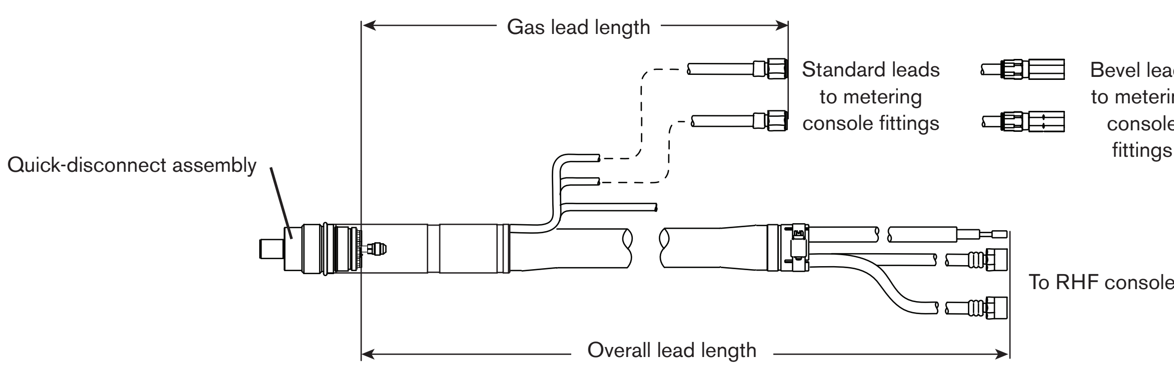
	Retaining cap	Shield	Inner retaining cap	Nozzle	Swirl ring	Electrode	Water tube
130A	220398	220609	220608	220656	220179	220606	220571
260A	220398	220609	220608	220607	220405	220606	220571

Part selection

Note: Standard consumables can be used for bevel cutting, but are not optimized for bevel cutting.

Water tube 220571 or 220700 must be installed in the HPR torch when using consumables specifically designed for bevel cutting. The bevel quick-disconnect with the short torch-mounting sleeve has push-to-connect fittings and must be used with the specific lead sets listed in this section.





1. Leads for use with the standard quick-disconnect (220163)

All leads have standard fittings that are identical to the hoses listed in the *Installation* section in this manual. The only difference is that the gas leads have been extended to 2.5 m (8.17 ft).

Part number	Overall length	Gas lead length
128986	1.83 m (6 ft)	1.83 m (6 ft)
128935	3.05 m (10 ft)	1.83 m (6 ft)
128934	4.5 m (15 ft)	1.83 m (6 ft)
128784	7.5 m (25 ft)	1.83 m (6 ft)
128987	10 m (35 ft)	1.83 m (6 ft)
128785	15 m (50 ft)	1.83 m (6 ft)
128988	20 m (65 ft)	1.83 m (6 ft)
228040*	4.5 m (15 ft)	2.5 m (8.17 ft)
228043*	7.5 m (25 ft)	2.5 m (8.17 ft)
228065*	10 m (35 ft)	2.5 m (8.17 ft)
228045*	15 m (50 ft)	2.5 m (8.17 ft)
228066*	20 m (65 ft)	2.5 m (8.17 ft)

2. Leads for use with the bevel quick-disconnect/short torch-sleeve assembly (220573)

All of the gas leads have push-to-connect fittings and can only be used with the 220573 assembly. The 2 hoses to the off-valve have adapters that change the push-to-connect fitting to a screw-on fitting.

Part number	Overall length	Gas lead length
228075	1.83 m (6 ft)	1.83 m (6 ft)
228076	3.05 m (10 ft)	1.83 m (6 ft)
228079	4.5 m (15 ft)	1.83 m (6 ft)
228081	7.5 m (25 ft)	1.83 m (6 ft)
228083	10 m (35 ft)	1.83 m (6 ft)
228086	15 m (50 ft)	1.83 m (6 ft)
228088	20 m (65 ft)	1.83 m (6 ft)
228077*	3.05 m (10 ft)	2.5 m (8.17 ft)
228061*	4.5 m (15 ft)	2.5 m (8.17 ft)
228062*	7.5 m (25 ft)	2.5 m (8.17 ft)
228084*	10 m (35 ft)	2.5 m (8.17 ft)
228063*	15 m (50 ft)	2.5 m (8.17 ft)
228089*	20 m (65 ft)	2.5 m (8.17 ft)

*Use of these lead assemblies will result in reduced consumable life.

Changed Page	**Description of change for revision 5 (date of change - 4/2008)**
i - x	Updated EMC and Warranty information to the latest version. Updated table of contents to reflect changes for the new revision.
2.4	Added information to the gas quality and pressure requirements table. Added notes below the table.
2.5	Updated Amperage and Power information in the table.
2.9 and 3.15	Added a bullet point about keeping the vent hole clear.
2.10	Added a second bullet point with bend radius information. The maximum bend radius for the torch leads is 152.4 mm (6 in).
3.6 – 3.10	Added new recommended grounding and shielding practices information.
3.11	Added a line to the first bullet point " Allow 1 m (3 ft) of space on all sides of the power supply for ventilation and service.
3.16	Changed negative lead part numbers for 60 m (200 ft) and 75 m (250 ft) from 123771 and 123772 to 123778 and 123779.
3.24	Corrected the part number for the 10 m (35 ft) CNC interface cable. It was 123314 and is was changed to 123214.
3.30	Changed the part numbers for the 60 m (200 ft) and 75 m (250 ft) work leads. They were 4/0 and are now 2/0 cables.
3.31 and 3.33	Removed reference to plastic insulator in step 4. It is no longer used. Replaced the term braiding with braided sleeve (3.33).
3.32	Added new pilot arc connection instructions.
3.34	Removed the instruction to lubricate the threads on the quick-disconnect receptacle. They should not be lubricated.
3.36	Updated values in the recommended slow-blow fuse size column.
3.38 – 3.40	Updated torch coolant requirements to include specific requirements for standard, cold and hot operating conditions. Added more information under water purity requirements.
3.41	Changed the text in the caution box.
4.9, 4.13, 4.14, and 4.16	Added 50 amp consumables (4-9), kerf width compensation for 50 amp cutting (4-13 and 4-14), and 50 amp cut chart (4-16).
4.12	Removed "consumable for bevel cutting" reference. "Bevel cutting" already references appendix C.
4.15	Corrected the flow rates.
4.29	Corrected the numbers for initial pierce height (mm) for 15 and 20 mm material thicknesses.
4.33	Corrected cutting speeds in the Metric cut chart.
5.5 – 5.7	Added "Gas system purge cycle" and "Gas system valve usage" information.
5.9	Added text saying that the screens used will vary depending on the CNC that is being used.
5.10 – 5.19	Added 1 page to the error code troubleshooting and revised error codes as necessary. All HPR error codes are listed in all HPR manuals, including the auto gas specific codes. Added new code numbers 066, 140 - 143, 180, and 181
5.21	Changed the name in the first column from “ID” to “State code”
5.28 – 5.34	Added new coolant flow troubleshooting information.
5.35 and 5.36	Updated gas leak test procedure.
5.37	Added caution about using revision "J" software
5.41	Added 50 amp information and updated information for other amperages in the pilot arc current table and the transfer current table.
5.44	Added call-outs for pressure sensors (P1-P4) and for solenoid valves (SV1-SV14) in the selection console.
5.45	Added call-outs for pressure sensors (P5-P8) and for Berkert valves (B1-B4) in the metering console.

Changed Page	Description of change for revision 5 (date of change - 12/2007)
5.47 and 5.48	New chopper test.
5.56 and 5.57	Updated service parts replacement schedule.
6.2	The part number for sheet metal screws (item 3) has changed from 075630 to 075241. Added part numbers for sheet metal (front, top, and side panels).
6.4	Listed the 3 current sensors separately (5, 6a, and 6b) to identify their designators. 108263 (items 7a and 7b - fuse) was a 150 amp fuse and is now 175 amps (page 6-13 also). Fuses listed separately to identify their designators. Corrected the part number for the contactor. It was 003139, and is now 003217 (also changed in recommended spare parts list 6-13).
6.5	Added the designator for the control transformers.
6.6	Added temperature sensor (item number 1 – 109393). Added pressure transducer (item 2 – 109524). Changed stand alone pump and motors to kits that include the clamp.
6.7	Added designator for HFHV ignition PCB.
6.8	Changed item number 3 from 041828 (Control PCB) to 228069 (Kit: control PCB). Added designators for control PCB, pressure sensors, and power distribution PCB.
6.9	Added designators for valve driver PCB and the motor valves in the selection console. Added designators for the power distribution PCB, control PCB, solenoid valves, pressure transducers, and proportional valves.
6.11	Changed silicone lubricant part number from 027012 to 027055. Added spanner wrench (104269).
6.12	Added 50 amp consumables.
Wiring diagrams (Section 7)	Added information on jumper removal for intermittent communication problems on sheets 18, 19, and 20. All sheets updated to revision D.
Appendix A	MSDS appendix changed from appendix B to appendix A.
Appendix B	CNC interface protocol changed from appendix A to appendix B. Updated error codes (b.20 and b.21).
Appendix D	Added 130 amp bevel processes.

Changed Page	**Description of change for revision 4 (date of change - 12/2006)**
I Through iv	Updated EMC and Warranty to new format. This information was on 2 pages and is now on 4 pages
Safety Sections 1, 1a, and 1b	Updated Section 1, 1a, and 1b.
2.4	Added note below table about O2, N2, and air being required. That note gets 1 asterisk (*) and the "Grade" note gets 2 asterisks (**).
3.3 and 3.9	Removed bullet point under torque specifications about the 10 degree incline. The information is not on page 3.9.
3.15	Switched the order of connections in the graphic on the bottom of the page to show the pilot arc connection first and then the negative lead.
3.26, 3.35, and 5.39	Changed WARNING to DANGER in the safety box at the top of the page.
3.33	Added a note about main feed protection above the power requirements table.
3.37	Added a note about O2, Air, and N2 being required.
4.14 through 4.39	Updated all cut charts with changes for the firmware upgrade.
5.7 through 5.14	Updated all error code tables. Added error codes 42, 103, 104, 105, and 106.
5.31, 5.34, and 5.38	Added test points to the graphic of the control PCB for reference.
Appendix A	Updated error code table. Added error codes 42, 103, 104, 105, and 106.
Appendix C	Added appendix C to capture the cut charts for system firmware revisions previous to this release.

	Revision 2 was never printed. Printed manuals went from Revision 1 to 3.
2.2 and 3.4	Updated graphic to show item number 7 (on page 3.4) as a bundle
2.4	Updated the "Gas purity and pressure requirements" table to add grade information. Also changed the maximum flow rate for Nitrogen and Air from 7080 l/h 250 scfh to 9910 l/h 350 scfh.
2.5	Update table to include part numbers, add 220V and 380V power supplies and add regulatory approvals.
2.8 and 3.12	Changed maximum cable length from the power supply to the gas console from 46 m (150 ft) to 75 m (250 ft). Changed maximum cable length from the gas console to the off-valve assembly from 15 m (50 ft) to 20 m (65 ft).
3.14	Added an asterisk (*) to part numbers 123683 and 123829 and a note saying that these part numbers are for systems with the ignition console mounted on the power supply.
3.16	Added an asterisk (*) to part number 123685 and a note saying that this part number is for systems with the ignition console mounted on the power supply. Added cable 123419 3 m (10 ft)
3.17	Corrected the color call-outs on the ignition console by switching the red and green call-outs.
3.18	Added an asterisk (*) to part numbers 123784 and 123785 and a note saying that these part numbers are for systems with the ignition console mounted on the power supply.
3.22	Updated table with cable part numbers to add additional lengths.
3.23 and 3-25	Added "The external relay's life may be improved by adding a metallized-polyester capacitor (0.022uF 100V or higher) in parallel with the relay contacts" to note number 1. Updated 1. Relay interface graphic to show the additional relay.
3.27	Added caution "Locate the exposed end of the plasma gas vent hose away from sparks caused by piercing to avoid ignition and possible damage to the torch leads".
3.28	Removed part number 123829 1.5 m (5 ft).
3.29 and 3.30	Added use of spanner wrench in step 2. Removed references to "plastic insulator" from steps 4 and 10. The insulator is no longer used.
3.32	Updated torch graphic and installation note to HPR torch
3.33	Added 220V and 380V power supplies to the table.
3.36 and 5.20	Removed caution about damage caused to coolant pum if it is run with water only. The new pump can be run with water under the right conditions.
3.39	Updated table with fittings and sizes.
3.40	Updated tables with additional cable lengths.
4.2, 4.9, 4.10 and 6.12	Changed description from "Shield cap" to "Retaining cap" and "Retaining cap" to "Inner retaining cap"
4.12	Added bevel information referring to appendix C
4.13	Corrected data for Stainless steel - 200A N2-N2, 12 mm (2.88 to 2.29) and Aluminum 200A N2-N2 12 mm (2.29 to 2.58) 20 mm (2.67 to 3.01)
5.7 - 5.14	Updated the error codes. All error codes are now included in all HPR manuals. Codes that are specific to Auto gas or Manual gas are called out.
5.19	Correction. The striped ground wire was not shown properly in the graphic.
5.25	Resized art to fit text next to the dip switch in the lower right hand corner of the PCB. Updated part number for firmware from 081094 to 081107.
5.26 and 5.37	Updated the graphic of the 041802 PCB.
5.30 and 5.33	Updated graphic to show termination resistor and added note to explain when the resistor must have the jumper installed or removed. Updated part number for firmware from 081096 to 081110.
6.2 and 6.5	Added 220V and 380V power supplies
6.10	Removed item number 5 (024751 insulating sleeve). Added spanner wrench (item number 6). Added note to see appendix C for bevel part information
6.11	Corrected the consumable parts kit number (from 128878 to 228027) and updated the list of parts.
Section 7	Schematic number 013362 updated to Rev C. All sheets
Appendix C	Added appendix C. It includes all the information about bevel consumables and parts.

8/5/05

vi	Corrected page number for error code troubleshooting 8 of 8. It was 5-13. Changed to 5-14
vii	Hardware (a-3) removed from table of contents. There is no hardware header.
3.29	Updated art for step number 5 to show the new pilot arc connector. Added text to step number 5 " Tighten by hand only".
3.33	Corrected recommended cable size for 200/208V, rated for 90 degrees C. It was (2 AWG) and is now (2/0 AWG). Corrected recommended cable size for 240V, rated for 60 and 90 degrees C. 60 degrees C was (4 AWG) and is now (4/0 AWG). 90 degrees C was (1 AWG) and is now (1/0 AWG)
3.37	The screen shots were fuzzy and have been replaced with the higher resolution jpeg from page 3.36.
4.14-4.39	All marking cut charts updated.
5.7-7.14 (General)	Added Metric units where needed in the troubleshooting tables.
5.12	The description for error code number 102 was changed from "Chopper current signal is active on power-up" to "No current or over-current detected during chopper test at power-up".
5.21	Removed "and strainer" from heading. There is no strainer in the cooling system.
5.40 and 5.41	Corrected the numbering of the checklist. It used to go from number 4 to number 6.
6.2 and 6.5	Added /208 to the description for part number 078187.