

THERMAL DYNAMICS[®]



A THERMADYNE[®] Company

PAK MASTER[®] 100
Air Plasma Cutting System

The System Includes:

- ***PAK MASTER[®] 100 Power Supply***
- ***PCH/M-53 Torch with Leads***
- ***Work Cable with Clamp***
- ***Input Gas Regulator Assembly***

Operating Manual

October 10, 1997

Manual No. 0-2427

**WARNING**

Read and understand this entire Operating Manual and your employer's safety practices before installing, operating, or servicing the equipment.

**WARNING**

While the information contained in this Operating Manual represents our best judgement, Thermal Dynamics Corporation assumes no liability for its use.

Pak Master® 100 Air Plasma Cutting System Operating Manual
Number 0-2427

Published by:

Thermal Dynamics Corporation

Industrial Park No. 2

West Lebanon, New Hampshire, USA 03784

(603) 298-5711

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SECTION 1: GENERAL INFORMATION

1.01 Notes, Cautions and Warnings

Throughout this manual, notes, cautions, and warnings are used to highlight important information. These highlights are categorized as follows:

NOTE

An operation, procedure, or background information which requires additional emphasis or is helpful in efficient operation of the system.

CAUTION

A procedure which, if not properly followed, may cause damage to the equipment.



WARNING

A procedure which, if not properly followed, may cause injury to the operator or others in the operating area.

1.02 Important Safety Precautions



WARNING

OPERATION AND MAINTENANCE OF PLASMA ARC EQUIPMENT CAN BE DANGEROUS AND HAZARDOUS TO YOUR HEALTH.

To prevent possible injury, read, understand and follow all warnings, safety precautions and instructions before using the equipment. Call 1-603-298-5711 or your local distributor if you have any questions.



GASES AND FUMES

Gases and fumes produced during the plasma cutting process can be dangerous and hazardous to your health.

- Keep all fumes and gases from the breathing area. Keep your head out of the welding fume plume.

- Use an air-supplied respirator if ventilation is not adequate to remove all fumes and gases.
- The kinds of fumes and gases from the plasma arc depend on the kind of metal being used, coatings on the metal, and the different processes. You must be very careful when cutting or welding any metals which may contain one or more of the following:

Antimony	Chromium	Mercury
Arsenic	Cobalt	Nickel
Barium	Copper	Selenium
Beryllium	Lead	Silver
Cadmium	Manganese	Vanadium

- Always read the Material Safety Data Sheets (MSDS) that should be supplied with the material you are using. These MSDSs will give you the information regarding the kind and amount of fumes and gases that may be dangerous to your health.
- For information on how to test for fumes and gases in your workplace, refer to item 1 in Subsection 1.03, Publications in this manual.
- Use special equipment, such as water or down draft cutting tables, to capture fumes and gases.
- Do not use the plasma torch in an area where combustible or explosive gases or materials are located.
- Phosgene, a toxic gas, is generated from the vapors of chlorinated solvents and cleansers. Remove all sources of these vapors.



ELECTRIC SHOCK

Electric Shock can injure or kill. The plasma arc process uses and produces high voltage electrical energy. This electric energy can cause severe or fatal shock to the operator or others in the workplace.

- Never touch any parts that are electrically “live” or “hot.”
- Wear dry gloves and clothing. Insulate yourself from the work piece or other parts of the welding circuit.
- Repair or replace all worn or damaged parts.
- Extra care must be taken when the workplace is moist or damp.
- Install and maintain equipment according to NEC code, refer to item 4 in Subsection 1.03, Publications.
- Disconnect power source before performing any service or repairs.
- Read and follow all the instructions in the Operating Manual.



FIRE AND EXPLOSION

Fire and explosion can be caused by hot slag, sparks, or the plasma arc.

- Be sure there is no combustible or flammable material in the workplace. Any material that cannot be removed must be protected.
- Ventilate all flammable or explosive vapors from the workplace.
- Do not cut or weld on containers that may have held combustibles.
- Provide a fire watch when working in an area where fire hazards may exist.
- Hydrogen gas may be formed and trapped under aluminum workpieces when they are cut underwater or while using a water table. **DO NOT** cut aluminum alloys underwater or on a water table unless the hydrogen gas can be eliminated or dissipated. Trapped hydrogen gas that is ignited will cause an explosion.



NOISE

Noise can cause permanent hearing loss. Plasma arc processes can cause noise levels to exceed safe limits. You must protect your ears from loud noise to prevent permanent loss of hearing.

- To protect your hearing from loud noise, wear protective ear plugs and/or ear muffs. Protect others in the workplace.
- Noise levels should be measured to be sure the decibels (sound) do not exceed safe levels.
- For information on how to test for noise, see item 1 in Subsection 1.03, Publications, in this manual.



PLASMAARC RAYS

Plasma Arc Rays can injure your eyes and burn your skin. The plasma arc process produces very bright ultra violet and infra red light. These arc rays will damage your eyes and burn your skin if you are not properly protected.

- To protect your eyes, always wear a welding helmet or shield. Also always wear safety glasses with side shields, goggles or other protective eye wear.
- Wear welding gloves and suitable clothing to protect your skin from the arc rays and sparks.

- Keep helmet and safety glasses in good condition. Replace lenses when cracked, chipped or dirty.
- Protect others in the work area from the arc rays. Use protective booths, screens or shields.
- Use the shade of lens as recommended in Subsection 1.03, item 4.

1.03 Publications

Refer to the following standards or their latest revisions for more information:

1. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
3. 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
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from 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 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 American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING AND ALLIED PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202

12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING, obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103
14. American Welding Society Standard AWSF4.1, 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 N.W. LeJeune Rd, Miami, FL 33126
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

1.04 Note, Attention et Avertissement

Dans ce manuel, les mots “note,” “attention,” et “avertissement” sont utilisés pour mettre en relief des informations à caractère important. Ces mises en relief sont classifiées comme suit :

NOTE

Toute opération, procédure ou renseignement général sur lequel il importe d'insister davantage ou qui contribue à l'efficacité de fonctionnement du système.

ATTENTION

Toute procédure pouvant résulter l'endommagement du matériel en cas de non-respect de la procédure en question.



AVERTISSEMENT

Toute procédure pouvant provoquer des blessures de l'opérateur ou des autres personnes se trouvant dans la zone de travail en cas de non-respect de la procédure en question.

1.05 Precautions De Securite Importantes



AVERTISSEMENT

L'OPÉRATION ET LA MAINTENANCE DU MATÉRIEL DE SOUDAGE À L'ARC AU JET DE PLASMA PEUVENT PRÉSENTER DES RISQUES ET DES DANGERS DE SANTÉ.

Il faut communiquer aux opérateurs et au personnel TOUS les dangers possibles. Afin d'éviter les blessures possibles, lisez, comprenez et suivez tous les avertissements, toutes les précautions de sécurité et toutes les consignes avant d'utiliser le matériel. Composez le + 603-298-5711 ou votre distributeur local si vous avez des questions.



FUMÉE et GAZ

La fumée et les gaz produits par le procédé de jet de plasma peuvent présenter des risques et des dangers de santé.

- Eloignez toute fumée et gaz de votre zone de respiration. Gardez votre tête hors de la plume de fumée provenant du chalumeau.
- Utilisez un appareil respiratoire à alimentation en air si l'aération fournie ne permet pas d'éliminer la fumée et les gaz.
- Les sortes de gaz et de fumée provenant de l'arc de plasma dépendent du genre de métal utilisé, des revêtements se trouvant sur le métal et des différents procédés. Vous devez prendre soin lorsque vous coupez ou soudez tout métal pouvant contenir un ou plusieurs des éléments suivants:

antimoine	cadmium	mercure
argent	chrome	nickel
arsenic	cobalt	plomb
baryum	civre	sélénium
béryllium	manganèse	vanadium
- Lisez toujours les fiches de données sur la sécurité des matières (sigle américain “MSDS”); celles-ci devraient être fournies avec le matériel que vous utilisez. Les MSDS contiennent des renseignements quant à la quantité et la nature de la fumée et des gaz pouvant poser des dangers de santé.
- Pour des informations sur la manière de tester la fumée et les gaz de votre lieu de travail, consultez l'article 1 et les documents cités à la page 5.

- Utilisez un équipement spécial tel que des tables de coupe à débit d'eau ou à courant descendant pour capter la fumée et les gaz.
- N'utilisez pas le chalumeau au jet de plasma dans une zone où se trouvent des matières ou des gaz combustibles ou explosifs.
- Le phosgène, un gaz toxique, est généré par la fumée provenant des solvants et des produits de nettoyage chlorés. Éliminez toute source de telle fumée.



CHOC ELECTRIQUE

Les chocs électriques peuvent blesser ou même tuer . Le procédé au jet de plasma requiert et produit de l'énergie électrique haute tension. Cette énergie électrique peut produire des chocs graves, voire mortels, pour l'opérateur et les autres personnes sur le lieu de travail.

- Ne touchez jamais une pièce "sous tension" ou "vive"; portez des gants et des vêtements secs. Isolez-vous de la pièce de travail ou des autres parties du circuit de soudage.
- Réparez ou remplacez toute pièce usée ou endommagée.
- Prenez des soins particuliers lorsque la zone de travail est humide ou moite.
- Montez et maintenez le matériel conformément au Code électrique national des Etats-Unis. (Voir la page 5, article 9.)
- Débranchez l'alimentation électrique avant tout travail d'entretien ou de réparation.
- Lisez et respectez toutes les consignes du Manuel de consignes.



INCENDIE ET EXPLOSION

Les incendies et les explosions peuvent résulter des scories chaudes, des étincelles ou de l'arc de plasma. Le procédé à l'arc de plasma produit du métal, des étincelles, des scories chaudes pouvant mettre le feu aux matières combustibles ou provoquer l'explosion de fumées inflammables.

- Soyez certain qu'aucune matière combustible ou inflammable ne se trouve sur le lieu de travail. Protégez toute telle matière qu'il est impossible de retirer de la zone de travail.
- Procurez une bonne aération de toutes les fumées inflammables ou explosives.
- Ne coupez pas et ne soudez pas les conteneurs ayant pu renfermer des matières combustibles.

- Prévoyez une veille d'incendie lors de tout travail dans une zone présentant des dangers d'incendie.
- Le gas hydrogène peut se former ou s'accumuler sous les pièces de travail en aluminium lorsqu'elles sont coupées sous l'eau ou sur une table d'eau. NE PAS couper les alliages en aluminium sous l'eau ou sur une table d'eau à moins que le gas hydrogène peut s'échapper ou se dissiper . Le gas hydrogène accumulé explosera si enflammé.



RAYONS D'ARC DE PLASMA

Les rayons provenant de l'arc de plasma peuvent blesser vos yeux et brûler votre peau. Le procédé à l'arc de plasma produit une lumière infra-rouge et des rayons ultra-violet très forts. Ces rayons d'arc nuiront à vos yeux et brûleront votre peau si vous ne vous protégez pas correctement.

- Pour protéger vos yeux, portez toujours un casque ou un écran de soudeur. Portez toujours des lunettes de sécurité munies de parois latérales ou des lunettes de protection ou une autre sorte de protection oculaire.
- Portez des gants de soudeur et un vêtement protecteur approprié pour protéger votre peau contre les étincelles et les rayons de l'arc.
- Maintenez votre casque et vos lunettes de protection en bon état. Remplacez toute lentille sale ou comportant fissure ou rognure.
- Protégez les autres personnes se trouvant sur la zone de travail contre les rayons de l'arc en fournissant des cabines ou des écrans de protection.
- Respectez le teint de lentille recommandé dans le article 4, page 5.



BRUIT

Le bruit peut provoquer une perte permanente de l'ouïe. Les procédés de soudage à l'arc de plasma peuvent provoquer des niveaux sonores supérieurs aux limites normalement acceptables. Vous devez vous protéger les oreilles contre les bruits forts afin d'éviter une perte permanente de l'ouïe.

- Pour protéger votre ouïe contre les bruits forts, portez des tampons protecteurs et/ou des protections auriculaires. Protégez également les autres personnes se trouvant sur le lieu de travail.
- Il faut mesurer les niveaux sonores afin d'assurer que les décibels (le bruit) ne dépassent pas les niveaux sûrs.

- Pour des renseignements sur la manière de tester le bruit, consultez l'article 1, page 5.

1.06 Documents De Reference

Consultez les normes suivantes ou les révisions les plus récentes ayant été faites à celles-ci pour de plus amples renseignements :

1. OSHA, NORMES DE SÉCURITÉ DU TRAVAIL ET DE PROTECTION DE LA SANTÉ, 29CFR 1910, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. Norme ANSI Z49.1, LA SÉCURITÉ DES OPÉRATIONS DE COUPE ET DE SOUDAGE, disponible auprès de la Société Américaine de Soudage (American Welding Society), 550 N.W. LeJeune Rd., Miami, FL 33126
3. NIOSH, LA SÉCURITÉ ET LA SANTÉ LORS DES OPÉRATIONS DE COUPE ET DE SOUDAGE À L'ARC ET AU GAZ, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. Norme ANSI Z87.1, PRATIQUES SURES POUR LA PROTECTION DES YEUX ET DU VISAGE AU TRAVAIL ET DANS LES ECOLES, disponible de l'Institut Américain des Normes Nationales (American National Standards Institute), 1430 Broadway, New York, NY 10018
5. Norme ANSI Z41.1, NORMES POUR LES CHAUSSURES PROTECTRICES, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
6. Norme ANSI Z49.2, PRÉVENTION DES INCENDIES LORS DE L'EMPLOI DE PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
7. Norme A6.0 de l'Association Américaine du Soudage (AWS), LE SOUDAGE ET LA COUPE DE CONTENEURS AYANT RENFERMÉ DES PRODUITS COMBUSTIBLES, disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
8. Norme 51 de l'Association Américaine pour la Protection contre les Incendies (NFP A), LES SYSTEMES À GAZ AVEC ALIMENTATION EN OXYGENE POUR LE SOUDAGE, LA COUPE ET LES PROCÉDÉS ASSOCIÉS, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. Norme 70 de la NFP A, CODE ELECTRIQUE NATIONAL, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. Norme 51B de la NFP A, LES PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. Brochure GCA P-1, LA MANIPULATION SANS RISQUE DES GAZ COMPRIMÉS EN CYLINDRES, disponible auprès de l'Association des Gaz Comprimés (Compressed Gas Association), 1235 Jefferson Davis Highway Suite 501, Arlington, VA 22202
12. Norme CSA W117.2, CODE DE SÉCURITÉ POUR LE SOUDAGE ET LA COUPE, disponible auprès de l'Association des Normes Canadiennes, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada, M9W 1R3
13. ivret NWSA, BIBLIOGRAPHIE SUR LA SÉCURITÉ DU SOUDAGE, disponible auprès de l'Association Nationale de Fournitures de Soudage (National Welding Supply Association), 1900 Arch Street, Philadelphia, PA 19103
14. Norme AWSF4.1 de l'Association Américaine de Soudage, RECOMMANDATIONS DE PRATIQUES SURES POUR LA PRÉPARATION À LA COUPE ET AU SOUDAGE DE CONTENEURS ET TUYAUX AYANT RENFERMÉ DES PRODUITS DANGEREUX, disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
15. Norme ANSI Z88.2, PRATIQUES DE PROTECTION RESPIRATOIRE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018

1.07 Declaration of Conformity

Manufacturer: Thermal Dynamics Corporation
Address: Industrial Park #2
West Lebanon, New Hampshire 03784
USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EU, as recently changed in Directive 93/63/EU) and to the National legislation for the enforcement of this Directive.

Serial numbers are unique with each individual piece of equipment and details description, parts used to manufacture a unit and date of manufacture.

National Standard and Technical Specifications

The product is designed and manufactured to a number of standards and technical requirements among them are:

- * CSA (Canadian Standards Association) standard C22.2 number 60-M1990 for Arc welding equipment.
- * UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.
- * IEC 974-1 (BS 638-PT10) (EN 60 974-1) applicable to welding equipment and associated accessories.

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process, to ensure the product is safe and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Thermal Dynamics has been manufacturing products that perform in a safe manner for more than 30 years and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative: David Ashworth
Vice President & Managing Director
Thermadyne Europe
Chorley England.

1.08 Statement of Warranty

LIMITED WARRANTY: Thermal Dynamics Corporation (hereinafter "Thermal") warrants that its products will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the time period applicable to the Thermal products as stated below, Thermal shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal's sole option, of any components or parts of the product determined by Thermal to be defective.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: Thermal shall not under any circumstances be liable for special or consequential damages, such as, but not limited to, damage or loss of purchased or replacement goods, or claims of customers of distributor (hereinafter "Purchaser") for service interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based.

THIS WARRANTY BECOMES INVALID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL PRODUCT.

THIS WARRANTY IS INVALID IF THE PRODUCT IS SOLD BY NON-AUTHORIZED PERSONS.

The limited warranty periods for Thermal products shall be as follows (with the exception of STAK PAK II): A maximum of three (3) years from date of sale to an authorized distributor and a maximum of two (2) years from date of sale by such distributor to the Purchaser, and with the following further limitations on such two (2) year period. The limited warranty period for STAK PAK II shall be as follows: A maximum of four (4) years from date of sale to an authorized distributor and a maximum of three (3) years from date of sale by such distributor to the Purchaser, and with the following further limitations on such three (3) year period:

<u>PAK UNITS, POWER SUPPLIES</u>	<u>STAK PAK II</u>	<u>PARTS</u>	
		<u>ALL OTHERS</u>	<u>LABOR</u>
MAIN POWER MAGNETICS	3 YEARS	2 YEARS	1 YEAR
ORIGINAL MAIN POWER RECTIFIER	3 YEARS	2 YEARS	1 YEAR
CONTROL PC BOARD	3 YEARS	2 YEARS	1 YEAR
ALL OTHER CIRCUITS AND COMPONENTS	1 YEAR	1 YEAR	1 YEAR
INCLUDING, BUT NOT LIMITED TO, STARTING CIRCUIT, CONTACTORS, RELAYS, SOLENOIDS, PUMPS, POWER SWITCHING SEMI-CONDUCTORS			
<u>CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES, AND ACCESSORY EQUIPMENT</u>	1 YEAR	1 YEAR	1 YEAR
<u>TORCH AND LEADS</u>	180 DAYS	180 DAYS	180 DAYS
<u>REPAIR/REPLACEMENT PARTS</u>	90 DAYS	90 DAYS	NONE

Warranty repairs or replacement claims under this limited warranty must be submitted by an authorized Thermal Arc® repair facility within thirty (30) days of the repair. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the customer. All returned goods shall be at the customer's risk and expense. This warranty supersedes all previous Thermal warranties.

Thermal Arc® is a Registered Trademark of Thermal Dynamics.

Effective February 1, 1995

SECTION 2: INTRODUCTION

2.01 Scope of Manual

This manual contains descriptions, operating instructions and basic maintenance procedures for the PAK Master[®] 100 Air Plasma Cutting System. Service of this equipment is restricted to Thermal Dynamics trained personnel; unqualified personnel are strictly cautioned against attempting repairs or adjustments not covered in this manual, at the risk of voiding the Warranty.

Read this manual thoroughly. A complete understanding of the characteristics and capabilities of this equipment will assure the dependable operation for which it was designed.

2.02 System Description

The Pak Master 100 Air Plasma Cutting System Includes:

A. Power Supply

The power supply provides 70 amp maximum output and includes all control circuitry, electrical and gas inputs and outputs, pilot circuitry, torch leads receptacle and a work cable with clamp. A ten foot primary input power cable is wired to the supply. Machine torch systems also include a remote hand ON/OFF pendant.

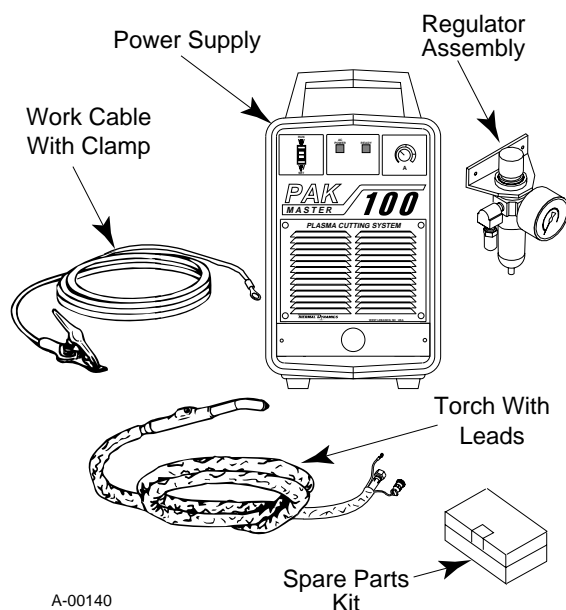


Figure 2-A System Components

B. Torch With Leads

The Torch, PCH/M-53 with Leads, provides a maximum 1 inch (25.4 mm) cut capacity. Hand torches are available in 70° and 90° configurations. Machine torches include a rack and pinion mounting assembly. Torch leads are available in 25 ft (7.6 m), or 50 ft (15.2 m) lengths with fittings for simple installation. The torch includes a spare parts kit which provides an assortment of replacement torch parts.

NOTE

Refer to Sections 2.04 and 2.05 for other system accessories.

2.03 Specifications/Design Features

A. Power Supply Technical Specifications

The following specifications apply to the Power Supply only:

1. Front Panel Controls:

RUN/SET Switch and Output Current Control

2. Front Panel LED Indicators:

AC POWER and READY

3. Rear Panel Controls:

ON/OFF Switch, input power cable and gas connection

4. Input Power

Available for the following input power:

208/230 VAC (±10%), 50/60 Hz, Single-Phase

380/415 VAC (±10%), 50/60 Hz, Three-Phase

460 VAC (±10%), 50/60 Hz, Three-Phase

5. Load/No Load Input Current

Unit	At No Load			At Rated Load		
	Amps	KVA	KW	Amps	KVA	KW
208 VAC 1-Phase	2.4	0.5	0.3	75	15.6	9.9
230 VAC 1-Phase	2.2	0.5	0.3	68	15.6	9.9
230 VAC 3-Phase	1.3	0.5	0.3	32	12.7	9.9
380 VAC 3-Phase	0.8	0.5	0.3	19	12.7	9.9
415 VAC 3-Phase	0.7	0.5	0.3	18	12.7	9.9
460 VAC 3-Phase	0.6	0.5	0.3	16	12.7	9.9

6. Output Power

Continuously variable from 16 to 70Amps maximum
40% Duty Cycle

7. Cut Capacity

1 in (25.4 mm)

8. Pilot Circuitry

High Frequency (HF), Pulsed DC

9. Weight

95 lbs (43 kg)

10. Dimensions

20" (510 mm) High x 11" (280 mm) Wide x 18.5" (470 mm) Long

B. Torch Specifications

The following specifications apply to the Torch Assembly only:

1. Configurations

70° or 90° Hand Torch, 180° Machine Torch

2. Current Rating

70 amps Maximum, DC Straight Polarity

3. Duty Cycle

100% @ 70 amps

4. Cutting Range

Most metals up to 1 inch (25.4 mm)

5. Pierce Rating

1/2 in (12.7 mm)

6. Transfer Distance

Approximately 3/8 in (9.5 mm)

7. Torch Parts

Electrode, Tip, Shield Cup

8. Gases

Compressed Air, Nitrogen (N₂)

9. Pressure Requirements

70 psi (4.8 BAR)

10. Flow Requirements:

Cutting - 300 scfh (141.5 lpm)

Gouging - 300 scfh (141.5 lpm)

11. Available Leads Lengths

25 ft (7.6 m), or 50 ft (15.2 m)

C. Regulator/Filter Assembly Specifications

The following specifications apply to the Regulator/Filter Assembly only:

1. Regulator maximum gauge pressure

160 psi (11 BAR)

2. Filter

Coalescent type filter

2.04 Power Supply Accessories

NOTE

Refer to Section 6, Parts Lists, for part numbers and ordering information.

The following are accessories that are available for this power supply:

A. Remote Hand Pendant Control

Hand-held remote ON/OFF control device. Includes a 25 ft (7.6 m) cable.

B. High Pressure Regulators

High pressure regulators are available for air and nitrogen. The regulators are used to set the proper pressure for the type gas being used.

C. Two Stage Air Line Filter

An optional two stage air line filter is available. The filter will remove moisture and contaminants from the air stream when using compressed air. The filter is capable of filtering to at least 5 microns. The filter assembly is pre-assembled at the factory and need only be attached to the power supply.

D. Interface Cable

The interface cable is available in two lengths, 25 ft (7.6 m) and 50 ft (15.2 m). The cable is used to interface the power supply with an auxiliary control device to provide an ON/OFF signal.

E. Smart Cart - Wicked Wheels

Steel cart on easy rolling 10" pneumatic tires to provide maximum mobility for the power supply. Handle is 3/4" tubing with hooks for storage of torch leads. A tie down strap is also included.

2.05 Torch Accessories

NOTE

Refer to Section 6, Parts Lists, for part numbers and ordering information.

The following are accessories that are available for this torch:

A. Spare Parts Kits

Cutting and gouging spare parts kits contain replacement front-end torch parts.

B. Circle Cutting Attachment

Provides manual guidance of circle cuts from 2-1/4 inches (57mm) to 24 inches (610mm) when used with a 70° or 90° hand torch. Includes roller guides and pivots that attach to the torch.

C. Extension Rod

A 12 inch (300mm) extension rod to be used with the Circle Cutting Attachment.

SECTION 3: INSTALLATION PROCEDURES

3.01 Introduction

This Section describes installation of the Power Supply and Torch.

These instructions apply to the Power Supply and Torch Assemblies only; installation procedures for Options and Accessories are given in Manuals specifically provided for those units.

The complete installation consists of:

1. Site selection
2. Unpacking
3. Connections to Power Supply
 - a. Input power
 - b. Gas
 - c. Work cable
 - d. Torch Leads
4. Grounding
5. Torch installation
 - a. Set-up
 - b. Installation
6. Operator training

3.02 Site Selection

Select a clean, dry location with good ventilation and adequate working space around all components.

NOTE

Review Important Safety Precautions (page 1) to be sure that the selected location meets all safety requirements.

The power supply is fan cooled by air flow through the rear panel. Air flow must not be obstructed. Provide at least 2 feet (0.61 m) in the rear and at least 6 inches (0.15 m) on each side for clearance. Provide sufficient clearance in front of the unit to allow access to the front panel controls (minimum 6 inches or 0.15 m).

CAUTION

Operation without proper air flow will inhibit proper cooling and reduce duty cycle.

3.03 Unpacking

Each component of the system is packaged separately and protected with a carton and packing material to prevent damage during shipping.

A. Power Supply Package

Included with each power supply is:

- (1) Ten foot input Power Cable
- (1) Fuse - 2 Amp, 600V

B. Torch Package

The Torch Package packaged separately and includes:

- (1) PCH/M-53Torch and Leads with Shield Cup, Tip, Electrode and all connectors installed)
- (1) Work Cable with Clamp
- (1) Operating Manual
- (1) Remote Control Hand Pendant with PCM-53 only
- (1) Pressure regulator assembly with filter and connection hardware
- (1) Spare Parts Kit - Includes:
 - (1) Lubricant
 - (1) Box, Utility
 - (1) O-Ring
 - (1) Nut Driver, 1/4"
 - (5) Electrode, Air, Plated
 - (5) Tip, Air, 0.049 Orifice
 - (1) Shield Cup - Crown
 - (1) Shield Cup, Standard (Phenolic)
 - (1) Wrench, Open End, 1/2"
- (1) Torch Handle Assembly (For Hand Torches)
or
- (1) Machine Torch Mounting Assembly (For Machine Torches)

C. Accessories

Accessories are packaged separately.

D. Unpacking Procedure

1. Unpack each item and remove all packing material.

2. Locate the packing list(s) and use the list to identify and account for each item.
3. Inspect each item for possible shipping damage. If damage is evident, contact your distributor and/or shipping company before proceeding with system installation.

3.04 Lifting Options



WARNINGS

Do not touch live electrical parts.

Disconnect input power conductors from de-energized supply line before moving unit.

This unit is equipped with two handles molded into the case for carrying purposes.



WARNING

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

- Lift unit with handles on top ends of case.
- Have two persons of adequate physical strength lift unit.
- Use hand cart or similar device of adequate capacity.
- If using a fork lift vehicle, place and secure unit on a proper skid before transporting.
- This unit has built-in handles on top ends of case for **hand lifting only**. Be sure unit is lifted and transported safely and securely.



WARNING

HANDLES are not for mechanical lifting.

- Do not lift unit by one handle.

3.05 Input Power Connections

A. Primary Input Voltages

Depending on the unit the input voltage level can be one of the following:

208/230 VAC ($\pm 10\%$) Single Phase, 50/60 Hz

380/415 VAC ($\pm 10\%$) Three Phase, 50/60 Hz

460 VAC ($\pm 10\%$) Three Phase, 50/60 Hz

B. Voltage Selection

The input voltage must match the electrical input voltage for the model to be installed.

The 208/230 VAC and 380/415 VAC models incorporate a "Smart Logic" circuit, which automatically senses the input voltage levels and adjusts it to allow for operation of unit within input rating on data tag. It is not necessary to manually switch (terminals or links) if unit is moved to a new location and a different input power is selected.

NOTE

The 460 VAC model does not use the "Smart Logic" circuit.

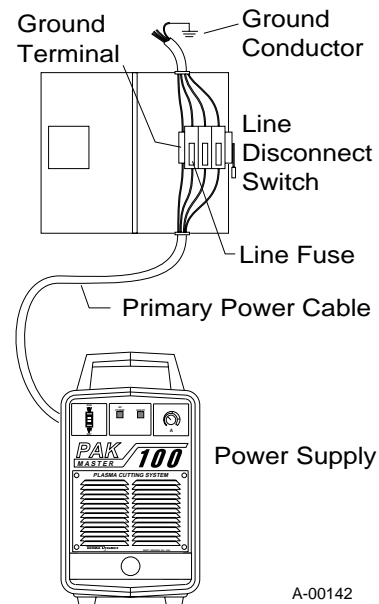


Figure 3-A Electrical Input Connections

- The surge current prevention circuit becomes activated when the PRIMARY POWER switch is turned ON.
- On the 208/230 VAC and 380/415 VAC models only about two seconds after power on, the Smart Logic circuit detects the input voltage and automatically selects the correct circuits for operation.
- The unit is ready for operation in five seconds after turn-on.

3.06 Gas Connections

A. Gas Requirements



WARNING

This unit not to be used with oxygen (O₂).

Gases: Compressed Air or Nitrogen (N₂) Only

Pressure: 70 psi (4.8 BAR)

CAUTION

Maximum input gas pressure must not exceed 125 psi (8.6 BAR)

Flow: Cutting - 300 scfh (141.5 lpm)

Gouging - 300 scfh (141.5 lpm)

CAUTION

Air supply must be free of oil, moisture, and other contaminants. Excessive oil and moisture may cause double-arcing, rapid tip wear, or even complete torch failure. Contaminants may cause poor cutting performance and rapid electrode wear.

B. Checking Air Quality

To test the quality of air, place the RUN/SET switch to SET position, place a welding filter lens in front of the torch and turn on the gas. Any oil or moisture in the air will be visible on the lens. Do not initiate an arc!

C. Filtering (Included with Regulator)

CAUTION

The air supply must be free of oil, moisture, and other contaminants. Excessive oil and moisture may cause double-arcing, rapid tip wear, or even complete torch failure. Contaminants may cause poor cutting performance and rapid electrode wear.

An air line filter is supplied as part of the pressure regulator and must be installed on the rear of the unit. The filter is required when using air from a compressor to insure that moisture and debris from the supply hose does not enter the torch.

NOTE

It is recommended to order the Optional Two Stage Air Line Filter for improved air filtering.

1. Mount the Pressure Regulator/Filter Assembly onto the rear panel of the unit using the two screws and lock washers provided..

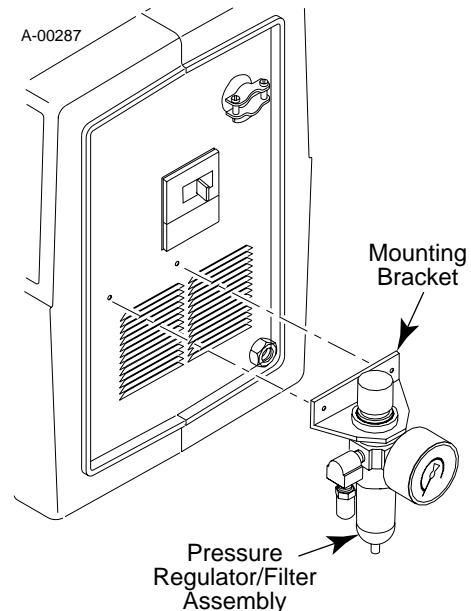


Figure 3-B Regulator/Filter Assembly Mounting

3. Place thread sealer on the threads of the elbow .

NOTE

Do not use teflon tape pipe sealer as pieces may fall off and then clog the small openings in the system.

4. Screw the 90 ° elbow into the GAS fitting on the rear of the unit.

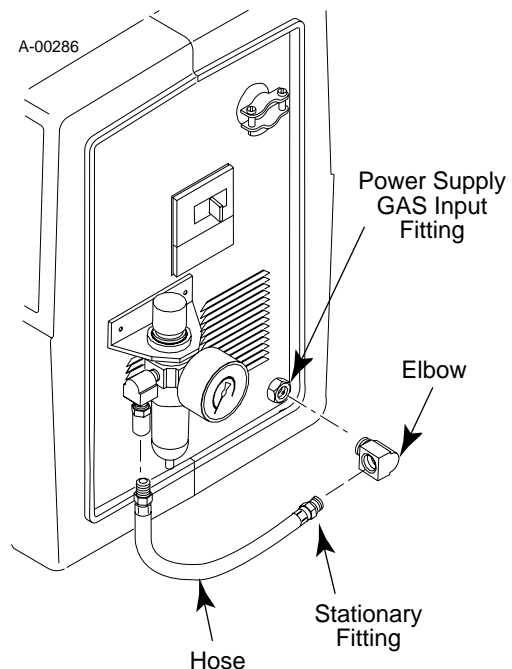


Figure 3-C Connections To Regulator Assembly

5. Place thread sealer on the threads of the stationary fitting on the end of the hose.
6. Screw the stationary fitting into the elbow. Note that the hose will turn with the fitting.

NOTE

Hold the elbow with a wrench while tightening the hose fitting as damage may occur to the GAS input fitting.

7. Place the fitting on the other end of the hose into the fitting on the Regulator/Filter Assembly and tighten in place. No need for thread sealer on this fitting as it is self sealing.
8. Place the adjustable clamp (1/4" to 5/8") over the gas supply hose.
9. Slide the gas supply hose over the barb fitting on the inlet fitting of the Regulator/Filter Assembly.
10. Secure the gas supply hose in place with the adjustable clamp.

NOTE

Supply hoses must be at least #6 hose (3/8 in or 9.5 mm I.D.).

D. Using High Pressure Gas Cylinders

CAUTION

Do not use an air line filter with high pressure gas cylinders.

The rear panel of the power supply is equipped with a 1/8 NPT gas input fitting.

Refer to the manufacturer's specifications for installation and maintenance procedures for high pressure gas regulators.

To use air or nitrogen from a high pressure gas cylinder:

1. Examine the cylinder valves to be sure they are clean and free of oil, grease or any foreign material. Momentarily open each cylinder valve to blow out any dust which may be present.
2. The cylinder must be equipped with an adjustable high-pressure regulator capable of outlet pressures up to 125 psi (8.6 BAR) maximum and flows of up to 700 scfh (328 lpm).
3. Connect the 1/8 NPT adaptor fitting to the gas input fitting on the rear panel of the power supply

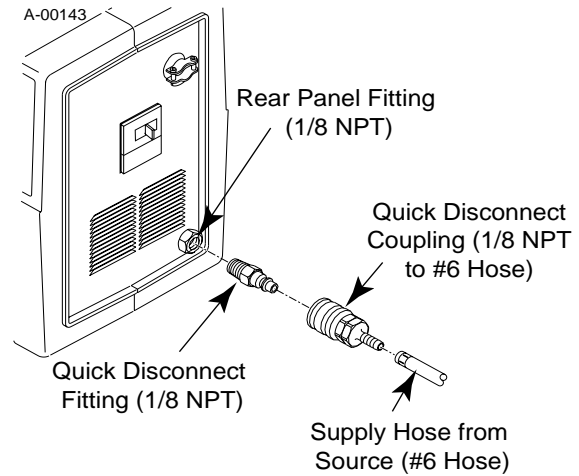


Figure 3-E Gas Connection

6. Connect the quick disconnect coupling.

3.07 Connecting Torch Leads and Work Cable



WARNING

Disconnect primary power at the source before assembling or disassembling the power supply, torch parts, or torch and leads assemblies.

The Torch Leads and Work Cable must be properly installed to the Power Supply for proper operation. Make all connections to the Lower Front Panel per the following:

1. Remove the two screws securing the lower front panel cover to the unit.

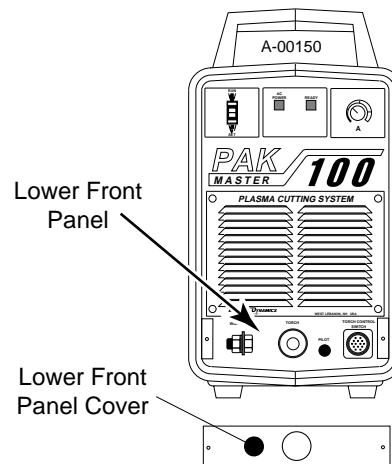


Figure 3-F Panel Removal

2. Feed the end of the torch leads through the large hole in the center of the panel.

CAUTION

This system is designed for use with the PCH/M-53 torch only. Do not connect any other torch to this power supply.

3. Connect the torch gas connection fitting onto the TORCH connector at the Power Supply Lower Panel.

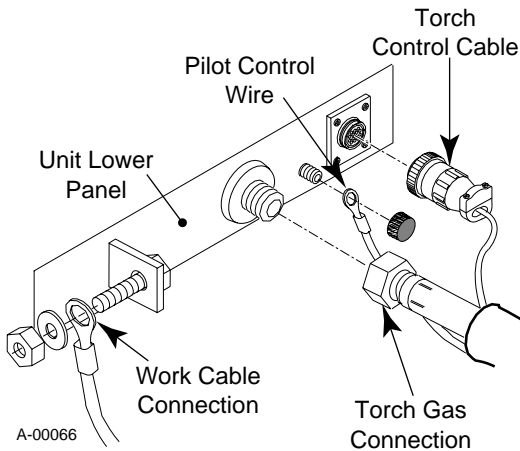


Figure 3-G Torch Leads and Work Cable Connections

4. Remove the knurl nut from the PILOT terminal.
5. Place the lug on the Pilot Control Wire onto the stud and secure with the knurl nut removed in Step 4.
6. Connect the Torch Control Cable Plug to the TORCH CONTROL connection on the unit.
7. Feed the lug end of the Work Cable through the large hole in the lower panel cover.
8. Remove the nut (10mm) and washer from the WORK connector on the Power Supply.
9. Place the Work Cable lug over the bolt body and reinstall the washer and nut.

NOTE

The bolt head must be to the right. If the bolt is turned around it may interfere with the torch gas connection.

10. Reinstall the lower front panel cover.

3.08 Ground Connections

A. Electromagnetic Interference (EMI)

High frequency pilot arc initiation generates electromagnetic interference (EMI), commonly called RF noise. EMI may interfere with nearby electronic equipment such as CNC controllers, etc. To minimize RF interference, establish a good earth ground.

B. Establishing Earth Ground

Use the following procedure to establish a good earth ground when installing mechanized systems:

1. Install a ground wire (not included) at the customer's power source and a solid earth ground (or star ground). To create a solid earth ground, drive a 1/2 inch (12 mm) copper rod approximately 6 to 8 ft (1.8 to 2.4 m) into the earth so that the rod contacts moist soil over most of its length. The depth required will vary depending on location. Locate the rod as close as possible to the power source. The work table should be connected to the same earth ground.
2. Connect the control device (CNC) to a separate earth ground. The ground cable should be at least 12 gauge wire.
3. To minimize RF interference, position torch leads as far as possible (at least 1 foot or 0.3 m) from any CNC components, control cables, or primary power lines.
4. Keep torch leads clean. Dirt and metal particles bleed off energy, which causes difficult starting and increased chance of RF interference.

3.09 Torch Installation



WARNING

Disconnect primary power at the source before assembling or disassembling the power supply, torch parts, or torch and leads assemblies.

A. Hand Torch Set-Up

The torch parts (shield cup, tip and electrode) must correspond with the type of operation (cutting or gouging). Refer to Section 4.05-A, Torch Parts Selection.

B. Machine Torch Set-Up

The torch parts (shield cup, tip and electrode) must correspond with the type of operation (cutting or gouging). Refer to Section 4.05-A, Torch Parts Selection.

Metal mounting tubes with rack and pinion assemblies are standard for machine torches.

1. Mount the torch assembly on the cutting table.
2. To obtain a clean vertical cut, use a square to align the torch perpendicular to the surface of the workpiece.

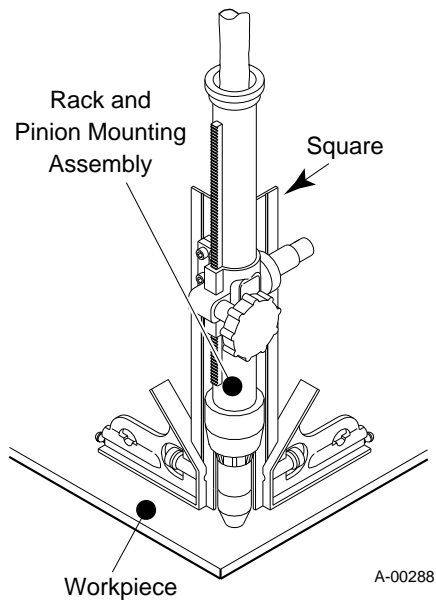


Figure 3-H Machine Torch Set-Up

SECTION 4: OPERATION

4.01 Introduction

This Section provides a description of the Power Supply operating controls and procedures. Identification of the Front and Rear Panel Controls is followed by operating procedures.

4.02 Functional Overview

The PAKMaster 100 provides a degree of operating flexibility and the use of simple controls.

4.03 Operating Controls

This subsection provides specific functional descriptions of the Power Supply operating controls and indicators.

A. Upper Front Panel

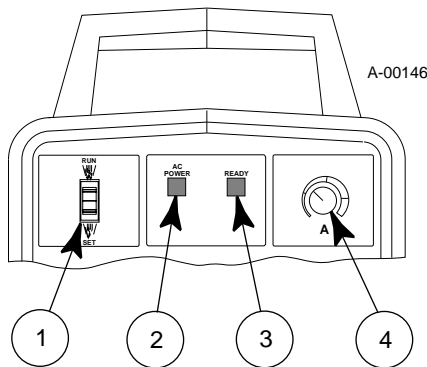


Figure 4-A Operating Controls

1. RUN/SET Switch

RUN position is used for torch operation. SET position used for setting gas pressure and purging lines.

2. AC POWER Indicator

Green LED light indicates AC input power is present in the system when the Primary Power Switch on rear panel is in ON position.

3. READY Indicator

Green LED light indicator that is turned on approximately 5 seconds after the ON/OFF primary power switch is set to ON.

4. Current Control

Adjustment to set the desired output current between 16-70 amps. Dial is marked for Drag and Standoff (Std OFF) cutting.

B. Lower Front Panel

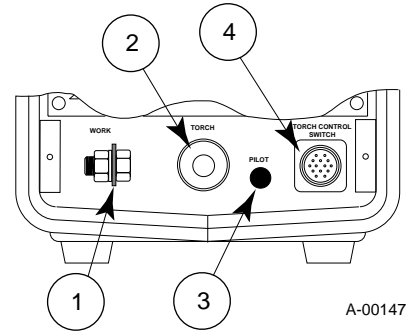


Figure 4-B Lower Front Panel Connections

1. Work Cable Connection

Connection for the work cable with clamp attached.

2. Torch Leads Connection

Connects the torch gas/negative lead to the unit.

3. Torch Leads Pilot Control Connection

Connects the pilot control wire on the torch to the unit.

4. Torch Control Switch Connector

Connects the torch switch to the unit. In machine torch applications connects the torch switch on the pendant to the unit.

C. Rear Panel

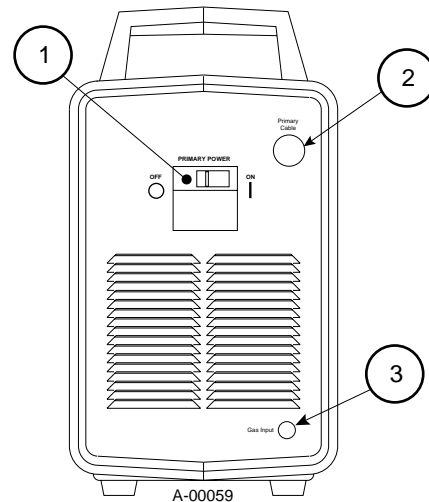


Figure 4-C Rear Panel Controls

1. Primary Power Switch

ON position supplies AC power to activate all system control circuits. OFF position deactivates control circuits.

2. Primary Cable

The unit is supplied with a primary power cable capable of handling the input voltage designed for this unit.



WARNING

This unit not to be used with oxygen (O₂).

3. Gas Input

Input connection for nitrogen (N₂) or air input.

4.04 Sequence Of Operation

The following is a typical sequence of operation for this cutting system. Refer to Appendix II for a block diagram.

1. Close main power source switch.
 - a. AC power is available at the Power Supply
2. Place the ON/OFF primary power switch on the rear of the Power Supply to ON.
 - a. AC POWER indicator LED comes on.
 - b. Fan turns on.
 - c. READY indicator LED comes on after approximately 5 seconds.
3. Place RUN/SET switch to SET mode.
 - a. Gas solenoid opens and gas flows to set pressure.
4. Place RUN/SET switch to RUN mode.
 - a. Gas flow stops.
5. Protect eyes and press or activate torch switch
 - a. Gas pre-flows starts.
6. After gas pre-flow (approximately 4 seconds)
 - a. Power supply enabled.
 - b HF relay closes.
7. Pilot arc is established
8. Move Torch within transfer distance of workpiece within 4 seconds or pilot goes out.
 - a. Main arc transfer.
 - b. Pilot arc off.
9. Complete cutting operation

NOTE

If the torch is lifted from the workpiece, while still having torch switch activated, the main arc will stop and the pilot arc will automatically restart.

10. Release or deactivate the torch switch.
 - a. Main arc stops.
 - b. Pilot arc stops (power supply enable signal removed).

NOTE

If torch is activated during post-flow, pilot arc will immediately restart.

If torch is within transfer distance (3/8 in) of workpiece, main arc will transfer.

11. Gas will flow for 12 seconds (post-flow).
 - a. Gas solenoid closes
 - b. Gas flow stops.
12. Place the primary power switch on the rear of the unit to OFF
 - a. All LED indicators go of.
 - b. Power supply fan turns off.
13. Place the main power switch open.
 - a. Main AC power is removed from the system.

4.05 Preparations for Operating

Follow this set-up procedure each time the system is operated:

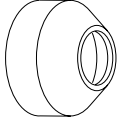
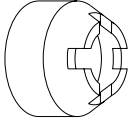
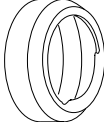

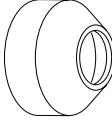
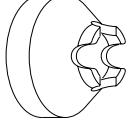

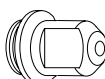




WARNING

Disconnect primary power at the source before disassembling the power supply, torch, or torch leads.

A. Torch Parts Selection

Check the torch for proper assembly and appropriate front end torch parts. The torch parts (shield cup, tip and electrode) must correspond with the type of operation (cutting or gouging).

 Shield Cup Standard Phenolic Catalog No. 9-5781	 Shield Cup Ceramic Crown Catalog No. 9-5694
 Shield Cup - Gouging Catalog No. 8-5128	 Heat Shield - Gouging Catalog No. 8-5130
 Shield Cup - Ceramic Catalog No. 9-5617	 Shield Cup - Copper Catalog No. 9-5780 (Requires Cat #9-5781)
 Cutting Tip, Air 0.049" Orifice, 70 Amps Catalog No. 9-5897	 Gouging Tip, Air 0.082" Orifice Catalog No. 8-5129
 Gouging Tip, Air 0.078" Orifice Catalog No. 9-5709	 Air Electrode Cutting or Gouging Catalog No. 9-5898

A-00144

Figure 4-D Torch Parts Selection

B. Check primary power source as follows:

1. Check the power source for proper input voltage. Make sure the input power source meets the power requirements for the unit per Section 2.03-A-3, Specifications/Design Features.
2. Connect the input power cable (or close the main disconnect switch) to supply power to the system.

C. Gas Selection

Select desired gas (air or nitrogen). Make sure gas source meets pressure and flow requirements (refer to Section 3.06, Gas Connections). Check connection and turn gas supply on.

D. Work Cable Connection

Check for a solid and clean work cable connection to the workpiece. The area must be free from paint and rust.

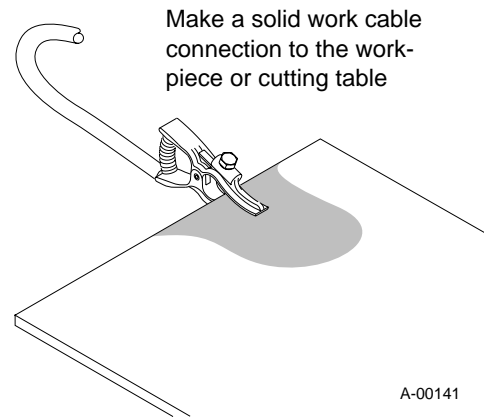


Figure 4-E Work Cable Connection To Workpiece

E. Torch Connection

Check that the torch is properly connected.

F. Purge the System (Gas Pre-Flow)

Move the ON/OFF switch to ON position. To start the pre-flow move the RUN/SET switch to SET position for a minimum of 20 seconds. The pre-flow gas purge will remove any moisture that may have accumulated in the torch and leads while the system was shut down. The torch cannot be activated during pre-flow

G. Select Output Current

Select the desired current output level (16 to 70 amps).

H. Set Operating Pressure

Move the RUN/SET switch to SET position. Adjust the gas pressure to 70 psi (4.8 BAR).

I. RUN/SET Switch

Set the RUN/SET switch to RUN position.

The system is now ready for operation.

4.06 Operating Procedures

A. Hand Operation

Cutting with a Hand Torch

1. The torch can be comfortably held in one hand or steadied with two hands. Choose the technique that feels most comfortable and allows good control and movement. Position the index finger or thumb to press the control switch on the torch handle.

- For edge starts, hold the torch perpendicular to the workpiece with the front of the tip on the edge of the workpiece at the point where the cut is to start.

For piercing, angle the torch slightly to direct sparks away from the torch until the pierce is complete.

- For drag cutting, keep the torch in contact with the workpiece and limit the output current to 40 amps. Drag cutting above 40 amps may cause premature torch parts failure. Drag cutting is not recommended on materials over 3/16 inch (5 mm) thick.

For standoff cutting, hold the torch 1/8 to 1/4 inch (3-6 mm) from the work.

- With the torch in starting position, press and hold the control switch. After an initial two-second gas purge, the pilot arc will come on and remain on until the cutting arc starts.
- Once on, the main arc remains on as long as the control switch is held down, unless the torch is withdrawn from the work or torch motion is too slow. If the cutting arc is interrupted, the pilot arc comes back on automatically.
- To shut off the torch simply release the control switch. When the switch is released a ten second post-flow will occur. If the torch switch is closed during the post-flow the cutting arc will restart immediately when the torch is brought within range of the workpiece.

Piercing with a Hand Torch

- When piercing with a hand torch, tip the torch slightly so that blowback particles blow away from the torch tip (and operator) rather than directly back into it.
- Complete the pierce of the cutting line and then continue the cut onto the line. Hold the torch perpendicular to the workpiece after the pierce is complete.
- Clean spatter and scale from the shield cup and the tip as soon as possible. Spraying or dipping the shield cup in anti-spatter compound will minimize the amount of scale which adheres to it.

B. Machine Torch Operation



WARNING

Disconnect primary power at the source before disassembling the power supply, torch, or torch leads.

NOTE

Frequently review the Important Safety Precautions beginning on page 1 of this manual.

Standoff Distance

Proper tip-to-work (standoff) distance is critical to ensure accuracy, optimum cut quality and maximum consumable parts life in mechanical systems. The recommended standoff distance for mechanized systems is 3/16 inch (5 mm).

Travel Speed

Proper travel speed is indicated by the trail of the arc which is seen below the plate (refer to Figure 4-F). A straight arc trail which is perpendicular to the work piece is generally recommended for the best cut using air plasma on stainless or aluminum. A five degree leading arc trail which is directed in the same direction as torch travel is recommended for air plasma on mild steel. A trailing arc trail is directed in the opposite direction of torch travel.

For optimum smooth surface quality the travel speed should be adjusted so that only the leading edge of the arc column produces the cut. If the travel speed is too slow, a rough cut will be produced as the arc moves from side to side in search of metal for transfer.

Travel speed also affects the bevel angle of a cut. When cutting in a circle or around a corner, slowing down the travel speed will result in a squarer cut.

Cutting with a Machine Torch

The machine torch can be activated by remote control pendant or by a remote interface device such as CNC.

Refer to Figure 4-F below and:

- Use a square to align the torch perpendicular to the workpiece to obtain a clean, vertical cut (refer to Section 3.09-B, Machine Torch Set-Up).
- To start a cut at the plate edge, position the center of the torch along the edge of the plate.

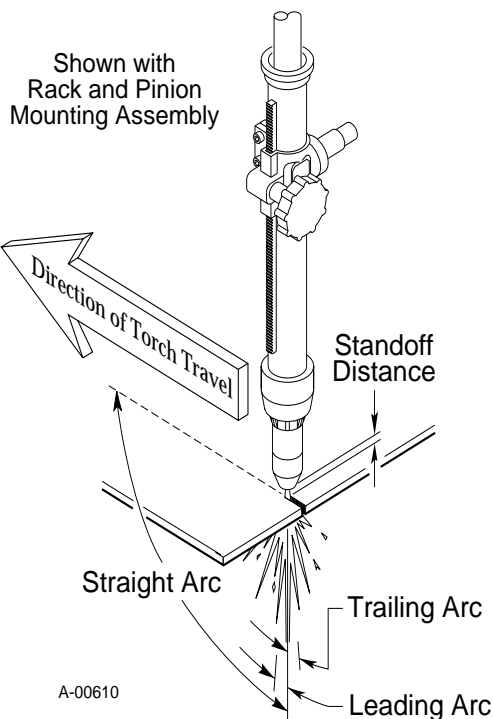


Figure 4-F Machine Torch Operation

C. Piercing

Piercing with a Machine Torch

To pierce with a machine torch, the arc should be started with the torch positioned as high as possible above the plate while allowing the arc to transfer and pierce. This standoff helps avoid having molten metal blow back onto the front end of the torch.

When operating with a cutting machine, a pierce or dwell time is required. Torch travel should not be enabled until the arc penetrates the bottom of the plate. As motion begins, torch standoff should be reduced to the recommended 1/8 to 1/4 inch (3 to 6 mm) distance for optimum speed and cut quality. Clean spatter and scale from the shield cup and the tip as soon as possible. Spraying or dipping the shield cup in anti-spatter compound will minimize the amount of scale which adheres to it.

D. Gouging with a Hand or Machine Torch



WARNING

Be sure the operator is equipped with proper gloves, clothing, eye and ear protection and that all safety precautions at the front of this manual (page i) have

been followed. Make sure no part of the operator's body comes in contact with the workpiece when the torch is activated.

CAUTIONS

Sparks from plasma gouging can cause damage to coated, painted or other surfaces such as glass, plastic, and metal.

Check torch parts. The torch parts (shield cup, tip and electrode) must correspond with the type of operation (cutting or gouging). Refer to Section 4.05-A, Torch Parts Selection.



WARNING

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

Gouging Parameters

Gouging performance depends on parameters such as torch travel speed, current level, lead angle (the angle between the torch and workpiece), and the distance between the torch tip and workpiece (standoff).

Torch Travel Speed

Optimum torch travel speed for gouging is between 20 and 120 inches per minute (0.5 and 3.0 meters per minute). Travel speed is dependent on current setting, lead angle, and mode of operation (hand or machine torch).

Current Setting

Current settings depend on torch travel speed, mode of operation (hand or machine torch), and the amount of material to be removed.

Lead Angle

The angle between the torch and workpiece depends on the current setting and torch travel speed. At 35 amps, the recommended lead angle is 35°. An angle greater than 45° may result in inconsistent metal removal. If the lead angle is too small (less than 35°), less material may be removed, requiring more passes. In some applications, such as removing welds or working with light metal, this may be desirable.

Standoff Distance

The tip to work distance affects gouge quality and depth. A standoff of 1/8 to 1/4 inch (3 to 6 mm) allows smooth, consistent metal removal. A smaller standoff may result

in a severance cut rather than a gouge. A standoff greater than 1/4 inch (6 mm) may result in minimal metal removal or loss of transferred main arc.

Slag Build-up

Slag generated by gouging on materials such as carbon and stainless steels, nickels, and alloyed steels, can be removed easily in most cases. Slag does not obstruct the gouging process if it accumulates to the side of the gouge path. However, slag build-up can cause inconsistencies and irregular metal removal if large amounts of material build up in front of the arc. The build-up is most often a result of improper travel speed, lead angle, or standoff height.

4.07 Cut Quality

Cut quality requirements differ depending on application. For instance, nitride build-up and bevel angle may be major factors when the surface will be welded after cutting. Dross-free cutting is important when finish cut quality is desired to avoid a secondary cleaning operation. The following cut quality characteristics are illustrated in Figure 4-G below:

Cut Surface

The condition (smooth or rough) of the face of the cut.

Bevel Angle

The angle between the surface of the cut edge and a plane perpendicular to the surface of the plate. A perfectly perpendicular cut would result in a 0° bevel angle.

Top-Edge Rounding

Rounding on the top edge of a cut due to wearing from the initial contact of the plasma arc on the workpiece.

Dross Build-up and Top Spatter

Dross is molten material which is not blown out of the cut area and re-solidifies on the plate. Top spatter is dross which accumulates on the top surface of the workpiece. Excessive dross may require secondary clean-up operations after cutting.

Kerf Width

The width of material removed during the cut.

Nitride Build-up

Nitride deposits which may remain on the surface of the cut when nitrogen is present in the plasma gas stream. Nitride buildups may create difficulties if the material is welded after the cutting process.

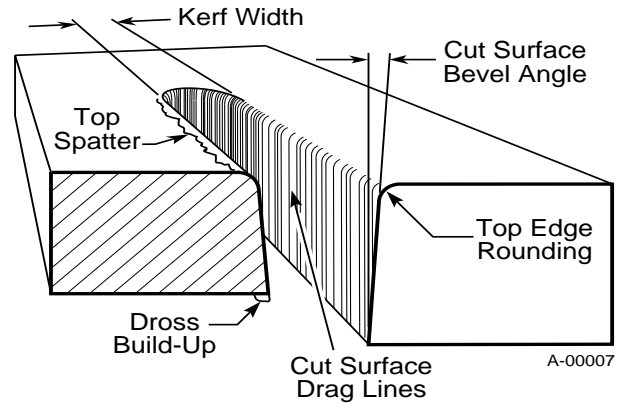


Figure 4-G Cut Quality Characteristics

Cut quality will vary on different types of and material thicknesses.

The following table shows the cut quality that can be expected from this equipment for materials with a thickness from gage to 1 inch:

Table 4-B Cut Quality

Gas	Type of Material		
	Carbon Steel	Stainless Steel	Aluminum
Air	Good - Excellent	Good - Excellent	Good - Excellent
Nitrogen	Good	Good	Good

Description of Cut Characteristics

Excellent - Minimum bevel (0 - 4°), minimum kerf (2 x tip orifice diameter), little or no dross, smooth cut surface.

Good - Slight bevel (0 - 10°), slightly wider kerf (2-1/2 x tip orifice diameter), some dross (easily removed), medium-smooth cut surface, slight top edge rounding.

Fair - Excessive bevel (over 10°), wide kerf (over 2-1/2 x tip orifice diameter), medium to heavy dross, rough cut surface, top edge rounding.

NOTE

Cut quality depends heavily on set-up and parameters such as torch standoff, alignment with the workpiece, cutting speed, gas pressures, and operator ability.

4.08 Recommended Cutting Speeds

Refer to Appendix I, Cutting Speed Charts.

Cutting speed depends on material, thickness, and the operator's ability to accurately follow the desired cut line. The following factors may have an impact on system performance:

- Torch parts wear
- Air quality
- Line voltage fluctuations
- Torch standoff height
- Proper work cable connection

NOTE

This information represents realistic expectations using recommended practices and well-maintained systems. Actual speeds may vary up to 50% from those shown.

SECTION 5: CUSTOMER/OPERATOR SERVICE

5.01 Introduction

This Section describes basic maintenance procedures performable by operating personnel. No other adjustments or repairs are to be attempted by other than Thermal Dynamics Trained personnel.

For major troubleshooting and parts replacement procedures refer to PAK Master 100 Plasma Inverter Cutting System Service Manual 0-2440.

5.02 Power Supply Maintenance



WARNING

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

CAUTION

Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.

To clean the unit, open the enclosure (refer to Section 5.08-A, Opening Enclosure) and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean. If necessary, solvents that are recommended for cleaning electrical apparatus may be used.

5.03 General Torch Maintenance

A. Cleaning the Torch

Even if precautions are taken to use only clean air with a torch, eventually the inside of the torch becomes coated with residue. This buildup can affect the pilot arc initiation and the overall cut quality of the torch.



WARNINGS

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

DO NOT touch any internal torch parts while the AC indicator light on the front panel of the power supply is lit.

The inside of the torch should be cleaned with electrical contact cleaner using a cotton swab or soft wet rag. In severe cases, the torch can be removed from the leads and cleaned more thoroughly by pouring electrical contact cleaner into the torch and blowing it through with compressed air (refer to Service Manual 0-2440).

CAUTION

Dry the torch thoroughly before reinstalling.

5.04 Common Operating Problems



WARNINGS

Disconnect primary power at the source before disassembling the power supply, torch, or torch leads.

Frequently review the Important Safety Precautions (page 1). Be sure the operator is equipped with proper gloves, clothing, eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece while the torch is activated.

CAUTION

Sparks from the cutting process can cause damage to coated, painted, and other surfaces such as glass, plastic and metal.

NOTE

Handle torch leads with care and protect them from damage.

A. Piloting

Piloting is harder on parts life than actual cutting because the pilot arc is directed from the electrode to the tip rather than to a workpiece. Whenever possible, avoid excessive pilot arc time to improve parts life.

B. Torch Standoff

Improper standoff (the distance between the torch tip and workpiece) can adversely affect tip life as well as shield cup life. Standoff may also significantly affect the bevel angle. Reducing standoff will generally result in a more square cut.

C. Edge Starting

For edge starts, hold the torch perpendicular to the workpiece with the front of the tip at the edge of the workpiece at the point where the cut is to start. When starting at the edge of the plate, do not pause at the edge and force the arc to "reach" for the edge of the metal. Establish the cutting arc as quickly as possible.

D. Direction of Cut

In the PCH/M-53 torch, the plasma gas stream swirls as it leaves the torch to maintain a smooth column of gas. This swirl effect results in one side of a cut being more square than the other. Viewed along the direction of travel, the left side of the cut is more square than the right (Refer to Figure 4-G). To make a square-edged cut along an inside diameter of a circle, the torch should move counter clockwise around the circle. To keep the square edge along an outside diameter cut, the torch should travel in a clockwise direction.

E. Dross

Generally when dross is present on carbon steel, it is referred to as either "high speed or slow speed dross".

"High speed dross" usually forms a narrow bead along the bottom of the cut edge and is very difficult to remove. "Slow speed dross" will be in larger quantities but does not adhere tightly to the cut edge and can be easily removed.

When cutting a troublesome steel, it is suggested that the torch travel speed be reduced to produce "slow speed dross". Any required cleanup can then be done by scraping, not grinding.

Dross present on top of the plate (top spatter), is normally caused by a slow torch travel speed or too high of a torch standoff distance.

F. Common Cutting Faults

1. Insufficient Penetration

- a. *Cutting speed too fast*
- b. *Torch tilted too much*
- c. *Metal too thick*
- d. *Worn torch parts*
- e. *Cutting current too low*

2. Main Arc Extinguishes

- a. *Cutting speed too slow*
- b. *Torch standoff too high from workpiece*
- c. *Cutting current too high*
- d. *Work cable disconnected*
- e. *Worn torch parts*

3. Excessive Dross Formation

- a. *Cutting speed too slow*
- b. *Torch standoff too high from workpiece*
- c. *Worn torch parts*
- d. *Improper cutting current*

4. Short Torch Parts Life

- a. *Oil or moisture in air source*
- b. *Exceeding system capability (material too thick)*
- c. *Excessive pilot arc time*
- d. *Air flow too low (incorrect pressure)*
- e. *Improperly assembled torch*

5.05 Inspection and Replacement Consumable Torch Parts



WARNINGS

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

DO NOT TOUCH internal torch parts while the AC indicator on the front panel of the power supply is on.

1. Remove the shield cup from the torch. Inspect the cup for damage. Wipe it clean or replace if damaged.

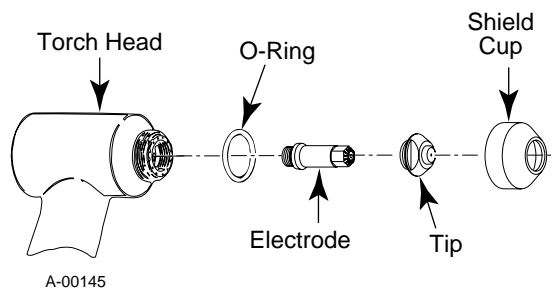


Figure 5-A: Consumable Torch Parts

2. Unscrew the tip using 1/2" open end wrench. Check for tip wear (indicated by elongated or oversize orifice). Clean the tip and make sure the threads and sealing face are not damaged. Replace tip if necessary.
3. Remove the electrode using 1/4" nut driver. Inspect the condition of the face of the electrode. If less than 1/8" (3.2 mm) of the hex area on the front of the electrode remains, the electrode should be replaced.

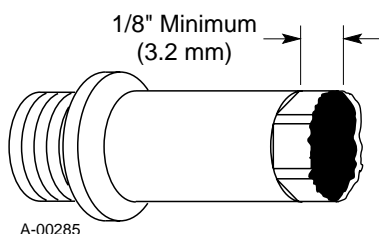


Figure 5-B: Electrode Wear

4. Install the electrode in the torch body. Secure in place using a 1/4" nut driver

CAUTION

Do not overtighten the electrode or tip.

5. Install the tip in the front of the torch and secure it with a 1/2" open end wrench.
6. Install the shield cup using a slight twisting motion to seat the cup properly on the O-ring and against the torch face.

5.06 Troubleshooting Guide

A. General

Troubleshooting and repairing the this unit is a process which should be undertaken only by those familiar with high voltage high power electronic equipment.



WARNING

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have had training in power electronics measurement and troubleshooting techniques.

B. Basic Troubleshooting

This manual covers a basic level of troubleshooting that requires limited disassembly and measurements. It is helpful for solving many of the common problems that can arise with this system.

If major complex subassemblies are faulty, the unit must be returned to an authorized service center for repair.

Follow all instructions as listed and complete each section in the order presented.

For major troubleshooting and parts replacement procedures refer to PAK Master 100 Plasma Inverter Cutting System Service Manual 0-2440.

C. How to use this Guide

The following information is a guide to help the Customer/Operator determine the most likely causes for various symptoms.

This guide is set up in the following manner:

X. Symptom (Bold Type)

Any Special Instructions (Text Type)

1. Cause (Italic Type)
 - a. Check/Remedy (Text Type)

Locate your **symptom**, check the *causes* (easiest listed first) then remedies. Repair as needed being sure to verify that unit is fully operational after any repairs.

A. Molded circuit breaker MCB1 (primary power switch) trips

1. *Faulty input power*
 - a. Check customer's input power source for correct voltage.
2. *Faulty components in unit*
 - a. Return for repair or have qualified technician repair per Service Manual.

B. AC POWER indicator not on

NOTE

Wait for 10 seconds after applying power for the power smart logic to check input power.

1. *Switch at customer's main power panel in OFF position.*
 - a. Close main power panel switch
2. *Input power not properly connected to customer's main power panel*
 - a. Check that input power is present and unit is properly connected (refer to Section 3.05, Input Power Connections)
3. *Actual input voltage does not correspond to voltage rating of unit*
 - a. Check actual line voltage vs. voltage rating on primary power switch (rear of unit)
4. *Customer's main power line fuse(s) blown*
 - a. Check main power panel fuse(s) and replace as required.
5. *Unit internal fuse (F1) blown or loose*
 - a. If blown, doublecheck input voltage vs. voltage rating on primary power switch (rear of unit) and replace fuse per Section 5.08-B. If fuse blows again, return unit to an authorized service center.
6. *Faulty components in unit*
 - a. Return for repair or have qualified technician repair per Service Manual.

C. AC POWER indicator on. READY indicator off

1. *Airflow obstructed*
 - a. Check for obstructed air flow and correct condition.
2. *Fan blocked*
 - a. Check and correct condition
3. *Unit is overheated*
 - a. Allow unit to cool down for about 5 minutes. Make sure the unit has not been operated beyond 70% duty cycle limit.
4. *Input line voltage is below 75% of rated level*
 - a. Check and connect to proper input power line
5. *Input voltage of 460 VAC applied to 208/230 VAC or 380/415 VAC Models*

- a. Check input line voltage and correct as required.

6. *Pilot current flow longer than 3 seconds*

- a. Release and press torch switch again.

7. *Faulty components in unit*

- a. Return for repair or have qualified technician repair per Service Manual.

D. Torch will not pilot when torch switch is activated

1. *RUN/SET switch in SET position*

- a. Move switch to RUN position.

2. *Switch activated during 20 second pre-flow*

- a. Release switch and wait at least 20 seconds before activating switch again

3. *Faulty torch parts*

- a. Inspect torch parts and replace if necessary (refer to Section 5.05, Replacing Consumable Torch Parts)

4. *Gas pressure too high*

- a. Set pressure to 50 psi.

5. *Faulty components in unit*

- a. Return for repair or have qualified technician repair per Service Manual.

E. AC Power indicator on, READY indicator on, Fan operating, No cutting output

1. *Torch not properly connected to power supply*

- a. Check that torch leads are properly attached to power supply

2. *Shield cup not properly installed on torch*

- a. Check that shield cup is fully seated against torch head (do not overtighten)

3. *Faulty components in unit*

- a. Return for repair or have qualified technician repair per Service Manual.

F. Low cutting output with no control

1. *Incorrect setting of AMPERAGE control*

- a. Check and adjusted to proper setting.

2. *Faulty components in unit*

- a. Return for repair or have qualified technician repair per Service Manual.

G. Limited output with no control

1. *Poor input or output connections*

- a. Check all input and output connections.
- 2. *Incorrect setting of AMPERAGE control*
 - a. Check and adjusted to proper setting.
- 3. *Faulty components in unit*
 - a. Return for repair or have qualified technician repair per Service Manual.

H. Erractic or improper cutting output

- 1. *Poor input or output connections*
 - a. Check all input and output connections.
- 2. *Incorrect type and size cable on input or output*
 - a. Use proper type and size cables.

I. AC Power indicator on, READY indicator on, cutting output available, Fan not operating,

- 1. *Fan blades blocked*
 - a. Check and clear blades.
- 2. *Faulty components in unit*
 - a. Return for repair or have qualified technician repair per Service Manual.

J. AC POWER indicator on, READY indicator on, Fan operates, No gas flow

- 1. *Gas not connected or pressure too low*
 - a. Check source for at least 70 psi (4.8 BAR).
- 2. *Faulty components in unit*
 - a. Return for repair or have qualified technician repair per Service Manual.

K. Torch cuts but not adequately

- 1. *Current set too low*
 - a. Increase current setting
- 2. *Torch is being moved too fast across workpiece*
 - a. Reduce cutting speed (refer to Appendix I, Cutting Speed Charts)
- 3. *Excessive oil or moisture in torch*
 - a. Hold torch 1/8 inch (3 mm) from clean surface while purging and observe oil or moisture buildup (do not activate torch)

5.07 Power Supply Parts Replacement



WARNING

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

A. Opening Enclosure

To open the enclosure requires the removal of several phillips head screws. Carefully remove all the screws before attempting to separate the two halves of the enclosure. The screws should be removed in the following order:

- 1. Two small screws on the bottom front and rear
- 2. Two on each side at bottom.
- 3. Two long screws and nuts in the handles.
- 4. Two on the center molding between the two handles.
- 5. Two on each side at top.

By removing the screws in this order it will help hold the two halves in place until all the screws have been removed.

Reverse the above sequence to reassemble the enclosure.

B. Fuse Replacement

- 1. Open the enclosure per paragraph "A" above.
- 2. Remove the plastic cover protecting the top of the unit inside.
- 3. Locate the internal fuse (F1) at the top rear of the unit.
- 4. Replace the fuse (5 amp 600V).
- 5. Reinstall the plastic cover removed in Step 2.
- 6. Close the enclosure per paragraph "A" above.

5.08 Hand Torch Head And Leads Replacement



WARNING

Disconnect primary power to the system before disassembling the torch, leads, or power supply.

A. Hand Torch Head Replacement

1. Roll the torch switch sheath back over the handle to expose the torch switch connectors.
2. Disconnect the torch switch leads.
3. With a twisting motion, pull the torch from the handle.
4. Disconnect the negative lead and pilot lead from the torch head.
5. Remove the defective torch head assembly .
6. Connect the negative lead and pilot leads to the replacement torch head assembly .
7. Feed the torch switch leads through the handle and install the torch head on the handle.
8. Connect the two torch switch leads to the connectors in the leads assembly . Position the torch switch leads so the connectors do not extend beyond the edge of the handle and the leads do not extend out from under the sheath. Allow sufficient slack in the leads to avoid pulling the leads tightly around the edge of the handle.
9. Roll the torch switch sheath back over the handle.

B. Hand Torch Leads Replacement

1. Remove the torch head as described in paragraph "A" above.
2. Remove the torch handle from the defective leads assembly.
3. Remove the lower front panel cover from the front of the power supply
4. Disconnect the torch gas connection, pilot control wire and torch control cable from the lower front panel of the power supply
5. Pull the defective leads from the lower front panel cover.
6. Feed the replacement leads assembly through the hole in the lower front panel.
7. Connect the torch gas connection, pilot control wire and torch control cable to the lower front panel of the power supply
8. Reinstall the lower front panel cover.
9. Slide the torch handle onto the leads.
10. Install the torch head assembly onto the leads.

C. Hand Torch Switch Replacement

1. Roll the torch switch sheath back over the handle to expose the torch switch connectors.

2. Disconnect the torch switch leads and remove the defective torch switch from the sheath.
3. Position the replacement torch switch in the sheath.
4. Connect the two torch switch leads to the connectors in the leads assembly . Position the torch switch leads so the connectors do not extend beyond the edge of the handle and the leads do not extend out from under the sheath. Allow sufficient slack in the leads to avoid pulling the leads tightly around the edge of the handle.
5. Roll the torch switch sheath back over the handle.

5.09 Machine Torch Head And Leads Replacement

A. Machine Torch Head Replacement

1. Pull the torch head from the adapter sleeve and slide the entire mounting assembly up over the torch leads assembly to expose the connections.
2. Disconnect the negative lead and pilot lead from the torch head.
3. Remove the defective torch head assembly .
4. Connect the negative lead and pilot leads to the replacement torch head assembly .
5. Reinstall the torch head into the mounting assembly.

B. Machine Torch Leads Replacement

1. Remove the torch head as described in paragraph "A" above.
2. Remove the lower front panel cover from the front of the power supply
3. Disconnect the torch gas connection, pilot control wire and torch control cable from the lower front panel of the power supply
4. Pull the defective leads from the lower front panel cover.
5. Feed the replacement leads assembly through the hole in the lower front panel.
6. Connect the torch gas connection, pilot control wire and torch control cable to the lower front panel of the power supply
7. Reinstall the lower front panel cover.
8. Install the torch head assembly onto the leads.

SECTION 6: PARTS LISTS

6.01 Introduction

A. Parts List Breakdown

The parts list provide a breakdown of all replaceable components. The parts lists are arranged as follows:

Section 6.03: Complete Systems

Section 6.04: Options and Accessories

Section 6.05: Replacement Torches With Leads Only

Section 6.06: Spare Parts Kits

Section 6.07: Replacement Torch Parts

Section 6.08: Replacement Torch Head Assemblies

Section 6.09: Replacement Torch Leads Only

NOTE

Parts listed without item numbers are not shown, but may be ordered by the catalog number shown.

B. Returns

If a Thermal Dynamics product must be returned for service, contact your Thermal Arc distributor. Materials returned to Thermal Dynamics without proper authorization will not be accepted.

6.02 Ordering Information

Order replacement parts by catalog number and complete description of the part or assembly, as listed in the parts list for each type item. Also include the model and serial number of the torch. Address all inquiries to your authorized Thermal Dynamics distributor

6.03 Complete Systems

Complete systems include: Power supply with primary power cable, work cable, PCH/M-53 torch with leads, pressure regulator/air filter/air hose and fittings, torch spare parts kit, and operating manual.

Machine torch systems also include: Remote pendant control with ON/OFF switch and metal mounting tube with rack and pinion assembly

A. PAKMASTER 100 with PCH-53 70° Torch

Catalog #	Description
1-7100-2	208/230V Single Phase with 25' Leads
1-7104-2	380/415V Three Phase with 25' Leads
1-7108-2	460V Three Phase with 25' Leads
1-7102-2	208/230V Single Phase with 50' Leads
1-7106-2	380/415V Three Phase with 50' Leads
1-7110-2	460V Three Phase with 50' Leads

B. PAKMASTER 100 with PCH-53 90° Torch

Catalog #	Description
1-7100-1	208/230V Single Phase with 25' Leads
1-7104-1	380/415V Three Phase with 25' Leads
1-7108-1	460V Three Phase with 25' Leads
1-7102-1	208/230V Single Phase with 50' Leads
1-7106-1	380/415V Three Phase with 50' Leads
1-7110-1	460V Three Phase with 50' Leads

C. PAKMASTER 100 with PCM-53 Machine Torch

Catalog #	Description
1-7101	208/230V Single Phase with 25' Leads
1-7105	380/415V Three Phase with 25' Leads
1-7109	460V Three Phase with 25' Leads
1-7103	208/230V Single Phase with 50' Leads
1-7107	380/415V Three Phase with 50' Leads
1-7111	460V Three Phase with 50' Leads

D. PAKMASTER 100 Power Supply Only

Catalog #	Description
3-7100	208/230V Single Phase
3-7101	380/415V Three Phase
3-7102	460V Three Phase

6.04 Options and Accessories

Catalog #	Description
7-0100	Two Stage Air Filter Kit Replacement Element
9-1021	First Stage
9-1022	Second Stage
7-3114	Remote Pendant Control Interface Cable
8-5557	25 foot (7.62m)
8-5558	50 foot (15.24m)
7-3124	Circle Cutting Attachment
9-2493	Extension Rod - 12 inch (300mm)
7-7777	Smart Cart - Wicked Wheels

6.05 Replacement Torches With Leads Only

The following replacement Torches come one each to a package and include Torch and Torch Leads:

PCH-53 70° Hand Torches

Catalog #	Description
2-7101	Torch with 25 ft (7.6 m) Leads
2-7111	Torch with 50 ft (15.2 m) Leads

PCM-53 90° Hand Torches

Catalog #	Description
2-7100	Torch with 25 ft (7.6 m) Leads
2-7110	Torch with 50 ft (15.2 m) Leads

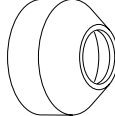
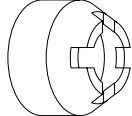
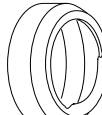

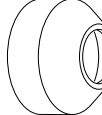
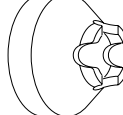

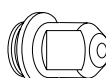


PCM-53 Machine Torches, Metal Mounting Tube, Rack and Pinion Assembly

Catalog #	Description
2-7102	Torch with 25 ft (7.6 m) Leads
2-7112	Torch with 50 ft (15.2 m) Leads

6.06 Spare Parts Kits

Catalog #	Qty	Description
5-0100	1	Cutting, Air, Parts Kit Includes:
8-4025	1	Lubricant
8-3141	1	Box, Utility
8-5525	1	O-Ring
9-5620	1	Nut Driver, 1/4"
9-5898	5	Electrode, Air, Plated
9-5897	5	Cutting Tip, Air, 0.049 Orifice
9-5694	1	Shield Cup - Crown
9-5781	1	Shield Cup, Standard (Phenolic)
8-4007	1	Wrench, Open End, 1/2"
5-0101	1	Gouging, Air, Parts Kit Includes:
8-4025	1	Lubricant
8-3141	1	Box, Utility
8-5525	2	O-Ring
9-5620	1	Nut Driver, 1/4"
9-5898	5	Electrode, Air, Plated
8-5129	5	Gouging Tip, 0.082 Orifice
8-5128	3	Shield Cup, Gouging
8-4053	1	Wrench, Open End, 7/16"
8-5130	1	Heat Shield

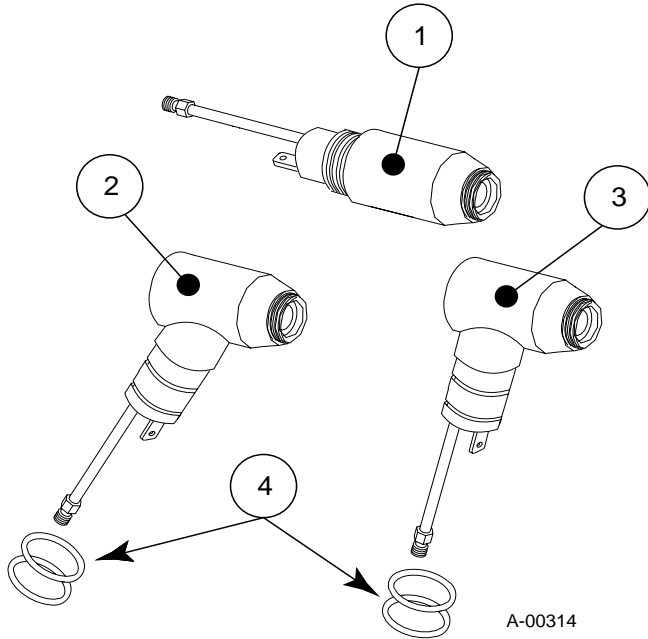
6.07 Replacement Torch Parts

 Shield Cup Standard Phenolic Catalog No. 9-5781	 Shield Cup Ceramic Crown Catalog No. 9-5694
 Shield Cup - Gouging Catalog No. 8-5128	 Heat Shield - Gouging Catalog No. 8-5130
 Shield Cup - Ceramic Catalog No. 9-5617	 Shield Cup - Copper Catalog No. 9-5780 (Requires Cat #9-5781)
 Cutting Tip, Air 0.049" Orifice, 70 Amps Catalog No. 9-5897	 Gouging Tip, Air 0.082" Orifice Catalog No. 8-5129
 Gouging Tip, Air 0.078" Orifice Catalog No. 9-5709	 Air Electrode Cutting or Gouging Catalog No. 9-5898

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6.08 Replacement Torch Head Assemblies

Item #	Catalog #	Description
1	9-6180	PCM-53 Machine Torch
2	9-6170	PCH-53 70 ° Hand Torch
3	9-6190	PCH-53 90 ° Hand Torch
4	8-0536	O-Rings



6.09 Replacement Torch Leads Only

The following are replacement Torch Leads only and come one each to a package:

PCH-53 Hand Torches

Catalog #	Description
4-6048	25 ft (7.6 m) Leads
4-6050	50 ft (15.2 m) Leads

PCM-53 Machine Torches

Catalog #	Description
4-6049	25 ft (7.6 m) Leads
4-6051	50 ft (15.2 m) Leads

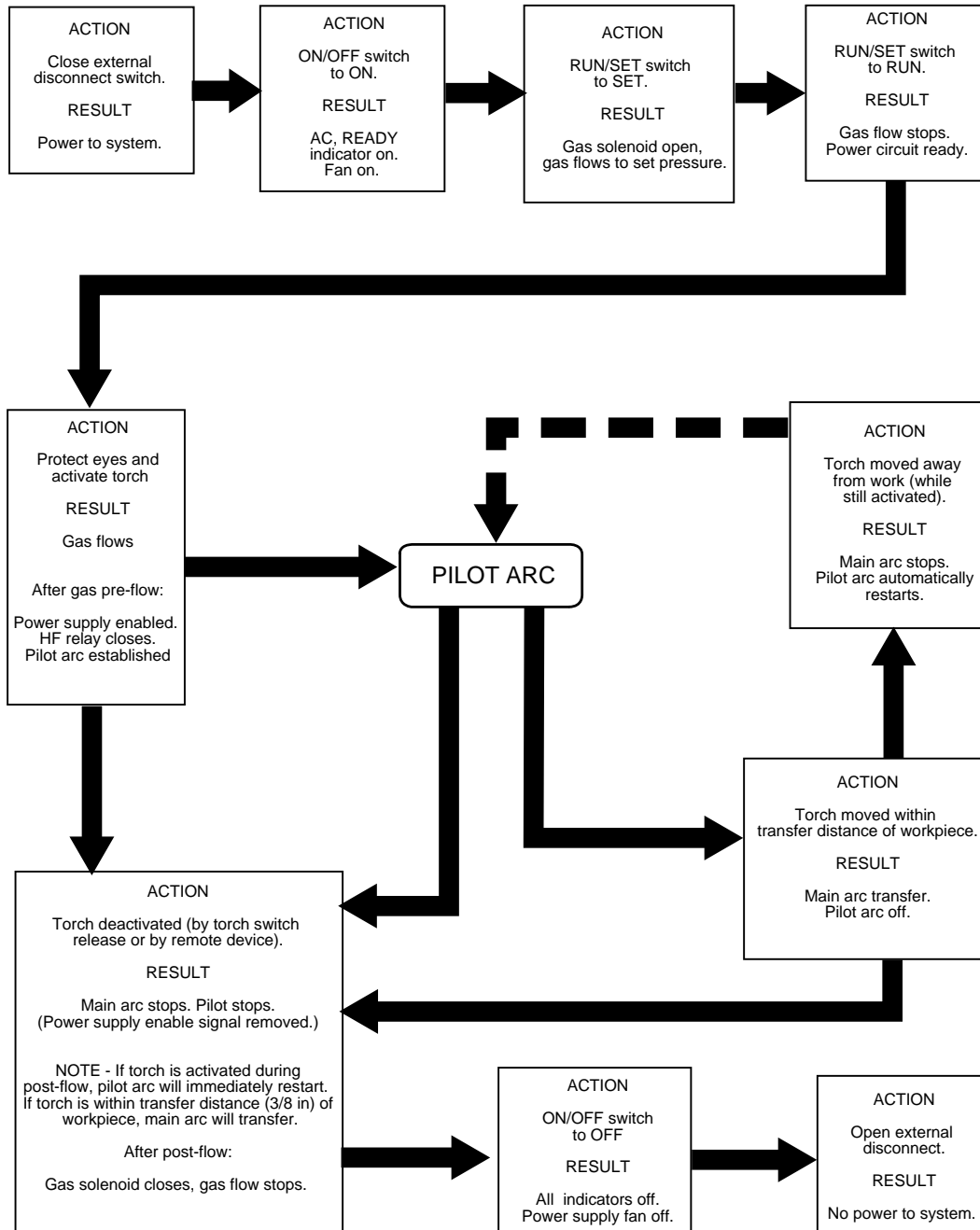
APPENDIX I: CUTTING SPEED CHARTS

PCH/M-53 Cutting Speeds - Air Plasma on Mild Steel									
Thickness (Inches)	Tip (Cat. No.)	Gas(es)	Voltage (Volts)	Amperage (Amps)	Speed Per Minute		Standoff (Inches)	Gas Pressure (PSI)	Total Flow (CFH)
					Inches	Meters			
1/16	9-5897	Air	105	35	175	4.45	3/16	70	350
1/8	9-5897	Air	112	35	60	1.52	3/16	70	350
1/4	9-5897	Air	115	35	25	0.64	3/16	70	350
1/4	9-5897	Air	98	70	75	1.91	3/16	70	350
3/8	9-5897	Air	97	70	40	1.02	3/16	70	350
1/2	9-5897	Air	106	70	30	0.76	3/16	70	350
3/4	9-5897	Air	112	70	12	0.30	3/16	70	350
1	9-5897	Air	121	70	6	0.15	3/16	70	350

PCH/M-53 Cutting Speeds - Air Plasma on Aluminum									
Thickness (Inches)	Tip (Cat. No.)	Gas(es)	Voltage (Volts)	Amperage (Amps)	Speed Per Minute		Standoff (Inches)	Gas Pressure (PSI)	Total Flow (CFH)
					Inches	(Meters)			
1/16	9-5897	Air	110	35	225	5.72	3/16	70	350
1/8	9-5897	Air	117	35	90	2.29	3/16	70	350
1/4	9-5897	Air	127	35	20	0.51	3/16	70	350
1/8	9-5897	Air	100	70	200	5.08	3/16	70	350
1/4	9-5897	Air	105	70	120	3.05	3/16	70	350
3/8	9-5897	Air	110	70	50	1.27	3/16	70	350
1/2	9-5897	Air	115	70	30	0.76	3/16	70	350
3/4	9-5897	Air	125	70	15	0.38	3/16	70	350
1	9-5897	Air	135	70	6	0.15	3/16	70	350

PCH/M-53 Cutting Speeds - Air Plasma on Stainless Steel									
Thickness (Inches)	Tip (Cat. No.)	Gas(es)	Voltage (Volts)	Amperage (Amps)	Speed Per Minute		Standoff (Inches)	Gas Pressure (PSI)	Total Flow (CFH)
					Inches	Meters			
1/16	9-5897	Air	111	35	60	1.52	1/8	70	350
1/8	9-5897	Air	114	35	30	0.76	1/8	70	350
1/4	9-5897	Air	120	35	20	0.51	1/8	70	350
1/8	9-5897	Air	95	70	115	2.92	1/8	70	350
1/4	9-5897	Air	105	70	80	2.03	1/8	70	350
1/2	9-5897	Air	115	70	20	0.51	1/8	70	350
3/4	9-5897	Air	122	70	8	0.20	1/8	70	350

APPENDIX II: SEQUENCE OF OPERATION (BLOCK DIAGRAM)



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