MAX200

Remote High Frequency

Plasma Arc
Cutting System

Instruction Manual
800990 - Rev. 2

HYPERTHERM®

MAX200/RHF

Remote High Frequency Plasma Arc Cutting System

Instruction Manual IM-99 (P/N 800990)

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HYPERTHERM, Inc.
P.O. Box A-10 Etna Road
Hanover, New Hampshire 03755
(603) 643-3441

Hypertherm Offices Worldwide:

Hypertherm, Inc.
Etna Road, P.O. Box 5010
Hanover, NH 03755 USA
Tel.: (603) 643-3441 (Main Office)
Fax: (603) 643-5352 (All Departments)
Tel.: (800) 643-9878 (Technical Service – toll-free in USA and Canada)
Tel.: (800) 737-2978 (Customer Service – toll-free in USA and Canada)
email: info@hypertherm.com (General Information)
email: service@hypertherm.com (Technical/Customer Services)

Hypertherm Plasmatechnik GmbH
Technologiepark Hanau
Rodenbacher Chaussee 6
D–63457 Hanau-Wolfgang, Germany
Tel.: 49 6181 58 2100
Fax: 49 6181 58 2134

Hypertherm (S) Pte Ltd
No. 19 Kaki Bukit Road 2
K.B. Warehouse Complex
Singapore 417847
Tel.: 65 841 2489
Fax: 65 841 2490

Hypertherm UK Ltd
9 Berkeley Court, Manor Park
Runcorn, Cheshire, England WA7 1TQ
Tel.: 44 1928 579 074
Fax: 44 1928 579 604

France
15 Impasse des Rosiers
95610 Eragny, France
Tel.: 33 1 30 37 15 28
Fax: 33 1 30 37 15 79

Hypertherm S.r.L.
Via Torino 2
20123 Milan, Italy
Tel.: 39 02 725 46 312 (Customer Service)
Tel.: 39 02 725 46 314 (Technical Service)
Fax: 39 02 725 46 400 (All Departments)

Hypertherm B.V.
Burg, Haverkampstraat 13
7091 CN Dinxperlo, The Netherlands
Tel.: 31 315 655 866 (Customer Service)
Fax: 31 315 655 886

European Technical Support Organization (ETSO)
Edisonstraat 12
3281 NC Numansdorp, The Netherlands
Tel.: 00 800 4973 7843 (00 800 Hypertherm) – (toll-free Technical Service)
Tel.: 31 186 659494
Fax: 31 186 659495

Japan
Shinjuku Park Tower
30th Floor
3-7-1 Nishi-Shinjuku
Shinjuku-ku, Tokyo
163-1030, Japan
Tel.: 81 03 5326 3142
Fax: 81 03 5326 3001

MAX200/RHF System Configuration Serial Numbers

The following units with associated starting serial numbers are supported by IM-99 Revision 1.

Power Supply	Serial Number 200-375
HF Console	Serial Number 201-0120
Display Console	Serial Number 202-0120

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.

WARNING

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

WARNING

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

GENERAL

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

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LIMITATION OF LIABILITY

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

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

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

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

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Section 1-A SAFETY

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SAFETY

INTRODUCTION

Abbreviated safety precautions are printed on the MAX200 unit. Before using the equipment (including compressed gas), 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 MAX200.

> Caution: A caution describes a situation that may cause damage to the MAX200, 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

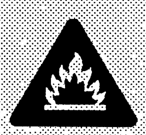
ELECTRIC SHOCK CAN KILL.
- Do not touch live electrical parts.
- Keep all panels and covers in place when the machine is connected to a power source.
- Insulate yourself from work and ground: wear insulating gloves, shoes and clothing.
- Keep gloves, shoes, clothing, work area, torch, and this machinery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

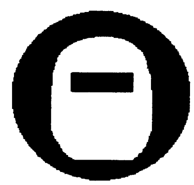
SAFETY INSTRUCTIONS

Burn Prevention

Eye Safety

To protect eyes against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear a welding helmet. Refer to the chart below for recommended lens shades:



Arc Current	Shield Shade
Up to 100 Amps	Shade No. 8
100 - 200 Amps	Shade No. 10
200 - 400 Amps	Shade No. 12
Over 400 Amps	Shade No. 14

- Replace the helmet when the shield becomes pitted or broken.
- Warn other people in the area not to look directly at the arc unless they wear a helmet.
- Cool the torch cap and consumable parts after extended cutting with a gas flow by placing the gas TEST/RUN switch in the TEST position.
- 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 Safety

To protect skin against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear protective clothing:
  - Wear gauntlet gloves, safety shoes and hat.
  - Wear flame-retardant clothing which covers all exposed areas.
  - Wear cuffless trousers to prevent entry of sparks and slag.
- Hold the torch away from your body when starting. The pilot arc may come on immediately when you press 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.

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 such containers thoroughly before cutting.

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 MAX200 produces hot metal, sparks and slag. Take the following precautions against fire:

- Make fire extinguishers available in the cutting area.
- Remove combustible material from the immediate cutting area to a distance of at least 35 feet (ten meters).
- Quench freshly cut metal or allow metal to cool before handling it or bringing it into contact with combustible materials.
- Never use a MAX200 to cut containers with potentially flammable materials inside. Such containers must be thoroughly cleaned prior to cutting.

- Ventilate potentially flammable atmospheres before using the MAX200. Never operate the MAX200 in an atmosphere which contains heavy concentrations of dust, flammable gas or combustible liquid vapors.

Electric Shock Prevention

The MAX200 uses high voltage (approximately 280 VDC) to initiate the plasma arc. Take the following precautions when operating the MAX200:

- Keep your body and clothing dry.
- Do not stand in, sit on or lie on any wet surface when using the MAX200.
- Maintain proper insulation against electrical shock. If you must work in or near a damp area, use extreme caution. Wear insulated gloves and boots.
- Provide a wall-mounted disconnect switch with proper size fuses close to the MAX200 power supply. This switch allows the operator to turn the MAX200 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 the system with a damaged power cord. If a power cord is damaged, replace it immediately.
- Inspect the torch leads. Replace if frayed or damaged.
- Should you need to remove the power supply cover after operation, disconnect the main power or unplug the power supply. Wait five minutes to allow capacitor discharge to occur. Failure to do so exposes you to severe electrical hazard.
- Never operate the MAX200 unless the power supply unit cover is in place. Exposed power supply connections present a severe 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 attached at all times.
- Before changing the torch parts, disconnect the main power or unplug the MAX200. After changing the torch parts and returning the retaining cap to its operating position, plug the MAX200 in again.
- Never bypass or shortcut the safety interlocks.

Explosion Prevention

WARNING

The MAX200 uses compressed gas. Proper precautions must be observed when handling and using compressed gas equipment and cylinders. Refer to CGA standard P-1.

When cutting with the MAX200:

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

Pressure Regulators

- Maintain all pressure regulators in proper working condition. Faulty regulators can cause damage or operator injury and must be serviced by trained repair technicians.
- 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.

Compressed Gas Cylinders

- Handle and use compressed gas cylinders in accordance with CGA and AWS safety standards.
- 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 the 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.

Hoses

The gas supply hose to the plasma arc cutting system must adhere to the following color coding:

Green	Oxygen
Black	Inert gases and air

- Never use green oxygen hose for any gas other than oxygen.
- Replace hose that is damaged by physical abuse or by sparks, heat or open flame.
- Lay hose out straight to prevent kinks.
- Coil excess hose and place it out of the way to prevent damage and to eliminate tripping danger.
- Examine hoses at regular intervals for leaks, wear, loose connections or other hazard.
- Keep hose lengths to a minimum to prevent damage, reduce pressure drop and to prevent possible volume flow restriction.

Grounding

Before operating the MAX200:

Input Power

- Be sure the power cord ground wire is properly connected to the ground in the disconnect box.
- Be sure the power cord ground wire is properly connected to the ground stud in the MAX200. Place the power cord ground wire first on the stud; then place the other wires on top of the power cord ground. Fasten the retaining nut tightly.
- Make sure that all electrical connections are tight to avoid excessive heating.

Output Power

- Clamp the work cable with good metal-to-metal contact to the workpiece (not the portion that will fall away) or to the work table.
- Connect the work table to a good earth ground. Consult the National Electrical Code, Article 250, Section H *Grounding Electrode System*, or other appropriate code.

For additional information, refer to the *Standards Index* in this manual.

SAFETY DEVICES

- The MAX200 is designed with a safety interlock which turns off the power unit when the retaining cap is loosened.
- Never bypass or shortcut the safety interlocks.
- The MAX200 is designed specifically to be used with MAX200 torches. Do not use other torches.
- Use only Hypertherm replacement and consumable parts. Any damage caused by the use of other than genuine Hypertherm parts is not covered by the Hypertherm warranty.
- Never operate the MAX200 with any of the power supply covers not in place. It is hazardous to the operator and 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*.

Section 1-B SÉCURITÉ

Cette section comprend:

Introduction 1b-2
Notes, prévention et avertissement 1b-2
Consignes de sécurité 1b-4
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   Vapeurs toxiques 1b-5
   Prévention des incendies 1b-5
   Prévention des chocs électriques 1b-6
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   Mise à la masse 1b-9
Dispositifs de sécurité 1b-9
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SÉCURITÉ

INTRODUCTION

Des consignes de sécurité condensées sont imprimées sur l'appareil du MAX200. 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 MAX200.

Prévention: Un signe de prévention décrit une situation qui risquerait d'endommager le MAX200, 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.

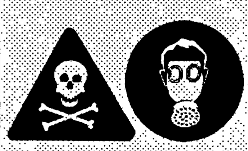
AVERTISSEMENT

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 du sol 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'OUIE.
- 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 agré.

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.
- L'arc pilote peut causer des brûlures. Éloigner la buse de la torche de soi-même et des autres lorsque l'interrupteur est enclenché.
- Porter des protecteurs appropriés pour les yeux et le corps.

CONSIGNES DE SÉCURITÉ

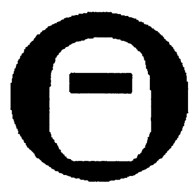
Prévention des brûlures

Protection des yeux

Pour se protéger les yeux des brûlures que peuvent causer le rayonnement ultraviolet de forte intensité, les étincelles et le métal brûlant:

- Porter des lunettes de sécurité à verres teintés munies d'écrans latéraux. Le tableau ci-dessous indique les pouvoirs obscurcissants recommandés pour les verres.

Courant	Pouvoir obscurcissant des verres
Jusqu'à 100 A	No. 8
100 - 200 A	No. 10
200 - 400 A	No. 12
Plus de 400 A	No. 14



- Remplacer les lunettes quand les verres sont brisés ou endommagés.
- Avertir les autres personnes se trouvant dans l'endroit de travail de ne pas regarder directement l'arc, à moins de porter des lunettes à verres teintés.
- Refroidir le bouchon de la torche et les pièces consommables après une longue coupe en mettant le commutateur RUN/TEST en position TEST.
- Préparer l'endroit de travail de façon à réduire la réflexion et la transmission du rayonnement ultraviolet:
  - Peindre les murs et autres surfaces de couleur foncée pour réduire la réflexion.
  - Installer des écrans et des rideaux protecteurs pour réduire la transmission du rayonnement ultraviolet.

Protection de la peau

Pour protéger la peau des brûlures que peuvent causer le rayonnement ultraviolet à haute intensité, les étincelles et le métal brûlant:

- Porter des habits de sécurité:
  - Des gants à crispin et des chaussures et un casque de sécurité.
  - Des habits en tissu ignifuge couvrant toutes les parties du corps qui sont exposées.

- Un pantalon sans revers pour éviter que des étincelles ou des scories puissent s'y loger.

- Éloigner la torche du corps à l'amorçage. L'arc pilote jaillit aussitôt que l'on appuie sur le bouton d'amorçage.

- A l'amorçage, ne pas toucher l'extrémité de la torche. Après le coupage, laisser l'extrémité de la torche se refroidir.

Vapeurs toxiques

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

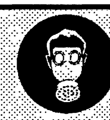
- Tenir l'endroit de travail bien aéré.

- Enlever avant le coupage tous les solvants chlorés de l'endroit de coupage. Certains solvants chlorés se décomposent sous l'effet du rayonnement ultraviolet et forment du phosgène.

- Porter un masque approprié lors du coupage de métaux galvanisés, et s'assurer à ce que la ventilation soit efficace.

- Ne pas couper de réservoirs contenant ou ayant servi à 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 au vapeurs ne portent un appareil respiratoire ou un casque ventilé.

Prévention des incendies

Le coupage avec le MAX200 génère du métal brûlant, des étincelles et des scories. Il faut donc prendre des précautions contre les incendies:

- Des extincteurs d'incendie doivent être accessibles dans l'endroit de coupage.

- Les matières inflammables doivent être maintenues à au moins 10 m (35 pieds) de l'aire du 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 MAX200 pour découper des réservoirs contenant des matières potentiellement inflammables. De tels récipients doivent être soigneusement nettoyés avant le coupage.

- Évacuer toute atmosphère potentiellement inflammable avant de faire fonctionner le MAX200. Ne jamais faire fonctionner le MAX200 dans une atmosphère qui comporte une forte concentration de poussière, de gaz inflammables ou de vapeurs de liquides inflammables comme l'essence.

Prévention des chocs électriques

Le MAX200 produit une forte tension (environ 280 VDC) pour amorcer l'arc-plasma. On doit prendre les précautions suivantes en utilisant cet appareil:

- Garder le corps et les habits à sec.

- Ne pas se tenir, s'assoir ou se coucher dans une surface mouillée quand on utilise le MAX200.

- S'isoler contre le choc électrique. Prendre garde si l'on travaille près d'un endroit humide. Porter des gants et bottes isolants.

- Installer un interrupteur mural à fusibles, de caractéristiques appropriées, à proximité du bloc d'alimentation du MAX200. Cet interrupteur doit permettre à l'utilisateur d'arrêter rapidement le MAX200 en cas d'urgence.

- Conformer aux codes électriques pour les types et grandeurs de la filerie électrique primaire.

- Inspecter fréquemment le cordon d'alimentation primaire pour s'assurer à ce qu'il ne soit ni endommagé ni fissuré. **Un conducteur 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.

- 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 électriques importants.

- Ne jamais utiliser le MAX200 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, (y compris la chute) lors du coupage. Laisser la pièce à travailler en place ou sur l'établi, et le câble de masse toujours connecté.

- Avant de changer les pièces de la torche, couper l'alimentation ou débrancher le bloc d'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

AVERTISSEMENT

Cet appareil ne doit être alimenté qu'en gaz comprimé. Prendre les précautions nécessaires lors de la manutention et de l'utilisation des appareils et des bouteilles à gaz sous pression.

Quand on utilise le MAX200:

- Ne pas couper en présence de poussière ou de vapeurs explosives.

- Ne pas couper de réservoirs sous pression.

Régulateurs de pression

- Bien entretenir les régulateurs de pression. Un régulateur défectueux peut entrainer des dommages et causer des blessures; on doit en confier la réparation à un technicien qualifié.

- Ne jamais utiliser un régulateur avec un autre gaz que celui pour lequel il a été conçu.

- Ne jamais utiliser un régulateur qui fuit, présente une dérive excessive ou est endommagé.

- Ne jamais lubrifier un régulateur à l'aide d'huile ou de graisse.

Bouteilles de gaz comprimé

- Manipuler et utiliser les bouteilles de gaz comprimé conformément aux normes de sécurité de la CGA, de l'AWS et de la CSA.
- Ne jamais utiliser une bouteille qui fuit ou est endommagée.

- Ne jamais utiliser une bouteille qui n'est pas placée dans le bon sens et bien assujettie.
- Ne jamais transporter une bouteille si le chapeau de protection du robinet n'est pas en place.
- Ne jamais utiliser une bouteille à gaz ou son contenu à des fins autres que celles pour lesquelles elle est conçue.
- Ne jamais lubrifier les valves des cylindres avec de l'huile ou de la graisse.
- Eviter à tout prix le contact électrique entre l'arc de plasma et le cylindre.
- Ne jamais exposer des cylindres à une chaleur excessive, ètincelles, scories ou flames.
- Ne jamais utiliser de marteaux, clés anglaises ou autres outils pour d'ébloquer des valves de cylindres.

Tuyaux

- Des tuyaux à gaz pour la coupe de plasma à l'arc doivent adhérer aux codes de couleurs suivant:

Vert	**Oxygène**
Noir	**Air et gaz inerte**

- Jamais utiliser de tuyau à oxygène vert pour un autre gaz.
- Le tuyau endommagé par l'usure, les étincelles, la chaleur ou la flame doit être remplacé.
- Poser le tuyau à plat pour éviter des noeuds.
- Enrouler le tuyau en trop et le placer à l'abri pour éviter tout dégat ou encoublement.
- Examiner le tuyaux à intervales réguliers pour des fuites, de l'usure des mauvaises connections ou d'autres dangers.
- Garder les longeurs de tuyaux à un minimum pour éviter des dégats, réduire la chute de pression et éviter la pénurie.

Mise à la masse

Avant de faire fonctionner le MAX200:

Alimentation du poste

- S'assurer à ce que le fil de terre du cordon d'alimentation soit bien mis à la terre dans le coffret de l'interrupteur.

  S'assurer à ce que le fil de terre du cordon d'alimentation soit correctement relié à la cosse de mise à la terre du bloc d'alimentation. Se conformer aux exigences de la CSA en reliant le fil de terre à la cosse de terre avant les autre fils. Bien serrer l'écrou de retenue.

- S'assurer à ce que toutes les connections soient bien serrées pour éviter le surchauffement.

Dépense d'énergie

- 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 la câble de masse à la partie de la pièce à travailler qui doit se détacher.
- Mettre le plan de travail à la terre de façon fiable. Consulter le National Electrical Code, Article 250, Section H, initulée "Grounding Electrical System" (Système de tiges de mise à terre) ou un autre code approprié.

Pour de plus amples renseignements sur la mise à terre, consulter le chapitre *Index des normes*.

DISPOSITIFS DE SÉCURITÉ

- Le MAX200 comporte un verrouillage de sécurité qui met hors service le bloc d'alimentation lorsque le capuchon de retenue est désserré.
- Ne jamais neutraliser les verrouillages de sécurité.
- Le MAX200 est conçu pour les torches MAX200. Ne pas utiliser d'autre torche.
- 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 MAX200 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 l'arc-plasma. Cet index peut fournir des renseignements supplémentaires et la norme ACNOR (CSA) W117.2 y figuré.

Section 2 INTRODUCTION & SPECIFICATIONS

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INTRODUCTION

General

Hypertherm's MAX200 Remote High Frequency System (RHF) is designed as a machine torch plasma cutting system for cutting most metals from gauge to two inches thick. The MAX200/RHF System provides the user with capability of locating the power supply and the torch apart by a maximum of 200 feet. This is accomplished by adding a High Frequency (HF) unit and a Display Console unit to interface between the power supply and the torch.

The MAX200/RHF provides continuously variable current output from 40 to 200 amps for optimum performance on all thicknesses of metal. This allows the operator wide variations in cutting speeds on the same thickness of metal. Three nozzle sizes (40-amp, 100-amp, and 200-amp) are provided to produce high quality cuts throughout its range of cut thicknesses. Refer to the *Cut Charts* in Section 4.

MAX200/RHFs can be configured for mild steel cutting with air supplied to both the plasma and shield gas inlets from a single pressure/filter regulator. The regulator ensures that the correct air pressure is supplied to the system at the proper quality. For better cut quality on metals such as stainless steel, aluminum, and other non-ferrous materials, either nitrogen or argon/hydrogen (Hypertherm recommends a mixture of 35% hydrogen and 65% argon) can be used as the plasma gas. When cutting mild steel, oxygen can also be used as the plasma gas. Shield gases other than air which can be used are nitrogen and carbon dioxide.

In addition, the plasma gas supply input at the HF provides for switch-controlled parallel lines to allow either oxygen or air/inert gas to be selected as the plasma gas. This greatly reduces the problem of cross contamination of the oxygen lines.

The following descriptions briefly describe the purpose and configuration of the major units which comprise the MAX200/RHF System. See Figure 3-8.

MAX200/RHF Power Supply

This unit houses two 100-amp, 15-kHz chopper power supplies to produce a smooth constant current DC output, variable from 40 amps to 200 amps. Also located in this unit is the Torch Height Control (THC) and torch coolant system. A cooling hose set which is interfaced through the RHF provides the torch coolant supply and return to the torch through the torch lead set. The power supply also interconnects with the RHF, IHS, computer interface, and Remote V/C. The power supply can be interfaced with other MAX200 power supplies if required.

High Frequency Console (HF)

This unit houses the high frequency starting circuit which permits more effective RF shielding and allows the power supply to be installed at a distance of up to 200 feet from the torch. Also located in the HF are the plasma gas pressure switches, critical orfices for the plasma gas pre- and post flow and cap sensor, and solenoid valves to control the plasma and shield gases and cap sensor. The HF inputs the supplied air and gases and interrconnects with the power supply and Display Console. The torch lead set also connects to the HF.

Display Console

This unit houses the plasma and shield gas pressure gauges and the associated plasma and shield gas metering valves which allow the user to monitor and regulate the gas flows. Plasma gas selection (Air/N_2 or O_2) is also made at this unit.

Remote Voltage/Current (V/C) Control

This unit provides accurate operator control of the arc voltage and current. It includes high intensity LED displays which indicate the setpoints for volts and amperes prior to starting the arc. After the arc is initiated, the displays automatically switch to show the the actual values of the voltage and current reached. This unit interfaces with the power supply. Three different types of Remote V/C Controls are available:

Switch Remote - This unit includes the voltage and current displays, two potentiometers used to select the desired values, a plasma start switch, and THC and IHS select switches. This unit is for use on guidance machinery that does not include switches to control the initial height sensing and torch height functions.

Digital Remote - This unit includes the voltage and current displays and two potentiometers used to select the desired values. It is used with guidance machinery that already includes plasma control switches.

Programmable Remote - This unit includes the voltage and current displays. No switches or potentiometers are included. All functions are controlled by the guidance machinery computer. This unit also interconnects with the computer interface.

Initial Height Sensor (IHS) - Optional

This unit, used with two inductive probes, is designed to automatically detect the workpiece surface and index the torch to the pierce position. This system can be used for underwater, at the water line, or above-water applications. This unit interconnects with the power supply and the inductive probes.

MAX200 Water Muffler - Optional

The MAX200 Water Muffler is a machine torch option which greatly improves cutting safety and pollution control capabilities. The Water Muffler can be used to cut both above and below water. Refer to the MAX200 Water Muffler Instruction Manual (P/N 802050) for more detailed information.

SPECIFICATIONS

System Requirements

Power Requirements:
Refer to MAX200/RHF Power Supply specifications below:

Gas Requirements:

Plasma Gas Types	Air, Oxygen (O_2), Nitrogen (N_2), Argon/Hydrogen (H35 = 35% Hydrogen/ 65% Argon)
Shield Gas Types	Air, Carbon Dioxide (CO_2), Nitrogen (N_2)
Gas Quality	Clean, Dry, Oil-Free
Plasma Gas Flow	Refer to the Above water and the Underwater (3") *Cutting Charts* in Section 4, *Operation*, for specific gas requirements.
Shield Gas Flow	
Plasma Gas Inlet Pressure	
Shield Gas Inlet Pressure	
Plasma Gas Pressure (Test/Run)	
Shield Gas Pressure	

MAX200/RHF Power Supply

Maximum OCV	280 VDC
Output Current	40-200 amps
Output Voltage	150 VDC
Duty Cycle Rating	100%

Input Power:

# 073029	240/480 VAC, 3PH, 60 Hz, 90/45 amps
# 073030	600 VAC, 3PH, 60 Hz, 36 amps
# 073031	208 VAC, 3PH, 60 Hz, 104 amps
# 073032	220/380/415 VAC, 3PH, 50 Hz, 98/57/52 amps
# 073033	200 VAC, 3Ø, 50 Hz, 108 amps

Width	28-1/4" (71 cm)
Height	35-1/2" (90 cm) w/o casters 43" (109 cm) w/casters
Depth	41-1/4" (104 cm) w/o handle 50" (127 cm) w/handle
Weight	780 pounds (351 kg)
Cooling	Forced Air (Class F)
Torch Coolant Tank Capacity	2.9 gallons (11 liters); refer to Section 3, *Torch Coolant System*, for coolant specifications, warning, and cautions.

MAX200 Machine Torch

Maximum cutting thickness .... 2 inches (51 mm)
Maximum current at 100% duty cycle .... 200 amps

Plasma gas flow ....
Shield gas flow ....
Refer to the Above water and the Underwater (3") *Cutting Charts* in Section 4, *Operation*, for specific gas requirements.

Water coolant flow rate .... 0.8 gpm

Weight .... 2-1/2 pounds (1.13 kg)

High Frequency Console

Width .... 16" (41 cm) w/o hardware; 19-7/8" (50 cm) w/ hardware
Height .... 20-1/2" (52 cm)
Depth .... 12-3/4" (32 cm)
Weight .... 69 pounds (31 kg)

Display Console

Width .... 11-1/2" (29 cm)
Height .... 11-1/2" (29 cm)
Depth .... 5.0" (13 cm) w/o hardware; 7-3/4" (20 cm) w/hardware

Weight .... 17 pounds (7.7 kg)

Remote V/C Control

Controls .... Arc Voltage and Arc Current presettable. Settings accurately indicated by LED displays prior to arc ignition. Actual value indicated when arc is on.
Control Range .... Current: 40 to 200 Amps
Voltage: 100 to 200 Volts
Control Resolution .... Current: 20 Amps
Voltage: 5 Volts

Width .... 11-1/2" (29 cm)
Height .... 5" (13 cm)
Depth .... 13-1/4" (34 cm)

Weight .... 6 pounds (2.7 kg)

Initial Height Sensor - Optional

Input power	120 VAC from power supply
Air pressure	20 psig regulated shop air input to solenoid.
Width	9" (23 cm)
Height	4.5" (11 cm)
Depth	11-1/2" (29 cm)
Weight	13 pounds (6 kg)

MAX200 Water Muffler - Optional

Refer to MAX200 Water Muffler Instruction Manual (P/N 802050).

Section 3 SETUP

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UPON RECEIPT

The MAX200/RHF System is shipped mounted on skid(s) and protected by heavy carton covers. The power supply is on one skid. The other units, cables, hoses, parts, and items are on the other skid. Before unpacking, inspect the cartons for evidence of damage during shipment. If there evidence of damage, refer to *Claims for Damage During Shipment* on page 3-3 for details.

1. Remove all packing material and discard and remove the units and items from the shipping skid.

2. Verify that the MAX200/RHF System units, optional units, cables and hoses, and items listed below are included.

   Alert your distributor if any of the items are damaged or missing. All communications regarding this equipment must include the model number and serial number (located on the back of the MAX200/RHF). Refer to *Claims for Defective or Missing Merchandise* on page 3-3 for details.

MAX200/RHF System

- MAX200/RHF Power Supply
- High Frequency Console
- Display Console
- Remote Voltage/Current (V/C) Control
  Switch Remote (SR)
  or
  Digital Remote (DR)
  or
  Programmable Remote (PR)
- Machine torch with torch lead set
- Torch coolant (four) gallons
- Instruction manual (IM-99)

Options

- Initial Height Sensor
- Water Muffler
- Consumable spare parts kit

CLAIMS

Claims for damage during shipment — If your unit was damaged during shipment, you must file a claim with the carrier. Hypertherm will furnish you with a copy of the bill of lading upon request. If you need additional assistance, call our Customer Service or Field Service group at 1-800-643-0030.

Claims for defective or missing merchandise — All units shipped from Hypertherm under go rigorous quality control inspections for defects. If any of the merchandise is defective or missing, call your distributor. He will be able to help you. If you need additional assistance, call our Customer Service or Field Service group at 1-800-643-0030.

AIR AND GAS SUPPLY REQUIREMENTS

Air Supply

Two different sources of air can be used to supply the plasma and shield gas requirements of the MAX200/RHF System: cylinder compressed air or shop compressed air. Use an inert gas hose to connect the air supply to the input connection on the filter/pressure regulator.

WARNING

Do not exceed 150 psi to the filter/pressure regulator when using cylinder compressed air or shop compressed air. The plastic filter bowl may explode if this pressure is exceeded, causing serious injury. See the warning label on the filter bowl for other safety warnings.

Cylinder Compressed Air

The cylinder air supply must be clean, dry and oil-free. A high-pressure regulator on the cylinder must be used and must be capable of delivering air at a pressure of between 110 and 130 psi to the filter/pressure regulator. The filter/pressure regulator must be set for a 90 psi input to the RHF unit (refer to the procedure below). Refer to the *Cut Charts* in Section 4 for detailed information.

Shop Compressed Air

The shop air supply must be clean, dry and oil-free. Shop air must capable of delivering air at a pressure of between 110 and 130 psi to the filter/pressure regulator. The filter/pressure regulator must be set for a 90 psi input to the RHF unit (refer to the procedure below). Refer to the *Cut Charts* in Section 4 for detailed information.

Adjusting the Filter/Pressure Regulator

To adjust the filter/pressure regulator for the required air pressure (90 psi):

1. Turn the Lock Knob, which secures the Adjusting Knob, counter clockwise (ccw).
2. Set the Adjusting Knob until the pressure gauge indicates 90 psi.
3. Turn the Lock Knob clockwise (cw) to secure the Adjusting Knob.

Additional Air Filtration

When site conditions introduce moisture, oil, or other contaminants into the air line, additional filtration is required. A three-stage coalescing filtration system is recommended. (Refer to *Appendix A*.) The order in which the filtration components are to be mounted from the air supply towards the RHF unit:

		Model #		Model #		Model #		
Air Supply	>	3401.4	>	1302.4	>	1502.4	>	MAX200

Gas Supply

Use inert gas hoses to connect the plasma and shield gas supplies to the gas input connectors on the RHF unit.

Plasma Gas

To use nitrogen, oxygen, or argon/hydrogen as the plasma gas, it must be supplied to the MAX200/RHF System at 99.995% purity. The gas supply source can be compressed gas cylinders or liquid containers. It must be capable of delivering the required gas at a delivery pressure of 120 psi to the RHF unit. Refer to the *Cut Charts* in Section 4 for detailed information.

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

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

Shield Gas

To use nitrogen or carbon dioxide as the shield gas, it must be supplied to the MAX200/RHF System at 99.995% purity. The gas supply source can be compressed gas cylinders or liquid containers. It must be capable of delivering the required gas at a delivery pressure of 90 psi to the RHF unit. Refer to the *Cut Charts* in Section 4 for detailed information.

TORCH COOLANT REQUIREMENTS

The power supply is shipped to the customer without any coolant in the tank. A mixture of ethylene glycol (25%) and deionized water (75%), which resists freezing to +10° F (-12° C), is recommended.

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

The coolant is available in one gallon containers. The standard mixture, 75/25, is available by ordering part number 028393. Containers of 100% ethylene glycol is available by ordering part number 028419.

Observe the warning and cautions below. Refer to the Material Safety Data Sheets on Ethylene Glycol for data on safety, handling, and storage in *Appendix B*.

WARNING

Torch Coolant System Contains Ethylene Glycol which is irritating to skin and eyes, and harmful or fatal if swallowed. Upon contact, flush skin or eyes with water. If swallowed, induce vomiting and call a physican immediately.

Caution: Always use ethylene glycol in the coolant mixture. Do not use anti-freeze in place of ethylene glycol. Anti-freeze contains corrosion inhibitors which will damage the torch coolant system. Always use deionized water in the coolant mixture in order to prevent corrosion in the torch coolant system.

Filling the System

To fill the torch coolant tank prior to initial startup:

1. Ensure the torch lead set is connected. Refer to page 3-43, *Torch Lead Set Connections.*

   Note: Always add coolant with the MAX200 system off.

2. Fill the tank with coolant until the level reaches the bottom of the neck, approximately 2.9 gallons (11liters).

POWER REQUIREMENTS

A separate line disconnect fuse box should be provided for each MAX200/RHF power supply. The disconnect box should be sized to the following requirements:

Input Voltage (VAC)	Phase	Rated Input Current @ 30 kw Output (Amps)	Recommended Fuse Size (Amps)
200	3	108	150
208	3	104	150
220	3	98	150
380	3	57	80
415	3	52	70
480	3	45	60
600	3	36	50

Line Disconnect Fuse Box

- Use a primary line disconnect fuse box for each power supply. This disconnect box allows you to turn the power supply off quickly in an emergency situation. The box should be located on a wall near the power supply, and should be easily accessible to the operator. The interrupt level of the switch must be equal to or exceed the continuous rating of the fuses. Refer to *Power Requirements* listed above.

Power Cables

- Use AWG wire sizes as outlined by applicable local electrical codes. Wire sizes vary based on the distance of the receptacle from the main box.

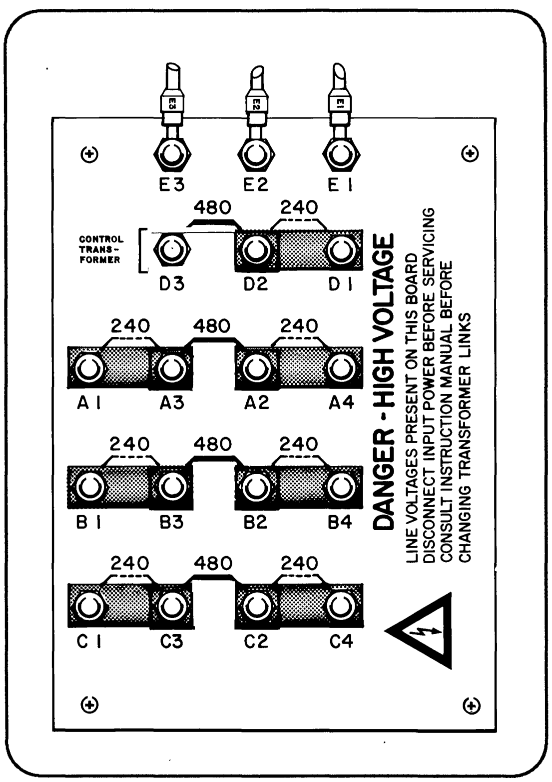
- Use a 4-conductor Type SO input power cable with a conductor temperature rating of 60°C (140°F) according to the following requirements:

Input Voltage (VAC)	Cable Size (AWG/Conductors)	Current Rating (Amps)
200	1/4	107
208	1/4	107
220	1/4	107
380	4/4	69
415	4/4	69
480	6/4	52
600	8/4	39

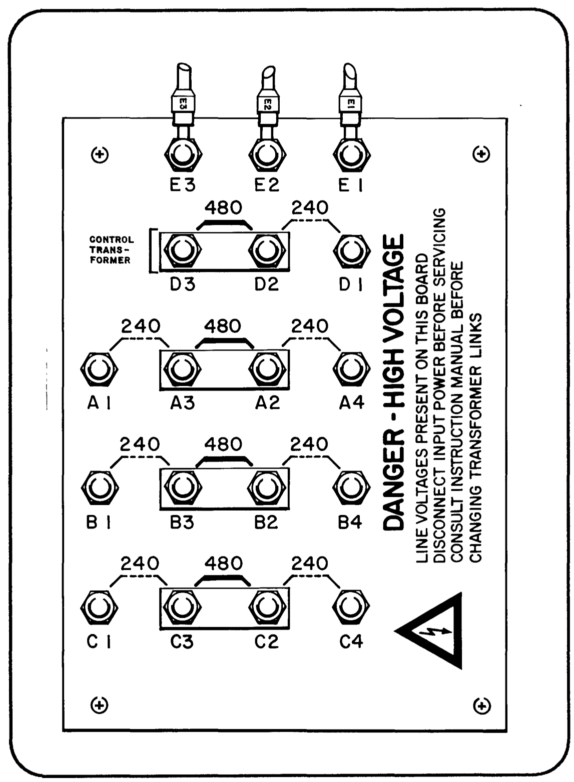
240/480V Linkboard Configurations

- The 240/480-volt unit (Model 073029) is shipped from the factory linked for 480-volt operation. The links must be moved for 240-volt operation. Ensure that the linkboard is configured properly to the appropriate voltage line (see Figure 3-1).

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



240-Volt Configuration



480-Volt Configuration

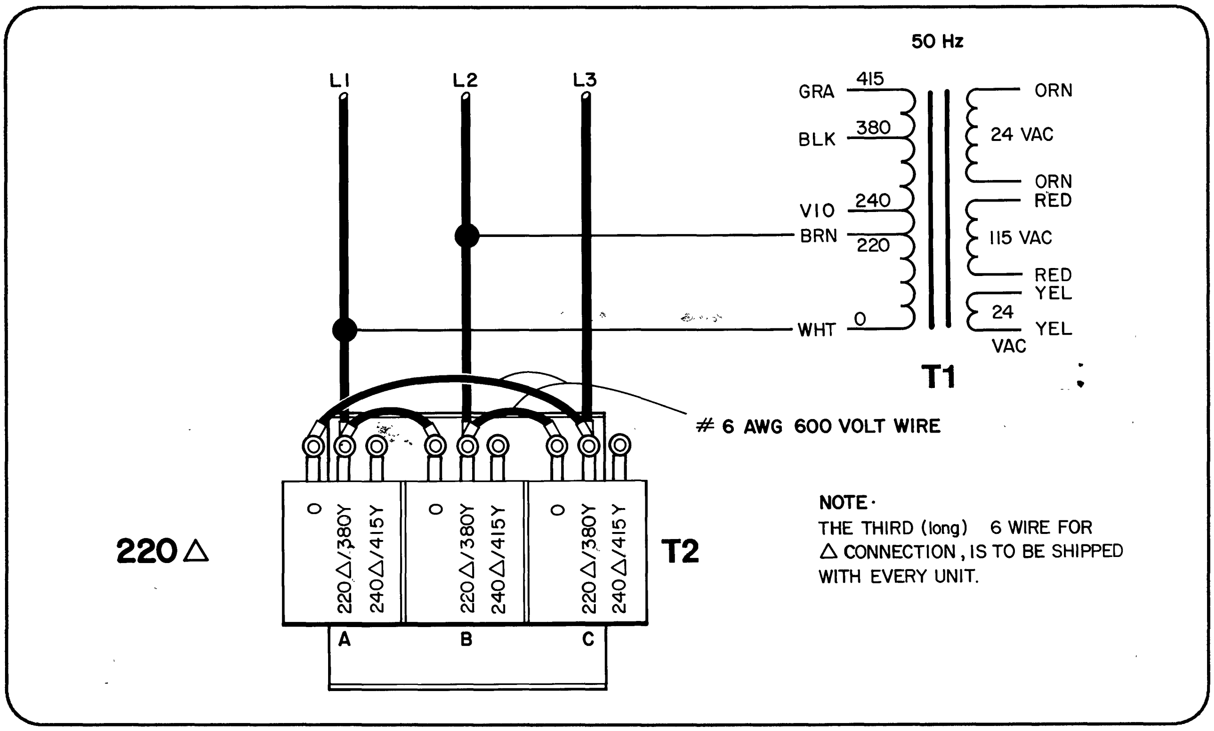
Figure 3-1 Dual Voltage 240/480-Volt Linkboard Configurations

220/380/415V Transformer T1 and T2 Configurations

- The 220/380/415-volt, 3PH, 50 Hz power supply (Model 073032) is normally shipped from the factory set up for 380-volt operation, unless otherwise specified. To change the power supply to a different voltage (220 or 415 volts), the control transformer T1 and 30 kw transformer T2 must be reconfigured (see Figure 3-2). Refer to Section 5, *Standard Components*, Figure 5-3 to locate transformers T1 (index no. 2) and T2 (index no. 4).

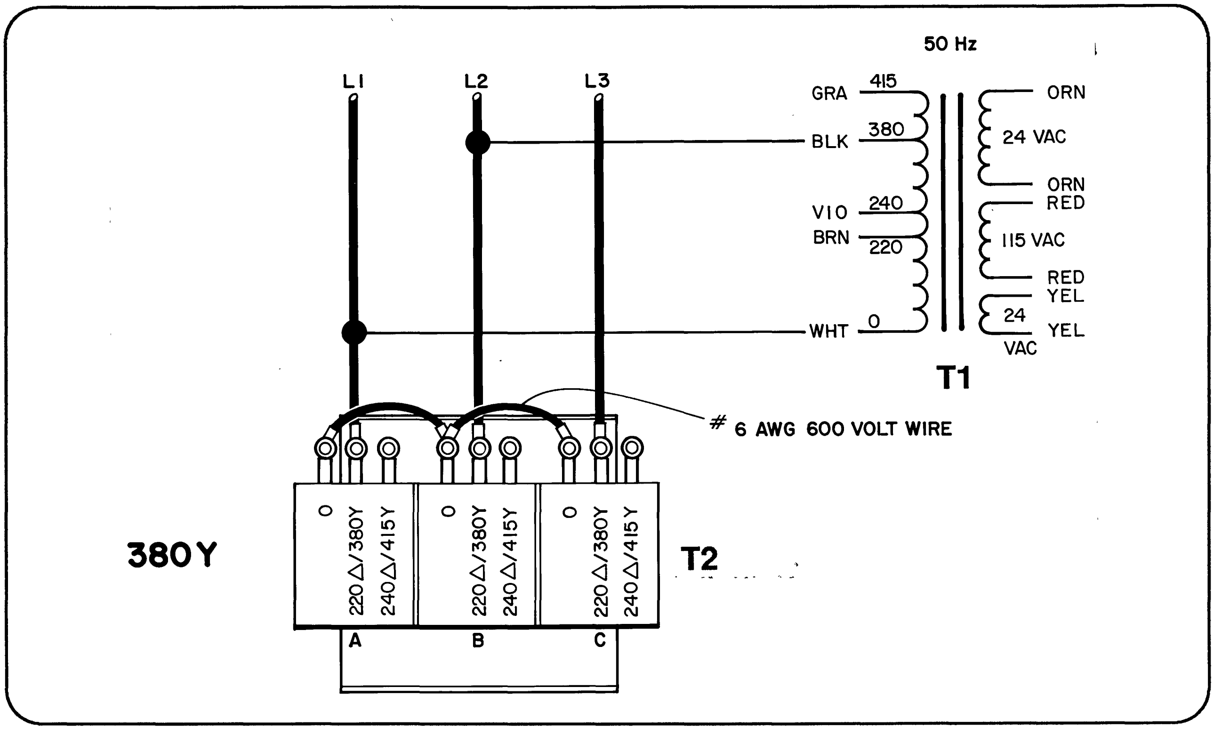
WARNING

Danger: High Voltage. Line voltage is present in the power supply unless disconnected. Always disconnect input power at the line disconnect switch before servicing.



* The long # 6 wire, required for a Δ connection, is shipped with every unit.

Figure 3-2 220/380/415V Transformer T1 and T2 Configurations



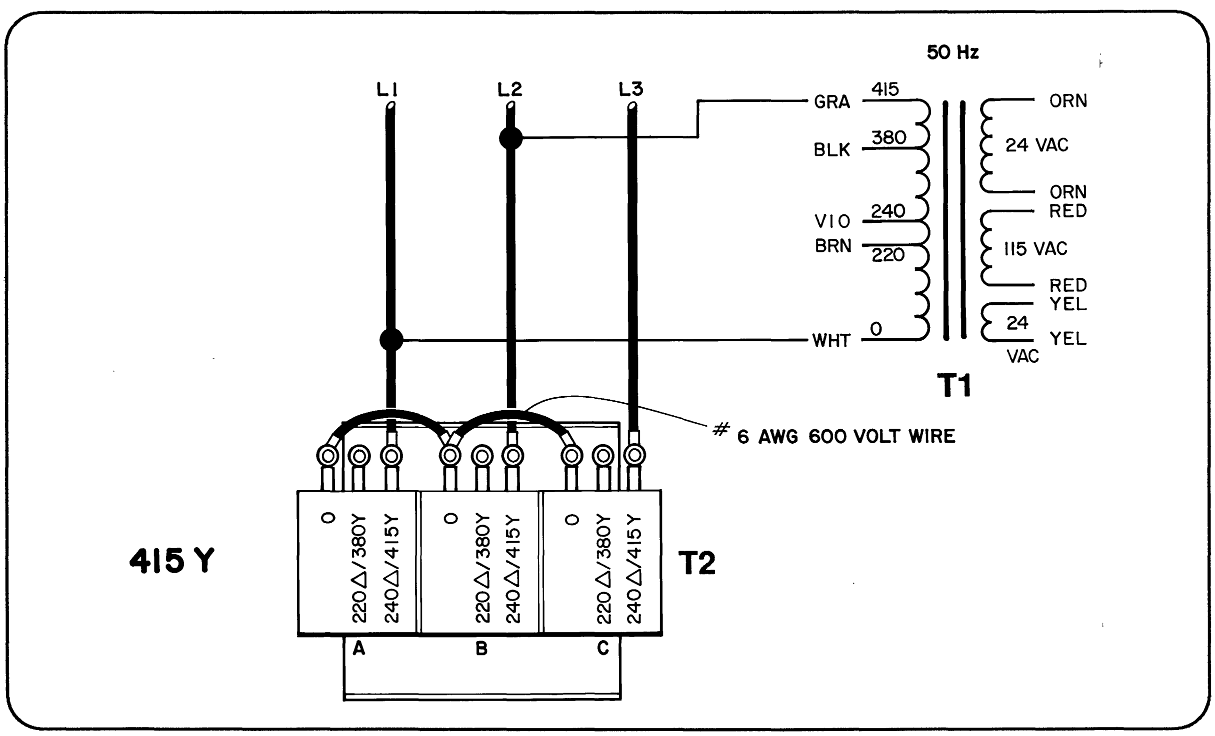


Figure 3-2 220/380/415V Transformer T1 and T2 Configurations (Continued)

GROUNDING REQUIREMENTS

Before operating the MAX200/RHF, observe the following grounding requirements to ensure proper operation, personal safety, and to reduce emission of radio frequency interference:

- Ensure the power cord ground wire is properly connected to the ground in the disconnect box.
- Ensure the power cord ground wire is properly connected to the MAX200/RHF power supply terminal TB1. Refer to page 3-15.
- Ensure that all electrical connections are tight to avoid excessive heating.
- Connect the work table to a high-quality earth ground within 20 feet of the table. A suitable ground consists of a solid copper rod of at least 1/2-inch diameter driven to a depth of at least 8 feet into the earth below the permanent moisture level. For additional information consult the National Electrical Code, Article 250, Section H *Grounding Electrode System*, or other appropriate code and refer to the *Standards Index* in this manual.

NOISE LEVELS

Figure 3-3 presents the noise levels in decibels experienced by an operator standing 10 feet from the torch in a confined area under varied conditions while cutting.

SYSTEM UNITS PLACEMENT

Position all units prior to making electrical, gas, and interface connections.
Refer to Figure 3-4 to view typical unit placements on or near a typical cutting machine configuration.

Power Supply

1. Place the power supply in an area that is free of excessive moisture, has proper ventilation, and is relatively clean.
2. Place the power supply 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.)

SYSTEM UNITS PLACEMENT (Continued)

3. Do not place any filter device over the air intake locations. This reduces cooling efficiency and VOIDS THE WARRANTY.
4. After placement of the power supply, the line disconnect switch box can be placed close to the power supply for safety purposes. Refer to *Power Requirements* in this section for the line disconnect switch information.

Remote High Frequency Unit (RHF)

Place the RHF unit in a convenient location to allow easy routing and connection of the torch lead set. Bolt the unit to the mounting surface.

Display Console

Place the Display Console in a convenient location near the operator for easy plasma and gas pressure monitoring and adjustment. Bolt the unit to the mounting surface.

Remote Voltage/Current (V/C) Control

Place the Remote V/C Control in a convenient location near the operator for easy monitoring and adjustment. Bolt the unit to the mounting surface.

Initial Height Sensor (IHS) - Optional

Place the IHS in a convenient location near the RHF. Bolt the IHS to the mounting surface.

Torch Mounting Subassembly

Mount the Torch Mounting Subassembly (# 029344) on to the torch lifter of the cutting machine.

Water Muffler - Optional

Refer to the MAX200 Water Muffler Instruction Manual, # 802050.

Decibels experienced by an operator standing 10 feet from the torch in a confined area (see dimensions below) under varied setup conditions while cutting 1-inch mild steel using oxgyen-air at a travel rate of 20 inches per minute.

- Above water 6" without Water Muffler @ 10 feet - 106 dbs
- Above water 6" with Water Muffler @ 10 feet - 104 dbs
- Water at bottom of plate without Water Muffler @ 10 feet - 100 dbs
- Water at bottom of plate with Water Muffler @ 10 feet - 95 dbs
- Water 3" over plate without Water Muffler @ 10 feet - 75 dbs
- Water 3" over plate with Water Muffler @ 10 feet - 72 dbs

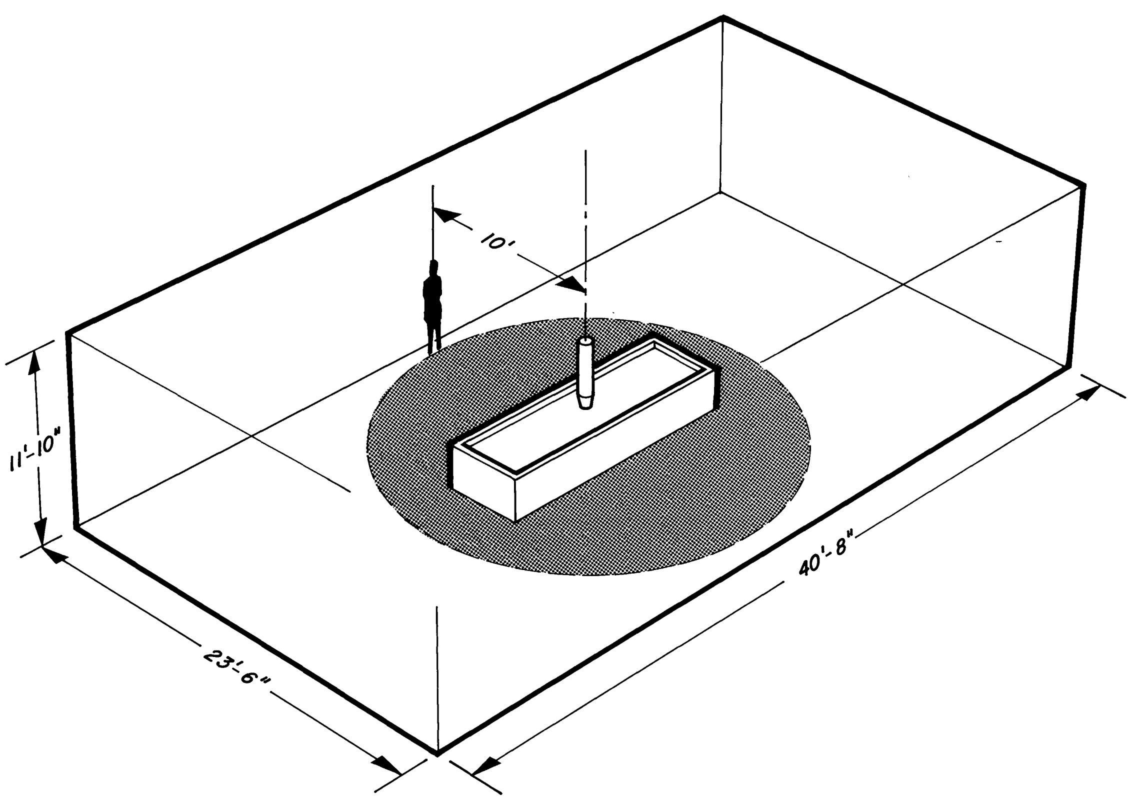


Figure 3-3 Noise Levels (Decibels)

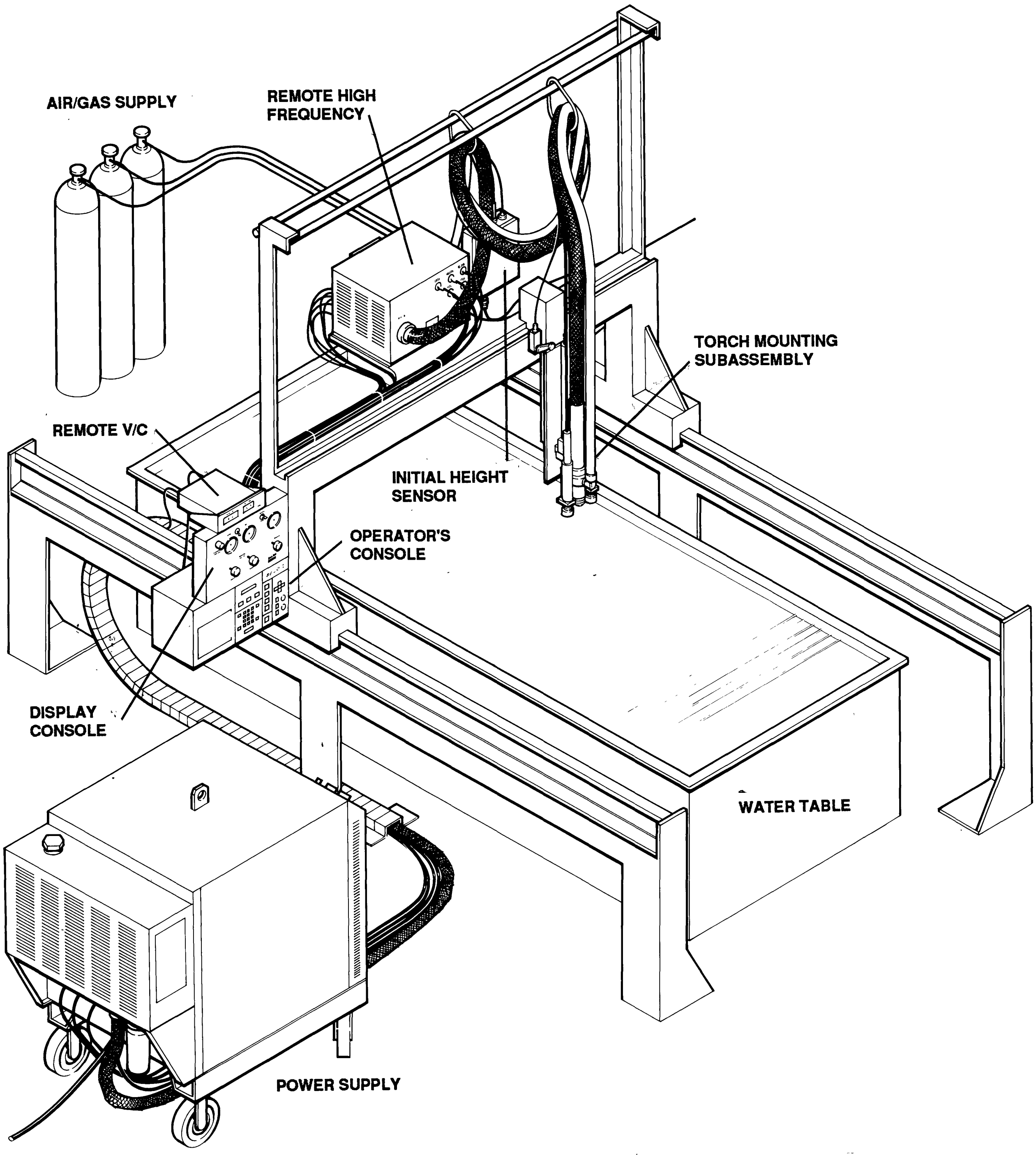
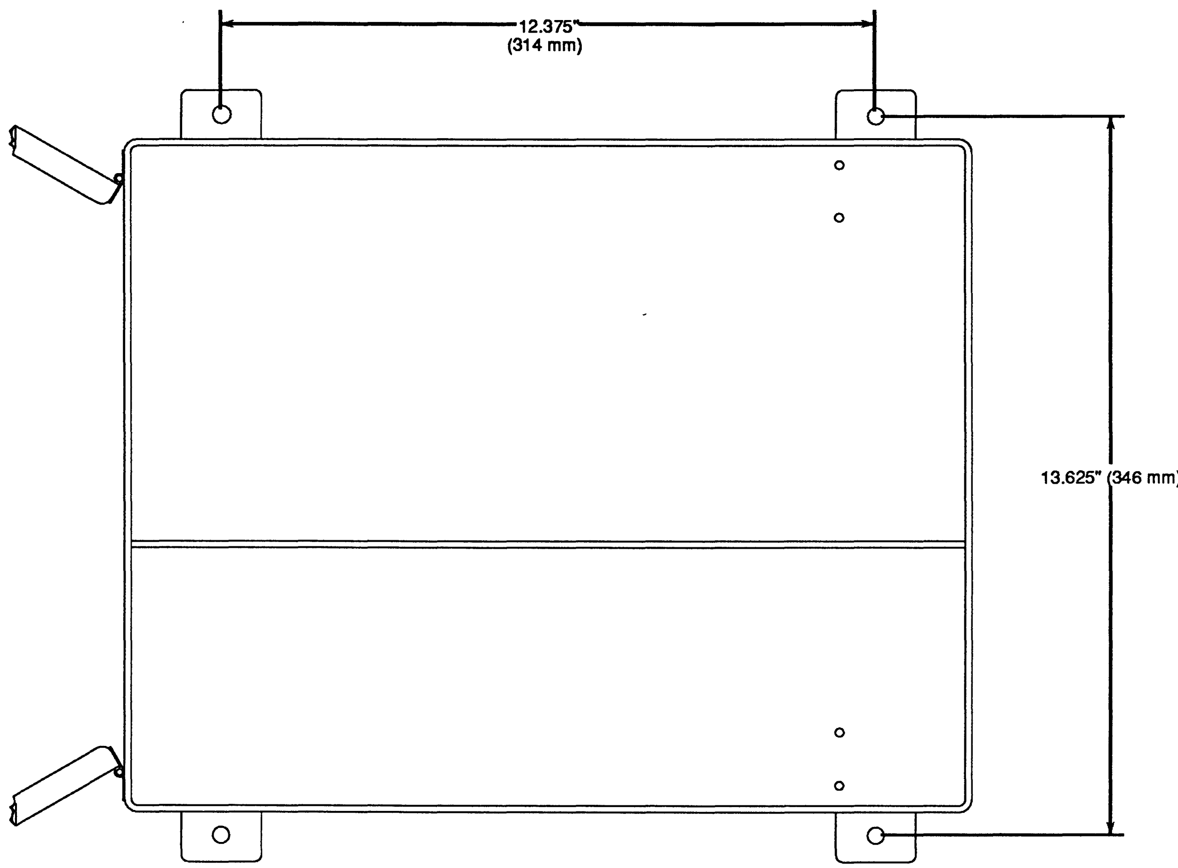
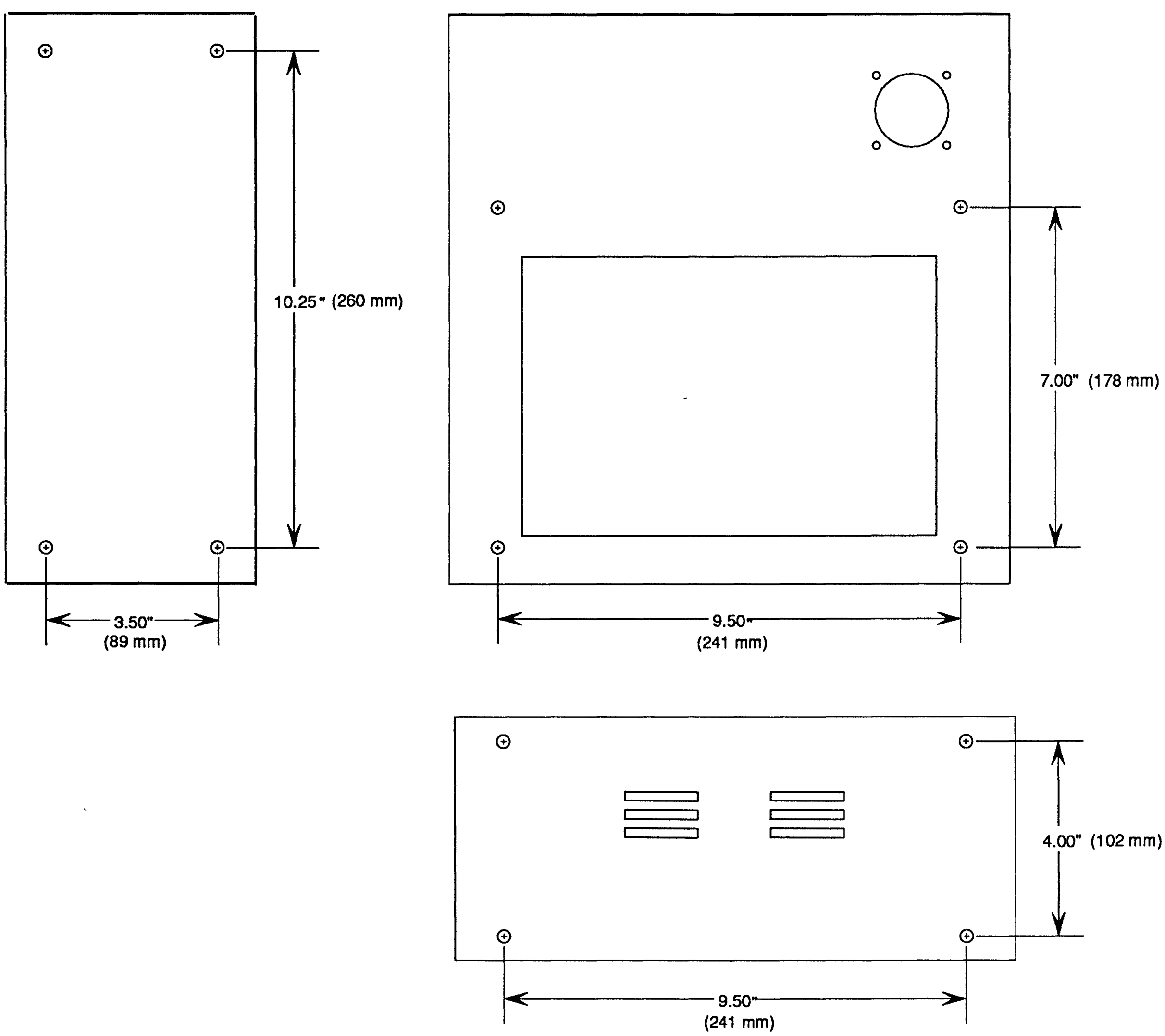


Figure 3-4 Typical Unit Placement for Gantry Cutter



Note: All mounting holes are .312 dia. (8 mm)

Figure 3-5 High Frequency Console Mounting Details



Note: All mounting holes are .265 dia. (6.7 mm)

Figure 3-6 Display Console Mounting Details

ELECTRICAL CONNECTIONS

Connect the Power Cable (Fig. 3-7)

To connect the power cable to the MAX200/RHF Power Supply:

1. Insert the power cable through the strain relief at the rear of the power supply. Connect the power cable leads to TB1 located at the rear center panel of the right side.
2. Connect the power leads to the L1, L2, and L3 terminals of TB1.
3. Connect the ground lead to the yellow/green terminal of TB1.

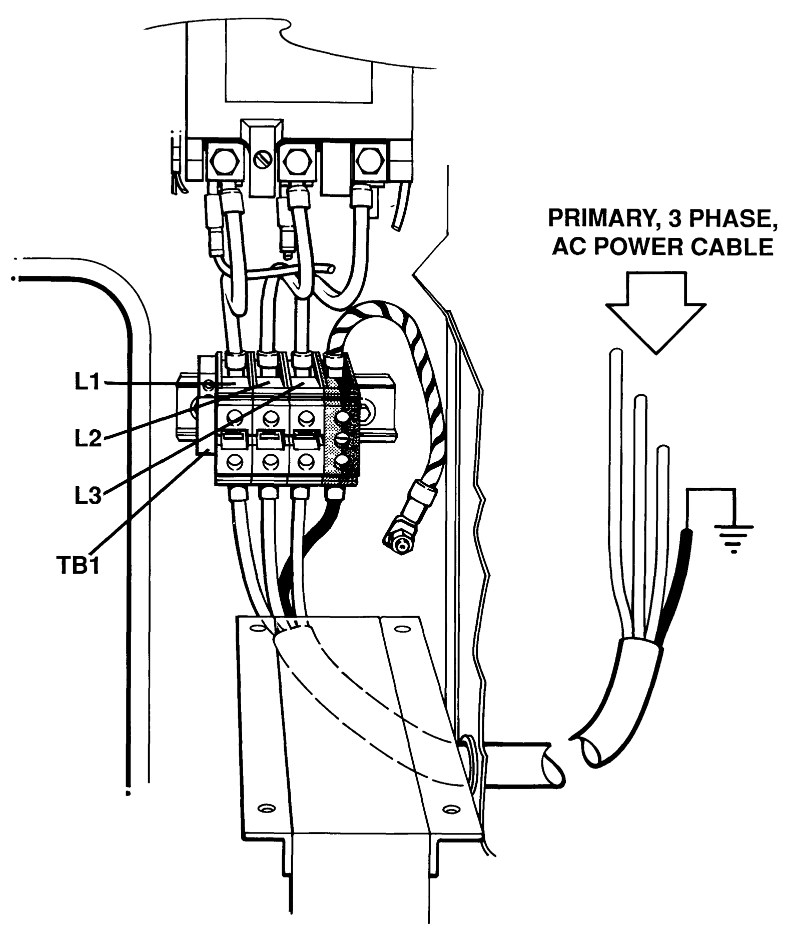


Figure 3-7 Power Cable Connections

The following electrical connections are supported by the system interconnection diagram, Figure 3-8. Also provided is are illustrations of each unit showing where the connections are to be made and illustrations of the leads and cables.

Negative Lead - Power Supply to HF Console (Figs. 3-9, 3-10, 3-11, 3-12)

1. Route one end of the lead through the brass feed-thru on the rear of the power supply and connect to the 3/8 - 16 tapped hole on the end of the cathode block.

2. Route the other end of the lead through the **TORCH (-)** strain relief on the HF and connect to the 3/8 - 16 threaded standoff on the I/O & HF PCB (# 041211) marked **Negative**.

Pilot Arc Lead - Power Supply to HF Console (Figs. 3-9, 3-10, 3-11, 3-13)

1. Route the 1/2" ring end of the lead through the brass feed-thru on the rear of the power supply and connect to the # 5, 37° flare adapter on the HF coil.

2. Route the other end of the cable through the **PILOT ARC (+)** strain relief on the HF and connect to the 5/16 - 18 threaded standoff on the I/O & HF PCB1 (# 041211) marked **Pilot Arc**.

Remote HF Cable - Power Supply to HF Console (Figs. 3-9, 3-10, 3-14)

1. Connect the cable plug marked **1X4** to the receptacle marked **1X4** on the rear of the power supply.

2. Connect the other end of the cable marked **2X1** on the plug to the receptacle marked **2X1** on the HF.

Work Cable - Power Supply to Work Table (Figs. 3-9, 3-12)

1. Route one end of the cable through the strain relief behind the brass feed-thru on the rear of the power supply and connect to the 3/8 - 16 standoff on the HF PCB.

2. Connect the other end of the cable to the work table ground rod or to the work table. Make sure that good metal-to-metal contact has been made.

Machine Interface Cable - Power Supply to Machine Interface (Figs. 3-9, 3-15)

1. Connect the cable plug marked **1X1** to the receptacle marked **MACHINE -1X1** on the rear of the power supply.

2. Connect the other end to the computer or machine interface.

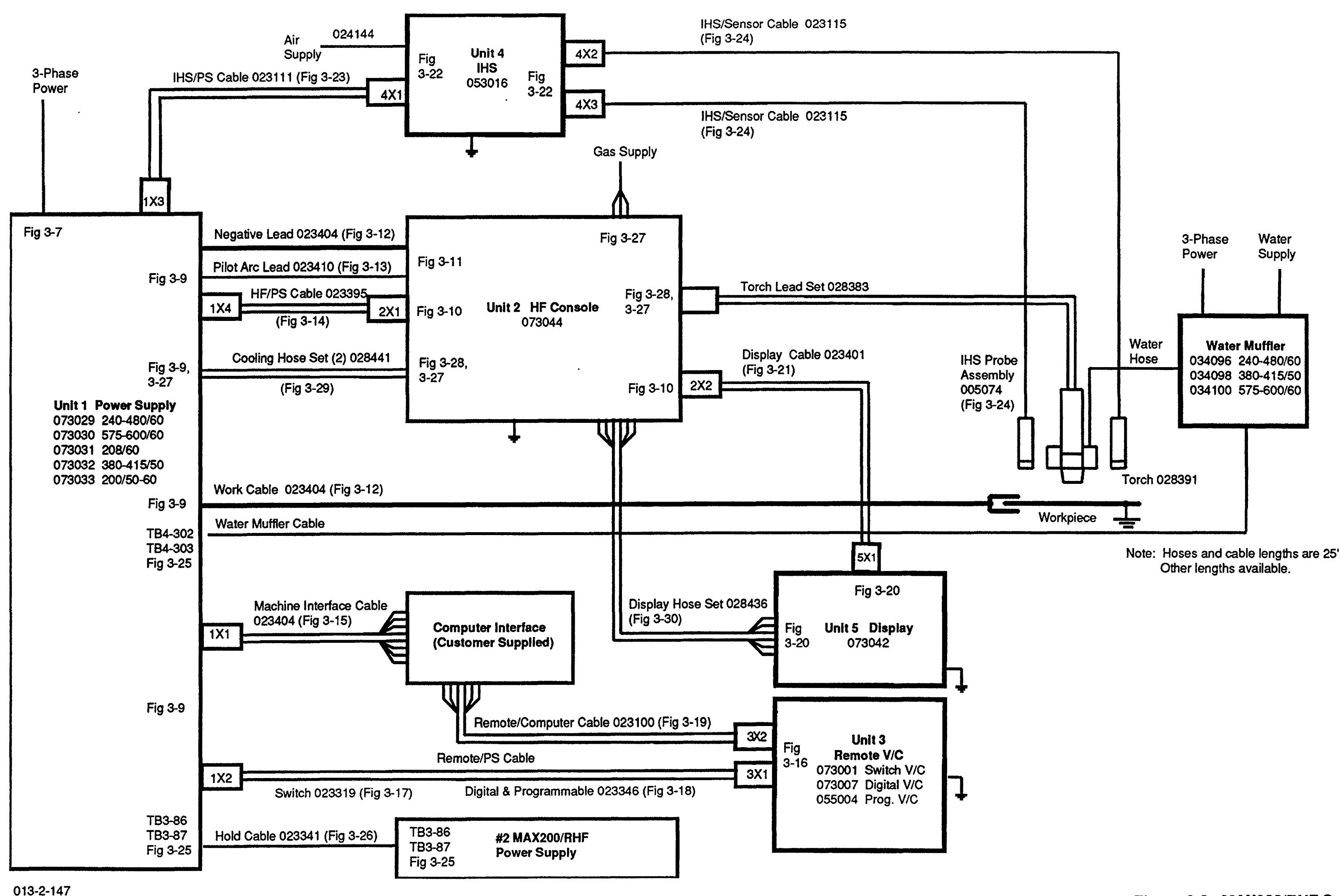
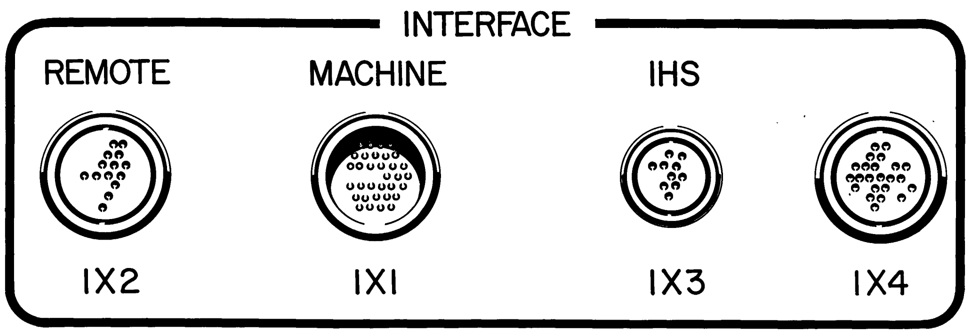


Figure 3-8 MAX200/RHF System Interconnection Diagram



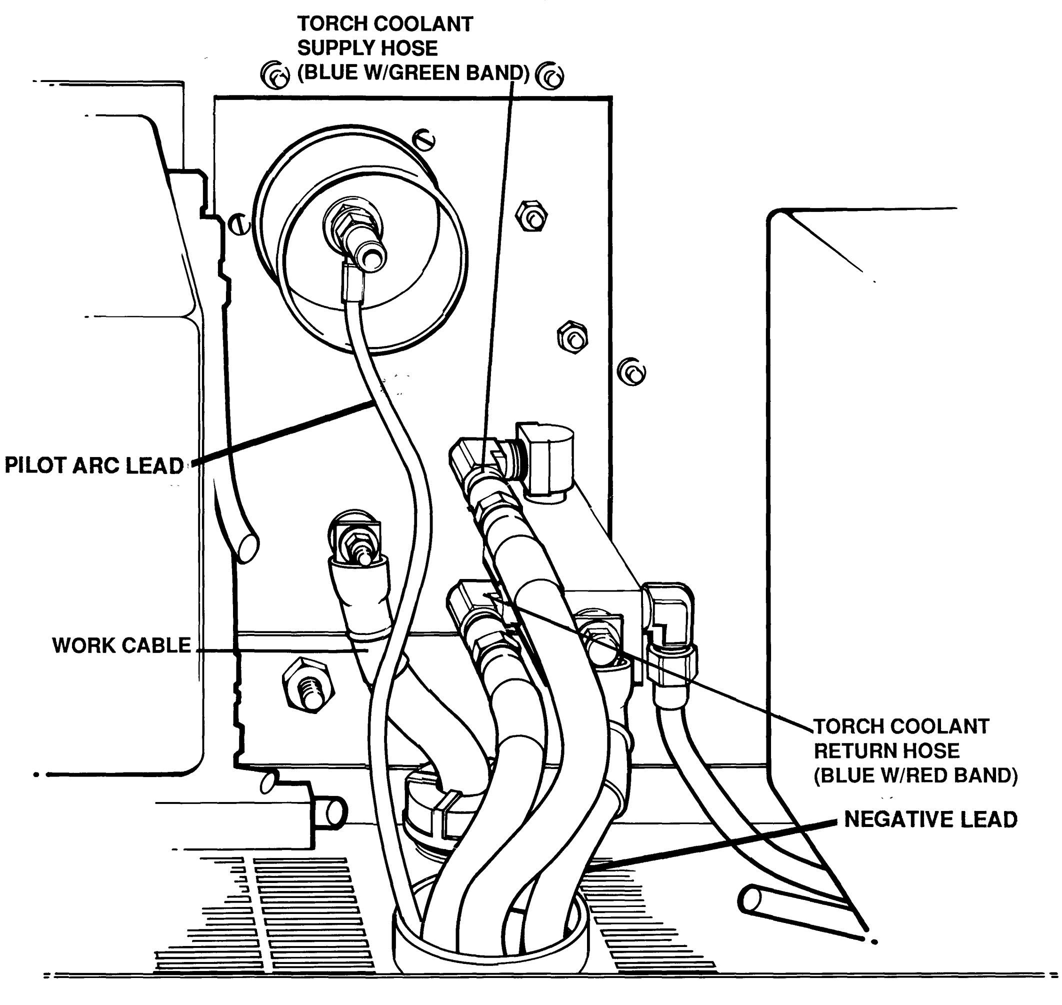


Figure 3-9 Power Supply Rear Connections

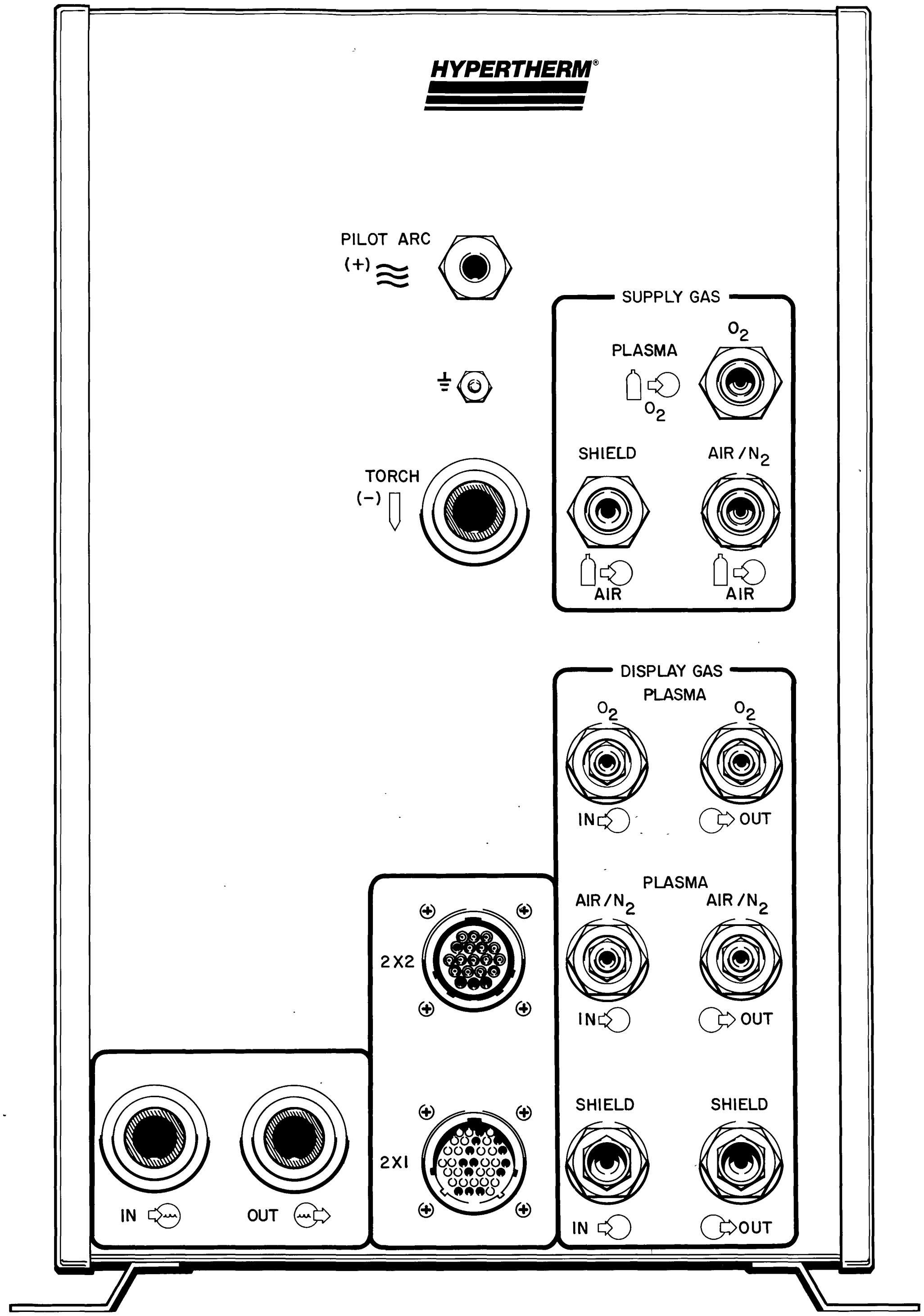


Figure 3-10 HF Console Connections

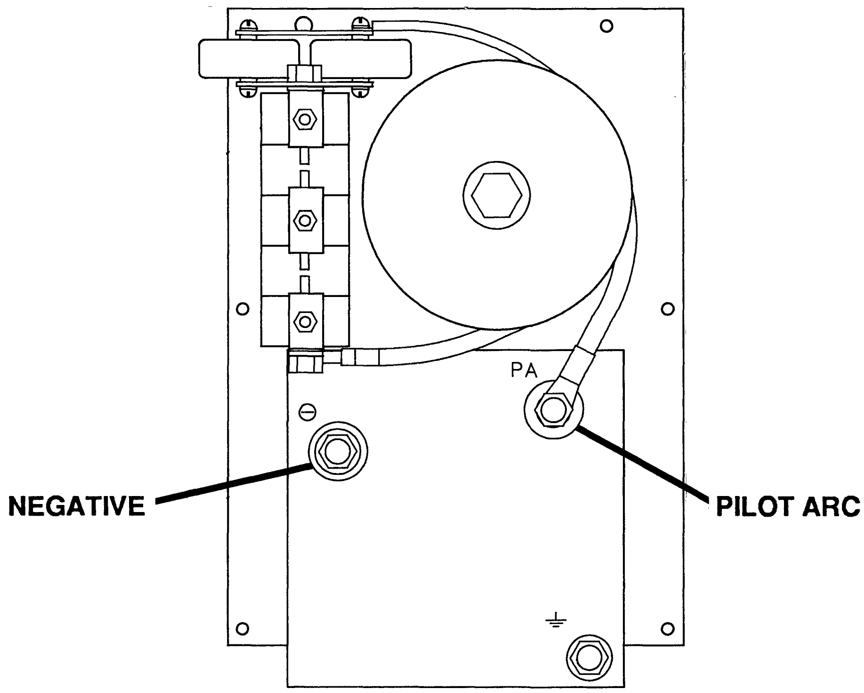
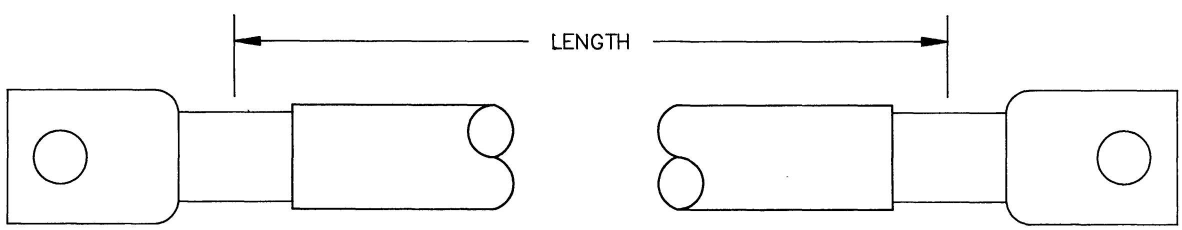
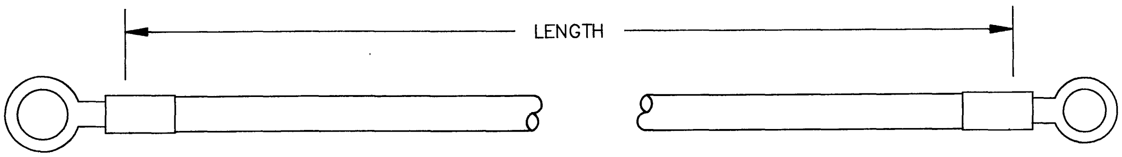


Figure 3-11 RHF HF & I/O PCB SA - Pilot Arc and Negative Lead Connections



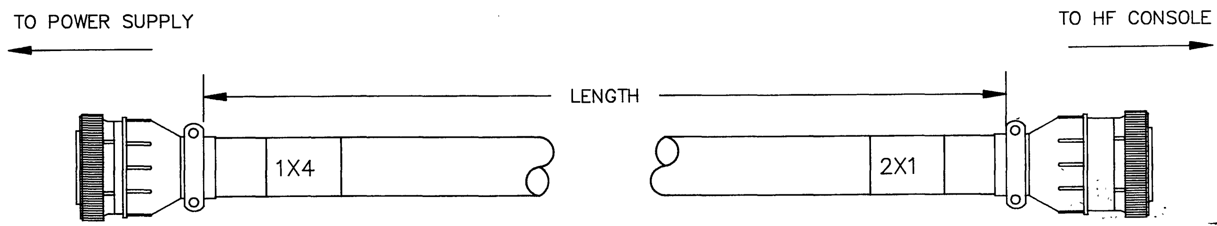
PART NUMBER	LENGTH
023403	15'
023404	25'
023405	50'
023406	75'
023407	100'
023408	150'

Figure 3-12 Negative Lead and Work Cable



PART NUMBER	LENGTH
023409	15'
023410	25'
023411	50'
023412	75'
023413	100'
023414	150'

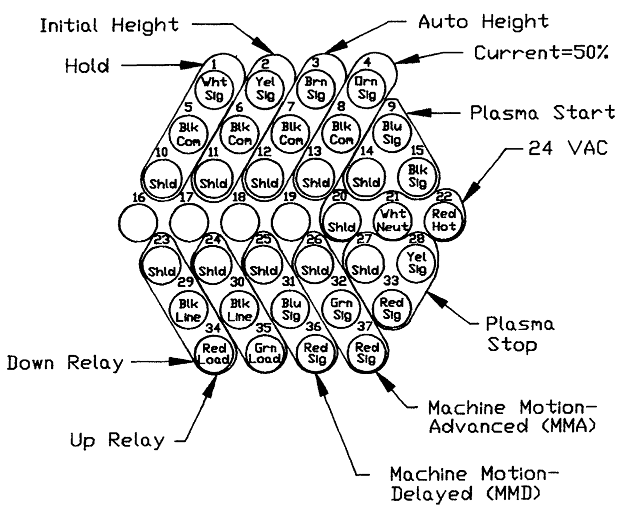
Figure 3-13 Pilot Arc Lead

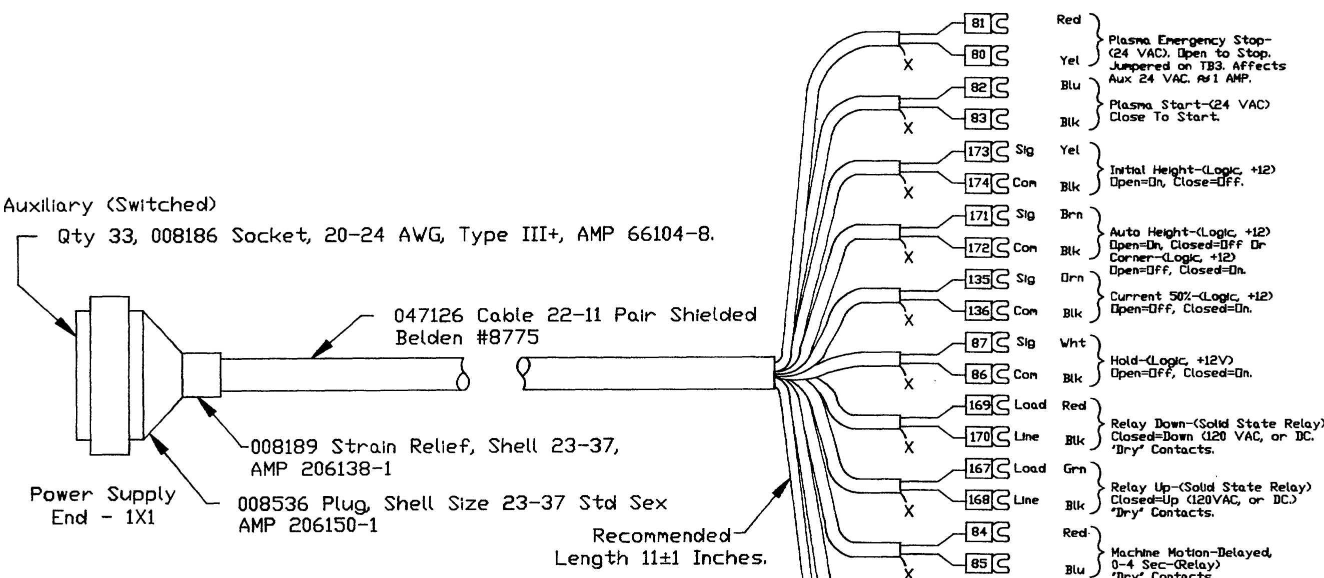


RUN LIST HF CABLE		
PLUG 1X4	COLOR	PLUG 2X1
1	BLACK	1
2	RED	2
3	DRAIN	CUT 3
4	BLACK	4
8	WHITE	8
9	DRAIN	CUT 9
5	BLACK	5
6	GREEN	6
7	DRAIN	CUT 7
10	BLACK	10
11	BLUE	11
12	DRAIN	CUT 12
13	BLACK	13
14	YELLOW	14
15	DRAIN	CUT 15
16	BLACK	16
17	BROWN	17
18	DRAIN	CUT 18
20	BLACK	20
21	ORANGE	21
22	DRAIN	CUT 22
23	RED	23
24	WHITE	24
25	DRAIN	CUT 25
26	RED	26
27	GREEN	27
28	DRAIN	CUT 28
29	RED	29
30	BLUE	30
31	DRAIN	31
32	RED	32
33	YELLOW	33
37	DRAIN	37

PART NUMBER	LENGTH
023394	15' (4.6M)
023395	25' (7.6M)
023396	50' (15M)
023421	75' (22.5M)
023397	100' (30M)
023398	150' (46M)

Figure 3-14 Remote HF Cable





Qty 22, 074027 Terminal, Insulated Locking, Fork, 22-18 AWG #6, T&B RA2217

Legend - Power Supply End - 1X1		
SCKT	COLOR	FUNCTION
1	Wht	Hold-Signal
2	Yel	Initial Height-Signal
3	Brn	Auto Height-Signal
4	Orn	Current 50%-Signal
5	Blk	Hold-Common
6	Blk	Initial Height-Common
7	Blk	Auto Height-Common
8	Blk	Current 50%-Common
9	Blu	Plasma Start-Signal
10	Shld	Hold-Shield
11	Shld	Initial Height-Shield
12	Shld	Auto Height-Shield
13	Shld	Current 50%-Shield
14	Shld	Plasma Start-Shield
15	Blk	Plasma Start-Signal
16		
17		
18		
19		

Legend - Power Supply End - 1X1		
SCKT	COLOR	FUNCTION
20	Shld	24 VAC Auxiliary, Shield
21	Wht	24 VAC Auxiliary, Neutral
22	Red	24 VAC Auxiliary, Hot
23	Shld	Down Relay, Shield
24	Shld	Up Relay, Shield
25	Shld	Machine Motion-Delayed, Shield
26	Shld	Machine Motion-Advanced, Shield
27	Shld	Plasma Stop-Shield
28	Yel	Plasma Stop-Signal
29	Blk	Down Relay, Line
30	Blk	Up Relay, Line
31	Blu	Machine Motion-Delayed, Signal
32	Grn	Machine Motion-Advanced, Signal
33	Red	Plasma Stop-Signal
34	Red	Down Relay, Load
35	Grn	Up Relay, Load
36	Red	Machine Motion-Delayed, Signal
37	Red	Machine Motion-Advanced, Signal

PART NO.	LENGTH
023334	25 FT
023335	50 FT
023336	75 FT
023337	100 FT
023338	150 FT
023339	200 FT

Figure 3-15 Power Supply to Machine Interface Cable Diagram

ELECTRICAL CONNECTIONS (Continued)

Remote V/C Cable - Power Supply to Remote V/C (Figs. 3-9, 3-16, 3-17, 3-18)

See Figure 3-17 for the switch remote cable details and Figure 3-18 for the digital remote and programmmable remote cable details.

1. Connect the cable plug marked **1X2** for either the Switch Remote (SR), Digital Remote (DR), or Programmable Remote (PR) receptacle to the **REMOTE - 1X2** at the rear of the power supply.

2. Connect the other end of the cable marked **3X1** on the plug to the receptacle marked **3X1** on the Remote V/C.

Remote Computer Cable - PR V/C to Computer Interface (Figs. 3-16, 3-19)

1. Connect the cable plug marked **3X2** to the receptacle marked **3X2** on the rear of the Programmable Remote V/C. (The Switch Remote V/C and Digital Remote V/C do not have this option.)

2. Connect the other end to the computer or machine interface.

Display Cable - HF Console to Display Console (Figs. 3-10, 3-20, 3-21)

1. Connect the cable plug marked **2X2** to the receptacle marked **2X2** on the HF.

2. Connect the other end of the cable marked **5X1** on the plug to the receptacle marked **5X1** on the rear of the Display Console.

IHS Cable - Power Supply to IHS (Figs. 3-9, 3-22, 3-23)

1. Connect the cable plug marked **3X1** to the receptacle marked **IHS -1X1** on the rear of the power supply.

2. Connect the other end of the cable marked **4X1** on the plug to the receptacle marked **4X1** on the IHS.

IHS Sensor Cables/Inductor Probes - IHS to Inductor Probes (Figs. 3-22, 3-24)

1. At the Torch Mounting Subassembly, connect the two (2) 40-foot IHS/Sensor cables to the two (2) 3-pin connectors of the inductor probe assemblies.

2. Route the two (2) IHS/Senor cables to the IHS Control Module and connect to the 4-pin receptacles.

Upper Limit Switch and Cable - Upper Limit Switch to IHS (Fig. 3-22)

Install the upper limit switch on to the torch lifter. This switch is normally closed. It opens when the torch is fully retracted. The required operating specifications are +12 VDC @ 1.2 mA. Gold-type contacts are preferred.

Caution:	To avoid electromagnetic interference problems caused by the close proximity of the upper limit switch cable to the torch lead set, carefully follow the cable installation procedure.

1. Use a shielded, twisted pair of 22-24 gauge wire (stranded). Use Belden # 8761.
2. At the upper limit switch, connect the **common wire (black**) and **signal wire (clear)** to the upper limit switch. Cut the shield drain wire (uninsulated). Wrap the cut end with tape to ensure the cut end does not contact the cutting machine frame.
3. At the IHS Control Module, loosen the two (2) latches and open the front cover.
4. Route the cable through the strain relief to connect the cable wires to 1TB.
5. Connect the **shield drain wire (uninsulated)** to **1TB-10 (#S)**. Be sure the drain wire does not contact the IHS Control Module case. Note that the cable shield is now electrically connected to the MAX200 frame.
6. Connect the **common wire (black)** to **1TB-11 (#4)**.
7. Connect the **signal wire (clear)** to **1TB-12 (#67).**

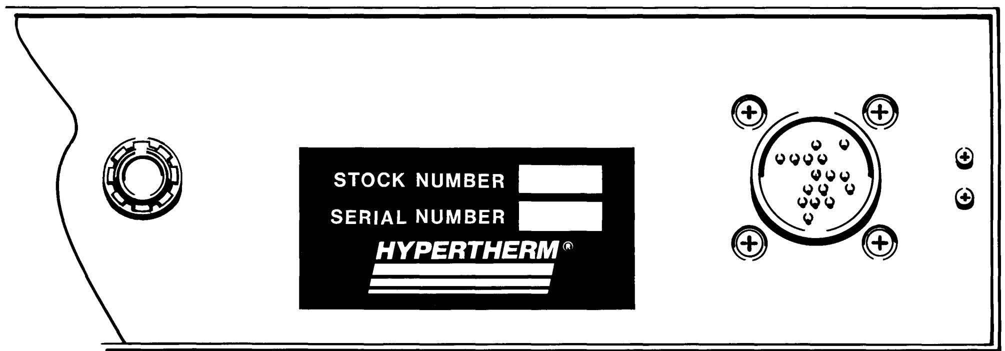
   Note: If the upper limit switch signal comes from an interface on the cutting machine, exactly the same wiring (using twisted shielded pair) must be provided from the limit switch. This shield must be electrically isolated from other shields in other cables. A separate cable is recommended to avoid ground - loop problems.

Hold Cable - Power Supply # 1 to Power Supply # 2 (Figs. 3-25, 3-26)

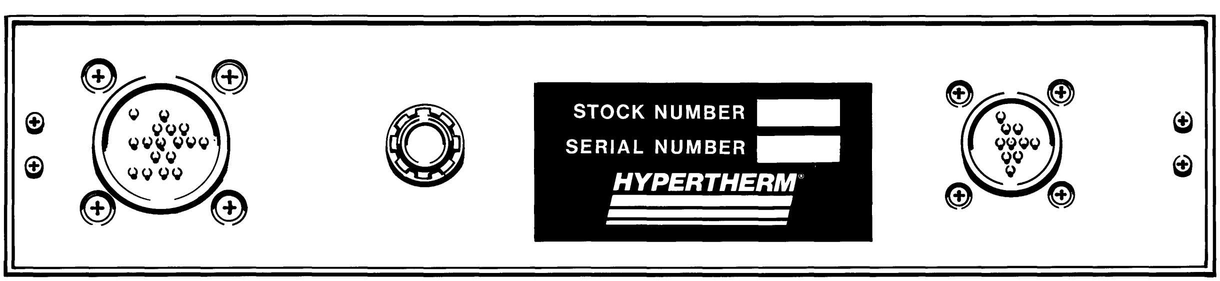
1. Route one end of the lead through the strain relief on the rear of power supply # 1 and terminate the red wire to TB3-86 (+12 VDC), the black wire to TB3-87 (neutral), and the shield to a ground screw on TB3.
2. Route the end of the lead through the strain relief on the rear of power supply # 2. Terminate the wires as in step 1.

Water Muffler - Power Supply to Water Muffler

Refer to the MAX200 Water Muffler Instruction Manual, # 800970.



Switch and Digital Remote



Programmable Remote

Figure 3-16 Remote V/C Control Rear Connections

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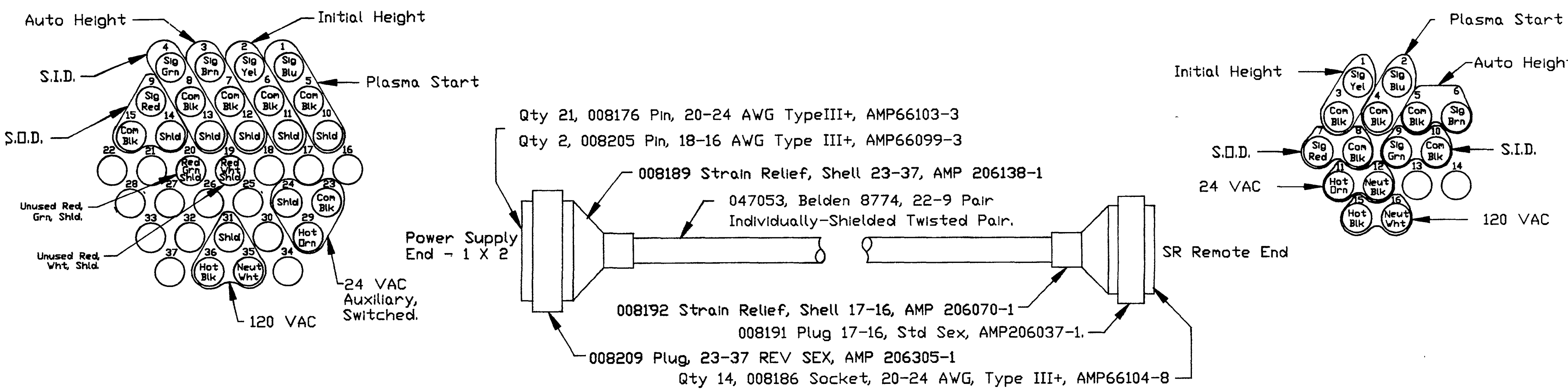


Legend - Power Supply End - 1 X 2

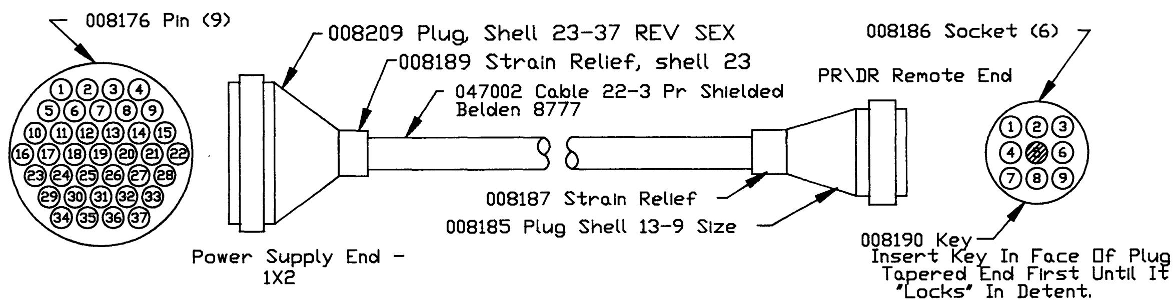
SCKT	COLOR	FUNCTION	SCKT	COLOR	FUNCTION
1	Blu	Plasma Start-Signal	20	Shld	Unused Pair-Red\Grn\Shield
2	Yel	Initial Height-Signal	21		
3	Brn	Auto Height-Signal	22		
4	Grn	Serial Input Data(Sid)-Signal	23	Blk	24 VAC Auxiliary, Neutral
5	Blk	Plasma Start-Common	24	Shld	24 VAC Auxiliary, Shield
6	Blk	Initial Height-Common	25		
7	Blk	Auto Height-Common	26		
8	Blk	Serial Input Data(Sid)-Common	27		
9	Red	Serial Output Data(Sod)-Signal	28		
10	Shld	Plasma Start-Shield	29	Orn	24 VAC Auxiliary, Hot
11	Shld	Initial Height-Shield	30		
12	Shld	Auto Height-Shield	31	Shld	120 VAC-Shield
13	Shld	Serial Input Data(Sid)-Shield	32		
14	Shld	Serial Output Data(Sod)-Shield	33		
15	Blk	Serial Output Data(Sod)-Common	34		
16			35	Wht	120 VAC-Neutral
17			36	Blk	120 VAC-Hot
18			37		
19	Shld	Unused Pair-Red\Wht\Shield			

Legend - SR Remote End

SCKT	COLOR	FUNCTION
1	Yel	Initial Height-Signal
2	Blu	Plasma Start-Signal
3	Blk	Initial Height-Common
4	Blk	Plasma Start-Common
5	Blk	Auto Height-Common
6	Brn	Auto Height-Signal
7	Red	Serial Output Data(Sod)-Signal
8	Blk	Serial Output Data(Sod)-Common
9	Grn	Serial Input Data(Sid)-Signal
10	Blk	Serial Input Data(Sid)-Common
11	Orn	24 VAC Auxiliary, Hot
12	Blk	24 VAC Auxiliary, Neutral
13		
14		
15	Blk	120 VAC-Hot
16	Wht	120 VAC-Neutral

PART NO.	LENGTH
023319	25 FT
023328	50 FT
023339	75 FT
023330	100 FT
023331	150 FT
023332	200 FT

Figure 3-17 Power Supply to Switch Remote Interface Cable Diagram



Legend - Power Supply End 1X2									Legend - DR\PR Remote End		
PIN	COLOR	FUNCTION	PIN	COLOR		PIN	COLOR		SOCKET	COLOR	FUNCTION
1			14		Shield-Red/Blk	27			1	Grn	Sid Data Input to PS-THC
2			15	Blk	Sod Common	28			2	Blk	Sid Common
3			16			29			3	Red	Sod Data Output From PS-THC
4	Grn	Sid Data Input Data To THC	17			30			4		
5			18			31		Shield (AC PWR) Wht/Blk	5		Key
6			19			32			6	Blk	Sod Common
7			20			33			7	Wht	AC Power
8	Blk	Sid Common	21			34			8	Blk	AC Power
9	Red	Sod Data Output From THC	22			35	Wht	AC Power	9		
10			23			36	Blk	AC Power			
11			24			37					
12			25								
13		Shield-Grn/Blk	26								

] Indicates pairs.

NOTE: Shields cut on remote end.

Part No.	Length
023346	25'
023347	50'
023348	75'
023349	100'
023350	150'
023351	200'

Figure 3-18 Power Supply to Digital Remote/Programmable Remote Interface Cable

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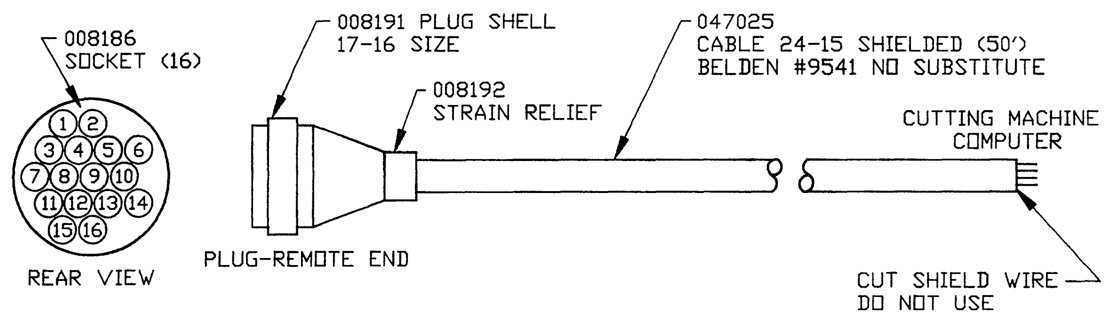
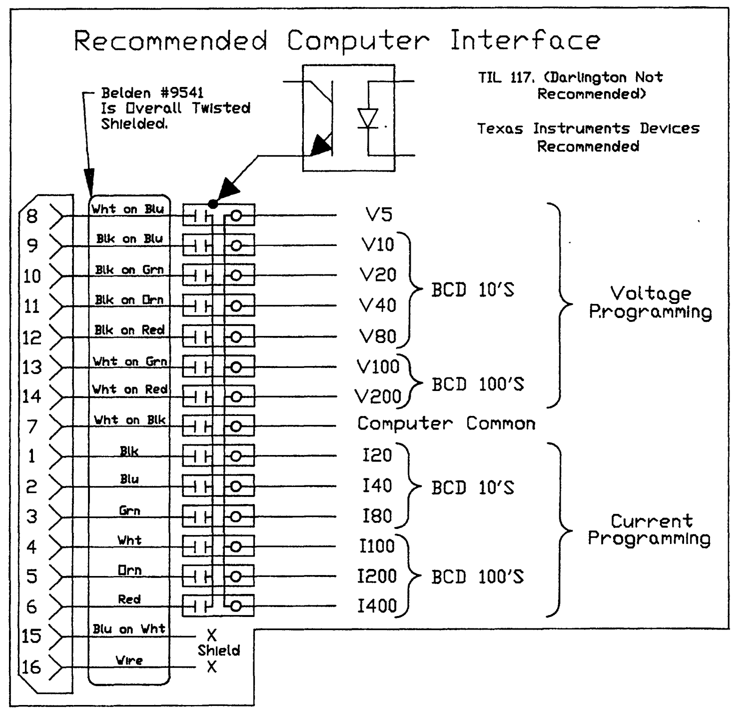


Legend - PR Remote End		
SOCKET	COLOR	FUNCTION
1	Blk	Current Program I20
2	Blu	" " I40
3	Grn	" " I80
4	Wht	" " I100
5	Orn	" " I200
6	Red	" " I400
7	Wht on Blk	Common (Remote Chassis)
8	Wht on Blu	Voltage Program V5
9	Blk on Blu	" " V10
10	Blk on Grn	" " V20
11	Blk on Orn	" " V40
12	Blk on Red	" " V80
13	Wht on Grn	" " V100
14	Wht on Red	" " V200
15	Blk on Wht	Spare (Remote Chassis)
16	Shield Wire	Shield (Remote Chassis)



PART NO.	LENGTH
023100	50 FT

Figure 3-19 Programmable Remote to Computer Interface Cable Diagram

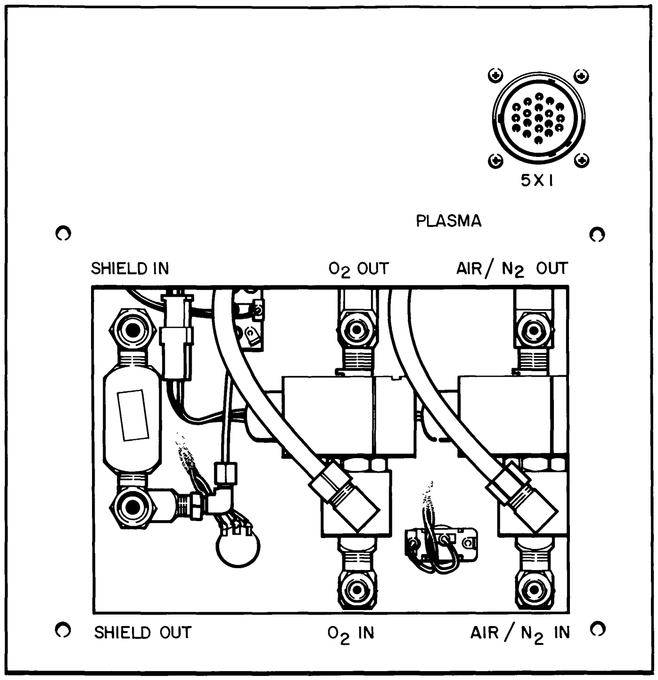
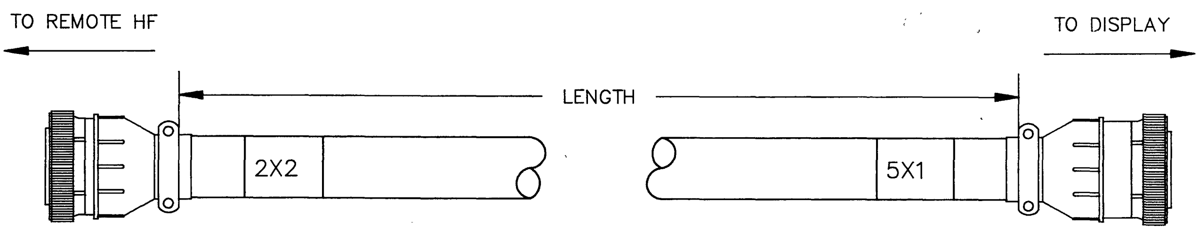


Figure 3-20 Display Console Connections



DISPLAY RUN LIST		
PLUG 2X2	COLOR	PLUG 5X1
1	BLACK	1
2	RED	2
3	DRAIN	CUT
4	BLACK	4
5	WHITE	5
6	DRAIN	CUT
8	BLACK	8
13	GREEN	13
9	DRAIN	CUT
10	BLACK	10
11	BLUE	11
12	DRAIN	CUT
13	BLACK	16
14	YELLOW	14
15	DRAIN	CUT
18	BLACK	18
19	BROWN	19
17	DRAIN	CUT

PART NUMBER	LENGTH
023399	10'
023400	15'
023401	25'
023402	35'

Figure 3-21 RHF to Display Console Cable Diagram

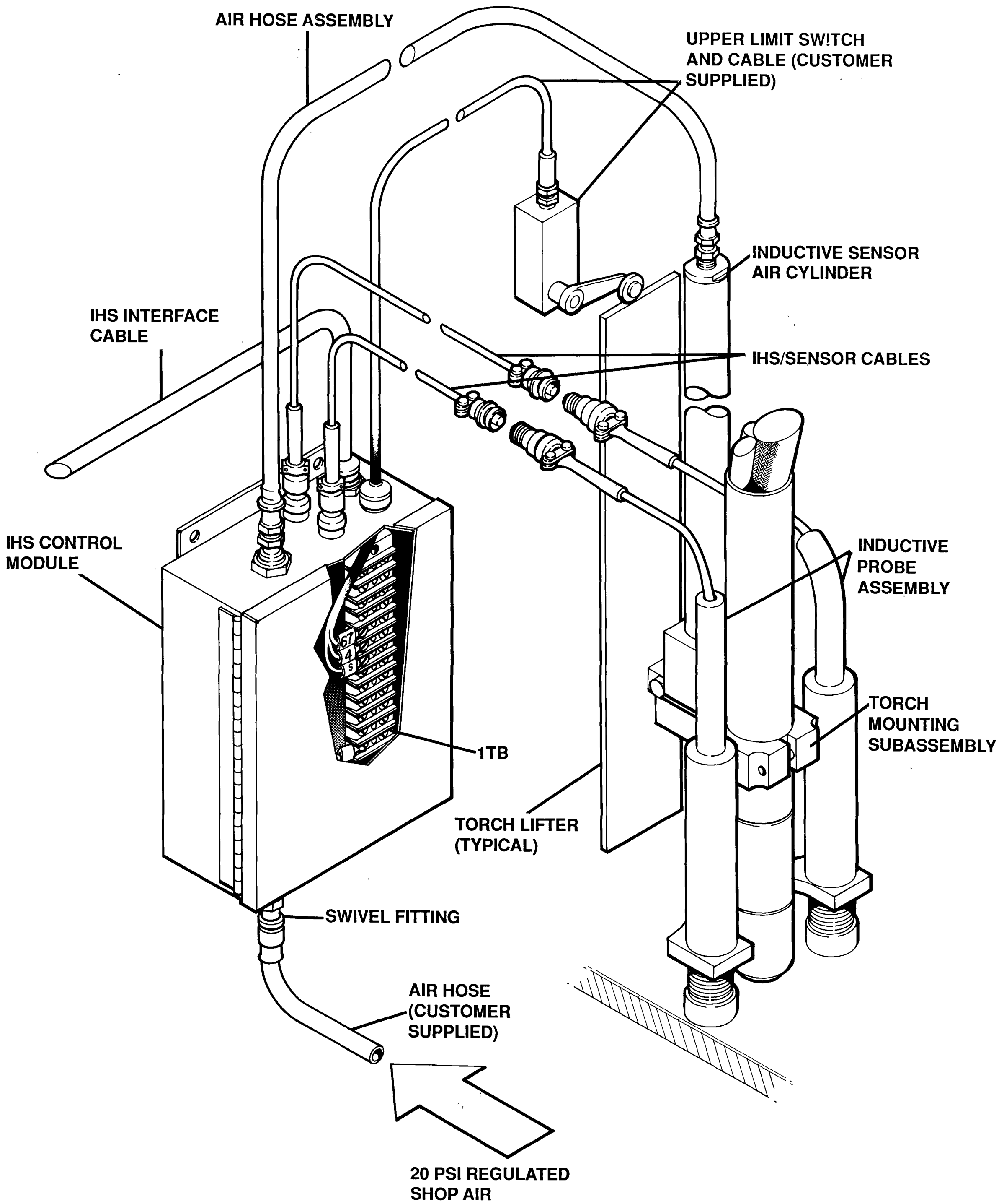
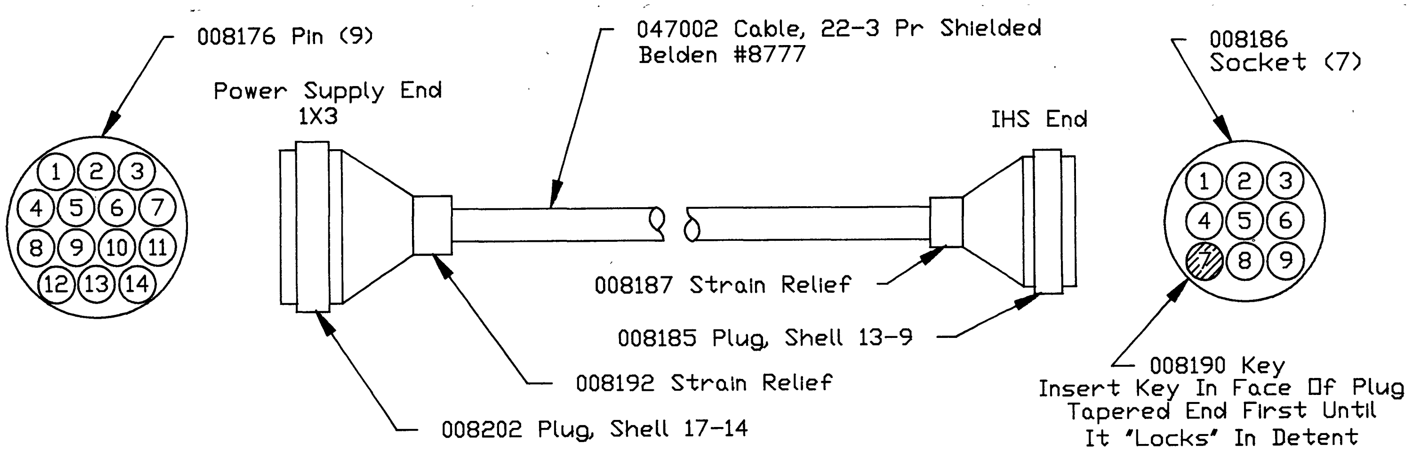


Figure 3-22 IHS Control Module Connections



PART NO.	LENGTH
023111	25 FT
023112	50 FT
023155	75 FT
023113	100 FT
023114	150 FT
023284	200 FT

Legend-Power Supply End-1X3

PIN	COLOR	FUNCTION
1	Red	IHS Complete Sig.
2	Grn	Upper Limit Sw. Sig.
3		
4	Blk	IHS Complete Com
5	Blk	Upper Limit Sw Com
6		
7	Drain	Shield - Wht/Blk
8	Drain	Shield - Red/Blk
9	Drain	Shield - Grn/Blk
10		
11	Blk	AC Power
12		
13		
14	Wht	AC Power

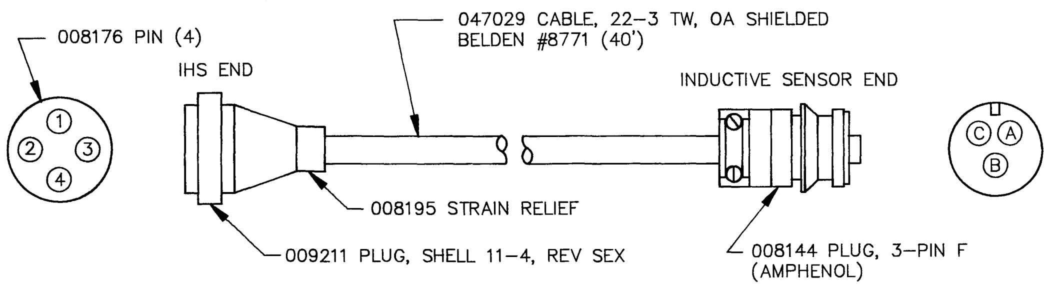
Legend-IHS End

SOCKET	COLOR	FUNCTION
1	Red	IHS Complete Sig
2	Grn	Upper Limit Sw Sig
3	Blk	Upper Limit Sw Com
4	Blk	IHS Complete Com
5	Drain	Shield - Grn/Blk
6		
7		Key
8	Wht	AC Power
9	Blk	AC Power

] Indicates Pairs.

NOTE: On IHS End, Cut Red/Black Shield & White/Black Shield Wires

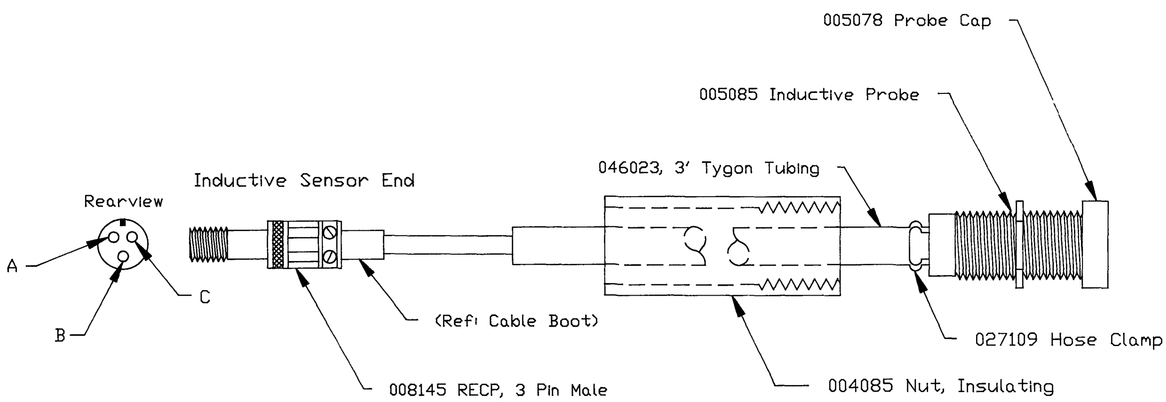
Figure 3-23 Power Supply to IHS Cable Diagram



PART NO.	LENGTH
023115	40 Ft.

Legend – IHS End			Legend – Inductive Sensor End		
PIN	COLOR	FUNCTION	PIN	COLOR	FUNCTION
1	Clear	Signal	A	Red	Power (+15 VDC)
2	Blk	Common	B	Blk	Common
3	Braid	Shield	C	Clear	Signal
4	Red	Power (+15 VDC)	NOTE: Cut Shield Sensor End.		

IHS/Sensor Cable



Legend - Inductive Sensor End		
PIN	COLOR	FUNCTION
A	Brn	Power (+15 VDC)
B	Blu	Common
C	Blk	Signal

Part No.
005074

Inductive Probe Assembly

Figure 3-24 IHS Control Module to Inductive Probe Assembly Cable Details

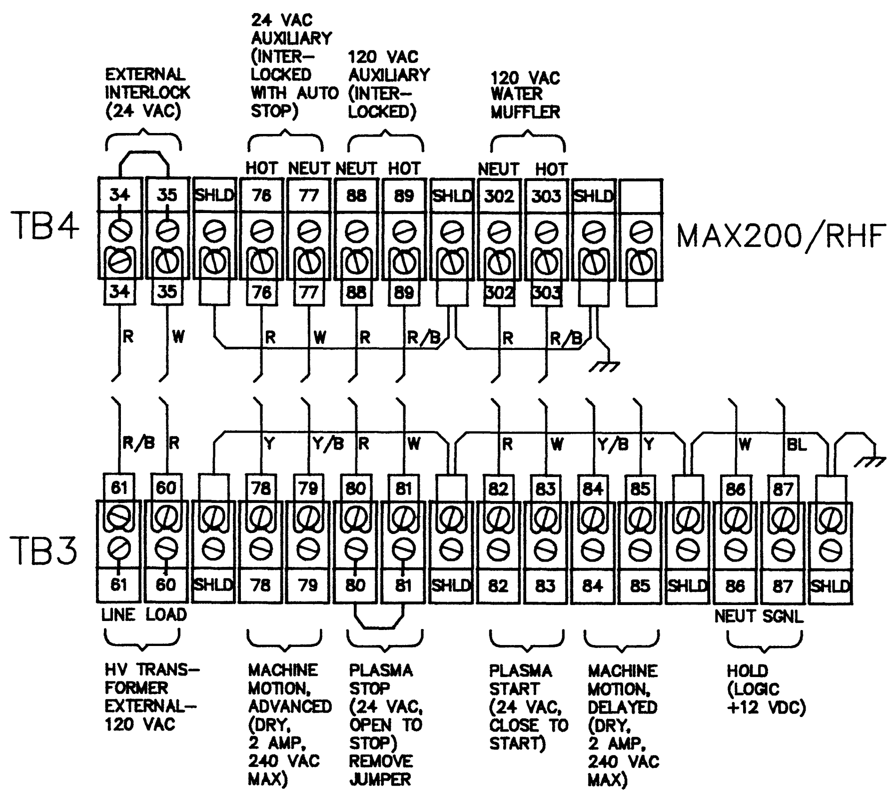
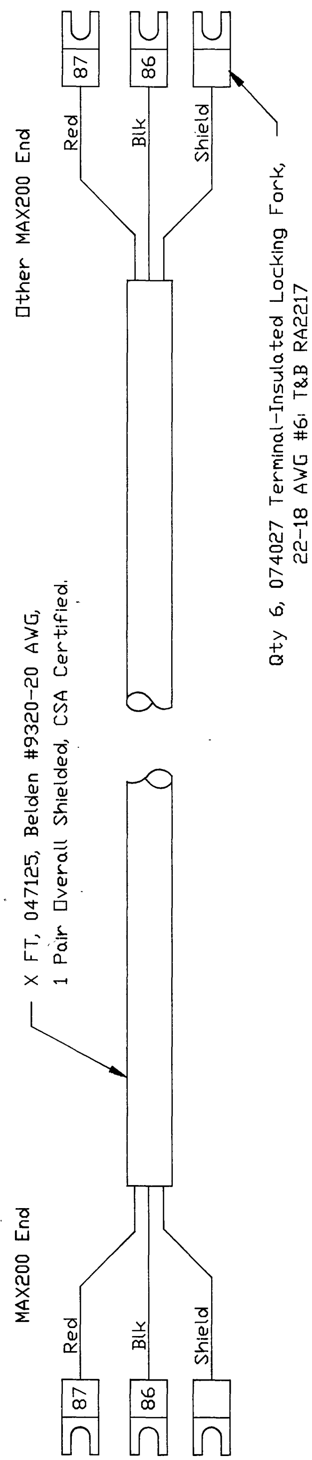


Figure 3-25 Power Supply TB3 and TB4 Connections



Legend - MAX200 End

Wire #	Color	Function
86	Blk	Hold Signal
87	Red	Hold Common
Shield	Shld	Hold Shield

Legend - Other MAX200 End

Wire #	Color	Function
86	Blk	Hold Signal
87	Red	Hold Common
Shield	Shld	Hold Shield

PART NO.	LENGTH
023340	15 FT
023341	25 FT
023342	50 FT
023343	100 FT
023344	150 FT

Figure 3-26 Power Supply Hold Cable

COOLING AND AIR/GAS CONNECTIONS

The following connections are supported by an overall cooling and air/gas interconnection diagram, Figure 3-27. Also provided is an illustration of each unit showing where the connections are to be made and the hoses used.

Cooling Hose Set - Power Supply to HF Console (Figs. 3-9, 3-10, 3-28, 3-29)

1. Route the two (2) # 6 black hoses through the brass torch lead adapter on the rear of the power supply.
2. Connect the hose with the red band to the red # 6 fitting on the cathode block. Connect the hose with the green band to the green # 6 fitting.
3. Route the other end of the hose set through the **IN** (hose with green band) and **OUT** (hose with red band) strain reliefs on the HF.
4. Connect the hose with the red band to the red fitting. Connect the hose with the green band to the green fitting.

Display Hose Set - HF Console to Display Console (Figs. 3-10, 3-20, 3-30)

1. Connect the red hoses to red gas **OUT** fittings and the green hoses to the green gas **IN** fittings on the **DISPLAY GAS** section of the HF.
2. Connect the other end of the hose set to the Display Console. Connect the red hoses to the red gas **OUT** fittings and the green hoses to the green **IN** fittings.

Air/Gas Supply - Customer Air/Gas Supply to HF Console (Fig. 3-10)

Note: The plasma gas supply is provided in parallel to allow either the use of oxygen or air/inert gas (nitrogen for example). This prevents the cross contamination of the oxygen lines.

Mount the Filter/Pressure Regulator (Fig. 3-31)

Mount the filter/pressure regulator either on to the HF or in a convenient spot near the HF.

Plasma Air/Shield Air Hoses (Fig. 3-10)

1. Connect the supply air hose to the input of the filter/pressure regulator.

COOLING AND AIR/GAS CONNECTIONS (Continued)

2. Connect the two # 6 black hoses from the output of the filter/pressure regulator to the **PLASMA-AIR/IN$_2$** and **SHIELD AIR** fittings on the **SUPPLY GAS** section of the HF.

Plasma Air/N$_2$/Shield Air Hoses (Fig. 3-10)

1. Connect the supply air hose to the input of the filter/pressure regulator.
2. Connect the # 6 black shield air hose from the output of the filter/pressure regulator to the **SHIELD AIR** fitting.

   Note: In this configuration, the plasma air hose must be disconnected from the regulator and replaced by a supplied **# 6 JIC cap**. The cap is required to stop the discharge of air from the regulator plasma output in order to keep the shield air pressure within specification.

3. Connect the plasma gas supply hose to the to the **PLASMA-AIR/IN$_2$** fitting.

Plasma Air/N$_2$/Shield Gas Hoses (Fig. 3-10)

Connect the plasma and shield gas hoses to the **PLASMA-AIR/INERT** fitting and **SHIELD** fitting.

Plasma Oxygen/Shield Gas Hoses (Fig. 3-10)

Connect the plasma and shield gas hoses to the **PLASMA-O$_2$** and **SHIELD** fittings.

IHS Air Supply - Customer Air Supply to IHS (Fig. 3-22)

1. The customer must supply the 20 psig regulated shop air and the air hose. A #4 swivel fitting (# 015006) is provided.
2. Attach the swivel fitting to the air hose. Connect this fitting to the air inlet fitting on the IHS Control Module.
3. Attach the other end of the air hose to the regulated shop air supply.

Air Cylinder Air Supply - IHS to Inductive Sensor Air Cylinder (Fig. 3-22)

1. At the Inductive Sensor Air Cylinder, connect the air hose (# 024144) to the air cylinder adapter (# 027024).

2. Route the air hose to the air outlet fittng (same side as the inductor sensor connections) on the IHS Control Module.

Water Muffler - Water Source to Water Muffler

Refer to the MAX200 Water Muffler Instruction Manual, # 802050.

TORCH LEAD SET CONNECTION

Routing the Torch Lead

When routing the torch lead to the HF Console, you will generally need to route the torch lead through a festoon or a power track. Before routing the lead using either method, remove the torch from the torch lead. Once the torch lead has been routed, replace the torch; it is now ready to be mounted to the torch mounting bracket. Refer to the *Maintenance* section for the torch removal and replacement procedures.

> Caution: Do not route the torch lead with the torch connected. Damage to the torch could result from dropping, banging, or scraping.

Connect the Torch Lead (Figs. 3-10, 3-27, 3-28)

To connect the torch lead set:

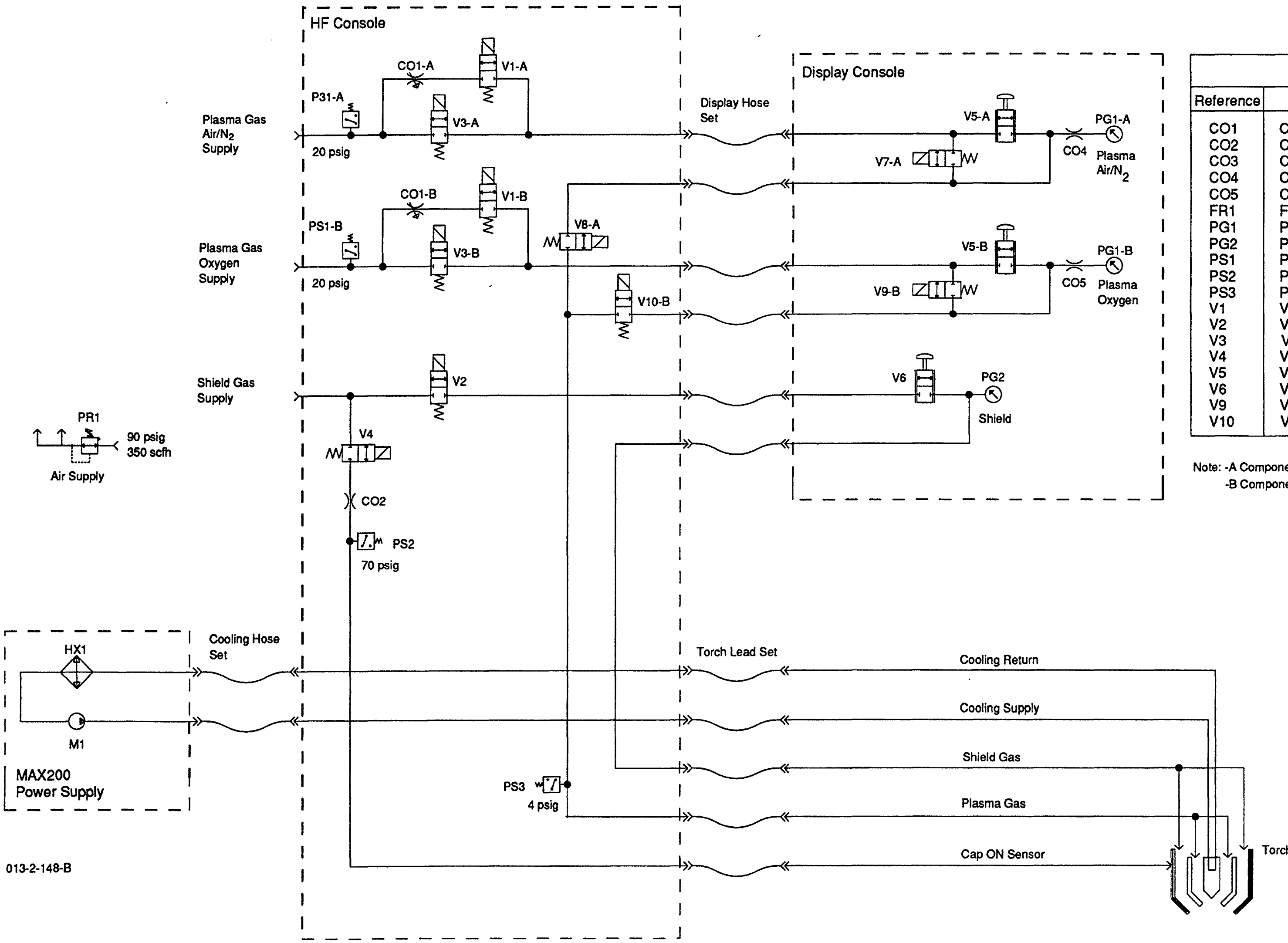
1. Route the torch lead set through the brass torch lead adapter on the HF.
2. Connect the torch coolant hose (blue-w/red band) to the red # 5 fitting on the cathode block.
3. Connect the torch coolant hose (blue-w/green band) to the green # 5 fitting on the cathode block.
4. Connect the shield gas hose (blue) to the bulkhead adapter.
5. Connect the plasma gas hose (red) to the adapter. This connection is left hand-threaded; it tightens in a counter-clockwise (ccw) direction.
6. Connect the cap on sensor hose (gray) to the adapter.

Mount the Machine Torch

1. Install the machine torch (with torch lead attached) in the bracket of the Torch Mounting Subassembly.

2. Position the torch until the torch body extends all the way through the bracket, so that the bracket is now around the plastic torch sleeve. Tighten the bracket.

3. The final torch position adjustment is described on page 4-6.



Gas System Designator

Reference	Description
CO1	Critical Orifice, Pre/Post Flow
CO2	Critical Orifice, Cap ON Sensor
CO3	Critical Orifice, PS4
CO4	Critical Orifice, PG1-A Snubber
CO5	Critical Orifice, PG1-B Snubber
FR1	Filter Regulator, Air Supply
PG1	Pressure Gauge, Plasma Gas
PG2	Pressure Gauge, Shield Gas
PS1	Pressure Switch, Plasma Gas Inlet
PS2	Pressure Switch, Shield Gas & Cap ON Sense
PS3	Pressure Switch, Plasma Gas Outlet
V1	Valve, Plasma Pre/Post Flow Solenoid
V2	Valve, Shield Gas Solenoid
V3	Valve, Plasma Step Gas Solenoid
V4	Valve, Cap ON Sense Solenoid
V5	Valve, Plasma Gas Metering
V6	Valve, Shield Gas Metering
V9	Valve, Plasma Charging
V10	Valve, Back Pressure

Note: -A Components for Air/Inert and
-B Components for Oxygen

Figure 3-27 MAX200/RHF System Coolant and Air/Gas Interconnection Diagram

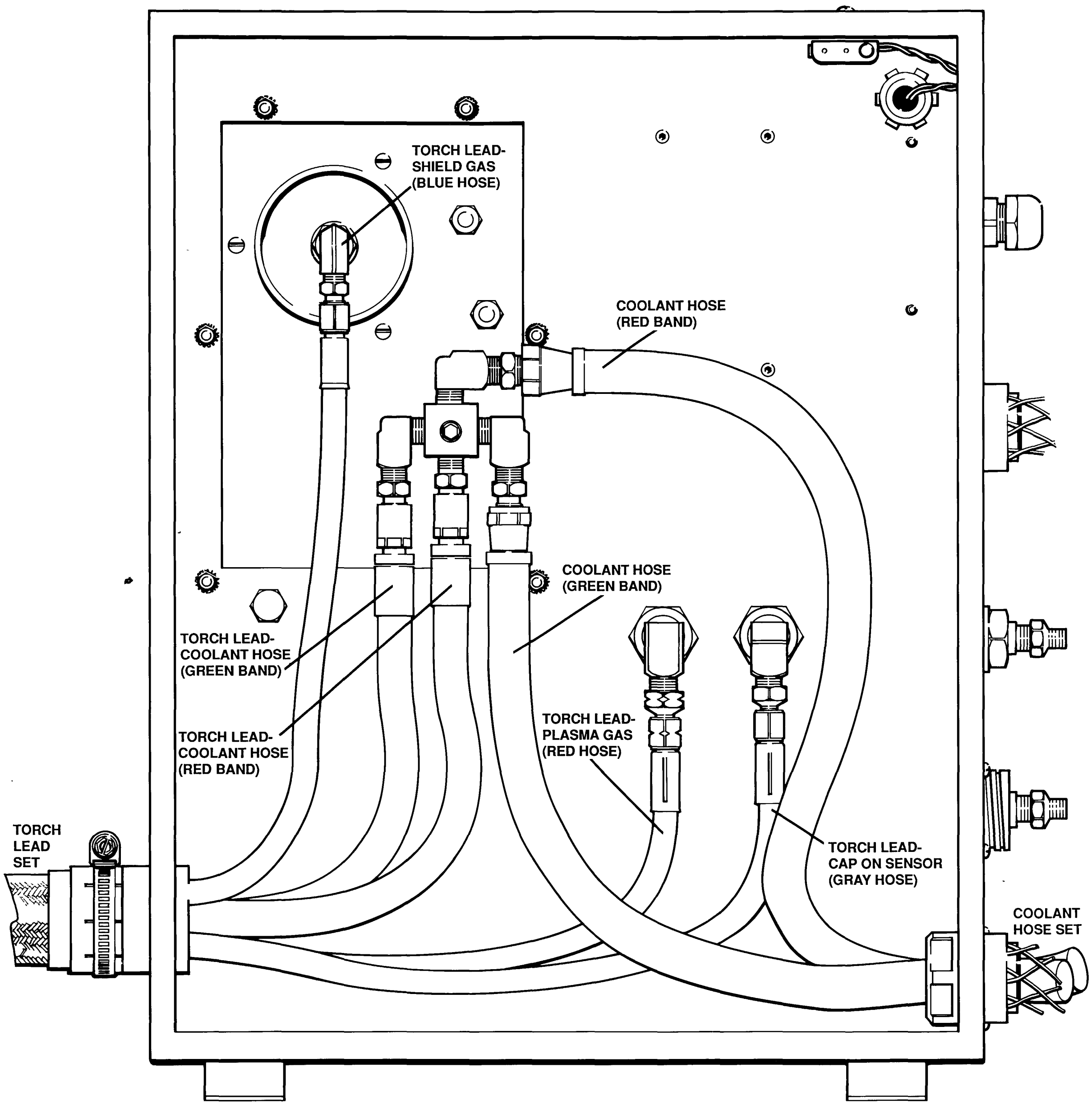
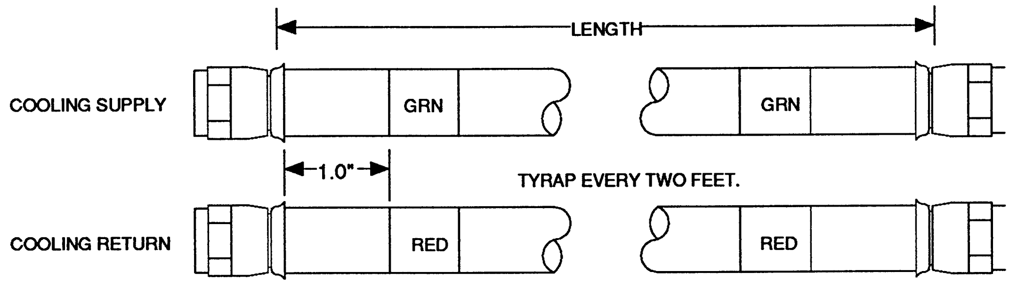
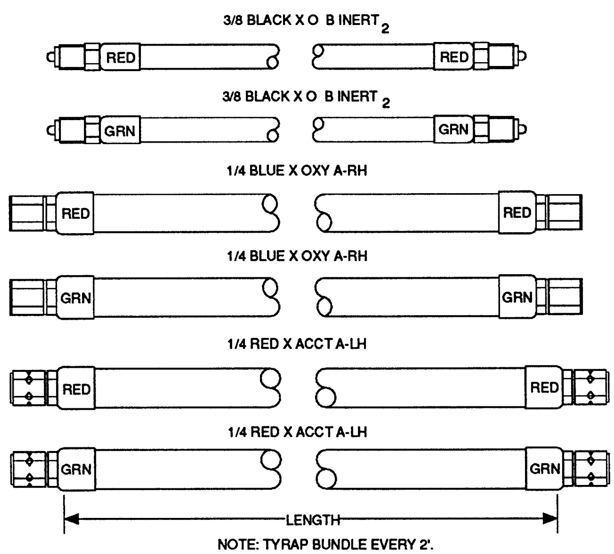


Figure 3-28 Coolant Hose Set and Torch Lead Set Connections



HOSE SET PART NUMBER	LENGTH	COOLING HOSE (2 REQ'D)
028440	15'	024200
028441	25'	024133
028442	50'	024012
028443	75'	024147
028444	100'	024115
028445	150'	024119

Figure 3-29 Coolant Hose Set



	10'	15'	20'	25'	35'
SHIELD OUT	024210	024203	024232	024134	024211
SHIELD IN	024210	024203	024232	024134	024211
OXYGEN OUT	024026	024027	024017	024028	024030
OXYGEN IN	024026	024027	024017	024028	024033
AIR/INERT OUT	024032	024033	024018	024034	024036
AIR/INERT IN	024032	024033	024018	024034	024036

PART NUMBER	LENGTH
028436	10'
028437	15'
028490	20'
028438	25'
028439	35'

Figure 3-30 Display Hose Set

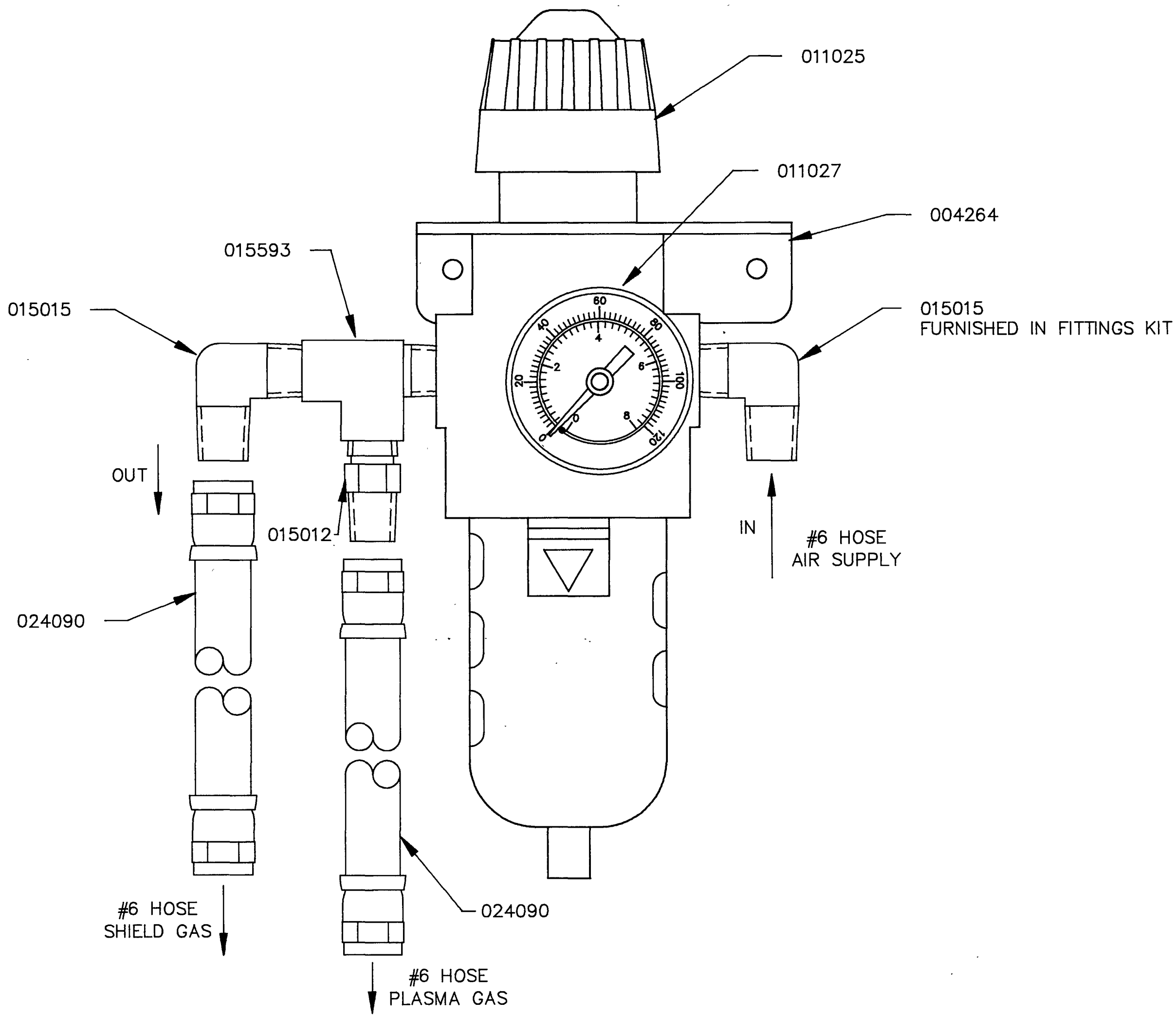


Figure 3-31 Filter/Pressure Regulator

Section 4 OPERATION

In this section:

Front Panel Controls 4-2
MAX200/RHF Power Supply 4-2
Display Console 4-2
Pre-operation 4-4
Torch Alignment 4-5
Torch Position Adjustment 4-6
Operating Tips 4-7
Changing Consumable Parts 4-7
Cutting Techniques 4-8
Common Cutting Faults 4-9
Technical Questions 4-9
Cut Charts 4-10

FRONT PANEL CONTROLS

MAX200/RHF Power Supply

Power

- **ON (1)** button
  Activates the power supply and its control circuits.
- **OFF (0)** button
  Shuts the power supply down.
- **DC ON** LED
  Indicates that DC power is present at the torch.

Status

- **INTERLOCK** LED
  Indicates that the external door or another interlock is engaged.
- **TRANSFORMER** LED
  Indicates that the main transformer has overheated.
- **COOLANT LEVEL** LED
  Indicates that the coolant level is too low.
- **SHIELD GAS/CAP** LED
  Indicates that the shield gas pressure is too low, or that the cap is not installed in the torch.
- **PLASMA GAS** LED
  Indicates that the plasma gas pressure is too low.
- **COOLANT TEMP** LED
  Indicates that the torch coolant temperature is too high.
- **COOLANT FLOW** LED
  Indicates that the coolant flow from the torch is inadequate.

Display Console

- **MACHINE DELAY** dial
  Adjusts the machine motion delay from 0.1 seconds to 6.0 seconds.
- **PLASMA-AIR/IN$_2$ - O$_2$** switch
  Selects the use of either of Air/N$_2$ gas or Oxygen lines.

- **TEST/RUN** switch
  Sets dynamic (flowing) gas flow.

- **PLASMA - AIR/N_2-O_2** pressure gauges/plasma gas metering valves.
  Adjusts and displays the plasma gas flow pressure for Air/N_2 gas or Oxygen.

- **SHIELD** pressure gauge/shield gas metering valve
  Adjusts and displays the shield gas flow pressure.

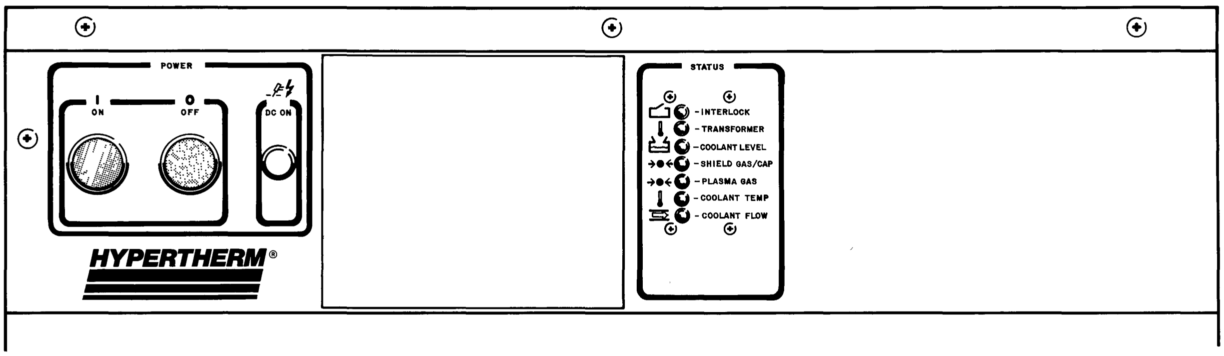


Figure 4-1 MAX200/RHF Power Supply Controls and Indicators

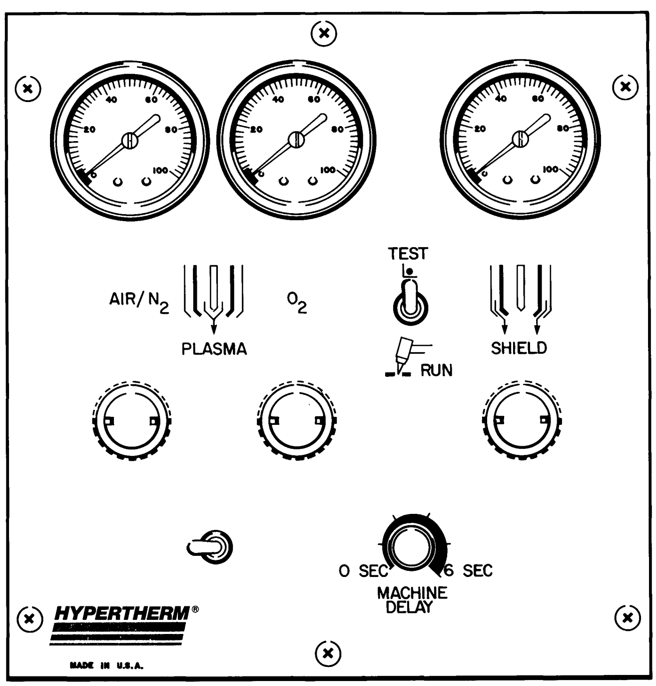


Figure 4-2 Display Console Controls and Indicators

PRE-OPERATION

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

2. Refer to the *Cut Charts* (page 4-10) for the type and width of material you plan to cut and to select the gas combination that will create the desired results.

   - Check to see if your gas supplies are adequate for the amount of cutting to be done and are input to the power supply at the proper pressure.

Caution: Input gas pressures below 60 psi (plasma) and 70 psi (shield/cap) will cause the safety interlock circuit to shut down the power supply. If the low pressure interlocks are bypassed for any reason and low gas pressures occur, the consumables and torch can burn out.

3. Select the proper torch parts from the cut chart.

   - Install the parts in the torch. (See *Changing Consumable Parts* for proper installation, page 4-7.)

4. Ensure the MAX200/RHF power supply work cable is attached to the work table.

   - Make sure that there is good metal-to-metal contact between the work cable and the work table.

5. Apply power to the MAX200/RHF power supply via the wall disconnect switch.

6 Square the torch with the workpiece if you are straight cutting, or angle the torch as required to accomplish your cut.

7. Set the torch-to-work distance (refer to page 4-6) and set the arc voltage and current on the remote control according to the cut charts.

8. Select the proper travel speed from the cut charts and adjust the cutting machine speed accordingly.

9. Adjust the MACHINE DELAY dial on the power supply to meet the recommended motion delay time in the cut charts.

Torch Alignment

Prior to cutting with a machine torch, ensure that the torch is at right angles to the workpiece to get a clean, vertical cut. Use a square to align the torch. The torch should be aligned at 0° and 90° (see Figure 4-3).

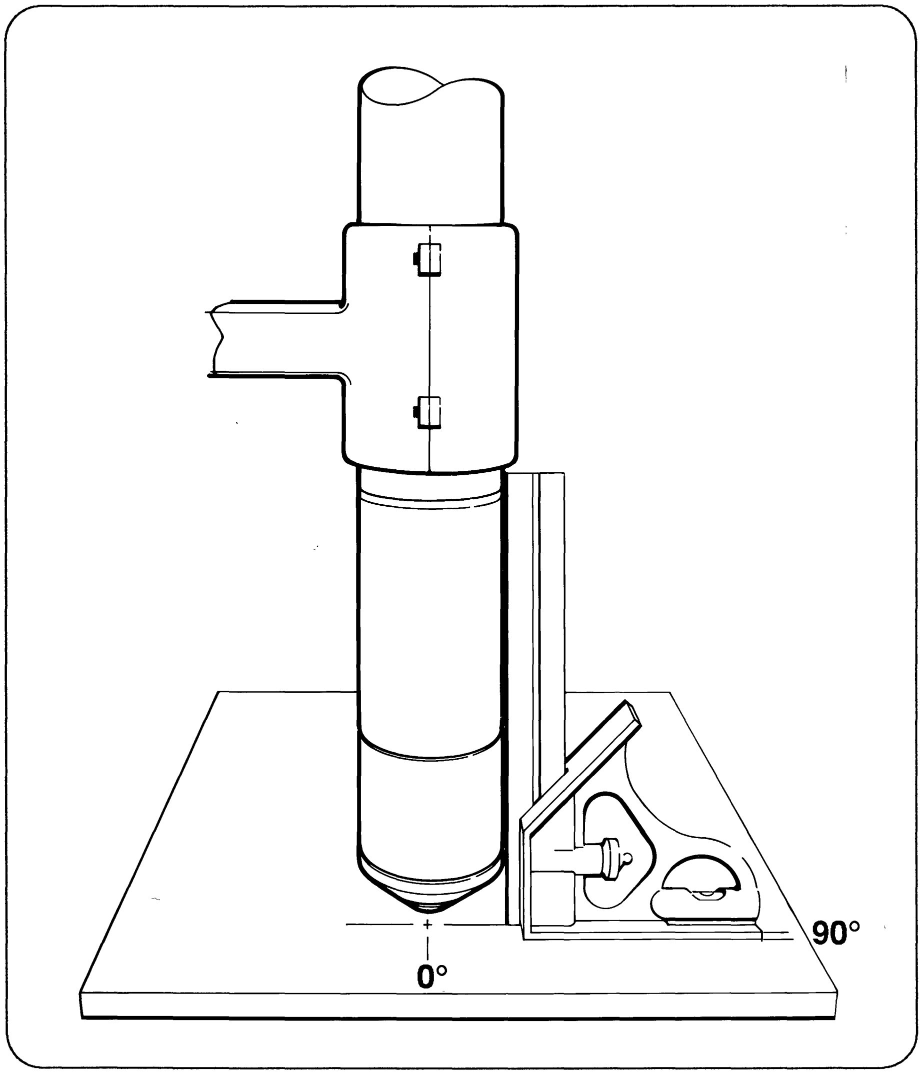


Figure 4-3 Torch Alignment

Torch Position Adjustment

Before using the machine torch system, the torch must be adjusted for the torch-to-work distance for the metal to be cut. To adjust the torch, perform the following procedure.

WARNING

Disconnect all power to the MAX200 before adjusting the torch. Failure to do so could result in eye or bodily injury due to accidental firing or movement of the torch.

Note: Two people may be required to perform the torch position adjustment.

1. Retract the torch from the work at least 3-4 inches.
2. Manually extend probes fully by pulling down on the plastic mounting yoke.
3. Adjust the position of the torch in the mounting bracket by loosening the securing bolt and positioning the torch so that the torch shield is within 1/16 to 1/8 inch of the extended probe plastic caps. Use a straight edge to determine this (see Figure 4-4). Secure the torch in the mounting bracket by tightening the securing bolt.

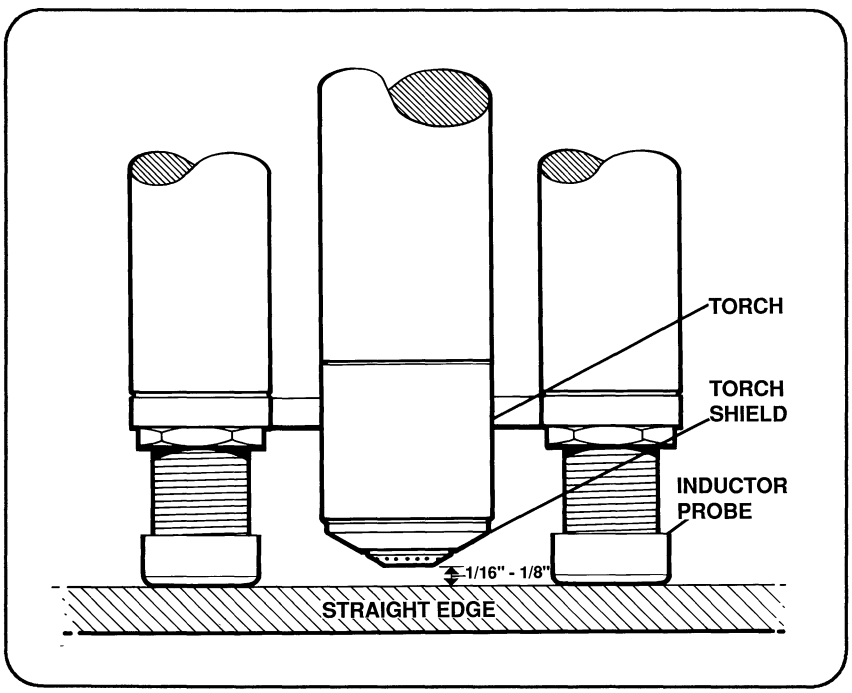


Figure 4-4 Torch Standoff Adjustment Setup

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 monitored periodically for signs of wear. A good rule of thumb is to check the parts after every 150 starts (pierces, edge starts, parts cut, etc.).

To remove the consumables:

1. Unscrew the retaining cap. First bring the torch to the edge of the machine, with the lifter raised to its highest point. Positioning the torch in this way prevents the danger of dropping the consumables into the water in the Water Table.

2. Remove the retaining cap.

3. Check the shield for external signs of wear. The shield should be clean and clear of metal debris. 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. Using the 7/8" side of the wrench (supplied in the spare parts kit), remove the shield. Inspect the gas holes from the inside. The holes should be clear of metal or other debris. (Debris will cause arcing.) If the shield is still good, screw it back on to the retaining cap and tighten it with the wrench. If it is damaged, replace it with a new one.

5. Inspect the two O-rings on the torch. They should be lubricated and undamaged. If they are dry, lubricate them lightly with a very thin film of the lubricant provided in the spare parts kit. If they are damaged, replace them.

6. Remove the nozzle with the 3/4" side of the wrench. Inspect it 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.

7. Remove the electrode with the center hole in the wrench and inspect it. If the center of the electrode has a pit more than 1/16" (2.0 mm) deep, replace it. If the electrode is still good, inspect its O-ring; it should be lubricated and undamaged. If it is dry, lubricate it lightly with a very thin film of lubricant provided in the spare parts kit. If it is damaged, replace it.

8. Remove the swirl ring from the electrode and inspect it. It should be clean, and the holes on the top and sides should not be plugged. If the swirl ring is still good, inspect its O-ring. It should be lubricated and undamaged. If it is dry, lubricate it lightly with a very thin film of lubricant provided in the spare parts kit. If it is damaged, replace it.

9. Inspect the inside of the torch body by using a mirror, or by looking carefully inside. The inside of the torch body should be clean and undamaged.

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

11. Install the swirl ring with the bottom O-ring facing the inside of the torch; it won't fit in properly if it is installed in the wrong direction. Push it into place. Be sure to hold the swirl ring in place until the nozzle is installed to avoid dropping it into the Water Table.

12. Install the nozzle and finger-tighten it. Finish tightening it with the wrench. **Do not overtighten it.**

13. Replace the retaining cap. Make sure that it is tightened snugly; if it is loose, it can affect the shield gas flow.

Cutting Techniques

Cutting

- Start cutting from the edge of the workpiece, unless you must pierce. For tips on piercing, refer to the *Piercing* section.

- When cutting, make sure that the sparks are coming out of the bottom of the workpiece. If not, check for the following:

  - If the sparks are spraying on top of the workpiece, the torch may be moving too fast. Check the cut charts for the correct travel speeds. The optimum travel speed is generally just slightly under the speed that causes the arc to "rooster tail" off of the workpiece.

  - If there is not sufficient power to fully penetrate the workpiece, reduce the travel speed. If this does not work, stop cutting and re-check the cut chart specifications.

Piercing

Note: The MAX200/RHF can pierce metals up to a thickness of one (1) inch.

- Set the torch-to-work distance (standoff) so that the shield cap is 1/8 inch or more away from the workpiece. (Refer to the *Adjust the Torch Position* procedure, page 4-6.)
- Ensure the MACHINE DELAY dial on the power supply is set to the recommended motion time delay (refer to cut charts) in order for the metal to be pierced completely before the travel motion begins.
- Position the torch directly over the workpiece juncture/cut line to be pierced.
- The workpiece can now be pierced.

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 or too fast.
  - The torch parts are worn.

TECHNICAL QUESTIONS

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 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, call our Customer Service or Field Service group at 1-800-643-0030.

CUT CHARTS

The following *Cut Charts* provide the necessary information in order for the operator using the MAX200/RHF machine torch system to be successful in plasma arc cutting. The Cut Charts are divided into two areas: 1) above water cutting (pages 4-11 through 4-33) and 2) under water cutting, where the water table water is 3" above the top surface of the workpiece (pages 4-34 through 4-45).

The following table provides the operator with a quick reference of the consumables used for all cutting and gouging applications with the MAX200 Rev 1 machine torch. Also listed are the consumables used with the water- muffler.

MAX200 Rev 1 Machine Torch Consumables

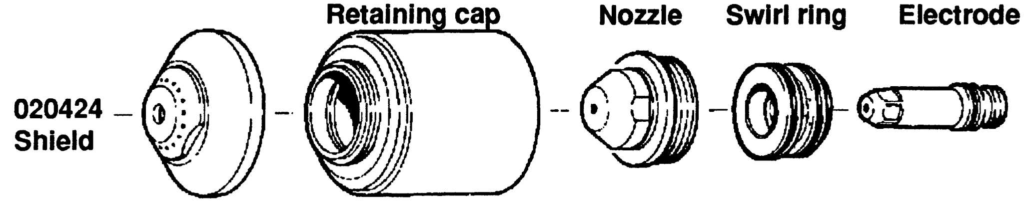
		Part Numbers				
Plasma Gas/ Shield Gas	Nozzle Type (Amps)	Shield	Retaining Cap	Nozzle	Swirl Ring	Electrode
Air/Air	200 100 40 200 gouging	020424 020448 020688 020485	020423	020608 020611 020689 020615	020607 020607 020613 020607	020414
O_2/Air	200 100	020424 020448	020423	020605 020616	020604 020617	020414
H35/N_2	200 100 200 gouging	020602 020448 020485	020423	020608 020611 020615	020607 020607 020607	020415
N_2/CO_2	200	020424	020423	020608	020607	020415
N_2/Air	200	020424	020423	020608	020607	020415
		Consumables Used with MAX200 Water-Muffler				
Air/Air	200 100	020566 020618	020423	020608 020611	020607 020607	020414
O_2/Air	200 100	020566 020618	020423	020605 020616	020604 020617	020414
N_2/CO_2	200	020566	020423	020608	020607	020415
N_2/Air	200	020566	020423	020608	020607	020415

MAX200 Machine Torch - Above Water

Mild Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16		**Air**	**44-48 / 58-62**	**Air**	**60**	1/8	3	**200**	130	200	5080		**90**	**90**
1/4	6		(66 SCFH)		(270 SCFH)	1/8	3		130	135	3400	0.5		
	8					1/8	3		135	115	2900	0.5		
3/8	10					1/8	3		135	100	2540	1.0		
1/2	13						4		140	80	2030	2.0		
5/8	15						4		145	60	1520	2.0		
3/4	20					3/16	5		150	45	1140	2.5		
7/8						1/4	6		155	30	760	2.5		
1	25					1/4	6		160	25	635	2.5		
1-1/4	32					1/4	6		165	15	380	3.0		
1-1/2						1/4	6		170	10	250	3.0		
1-3/4						5/16	8		180	7	180	3.0		
2	50					5/16	8		185	5	130	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

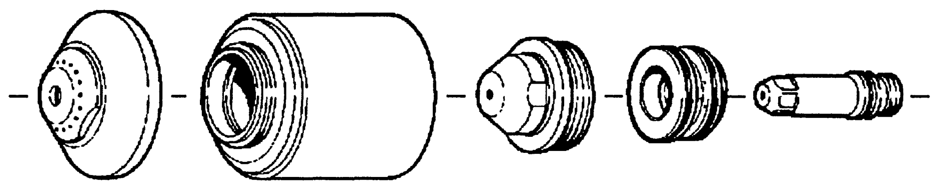
MAX200 Machine Torch - Above Water

Mild Steel

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross level and is very economical. Some surface nitriting can occur.

020448 Shield | **020423 Retaining cap** | **020611 Nozzle** | **020607 Swirl ring** | **020414 Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
	2	**Air**	**22-26 / 48-52**	**Air**	**60**	3/32	2.5	**80**	120		6050		**90**	**90**
1/8	3		**22-26 / 54-58**		**60**	3/32	2.5	**100**	125	185	4700	0.5		
3/16	5		(37 SCFH)		(270 SCFH)	1/8	3		125	175	4450	0.5		
1/4	6					1/8	3		130	125	3175	0.5		
3/8	10					1/8	3		135	50	1270	1.0		
1/2	12					1/8	3		140	35	890	1.5		
5/8	15						4		145	25	635	2.0		
3/4	20					3/16	5		150	20	510			

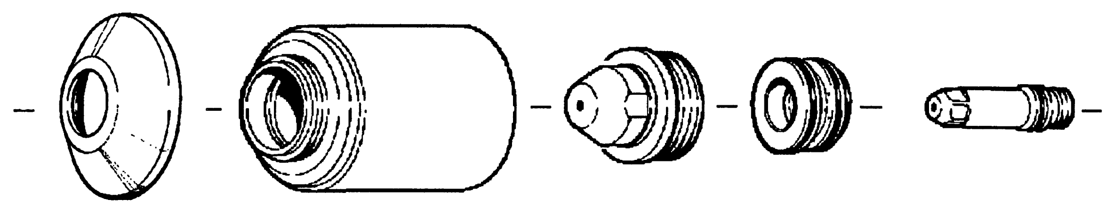
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Mild Steel

40 amps • Air Plasma / Air Shield

This gas combination gives good cut speeds, low dross levels and is very economical. Some surface nitriting can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
.050	(18 GA.)	**Air**	**16-20 / 56-60**	**Air**	**60**	3/32	2.5	**40**	110	320	8100		**90**	**90**
1/16			(25 SCFH)		(275 SCFH)	3/32	2.5		110	300	7600			
.075	2					3/32	2.5		110	220	5600			
1/8	3					3/32	2.5		110	140	3550	0.5		
.158	4					3/32	2.5		115	120	3050	0.5		
.197	5					3/32	2.5		115	50	1250	0.5		
1/4	6					3/32	2.5		120	35	850	1.0		
3/8	10					3/32	2.5		125	20	500	1.5		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

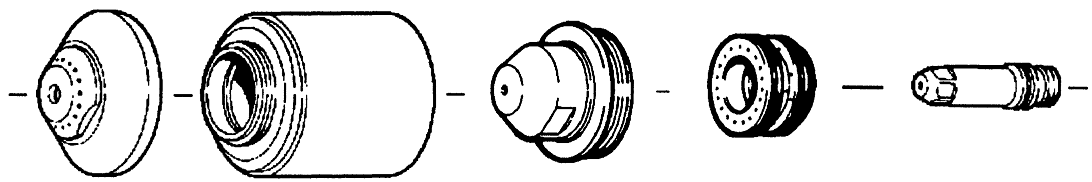
MAX200 Machine Torch - Above Water

Mild Steel

200 amps • O_2 Plasma / Air Shield

This gas combination gives superior cut speed, minimum dross, minimum amount of surface nitriting and excellent weldability.

020424 **Shield** | **020423** **Retaining cap** | **020605** **Nozzle** | **020604** **Swirl ring** | **020414** **Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/4	6	**O_2**	**48-52 / 64-68**	**Air**	**60**	1/8	3	**200**	120	160	4060	0.5	**120**	**90**
	8	(72 SCFH)		(270 SCFH)		1/8	3		125	120	3000	0.5		
3/8	10					1/8	3		125	100	2540	1.0		
1/2	12						4		125	80	2030	2.0		
5/8	15						4		130	70	1780	2.0		
3/4	20					3/16	5		135	55	1400	2.5		
7/8						1/4	6		135	45	1140	2.5		
1	25					1/4	6		140	35	890	2.5		
1-1/4	32					1/4	6		150	22	560	3.0		
1-1/2						1/4	6		155	15	380	3.0		
1-3/4						5/16	8		165	10	250	3.0		
2	50					5/16	8		170	7	180	3.0		

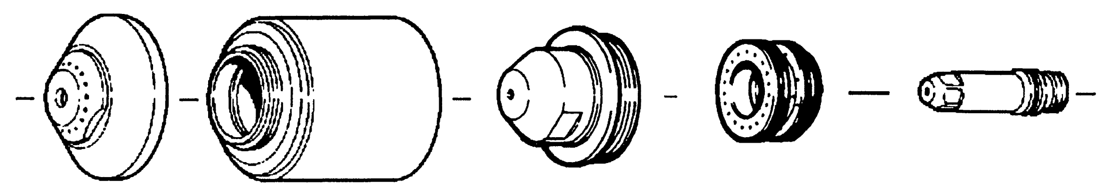
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Mild Steel

100 amps • O_2 Plasma / Air Shield

This gas combination gives good cut speed, low dross level and is very economical. Some surface nitriting can occur.



Material Thickness (Inches)	Material Thickness (mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	Travel Speed (mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**O_2**	**12-16 / 52-56**	**Air**	**60**	3/32	2.5	**100**	105	240	6100		**120**	**90**
3/16	5					1/8	3		110	180	4550			
1/4	6		(40 SCFH)		(270 SCFH)	1/8	3		110	110	3050	0.5		
3/8	10					1/8	3		115	70	1780	0.5		
1/2	12					1/8	3		115	50	1270	1.0		
5/8	15						4		125	40	1020	1.0		
3/4	20					3/16	5		130	30	760	1.5		

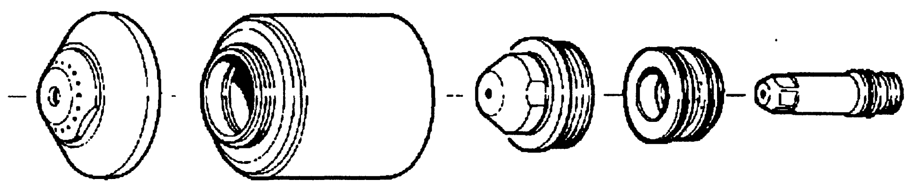
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Mild Steel

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when cut edge quality and surface nitriting are less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**36-40 / 52-56**	**CO_2**	**60**	1/8	3	**200**	120	130	3300	0.5	**120**	**90**
1/4	6	(60 SCFH)		(210 SCFH)		1/8	3		125	110	2800	1.0		
3/8	10					1/8	3		130	85	2160	1.5		
1/2	12					1/8	3		130	55	1400	2.0		
5/8	15						4		135	45	1140	2.0		
3/4	20					3/16	5		145	25	635	2.5		
7/8						1/4	6		150	20	510	3.0		
1	25					1/4	6		160	15	380	3.0		
1-1/4	32					1/4	6		165	10	250	3.0		
1-1/2						1/4	6		175	5	130	3.0		

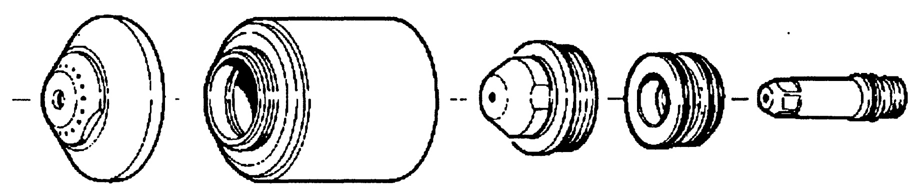
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Stainless Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**Air**	**44-48 / 58-62**	**Air**	**60**	1/8	3	**200**	125	220	5600		**90**	**90**
1/4	6		(66 SCFH)		(270 SCFH)	1/8	3		130	195	5000	0.5		
3/8	10					1/8	3		130	145	3700	1.0		
1/2	12					1/8	3		135	105	2700	2.0		
5/8	15						4		140	75	1900	2.0		
3/4	20					3/16	5		140	55	1400	2.5		
7/8						1/4	6		145	40	1000	3.0		
1	25					1/4	6		150	30	760	3.0		
1-1/4	32					1/4	6		160	15	380	3.0		
1-1/2						1/4	6		170	10	250	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

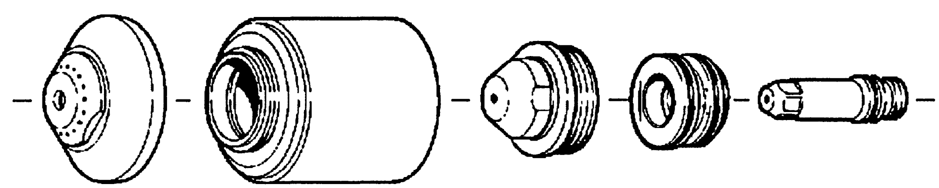
MAX200 Machine Torch - Above Water

Stainless Steel

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.

020448 Shield | **020423 Retaining cap** | **020611 Nozzle** | **020607 Swirl ring** | **020414 Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**Air**	**22-26 / 54-58**	**Air**	**60**	3/32	2.5	**100**	125	140	3560		**90**	**90**
3/16	5		(37 SCFH)		(270 SCFH)	1/8	3		130	110	2800	0.5		
1/4	6					1/8	3		130	80	2030	0.5		
3/8	10					1/8	3		135	55	1400	0.5		
1/2	12					1/8	3		140	35	890	1.0		
5/8	15						4		145	25	635	1.5		
3/4	20					3/16	5		150	20	510	2.0		

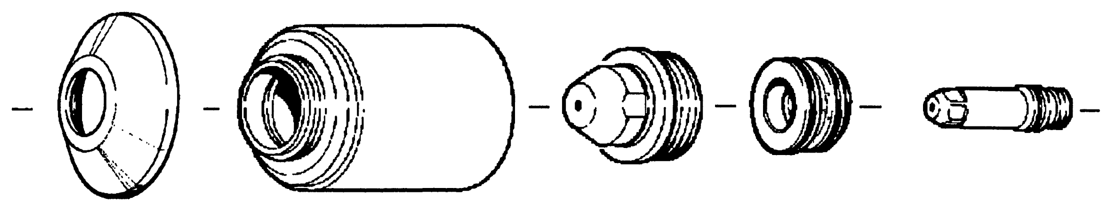
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Stainless Steel

40 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
.050	(18 GA.)	**Air**	**16-20 / 56-60**	**Air**	**60**	3/32	2.5	**40**	120	145	3700		**90**	**90**
1/16			(25 SCFH)		(275 SCFH)	3/32	2.5		120	120	3050			
1/8	3					3/32	2.5		125	75	1900	0.5		
1/4	6					1/8	3		135	30	750	1.0		
3/8	10					1/8	3		140	12	300	1.5		

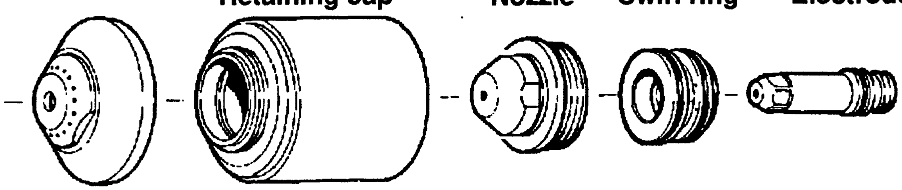
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Stainless Steel

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality, surface nitriting and surface oxidation of alloying elements are less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**34-38 / 50-54**	**Air**	**60**	1/8	3	**200**	125	135	3430		**120**	**90**
1/4	6	(60 SCFH)		(270 SCFH)		1/8	3		130	120	3050	0.5		
3/8	10					1/8	3		130	100	2540	1.0		
1/2	12					1/8	3		135	75	1900	2.0		
5/8	15						4		140	60	1520	2.0		
3/4	20					3/16	5		140	45	1140	2.5		
7/8						1/4	6		145	35	890	2.5		
1	25					1/4	6		150	20	510	3.0		
1-1/4	32					1/4	6		160	15	380	3.0		
1-1/2						1/4	6		160	10	250	3.0		

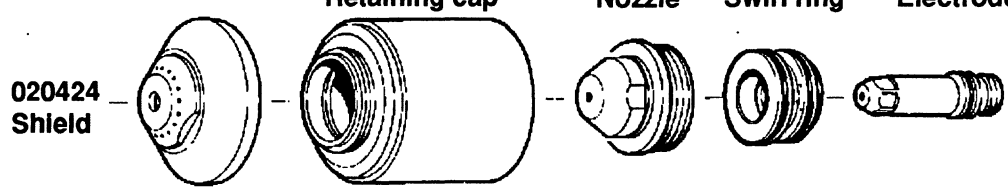
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Stainless Steel

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when surface nitriting and surface oxidation of alloying elements is less important. Electrode life is extended when using this gas combination.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**36-40 / 52-56**	**CO_2**	**60**	1/8	3	**200**	125	190	4800	0.5	**120**	**90**
1/4	6	(60 SCFH)		(210 SCFH)		1/8	3		130	170	4300	1.0		
3/8	10					1/8	3		130	125	3200	1.5		
1/2	12					1/8	3		135	95	2400	2.0		
5/8	15						4		140	70	1800	2.0		
3/4	20					3/16	5		140	50	1250	2.5		
7/8						1/4	6		145	40	1000	3.0		
1	25					1/4	6		150	30	760	3.0		
1-1/4	32					1/4	6		160	15	380	3.0		
1-1/2						1/4	6		170	10	250	3.0		

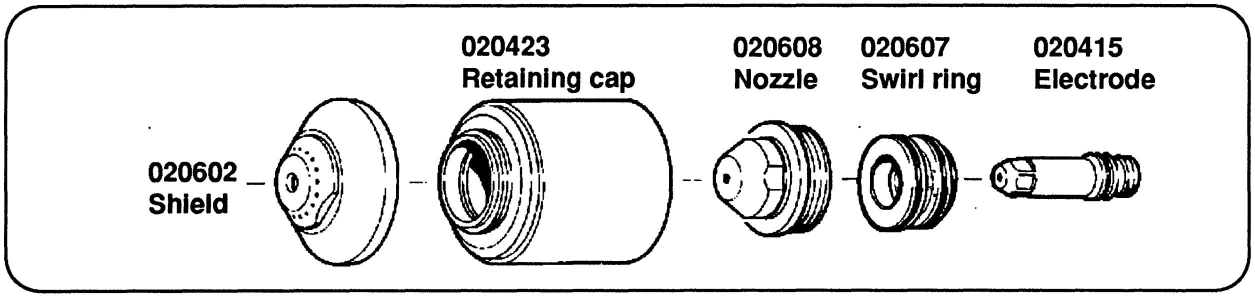
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Stainless Steel

200 amps • H35 Plasma / N_2 Shield

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives maximum thickness cutting capability, minimum dross levels, minimum amount of surface contamination, excellent weldability and excellent cut quality. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/4	6	**H35**	**36-40 / 62-66**	**N_2**	**60**	3/16	5	**200**	135	62	1600	1.0	**120**	**90**
3/8	10	(70 SCFH)		(275 SCFH)		3/16	5		140	52	1300	1.0		
1/2	12					3/16	5		140	42	1100	2.0		
5/8	15					1/4	6		145	37	940	2.0		
3/4	20					1/4	6		150	32	810	2.5		
7/8						5/16	8		155	27	690	2.5		
1	25					5/16	8		155	22	560	2.5		
1-1/4	32					5/16	8		165	16	400	3.0		
1-1/2						5/16	8		170	11	280	3.0		
1-3/4						5/16	8		180	8	200	3.0		
2						5/16	8		185	6	150	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

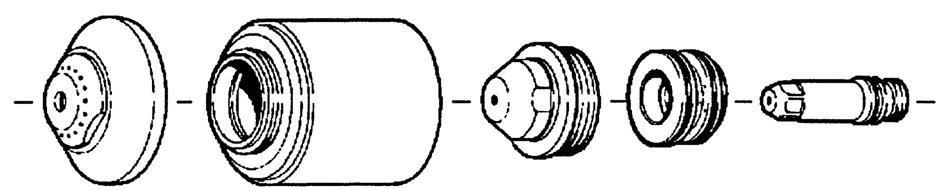
Note: Maximum piercing thickness 3/4" (20mm) and IHS recommended.

MAX200 Machine Torch - Above Water

Stainless Steel

100 amps • H35 Plasma / N_2 Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.



Material Thickness (Inches)	Material Thickness (mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	Travel Speed (mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**H35**	**32-36/ 56-60**	**N_2**	**60**	3/32	2.5	**100**	130	50	1260		**120**	**90**
3/16	5	(20 SCFH)		(270 SCFH)		1/8	3		135	40	1060	0.5		
1/4	6					1/8	3		140	35	890	0.5		
3/8	10					1/8	3		140	30	750	0.5		
1/2	13					1/8	3		145	25	630	1.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

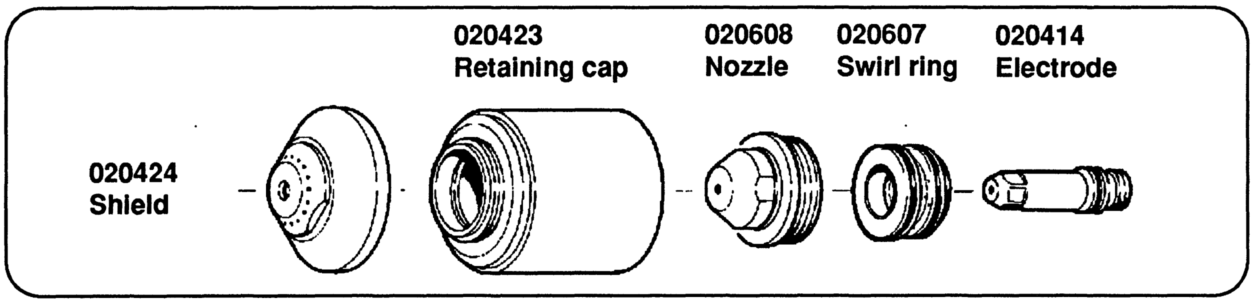
Note: Maximum piercing thickness 3/8-inch (10 mm) and IHS recommended.

MAX200 Machine Torch - Above Water

Aluminum

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**Air**	**44-48 / 58-62**	**Air**	**60**	1/8	3	**200**	130	220	5600	0.5	**90**	**90**
1/4	6		(66 SCFH)		(270 SCFH)	1/8	3		140	190	4800	1.0		
3/8	10					1/8	3		140	145	3700	2.0		
1/2	12					1/8	3		145	110	2800	2.5		
5/8	15						4		150	85	2200	2.5		
3/4	20					3/16	5		155	65	1650	2.5		
7/8						1/4	6		160	50	1300	2.5		
1	25					1/4	6		165	35	900	3.0		
1-1/4	32					1/4	6		170	20	500	3.0		
1-1/2						1/4	6		175	12	300	3.0		

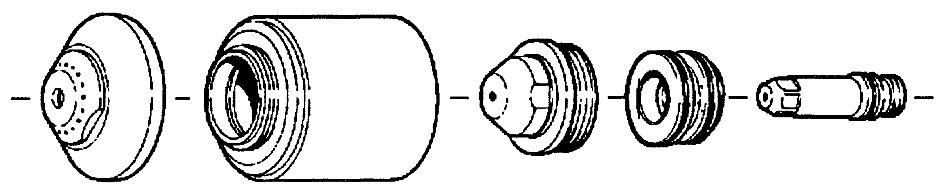
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Aluminum

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



Material Thickness (Inches)	Material Thickness (mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	Torch-to-work Distance (mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	Travel Speed (mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**Air**	**22-26 / 54-58**	**Air**	**60**	3/32	2.5	**100**	135	110	2800		**90**	**90**
3/16	5	(37 SCFH)		(270 SCFH)		1/8	3		140	90	2290	0.5		
1/4	6					1/8	3		145	70	1780	0.5		
3/8	10					1/8	3		145	50	1270	0.5		
1/2	12					1/8	3		150	40	1010	1.0		
5/8	15						4		155	30	760	1.5		
3/4	20					3/16	5		160	25	635	2.0		

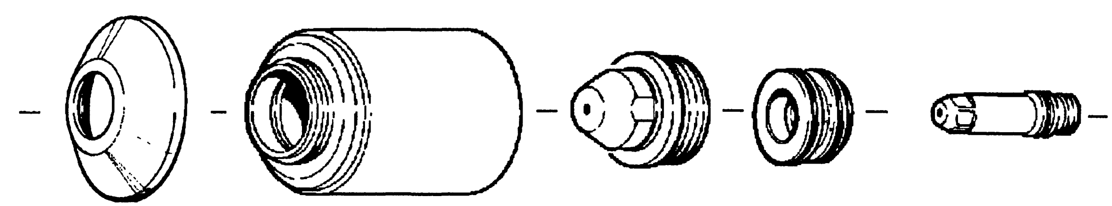
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Aluminum

40 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/32		**Air**	**16-20 / 56-60**	**Air**	**60**	3/32	2.5	**40**	120	140	3550		**90**	**90**
1/8	3	(25 SCFH)		(275 SCFH)		3/32	2.5		130	100	2550	0.5		
1/4	6					1/8	3		140	35	900	1.0		
3/8	10					1/8	3		150	15	350	1.5		

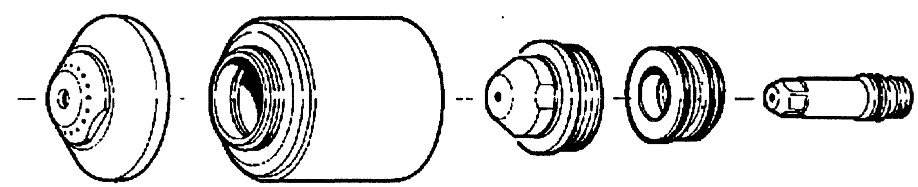
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Aluminum

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5					1/8	3	**200**	130	180	4570	0.5	**120**	**90**
1/4	6	**N_2**	**34-38 / 54-54**	**Air**	**60**	1/8	3		135	160	4060	1.0		
3/8	10	(60 SCFH)		(270 SCFH)		1/8	3		135	120	3050	1.5		
1/2	12					1/8	3		140	80	2030	2.0		
5/8	15						4		140	70	1780	2.0		
3/4	20					3/16	5		150	50	1270	2.5		
7/8						1/4	6		160	35	890	2.5		
1	25					1/4	6		165	25	635	3.0		
1-1/4	32					1/4	6		175	20	510	3.0		
1-1/2						1/4	6		185	10	250	3.0		

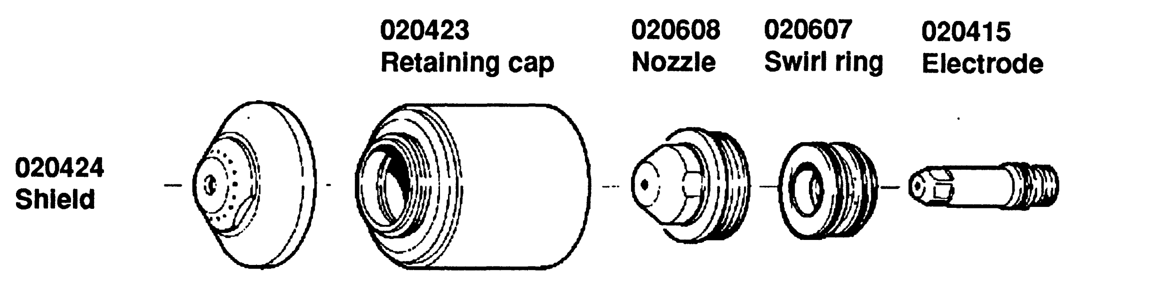
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - Above Water

Aluminum

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**36-40 / 52-56**	**CO_2**	**60**	1/8	3	**200**	130	185	4700	0.5	**120**	**90**
1/4	6	(60 SCFH)		(210 SCFH)		1/8	3		135	160	4050	1.0		
3/8	10					1/8	3		135	120	3050	2.0		
1/2	12					1/8	3		140	95	2400	2.5		
5/8	15						4		140	70	1800	2.5		
3/4	20					3/16	5		150	55	1400	3.0		
7/8						1/4	6		160	42	1050	3.0		
1	25					1/4	6		165	33	840	3.0		
1-1/4	32					1/4	6		175	20	510	3.0		
1-1/2						5/16	8		185	11	280	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

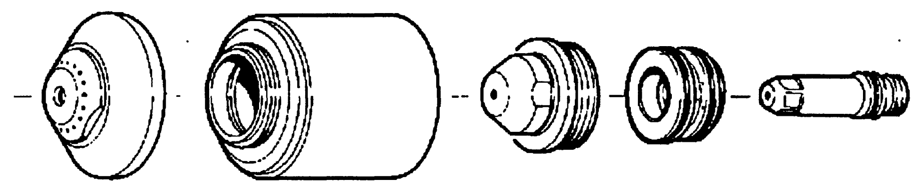
MAX200 Machine Torch - Above Water

Aluminum

200 amps • H35 Plasma / N_2 Shield

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives maximum thickness cutting capability, excellent cut quality and excellent weldability. Electrode life is extended when this combination is used.

020602 Shield — **020423 Retaining cap** — **020608 Nozzle** — **020607 Swirl ring** — **020415 Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16		**H35**	**36-40 / 62-66**	N_2	**60**	3/16	5	**200**	130	170	4300	0.5	**120**	**90**
1/4	6	(70 SCFH)		(275 SCFH)		3/16	5		130	155	4000	1.0		
3/8	10					1/4	6		135	120	3000	2.0		
1/2	12					1/4	6		140	100	2550	2.0		
5/8	15					1/4	6		145	80	2000	2.5		
3/4	20					5/16	8		150	60	1500	2.5		
7/8						5/16	8		155	50	1250	2.5		
1	25					5/16	8		155	40	1000	3.0		
1-1/4	32					5/16	8		165	26	660	3.0		
1-1/2						5/16	8		170	18	460	3.0		
1-3/4						5/16	8		180	12	300	3.0		
2	50					5/16	8		185	7	180	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

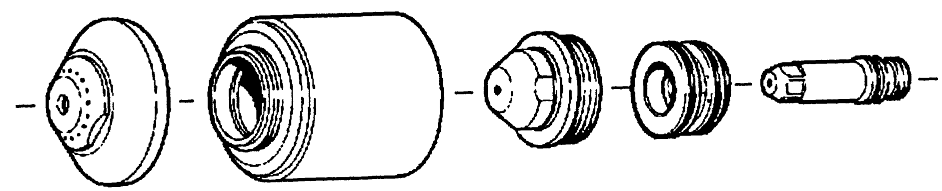
MAX200 Machine Torch - Above Water

Aluminum

100 amps • H35 Plasma / N_2 Shield

This gas combination gives good cut speed, low dross levels and is very economical.

020448 Shield	020423 Retaining cap	020611 Nozzle	020607 Swirl ring	020415 Electrode

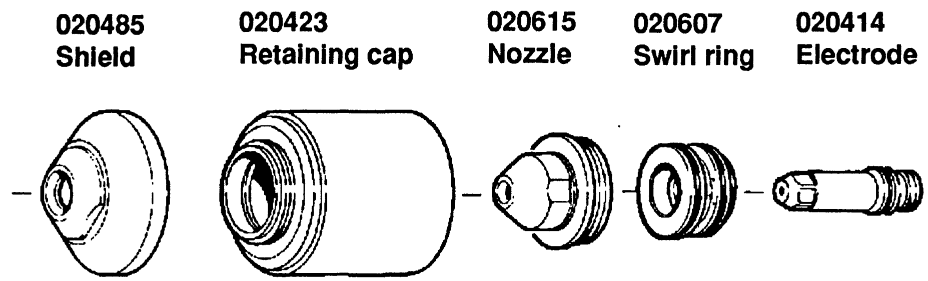


Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**H35**	**32-36 / 56-60**	N_2	**60**	3/32	2.5	**100**	135	95	2440		**120**	**90**
3/16	5	(20 SCFH)		(270 SCFH)		1/8	3		140	85	2200	0.5		
1/4	6					1/8	3		145	80	1980	0.5		
3/8	10					1/8	3		145	60	1530	0.5		
1/2	12					1/8	3		150	50	1280	1.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Mild Steel Gouging

200 amps • Air Plasma / Air Shield



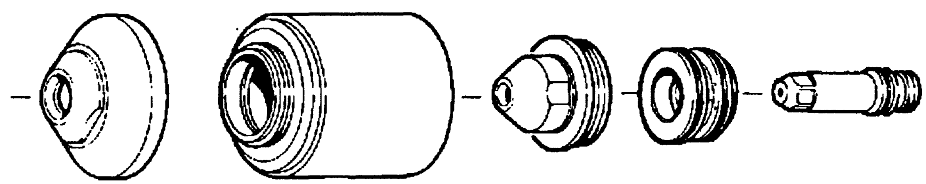
Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Arc Current Setting (amps)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
Air	**49-51 / 50-52**	**Air**	**50**	**200**	**90**	**90**

1 psi = .0689 bar = 6.895 KPa

Stainless Steel Gouging

200 amps • H35 Plasma / N_2 Shield

Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas.



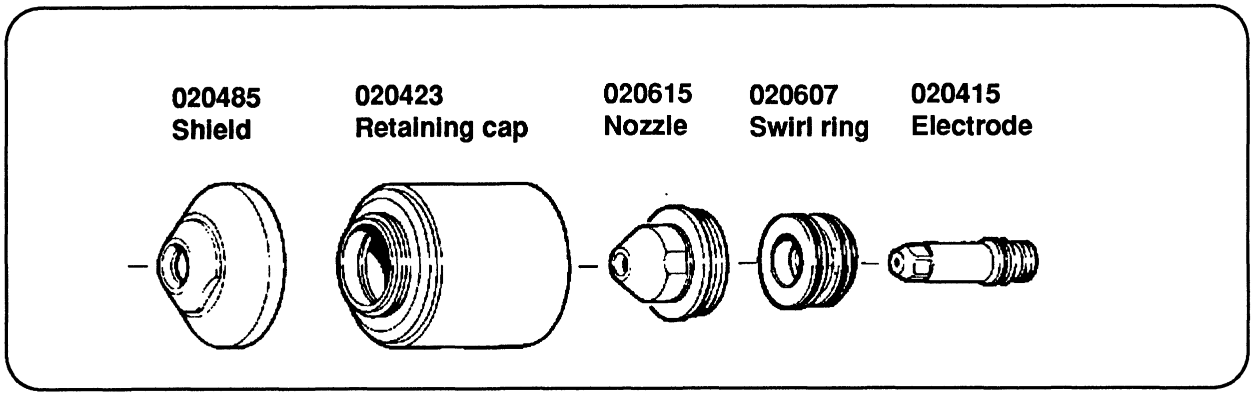
Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Arc Current Setting (amps)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
H35	**49-51 / 50-52**	**N_2**	**50**	**200**	**120**	**120**

1 psi = .0689 bar = 6.895 KPa

Aluminum Gouging

200 amps • H35 Plasma / N_2 Shield

Hyperthem recommends a mixture of 35% hydrogen and 65% argon for the plasma gas..



Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Arc Current Setting (amps)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
H35	**49-51 / 50-52**	**N_2**	**50**	**200**	**120**	**120**

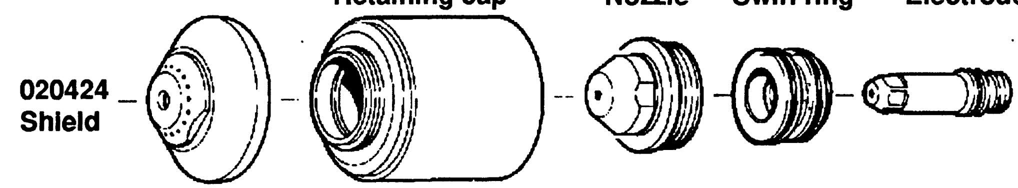
1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Mild Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/4	6	**Air**	**44-48 / 58-62**	**Air**	**70**	1/8	3	**200**	130	130	3300	0.5	**90**	**90**
	8	(66 SCFH)		(280 SCFH)		1/8	3		135	110	2700	0.5		
3/8	10					1/8	3		135	95	2400	1.0		
1/2	12					1/8	3		140	75	1900	2.0		
5/8	15						4		145	50	1200	2.0		
3/4	20					3/16	5		150	35	850	2.5		
7/8						1/4	6		155	20	530	3.0		
1	25					1/4	6		165	15	400	3.0		

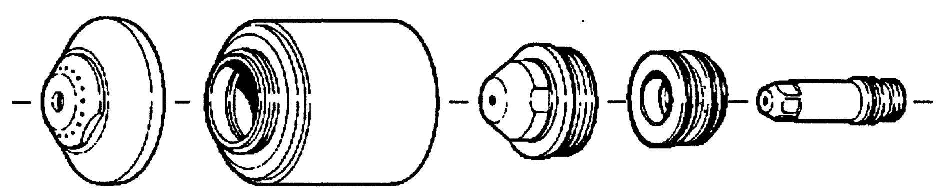
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Mild Steel

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross level and is very economical. Some surface nitriting can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
	2	**Air**	**22-26 / 48-52**	**Air**	**70**	5/64	2	**80**	120	240	6050		**90**	**90**
1/8	3		**22-26 / 54-58**		**70**	5/64	2	**100**	130	120	3050			
3/16	5	(37 SCFH)		(280 SCFH)		1/8	3		135	90	2300	0.5		
1/4	6					1/8	3		140	70	1730	0.5		
3/8	10					1/8	3		145	42	1050	0.5		
1/2	12					1/8	3		145	28	700	1.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

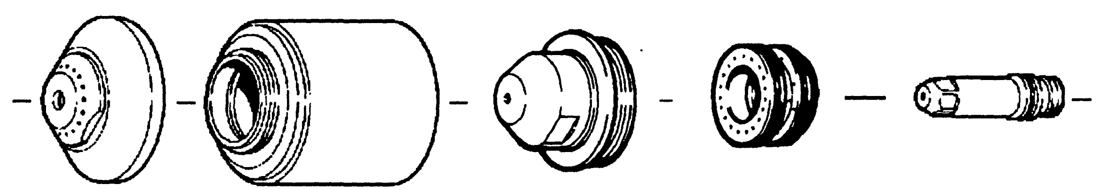
MAX200 Machine Torch - 3" Under Water

Mild Steel

200 amps • O_2 Plasma / Air Shield

This gas combination gives superior cut speed, minimum dross, minimum amount of surface nitriting and excellent weldability.

020424 **Shield** — **020423** **Retaining cap** — **020605** **Nozzle** — **020604** **Swirl ring** — **020414** **Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/4	6	**O_2**	**48-52 / 64-68**	**Air**	**70**	1/8	3	**200**	125	145	3700	0.5	**120**	**90**
	8	(72 SCFH)		(280 SCFH)		1/8	3		125	110	2800	0.5		
3/8	10					1/8	3		130	80	2000	1.0		
1/2	12					1/8	3		130	70	1800	2.0		
5/8	15						4		135	60	1500	2.0		
3/4	20					3/16	5		140	48	1200	2.5		
7/8						1/4	6		140	38	950	3.0		
1	25					1/4	6		145	25	680	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

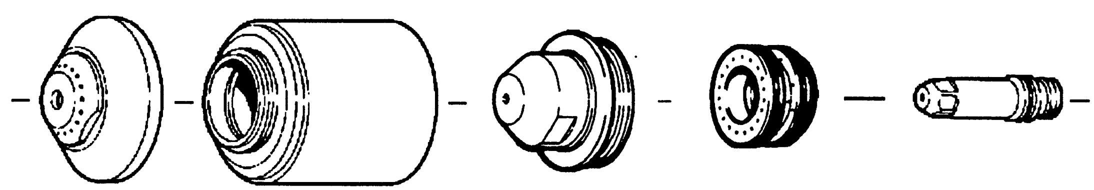
MAX200 Machine Torch - 3" Under Water

Mild Steel

100 amps • O_2 Plasma / Air Shield

This gas combination gives good cut speed, low dross level, and is very economical. Some surface nitriting can occur.

020448 **Shield** | **020423** **Retaining cap** | **020616** **Nozzle** | **020617** **Swirl ring** | **020414** **Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**O_2**	**20-24 / 60-64**	**Air**	**60**	5/64	2	**100**	115	200	5080		**120**	**90**
3/16	5	(40 SCFH)		(280 SCFH)		1/8	3		120	125	3175	0.5		
1/4	6					1/8	3		120	90	2280	0.5		
3/8	10					1/8	3		125	70	1780	0.5		
1/2	12					1/8	3		125	55	1400	1.0		

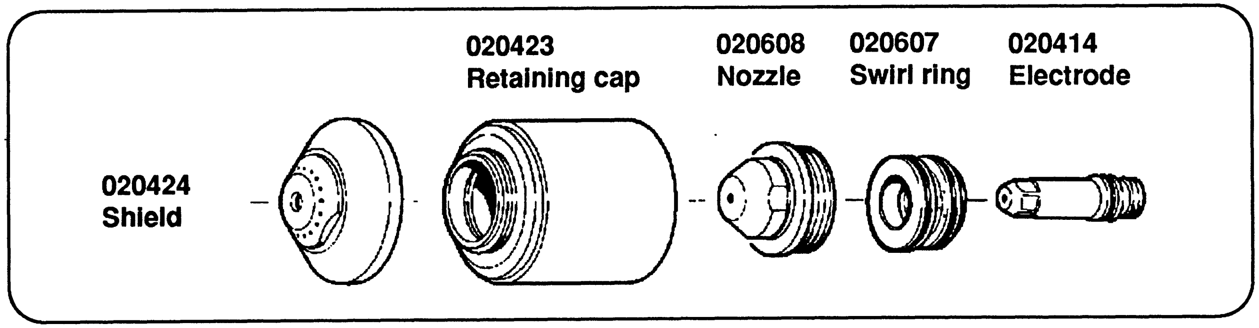
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Stainless Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**Air**	**44-48 / 58-62**	**Air**	**70**	1/8	3	**200**	125	210	5320		**90**	**90**
1/4	6	(66 SCFH)		(280 SCFH)		1/8	3		130	180	4500	0.5		
3/8	10					1/8	3		135	125	3150	1.0		
1/2	12					1/8	3		140	90	2300	2.0		
5/8	15						4		145	60	1520	2.0		
3/4	20					3/16	5		145	45	1150	2.5		
7/8						1/4	6		150	30	750	3.0		
1	25					1/4	6		155	22	570	3.0		

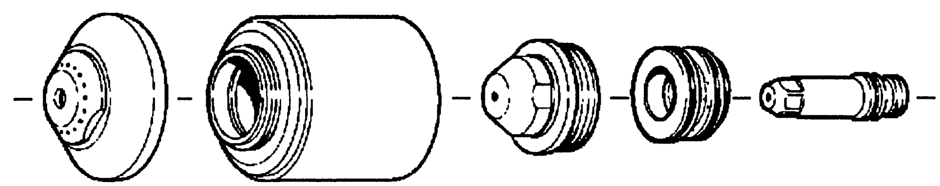
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Stainless Steel

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriting and surface oxidation of alloying elements can occur.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**Air**	**22-26 / 54-58**	**Air**	**70**	5/64	2	**100**	125	135	3400		**90**	**90**
3/16	5	(37 SCFH)		(280 SCFH)		1/8	3		130	100	2520	0.5		
1/4	6					1/8	3		135	65	1720	0.5		
3/8	10					1/8	3		140	45	1120	0.5		
1/2	12					1/8	3		145	25	670	1.0		
												1.5		
												2.0		

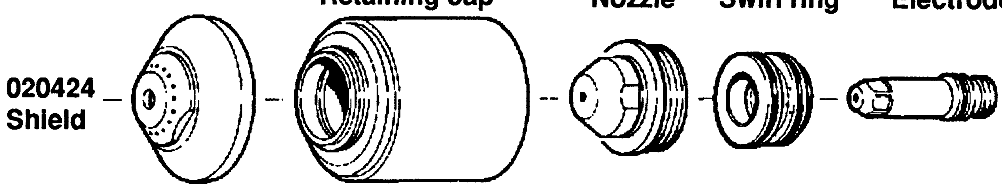
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Stainless Steel

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality, surface nitriting and surface oxidation of alloying elements are less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**34-38 / 50-54**	**Air**	**70**	1/8	3	**200**	125	130	3250		**120**	**90**
1/4	6	(60 SCFH)		(280 SCFH)		1/8	3		130	110	2750	0.5		
3/8	10					1/8	3		135	85	2160	1.0		
1/2	12					1/8	3		140	60	1520	2.0		
5/8	15						4		145	45	1140	2.0		
3/4	20					3/16	5		145	30	800	2.5		

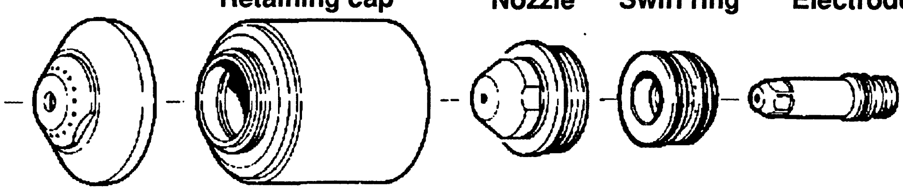
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Stainless Steel

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when surface nitriting and surface oxidation of alloying elements is less important. Electrode life is extended when using this gas combination.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**36-40 / 52-56**	**CO_2**	**70**	1/8	3	**200**	125	180	4550	0.5	**120**	**90**
1/4	6	(60 SCFH)		(210 SCFH)		1/8	3		130	150	3850	1.0		
3/8	10					1/8	3		135	110	2700	1.5		
1/2	12					1/8	3		140	75	1920	2.0		
5/8	15						4		145	50	1350	2.0		
3/4	20					3/16	5		145	38	950	2.5		
7/8						1/4	6		150	28	700	3.0		

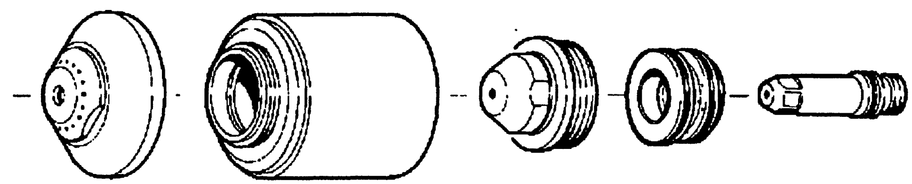
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Aluminum

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**Air**	**44-48 / 58-62**	**Air**	**70**	1/8	3	**200**	135	210	5300	0.5	**90**	**90**
1/4	6	(66 SCFH)		(280 SCFH)		1/8	3		140	170	4300	1.0		
3/8	10					1/8	3		145	125	3150	2.0		
1/2	12					1/8	3		150	90	2240	2.5		
5/8	15						4		155	65	1650	3.0		
3/4	20					3/16	5		160	45	1150	3.0		

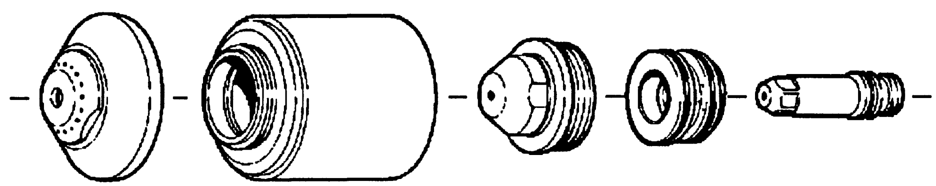
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Aluminum

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
1/8	3	**Air**	**22-26/ 54-58**	**Air**	**70**	5/64	2	**100**	135	100	2650		**90**	**90**
3/16	5	(37 SCFH)		(280 SCFH)		1/8	3		140	80	2050	0.5		
1/4	6					1/8	3		145	60	1510	0.5		
3/8	10					1/8	3		150	40	1000	0.5		
1/2	12					1/8	3		155	30	750	1.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

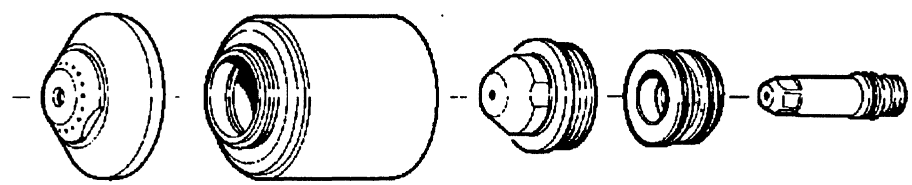
MAX200 Machine Torch - 3" Under Water

Aluminum

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.

020424 Shield — **020423 Retaining cap** — **020608 Nozzle** — **020607 Swirl ring** — **020415 Electrode**



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5					1/8	3	**200**	135	170	4350	0.5	**120**	**90**
1/4	6	**N_2**	**34-38 / 50-54**	**Air**	**70**	1/8	3		140	140	3650	1.0		
3/8	10	(60 SCFH)		(280 SCFH)		1/8	3		140	100	2600	1.5		
1/2	12					1/8	3		145	65	1620	2.0		
5/8	15						4		145	55	1350	2.5		
3/4	20					3/16	5		155	35	890	3.0		
7/8						1/4	6		165	25	620	3.0		

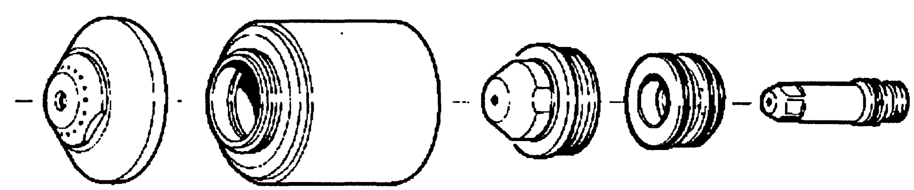
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

MAX200 Machine Torch - 3" Under Water

Aluminum

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.



Material Thickness (Inches)	(mm)	Plasma Gas Type	Plasma Gas Pressure TEST/RUN (psi)	Shield Gas Type	Shield Gas Pressure (psi)	Torch-to-work Distance (Inches)	(mm)	Arc Current Setting (amps)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min)	Approx. Motion Delay Time (sec)	Plasma Gas Inlet Pressure (psi)	Shield Gas Inlet Pressure (psi)
3/16	5	**N_2**	**36-40 / 52-56**	**CO_2**	**70**	1/8	3	**200**	130	175	4450	0.5	**120**	**90**
1/4	6	(60 SCFH)		(220 SCFH)		1/8	3		135	145	3650	1.0		
3/8	10					1/8	3		140	100	2600	2.0		
1/2	12					1/8	3		145	75	1820	2.5		
5/8	15						4		145	55	1350	2.5		
3/4	20					3/16	5		155	40	980	3.0		
7/8						1/4	6		165	30	750	3.0		

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Section 5 Standard Components

In this section:

MAX200/RHF Power Supply 5-2
High Frequency Console 5-16
Display Console 5-19
MAX200 Consumables, Torch Assembly & Torch Leads 5-23
MAX200 Rev 1 Machine Torch Consumables 5-23
Consumable Parts Kits 5-25
MAX200 Rev 1 Machine Torch Assembly 5-26
Machine Torch Lead Assemblies and Parts 5-27
Recommended Spare Parts 5-29

STANDARD COMPONENTS

POWER SUPPLY

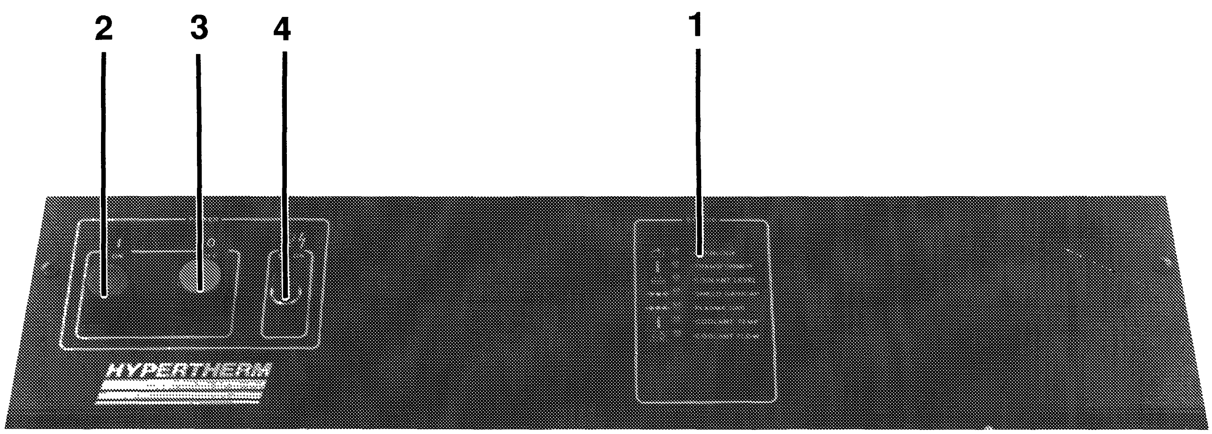


Figure 5-1 Power Supply - Control Panel SA, Front

Item	Part Number	Description	Designator	Qty.
	029456	**Panel, Control SA**		1
1	041149	PC BD, assembly, interlock display		1
	009074	Light, green, LED	LED 1-7	7
2	005121	Pushbutton, 2 NO, green, illmn.	PB1	1
3	005122	Pushbutton, 2 NC, red, extended	PB2	1
4	005088	Holder, lamp		1
	005090	Bulb, 28VDC, 40 MA		1
	005091	Cap, red		1

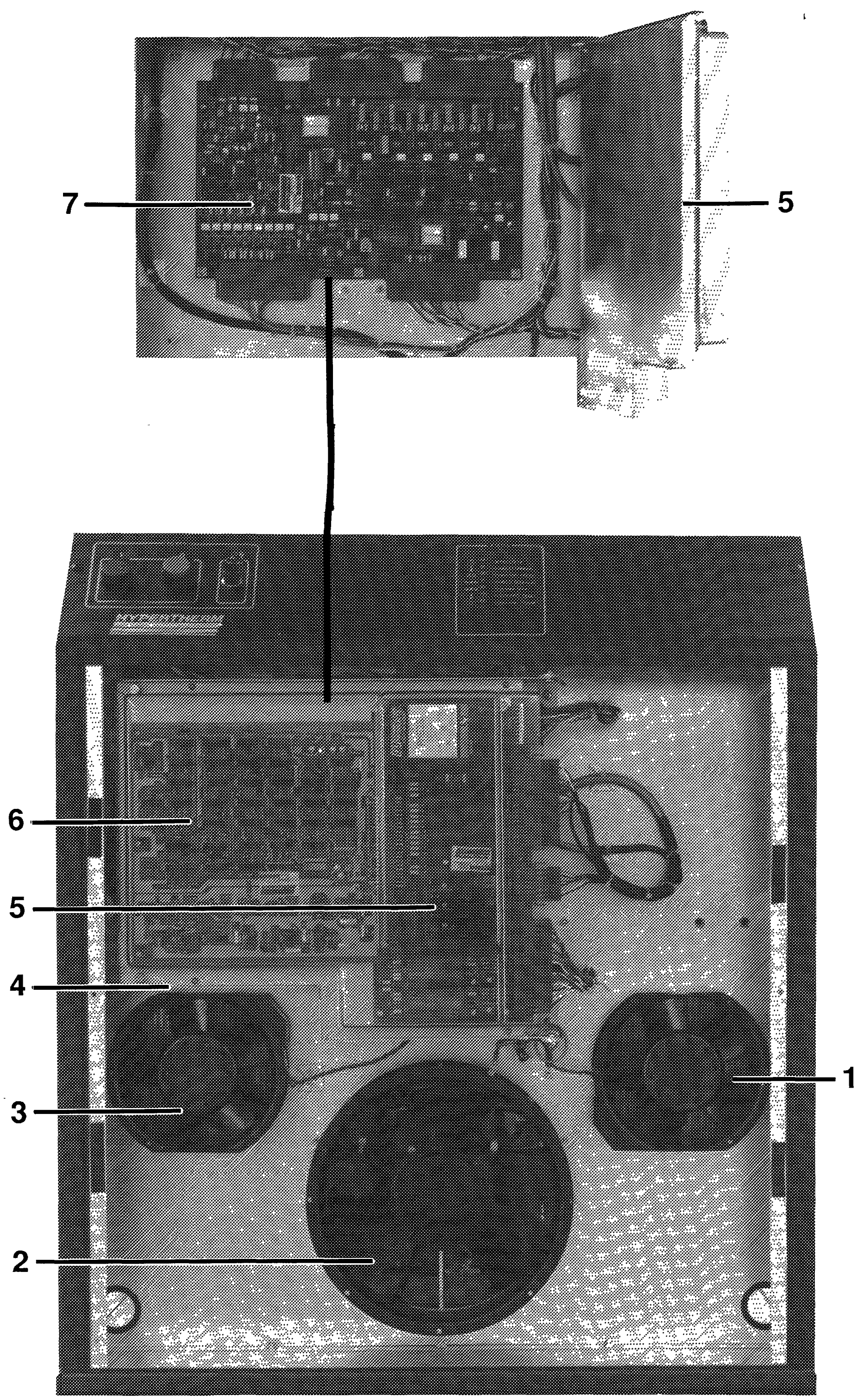


Figure 5-2 Power Supply - Front View

Item	Part Number	Description	Designator	Qty.
1	027080	Fan, 225 CFM, 120 VAC, 50/60 Hz	M2	1
2	027079	Fan, 450-550 CFM, 120 VAC, 50/60 Hz	M4	1
3	027080	Fan, 225 CFM, 120 VAC, 50/60 Hz	M3	1
4	029303	THC SA		1
5	041151	PC BD Assy, THC, Mother	PCB10	1
6	041186	PC BD SA , THC	PCB9	1
7	041143	PC BD Assy, Control	PCB7	1

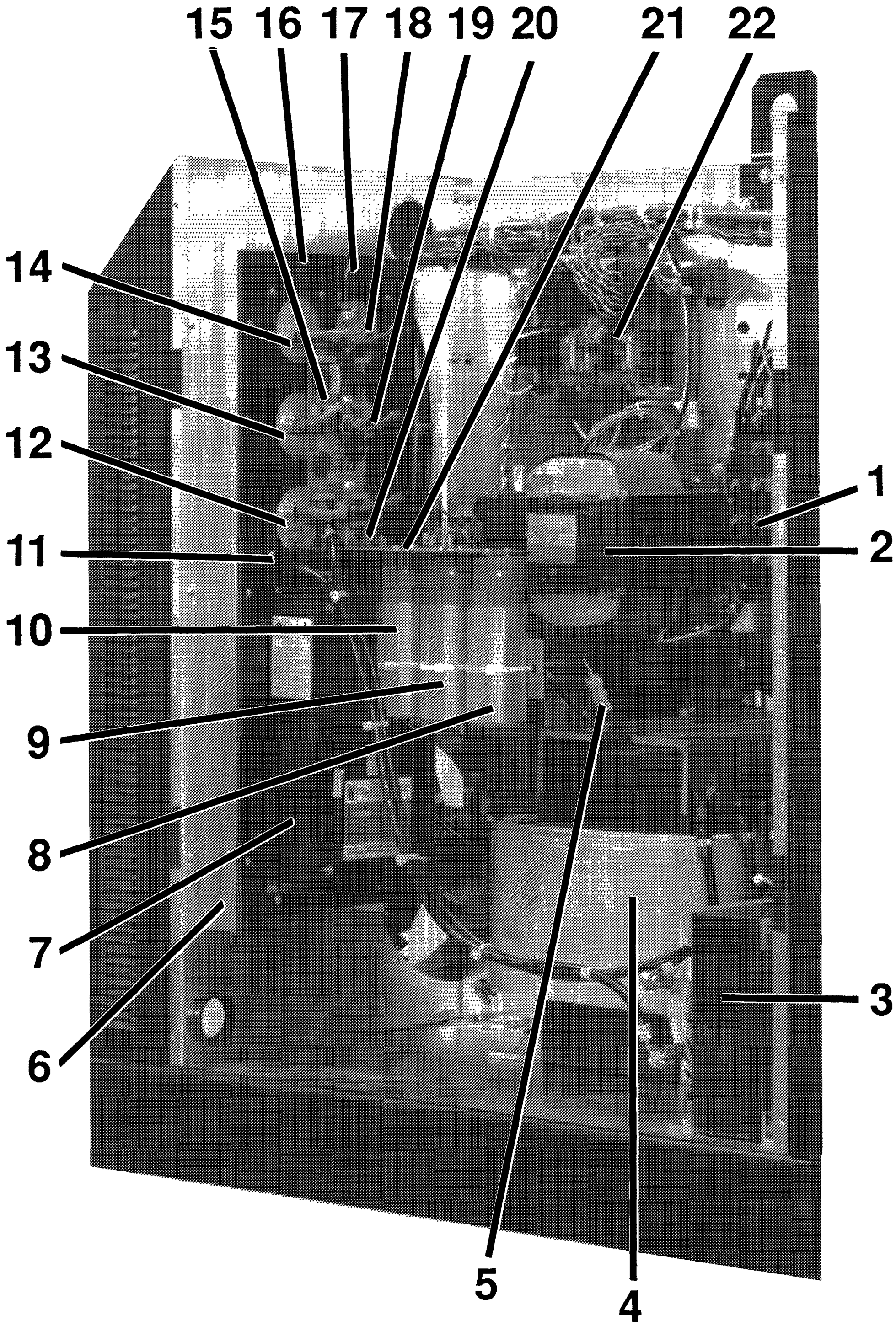


Figure 5-3 Power Supply - Right Side, Front View

Item	Part Number	Description	Designator	Qty.
1	029359	Linkboard SA (240/480V models only)	LB1	1
2	014079	Trans, control, 208/240/480V, 1Ø, 60 Hz	T1	1
	014081	Trans, control, 220/315/415V, 3Ø, 50 Hz	T1	1
	014083	Trans, control, 600V, 3Ø, 60 Hz	T1	1
	014101	Trans, control, 200V, 3Ø, 60 Hz	T1	1
3	014080	Inductor, 4 mh, 100 Amps, DC	L1	1
4	014078	Trans, 30 kw, 240/480V, 3Ø, 60 Hz	T2	1
	014088	Trans, 30 kw, 220/315/415V, 3Ø, 50 Hz	T2	1
	014082	Trans, 30 kw, 600V, 3Ø, 60 Hz	T2	1
	014097	Trans, 30 kw, 208V, 3Ø, 60 Hz	T2	1
	014100	Trans, 30 kw, 200V, 3Ø, 60 Hz	T2	1
5	005102	Thermostat, 165°C	TS1	1
6	029320	Chopper SA, CH1		1
7	041121	Module, chopper, CH1	PCB2	1
8	009522	Capacitor, elec, 1400 uf, 350 VDC	C3	1
9	009522	Capacitor, elec, 1400 uf, 350 VDC	C2	1
10	009522	Capacitor, elec, 1400 uf, 350 VDC	C1	1
11	029196	Diode bridge SA, positive polarity		1
12	009384	Diode, 85 Amp, 1000V, fwd polarity	D3	1
13	009384	Diode, 85 Amp, 1000V, fwd polarity	D2	1
14	009384	Diode, 85 Amp, 1000V, fwd polarity	D1	1
15	041118	PC BD Assy, snubber, CH1	PCB1	1
16	009623	Resistor, 1.5K Ohm, 50W	R7	1
17	029195	Diode bridge SA, negative polarity		1
18	009385	Diode, 85 Amp, 1000V, rev polarity	D4	1
19	009385	Diode, 85 Amp, 1000V, rev polarity	D5	1
20	009385	Diode, 85 Amp, 1000V, rev polarity	D6	1
21	014042	Transformer, CH1 control	T3	1
22	041147	PC BD Assy, power distribution	PCB6	1
	008322	Fuse, 8 Amp, 250 VAC		1

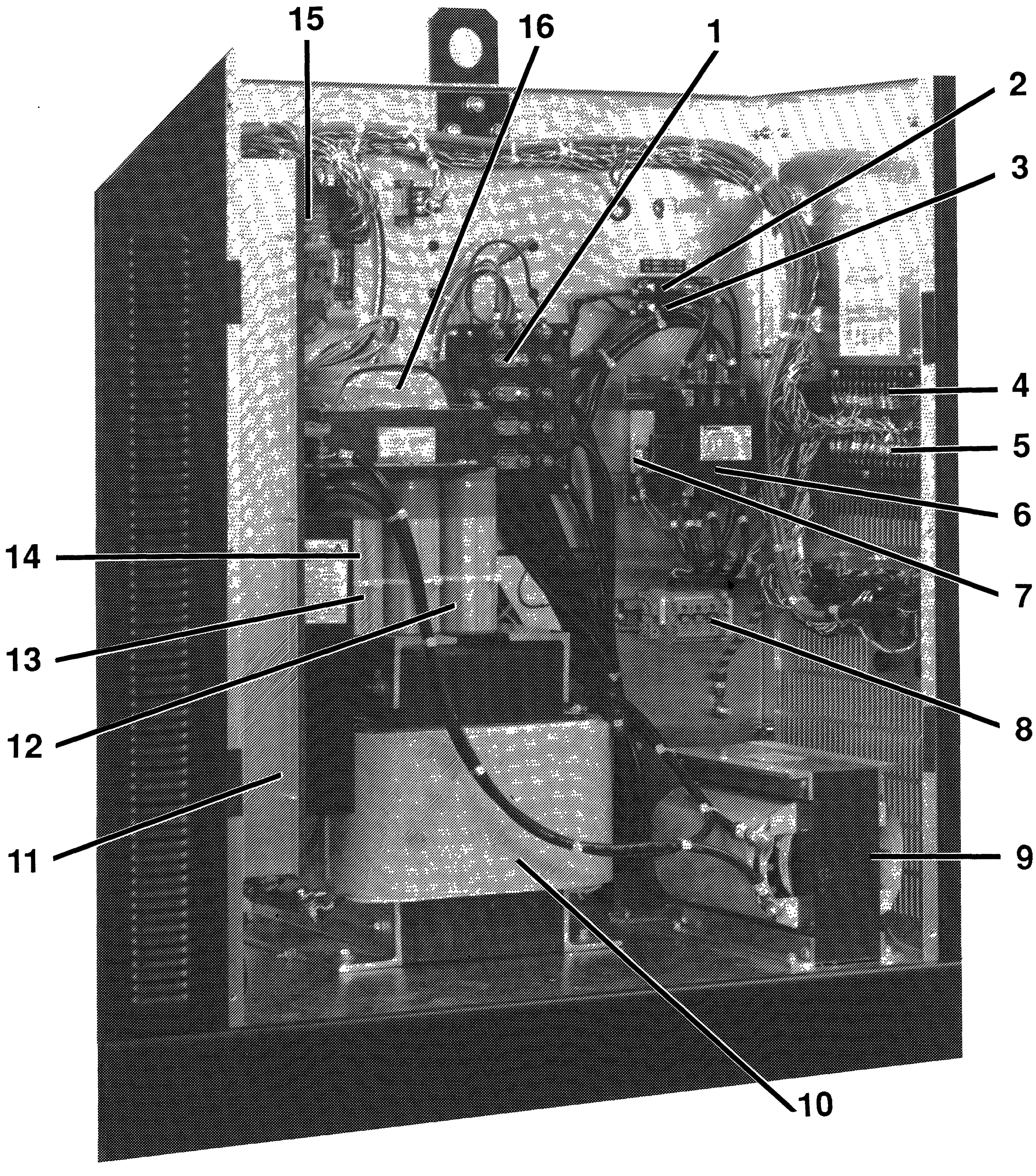


Figure 5-4 Power Supply - Right Side, Rear View

Item	Part Number	Description	Designator	Qty.
1	029359	Linkboard SA (240/480V models only)	LB1	1
2	008628	Fuse, 15 Amp	F1	1
3	008628	Fuse, 15 Amp	F2	1
4	008073	Terminal strip (16)	TB3	1
5	008079	Terminal strip (12)	TB4	1
6	003092	Contactor, 90 Amp, 3-pole, 24 VAC	CON1	1
7	003093	Switch, aux contactor, 90A	SW2	1
8	029316	Terminal Block SA, Incoming Power	TB1	1
9	014080	Inductor, 4 mh, 100 Amps, DC	L1	1
10	014078	Trans, 30 kw, 240/480V, 3Ø, 60 Hz	T2	1
	014088	Trans, 30 kw, 220/315/415V, 3Ø, 50 Hz	T2	1
	014082	Trans, 30 kw, 600V, 3Ø, 60 Hz	T2	1
	014097	Trans, 30 kw, 208V, 3Ø, 60 Hz	T2	1
	014100	Trans, 30 kw, 200V, 3Ø, 60 Hz	T2	1
11	029320	Chopper SA, CH1		
12	009522	Capacitor, elec, 1400 uf, 350 VDC	C3	1
13	009522	Capacitor, elec, 1400 uf, 350 VDC	C2	1
14	009522	Capacitor, elec, 1400 uf, 350 VDC	C1	1
15	041147	PC BD Assy, power distribution	PCB6	1
16	014079	Trans, control, 208/240/480V, 1Ø, 60 Hz	T1	1
	014081	Trans, control, 220/315/415V, 3Ø, 50 Hz	T1	1
	014083	Trans, control, 600V, 3Ø, 60 Hz	T1	1
	014101	Trans, control, 200V, 3Ø, 60 Hz	T1	1

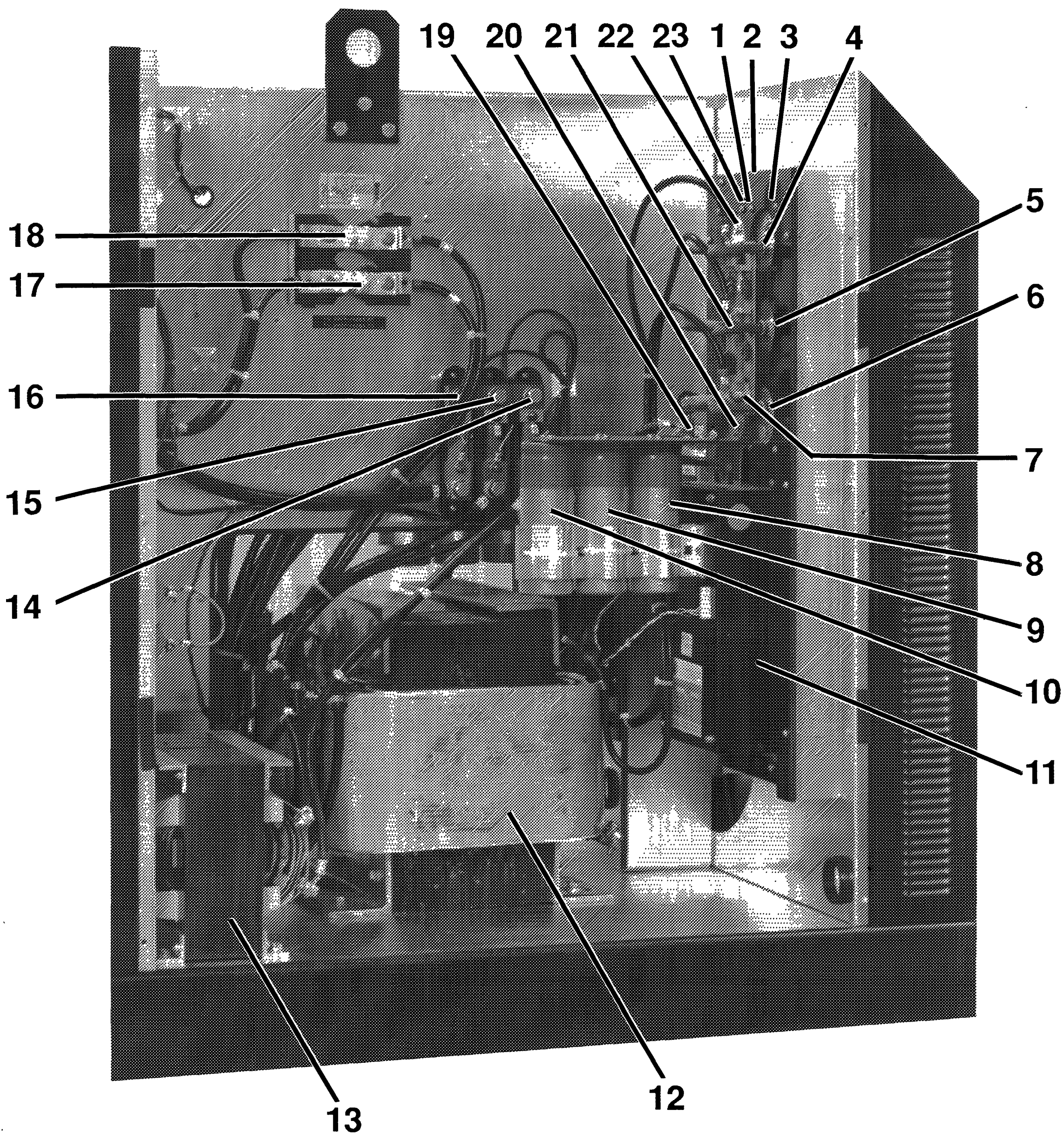


Figure 5-5 Power Supply - Left Side, Front View

Item	Part Number	Description	Designator	Qty.
1	029320	Chopper SA, CH2		1
2	009623	Resistor, 1.5K Ohm, 50W	R8	1
3	029195	Diode bridge SA, negative polarity		1
4	009385	Diode, 85 Amp, 1000V, rev polarity	D4	1
5	009385	Diode, 85 Amp, 1000V, rev polarity	D5	1
6	009385	Diode, 85 Amp, 1000V, rev polarity	D6	1
7	041118	PCB, snubber, CH2	PCB3	1
8	009522	Capacitor, elec, 1400 uf, 350 VDC	C4	1
9	009522	Capacitor, elec, 1400 uf, 350 VDC	C5	1
10	009522	Capacitor, elec, 1400 uf, 350 VDC	C6	1
11	041121	Module, chopper, CH2	PCB4	1
12	014078	Trans, 30 kw, 240/480V, 3Ø, 60 Hz	T2	1
	014088	Trans, 30 kw, 220/315/415V, 3Ø, 50 Hz	T2	1
	014082	Trans, 30 kw, 600V, 3Ø, 60 Hz	T2	1
	014097	Trans, 30 kw, 208V, 3Ø, 60 Hz	T2	1
	014100	Trans, 30 kw, 200V, 3Ø, 60 Hz	T2	1
13	014080	Inductor, 4 mh, 100 Amps, DC	L2	1
14	007022	Shunt, 100 Amp, 100 mv	R2	1
15	007022	Shunt, 100 Amp, 100 mv	R1	1
16	007024	Shunt, 200 Amp, 100 mv	R3	1
17	008317	Fuse, semiconductor, 125 Amp, 250 V	F4	1
18	008317	Fuse, semiconductor, 125 Amp, 250 V	F3	1
19	014042	Transformer, CH2 control	T4	1
20	029196	Diode bridge SA, positive polarity		1
21	009384	Diode, 85 Amp, 1000V, fwd polarity	D3	1
22	009384	Diode, 85 Amp, 1000V, fwd polarity	D2	1
23	009384	Diode, 85 Amp, 1000V, fwd polarity	D1	1

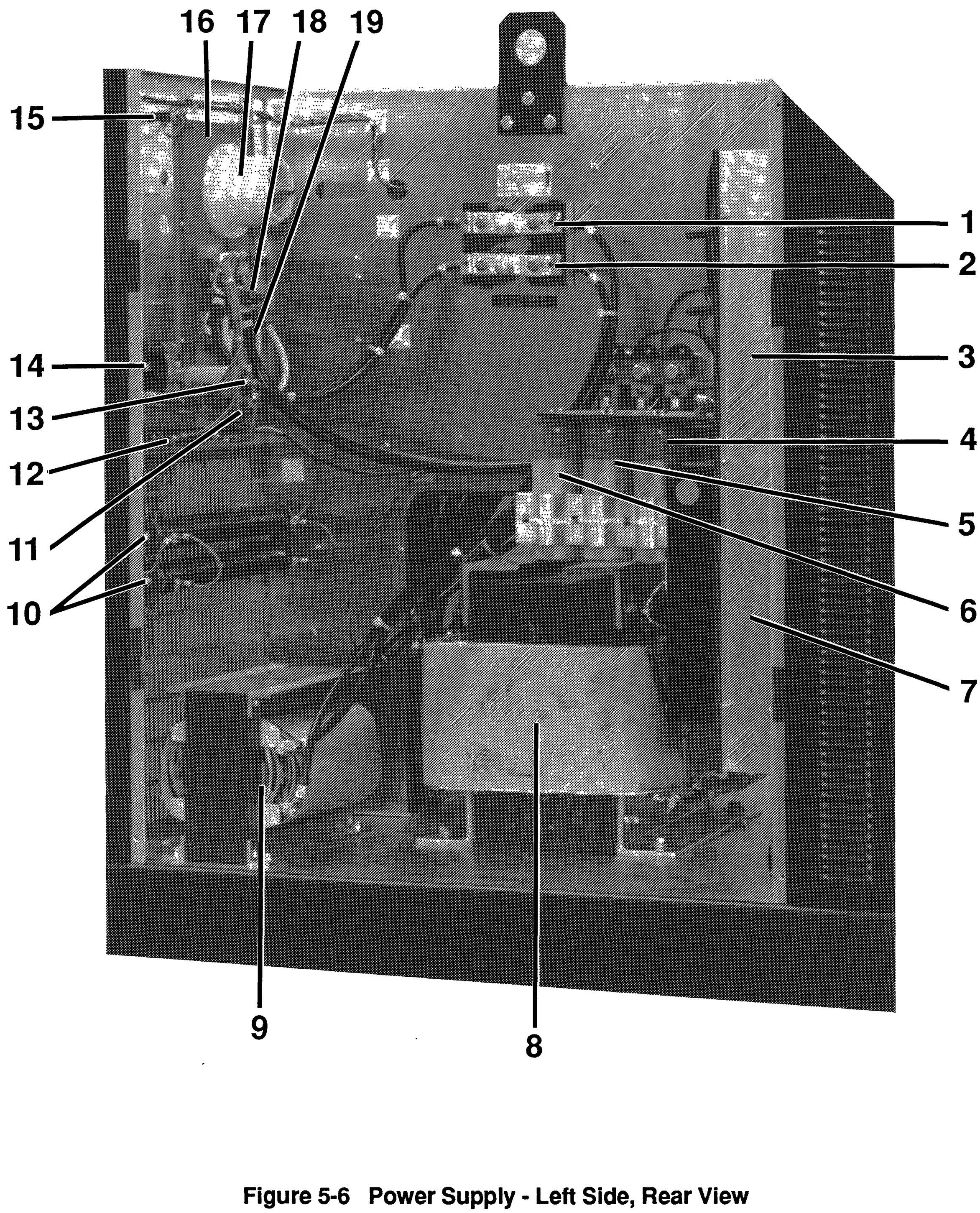


Figure 5-6 Power Supply - Left Side, Rear View

Item	Part Number	Description	Designator	Qty.
1	008317	Fuse, semiconductor, 125 Amp, 250 V	F3	1
2	008317	Fuse, semiconductor, 125 Amp, 250 V	F4	1
3	029320	Chopper SA, CH2		1
4	009522	Capacitor, elec, 1400 uf, 350 VDC	C4	1
5	009522	Capacitor, elec, 1400 uf, 350 VDC	C5	1
6	009522	Capacitor, elec, 1400 uf, 350 VDC	C6	1
7	041121	Module, chopper, CH2	PCB4	1
8	014078	Trans, 30 kw, 240/480V, 3Ø, 60 Hz	T2	1
	014088	Trans, 30 kw, 220/315/415V, 3Ø, 50 Hz	T2	1
	014082	Trans, 30 kw, 600V, 3Ø, 60 Hz	T2	1
	014097	Trans, 30 kw, 208V, 3Ø, 60 Hz	T2	1
	014100	Trans, 30 kw, 200V, 3Ø, 60 Hz	T2	1
9	014080	Inductor, 4 mh, 100 Amps, DC	L2	1
10	009466	Resistor, 4 Ohm, 420 W	R6	1
11	009015	Resistor, 10 K Ohm, 10 W	R5	1
12	009438	Resistor, 5 Ohm, 50 W	R4	1
13	009506	Capacitor, elec, 250 uf, 350 VDC	C9	1
14	003021	Relay, 120 VAC, NO SPST	CR1	1
15	008479	Terminal strip, quick connect	TB2	1
16	029514	HF & I/O PCB SA PWR SUP/RHF		1
17	009356	Coil, A.C.T		1
18	041145	PC BD, Input/Output	PCB5	1
19	029202	Current Sensor SA		1

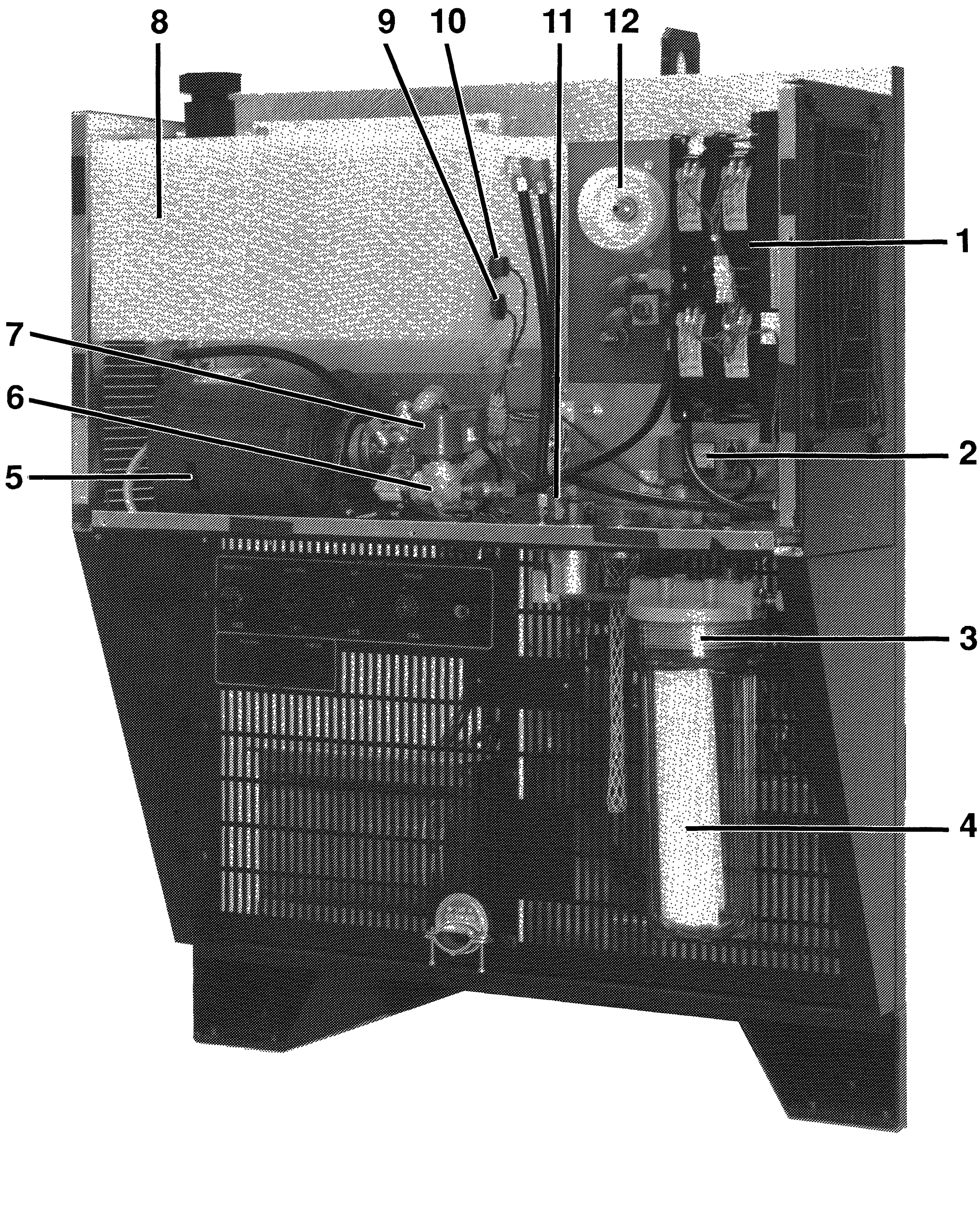


Figure 5-7 Power Supply - Rear View

Item	Part Number	Description	Designator	Qty.
	029324	Heat Exchanger SA		1
1	027136	Heat Exchanger Water/Air (w/fans)	HX1	1
2	006045	Valve, solenoid, coolant return	V8	1
3	027139	Housing, Filter	FL1	1
4	027137	Filter, Coolant, Deionizing		1
	029325	Coolant Pump SA		1
5	031113	Motor, 1/3 hp, carbonator	M1	1
6	031114	Pump, 70 gph, positive displacement	P1	1
7	006046	Valve, solenoid, coolant supply	V7	1
8	002174	Reservoir, coolant	RGS1	1
9	029323	Water temp switch SA (162° F)	TS2	1
10	029326	Level Switch SA	LS1	1
11	029361	Flow Switch SA (0.5 gpm)	FS1	1
12	009356	Coil, A.C.T		1

STANDARD COMPONENTS

HIGH FREQUENCY CONSOLE

Item	Part Number	Description	Designator	Qty.
1	001317	Enclosure, HF Console	-	1
2	027265	Timer DPDT Solid State 5A	-	1
3	029582	Plasma, Air/N_2 SA	-	1
4	005093	Switch, Pressure 0-90 psi	-	1
5	006014	Valve, Sol 90#, 1/4 NPTF Water	-	2
6	029581	Plasma, O_2 SA	-	1
7	005093	Switch, Pressure 0-90 psi	-	1
8	006014	Valve, Sol 90#, 1/4 NPTF Water	-	2
9	029584	Plasma Out SA	-	1
10	005130	Switch, 0-15 psi	-	1
11	029454	HF & I/O PCB SA	-	1
12	041211	PC BD Assy, I/O & HF	-	1
13	009730	Coil Assy, HF	-	1
14	009350	Spark Gap Assy	-	1
15	029583	Inlet/Outlet SA	-	1
16	006014	Valve, Sol 90#, 1/4 NPTF Water	-	2
17	029580	Shield Inlet SA	-	1
18	006032	Valve, Solenoid	-	1
19	006037	Valve, Sol, 24 VAC, 50/60 Hz, 60 psi	-	1
20	005093	Switch, Pressure 0-90 psi	-	1
21	029317	High Voltage Transformer SA	-	1
22	014021	Transformer, 5000 VAC, 20 MA	-	1
23	005100	Switch, Door Interlock	-	2
*	029457	Air Supply SA	-	1
*	011025	Filter Regulator	-	1
*	011027	Gauge, High Pressure (for 011025)	-	1

* The Air Supply SA is supplied as part of the High Frequency Console, but is not mounted on the console prior to shipping. The customer has the option of either mounting the filter regulator on the HF Console or elsewhere.

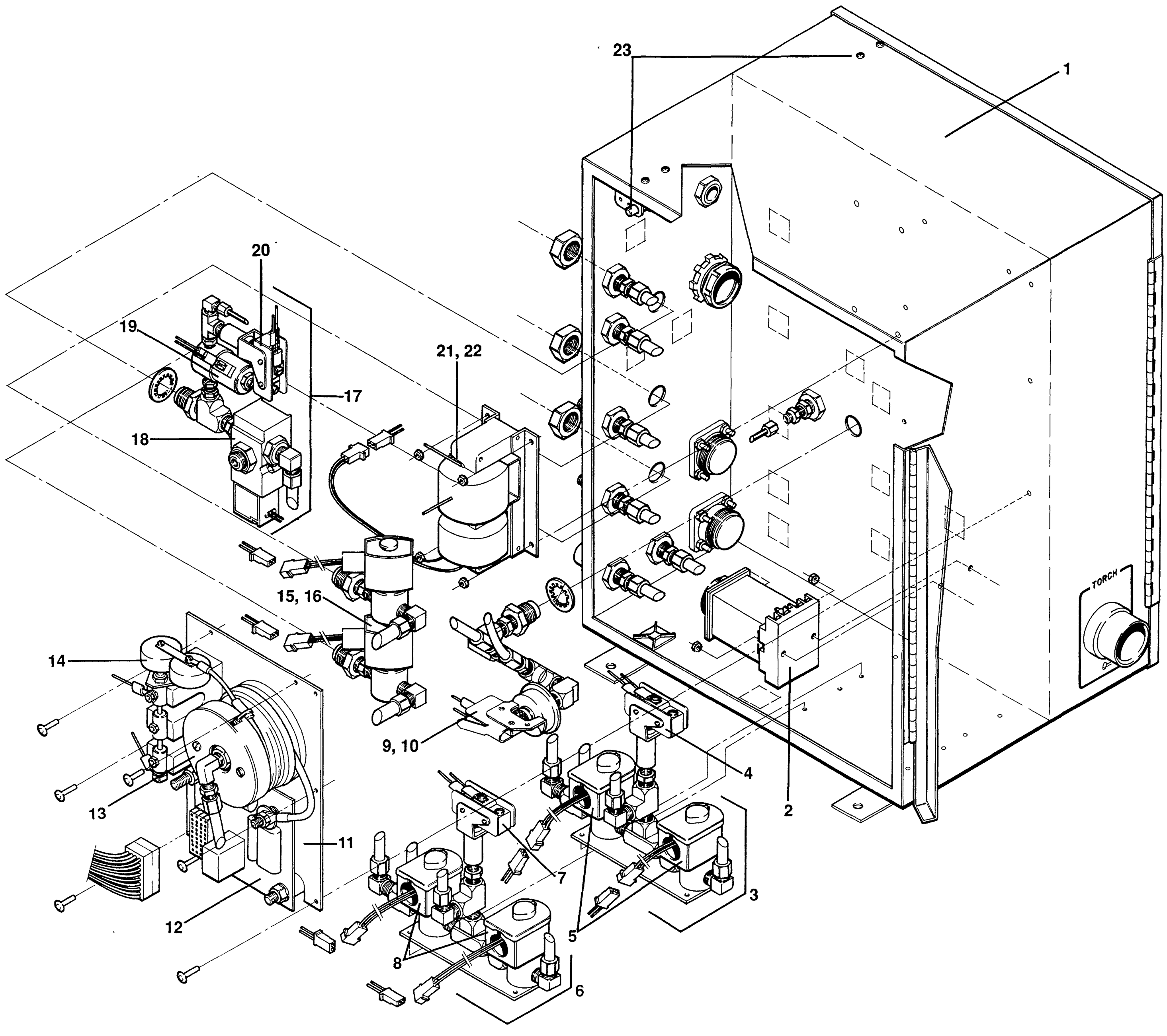


Figure 5-8 High Frequency Console - Exploded View

DISPLAY CONSOLE

Item	Part Number	Description	Designator	Qty.
1	002197	Enclosure, Display	-	1
2	029540	Valve SA, Shield Metering	-	1
3	006002	Valve, Needle, 1/4 NPT .125 Ori	-	1
4	004117	Cap, Valve, Flow Control	-	1
5	005044	Switch, Tog, SC TM Maint On/On	-	1
6	009604	Resistor, Variable, 100 K, 1 Turn	-	1
7	002198	Panel, Display	-	1
8	008328	Knob, .930 Dia Blk/Nat 1/4"	-	1
9	029543	Pressure Gauge SA, Display	-	1
10	022008	Gauge, Pressure 2-1/2" Dia 1-100	-	3
11	005041	Switch, Tog, 2 Pl Maint On/On	-	1
12	029541	Valve SA, Plasma Air Metering	-	1
13	006027	Valve, Needle, 1/4 NPT .125 Ori	-	1
14	004117	Cap, Valve, Flow Control	-	1
15	006014	Valve, Sol 90#, 1/4 NPTF Water	-	1
16	029542	Valve SA, Plasma O_2 Metering	-	1
17	006027	Valve, Needle, 1/4 NPT .125 Ori	-	1
18	004117	Cap, Valve, Flow Control	-	1
19	006014	Valve, Sol 90#, 1/4 NPTF Water	-	1
20	008307	Receptacle, CPC 23-19 Std Sex	-	1

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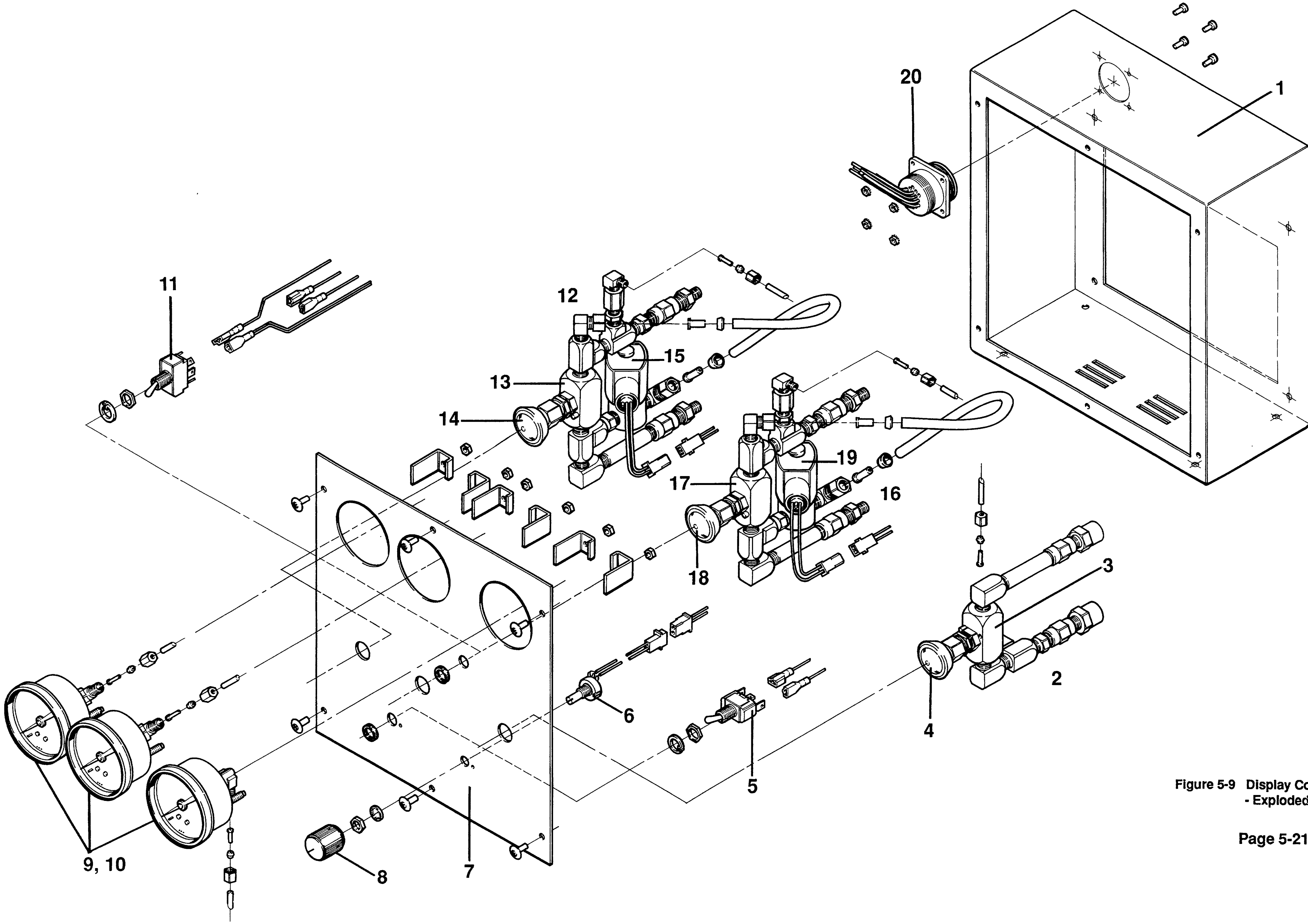


Figure 5-9 Display Console
- Exploded View

MAX200 CONSUMABLES, TORCH ASSEMBLY & TORCH LEADS

MAX200 Rev 1 Machine Torch Consumables (See Figure 5-10)

		Part Numbers				
Plasma Gas/ Shield Gas	**Nozzle Type (Amps)**	**Shield**	**Retaining Cap**	**Nozzle**	**Swirl Ring**	**Electrode**
Air/Air	200 100 40 200 gouging	020424 020448 020688 020485	020423	020608 020611 020689 020615	020607 020607 020613 020607	020414
O_2/Air	200 100	020424 020448	020423	020605 020616	020604 020617	020414
H35/N_2	200 100 200 gouging	020602 020448 020485	020423	020608 020611 020615	020607 020607 020607	020415
N_2/CO_2	200	020424	020423	020608	020607	020415
N_2/Air	200	020424	020423	020608	020607	020415
		Consumables Used with MAX200 Water-Muffler				
Air/Air	200 100	020566 020618	020423	020608 020611	020607 020607	020414
O_2/Air	200 100	020566 020618	020423	020605 020616	020604 020617	020414
N_2/CO_2	200	020566	020423	020608	020607	020415
N_2/Air	200	020566	020423	020608	020607	020415

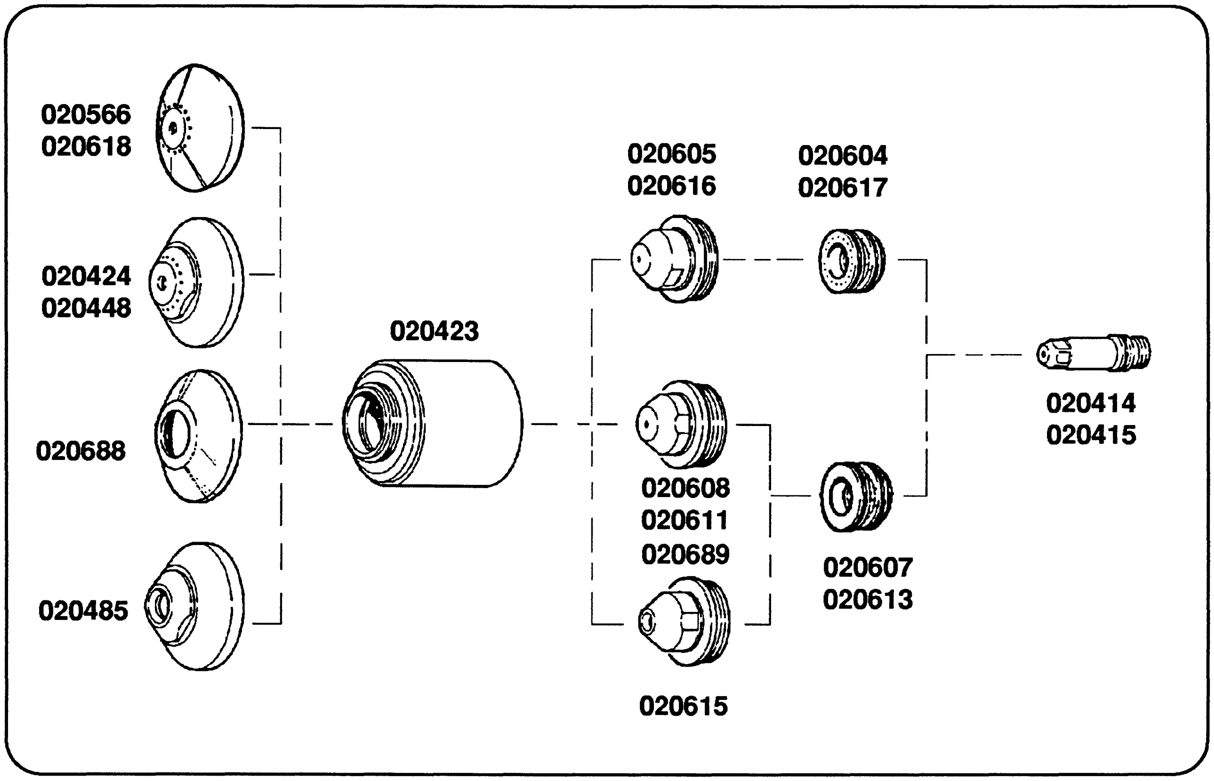


Figure 5-10 MAX200 Rev 1 Machine Torch Consumable Parts

Consumable Parts Kits

Consumable Parts Kit (028392)

Part #	Description	Quantity
001067	Enclosure, Consumable Parts Kit	1
015015	Adapter 90, 1/4 NPT x #6	1
015193	Cap, #6 JIC	1
020414	Electrode, Air/Oxygen	5
020415	Electrode, Nitrogen/H35	5
020423	Cap, Shield	1
020424	Shield, Machine 200A	1
020448	Shield, Machine 100A	1
020605	Nozzle, Shield Oxygen, .082	4
020607	Swirl Ring, Air/ Nitrogen	1
020608	Nozzle, Shield 200A, .086	4
020604	Swirl Ring, Oxygen	1
020611	Nozzle, Shield 100A, .059	4
027055	Lubricant, Silicon, 1/4 Oz. Tube	1
027194	Wrench, Nozzle, 3/4"	1
044027	O-Ring	2

Consumable Parts Kit (028429)

Part #	Description	Quantity
001067	Enclosure, Consumable Parts Kit	1
015015	Adapter 90, 1/4 NPT x #6	1
015193	Cap, #6 JIC	1
020414	Electrode, Air/Oxygen	5
020415	Electrode, Nitrogen/H35	5
020423	Cap, Shield	1
020424	Shield, Machine 200A	1
020448	Shield, Machine 100A	1
020688	Shield, 40A	1
020605	Nozzle, Shield Oxygen, .082	4
020607	Swirl Ring, Air/ Nitrogen	1
020608	Nozzle, Shield 200A, .086	4
020604	Swirl Ring, Oxygen	1
020611	Nozzle, Shield 100A, .059	4
020689	Nozzle, 40A	4
020613	Swirl Ring, 40A	4
027055	Lubricant, Silicon, 1/4 Oz. Tube	1
027194	Wrench, Nozzle, 3/4"	1
044027	O-Ring	2

MAX200 Rev 1 Machine Torch Assembly

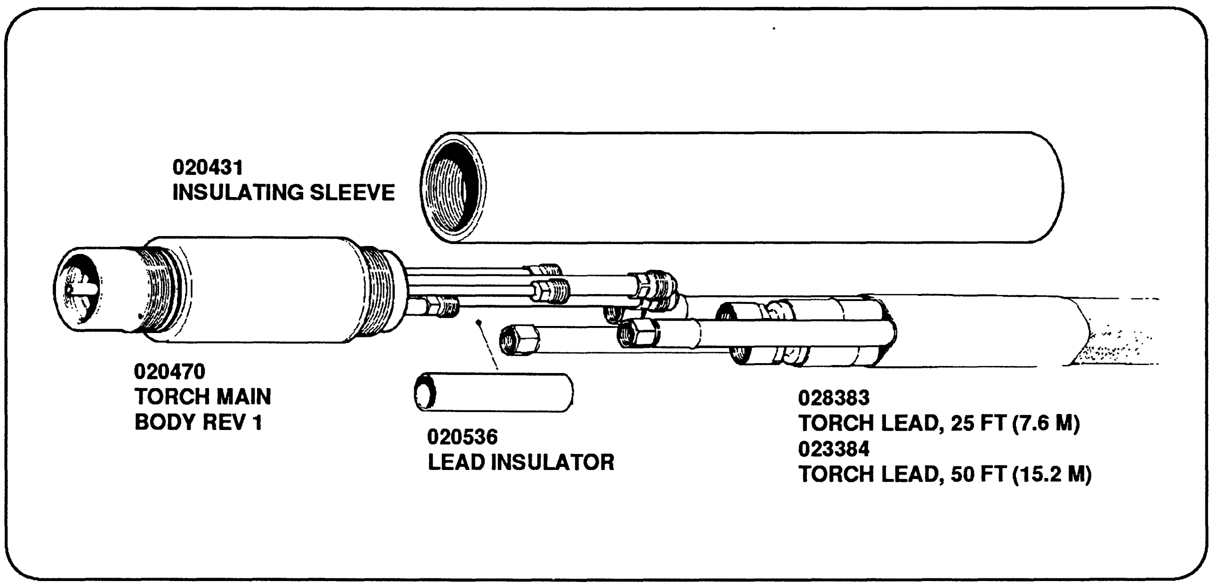


Figure 5-11 MAX200 Rev 1 Machine Torch Assembly

Machine Torch Lead Assemblies and Parts

Item	Part Number	Description	Qty
	028454	**Shielded Torch Lead, 10 Ft.***	1
1	023429	Pilot/Shield Gas Lead, 10 Ft. (blue)	1
2	024216	Plasma Gas Lead, 10 Ft. (red)	1
3	024221	Cap Sensor Lead, 10 Ft. (gray)	1
4	023422	Coolant Lead, 10 Ft. (blue-red band)	1
5	023422	Coolant Lead, 10 Ft. (blue-green band)	1
	028455	**Shielded Torch Lead, 15 Ft.***	1
1	023430	Pilot/Shield Gas Lead, 15 Ft. (blue)	1
2	024217	Plasma Gas Lead, 15 Ft. (red)	1
3	024222	Cap Sensor Lead, 15 Ft. (gray)	1
4	023423	Coolant Lead, 15 Ft. (blue-red band)	1
5	023423	Coolant Lead, 15 Ft. (blue-green band)	1
	028456	**Shielded Torch Lead, 20 Ft.***	1
1	023431	Pilot/Shield Gas Lead, 20 Ft. (blue)	1
2	024228	Plasma Gas Lead, 20 Ft. (red)	1
3	024223	Cap Sensor Lead, 20 Ft. (gray)	1
4	023424	Coolant Lead, 20 Ft. (blue-red band)	1
5	023424	Coolant Lead, 20 Ft. (blue-green band)	1
	028383	**Shielded Torch Lead, 25 Ft.***	1
1	023326	Pilot/Shield Gas Lead, 25 Ft. (blue)	1
2	024194	Plasma Gas Lead, 25 Ft. (red)	1
3	024192	Cap Sensor Lead, 25 Ft. (gray)	1
4	023324	Coolant Lead, 25 Ft. (blue-red band)	1
5	023324	Coolant Lead, 25 Ft. (blue-green band)	1
	028457	**Shielded Torch Lead, 30 Ft.***	1
1	023432	Pilot/Shield Gas Lead, 30 Ft. (blue)	1
2	024229	Plasma Gas Lead, 30 Ft. (red)	1
3	024224	Cap Sensor Lead, 30 Ft. (gray)	1
4	023425	Coolant Lead, 30Ft. (blue-red band)	1
5	023425	Coolant Lead, 30 Ft. (blue-green band)	1
	028458	**Shielded Torch Lead, 35 Ft.***	1
1	023433	Pilot/Shield Gas Lead, 35 Ft. (blue)	1
2	024218	Plasma Gas Lead, 35 Ft. (red)	1
3	024225	Cap Sensor Lead, 35 Ft. (gray)	1
4	023426	Coolant Lead, 35 Ft. (blue-red band)	1
5	023426	Coolant Lead, 35 Ft. (blue-green band)	1

STANDARD COMPONENTS

Item	Part Number	Description	Qty
	028459	**Shielded Torch Lead, 40 Ft.***	1
1	023434	Pilot/Shield Gas Lead, 40 Ft. (blue)	1
2	024230	Plasma Gas Lead, 40 Ft. (red)	1
3	024226	Cap Sensor Lead, 40 Ft. (gray)	1
4	023427	Coolant Lead, 40 Ft. (blue-red band)	1
5	023427	Coolant Lead, 40 Ft. (blue-green band)	1
	028460	**Shielded Torch Lead, 45 Ft.***	1
1	023435	Pilot/Shield Gas Lead, 45 Ft. (blue)	1
2	024231	Plasma Gas Lead, 45 Ft. (red)	1
3	024227	Cap Sensor Lead, 45 Ft. (gray)	1
4	023228	Coolant Lead, 45 Ft. (blue-red band)	1
5	023228	Coolant Lead, 45 Ft. (blue-green band)	1
	028384	**Shielded Torch Lead, 50 Ft.***	1
1	023327	Pilot/Shield Gas Lead, 50 Ft. (blue)	1
2	024195	Plasma Gas Lead, 50 Ft. (red)	1
3	024193	Cap Sensor Lead, 50 Ft. (gray)	1
4	023325	Coolant Lead, 50Ft. (blue-red band)	1
5	023325	Coolant Lead, 50 Ft. (blue-green band)	1

* Parts common to all machine torch lead assemblies

6	046065	Teflon Tube, 9/16" ID x 3.0"	1
7	046026	Heat Shrink, 1-1/2" ID	1
8	046061	Shield Braid (shipped 5' longer than torch lead length)	1
9	027015	Ring Compression	1
10	004080	Collar, Shield	1
11	015090	Clamp, Hose	1

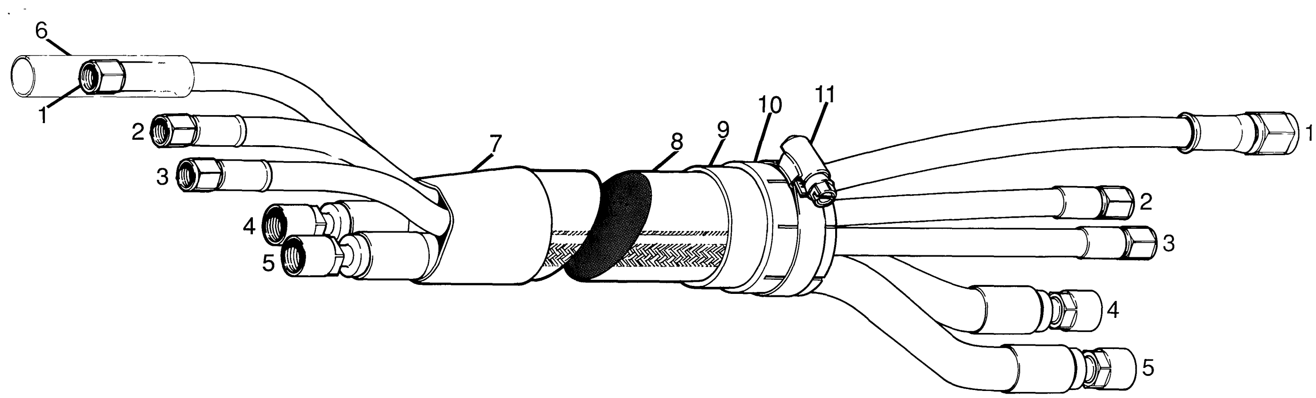


Figure 5-12 Machine Torch Lead Assemblies and Parts

RECOMMENDED SPARE PARTS

Power Supply

Part Number	Description	Designator
005121	Pushbutton, 2 NO green, illmn.	PB1
005122	Pushbutton, 2 NC red, extended	PB2
005088	Holder, lamp	-
005090	Bulb, 28VDC, 40 MA	-
005091	Cap, red	-
027080	Fan, 225 CFM, 120 VAC, 50/60 Hz	M2
027079	Fan, 450-550 CFM, 120 VAC, 50/60 Hz	M4
027080	Fan, 225 CFM, 120 VAC, 50/60 Hz	M3
041151	PC BD Assy, THC Motherboard	PCB10
041186	PC BDSA, THC	PCB9
041143	PC BD Assy, Control	PCB7
005102	Thermostat, 165°C	TS1
029320	Chopper SA, CH1/CH2	-
009384	Diode, 85 Amp, 1000V, Fwd Polarity	D1, D2, D3
009385	Diode, 85 Amp, 1000V, Rev Polarity	D4, D5, D6
041147	PC BD Assy, Power Distribution	PCB6
008317	Fuse, Semiconductor, 125 Amp, 250 V	F3, F4
003021	Relay, 120 VAC, NO SPST	CR1
029202	Sensor, Current	CS1
006045	Valve, Solenoid, Coolant Return	V8
006046	Valve, Solenoid, Coolant Supply	V7
027137	Filter, Coolant, Deionizing	-
029325	Coolant Pump SA	-
029323	Water Temp Switch SA (162°F)	TS2
029326	Level Switch SA	LS1
029361	Flow Switch SA (0.5 gpm)	FS1
028393	Coolant, ethylene glycol 25%/ deionized water 75% (standard mixture)	
028419	Coolant, ethylene glycol 100%	

Section 6 MAINTENANCE

In this section:

Maintenance 6-2
Removal and Replacement of Torch 6-3
Removal and Replacement of Torch Lead 6-4
Removal and Replacement of Individual Torch Leads 6-4

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).

MAINTENANCE

Becoming familiar with the contents of this manual and the electrical schematic information will aid in safely locating the most common problems. Also included are procedures to remove and replace the torch, torch lead, and individual torch leads.

If you need additional assistance, call our Customer Service or Technical Service Group at 1-800-643-0030.

REMOVAL AND REPLACEMENT OF TORCH

To remove and replace the torch main body from the torch lead, perform the following procedure. Refer to the *Machine Torch Lead Assembly Parts* list, page 5-27.

Removal

1. Unscrew the insulating sleeve from the torch main body and slide the sleeve out of the way in order to expose the torch lead fittings. See Figure 6-1.

2. On the larger leads, use a 3/8" open-end wrench to hold the torch body fittings and a 1/2" open-end wrench to turn the torch lead fittings.

   On the smaller leads, use a 5/16" open-end wrench to hold the torch body fittings and a 7/16" open-end wrench to turn the torch lead fittings.

   Turn the torch lead fittings counterclockwise (cw) to loosen the connections. Note that the red lead fitting is reverse threaded.

3. Remove the torch main body.

Replacement

1. Connect the torch leads to the replacement torch main body. Thread the torch main body fittings and the torch lead fittings together clockwise (cw). Use the size wrenches called out in the *Removal* procedure above. Note that the red lead fitting is reverse threaded and must be turned in the opposite direction.

2. Ensure the lead insulator is positioned over the pilot/shield gas lead fitting.

3. Slide the insulating sleeve to the torch main body and screw together.

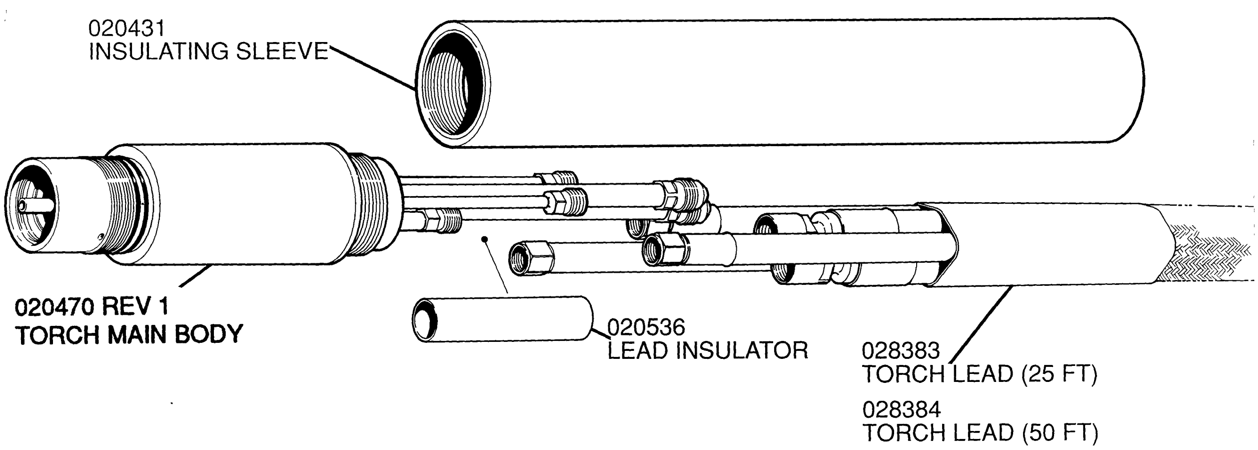


Figure 6-1 Machine Torch Assembly

REMOVAL AND REPLACEMENT OF TORCH LEAD

To remove and replace the torch lead, perform the following procedures.

Removal

1. Disconnect the torch lead from the HF Console by reversing the *Connect the Torch Lead* procedure on page 3-45.

2. Disconnect the torch from the torch lead as described in the *Torch Removal* procedure on page 6-3.

Replacement

1. Connect the torch lead to the HF Console by referring to the *Connect the Torch Lead* procedure on page 3-45.

2. Connect the torch lead to the torch referring to the *Torch Replacement* procedure on page 6-3.

REMOVAL AND REPLACEMENT OF INDIVIDUAL TORCH LEADS

To remove and replace individual torch leads, perform the following procedure and see Figure 6-2. Refer to the *Machine Torch Lead Assembly Parts* list, page 5-27.

Removal

1. Disconnect the torch lead from the HF Console by reversing the *Connect the Torch Lead* procedure on page 3-45.

2. Disconnect the torch from the torch lead as described in the *Torch Removal* procedure on page 6-3.

3. Lay the torch lead on the floor and stretch it out completely.

4. Cut away the heat shrink (7) and any tape underneath at both ends.

5. Remove the hose clamp (11), shield collar (10), and compression ring (9) from the torch lead at the other end. Cut away any tape under the compression ring.

6. Holding one end of the the torch lead, pull the shield braid (8) off of the torch lead.

7. Cut the tape (every 18 inches) that holds the torch leads together.

8 Remove the lead (1-5) requiring repair or replacement.

Replacement

1. Replace the repaired or replacement lead(s) with the other leads.
2. Ensure the lead lengths (1-5) at both ends are in accordance with those called out in Figure 6-2.
3. Tape the leads together every 18 inches.
4. Slide the shield braid (8) over the torch lead ends and pull the sheath until it approximates the length requirements called out in Figure 6-2.
5. Tape both ends of the shield braid to the torch lead.
6. Slide the heat shrink (7) over torch end of the shield braid. Heat the heat shrink until it tightly bonds around the shield braid and torch lead.
7. Replace the compression ring (9), shield collar (10), and hose clamp (11) over the power supply end of the shield braid. Tighten the hose clamp.
8. Connect the torch lead to HF Console. Refer to the *Connect the Torch Lead* procedure on page 3-45.
9. Connect the torch lead to the torch. Refer to the*Torch Replacement* procedure on page 6-3.

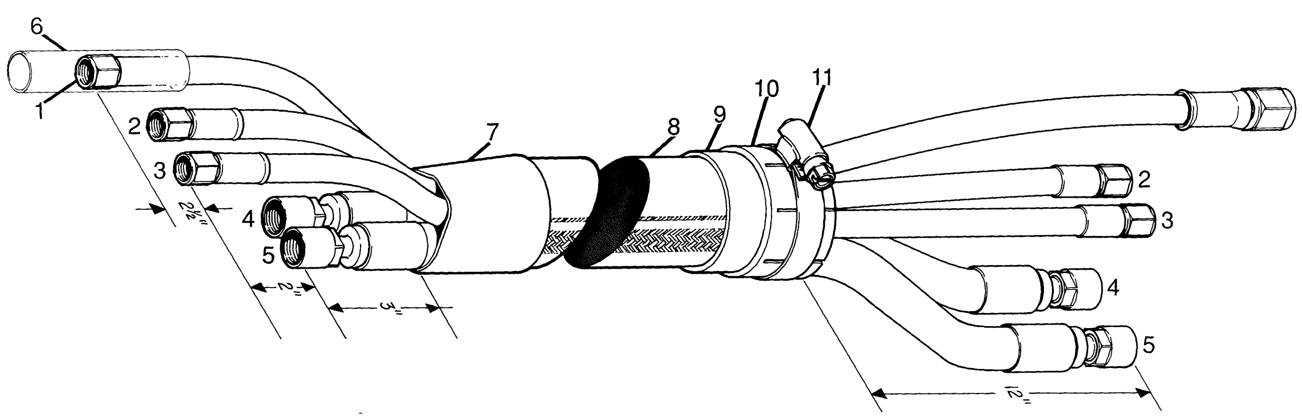


Figure 6-2 Machine Torch Lead Assembly

Section 7 STANDARDS INDEX

In this section:

Standards Index 7-2

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.

STANDARDS INDEX

Appendix A FILTERS

In this section:

Hankison® Centriflex® Filters a-2
Hankison® Aerolescer® Filters a-4
Wilkerson Type PC6 Filter/regulator a-6

HANKISON® CENTRIFLEX® Compressed Air Separator/Filter

Efficient Separation and 3 Micron Filtration in One Compact Housing

SEPARATION—

The First Stage

A unique stainless steel separator core, using the principles of centrifugal force and impaction, is 99% efficient in removing particles 10 microns in size and larger.

The reusable cartridge type separator is completely removable for easy cleaning.

FILTRATION—

The Second Stage

A replacement filter sleeve, which fits over the separator core, assures absolute removal of solids and liquids 3 microns and larger in size.

Solids removal — finer filtration at less cost

The filter sleeve, constructed of an in-depth arrangement of glass fibers, has a high percentage of void spaces, allowing it to accumulate 3 to 4 times more particulates than coarser surface (pore) type filter element materials such as porous metal and plastic. Also the in-depth arrangement of fibers resists clogging due to gummy residues and sticky lacquers which are frequently present in compressed air systems and readily adhere to and foul surface type filters. This ability to accumulate large amounts of solid particles and resist clogging means that there is only a gradual increase in pressure drop across the filter, resulting in a long operating life and less operating cost.

Liquids removal — higher efficiencies from no flow to full flow

By using coalescence to force small droplets to form into larger droplets, the filter media continually collects all liquid droplets 3 microns in size and larger, as well as a portion of smaller droplets. This means that 99% of water droplets and 40% of oil aerosols are collected and discharged from the system.

The combination of filter sleeve and separator core ensures high efficiency liquid separation over a full range of flows. There is no reduction in efficiency at less than rated flows, a common occurrence in purely centrifugal separators.

FEATURES:

- High efficiency separation — removes 99% of water droplets, 40% of oil aerosols.
- Combination of separator core and filter sleeve maintain high efficiency from no flow to full flow.
- Replaceable filter sleeve removes 100% of particles 3 microns and larger in size — while giving long sleeve life.

Housing design — features easy installation and maintenance

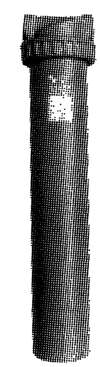
The in-line, inlet and outlet connection design reduces installation time and expense. Additional piping to maintain alignment is not required. Cartridge replacement is made easy by removable bowls for models C15 through C300 and by use of a convenient bottom access for models C400 and larger.

OPERATION

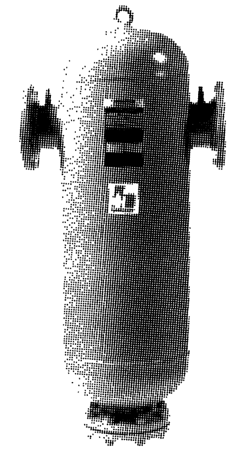
Air enters the top of the Centriflex separator/filter and flows down through the center of the separator core and radially outward. The air is subjected to a strong centrifugal force as it passes through the separator core which is constructed of a pair of stainless steel perforated tubes. The orifices in the first tube (**A**) are staggered in relation to those in the second (**B**). This causes particles 10 microns and larger to continue in a straight course after leaving the inner tube, impacting and impinging on the inside of the outer tube where they form a film which drains to the bottom of the separator core.

The air then passes into the filter sleeve (**C**) which is composed of an in-depth bed of resin impregnated glass fibers. Solid particles (to 3 microns absolute) are captured and retained here. Liquid aerosols are coalesced on the glass fibers forming large droplets which move downward to the bottom of the cartridge where they drain by gravity into the filter housing and are removed from the air system.

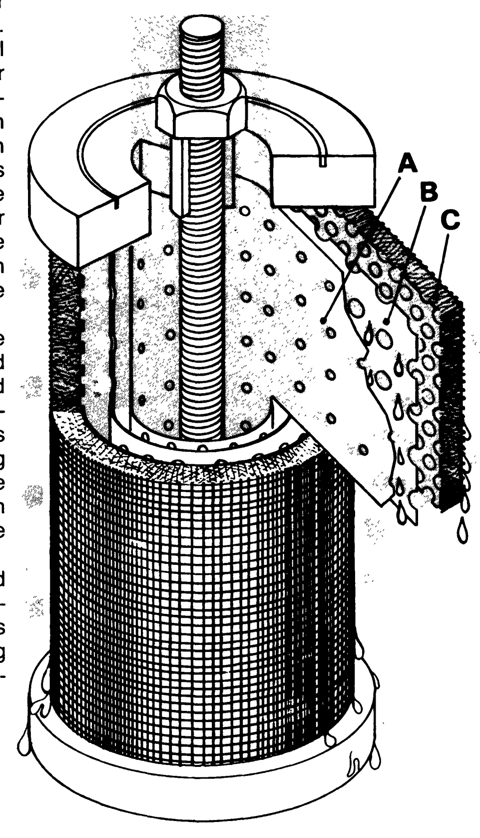
This combination of separation and coalescence allows the Centriflex separator/filter to handle large inlet liquid loads (up to 25,000 ppm w/w) while removing 99% of water droplets and 40% of oil aerosols over a full range of flow conditions.



MODEL C150



MODEL C6600



OPERATING CONDITIONS

Flow: maximum air flow for the various models at 100 psig is indicated in Table 1. To determine maximum air flows at inlet pressures other than 100 psig, multiply flow from Table 1 by multiplier from Table 2 that corresponds to the minimum operating pressure at the inlet of the filter.

EXAMPLE:

Choose a Centriflex® separator/filter to handle 705 scfm at 150 psig. From Table 1 pick a C600 with an air flow of 600 scfm @ 100 psig. Multiply 600 scfm by the correction factor 1.43 for 150 psig from Table 2 (600 x 1.43 = 858). A C600 has ample capacity for this requirement.

CAUTION:

Do not select filters by pipe size. Make selection by flow rate and operating pressure only.

Pressure Drop:

Initial pressure drop (dry) is less than 1 psi. Increases in pressure drop above this point occur as the cartridge is loaded with solid contaminants. It is recommended that filter cartridge(s) be replaced when pressure drop exceeds 10 psi.

OPTIONS

Automatic Drains

Hankison drains automatically discharge liquids collected in the filter sump from the compressed air system. They are available with the drain mechanism mounted internally on smaller models or in their own housings for external mounting on larger models.

Differential Pressure Alarms

(Optional on models C15 thru C600; standard on models C1200 and larger.) The Hankison differential pressure alarm signals both audibly and visually when a 10 psi differential pressure has been reached, indicating the need for cartridge replacement.

Stainless Steel Cartridges

Cartridges may be ordered with stainless steel materials for use in systems where corrosive fumes are present in the compressed air system.

TABLE 1

Maximum Air Flow (scfm*) @ 100 psig

MODEL	C15	C35	C55	C100	C150	C200	C300	C400	C600	C1200	C1800	C2400	C3000	C4800	C6600	C8400	C11400
FLOW	15	35	55	100	150	200	300	400	600	1200	1800	2400	3000	4800	6600	8400	11400

*Convert scfm to metric units as follows: 1 scfm = 1.736$m^3{}_n/h$

TABLE 2

Air Flow Correction Factor

Minimum inlet pressure (psig)	20	30	40	60	80	100	120	150	200	250	300
Multiplier	0.30	0.39	0.48	0.65	0.82	1.00	1.17	1.43	1.87	2.31	2.74

PHYSICAL DESCRIPTION

Model Number		Housing Type	Maximum Operating Pressure (psig)		Maximum Operating Temperature	Air Inlet/ Outlet Conn.	Width (Inlet to Outlet) and Height (in.)	Wt. (lb.)	Replacement Filter Cartridge	
with Manual Drain	with Internal Auto Drain		with Manual Drain	with Internal Auto Drain					No.	Qty. Reqd.
C15-03F-8P	—	8 oz. polycarbonate (2)	150	—	120°F	3/8″ NPTF	3 1/4 x 6 1/4	1 5/8	0734-1	1
C15-03F-16P	C15-03F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	3/8″ NPTF	3 1/4 x 10 1/4	2 1/2	0734-1	1
C15-03F-16M	C15-03F-16M-D	16 oz. metal	300	175	120°F	3/8″ NPTF	3 1/4 x 9 7/8	3 1/8	0734-1	1
C15-04F-16P	C15-04F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	1/2″ NPTF	3 1/4 x 10 1/4	2 1/2	0734-1	1
C15-04F-16M	C15-04F-16M-D	16 oz. metal	300	175	120°F	1/2″ NPTF	3 1/4 x 9 7/8	3 1/8	0734-1	1
C35-03F-16P	C35-03F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	3/8″ NPTF	3 1/4 x 10 1/4	2 1/2	0734-2	1
C35-03F-16M	C35-03F-16M-D	16 oz. metal	300	175	120°F	3/8″ NPTF	3 1/4 x 9 7/8	3 1/8	0734-2	1
C35-04F-16P	C35-04F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	1/2″ NPTF	3 1/4 x 10 1/4	2 1/2	0734-2	1
C35-04F-16M	C35-04F-16M-D	16 oz. metal	300	175	120°F	1/2″ NPTF	3 1/4 x 9 7/8	3 1/8	0734-2	1
C55-08F-48	C55-08F-48-D	48 oz. metal	300	175	120°F	1″ NPTF	4 9/16 x 13 9/16	5 7/8	0734-3	1
C100-08F-48	C100-08F-48-D	48 oz. metal	300	175	120°F	1″ NPTF	4 9/16 x 13 9/16	5 7/8	0734-3	1
C150-12F-100	(1)	100 oz. metal	300	—	120°F	1 1/2″ NPTF	5 1/4 x 23 1/4	13 1/4	0734-4	1
C200-12F-205	(1)	205 oz. metal	300	—	120°F	1 1/2″ NPTF	5 1/4 x 30 5/8	21	0734-5	1
C300-12F-205	(1)	205 oz. metal	300	—	120°F	1 1/2″ NPTF	5 1/4 x 30 5/8	21	0734-6	1
C400-16M-5L	(1)	5″ pressure vessel	300 (3)	300 (3)	120°F	2″ NPTM (4)	10 1/4 x 40 7/8	36	0734-7	1
C600-24M-5L	(1)	5″ pressure vessel	300 (3)	300 (3)	120°F	3″ NPTM (4)	10 1/4 x 40 7/8	37	0734-7	1
C1200-24M-8L	(1)	8″ pressure vessel	225 (3)	—	120°F	3″ NPTM (4)	16 x 48	86	0734-7	2
C1800-24M-10L	(1)	10″ pressure vessel	225 (3)	—	120°F	3″ NPTM (4)	16 1/4 x 49	131	0734-7	3
C2400-4FL-12L	(1)	12″ pressure vessel	225 (3)	—	120°F	4″ flange (5)	20 x 52 1/4	179	0734-7	4
C3000-4FL-12L	(1)	12″ pressure vessel	225 (3)	—	120°F	4″ flange (5)	20 x 52 1/4	182	0734-7	5
C4800-6FL-16L	(1)	16″ pressure vessel	225 (3)	—	120°F	6″ flange (5)	24 x 54 5/8	271	0734-7	8
C6600-6FL-20L	(1)	20″ pressure vessel	225 (3)	—	120°F	6″ flange (5)	28 x 62 9/16	518	0734-7	11
C8400-6FL-20L	(1)	20″ pressure vessel	225 (3)	—	120°F	6″ flange (5)	28 x 62 9/16	527	0734-7	14
C11400-8FL-24L	(1)	24″ pressure vessel	225 (3)	—	120°F	8″ flange (5)	33 x 69 1/8	709	0734-7	19

(1) Drain port is provided. Use externally mounted Hankison® automatic drain. For models C150 thru C600 use a model 505 Trip-L-Trap®. For models C1200 and larger use a model 506 Trip-L-Trap Models C400 and C600 may also be supplied with an internal drain.

(2) Polycarbonate bowls are furnished with bowl guards. Do not use polycarbonate bowls when synthetic lubricants are present.

(3) Units with higher maximum working pressures are available. Models C1200 and larger are ASME code constructed and stamped.

(4) Flanges and couplings are available.

(5) Optional flange sizes are available.

HANKISON DIVISION OF HANSEN INC.
CANONSBURG, PA 15317 U.S.A. TEL.: (412) 745-1555

PRICE AND ORDERING INFORMATION FROM

Energy Machinery
10 RESERVOIR PARK DRIVE
P.O. BOX 363
ROCKLAND, MA 02370

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HANKISON®

AEROLESCER®
Coalescing Type Oil Removal Filters

99.999+% efficient in removing oil aerosols from compressed air lines.

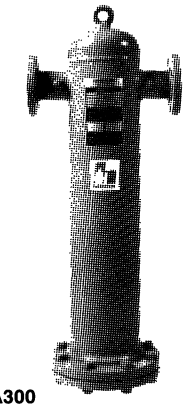
Why remove oil?
Compressor oil downstream — it can contaminate the end product, decrease the efficiency of the production process by ruining paint jobs, gumming up air tools, motors, etc., or clog the tiny orifices in instruments or fluid logic components. Oil from a lubricated compressor is subjected to high temperatures during the compression cycle. This alters its characteristics so that it does not adequately lubricate downstream pneumatic components. It's best to take this oil out of the system and add the proper lubricant at the point of use.

Are special filters required to remove oil?
In a typical 90 psig air system 72% by weight of the oil aerosols present are less than 5 microns in size. 50% are below 1 micron in size. Droplets of this size blow right through a mechanical separator. Air line filters (particulate filters e.g. a 5 micron filter) can't trap the bulk of the aerosols either. To adequately remove oil, a special filter is required. The Hankison Aerolescer filter has been designed to remove oil by means of coalescence.

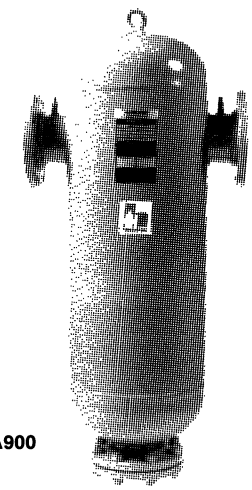
The result — an oil free compressed air system
The Hankison Aerolescer filter, when used within its rated design conditions, will eliminate the oil aerosols contained in a compressed air stream. Exhaustive tests verify a liquid oil removal efficiency of 99.999+%. In most instances, this means that the filtered air will contain less than .1 ppm of oil by weight. It assures virtually oil free air without the expense and maintenance headaches of non-lubricated compressors.

Features:
- Unique continuously stabilized filter media plus outer foam sleeve ensures 99.999+% efficiency for the life of the cartridge
- Removes: 100% of particles .025 micron and larger in size; some particles as small as .01 micron
- Cartridge replacement made easy by removable bowls or convenient bottom flange opening
- Rugged thru-bolt cartridge construction

MODELS from 10 SCFM to 6000 SCFM



MODEL A300

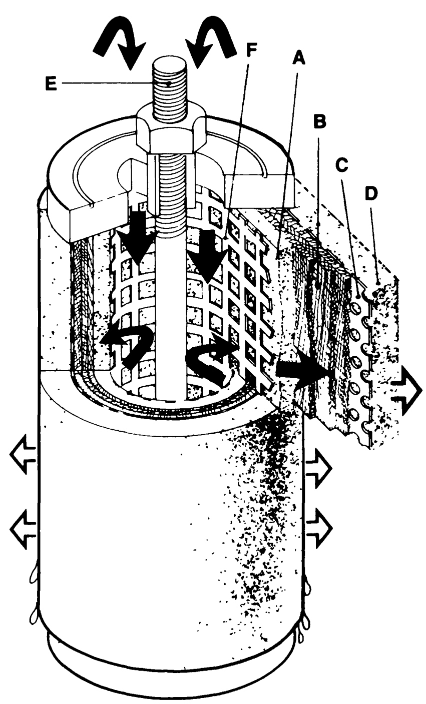


MODEL A900

The Patented* AEROLESCER Cartridge — designed for 99.999+% efficiency and long life

OPERATION
Oil aerosols moving through the filtering media (B), a maze of submicronic glass fibers with specific densities and diameters, are concentrated and coalesced into large droplets. High efficiency is achieved by stabilizing the filtering media between a rigid perforated cylinder (C) and an inner foam sleeve (A), which compensates for fluctuating flow rate and aerosol concentration. This design assures uniform distribution of oil aerosols which prevents liquid pocketing, fiber clotting, and subsequent air channelling. The coalesced oil droplets are collected by the outer foam sleeve (D). Having an enormous non-absorbing surface area, this sleeve allows oil droplets to drain to the bottom of the sleeve and then drop to the bottom of the housing for removal from the air system. When removing oil the life of the cartridge is indefinite.**
The cartridge continuously coalesces and separates oil aerosols from your system.

Thru bolt construction (E) assures structural strength and prevents liquid bypassing of the filter media. There is no reliance on adhesives to hold the unit together. An inside support (F) offers positive protection in case flow is accidentally reversed through the cartridge.



*U.S. Patent No. 3,802,160
**Excessive solid matter accumulation will limit life. Prefilters are available to prolong life. Request Bulletin 3100 covering HANKISON 3100 Series Air Line Filters.

Operating Conditions

Flow: maximum air flow for the various models at 100 psig is indicated in Table 1. To determine maximum air flows at inlet pressures other than 100 psig, multiply flow from Table 1 by multiplier from Table 2 that corresponds to the minimum operating pressure at the inlet of the filter.

EXAMPLE:

Choose an Aerolescer filter to handle 705 scfm at 150 psig. From Table 1 pick an A500 with an air flow of 500 scfm @ 100 psig. Multiply 500 scfm by the correction factor 1.43 for 150 psig from Table 2 (500 x 1.43 = 715). An A500 has ample capacity for this requirement.

CAUTION:

Do not select filters by pipe size. Make selection by flow rate and operating pressure only.

Pressure Drop:

Initial pressure drop (dry) is less than 1 psi. As the cartridge collects and coalesces liquid droplets a working pressure drop of 3 to 5 psi will develop. Increases in pressure drop above this point occur as the cartridge is loaded with solid contaminants. It is recommended that filter cartridge(s) be replaced when pressure drop exceeds 10 psi.

OPTIONS

Automatic Drains

Hankison drains automatically discharge liquids collected in the filter sump from the compressed air system. They are available with the drain mechanism mounted internally on smaller models or in their own housings for external mounting on larger models.

Differential Pressure Alarms

(Optional on models A10 thru A320; standard on models A500 and larger.) The Hankison differential pressure alarm signals both audibly and visually when a 10 psi differential pressure has been reached, indicating the need for cartridge replacement.

Stainless Steel Cartridges

Cartridges may be ordered with stainless steel materials for use in systems where corrosive fumes are present in the compressed air system.

TABLE 1
Maximum Air Flow (scfm*) @ 100 psig

MODEL	A10	A20	A50	A100	A200	A250	A300	A320	A500	A600	A900	A1300	A1600	A2500	A3500	A4400	A6000
FLOW	10	20	50	100	200	250	300	320	500	632	948	1264	1580	2528	3476	4424	6004

*Convert scfm to metric units as follows 1 scfm = 1.736m^3_n/h

TABLE 2
Air Flow Correction Factor

Minimum inlet pressure (psig)	20	30	40	60	80	100	120	150	200	250	300
Multiplier	0.30	0.39	0.48	0.65	0.82	1.00	1.17	1.43	1.87	2.31	2.74

PHYSICAL DESCRIPTION

Model Number		Housing Type	Maximum Operating Pressure (psig)		Maximum Operating Temperature	Air Inlet/ Outlet Conn.	Width (Inlet to Outlet) and Height (in.)	Wt. (lb.)	Replacement Filter Cartridge	
with Manual Drain	with Internal Auto Drain		with Manual Drain	with Internal Auto Drain					No.	Qty. Reqd.
A10-03F-8P		8 oz. polycarbonate (2)	150	150	120°F	3/8" NPTF	3 1/4 x 6 1/4	1 5/8	0713-2	1
A10-03F-16P	A10-03F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	3/8" NPTF	3 1/4 x 10 1/4	2 1/2	0713-2	1
A10-03F-16M	A10-03F-16M-D	16 oz. metal	300	175	120°F	3/8" NPTF	3 1/4 x 9 7/8	3 1/8	0713-2	1
A10-04F-16P	A10-04F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	1/2" NPTF	3 1/4 x 10 1/4	2 1/2	0713-2	1
A10-04F-16M	A10-04F-16M-D	16 oz. metal	300	175	120°F	1/2" NPTF	3 1/4 x 9 7/8	3 1/8	0713-2	1
A20-03F-16P	A20-03F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	3/8" NPTF	3 1/4 x 10 1/4	2 1/2	0713-3	1
A20-03F-16M	A20-03F-16M-D	16 oz. metal	300	175	120°F	3/8" NPTF	3 1/4 x 9 7/8	3 1/8	0713-3	1
A20-04F-16P	A20-04F-16P-D	16 oz. polycarbonate (2)	150	150	120°F	1/2" NPTF	3 1/4 x 10 1/4	2 1/2	0713-3	1
A20-04F-16M	A20-04F-16M-D	16 oz. metal	300	175	120°F	1/2" NPTF	3 1/4 x 9 7/8	3 1/8	0713-3	1
A50-08F-48	A50-08F-48-D	48 oz. metal	300	175	120°F	1" NPTF	4 9/16 x 13 9/16	5 7/8	0713-4	1
A100-08F-100	(1)	100 oz. metal	300		120°F	1" NPTF	4 9/16 x 23 1/4	13 1/4	0713-5	1
A200-12F-205	(1)	205 oz. metal	300		120°F	1 1/2" NPTF	5 1/4 x 30 5/8	21	0713-6	1
A300-12F-381	(1)	381 oz. metal	300		120°F	1 1/2" NPTF	5 1/4 x 36 3/8	29 1/4	0713-7	1
A250-16M-5L	(1)	5" pressure vessel	300 (3)		120°F	2" NPTM (4)	10 1/4 x 40 7/8	36	0713-12	1
A320-16M-5L	(1)	5" pressure vessel	300 (3)		120°F	2" NPTM (4)	10 1/4 x 40 7/8	37	0713-11	1
A500-24M-8L	(1)	8" pressure vessel	225 (3)		120°F	3" NPTM (4)	16 x 48	86	0713-12	2
A600-24M-8L	(1)	8" pressure vessel	225 (3)		120°F	3" NPTM (4)	16 x 48	86	0713-11	2
A900-24M-10L	(1)	10" pressure vessel	225 (3)		120°F	3" NPTM (4)	16 1/4 x 49	131	0713-11	3
A1300-4FL-12L	(1)	12" pressure vessel	225 (3)		120°F	4" flange (5)	20 x 52 1/4	179	0713-11	4
A1600-4FL-12L	(1)	12" pressure vessel	225 (3)		120°F	4" flange (5)	20 x 52 1/4	182	0713-11	5
A2500-6FL-16L	(1)	16" pressure vessel	225 (3)		120°F	6" flange (5)	24 x 54 5/8	271	0713-11	8
A3500-6FL-20L	(1)	20" pressure vessel	225 (3)		120°F	6" flange (5)	28 x 62 9/16	518	0713-11	11
A4400-6FL-20L	(1)	20" pressure vessel	225 (3)		120°F	6" flange (5)	28 x 62 9/16	527	0713-11	14
A6000-8FL-24L	(1)	24" pressure vessel	225 (3)		120°F	8" flange (5)	33 x 69 1/8	709	0713-11	19

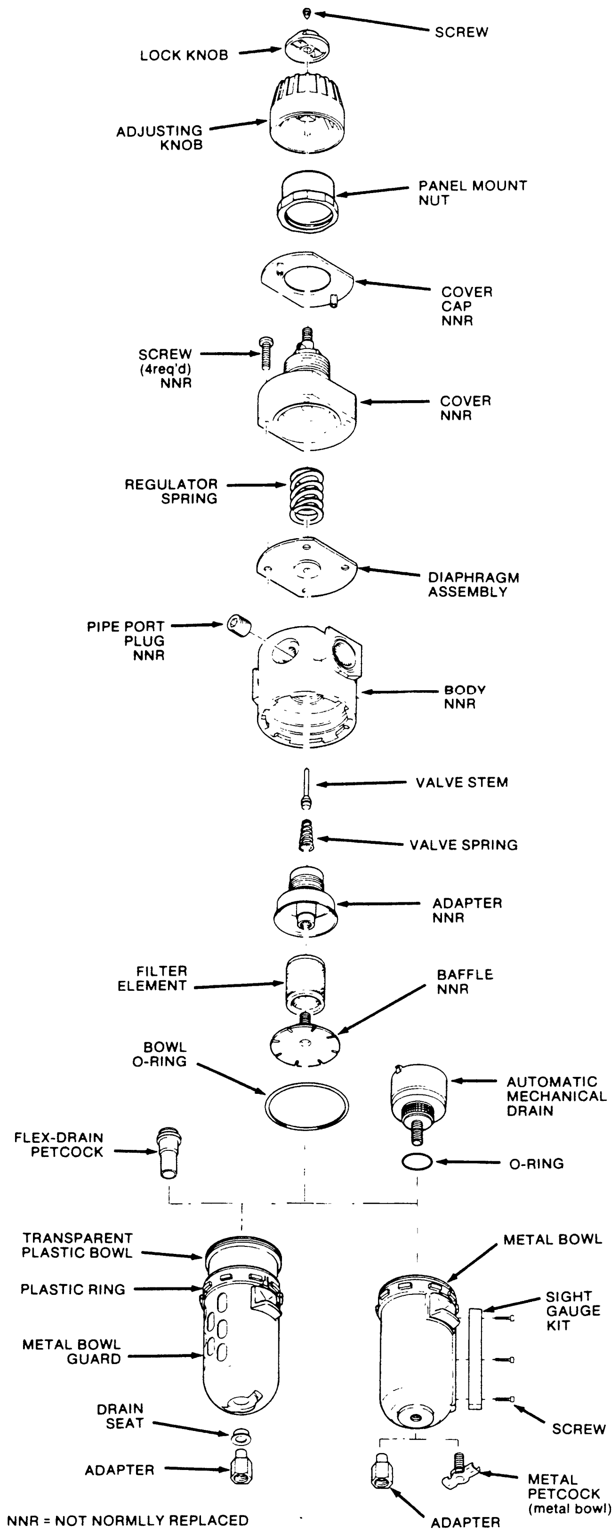
(1) Drain port is provided. Use externally mounted Hankison automatic drain. For models A100 thru A1600 use a model 504 Snap-Trap® (175 psig MWP); for models A2500 thru A6000 use a model 505 Trip-L-Trap®. Models A250 and A320 may also be supplied with an internal drain.
(2) Polycarbonate bowls are furnished with bowl guards. Do not use polycarbonate bowls when synthetic lubricants are present.
(3) Units with higher maximum working pressures are available. Models A500 and larger are ASME code constructed and stamped.
(4) Flanges and couplings are available.
(5) Optional flange sizes are available

HANKISON
HANKISON DIVISION OF HANSEN INC.
CANONSBURG, PA 15317 U.S.A. TEL: (412) 745-1555

1300-20

WILKERSON®
CORPORATION • ENGLEWOOD, CO 80150

PRECISION AIR PRESSURE REGULATOR
TYPE PC6 FILTER/REGULATOR



INSTALLATION

Install the Filter/Regulator as close as possible to the application. The inlet port is marked with an arrow cast into the body to indicate the direction of flow. Gauge ports (¼") are provided in either side of the body for installation of a gauge or use as an additional outlet port. Plug unused port(s). System piping should be same size as regulator porting. In systems with a cyclic demand, the regulator should be located upstream of cycling device.

OPERATION

Maximum pressure and temperature ratings are: for transparent plastic bowls, 150 psig (10 bar) and 125°F (52°C); and for metal bowls, 250 psig (17 bar) and 175 °F (79°C).

Before turning on the supply air pressure, turn the adjusting knob counterclockwise until there is no load on the regulating spring. Turn on the supply air pressure and then turn the adjusting knob clockwise until the desired secondary pressure is reached. To avoid minor readjustment after making a change in pressure setting, always approach the desired pressure from a lower pressure. When reducing from a higher to a lower setting, first reduce to some pressure less than that desired and then increase to the desired pressure.

CAUTION

EXCEPT as otherwise specified by manufacturer, this product is specifically designed for compressed air service, and use with any other fluid (liquid or gas) is a misapplication. For example, use with or injection of certain hazardous liquids or gases in the system (such as alcohol or liquid petroleum gas) could be harmful to the unit or result in a combustible condition or hazardous external leakage. Manufacturer's warranties are void in the event of misapplication and manufacturer assumes no responsibility for any resulting loss.

The relief flow capacity of relieving type regulators is limited. Under some operating conditions, the secondary (outlet) pressure could increase above the initial setting. If over-pressure conditions could cause malfunction or failure of downstream equipment, additional external pressure relief devices of suitable capacity must be installed.

Before using with fluids other than air for non-industrial applications or for life support systems, consult Wilkerson Corporation for approval.

SEE REVERSE SIDE FOR LIST OF MATERIALS UNSUITABLE FOR USE WITH POLYCARBONATE BOWLS

MAINTENANCE

1. The regulator can be disassembled for servicing without removal from line.
2. DEPRESSURIZE UNIT BEFORE REMOVING GUARD AND/OR BOWL.
3. TO DISASSEMBLE: shut off air to unit and vent air line on both sides of unit. Turn adjusting screw counterclockwise to relieve spring compression. Remove knob, cover cap, screws, cover, and spring. Diaphragm assembly can now be removed.
4. To remove valve from bottom of unit, remove bowl. Remove baffle and filter element exposing hex nut on adapter assembly. Remove adapter assembly, valve and spring.
5. If it is a plastic bowl unit. inspect daily to detect crazing, cracking, damage, or other deterioration. Immediately replace any crazed, cracked, damaged, or deteriorated bowl with a metal bowl or a new plastic bowl and metal bowl guard.
6. a. If unit has a rigid (felt) filter element, clean periodically by removing from filter, tapping on surface, and blowing off with air blow gun.
   1b. If unit has soft cloth element, replace with a new one at least every six months, or sooner if it looks dirty or causes excessive pressure drop (10 psi or more at rated flow).

(continued on reverse side)

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7. a. If unit is equipped with a manual petcock, drain bowl at least once per work shift.
   b. If unit is equipped with a float in the bowl, clean the bowl each time the element is cleaned or changed by turning the bowl upside down and tapping onto tabletop. Blow clean with blow gun.
8. If bowl is crazed, cracked, or otherwise damaged or deteriorated, replace bowl and use manufacturer's approved bowl seal.
9. IF UNIT WILL NOT REGULATE TO REQUIRED PRESSURE, OR IF PRESSURE BECOMES EXCESSIVE follow instructions (see 4.) for removal of valve. Remove valve and spring. Clean and check valve stem and valve seat for wear or damage and replace if required.
10. Before placing unit is service, make sure that bowl and bowl guard are reinstalled and securely locked in place.

REPAIR KITS AND REPLACEMENT PARTS

SELF-RELIEVING REPAIR KIT (includes self-relieving diaphragm assy, valve stem, valve spring, filter element, and bowl o-ring)	**PRP-95-025**
Regulating Springs:	
0-30 psi	**RRP-95-916**
0-50 psi	**RRP-95-222**
0-120 psi	**RRP-95-224**
Self-Relieving Diaphragm Kit	**PRP-95-960**
Valve Assembly (valve stem, valve spring)	**PRP-95-959**
Filter Element Assembly (includes element and bowl o-ring)	**FRP-95-034**
Transparent Bowl Assemblies:	
with flexible drain	**FRP-95-017**
with bowl guard, Auto Drain	**FRP-95-015**
with bowl guard, flexible drain	**FRP-95-014**
Bowl O-Ring Kit (10 per kit)	**GRP-95-009**
Bowl Guard Kit	**GRP-95-013**
Metal Bowl Assemblies:	
with metal petcock	**FRP-95-178**
with Sight Gauge, metal petcock (for units with "G" in model no.)	**GRP-95-133**
Drains:	
Auto Drain Kit (includes o-ring, spacer, nut)	**GRP-95-714**
Brass Petcock (for metal bowls)	**GRP-95-182**
Flex Drain Kit (for plastic bowls)	**FRP-95-610**
Adjusting Knob Kit	**RRP-95-007**

NOTE: All bowl kits include bowl o-ring

ACCESSORIES

Wall Mounting Bracket with Panel Mount Nut	**GPA-95-011**
Wall Mounting Bracket	**GPA-95-012**
Panel Mount Nut	**GPA-95-032**
Tamper Resistant Kit	**RPA-95-006**
Viton Valve Assembly	**PPA-95-067**
Gauges:	
0-30 psig	**PPA-95-107**
0-60 psig	**PPA-95-106**
0-120 psig	**PPA-95-108**

WARNING: IF YOUR UNIT HAS A PLASTIC BOWL

1. **DO NOT** use plastic bowl units without a metal bowl guard installed. Plastic bowl units are sold only with metal bowl guards to minimize the danger of flying fragments in the event of bowl failure.
2. **DO NOT** install the unit where it will be subjected to temperatures higher than 125°F (51 ,7°C).
3. **DO NOT** install the unit where it will be subjected to pressure higher than 150 psig (10,3 bar).
4. **CAUTION:**
   Certain compressor oils, household cleaners, chemicals, solvents, paints and fumes will attack plastic bowls and can cause plastic-bowl failure. See manufacturer's list below. Do not use near these materials.
5. **WHEN BOWL** becomes dirty, replace bowl or wipe only with a clean, dry cloth.
6. **DO NOT** install on a compressed air line where the compressor is lubricated with, or the air contains, a material that will attack plastic bowls.
7. **DO** inspect plastic bowls daily to detect crazing, cracking damage, or other deterioration. Immediately replace any crazed, cracked, damaged, or deteriorated bowl with a metal bowl or a new plastic bowl and metal bowl guard.

WARNING: IF YOUR UNIT HAS A METAL BOWL

1. **DO NOT** install unit where it will be subjected to temperatures higher than 175°(80°C).
2. **DO NOT** install the unit where it will be subjected to pressure higher than 250 psi (17 bar).

SOME OF THE MATERIALS THAT WILL ATTACK POLYCARBONATE PLASTIC BOWLS

Acetaldehyde	Chlorobenzene	Methylene chloride
Acetic acid (conc)	Chloroform	Methylene salicylate
Acetone	Cresol	Milk of lime (CaOH)
Acrylonitrile	Cyclohexanol	Nitric acid (conc)
Ammonia	Cyclohexanone	Nitrobenzene
Ammonium fluoride	Cyclohexene	Nitrocellulose lacquer
Ammonium hydroxide	Dimethyl formamide	Phenol
Ammonium sulfide	Dioxane	Phosphorous hydroxy chloride
Anaerobic adhesives & sealants	Ethane tetrachloride	Phosphorous trichloride
Antifreeze	Ethyl acetate	Propionic acid
Benzene	Ethyl ether	Pyridine
Benzoic acid	Ethylamine	Sodium hydroxide
Benzyl alcohol	Ethylene chlorohydrin	Sodium sulfide
Brake fluids	Ethlene dichloride	Styrene
Bromobenzene	Ethlene glycol	Sulfuric acid (conc)
Butyric acid	Formic acid (conc)	Sulphural chloride
Carbolic acid	Freon (refrigerant & propellant)	Tetrahydronaphthalene
Carbon disulfide	Gasoline (high aromatic)	Thiophene
Carbon tetrachloride	Hydrazine	Toluene
Caustic potash solution	Hydrochloric acid (conc)	Turpentine
Caustic soda solution	Lacquer thinner	Xylene
	Methyl alcohol	Perchlorethylene and others

TRADE-NAMES OF SOME COMPRESSOR OILS, RUBBER COMPOUNDS AND OTHER MATERIALS THAT WILL ATTACK POLYCARBONATE PLASTIC BOWLS

Atlas "Perma-Guard"	National Compound #N11
Buna N	"Nylock" VC-3
Cellulube #150 and #220	Parco #1306 Neoprene
Crylex #5 cement	* Permabond 910
* Eastman 910	Petron PD287
Garlock #98403 (polyurethane)	Prestone
Haskel #568-023	Pydraul AC
Hilgard Co 's hil phene	Sears Regular Motor Oil
Houghton & Co oil #1120, #1130 and #1055	Sinclair oil "Lily White"
Houosafe 1000	Stauffer Chemical FYRQUEL #150
Kano Kroil	Stillman #SR 269-75 (polyurethane)
Keystone penetrating oil #2	Stillman #SR 513-70 (neoprene)
* Loctite 271	Tannergas
* Loctite 290	Telar
* Loctite 601	Tenneco anderol #495 and #500 oils
* Loctite Teflon-Sealant	Titon
Marvel Mystery Oil	* Vibra-tite
Minn Rubber 366Y	Zerex

* When in raw liquid form

WE CANNOT POSSIBLY LIST ALL HARMFUL SUBSTANCES, SO CHECK WITH A MOBAY CHEMICAL OR GENERAL ELECTRIC OFFICE FOR FURTHER INFORMATION ON POLYCARBONATE PLASTIC

Appendix B ETHYLENE GLYCOL SAFETY DATA

In this section:

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III. Ingredients b-3
IV. Fire and Explosion Hazard Data b-3
V. Health Hazard Data b-3
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VII. Spill or Leak Procedures b-5
VIII. Special Protection Information b-5
IX. Special Precautions b-5
X. Regulatory Information b-6

UNION CARBIDE CORPORATION

Industrial Chemicals Division

MATERIAL SAFETY DATA SHEET

EFFECTIVE DATE: 01/01/89

Union Carbide urges each customer or recipient of this MSDS to study it carefully to become aware of and understand the hazards associated with the product. The reader should consider consulting reference works or individuals who are experts in ventilation, toxicology, and fire prevention, as necessary or appropriate to use and understand the data contained in this MSDS.

To promote safe handling, each customer or recipient should: (1) notify its employees, agents, contractors and others whom it knows or believes will use this material of the information in this MSDS and any other information regarding hazards or safety; (2) furnish this same information to each of its customers for the product; and (3) request its customers to notify their employees, customers, and other users of the product of this information.

I. IDENTIFICATION

PRODUCT NAME: ETHYLENE GLYCOL, IND., TECH., AND LOW FREEZE GRADES

CHEMICAL NAME: Ethylene Glycol

CHEMICAL FAMILY: Glycols

FORMULA: HOC_2H_4OH MOLECULAR WEIGHT: 62.07

SYNONYMS: EG; Glycol; 1,2-Ethanediol

CAS # and 107-21-1
CAS NAME: 1,2-Ethanediol

II. PHYSICAL DATA (Determined on typical material)

BOILING POINT, 760 mm Hg: 197 C (387 F)

FREEZING POINT: -13 C (9 F)

SPECIFIC GRAVITY(H_2O =1): 1.115 at 20/20 C

VAPOR PRESSURE AT 20'C: 0.08 mm Hg

VAPOR DENSITY (air = 1): 2.1

SOLUBILITY IN WATER by wt: 100

EVAPORATION RATE (Butyl Acetate = 1): 0.01

APPEARANCE AND ODOR: Colorless liquid; mild odor.

EMERGENCY PHONE NUMBER: 1-800-UCC-HELP (Number available at all times)

UNION CARBIDE CORPORATION
Industrial Chemicals Division
39 Old Ridgebury Road, Danbury, CT. 06817-0001

PRODUCT NAME: ETHYLENE GLYCOL, IND., TECH., AND LOW FREEZE GRADES

III. INGREDIENTS

MATERIAL	%	TLV (Units)	HAZARD
Ethylene Glycol	100	50 ppm C, ACGIH	See Section V

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method(s)):
241 F, Tag closed cup, ASTM D 56
240 F, Cleveland open cup, ASTM D 92

FLAMMABLE LIMITS IN AIR, % by volume:
LOWER: 3.2 Calculated
UPPER: 15.3 (Estimated)

EXTINGUISHING MEDIA: Apply alcohol-type or all-purpose-type foams by manufacturers' recommended techniques for large fires. Use C02 or dry chemical media for small fires.

SPECIAL FIRE FIGHTING PROCEDURES: Do not spray pool fires directly; a solid stream of water or foam directed into hot burning liquid can cause frothing. Use self-contained breathing apparatus and protective clothing.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

V. HEALTH HAZARD DATA

TLV AND SOURCE: See Section III.

EFFECTS OF SINGLE OVEREXPOSURE:

SWALLOWING: May cause abdominal discomfort or pain, nausea, vomiting, dizziness, drowsiness, malaise, blurring of vision, irritability, lumbar pain, oliguria, uremia, and central nervous system effects, including irregular eye movements, convulsions and coma. Cardiac failure and pulmonary edema may develop. Severe kidney damage follows the swallowing of large volumes of ethylene glycol. May be fatal. A few reports have been published describing the development of weakness of the facial muscles, diminished hearing, and difficulty with swallowing, during the late stages of severe poisoning.

SKIN ABSORPTION: No evidence of adverse effects from available information.

INHALATION: May cause irritation of the nose and throat with headache, particularly from mists. High vapor concentrations caused, for example, by heating the material in an enclosed and poorly ventilated workplace, may produce nausea, vomiting, headache, dizziness, and irregular eye movements.

SKIN CONTACT: No evidence of adverse effects from available information.

EYE CONTACT: Liquid, vapor, and mist, may cause discomfort in the eye with persistent conjunctivitis, seen as slight excess redness of conjunctiva. Serious corneal injury is not anticipated.

EFFECTS OF REPEATED OVEREXPOSURE:
Inhalation of mist may produce signs of central nervous system involvement, particularly dizziness and nystagmus.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:
The available toxicology information and a knowledge of the physical and

chemical properties of the material suggest that overexposure is unlikely to aggravate existing medical conditions.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. Also, in a preliminary study to assess the effects of exposure of pregnant rats and mice to aerosols at concentrations 150, 1000 and 2500 mg/m3 for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentration, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol, percutaneous absorption of ethylene glycol from contaminated skin, or swallowing of ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure resulted in maternal toxicity (1000 and 2500 mg/m3) and developmental toxicity with minimal evidence of teratogenicity (2500 mg/m3). The no-effects concentration (based on maternal toxicity) was 500 mg/m3. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to the skin of pregnant mice over the period of organogensis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen; there is currently no available information to suggest that ethylene glycol has caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental toxicity; exposure to high aerosol concentration is only minimally effective in producing developmental toxicity; the major route for producing developmental toxicity is perorally. Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases or tumor incidence, or a different pattern of tumors compared to untreated controls. The absence of a carcinogenic potential for ethylene glycol has been supported by numerous in vitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

OTHER EFFECTS OF OVEREXPOSURE:
Repeated skin contact may, in a very small proportion of cases, cause sensitization with the development of allergic contact dermatitis.

EMERGENCY AND FIRST AID PROCEDURES:

SWALLOWING: If conscious, give two glasses of water and induce vomiting. Call a physician immediately.

SKIN: Remove contaminated clothing and flush skin with water.

INHALATION: Remove to fresh air. Call a physician if discomfort persists.

EYES: Immediately flush with water, and continue washing the eyes for several minutes.

NOTES TO PHYSICIAN: The principal toxic effects of ethylene glycol, when swallowed , are kidney damage and metabolic acidosis. Ethanol is antidotal, and its early administration may block the formation of nephrotoxic metabolites of ethylene glycol in the liver. Ethanol should be given intravenously, as a 5% solution in sodium bicarbonate, at a rate of about 10 ml ethanol per hour. A desired therapeutic level of ethanol in blood is 100 mg/dl. Hemodialysis may be required. 4-Methylpyrazole, a potent inhibitor of alcohol dehydrogenase, has been used therapeutically to decrease the metabolic consequences of ethylene glycol poisoning before coma, seizure, and renal failure have occurred (20 mg/kg/day).
Pulmonary edema with hypoxemia has been described in a number of patients following poisoning with ethylene glycol. The mechanism of production has not been elucidated, but it appears to be noncardiogenic in origin in several cases. Respiratory support with mechanical ventilation and positive end-expiratory pressure may be required.
There may be cranial nerve involvement in the late stages of toxicity from swallowed ethylene glycol. In particular, effects have been reported involving the seventh, eighth and ninth cranial nerves, presenting with bilateral facial paralysis, diminished hearing, and dysphagia.

VI. REACTIVITY DATA

PRODUCT NAME: ETHYLENE GLYCOL, IND., TECH., AND LOW FREEZE GRADES

STABILITY: Stable

CONDITIONS TO AVOID: None

INCOMPATIBILITY (materials to avoid):
Normally unreactive; however, avoid strong bases at high temperatures, strong acids, strong oxidizing agents and materials reactive with hydroxyl compounds.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS:
Burning can produce carbon monoxide and/or carbon dioxide.

HAZARDOUS POLYMERIZATION: Will Not Occur

CONDITIONS TO AVOID: None

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Wear suitable protective equipment. Small spills should be flushed with large quantities of water. Larger spills should be collected for disposal.

WASTE DISPOSAL METHOD: Incinerate in a furnace where permitted under appropriate Federal, State, or local regulations. At very low concentration in water, ethylene glycol is readily biodegradable in a biological wastewater treatment plant.

VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type):
NIOSH approved breathing air equipment or NIOSH approved face mask with organic vapor cartridge and dust or mist pre-filter (not for use in fire fighting or in atmospheres with reduced oxygen content).

VENTILATION: General (mechanical) room ventilation may be adequate if handled at ambient temperatures or in covered equipment. If ambient temperatures are exceeded or operations exist which may produce misting, local exhaust ventilation is needed.

PROTECTIVE GLOVES: Rubber or polyvinyl chloride coated.

EYE PROTECTION: Monogoggles or faceshield.

OTHER PROTECTIVE EQUIPMENT:
Eye bath and safety shower.

IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
DANGER!! Harmful or fatal if swallowed.
Prolonged or repeated breathing of mist or vapor harmful.
Causes eye irritation.
Causes birth defects in laboratory animals.
Repeated contact may cause allergic skin reaction.
May cause kidney and nervous system damage.
Do not swallow.
Do not breathe mist from spray.

Avoid prolonged or repeated breathing of vapor.
Avoid contact with eyes, skin or clothing.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
FOR INDUSTRY USE ONLY

OTHER PRECAUTIONS: None known.

X. REGULATORY INFORMATION

STATUS ON SUBSTANCE LISTS:

The concentrations shown are maximum or ceiling levels (weight %) to be used for calculations for regulations. Trade Secrets are indicated by "TS".

FEDERAL EPA

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center of release of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQs) in 40 CFR 302.4.

Components present in this product at a level which could require reporting under the statute are:

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Dioxane	123-91-1	.0026

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III
requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on Reportable Quantities (RQs) in 40 CFR 355 (used for SARA 302, 304, 311 and 312).

Components present in this product at a level which could require reporting under the statute are:
*** NONE ***

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III
requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all MSDSs that are copied and distributed for this material.

Components present in this product at a level which could require reporting under the statute are:

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Ethylene Glycol	107-21-1	92.0

STATE RIGHT-TO-KNOW

CALIFORNIA Proposition 65

This product contains trace levels of Dioxane which the State of California has found to cause cancer, birth defects or other reproductive harm.

MASSACHUSETTS Right-To-Know, Substance List (MSL) Hazardous Substances and Extraordinarily Hazardous Substances on the MSL must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are:
EXTRAORDINARILY HAZARDOUS SUBSTANCES (=> 0.0001%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Dioxane	123-91-1	.0013

PRODUCT NAME: ETHYLENE GLYCOL, IND., TECH., AND LOW FREEZE GRADES

HAZARDOUS SUBSTANCES (=> 1%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Ethylene Glycol	107-21-1	100.00

PENNSYLVANIA Right-To-Know, Hazardous Substance List Hazardous Substances and Special Hazardous Substances on the List must be identified when present in products.

Components present in this product at a level which could require reporting under the statute are:

HAZARDOUS SUBSTANCES (=> 1%)

CHEMICAL	CAS NUMBER	UPPER BOUND CONCENTRATION %
Ethylene Glycol	107-21-1	100.00

Toxic Substances Control Act(TSCA) STATUS:

The ingredients of this product are on the TSCA inventory.

CALIFORNIA SCAQMD RULE 443.1 VOC'S:

Not presently available

NOTE ----

The opinions expressed herein are those of qualified experts within Union Carbide Corporation. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and of these opinions and the conditions of the use of the product are not within the control of Union Carbide Corporation, it is the user's obligation to determine the conditions of safe use of the product.

Date: 10/31/88

Revision Date: 01/25/89 Printed in USA

PC: 35187

F NUMBER: N0178

AC	**A**lternating **C**urrent. 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	**Amp**eres. 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	**A**merican **W**ire **G**auge. 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, O-ring, nozzle, swirl ring and retaining cap.
current	Movement of electricity, measured in amperes. Current is said to move in a direction opposite that of electron flow.
DC	**D**irect **C**urrent. 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 the MAX100 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.
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 surplus 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, from 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.
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 *transfers* to the work when the plasma arc leaves the surface of the nozzle and attaches to the work.

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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