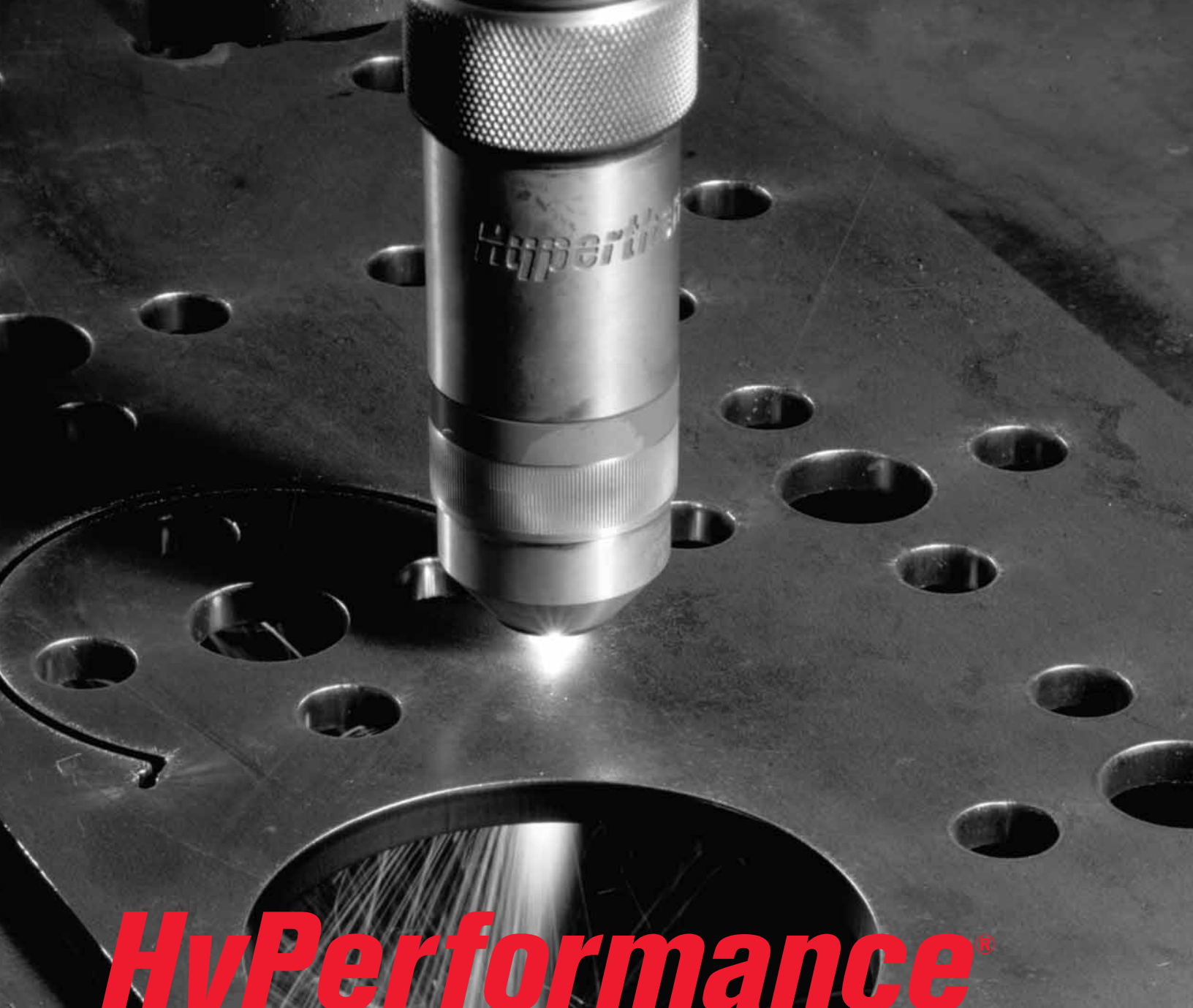




Hyperformance[®] Plasma HPR260[®]

Manual gas

Instruction manual

804940 – Revision 4

Hypertherm[®]

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Maintenance notes:

HyPerformance Plasma

HPR260 Manual Gas

Instruction Manual

(P/N 804940)

Revision 4 – April, 2008

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Hanover, NH USA
www.hypertherm.com**

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Hypertherm, Inc.

Etna Road, P.O. Box 5010
Hanover, NH 03755 USA
603-643-3441 Tel (Main Office)
603-643-5352 Fax (All Departments)
info@hypertherm.com (Main Office Email)

800-643-9878 Tel (Technical Service)

technical.service@hypertherm.com (Technical Service Email)
800-737-2978 Tel (Customer Service)
customer.service@hypertherm.com (Customer Service Email)

Hypertherm Automation

5 Technology Drive, Suite 300
West Lebanon, NH 03784 USA
603-298-7970 Tel
603-298-7977 Fax

Hypertherm Plasmatechnik GmbH

Technologiepark Hanau
Rodenbacher Chaussee 6
D-63457 Hanau-Wolfgang, Deutschland
49 6181 58 2100 Tel
49 6181 58 2134 Fax
49 6181 58 2123 (Technical Service)

Hypertherm (S) Pte Ltd.

No. 19 Kaki Bukit Road 2
K.B. Warehouse Complex
Singapore 417847, Republic of Singapore
65 6 841 2489 Tel
65 6 841 2490 Fax
65 6 841 2489 (Technical Service)

Hypertherm (Shanghai) Trading Co., Ltd.

Unit 1308-09, Careri Building
432 West Huai Hai Road
Shanghai, 200052
PR China
86-21 5258 3330/1 Tel
86-21 5258 3332 Fax

Hypertherm

Branch of Hypertherm, UK, UC
PO Box 244
Wigan, Lancashire, England WN8 7WU
00 800 3324 9737 Tel
00 800 4973 7329 Fax
00 800 4973 7843 (Technical Service)

France (Representative office)

15 Impasse des Rosiers
95610 Eragny, France
00 800 3324 9737 Tel
00 800 4973 7329 Fax

Hypertherm S.r.l.

Via Torino 2
20123 Milano, Italia
39 02 725 46 312 Tel
39 02 725 46 400 Fax
39 02 725 46 314 (Technical Service)

Hypertherm Europe B.V.

Vaartveld 9
4704 SE Roosendaal, Nederland
31 165 596907 Tel
31 165 596901 Fax
31 165 596908 Tel (Marketing)
31 165 596900 Tel (Technical Service)
00 800 49 73 7843 Tel (Technical Service)

Hypertherm Japan Ltd.

801 Samty Will Building
2-40 Miyahara 1-Chome,
Yodogawa-ku, Osaka
532-0003, Japan
81 6 6170 2020 Tel
81 6 6170 2015 Fax

HYPERTHERM BRASIL LTDA.

Avenida Doutor Renato de
Andrade Maia 350
Parque Renato Maia
CEP 07114-000
Guarulhos, SP Brasil
55 11 6409 2636 Tel
55 11 6408 0462 Fax

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.

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Section 1

SAFETY

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RECOGNIZE SAFETY INFORMATION

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



FOLLOW SAFETY INSTRUCTIONS

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

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

- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

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.

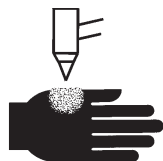
The air quality level in any relevant workplace depends on site-specific variables such as:

- 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.

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.

Arc current		Lens shade	
		AWS (USA)	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

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.

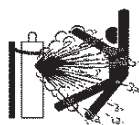
Work table Connect the work table to an earth ground, in accordance with appropriate national or local electrical codes.

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.



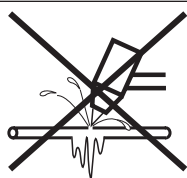
PACEMAKER AND HEARING AID OPERATION

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.



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.

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 dépannage. • Couper l'alimentation avant de démonter la torche. • Utiliser exclusivement les torches indiquées dans le manuel d'instructions. • Le raccordement au réseau de cette machine de coupage à arc-plasma doit être conforme 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.	 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.
 Explosion will result if pressurized containers are cut.	 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.
 Arc rays can injure eyes and burn skin. • Wear correct eye and body protection.	 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.
 Noise can damage hearing. • Wear correct ear protection.	
DO NOT REMOVE THIS MARKING	NE PAS ENLEVER CET AVIS
010298 Rev. B	TLF

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.....	1a-2
Suivre les instructions de sécurité	1a-2
Le coupage peut provoquer un incendie ou une explosion	1a-2
Les chocs électriques peuvent être fatals.....	1a-3
L'électricité statique peut endommager les cartes de circuits imprimés	1a-3
Les vapeurs toxiques peuvent provoquer des blessures ou la mort.....	1a-4
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Les rayons de l'arc peuvent brûler les yeux et la peau.....	1a-5
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Sécurité des bouteilles de gaz comprimé	1a-6
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IDENTIFIER LES CONSIGNES DE SÉCURITÉ

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



SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

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 émanant.

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.

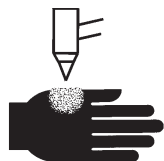
Le niveau de qualité de l'air dans tout lieu de travail dépend des variables propres au site comme :

- 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.

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.

Courant de l'arc

Jusqu'à 100 A
100-200 A
200-400 A
Plus de 400 A



Puissance des verres teintés

AWS (É.-U.)

Nº 8
Nº 10
Nº 12
Nº 14

ISO 4850

Nº 11
Nº 11-12
Nº 13
Nº 14

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.

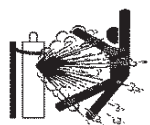
Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

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.

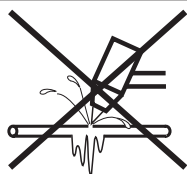


PACEMAKERS ET PROTHÈSES AUDITIVES

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.



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.

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	 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 dépannage. • Couper l'alimentation avant de démonter la torche. • Utiliser exclusivement les torches indiquées dans le manuel d'instructions. • Le raccordement au réseau de cette machine de coupage à arc-plasma doit être conforme 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.	 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.
 Explosion will result if pressurized containers are cut.	 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.
 Arc rays can injure eyes and burn skin. • Wear correct eye and body protection.	 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.
 Noise can damage hearing. • Wear correct ear protection.	
DO NOT REMOVE THIS MARKING	NE PAS ENLEVER CET AVIS
010298 Rev. B	TLF

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.

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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 sí 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 sustancias, 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 natioidad 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.

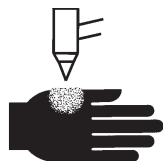
El nivel de la calidad del aire en cualquier lugar de trabajo relevante depende en variables específicas al sitio tales como:

- 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.

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.
- Ropa 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.

Corriente del arco

Hasta 100A
100-200 A
200-400 A
Más de 400 A



Número del cristal

AWS (EE.UU.)

No. 8
No. 10
No. 12
No. 14

ISO 4850

No. 11
No. 11-12
No. 13
No. 14

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 sujeta 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.

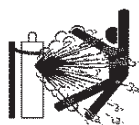
Mesa de trabajo Conecte la mesa de trabajo a una buena toma de tierra, de conformidad con los códigos eléctricos nacionales o locales apropiados.

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.

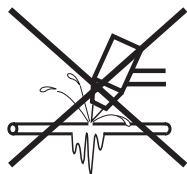


OPERACIÓN DE MARCAPASOS Y DE AUDÍFONOS

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.



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.

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	 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 dépannage. • Couper l'alimentation avant de démonter la torche. • Utiliser exclusivement les torches indiquées dans le manuel d'instructions. • Le raccordement au réseau de cette machine de coupage à arc-plasma doit être conforme 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.	 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.
 Explosion will result if pressurized containers are cut.	 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.
 Arc rays can injure eyes and burn skin. • Wear correct eye and body protection.	 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.
 Noise can damage hearing. • Wear correct ear 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.



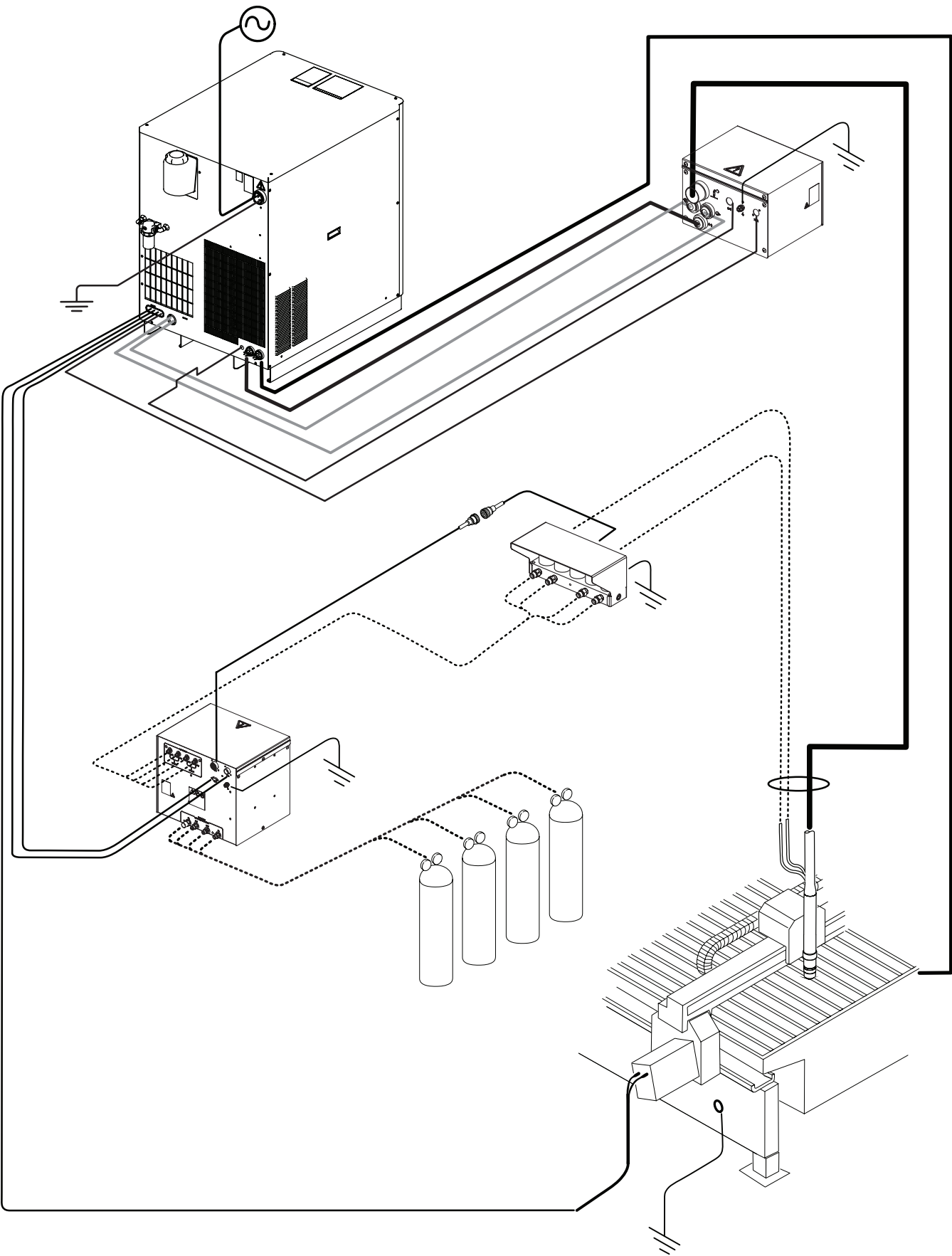
1. Las chispas producidas por el corte pueden causar explosiones o incendios.
 - 1.1 Mantenga los materiales inflamables lejos del lugar de corte.
 - 1.2 Tenga a mano un extinguidor de incendios y asegúrese de que alguien esté preparado para utilizarlo.
 - 1.3 No corte depósitos cerrados.
2. El arco 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, capacítase y lea las instrucciones completamente.
7. No retire las etiquetas de advertencia ni las cubra con pintura.

Section 2

SPECIFICATIONS

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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.

Gas console

The power switch located on the gas console is the main power switch for the system. Power may be present at all other components when it is in the ON (I) position. The gas console manages the selection and flow rate of all incoming gases. The gas console includes motor valves, solenoid valves, check valves and pressure transducers. The gas console also houses a relay PC board and a control PC board.

Off-valve

The off-valve consists of 5 solenoid valves, a manifold block and a wiring harness with connector. The assembly interfaces with the machine torch, the ignition console and the gas console.

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

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 120 psi	4250 l/h 150 scfh
N ₂ Nitrogen*	99.99% pure Clean, dry, oil-free	E	827 kPa / 8.3 bar 120 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 120 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 120 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 120 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.

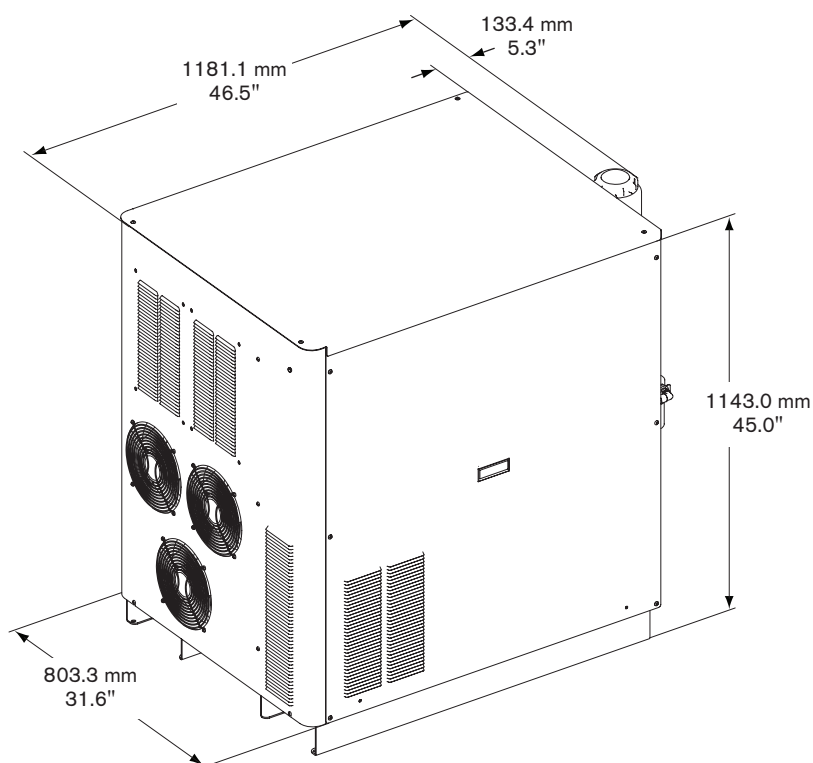
*** ISO standard 8573-1 Class 1.2.2 requirements are:

- 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

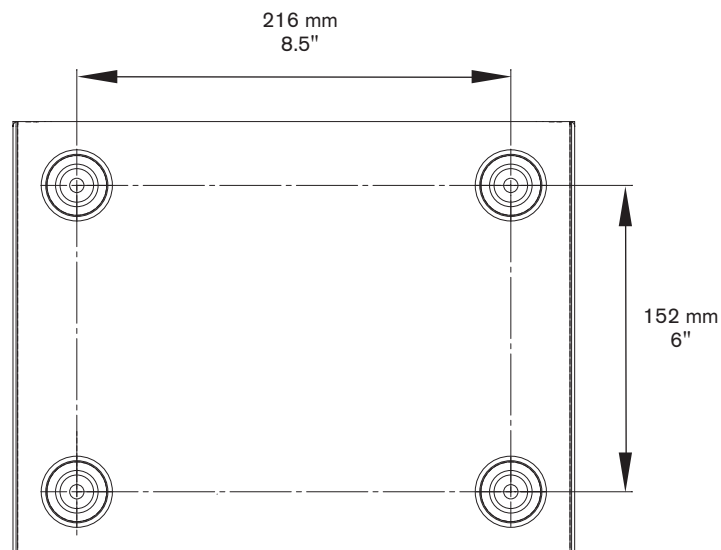
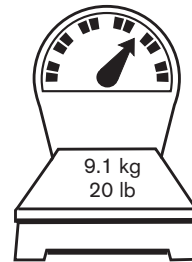
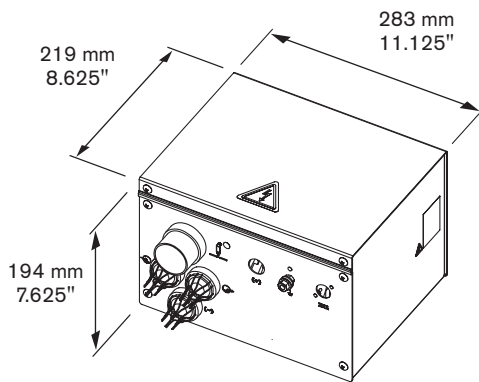
General						
Maximum OCV (U_0)			311 VDC			
Maximum output current (I_2)			260 Amps			
Output voltage (U_2)			50 – 175 VDC			
Duty cycle rating (X)			100% @ 45.5 kw, 40° C (104° F)			
Ambient temperature/Duty cycle			Power supplies will operate between -10° C and +40° C (+14° and 104° F)			
Power factor(cosφ)			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%) ($U_1 \times I_1 \times 1.73$)
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



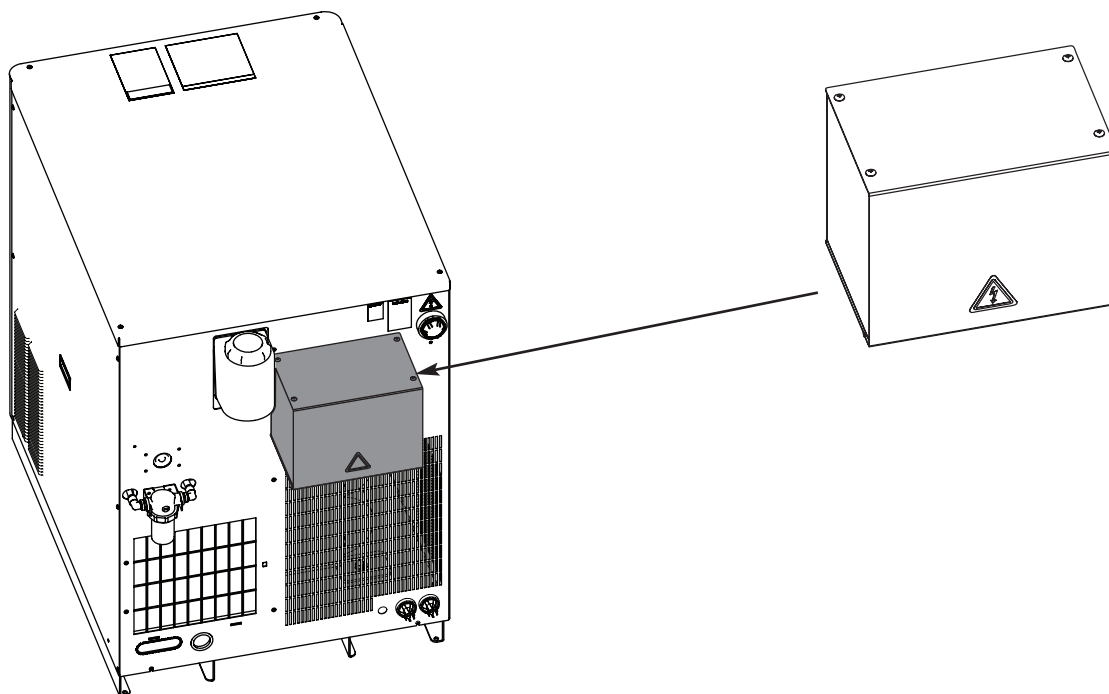
SPECIFICATIONS

Ignition console – 078172

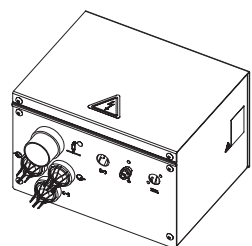
- The ignition console may be mounted locally on the power supply (LHF) or remotely on the cutting table's bridge (RHF). See *Installation* section for details.
- Maximum cable length from the ignition console to the torch lifter station is 20 m (65 ft). Allow room to remove the top for servicing.
-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



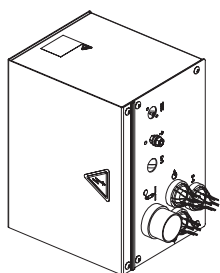
LHF mounting (local)



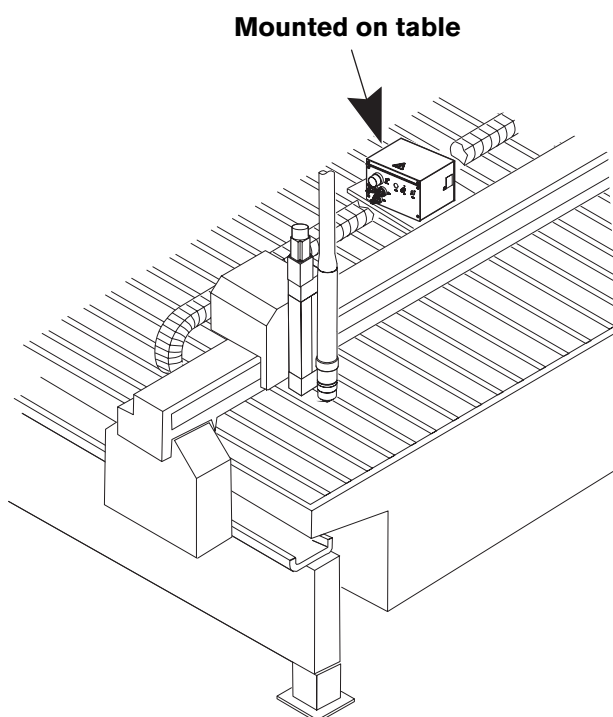
RHF mounting (remote)



Horizontal mounting



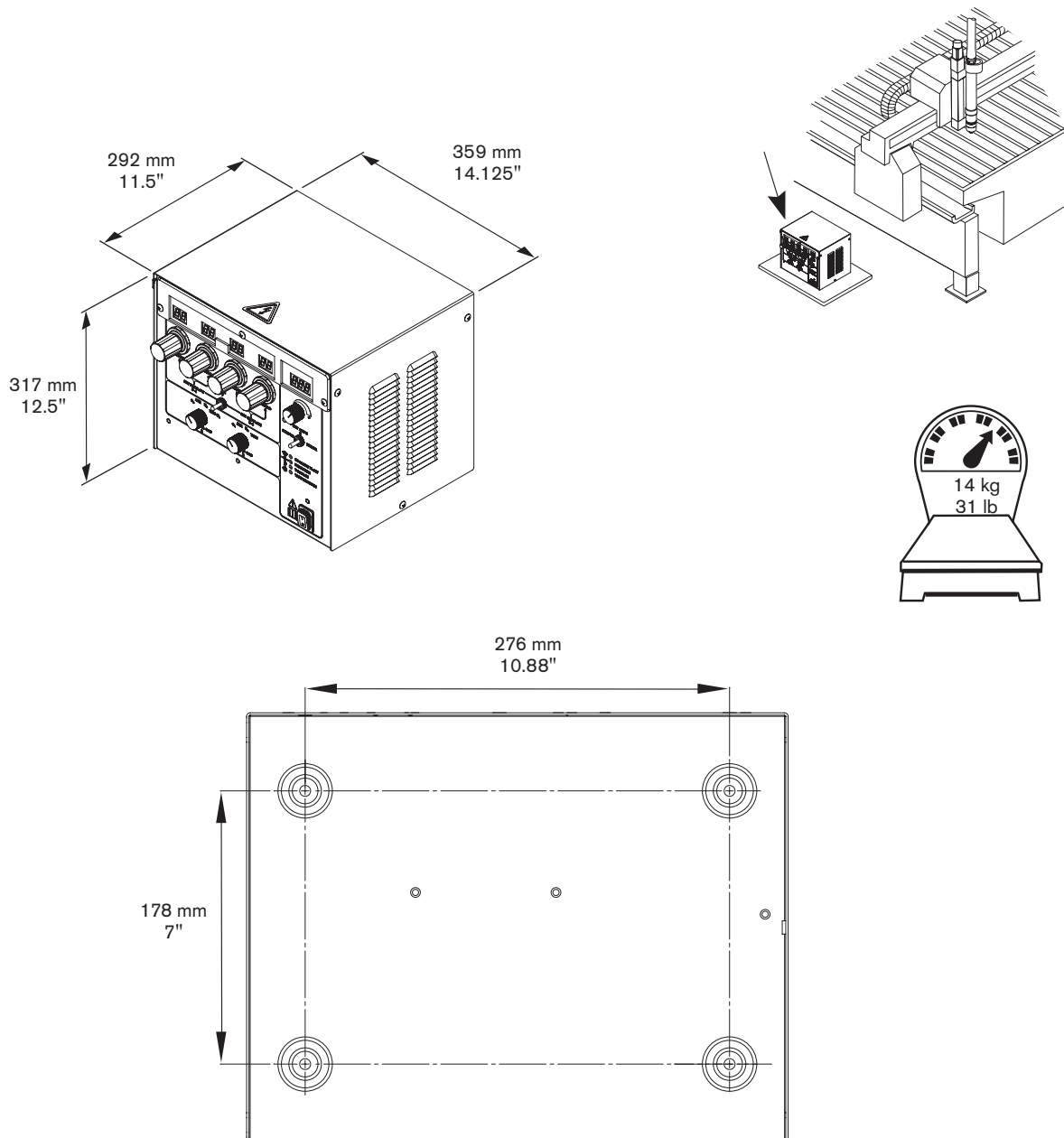
Vertical mounting



SPECIFICATIONS

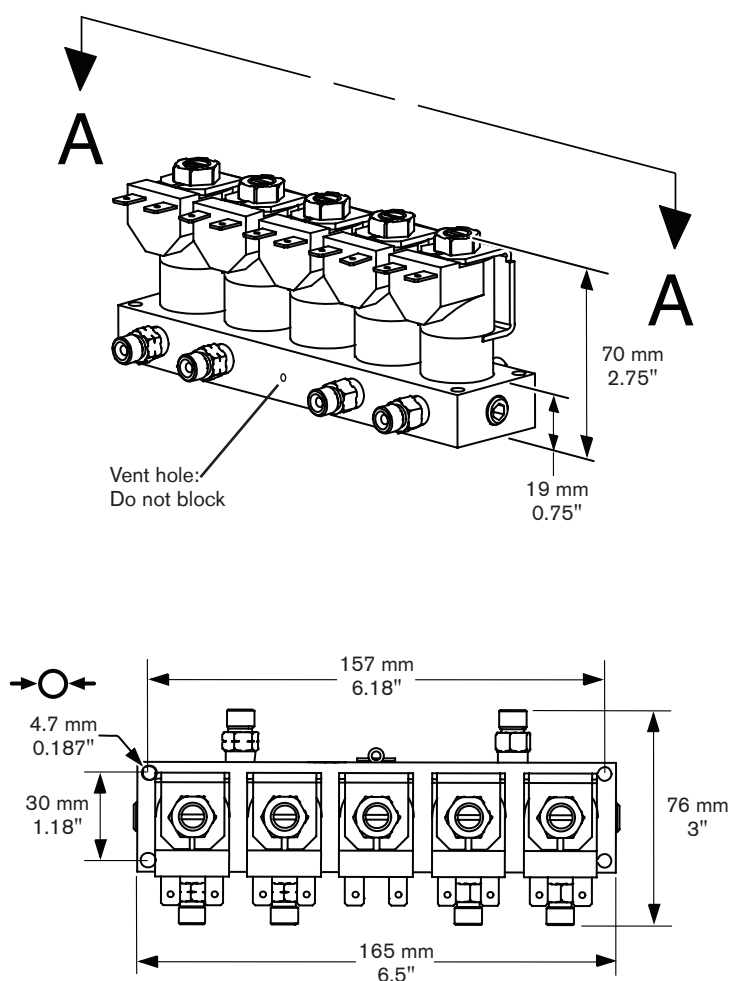
Gas console – 078170

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

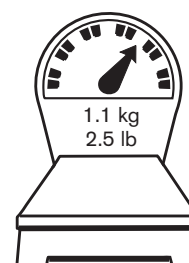
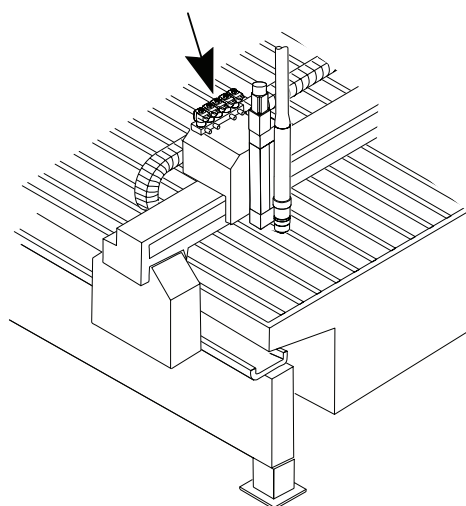


Off-valve – 129816

- Maximum cable length from the off-valve to the torch lifter station is 1.8 m (6 ft).
- Mount the off-valve assembly 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 manifold must be kept clear at all times.



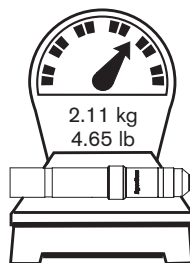
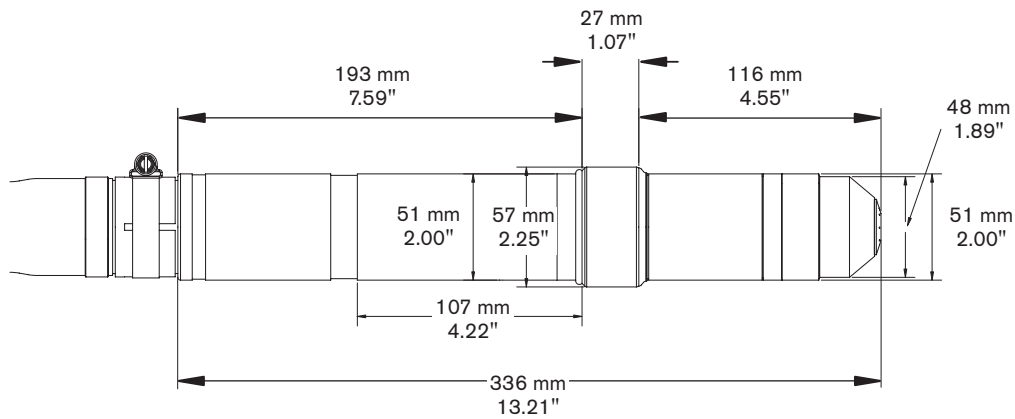
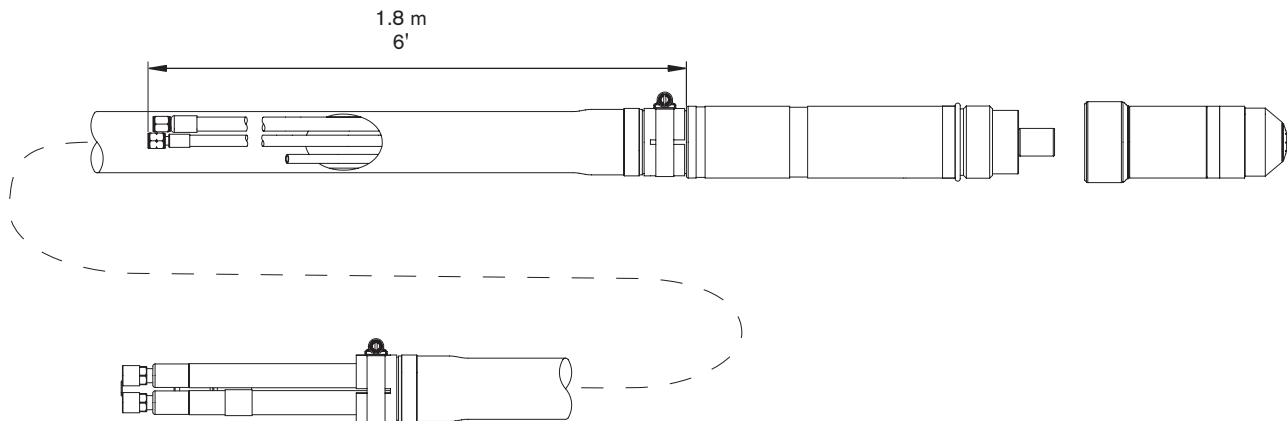
A - A



SPECIFICATIONS

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

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Upon receipt

- Verify that all system components on your order have been received. Contact your supplier if any items are missing.
- Inspect the system components for any physical damage that may have occurred during shipping. If there is evidence of damage, refer to *Claims*. All communications regarding claims must include the model number and serial number located on the 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 O₂ /Air process 3 inches 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.

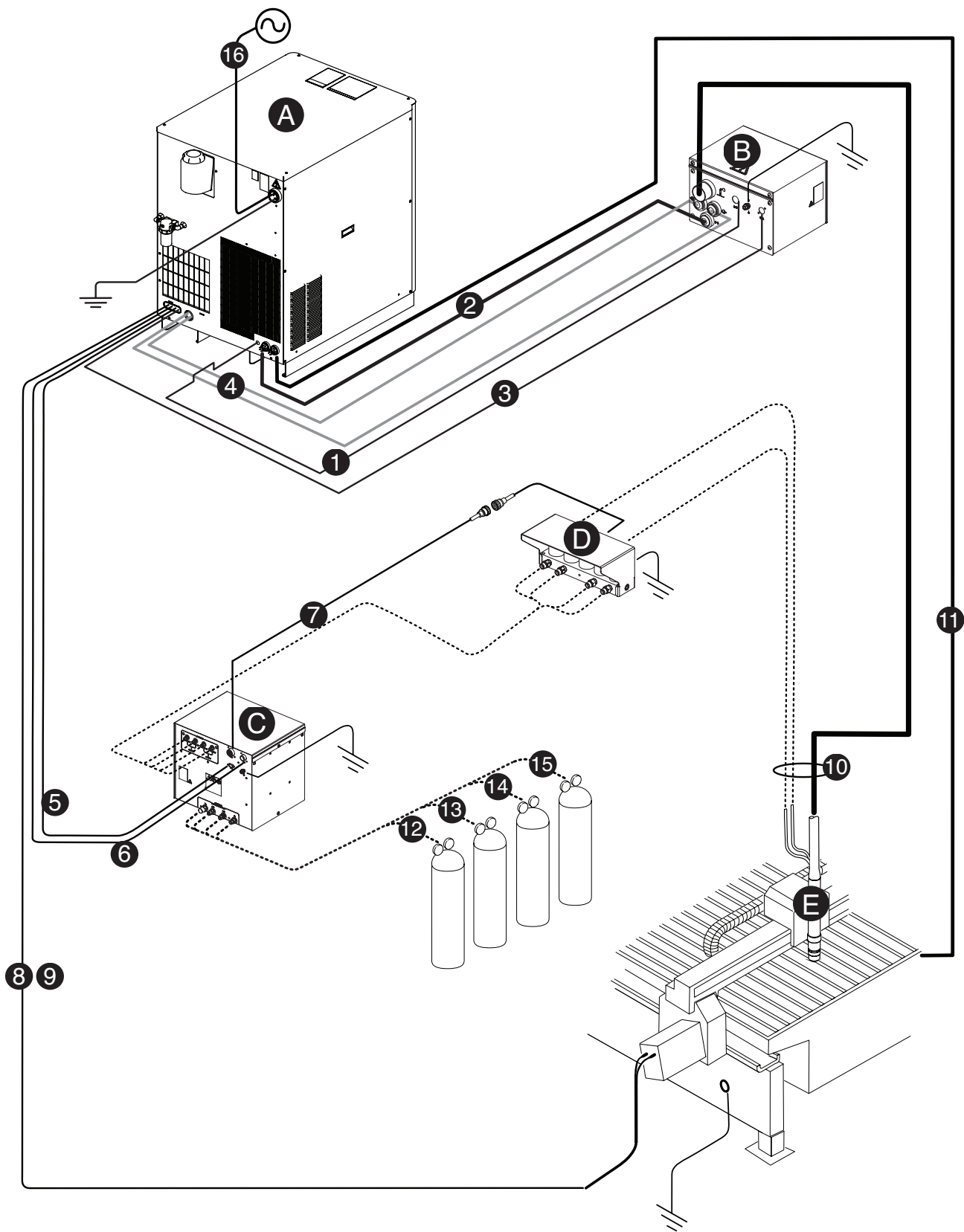
Placement of system components

- 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** Gas console
- D** Off-valve assembly
- 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** Gas console to off-valve 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

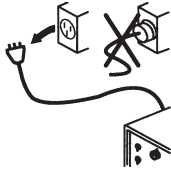
Supply gas hoses

- 12** Oxygen
- 13** Nitrogen
- 14** Air
- 15** H35 or F5

Customer-supplied power cable

- 16** 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.

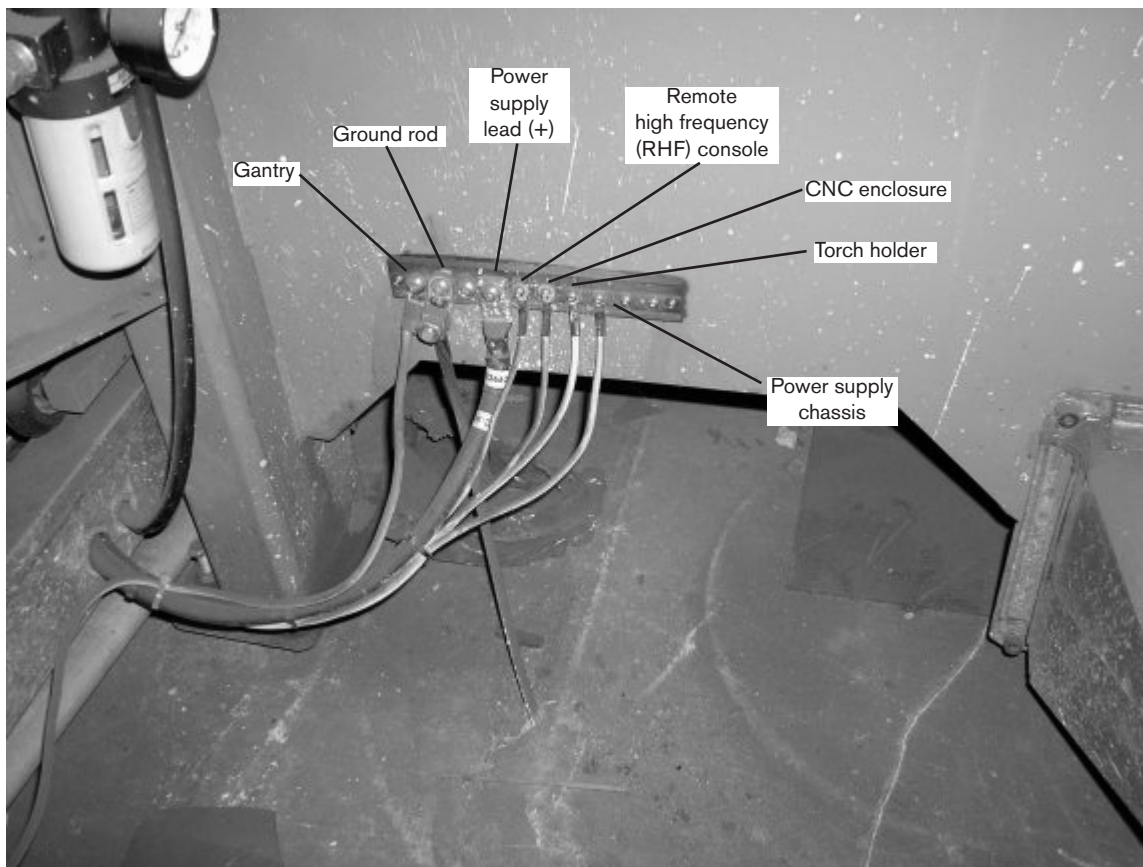
Steps to take

1. Unless noted, use only 6 AWG (16 mm²) 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

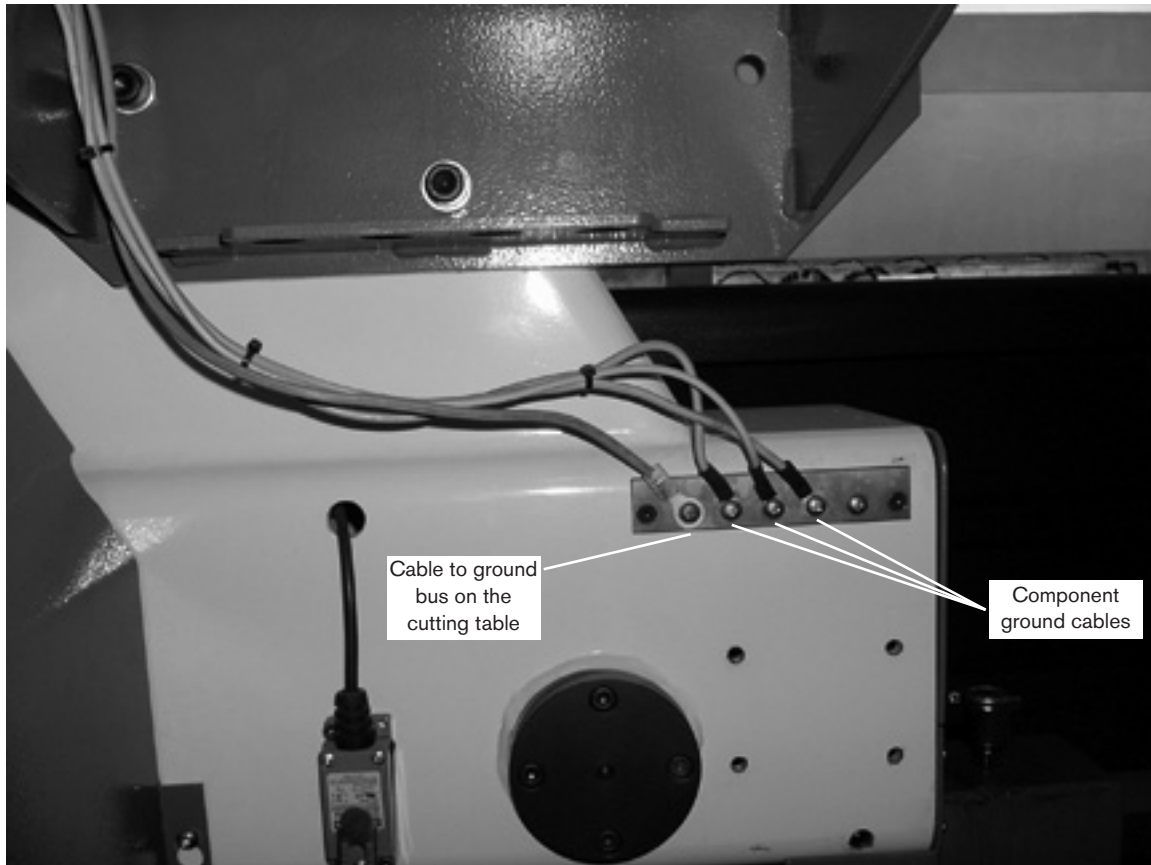
INSTALLATION

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.



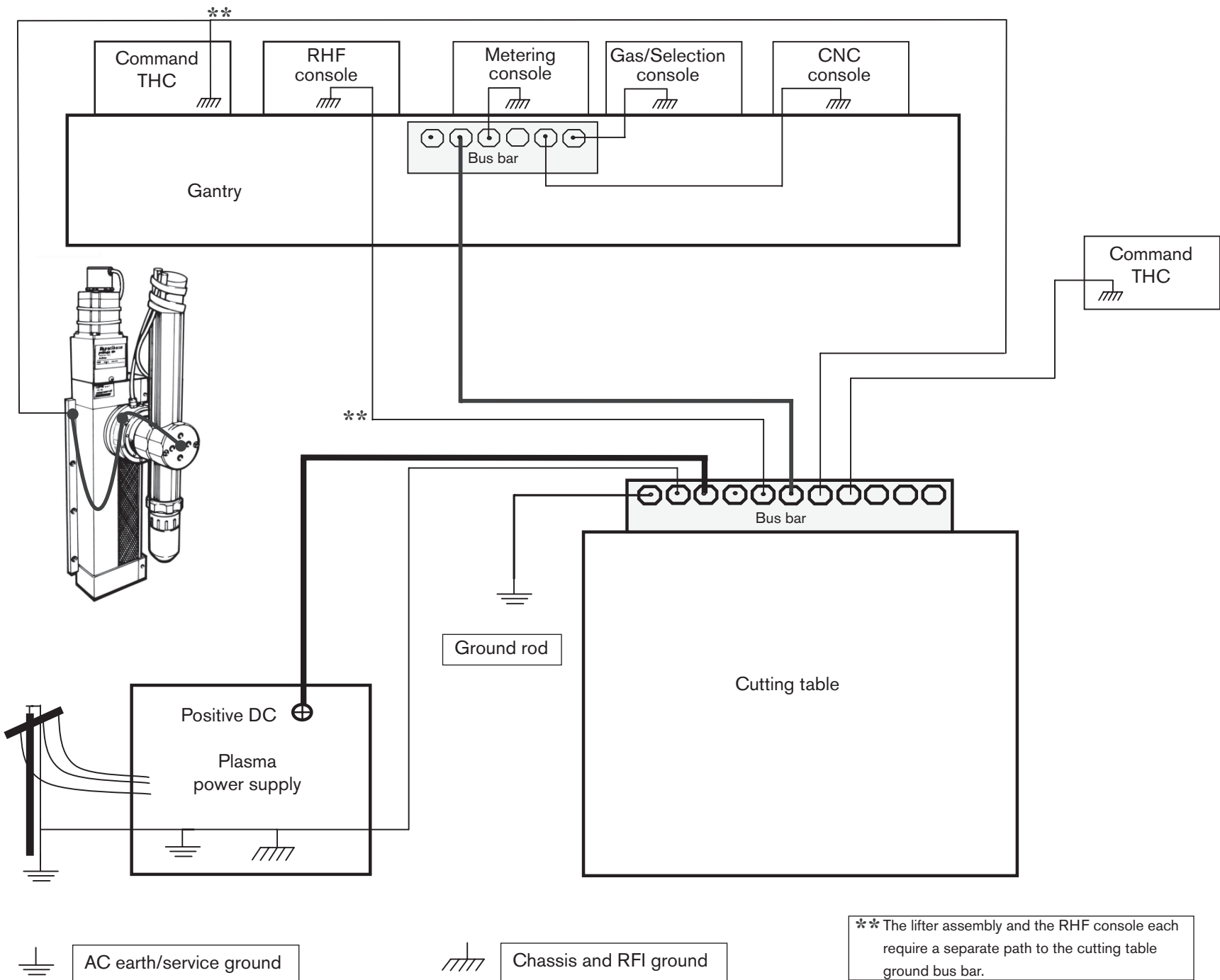
Example of a good cutting table ground bus. The picture above shows the connection from the gantry ground bus, the connection from the ground rod, the power supply positive lead, the RHF console*, the CNC enclosure, the torch holder, and the power supply chassis.

* 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



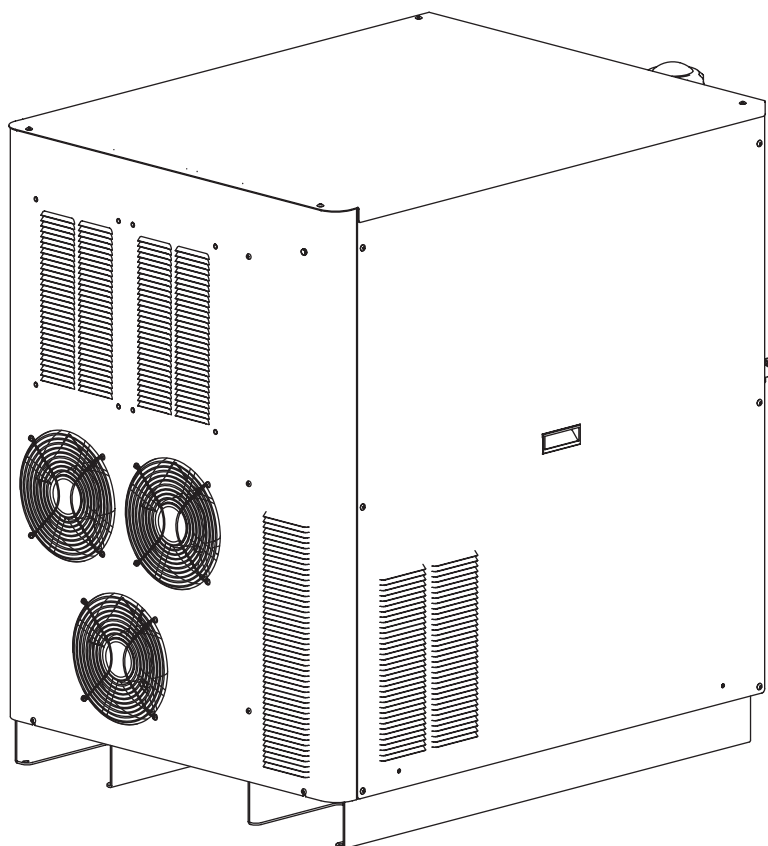
Grounding diagram (some systems will not include all the components shown)

A 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.		

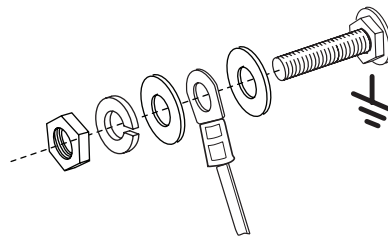
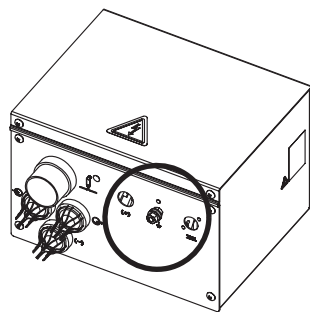
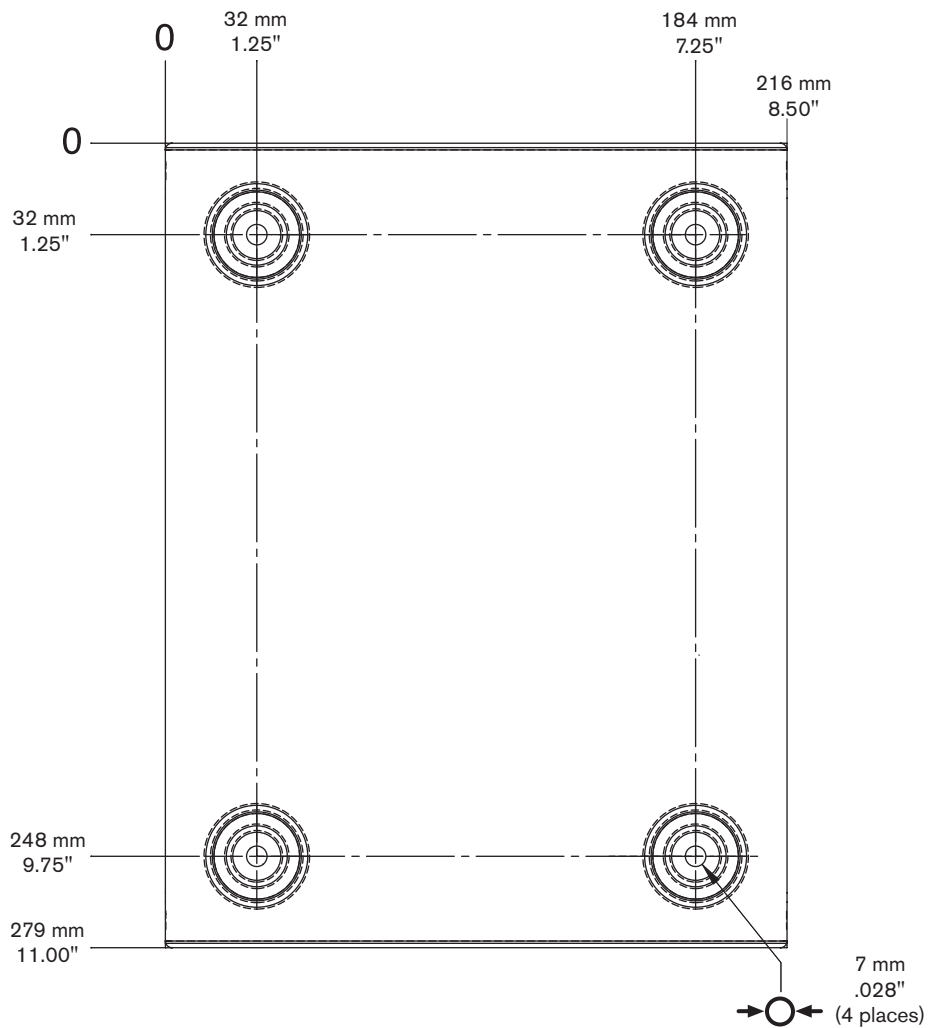
The power supply can be moved by forklift but the forks must be long enough to extend the entire length of the base. Take care when lifting so that the underside of the power supply is not damaged.

- 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.

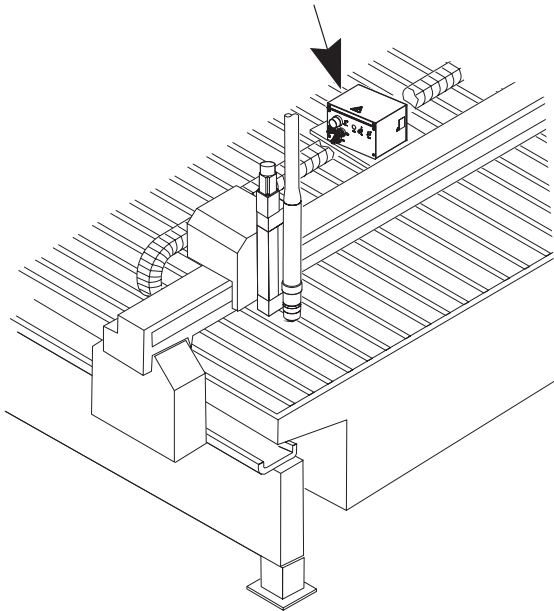


B Install the ignition console

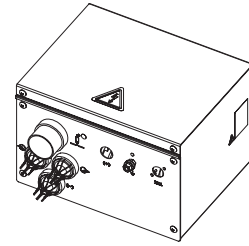
- Mount the ignition console on the gantry (bridge) for the RHF configuration.
- Mount the ignition console on the power supply for the LHF configuration.
- Allow room to remove the top for servicing.



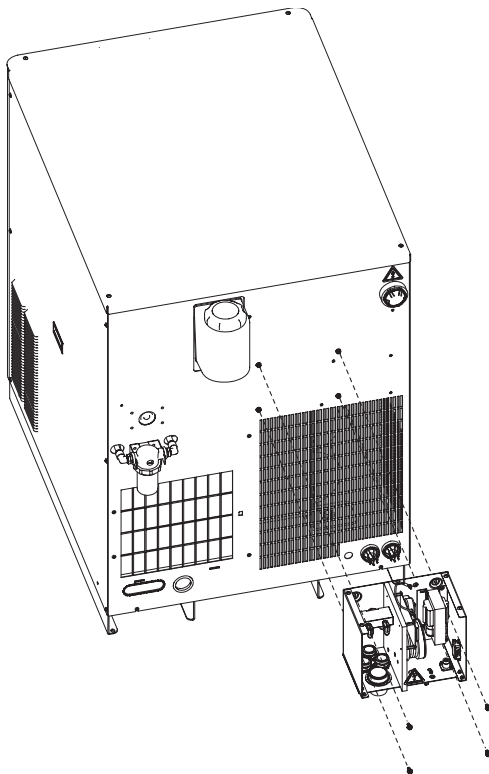
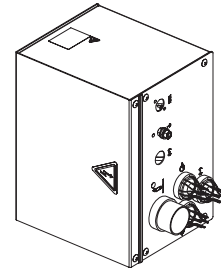
Ignition console grounding



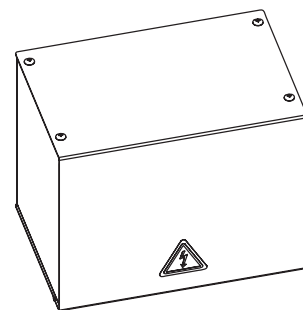
Horizontal RHF mounting



Vertical RHF mounting

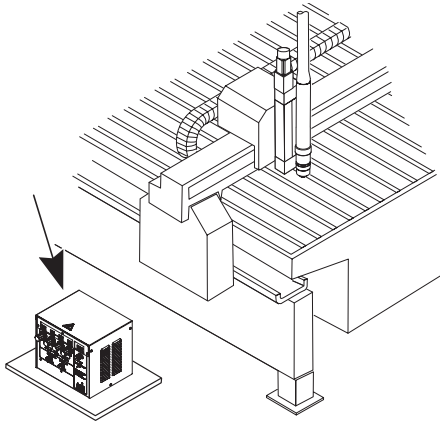


LHF mounting

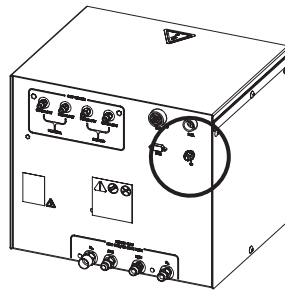


C Placement of the gas console

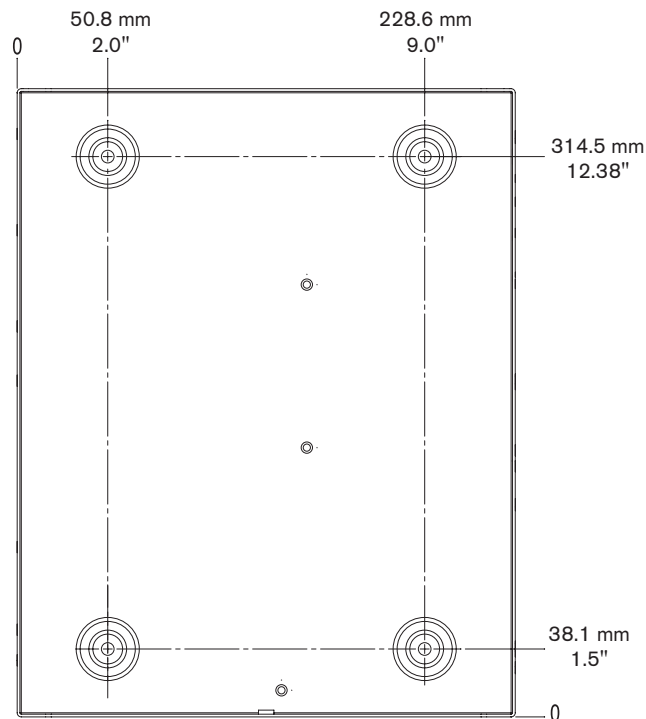
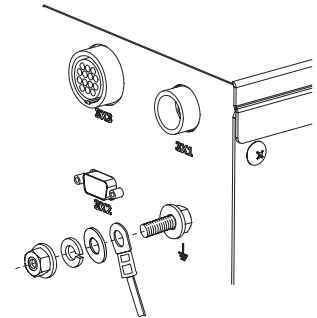
- Mount the gas console near the cutting table. Allow room to remove the top and right side cover for servicing. Preferred orientation is shown in the figure below. The maximum length of cables between the power supply and gas console is 75 m (250 ft). The maximum length of cables and hoses between the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



Preferred gas console orientation

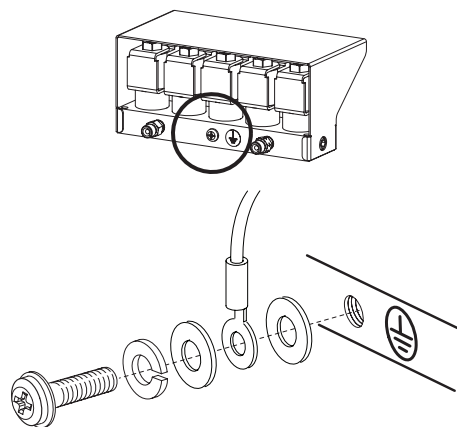
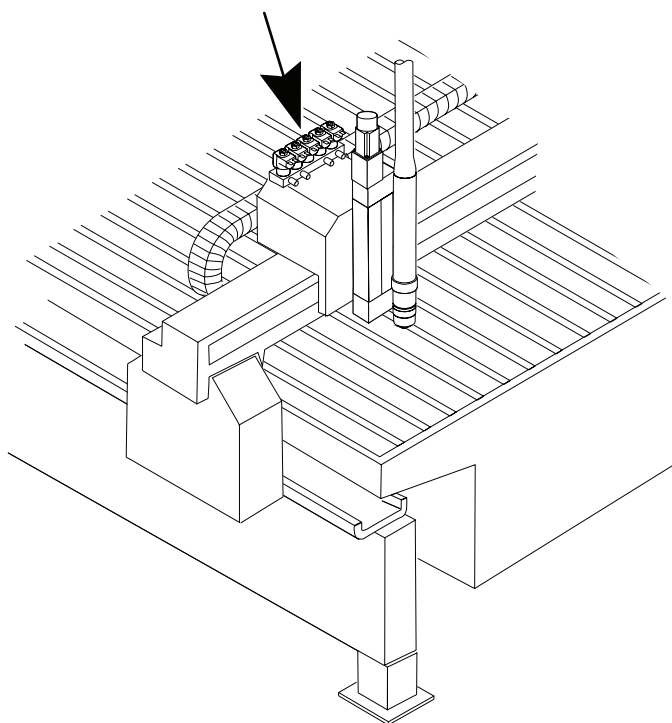


Gas console grounding

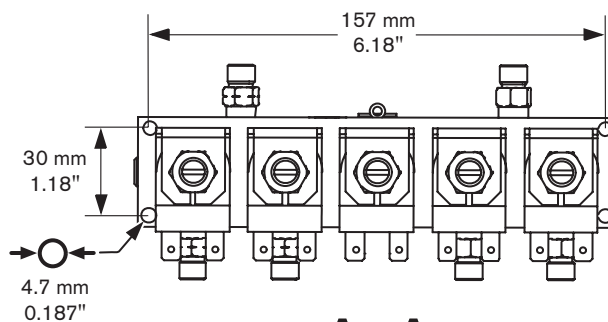
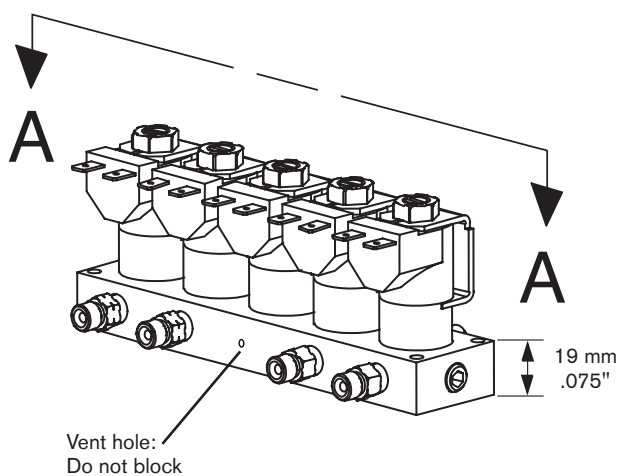


D Install the off-valve

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



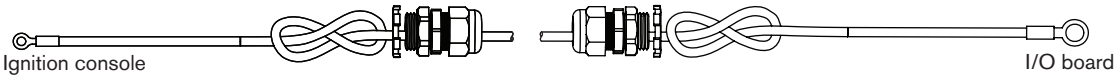
Off-valve grounding



A-A

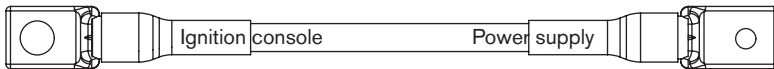
Power supply to ignition console leads

1 Pilot arc lead



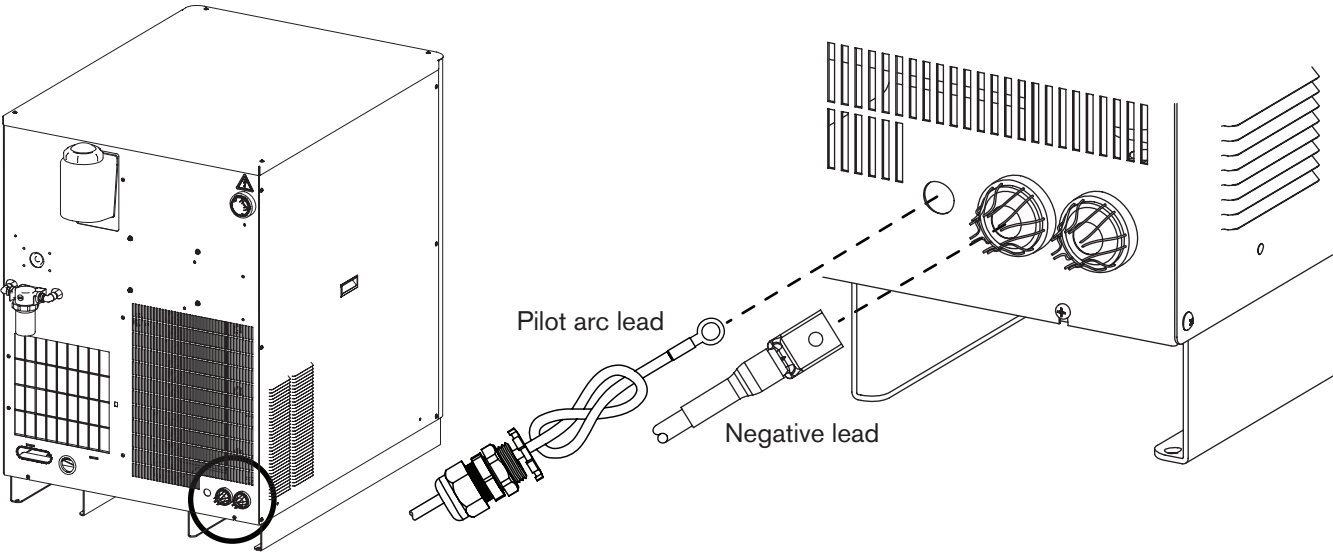
Part no.	Length	Part no.	Length
123683*	1.5 m (5 ft)	123823	20 m (65 ft)
123820	3 m (10 ft)	123735	25 m (82 ft)
123821	4.5 m (15 ft)	123668	35 m (115 ft)
123666	7.5 m (25 ft)	123669	45 m (150 ft)
123822	10 m (35 ft)	123824	60 m (200 ft)
123667	15 m (50 ft)	123825	75 m (250 ft)

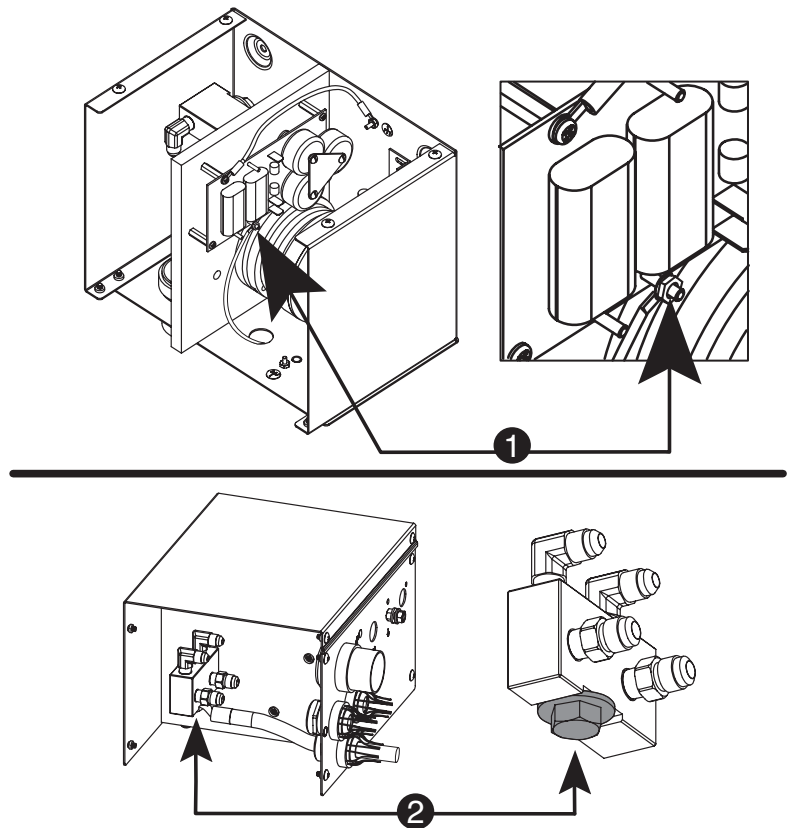
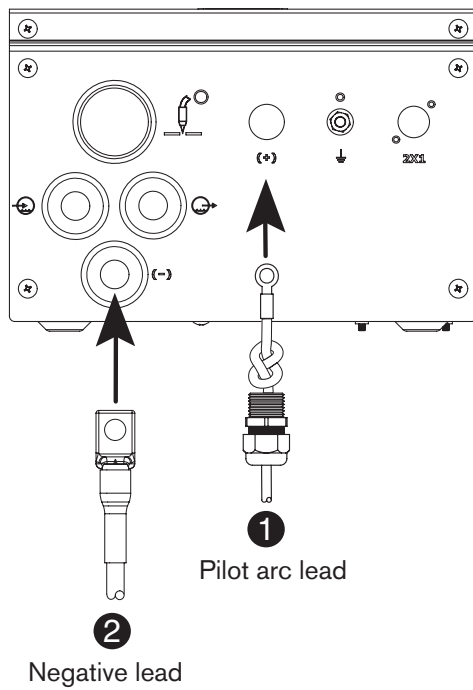
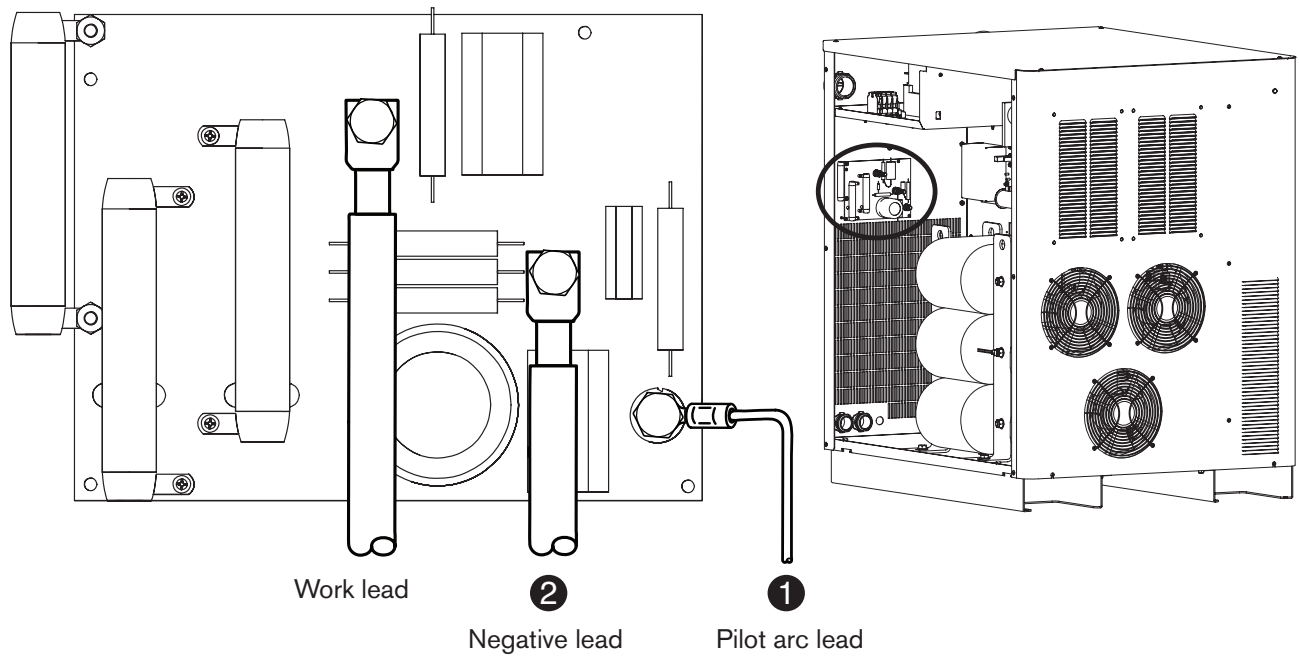
2 Negative lead



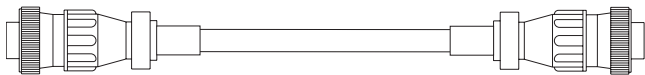
Part no.	Length	Part no.	Length
123829*	1.5 m (5 ft)	123819	20 m (65 ft)
123816	3 m (10 ft)	123775	25 m (82 ft)
123817	4.5 m (15 ft)	123776	35 m (115 ft)
123773	7.5 m (25 ft)	123777	45 m (150 ft)
123818	10 m (35 ft)	123778	60 m (200 ft)
123774	15 m (50 ft)	123779	75 m (250 ft)

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





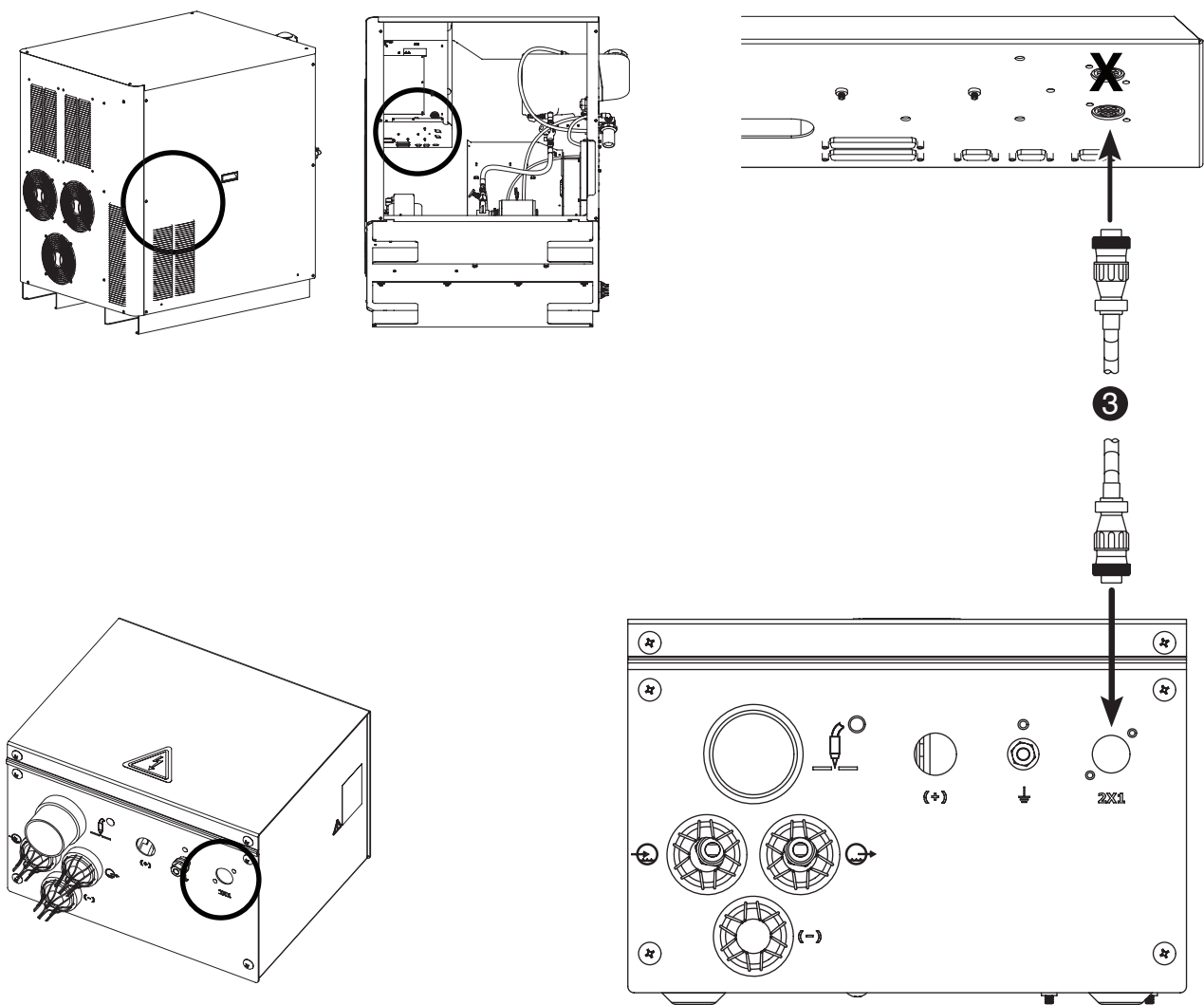
3 Ignition console power cable



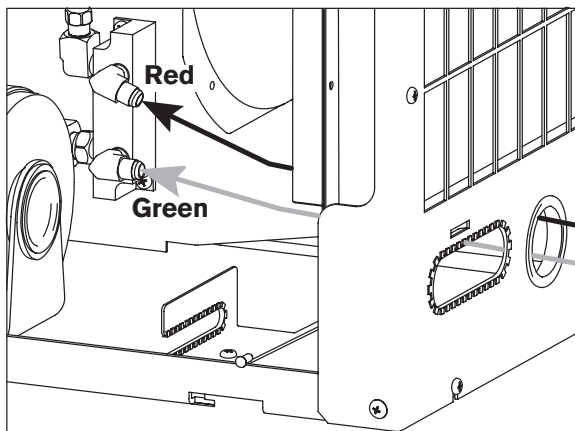
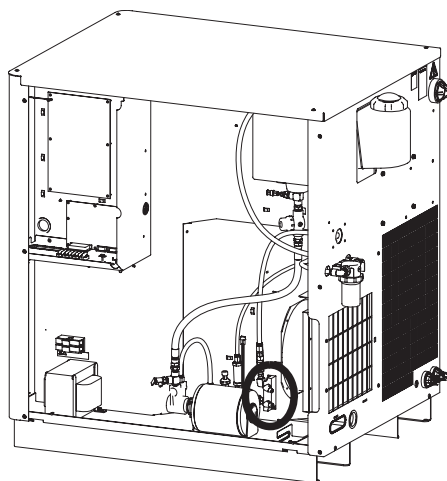
Part no.	Length	Part no.	Length
123865*	2.1 m (7 ft)	123836	20 m (65 ft)
123419	3 m (10 ft)	123736	25 m (82 ft)
123834	4.5 m (15 ft)	123672	35 m (115 ft)
123670	7.5 m (25 ft)	123673	45 m (150 ft)
123835	10 m (35 ft)	123837	60 m (200 ft)
123671	15 m (50 ft)	123838	75 m (250 ft)

Cable signal list – power supply to ignition console					
Power supply end			Ignition console end		
Pin #	I/O	Description	Pin #	I/O	Function
1		120Vac Hot	1		
2		120Vac 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

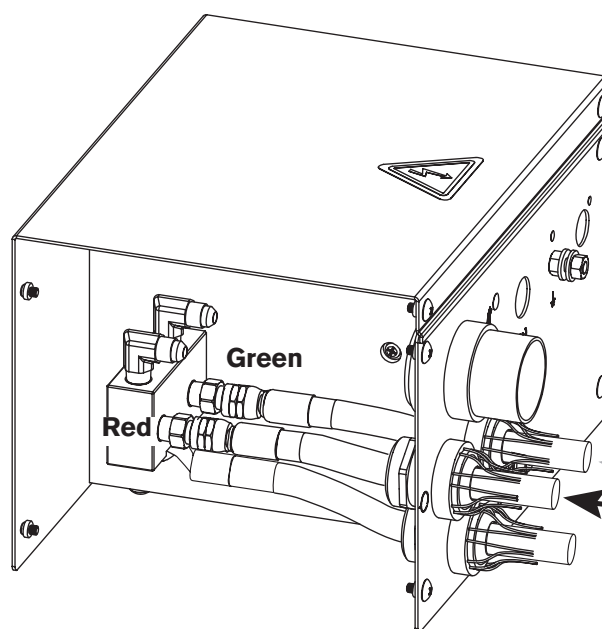


4 Ignition console coolant hoses



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)
123173	10 m (35 ft)	028637	60 m (200 ft)
028442	15 m (50 ft)	128985	75 m (250 ft)

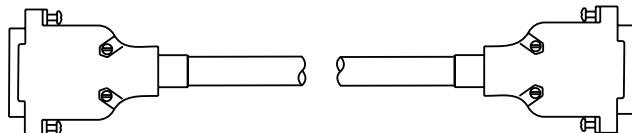
*Hose set number 228031 is for use with systems that have the ignition console mounted on the power supply



4

Power supply to gas console cables

5 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 gas console					
Power supply end			Gas 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		

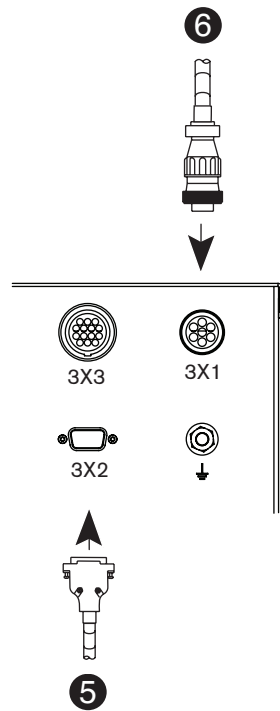
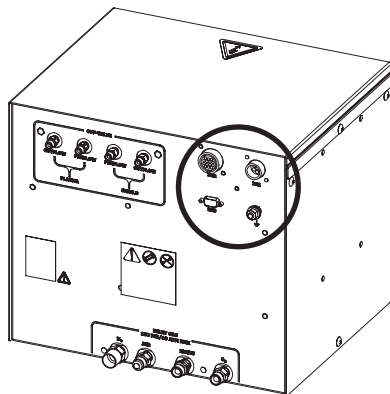
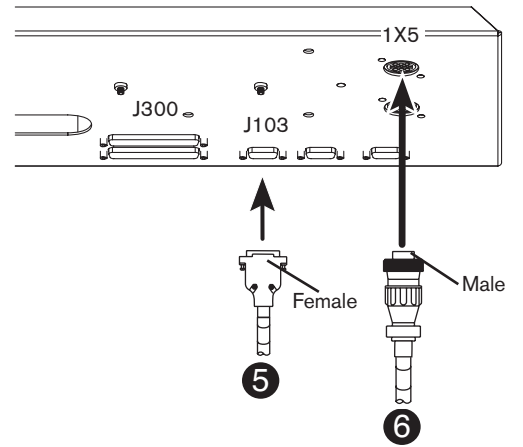
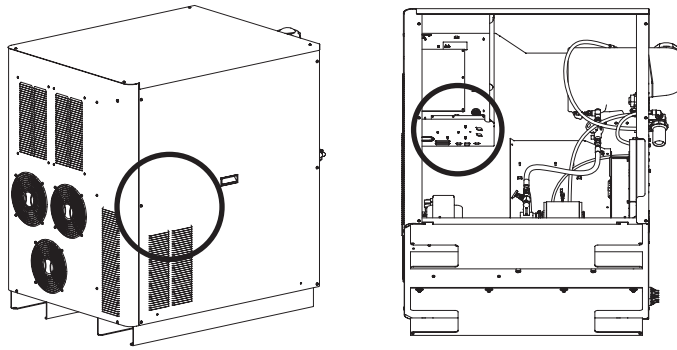
6 Power cable



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 gas console					
Power supply end			Gas console end		
Pin #	I/O	Description	Pin #	I/O	Function
1		120Vac-hot	1		
2		120Vac-return	2		
3		ground	3		
4		unused	4		
5		unused	5		
6		24Vac-hot	6		
7		24Vac-return	7		

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

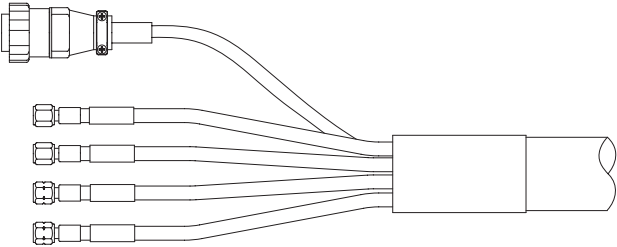


Gas console to off-valve connections

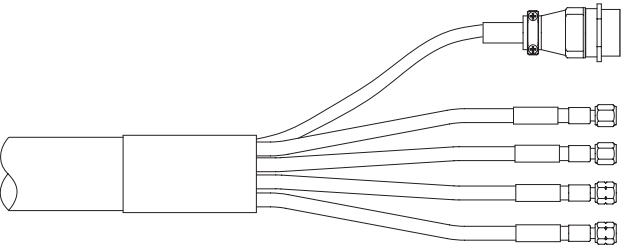
7 Cable and gas hose assembly

Part no.	Length
128989	3 m (10 ft)
128990	4.5 m (15 ft)
128782	7.5 m (25 ft)
128967	10 m (35 ft)
128786	15 m (50 ft)
128991	20 m (65 ft)

Female end at off-valve



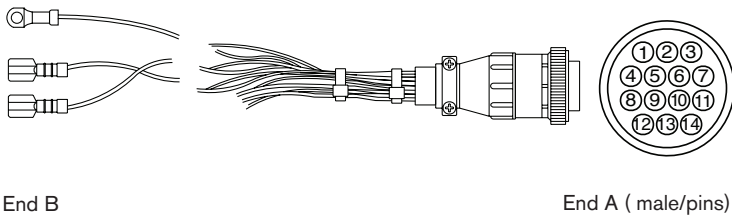
Male end at gas console



Gas console to off-valve cable

Cable signal list – gas console to off-valve cable		
Gas console end		Off-valve end
Pin #	Description	Pin #
1	120Vac Hot – Shield preflow	1
2	120Vac Return – Shield preflow	2
3	120Vac Hot – Shield cutflow	3
4	120Vac Return – Shield cutflow	4
5	120Vac Hot – Plasma preflow	5
6	120Vac Return – Plasma preflow	6
7	120Vac Hot – Plasma cutflow	7
8	120Vac Return – Plasma cutflow	8
9	120Vac Hot – Plasma vent	9
10	120Vac Return – Plasma vent	10
11	Ground	11

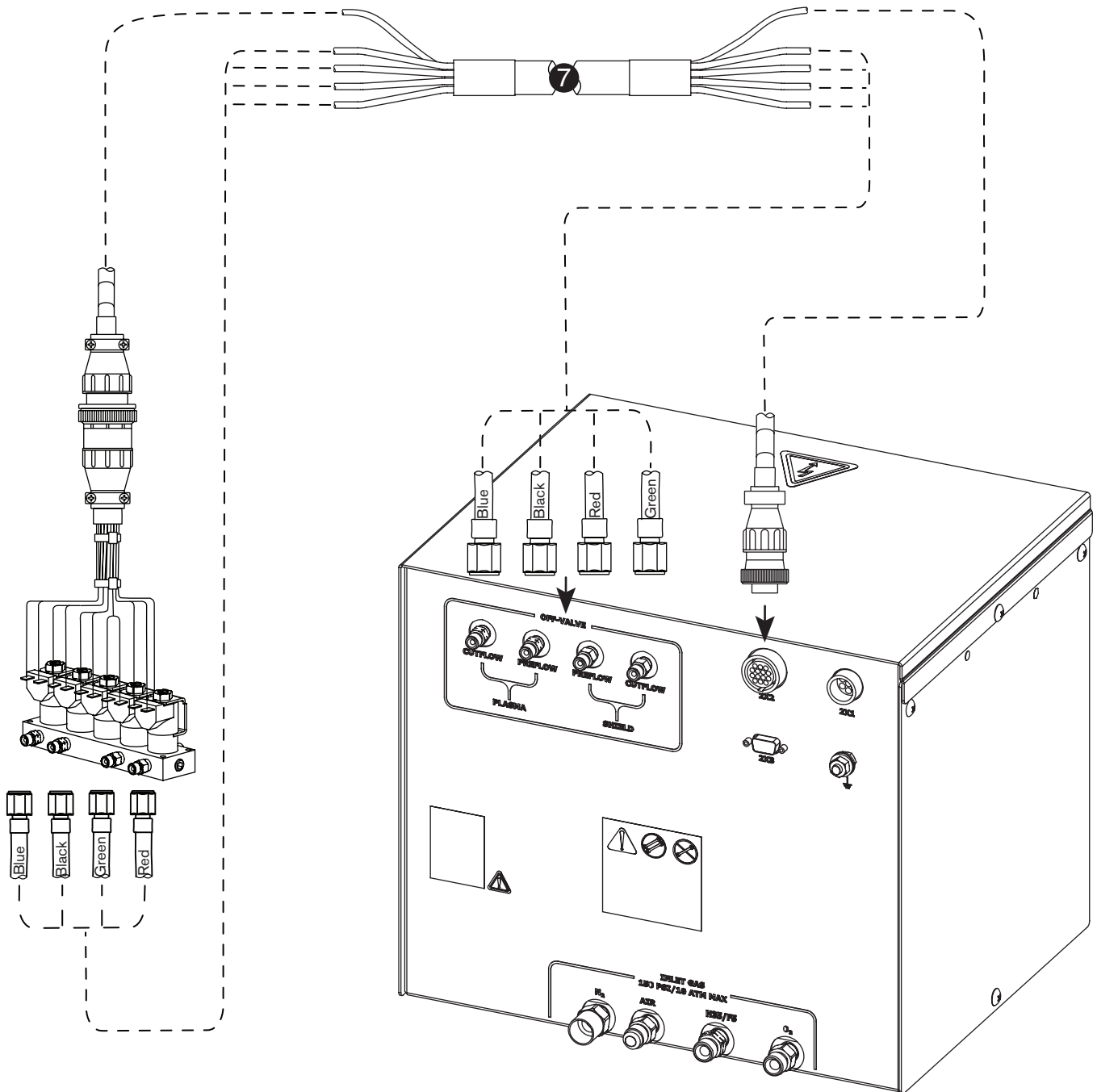
Off-valve cable



End B

End A (male/pins)

Cable signal list			
Function	End B	Color	End A
Shield Preflow	S	Red/Black	1
	P	Red	2
Shield Cutflow	S	Red/Black	3
	C	Red	4
Plasma Preflow	P	Red/Black	5
	P	Red	6
Plasma Cutflow	P	Red/Black	7
	C	Red	8
Vent	V	Red/Black	9
	V	Red	10
Ground	Ground	Green/Yellow	11
	Ground		12
	Ground		13
	Ground		14



INSTALLATION

8 Power supply to CNC interface cable

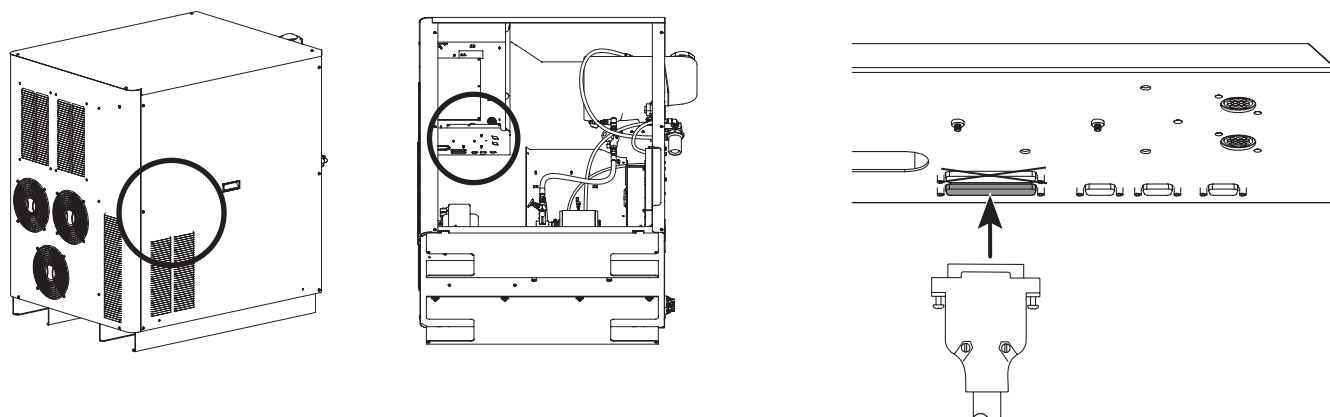
Part no.	Length	Part no.	Length
123210	3 m (10 ft)	123741	25 m (82 ft)
123211	4.5 m (15 ft)	123742	35 m (115 ft)
123022	7.5 m (25 ft)	123220	45 m (150 ft)
123214	10 m (35 ft)	123852	60 m (200 ft)
123023	15 m (50 ft)	123853	75 m (250 ft)
123851	20 m (65 ft)		

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



Notes to CNC interface cable run list

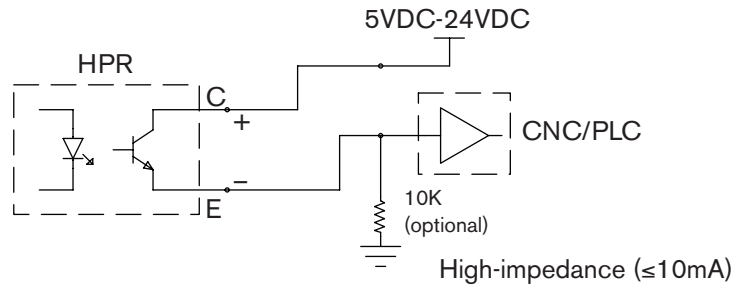
- Note 1. Inputs are optically isolated. They require 24 VDC at 7.3 mA, or dry-contact closure. The external relay's life may be improved by adding a metallized-polyester capacitor (0.022 μ F 100V or higher) in parallel with the relay contacts.
- Note 2. Outputs are optically isolated, open collector,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

Caution: The CNC cable must be constructed using cable with 360-degree 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.

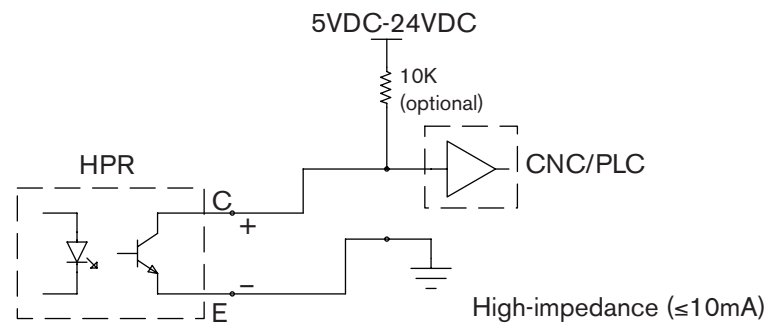


Examples of output circuits

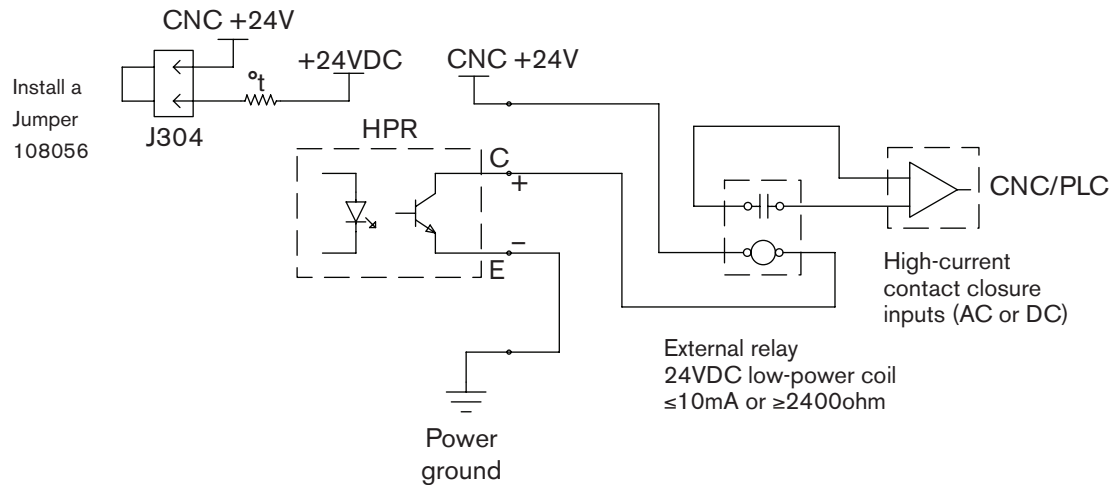
1. Logic interface, active-high



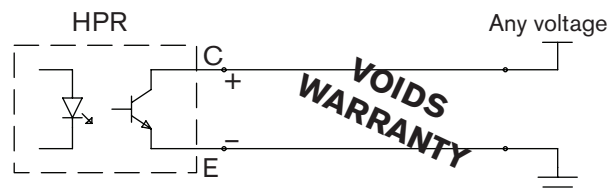
2. Logic interface, active-low



3. Relay interface

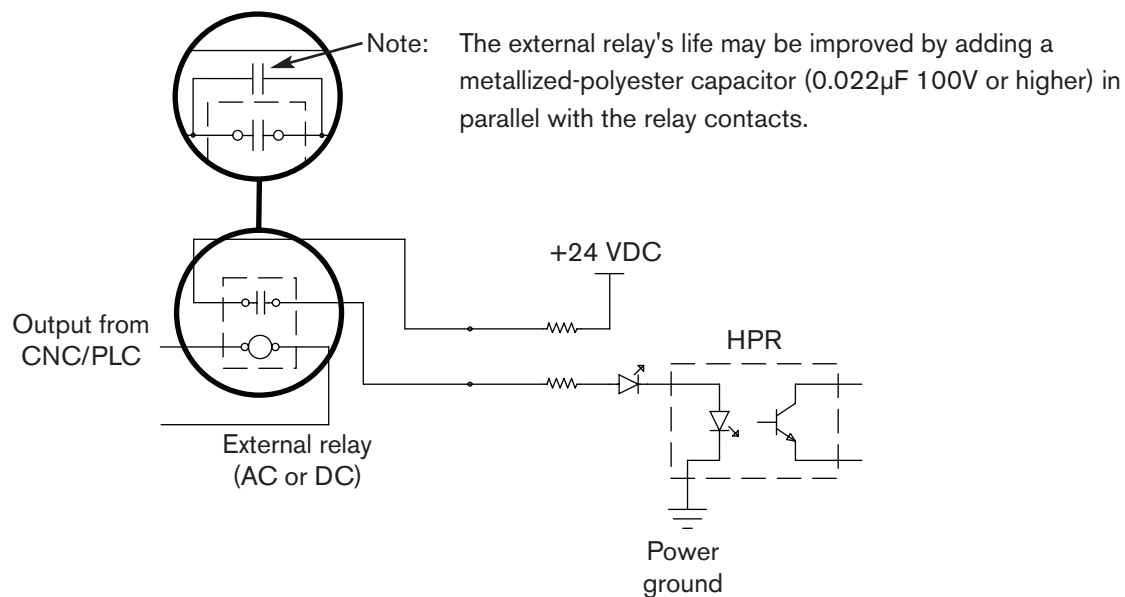


4. Do not use this configuration. Warranty will be void.

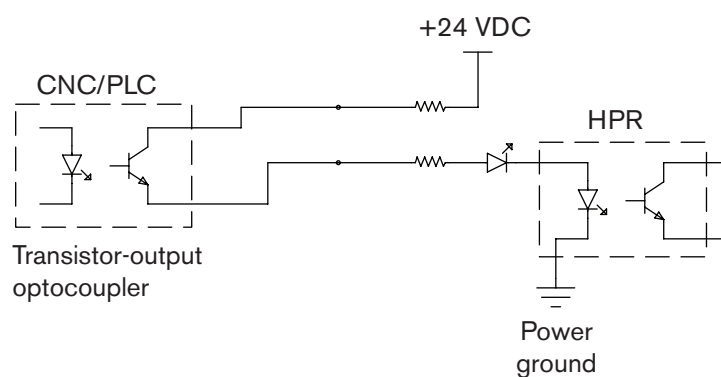


Examples of input circuits

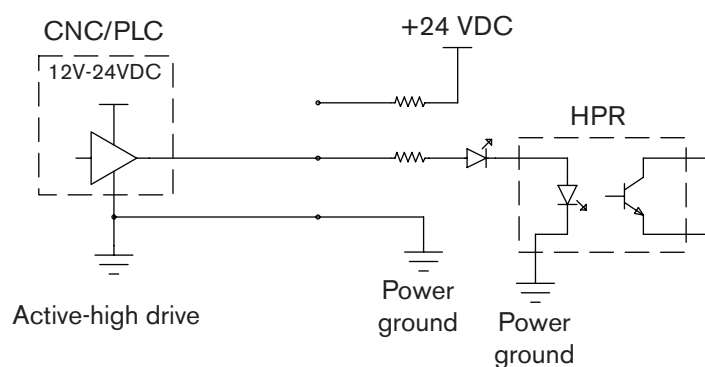
1. Relay interface



2. Optocoupler interface



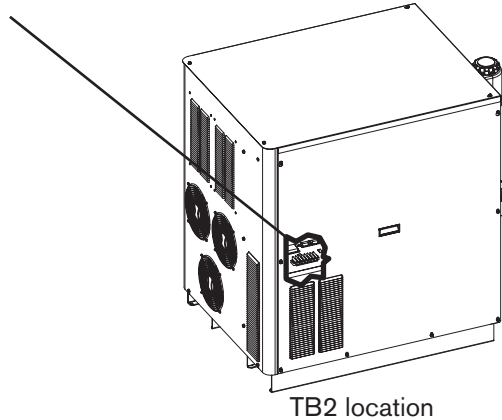
3. Amplified-output interface



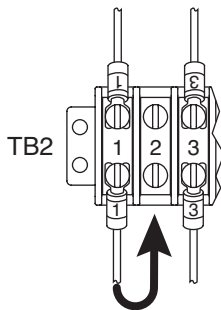
Remote ON/OFF switch (provided by customer)

		WARNING ELECTRIC SHOCK CAN KILL
Disconnect electrical power before performing any maintenance. See the <i>Safety</i> section in this manual for more safety precautions.		

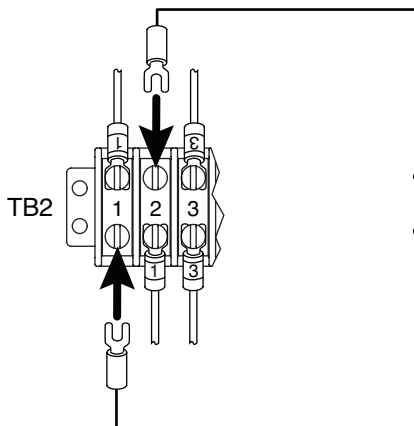
1. Locate terminal block 2 (TB2) in the power supply.



2. Remove wire 1 as shown and connect it to terminal 2.



3. Connect switch to terminals 1 and 2 as shown.

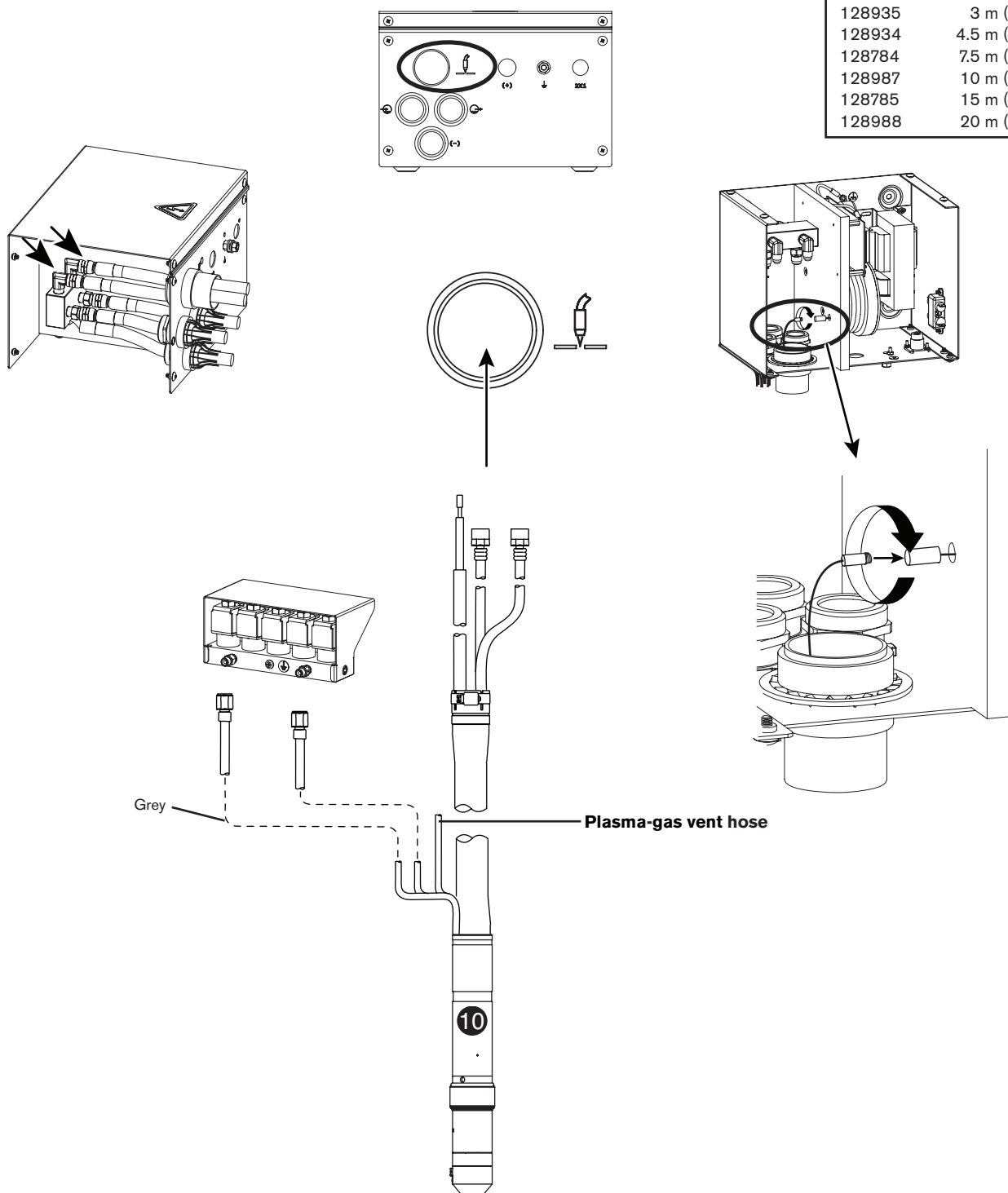


Note: Use a switch, relay or solid-state relay that is compatible with 24 VAC @ 100 mA. It must be a maintained-contact switch, not a momentary-contact switch.

Note: The main power switch on the gas console must be in the ON position for the remote switch to function.

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)



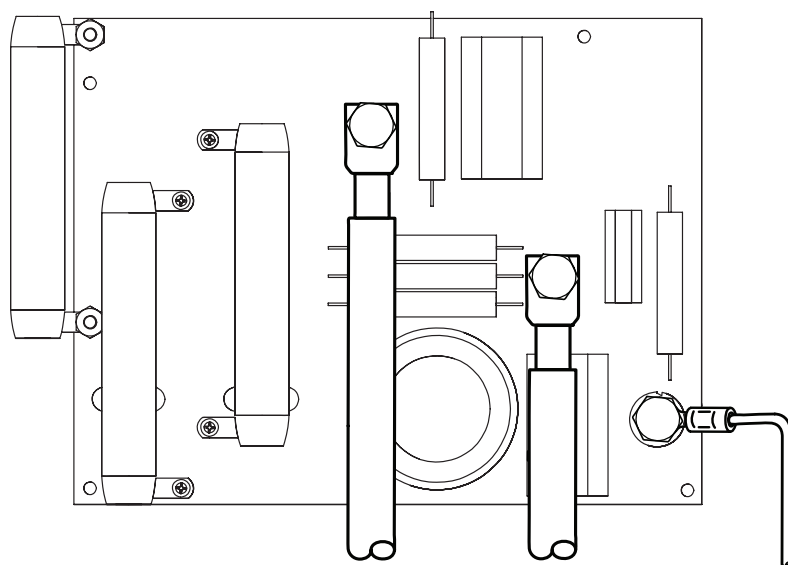
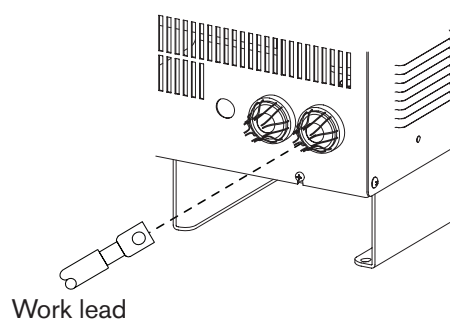
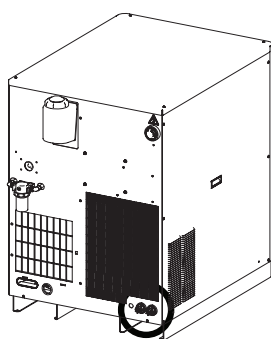
Caution: Locate the exposed end of the plasma-gas vent hose away from sparks caused by piercing to avoid ignition and possible damage to the torch leads.



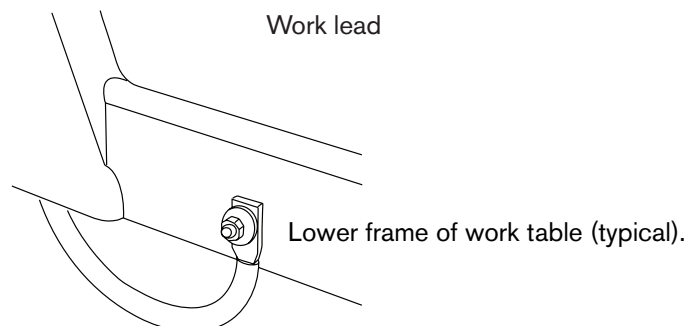
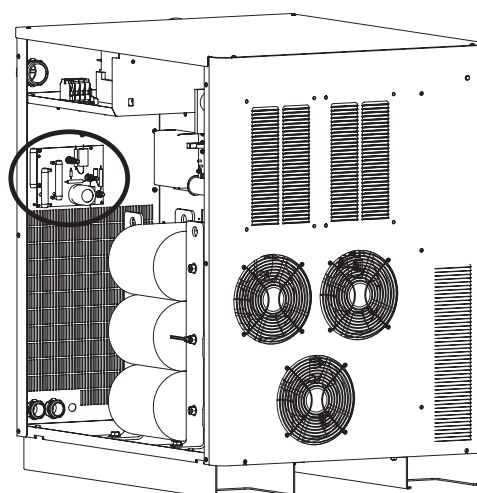
11 Work lead



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

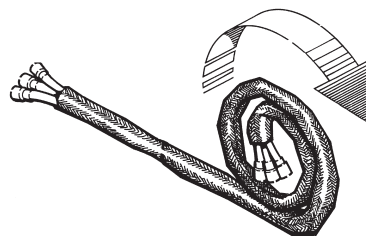


Lower frame of work table (typical).

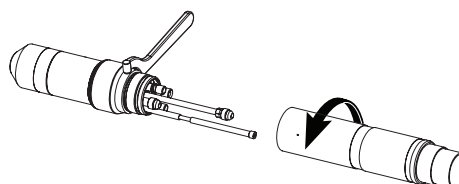
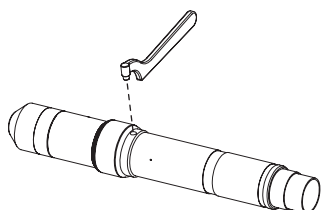
Torch connections

Connect the torch to the torch lead assembly

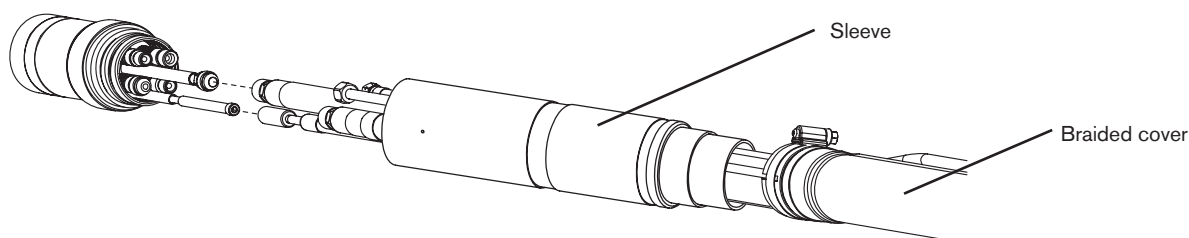
1. Uncoil the first 2 meters (6.5 ft) of the leads on a flat surface.



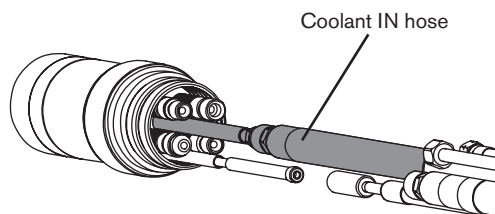
2. Hold the torch assembly in place with the spanner wrench (104269) and remove the mounting sleeve from the torch assembly.



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.



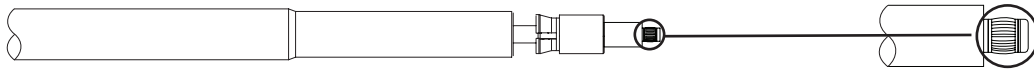
4. Connect the coolant IN hose (green) to the torch.



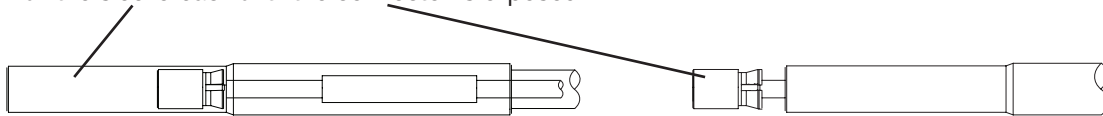
INSTALLATION

5. Connect the pilot arc lead.

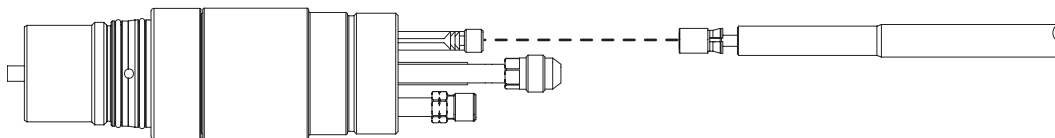
Note: Be careful not to damage or remove the small slotted metal band at the end of the pilot arc cable.



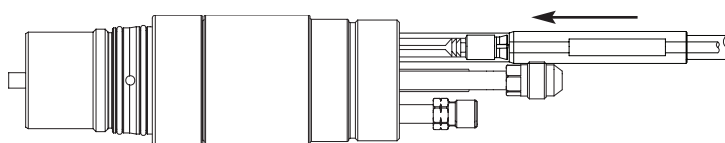
5a. Pull the sleeve back until the connector is exposed.



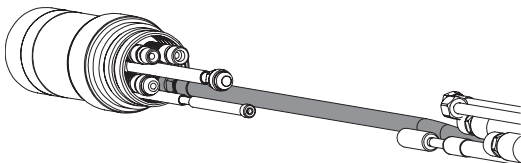
5b. Screw the connector onto the pilot arc connection from the torch. Tighten by hand until it is firmly seated.



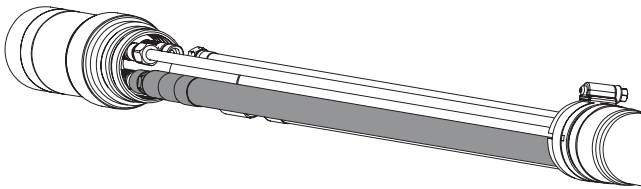
5c. Slide the sleeve forward until it clicks into place.



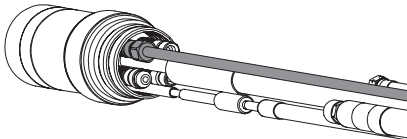
6. Connect the plasma-gas vent hose.



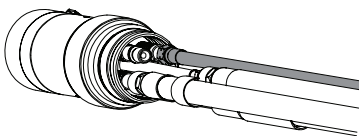
7. Connect the coolant return hose (red).



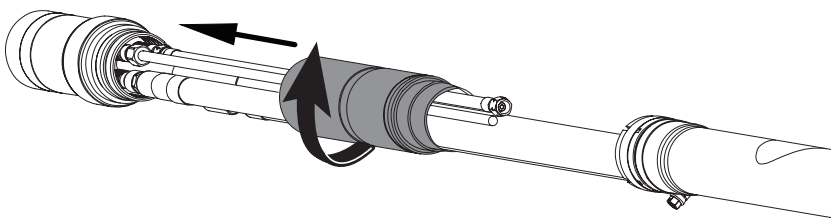
8. Connect the plasma gas hose.



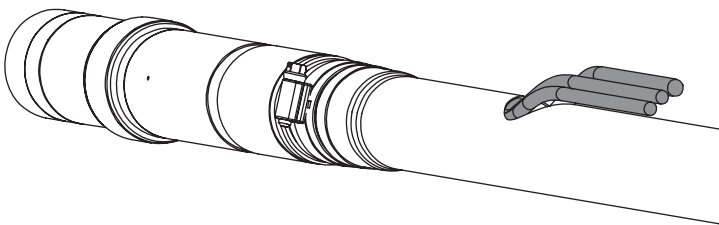
9. Connect the shield gas hose.



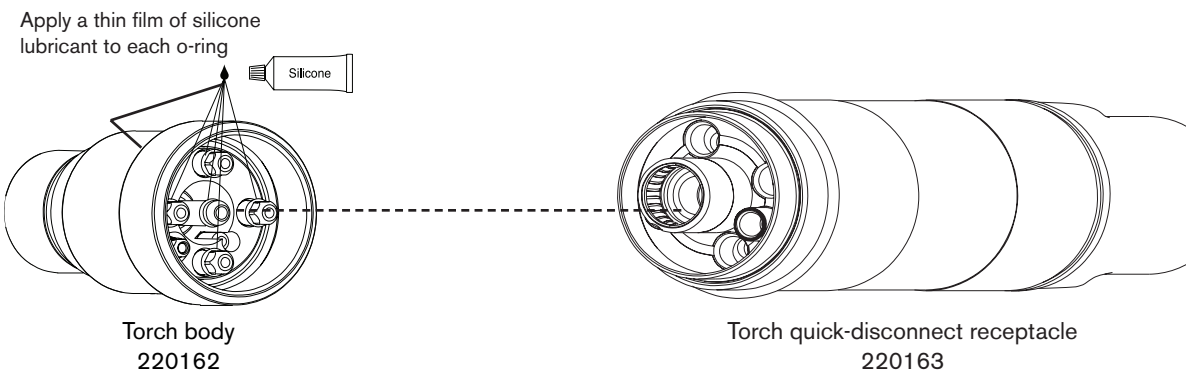
10. Slide the torch sleeve over connections and screw it onto the torch body.



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.

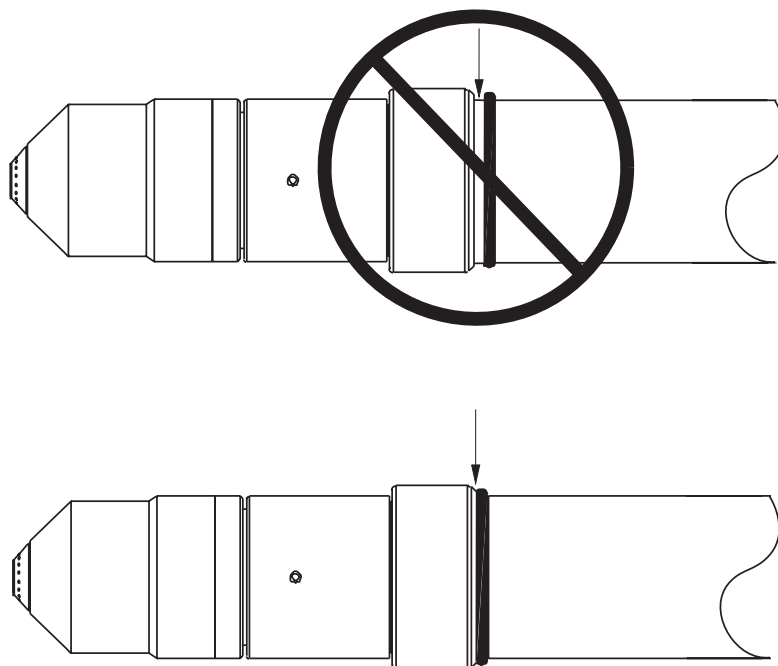


Connect the torch to the quick-disconnect



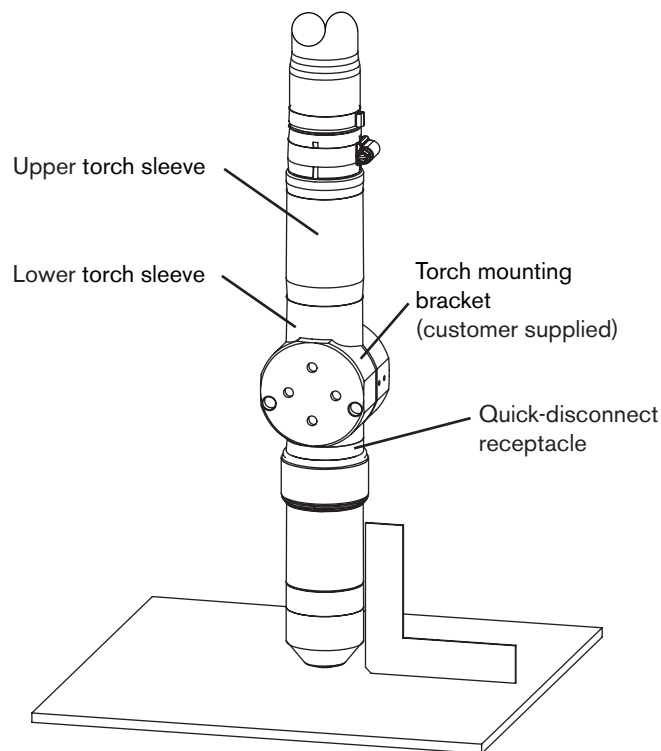
Installation note

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.

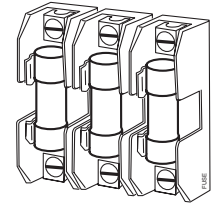
Torch lifter requirement

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).

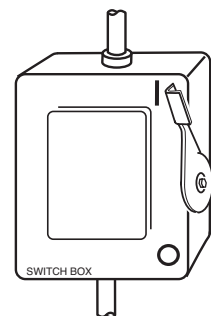
Line disconnect switch

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

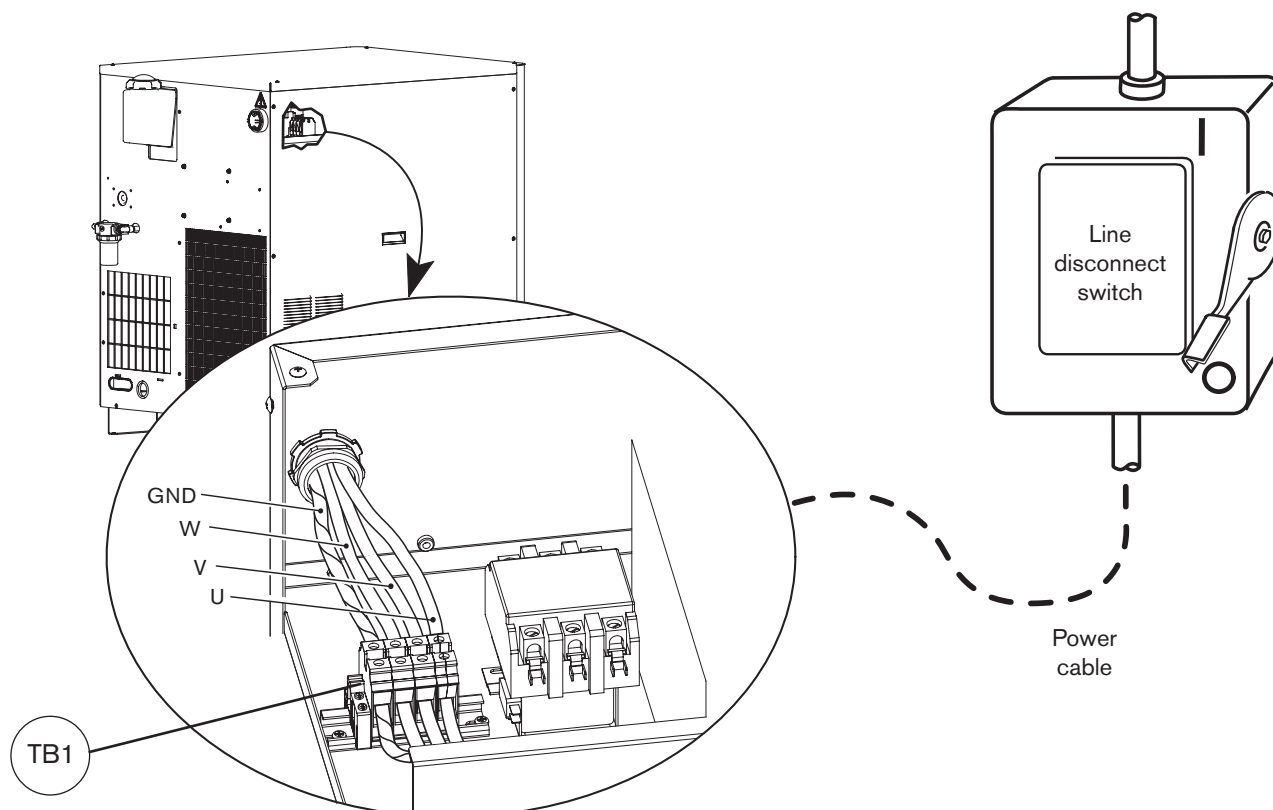
European wire colors

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.
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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).

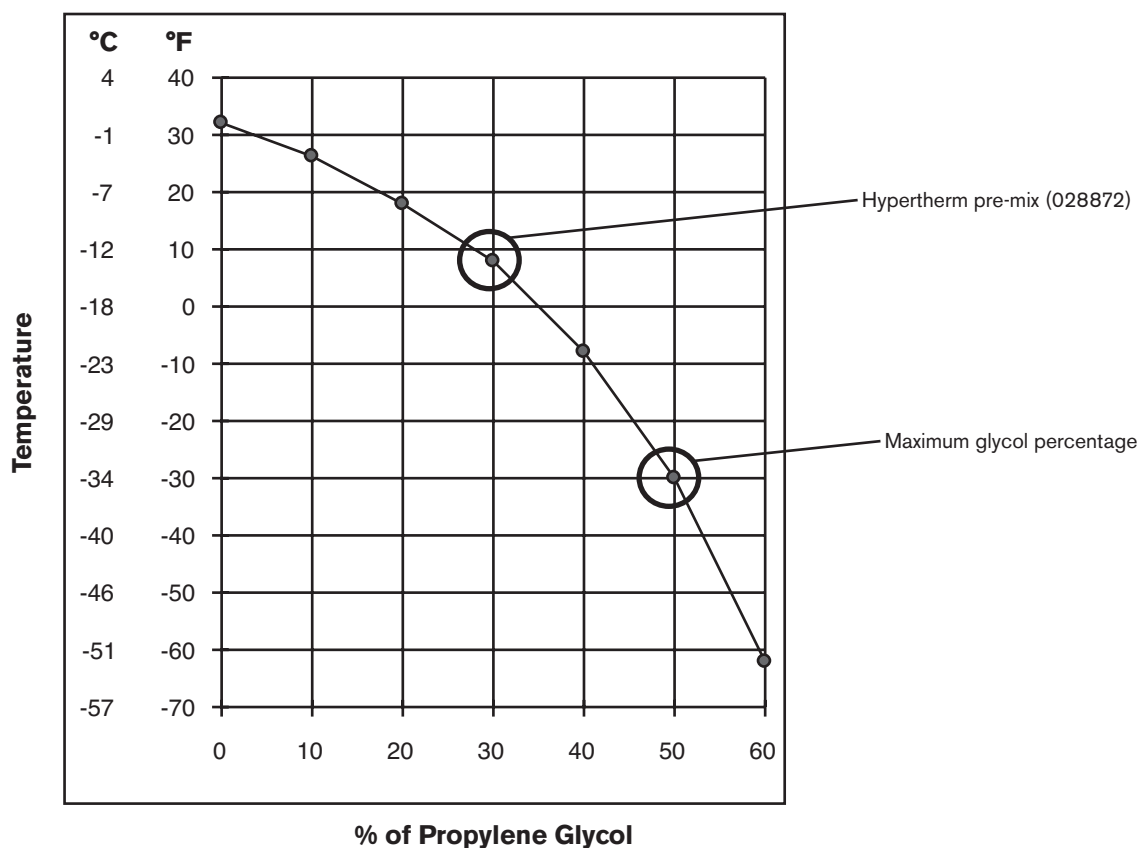
Caution: For operating temperatures colder than the temperature stated above, the percentage of propylene glycol must be increased. Failure to do so could result in a cracked torch head, hoses or other damage to the torch coolant system due to freezing.



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

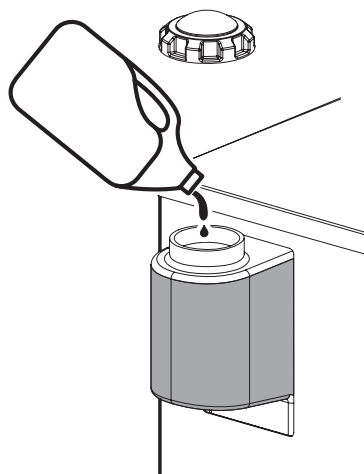
The system will take 11.4 – 15.1 liters (3 to 4 gallons) of coolant depending on the length of the torch leads and if the system has a local or remote ignition console.

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

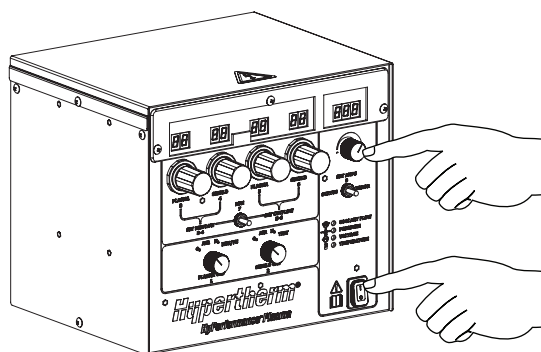


Do not over fill the coolant tank.

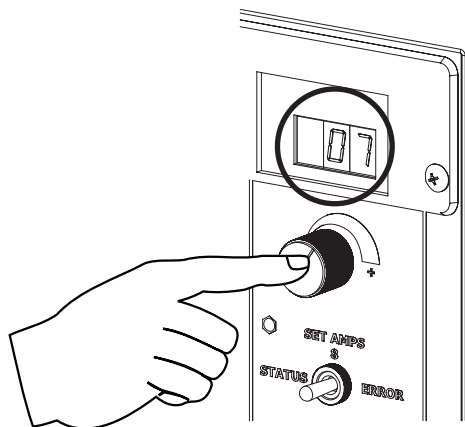
- ① Add coolant to the power supply until the tank is full.



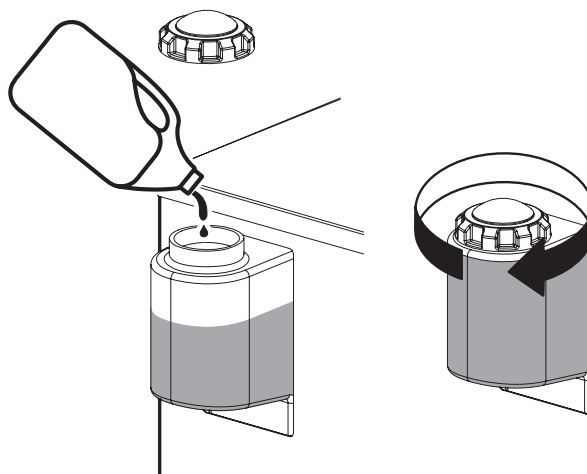
- ② Press and hold the current selection knob (8) and press power switch on the gas console. The pump will run continuously while (8) is pressed.



- ③ The current display shows the flow rate. When the flow rate is constant and greater than 22.7 lpm (0.6 gpm), release the knob. The display will show the current again. The pump will continue to run.



- 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 gas 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.



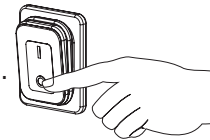
Caution: Gas supply pressures not within the specifications in Section 2 can cause poor cut quality, poor consumable life and operational problems.

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,

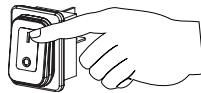
- Cut speeds can decrease
- Cut quality can deteriorate
- Cutting thickness capability can decrease
- Parts life can shorten

Setting the supply regulators

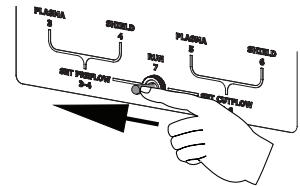
1. Turn OFF the power to the system. Set all gas regulator pressures to 8 bar (120 psi).



2. Turn ON the power to the system.



3. After the purge cycle stops, move switch (7) on the gas console to SET PREFLOW.

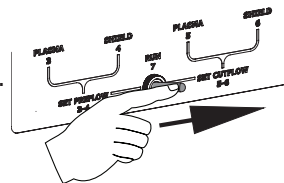


4. While gas is flowing adjust the supply regulator for the shield gas pressure to 8.3 bar (120 psi).

5. Move switch (7) back to the RUN position (center).



6. Move switch (7) to the CUTFLOW position (right position).



7. While gas is flowing adjust the supply regulator for the plasma gas to 8.3 bar (120 psi).

8. Move switch (7) to the RUN position.



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

INSTALLATION

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 gas 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 gas console to achieve the proper mixtures in the preflow and cutflow conditions.



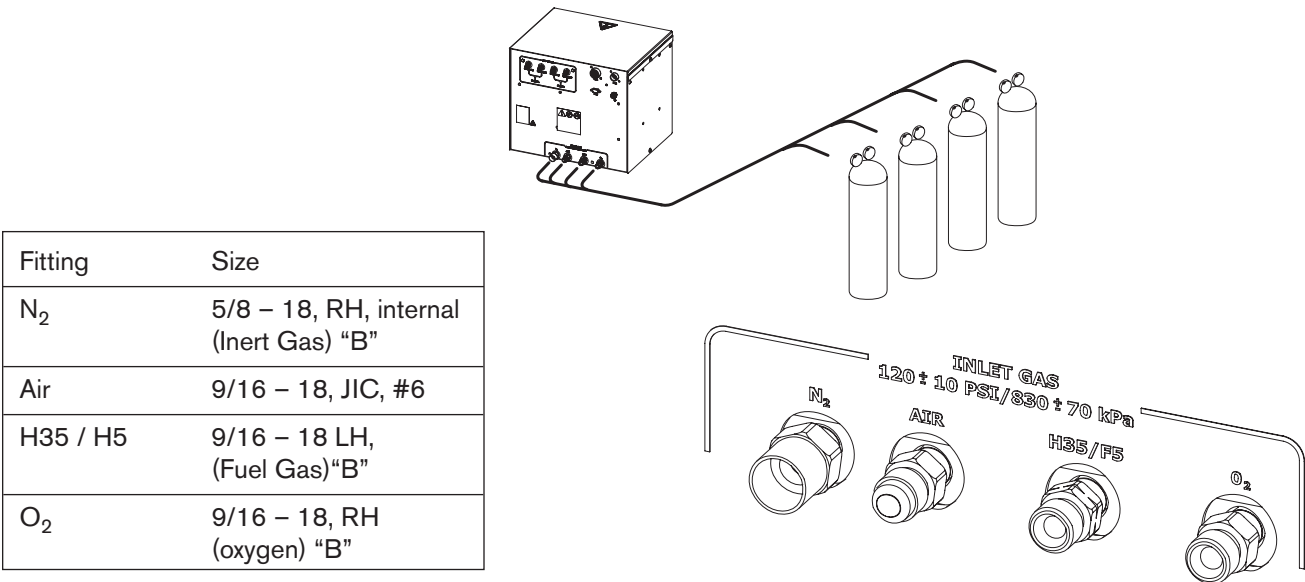
WARNING

CUTTING WITH OXYGEN CAN CAUSE FIRE OR EXPLOSION

Cutting with oxygen as the plasma gas can cause a potential fire hazard due to the oxygen-enriched atmosphere that it creates. As a precaution, Hypertherm recommends that an exhaust ventilation system be installed when cutting with oxygen. Flashback arrestors are required (unless not available for specific gases or required pressures) to prevent fire from propagating to supply gas.

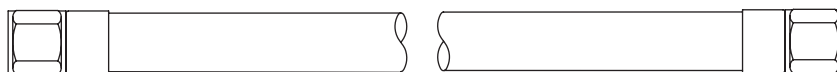
Connect the supply gases

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



Supply gas hoses

12 Oxygen hose



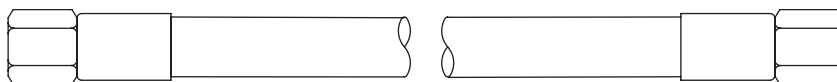
Part no.	Length	Part no.	Length
024607	3 m (10 ft)	024738	25 m (82 ft)
024204	4.5 m (15 ft)	024450	35 m (115 ft)
024205	7.5 m (25 ft)	024159	45 m (150 ft)
024760	10 m (35 ft)	024333	60 m (200 ft)
024155	15 m (50 ft)	024762	75 m (250 ft)
024761	20 m (65 ft)		

13 Nitrogen hose



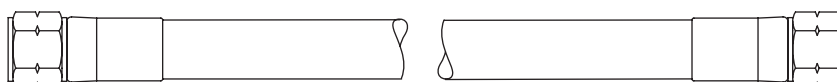
Part no.	Length	Part no.	Length
024210	3 m (10 ft)	024739	25 m (82 ft)
024203	4.5 m (15 ft)	024451	35 m (115 ft)
024134	7.5 m (25 ft)	024120	45 m (150 ft)
024211	10 m (35 ft)	024124	60 m (200 ft)
024112	15 m (50 ft)	024764	75 m (250 ft)
024763	20 m (65 ft)		

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

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Daily start-up

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

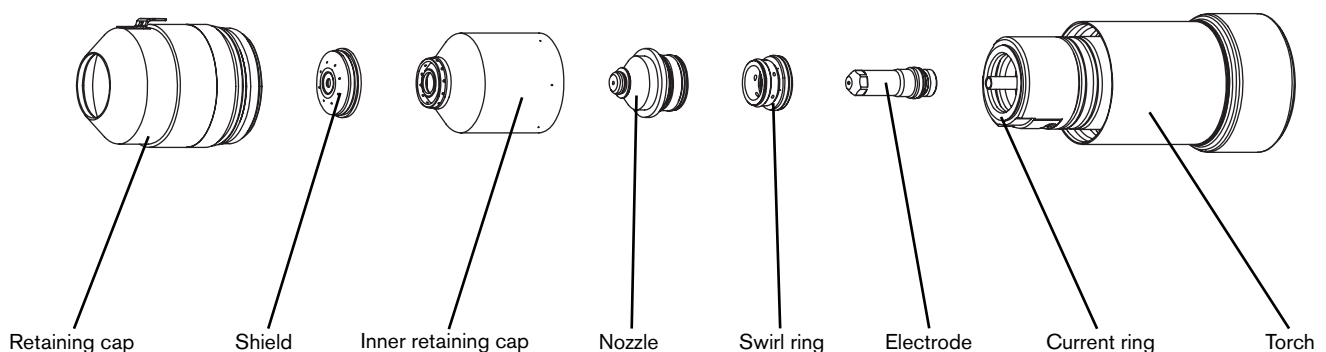
Check torch



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.

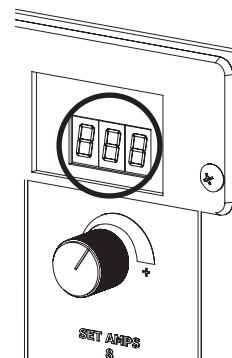
1. Turn main disconnect switch to the power supply OFF.
2. Remove the consumables from the torch and check for worn or damaged parts. **Always place the consumables on a clean, dry, oil-free surface after removing. Dirty consumables can cause the torch to malfunction.**
 - Refer to *Changing consumable 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.



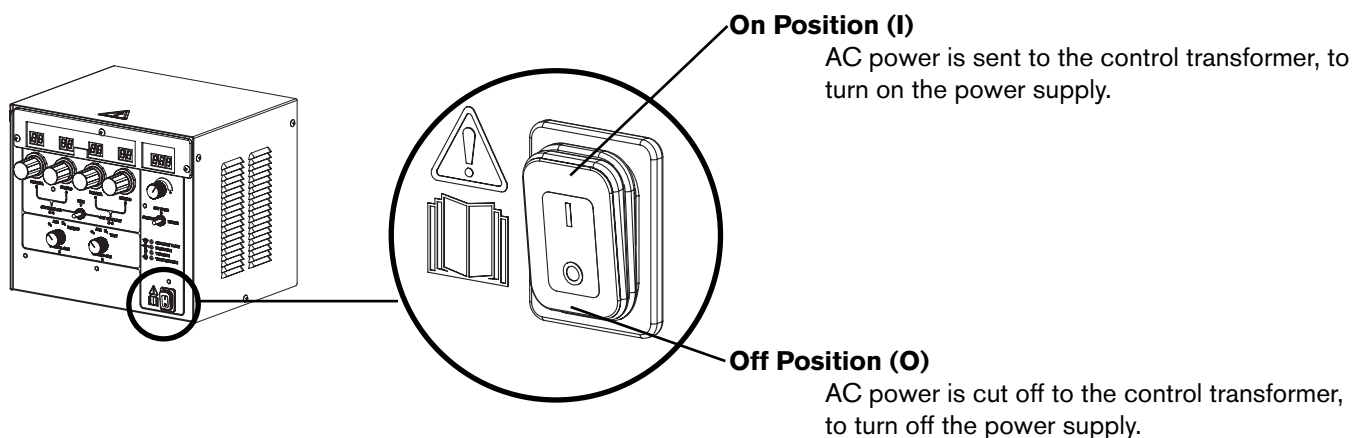
Controls and indicators

General

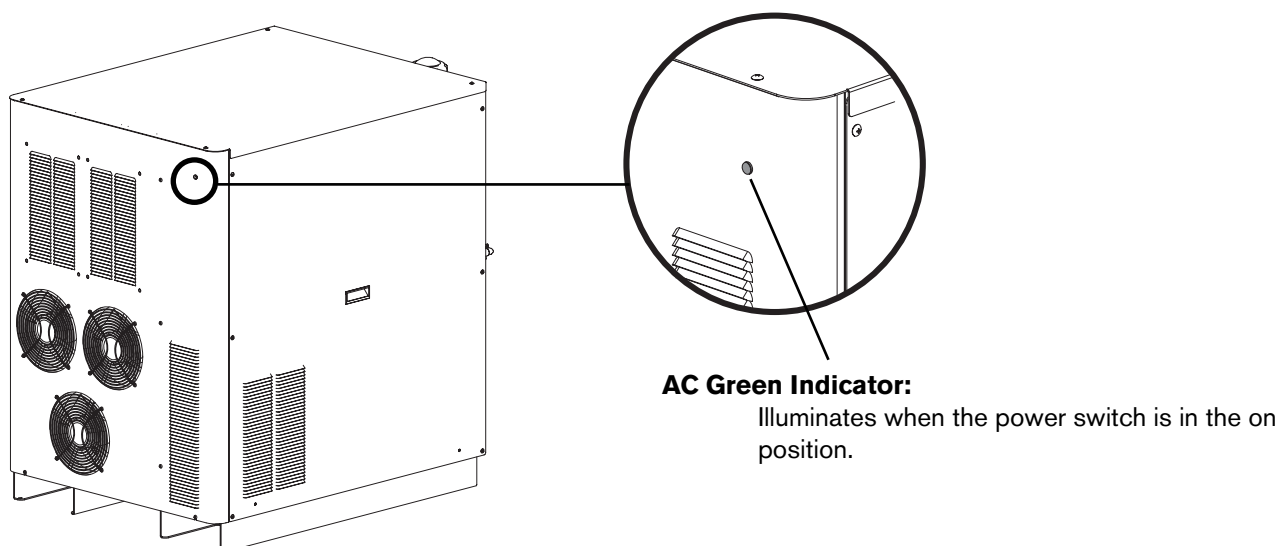
The main power switch for the HyPerformance plasma system is located on the gas console. There is no power switch on the power supply. The gas console controls all systems functions. Error codes are shown in the LED display over the current select knob.



Main power switch

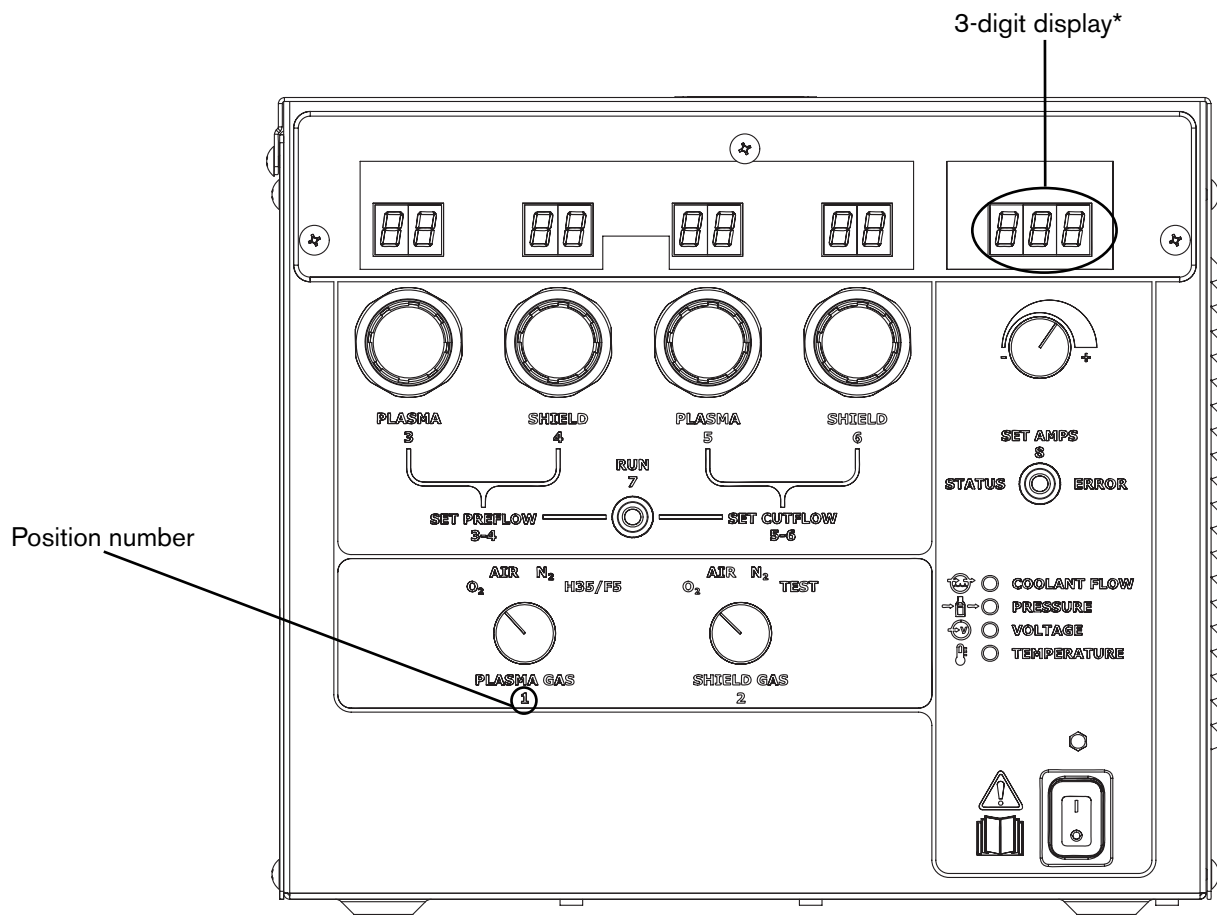


Power indicators



Manual gas console operation

The term “position number” refers to the numbers on the front panel of the gas console.



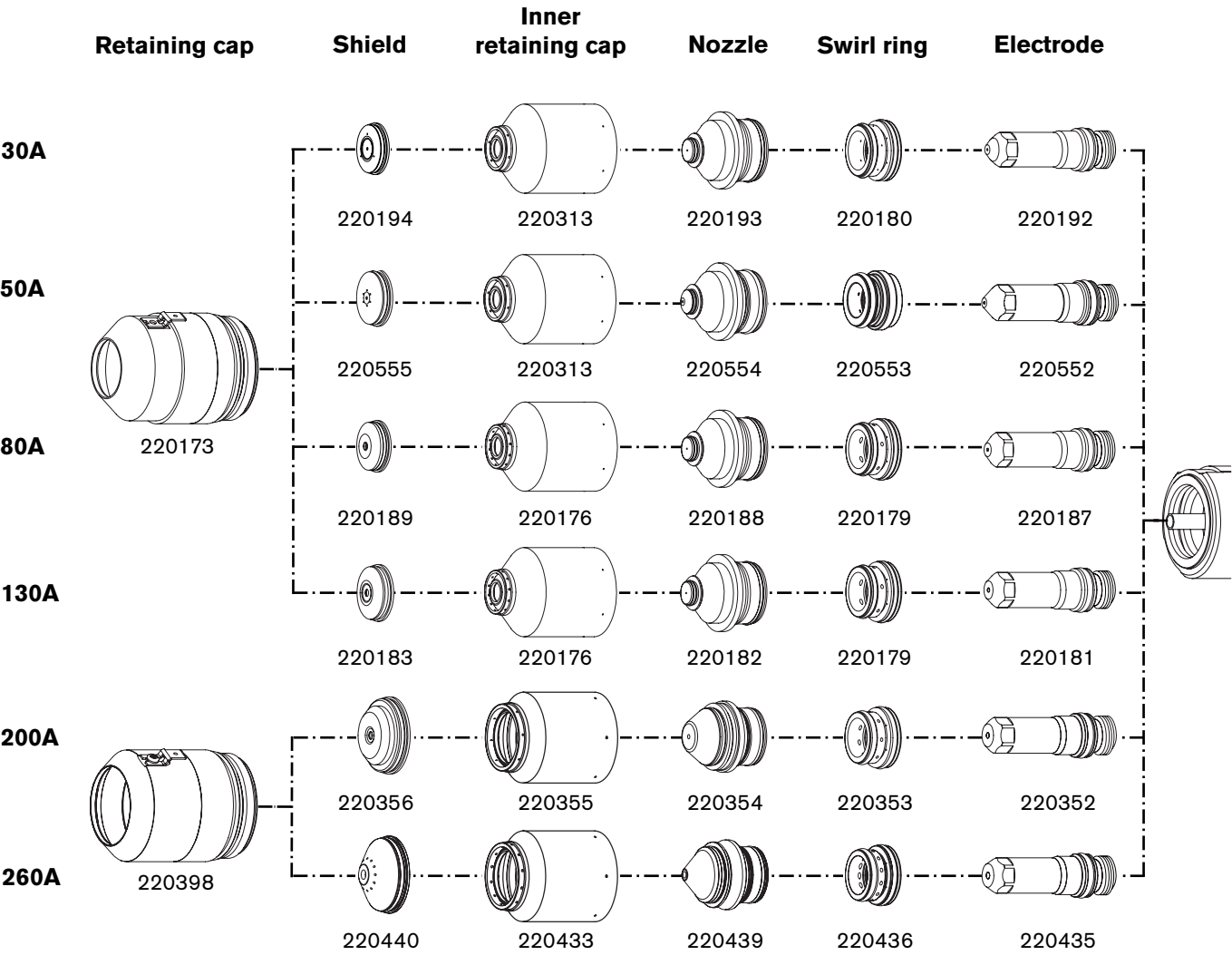
1. Turn ON the power.
2. Follow instructions below using the settings provided in the *Cut charts*.

Position #	Instruction
1	Select PLASMA GAS.
2	Select SHIELD GAS.
3, 4 & 7	Position switch (7) to SET PREFLOW (3-4). Set plasma preflow (3). Set shield preflow (4)
5, 6 & 7	Position switch (7) to SET CUTFLOW (5-6). Set plasma cutflow (5). Set shield cutflow (6).
7	Position switch (7) to RUN.
8	Position switch (8) to SET AMPS. Set amperage using knob above switch (8). Switch 8 can be in any position while operating.
	System is ready to cut.

*The 3-digit display is for reference. The current shown during cutting may vary by +/- 2 amps from the current shown when the amperage is set.

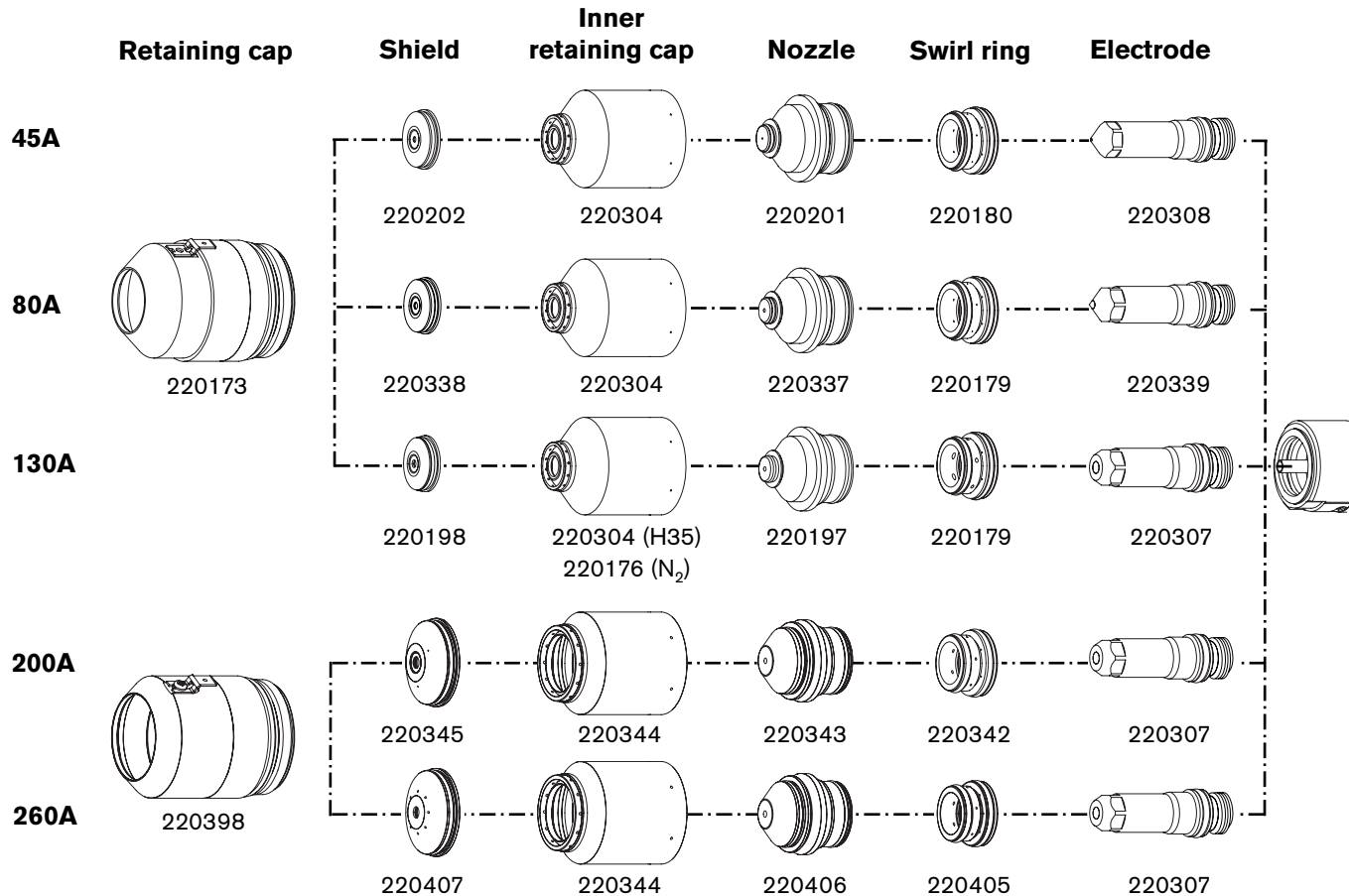
Consumable selection

Mild steel

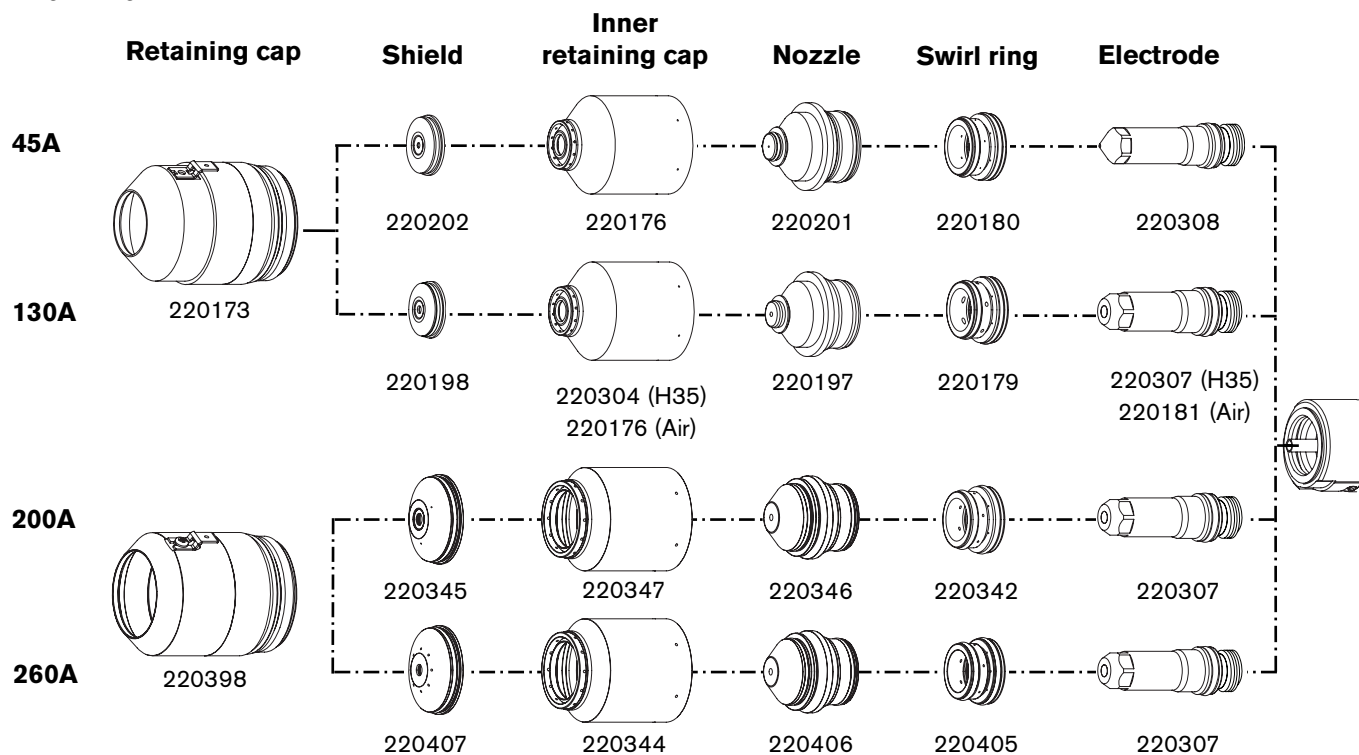


OPERATION

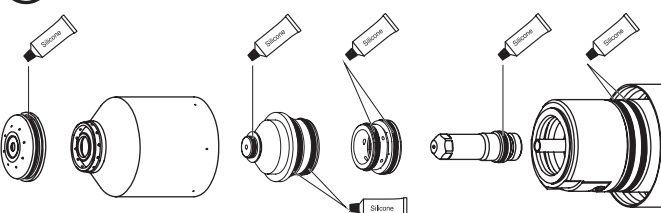
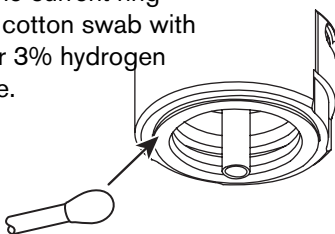
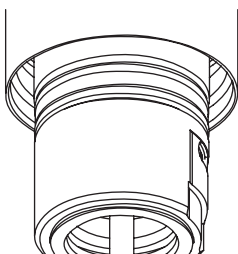
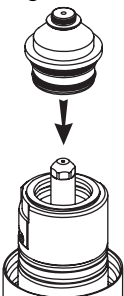
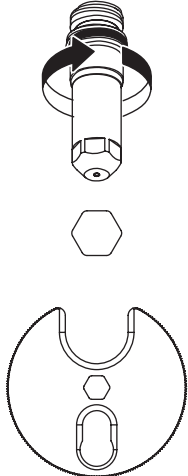
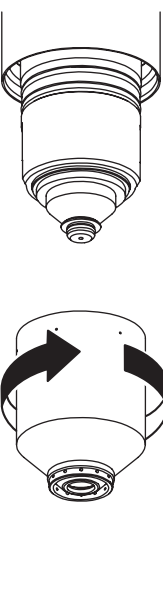
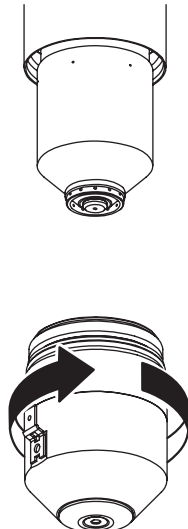
Stainless steel



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 	④ Install the swirl ring 	⑤ Install the nozzle and swirl ring 
⑥ Install the inner retaining cap  Tool part number 104119	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						

OPERATION

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 N ₂ / 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						

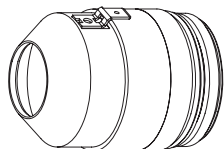
Mild steel

O₂ Plasma / O₂ Shield

30 A Cutting

Flow rates - lpm/scfh		
	O ₂	Air
Preflow	0 / 0	46 / 97
Cutflow	22 / 46	0 / 0

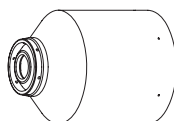
Note: Air must be connected to use this process. It is used as the preflow gas



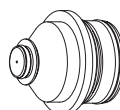
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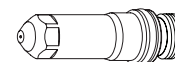
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Metric

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	80	15	92	15	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		5	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	80	15	92	15	.018	114	0.050	215	0.090	180	0.1
						.024			200			0.2
						.030	115		170			0.3
						.036	116		155			
						.048	117		110			
			.060		119	85	0.110	0.4				
			35		5	.075		120	60	0.060		0.5
						.105		122	50			0.7
						.135*		123	40			0.9
						3/16*		128	30			1.1
									25			1.3
75	1/4*	128	25	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	15	2.5	0.100	6350	250	105

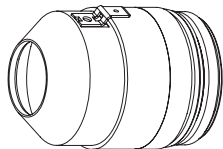
*Pierce complete is recommended for these thicknesses

OPERATION

Mild steel O₂ Plasma / O₂ Shield 50 A Cutting

Flow rates - lpm/scfh		
	O ₂	Air
Preflow	0 / 0	43 / 90
Cutflow	25 / 52	0 / 0

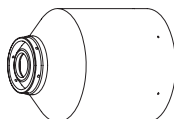
Note: Air must be connected to use this process. It is used as the preflow gas



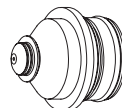
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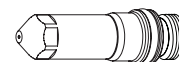
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220553



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	75	15	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

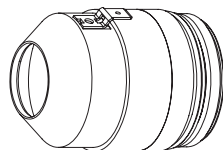
Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	Volts	in	ipm	in	factor %	seconds
O ₂	O ₂	70	30	75	15	.030	110	0.04	270	0.08	200	0.0
						.036			210			
						.048			112			
						.060	114	0.05	125	0.10		
						.075	115		110			
						.105	118		0.06	80		0.12
						.135	120	60				
						3/16	121	50	0.08	35		
						1/4	125	25		0.5		
						5/16	130					

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
O₂ Plasma / Air Shield
80 A Cutting

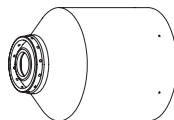
Flow rates - lpm/scfh		
	O ₂	Air
Preflow	0 / 0	76 / 161
Cutflow	23 / 48	41 / 87



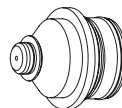
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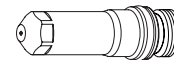
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Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	mm	Volts	mm	mm/m	mm	factor %	seconds
O ₂	Air	50	30	72	30	2	112	2.5	9810	3.8	150	0.1
						2.5	115		7980			
						3	117		6145			
						4	120	2.0	4300	4.0	200	0.2
						6	123		3045			0.3
						10	127		1810			0.5
						12	130		1410			0.7
					15	15	133		1030	5.0	250	0.8
						20	135		545			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	50	30	72	30	.075	112	0.100	400	0.150	150	0.1
						.105	115		290			
						.135	117		180			
						3/16	120	0.080	155	0.160	200	0.2
						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

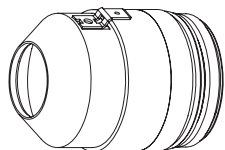
Marking

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

OPERATION

Mild steel O₂ Plasma / Air Shield 130 A Cutting

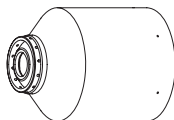
Flow rates - lpm/scfh		
	O ₂	Air
Preflow	0 / 0	102 / 215
Cutflow	33 / 70	45 / 96



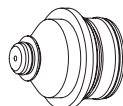
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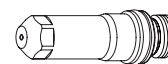
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220182



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	35	40	80	35	3	124	2.5	6505	5.0	200	0.1
						4	126	2.8	5550	5.6		0.2
						6	127		4035			0.3
					28	10	130	3.0	2680	6.0		0.5
			12			132	3.3	2200	6.6	0.7		
			15			135	3.8	1665	7.6	1.0		
			20			138		1050				
			25			141	4.0	550	190	1.8		
			32			160	4.5	375	Edge start			
						38		167			255	

English

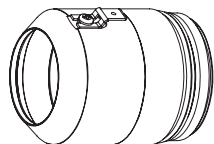
Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time	
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	Volts	in	ipm	in	factor %	seconds	
O ₂	Air	35	40	80	35	.135	124	0.100	240	0.200	200	0.1	
						3/16	126	0.110	190	0.220		0.2	
						1/4	127		150			0.3	
					28	3/8	130	0.120	110	0.240		0.300	0.5
						1/2	132	0.130	80	0.260			0.7
						5/8	135	0.150	60	190			1.0
			3/4			138	45		1.8				
			1			141	0.160	20	Edge start				
			1-1/4			160	0.180	15					
			1-1/2			167		10					

Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	15	2.5	0.100	6350	250	130

Mild steel
O₂ Plasma / Air Shield
200 A Cutting

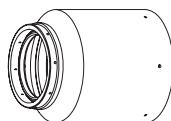
Flow rates - lpm/scfh		
	O ₂	Air
Preflow	0 / 0	128 / 270
Cutflow	39 / 82	48 / 101



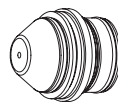
220398



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	24	65	69	28	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			Edge start
						38	152		510			
						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
O ₂	Air	24	65	69	28	3/16	124	0.130	230	0.260	200	0.2
						1/4			200			0.3
						3/8			140			0.5
						1/2			115			0.6
						5/8	131	0.160	80	0.320		0.8
						3/4	133		65			1.0
						1	143	0.200	45	0.400		Edge start
						1-1/4	145		30			
						1-1/2	152		20			
						2	163		10			

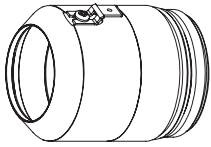
Marking

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

OPERATION

Mild steel O₂ Plasma / Air Shield 260 A Cutting

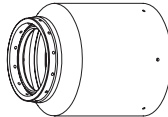
Flow rates - lpm/scfh @ 3/4" setting		
	O ₂	Air
Preflow	0 / 0	130 / 275
Cutflow	42 / 88	104 / 220



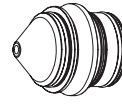
220398



220440



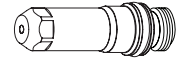
220433



220439



220436



220435

Metric

Select Gases		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	24	75	70	70	6	150	2.8	6500	8.5	300	0.3
						10			4440			
						12			3850			
				75	75	15	155	3.6	3130	9.0	250	0.5
						20	159		2170			0.6
						22	166		1930			0.7
						25	171		1685			0.8
				80	75	28	170	4.8	1445	9.5	200	0.9
						32	172		1135			1.0
						38	174		895			1.2
						44	185		580			Edge start
						50	188		405			
						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
O ₂	Air	24	75	70	70	1/4	150	0.110	245	0.330	300	0.3
						3/8			180			
						1/2			145			0.4
				75	75	5/8	155	0.140	115	0.350	250	0.5
						3/4	159		90			0.6
						7/8	166		75			0.7
						1	171		65			0.8
				80	75	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			Edge start
						2	188		15			
						2-1/4	193		12			
						2-1/2	202		8			

Marking

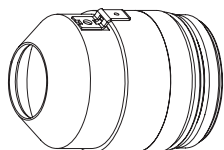
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	18	2.5	0.100	6350	250	135

Stainless steel

N₂ Plasma / N₂ Shield

45 A Cutting

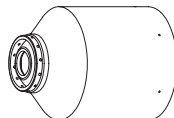
Flow rates - lpm/scfh	
N ₂	
Preflow	24 / 51
Cutflow	75 / 159



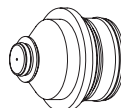
220173



220202



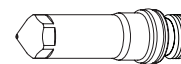
220304



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	55	60	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			
						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	55	60	.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

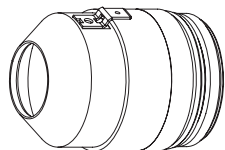
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	15	2.5	0.100	6350	250	85

Note: This process produces a darker cut edge than the 45 A, F5/N₂ stainless steel process

OPERATION

Stainless steel F5 Plasma / N₂ Shield 45 A Cutting

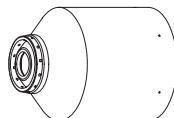
Flow rates - lpm/scfh		
	F5	N ₂
Preflow	0 / 0	43 / 91
Cutflow	8 / 17	65 / 138



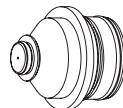
220173



220202



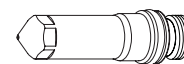
220304



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	55	60	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			
						4	104		1435			0.3
					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	55	60	.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
						3/16	108	0.080	45		190	0.4
					15	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

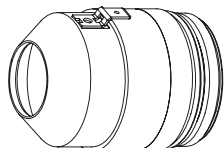
Note: This process produces a shinier cut edge than the 45 A, N₂/N₂ stainless steel process

Stainless steel

F5 Plasma / N₂ Shield

80 A Cutting

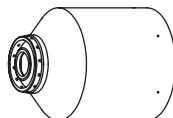
Flow rates - lpm/scfh		
	F5	N ₂
Preflow	0 / 0	67 / 142
Cutflow	31 / 65	55 / 116



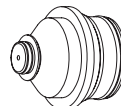
220173



220338



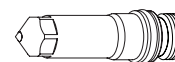
220304



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	35	30	60	45	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	35	30	60	45	.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		0.5
						3/8	120	0.120	25	0.180		0.5

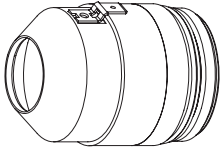
Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
N ₂	N ₂	10	10	10	10	Amps	mm	in	mm/min	ipm	Volts
						15	2.5	0.100	6350	250	95

Stainless steel

N₂ Plasma / N₂ Shield
130 A Cutting

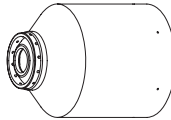
Flow rates - lpm/scfh	
	N ₂
Preflow	97 / 205
Cutflow	79 / 168



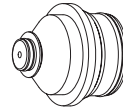
220173



220198



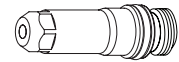
220176



220197



220179



220307

Metric

Select Gases		Set Preflow		Set Outflow		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	65	70	30	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 Outflow		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	65	70	30	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

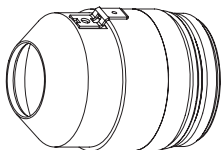
Note: This process produces a rougher, darker cut edge with more dross, and the cut edges are closer to perpendicular than the 130 A, H35/N₂ process

Stainless steel

H35 Plasma / N₂ Shield

130 A Cutting

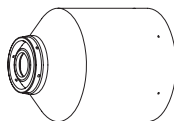
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144



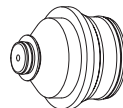
220173



220198



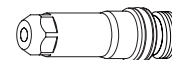
220304



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	20	40	70	60	10	154	4.5	980	7.7	170	0.3
					45	12	158		820			0.5
					30	15	162		580			0.8
						20	165		360			1.3
					20	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	20	40	70	60	3/8	154	0.180	40	0.310	170	0.3
					45	1/2	158		30			0.5
					30	5/8	162		20			0.8
						3/4	165		15			1.3
					20	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

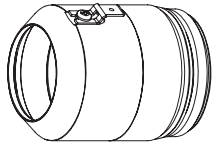
Note: This process produces a smoother, shinier cut edge with less dross, and the cut edges are less perpendicular than the 130 A, N₂/N₂ process

Stainless steel

H35 Plasma / N₂ Shield

200 A Cutting

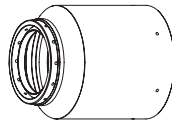
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	116 / 245
Cutflow	30 / 63	104 / 220



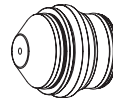
220398



220345



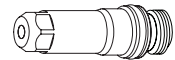
220344



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	21	65	82	75	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 Outflow		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	21	65	82	75	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

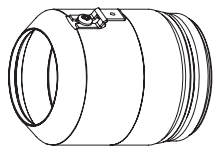
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	18	2.5	0.100	6350	250	140

Stainless steel

N₂ Plasma / N₂ Shield

200 A Cutting

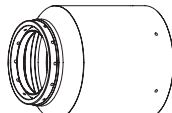
Flow rates - lpm/scfh	
	N ₂
Preflow	111 / 235
Cutflow	137 / 290



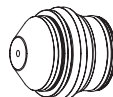
220398



220345



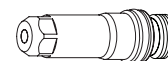
220344



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
N ₂	N ₂	21	65	82	65	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	21	65	82	65	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

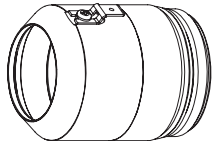
Marking

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

OPERATION

Stainless steel H35 Plasma / N₂ Shield 260 A Cutting

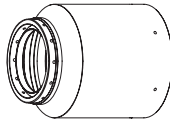
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



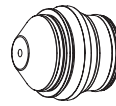
220398



220407



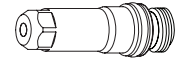
220344



220406



220405



220307

Metric

Select Gases		Set Preflow		Set Outflow		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	11	75	80	88	10	185	11.0	1870	12.5	100	0.3	
						12	173	9.0	1710	9.0		120	0.4
						15	171	7.5	1465		0.5		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 Outflow		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	11	75	80	88	3/8	185	0.450	75	0.450	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

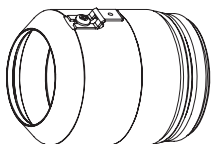
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	18	2.5	0.100	6350	250	120

Stainless steel

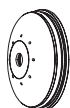
N₂ Plasma / Air Shield

260 A Cutting

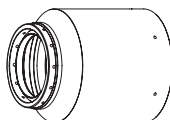
Flow rates - lpm/scfh		
	N ₂	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



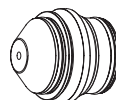
220398



220407



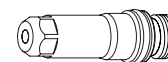
220344



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	11	75	75	82	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	11	75	75	82	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

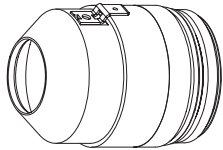
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	18	2.5	0.100	6350	250	120

OPERATION

Aluminum

Air Plasma / Air Shield
45 A Cutting

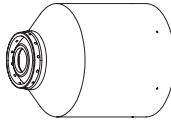
Flow rates - lpm/scfh	
	Air
Preflow	45 / 95
Cutflow	78 / 165



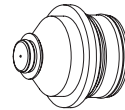
220173



220202



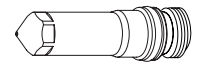
220176



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	55	60	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			
					40	4	102	1.8	2660	2.7		0.3
						6	117	3.0	1695	4.5		0.6

English

Select Gases		Set Preflow		Set Outflow		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	55	60	.040	130	0.100	220	0.150	150	0.2	
						.051	115		170				
						.064	113		160				
						.102	110		140				
					40	.125	102	0.070	110	0.110		0.180	0.3
						3/16	114	0.120	90	0.4			
						1/4	117		60	0.6			

Marking

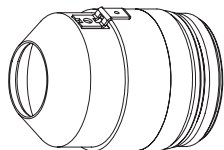
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	15	2.5	0.100	6350	250	85

Aluminum

Air Plasma / Air Shield

130 A Cutting

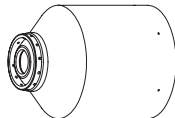
Flow rates - lpm/scfh	
	Air
Preflow	73 / 154
Cutflow	78 / 165



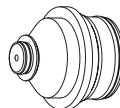
220173



220198



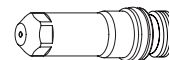
220176



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	20	40	70	30	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	20	40	70	30	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

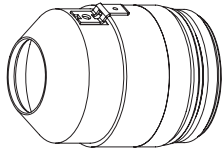
Note: This process produces a rougher cut edge that is less perpendicular than the 130 A, H35/N₂ process

OPERATION

Aluminum

H35 Plasma / N₂ Shield
130 A Cutting

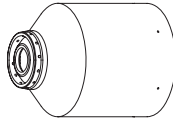
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	76 / 160
Cutflow	26 / 54	68 / 144



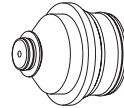
220173



220198



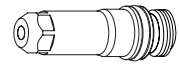
220304



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	20	40	70	60	10	158	5.0	1615	6.5	130	0.3
					45	12	156	4.5	1455	7.7	170	0.5
					30	15			1305			0.8
						20	20		157			940
					20	25	176		540	Edge start		

English

Select Gases		Set Preflow		Set Outflow		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	20	40	70	60	3/8	158	0.200	65	0.260	130	0.3
					45	1/2	156	0.180	55	0.310	170	0.5
					30	5/8			50			0.8
						3/4	157		40			1.3
					20	1	176		0.180	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	130

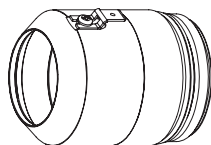
Note: This process produces a smoother cut edge that is more perpendicular than the 130 A, Air/Air process

Aluminum

H35 Plasma / N₂ Shield

200 A Cutting

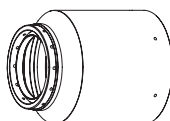
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	113 / 240
Cutflow	34 / 72	90 / 190



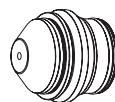
220398



220345



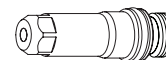
220347



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	21	65	70	65	10	152	6.4	4400	9.0	140	0.3
						12	150		3800			0.4
						15			3000			0.5
						20			159			1450

English

Select Gases		Set Preflow		Set Outflow		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	21	65	70	65	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

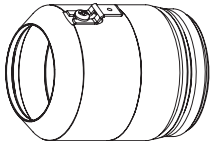
Marking

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

OPERATION

Aluminum N₂ Plasma / N₂ Shield 200 A Cutting

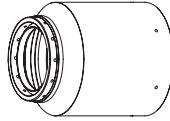
Flow rates - lpm/scfh	
	N ₂
Preflow	113 / 240
Cutflow	135 / 287



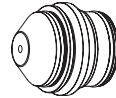
220398



220345



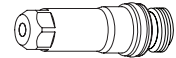
220347



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	21	65	70	65	10	158	6.4	4750	9.0	140	0.4
						12			3500			0.5
						15			2350			0.6
						20			1000			0.8

English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	Volts	in	ipm	in	factor %	seconds
N ₂	N ₂	21	65	70	65	3/8	158	0.250	200	0.350	140	0.4
						1/2			120			0.5
						5/8			80			0.6
						3/4			50			0.8

Marking

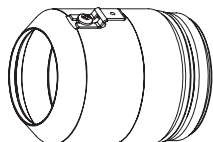
Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N ₂	N ₂	10	10	10	10	18	2.5	0.100	6350	250	140

Aluminum

H35 Plasma / N₂ Shield

260 A Cutting

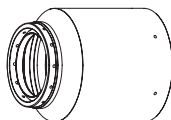
Flow rates - lpm/scfh		
	H35	N ₂
Preflow	0 / 0	127 / 270
Cutflow	33 / 70	118 / 250



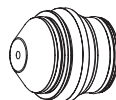
220398



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
H35	N ₂	11	75	70	85	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	11.0	150	Edge start
						25	174		1930			
						32	175		1510			
						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	11	75	70	85	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	0.450	150	
						1	174		75			
						1-1/4	175		60	Edge start		
						1-1/2	176		45			
						1-3/4	183		25			
						2	190		14			

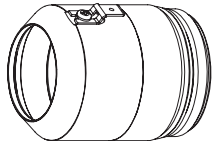
Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		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

OPERATION

Aluminum N₂ Plasma / Air Shield 260 A Cutting

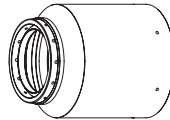
Flow rates - lpm/scfh		
	N ₂	Air
Preflow	125 / 265	0 / 0
Cutflow	50 / 105	113 / 240



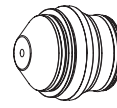
220398



220407



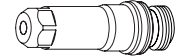
220344



220406



220405



220307

Metric

Select Gases		Set Preflow		Set Outflow		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	11	75	70	82	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	11	75	70	82	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	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! <u>Always</u> disconnect power to the power supply before inspecting or changing torch consumable parts. Use gloves when removing consumables. The torch might be hot.		

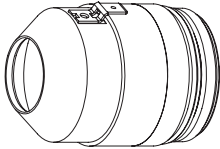
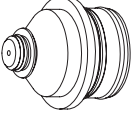
Remove consumables

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.

① Turn OFF all power to the system.	④ Remove the nozzle and swirl ring	⑤ Remove the electrode
② Remove the retaining cap and shield	③ Remove the inner retaining cap	
		Tool part number 104119

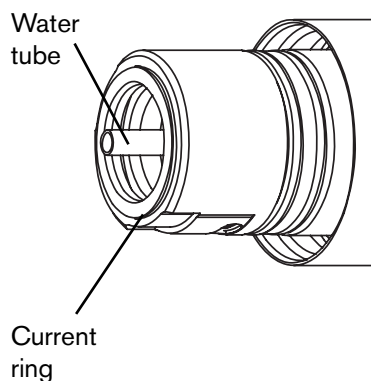
OPERATION

Inspect consumables

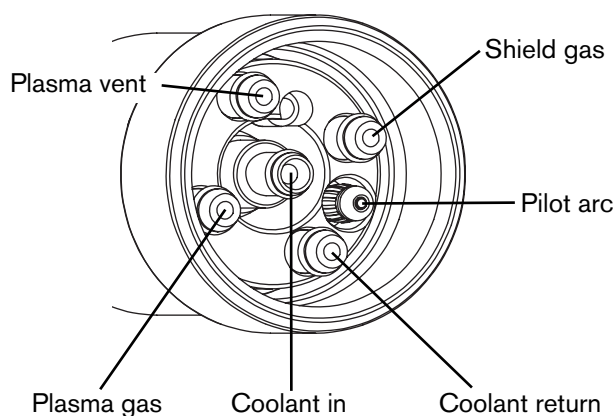
Part	Check for	Action
Cap 	Erosion, missing material Cracks Burned	Replace cap Replace cap Replace cap
Nozzle 	Erosion or missing material Blocked gas holes Center hole 1. Must be round 2. Signs of arcing O-rings 1. Damage 2. Lubricant	Replace nozzle* Replace nozzle* Replace nozzle if hole is no longer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

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

Inspect torch



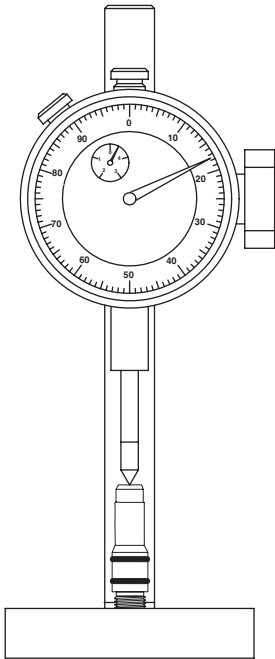
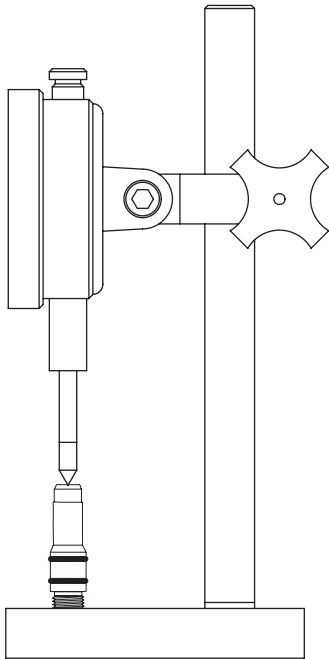
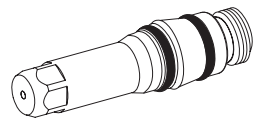
Bullet connectors



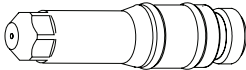
Inspect	Check for	Action
All surfaces	Dirt or debris Erosion, missing material Cracks Internal burn or arcing marks	Clean surfaces Replace torch Replace torch Replace torch
Current ring	1. Dirt or debris 2. Pitted or missing material	Clean Replace torch
Threads	Wear or damage	Replace torch
Bullet connectors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

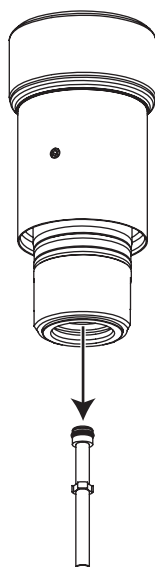
The system is designed to go into an idle mode if the retaining cap is removed. However, **DO NOT REMOVE CONSUMABLE PARTS WHILE IN THE IDLE MODE.** Always disconnect power to the power supply before removing torch consumable parts. Use gloves when removing consumables. The torch might be hot.

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

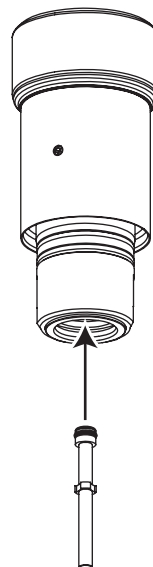
① Turn OFF all power to the system.

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

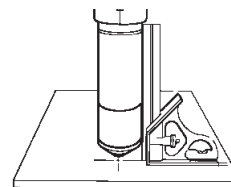
- Torch pilot arc will initiate, but will not transfer. Causes can be:
 1. Work cable connection on the cutting table is not making good contact.
 2. Malfunction in the system. See Section 5.
 3. Torch-to-work distance is too high.
- The workpiece is not totally penetrated, and there is excessive sparking 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

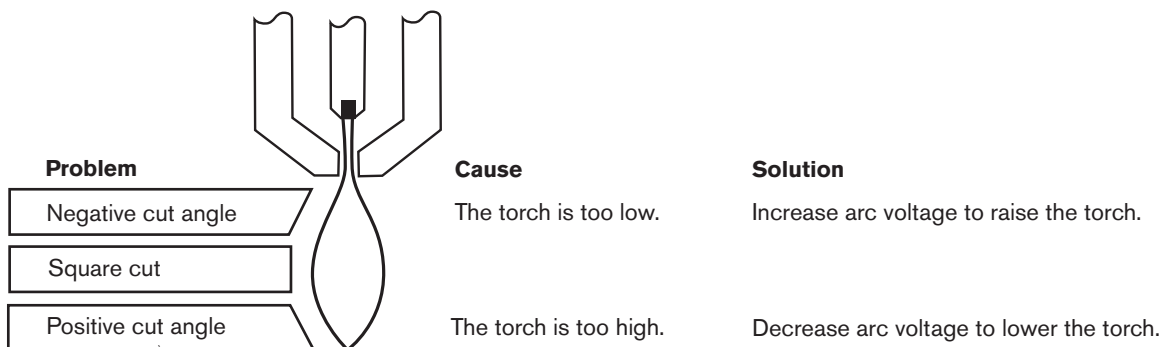
A cut part whose 4 sides average less than 4° of cut angle is considered acceptable.

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.



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 O₂ 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.

MAINTENANCE

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Introduction

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

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

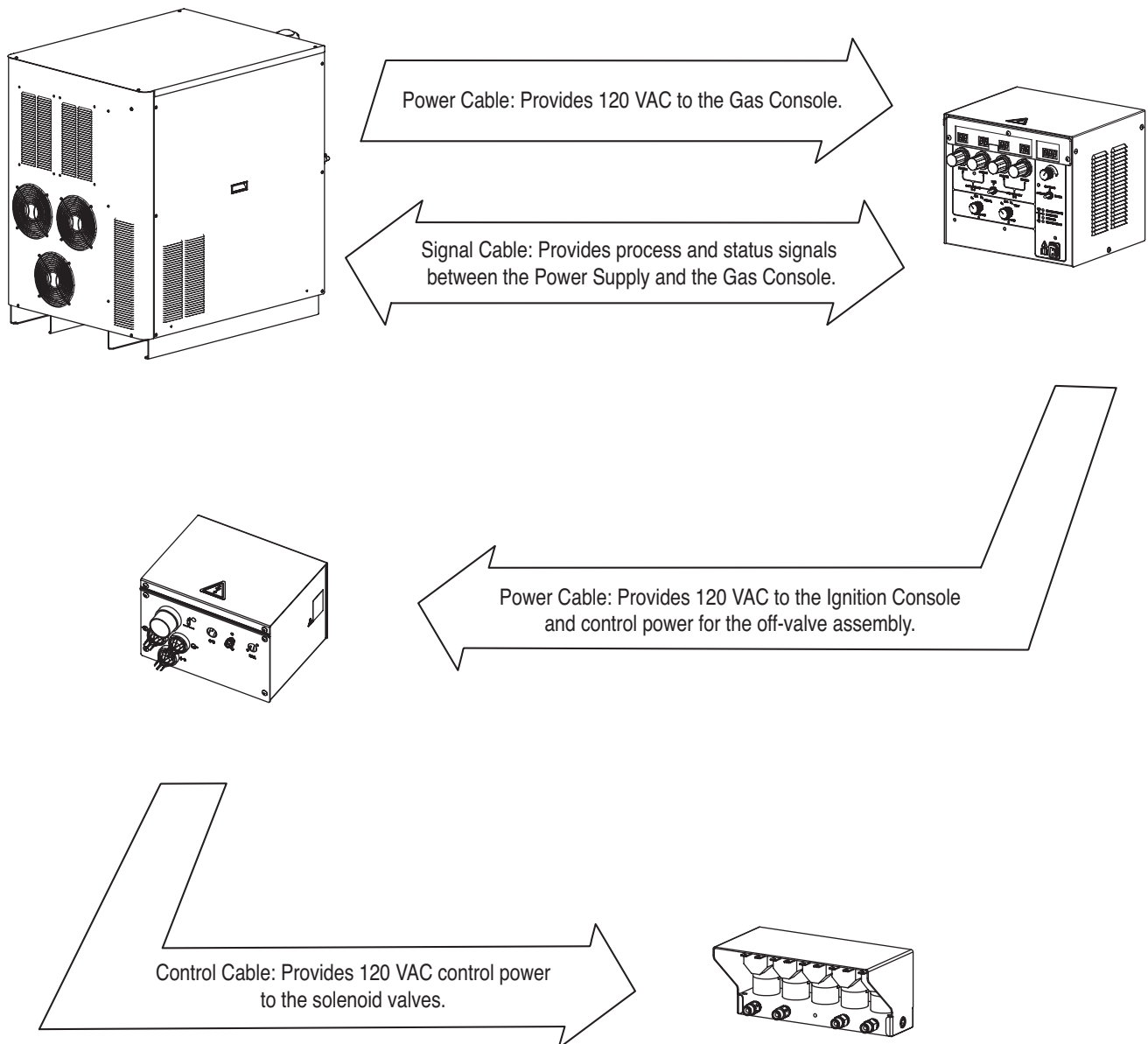
		WARNING SHOCK HAZARD
Use extreme care when working near the chopper modules. The large blue capacitors store high voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper and the heatsinks. Discharging any capacitor with a screwdriver or other implement may 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 over-temp off
 - Magnetics over-temp off
 - Coolant over-temp off
 - Plasma start off
2. Purge – Air or N₂ gas flows through torch for 20 seconds
 - Coolant flow on
 - 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 flow 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 set point and gas switches 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 over-temp off
 - Magnetics over-temp off
 - Coolant over-temp off
9. Ramp-down – Current and gas flow decreases 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 process to another, the system automatically goes through a purge process. The purge process has 2 stages; a preflow purge and a cutflow purge.

The preflow gas is turned on for 8 seconds with an auto gas console, or 12 seconds with a manual gas console.

The cutflow gas is turned on for 8 seconds with an auto gas console, or 12 seconds with a manual gas console.

There are 2 exceptions to the process described above.

Exception 1 – if the operator changes from a non-fuel gas process (O₂/Air, Air/Air, or N₂/Air) to a fuel gas process (H35/N₂, or F5/N₂) 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 process will occur if the operator changes from any 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	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow	SV1	SV2		SV4			SV7			SV10							SV17	SV18		
Cutflow	SV1	SV2		SV4			SV7			SV10				SV14		SV16			SV19	

O ₂ /Air process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow	SV1	SV2			SV5		SV7			SV10							SV17	SV18		
Cutflow	SV1	SV2			SV5		SV7			SV10				SV14		SV16			SV19	

N ₂ /N ₂ process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow						SV6		SV8			SV11						SV17	SV18		
Cutflow						SV6		SV8			SV11			SV14		SV16			SV19	

F5/N ₂ process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow			SV3			SV6		SV8				SV12					SV17	SV18		
Cutflow			SV3			SV6		SV8				SV12		SV14		SV16			SV19	

H35/N ₂ process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow			SV3			SV6		SV8				SV12					SV17	SV18		
Cutflow			SV3			SV6		SV8				SV12		SV14		SV16			SV19	

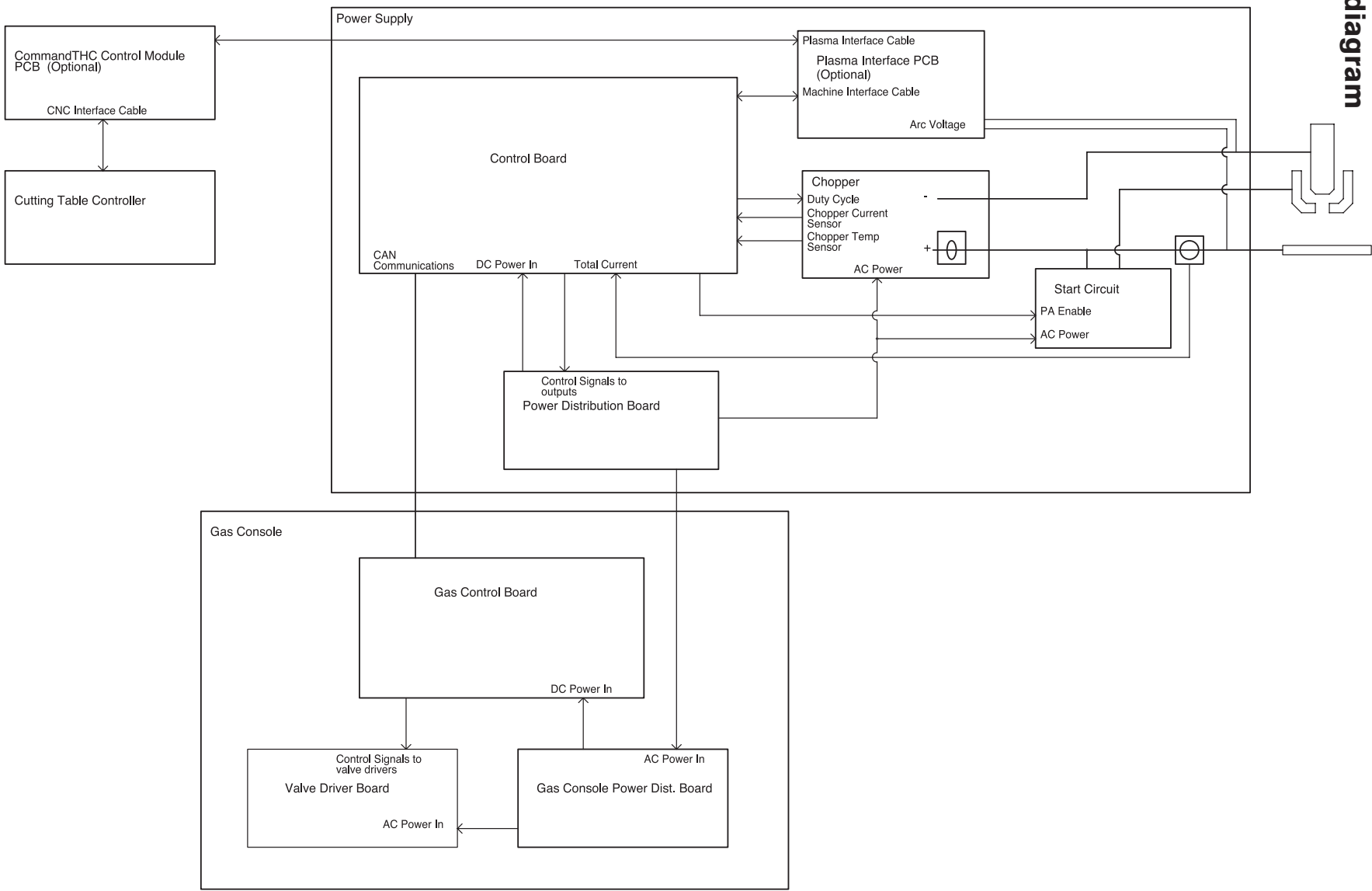
N ₂ /Air process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow	SV1				SV5			SV8			SV11						SV17	SV18		
Cutflow	SV1				SV5			SV8			SV11			SV14		SV16			SV19	

MAINTENANCE

Air/Air process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow	SV1				SV5		SV7		SV9								SV17	SV18		
Cutflow	SV1				SV5		SV7		SV9					SV14		SV16			SV19	

Marking process	Gas console AC valve driver board – LEDs																			
Valve location	Gas console															Off-valve				
LED number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preflow						SV6		SV8			SV11						SV17	SV18		
Cutflow						SV6		SV8			SV11			SV14		SV16			SV19	

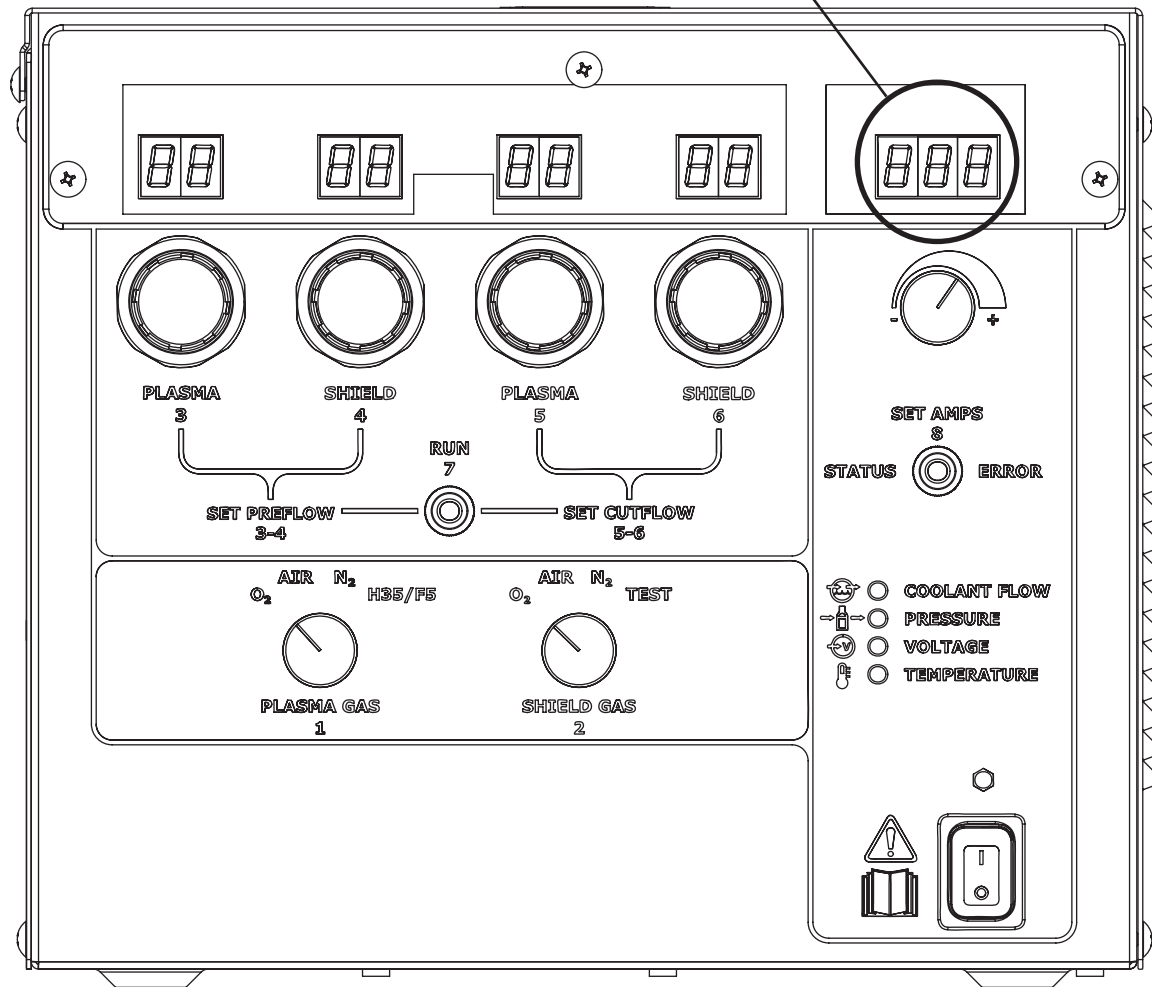
PCB block diagram



Error codes

HyPerformance plasma system error codes

Error codes are displayed in the 3-digit LED display on the gas console.



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 <i>Maintenance</i> section). 4. Verify spark across spark gap. 5. Inspect CON1 and pilot arc relay for excessive wear. 6. Perform gas flow test (see <i>Maintenance</i> section). 7. Perform torch lead test (see <i>Maintenance</i> section). 8. Perform start circuit test (see <i>Maintenance</i> section). 9. Perform chopper test (see <i>Maintenance</i> 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 <i>Maintenance</i> 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 <i>Maintenance</i> 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 lose 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 <i>Maintenance</i> 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 <i>Maintenance</i> 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 <i>Setting the supply regulators (Installation section)</i>.
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 <i>Setting the supply regulators (Installation section)</i>. 4. Perform gas leak tests (<i>Maintenance section</i>).

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 <i>Setting the supply regulators (Installation section)</i>. 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 <i>Setting the supply regulators</i> (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 <i>Setting the supply regulators</i> (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 (<i>Maintenance</i> 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 1 or 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.

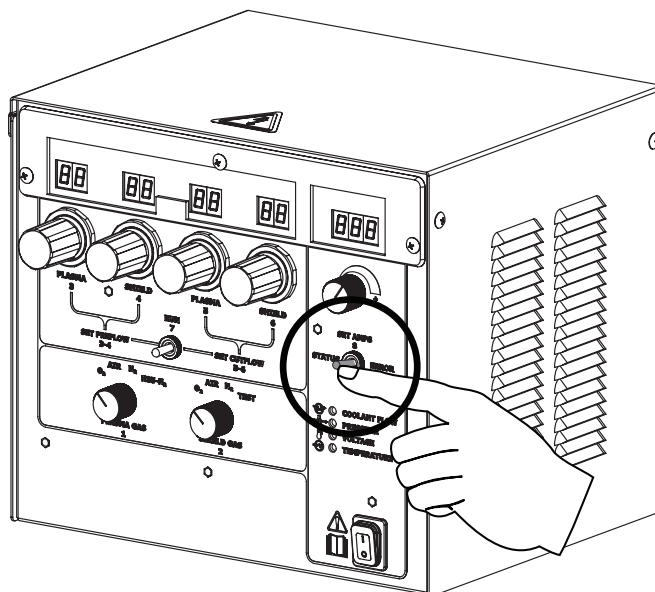
Error code troubleshooting – 10 of 10

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.

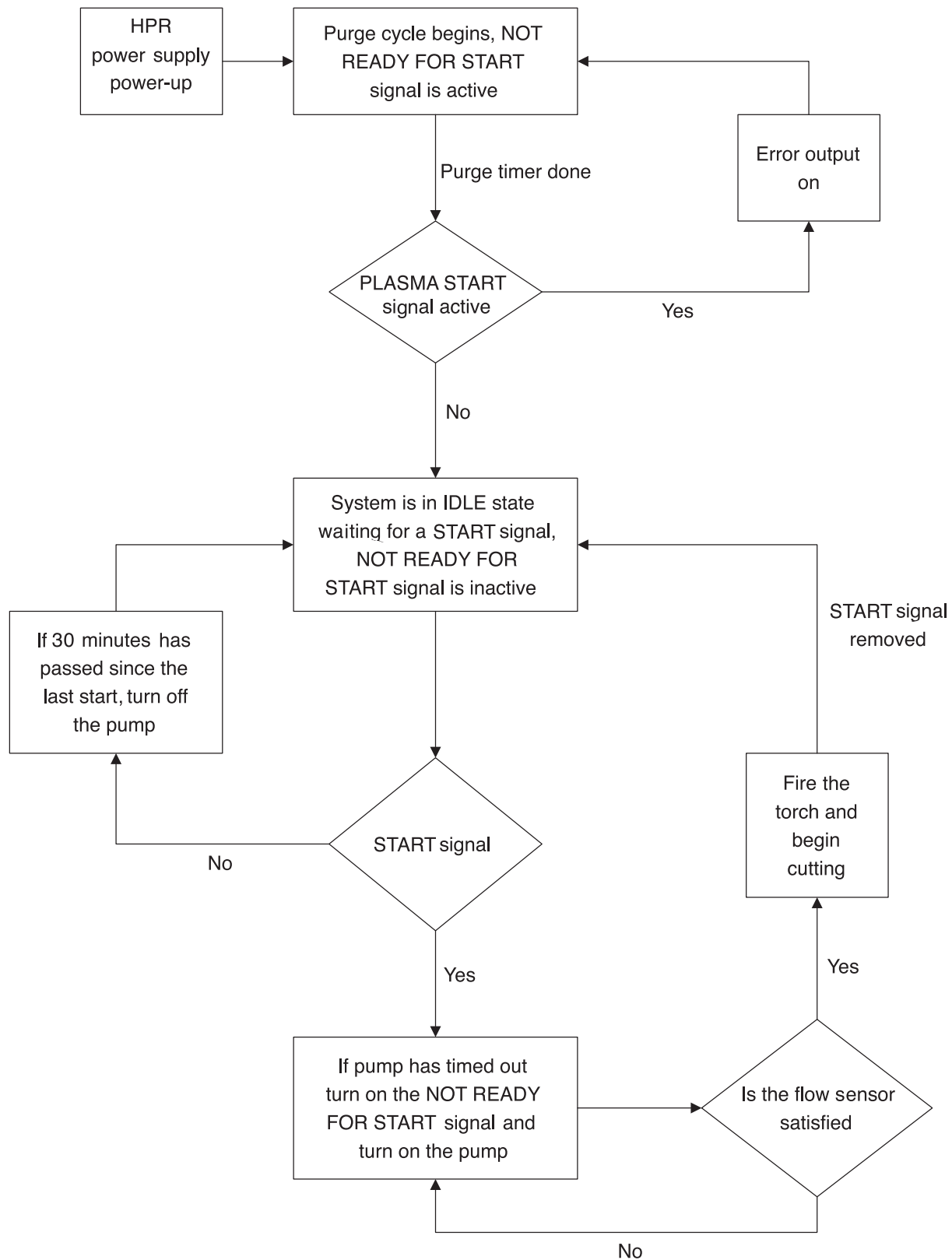
Power supply states

Set switch 8 on the gas console to the status position to view ID numbers.

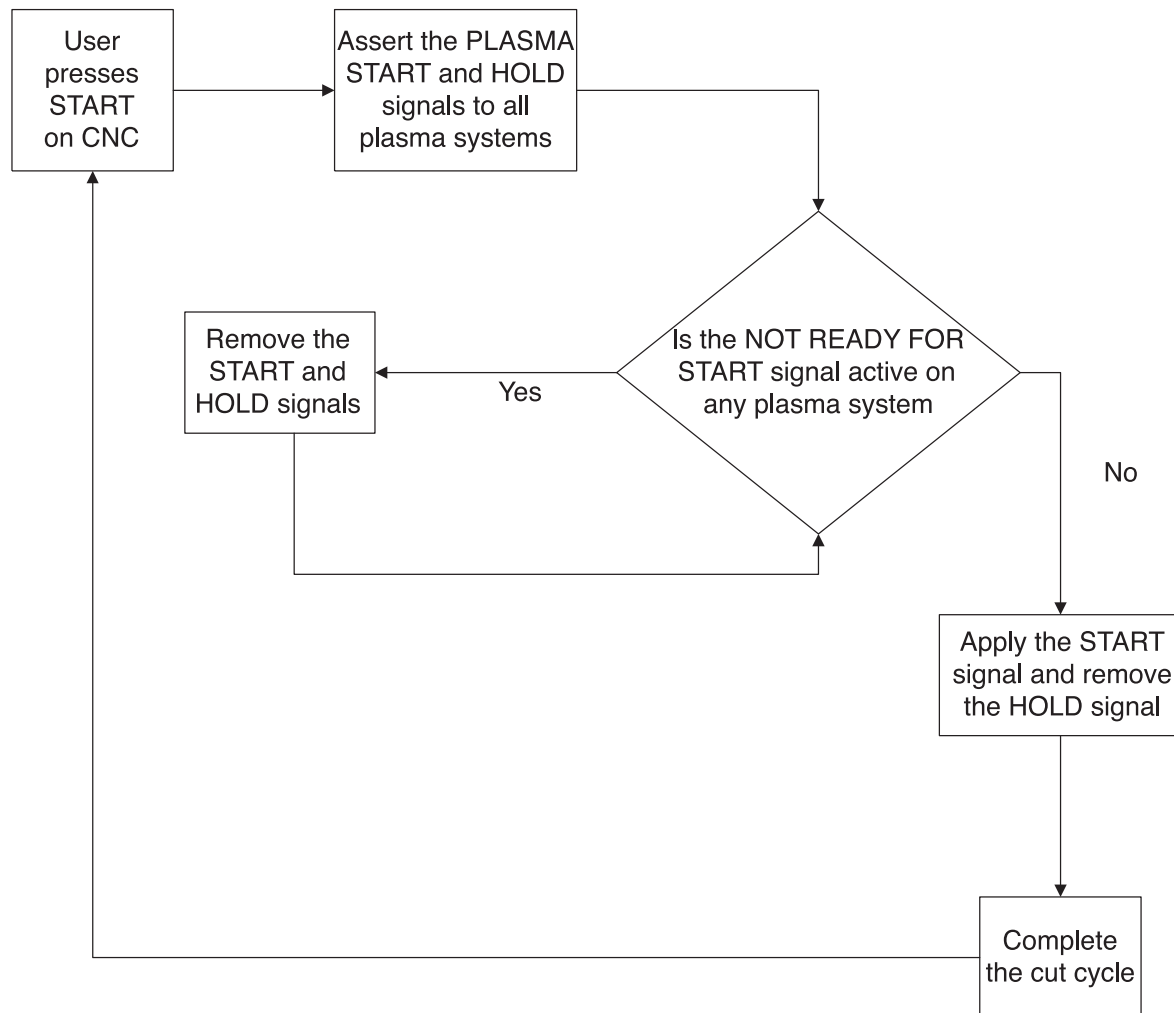
State code	Name
00	Idle
02	Purge
03	Idle 2
04	Preflow
05	Pilot arc
06	Transfer
07	Ramp-up
08	Steady state
09	Ramp-down
10	Final ramp-down
11	Auto off
12	Test cutflow
14	Shutdown
15	Reset
16	Maintenance
20	Test preflow
22	Manual pump control
23	Inlet leak check
24	System leak check



Plasma system operation with pump timeout



CNC operation with pump timeout



Initial checks

Before troubleshooting, 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.		

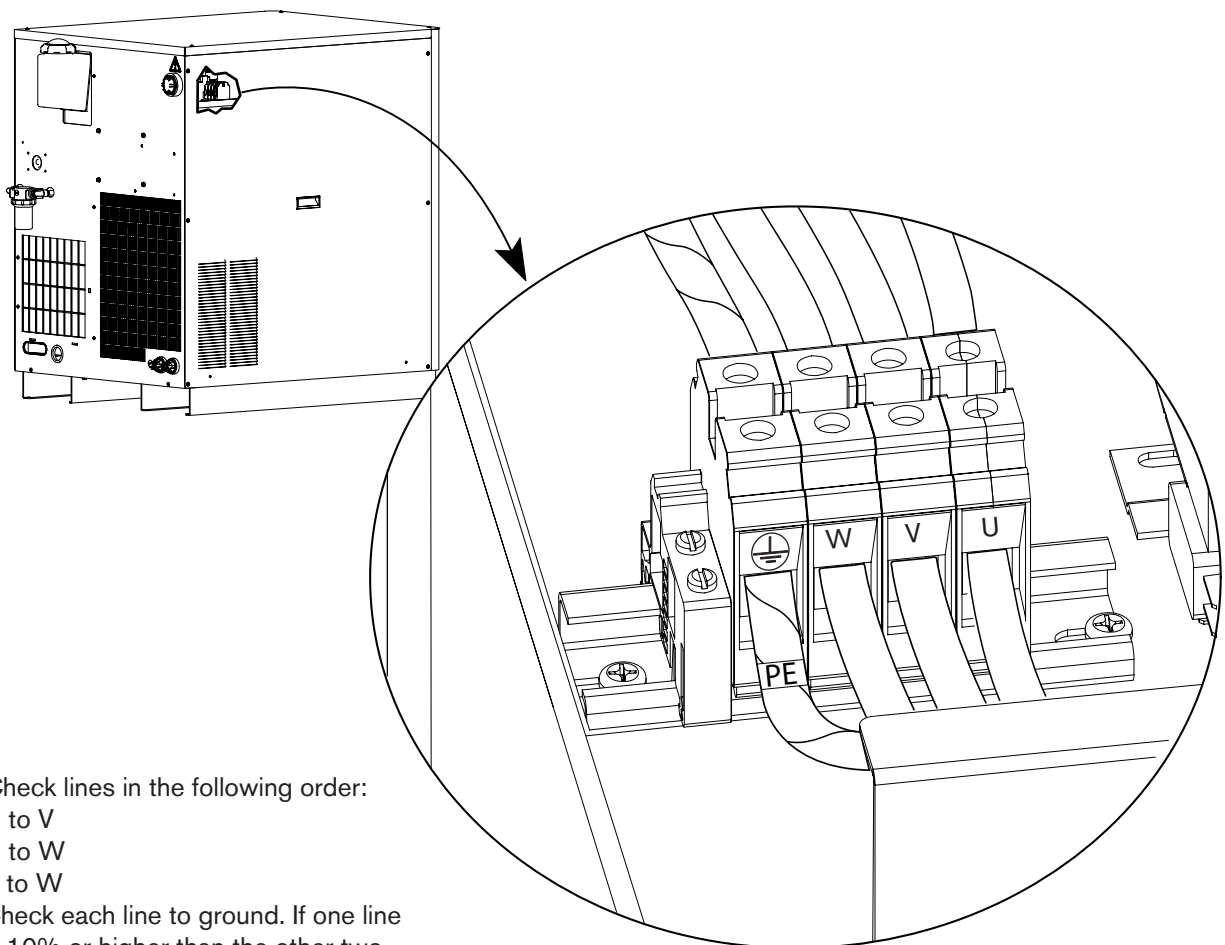
1. Disconnect line power by turning OFF the main disconnect switch.
2. Remove the power supply's top panel and two side panels.
3. Inspect interior of power supply for discoloration on PC boards, or other apparent damage. If a component or module is obviously defective, remove and replace it before doing any testing. Refer to the *Parts List* section to identify parts and part numbers.
4. If no damage is apparent, connect power to the power supply, and turn the main disconnect switch ON.
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. Use extreme care when measuring primary power in these areas. Voltages present at the terminal block and contactors can cause injury or death.

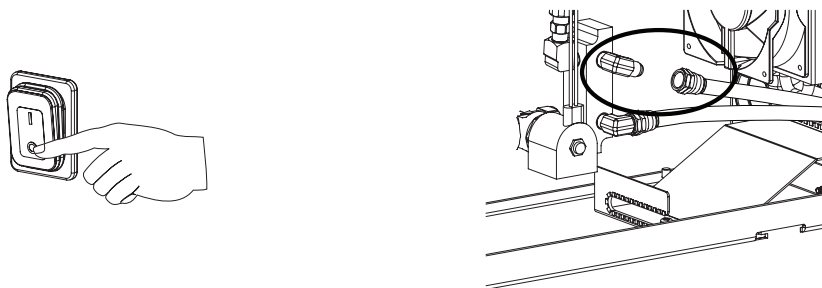


Note: Check lines in the following order:
 U to V
 U to W
 V to W
 Check each line to ground. If one line is 10% or higher than the other two, put that leg on U.

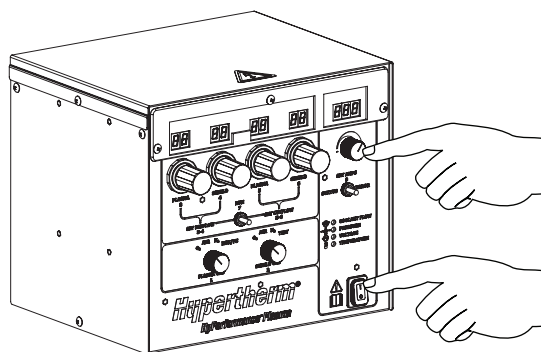
Power supply coolant system servicing

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. Press and hold the current selection knob (8) and turn ON the power switch. The pump will run continuously while (8) is pressed.



3. Run the pump until the coolant stops flowing and immediately release the current selection knob (8).

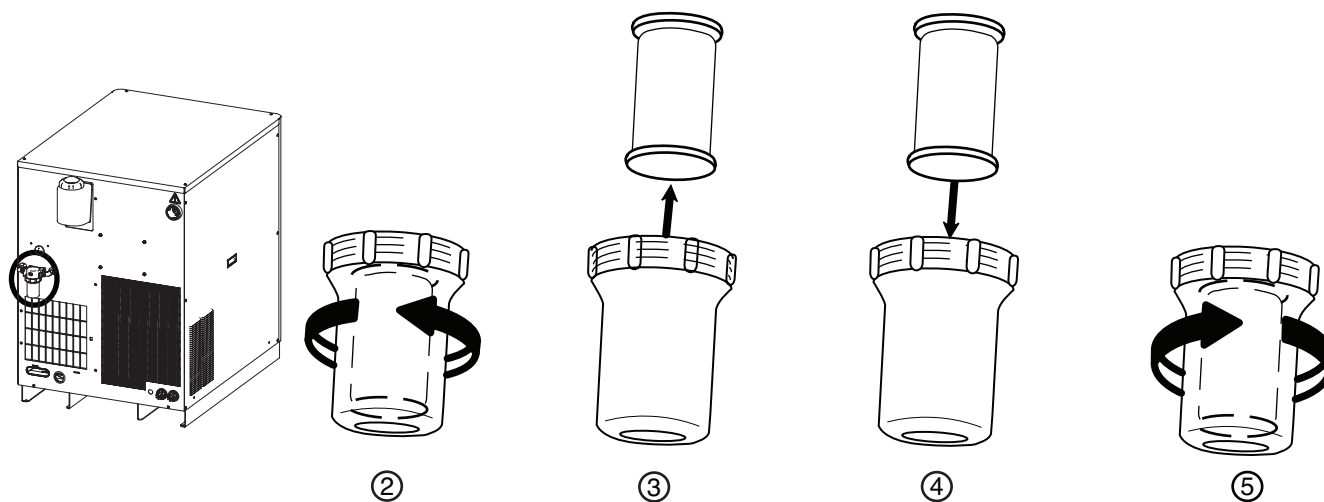


Caution: Coolant will flow from the filter when its housing is removed. Drain coolant before servicing the filter.

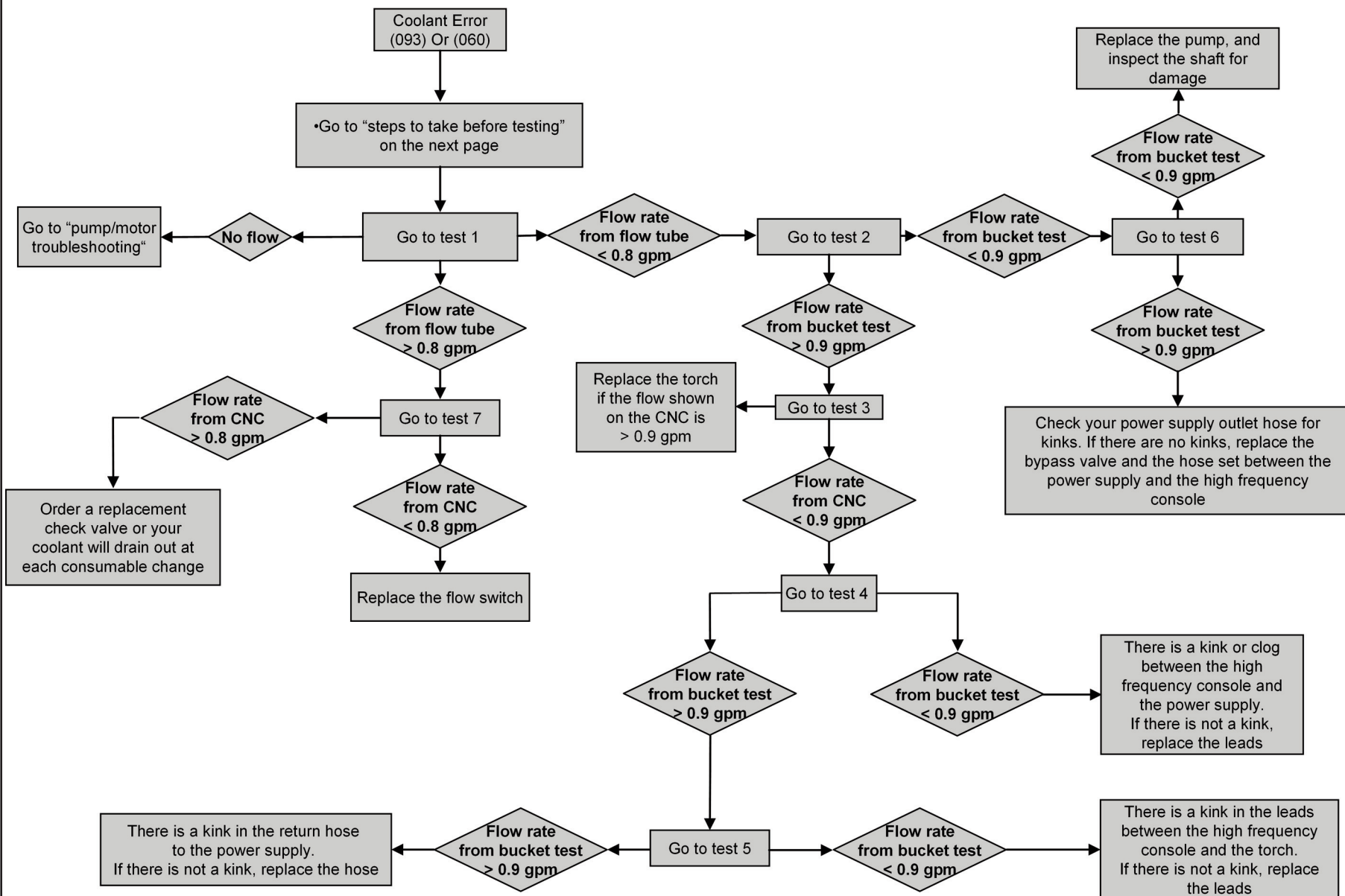
Coolant system filter

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

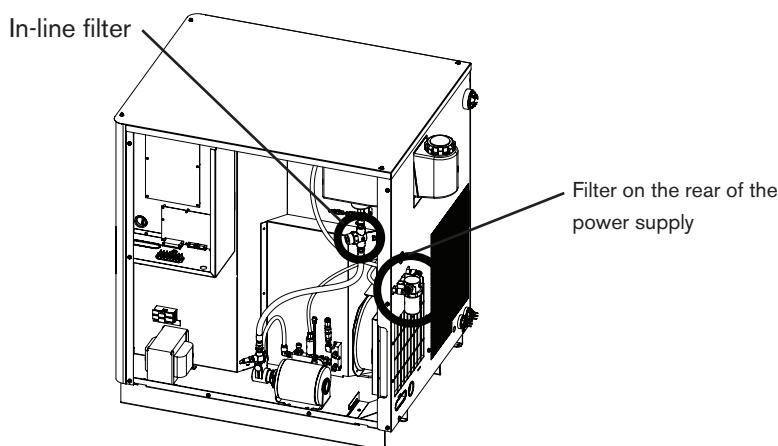
If the LED display on the gas console shows a coolant flow error (093 or 060), turn OFF the system and then ON again to clear the error. Then perform the following tests to find the cause of the problem.

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. An in-line flow meter (part number 128933) is available from Hypertherm. The following "bucket" tests give a good idea of the flow rate.

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.

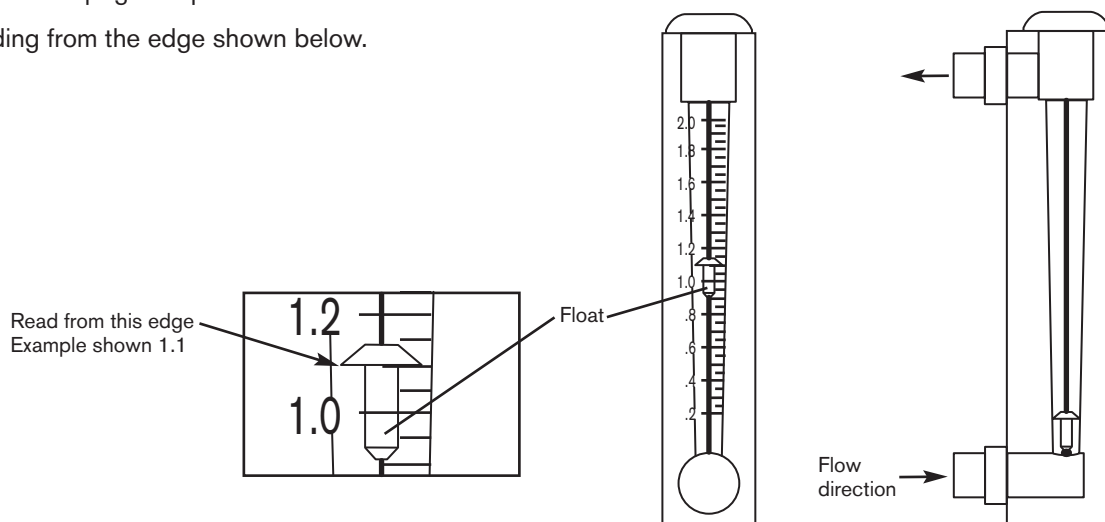
1. Clean the in-line filter.
2. Replace the filter on the rear of the power supply.
3. Verify that the system has the correct level of coolant, when refilling the system after completing steps 1 and 2.



Using the Hypertherm flow meter (128933)

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

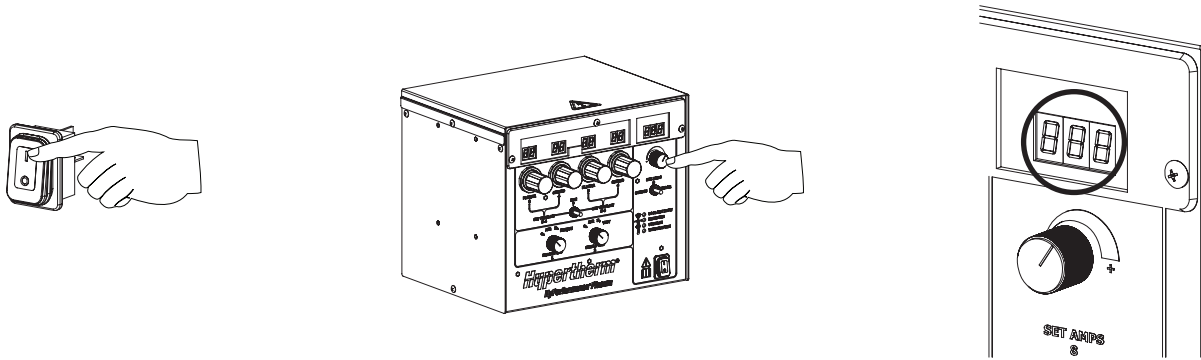
1. Hold the flow meter upright. Square in both axis.
2. Take your reading from the edge shown below.



Manual pump operation

If the LED display on the gas console shows coolant flow error 093, the pump must be turned on manually within 12 seconds of turning on the power supply, or the power will have to be turned off and then on again.

1. Turn ON the power. Press and hold the current selection knob (8) to turn on the pump manually, and allow the coolant to flow for 60 seconds.



2. Write down the coolant flow rate shown on the gas console's LED display. 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.
3. Release the current selection knob (8) and then turn OFF the power.

Note: a flow diagram can be found on schematic 013361, sheet 14 of 17

Test 1 – return line

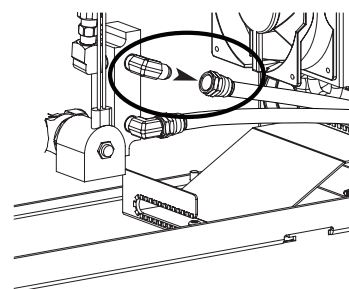
Note: an in-line flow meter is required to complete this test.

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 (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.



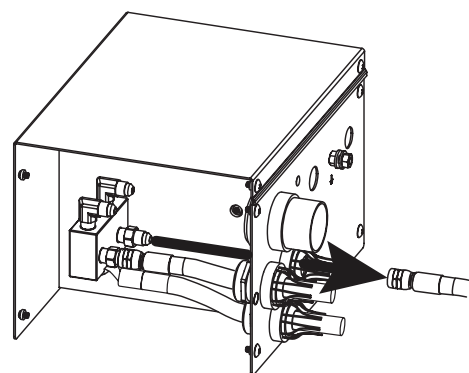
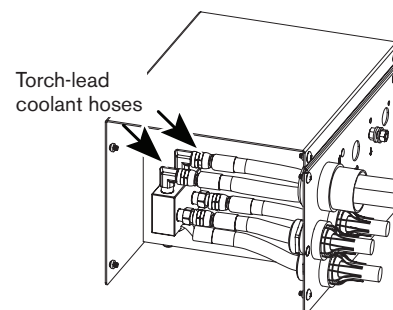
Test 2 – supply line at ignition console

Note: remove the torch-lead coolant hoses to access the supply line.

1. Turn OFF the power. Remove the supply coolant line (blue hose with green tape) from the RHF/LHF console, and place it in a 3.8 liter (1 gallon) container. A Hypertherm coolant container works well.
2. Measure how long it takes to fill the container. Turn ON the power. Turn ON the pump manually (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 (see step 1 under “Manual pump operation”), let it run for 60 seconds, and look at the flow rate on the LED display on the gas console.

If the flow rate shown on the LED display 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 (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.
3. Reconnect the coolant supply line to the torch receptacle.

If it takes more than 65 seconds to fill the container, look for an obstruction or kink in the coolant hose between the torch and the LHF/RHF console. If there is no obstruction or kink, replace the torch leads.

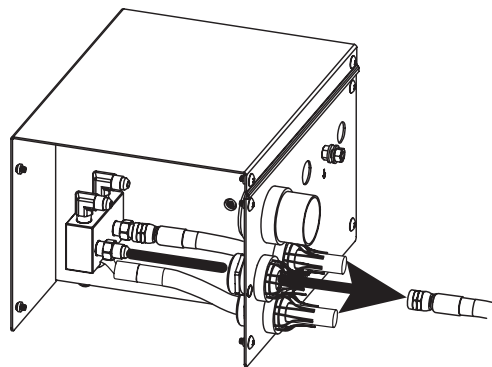
If the container is full in 65 seconds or less, go to test 5.

Test 5 – return line from the torch receptacle (remove at the ignition console)

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

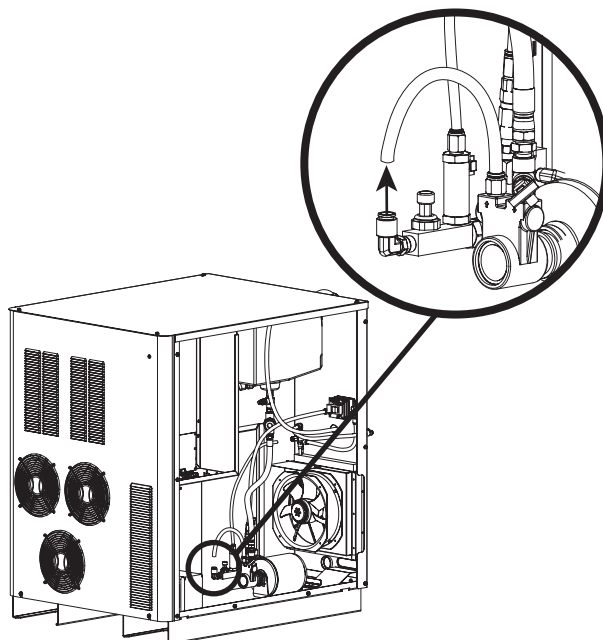


Test 6 – bucket test at the pump

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 (see step 1 under “Manual pump operation”). Write down how long it takes to fill the container.

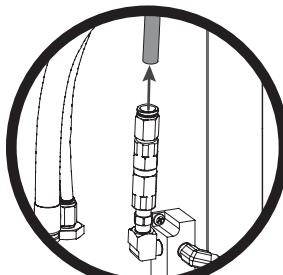
If it takes more than 65 seconds to fill the container, replace the pump and check the motor shaft for damage.

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.

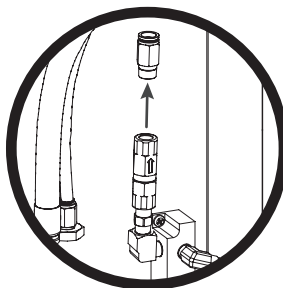


Test 7 – bypass the check valve

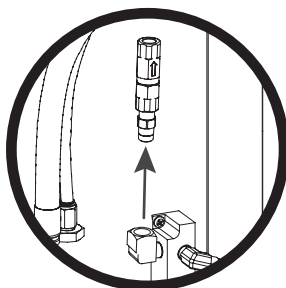
1. Turn OFF the power. Remove the hose from the relief valve.



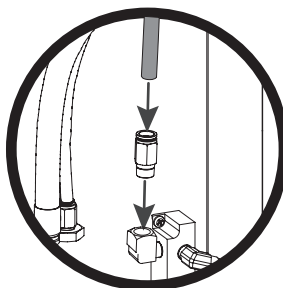
2. Remove the push-to-connect fitting from the relief valve.



3. Remove the relief valve.



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



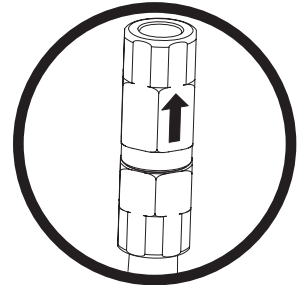
Test 7 – continued

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

If the flow shown on the LED display 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 LED display 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?

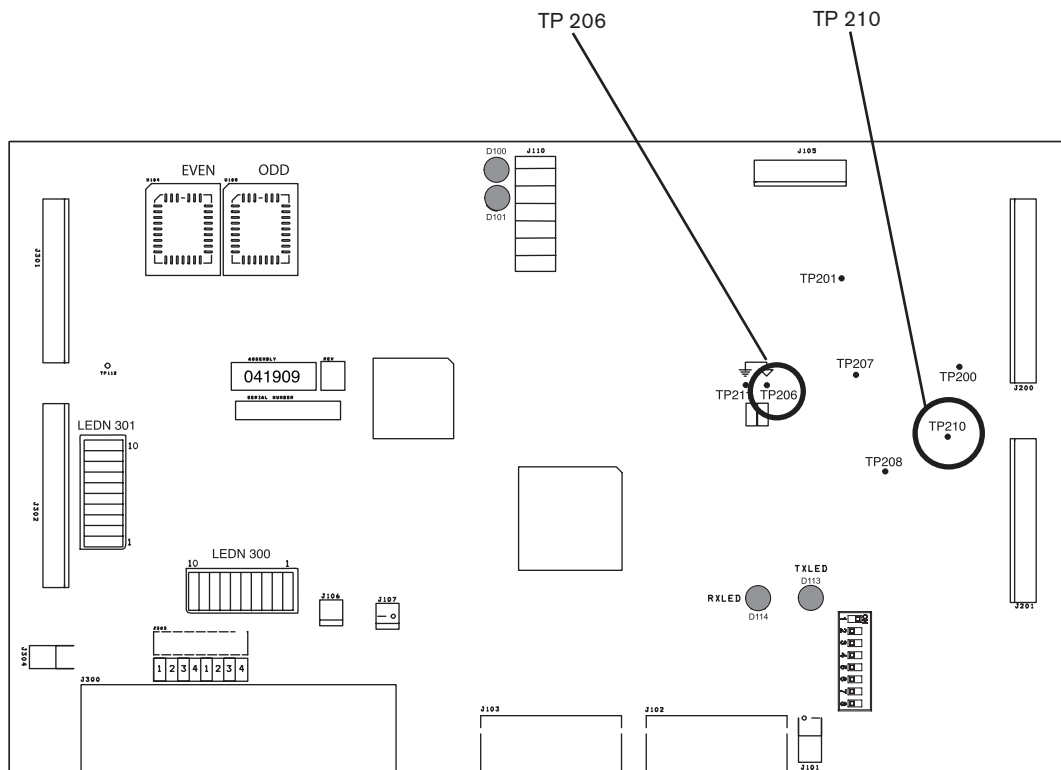
Is the motor on?

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 check valve are working correctly.

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

The system has two automatic leak test modes. The leak test mode is activated by switching the shield gas selector switch (2) to the TEST position and then switching the RUN/SET switch (7) to either SET PREFLOW or SET CUTFLOW to begin the leak test.

Leak test mode 1 – With switch 7 in the SET PREFLOW position.

The inlet valves within the gas console will close and the off-valves will open to allow any trapped gas to escape. After 20 seconds all the off-valves will close. At this point there should be no pressure between the gas console and off-valve, and the pressure displays should read zero.

This test is intended to identify a problem with any inlet supply valve that does not close properly in the gas console, in which case pressure will build at the off-valve and be displayed on the gas console. This test also checks for leaks in the supply lines.

Leak Check Mode 2 – Switch 7 in the SET CUTFLOW position.

The inlet valves will open and pressurize the gas lines between the off-valve and the gas console. After 20 seconds all inlet valves are turned off. The pressures displayed should remain constant.

This test is intended to identify a leak between the gas console and the off-valve.

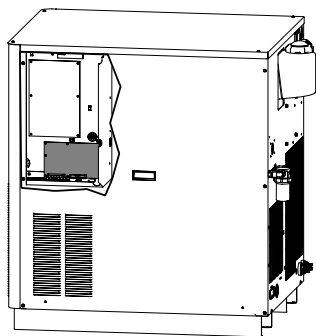
Leak test 1

1. Turn ON power to the HPR260.
2. After initial gas purge switch shield selector switch (2) to TEST.
3. Select SET PREFLOW on switch 7. The off-valve opens and exhausts gas between the gas console and torch. The inlet valves in gas console will remain closed.
4. The off-valve will close after 20 seconds.
5. Close gas supply valves.
6. Monitor the pressure displays and the gas supply pressure gauges for 20 minutes. The pressure displays should remain at or close to zero while inlet pressures remain constant.
7. If any pressure display increases, then one or more inlet valves in the gas console are not closing properly.
8. If a gas supply pressure gauge decreases but no pressure is displayed on gas console, then there is a leak in the supply hoses between the shut-off and the gas console.

Leak test 2

1. After performing leak test 1, turn on gas supply valves again and move switch 7 to SET CUTFLOW. The inlet valves in the gas console will open for 20 seconds and then close, while the off-valve remains closed. This traps pressure between the gas console and the off-valve.
2. Close the gas supply valves.
3. Monitor the pressure displays on the gas console and the gas supply pressure gauges for 20 minutes. Pressure displays and gas supply gauges should remain constant.
4. If any pressure displays decrease, then there is a leak in a gas line between the gas console and the off-valve.
5. If a gas supply pressure gauge decreases then there is a leak in the supply hoses between the shut-off and the gas console.

Power supply control board PCB3

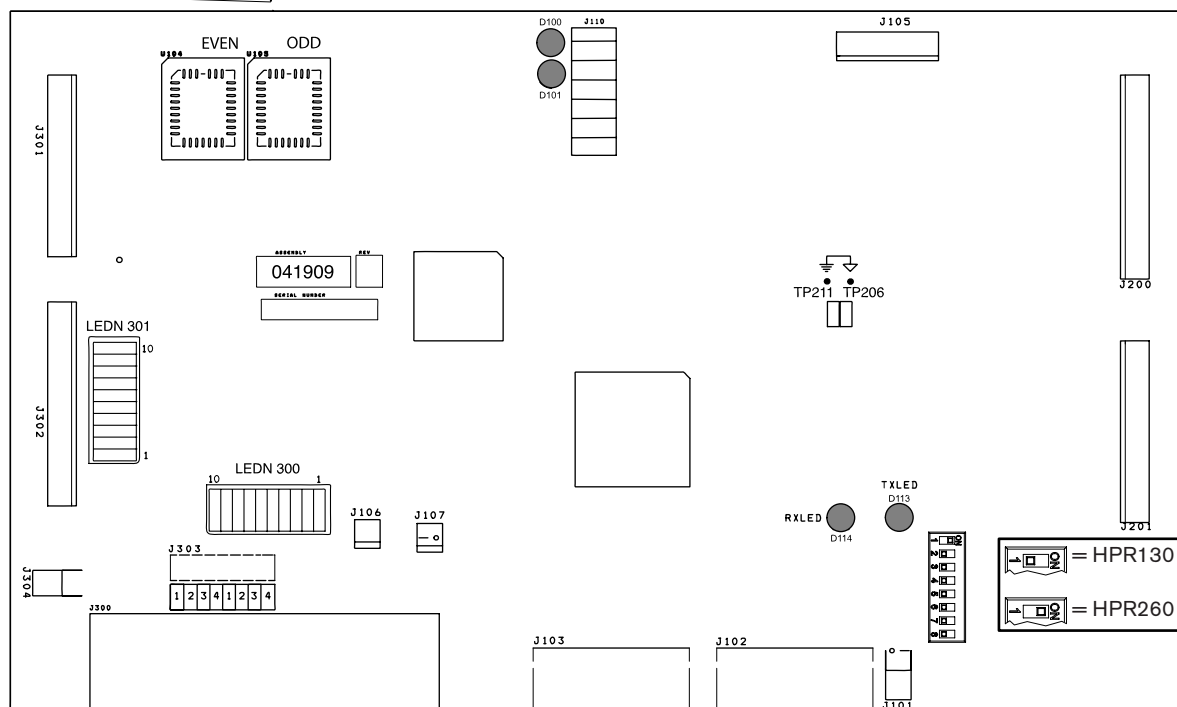


Control PC board LED list

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

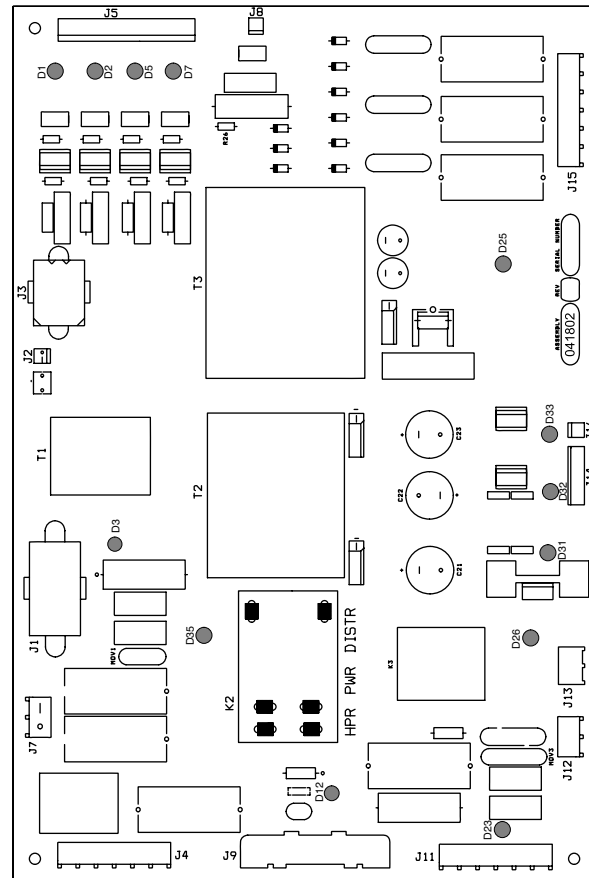
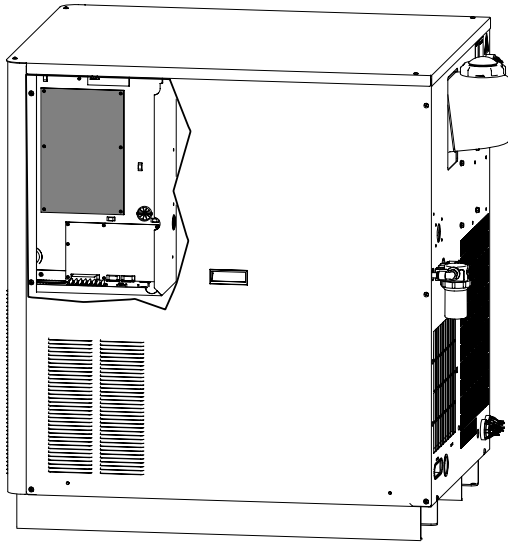
Control PC Board LEDN300 List

LEDN	Output	Input	Notes
LEDN1	Machine motion		
LEDN2	Error		
LEDN3	Rampdown 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

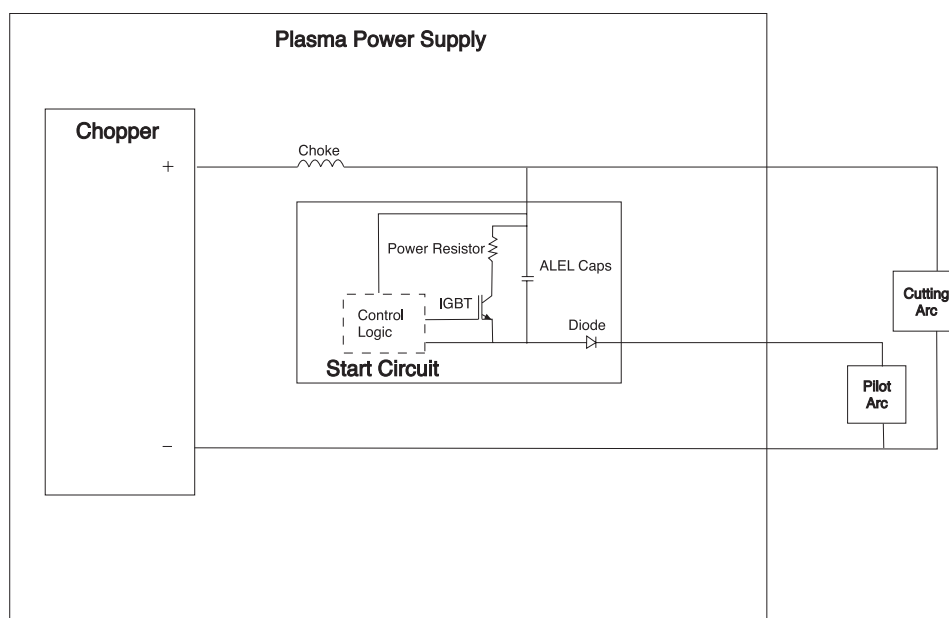
Start-circuit PCB1

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.

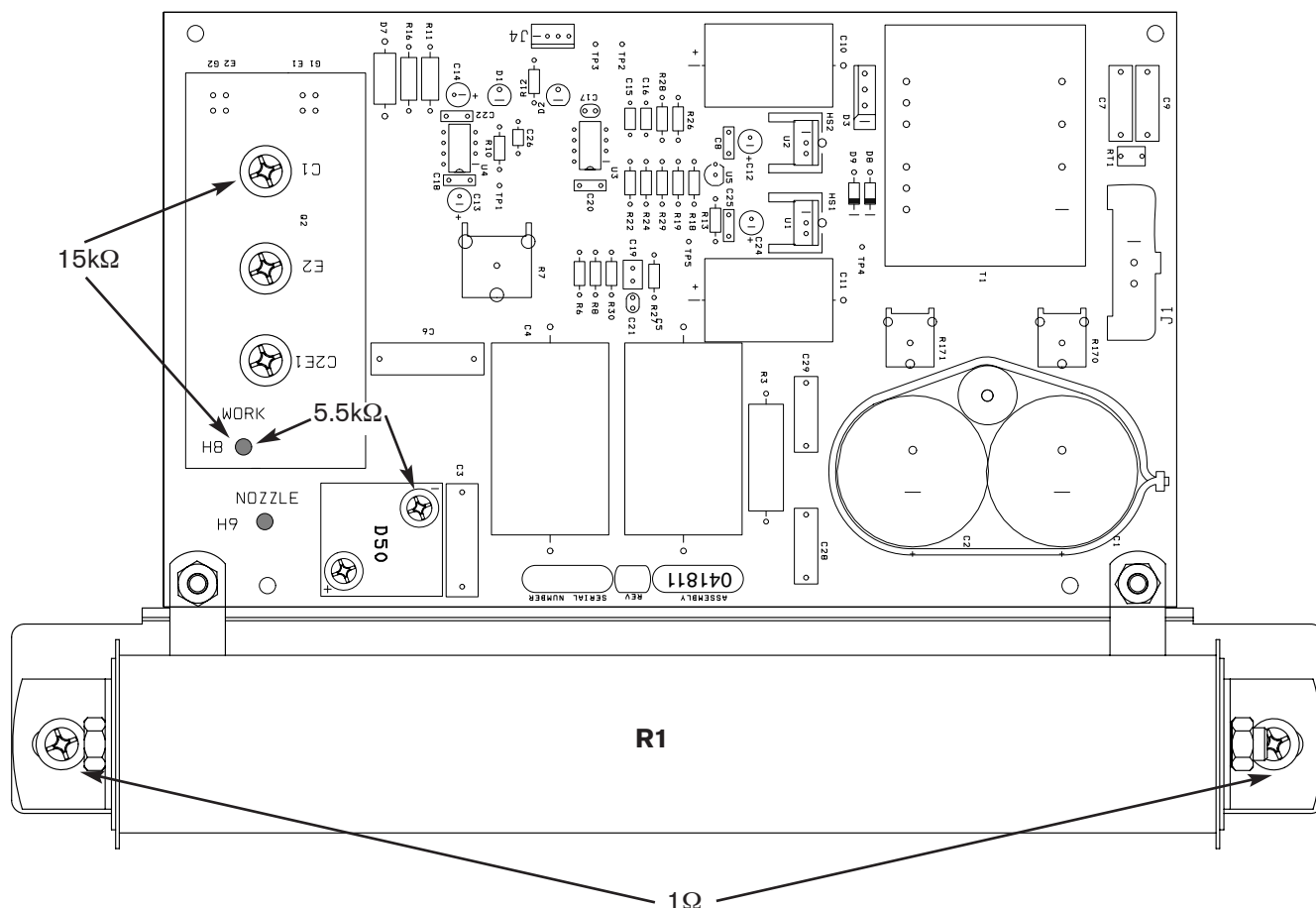
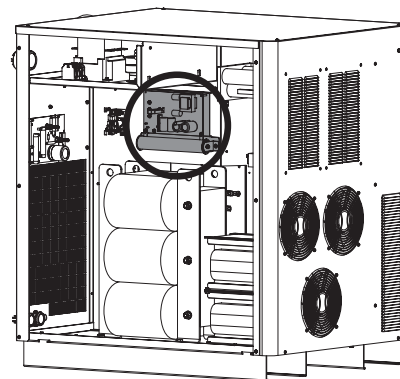
If there is no arc at the torch or if the arc will not transfer:

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 k Ω 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 k Ω between C1 and H8.

- The work lead should not have any cuts or breaks. verify a resistance of 1 Ω 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.



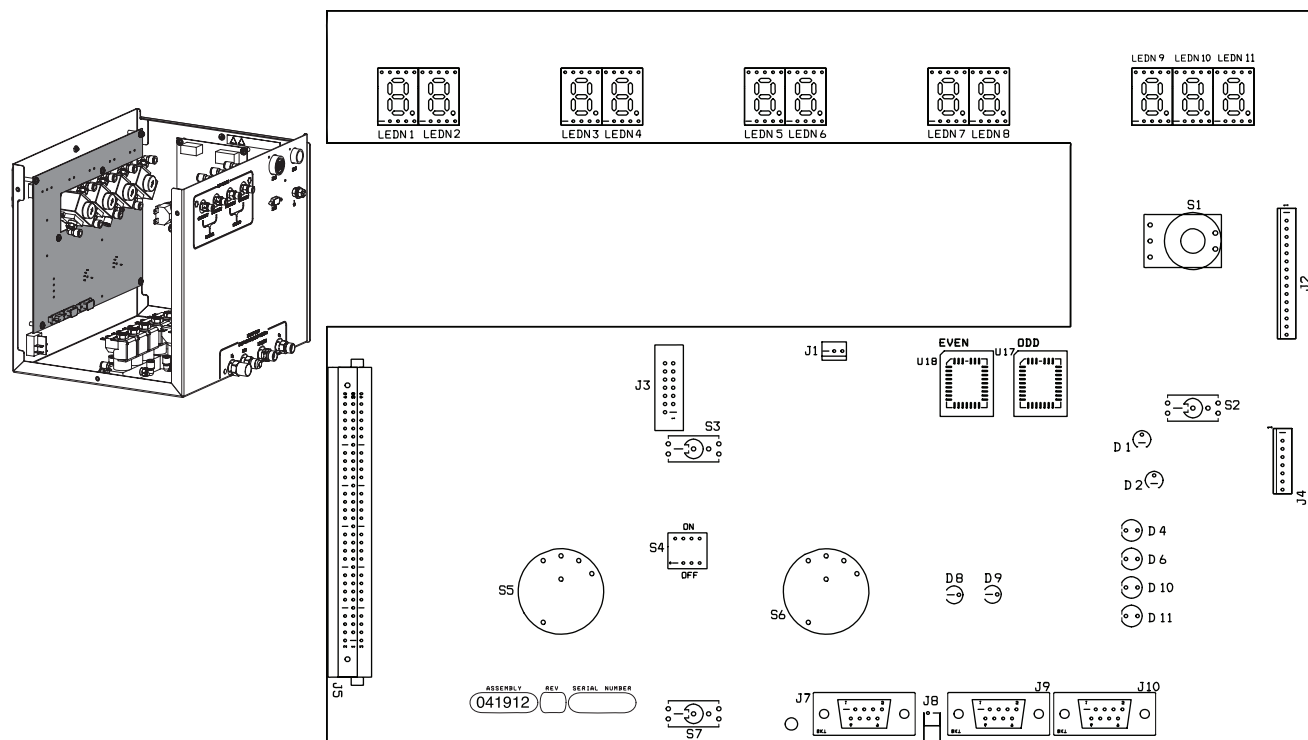
Pilot arc current levels

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

Gas console control board PCB2



Control PCB2 firmware list

Item	Part Number
U17	081109 ODD
U18	081109 EVEN

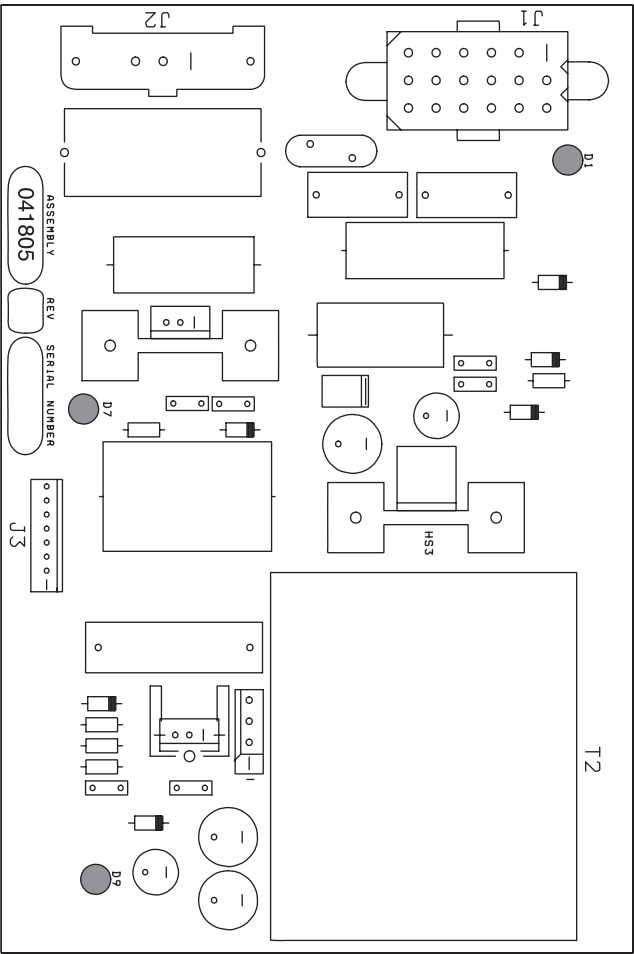
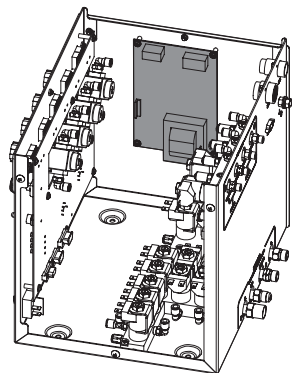
Gas console control board LEDN list

LEDN	Signal name	Color
LEDN1	Plasma preflow, left digit	Red
LEDN2	Plasma preflow, right digit	Red
LEDN3	Plasma cutflow, left digit	Red
LEDN4	Plasma cutflow, right digit	Red
LEDN5	Shield preflow, left digit	Red
LEDN6	Shield preflow, right digit	Red
LEDN7	Shield cutflow, left digit	Red
LEDN8	Shield cutflow, right digit	Red
LEDN9	Current, left digit	Red
LEDN10	Current, center digit	Red
LEDN11	Current, right digit	Red

Gas console control board LED list

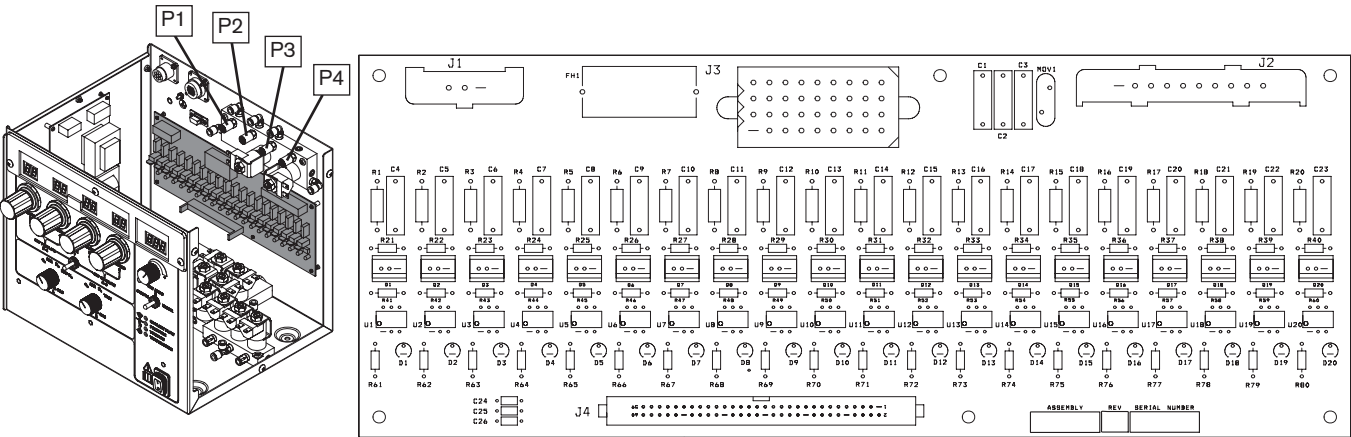
LED	Signal name	Color
D1	+ 5 VDC	Green
D2	+ 3.3 VDC	Green
D4	Coolant error	Yellow
D6	Pressure error	Yellow
D8	CAN- TX	Green
D9	CAN- RX	Green
D10	Voltage error	Yellow
D11	Temperature error	Yellow

Gas console power distribution board PCB1

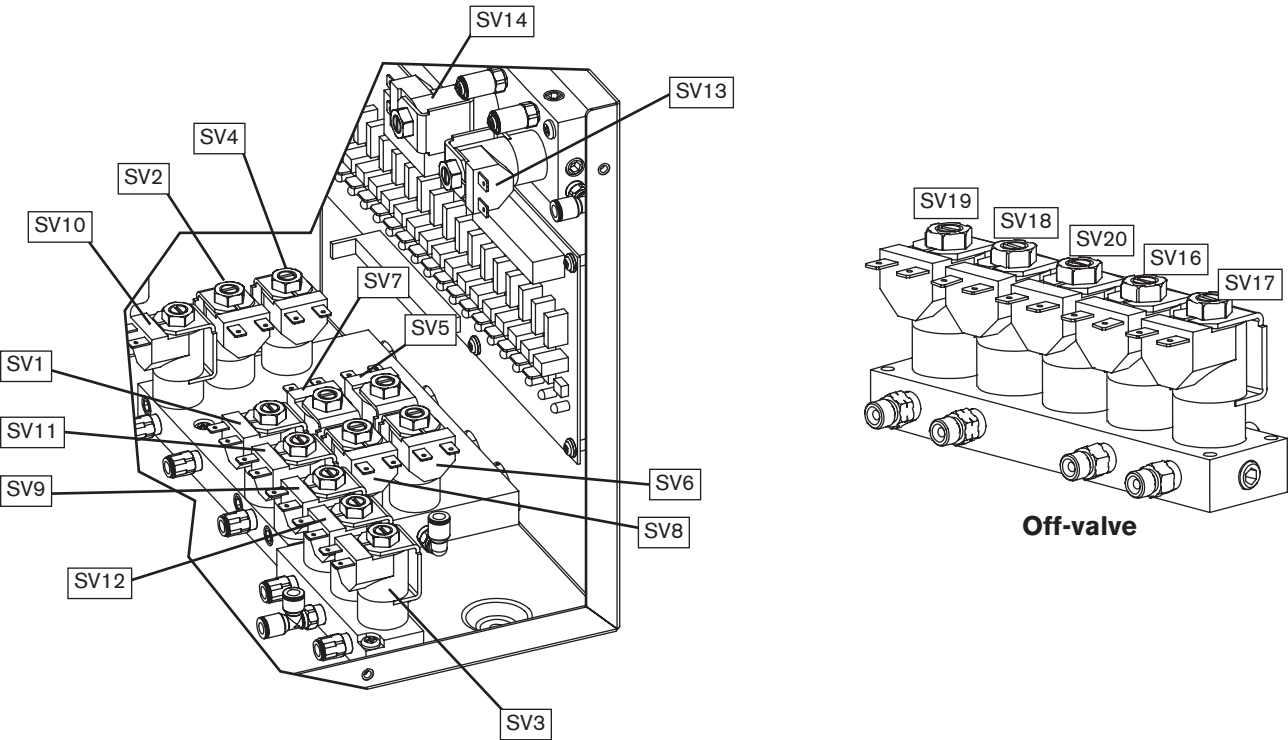


LED	Signal Name	Color
D1	120 VAC (switched)	Green
D7	+ 5 VDC	Red
D9	+ 24 VDC	Red

Gas 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	SV15 (not used)	Red
D6	SV6	Red	D16	SV16	Red
D7	SV7	Red	D17	SV17	Red
D8	SV8	Red	D18	SV18	Red
D9	SV9	Red	D19	SV19	Red
D10	SV10	Red	D20	SV20	Red



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.		

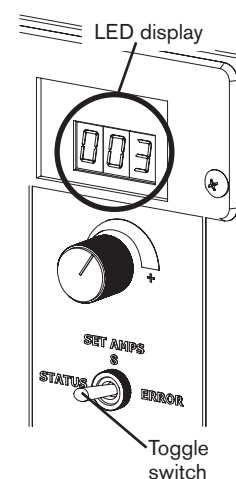
Automatic chopper and current sensor tests during power-up

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 appear in the LED display if the current is < 10 amps or there is no feedback on current sensor 1 (CS1). Error code 103 will appear in the LED display 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 appear in the LED display if the current is < 10 amps. Error code 104 will appear in the LED display if the current is > 35 amps.

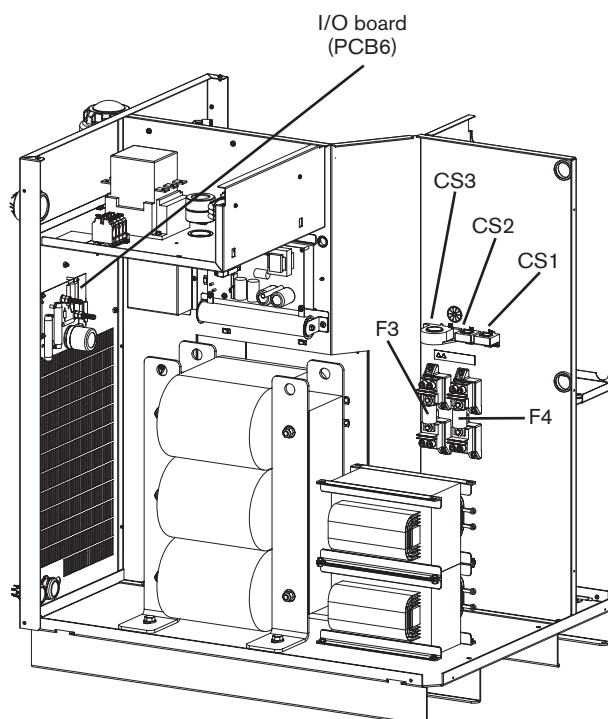
Place the toggle switch in the ERROR position if the system completes the power up sequence. If the system shows error code 003 the test passed. The choppers and current sensors are OK.

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



Troubleshooting low-current error codes 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. Measure the resistance between wire 38 and wire 39 on PCB6 with a meter. The value should be increasing 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.

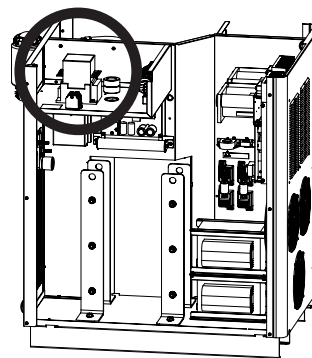


Troubleshooting high-current error codes 103 and 104

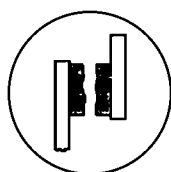
1. Verify that the current sensors (CS1 and CS2) and cables are not damaged.
2. Exchange CS1 and CS2. Replace the faulty sensor if the error the code is not displayed again.
3. Look at the surge capacitor to ensure that it is not short-circuited. Replace PCB6 if the surge capacitor is shorted.
4. Check 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

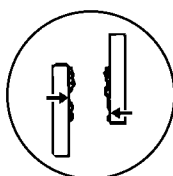
1. Turn OFF all power to the system and remove the cover from CON1.



2. Inspect the condition of the 3 contacts for excessive wear. If one of more of the contacts are worn excessively, replace CON1 and restart the system. If the error remains, perform the following steps.

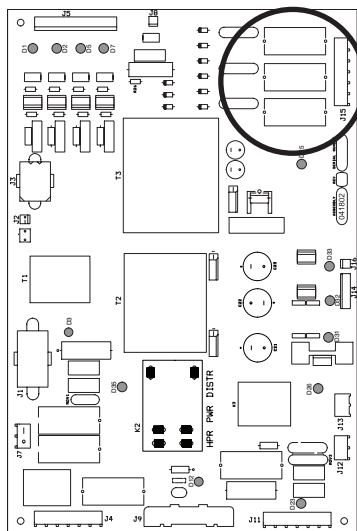


OK



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 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 one 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.

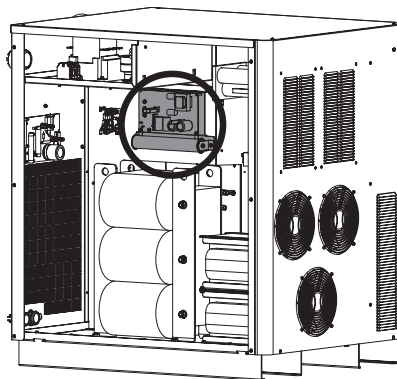


DANGER

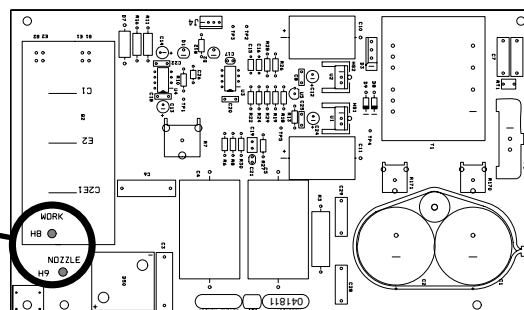
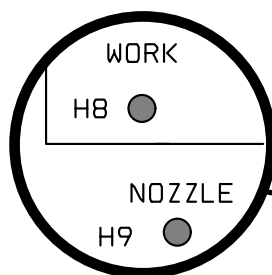
SHOCK HAZARD: Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

Torch lead test

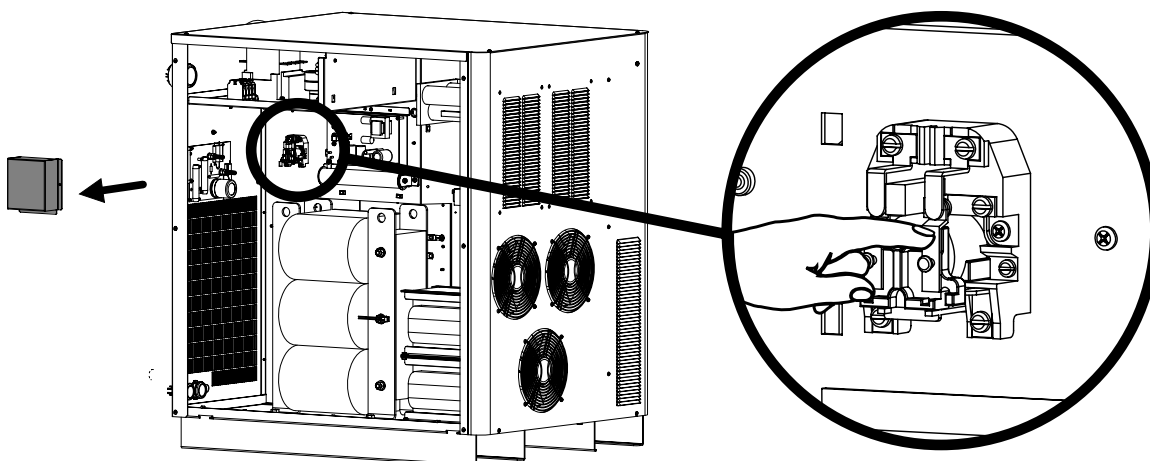
1. Turn OFF all power to the system.
2. Locate the start circuit assembly.



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 two 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.

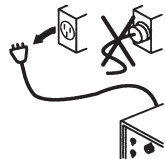
Proper maintenance often eliminates the problems that shorten the life of consumable parts. Since labor and overhead can account for 80% of the cost of cutting, improved productivity can reduce cutting costs dramatically.

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 back 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 8.3 bar (120 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 test 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 gas console, should be connected individually to a ground point. These connections should be made with 10 mm² (#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 power supply with dry, oil free compressed air, or a vacuum cleaner.
- Verify cooling fans are working properly.
- Clean torch threads and current ring.
- Verify proper coolant level.

Semi-Annually:

Year	1 st Service	2 nd 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 test
 - A. Oxygen pressure drop at _____
psi in 10 minutes (_____ bar)
 - B. Nitrogen pressure drop at _____
psi in 10 minutes (_____ bar)
- ☐ *P* ☐ *NP* 17. Inspect for hose restrictions
 - ☐ *P* ☐ *NP* A. Motor valve hoses
 - ☐ *P* ☐ *NP* B. Gas console to motor valve
 - ☐ *P* ☐ *NP* C. Off-valve to torch body
 - ☐ *P* ☐ *NP* D. Hoses in power track

Cable connections

- ☐ *P* ☐ *NP* 18. Inspect cables
 - ☐ *P* ☐ *NP* A. CommandTHC
 - ☐ *P* ☐ *NP* B. Control cable from off-valve to gas console
 - ☐ *P* ☐ *NP* C. From ignition console and gas 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	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
1 Year or 600 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
1.5 Years or 900 arc hours+	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
2 Years or 1200 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 dependant	1
2.5 Years or 1500 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
3 Years or 1800 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
	Cooling fan 6"	127039	4
	Cooling fan 10"	027079	3
3.5 Years or 2100 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	1
4 Years or 2400 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 dependant	1
	Coolant pump motor kit	128385	1
4.5 Years or 2700 arc hours	Coolant filter element	027664	1
	Coolant solution 70/30	028872	4
	Torch kit	128879	1
	Quick-disconnect kit	128880	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 dependant	1
	Gas leads	System dependant	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 dependant	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.....6-2

Ignition console6-7

Gas console – 1 of 2.....6-8

Gas console – 2 of 2.....6-9

Off-valve.....6-9

HyPerformance torch6-10

 Torch assembly6-10

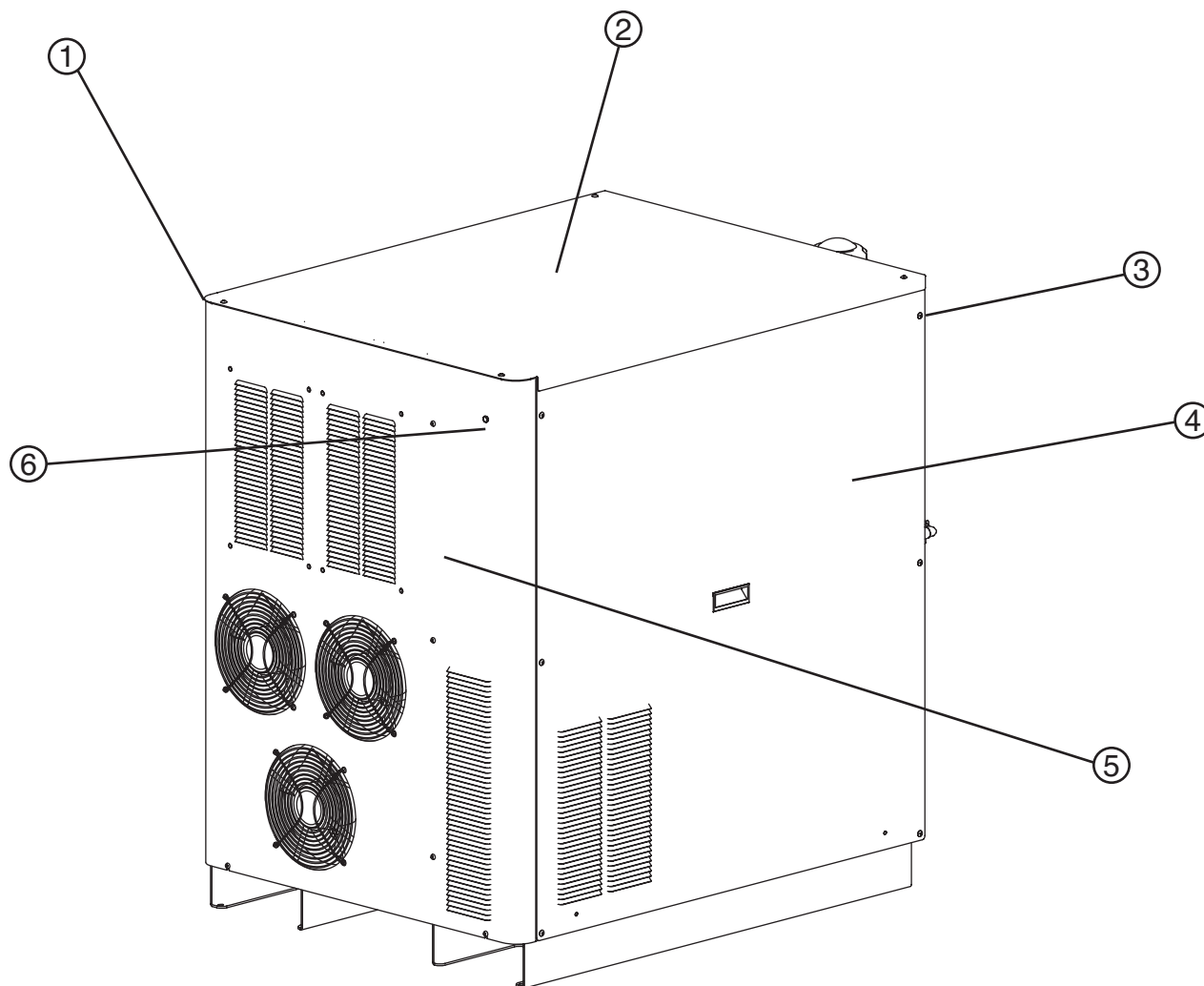
 Torch leads.....6-10

Consumable parts kit – 2280276-11

Consumables for mirror-image cutting6-12

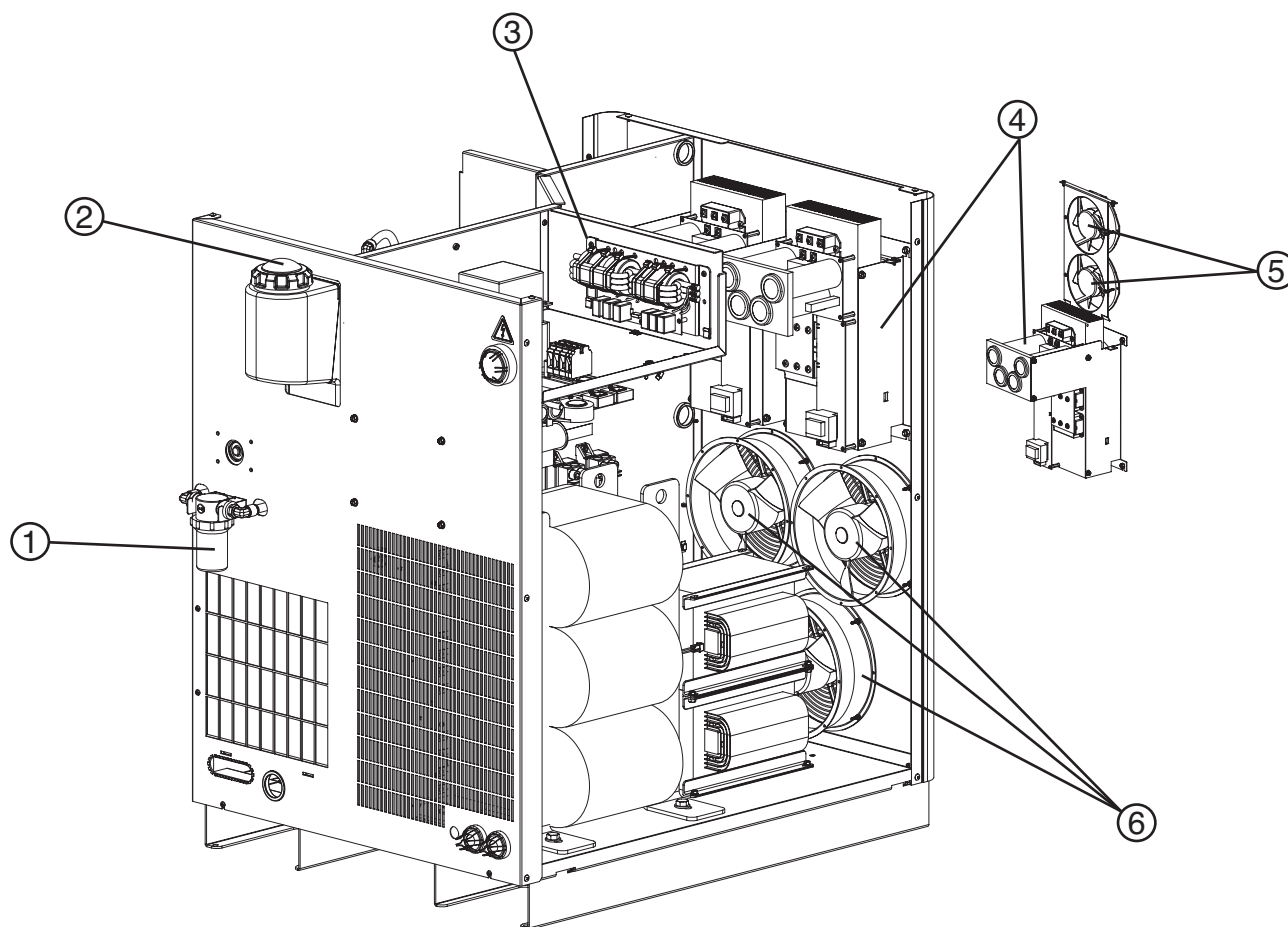
Recommended spare parts6-13

Power supply



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
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

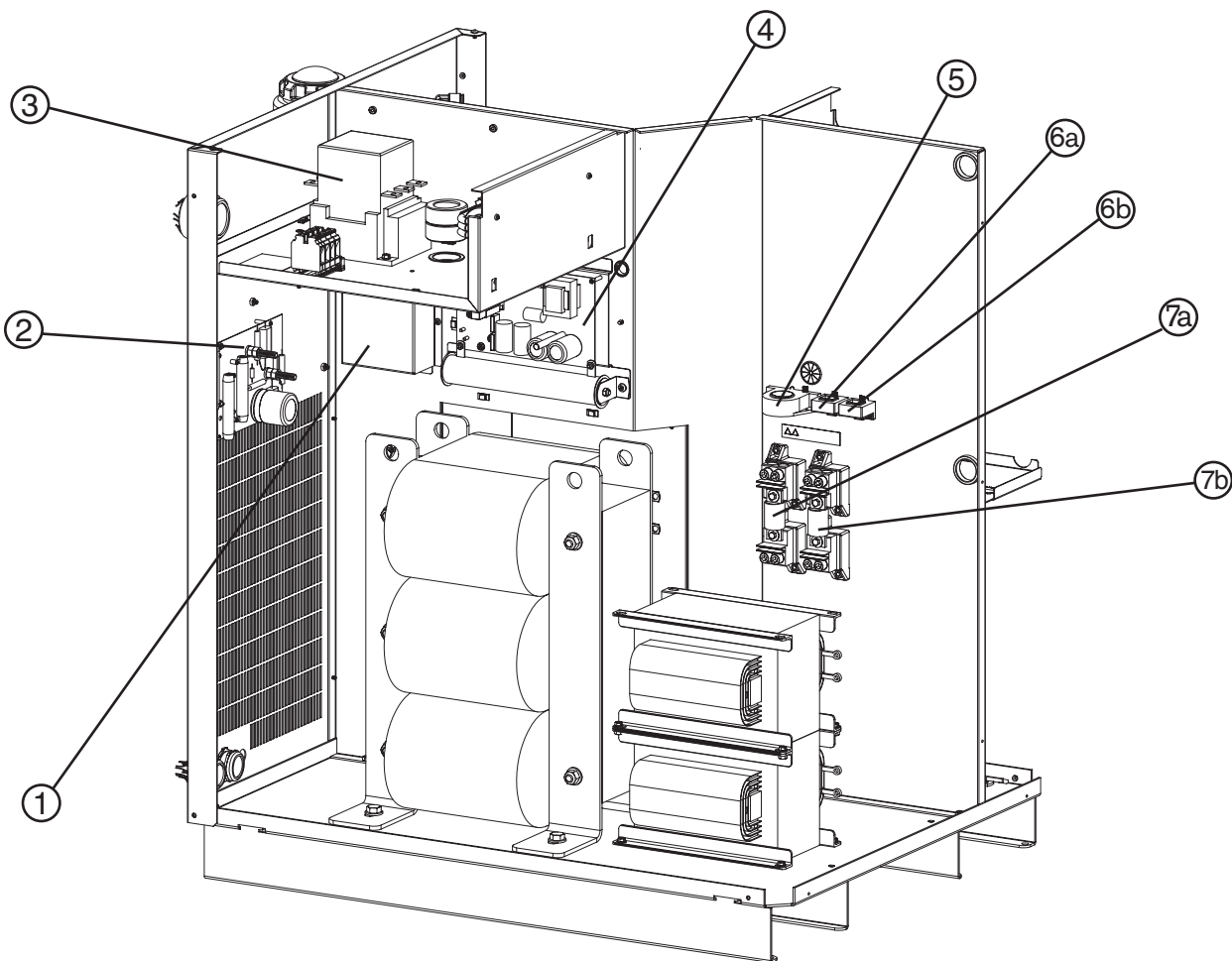
Power supply



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
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		4
6	027079	10" fan :450-550 CFM, 120 VAC 50-60 HZ		3

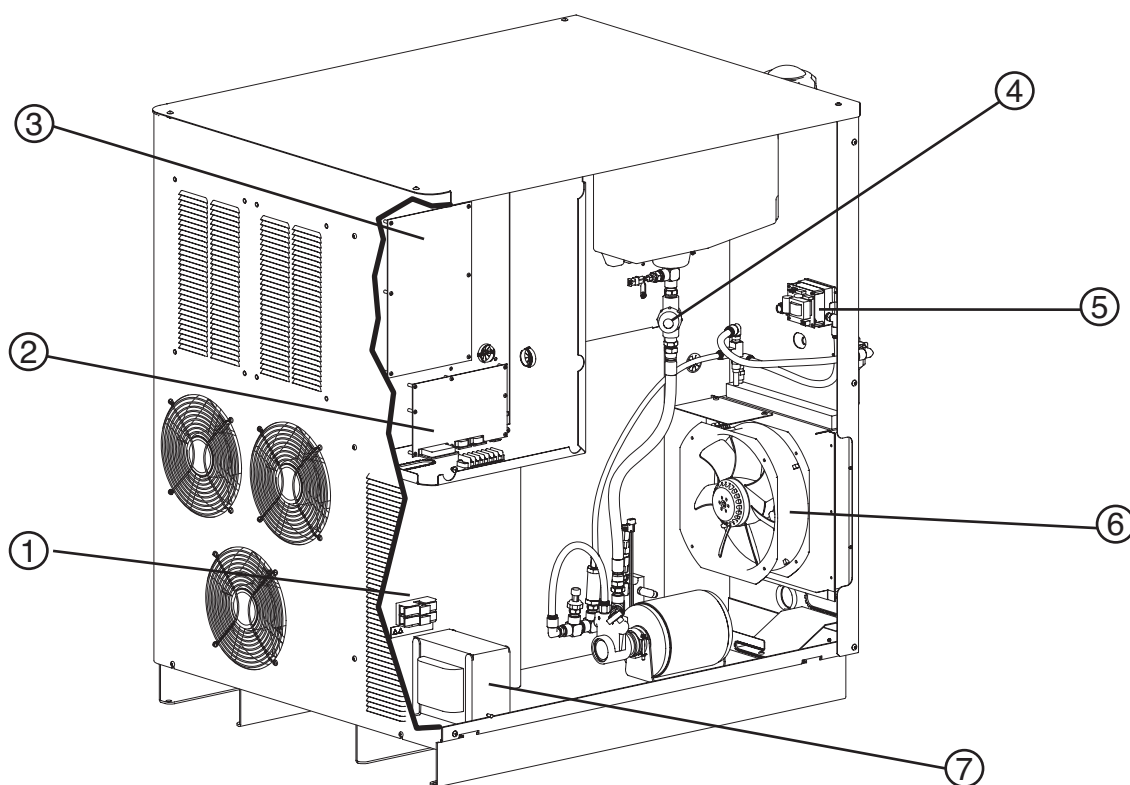
* 400 volt power supply only

Power supply



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
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

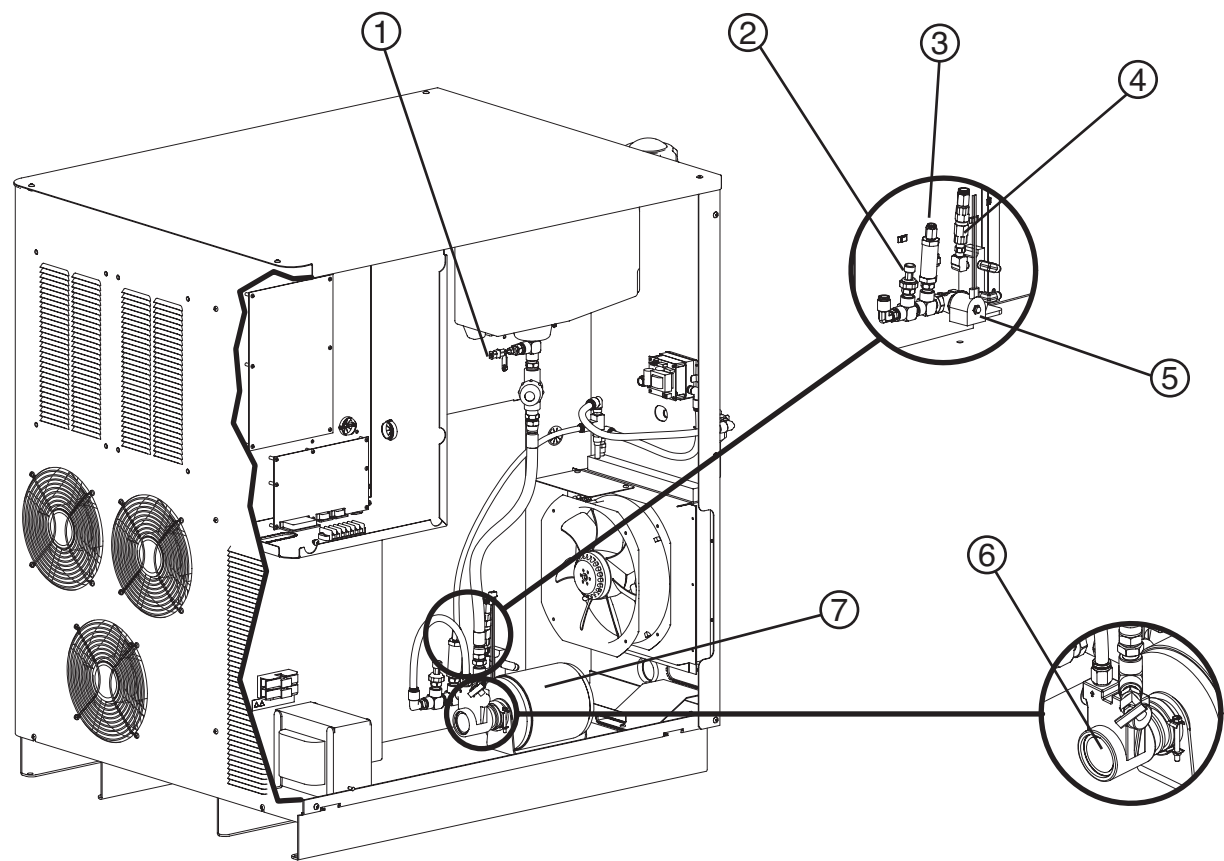


<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	008551*	Fuse: 7.5 amp, 600 volt	F1, F2	2
	008709**	Fuse: 20 amp, 500 volt	F1, F2	2
2	041909	Control PCB	PCB3	1
3	041802	Power distribution PCB	PCB2	1
4	027926	Filter assembly: 1/2" NPT low profile		1
5	129793	Flow switch 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

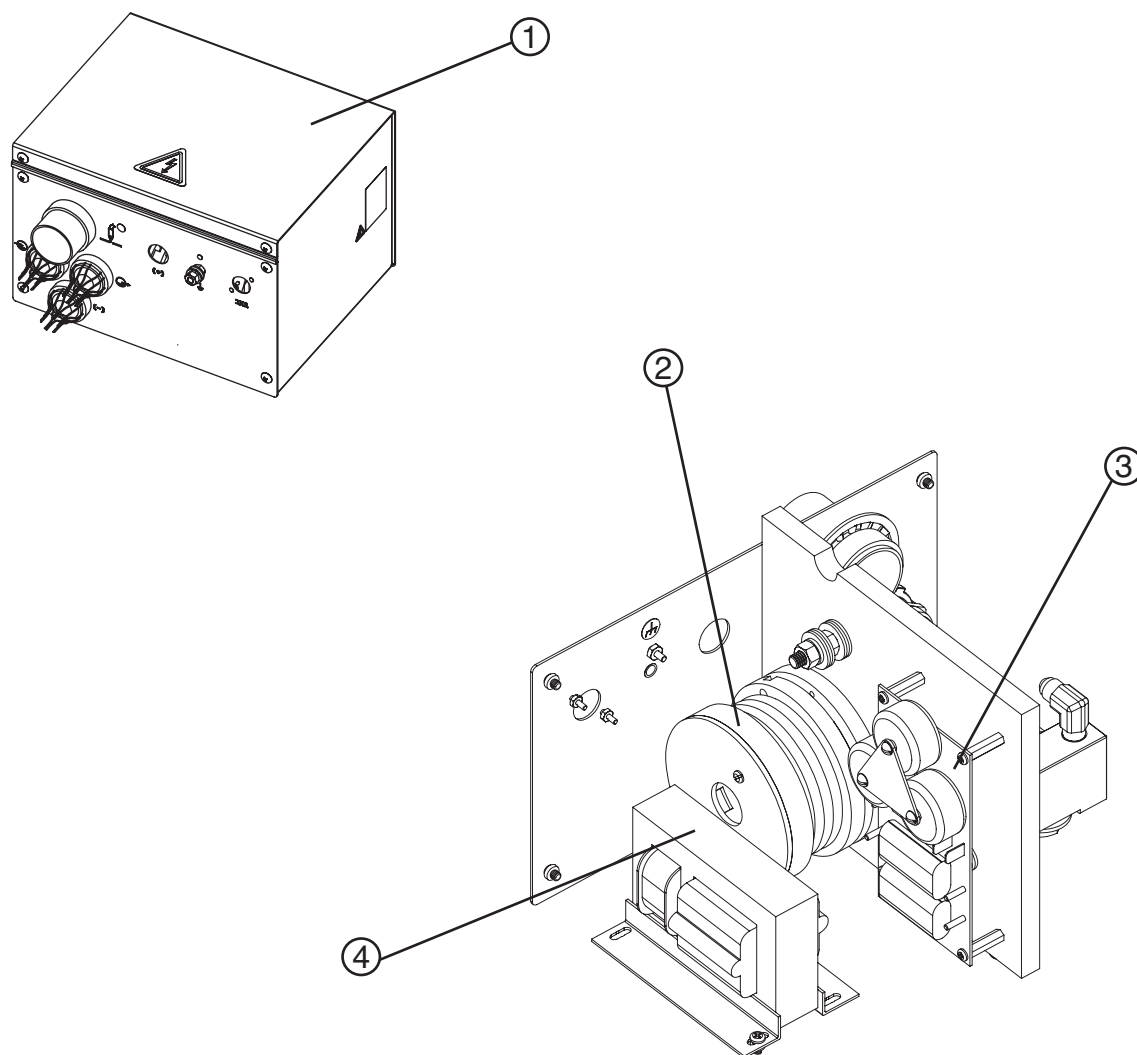
**200/208, 220 and 240 volt power supplies

Power supply



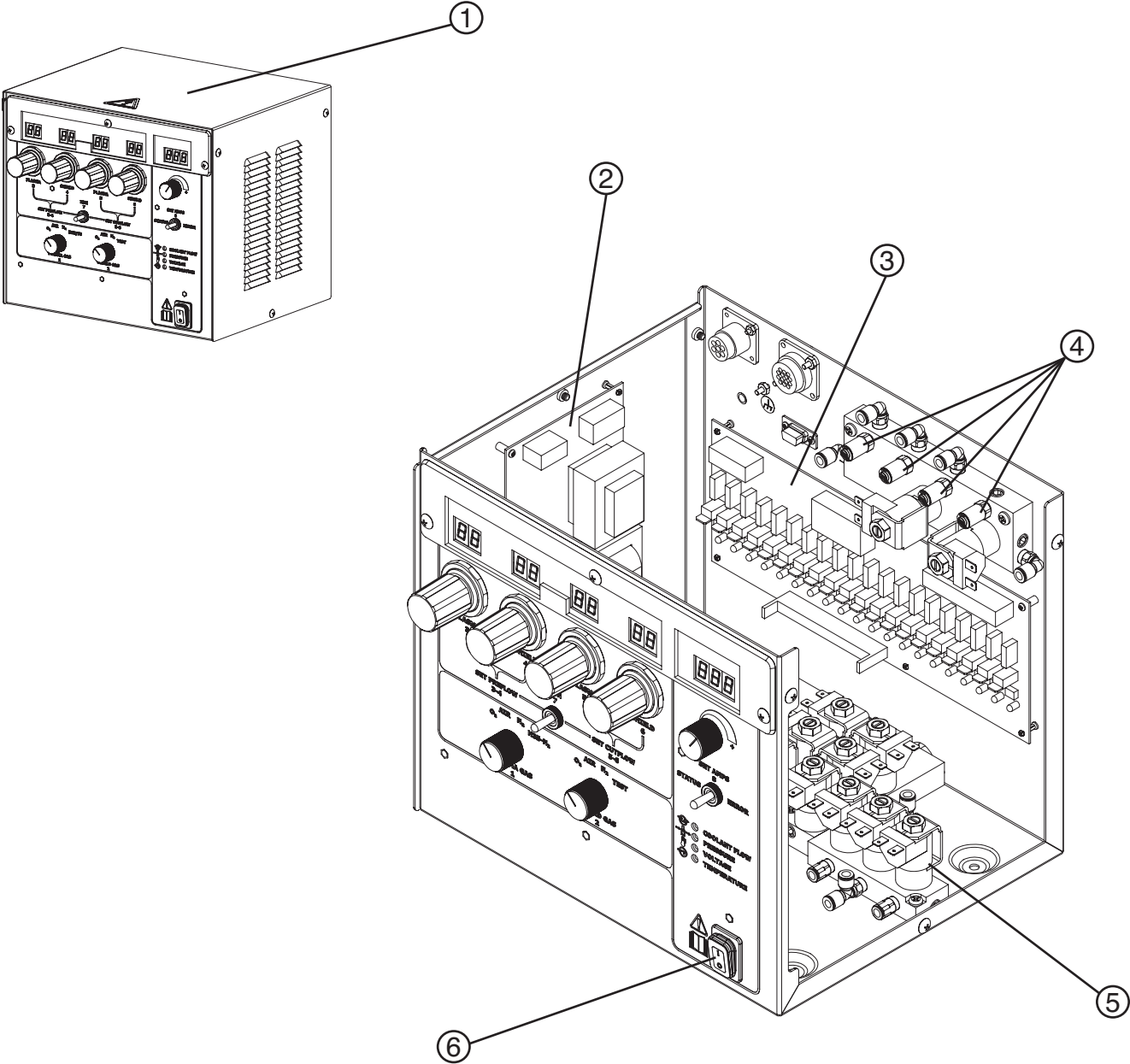
<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	109393	Temperature sensor	T2	1
2	109524	Pressure transducer	PT1	1
3	006132	Check valve: 1/4" NPT, 200 psi		1
4	006075	Check valve: 1/4" FPT		1
5	006046	Solenoid valve assembly: 3/8", 240 volt	CLT SOL	1
6	228171	Kit: Pump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

Ignition console



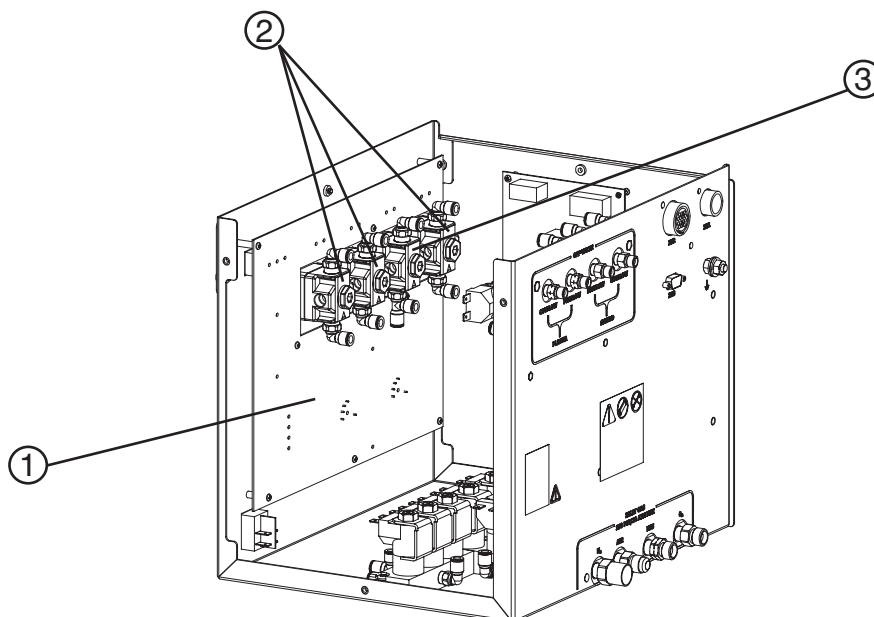
<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	078172	Ignition Console		
2	129831	Coil assembly	T2	1
3	041817	HFHV Ignition PCB	PCB IGN	1
4	129854	Transformer	T1	1

Gas console - 1 of 2



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	078170	Gas Console		
2	041805	Power distribution PCB	PCB1	1
3	041822	Valve driver PCB	PCB3	1
4	005263	Pressure sensor	PT1-PT4	4
5	006109	Solenoid valve	SV1-SV14	14
	006112	Replacement solenoid coil		
6	005262	Illuminated power switch	SW1	1

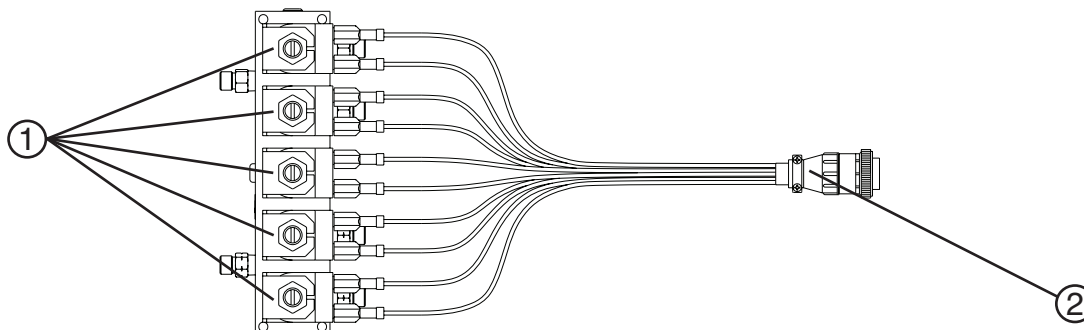
Gas console - 2 of 2



<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	041912	Control PCB	PCB2	1
2	229128	Regulator assembly with elbow fitting	PR1, PR3, PR4	3
3	229129	Regulator assembly with elbow and tee fitting	PR2	1
	228147	Kit: regulator upgrade (replaces all 4 regulators)		

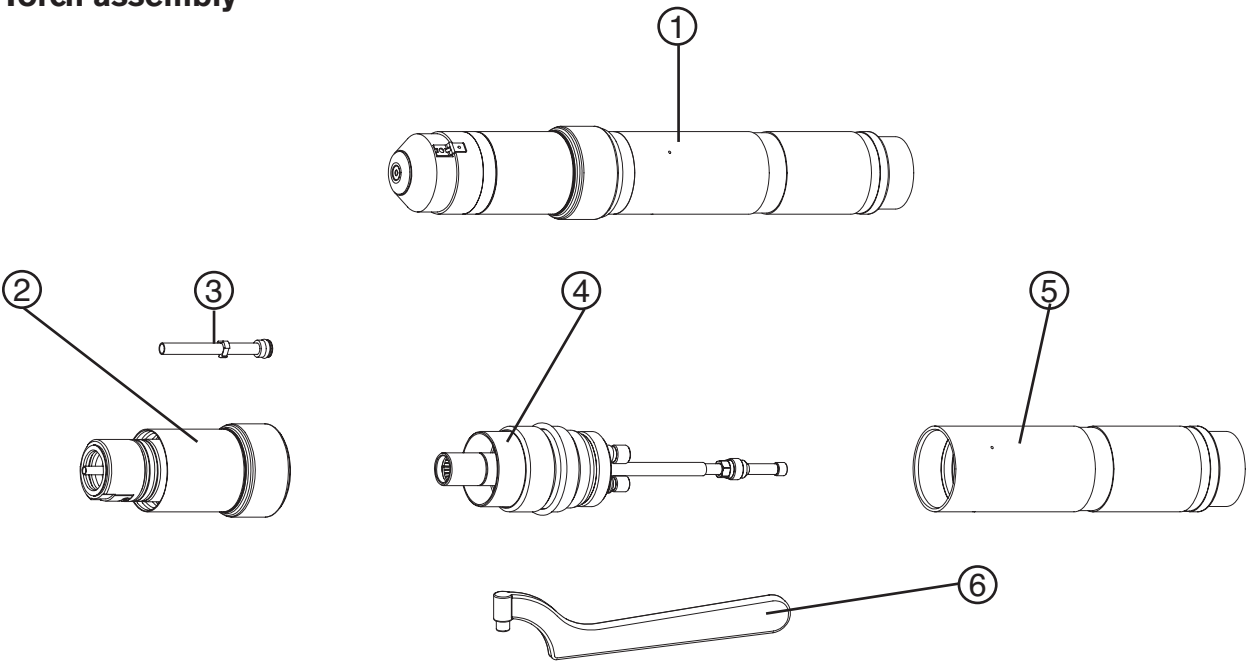
Off-valve

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	129816	Off valve assembly		1
1	006109	Solenoid valve	V16-V20	5
	006112	Replacement solenoid coil		5
2	123748	Off-valve cable		1



HyPerformance torch

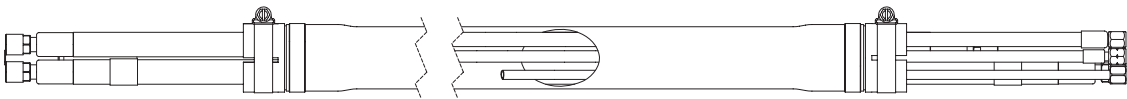
Torch assembly



<u>Item</u>	<u>Part Number</u>	<u>Description</u>
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 C of this manual for bevel cutting part numbers.

Torch leads



<u>Part Number</u>	<u>Description</u>
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)

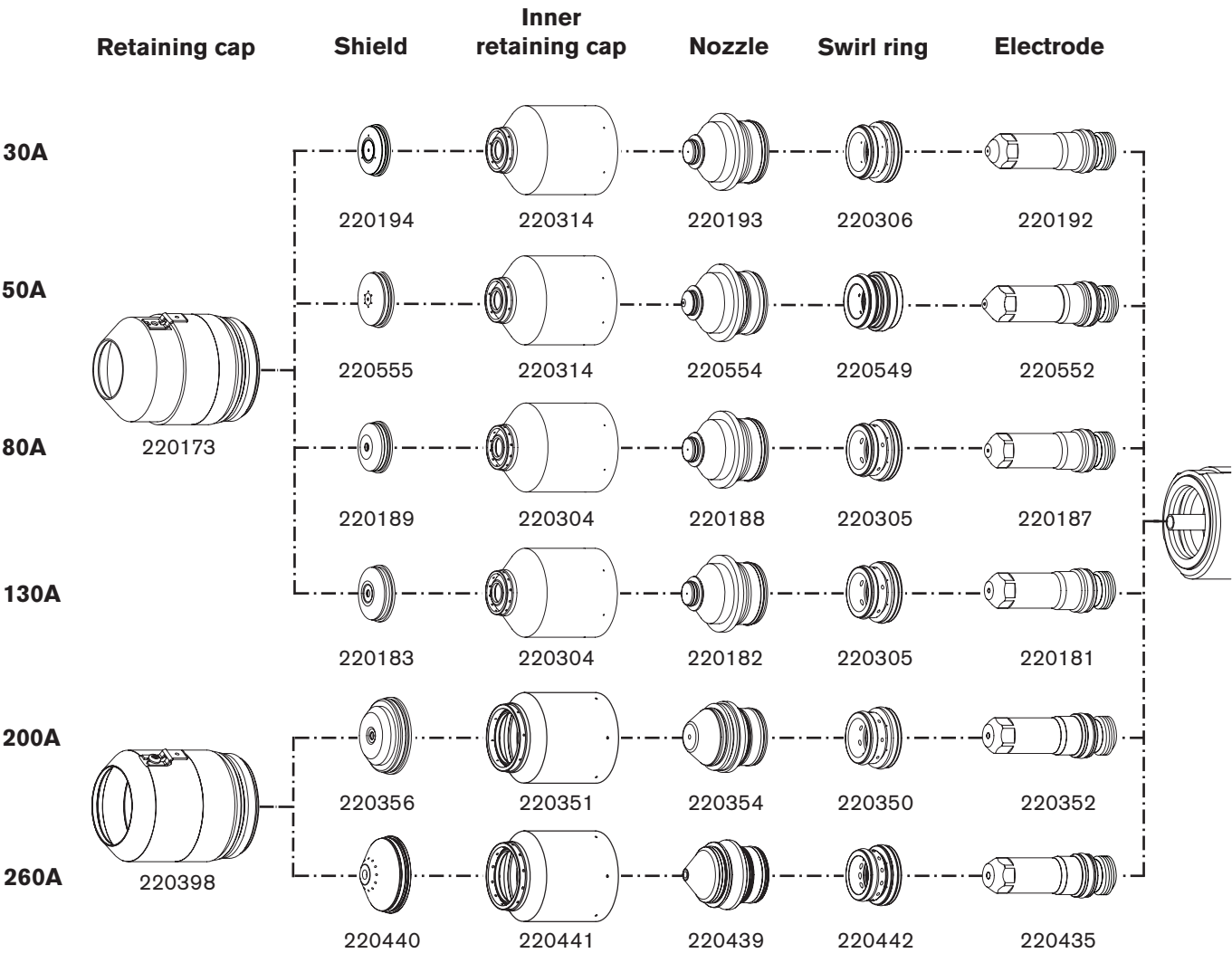
Consumable parts kit – 228027 (also includes HPR130 kit number 128878)

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

<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
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	HPR 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

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
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	Contactors	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
041808	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

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
041817	HFHV Ignition PCB		1
129854	Transformer	T1	1

Gas console

<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
041805	Power distribution PCB	PCB1	1
041822	Valve driver PCB	PCB3	1
005263	Pressure sensor	PT1-PT3	1
006109	Solenoid valve	SV1-SV14	2
005262	Illuminated power switch	SW1	1

Off-valve

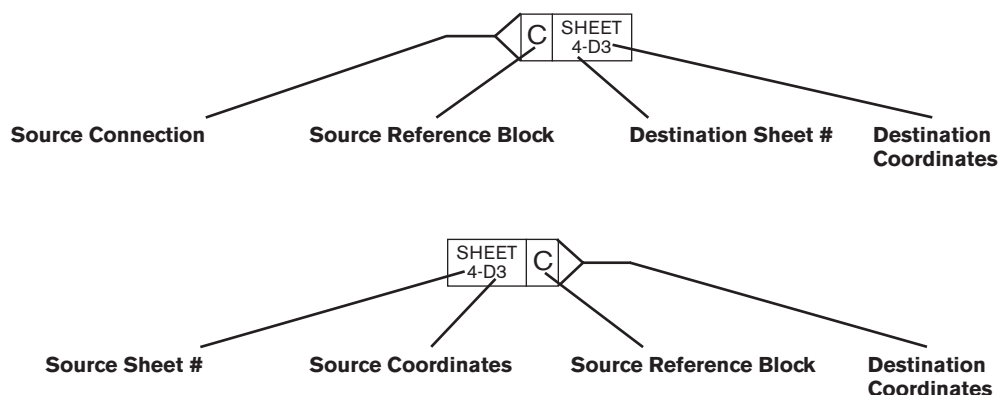
<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
006109	Solenoid valve	V16-V19	1

WIRING DIAGRAMS

Introduction

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

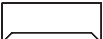
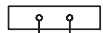
- Sheet numbers are located in the lower right-hand corner.
- Page-to-page referencing is done in the following manner:

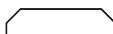


Destination and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).

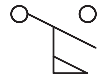
Wiring Diagram Symbols

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

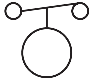
	Push Button, Normally Closed
	Push Button, Normally Open
	Receptacle
	Relay, Coil
	Relay, Normally Closed
	Relay, Normally Open
	Relay, Solid State, AC
	Relay, Solid State, DC
	Relay, Solid State, Dry
	Resistor
	SCR
	Shield
	Shunt
	Spark Gap

	Fuse
	Ground Clamp
	Ground, Chassis
	Ground, Earth
	IGBT
	Inductor
	LED
	Lamp
	MOV
	Pin
	Socket
	Plug
	PNP Transistor
	Potentiometer

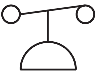
	Battery
	Cap, polarized
	Cap, non-polarized
	Cap, feed-thru
	Circuit breaker
	Coax shield
	Current Sensor
	Current sensor
	DC supply
	Diode
	Door interlock
	Fan
	Feedthru LC
	Filter, AC



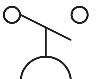
Switch, Flow



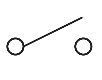
Switch, Level,
Normally Closed



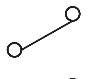
Switch, Pressure,
Normally Closed



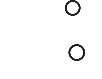
Switch, Pressure,
Normally Open



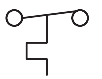
Switch, 1 Pole, 1 Throw



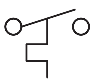
Switch, 1 Pole, 2 Throw



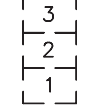
Switch, 1 Pole, 1 Throw,
Center Off



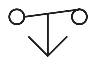
Switch, Temperature,
Normally Closed



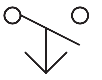
Switch, Temperature,
Normally Open



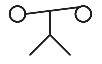
Terminal Block



Time Delay Closed,
NC/Off



Time Delay Open,
NO/Off



Time Delay Open,
NC/On



Time Delay Closed,
NO/Off



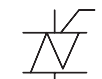
Transformer



Transformer, Air Core



Transformer Coil



Triac



VAC Source



Valve, Solenoid



Voltage Source

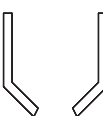


Zener Diode

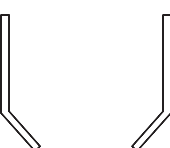
Torch Symbols



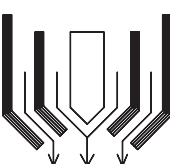
Electrode



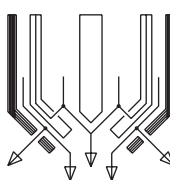
Nozzle



Shield

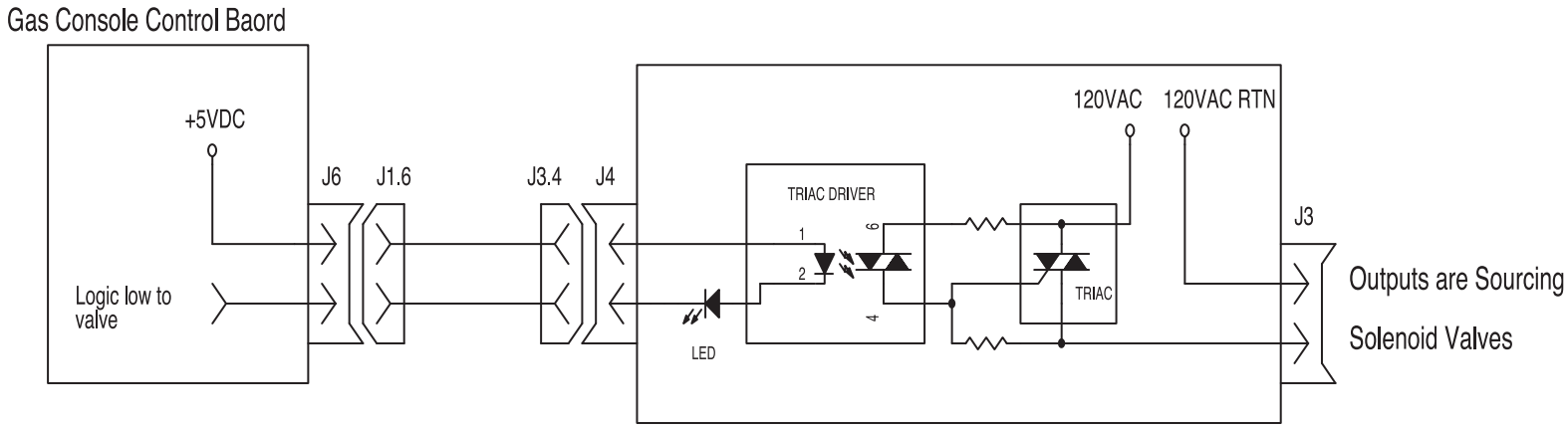
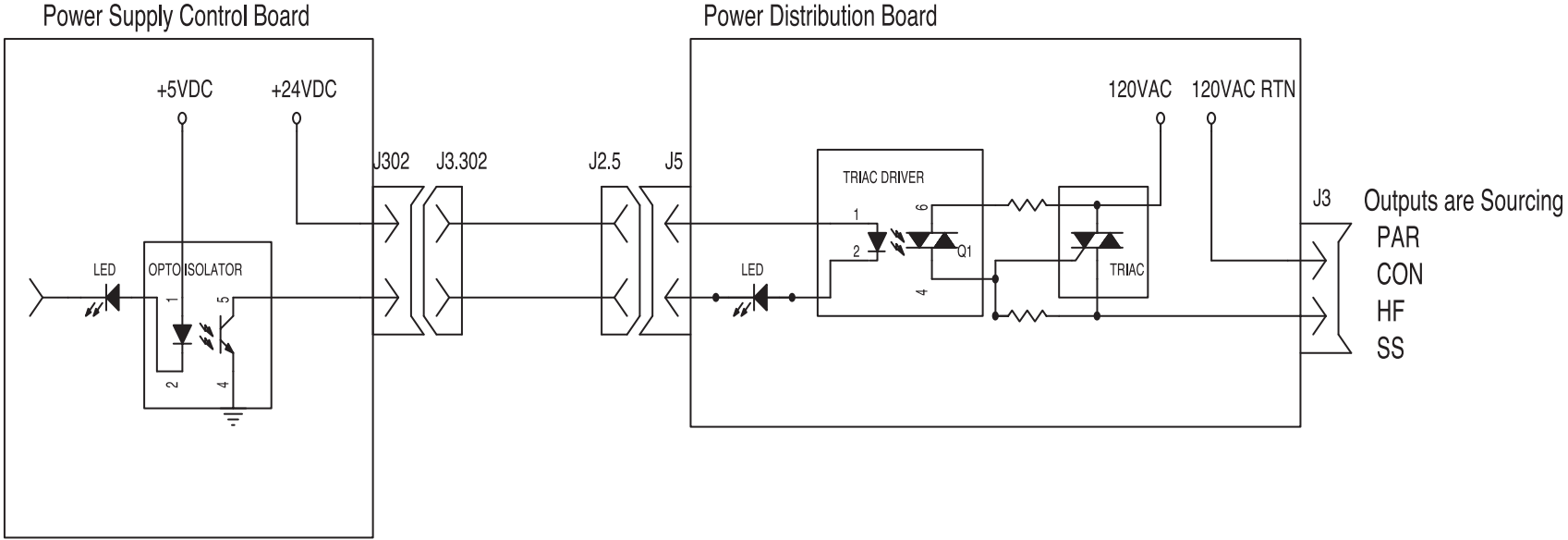


Torch

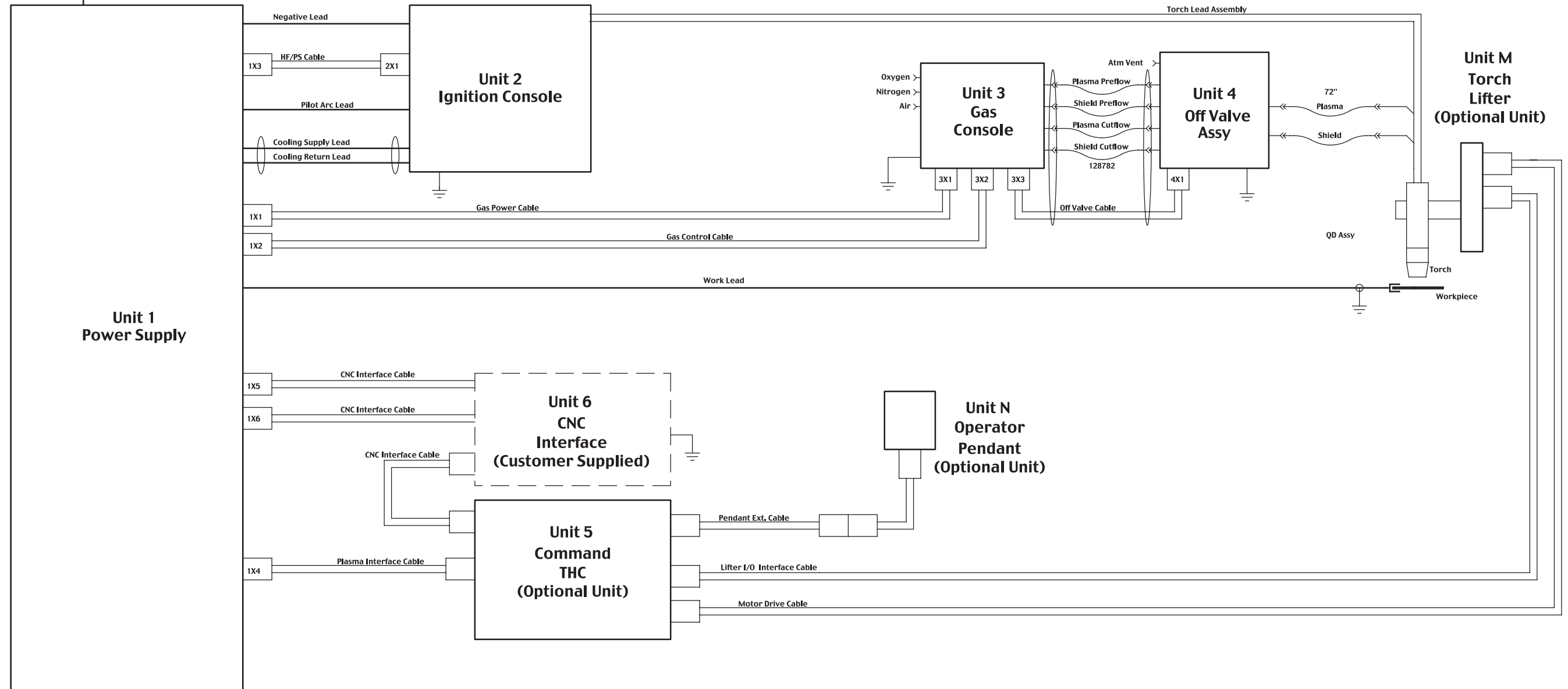


Torch, HyDefinition™

Discrete output functionality



3 Phase
Power
w/ Ground

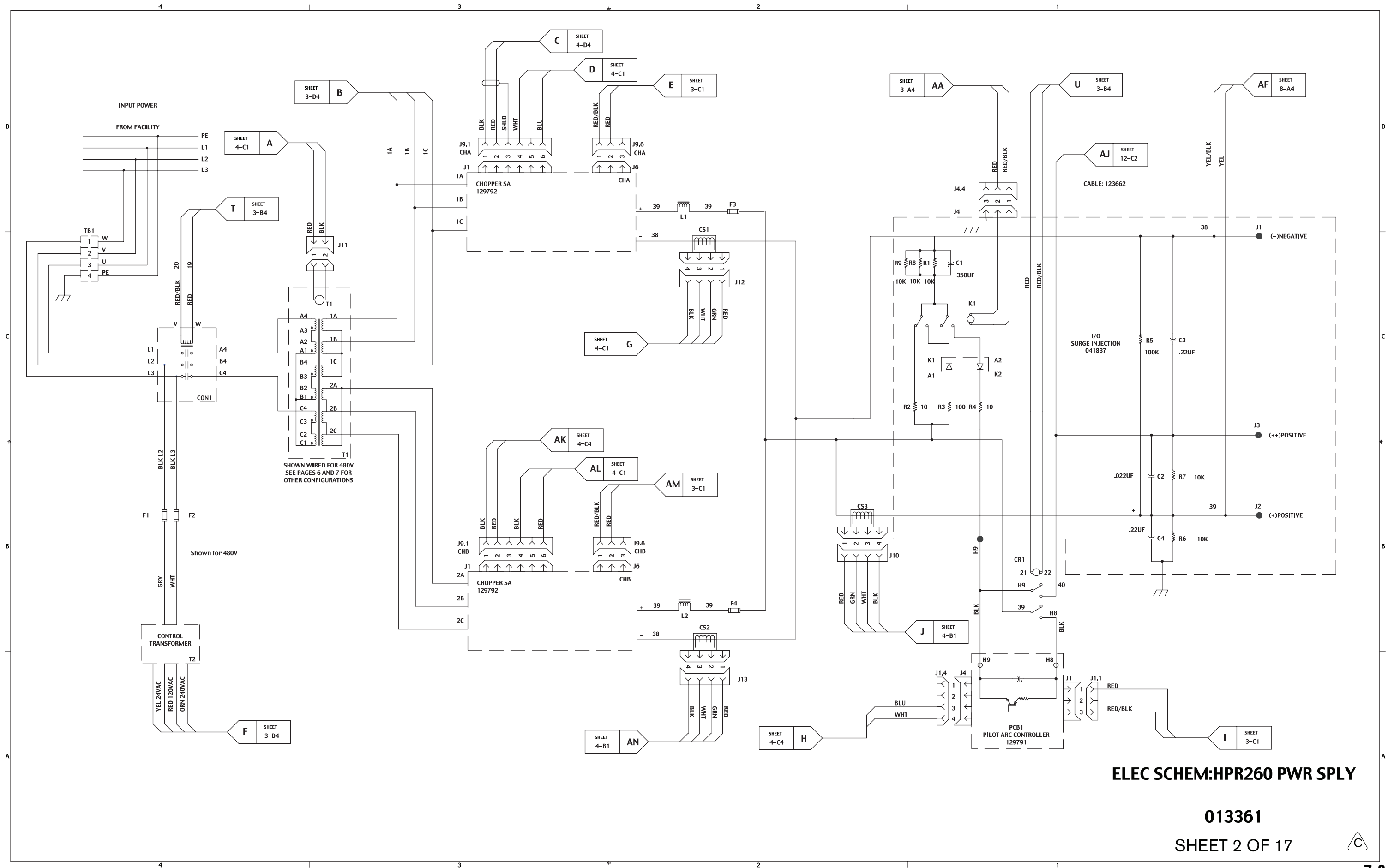


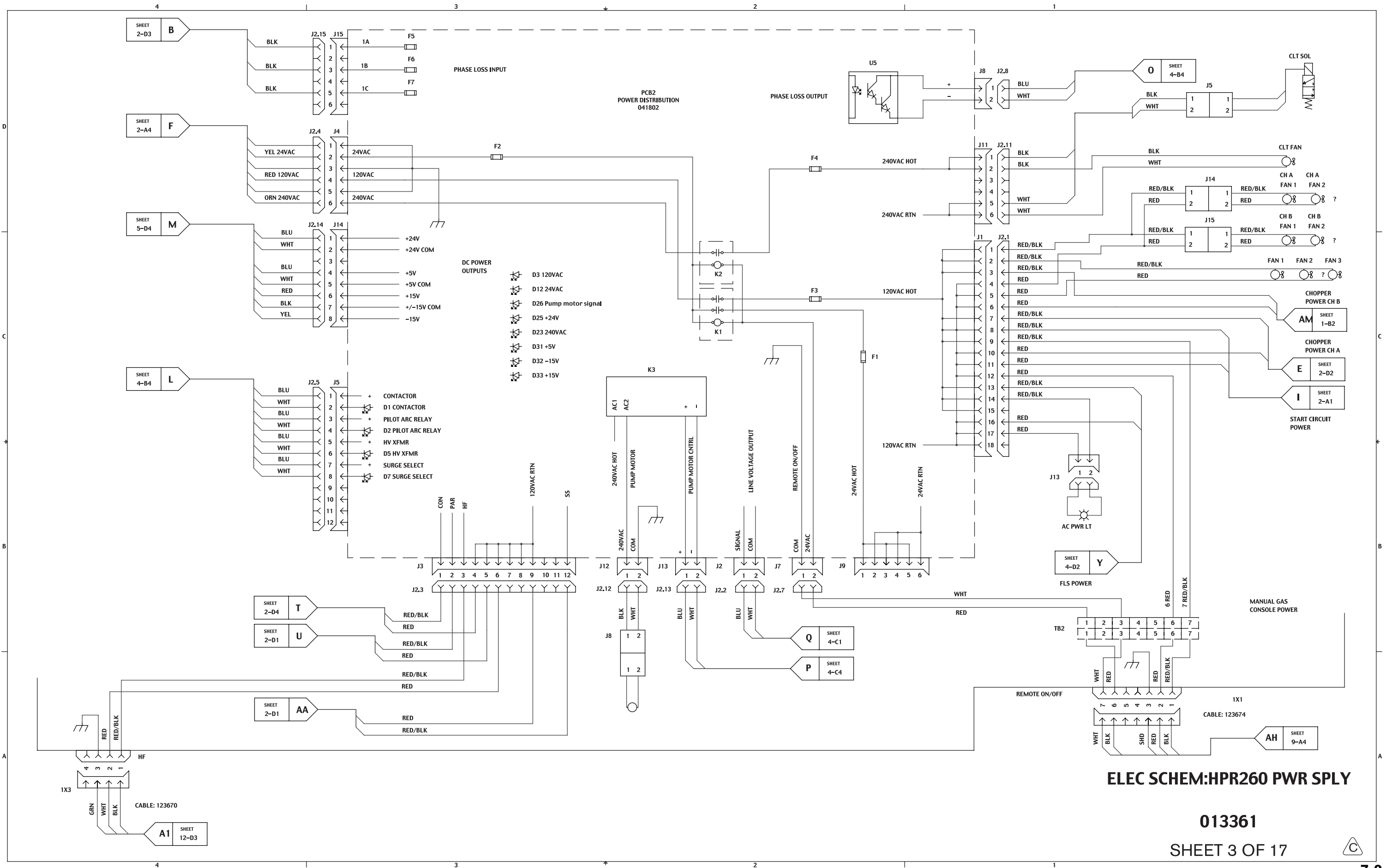
ELEC SCHEM:HPR260 PWR SPL

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SHEET 1 OF 17

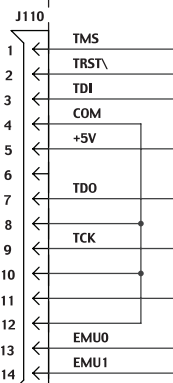
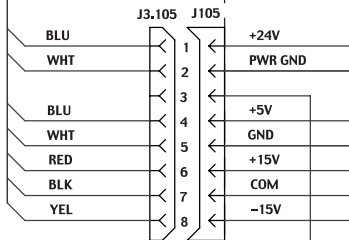






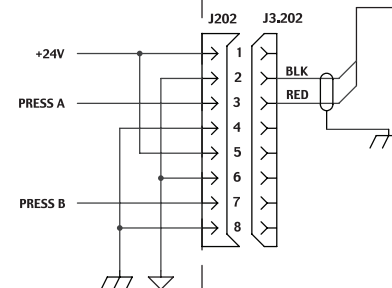
SHEET
3-D4

M



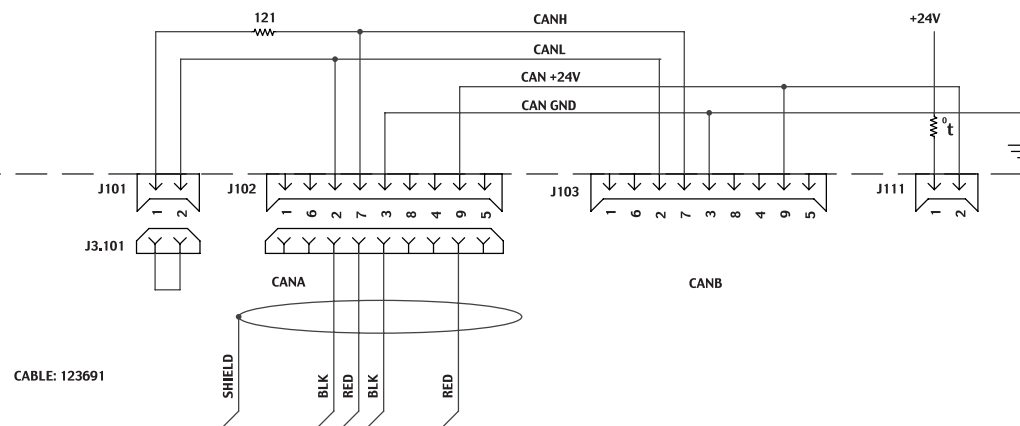
JTAG

PCB3
POWER SUPPLY CONTROL
041909



A0

SHEET
4-D1



SHEET
10-B4

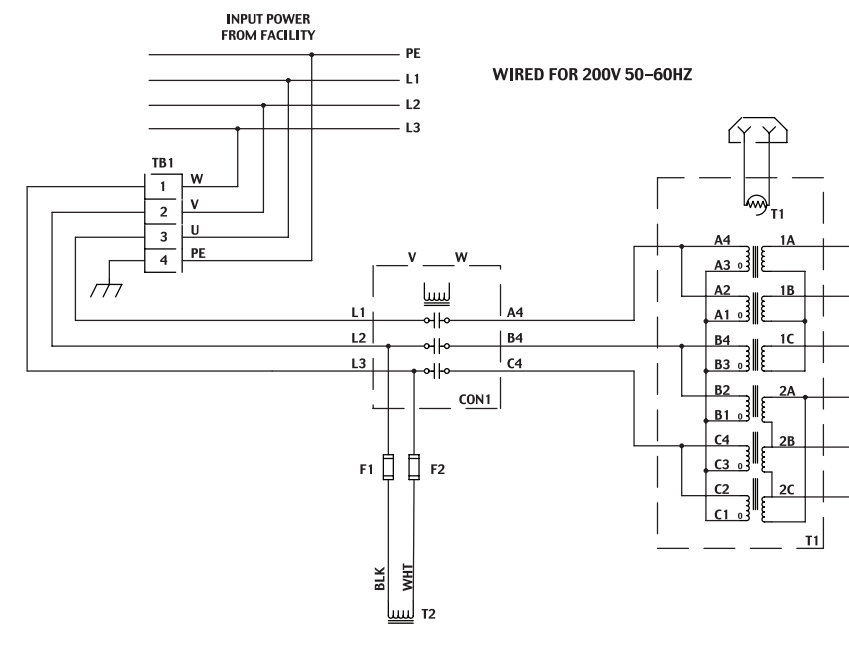
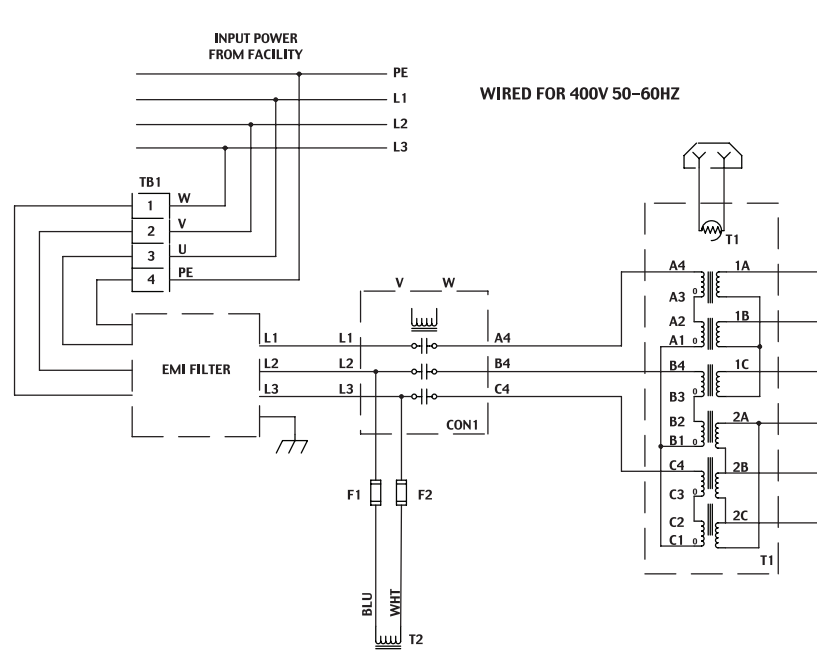
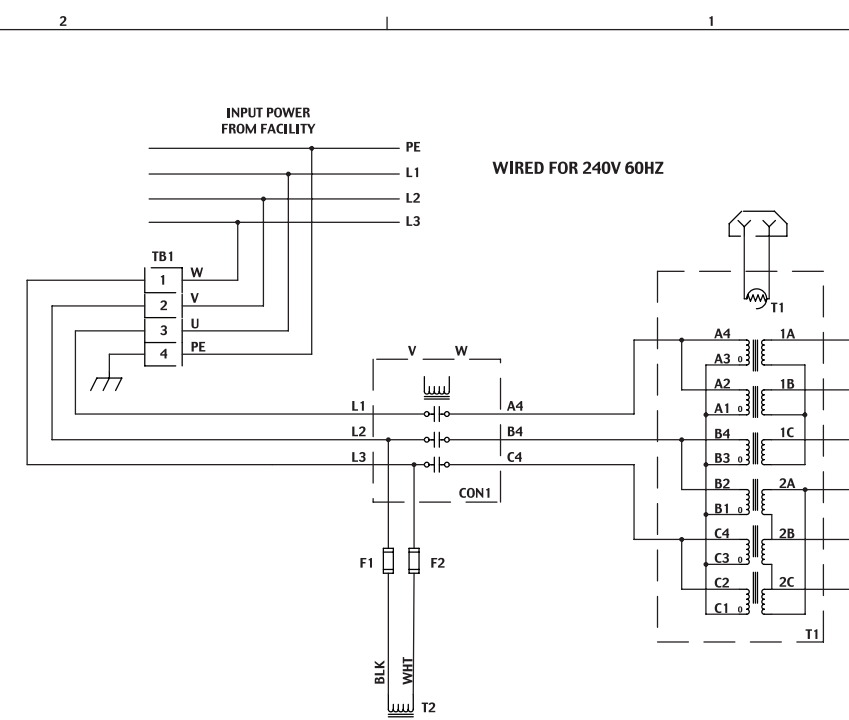
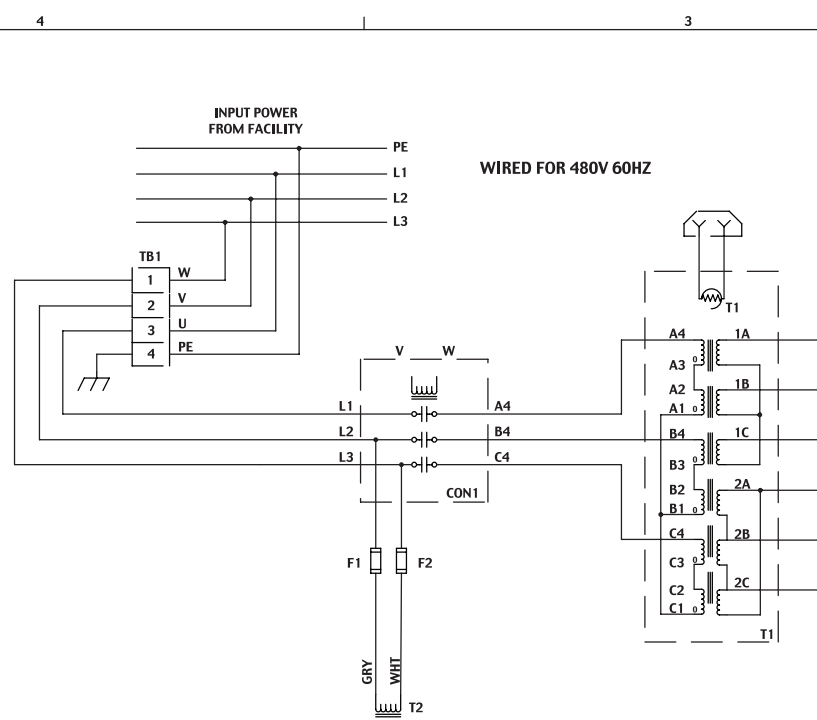
AG

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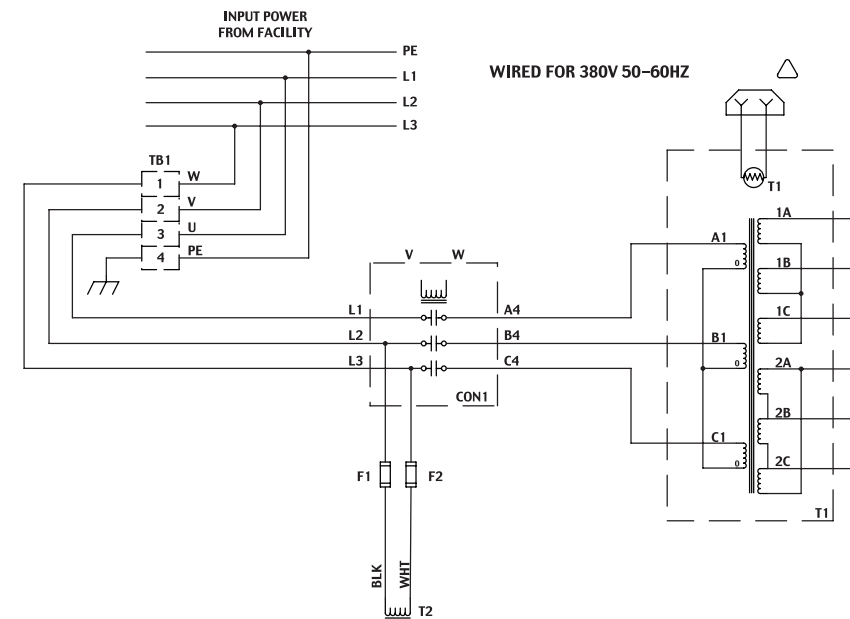
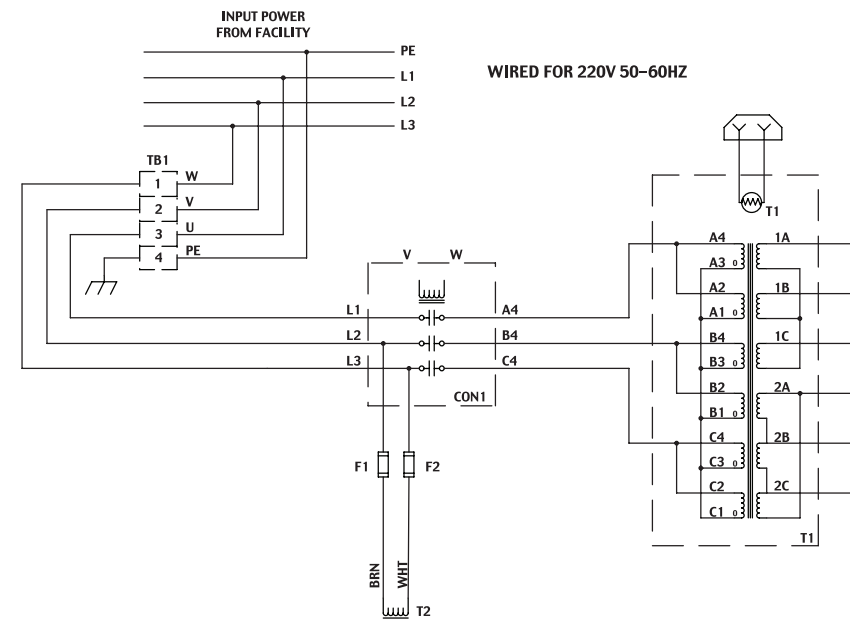
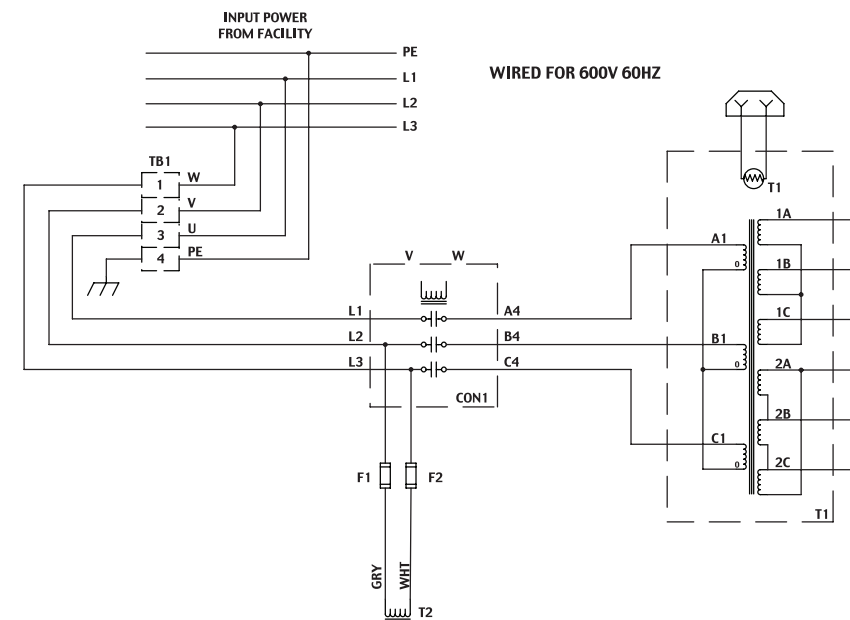
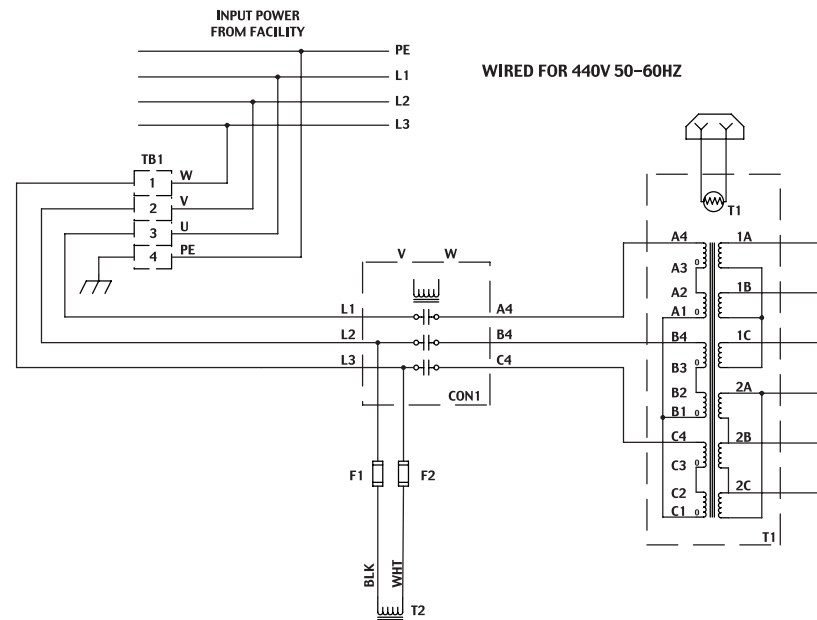


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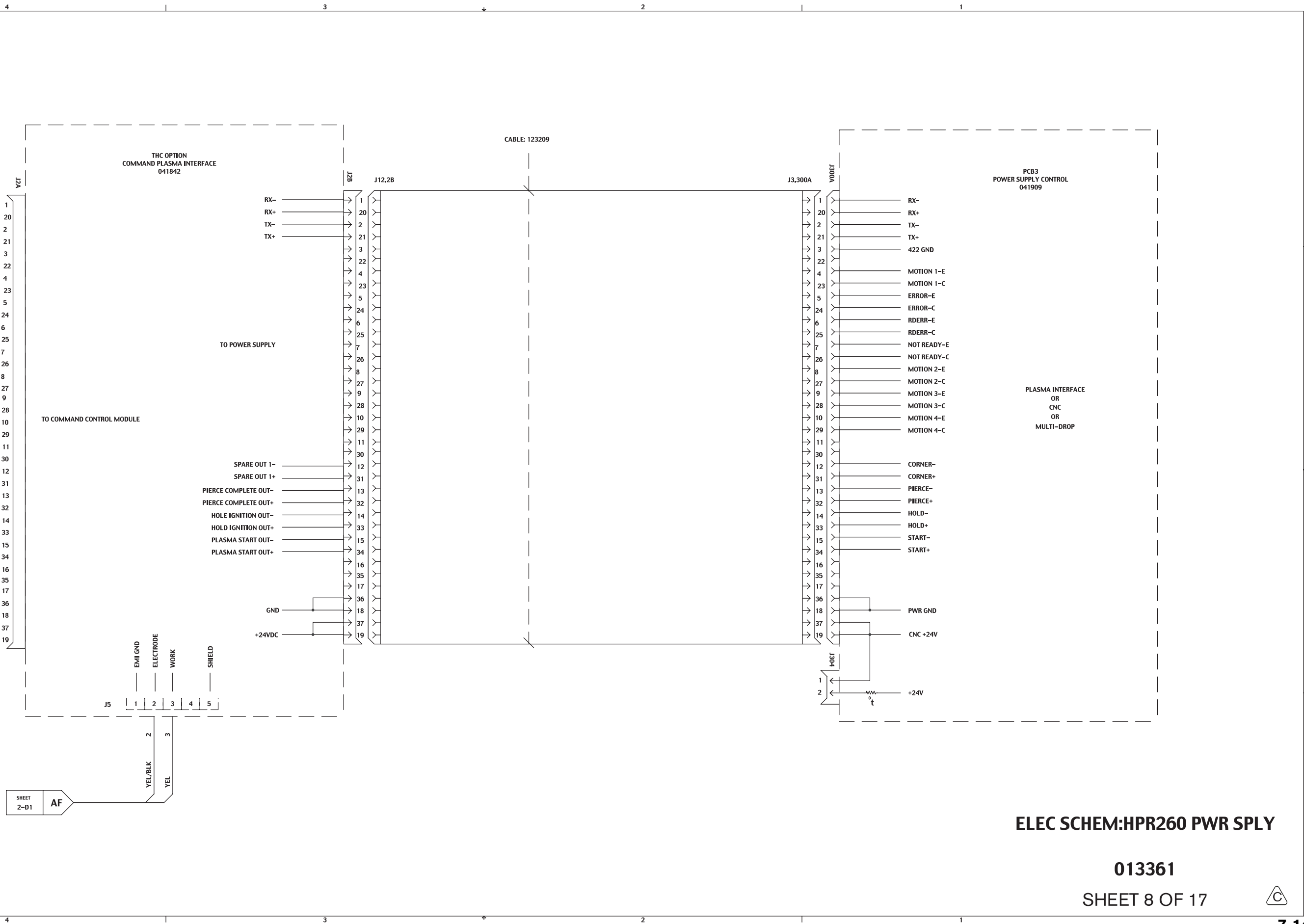


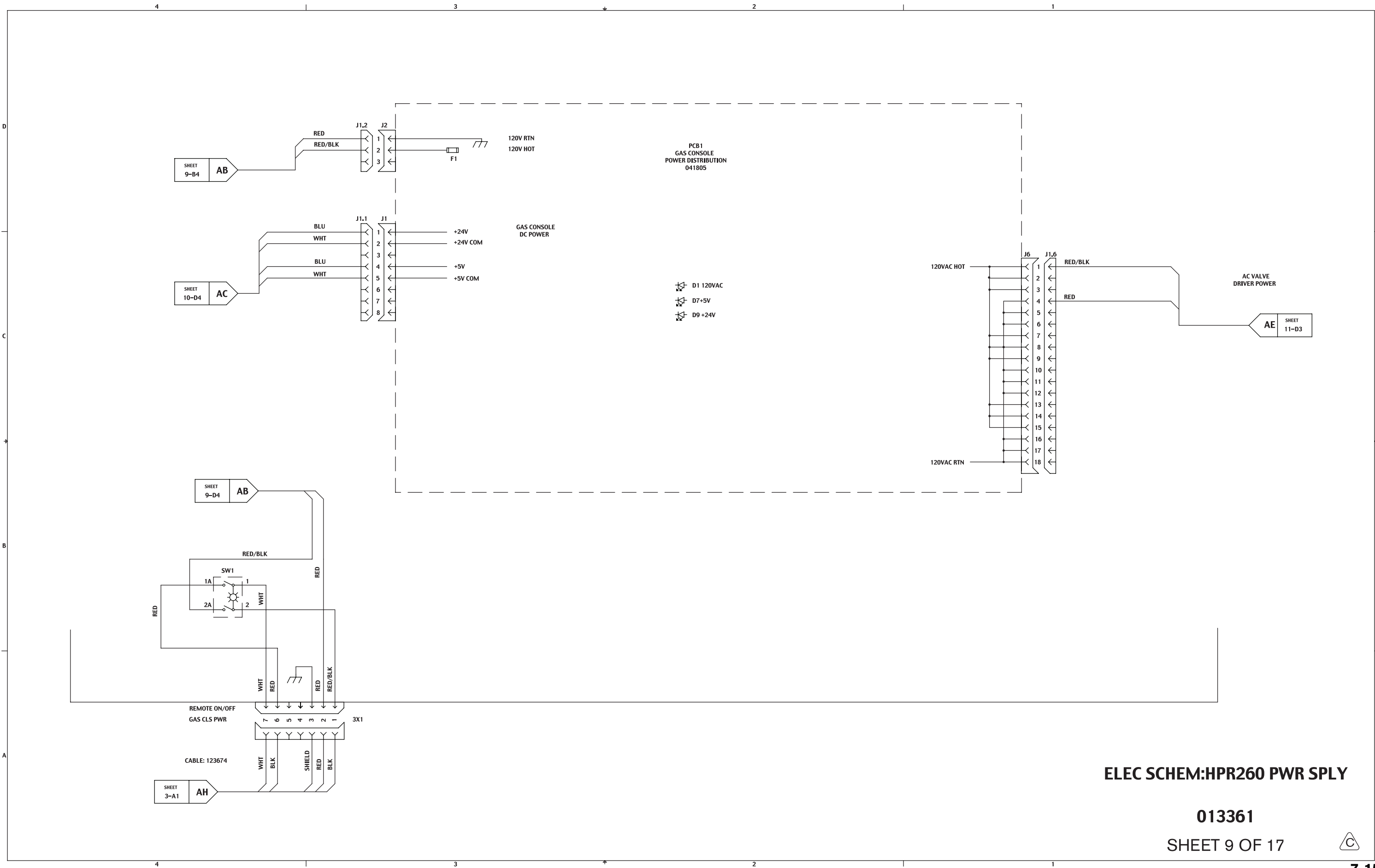
ELEC SCHEM:HPR260 PWR SPLV

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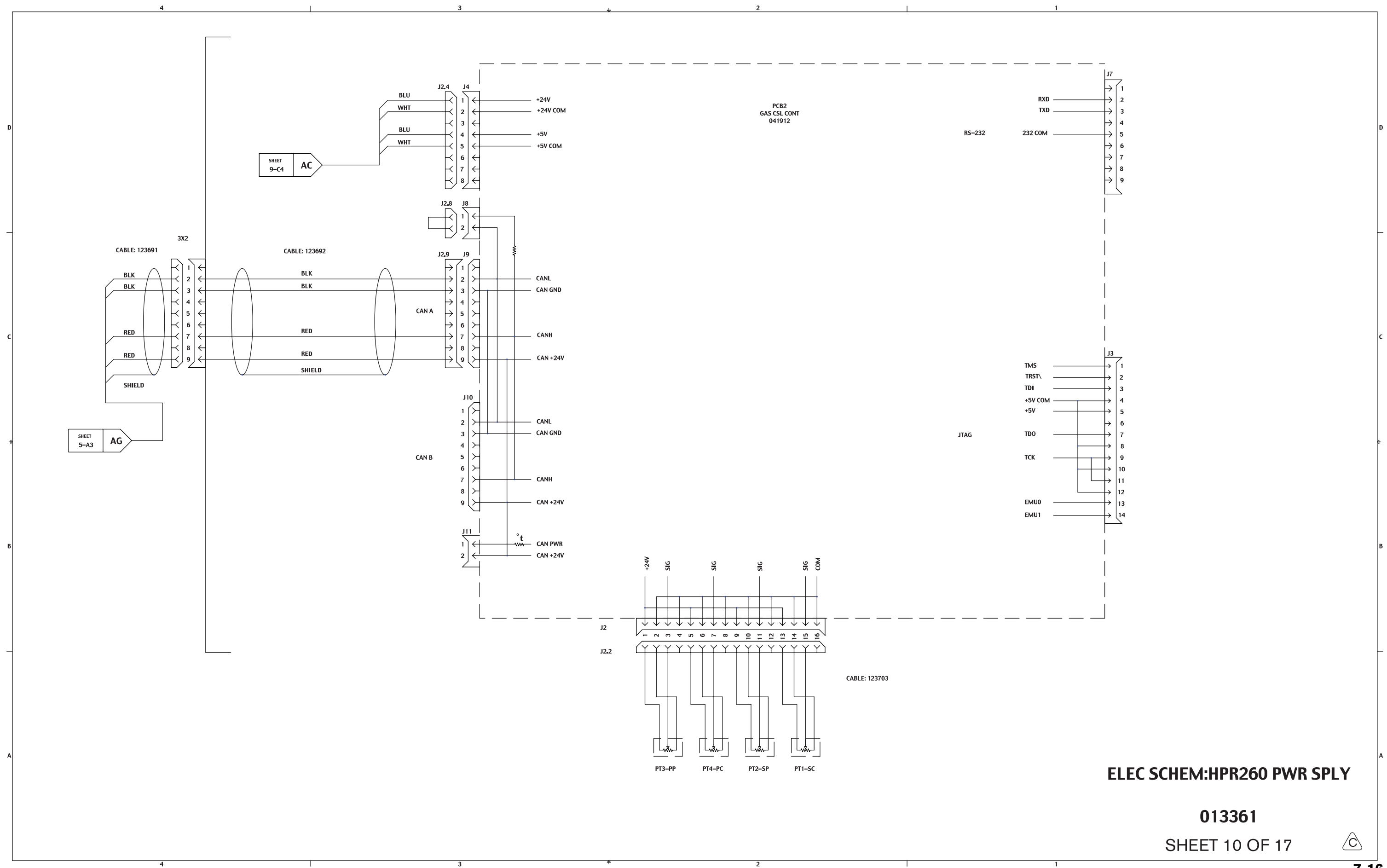


ELEC SCHEM:HPR260 PWR SPL

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SHEET 9 OF 17



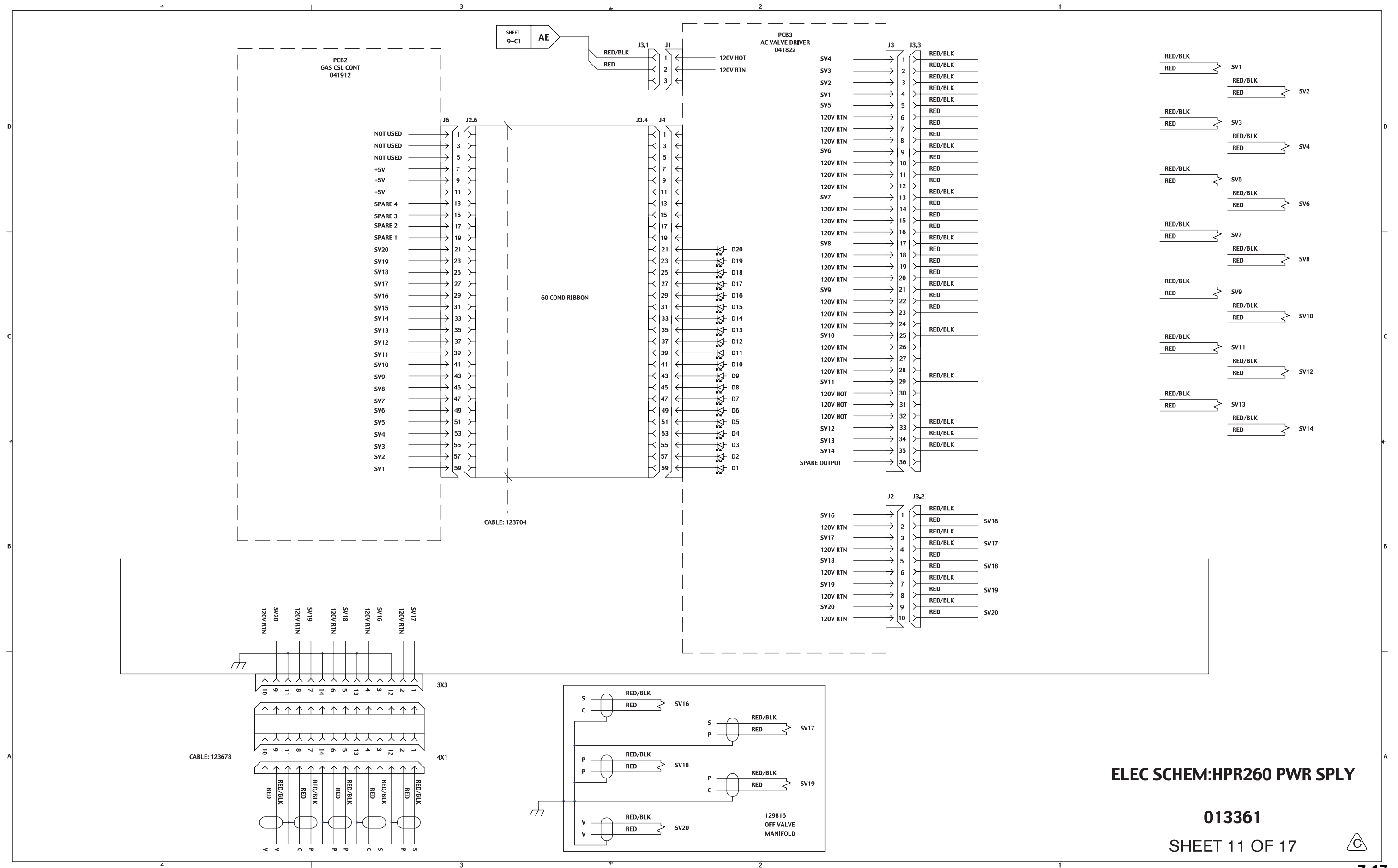


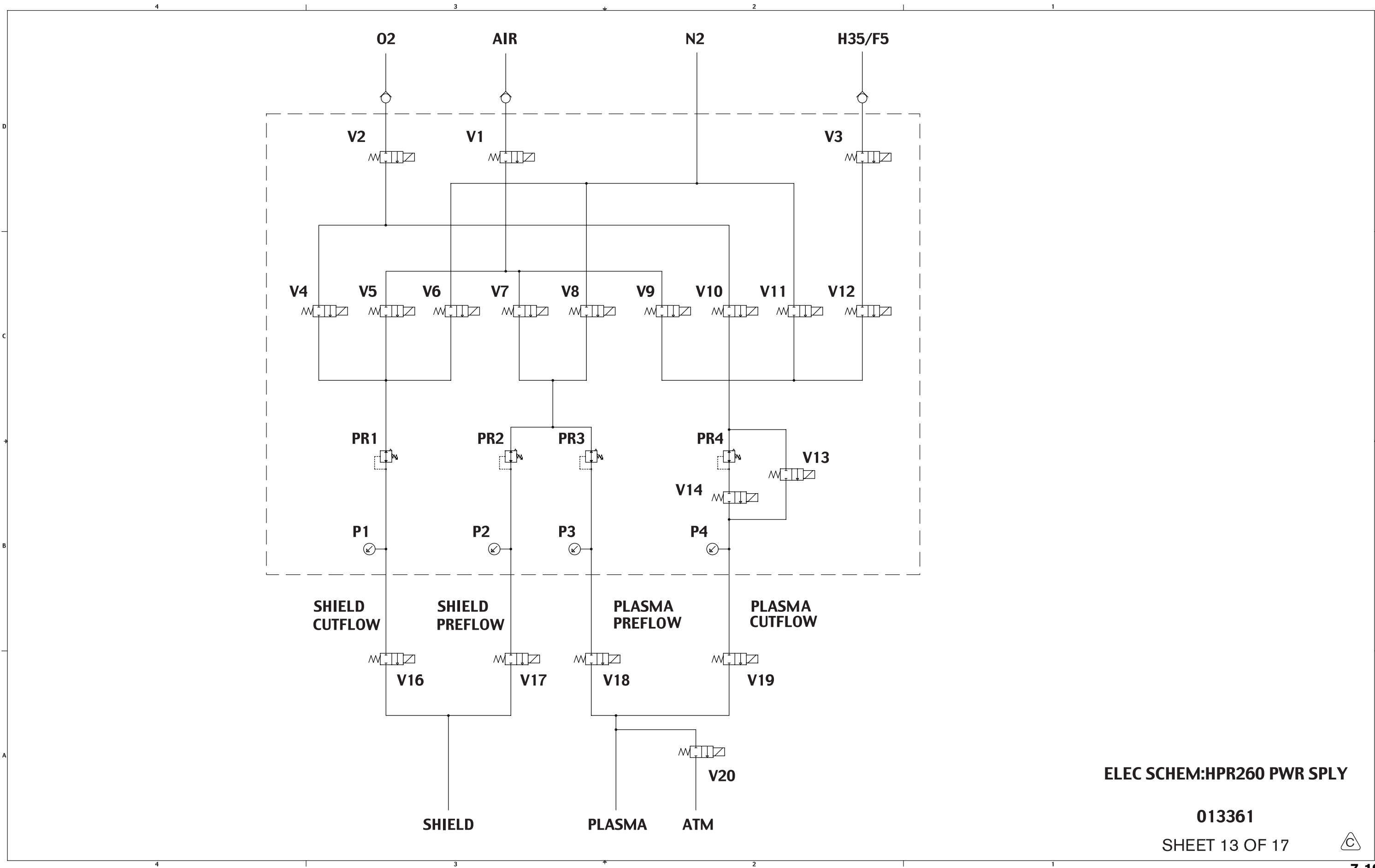
ELEC SCHEM:HPR260 PWR SPL

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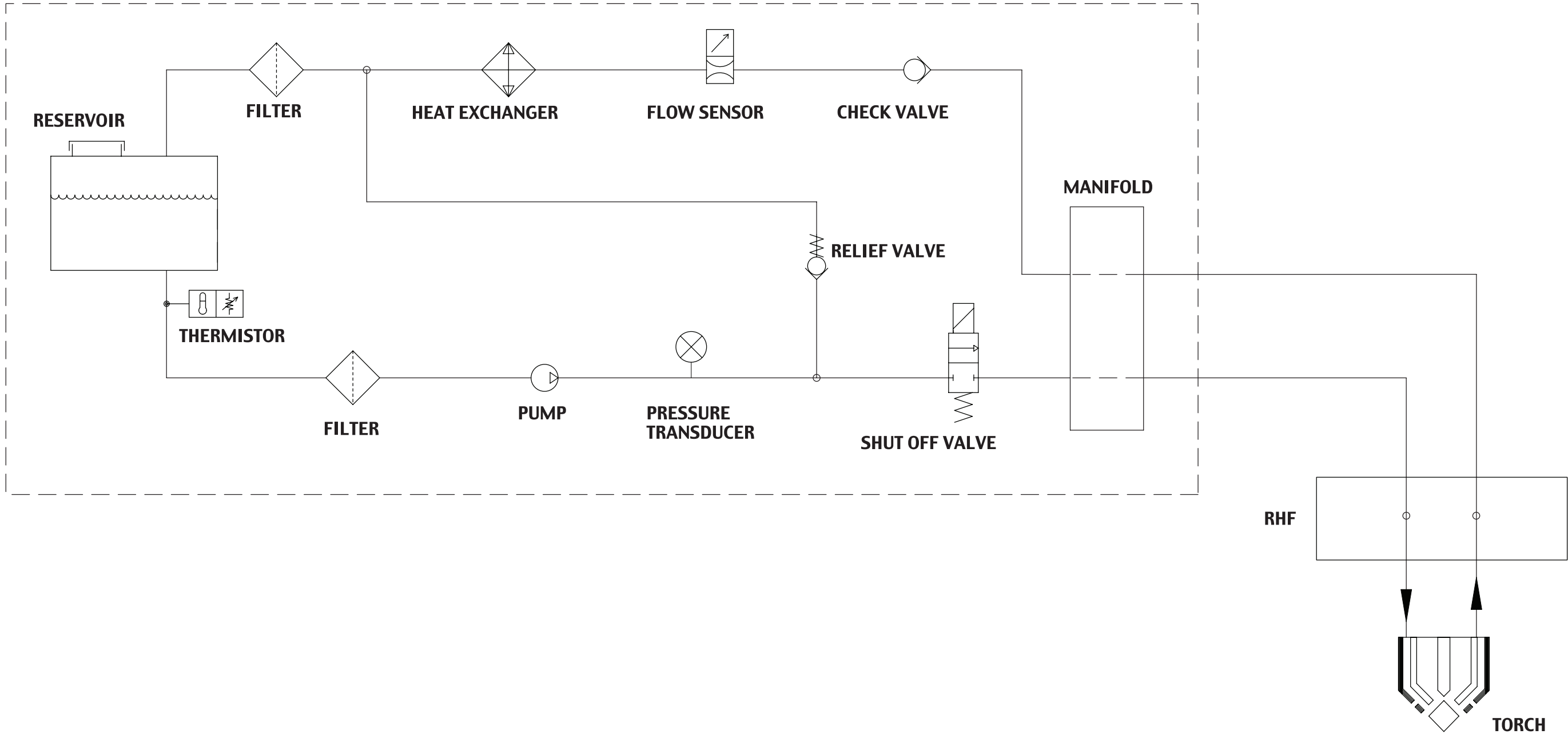


ELEC SCHEM:HPR260 PWR SPLY

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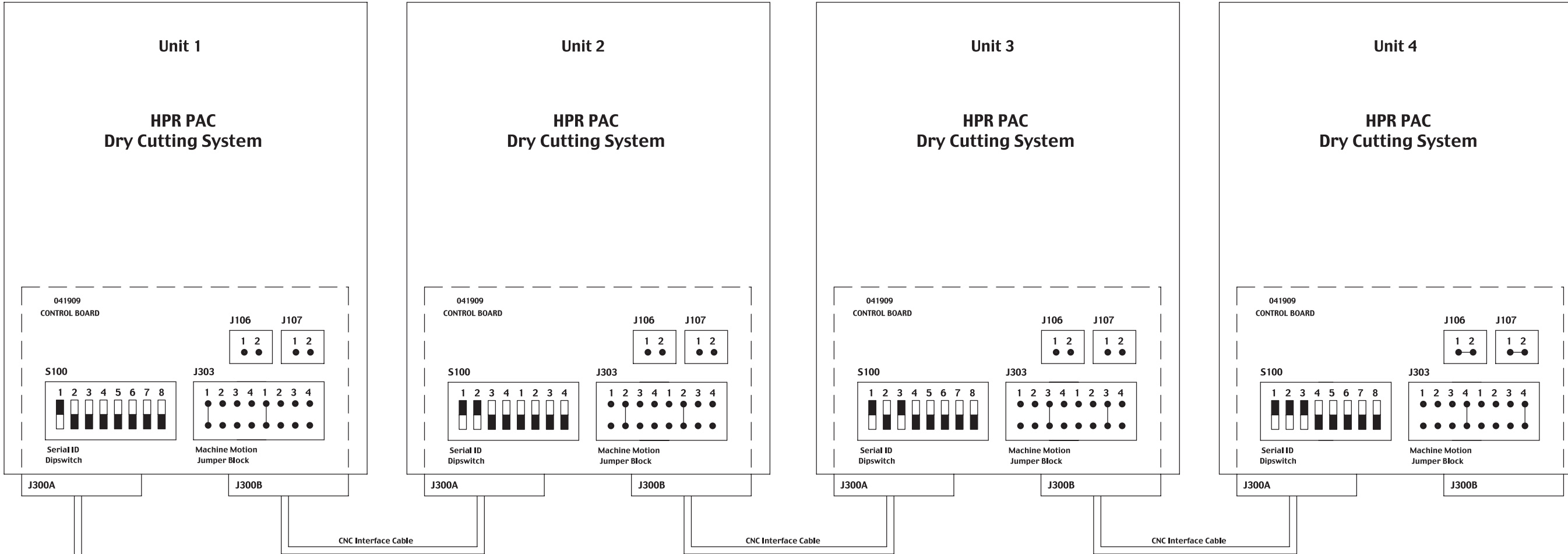


ELEC SCHEM:HPR260 PWR SPLY

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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.

Dipswitch setting example:

S100

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

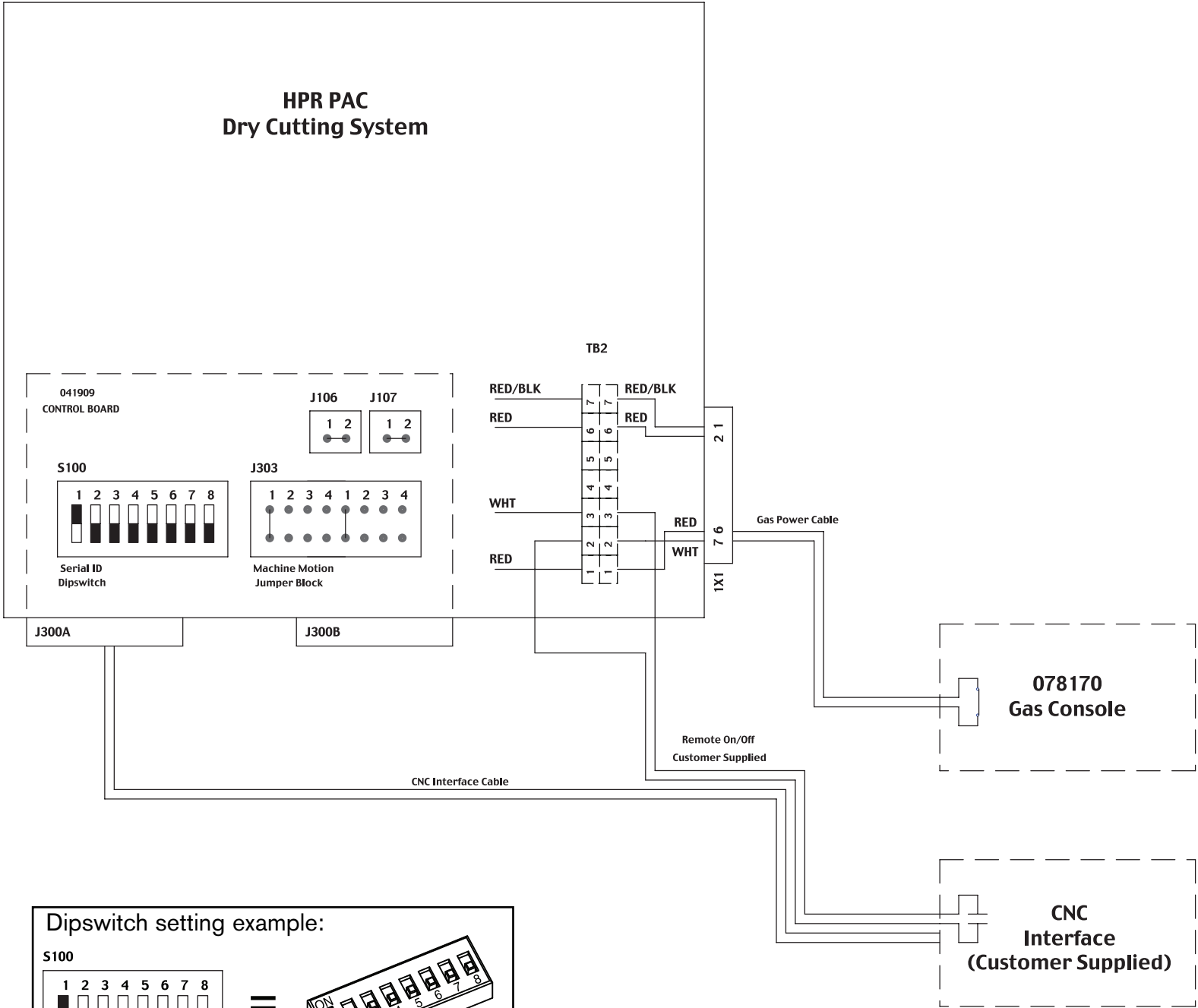
ELEC SCHEM: HPR260 PWR SPLY

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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)



Dipswitch setting example:

S100

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

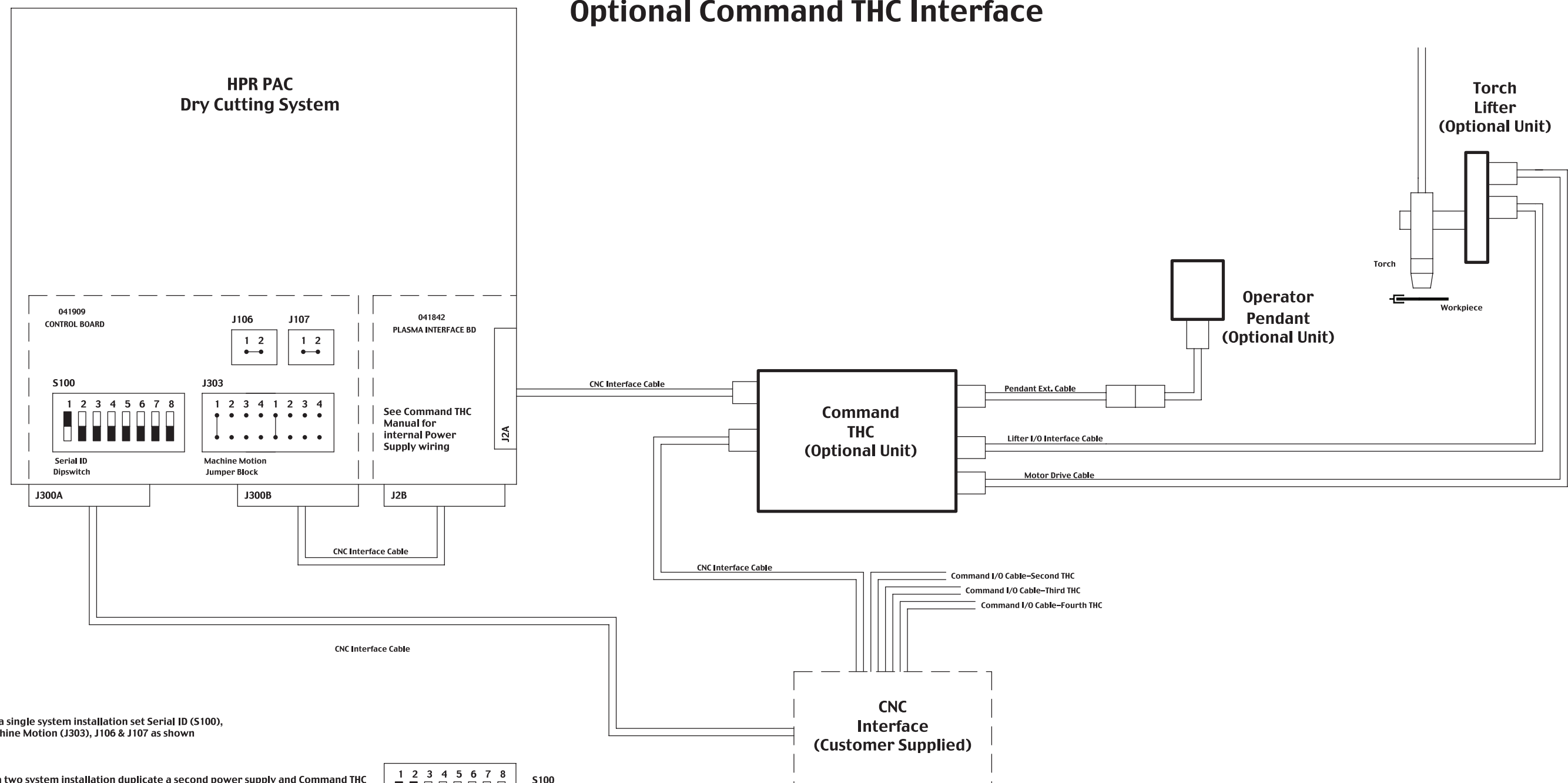
ELEC SCHEM:HPR260 PWR SPL

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SHEET 16 OF 17

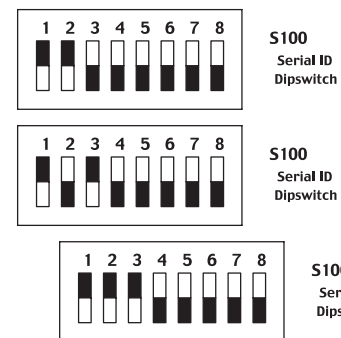


Optional Command THC Interface

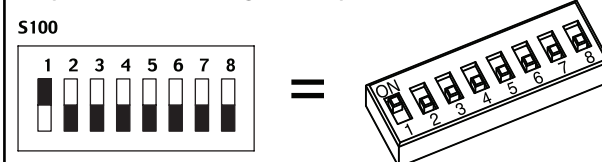


Notes:

- 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



Dipswitch setting example:



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

ELEC SCHEM: HPR260 PWR SPLY

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HYPERTHERM TORCH COOLANT SAFETY DATA

In this section:

Section 1	Chemical Product and Company Identification	a-2
Section 2	Information on Ingredients	a-2
Section 3	Hazards Identification.....	a-2
Section 4	First Aid Measures	a-3
Section 5	Fire Fighting Measures	a-3
Section 6	Accidental Release Measures.....	a-3
Section 7	Handling and Storage	a-3
Section 8	Exposure Controls / Personal Protection	a-4
Section 9	Physical and Chemical Properties	a-4
Section 10	Stability and Reactivity.....	a-4
Section 11	Toxicological Information	a-4
Section 12	Ecological Information.....	a-5
Section 13	Disposal Considerations	a-5
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Section 16	Other Information	a-5
	Freezing Point of Propylene Glycol Solution.....	a-6

MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME	Hypertherm Torch Coolant

Latest Revision Date	09-02-2004
----------------------	------------

EMERGENCY TELEPHONE NUMBERS

ISSUE DATE	03-10-2005
------------	------------

Product Information: (603) 643-3441

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

SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Component	CAS No.	% by wt.	EXPOSURE LIMITS		R Phrases
			OSHA PEL	ACGIH TLV	
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 disposal 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; Daphnia 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

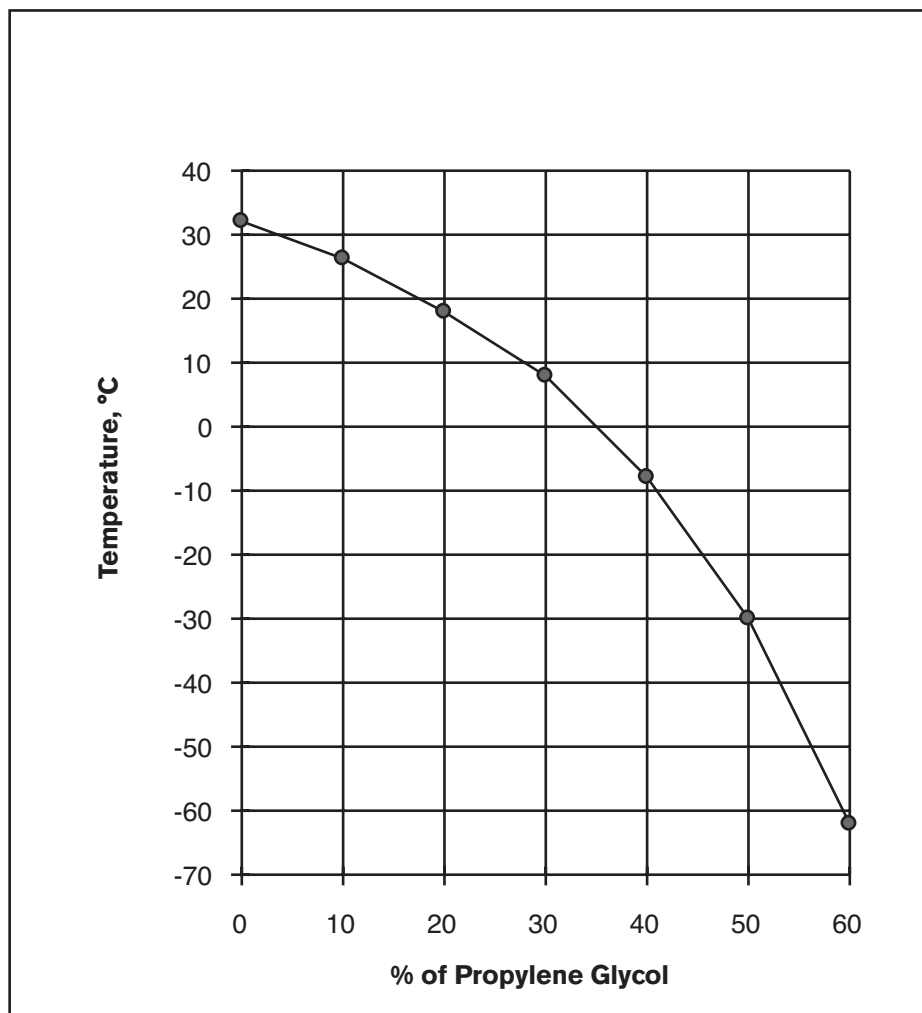
1.	Labeling Information	Irritant
2.	R Phrases	R 36/37/38, 22
3.	S Phrases	S 24/25, 26
4.	EI NECS No.	Not listed
5.	EC annex 1 Classification	Nil.
6.	German WGK	–

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

FUNCTIONAL DESCRIPTION OF SOFTWARE

I. Power-up

- a. Processor boots in microprocessor mode and begins to execute code in external flash memory.
- b. Limited initialization of digital-signal processing (DSP) hardware.
- c. Calculate checksum on external flash and on DSP internal flash.
 - If checksums don't match, copy code in external flash to internal flash.
- d. Jump to internal flash and start execution.

II. Initialization

- a. Full initialization of DSP hardware.
- b. Read EEPROM for previous current setpoint.

III. Main loop

- a. Check for serial messages from the internal UART.
 - If valid message is received, parse the message and take action.
- b. Check for serial messages from the external UART.
 - If valid message is received, parse the message and take action.
- c. Check for CAN message.
 - If CAN message has arrived, parse the message and take action.
- d. Check for error conditions every 10 milliseconds.
- e. Refresh data from gas console (i.e. pressures) every 250 milliseconds.
- f. Update the chopper control loop every 26 microseconds.
- g. If an error has occurred, take action.
- h. Update analog inputs.
- i. If current setpoint has changed, update the data in the EEPROM.
- j. If inlet gases change, perform a purge cycle.
- k. Descriptions of machine states
(Numbers listed below do not correspond to actual state numbers.)
 1. Idle
 - Outputs are off.
 - Chopper setpoints = 0.
 - 6-second delay for other processors to initialize.

- After delay, wait for CAN watchdog message from the gas console.
- After CAN watchdog messages have been received, send a CAN reset message to the gas console and go to the Purge state.

Error checking

- Verify that Start signal is off (050).
- Check for coolant flow at power-up (109).
- Check for no chopper current (102).
- If no CAN watchdog message after 6-second delay, report error "UNKNOWN GAS CONSOLE" (133).

2. Purge

- Turn on coolant pump or motor.
- Gas console runs preflow gases for 12 seconds.
- After preflow cycle is done, verify coolant flow.
- Gas console runs cutflow gases for 12 seconds.
- Verify that the Plasma Start signal is off before going to Idle2 state.

Error checking

- If coolant flow rate is less than 1.1 lpm (0.3 gpm) (093), shut down the system.
- If coolant flow rate is less than 2.2 lpm (0.6 gpm) (060), continue pumping coolant until flow is above 2.2 lpm (0.6 gpm), with no start allowed at this time.

3. Idle2

- If Start signal is active, the gas console goes into Preflow state, the contactor and the soft-start controller turn on, and system goes into Preflow state.
- If the gas console or serial interface requests a state change, take action.
- After more than 10 seconds since the last Start signal, turn off the contactor and soft-start controller.

Error checking

- Check for coolant flow at power-up (093)
- Check for no chopper current (102).
- Verify that all temperatures are below the specified temperature limits.

4. Preflow_IHS

- Chopper setpoint = pilot arc current.
- Wait for preflow to finish (2 seconds if contactor timeout, otherwise 0.5 seconds) and for the Hold signal to be removed.

Error checking

- Check for coolant flow at power-up (093)
- Check for over/under line voltage (047/046)
- Check for coolant over temperature (071).
- Check for chopper over temperature (065).
- Check for transformer over temperature (067).

5. Pilot Arc

- Turn on pilot arc controller and pilot arc relay.
- Pulse HF after 50-millisecond delay to allow pilot arc relay to close.

- If chopper current = $\frac{1}{2}$ of pilot arc current, turn off HF and go to Transfer state.
- If no chopper current after 10 HF pulses, go to Auto Off state with error code (020), "No pilot arc."

Error checking

- No error checking due to HF noise.

6. Transfer

- If work lead current is $>$ transfer reference current, go to Ramp-up state and turn off pilot arc controller and pilot arc relay.
- If no transfer after 500 milliseconds, go to Auto Off state with error code (021), "No arc transfer."
- If chopper current is $<$ $\frac{1}{2}$ of setpoint, turn on HF.

Error checking

- No error checking due to HF noise.

7. Ramp-up

- If Pierce-complete input is off, then switch to cutflow gases.
- Ramp-up current is based on tables.
- Once chopper current is $=$ or $>$ setpoint, go to Steady state.

Error checking

- Check for coolant flow at power-up (093)
- Check for over/under line voltage (047/046)
- Check for coolant over temperature (071)
- Check for chopper over temperature (065)
- Check for transformer over temperature (067)

8. Steady state

- If Pierce-complete input is off, then switch to cutflow gases.
- If corner-current input is on, then switch to corner-current setpoint.
- If start-signal input is off, then go to Ramp-down state.

Error checking

- Check for loss of phase (027).
- Check for coolant flow at power-up (093)
- Check for over/under line voltage (047/046)
- Check for coolant over temperature (071)
- Check for chopper over temperature (065)
- Check for transformer over temperature (067)
- If chopper current is $<$ $\frac{1}{2}$ of current setpoint, show current lost error (024).
- If work lead current $<$ $\frac{1}{2}$ of setpoint, show transfer lost error (026).

9. Ramp-down

- Do current ramp-down according to tables.
- Put gas console into Idle state or Ramp-down state according to tables.
- Once current reaches end current, go to final Ramp-down state.

Error checking

- Check for coolant flow at power-up (093)

10. Final ramp-down

- Chopper setpoints = 0

Error checking

- Check for coolant flow at power-up (093)

11. Auto-off

- Turn off pilot arc relay, pilot arc controller, HF, and machine motion outputs.
- Preflow gases run for a 10-second postflow period.
- If error has occurred, turn on CNC error output.
- If Ramp-down error has occurred, turn on CNC Ramp-down error output.
- Postflow timer and contactor timer run for 10 seconds.
- If no Start signal, go to Idle2 state.

Error checking

- Check for coolant flow at power-up (093)

12. Shut-down

- Gas console goes to Shut-down state.
- All outputs off.
- CNC error output on.
- Chopper setpoints = 0.
- Wait for reset request.

13. Reset

- Reset CAN controller.
- Initialize timers.
- Go to Idle state.

14. Test cutflow

- Gas console runs cutflow gases.
- Wait for request to go to Idle state or Test Preflow state.

Error checking

- Check for coolant flow at power-up (093)
- Check for no Start signal.

15. Test preflow

- Gas console runs preflow gases.
- Wait for request to go to Idle state or Test Cutflow state.

Error checking

- Check for coolant flow at power-up (093)
- Check for no Start signal

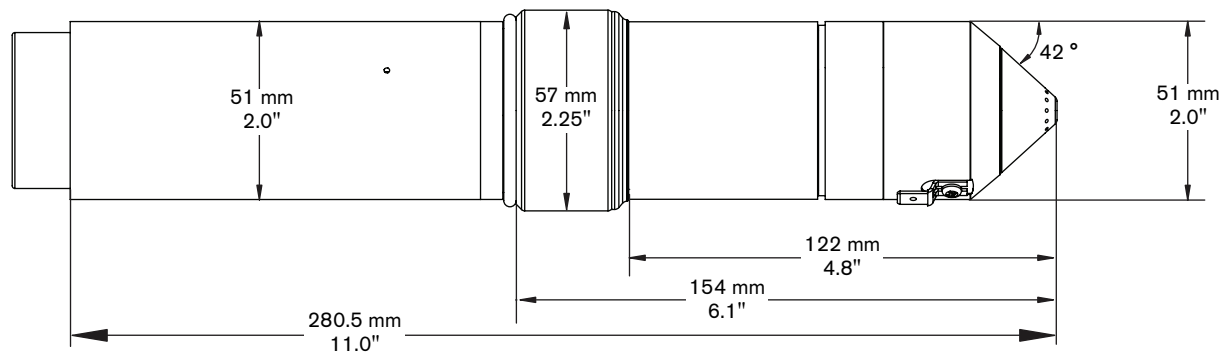
Appendix C

BEVEL CUTTING

In this appendix:

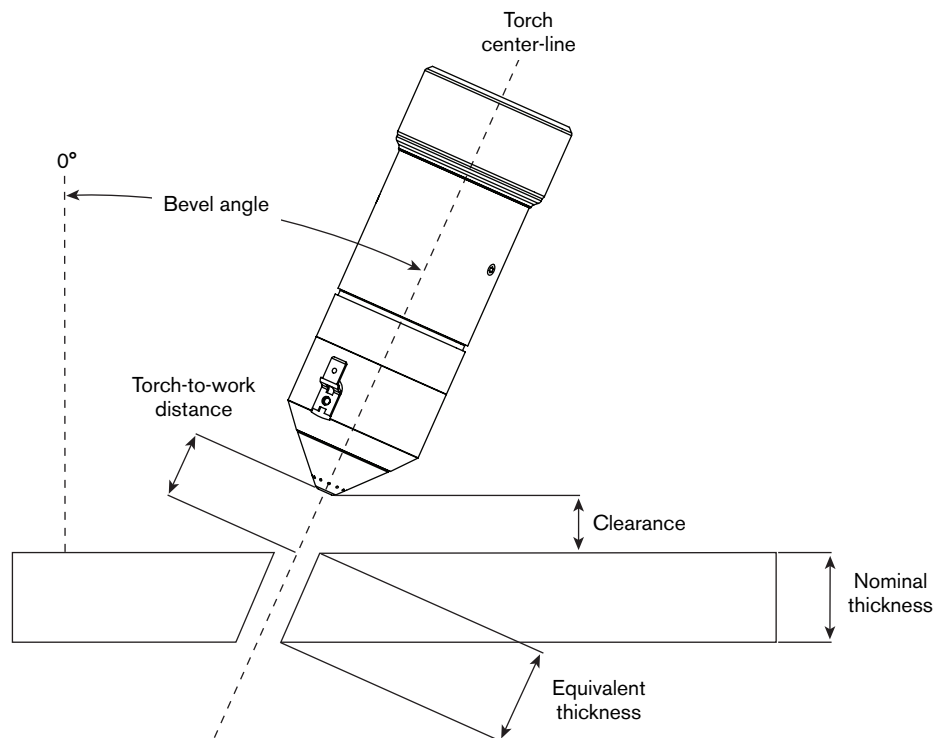
Bevel torch dimensions	c-2
Bevel cutting definitions	c-3
Cut charts	c-4
Torch connections	c-10
Connect the torch lead assembly to the quick-disconnect assembly	c-10
Parts list	c-12
Consumables	c-12
Part selection	c-13

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.



APPENDIX C – BEVEL CUTTING

Cut charts

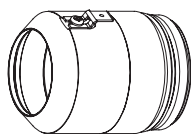
Initial pierce heights and pierce delay times listed in the cut charts are for straight cuts. Edge start indicates that the material thickness is outside the range that can be pierced. These thicknesses can only be cut by using an edge start.

Mild steel bevel cutting

O₂ Plasma / Air Shield

130 A

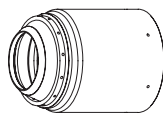
Flow rates – lpm/scfh		
	O ₂	Air
Preflow	0 / 0	64 / 135
Cutflow	33 / 70	45 / 96



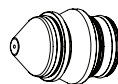
220398



220645



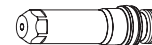
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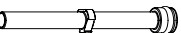
220646



220179



220649

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

Metric

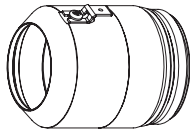
Select Gases		Set Preflow		Set Outflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	mm	mm	mm	mm/m	mm	factor %	seconds
O ₂	Air	15	23	80	30	2.0	3	2.5 – 8.6	6505	5.0	200	0.1
					4		2.8 – 8.6	5550	5.6	0.2		
					6			4035		0.3		
					10		3.0 – 8.6	2680	6.0	0.5		
					12		3.3 – 8.6	2200	6.6	0.7		
					15		3.8 – 8.6	1665	7.6	190		1.0
					20			1050				1.8
					25		4.0 – 8.6	550	Edge start			
					32		4.5 – 8.6	375				
					38			255				

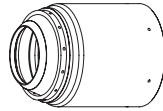
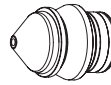
English

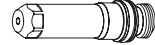
Select Gases		Set Preflow		Set Cutflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	in	in	ipm	in	factor %	seconds
O ₂	Air	15	23	80	30	0.080	0.135	0.100 – 0.340	240	0.200	200	0.1
							3/16	0.110 – 0.340	190	0.220		0.2
							1/4		150			0.3
							3/8	0.120 – 0.340	110	0.240		0.5
							1/2	0.130 – 0.340	80	0.260		0.7
							5/8	0.150 – 0.340	60	0.300	1.0	
							3/4		45		1.8	
							1	0.160 – 0.340	20	Edge start		
							1-1/4	0.180 – 0.340	15			
							1-1/2		10			

Mild steel bevel cutting
O₂ 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	24	75	70	70	2.0	6	2.8 – 7.6	6500	8.5	300	0.3
							10		4440			
							12		3850			
				75	75		15	3.6 – 7.6	3130	9.0	250	0.5
							20		2170			0.6
							22		1930			0.7
							25		1685			0.8
				80	75		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 Outflow		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	24	75	70	70	0.080	1/4	0.110 – 0.300	245	0.330	300	0.3
							3/8		180			
							1/2		145			
				75	75		5/8	0.140 – 0.300	115	0.350	250	0.5
							3/4		90			0.6
							7/8		75			0.7
							1		65			0.8
				80	75		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			

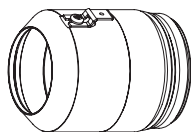
APPENDIX C – BEVEL CUTTING

Stainless steel bevel cutting

H35 Plasma / N₂ Shield

130 A

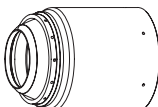
Flow rates – lpm/scfh		
	H35	N ₂
Preflow	0 / 0	90 / 190
Cutflow	26 / 54	114 / 240



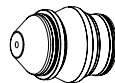
220398



220609



220608



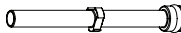
220656



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 Outflow		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	20	40	70	80	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

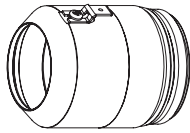
Select Gases		Set Preflow		Set Outflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	in	in	ipm	in	factor %	seconds
H35	N ₂	20	40	70	80	0.080	3/8	0.180 – 0.400	40	0.310	170	0.3
							1/2		30			0.5
							5/8		20			0.8
							3/4		15			1.3
							1		10	Edge start		

Stainless steel bevel cutting

N₂ Plasma / N₂ Shield

130 A

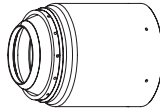
Flow rates - lpm/scfh	
	N ₂
Preflow	97 / 205
Cutflow	125 / 260



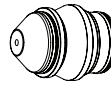
220398



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 Outflow		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	20	65	70	80	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

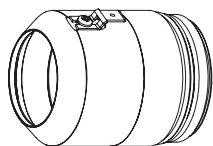
Select Gases		Set Preflow		Set Outflow		Minimum Clearance	Equivalent Material Thickness	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	in	in	ipm	in	factor %	seconds
N ₂	N ₂	20	65	70	80	0.080	1/4	0.120 – 0.400	75	0.240	200	0.3
							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			

APPENDIX C – BEVEL CUTTING

Stainless steel bevel cutting

H35 Plasma / N₂ Shield
260 A

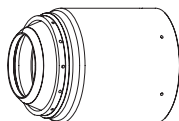
Flow rates – lpm/scfh @ 3/4" setting		
	H35	N ₂
Preflow	0 / 0	127 / 270
Cutflow	40 / 84	122 / 260



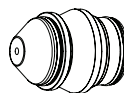
220398



220609



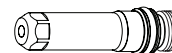
220608



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	11	75	80	88	2.0	10	11.0	1870	11.0	100	0.3	
							12	9.0 – 10.0	1710	9.0		120	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					

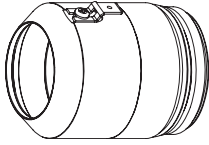
English

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	11	75	80	88	0.080	3/8	0.450	75	0.450	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				

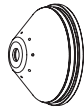
Stainless steel bevel cutting

N₂ Plasma / Air Shield
260 A

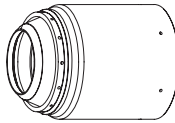
Flow rates – lpm/scfh @ 3/4" setting		
	N ₂	Air
Preflow	127 / 270	0 / 0
Cutflow	54 / 114	116 / 245



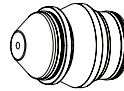
220398



220609



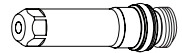
220608



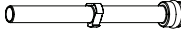
220607



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 Outflow		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	11	75	75	82	2.0	6	3.8 – 10.0	6375	7.5	200	0.3
							10		3440			
							12		2960			
							15		2520			
							20		1590			
							25		1300			
							32		875			
							38		515	Edge start		
							44		365			
							50		180			

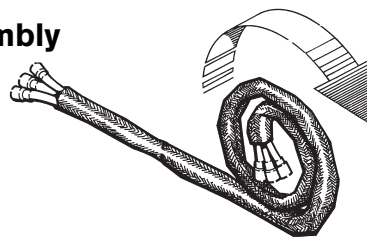
English

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	11	75	75	82	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				

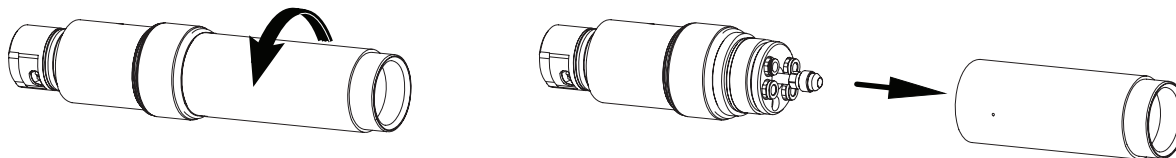
Torch connections

Connect the torch lead assembly to the quick-disconnect assembly

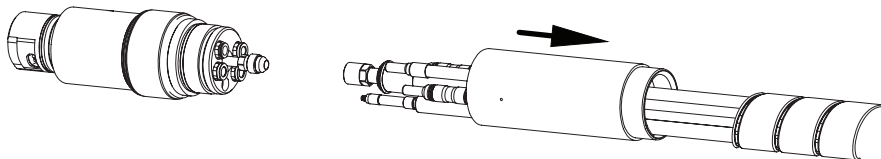
1. Uncoil the first 2 meters (6.5 feet) of lead assembly on a flat surface.



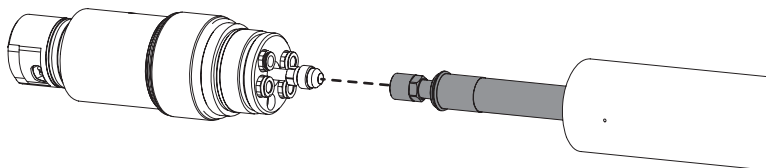
2. Hold the torch assembly and remove the mounting sleeve from the torch quick-disconnect assembly.



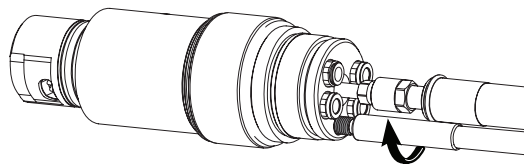
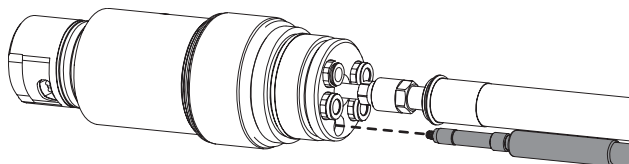
3. Slide the mounting sleeve over the leads and align the torch quick-disconnect fittings with the hoses in the lead assembly. The connections are color coded. The hoses must not be twisted and are taped together to help prevent twisting. Do not remove tape from leads.



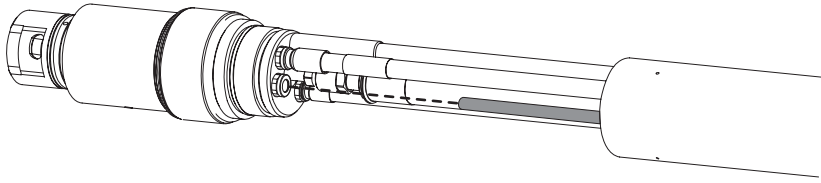
4. Connect the coolant inlet hose (green).



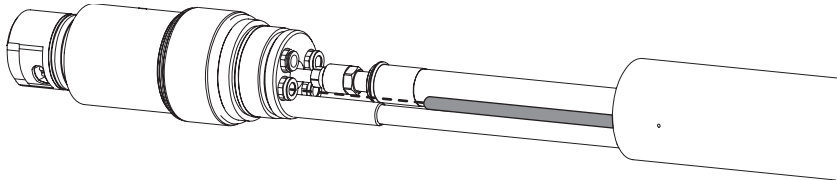
5. Connect the pilot arc lead (yellow).



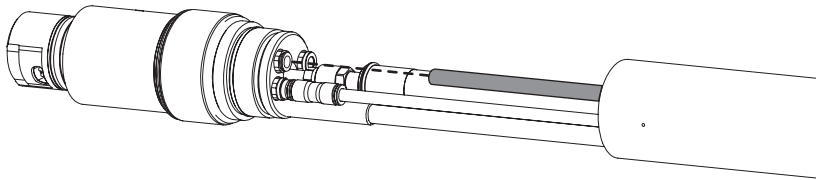
6. Connect the plasma vent hose (white).



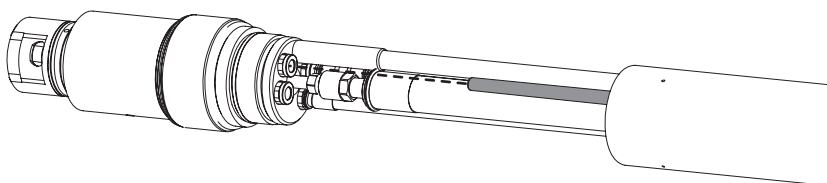
7. Connect the coolant return hose (red).



8. Connect the plasma gas hose (black).

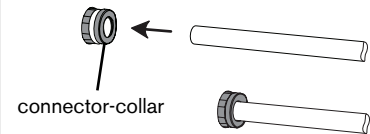


9. Connect the shield gas hose (blue).

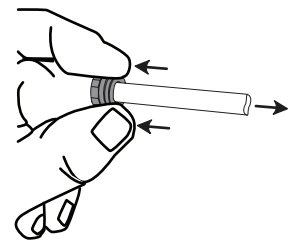


Note: The connectors in steps 6–9 are push-to-connect fittings.

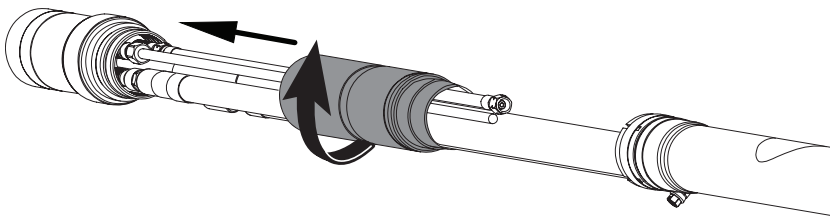
To make a connection, slide the hose fitting into the appropriate connector until it stops.



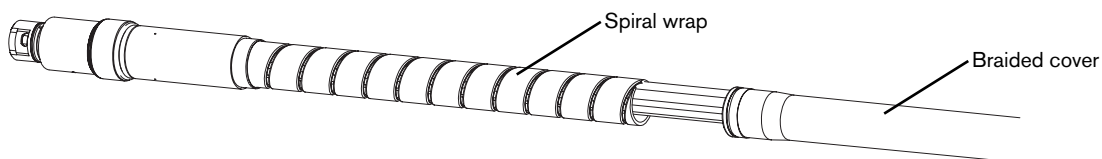
To disconnect a fitting, pull back on the connector-collar and pull out the hose fitting.



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



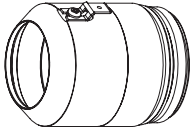
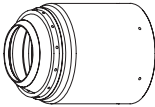
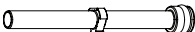
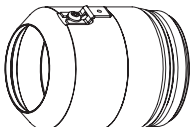
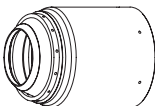
11. Slide the spiral wrap into the torch sleeve, about 50 mm (2 in). There will be a gap between the spiral wrap and the braided cover. The spiral wrap and braiding do not get clamped in place.



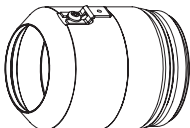
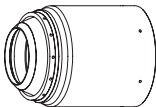
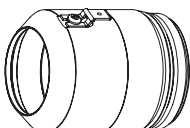
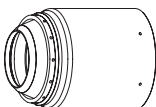
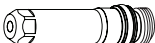
Parts list

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

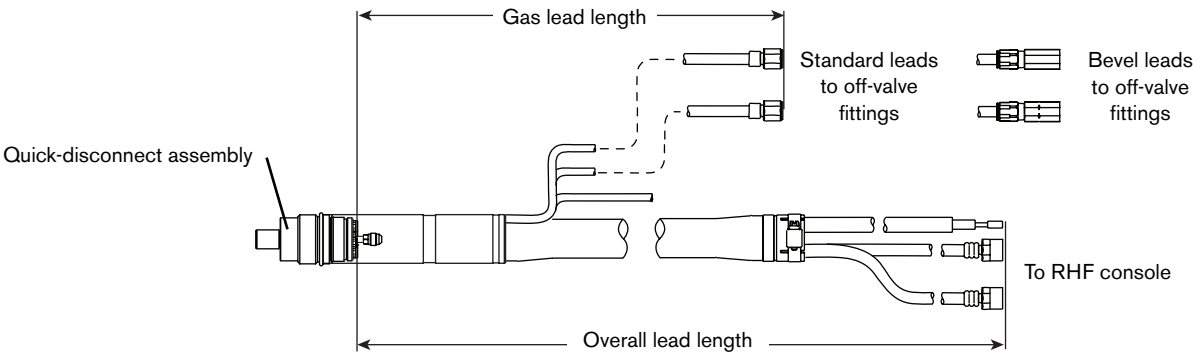
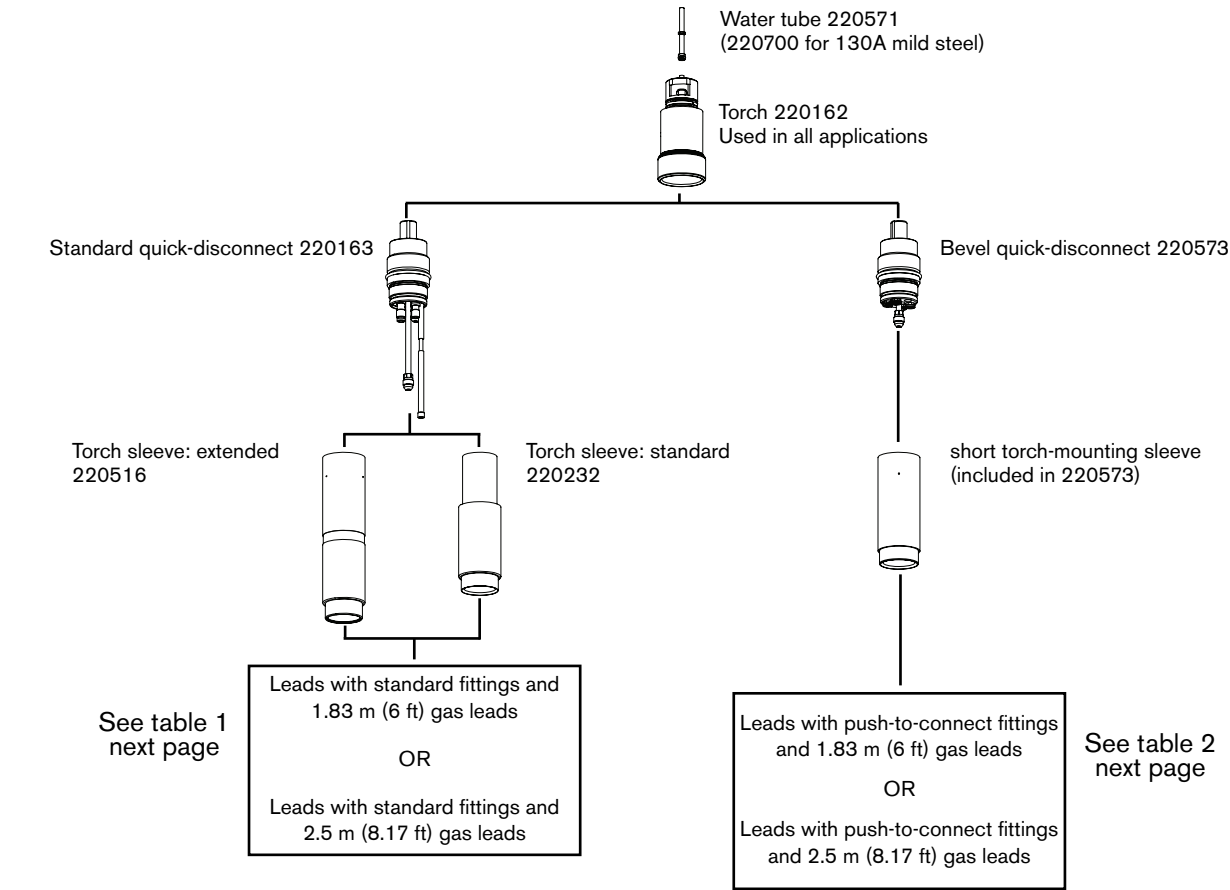
Stainless steel

	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.



APPENDIX C – BEVEL CUTTING

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 4 (date of change - 4/2008)
i - x	Updated EMC and Warranty information to the latest version and new format. 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	Changed the format of the table to include the power supply part numbers. Updated values in the power column.
2.9 and 3.15	Added a bullet point and call-out to the graphic 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." Added a third bullet point about 10 degree incline (moved from page 3-3).
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.
3.17	Added numbers (1 and 2) to the right side, bottom graphic for clarity.
3.20	Added note explaining asterisk for short cables lengths, that are used when the gas console is mounted on the power supply.
3.24	Corrected the part number for the 10 m (35 ft) CNC interface cable. It was 123314 and is was changed to 123214.
3.31	Removed reference to plastic insulator in step 4. It is no longer used.
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	Added note about main feed protection.
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.
3.42	Added a note above the caution box.
4.5, 4.9, 4.10, and 4.12	Added 50 amp consumables (4-5), kerf width compensation for 50 amp cutting (4-9), and 50 amp cut chart (4-11).
4.26	Corrected cutting speeds in the Metric cut chart. Corrected material thicknesses in the English cut chart.
5.6 – 5.7	Added "Gas system purge cycle" and "Gas system valve usage" information.
5.11 – 5.20	Added 2 pages 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.
5.41	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) to the graphic at the top of the page. Added graphics with call-outs for solenoid valves in the gas console and off-valve.
5.45 and 5.46	New chopper test.
5.54 and 5.55	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).

Changed Page	Description of change for revision 6 (date of change - 12/2007)
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), pressure transducer (item number 2 - 109524), and their designators. Changed stand alone pump and motors to kits that include the clamp.
6.7	Added designator for HFHV ignition PCB.
6.11	Changed silicone lubricant part number from 027012 to 027055. Added spanner wrench (104269).
6.12	Added 50 amp consumables.
Appendix A	MSDS appendix changed from appendix B to appendix A.
Appendix B	Software functional description changed from appendix A to appendix B.
Appendix C	Added 130 amp bevel process information.

	Revision 2 was never printed. Printed manuals went from Revision 1 to 3.
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.
3.22	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 pump if it is run with water only. The new pump can be run with water under the right conditions.
3.40	Updated tables with additional cable lengths.
4.2, 4.5, 4.6 and 6.12	Changed description from "Shield cap" to "Retaining cap" and "Retaining cap" to "Inner retaining cap".
4.4	Added "3-digit display*" description to graphic and note saying that the display is for reference.
4.8	Added bevel information referring to Appendix C.
4.9	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).
5.1, 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 5.35	Updated the graphic of the 041802 PCB.
5.30	Updated part number for firmware from 081093 to 081109.
5.41	Updated information under Cable connections (18).
6.2 and 6.5	Added 220V and 380V power supplies. (6.5) Updated part number for item number 2 (control PCB) from 041808 to 041909.
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 013361 updated to Rev C. All sheets.
Ap - C	Added Appendix C. It includes all the information about bevel consumables and parts.

8/05/05

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)
4.10-4.30	All marking cut charts updated.
5.7-7.12 (General)	Added Metric units where needed in the troubleshooting tables.
5.11	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".
5.19	Removed "and strainer" from heading. There is no strainer in the cooling system.
5.39 and 5.40	Corrected the numbering of the checklist. It used to go from number 4 to number 6.
6.2	Added /208 to the description for part number 078187.
6.5	Added /208 to the description for part number 129786.