MAX100®

380-415V CE

Plasma Arc Cutting System

Instruction Manual
802720 - Rev. 1

CE
EN50199
EN50192

Hypertherm®
The world leader in plasma cutting technology

MAX100®
380-415V CE

Plasma Arc Cutting System

Instruction Manual
IM-272
(P/N 802720)

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ELECTROMAGNETIC COMPATIBILITY (EMC)

EMC INTRODUCTION

This plasma cutting equipment has been built in compliance with standard EN50199. To ensure that the equipment works in a compatible manner with other radio and electronic systems, the equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

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

This plasma equipment should be used only in an industrial environment. It may be difficult to ensure electromagnetic compatibility in a domestic environment.

INSTALLATION AND USE

The user is responsible for installing and using the plasma equipment according to the manufacturers 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 should be connected to the mains supply according to the manufacturers 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 should be routinely maintained according to the manufacturers 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 manufacturers instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting Cables

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

Equipotential Bonding

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

Earthing of Workpiece

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

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

Screening and Shielding

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

WARRANTY

ATTENTION

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Use of other than genuine Hypertherm parts may be cause for invalidation of the Hypertherm warranty.

GENERAL

HYPERTHERM, Inc. warrants that Products shall be free from defects in materials and workmanship, under proper and normal use for which such Equipment is recommended, for a period of two (2) years, except only with respect to the Torch, for which the warranty period shall be one (1) year, from the date of its delivery to you.

HYPERTHERM, at its sole option, shall repair, replace, or adjust, free of charge, any 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, all costs, insurance and freight prepaid, and which examination proves not to be free from defects in materials and workmanship. HYPERTHERM shall not be liable for any repairs, replacements, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with HYPERTHERM's written consent. This warranty shall not apply to any Product which has been mishandled, incorrectly installed, modified or assembled by you or any other person. HYPERTHERM shall be liable for breach of this warranty only if it receives written notice of such breach within the applicable warranty period specified herein above. THE FOREGOING SHALL CONSTITUTE THE SOLE REMEDY TO DISTRIBUTORS OR THEIR CUSTOMERS FOR ANY BREACH BY HYPERTHERM OF ITS WARRANTY.

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 agrees to indemnify, protect and hold harmless Distributors and their customers against any and all liability or claims in any manner imposed upon or accruing against Distributors and their customers because of the use in or about the construction or operation of Equipment or any design, system, formula, combination, article or material which infringes or alleges to infringe on any patent or other right. Distributors shall notify HYPERTHERM promptly upon learning of any action or threatened action in connection with any such alleged infringement, and each party may appoint its own counsel for any such action or threatened action.

DISCLAIMER OF OTHER WARRANTIES

HYPERTHERM MAKES NO WARRANTIES REGARDING PRODUCTS MANUFACTURED BY IT OR OTHERS (INCLUDING WITHOUT IMPLIED LIMITATION WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), EITHER EXPRESS OR IMPLIED, EXCEPT AS PROVIDED HEREIN. This warranty is in lieu of any and all warranties, express or implied, by law or otherwise; and Distributors are not authorized to give any other warranty purporting to be binding upon HYPERTHERM upon resale of Products to their customers. IN NO EVENT shall HYPERTHERM be liable for incidental or consequential damages or injury to the person or property of anyone by reason of any defect in any Equipment sold hereunder.

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Section 1 SAFETY

In this section:

Before using this plasma arc system. . . .

Each person who will operate this equipment, perform service or maintenance, or supervise its use must read the safety instructions and warnings in this manual and the labels on the equipment.

About Notes, Cautions and Warnings

Notes: Throughout this manual, useful information for operating the plasma system is presented in "notes", such as shown in this paragraph.

Cautions: Information in bold type and surrounded by a box describes a situation that may cause damage to the plasma system.



WARNINGS



Warnings describe situations that present a physical danger to the operator, and advice to avoid or correct the situation. Each type of warning includes applicable danger symbols, such as a hand burn, electrical shock, fire, explosion, etc.

WARNING — Instant-On Torches

Instant-on torches produce a plasma arc immediately after the torch switch is pushed.

Always hold a hand torch away from your body as a precaution against accidental torch firing. Be aware of this hazard, which has potential for serious bodily injury.

WARNING — Electric Shock

- **Never touch the torch body, workpiece or the water in a water table when operating the plasma system.**
- **When using a water table, be sure that it is correctly connected to earth ground.**
- **Operating the plasma system completes an electrical circuit between the torch and the workpiece and anything touching the workpiece. The workpiece is part of the electrical circuit.**

Eye Protection

- Wear dark safety glasses or goggles with side shields, or a welding helmet, in accordance with applicable national or local codes, to protect eyes against the plasma arc's ultraviolet and infrared rays.

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

- Replace the glasses, goggles or helmet when the lens becomes pitted or broken.
- Warn other people in the area not to look directly at the arc unless they are wearing glasses, goggles or a helmet.
- Prepare the cutting area in a manner that reduces the reflection and transmission of ultraviolet light:
  - Paint walls and other surfaces with dark colors to reduce reflection.
  - Install protective screens or curtains to reduce ultraviolet transmission.

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 which covers all exposed areas.
  - Cuffless trousers to prevent entry of sparks and slag.

Toxic Fume Prevention

- Keep the cutting area well ventilated.
- Remove all chlorinated solvents from the cutting area before cutting. Certain chlorinated solvents decompose when exposed to ultraviolet radiation to form phosgene gas.
- Wear proper breathing mask and use proper ventilation when cutting galvanized metal.
- Do not cut containers with toxic materials inside. Clean containers that have held toxic materials thoroughly before cutting.

WARNING — Toxic Fumes

Do not cut metal or painted metals containing zinc, lead, cadmium or beryllium unless the operator, or anyone else subjected to the fumes, wears respiratory equipment or an air-supplied helmet.

Fire Prevention

- Make fire extinguishers available in the cutting area.
- Remove combustible material from the immediate cutting area to a distance of at least 35 feet (10 m).
- Quench freshly cut metal or allow metal to cool before handling it or bringing it into contact with combustible materials.
- Never use a plasma system to cut containers with potentially flammable materials inside. Such containers must be thoroughly cleaned prior to cutting.
- Ventilate potentially flammable atmospheres before cutting with a plasma system. When cutting with oxygen as the plasma gas, an exhaust ventilation system is required.
- Never operate the plasma system in an atmosphere which contains heavy concentrations of dust, flammable gas or combustible liquid vapors unless properly vented.

Electric Shock Prevention

All Hypertherm plasma systems use high voltage (up to 280 VDC) to initiate the plasma arc. Take the following precautions when operating the plasma system:

- Wear insulated gloves and boots, and keep body and clothing dry.
- Do not stand, sit or lie on—or touch—any wet surface when using the plasma system.
- Maintain proper insulation against electrical shock. If you must work in or near a damp area, use extreme caution.
- Provide a wall-mounted disconnect switch with properly sized fuses close to the power supply. This switch allows the operator to turn the power supply off quickly in an emergency situation.
- Conform to all local electrical codes for primary wiring sizes and types.
- Inspect the primary power cord frequently for damage or cracking of the cover. Bare wiring can kill. Do not use a system with a damaged power cord. Replace a damaged power cord immediately.
- Inspect the torch leads. Replace if frayed or damaged.
- 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.

Electric Shock Prevention (continued)

- Before changing the torch parts, disconnect the main power or unplug the power supply. After changing torch parts and replacing the retaining cap, plug in the power supply again.
- Never bypass or shortcut the safety interlocks.
- Before removing a power supply cover for maintenance, disconnect the main power at the wall disconnect switch or unplug the power supply. To avoid exposure to severe electrical hazard, wait five minutes after disconnecting the main power to allow capacitors to discharge.
- Never operate the plasma system unless the power supply unit covers are in place. Exposed power supply connections present a severe electrical hazard.

Explosion Prevention

WARNING — Compressed Gas

The plasma system uses compressed gas. Observe proper precautions when handling and using compressed gas equipment and cylinders.

- Do not use the plasma system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders or any closed container.

WARNING — Hydrogen Explosion Hazard

If your system uses hydrogen, remember that this is a flammable gas that presents an explosion hazard. Keep flames away from cylinders containing hydrogen mixtures and hoses that carry hydrogen mixtures. Also, keep flames and sparks away from the torch when using argon-hydrogen as the plasma gas.

Compressed Gas Cylinders

Handle and use compressed gas cylinders in accordance with safety standards published by the U.S. Compressed Gas Association (CGA), American Welding Society (AWS), Canadian Standards Association (CSA) or applicable national or local codes.

- Never use a cylinder that leaks or is physically damaged.
- Never use a cylinder that is not upright and secured in place.
- Never move or transport a cylinder without its protective valve cover in place.
- Never use a gas cylinder or its contents for any purpose other than that for which it is intended.
- Never lubricate cylinder valves with oil or grease.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use hammers, wrenches or other tools to open stuck cylinder valves.

Pressure Regulators

- Be certain that all pressure regulators are in proper working condition.
- Never use a regulator for any gas other than that for which it is intended.
- Never use a regulator that leaks, creeps excessively or is physically damaged in any way.
- Never attempt to lubricate a regulator with oil or grease.

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.

Installing an aeration manifold on the floor of the water table is an effective way to eliminate the possibility of hydrogen detonation when cutting aluminum. Refer to the Appendix section of this manual for instructions on how to fabricate an aeration manifold.

Hoses

- Label and color-code all gas hoses in order to clearly identify the type of gas in each hose. Consult applicable national or local codes.
- Never use the oxygen hose for any gas other than oxygen.
- Examine hoses at regular intervals for leaks, wear, loose connections or other hazard.
- Replace hose that is damaged in any way.

Hoses (continued)

- Keep hose lengths to a minimum to prevent damage, reduce pressure drop and to prevent possible flow restrictions.
- Prevent kinking by laying out hoses as straight as possible between termination points.
- Coil any excess hose and place it out of the way to prevent damage and to eliminate the danger of tripping.

Noise Protection

The plasma cutting process can generate high levels of noise. Depending on the arc current, material being cut, acoustics and size of the cutting room, distance from the torch and other factors, acceptable noise levels as defined by national or local codes may be exceeded by your plasma system.

- Always wear proper ear protection when cutting or gouging with the plasma system.

Grounding

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 properly connect the power cord ground wire. Conform to Canadian Standards Association (CSA) standards by placing the power cord 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.

Work Cable

- Attach the work cable securely to the workpiece or the work table by making 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 a high-quality earth ground, in accordance with the U.S. National Electrical Code, Article 250, Section H, Grounding Electrode System, or other appropriate national or local codes.

Safety Reminders

- Never bypass or shortcut the safety interlocks on any of the plasma system units.
- Except in Hypertherm's largest mechanized systems, all Hypertherm torches are designed with a safety interlock that prevents firing of the plasma arc when the retaining cap is loosened.
- 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 potentially dangerous situation to the operator and any personnel in the area. Hypertherm's warranty does not cover problems caused by the use of torches not made by Hypertherm.
- Use only consumable parts and replacement parts made by Hypertherm. Hypertherm's warranty does not cover problems caused by the use of parts not made by Hypertherm.
- Never operate the plasma system with any of its covers not in place. This would be hazardous to the operator and other people in the area, and prevents the proper cooling of the equipment.

Electronic Health Support Equipment

Plasma arc cutting and gouging systems create electric and magnetic fields that may interfere with the correct operation of electronic health support equipment, such as pacemakers or hearing aids. Any person who wears a pacemaker or hearing aid should consult a doctor before operating or being near any plasma system when it is in use. To minimize exposure to EMF:

- Keep both the work cable and the torch lead on one side of your body. Keep your body from coming in between the torch lead and the work cable.
- Keep distance between the work cable and the workpiece as short as possible to eliminate loop areas.
- Route torch leads as close as possible to work cable.
- Do not wrap the torch lead or work cable around your body.
- Stay as far away from the power source as possible.

Section 2 SPECIFICATIONS

In this section:

GENERAL

Hypertherm's MAX100 plasma cutting system is designed for cutting most metals from gauge to 32 mm thick. In addition to hand cutting, it can be used with a machine torch and a THC-2 Torch Height Control system (Instruction manual IM-20) for high-speed mechanized cutting.

The MAX100 provides continuously variable current output from 30 to 100 amps for optimum performance on all thicknesses of metal up to 32 mm thick. This allows the operator wide variations in cutting speeds on the same thickness of metal. Three nozzle sizes (40-amp, 80-amp and 100-amp) are provided to produce high quality cuts throughout its range of cut thicknesses.

The system provides a continuous pilot arc which allows high quality cutting of perforated or expanded metal without any appreciable deterioration in parts life. This feature is only available for use with the small nozzle up to 40 amps of output.

Cut quality is superior and torch parts life is several times longer than any other air plasma cutting system. The unique MAX100 power supply design uses transistor technology to produce a very smooth constant current DC output.

Air is used as the primary plasma gas, providing low operating costs combined with high-speed performance. Cylinder air or shop air can be used as long as it is free of moisture, oil and particulate matter contamination. For better cut quality on metals such as stainless steel, aluminum and other non-ferrous materials, nitrogen can be used as the plasma gas. (A nitrogen electrode is the only part change required to switch from air to nitrogen.) A regulator and air filter are provided to ensure that the correct pressure and air flow are supplied to the system at the proper quality.

PRODUCT SPECIFICATIONS

MAX100 Power Supply

The MAX100 is a constant current, secondary converter chopper power supply providing continuously variable amperage from 30 amps to 100 amps. It conforms to the following specifications:

SPECS

Maximum OCV ..... 280 VDC

Output Current ..... 30-100 Amps

Output Voltage ..... 150 VDC

Duty Cycle Rating ..... 80% at 15 KW, 40° C (104° F)

Ambient Temperatures/Duty Cycle ..... Power supplies will operate between -10° and +40° C (+14° and 104° F). Power supplies operated in an ambient temperature above 30° C (86° F) may show some decrease in duty cycle.

Input Power:

059195 ..... 380/415V, CE/LVD, 3PH, 50 Hz

Dimensions and Weight:

Width ..... 675 mm
Height ..... 1090 mm
Depth ..... 805 mm
Weight ..... 200 kg

Gas Requirements:

Gas Type ..... Air, Nitrogen

Gas Quality ..... Clean, dry, oil-free

Gas Flow ..... 208 liters/minute

Gas Inlet Pressure ..... 4.8 bar to 8.5 bar

Gas Pressure Setting ..... 4.1 bar to 5.1 bar dynamic (flowing)

WARNING

The voltage between the tip of the torch and the workpiece will exceed 113 VDC if shielded consumable parts are not installed in the torch. The PAC130 hand torch must be operated with shielded parts to maintain the [S] mark and CE low voltage compliance for hand held applications. This requirement does not apply to machine torch applications.

PAC130 Torch

Maximum cutting thickness range	32 mm
Maximum current at 80% duty cycle	100 Amps
Gas Flow	208 liters/minute at 4.1 bar
Weight	0.462 kg

MAX100 Machine Torch

Maximum mechanized cutting	16 mm
Maximum current at 80% duty cycle	100 Amps
Gas Flow	208 liters/minute at 4.1 bar
Weight	0.604 kg

THC-2 - Optional

See IM20 (#800200) for details and instructions for the THC-2 Torch Height Control system.

Section 3 SETUP

In this section:

UPON RECEIPT

Verify that all components listed below are present. Alert your distributor if any parts are missing. All communications regarding this equipment must include the model number and serial number (located on the back of the MAX100).

PAC130 System with Hand Torch:

- MAX100 power supply with work cable (ground) and clamp
- PAC130 hand torch with torch lead assembly
- Consumable parts kit

MAX100 Machine Torch System - Machine Torch Configuration:

- MAX100 power supply with work cable (ground) and clamp
- MAX100 machine torch and torch lead assembly
- Consumable parts kit

- THC-2 Torch Height Control - optional
- Remote Start/Stop Switch - optional

Note: For detailed part number information, see the **Parts List** (**Section 6**).

CLAIMS & TECHNICAL QUESTIONS

Claims for damage during shipment — If your unit was damaged during shipment, you must file a claim with the carrier. When requested, Hypertherm will furnish you with a copy of the bill of lading.

Claims for defective merchandise — All units shipped from Hypertherm undergo rigorous quality control testing. However, if your unit does not function correctly:

1. Read *Troubleshooting* in the **Maintenance** section (**Section 5**) of this manual. You may find the problem is quite easy to fix, such a loose connection.

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

3. If you need additional assistance, contact the nearest Hypertherm Technical Service Department listed at the front of this manual.

INTRODUCTION

The following requirements must be fulfilled prior to the installation of the MAX100 plasma cutting system. Please read these requirements carefully. Their purpose is to aid you in the installation of your plasma cutting system and to allow maximum performance.

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.

For installation, operation or service questions or problems, contact the nearest Hypertherm Technical Service Department listed at the front of this manual.

GROUNDING REQUIREMENTS

The plasma system must be properly grounded to ensure personal safety, and to reduce emission of radio frequency interference.

- Connect the work table to a high-quality earth ground within 6 m of the table. A suitable ground consists of a solid copper rod of at least 13 mm diameter driven to a depth of at least 2.5 m into the earth below the permanent moisture level.
- For more information, refer to applicable national and local electrical codes.

POWER SUPPLY PLACEMENT

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

POWER REQUIREMENTS

Line Disconnect Switch

- Use a primary line disconnect switch for each power supply. This disconnect switch allows you to turn the power supply off quickly in an emergency situation. The switch should be located on a wall near the power supply, and be easily accessible to the operator. The interrupt level of the switch must be equal to or exceed the continuous rating of the fuses. The line disconnect switch fuses should be sized according to the table below:

Input Voltage	Rated Input Current	Time Lag type gG Fuse Size	Recommended Power Cord Gauge Size (mm^2)			
			to 25 m	25-50 m	50-75 m	75-100 m
380 VAC	28 A	40 A	4 mm^2	6 mm^2	10 mm^2	16 mm^2
415 VAC	26 A	40 A	4 mm^2	6 mm^2	10 mm^2	16 mm^2

Power Cables

- Power cables are supplied by the customer.
- Cable sizes vary based on the distance of the receptacle from the main box - see table above. In Europe, use a 4-conductor Harmonized ("HAR") type cord. Final specification and installation of the power cord should be made by a licensed electrician and according to applicable national or local codes. See also *Mains Supply* on page i in the front part of this manual for further power (supply) cable shielding recommendations.
- To connect power cable to power supply, see *Power Cable Connection* later in this section.

GAS SUPPLY REQUIREMENTS

The MAX100 uses air or nitrogen as the operating gas.

The gas source must be capable of delivering at least **208 liters/minute** of gas at **6.2 bar** output pressure.

Do not exceed 8.3 bar delivery pressure to the system. Exceeding this pressure will shorten life of the torch parts.

Hoses

To obtain the proper gas flow rates and pressures, use hose that meets the following specifications:

I.D.: **9.5 mm minimum**
Length: **30 m maximum**

Two different sources of air can be used to supply the MAX100: cylinder compressed air or shop compressed air:

Cylinder Compressed Air

The cylinder air supply must be clean, dry and oil-free.

CAUTION:	**Do not use the regulator supplied on the MAX100 system if compressed air cylinders are used; the pressure could exceed the capability of the regulator. See *Power Supply Gas Connections* later in this section for hookup to the MAX100.**

Shop Compressed Air

Shop compressed air must be clean, dry, and oil-free if used to supply the MAX100. Poor quality air reduces cut speeds, produces poor cut quality, and reduces parts life. See *Power Supply Gas Connections* later in this section for hookup to the MAX100.

If the shop air is not clean, refer to *Additional Filtration* later in this section, and Appendix A for recommended filter specifications. These filters are available from any industrial supplier.

Nitrogen

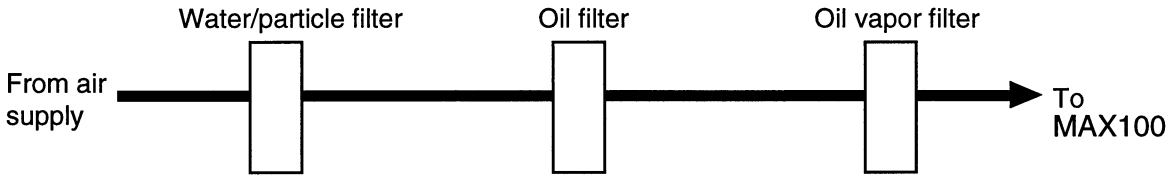
To use nitrogen as the operating gas, it must be supplied to the MAX100 at 99.995% purity. The source can be compressed gas cylinders or liquid containers. If the purity level of the nitrogen is too low, cut speeds decrease, cut quality deteriorates, cutting thickness capability decreases, and parts life shortens.

Note: These conditions also occur if there are leaks in the gas supply hoses or connections.

To connect nitrogen supply to MAX100, see *Power Supply Gas Connections* later in this section.

Additional Filtration

Use a 3-stage coalescing filtration system as shown below when site conditions introduce moisture, oil or other contaminants into the air line. See Appendix A for recommended filter specifications.



POWER SUPPLY ELECTRICAL CONNECTIONS

380/415V Linkboard Configurations

The 380/415-volt power supply is shipped from the factory linked for 380-volt operation. The links must be moved for 415-volt operation - see Fig. 3-1.

WARNING

Danger: High Voltage. Line voltage may be present on this linkboard. Disconnect input power before servicing.

1. Remove the left-side cover of the power supply, and locate the linkboard on the inside front wall.

2. Ensure that the linkboard is configured for the proper line voltage.

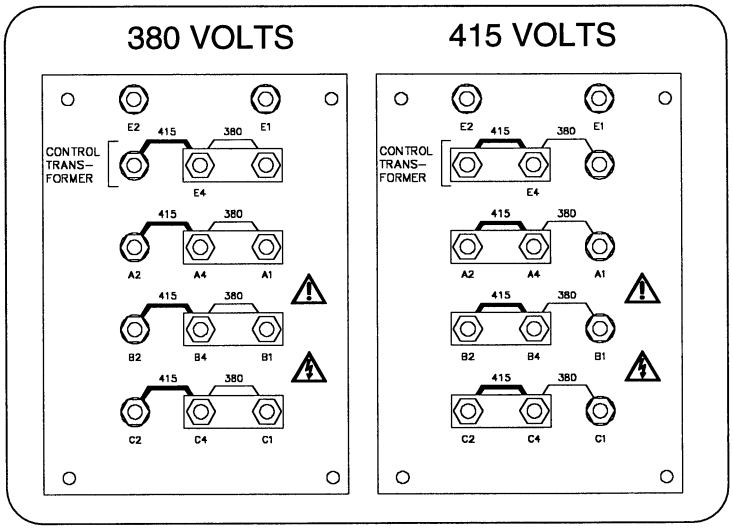


Figure 3-1 Dual Voltage 380/415-Volt Linkboard

Power Cable Connection

Power Cable to MAX100 Power Supply

1. Locate the EMI filter box on the rear of the power supply.
2. Unscrew the filter cover screws and remove the cover for access to the input voltage connections.
3. Insert the power cable through the strain relief.
4. Connect leads L1 to U, L2 to V, and L3 to W terminals of the filter (see Fig. 3-2). Ensure that all connections are tight to avoid excessive heating.
5. Connect the ground lead to rear terminal of filter marked ⏚.

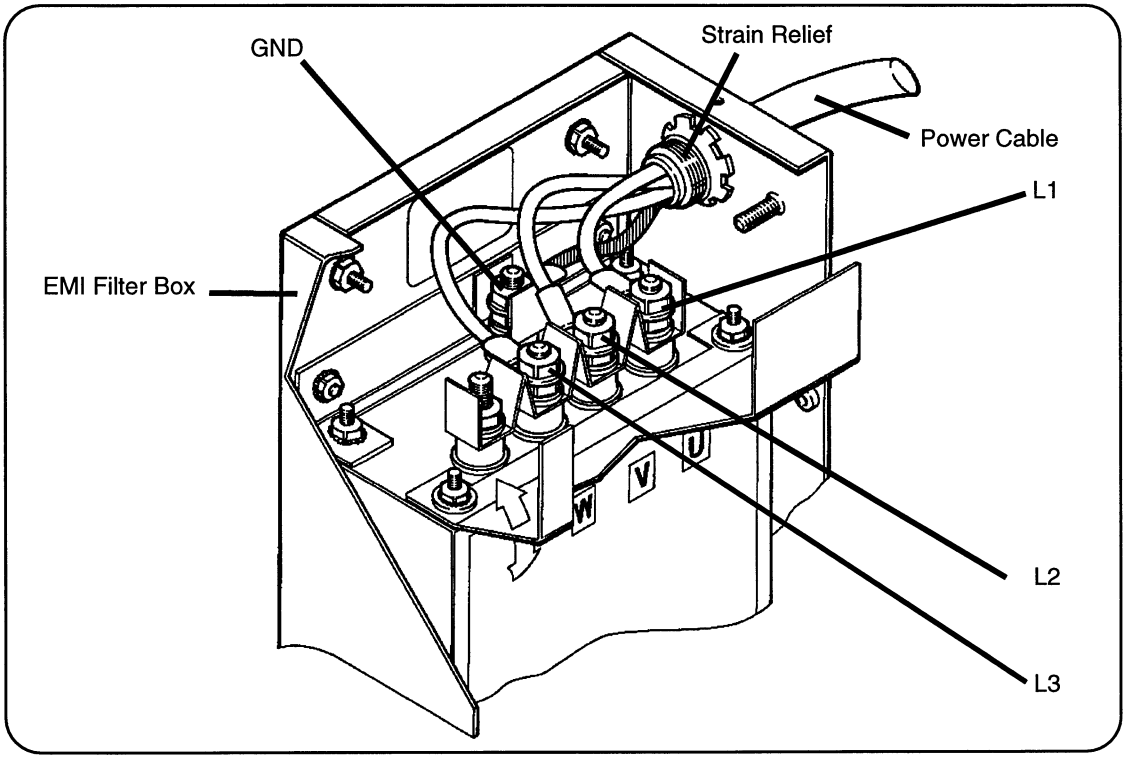


Figure 3-2 MAX100 Primary Power Connections

WARNING

There is line voltage at the filter even if the I (ON) pushbutton on the MAX100 power supply has not been pressed. <u>As a common safety practice, ALWAYS verify that the line disconnect switch is in the OFF position before installing, disconnecting or servicing in this area.</u> In the U.S., use a "lock-out / tag out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.

Power Cable Connection (Continued)

Power Cable from MAX100 Power Supply to Power Source

1. **Be certain that the line disconnect switch is in the OFF position.**

2. Connect the power cord leads to the line disconnect switch. Follow applicable national or local electrical codes.

3. **Be certain that the line disconnect switch remains in the OFF position during the rest of the setup of the MAX100 system.**

Remote Start/Stop Switch (Optional)

To connect the remote start/stop switch:

1. Pass the remote start/stop switch cable assembly through the strain relief at the rear of the MAX100.

2. Connect wires 33 and 34 to TB1-5 and TB1-6 for machine "start." (See Fig. 6-3 for location of TB1, and Fig. 3-3 for detail of TB1.)

3. Connect wires 37 and 38 to TB1-7 and TB1-8 for "auxiliary 24-volt AC input."

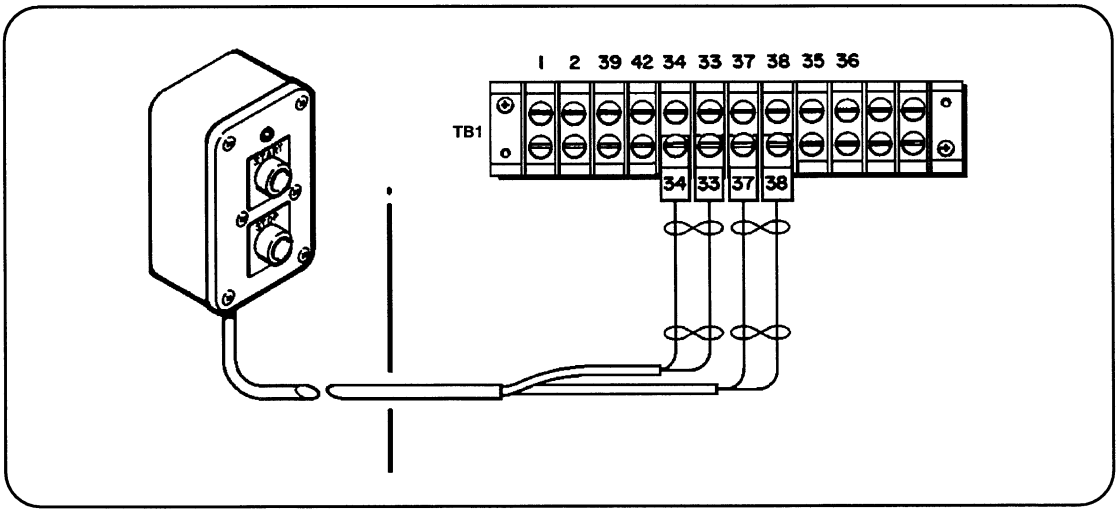


Figure 3-3 Remote Start/Stop Switch Connections

Machine Computer Interface (Optional)

The customer must supply 2-pair twisted 22 AWG (American Wire Gauge) cable (or equivalent).

Refer to TB1 in Figure 7-2 of the *Wiring Diagrams* for machine interface connections.

POWER SUPPLY GAS CONNECTIONS

When using compressed air cylinders, remove the hose from the MAX100 regulator and feed the OUTPUT OF AIR CYLINDER REGULATOR directly into the air input at the bottom rear of the MAX100 power supply. (Fig.3-4)

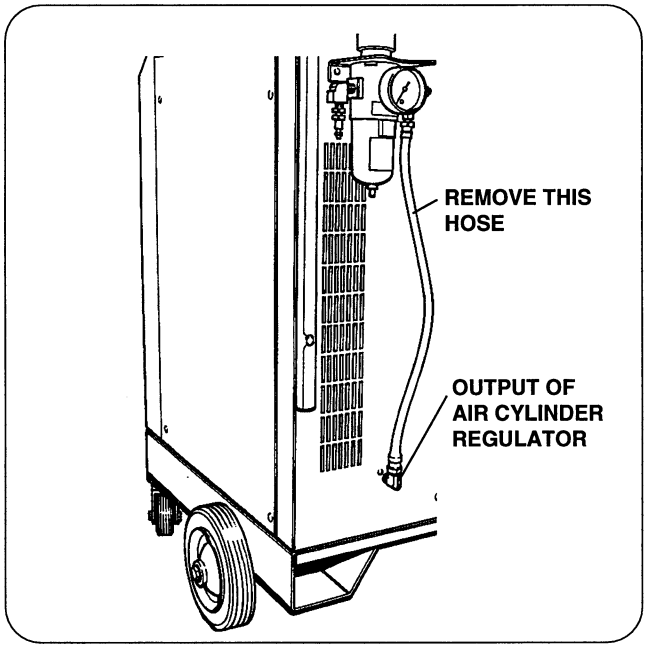


Figure 3-4 Gas Connection for Air Cylinder

When using **air** or **nitrogen** as the operating gas, and the source pressure **does not** exceed **8.3 bar**, connect hose from **SOURCE SUPPLY** to the connector located on the left of the regulator on the rear of the power supply. (Fig. 3-5)

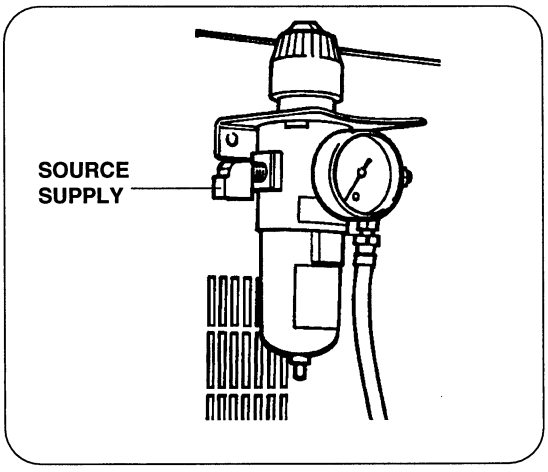


Figure 3-5 Gas Connection for Shop Air or Nitrogen

CONNECTING THE TORCH

There are 2 configurations of power supplies to accommodate 2 configurations of torch / torch lead assemblies:

Quick Disconnect Torch Leads to Power Supply

1. Align the **TORCH CONNECTOR KEY PLUG** with the **RECEPTACLE KEY SLOT** (on the back of the power supply) and push it in until the pins seat. (Fig. 3-6)

2. Turn the connector **SECURING RING** 1/4 turn counterclockwise to ensure that the securing ring threads and the receptacle threads are aligned prior to tightening.

Caution:	The connector securing ring and receptacle are fine-threaded. Thread damage could occur if cross-threaded.

3. Turn the connector securing ring clockwise to tighten.

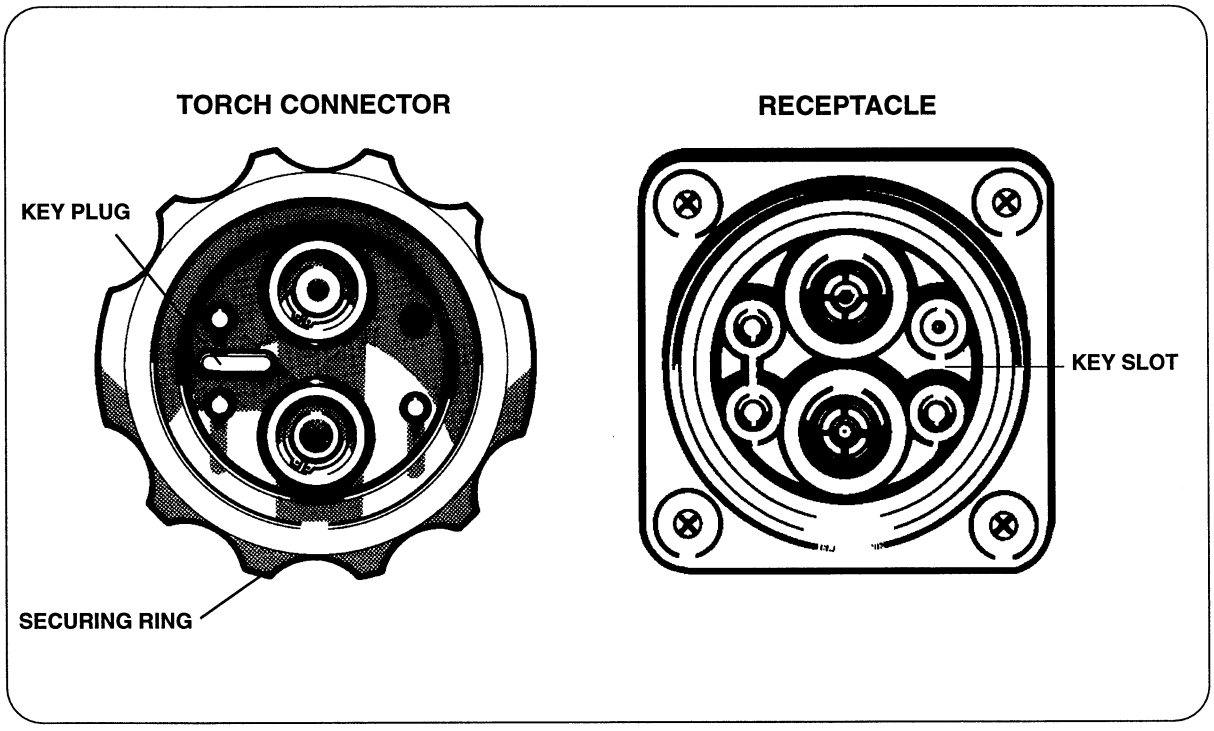


Figure 3-6 Quick Disconnect Alignment

Torch Leads without Quick Disconnect to Power Supply

For torches not equipped with the quick disconnect torch leads:

1. Unscrew and remove the left-side cover of the power supply.
2. Connect the torch **CATHODE LEAD** (larger diameter lead) to the center of the coil assembly. (Fig. 3-7)
3. Connect the **PILOT ARC LEAD** (smaller diameter lead) to the other fitting located on the lower left of the ground cable connection. (Fig. 3-7)
4. Connect the cable terminals labeled **33** and **34** to TB1-5 and TB1-6. (Fig. 3-7)
5. Replace the left-side cover of the power supply.

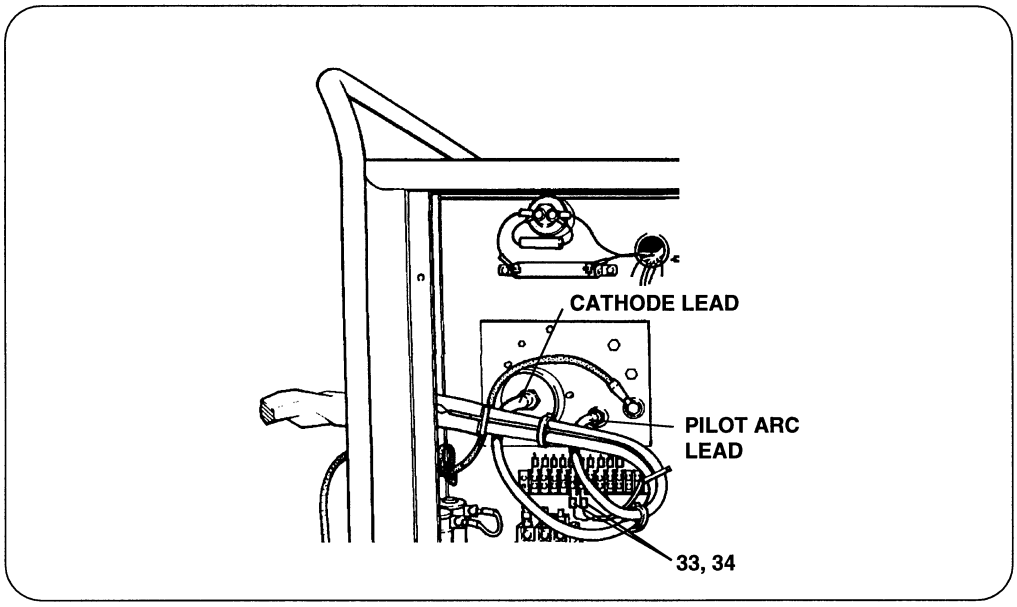


Figure 3-7 Torch Lead Connections to Inside of Power Supply

Section 4 OPERATION

In this section:

DESCRIPTION OF CONTROLS

MAX100 Control Panel (Figure 4-1)

- **Green I (ON) button**
  Activates the power supply and its control circuits.

- **Red O (OFF) button**
  Shuts the power supply down.

- **White POWER ON light**
  Illuminates after the I (ON) button is released to indicate that all control circuits are activated, safety interlocks are satisfied, and the system is ready for operation.

- **Green GAS PRESSURE light**
  Illuminates after the I (ON) button is released to indicate that the gas pressure is adequate. If power supply shuts down and light is not illuminated when the I (ON) button is pushed, then the gas pressure is inadequate.

- **Yellow OVER-TEMPERATURE light**
  Normally not illuminated. If power supply shuts down and light is illuminated when the I (ON) button is pushed, then the power transformer and/or the chopper has overheated.

- **AMPS output adjustment knob**
  Adjusts output current between 30 and 100 amps. (Increase the amperage to cut thicker material.)

- **PLATE - EXPANDED/NORMAL switch**
  In EXPANDED (up) position, a continuous pilot arc remains on. This setting is recommended for cutting expanded plate. Never exceed 40 amps while in this position.

  Use in NORMAL (down) position when cutting normal plate.

- **GAS TEST/RUN switch**
  In TEST mode, plasma gas flows so that adjustments to the pressure can be made. RUN mode is used after gas has been set in TEST mode, and cut is about to be made.

- **GAS Adjustment Valve**
  Adjusts dynamic (flowing) plasma gas.

- **GAS Pressure Gauge**
  Indicates dynamic (flowing) plasma gas pressure.

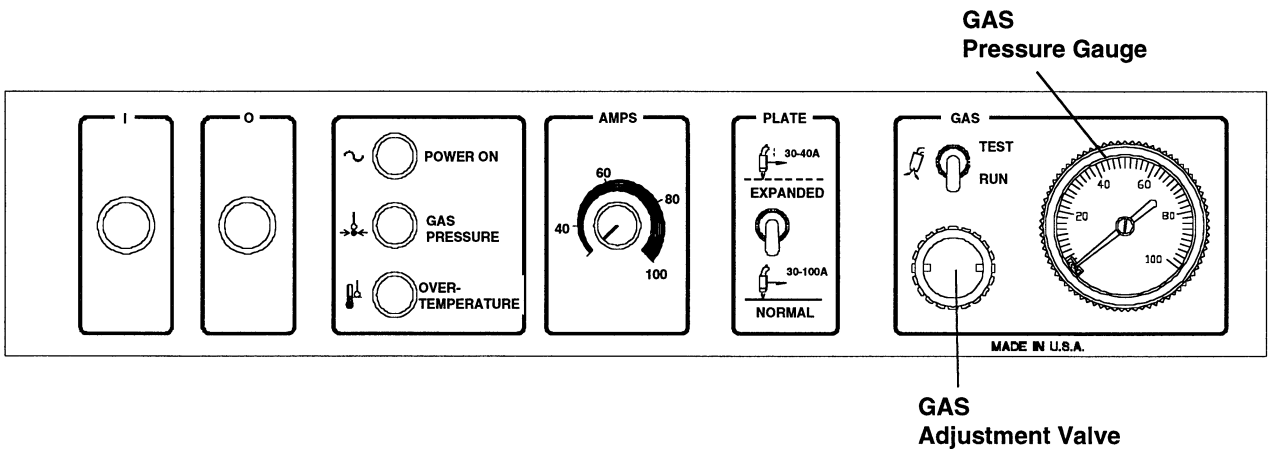


Figure 4-1 MAX100 Control Panel

OPERATING INSTRUCTIONS

WARNING

Before operating this system, you must read the *Safety* section of this manual thoroughly!

1. Ensure that the work environment and your clothing meet the safety requirements outlined in the *Safety* section.

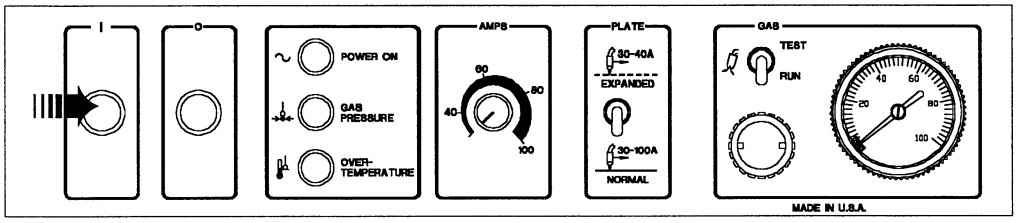
2. Follow the system installation instructions in the *Setup* section.

3. Be sure that the correct consumable parts are in the MAX100 torch. See *Cut Charts* later in this section for correct consumables.

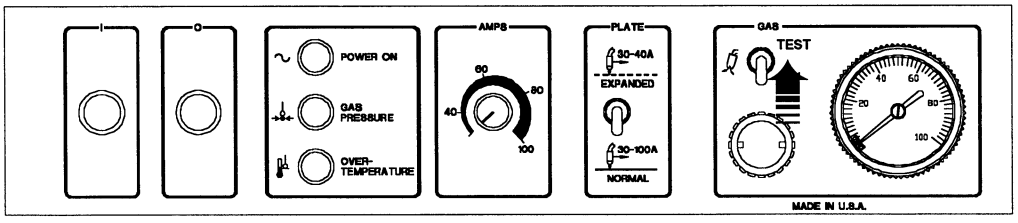
4. Turn on the gas supply. Adjust incoming plasma gas pressure to a minimum of **6.2 bar**.

5. Apply 3-phase power to the MAX100.

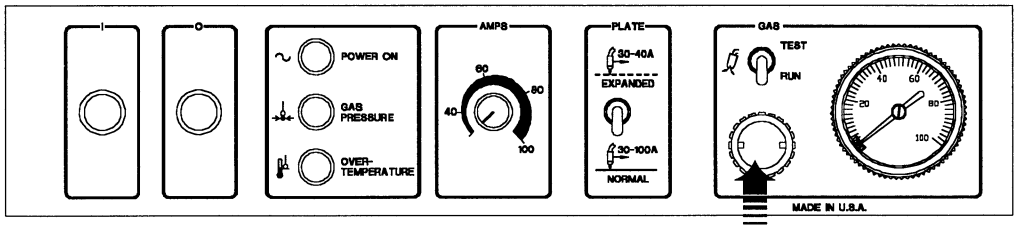
6. Press the green **I (ON)** button to power up the system. Hold it down until both the white **POWER ON** light and the green **GAS PRESSURE** light illuminate.



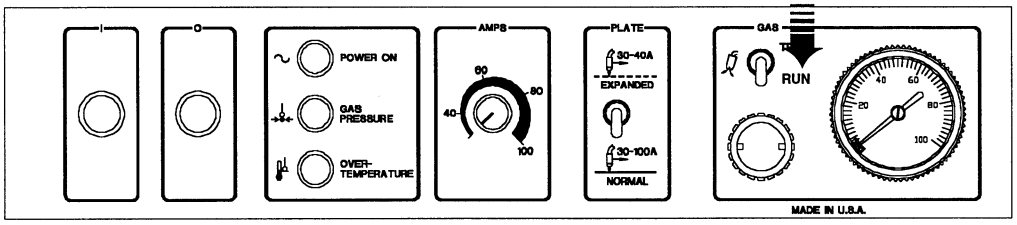
7. Place the TEST/RUN switch in the **TEST** position. Plasma gas will flow through the system.



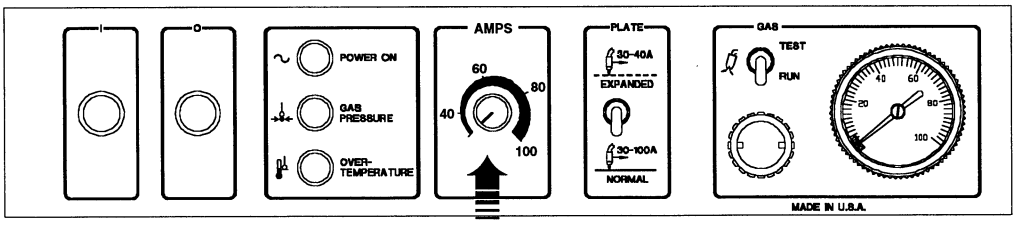
8. With the GAS adjustment valve, set the plasma gas pressure for the particular metal you will cut. Refer to the **Plasma Gas Pressure** in **TEST** mode in the *Cut Charts* later in this section.



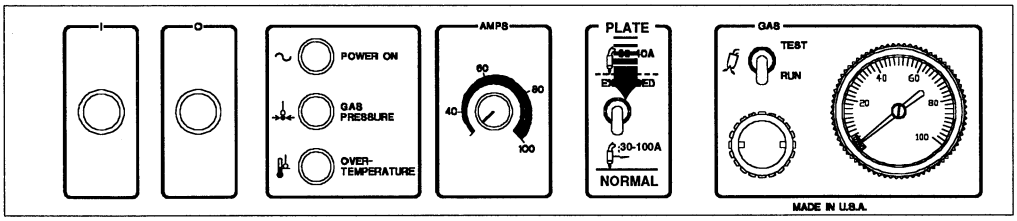
9. After gas pressure has been set, switch to the **RUN** position. Gas will stop flowing through the system.



10. Adjust the **AMPS** potentiometer to the desired current. Refer to the **Arc Current Setting** in the *Cut Charts* later in this section.



11. Place the **PLATE** switch in the **NORMAL** (down) position.
    Note: If you are cutting metal grate, place the **PLATE** switch in the **EXPANDED** (up) position.



12. If you are using a torch height control system, adjust the **Arc Voltage Setting** on the torch height control according to the specifications in the *Cut Charts* later in this section.

13. Attach the work clamp to the work table or workpiece. Do not attach the work clamp to the portion of the workpiece that will fall away. (Fig. 4-2).

14. Position the torch the appropriate distance from the workpiece. Refer to the **Torch-to-work Distance** in the *Cut Charts* later in this section.

15. Cut at the speed specified under **Travel Speed** in the *Cut Charts* later in this section for the material and thickness being cut. Be sure to follow the proper **Pierce Time** outlined in the charts. For machine-torch systems, program the cutting machine accordingly.

16. **Hand Torch:** Press the torch start button and hold it down.
    Machine Torch: Press the START button.

    After a 2-second delay, the pilot arc will activate, and the arc will transfer if the **Torch-to-work Distance** is set properly.

Notes:

Hand Torch: The arc will extinguish if the torch switch is released or if no material remains under the arc.

Machine Torch: The arc will extinguish if the STOP button is pressed or if no material remains under the arc.

Postflow of gas will continue for 10 seconds after the arc is extinguished.

WARNING

All input power to the power supply is not turned off until the wall disconnect switch is turned off.

WARNING

Never remove any power supply cover before disconnecting main power.

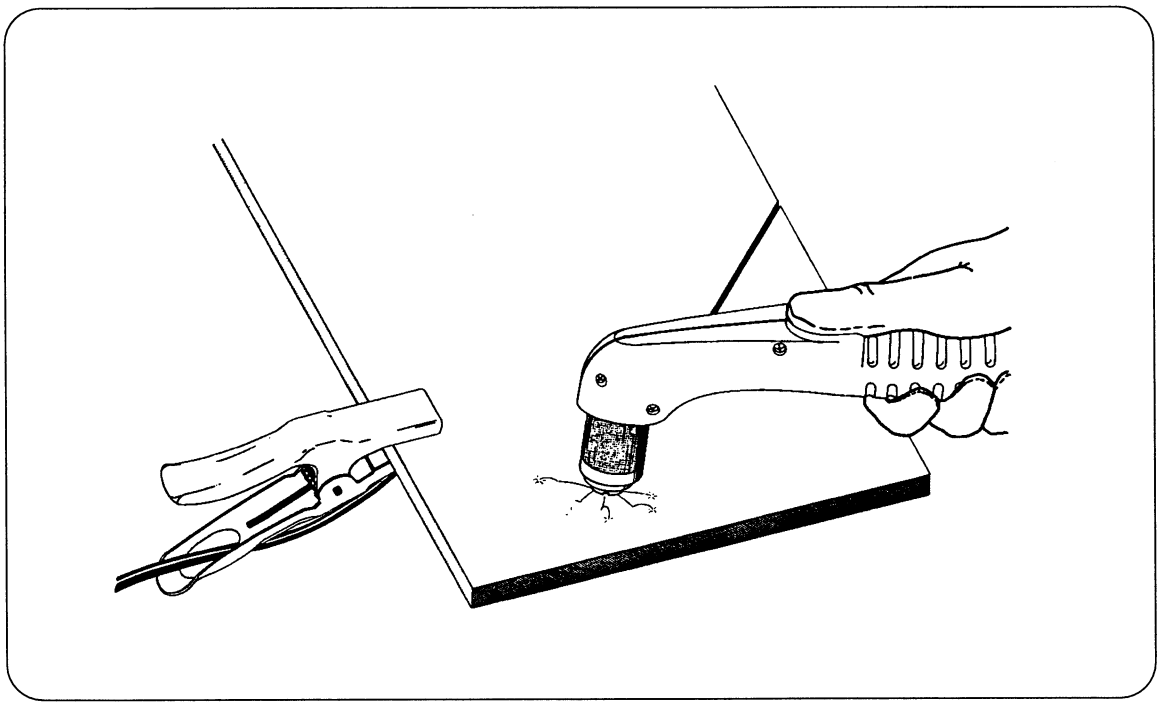


Figure 4-2 Proper Work Clamp Connection

OPERATING TIPS

Changing Consumable Parts

WARNING

Always unplug the power supply before inspecting or changing the torch parts.

The consumable parts in the torch need to be inspected periodically for signs of wear. A good rule of thumb is to check the parts after every 100 starts (pierces, edge starts, parts cut, etc.).

To remove the consumables (Fig. 4-3):

1. **Machine torch.** Bring the torch to the edge of the machine with the lifter raised to its highest point. Hold your hand under the retaining cap - the nozzle and swirl ring may fall when you remove the retaining cap. Unscrew and remove the **retaining cap**. If the **nozzle** and **swirl ring** remain inside the cap, take them out and set them aside.

   Hand torch. Unscrew and remove the **retaining cap**. The **nozzle** and **swirl ring** will come out; set them aside.

2. Inspect the retaining cap. It should be undamaged.

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

4. Unscrew the shield. Inspect the gas holes from the inside. The holes should be clear of metal or other debris. If the gas holes are blocked by debris, try to open them by pushing a pin through each one **from the outside of the shield to the inside**. If the shield is still good, screw it back on to the retaining cap. If it is damaged, replace it with a new one.

5. Inspect the **O-ring** on the **torch**. It should be lubricated and undamaged. If it is dry, lubricate it with a thin film of the lubricant provided in the consumable parts kit. If it is damaged, replace it.

6. Inspect the **nozzle** for damage or signs of wear. The inside of the nozzle should be clean and bright, with no deposits from the electrode. You can clean the inside of the nozzle with steel wool, but be sure to remove any remnants of the steel wool afterward. The hole in the nozzle should not be worn or oval-shaped. If the nozzle is damaged, replace it with a new one.

7. Inspect the **swirl ring**. It should be clean, and the holes along the side should not be plugged. If the swirl ring is damaged, replace it with a new one.

8. Remove the **electrode** with the wrench supplied in the consumable parts kit. Inspect it. If the center of the electrode has a pit more than 1 mm deep, replace it. If the electrode is still good, inspect its O-ring; it should be lubricated and undamaged. If the O-ring is dry, lubricate it with a thin film of the lubricant supplied in the consumable parts kit. If it is damaged, replace it.

9. Inspect the inside of the **torch** body. It should be clean and undamaged.

10. Replace the electrode and tighten it with the wrench. **Do not overtighten it.**

11. Install the swirl ring on the electrode with the word "front" facing away from the torch body—it won't fit in properly if it is installed in the wrong direction. Place the nozzle on top of the swirl ring.

12. Replace the retaining cap and shield. Make sure that it is tightened snugly; if it is loose, it can affect cut quality.

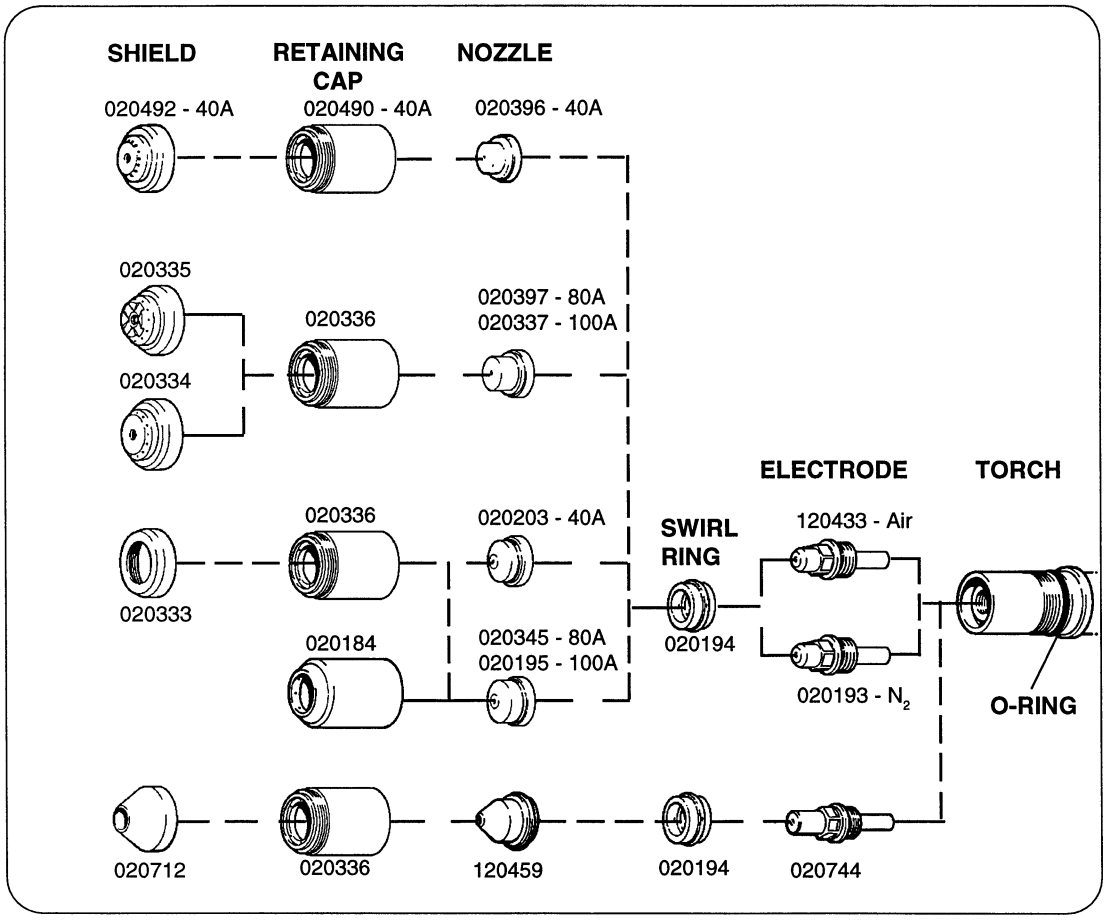


Figure 4-3 Consumable Parts

OPERATION

Cutting with Hand Torch

- Do not fire the pilot arc into the air needlessly—doing so causes a drastic reduction of the nozzle and electrode life.
- Start cutting from the edge of the workpiece (Fig. 4-4) unless you must pierce. For tips on piercing, see *Piercing* later in this section .
- When cutting, make sure that the sparks are coming out of the bottom of the workpiece. If they are spraying on top of the workpiece, you are moving the torch too fast, or you do not have sufficient power to fully penetrate the workpiece.
- Hold the torch lightly on the metal or just off the metal. Holding the torch firmly to the workpiece causes the nozzle to stick and makes smooth cutting difficult. The arc transfers once the torch is within 3 mm of the workpiece.
- To cut circles, use a template or a radius cutter attachment (Fig. 4-5).
- Pull the torch through the cut. Pulling it is easier than pushing it.
- Hold the torch nozzle (tip) at a vertical position and watch the arc as it cuts along the line (Fig. 4-6). By lightly dragging the nozzle on the workpiece, you can maintain a steady cut. For straight-line cuts, use a straight edge as a guide.

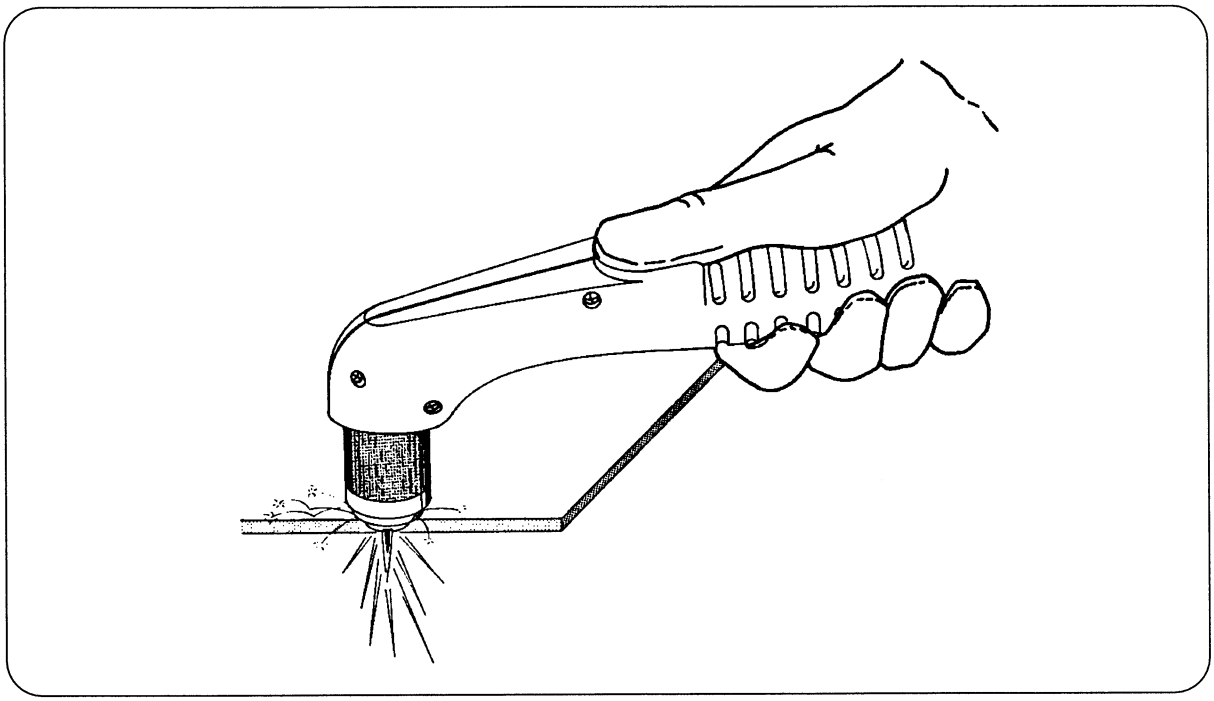


Figure 4-4 Starting a Cut

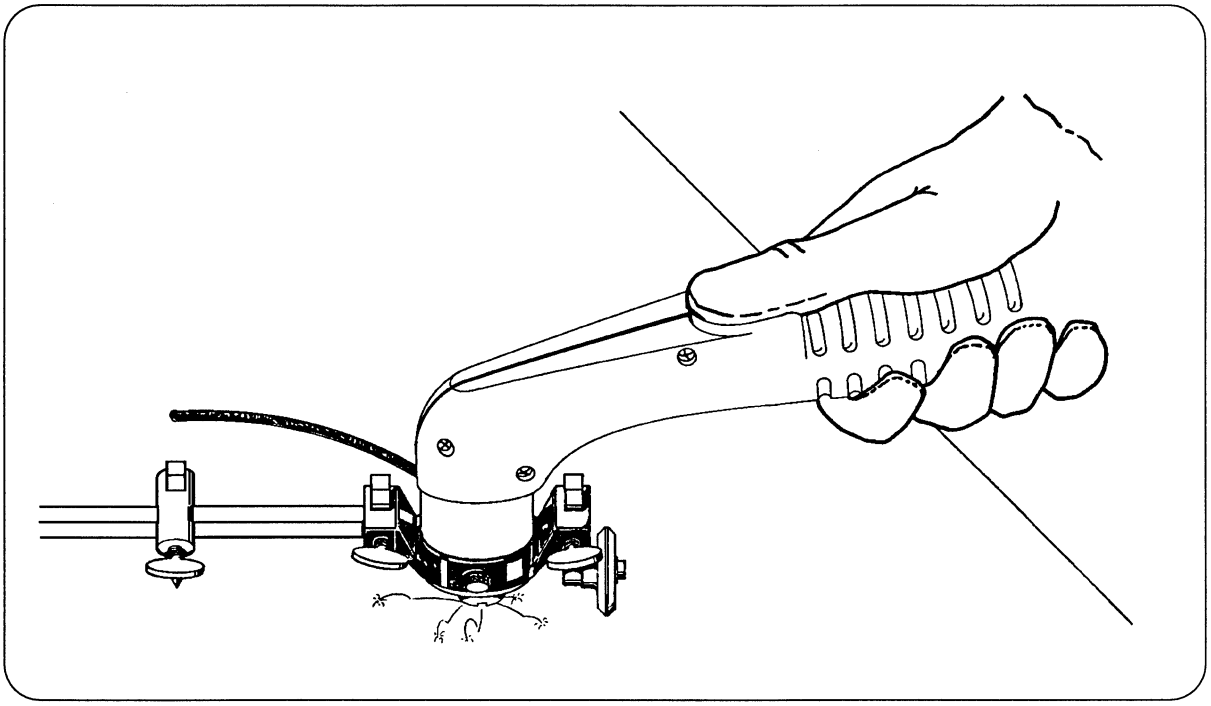


Figure 4-5 Cutting a Circle

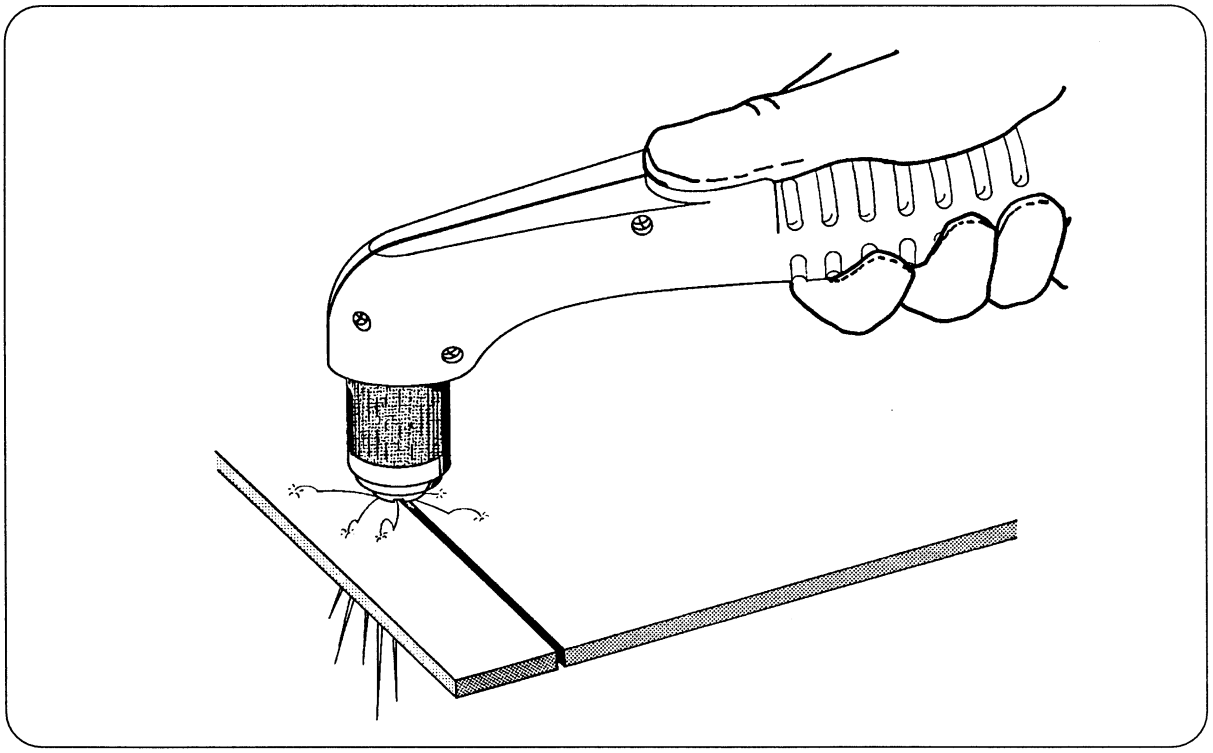


Figure 4-6 Dragging the Torch

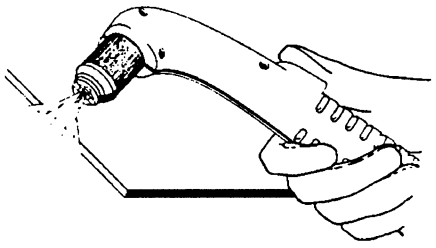
Piercing with Hand Torch

- Hold the torch so that the nozzle is approximately 1.5 mm away from the workpiece before pressing the start button. This method maximizes the life of the nozzle.

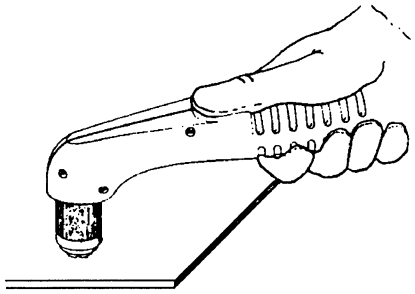
- Hold the torch at an angle to the workpiece away from yourself, then slowly roll it to a vertical position. (This is particularly important when cutting thicker material.) Make sure that the torch is pointed away from you and the people around you to avoid any danger from sparks and hot metal.

- Start the cut at an angle rather than in an upright position. This method permits the hot metal to escape to one side rather than splashing back against the nozzle, protecting the operator from the sparks and extending the torch nozzle life (Fig. 4-7).

- When the pierce is complete, proceed with the cut.



1. Tilt the torch and push the start button.



2. Rotate the torch to an upright position.

Figure 4-7 Piercing

Gouging with Hand Torch

The MAX100 can be used for gouging mild steel by using the optional gouging nozzle and shield. Use the following guidelines to assist you with the gouging process:

- When gouging, it is absolutely necessary to wear full protection - a welding helmet with at least a #8 glass, welding gloves and a welding jacket. The arc is fully exposed and will cause serious burns if skin is not covered.
- Install the gouging nozzle just as you would install the standard cutting nozzle.
- Adjust the air pressure to 3.5 bar (with air flowing at the torch). Note that this is slightly lower than the cutting pressure.
- Tilt the torch approximately 40-45° from the surface to be gouged and feed into the gouge. Try not to allow the shield to come in contact with the plate since this can cause premature wear. Multiple passes or "wearing" may be necessary to gouge wider and deeper sections. (See Figure 4-8. See also data in *Cut Charts* for mild steel gouging.)

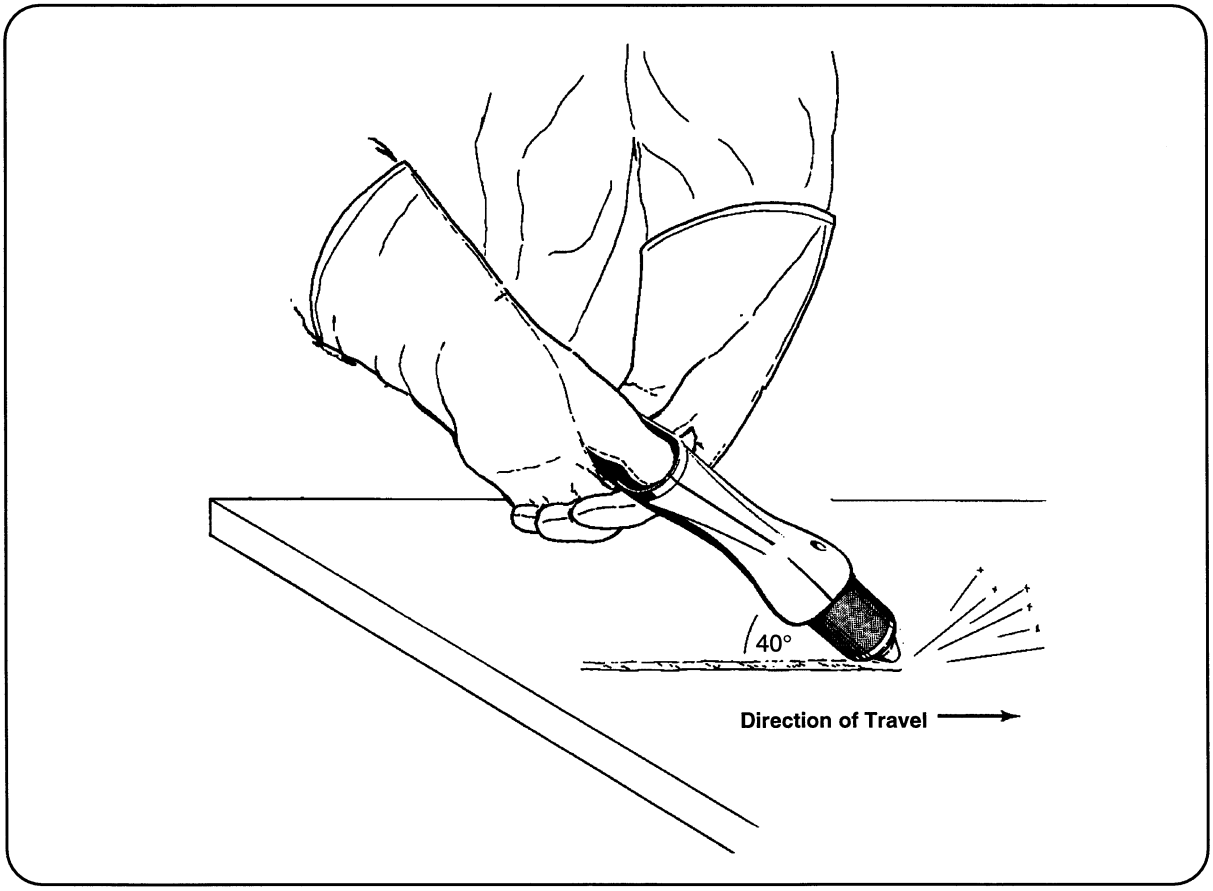


Figure 4-8 Gouging

Common Cutting Faults

- The workpiece is not totally penetrated. Causes can be:

  - The current is too low.
  - The cut speed is too high.
  - The torch parts are worn.
  - The metal being cut is too thick.

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

  - The cutting speed is too slow.
  - The torch parts are worn.

Duty Cycle

The duty cycle, or the amount of time the pilot or plasma arc can remain "on" in minutes within a 10-minute period, is affected by many factors. When the current is set at 100 amps, the MAX100 has an 80% duty cycle. During normal operation, the plasma arc can remain on 8 minutes out of every 10 minutes without causing the temperature sensors to disable the unit. The duty cycle increases to 100% when the current is set at or below 80 amps.

The duty cycle is reduced if:

- The input line voltage is less than nominal, due to a long power cord, poor utility supply, etc.
- You are cutting material greater than 25 mm thick.
- The work clamp is not making good electrical contact with the workpiece due to paint, rust, etc.

Gas Pressure

The plasma gas, compressed air or nitrogen, must be available at a flow rate of **208 liters/minute** and a minimum pressure of **4.8 bar**. If the pressure is below **2.7 bar**, the torch will extinguish.

CUT CHARTS

The cut chart information on the following pages will enable you to successfully cut or gouge using the MAX100 system.

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

WARNING

The voltage between the tip of the torch and the workpiece may exceed 113 VDC if shielded consumable parts are not installed in the torch. Cut charts that specify non-shielded consumables are for machine torch applications only. The PAC130 hand torch must be operated with shielded parts to maintain the S mark and CE low voltage compliance.

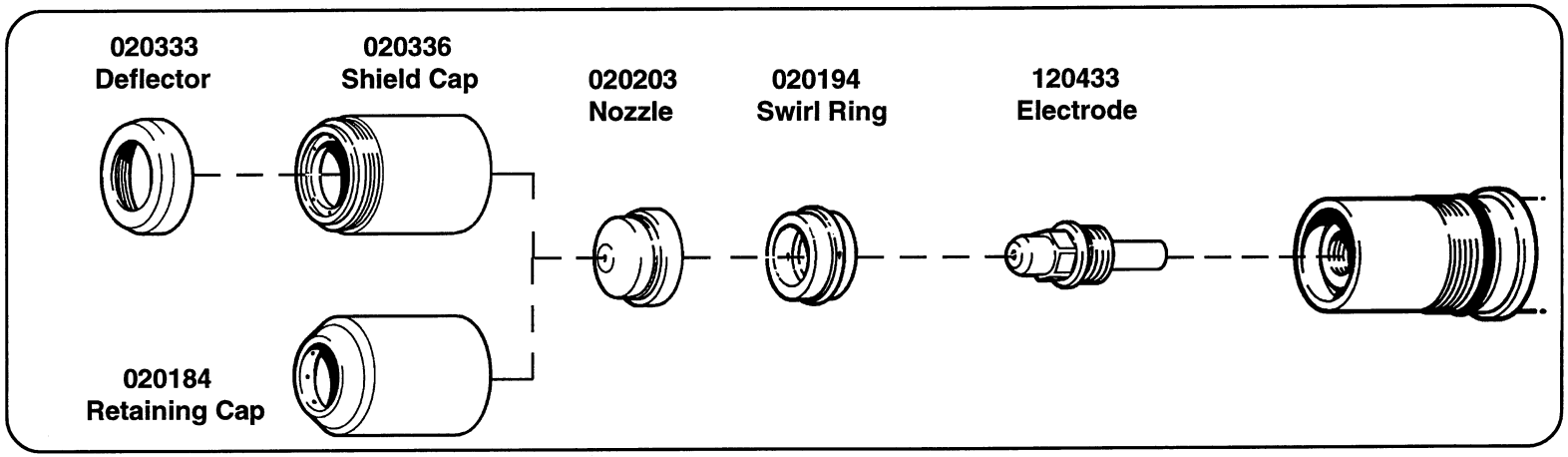
CUT CHART INDEX

MAX100 Machine Torch

Mild Steel Cutting

Plasma Gas: **Air**
Current Setting: **40 Amps**
Consumables: **Non-Shielded**

CUTTING



Material Thickness (GA) (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Expanded Metal Travel Speed (mm/min)	Plasma Gas (Air) Inlet Pressure (bar)
28 GA	**4.5***	2	**40**	90	**100**	8640		6100	**6.2-8.3**
26 GA		2		90		8130		5720	
24 GA		2		95		7200		5080	
1		2		100		5970		4190	
18 GA		2		100		4320		3050	
1.5		2		105		3800	0.50	2670	
2		2		105		3300	0.50	2290	
3		2		105		2160	1.00	1520	
4		3		110		1520	1.50	1020	
5		3		120		1140	1.50	760	
6		3		120		760	1.75		
10		3		125		200	2.00		

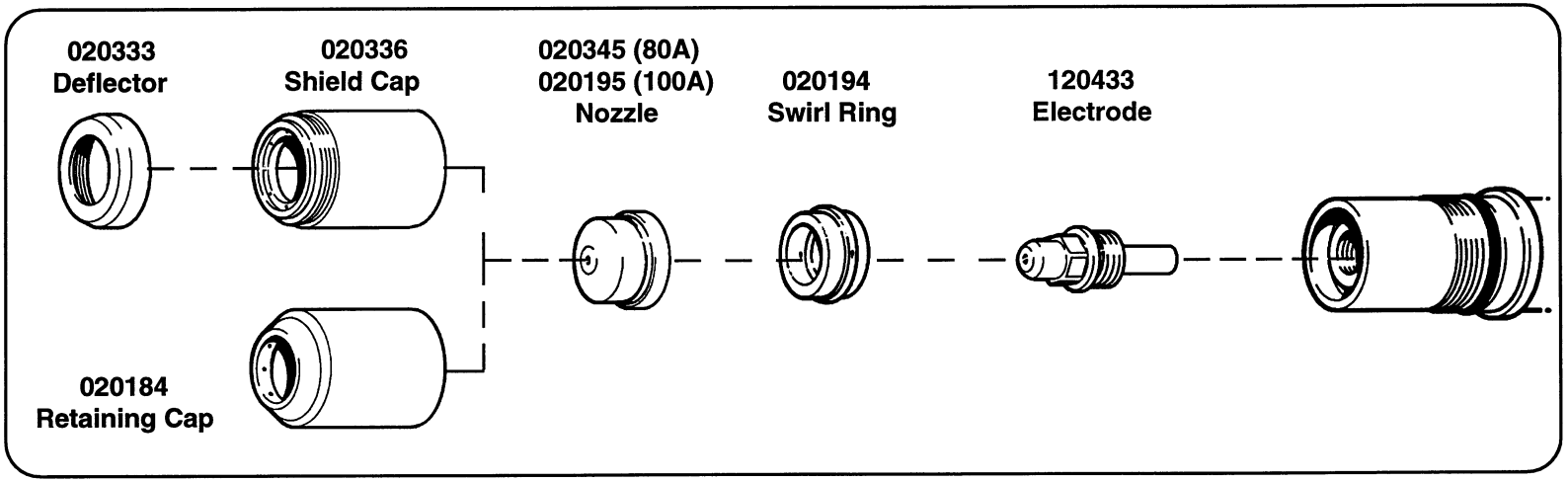
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Mild Steel Cutting

Plasma Gas: **Air**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Non-Shielded**

CUTTING



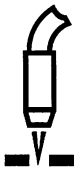
Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
3	**4.5***	3	80	100	100	5080	0.50	**6.2-8.3**
5		3	80	110	100	3050	0.50	
6		4	80	120	100	2400	0.75	
10		4	100	115	80	1400	1.00	
13		4	100	125	80	1000	1.25	
16		5	100	130	80	750	1.50	
19		5	100	140	80	500		
22		6	100	145	80	380		
25		6	100	150	80	250		
32		6	100	160	80	130		

bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

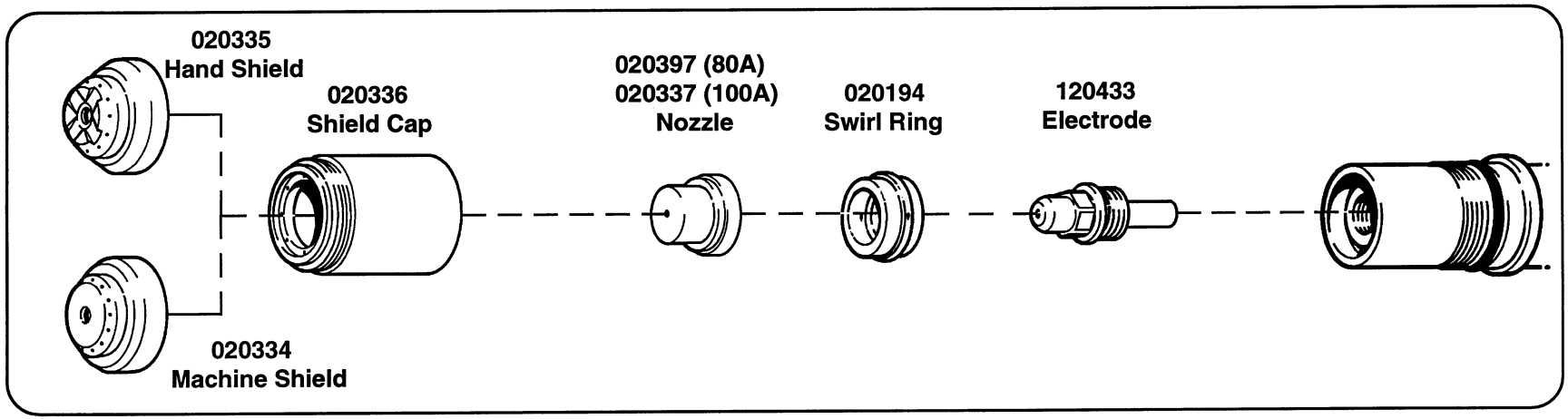
MAX100 Machine/PAC130 Hand Torch

Mild Steel Cutting

Plasma Gas: **Air**
Current Setting: **80 Amps / 100 Amps**
Consumables: **Shielded**



CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
6	4*	3	80	130	100	2290	0.75	**6.2-8.3**
10		3	100	125	80	1270	1.00	
13		3	100	130	80	890	1.25	
15		4	100	140	80	640	1.50	
19		5	100	150	80	380		
25		6	100	160	80	250		

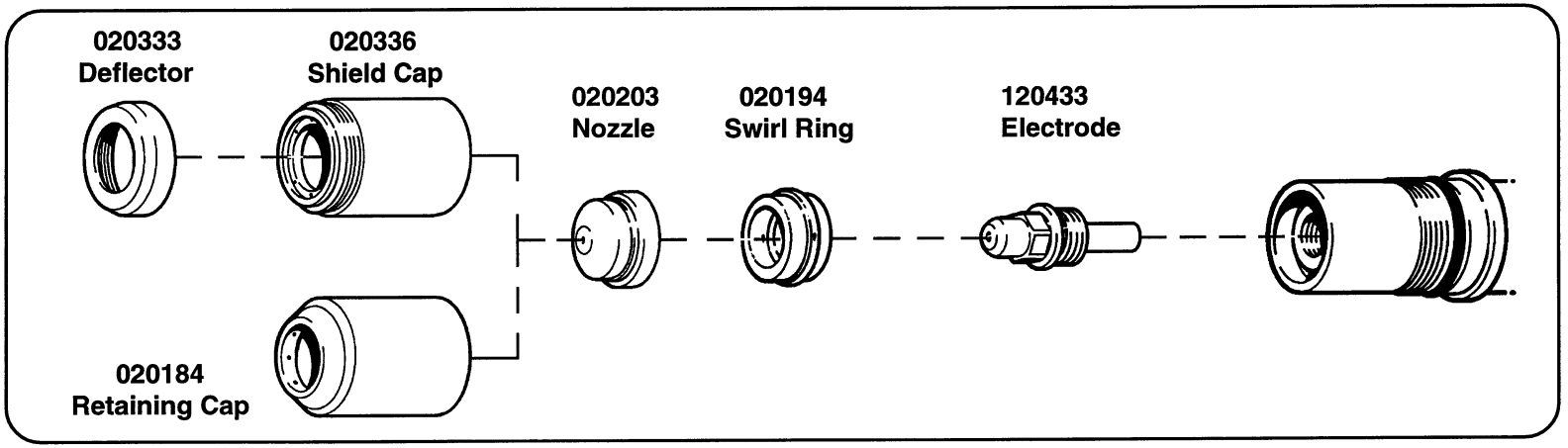
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Aluminum Cutting

Plasma Gas: **Air**
Current Setting: **40 Amp**
Consumables: **Non-Shielded**

CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (ipm)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Expanded Metal Travel Speed (mm/min)	Plasma Gas (Air) Inlet Pressure (bar)
.8	**4.5***	2	**40**	90	**100**	240	6100	0.50	4190	**6.2-8.3**
1.5		2		100		150	3800	0.75	2670	
2.4		2		100		110	2790	1.00	1910	
3		2		105		85	2160	1.00	1520	
6		3		120		30	760	1.25		
10		3		125		08	200	1.50		

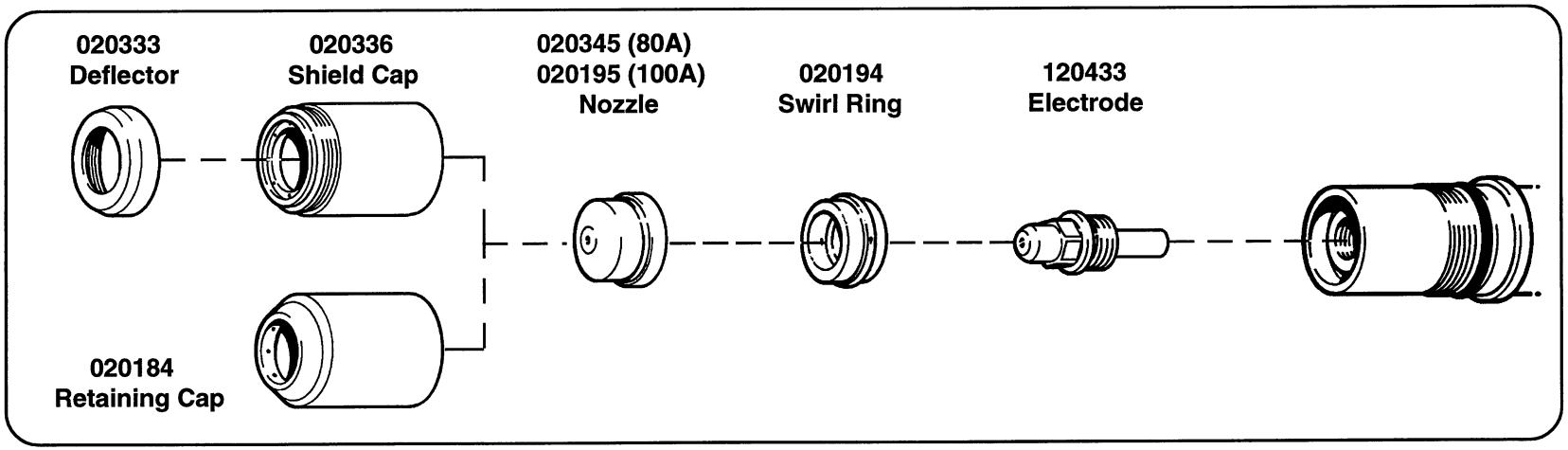
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Aluminum Cutting

Plasma Gas: **Air**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Non-Shielded**

CUTTING



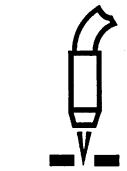
Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
3	**4.5***	3	80	110	100	4320	0.50	**6.2-8.3**
6		4	80	125	100	1500	0.75	
10		4	100	120	80	1020	1.00	
13		4	100	130	80	760	1.25	
15		5	100	135	80	380	1.50	
19		5	100	145	80	250		
25		6	100	155	80	125		

bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

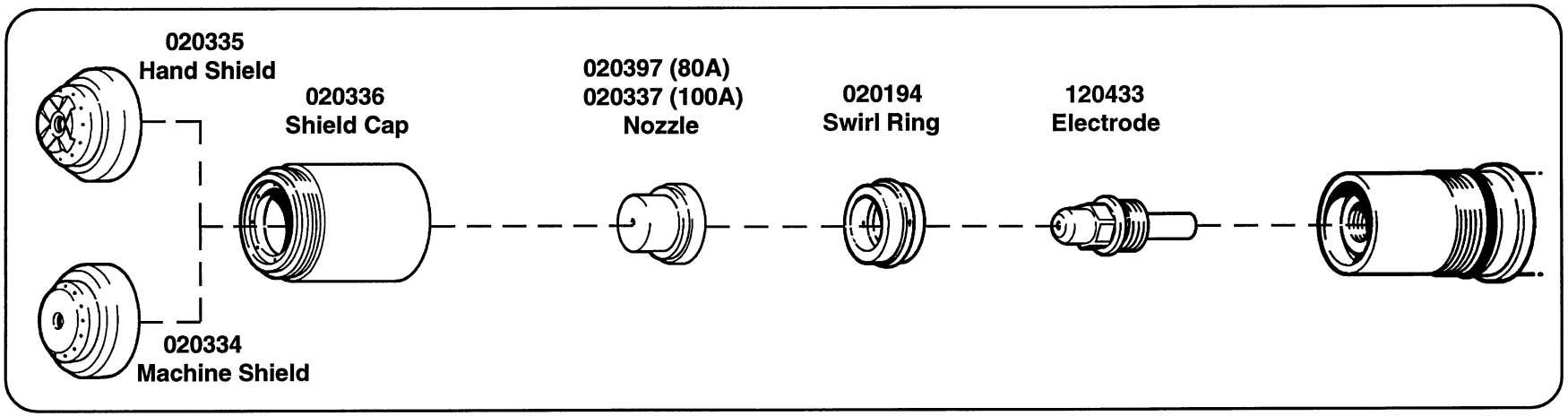
MAX100 Machine/PAC130 Hand Torch

Aluminum Cutting

Plasma Gas: **Air**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Shielded**



CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
6	**4***	3	80	130	100	1400	0.75	**6.2-8.3**
10		3	100	130	80	890	1.00	
13		4	100	140	80	640	1.25	
15		4	100	145	80	380	1.50	
19		5	100	155	80	250		

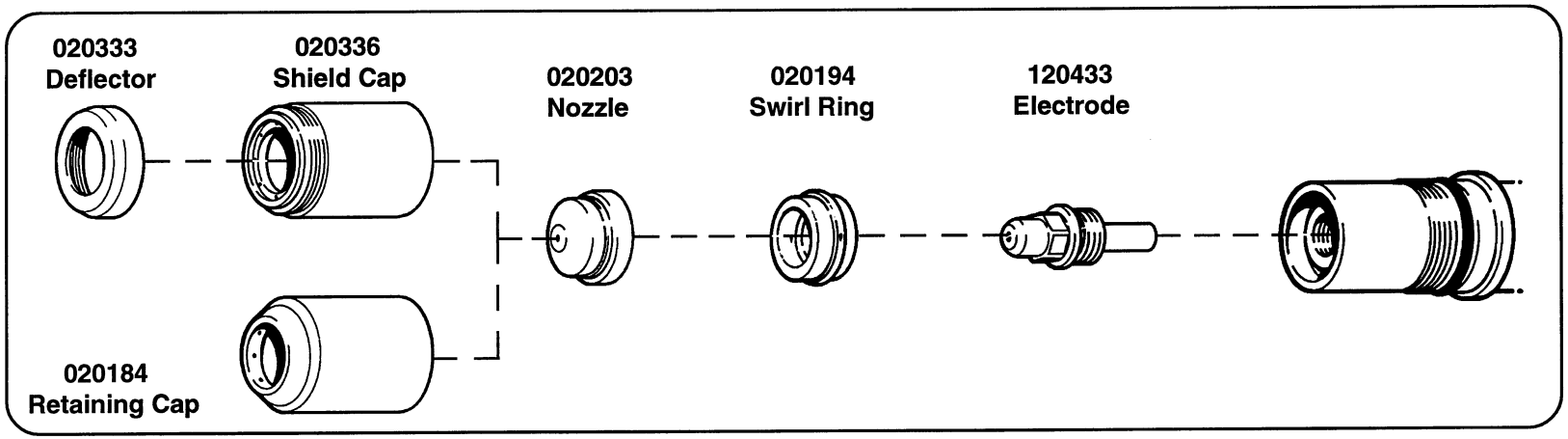
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Stainless Steel Cutting

Plasma Gas: **Air**
Current Setting: **40 Amp**
Consumables: **Non-Shielded**

CUTTING



Material Thickness (GA) (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Expanded Metal Travel Speed (mm/min)	Plasma Gas (Air) Inlet Pressure (bar)
28 GA	**4.5***	2	**40**	100	**100**	7400		5080	**6.2-8.3**
26 GA		2		100		6860		4830	
24 GA		2		105		6100		4320	
.8		2		105		5080		3560	
18 GA		2		110		3680		2540	
1.5		2		110		3300	0.50	2290	
3		2		120		1910	1.00	1270	
6		3		130		760	1.75		
10		3		135		200	2.00		

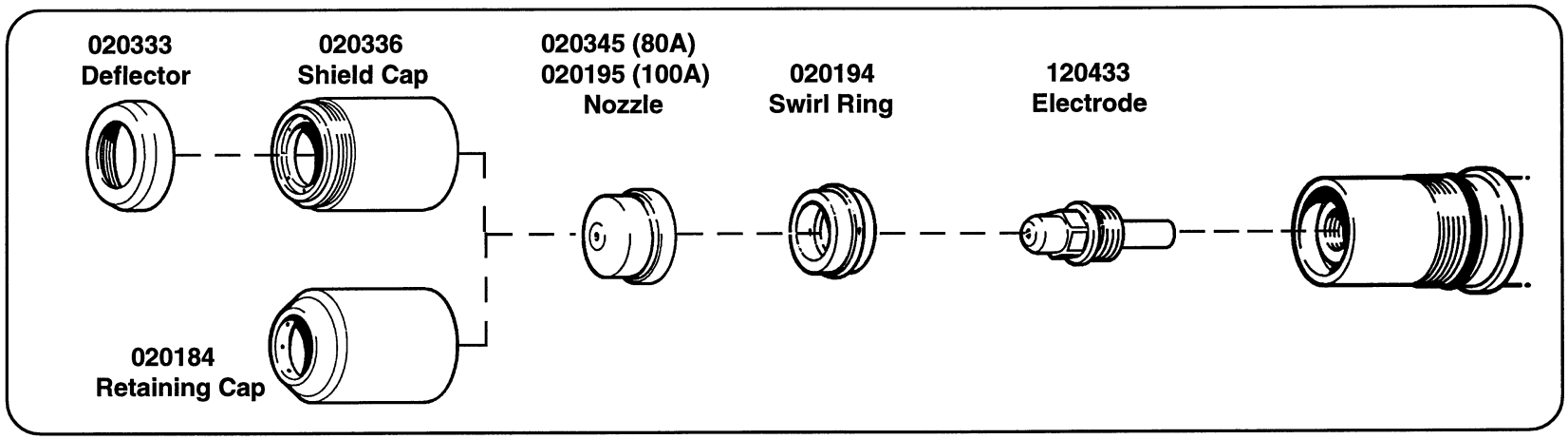
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Stainless Steel Cutting

Plasma Gas: **Air**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Non-Shielded**

CUTTING



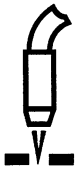
Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
3	**4.5***	3	80	125	100	4320	0.50	**6.2-8.3**
6		4	80	125	100	2000	0.75	
10		4	100	130	80	1140	1.00	
13		4	100	135	80	760	1.25	
15		5	100	135	80	640	1.50	
19		5	100	140	80	380		
25		6	100	145	80	250		

bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

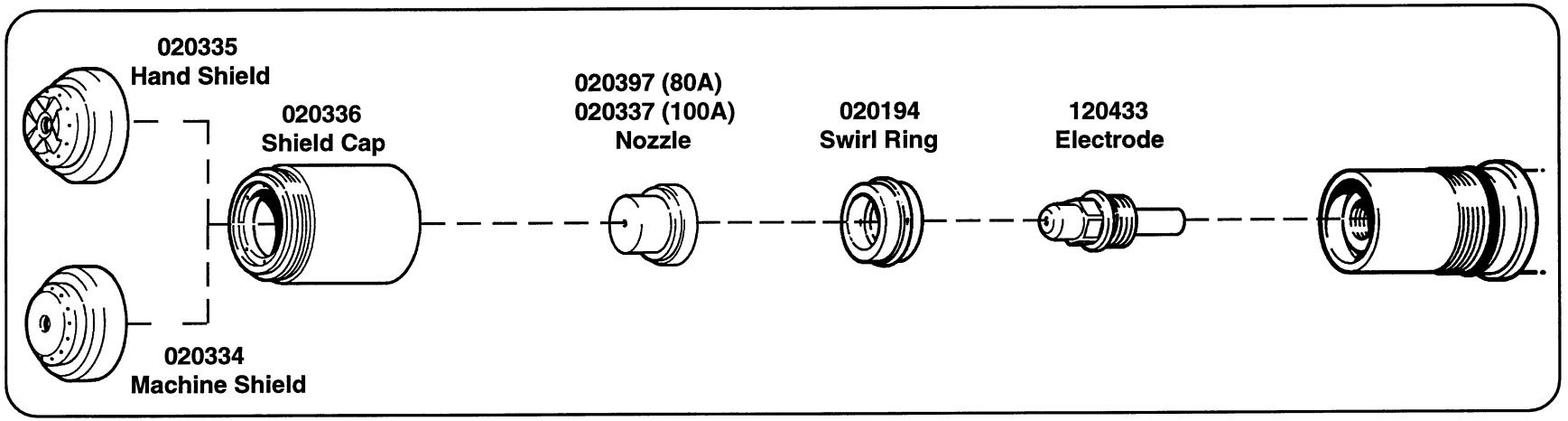
MAX100 Machine/PAC130 Hand Torch

Stainless Steel Cutting

Plasma Gas: **Air**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Shielded**



CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
6	**4***	3	80	130	100	1910	0.75	**6.2-8.3**
10		3	100	135	80	1020	1.00	
13		3	100	140	80	760	1.25	
15		4	100	140	80	510	1.50	
19		5	100	145	80	380		
25		6	100	150	80	200		

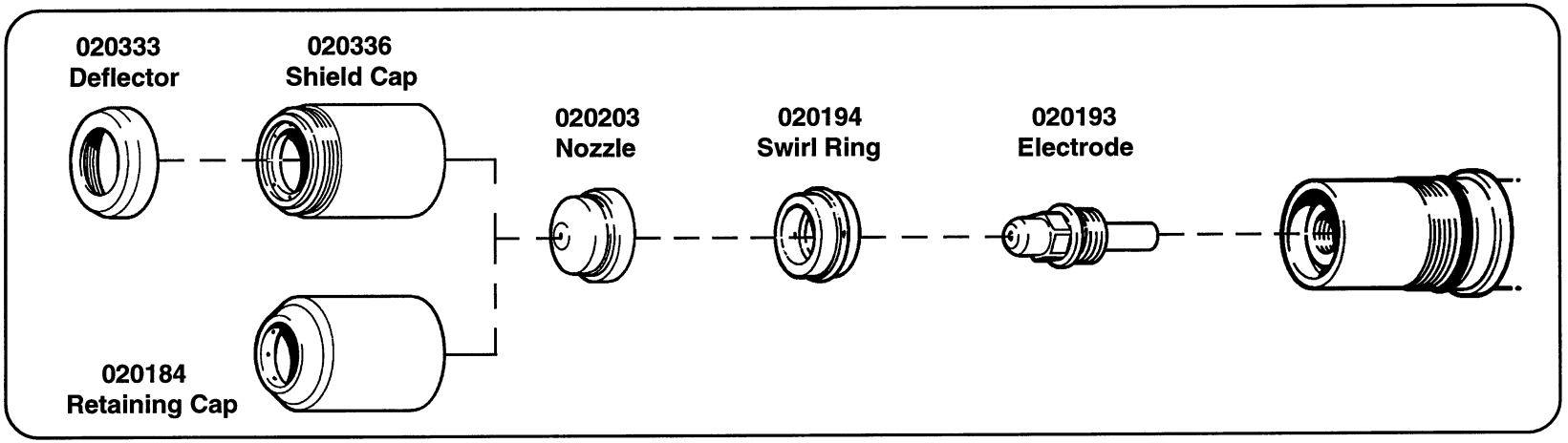
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Stainless Steel Cutting

Plasma Gas: **Nitrogen**
Current Setting: **40 Amp**
Consumables: **Non-Shielded**

CUTTING



Material Thickness (GA) (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
(28 GA)	**4.5***	2	**40**	105	**100**	6600		**6.2-8.3**
(26 GA)		2		105		6100		
(24 GA)		2		110		5460		
1		2		110		4570		
(18 GA)		2		115		3300		
1.5		2		115		3050	0.50	
3		2		125		1650	1.00	
6		3		135		640	1.75	

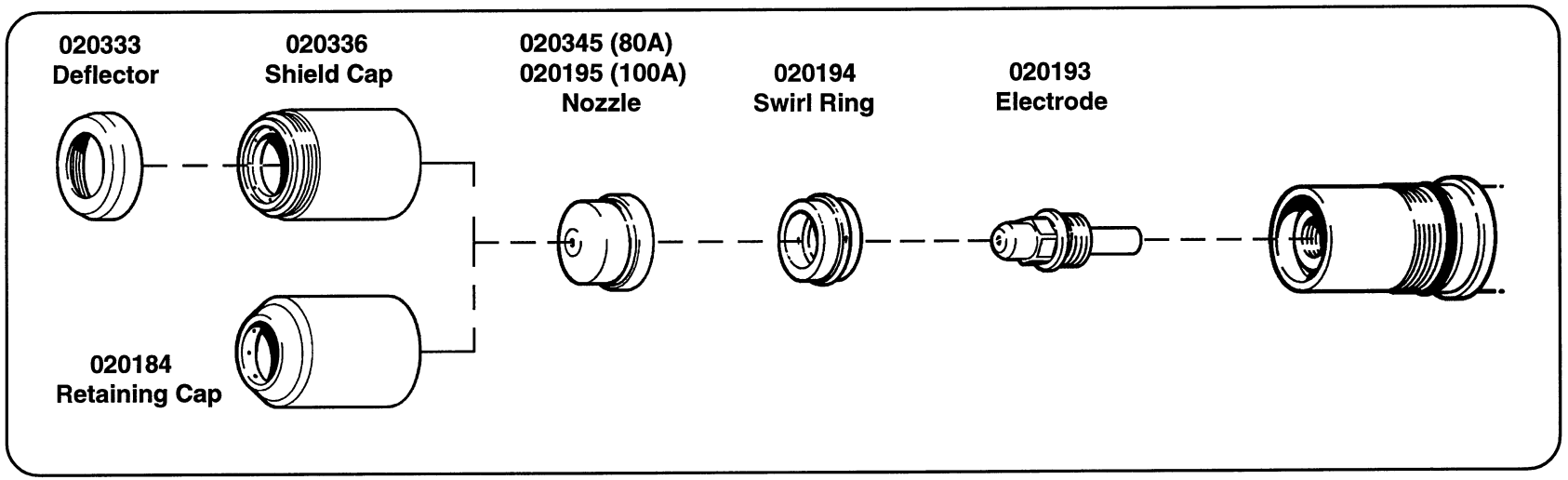
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine Torch

Stainless Steel Cutting

Plasma Gas: **Nitrogen**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Non-Shielded**

CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
3	**4.5***	3	80	130	100	3810	0.50	**6.2-8.3**
6		4	80	130	100	1780	0.75	
10		4	100	135	80	1020	1.00	
13		4	100	140	80	640	1.25	
15		5	100	140	80	510	1.50	
19		5	100	145	80	310		

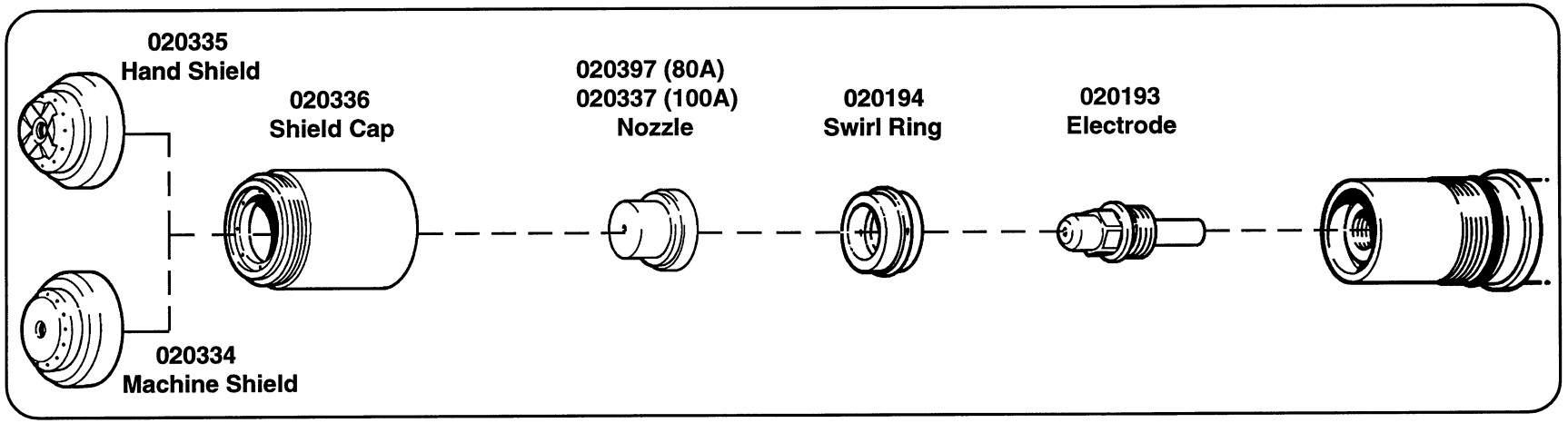
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

MAX100 Machine/PAC130 Hand Torch

Stainless Steel Cutting

Plasma Gas: **Nitrogen**
Current Setting: **80 Amp / 100 Amp**
Consumables: **Shielded**

CUTTING



Material Thickness (mm)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Pierce Time (sec)	Plasma Gas (Air) Inlet Pressure (bar)
6	**4***	3	80	135	100	1650	0.75	**6.2-8.3**
10		3	100	140	80	890	1.00	
13		3	100	145	80	640	1.25	
15		4	100	145	80	380	1.50	
19		5	100	150	80	310		

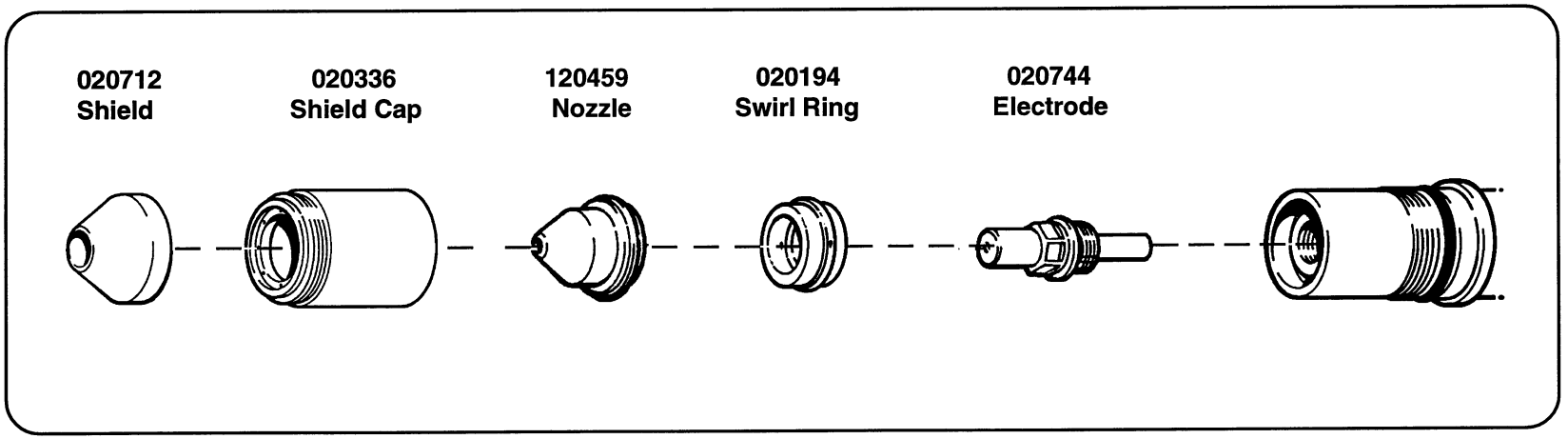
bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

PAC130 Hand Torch

Mild Steel Gouging

Plasma Gas: **Air**
Current Setting: **100 Amp**

GOUGING



Torch-to-work Angle of inclination Θ (Degrees)	Plasma Gas Pressure in TEST (bar)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Duty Cycle (%)	Normal Plate Travel Speed (mm/min)	Plasma Gas (Air) Inlet Pressure (bar)
40-45°	3.4*	1.5	100	80	380	6.2-8.3

bar = 6.895 KPa
* Plasma Gas Pressure setting is for **7.6 m** leads. Add **0.34 bar** for 15 m leads. Add **0.7 bar** for 23 m leads.

Section 5 MAINTENANCE

In this section:

INTRODUCTION

The MAX100, and all Hypertherm plasma systems, undergo rigorous testing prior to shipment and should require little maintenance if proper setup and operation procedures as outlined in **Sections 3** and **4** are followed.

If a problem does arise, this section will familiarize qualified service personnel with the proper operation of the MAX100 system, and will provide guides to troubleshoot problems that may occur during operation. The intent of this section is to isolate a problem at a modular level. PC board component level troubleshooting is not addressed.

This section begins with a detailed sequence of events flowchart, an initial checks procedure, a troubleshooting guide, test procedures and instructions to remove and replace the torch and torch leads.

The service personnel performing the troubleshooting testing must be high-level electronic service technicians that have worked with high voltage electro-mechanical systems. Knowledge of final isolation troubleshooting techniques is assumed.

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

For service questions or problems, contact the nearest Hypertherm Technical Service Department listed at the front of this manual.

WARNING

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

ROUTINE MAINTENANCE

Hypertherm systems are designed to require little maintenance under normal use and conditions. The routine maintenance suggestions in this section will allow the operator to keep the system in peak operating condition.

Torch and Torch Leads

Inspect the torch and torch leads on a regular basis:

- Always inspect the torch's consumable parts and main body before cutting. Worn or damaged parts can cause gas leaks, which can cause cut quality to deteriorate. Inspect consumables for indications of arcing, overheating or pitting, and replace any parts that appear worn or damaged. See *Changing Consumable Parts* in Section 4.

- The torch leads should be checked occasionally for cracking or other damage.

Power Supply

Inspect the power supply on a regular basis:

- Check the exterior for any damage that might affect safe operation of the power supply.

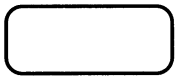
- Remove the power supply cover and inspect the interior. Check wiring harnesses and connections for wear or damage. Check for loose connections and areas of discoloration which may indicate overheating.

- Clean the power supply periodically: use compressed air to blow dust and dirt that may have accumulated inside the unit. In an excessively dirty environment, do this weekly.

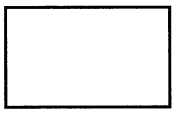
SEQUENCE OF EVENTS

On the following pages is a detailed flow chart outlining the sequence of events during proper MAX100 operation with a hand or machine torch. Shaded boxes represent action taken by the operator.

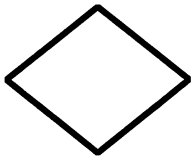
The following symbols used in the flowchart are ANSI standard flowcharting symbols. Their names and definitions are as follows:



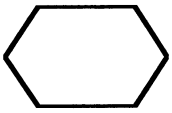
Terminus The terminus is used to indicate the beginning or ending point of a flowchart.



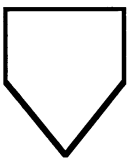
Task/Process Box The process or task box is used to indicate any process or task other than an input/output operation or a decision.



Decision Diamond The decision diamond is used to indicate a decision or branching point.

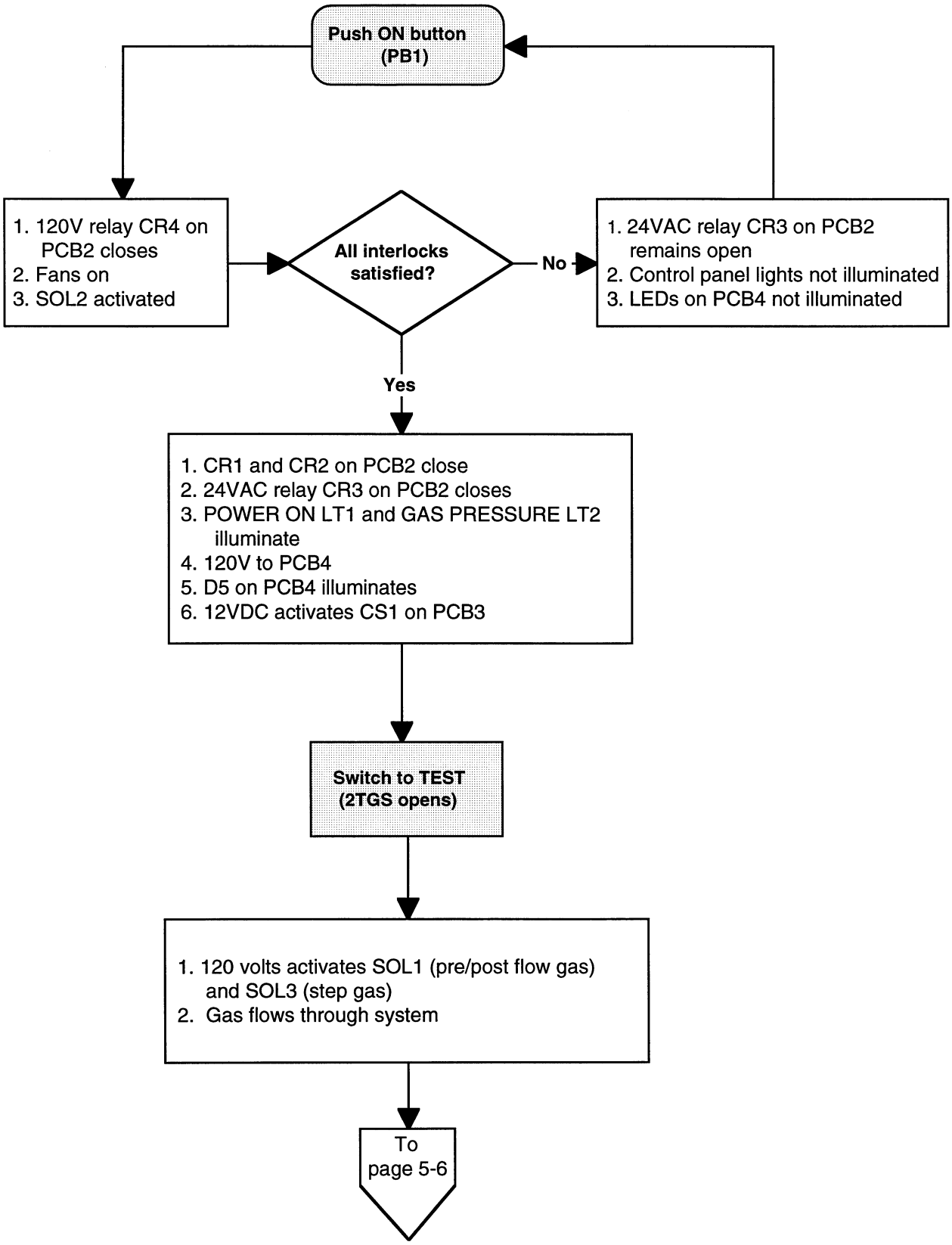


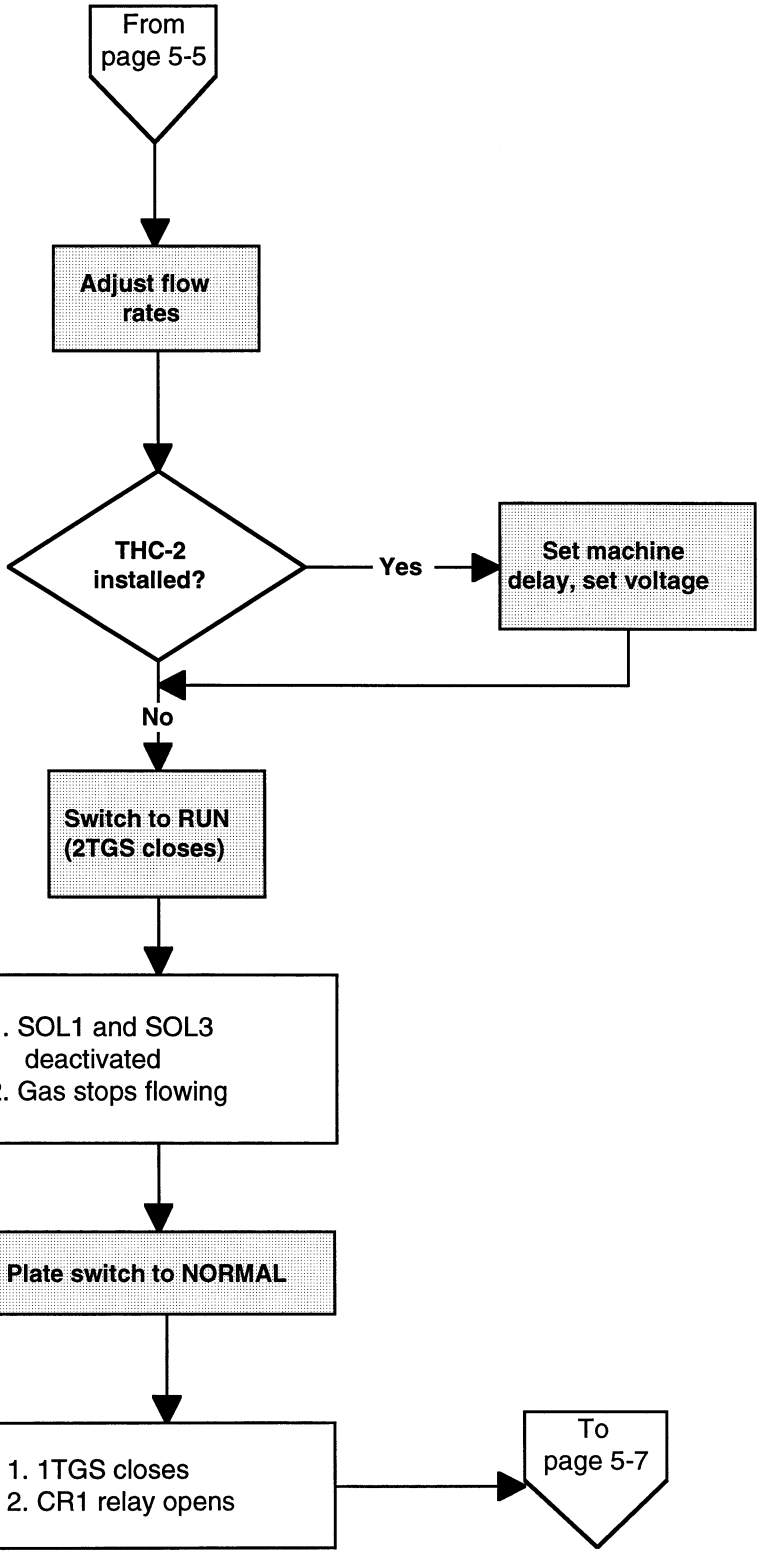
Preparation The preparation symbol is used to indicate an instruction modification.

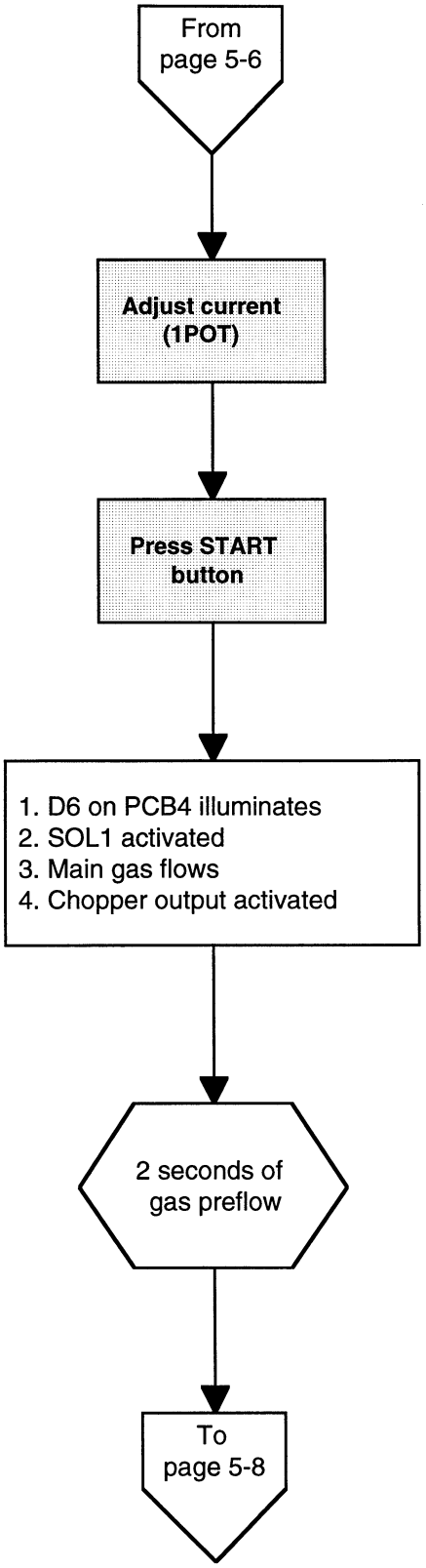


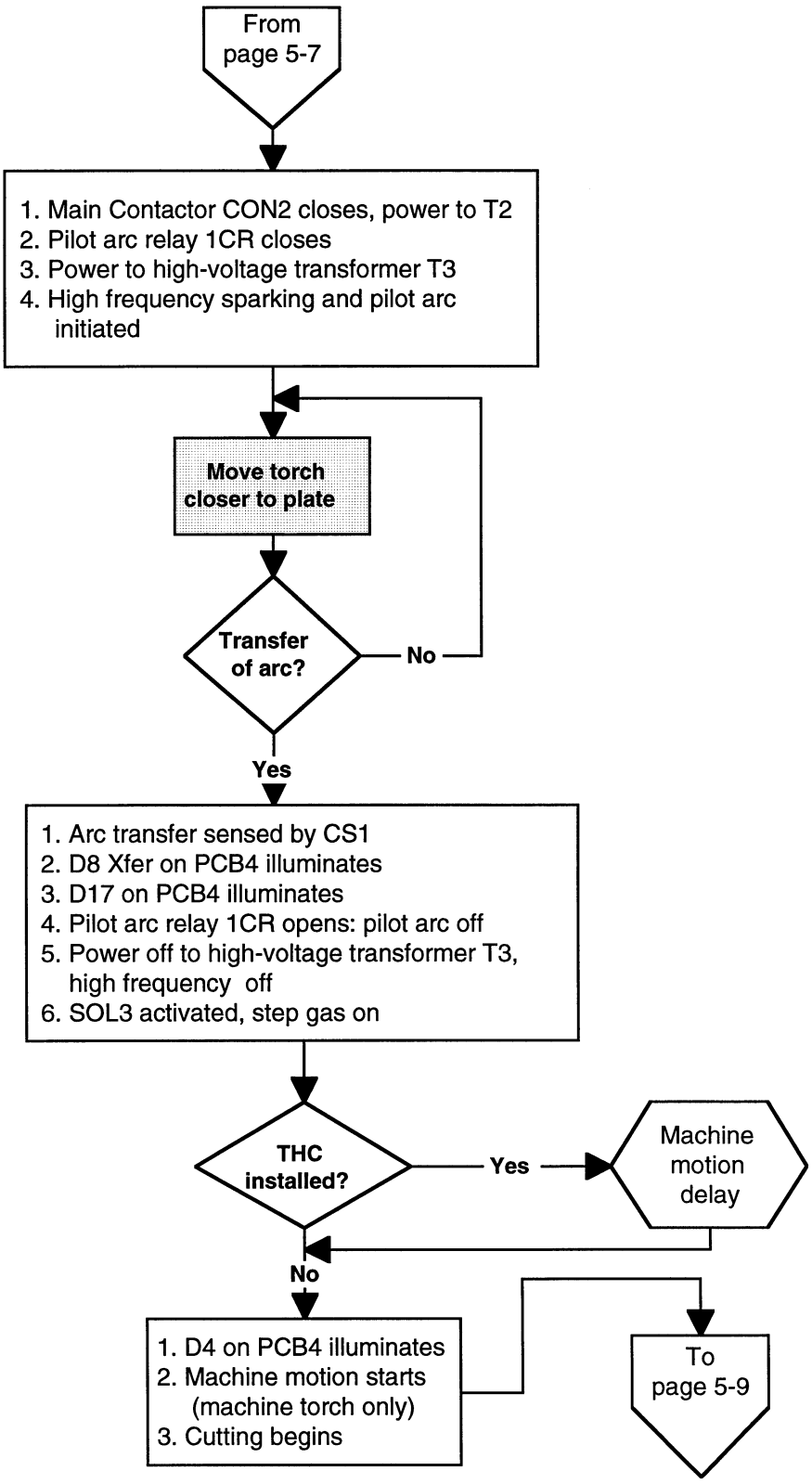
Off-page Connector The off-page connector is used to indicate exit or entry from another page to the flowchart.

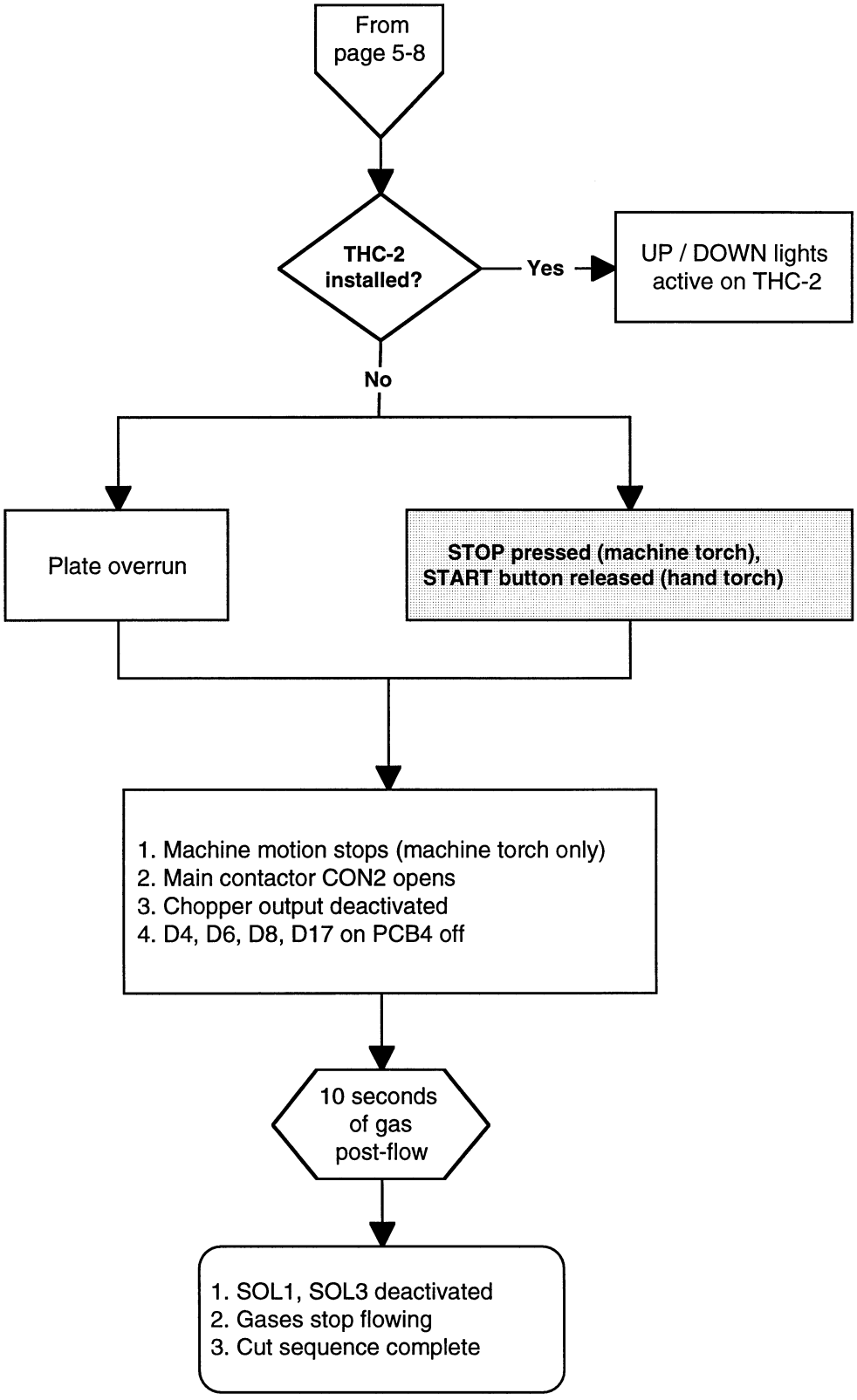
MAINTENANCE


Push ON button
(PB1)
1. 120V relay CR4 on PCB2 closes
2. Fans on
3. SOL2 activated
All interlocks satisfied?
No
1. 24VAC relay CR3 on PCB2 remains open
2. Control panel lights not illuminated
3. LEDs on PCB4 not illuminated
Yes
1. CR1 and CR2 on PCB2 close
2. 24VAC relay CR3 on PCB2 closes
3. POWER ON LT1 and GAS PRESSURE LT2 illuminate
4. 120V to PCB4
5. D5 on PCB4 illuminates
6. 12VDC activates CS1 on PCB3
Switch to TEST
(2TGS opens)
1. 120 volts activates SOL1 (pre/post flow gas) and SOL3 (step gas)
2. Gas flows through system
To page 5-6


From page 5-5
Adjust flow rates
THC-2 installed?
Yes
Set machine delay, set voltage
No
Switch to RUN (2TGS closes)
1. SOL1 and SOL3 deactivated
2. Gas stops flowing
Plate switch to NORMAL
1. 1TGS closes
2. CR1 relay opens
To page 5-7


From
page 5-6
Adjust current
(1POT)
Press START
button
1. D6 on PCB4 illuminates
2. SOL1 activated
3. Main gas flows
4. Chopper output activated
2 seconds of
gas preflow
To
page 5-8


From page 5-7
1. Main Contactor CON2 closes, power to T2
2. Pilot arc relay 1CR closes
3. Power to high-voltage transformer T3
4. High frequency sparking and pilot arc initiated
Move torch closer to plate
Transfer of arc?
No
Yes
1. Arc transfer sensed by CS1
2. D8 Xfer on PCB4 illuminates
3. D17 on PCB4 illuminates
4. Pilot arc relay 1CR opens: pilot arc off
5. Power off to high-voltage transformer T3, high frequency off
6. SOL3 activated, step gas on
THC installed?
Yes
Machine motion delay
No
1. D4 on PCB4 illuminates
2. Machine motion starts (machine torch only)
3. Cutting begins
To page 5-9


From page 5-8
THC-2 installed?
Yes
UP / DOWN lights active on THC-2
No
Plate overrun
STOP pressed (machine torch), START button released (hand torch)
1. Machine motion stops (machine torch only)
2. Main contactor CON2 opens
3. Chopper output deactivated
4. D4, D6, D8, D17 on PCB4 off
10 seconds of gas post-flow
1. SOL1, SOL3 deactivated
2. Gases stop flowing
3. Cut sequence complete

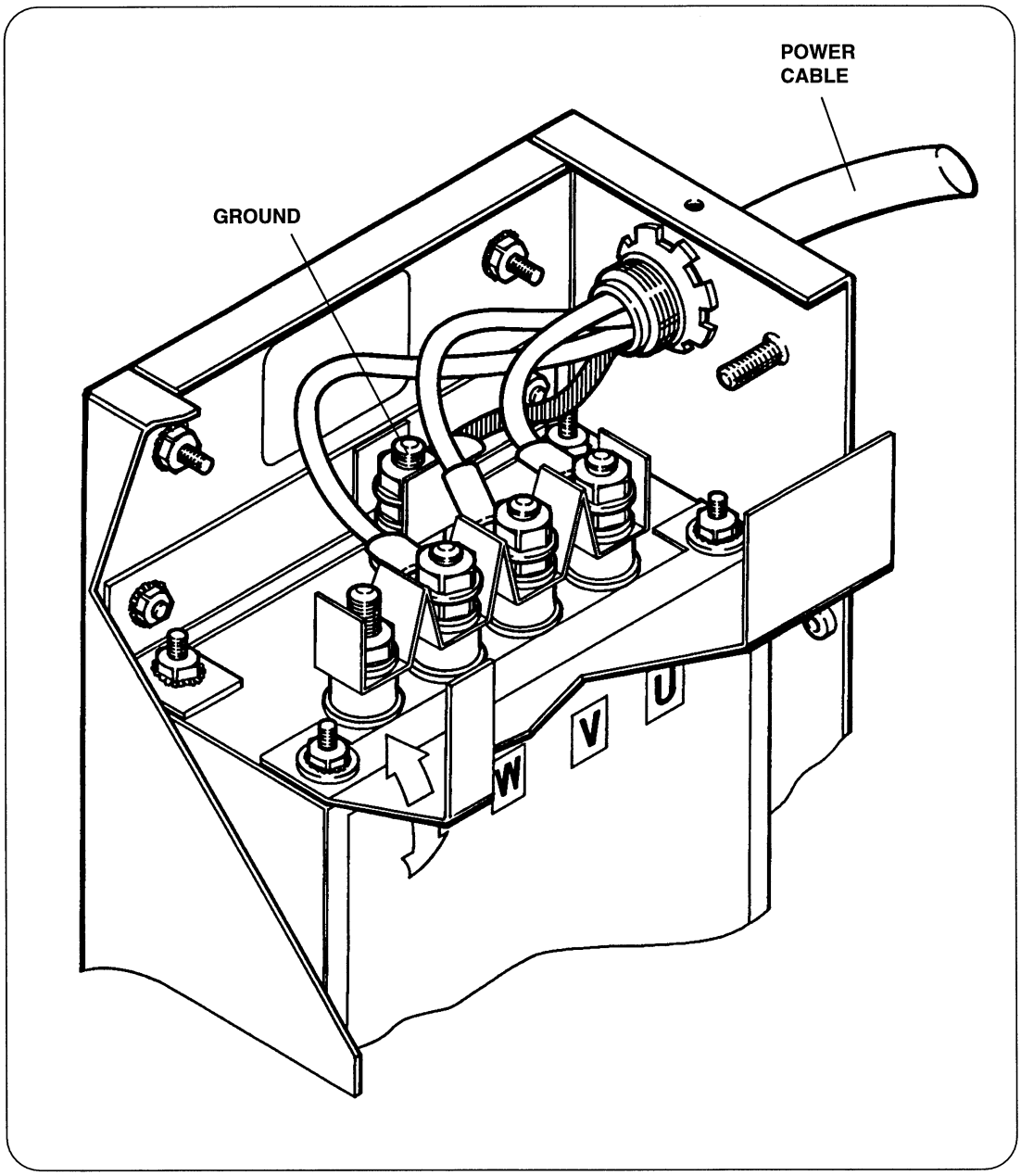
INITIAL CHECKS

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

WARNING

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

1. Disconnect line power by turning main disconnect switch off.
2. Using a Phillips head screwdriver, remove top plate, two side plates, front plate and rear plate.
3. Inspect interior of unit for discoloration on pc boards, or other apparent damage. If a component or module is obviously defective upon visual inspection, remove and replace it before doing any testing. Refer to the **Parts List** section (**6**) to identify parts and part numbers.
4. If no damage is apparent, apply power by turning on the main disconnect switch.
5. Measure the voltage between the U, V and W terminals on the EMI filter located on the rear of the MAX100 power supply. Refer to Figure 5-1. The voltage between any two of the three terminals should be equal to the supply voltage (380 or 415 VAC). If there is a problem at this point, disconnect main power and check connections, power cable, and fuses at line disconnect switch. Repair and/or replace defective component(s) if necessary.



MAINTENANCE

Figure 5-1 Primary Power Measurement Location - MAX100 CE

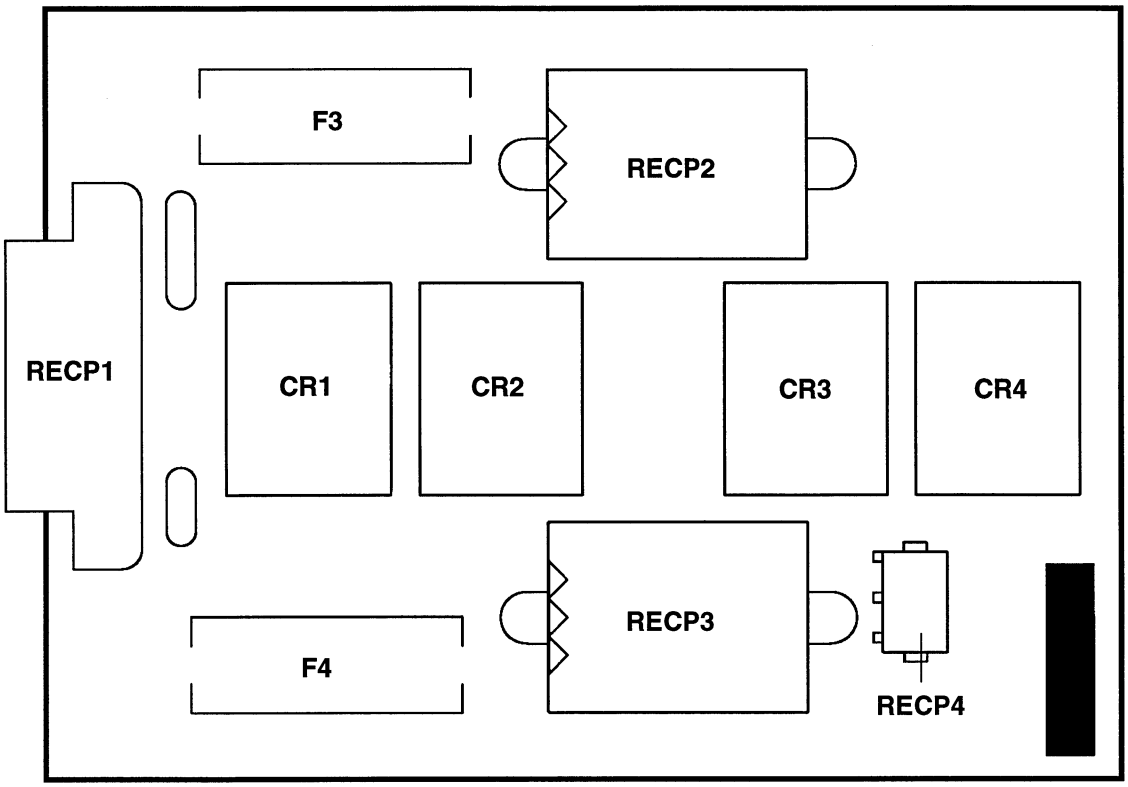


Figure 5-2 Power Distribution Board PCB2

6. Measure voltage at Power Distribution Board PCB2. Refer to Figure 5-2 for detail of PCB2. Look on the board for fuses **F3** and **F4**. Measurements between each fuse and chassis ground should be as follows:

   F3: 115 VAC
   F4: 24 VAC

   If voltages are not present, or incorrect at one or more of these points, disconnect power and troubleshoot PCB2 fuses and associated pins, connectors and wiring between power distribution board connector RECP1 and transformer secondary T1. See Figure 6-4 for location of T1.

   Also, check main power fuses F1 and F2 (located in Figure 6-1), and associated wiring and connections between T1 and L1 and L2.

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

TROUBLESHOOTING

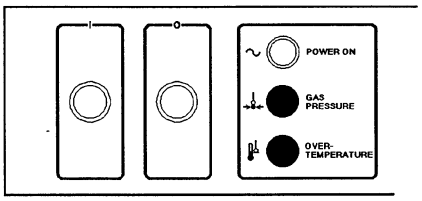
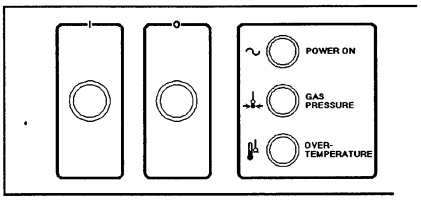
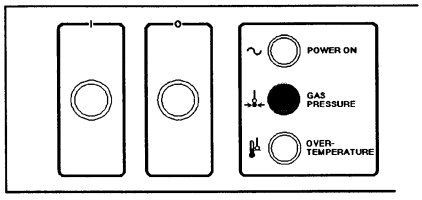
The troubleshooting section is presented by following normal operational sequence. Shaded boxes with operator action correspond to action outlined in *Sequence of Events.* Before troubleshooting for specific problems, be sure that unit passes *Initial Checks* as outlined earlier in this section.

WARNING

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

Push ON button (PB1)

Problem	Possible Causes and Solutions
1. The fans are not operating and the POWER ON indicator does not illuminate.	**1.1.** *The green I (ON) PB1 pushbutton is defective.* Check switch. The ON switch is normally open. **1.2.** *The red O (OFF) PB2 pushbutton is defective.* Check switch. The OFF switch is normally closed. **1.3.** *Associated wiring not making good contact.* Check wiring and repair or replace, if necessary.
2. POWER ON indicator illuminates, but the fans are not operating.	**2.1.** *CR4 on the Power Distribution Board is defective.* Check that CR4 switches when ON pushbutton is pressed. See Figure 5-2 for location of CR4. If CR4 is defective, replace PCB2. **2.2.** *Terminals to fans are not seated together securely and/or not getting 120VAC from Power Distribution Board.* Check terminals and associated wiring for good continuity. Check for 120VAC at terminals.

Problem	Possible Causes and Solutions
	2.3. *PL2 and RECP2 on Power Distribution Board (see Figure 5-2 for location of RECP2) are not seated well.* Check pins, connectors and associated wiring for good continuity. Repair or replace, if necessary.
3. The fans are operating, but the POWER ON indicator does not illuminate.	**3.1.** *The I (ON) PB1 pushbutton was not held down for a long enough time.* Press and hold the I (ON) button for a minimum of 5 seconds. If the POWER ON indicator will not illuminate after holding down the I (ON) button for 5 seconds, check the safety "interlock" indicators while holding down the I (ON) button. Refer to the control panel indicator conditions and possible causes and solutions listed opposite.
Note: Indicator On = ○ Indicator Off = ●	
	**3.2.1** *Gas is not on or is set too low.* Control panel indicator GAS PRESSURE will not illuminate if the pressure to the MAX100 is set too low. Be certain that the plasma supply gas is on and is set at a minimum of **90 psi (6.2 bar).**
	3.2.2. *There is a gas leak somewhere in the system.* Be certain that there is no hissing sound coming from the torch, or anywhere between the torch and the gas supply.
	3.2.3 *Pressure switch PS1 not functioning.* PS1 is normally open, and closes when gas pressure of **40 psi (2.7 bar)** or greater is sensed. It is powered by 24VAC from the Power Distribution Board. After PS1 is closed, 24VAC illuminates the GAS PRESSURE indicator. Use wiring diagram in **Section 7** to troubleshoot.
	**3.3.** *Main Transformer T2 and/or chopper has overheated* Temperature switch TS1 will open when the transformer overheats. Temperature switch TS2 will open when the chopper overheats. If transformer T2 or chopper are excessively hot, leave the MAX100 off with fans running for 1 hour to cool down. If transformer and chopper are <u>not</u> hot, take TS1 connector apart and check for continuity. TS1 and TS2 are normally closed. Also, check TS2 for continuity. Check pins, connectors and associated wiring from TS1 and TS2 to PL3 of power distribution board PCB2.
	**3.4.** *There are problems with the gas pressure <u>and</u> the transformer or chopper.* See 3.2. to 3.3. above.

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Switch to TEST

Problem	Possible Causes and Solutions
4. Gas flow is weak, or not flowing.	**4.1.** *TEST/RUN switch not functioning* 2TGS is open in TEST mode. Make a continuity check. **4.2.** *GAS adjustment valve is closed* Open gas valve on front panel. **4.3.** *Solenoid valves SOL1 and/or SOL3 not getting 120VAC from Control Board PCB4.* Disconnect receptacles from SOL1 and SOL3, and check for 120VAC from Control Board PCB4 after 2TGS is in the TEST position. See Figure 6-5 for location of SOL1 and SOL3. If there is no 120VAC use wiring diagram and check pins, connections and associated wiring from SOL1 and SOL3 to PCB4. If wiring is OK, replace Control Board PCB4. **4.4.** *Solenoid valves SOL1 and/or SOL3 not functioning* If valves are getting 120VAC from PCB4, verify that valves are opening. If not, replace them. **4.5.** *Gas line(s) from solenoid valves to gas adjustment valve to torch are blocked or leaking.* Check hoses and repair or replace if necessary.

Adjust flow rates

Problem	Possible Causes and Solutions
5. Flow rates cannot be adjusted to specifications suggested in Cut Charts	**5.1.** *Source gas pressure not on or set too low* Set incoming pressure to a minimum of **6.2 bar** at **208 liters/minute**. **5.2.** *Gas line(s) from solenoid valves to gas adjustment valve to torch are blocked or leaking* Check hoses and repair or replace if necessary.

Switch to RUN

Problem	Possible Causes and Solutions
6. Gas continues to flow	**6.1.** *TEST/RUN switch not functioning* 2TGS is closed in RUN mode. Make a continuity check. **6.2.** *Solenoid valves SOL1 and/or SOL3 not getting 0VAC from Control Board PCB4.* Disconnect receptacles from SOL1 and SOL3, and check for 0VAC from Control Board PCB4 after 2TGS is in the RUN position. See Figure 6-5 for location of SOL1 and SOL3. If there is 120VAC replace Control Board PCB4. **6.3.** *Solenoid valves SOL1 and/or SOL3 not functioning* If valves are getting 0VAC from PCB4, verify that valves are opening correctly. If not, replace them.

Press START button

Problem	Possible Causes and Solutions
7. There is no high frequency and no pilot arc.	**7.1.** *There is no spark between the spark gap electrodes* Clean (with emery cloth), align, and/or regap (.5 mm per gap) the electrodes, if necessary. Ensure that the electrode surfaces between the gaps are flat. If surfaces are rounded, replace and regap. See Figure 6-2 for location of spark gap assembly SG1. **7.2.** *High voltage transformer T3 is overheating* Check T3 for leaking or overheating. Replace, if necessary. **7.3.** *High voltage transformer T3 not getting 120VAC from Control Board PCB4* Check pins, connectors and associated wiring from T3 to PCB4. **7.4.** *T3 or capacitor pair 4CAP, 5CAP in spark gap assembly defective* Shut down system and remove capacitors 4CAP, 5CAP (see Figure 6-2 for location). Restart system and see if a faint spark is now observed across the gaps. If a spark is not observed at the gaps, replace T3. If there is a spark, replace capacitor pair 4CAP, 5CAP. Always replace the capacitors in pairs.

Problem	Possible Causes and Solutions
	7.5. *There is no high frequency at the torch* Check for a shorted torch, a damaged pilot arc lead, or loose lead connections. Replace the torch or pilot arc lead or tighten the lead connections. **7.6.** *Pilot arc relay CR1 is not functioning or not getting 120VAC from the Control Board PCB4* See if the CR1 relay contacts close after the START command is given. If CR1 does <u>not</u> close, check to see if CR1 is getting 120VAC from PCB4. If it is, replace CR1. If there is no 120VAC from pins 5&6 of S2 of PCB4, replace Control Board PCB4.
8. There is high frequency, but there is no pilot arc.	**8.1.** *Torch parts are worn* Check consumable parts and replace, if necessary. See *Changing Consumable Parts* in **Section 4**. **8.2.** *Torch leads are loose or worn* Replace torch leads as required. **8.3.** *Pilot arc relay CR1 not functioning* See solution 7.6. **8.4.** *Main contactor CON2 or PCB4 is defective* Check to see if CON2 is getting 24VAC after START command is given. If there is no 24VAC, check pins, connections and associated wiring from CON2 to PCB4. If wiring is O.K., replace PCB4. If there <u>is</u> 24VAC at CON2 after START command is given, measure for 200VAC between terminals A, B and C of main transformer T2. If there is no voltage between these points, replace CON2. **8.5.** Surge injection circuit is defective. Check capacitor C3 and resistor R3. Replace as required. See Figure 6-4 for location of C3 and R3. **8.6.** *Chopper defective or not functioning.* See *Chopper Module Test Procedure* later in this section to troubleshoot.

Move torch close to plate

Problem	Possible Causes and Solutions
9. Arc not transferring to workpiece	**9.1.** *The work clamp is not connected or it is broken.* Connect or repair the work clamp. **9.2.** *Torch Height Control receiving incorrect voltage for correct standoff distance (for machine torches with THC)* Check the arc voltage setting for the type and thickness of metal you are cutting from the *Cut Charts* in **Section 4**. **9.3.** *Transfer of arc not sensed by MAX100* See *Arc Transfer Test Procedure* later in this section. **9.4.** *Chopper defective or not functioning* See *Chopper Module Test Procedure* later in this section.
10. The unit stops cutting during cut, or cuts poorly.	**10.1.** *There is insufficient air or gas pressure* Check that gas inlet pressure is at least **6.2 bar**. Check plasma gas pressures in TEST mode as specified under *Cut Charts* in **Section 4**. **10.2.** *Torch is getting insufficient current* Check the arc current setting for the type and thickness of metal you are cutting from the *Cut Charts* in **Section 4**. **10.3.** *Torch consumable parts are worn* Check consumables and replace if necessary. See *Changing Consumable Parts* in **Section 4.** **10.4.** *Plate switch is in the Expanded position* When cutting most metals, place the Plate switch in the Normal position. Switch to Expanded position only when cutting metal grate (see *Description of Controls* and *Operating Instructions* in **Section 4**). **10.5.** *The power supply has overheated* Shut down system and wait for unit to cool down. If unit will not restart, see interlock troubleshooting guide earlier in this troubleshooting section **(3.2)**. **10.6.** *Chopper defective or not functioning* See *Chopper Module Test Procedure* later in this section.

Plate overrun	or	STOP pressed (machine torch), START button released (hand torch)

Problem	Possible Causes and Solutions
11. Machine motion continues (machine torch only)	**11.1.** *Defective or miswired machine START switch* Check switch and wiring diagrams for correct hookup of PLASMA START and MACHINE START. **11.2.** *Arc transfer signal not changing* Check to see if D8 on Control Board PCB4 remains illuminated after torch moves away from plate. See Figure 5-6 for location of D8. • If D8 remains illuminated, check to see if Hall effect sensor CS1 is sending a 0 volt signal to pin 14 of S2 of PCB4. If there is 0 volts at pin 14, replace sensor CS1. See Figure 6-2 for location of CS1. If voltage at pin 14 is greater than 0 volts, replace Control Board PCB4. • If D8 is extinguished, replace Control Board PCB4.
12. Gas continues to flow after 10 seconds	**12.1.** *Gas TEST/RUN switch is in the TEST position* Be certain that Gas switch is in the RUN position when cutting.
13. No post-flow of gas	**13.1.** *Defective Control Board PCB4* See step 4.3. If valves are working in TEST mode, but not in post-flow mode, replace Control Board PCB4. **13.2.** *Defective valves* See step 4.4.
14. Short torch consumables life	**14.1.** *Plate is in the Expanded position* Plate switch should be in the Expanded position only when cutting metal grate (expanded metal). **14.2.** *Pilot arc relay CR1 not opening after transfer of arc* Check to see if contacts on relay CR1 are stuck shut. Replace if necessary. If relay is OK, check to see if CR1 is receiving 120VAC from the Control Board PCB4 after transfer of arc. If Control Board PCB4 continues to send 120VAC to CR1 after arc transfer, replace Control Board PCB4.

TEST PROCEDURES

WARNING

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

Arc Transfer Test Procedure

The "transfer" of arc refers to the arc being made between the electrode of the torch and the workpiece. The pilot arc is made between the torch electrode and the torch nozzle and precedes transfer in normal operation. When transfer is made, it is sensed by a Hall effect device (CS1) on the I/O board and the signal is sent to the Control Board PCB4. To check for proper functioning of the arc transfer sensing system, perform the following procedure:

1. Observe D8 on PCB4 (see Figure 5-6) and see if it illuminates after main contactor closes (see sequence flowchart earlier in this section). If it does not illuminate, continue to next step. If it does illuminate, return to *Troubleshooting* section.

2. Disconnect PL4 (small 3-pin connector) from CS1 (see Figure 6-2 for location of CS1) and check for +12VDC between pins 2&3. If there is +12VDC, go to step 5.

3. If there is no +12VDC, power down and check connectors, pins and associated wiring between PL4 and PL6 (connected to S2 on Control Board PCB4). Repair and/or replace defective component(s) if necessary.

4. If wiring is OK, replace Control Board PCB4.

5. If there is +12VDC between pins 2&3 of PL4, reconnect PL4 and take voltage between pins 13&14 of PL6 on Control Board PCB4 after arc is established. This should read 0 volts.

   If there is no 0 volts, replace CS1.

TEST PROCEDURES (Cont.)

Chopper Module Test Procedure

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

WARNING

SHOCK HAZARD: Use extreme care when working near the chopper modules. The large electrolytic capacitor(s) (blue-cased cylinder(s)) store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge the capacitor(s) with a screwdriver or other implement...explosion, property damage and/or personal injury will result. Wait at least five minutes after turning the power supply off before touching the chopper or the capacitor(s).

1. Turn all power to the MAX100 OFF.
   Disconnect terminals labeled 21&22 from their mating receptacles to disable the high frequency transformer. Terminals 21&22 are located near the high voltage transformer T3. See Fig. 6-2 for location of T3.

2. Remove large fuse F5. Check to see if fuse is open. See Fig. 6-2 for location of F5.

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

4. Turn power to the MAX100 ON, and start system up. After the START command has been given, check voltage. The input to the chopper at these points should be about +280 VDC. If the input is OK and F5 was blown, replace the chopper module.
   If there is no +280 VDC input, check input to bridge for shorts. Also, check contactor CON2, connections and associated wiring to the contactor. Repair and/or replace defective component(s) if necessary.

5. If voltage from above step is +280 VDC and F5 is not blown, check output of chopper by putting the positive lead of the voltmeter at point (+) WORK and placing the negative lead on point (-) TORCH. See Fig. 5-3.

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

7. If the chopper does not output +280 VDC, check to see if LED1 logic power light is illuminated. If LED1 is not illuminated, check if 120V is going to JP6. If there is no 120V at JP6, check wiring back to power distribution board. Repair or replace defective component(s), if necessary.

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Also check to see if LED3 is turning green when enabled (normal condition). If LED1 is illuminated and LED3 is red when enabled (fault condition), then make sure that JP9 is seated properly.

8. If chopper still does not output 280V after completing step 7, there may be a problem with the control signal or the chopper module. The chopper drive signal comes from the control board PCB4 as an analog level from 0 to +12 VDC, which varies the duty cycle and subsequent output current of the chopper. This analog signal is on pins 10&11 of S3 on PCB4.
   To determine if there is a problem with the chopper module or with control board PCB4, proceed as follows:

   - Ensure that high frequency is still disabled (see step 1).
   - Disconnect PL7 from S3 on PCB4.
   - Place voltmeter across output of chopper and press the START command.
   - If the voltmeter reads +280 VDC, then there is a problem with PCB4.
   - If the voltmeter reads 0 volts, then replace chopper module.

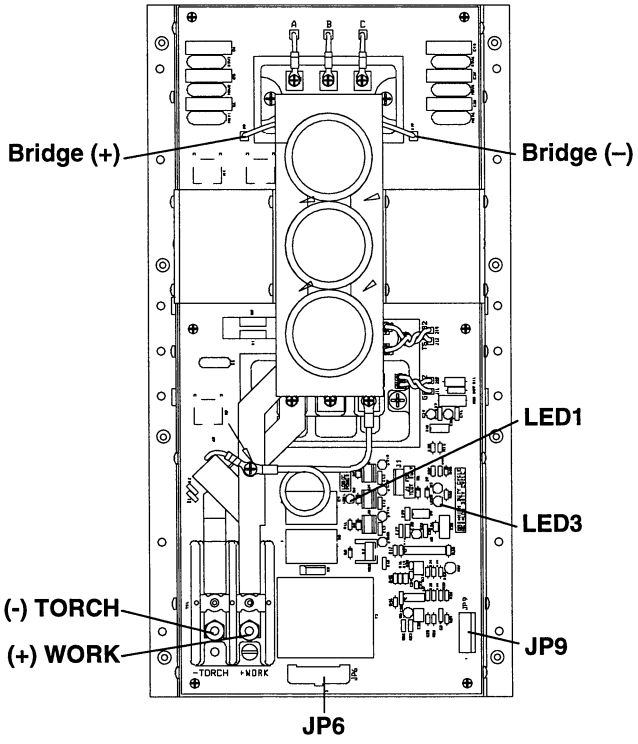

Figure 5-3 Chopper Module - Front View

DISASSEMBLY OF HAND TORCH

To remove and replace the hand torch main body from the torch lead, perform the following procedure and see Figure 5-4.

Removal

1. Remove the five (5) **screws** and separate the two **handle** halves.
2. Remove the torch **switch** from the handle **switch holder** and allow to hang freely.
3. On the larger lead, use a 3/8" open-end wrench to hold the torch body fitting and a 1/2" open-end wrench to loosen the torch lead fitting.

   On the smaller lead, use a 5/16" open-end wrench to hold the torch body fitting and a 7/16" open-end wrench to loosen the torch lead fitting.
4. Remove the torch **main body**.

Replacement

Reverse the above steps to replace the new torch body onto the torch leads.

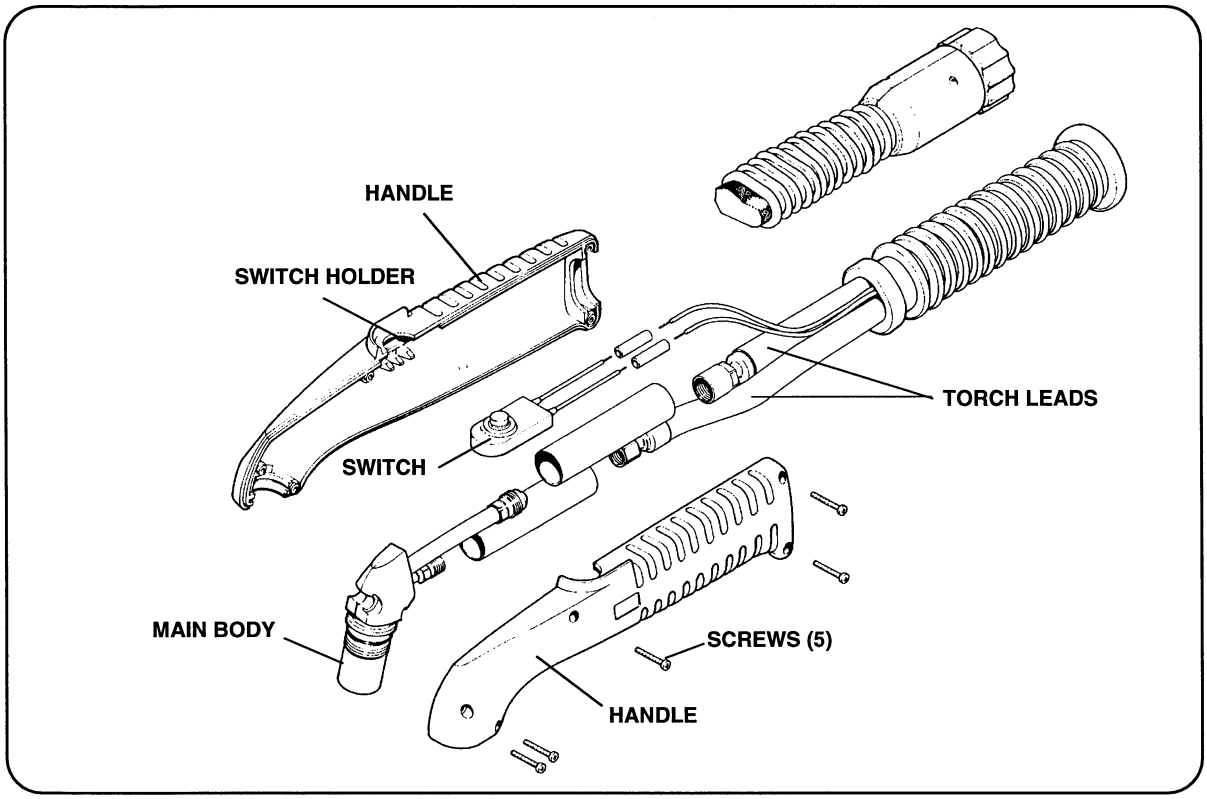

Figure 5-4 PAC130 Hand Torch Assembly

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DISASSEMBLY OF MACHINE TORCH

Refer to Figure 5-5 and follow the instructions below.

Removal

1. Unscrew the torch **sleeve** from the torch **main body** and slide it over the torch **leads**.

2. On the larger lead, use a 3/8" open-end wrench to hold the torch main body fitting and a 1/2" open-end wrench to loosen the torch lead fitting.

   On the smaller lead, use a 5/16" open-end wrench to hold the torch main body fitting and a 7/16" open-end wrench to loosen the torch lead fitting.

3. Remove the torch **main body**.

Replacement

Reverse the above steps to replace the new torch body onto the torch leads.

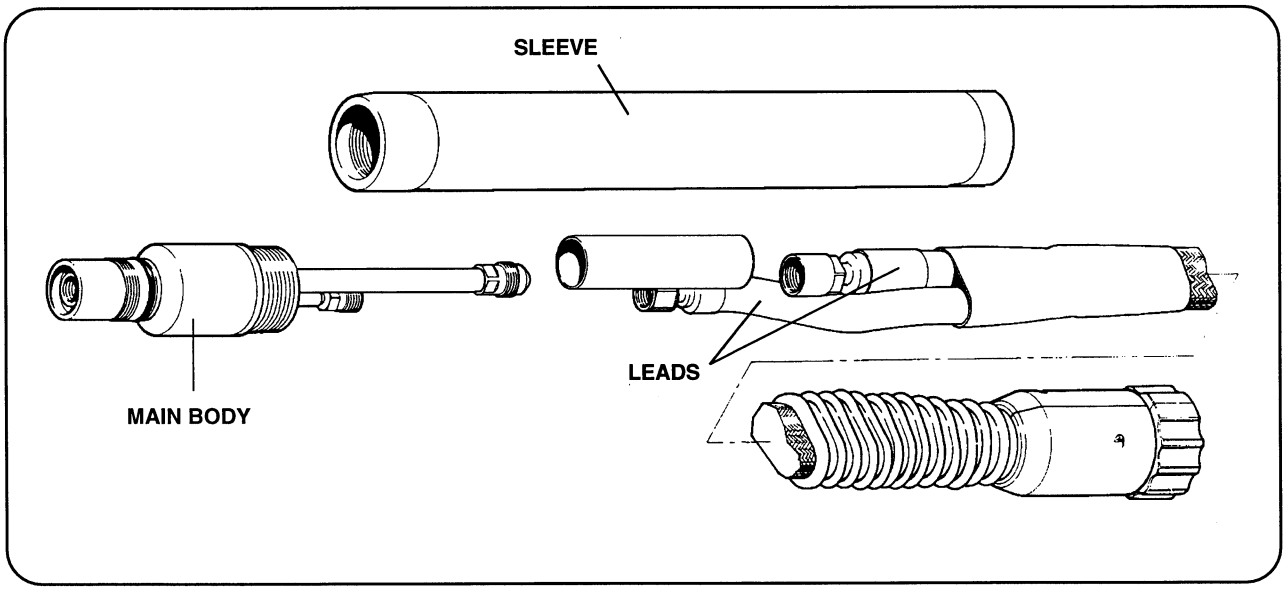

Figure 5-5 MAX100 Machine Torch

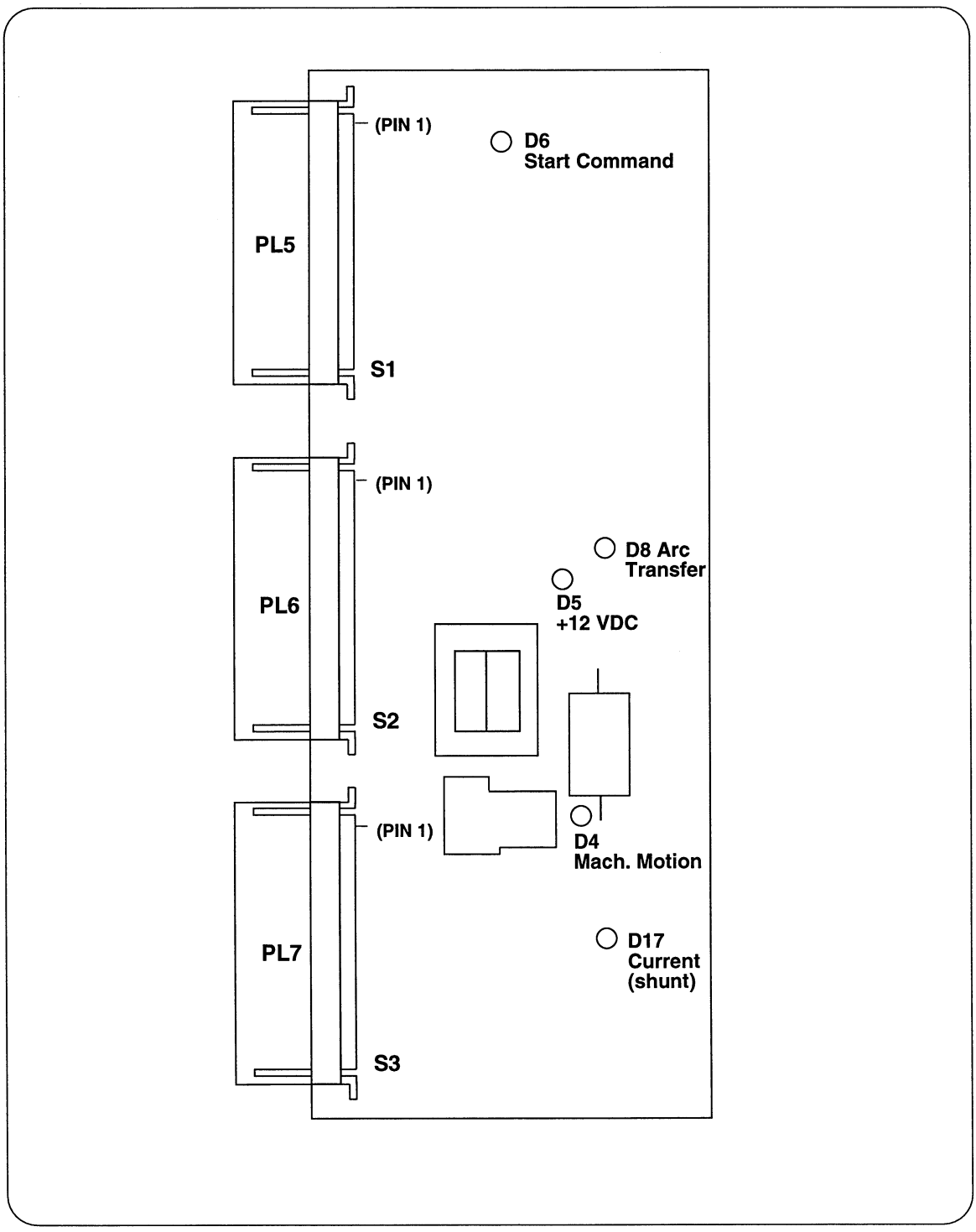

Figure 5-6 PCB4 Control Board

Section 6 PARTS LIST

In this section:

INTRODUCTION

In this section is a parts list breakdown with accompanying drawings for the MAX100 plasma torch system.

The format to list and call out Hypertherm parts is as follows:

Item	Part Number	Description	Designator	Qty.
	129113	**Cont Pnl SA: MAX100-CE/LVD**		1
1	001573	Pnl: MAX100-CE/LVD Cont		1
18		**129118 CH130-CE/LVD Chopper SA**		1
	041353	**PCB Assy CH100/130 Chopper**	**PCB5**	1
20	008997	Fuse: 2A 500V 10mmX38mm Gl Slo	**F1, F2**	2

Item: Refers to item call out on opposing or same page.
Number (Ex. 1) refers to numbered call out (1) on opposing or same page.

Part Number: Refers to Hypertherm part numbers.
Bold part numbers (Ex. **129113**) signify parent or subassemblies that contain additional items.

Normal-style part numbers (Ex. 001573) signify single items.

Description: Describes the item.
Bold descriptions not indented (Ex. **Cont Pnl SA: MAX100-CE/LVD**) signify parent assemblies that contain additional items.

Normal-style part numbers that are indented (Ex. Pnl: MAX100-CE/LVD Cont) signify items under parent or subassembly.

Normal-style part numbers that are not indented (Ex. Fuse: 2A 500V 10mmX38mm Gl Slo) represent items that are not under a parent subassembly.

Designator: Represents a cross reference to wiring diagrams or pneumatic diagrams.
(Ex. **F1, F2** refers to fuses F1 and F2 shown in wiring diagrams)

Qty.: Refers to the number of items in the parent or subassembly.

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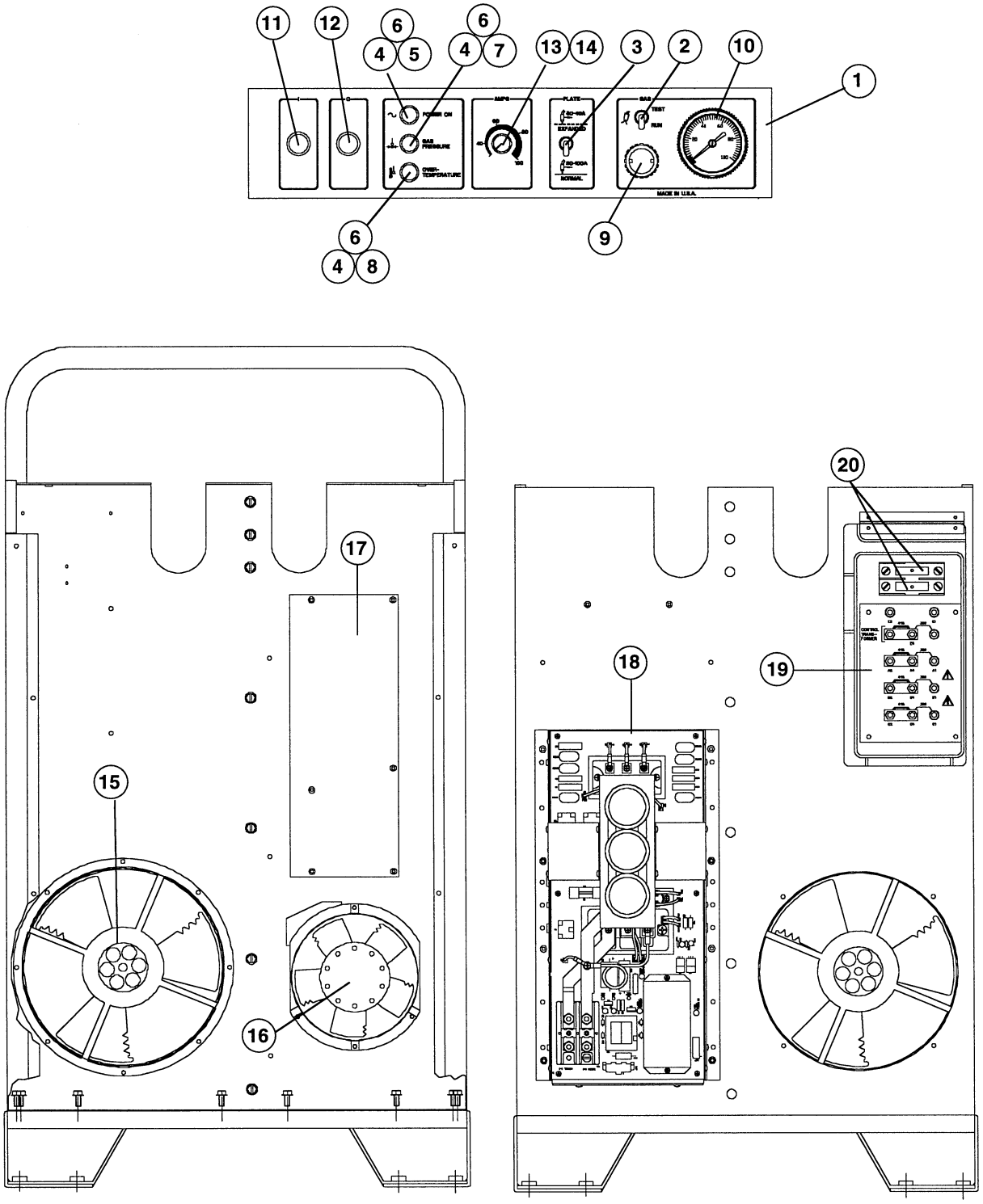


Figure 6-1 MAX100: Front Panel Outside, Front Panel Inside, and Control Panel

MAX100: Front Panel Outside, Front Panel Inside and Control Panel

Item	Part Number	Description	Designator	Qty.
	129113	**Cont Pnl SA: MAX100-CE/LVD**		1
1	001573	Pnl: MAX100-CE/LVD Cont		1
2	005044	Tgl Sw: SPDT Maint ON/ON	**2TGS**	1
3	005041	Tgl Sw: DP Maint ON/ON	**1TGS**	1
4	005088	Lamp Hldr: Use T3-1/4 LTBULB		3
5	005089	Lens: Wht For 005088		1
6	005168	Lightbulb: 28VDC 40ma T3-1/4	**LT1, LT2, LT3**	3
7	005177	Lens: Green for 005088		1
8	005197	Lens: Amber for 005088		1
9	006033	NDL Valve: 1/4 NPT .170 Orf		1
10	022008	Gauge, Press 2 1/2" Dia. 1-100		1
11	005121	PB Sw: Grn NO Full Gd	**PB1**	1
12	005122	PB Sw: Red NC	**PB2**	1
13	009483	Pot: 1K-Ohm 1W 10%	**1POT**	1
14	008328	Knob: .930 Dia 1/4 SFT Blk/Nat		1
15	027079	Fan 450-550 CFM 120VAC 50/60 Hz	**FAN1**	1
16	027080	Fan 225 CFM 120VAC 50/60 Hz	**FAN2**	1
17	**041114**	**PC BD Assy Ctrl MAX100**	**PCB4**	1
18	**129118**	**CH130-CE/LVD Chopper SA**		1
	005199	Temperature Switch 82°C	**TS2**	1
19	**129075**	**Linkboard SA: 100/D-CE/LVD 380-415**		1
20	008997	Fuse: 2A 500V 10mmX38mm Gl Slo	**F1, F2**	2
	001574	Panel:MAX100-CE/LVD Front		1

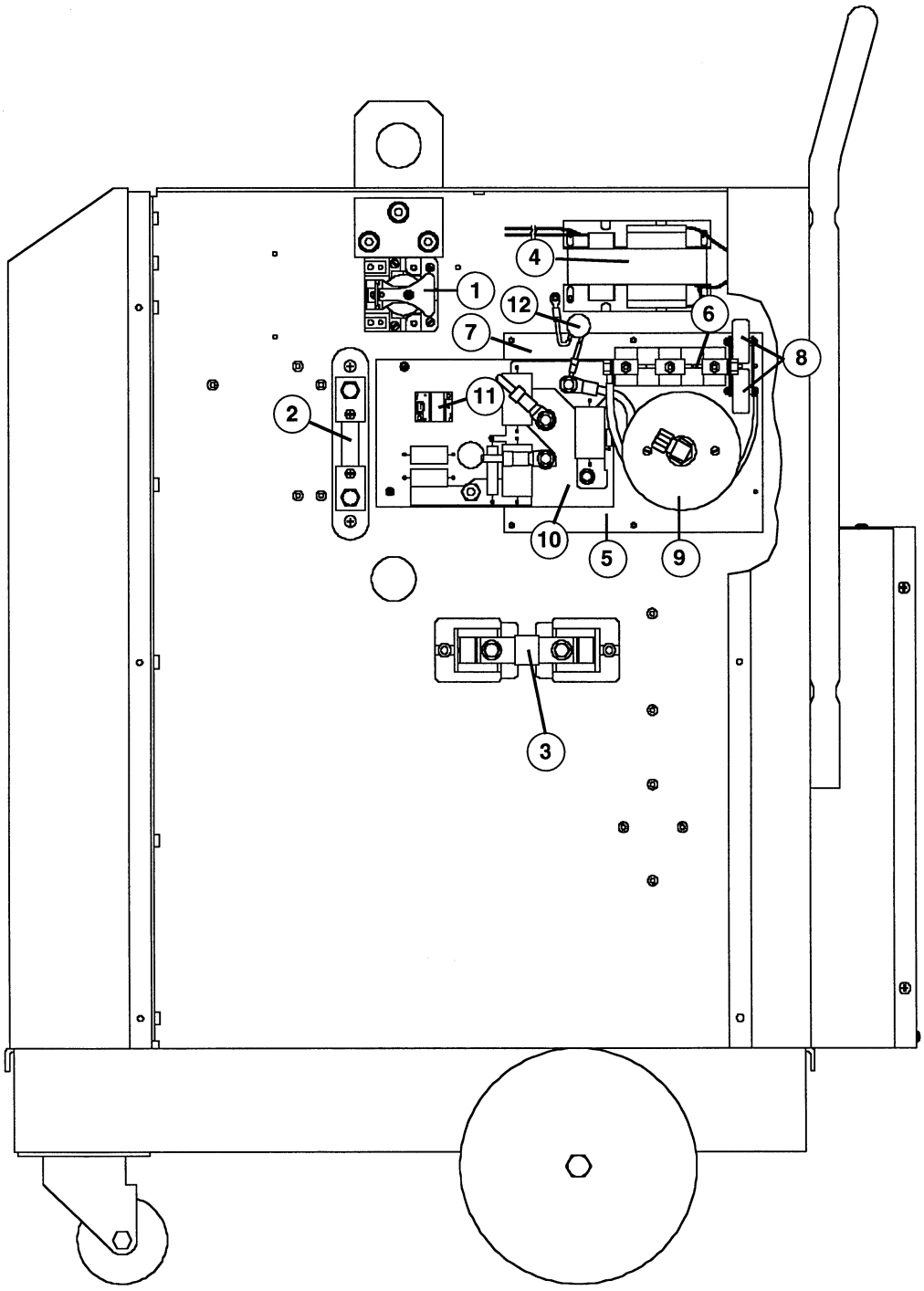


Figure 6-2 MAX100: Right Center Wall

MAX100: Right Center Wall

Item	Part Number	Description	Designator	Qty.
1	003021	Relay: 120VAC SPST NO	**CR1**	1
2	007022	Shunt: 100A 100 mv	**1MSH**	1
3	008317	Fuse: 125A 250V Semicond	**F5**	1
4	014021	Transformer, 5000VAC, 20ma	**T3**	1
5	**029190**	**Hi Freq/IO Panel SA, MAX100**	**PCB3**	1
	009350	**Spark Gap Assy: 40-20/2000/HD**	**SG1**	1
6	004061	Electrd:Spk Gap 1/8 x 1.6		3
7	004140	Base:40/80/100/200/HD Spk Gap		1
8	009280	Cap: .022uF 15kV	**4CAP,5CAP**	2
9	**009371**	**Coil Assy:80-100A HF**	**T4**	1
10	**041120**	**PC BD Assy I/O MAX100**		1
11	**029202**	**Current Sensor SA, MAX100**	**CS1**	1
12	129164	Capacitor SA: MAX100/D-CE/LVD Filter		1
	001578	Cover: MAX100-CE/LVD Side		1
	001575	Cover: MAX100-CE/LVD Top		1

MAX100: Base Plate Components

Item	Part Number	Description	Designator	Qty.
1	014043	Inductor, 4mh, 100ADC, MAX100	**L1**	1
2	014065	Transformer 15kW 220-380-415/3/50	**T2**	1

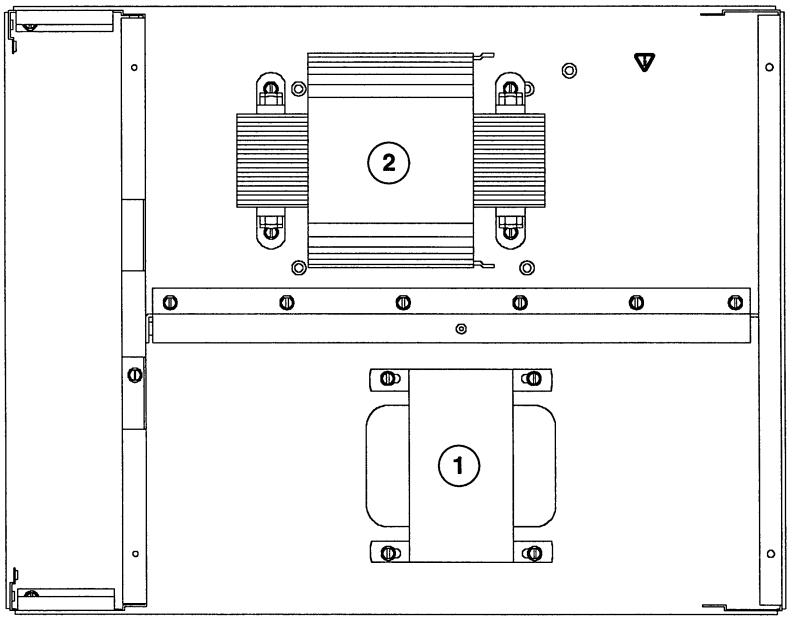


Figure 6-3 MAX100: Base Plate Components

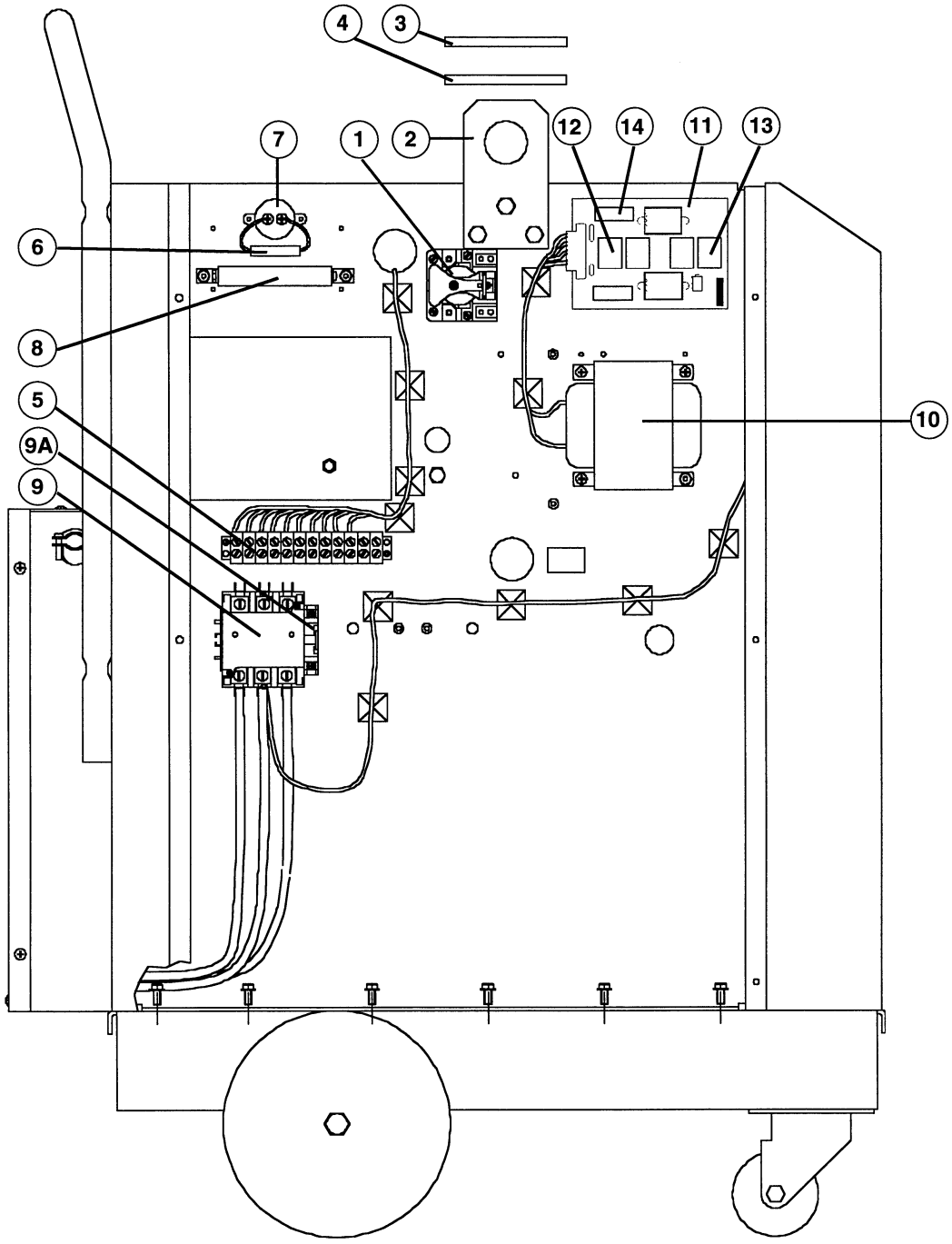


Figure 6-4 MAX100: Left Center Wall

MAX100: Left Center Wall

Item	Part Number	Description	Designator	Qty.
1	003021	Relay: 120VAC SPST NO	**CR3**	1
2	004261	Lifting Eye: 80/100 Pwr Unit		1
3	001601	Plate: MAX100-CE/LVD Lifting Eye		1
4	001602	Gasket: MAX100-CE/LVD Lifting Eye		1
5	008079	Term Bd: 12-Term	**TB1**	1
6	009015	Res: 10K ohm 10W 5% VIT	**R4**	1
7	009296	Cap: 100uF 350WV +50-10%	**C3**	1
8	009622	Res: 10 ohm, 50W 5% W/L Brk	**R3**	1
9	003153	Contactor, MAX100 60A 3P, 24VAC	**CON2**	1
9A	003154	Cont: MAX100 NO Aux		1
10	014028	Transformer, 40/100 220-380-415V	**T1**	1
11	**041530**	**PC Bd Assy Power Dist. MAX100-CE/LVD**	**PCB2**	1
12	003173	Relay: 24VAC 7A DPDT Mini	**CR1,CR2,CR3**	3
13	003174	Relay: 115VAC 7A DPDT Mini	**CR4**	1
14	108000	Fuse: 2A 250V 6.3mmX32mm	**F3,F4**	2
	001578	Cover: MAX100-CE/LVD Side		1

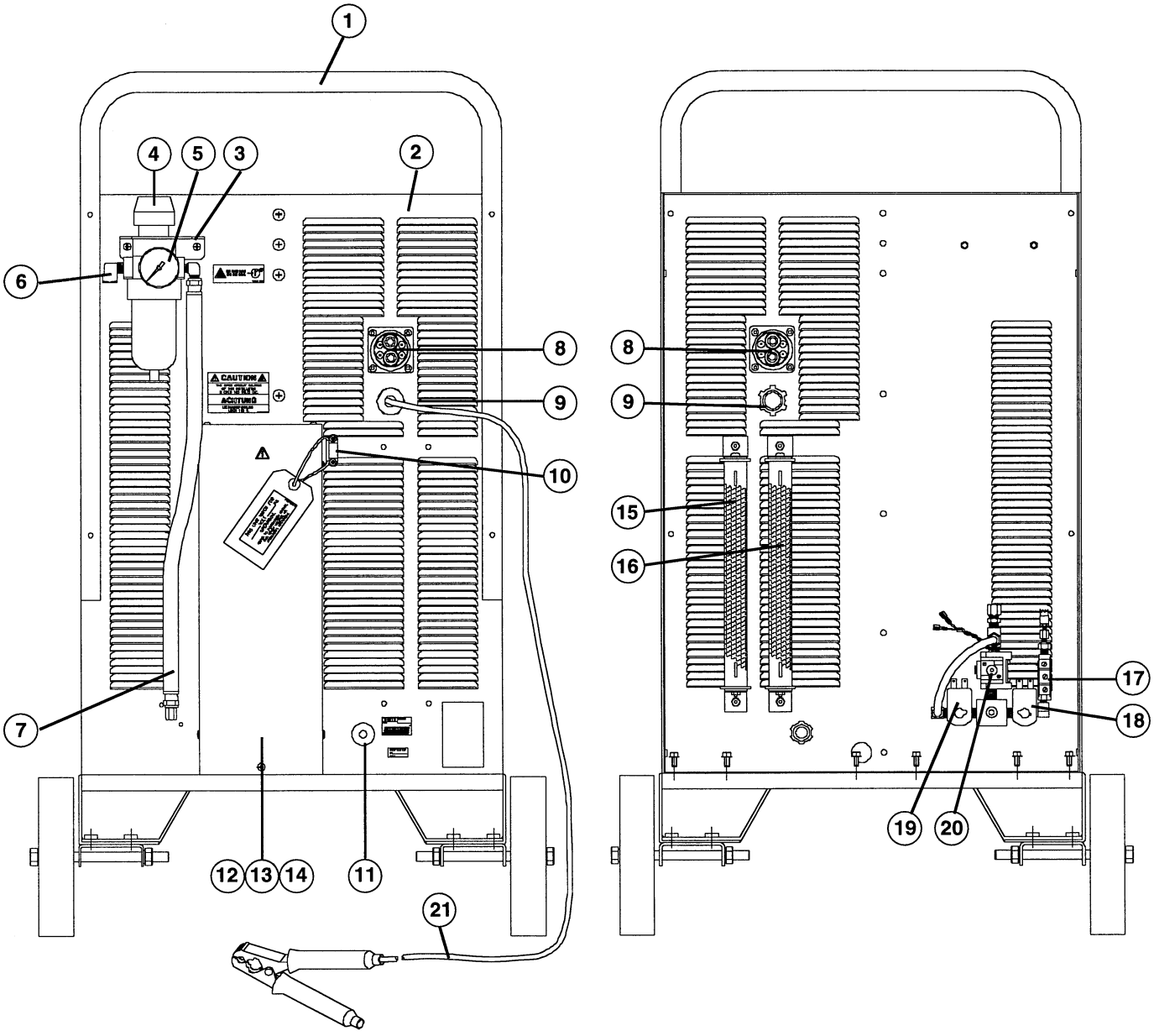


Figure 6-5 MAX100: Rear Panel Outside, Rear Panel Inside

MAX100 : Rear Panel Outside, Rear Panel Inside

Item	Part Number	Description	Designator	Qty.
1	001182	Handle: MAX80/MAX100		1
2	001577	Panel: MAX100-CE/LVD Rear		1
	029203	**Air Regulator SA: MAX100**		1
3	004264	Bracket: 80/100/200 Air Regulator		1
4	011025	Filter Regulator: 0-120 psi 1/4NPT Air		1
5	011027	Gauge,0-120 psig for 011025		1
6	015015	Adapter 1/4NPT x #6 Male 90 Brs		1
7	**024162**	**Hose Assy #6 x 19 1/2" Air Reg**		1
8	**028519**	**Rcpt Assy:80A/100A Qdisc**		1
9	008415	Strainrlf: 3/4 NPT x .310-.560		1
10	008944	Strainrlf: 3/4NPT .530 X .750		1
11	008070	Strainrlf: 1/2 NPT x .312-.375		1
12	001549	Enclosure:MAX100-CE Filter		1
13	001556	Cover:MAX100-CE Filter Enclosure		1
14	**129024**	**Line Filter SA:MAX100-CE**		1
15	009625	Resistor: 2.0 ohm, 395W	**R2**	1
16	009625	Resistor: 2.0 ohm, 395W	**R1**	1
	029191	**Gas Sply SA: MAX100**		
17	005093	Press Sw: 0-90 PSI 1/8 NPT	**PS1**	1
18	006014	Sol Valve: 90# 1/4 FPT 120V NC	**SOL2**	1
19	006014	Sol Valve: 90# 1/4 FPT 120V NC	**SOL1**	1
20	006032	Sol Valve: 150# 1/4 FPT 120V NC	**SOL3**	1
21	023209	Cable, Ground #4 W/Clamp 25'		1

MAX100 TORCH ASSEMBLIES WITH LEADS

INTERNATIONAL MACHINE TORCHES *			
Lead Configuration	with 25' Leads	with 50' Leads	with 75' Leads
With Quick Disconnect	059102	059103	059104
Without Quick Disconnect	059073	059074	059075

PAC130 HAND TORCHES **			
Lead Configuration	with 25' Leads	with 50' Leads	with 75' Leads
With Quick Disconnect	059093	059094	059095
Without Quick Disconnect	059076	059077	059079

90° HAND TORCHES			
Lead Configuration	with 25' Leads	with 50' Leads	with 75' Leads
With Quick Disconnect	059109	059110	059111
Without Quick Disconnect	059069	059070	059071

* See page 6-13 for breakdown of machine torch with Quick Disconnect.
** See page 6-15 for breakdown of PAC130 hand torch with Quick Disconnect.

INTERNATIONAL MACHINE TORCH

Item	Part Number	Description	Qty.
	059102	**MAX100 International Mach Torch Assy 25' QDisc.**	
	059167	**MAX100 International Mach Torch Assy 35' QDisc.**	
	059103	**MAX100 International Mach Torch Assy 50' QDisc.**	
	059104	**MAX100 International Mach Torch Assy 75' QDisc.**	
1	020245	Intl Torch Pos Sleeve 32mm O.D. MAX100	1
2	**020201**	**MAX100 180 Deg Torch Main Body**	1
3	020334	Shld:MAX80/100/C/D 100A	1
4	020336	Cap, Shld 80A/100A MAX100/100C	1
5	020337	Nozzle, Shld 100A MAX100/PAC130	1
6	020194	Swirl Ring, MAX100/PAC130	1
7	120433	Electrode:PAC130/160/MAX100/D Air	1
8	**028524**	**Leads:80A/100A Mch QDisc 25'**	1
9	**028909**	**Plug Assy:80A/100A Mach Qdisc.**	1
8	**028527**	**Leads:80A/100A Mch QDisc 35'**	1
9	**028909**	**Plug Assy:80A/100A Mach Qdisc.**	1
8	**028525**	**Leads:80A/100A Mch QDisc 50'**	1
9	**028909**	**Plug Assy:80A/100A Mach Qdisc.**	1
8	**028526**	**Leads:80A/100A Mch QDisc 75'**	1
9	**028909**	**Plug Assy:80A/100A Mach Qdisc.**	1

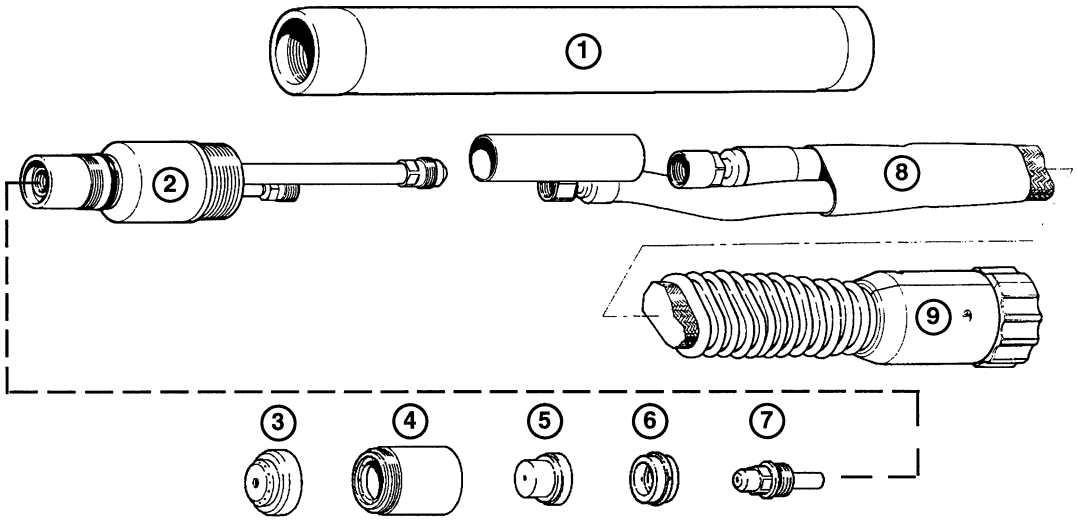


Figure 6-6 MAX100 Machine Torch

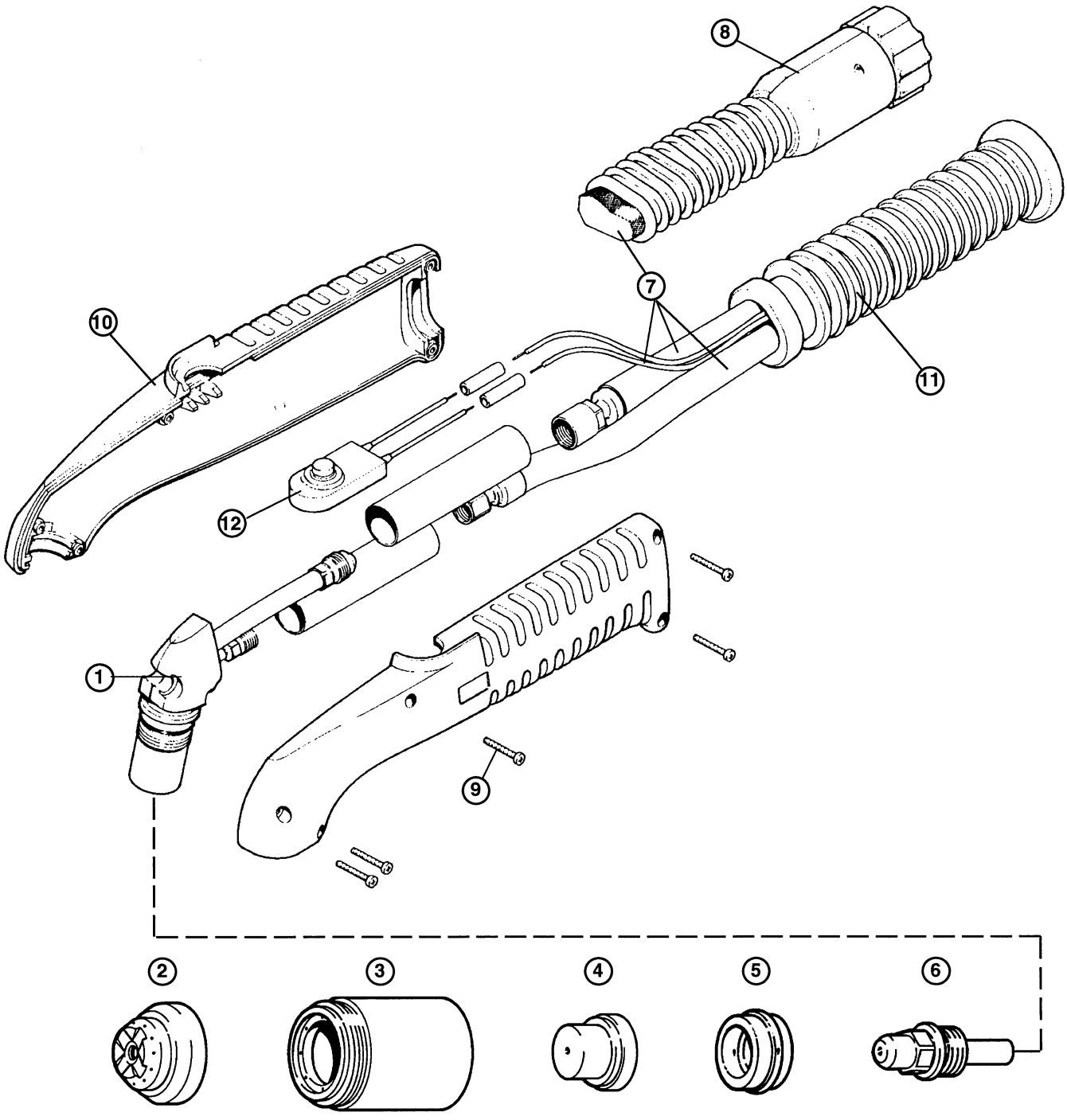


Figure 6-7 PAC130 Hand Torch

PAC130 HAND TORCH

Item	Part Number	Description	Qty.
	059093	**MAX100 Hand Torch Assy (PAC130) 25' QDisc.**	
	059094	**MAX100 Hand Torch Assy (PAC130) 50' QDisc.**	
	059095	**MAX100 Hand Torch Assy (PAC130) 75' QDisc.**	
1	**020461**	**PAC130 Torch Main Body**	1
2	020335	Shld:PAC130/160 100A	1
3	020336	Cap, Shld 80A/100A MAX100/100C	1
4	020337	Nozzle, Shld 100A MAX100/PAC130	1
5	020194	Swirl Ring, MAX100/PAC130	1
6	120433	Electrode:PAC130/160/MAX100/D Air	1
7	**029667**	**Leads:PAC130 Torch QDisc 25'**	1
7	**029668**	**Leads:PAC130 Torch QDisc 50'**	1
7	**029669**	**Leads:PAC130 Torch QDisc 75'**	1
8	**028518**	**PL Assy:80A/100A QDisc**	1
9	075365	P/S, #6X3/4, PH, Rnd, S/B	5
10	001214	Hndl:PAC130/PAC140 TCH	1
11	001217	Boot:PAC130 Torch	1
12	005094	PB Sw: Tch	1

CONSUMABLE PARTS: MAX100 Machine Torch

Item	Part Number	Description	Qty.
	028375	**Kit, Consum Parts, MAX100 Mach**	1
1	120433	Electrode: PAC130/160/MAX100/D Air	10
2	020194	Swirl Ring, MAX100/PAC130	2
3	020203	Nozzle, Std 40A MAX100	5
4	020336	Cap, Shield 80A/100A, MAX100/100D	1
5	020333	Deflector, MAX80/MAX100	1
6	020334	Shield: MAX80/100/C/D 100A	2
7	020337	Nozzle, Shield 100A, MAX100/PAC130	5
	001067	Box: Gra Plastic	1
	015111	Adapter: 1/4NPT X LH 'B' Inrt Fem Brs	1
	026018	O-Ring, Silicon	5
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	027102	Wrench: 3/8 Hex Electrode	1

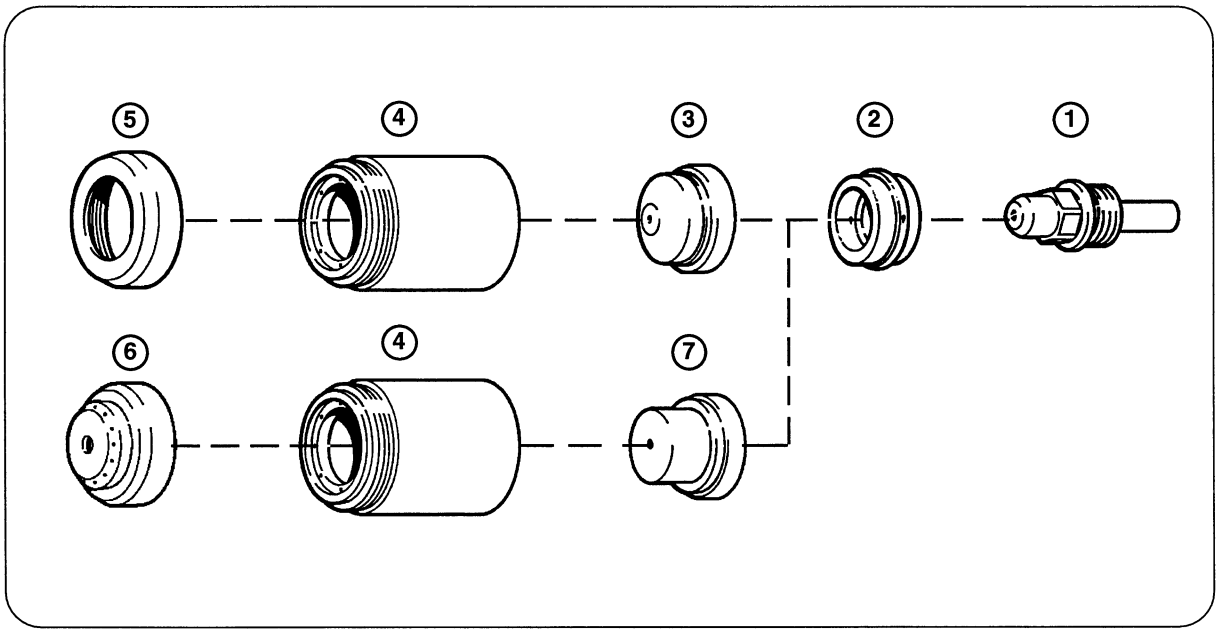


Figure 6-8 MAX100 Machine Torch Consumable Parts

CONSUMABLE PARTS: MAX100 Hand Torch

Item	Part Number	Description	Qty.
	028325	**Kit, Consum Parts, MAX100 Hand**	1
1	120433	Electrode: PAC130/160/MAX100/D Air	5
2	020194	Swirl Ring, MAX100/PAC130	2
3	020337	Nozzle, Shield 100A, MAX100/PAC130	5
4	020336	Cap, Shield 80A/100A, MAX100/100D	1
5	020335	Shield: PAC130/160 100A	1
6	020744	Electrode: Air Gouging	1
7	120459	Nozzle, Gouging, PAC130	1
8	020712	Shield, PAC130 Gouging	1
	001067	Box: Gra Plastic	1
	015111	Adapter: 1/4NPT X LH 'B' Inrt Fem Brs	1
	026018	O-Ring, Silicon	5
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	027102	Wrench: 3/8 Hex Electrode	1

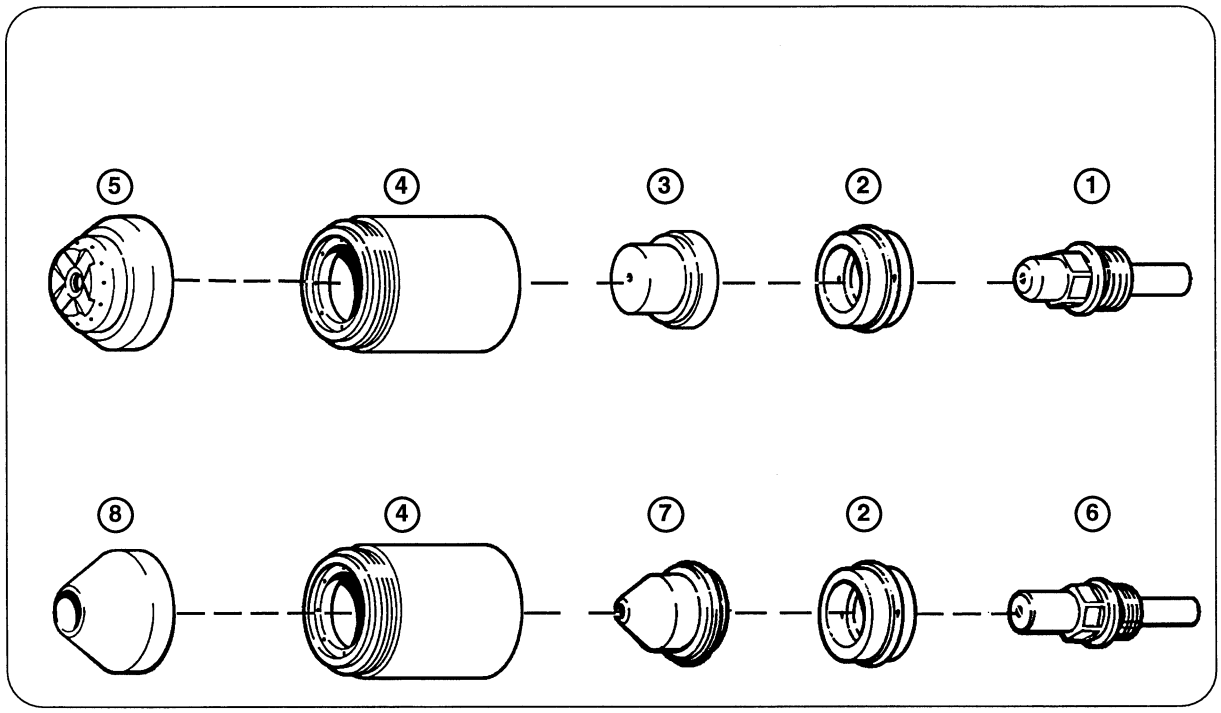


Figure 6-9 MAX100 Hand Torch Consumable Parts

RECOMMENDED SPARE PARTS

Part Number	Description	Designator	Page Number Showing Item
001027	Gauge, 0-120 psig for 011025		6-10
011025	Filter Regulator: 0-120 psi 1/4NPT Air		6-10
011031	Replacement filter		
005168	LTBULB:28VDC 40ma T3-1/4	LT1, LT2, LT3	6-4
005121	PB Sw: Grn NO Full Gd	PB1	6-4
005122	PB Sw: Red NC	PB2	6-4
005093	Press Sw: 0-90 psi 1/8 NPT	PS1	6-10
003021	Relay: 120VAC SPST NO	CR1,CR3	6-6,-8
003153	Contactor, MAX100 60A	CON1	6-8
008997	Fuse: 2A 500V 10mm x 38mm Glass Slo	F1,F2	6-4
009015	Resistor: 10K ohm 10W 5% Vitreous	R4	6-8
009622	Resistor: 10 ohm, 50W 5% W/L Brk	R3	6-8
009296	Capacitor: 100µF 350WV +50-10%	C3	6-8
005102	Thermostat, 75°C	TS1	
014021	Transformer, 5000VAC, 20ma	T3	6-6
009483	Pot, 1K ohm, 1W,1T	R6	6-4
027079	Fan 450-550 CFM 120VAC 50/60 Hz	FAN1	6-4
027080	Fan 225 CFM 120VAC 50/60 Hz	FAN2	6-4
041114	PC BD Assy Ctrl MAX100	PCB4	6-4
129118	CH130 CE/LVD Chopper SA 15KW		6-4
041530	PC Bd Assy Power Dist. MAX100-CE/LVD	PCB2	6-8
008317	Fuse: 125A 250V Semicond	F5	6-6
009350	Spark Gap Assy	SG1	6-6
014028	Transformer 220-380-415V	T1	6-8
006014	Sol Valve: 90# 1/4 FPT 120V NC	SOL1,SOL2	6-10
006032	Sol Valve: 150# 1/4 FPT 120V NC	SOL3	6-10
020461	PAC130 Torch Main Body		6-14
020201	MAX100 180 Deg Torch Main Body		6-13
020400	MAX100 90 Deg Torch Main Body		

Section 7 WIRING DIAGRAMS

In this section:

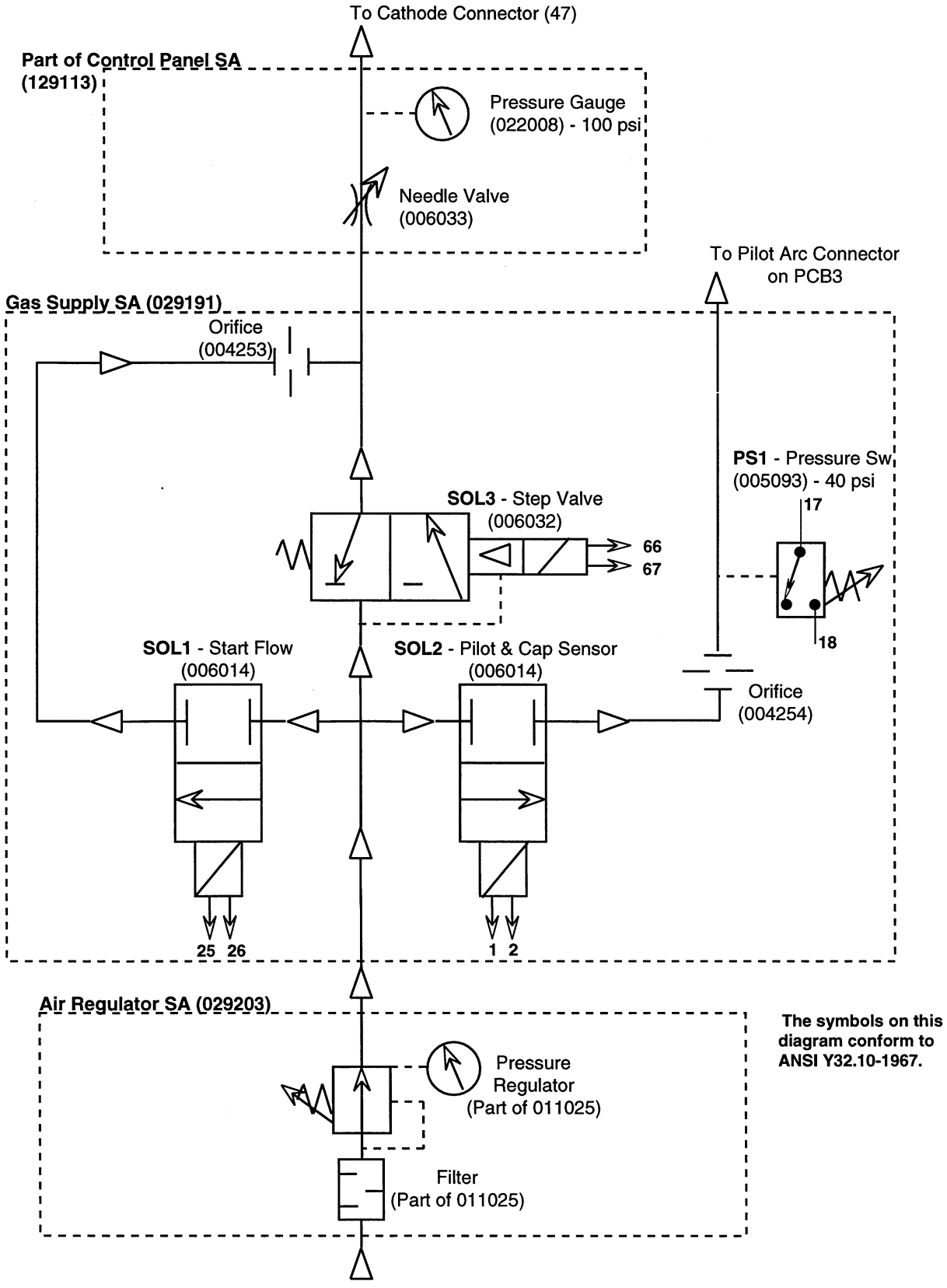


Figure 7-1 MAX100 CE/LVD Gas Supply Schematic

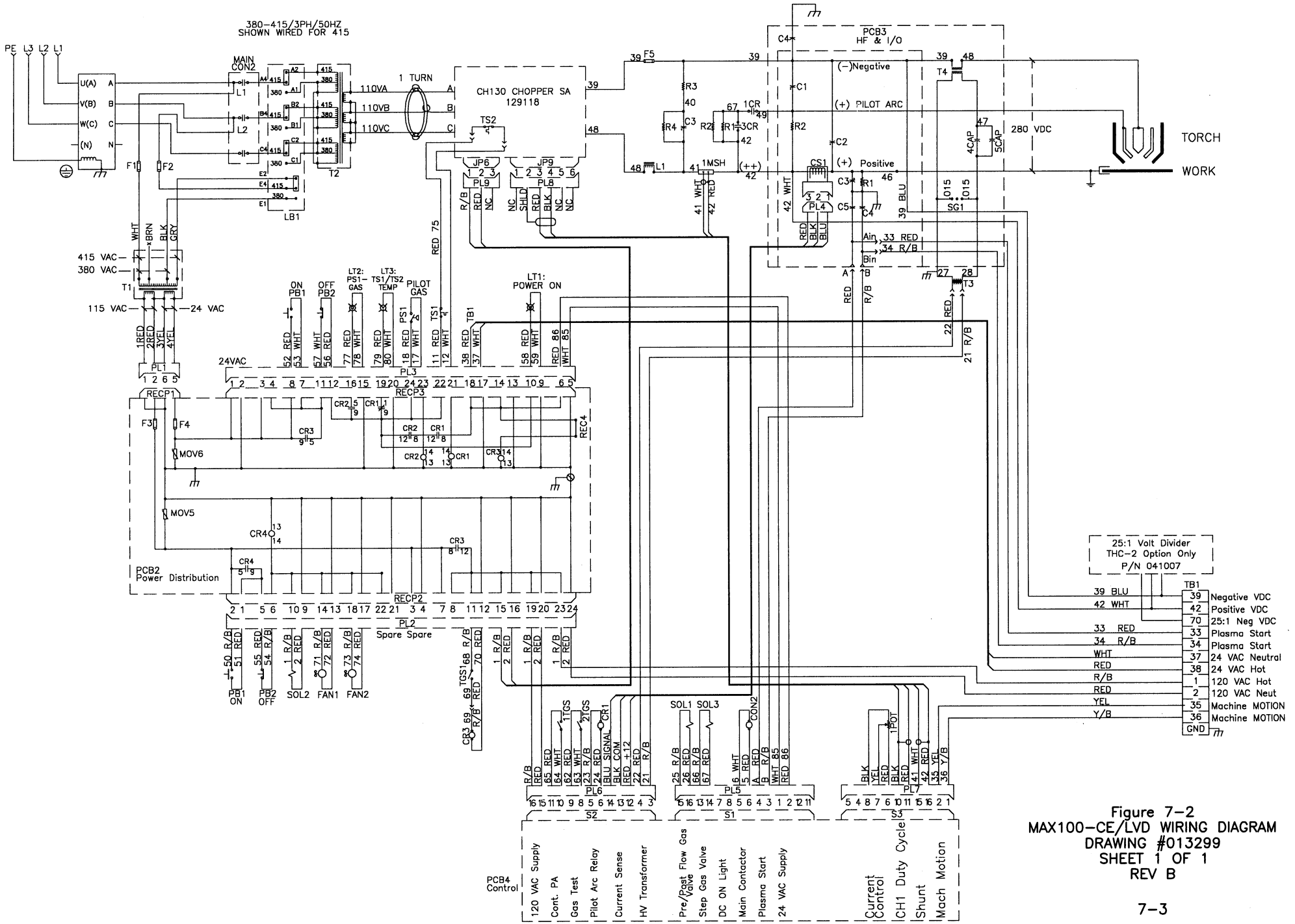


Figure 7-2
MAX100-CE/LVD WIRING DIAGRAM
DRAWING #013299
SHEET 1 OF 1
REV B

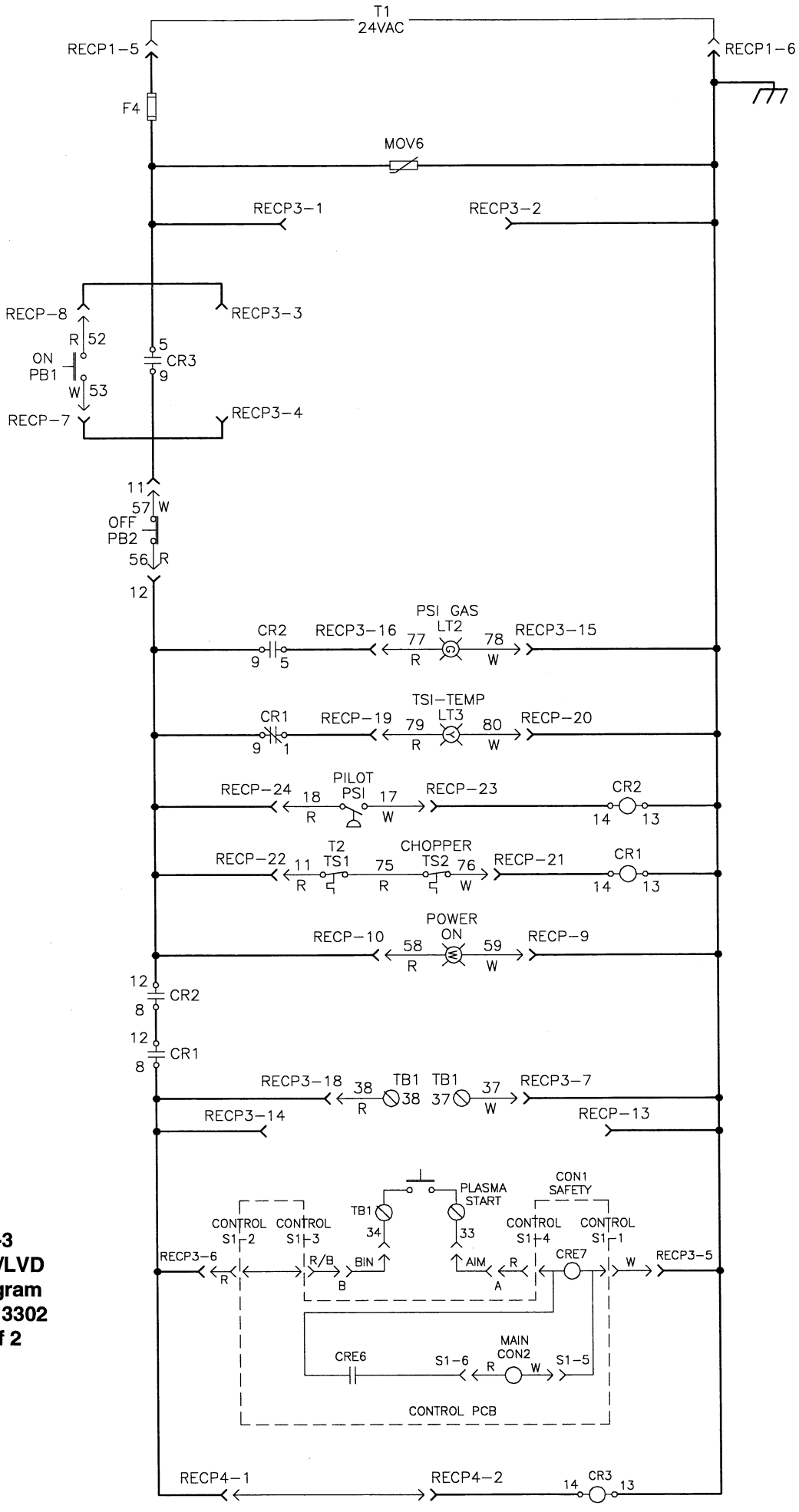


Figure 7-3
MAX100 CE/LVD
Ladder Diagram
Drawing #013302
Sheet 1 of 2

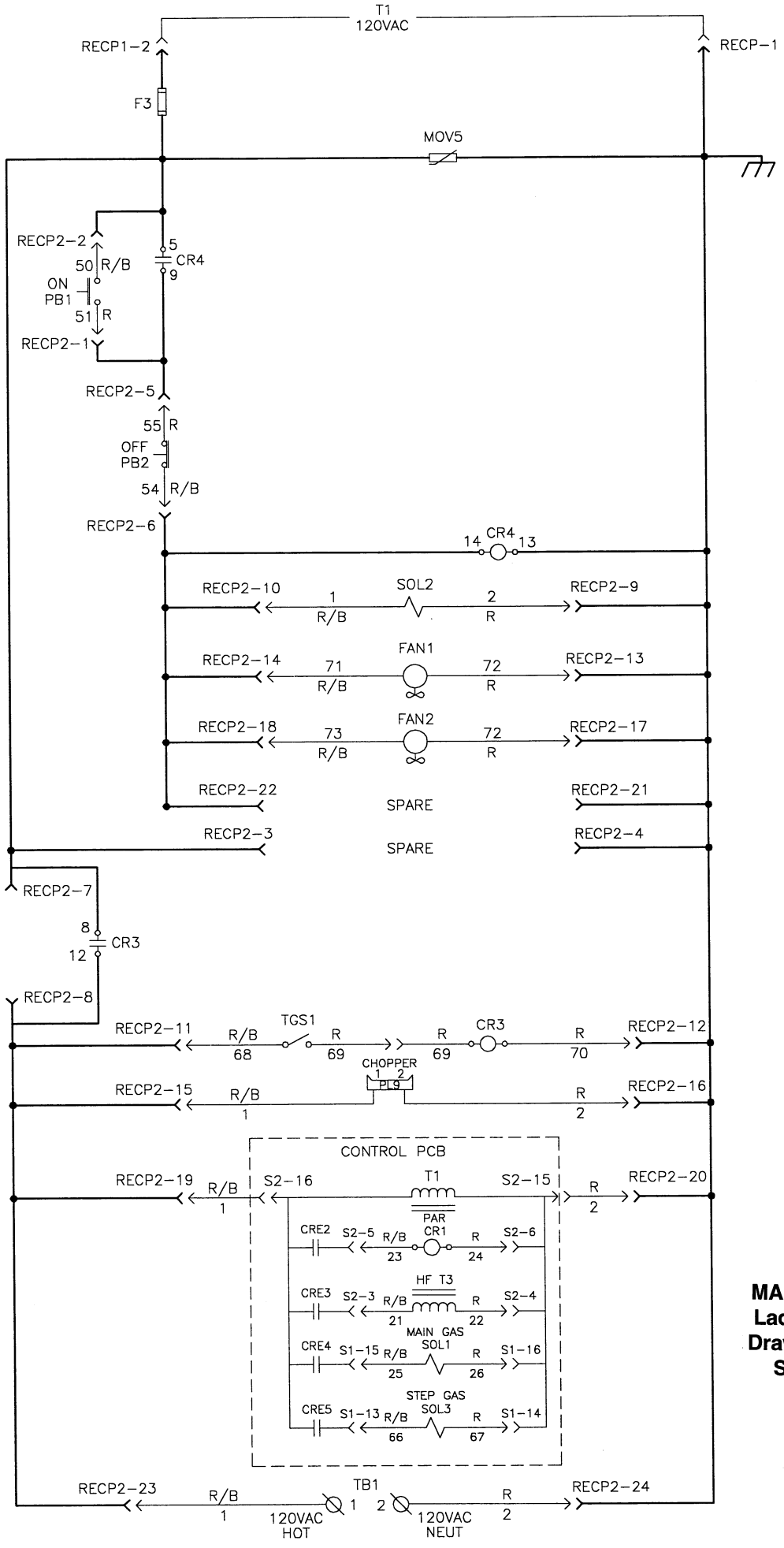


Figure 7-3
MAX100 CE/LVD
Ladder Diagram
Drawing #013302
Sheet 2 of 2

AIR FILTERS

Gas purity is critical for maximizing consumable parts life, as well as for producing the highest quality cutting which Hypertherm plasma equipment can achieve. Plasma air must be clean, dry and oil-free, and air must be delivered at the pressure and flow rate specified for each plasma system. If the air supply contains moisture, oil or dirt particles, cut quality will be lowered and consumable parts life will be shortened, which increase production costs.

To optimize both consumables life and cut quality, Hypertherm recommends a three-stage filtering process for compressor air for removing contaminants from the air supply.

1. The first stage of filtering should remove at least 99% of all particles and liquids 5 microns and larger in size.

2. The second stage should be a coalescing-type filter to remove oil. This filter should remove 99.99% of particles 0.025 micron and larger in size.

3. The third and final stage of filtration should be an activated carbon adsorbent filter that removes 99.999% of oil or hydrocarbons that have not been trapped by the previous stages.

IEC SYMBOLS USED

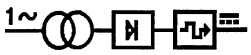
Direct Current (DC).

Alternating current (AC).

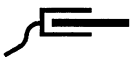
Plasma cutting torch.

AC input power connection.

The terminal for the external protective (earthed) conductor.



A chopper-based power source.



Anode (+) work clamp.

Temperature switch.

Pressure switch.

Plasma torch in the TEST position (cooling and cutting gas exiting nozzle).

I

The power is on.

O

The power is off.

Volt/amp curve.

APPENDIX

AERATION MANIFOLD FOR PLASMA CUTTING ALUMINUM

Introduction

When plasma arc cutting aluminum at the water table surface or below water, free hydrogen gas may be generated by the cutting process. The high temperature of the plasma process causes disassociation of oxygen and hydrogen from the water in the water table. The hot aluminum, which has a high affinity for oxygen, then combines with the oxygen leaving free hydrogen.

An effective means of avoiding free hydrogen buildup is to install an aeration manifold on the floor of the water table to replenish the oxygen content of the water.

Making an Aeration Manifold - Figure c-1

Make an **Aeration Manifold** with two-inch (50 mm) PVC tubing with one-inch (25 mm) **Distribution Lines** connected to it. Drill 1/8 inch (3 mm) holes every six inches (150 mm) in the distribution lines. Cap the ends of the distribution lines and install the lines so that oxygen is delivered to all parts of the cutting area.

Connect the manifold to a shop air line. Set a pressure regulator to obtain a steady stream of bubbles.

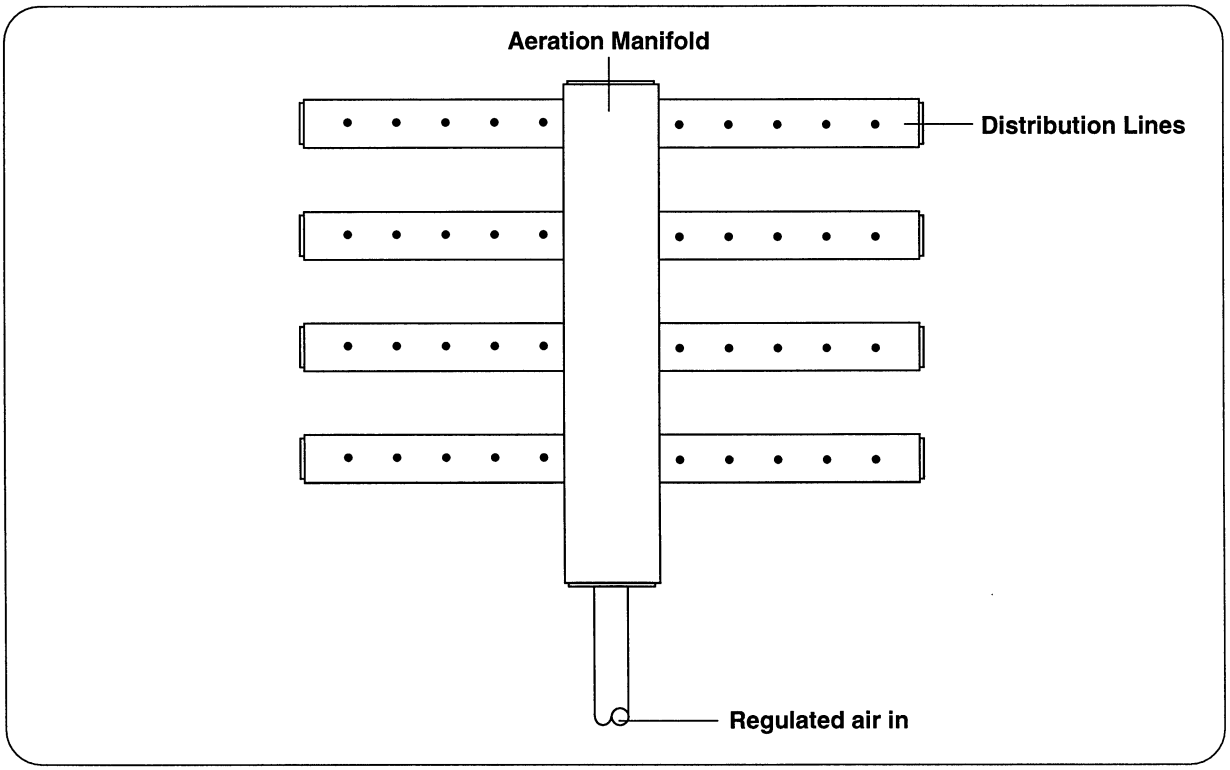


Figure c-1 Aeration Manifold

STANDARDS INDEX

For further information concerning safety practices to be exercised with plasma arc cutting equipment, please refer to the following publications:

1. ANSI Standard Z49.1, *Safety in Welding and Cutting*, obtainable from the American Welding Society, 550 LeJeune Road, P.O. Box 351020, Miami, FL 33135.

2. NIOSH, *Safety and Health in Arc Welding and Gas Welding and Cutting*, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

3. OSHA, *Safety and Health Standards*, 29FR 1910, obtainable from the U.S. Government Printing Office, Washington, D.C. 20402.

4. ANSI Standard Z87.1, *Safe Practices for Occupation and Educational Eye and Face Protection*, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

5. ANSI Standard Z41.1, *Standard for Men's Safety-Toe Footwear*, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

6. ANSI Standard Z49.2, *Fire Prevention in the Use of Cutting and Welding Processes*, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

7. AWS Standard A6.0, *Welding and Cutting Containers Which Have Held Combustibles*, obtainable from the American Welding Society, 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135.

8. NFPA Standard 51, *Oxygen — Fuel Gas Systems for Welding and Cutting*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

9. NFPA Standard 70-1978, *National Electrical Code*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

10. NFPA Standard 51B, *Cutting and Welding Processes*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

11. CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders*, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

12. CSA Standard W117.2, *Code for Safety in Welding and Cutting*, obtainable from the Canadian Standards Association Standard Sales, 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada.

13. NWSA booklet, *Welding Safety Bibliography*, obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.

14. American Welding Society Standard AWS F4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances*, obtainable from the American Welding Society, 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135.

15. ANSI Standard Z88.2, *Practices for Respiratory Protection*, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

16. Canadian Electrical Code Part 1, *Safety Standards for Electrical Installations*, obtainable from the Canadian Standards Association, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W1R3.