

MAX20

Plasma Arc Cutting System

***Instruction Manual
800710- Rev. 4***



MAX20
Plasma Arc Cutting System
Instruction Manual
IM-71

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WARRANTY



ATTENTION



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

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 or to a customer by you, BUT IN NO EVENT SHALL THIS WARRANTY EXTEND BEYOND 36 MONTHS FROM THE DATE OF ORIGINAL DELIVERY TO YOU BY HYPERTHERM.

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Section 1-A SAFETY

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SAFETY

INTRODUCTION

Abbreviated safety precautions are printed on the unit. In addition to these safety precautions, each person operating, maintaining or supervising the use of this equipment must read the following safety instructions.

NOTES, CAUTIONS & WARNINGS

Throughout this manual, notes, cautions and warnings are used to describe situations that require additional information. The following formats are used for each:

Notes: A note offers additional information, such as an operating tip, that aids the user in operating the MAX20.

Caution: A caution describes a situation that may cause damage to the MAX20, and offers advice to avoid or rectify the situation.



WARNING



A warning describes a situation that presents a physical danger to the operator, and offers advice to avoid or rectify the situation. Each type of warning displays an applicable danger symbol, ie. fire, explosion, electrical shock, etc.

WARNING



ELECTRIC SHOCK CAN KILL.

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



EXPLOSION WILL RESULT IF PRESSURIZED CONTAINERS ARE CUT.



ARC RAYS CAN INJURE EYES AND BURN SKIN.

- Wear correct eye and body protection.



NOISE CAN DAMAGE HEARING.

- Wear correct ear protection.



FUMES AND GASES CAN INJURE YOUR HEALTH.

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



HEAT, SPLATTER AND SPARKS CAUSE FIRE AND BURNS.

- Do not cut near combustible material.
- Do not cut containers that have held combustibles.
- Do not have on your person any combustibles such as a butane lighter or matches.
- Pilot arc can cause burns. Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

SAFETY

SAFETY INSTRUCTIONS

Burn Prevention



To protect eyes and skin against burns and high-intensity ultraviolet light:

- Wear dark safety glasses.
- Wear protective clothing.
- Hold the torch away from your body when starting. The pilot arc comes on immediately when you depress the start button.
- Do not touch the front of the torch when starting it. After cutting, allow time for the front of the torch to cool.
- Do not remove the torch retaining cap without first unplugging the machine.
- Warn other people in the area not to look directly at the arc unless they wear dark safety glasses.
- Cool the torch cap and consumable parts after extended cutting with a gas flow selected with the RUN/TEST switch in the TEST position.

Toxic Fume Prevention



To protect against the danger of toxic fumes which may be produced during cutting:

- 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 when cutting galvanized metal and use proper ventilation.
- Do not cut containers with toxic materials inside, or containers that have held toxic materials. Clean containers thoroughly before cutting.

SAFETY



WARNING



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

Fire Prevention



Cutting with the MAX20 produces sparks of hot metal. Take the following precautions against fire:

- Make fire extinguishers available in the cutting area.
- Remove combustible material from the immediate cutting area.
- Quench freshly cut metal or allow it to cool before handling it or bringing it into contact with combustible materials.
- Never use a MAX20 to cut containers with potentially flammable materials inside. Such containers must be thoroughly cleaned prior to cutting.
- Ventilate potentially flammable atmospheres before using the MAX20. Never operate the MAX20 in an atmosphere which contains heavy concentrations of dust, flammable gas or combustible liquid vapors.

SAFETY

Electric Shock Prevention



The MAX20 uses high voltage (approximately 250 VDC) to initiate the plasma arc. Take the following precautions when operating the MAX20:

- Keep your body and clothing dry.
- Do not stand in, sit on or lie on any wet surfaces when using the MAX20.
- Maintain proper insulation against electrical shock. If you must work in or near a damp area, use extreme caution. Wear insulated gloves and boots.
- Inspect the primary power cord frequently for damage or cracking of the cover. **Bare wiring can kill.** Do not use the MAX20 with a damaged power cable. Replace the damaged power cable immediately.
- Conform to all electrical codes for primary wiring sizes and types.
- Inspect the torch leads. Replace if frayed or damaged.
- Should you need to remove the power supply cover after operation, first unplug the power supply. Wait five minutes to allow capacitor discharge to occur. Failure to do so exposes you to severe shock hazard.
- Never operate the MAX20 unless the power supply unit cover is in place. Exposed power supply connections present an extreme electrical hazard.
- 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 (anode [+]) attached at all times.
- Before changing the torch parts, unplug the power supply. After changing the torch parts and returning the retaining cap to its operating position, plug the unit in again.
- Never bypass or shortcut the safety interlocks.

SAFETY

Explosion Prevention



When cutting with the MAX20:

- Do not cut pressurized cylinders.
- Do not cut in atmospheres containing explosive dust or vapors.

Grounding



Before operating the MAX20:

- Properly ground the plug connections for the primary power cord.
- Clamp the work cable with good metal-to-metal contact to the workpiece. Do not fasten the work clamp to that portion of the workpiece that will fall away.

For further guidance, consult the National Electrical Code, Article 250, Section H, entitled "Grounding Electrical System." For additional information, refer to the Standards Index in this manual. CSA (Canadian Standards Association) W117.2 is included.



WARNING



This unit uses compressed air **ONLY**. Inspect the filter bowl for cracks or aging. The bowl may explode if damaged. Maximum pressure is 150 psi. Maximum temperature is 120° F (49° C). The bowl will rupture if exposed to synthetic lubricating oils. Proper precautions must be observed when handling and using compressed gas equipment and cylinders. Refer to CGA Standard P-1.

SAFETY

SAFETY DEVICES

- The MAX20 is designed with a safety interlock which disables the power unit and disables the **I/O** (on/off) switch when the retaining cap is loosened.
- The MAX20 is designed specifically to be used with the PAC110 torch. Do not use other torches.
- Never bypass or shortcut the safety interlocks.
- Use only Hypertherm replacement and consumable parts. Any damage caused by the use of other than genuine Hypertherm parts is not covered under the Hypertherm warranty.
- Never operate the MAX20 with any of the power supply covers not in place. It is hazardous to the operator and to other people in the area, and prevents the equipment from properly cooling the components.

STANDARDS INDEX

The Standards Index contains a list of publications dealing with plasma arc cutting equipment safety practices. For additional information, refer to this Standards Index. CSA (Canadian Standards Association) W117.2 is included.

Section 1-B SÉCURITÉ

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SÉCURITÉ

INTRODUCTION

Des consignes de sécurité condensées sont imprimées sur l'appareil. En outre, il est impératif que chaque personne qui utilise, entretient ou surveille l'emploi de cet appareil lise les instructions suivantes.

NOTES, PRÉVENTION ET AVERTISSEMENT

À travers ce manuel, des indications de prévention sont utilisées pour décrire des situations qui nécessitent de l'information supplémentaire. Les formats suivant sont utilisé pour:

Notes: Une note offre de l'information supplémentaire comme des modes d'emploi qui permettent d'utiliser le MAX20.

Prévention: Un signe de prévention décrit une situation qui risquerait d'endommager le MAX20, et indique comment éviter ou rectifier la situation.



AVERTISSEMENT



Un signe d'avertissement décrit une situation qui présente un danger à l'opérateur, et permet d'éviter ou rectifier ce problème. Chaque type de danger produit un signe correspondant, comme le feu, l'explosion, le choc électrique, etc.

AVERTISSEMENT



LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE MORTELS.

- Ne pas toucher les pièces électriques sous tension.
- Les panneaux et les couvercles de protection doivent être en place lorsque la machine est raccordée au réseau.
- S'isoler de la pièce à couper et de la terre en portant des gants, des chaussures et des habits isolants.
- Garder au sec les gants, les chaussures, les habits, la zone de travail et l'appareil.



RISQUE D'EXPLOSION SI ON COUPE DES RÉSERVOIRS SOUS PRESSION.



RISQUE DE BRÛLURES AUX YEUX ET À LA PEAU PAR LE RAYONNEMENT DE L'ARC.

- Porter des protecteurs pour les yeux et pour le corps.



LE BRUIT PEUT ENDOMMAGER L'OUÏE.

- Porter des protecteurs auditifs appropriés.



LES VAPEURS ET LES GAZ PEUVENT ÊTRE TOXIQUES.

- Éloigner le visage des vapeurs.
- Prévoir une ventilation et(ou) une évacuation à proximité de l'arc pour éliminer les vapeurs et gaz de la zone de travail et de ses abords.
- Si la ventilation est inefficace, utiliser un appareil respiratoire agréé.



LA CHALEUR, LES PROJECTIONS DE MÉTAL ET LES ÉTINCELLES PEUVENT PROVOQUER DES INCENDIES ET DES BRÛLURES.

- Ne pas couper à proximité de matières inflammables.
- Ne pas couper des récipients ou réservoirs ayant servi à des produits inflammables.
- Ne pas porter sur soi des objets (briquets à gaz, allumettes) ou vêtements inflammables.
- Éloigner la buse de la torche de soi et des autres lorsque l'interrupteur est enclenché.
- Porter des protecteurs appropriés pour les yeux et le corps.

SÉCURITÉ

CONSIGNES DE SÉCURITÉ

Prévention des brûlures



Pour protéger les yeux et la peau des brûlures et du rayonnement ultraviolet de forte intensité:

- Porter des lunettes de sécurité à verres fumés.
- Porter une combinaison protectrice.
- Éloigner la torche du corps à l'amorçage. L'arc veilleuse jaillit aussitôt que l'on appuie sur le bouton d'amorçage.
- À l'amorçage, ne pas toucher l'extrémité de la torche. Après le coupage, laisser l'extrémité de la torche se refroidir.
- Ne pas enlever le capuchon de retenue de la torche sans préalablement débrancher la machine.
- Avertir les autres personnes se trouvant dans l'aire de travail de ne pas regarder directement l'arc, à moins de porter des lunettes à verres fumés.
- Après un coupage de longue durée, l'extrémité de la torche et les pièces fusibles sont chaudes. Réfrigérissez-les en laissant l'air circuler, l'interrupteur **ESSAI/MARCHE** étant à la position **ESSAI**.

Vapeurs toxiques



Pour se protéger contre les vapeurs toxiques qui peuvent éventuellement se dégager lors du coupage:

- Tenir l'aire de travail bien aérée.
- Enlever avant le coupage tous les solvants chlorés de l'aire de coupage. Certains solvants chlorés se décomposent quand ils sont exposés à une radiation ultraviolette et forme du gaz phosgène.
- Porter un masque approprié lors du coupage de métaux galvanisés, et s'assurer que la ventilation est efficace.

SÉCURITÉ

- Porter un masque approprié lors du coupage de métaux galvanisés, et s'assurer que la ventilation est efficace.
- Ne pas couper de réservoirs contenant des matières toxiques. Nettoyer soigneusement les réservoirs avant le coupage.



AVERTISSEMENT



Ne pas couper de métaux ni de métaux peints qui contiennent zinc, plomb, cadmium ou béryllium, à moins que l'utilisateur et toute personne exposée aux vapeurs ne porte un appareil respiratoire ou un casque ventilé.

Prévention des incendies



Le coupage avec le MAX20 génère des étincelles de métal à haute température. Il faut donc prendre des précautions contre les incendies:

- Des extincteurs d'incendie doivent être accessibles dans l'aire de coupage.
- Les matières inflammables doivent être enlevées de la zone avoisinant l'aire de coupage.
- Arroser le métal fraîchement coupé ou le laisser refroidir avant de le manipuler ou de le mettre en contact avec des matériaux inflammables.
- Ne jamais utiliser le MAX20 pour découper des réservoirs contenant des matières explosives. De tels récipients doivent être soigneusement nettoyés avant le coupage.
- Évacuer toute atmosphère potentiellement inflammable avant de faire fonctionner le MAX20. Ne jamais faire fonctionner le MAX20 dans une atmosphère où il existe une forte concentration de poussières, de gaz inflammables ou de vapeurs de liquides inflammables comme l'essence.

SÉCURITÉ

Prévention des chocs électriques



Le MAX20 produit une forte tension (environ 250 VDC) pour amorcer l'arc-plasma. On doit prendre les précautions suivantes en utilisant cet appareil:

- Assurer-vous d'avoir le corps et les vêtements secs.
- Ne vous tenez jamais debout, assis ou allongé sur une surface humide lorsque vous vous servez de cet appareil.
- Isolez-vous efficacement pour éviter les chocs électriques. Si le travail doit être effectué près d'une zone humide, soyez très prudent. Portez des gants et des bottes isolées.
- Inspecter fréquemment le cordon d'alimentation primaire pour s'assurer qu'il n'est ni endommagé ni fissuré. **Un conducteur nu peut tuer.** Ne pas utiliser l'appareil si le cordon d'alimentation est endommagé. Remplacer immédiatement le cordon s'il est endommagé.
- Inspecter les câbles de la torche. S'ils sont effilochés ou endommagés, les remplacer.
- Conformer aux codes électriques pour les types et grandeurs de la filerie électrique primaire.
- S'il faut retirer le couvercle du bloc d'alimentation après usage, couper l'alimentation et attendre cinq minutes pour laisser les condensateurs se décharger, sinon, on s'expose à des chocs importants.
- Ne jamais utiliser le MAX20 si le couvercle du bloc d'alimentation n'est pas en place. Si elles sont exposées, les connexions du bloc d'alimentation sont extrêmement dangereuses.
- Ne pas saisir la pièce à travailler lors du coupage. Un choc dangereux pourrait être ressenti. Laisser la pièce à travailler en place ou sur l'établi, et le câble de masse (anode "+") toujours connecté.
- Avant de changer les pièces de la torche, couper l'alimentation. Après avoir changé les pièces de la torche et ramené le capuchon de retenue à sa position de marche, rebrancher l'appareil.
- Ne jamais neutraliser les verrouillages de sécurité.

Prévention des explosions



Quand on utilise le MAX20:

- Ne pas couper de réservoirs sous pression.
- Ne pas couper en présence de poussières ou de vapeurs explosives.

Mise à la masse



Avant de faire fonctionner le MAX20:

- La prise qui reçoit le cordon d'alimentation primaire doit comporter une mise à la terre convenable.
- Le câble de masse doit être fixé à la pièce à travailler de façon à assurer un bon contact entre les métaux. Ne pas fixer le câble de masse à la partie de la pièce à travailler qui doit se détacher.

Pour plus de renseignements, consulter le National Electrical Code, Article 250, Section H, intitulée "Grounding Electrical System" (mise à la terre d'une installation électrique) ou un autre code approprié (Consulter l'index des normes).



AVERTISSEMENT



Cet appareil ne doit être alimenté qu'air comprimé. Inspecter le godet du filtre pour s'assurer qu'il n'est ni fissuré ni usé. Le godet peut exploser s'il est endommagé. pression maximale: 150 lb/po², température maximale 120°F (49°C). Le godet éclate lorsqu'il est exposé aux huiles de graissage synthétiques. Prendre les précautions nécessaires lors de la manutention et de l'utilisation des appareils et des bouteilles à gaz sous pression. Consulter la norme CGA P-1.

SÉCURITÉ

DISPOSITIFS DE SÉCURITÉ

- Le MAX20 comporte un verrouillage de sécurité qui met hors service le bloc d'alimentation et l'interrupteur I/O (marche/arrêt) lorsque le capuchon de retenue est desserré.
- Le MAX20 est conçu pour la torche PAC110. Ne pas utiliser d'autre torche.
- Ne jamais neutraliser les verrouillages de sécurité.
- Utiliser seulement des pièces de rechange et des pièces fusibles Hypertherm. La garantie de Hypertherm ne couvre pas des dégats causés par l'utilisation d'autres pièces de rechange que celles de Hypertherm.
- Ne jamais faire fonctionner le MAX20 si tous les couvercles du bloc d'alimentation ne sont pas en place car cela mettrait en danger l'opérateur et les autres personnes présentes, en plus de compromettre le refroidissement des pièces.

INDEX DES NORMES

L'index des Normes énumère des publications traitant des mesures de sécurité à suivre lorsque l'on utilise un appareil de coupage à arc-plasma. Cet index peut fournir des renseignements supplémentaires et la norme ACNOR (CSA) W117.2 y figure.

Section 2 SPECIFICATIONS

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SPECIFICATIONS

GENERAL

- Hypertherm's MAX20 air plasma cutting system is designed for hand cutting of most metals up to 3/16 inch in thickness.
- The MAX20 provides continuously variable current output from 10 to 20 amps to provide excellent cutting performance on all thicknesses within its range.
- The MAX20 power supply uses 120-volt, single-phase, 60 hertz power and incorporates advanced transistor technology. It offers the following benefits:
 - It weighs only 42 pounds, offering maximum portability.
 - The pilot arc ignition pierces coated, painted or rusted metals.
 - The solid-state design allows a steady cutting arc between the torch and the workpiece.
 - The transistorized design performs best while lightly dragging the torch tip (nozzle) on the workpiece. This makes the torch extremely easy to use.
 - The continuous pilot arc makes it easy to cut grate material or other perforated metals. The pilot arc transfers to the workpiece when the torch is within 1/8 inch of the cutting surface.
 - The nearly ripple-free output provides a smooth cutting arc, ensuring high-quality cuts across a wide variety of materials and thicknesses.
- The MAX20 uses compressed air as the plasma gas. A cylinder of compressed air or an air compressor may be used. The air supply must be free of moisture, oil or other contaminants. An air pressure regulator and air filter are provided. The air pressure regulator is preset to deliver the correct air flow and pressure.
- The variable amperage output (**OUTPUT POWER**) potentiometer mounted on the front panel adjusts the cutting current of the torch and varies the AC line draw of the system to conform with the fuse size at the primary power line.

SPECIFICATIONS

PRODUCT SPECIFICATIONS

MAX20 Power Supply

The MAX20 is a constant current chopper power supply providing continuously variable amperage from 10 amps to 20 amps. It conforms to the following specifications:

Maximum OCV	240 VDC at 120 VAC input power
Output Current	10 Amps Minimum to 20 Amps Maximum
Output Voltage	90 VDC
Duty Cycle Rating	@ 90 OCV 35% @ 20 amps 50% @ 17 amps 80% @ 13 amps 100% @ 11 amps
Input Power	120 Volt, Single Phase, 60 Hz, 21.5 Amps at 1.8 kw Output
Dimensions	Width – 8.0" Height – 11.75" Length – 17.0"
Weight	42 Pounds
Gas Supply	Type – Air Quality – Clean, Dry, Oil-Free
Air Flow	4.5 scfm
Air Pressure Setting	60 psi for 15-foot lead set 65 psi for 25-foot lead set
Air Requirements	70-125 psi

SPECIFICATIONS

PAC110 Torch

The PAC110 torch conforms to the following specifications:

Maximum cutting thickness range Up to 3/16"

Maximum current at 50% duty cycle 20 Amps

Maximum current at 100% duty cycle 10 Amps

Gas Flow 4.5 scfm

Weight 3 Pounds

Section 3 SETUP

In this section:

Upon Receipt	22
Claims & Technical Questions.....	23
Primary Connection	24
Grounding	25
Air Supply	26

SETUP

UPON RECEIPT

1. Remove the unit and save the carton. The carton is reusable and provides an impact-resistant box for transporting or storing the unit.

The carton should include:

- MAX20 Power Supply
 - PAC110 Torch and Leads (15 or 25 ft.)
 - Spare Parts Kit
 - Instruction Manual (IM-71)
2. Verify that all components are present. Alert your distributor if any parts are missing.
 3. Inspect the power supply for any physical damage that may have occurred during shipping. If there is evidence of damage, see the Claims section for instructions.

Before operating the MAX20, read the Safety and Operation sections of this manual.

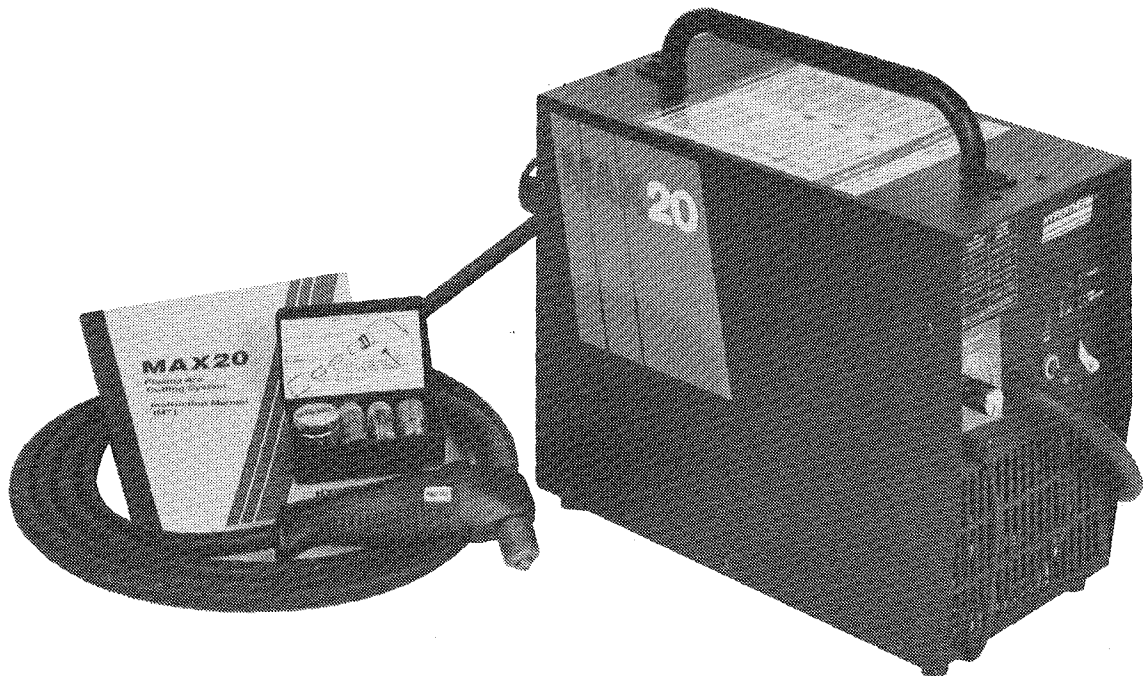


Figure 1 MAX20 System

CLAIMS AND TECHNICAL QUESTIONS

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

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

1. Read the Troubleshooting section of this manual. You may find that the problem is quite easy to fix, such as a loose connection.
2. If you are unable to solve the problem, call your Hypertherm distributor. He will be able to help you, or refer you to an authorized Hypertherm repair facility.
3. If you need additional assistance, call our Customer Service or Field Service group at 1-800-643-0030.

SETUP

PRIMARY CONNECTION

When OUTPUT POWER control is set to 13 amps or less, a 120-VAC service fused for 15, 20 or 30 amps can be used. A control setting from 13 to 17 amps requires a fused service of at least 20 amps. A setting above 17 amps requires a 30-amp service.



WARNING



Fusing a 20-amp circuit with a 30-amp fuse can cause an electrical fire. Use only circuits that are wired for 30-amp service.

OUTPUT POWER (AMPS)	LINE FUSE/BREAKER SIZE (AMPS)	AVERAGE CUT TIME (MINUTES)
10 - 11	15, 20, or 30	CONSTANT ON
11 - 13	15, 20, or 30	8 ON - 2 OFF
13 - 17	20 or 30	5 ON - 5 OFF
17 - 20	30	3.5 ON - 6.5 OFF

Figure 2 Output Power Control

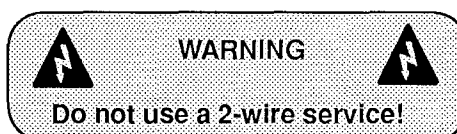
When operating in the field, check the fuse or circuit breaker size on the incoming line before cutting and adjust the system accordingly. If an extension cord is necessary, use one that is properly rated. Reducing the current enables you to cut with a longer extension cord. The following cord length and sizes are recommended for cutting at 20 amps:

25 ft	12 AWG 3-wire UL/CSA listed cord
50 ft	12 AWG 3-wire UL/CSA listed cord
100 ft	10 AWG 3-wire UL/CSA listed cord
150 ft	8 AWG 3-wire UL/CSA listed cord

For safety and performance, always minimize the length of the extension cord.

GROUNDING

- The power supply must be properly grounded through the power cable according to the National Electric Code. The 120 VAC MAX20 cabinet is electrically conductive and can present a shock hazard if it is not properly grounded through the wall outlet. The service must be of the 3-wire type ("HOT", NEUTRAL", and green wire protective "EARTH GROUND"). It must comply with the National Electric Code.



- The work clamp must make good metal-to-metal contact on the workpiece.
- Do not attach the work clamp to the portion of the workpiece being cut away.
- For further information, refer to the Electrical Code, Article 150, Section H, "Grounding of Electrical System," or other appropriate codes (See the Standards Index).

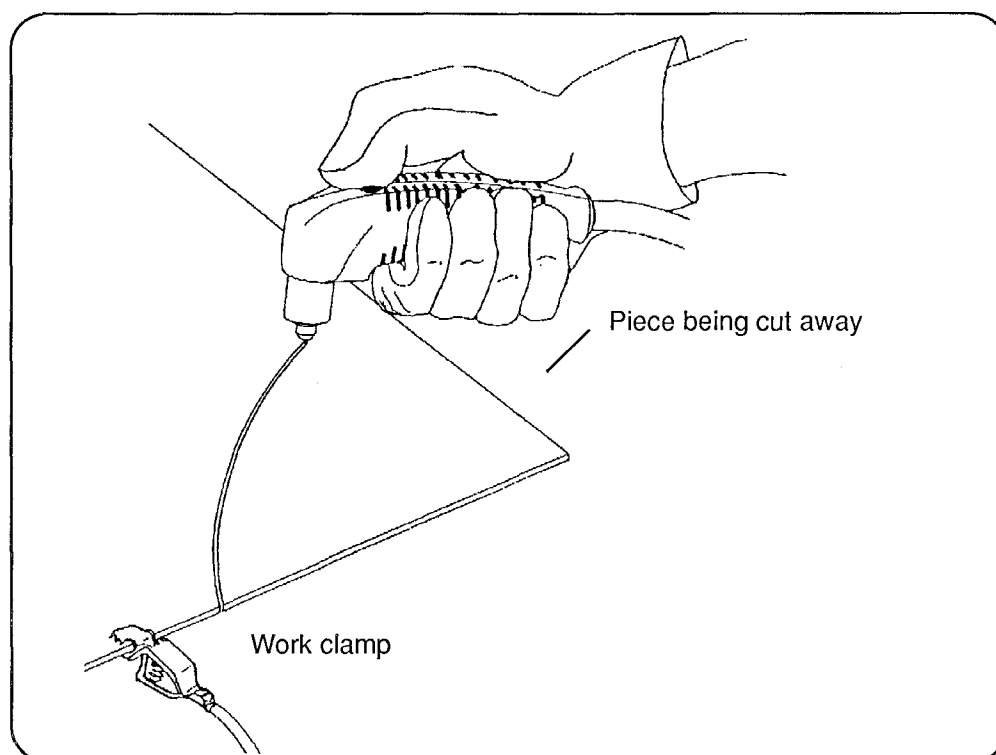


Figure 3 Proper Work Clamp Connection

SETUP

AIR SUPPLY

- The MAX20 uses compressed air as the plasma gas. A cylinder of compressed air or an air compressor may be used. The air supply must be free of moisture, oil or other contaminants. An air pressure regulator is preset to deliver the correct air flow and pressure. The air supply must provide 4.5 scfm at a pressure greater than 60 psi.
- Air pressure greater than 60 psi (70-125 psi) should be applied to the air filter unit located on the back panel of the unit. **Pressure must not exceed 125 psi.** The air pressure regulator is preset at the factory and regulated to 60 psi pressure when the gas flow is on. (The pressure is set to 65 ± 2 psi when a 25-foot lead is used.) Check the flow pressure by putting the gas flow test switch in the **TEST** position (located on front control panel) and looking at the gauge on the rear panel. It should read 60 ± 2 psi. (To adjust the regulator, refer to the adjustment procedure in the Troubleshooting section.)
- The quick connect is supplied in the spare parts kit. The air supply hose must meet the following specifications to fit the quick connect:
 - An inside diameter of 1/4-inch.
 - A 1/4-inch NPTF thread (National Pipe Thread Fine)

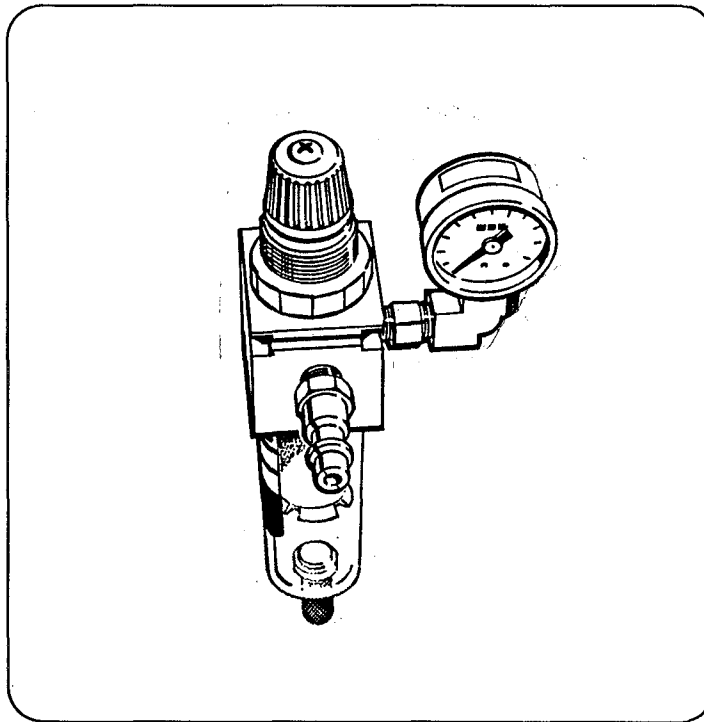


Figure 4
Filter/Regulator

Section 4 OPERATION

In this section:

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Operating Instructions	30
Operating Tips	32
Adjusting the Output Power	32
Cutting	33
Piercing	36
Common Cutting Faults	37
Duty Cycle	37
Air Pressure	38
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OPERATION

FRONT PANEL CONTROLS

On the front panel, there are two indicator lights (LEDs), an **OUTPUT POWER** adjustment knob, a **RUN/TEST** switch and an **I/O** (on/off) switch.

- The **POWER** LED is above the **I/O** switch and lights when the main power is on.
- The **TEMP/PRESSURE** LED is above the **I/O** switch and lights when the temperature and pressure are within operating limits. It goes out if:
 - The incoming air pressure is too low.
 - The duty cycle rating of the system has been exceeded and the thermal overload circuit has opened and disabled the power supply. The thermal overload switch remains open to allow the power supply to cool down.
- The **OUTPUT POWER** adjustment knob adjusts both the output cutting current and the AC line draw from your 120-volt AC power supply. The table above the adjustment knob lists the information you need to adjust the power so that you will not "blow" your circuit breaker. The label also tells you the approximate amount of time that you will be able to cut (duty cycle) before the MAX20 overheats.

Before using your MAX20, you need to know the amperage of your 120-volt AC circuit service and the rating of your circuit breaker (15, 20 or 30 amps). You can then adjust the **OUTPUT POWER** setting to the maximum indicated on the label and cut for the time indicated without concern that the breaker will be blown.

- The **RUN/TEST** switch permits you to see if the pressure is set correctly at 60 psi (65 psi if you use a 25 ft. lead). To adjust the pressure, follow the adjustment procedure described in the Troubleshooting section. If the gauge reads 5 psi more or less than the recommended pressure, an adjustment may be required.

OPERATION

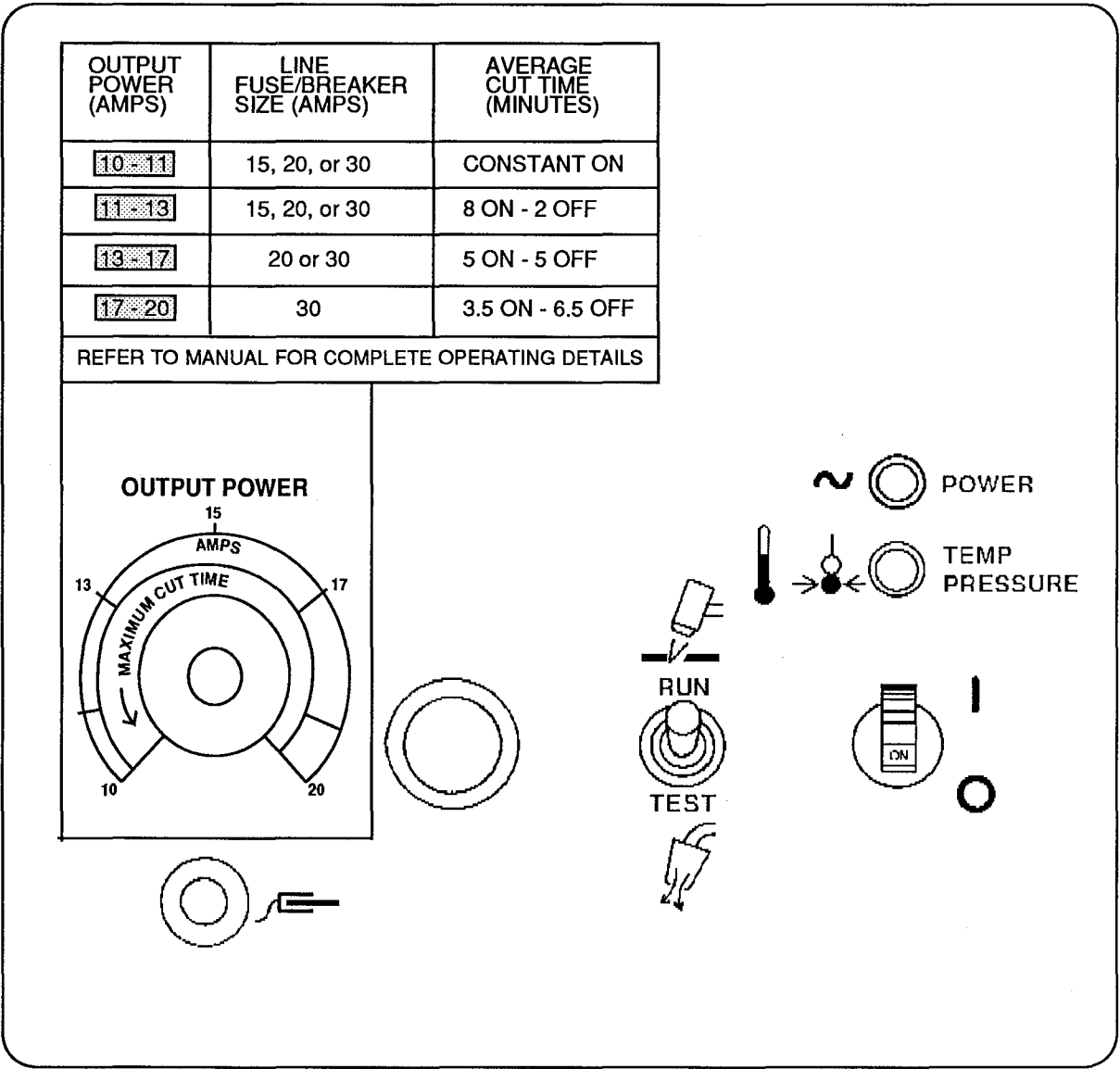


Figure 5 Front Panel Controls

OPERATION

OPERATING INSTRUCTIONS

1. Ensure that the work environment and your clothing meet the safety requirements outlined in the Safety section.
2. Place the power supply in an area where the air flow is not blocked or impeded.
3. Plug the unit into a 120-volt, 60 hertz, grounded outlet.
4. Using a quick connect air fitting, attach the compressed air to the male fitting on the air filter.
5. Check the filter bowl for water. If necessary, empty it by loosening the brass knob at the bottom of the bowl. Retighten the knob when the bowl is empty.
6. Using the **OUTPUT POWER** adjustment knob, adjust the output cutting current and the AC line draw from your 120-volt AC supply according to the amperage of your service and the rating of your circuit breaker. Hypertherm recommends that you use a 20 or 30-amp service and the proper breaker for your service, and that you cut at the lowest power setting which will give you good cut quality.
7. Move the I/O switch to the I position. The **POWER** LED should indicate the unit is "on." The **TEMP/PRESSURE** LED should indicate the temperature and air pressure are within the range of operation.
8. Place the **RUN/TEST** switch in the **TEST** position. Check the air pressure setting to ensure the pressure is set correctly.
9. Attach the work clamp securely to the workpiece.
10. Place the **RUN/TEST** switch in the **RUN** position.



WARNING



The pilot arc starts immediately (no preflow) when the torch switch is pressed.



AVERTISSEMENT



L'arc veilleuse jaillit aussitôt que l'on appuie sur le bouton d'amorçage.

OPERATION

11. The unit is now ready to operate. When you are ready to cut, place the torch on the workpiece. Push the start button on top of the torch handle.
12. The arc transfers from the torch to the workpiece. Move the torch in the desired direction, at a speed which gives good cut quality.
13. When the cut is finished, release the torch button to stop the arc.

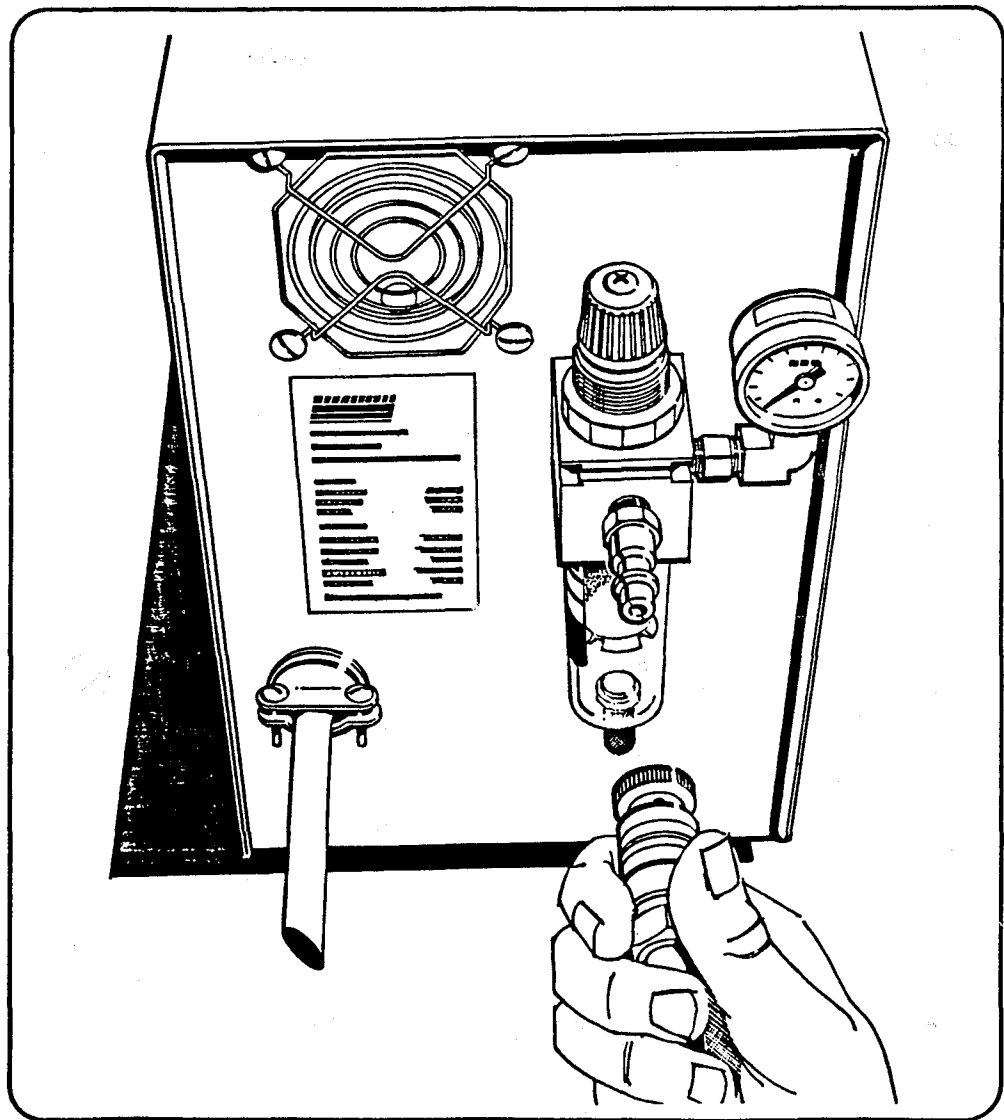


Figure 6 Connecting the Air Supply

OPERATION

OPERATING TIPS

Adjusting the Output Power

Hypertherm recommends that you use a 20 or 30-amp service and the proper breaker for your service, and that you cut at the lowest power setting which will give you good cut quality. Do not put a 30-amp circuit breaker into a 20-amp service. Do not put a 20 or 30-amp breaker into a 15-amp service.

Adjustment Example

For this example, assume that you have a 20-amp service and circuit breaker. You will be able to cut with the OUTPUT POWER setting in the following ranges:

- Blue range (10-11 amp output)
- Light green range (11-13 amp output)
- Green range (13-17 amp output)

OUTPUT POWER (AMPS)	LINE FUSE/BREAKER SIZE (AMPS)	AVERAGE CUT TIME (MINUTES)
10 - 11	15, 20, or 30	CONSTANT ON
11 - 13	15, 20, or 30	8 ON - 2 OFF
13 - 17	20 or 30	5 ON - 5 OFF
17 - 20	30	3.5 ON - 6.5 OFF

REFER TO MANUAL FOR COMPLETE OPERATING DETAILS

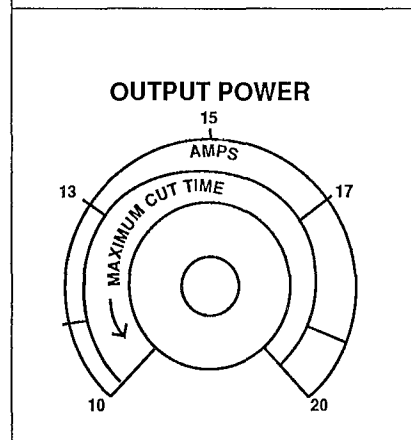


Figure 7 Output Power Adjustment

OPERATION

In these ranges, you will be able to cut for up to five minutes at a time without concern that you will "blow" your circuit breaker.

If you want to cut longer than five minutes, adjust the OUTPUT POWER into the light green or blue ranges. In the light green range (11-13 amps), you will be able to cut continuously for eight minutes. In the blue range (10-11 amps), you will be able to cut continuously. Pick the lowest range you can without sacrificing cut quality.

If you need more cut power, adjust the OUTPUT POWER setting into the red range (17-20 amps). You need a 30-amp service and breaker to be able to cut for the 3 1/2 minutes continuously (see the label). You can cut with the setting in the red range (17-20 amps) for short periods of time (under a minute usually), but you will blow your circuit breaker during longer cuts.

Cutting

- Do not fire the pilot arc into the air needlessly—doing so causes a significant reduction of the nozzle and electrode life.
- Start cutting from the edge of the workpiece (Fig. 8) unless you must pierce. For tips on piercing, see the Operating Tips on piercing.
- 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 1/8 inch of the workpiece.
- To cut perfect circles for spin fittings, use a template or a radius cutter attachment (Fig. 9).
- 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. 10). By lightly dragging the nozzle on the workpiece, you can maintain a steady cut. For straight-line cuts, use any straight edge as a guide.
- When cutting thin material, reduce the amps until you get the best quality cut.

OPERATION

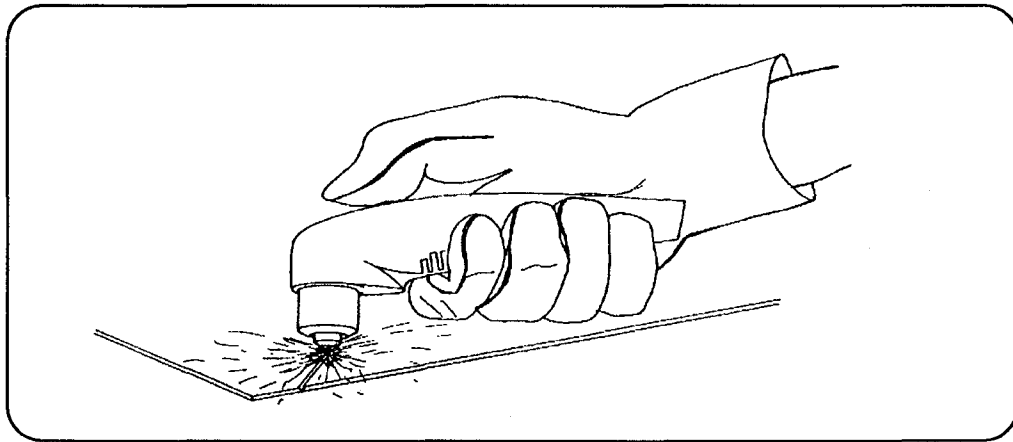


Figure 8 Starting a Cut

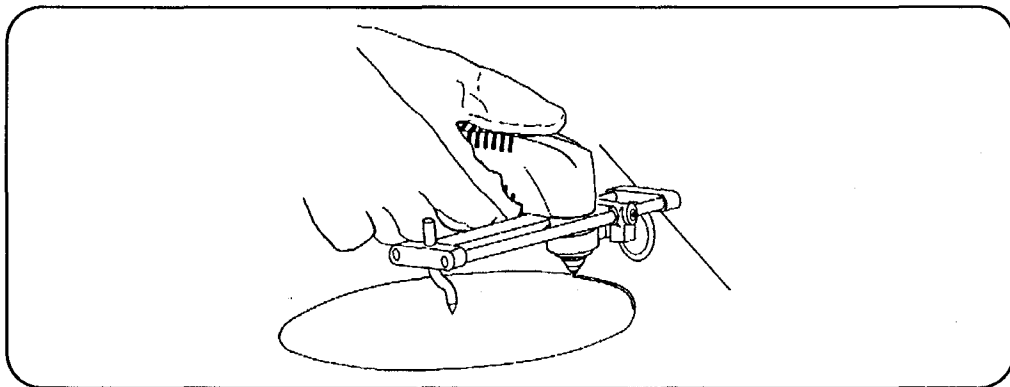


Figure 9 Cutting a Circle

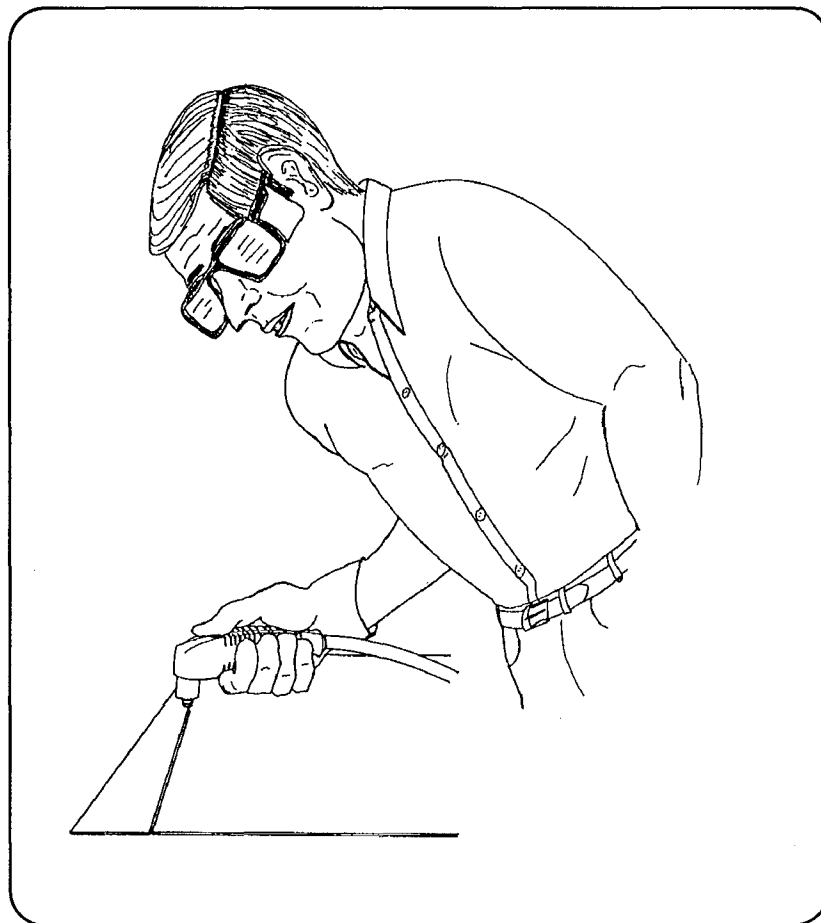


Figure 10 Dragging the Torch

OPERATION

Piercing

- Hold the torch so that the nozzle is approximately 1/16 inch away from the workpiece before pushing 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.
- When the pierce is complete, proceed with the cut.

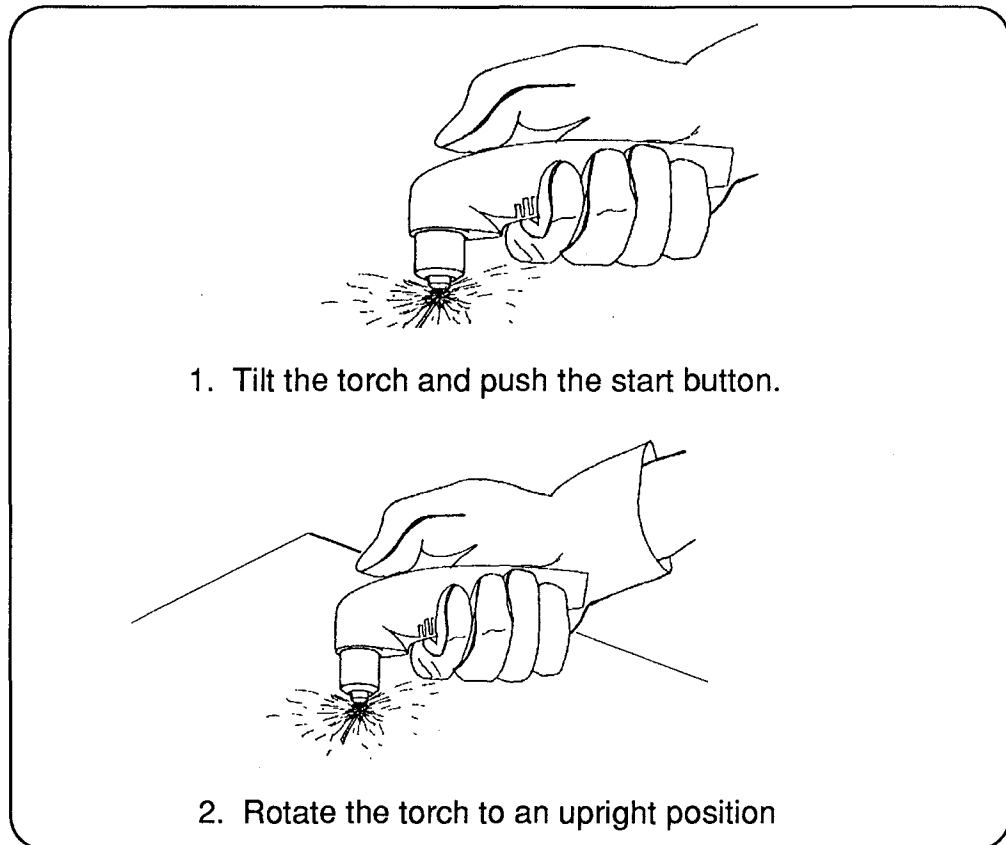


Figure 11 Piercing

OPERATION

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.
 - The current is too high.

Duty Cycle

The duty cycle is the amount of time the plasma arc can remain "on" (in minutes) within a 10-minute period. When the current is set at 20 amps, the MAX20 has a 35% duty cycle. In other words, the plasma arc can remain on 3.5 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 10 to 11 amps. The duty cycles for different amperages are listed on the front panel of the MAX20, as shown below:

OUTPUT POWER (AMPS)	LINE FUSE/BREAKER SIZE (AMPS)	AVERAGE CUT TIME (MINUTES)
10 - 11	15, 20, or 30	CONSTANT ON
11 - 13	15, 20, or 30	8 ON - 2 OFF
13 - 17	20 or 30	5 ON - 5 OFF
17 - 20	30	3.5 ON - 6.5 OFF

Figure 12 Duty Cycle

OPERATION

The duty cycle is reduced if:

- The work clamp is not connected to the workpiece. This causes the power supply heatsink to overheat rapidly causing the temperature sensor on the heatsink to shut the machine off.
- The pilot arc is fired in the air for a period of time before the nozzle makes contact with the workpiece.
- The work clamp is not making a good electrical contact to the workpiece due to paint, rust, etc.

Air Pressure

Compressed air must be available at a flow rate of 4.5 scfm and a minimum pressure of 70 psi. If the pressure is below 40 psi, the torch goes out.

Do not exceed 125 psi. The plastic filter bowl is rated for 150 psi and may explode if this pressure is exceeded. See the warning label on the filter bowl for other safety warnings.

Torch Heat

After several minutes of running, the torch retaining cap may become hot. To cool it, put the **RUN/TEST** switch in the **TEST** position until the cap cools down.

OPERATION

Changing Consumable Parts



WARNING



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



AVERTISSEMENT



Couper l'alimentation avant d'inspecter ou changer les pièces de la torche.

Inspect the nozzle (tip) for damage or wear. If the hole in the nozzle is worn or oval shaped, it is time to change it. Inspect the electrode. If the center of the electrode has a pit more than 1/16" deep, replace it.

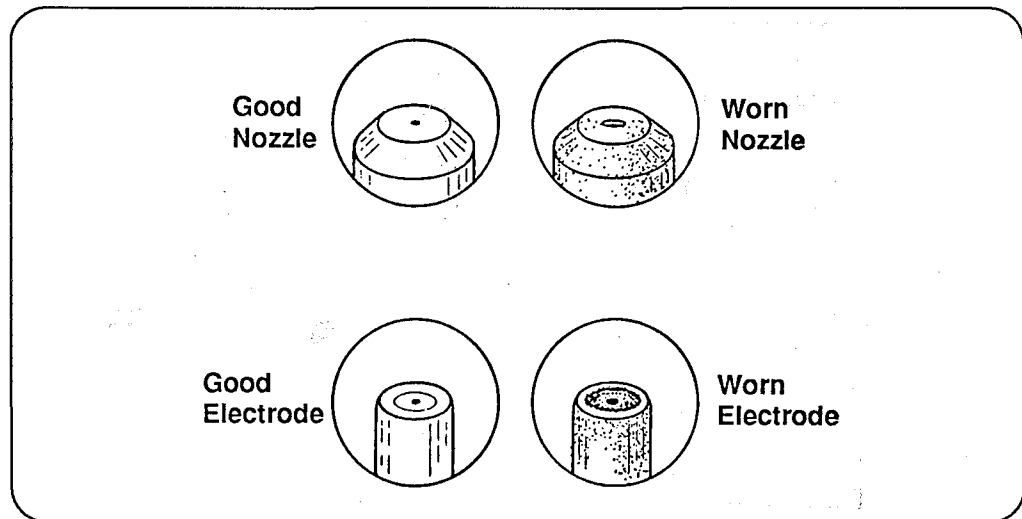


Figure 13 Worn Consumables

Changing the consumable parts requires no tools. Unscrew the retaining cap and the remaining parts will come apart easily. When you unscrew the retaining cap, you'll hear a click. This click is a microswitch disabling the torch so that the torch cannot accidentally be activated. Replace the parts as illustrated in Figure 14. Each part fits in only one direction, so you cannot put the parts in backwards. Also, the torch will not fire if the parts are improperly assembled.

OPERATION

When the nozzle, electrode and swirl ring are properly in place, replace the retaining cap. When the retaining cap is tightened, the microswitch will click, indicating that the torch is operable again.

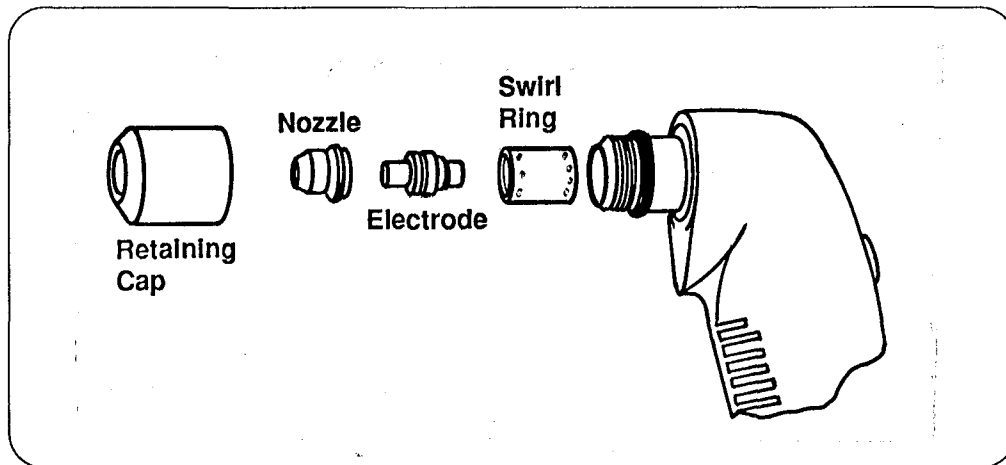


Figure 14 Changing Consumable Parts

Section 5 Standard Components

In this section:

MAX20 Power Supply	42
PAC110 Torch Assembly and Leads	46

STANDARD COMPONENTS

MAX20 POWER SUPPLY

System Description

070005	MAX20 System, 75° Torch, 120-Volt, Single-Phase, 60 Hz, 15-ft Torch Leads, 9-ft Primary Cable
070015	MAX20 System, 75° Torch, 120-volt, Single-Phase, 60 Hz, 25-ft Torch Leads, 9-ft Primary Cable

Component Part Number

Description

001195	Cover
001196	Base
001197	Handle
003078	Relay-1CR
003079	Relay-2CR
003080	Relay-3CR
004291	Spacer, Chopper
005044	Switch- 2TGS
005110	Switch-1TGS
008380	Bushing (2)
008381	Strain Relief, Anode Lead
008382	Clamp, Work (+), Anode Lead
008383	Strain Relief, Line Cord
009374	Light, Red LED-1LT, 2LT (2)
041139	2PC: INRUSH--5RES
029308	Transformer 2.0 kw- 1T, -2TAS
014086	Inductor, 6 MHY- 1X
023269	Lead, Anode, 15 Ft.
023270	Line Cord, 9 Ft.
027103	Fan, 115 VAC 50/60 34 scfh
029232	Chopper SA, 20A 240 OCV
006036	Valve, Solenoid, 24 VAC, 60 Hz, 60 psi
011039	Filter, reg. .5 micron, 120 psi, 1/8 NPT, 20-30scfm
011054*	Filter Elemen (inside 011039)
015152	Nipple, Quick Connect
022013	Gauge, Pressure 1 1/2", Dia. 0-100 psi
005112	Pressure Switch- 1PS
029234	Harness SA

* Filter element 011054 can also be obtained by contacting the following sources. In the USA, contact Watts FluidAir, Inc. Customer Service Department at 207-439-9511 for the name of the nearest authorized Watts FluidAir distributor. Order element replacement kit EK504VY. Overseas customers should contact their local Hypertherm distributor.

STANDARD COMPONENTS

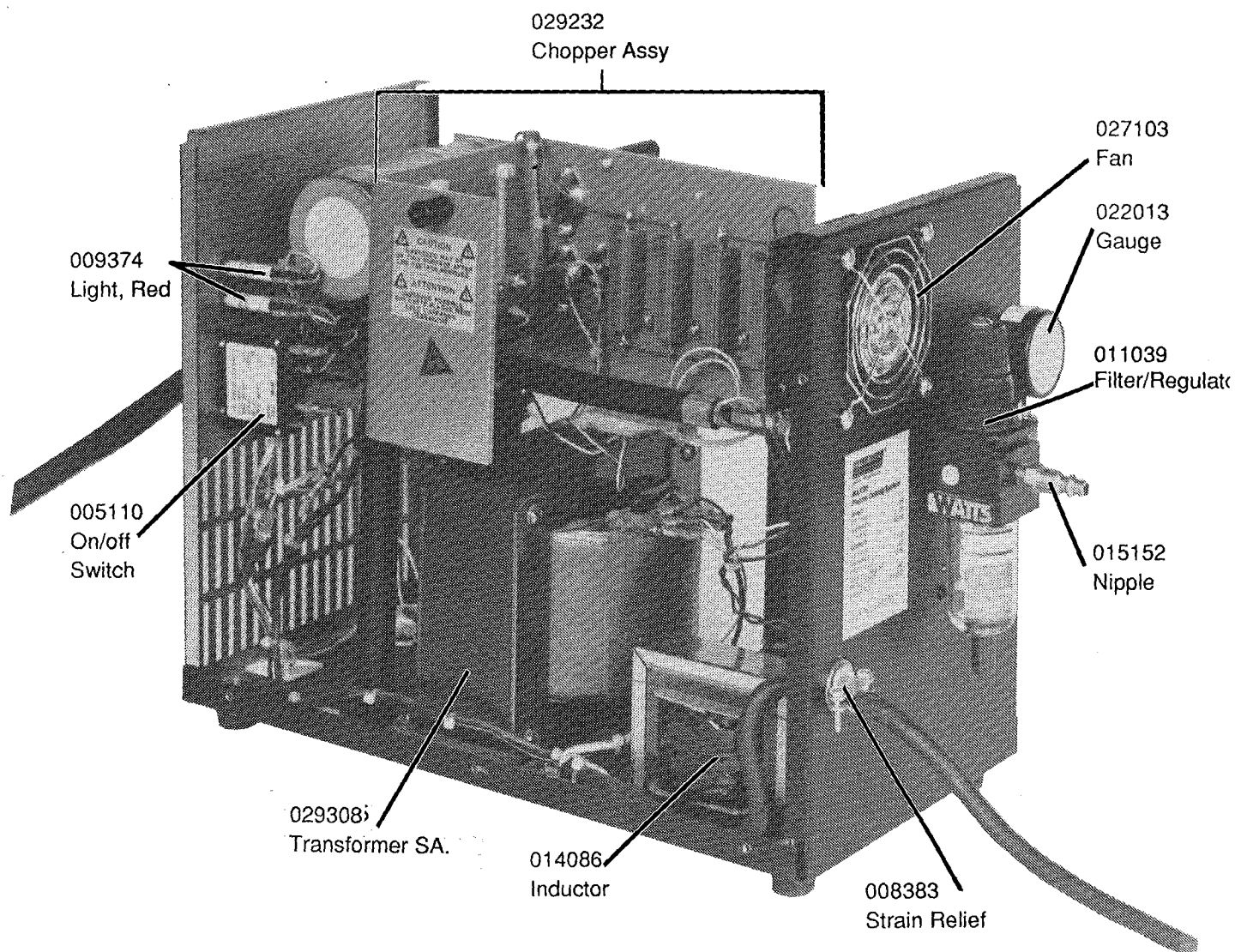


Figure 15 MAX20 - Right View, Rear

STANDARD COMPONENTS

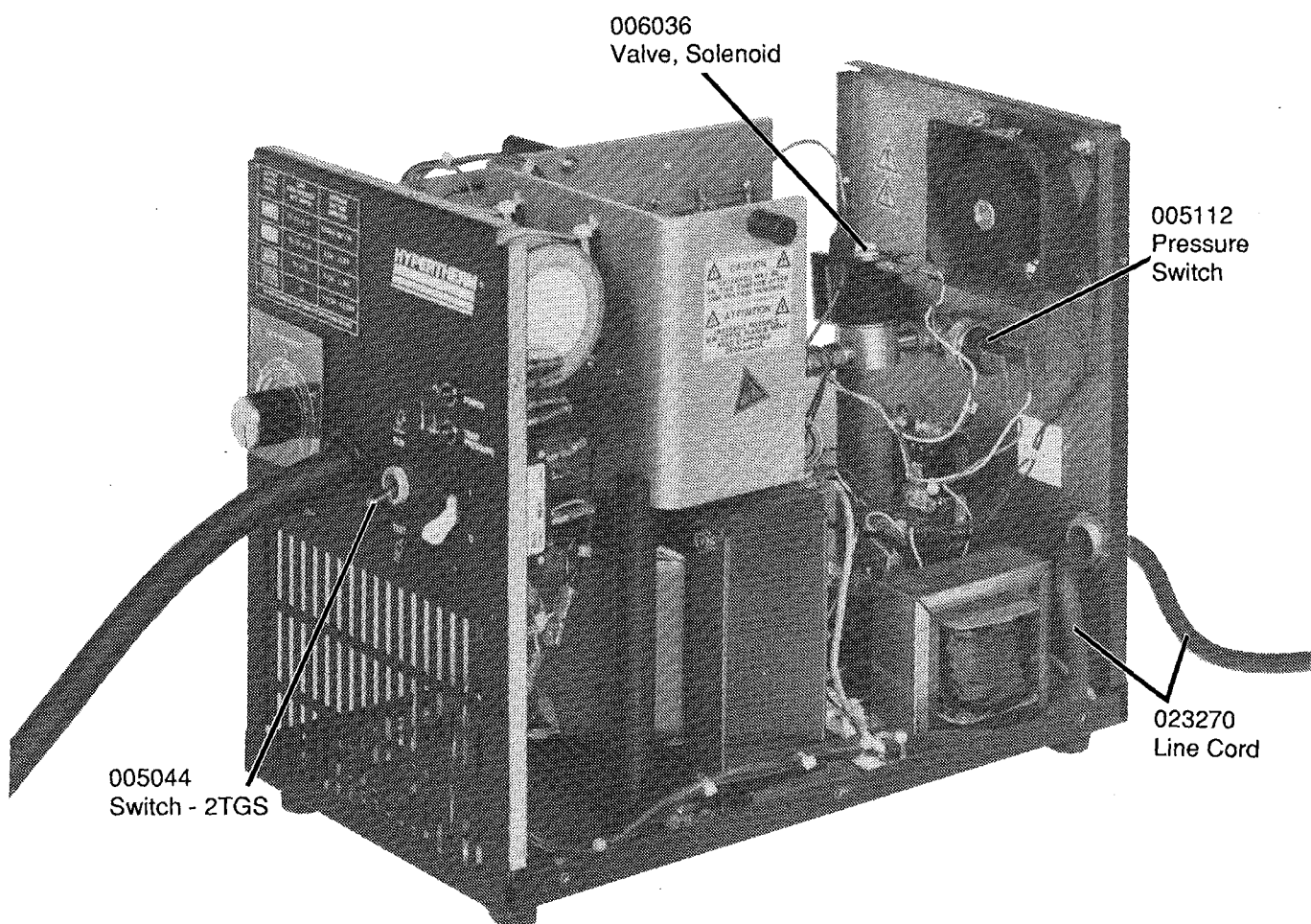


Figure 16 MAX20 - Right View, Front

STANDARD COMPONENTS

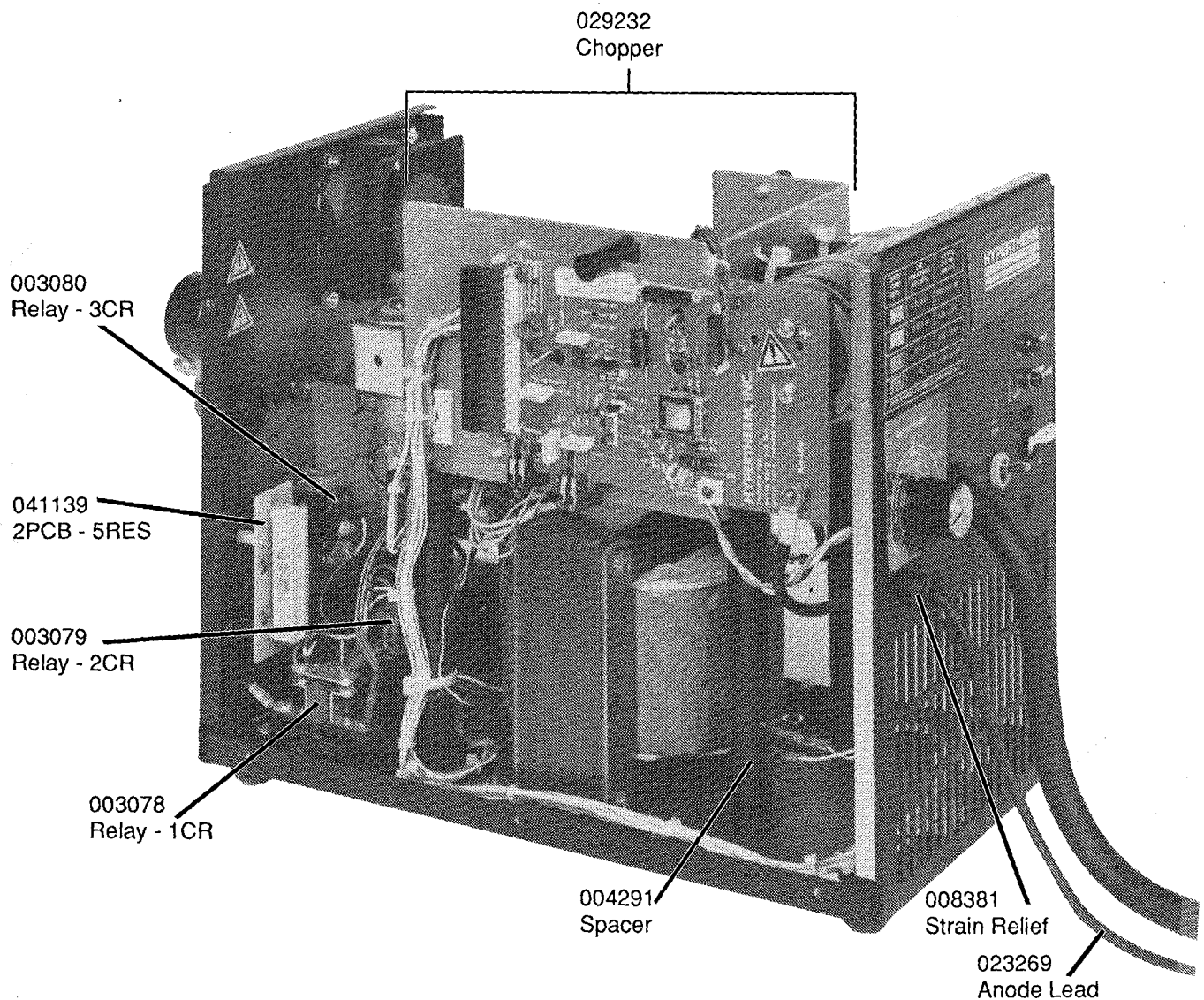


Figure 17 MAX20 - Left View, Front

STANDARD COMPONENTS

PAC110 TORCH ASSEMBLY AND LEADS

<u>Component Part Number</u>	<u>Description</u>
070003	PAC110 Torch Assembly (w/15 ft. lead)
070014	PAC110 Torch Assembly (w/25 ft. lead)
020218	Retaining Cap
020239	Swirl Ring
020382	Electrode, Extended
020381	Nozzle, Extended
044016	O-Ring
028349	Spare Parts Kit

Spare parts kit includes:

020239	Swirl Ring (1)
020382	Electrode, Extended (3)
020381	Nozzle, Extended (5)
044016	O-Ring (2)
015153	Quick Connect (1)

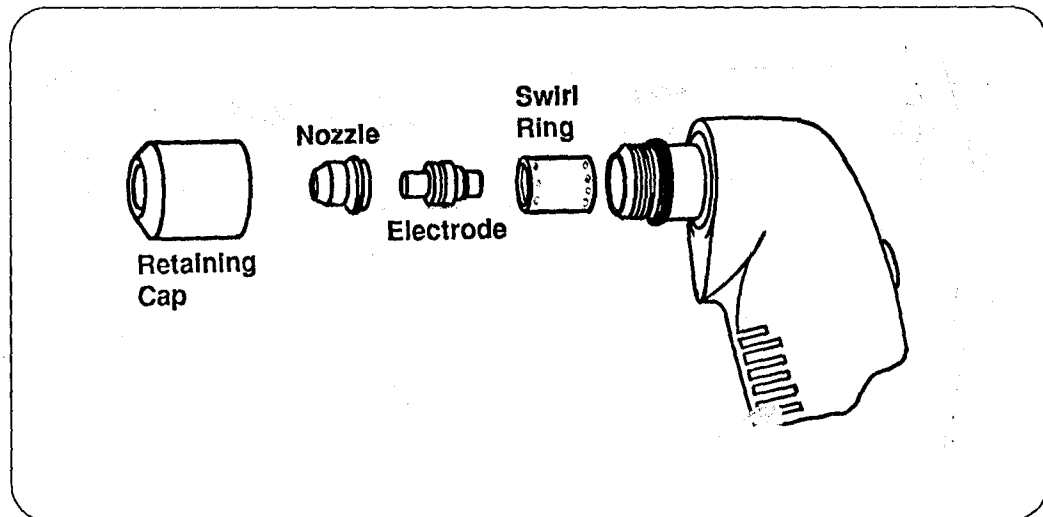


Figure 18 PAC110 Torch

STANDARD COMPONENTS

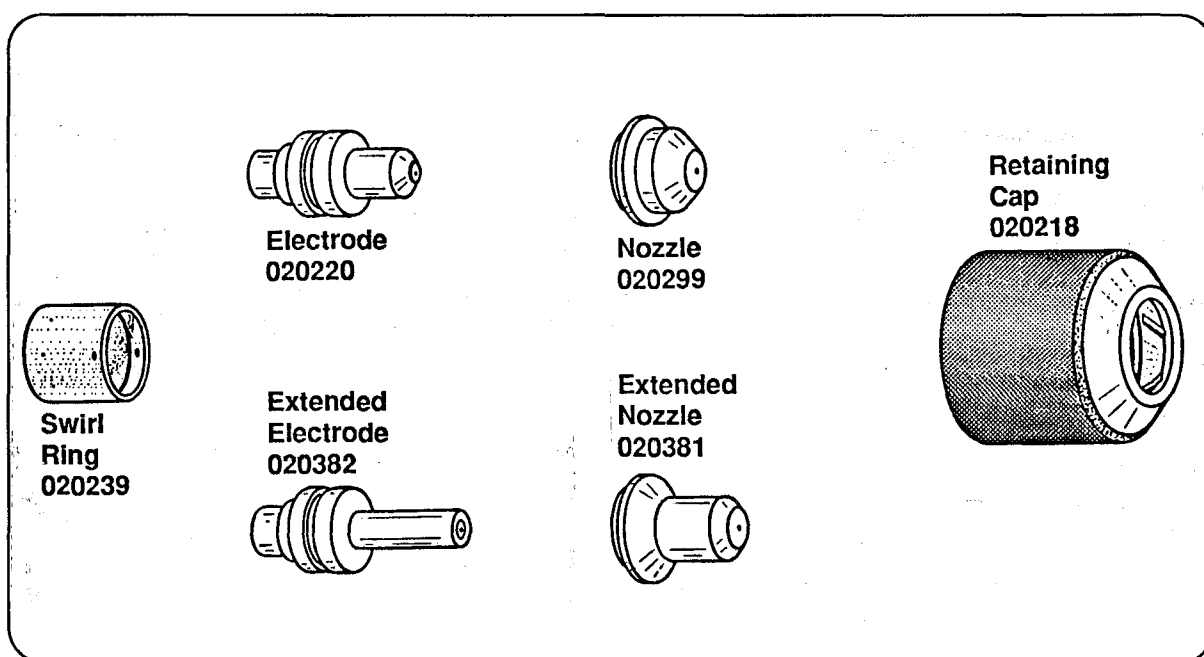


Figure 19 Consumable Parts

Section 6 TROUBLESHOOTING

In this section:

Problems: Causes and Solutions	51
System Illustrations	55

TROUBLESHOOTING



WARNING



The aluminum heatsink (the U-shaped piece of aluminum) is electrically live when the plasma is on. In case of an electronic failure of the chopper circuit, the heatsink may be live when the power is on.

SHOCK HAZARD: The large electrolytic capacitor (blue-cased cylinder located behind the front panel) stores large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the PC board, and on certain areas of the PC board. Discharge time to 40 volts is 90 seconds. Never discharge the capacitor 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 PC board or the capacitor.



AVERTISSEMENT



Le dissipateur de chaleur en aluminium (élément en U) est sous tension lorsque le plasma circule. En cas de défaillance du circuit de découpage, le dissipateur peut être mis sous tension aussitôt l'appareil en circuit.

DANGER DE CHOC: Les gros condensateurs électrolytiques (cylindres bleus, derrière le panneau avant) emmagasinent une quantité importante d'énergie sous forme de charge électrique. Même lorsque l'alimentation est coupée, une tension dangereuse subsiste aux bornes des condensateurs, sur la plaque de circuits imprimés et dans certaines zones de cette dernière. Le temps de décharge à 40 volts est de 90 secondes. Ne jamais décharger un condensateur à l'aide d'un tournevis ou autre outie; cela peut causer une explosion, des dégâts et des blessures. Attendre au moins cinq minutes après avoir coupé l'alimentation avant de toucher à la plaque de circuits imprimés ou aux condensateurs.

TROUBLESHOOTING

Problem: The machine is switched on, but the red POWER LED does not light up.

Cause: Power is not present in the power line, or the primary fuse is not operative.

Solution: Turn the power on. Check the line fuse; replace if defective.

Cause: The resistors on 2PCB have failed.

Solution: Replace 2PCB.

Problem: The machine is switched on, but the TEMP/PRESSURE LED fails to light up.

Cause: The air pressure is low.

Solution: Check the air filter for blockage. (Remove the air supply before changing the filter element.)

Increase the air pressure to the unit. Verify that the air supply can provide 4.5 scfm. Check the lines for blockage.

Cause: The unit is still overheated. The unit cools down faster with the fan on.

Solution: Turn the unit on. Let it cool for 8 minutes before operating the torch.

Cause: The thermal overload switches are defective.

Solution: Call the Hypertherm Service Department.

Cause: The 1FU fuse on the circuit board may be blown.

Solution: Check the fuse. Replace if defective.

Problem: The circuit breaker on the incoming 120V line fails occasionally when the unit is turned on.

Cause: There is a "weak" circuit breaker.

Solution: Replace the breaker.

Cause: The 2PCB/3CR circuit failed.

Solution: Check 3CR and 2PCB and replace them if necessary.

TROUBLESHOOTING

Problem: The circuit breaker on the incoming 120V line fails during cutting.

Cause: The power supply has exceeded the capacity of the breaker.

Solution: Decrease the cutting current by reducing the amperage setting on the front panel, or decrease the time of the cut.

Reduce the length of the extension cord, or increase the gauge of the extension cord.

Cause: Other equipment is being operated on the same circuit.

Solution: Do not operate any other equipment on the same circuit as the MAX20.

Problem: The POWER switch will not stay in the I (on) position.

Cause: The retaining cap is not screwed on correctly.

Solution: Gently tighten the cap.

Cause: The consumables are not installed properly.

Solution: Check the consumables for correct installation (See Figure 14).

Cause: The cap sensing circuit is inoperative, but the unit still won't turn on.

Solution: Check continuity between the blue wires from the torch cable.
Call the Hypertherm Service Department.

Problem: There is a very loud buzzing in the power supply during cutting.

Cause: Relay 1CR may have filings or dirt in it.

Solution: Clean out the relay with compressed air.

Cause: The air pressure is low.

Solution: Increase the air pressure. Ensure that the air supply can provide 4.5 scfm.

TROUBLESHOOTING

Problem: There is no plasma arc, or the arc fails during cutting and does not re-ignite.

Cause: There is scale build-up on the consumable parts.

Solution: Change the parts, or lightly scour away the oxides inside the nozzle using steel wool.

Cause: The consumable parts may be worn out.

Solution: Check the consumables, and replace if necessary. See Figure 14 for installation.

Cause: The retaining cap has been overtightened.

Solution: Loosen the retaining cap.

Cause: The system has overheated.

Solution: Check the TEMP/PRESSURE LED on the front panel. If it is not lit, wait for the unit to cool down.

Cause: There is insufficient air pressure.

Solution: Check the TEMP/PRESSURE LED on the front panel. If it is not lit, check the gauge on the back of the unit. Increase the air pressure to the unit.

Check the air filter. If it is clogged, remove the air supply and change the filter element.

Cause: The wire leads inside the torch are broken.

Solution: Replace the torch assembly.

Cause: There is low primary line voltage.

Solution: Check the incoming primary service. If you are using an extension cord, ensure that the gauge of the cord meets specifications. If possible, avoid using an extension cord, and plug the unit directly into the wall.

Cause: Relay 2CR has failed. The chopper fails to receive a signal from the relay.

Solution: Replace 2CR.

Cause: Relay 1CR has failed.

Solution: Replace 1CR.

Cause: 1SOL has failed, and the pilot arc does not ignite.

Solution: Replace 1SOL.

Cause: The circuit fuse failed.

Solution: Replace 1FU.

If all the above checks are satisfactory, the chopper may have failed. In this event, the chopper module needs to be replaced. Contact your field service representative or the factory for proper instructions.

TROUBLESHOOTING

Problem: The arc blows out, but re-ignites when the torch button is depressed.

Cause: There are faulty consumable parts.

Solution: Inspect and change the consumable parts if necessary.

Cause: There is low incoming line voltage, improperly sized or too lengthy an extension cord, or too many other devices on the same power circuit.

Solution: Check the incoming line voltage and, where possible, gain access to proper line voltage. Or, reduce the power output to 13 amps and try again.

Cause: The air pressure is incorrect.

Solution: Adjust the air pressure using the following procedure:

1. Apply air supply at 70-125 psi with at least 4.5 scfm flow capacity.
2. Using a Philips screwdriver, unlock the screw at the top of the air pressure regulator cap.
3. Adjust the air pressure downward ("relieve the regulator") by turning the knob in the direction shown on the regulator cap ("-" is counter-clockwise). Adjust the pressure below 40 psi using the gauge on the back of the unit.
4. Slowly increase the air pressure by turning the knob clockwise until 60 psi (or 65 psi if you are using a 25-foot lead) is reached. STOP! DO NOT BACK OFF ADJUSTMENT. IF YOU DO, YOU MUST RETURN TO STEP 3.
5. Using the Philips screwdriver, and being careful not to change the pressure adjustment, lock the screw at the top of the air regulator cap.
6. Typically, when the unit is operated in TEST mode, the no-flow (static) pressure is 60-65 psi and the pressure with flow (dynamic) is 55 psi. If consistent pressure cannot be maintained, the pressure gauge is probably faulty and/or the pressure regulator may be faulty.

TROUBLESHOOTING

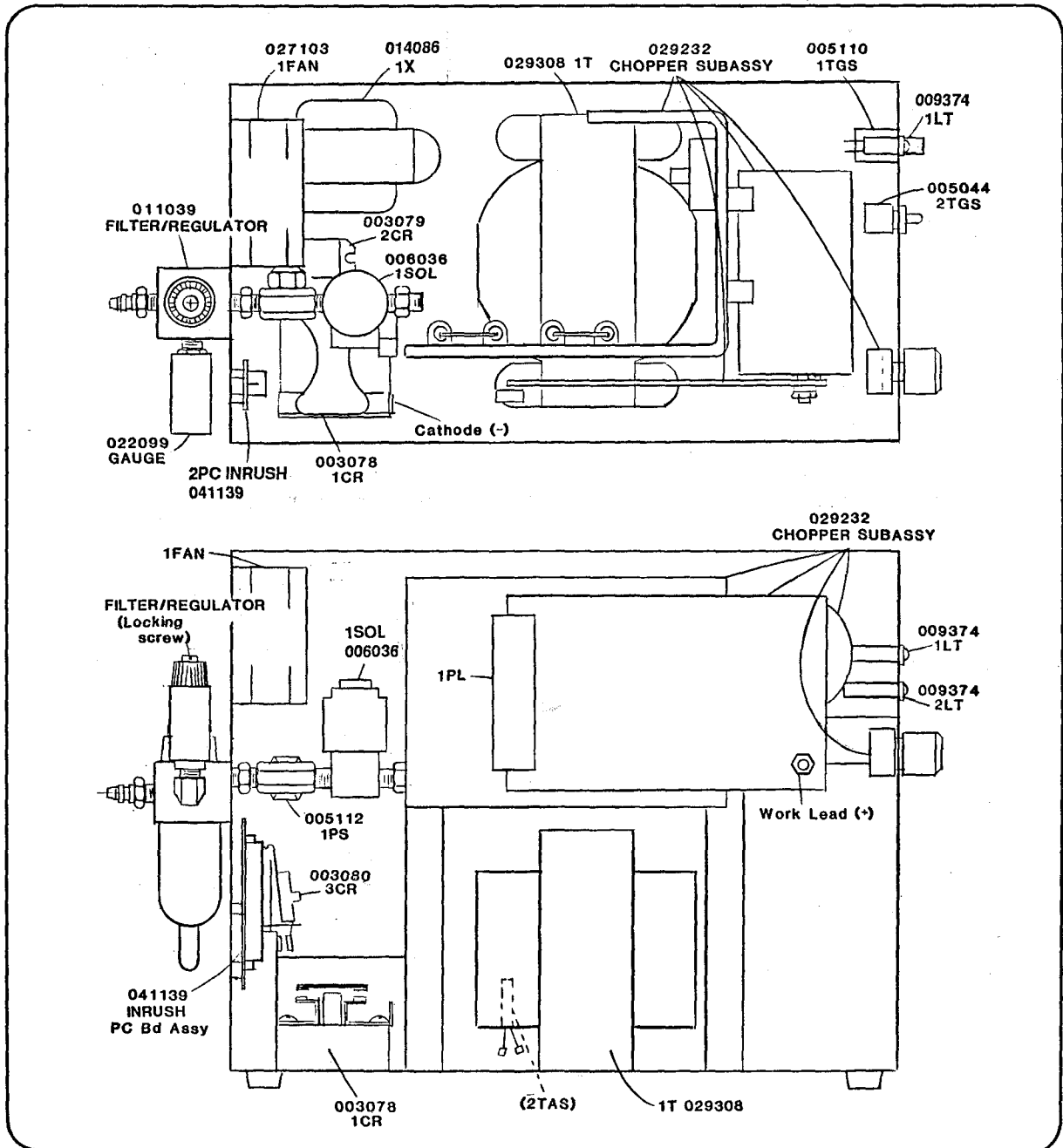


Figure 20 Torch Connections

TROUBLESHOOTING

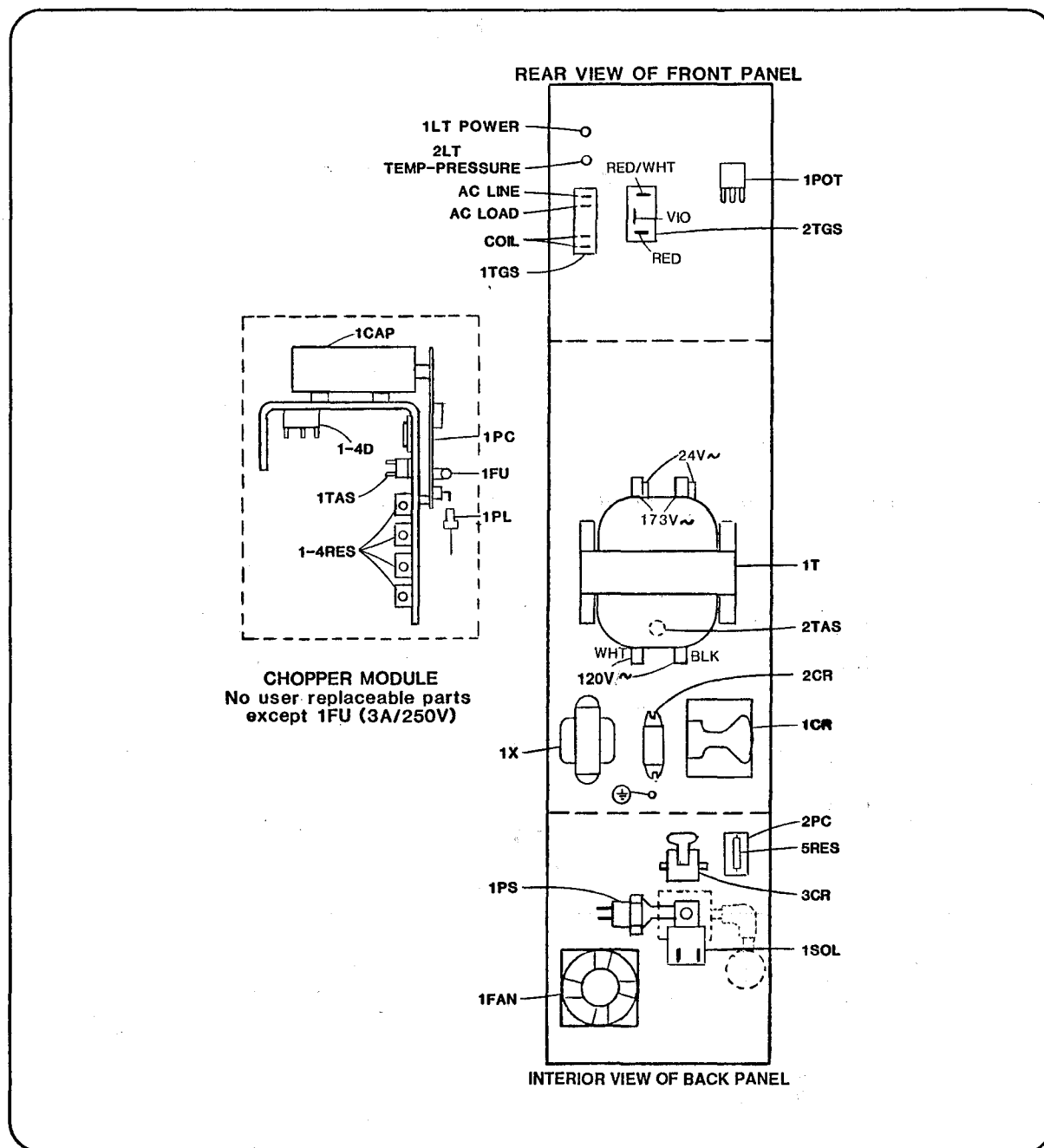


Figure 21 Component Locator

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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.

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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.

GLOSSARY

AC	Alternating Current. Motion of current alternately in one direction, then the other. The number of times per second the direction changes (the "frequency") is measured in hertz.
amp	Amperes. Measurement of the electron flow (the number of electrons per second) in an electrical circuit.
anode	The "positive" (+) side of a DC power source. Electrons leave the cathode and move toward the anode; ions move in the opposite direction. Plasma cutting requires the work and the nozzle to be the anode, and the electrode to be the cathode.
arc	Motion of electricity in a gas.
AWG	American Wire Gauge. Defines the diameter of wires.
breaker	A device which interrupts an electrical current if the current exceeds a preset amperage setting. Breakers can be returned to their conducting (non-interrupting) state by some mechanical action, such as flipping a switch.
cap	Nozzle retaining cap. Holds the swirl ring, electrode and nozzle inside the torch.
capacitor	A device that stores electric energy in the form of voltage.
cathode	The "negative" (-) side of a DC power source. (See anode)
consumable	Electrode, nozzle, swirl ring and retaining cap.
CSA	Canadian Standards Association. Product standards and testing agency.
current	Movement of electricity, measured in amperes. Current is said to move in a direction opposite that of electron flow.
DC	Direct Current. Motion of current in one direction only, from anode (+) to cathode (-).
dross	Globs of metal hanging around the kerf, usually on the bottom side.
duty cycle	Percentage of on-time (measured in minutes) in a 10 minute period in which a device can be operated.
electricity	Fundamental property of atoms that atoms can have their electrons pulled away ("ionized") and then the electrons can move about in metals or gases. An atom missing one or more electrons is called an ion. Both electrons and ions can move about in gases.
electrode	A part inside the torch connected to the cathode (-) of the power supply. Electrons come out of the electrode.

GLOSSARY

fuse	A protective device which melts when the current running through it exceeds the usage rating.
ground	An electrical connection buried in the earth to establish a voltage of zero (0) volts.
Hertz (Hz)	Measurement of "frequency" of an AC voltage or current in cycles per second.
interlock	A safety device which must be activated before another device can be activated.
ion	An atom which has an excess or shortage of electrons.
kerf	Slit made in a workpiece by a cutting torch.
kilowatt	Thousand (kilo) watts. Measurement of electrical power.
LED	Light Emitting Diode. An electronic indicator lamp.
line	As in "line voltage." Utility voltage from a branch circuit (wall outlet).
nozzle	Tip of the plasma torch, made from copper, out of which the plasma arc comes. The nozzle pinches the plasma arc. It is usually an anode (+).
OCV	Open Circuit Voltage. The highest voltage from a electrical power supply. It occurs when the power supply is on and active but not producing a plasma arc.
pilot arc	A plasma arc that attaches to the torch nozzle rather than the work.
plasma	An electrically charged gas is said to be "ionized". A cloud of ionized gas together with its electrons is called "plasma".
plasma arc	Movement of electric current in a plasma (ionized gas). An intensely hot and bright arc which exists between the cathode (-) (electrode) and the anode (+) (either the nozzle or the work).
pressure	Force per unit area.
psi	Pounds per Square Inch. Measurement of gas pressure.
quench	Put in water to cool.
regulator	A mechanical device to control the outlet pressure of a gas supply.
ripple	Unwanted variations in current or voltage from an electrical power supply.
scfm	Standard cubic feet per minute. A measurement of gas flow.

GLOSSARY

single phase	An alternating current carried by only two wires. In the U.S. the "hot" carries the AC voltage and the "neutral" is at approximately "ground" voltage. The "ground" wire carries current only in fault conditions.
swirl ring	An insulating ring that separates the electrode from the nozzle and causes the air inside the plasma torch to swirl and aid in squeezing the arc.
transfer	A pilot arc <i>transfers</i> to the work when the plasma arc leaves the surface of the nozzle and attaches to the work.
UL	Underwriters Laboratories. A U.S. product standards and testing laboratory.
VAC	Volts Alternating Current.
VDC	Volts Direct Current.
volt	Measurement of electrical force required to move an electric current through an electrical circuit.
watt	Measurement of electrical power. The ability to heat the work equivalent to a current of one ampere times an electrical force of one volt.
work(piece)	The object to be cut.

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