THERMAL DYNAMICS®

A THERMADYNE® Company

Plasma Cutting System

PAK 10

Instruction Manual

April 12, 2002 **Manual No. 0-0515**

WARNINGS

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

While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

Plasma Cutting System PAK 10
Instruction Manual Number 0-0515

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Record the following information for Warranty purposes:

Where Purchased:_____

Purchase Date:_____

Power Supply Serial #:_____

Torch Serial #:_____

Contents

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

WARNINGS

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

Plasma arc cutting produces intense electric and magnetic emissions that may interfere with the proper function of cardiac pacemakers, hearing aids, or other electronic health equipment. Persons who work near plasma arc cutting applications should consult their medical health professional and the manufacturer of the health equipment to determine whether a hazard exists.

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.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Sec. 25249.5 et seq.)

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 9 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.


PLASMA ARC 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 suggested in the following per ANSI / ASC Z49.1:

Arc Current	Minimum Protective Shade No.	Suggested Shade No.
Less Than 300*	8	9
300 - 400*	9	12
400 - 800*	10	14

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.*

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

AVERTISSEMENTS

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.

Coupant à l’arc au jet de plasma produit de l’énergie électrique haute tension et des émissions magnétique qui peuvent interférer la fonction propre d’un “pacemaker” cardiaque, les appareils auditif, ou autre matériel de santé electronique. Ceux qui travail près d’une application à l’arc au jet de plasma devrait consulter leur membre professionel de médication et le manufacturier de matériel de santé pour déterminer s’il existe des risques 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	cuivre	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. Eliminez toute source de telle fumée.
- Ce produit, dans le procéder de soudage et de coupe, produit de la fumée ou des gaz pouvant contenir des éléments reconnu dans L'état de la Californie, qui peuvent causer des défauts de naissance et le cancer. (La sécurité de santé en Californie et la code sécurité Sec. 25249.5 et seq.)

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-violets 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.
- Utilisez la nuance de lentille qui est suggèrée dans le recommendation qui suivent ANSI / ASC Z49.1:

Courant Arc	Nuance Minimum Protective Numéro	Nuance Suggerée Numéro
Moins de 300*	8	9
300 - 400*	9	12
400 - 800*	10	14

** Ces valeurs s'appliquent ou l'arc actuel est observé clairement. L'experience a démontrer que les filtres moins foncés peuvent être utilisés quand l'arc est caché par moiceau de travail.*

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 dú4ez 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 (NFPA), 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 NFPA, CODE ELECTRIQUE NATIONAL, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

10. Norme 51B de la NFPA, 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. Livret 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: 82 Benning Street
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/EEC as amended by Council Directive 93/68/EEC) 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 for Arc welding equipment.

* UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.

* ISO/IEC 60974-1 (BS 638-PT10) (EN 60 974-1) (EN50192) (EN50078) applicable to plasma cutting equipment and associated accessories.

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process. This is to ensure the product is safe, when used according to instructions in this manual and related industry standards, 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 for more than 30 years, and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative: Giorgio Bassi
Managing Director
Thermal Dynamics Europe
Via rio Fabbiani 8A
40067 Rastignano (BO)
Italy

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 XL Plus Series, CutMaster Series , Cougar and DRAG-GUN): 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 further limitations on such two (2) year period (see chart below).

The limited warranty period for XL Plus Series and CutMaster Series 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 further limitations on such three (3) year period (see chart below).

The limited warranty period for Cougar and DRAG-GUN shall be as follows: A maximum of two (2) years from date of sale to an authorized distributor and a maximum of one (1) year from date of sale by such distributor to the Purchaser, and with the further limitations on such two (2) year period (see chart below).

	Parts			
PAK Units, Power Supplies	**XL Plus & CutMaster Series**	**Parts Cougar/Drag-Gun**	**Parts All Others**	**Labor**
Main Power Magnetics	3 Years	1 Year	2 Years	1 Year
Original Main Power Rectifier	3 Years	1 Year	2 Years	1 Year
Control PC Board	3 Years	1 Year	2 Years	1 Year
All Other Circuits And Components Including, But Not Limited To, Starting Circuit, Contactors, Relays, Solenoids, Pumps, Power Switching Semi-Conductors	1 Year	1 Year	1 Year	1 Year
Consoles, Control Equipment, Heat Exchanges, And Accessory Equipment	1 Year		1 Year	1 Year
Torch And Leads				
Maximizer 300 Torch			1 Year	1 Year
SureLok Torches	1 Year		1 Year	1 Year
All Other Torches	180 Days	180 Days	180 Days	180 Days
Repair/Replacement Parts	90 Days	90 Days	90 Days	None

Warranty repairs or replacement claims under this limited warranty must be submitted by an authorized Thermal Dynamics® 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.

Effective November 15, 2001

SPECIFICATIONS

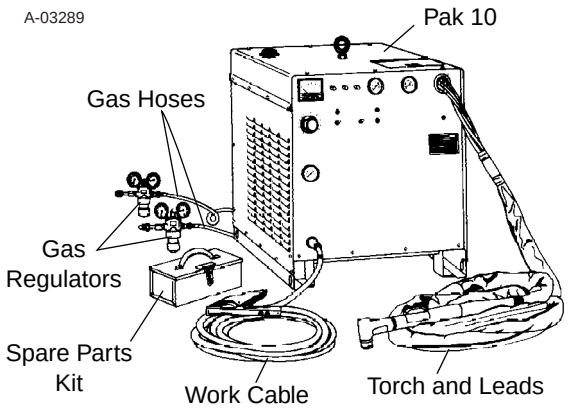


Figure 1-A Components of PAK 10 Cutting System

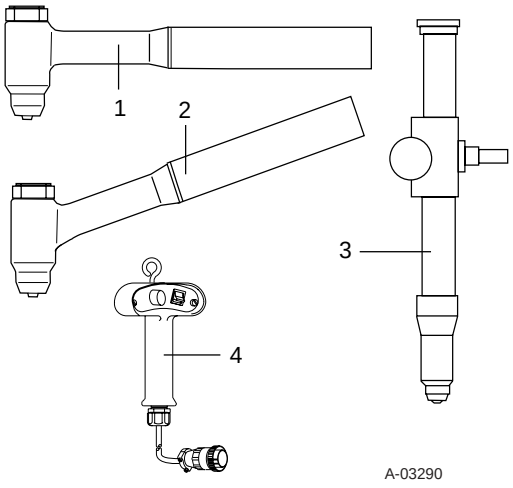


Fig. 1-B Type 4B LO-AMP Gas Cooled Torches

1. 90° Hand cutting torch (PCH-4B 90°)
2. 70° Hand cutting torch (PCH-4B 70°)
3. Machine mounted cutting torch (PCM-4BT)
4. Remote control unit for machine mounted torch

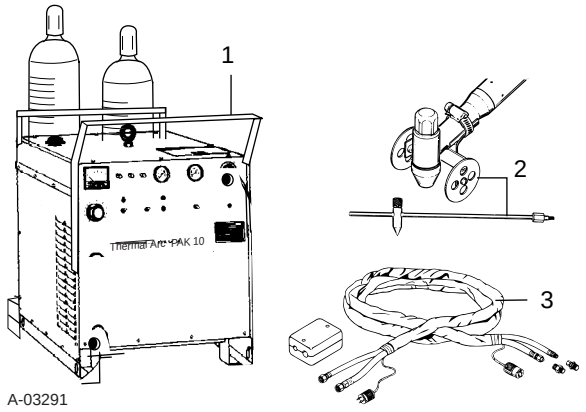


Fig. 1-C Accessories

1. Cylinder Rack
2. Torch Guide & Circle Cutting Attachment
3. Leads Extension Package

1.1. DESCRIPTION OF EQUIPMENT

A complete PAK 10 system includes a PCH-4B hand torch and/or PCM-4BT machine torch with 25 foot or 50 foot (7.62 m or 15.24 m) leads, a spare parts kit, a PAK 10, gas supply, pressure regulators, 10 foot gas supply hoses and a 25 foot work cable with clamp.

Three 4B torches are available (Figure 1-B): 90° hand torch (1), 70° hand torch (2), and a machine mounted torch (3). The 4BT machine mounted torch is controlled by a remote control assembly (4, Figure 1-B) with an ON/OFF switch and a remote current control. An initial supply of parts for the 4B is in the spare parts kit (Figure 1-A).

1.2. SPECIFICATIONS

TYPE 4B GAS COOLED TORCH

- Current Rating: 100 amperes maximum, DCSP, 80% duty cycle
- Plasma Gas: Nitrogen (N2), 30 psi (2.2 kg/cm^2), 15 SCFH (7.5 lpm); 65% Argon/35% Hydrogen, 40 psi (2.8 kg/cm^2), 30 SCFH
- Secondary Gas: Carbon dioxide ($C0_2$), 50 psi (3.52 kg/cm^2), 250 SCFH (125 lpm); compressed air, 50 psi (3.52 kg/cm^2), 250 SCFH (125 lpm)
- Cutting Capacity (most metals): Maximum thickness- 1 inch (25.4 mm); production cutting- 5/8 inch (15.9 mm); piercing- 3/4 inch (19 mm)
- Weight: Hand torch PCH-4B- 1-3/4 lbs. (0.79 kg); Machine mounted torch PCM-4BT- 3 lbs. (1.36 kg) without leads

PAK 10 UNIT

Power Input: 20 KVA, 50/60 Hertz, 3-phase in one of the following standard voltage/amperage combinations:

1- 208/230/460 volts, 60/50/25 amps

2- 230/460/575 volts, 50/25/20 amps

3- 380/415/460 volts, 30/30/25 amps

4- 380/460/500 volts, 30/25/25 amps

5- 220/380/500 volts, 50/30/25 amps

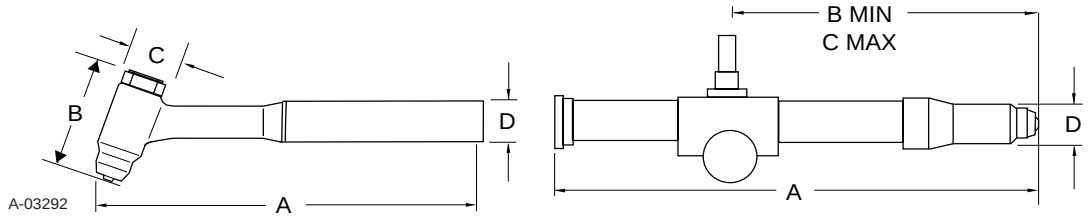
6- 180/200/220 volts, 70/60/50 amps

Certain other special voltage combinations are available.

- Rated Output: 100 amperes DC straight polarity
- Current Control: 50 to 100 amps continuously adjusted by feedback circuit
- Control Circuit: 24 volt AC
- Plasma and Secondary Gas Pressures: Controlled by pressure regulator at gas supply
- Weight: 615 lbs. (279 kg)
- Dimensions: Width- 26 inches (66 cm); Depth- 36 inches (91 cm); Height- 24 inches (61 cm)

ACCESSORIES AVAILABLE:

- A cylinder rack (1, Figure 1-C) that holds two gas cylinders
- A torch guide and circle cutting attachment (2, Figure 1-C)
- Torch lead extension packages to extend the torch leads in increments of 25 or 50 feet (3, Figure 1-C)



TORCH DIMENSIONS

	A	B	C	D
PCH-4B (70°)	16.00" (406 mm)	3.98" (100 mm)	1.25" (32 mm)	1.32" (34 mm)
PCH-4B (90°)	15.25" (390 mm)	3.98" (100 mm)	1.25" (32 mm)	1.32" (34 mm)
PCM-4BT	18.38" (467 mm)	8.12" (206 mm)	16.00" (406 mm)	0.69" (17 mm)

1.3. PLASMA CUTTING

Plasma is a gas which has been heated to an extremely high temperature and ionized so that the gas becomes electrically conductive. The plasma cutting process uses this plasma to transfer an electric arc to the workpiece. The metal to be cut is melted by the heat of the arc and then blown away.

In a plasma torch, a cool gas such as nitrogen (N2) enters in Zone A, Figure 1-D. In Zone B a pilot arc between the electrode and the front of the torch heats and ionizes the gas. An arc transfers to the workpiece through a column of plasma gas in Zone C.

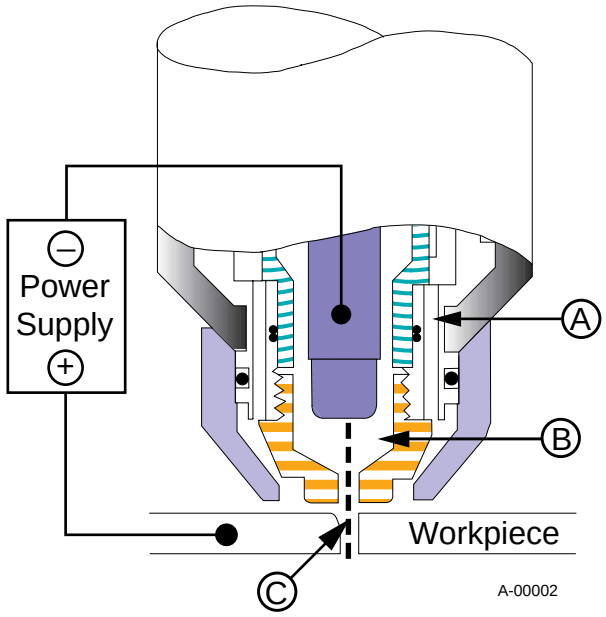


Figure 1-D Plasma Torch Operation

Plasma torches deliver a high concentration of heat to a very small area. The stiff, constricted plasma arc is shown in Zone C. Direct current straight polarity is used for plasma cutting, as shown in the illustration.

Plasma cutting torches use a secondary gas, which assists the high velocity plasma gas in blowing the molten metal out of the cut. This results in fast, clean, dross (slag)-free cuts. In the PAK l0 system, the secondary gas also cools the cutting torch. CO_2 or compressed air, supplied by either a cylinder or plant air system, is normally used as the secondary gas.

1.4. THEORY OF OPERATION

The main components of the PAK 10 cutting system are illustrated in the block diagram (Figure 1-E) and their function is summarized below.

PLASMA AND SECONDARY GASES

Plasma and secondary gases flow through the PAK unit to the cutting torch at pressures set at the external regulators. The pressure of each gas is indicated on the front panel gauges. Solenoid valves turn the gases on and off. The gas pressure interlocks shut the system down if the plasma gas pressure falls below 25 psi (1.7 bar) or the secondary gas pressure drops below 30 psi (2.0 bar).

The plasma gas flows through the green / black lead, around the electrode and gas distributor, and out through the tip orifice.

The secondary gas flows through the red / yellow torch lead, down the outside of the torch liner, through the holes at the base of the liner and out around the plasma arc.

PILOT ARC

When the torch is started, the pilot arc contactor closes and an arc is established between the electrode and cutting tip. The pilot arc makes a path for transferring the main arc to the work.

HIGH FREQUENCY

Because direct current alone is not sufficient to strike and maintain the pilot arc, high frequency is superimposed on the direct current.

CUTTING ARC

The main bridge rectifier converts the 3-phase AC power to DC power for the pilot and main cutting arcs. The negative output is connected to the torch electrode through the torch lead. The positive output is connected to the workpiece (through the work cable) and, through a contactor and resistor to the torch tip.

CURRENT CONTROL

The desired cutting current is set on the CURRENT ADJUST knob. A control circuit stabilizes cutting current against fluctuations due to changes in line voltages, material thickness, torch standoff and travel speed. Changing the amount of saturating current in the reactor changes the amount of AC power supplied to the main bridge rectifier. The amount of saturating current is controlled by a comparator which compares the actual cutting current to the amperage selector potentiometer setting.

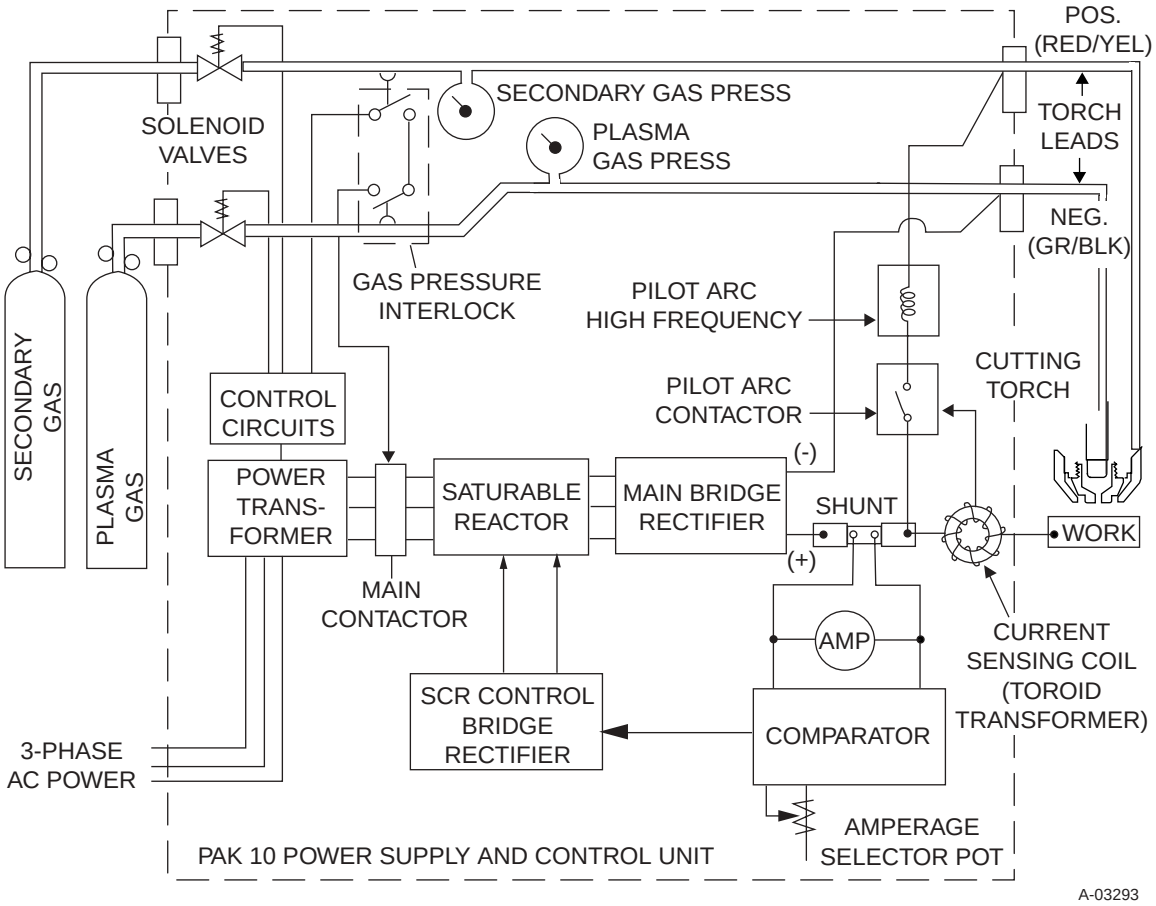


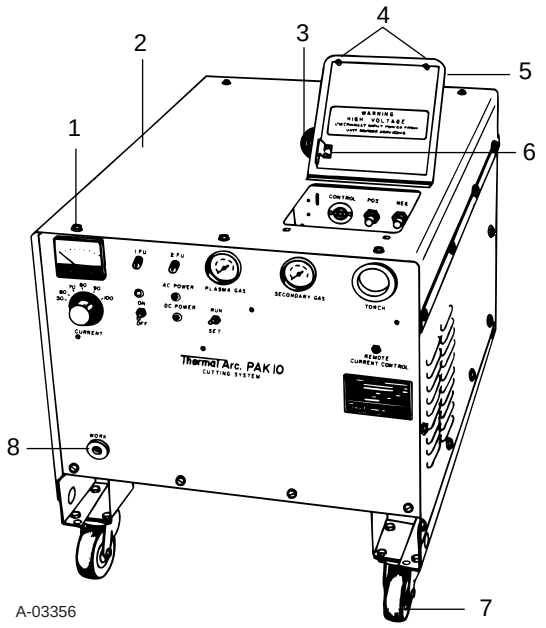
Figure 1-E Block Diagram of PAK 10 Cutting System

INSTALLATION

2.1 UNPACKING

The PAK 10 is skid-mounted and protected with a carton and padding material to prevent damage in shipment. The casters, lifting eye, gas hoses, work cable, torch, torch leads and miscellaneous parts are packed separately.

One copy of the PAK 10 Instruction Manual, in a transparent plastic envelope, is packed in with the PAK 10 unit.



1. Washer-head cover screws
2. Cover Assembly
3. Lifting eye
4. Access door fasteners
5. Lead connection access door assembly
6. Interlock switch actuator
7. Casters
8. Work cable receptacle

Figure 2-A Power Supply and Control Unit with Access Door Open

2.2 EQUIPMENT ASSEMBLY

After removing the carton, turn the lifting eye (3, Fig. 2-A) all the way into the threaded socket on top of the unit and tighten it securely. The lifting eye may then be used to lift the unit for removal of the skids and installation of the casters (7). If no crane or hoist is available for lifting, a fork lift or jack may be used. Use care so that the base of the unit will not be damaged. Lift the unit and remove the two skids which are secured to the base assembly with four bolts and hex nuts. Install the two swivel casters (7) at the front of the unit using four 5/16-18 x 3/4 inch cap screws and four 5/16-18 locknuts in each. Install the two fixed casters at the rear in the same manner. Lower the unit onto the casters and remove the lifting device.

2.3 EQUIPMENT INSTALLATION

Select a clean, dry location with good ventilation and adequate working space. Be sure that the air flow into the unit (from underneath) and out the back is not obstructed. A source of 3 phase power and a source of gases with pressure regulators are required.

Review PRECAUTIONS in the first section of this manual to be sure that location meets all safety requirements.

Most users prefer nitrogen (N2) as the plasma gas and carbon dioxide ($C0_2$) as the secondary gas, since it is easy to obtain good quality cuts with this combination. Argon / Hydrogen (Ar / H_2) (65% argon-35% hydrogen) is sometimes preferred as the plasma gas when cutting 1/2" to 1" thick aluminum to improve cut finish and reduce smoke and fumes. Compressed air (free of dirt and oil) may also be used as the secondary gas.

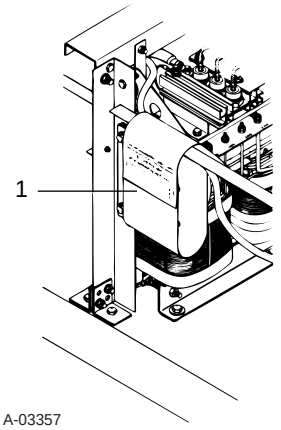


Figure 2-B Internal Packing Material

NOTE

A typical 50 lb. CO_2 cylinder is capable of delivering 35 SCFH on a continuous basis. Therefore, the manifolding of several CO_2 cylinders may be necessary to obtain the required torch flow rate, depending on application and duty cycle.

Connect the unit as follows:

1. Remove the top of the unit as follows:
   a. Remove the screws holding the cover.
   b. Open the lead connection access door (5, Figure 2-A).
   c. Lift off the cover of the unit.
2. Remove the paper band (1, Figure 2-B) stapled around the main terminal board.
3. Check for possible loose connections and damage that may have occurred during shipment.
4. Check the transformer (Figure 2-C) to be sure that it is set up for the available power. Three terminals (Figure 2-C) are provided for each phase. As shown in Figure 2-C, to connect the unit for 460 volts, the three wires from the input terminals attach to the three terminals marked 460. For other voltages, the three wires are connected to the appropriately marked terminals.

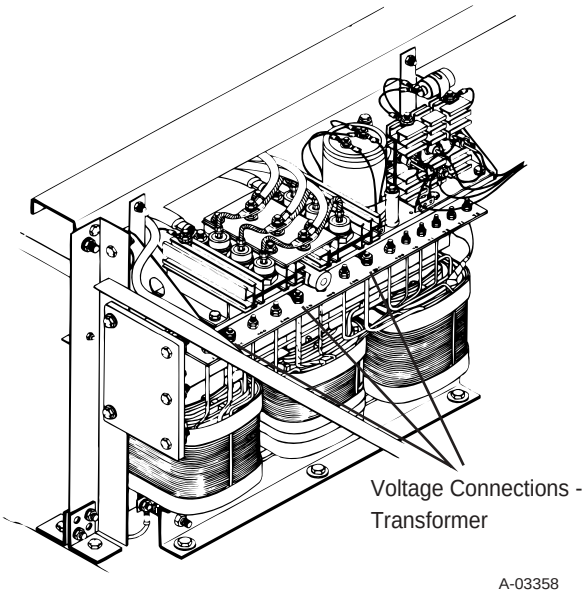


Figure 2-C Transformer Voltage Connections

CAUTION

Input voltage of the available three phase power source must correspond to one of the three operating voltages of the PAK 10. If not properly connected, damage to the equipment may result.

5. Check the three phase power service to be used. Recommended fuse or circuit breaker sizes are given in Table 2-A.

Power Transformer	Line Voltages Accepted	Fuse or Circuit Breaker Amperes	Recommended Minimum Primary Wire size *
1	208	80	4
	230	60	6
	460	30	10
2	230	60	6
	460	30	10
	575	25	10
3	380	40	8
	415	40	10
	460	30	10
4	380	40	8
	460	30	10
	500	30	10
5	220	60	6
	380	40	8
	500	30	10
6	180	90	4
	200	80	6
	220	60	6
** From the National Electric Code, 1978*			

Table 2-A Line Voltages, Circuit Protection & Recommended Wire Size

NOTE

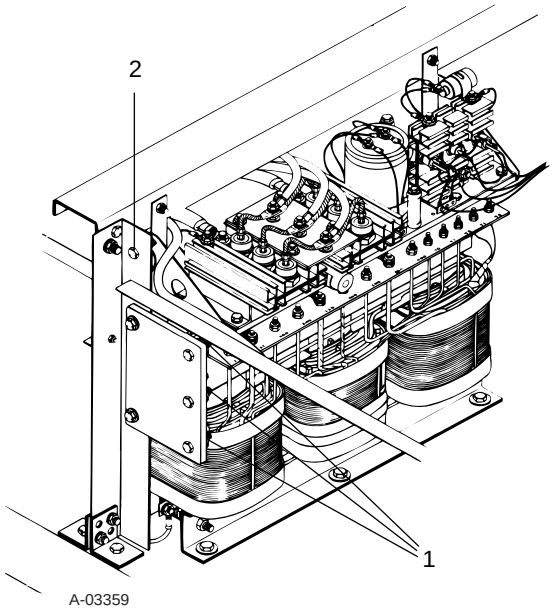
Larger wires may be required if the length is over 25 feet.

6. With the primary power disconnect switch open, connect the electrical ground and primary power leads to the terminals on the upper right hand side (facing the unit from the front.) Recommended wire sizes are given in Table 2-A. The leads are led through the "INPUT" fitting in the back (1, Figure 2-E). A proper ground connection must be made to the brass stud as shown (2, Figure 2-D). The other leads are attached to terminals L1, L2, and L3 (1, Figure 2-D).

WARNING

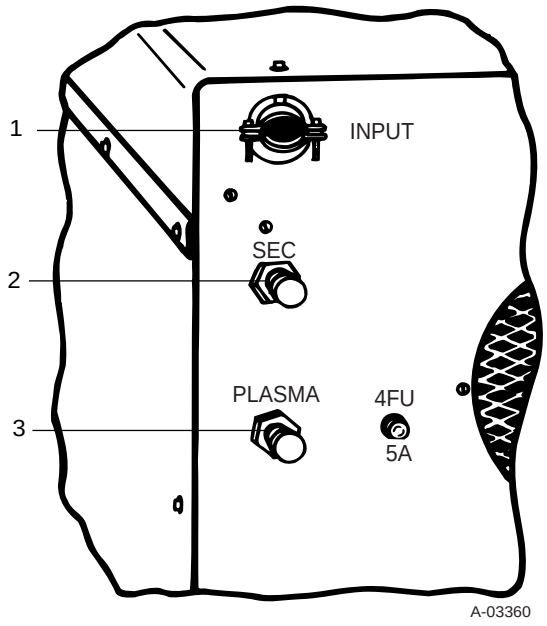
Do Not Turn on Power Until Step 10.

7. Connect the gases to be used to the fittings on the back of the unit (2 & 3, Fig. 2-E). Pressure regulators for use with PAK units and specifically calibrated for use with nitrogen (Cat. #9-2722), argon / hydrogen (Cat. #9-3053), carbon dioxide (Cat. #9-2759), and compressed air (Cat. #9-3022) are available from Thermal Dynamics. The gas supplies must be equipped with adjustable pressure regulators capable of being set between 0 and 60 psi (0-4.1 bar) and of delivering 15 Standard Cubic Feet per Hour (SCFH) (7 lpm) of N2 and 250 SCFH (118 lpm) of $C0_2$ or compressed air.



1. Primary Lead Terminals
2. Ground Terminal

Figure 2-D Primary Lead Connections



1. INPUT cable bushing
2. SECondary gas connection fitting
3. PLASMA gas connection fitting

Figure 2-E Rear Panel Connections

8. Check the torch to see that it is properly assembled (Refer to Section 4.1.).

   a. Pass the torch leads and control wire through the bushing on the front panel (5, Figure 2-F) and connect them to the appropriate fittings.

   b. If the torch is machine-mounted, the remote control assembly plug must also be inserted in the remote current control jack.

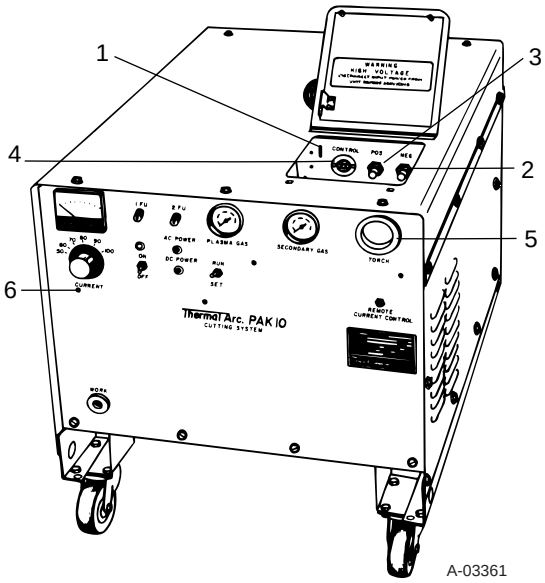
9. Re-install the cover of the unit (the leads access door must be open). Start the sheet metal screws but do not tighten them until the cover is lined up.

   Carefully close the leads access door, making sure that the switch actuator (1, Figure 2-F) enters its slot and activates the interlock switch. When the cover is properly positioned, tighten the screws.

WARNING

Do Not Operate the Unit unless all parts of the enclosure are in place. This is important for proper cooling as well as safety.

10. The work cable (Figure 1-A) is equipped with a twist-lock plug on one end and a work clamp on the other. The plug fits into the work receptacle on the front of the unit (8, Figure 2-A) and the clamp attaches to the workpiece. The unit is now ready for operation.



l. Actuator for Interlock Switch (SW3)
2. Negative (-) torch lead fitting
3. Positive (+) torch lead fitting
4. Torch control switch receptacle
5. Torch lead insulating bushing
6. Remote current control jack

Figure 2-F Torch Connection Access Door and Panel

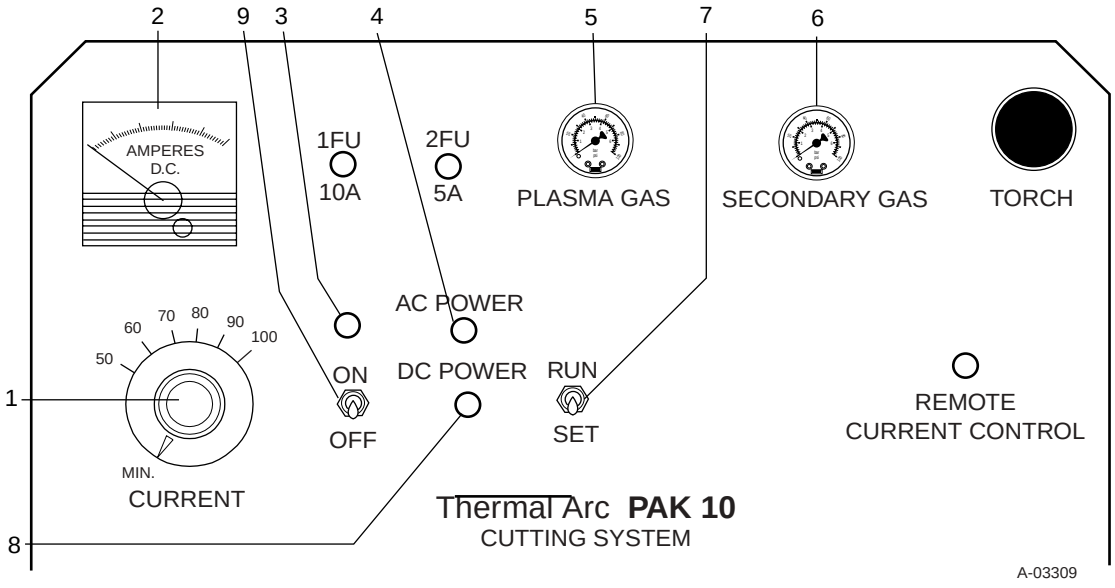


Figure 3-A PAK 10 Control Unit Operating Controls

3.1 OPERATING CONTROLS

1. Current Adjust Knob

   Select desired cutting current. Calibrated from Min. up to 100 amps.

2. Ammeter (A)

   Indicates amperage supplied to torch.

3. READY Indicator (LT3)

   Amber light indicates that the ON / OFF switch is ON and that lead connection access door is closed.

4. AC POWER Indicator (LT1)

   Red light indicates that 3 phase AC power is being supplied to the system.

   NOTE

   Fan is on when this light is on.

5. PLASMA GAS

   Indicates pressure at which plasma gas is being supplied to the torch.

6. SECONDARY GAS

   Indicates pressure at which secondary gas is being supplied to the torch.

7. RUN / SET Switch (SW2)

   Move up to RUN position for torch operation. Move down to SET position for purging gas lines and setting gas pressures with external regulators.

8. DC Power Indicator (LT2)

   Red light indicates that main contactor (W) has closed to supply current to the main bridge rectifier and that cutting current is available.

9. ON / OFF Switch (SW1)

   Move up to ON position to activate the control circuits. Move down to OFF position to deactivate control circuits.

3.2 PRE-OPERATION SET-UP

This procedure should be followed at the beginning of each shift:

WARNING

Check to be sure main disconnect switch is open.

l. Check the torch to be sure it has the proper components and is adjusted correctly. (Refer to Section 4.1).

2. Close the main disconnect switch supplying 3- phase power to the unit.

3. Turn the ON / OFF switch ON (9, Figure 3-A). The amber "READY" light will come on. (If the gas supply is on, the gases will flow for two seconds).
4. Turn the RUN / SET switch to the SET position. Open the plasma gas supply valve at the source. Adjust the pressure regulator on the gas supply until the plasma gas pressure reads 30 psi (2.0 bar).
5. Purge for approximately 3 minutes by letting the plasma gas run. This will remove any condensed moisture that may have accumulated in the torch or leads while the system was shut down.
6. Open the secondary gas supply valve at the source. Adjust the pressure regulator at the gas supply until pressure reads 50 psi (3.4 bar).
7. Return the RUN / SET switch to the RUN position.
8. Set the current adjust knob (l, Figure 3-A) to the desired amperage level.

The system is now ready for operation. The torch is controlled by the switch mounted on the torch handle (or the remote control switch for a machine mounted torch).

3.3 OPERATION

HAND TORCH OPERATION

WARNING

Be sure the operator is equipped with proper gloves, clothing, eye and ear protection and that all precautions at the front of this manual have been followed.

l. Hold the torch comfortably, as shown in Figure 3-B. One hand should be close to the head assembly and the other hand positioned so that the thumb can conveniently operate the control switch. Position the torch over the workpiece, resting the front of the cup on the edge of the workpiece at the point where the cut is to start. This will positively locate the line of the cut.

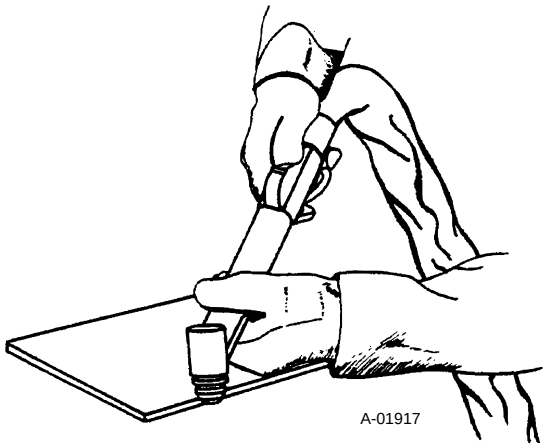


Figure 3-B Positioning the Hand Torch for a Cut

2. Lower the welding helmet and lift the torch about 1/8" (3 mm) from the workpiece. Then press and hold the control switch on the torch. After a two second gas purge, the pilot arc will come on and remain on until the main cutting arc is established, at which point the pilot arc circuit switches off automatically.

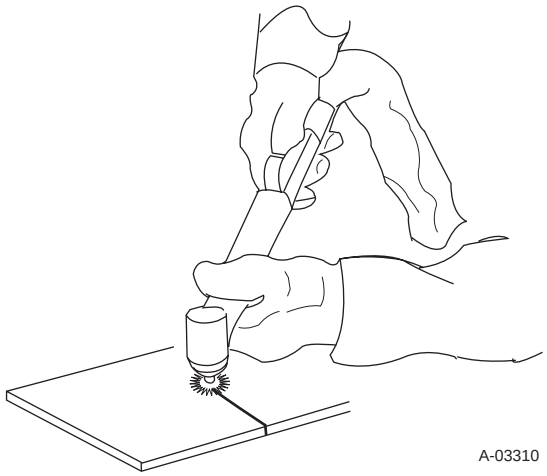


Figure 3-C Hand Cutting Over a Line on the Workpiece

3. The cutting arc will remain on as long as the control switch is held down unless the torch is withdrawn from the work or the torch motion is too slow. If the cutting arc is interrupted, the pilot arc will come on again. It will remain on until the cutting arc is again established or the control switch is released.
4. Cut with the torch about 1/8" to 1/4" (3 to 6 mm) from the workpiece, as shown in Figure 3-C. Keep the torch perpendicular to the work.

MACHINE TORCH OPERATION

When cutting with a machine torch, the torch must be at right angles to the plate to obtain a clean, vertical cut. Use a square, as shown in Figure 3-D, to align the torch. It is good to start a cut at a slow speed and increase the speed to obtain the desired cut quality. Table 3-B gives typical cutting speeds for various materials and material thicknesses.

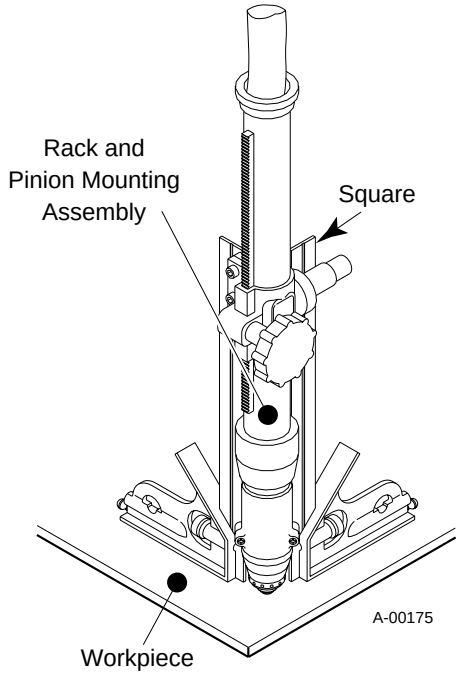


Figure 3-D Using a Square to Set Up the Machine Torch

To start a cut at the plate edge, line up the torch away from the plate, and press the control switch. The transferred cutting arc will then be established at the plate edge. Adjust cutting speed for good cutting performance, as indicated by a trailing arc of approximately 5° (Figure 3-E). When cutting expanded metal the cutting arc and pilot arc will alternate establishing themselves automatically.

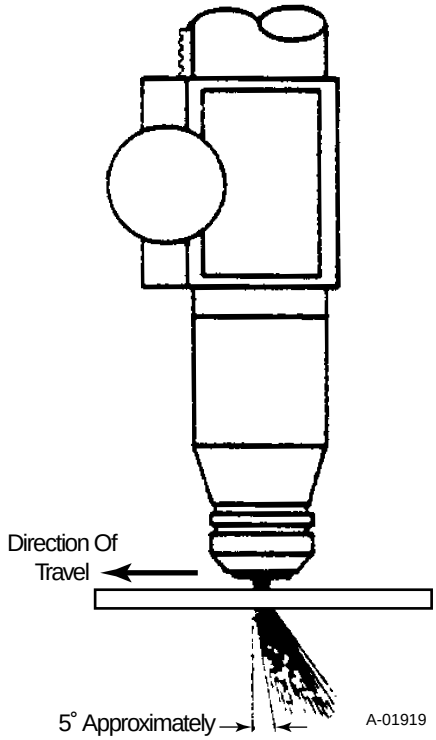
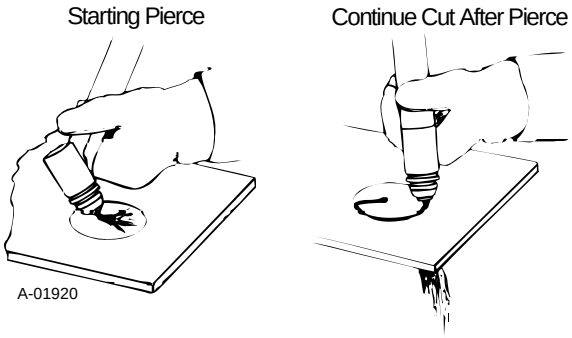


Figure 3-E A Good Cut Will Produce a Trailing Arc of Approximately 5°

PIERCING

In some cutting operations, it may be desirable to start the cut within the plate area rather than at the plate edge. Piercing the plate is not recommended on plates thicker than 3/4" (19 mm), based on a 5/16" (7 mm) standoff, using a mechanized torch with a "running start" and a maximum time to complete pierce of 3 seconds). Blowback from the piercing operation can shorten the life of torch parts. All piercing should therefore be done as quickly as possible with current set at 100 amperes.

A method called "running start" is recommended when piercing with a machine mounted torch. Position the torch off the cutting line a sufficient distance to allow the pierce to be made before reaching the cutting line. This allowance depends on the thickness of the material and the travel rate of the mechanized torch.



Figures 3-F and 3-G Piercing with Hand Torch

When using a hand torch, tip the torch slightly to pierce so that blowback particles blow away from the torch tip rather than directly into it, as shown in Figure 3-F. Pierce off the cutting line and then continue the cut as shown in Figure 3-G. Spatter and scale should be cleaned 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.

NOTE

The suggestions listed below should be followed in all cutting operations.

1. Wait five minutes before opening the main disconnect switch at shut down. This permits the cooling fan to run to remove operating heat from the unit.
2. For maximum parts life, do not operate the pilot arc any longer than necessary.
3. Remember that cutting current can be adjusted at any time. Learn to change the current output to provide a comfortable working speed for the particular material being cut.
4. Handle torch leads carefully and protect them from damage.
5. In continuous cutting applications, it is often necessary to manifold 4 to 6 $C0_2$ cylinders together to maintain pressure at 50 psi (3.4 bar).
6. Because of the swirl of plasma gas in the torch, the right hand side of the cut (in relation to torch travel) is normally of better quality. Reverse swirl tips are available for mirror image cutting.

FREQUENTLY REVIEW THE SAFETY PRECAUTIONS GIVEN AT THE FRONT OF THIS MANUAL.

WARNING

It is not enough to simply move the ON/OFF switch on the unit to its OFF position when cutting operations have been completed. Always open the power supply disconnect switch 5 minutes after the last cut is made.

COMMON CUTTING FAULTS

Listed below are common cutting problems followed by probable causes of each. If problems are caused by the PAK 10, refer to the Trouble Shooting Section (Section 4).

1. Insufficient Penetration

a. Cutting speed too high

b. Current too low

2. Main Arc Extinguishes

a. Cutting speed too low

b. Standoff too high

3. Dross Formation

a. Improper gas pressure or mixture

b. Improper cutting speed (Refer to Table 3-B)

c. Faulty electrode or tip

4. Burned-Out Tips

a. High cutting current

b. Damaged or loose cutting tip

c. Contact with work

d. Heavy spatter

e. Low plasma gas pressure

f. Back cap not tight

g. Spring not correctly installed

3.4 CUTTING CURRENT AND SPEED SELECTION

The desired cutting current and the speed at which the torch is moved along the line of the cut depend on the thickness and composition of the workpiece. In hand cutting, the speed is usually determined by how fast the operator can comfortably and accurately follow the line of the cut.

Most operators find that at speeds much above 30 ipm it is difficult to accurately follow the line of the cut. For machine cutting, faster speeds are often used. Refer to Table 3-B.

This chart is intended as a guide to determining approximate conditions for making good quality cuts in various thicknesses of material. Slower speeds may be obtained on thin sections by reducing the current to between 50 and 100 amperes.

The speeds shown are typical for cutting at 100 amperes using the 8-4153 (0.059) tip.

Plasma Gas - N2 at 30 psi (2.0 bar), 15 SCFH (7.1 lpm)

Secondary Gas - CO_2 or Compressed Air at 50 psi (3.4 bar), 250 SCFH (125.0 lpm)

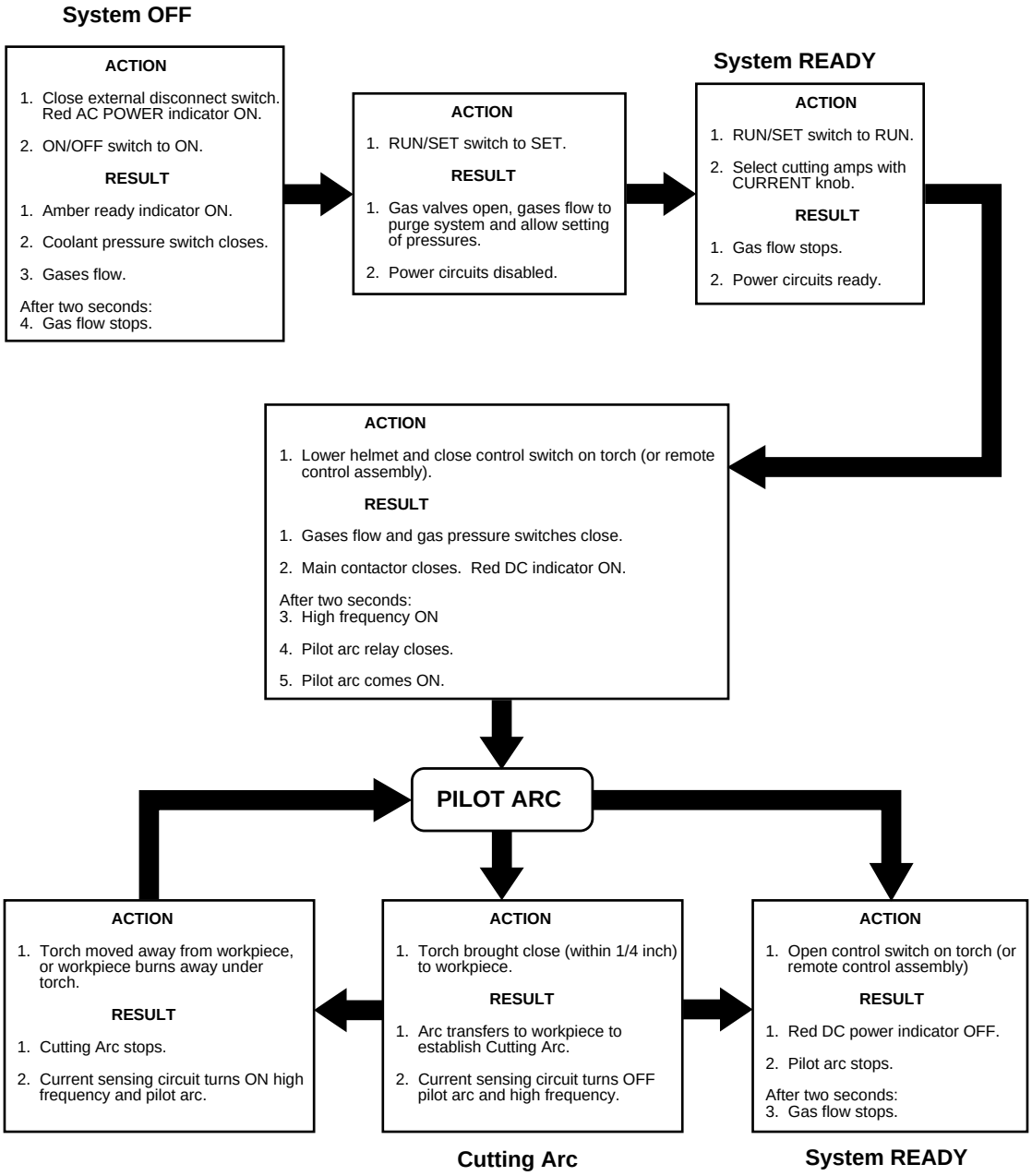
NOTE

This information represents our best judgment but Thermal Dynamics Corporation assumes no liability for its use.

INCHES/MINUTE (METERS/MINUTE)					
THICKNESS	1/8" (3.2 mm)	1/4" (6.4 mm)	1/2" (12.7 mm)	3/4' (19 mm)	1" (25.4 mm)
Stainless Steel	100 (2.54)	60 (1.52)	24 (0.61)	20 (0.50)	10 (0.25)
Aluminum	125 (3.18)	90 (2.29)	34 (0.86)	25 (0.63)	12 (0.30)
Carbon Steel	75 (1.90)	45 (1.15)	24 (0.61)	18 (0.46)	9 (0.23)
Note: Speeds for Argon/Hydrogen Plasma Gas at 40 psi (2.7 bar), 30 SCFH (14.2 lpm) with the 8-4170 LO-AMP tip at 100 amps are slightly faster. Argon/Hydrogen is not recommended for cutting carbon steel.					

Table 3-B Recommended Cutting Speeds

PAK 10 - SEQUENCE OF OPERATION



NOTE

To shut down system, move ON-OFF switch to OFF. Wait 5 minutes to allow fan to remove heat from unit. Then open external disconnect switch.

SERVICE

The Service Section is divided into six parts:

4.1 Torch Maintenance

4.2 Torch Leads and Leads Extension Packages

4.3 PAK Unit Maintenance

4.4 Gas Pressure Regulators

4.5 Trouble Shooting Guide

4.6 Test Procedures

4.1 TORCH MAINTENANCE

The 4B and 4BT torch parts are interchangeable with two exceptions. First of all, the 4BT collet is a different design than the 4B. This is so that the collet can be installed from the front of the torch. By installing the collet from the front of the torch the back cap is eliminated in the 4BT design. These differences require slightly different disassembly and assembly procedures. When a different procedure is required, the torch model will be specified, otherwise the step applies to both torch models.

Torch Disassembly and Inspection

WARNING

Disconnect primary power before disassembling the torch.

Disassemble the torch parts as follows:

1. Pull off the shield cup (1) and inspect it for damage. Wipe it clean, or replace it if it appears to be damaged.
2. Use the tip wrench (17) to unscrew the tip (2). Check the tip for wear as indicated by an elongated or oversize hole. Make sure that the tip is clean and that threads have not been damaged. Replace the tip if necessary.
3. Lift out the gas distributor (3). Remove the electrode (7) and check the end for pitting.

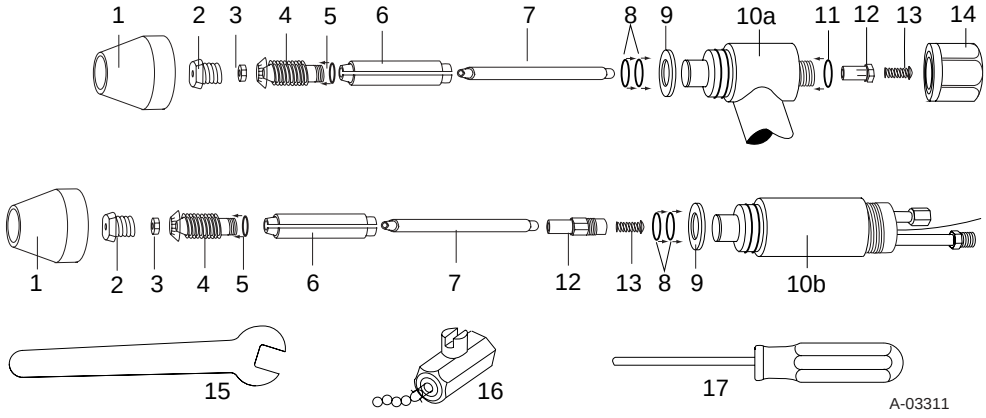


Figure 4-A Plasma Cutting Torch (PCH / M-4B), Exploded View

1. Shield Cup
2. Tip
3. Gas Distributor
4. Liner (includes 9-2960 O-ring)
5. O-ring (included with Liner)
6. Sleeve
7. Electrode
8. O-ring (included with Shield Cup)
9. Gasket
10. Head Assembly:
    a) PCH-4B
    b) PCM-4BT
11. O-Ring: PCH-4B
12. Collet with 8-0525 O-Ring
13. Spring
14. Back Cap: PCH-4B
15. Liner Wrench
16. Tip Wrench
17. Collet Wrench: PCM-4BT

If the end of the electrode is badly pitted (cavity almost covers diameter) then that end of the electrode should no longer be used.

The electrode may then be reversed. When both ends are pitted, the electrode should be replaced. Do not attempt to repoint the electrode.

NOTE

Remove the liner assembly (4) and sleeve (6), in accordance with the following step, only if either appears to be damaged and requires replacement.

4. Remove the liner assembly (4) with the liner wrench (16). After unscrewing the liner, slip out the sleeve (6).
5. PCH-4B: Unscrew the back cap (14) and remove the spring assembly (13) and collet assembly (12).
6. PCM-4BT: The collet (12) is removed by sliding the collet wrench (17) into the torch cavity and unscrewing it from the torch.

NOTE

The spring assembly (13) should come out with the collet. Care must be taken not to lose this spring.

Torch Assembly

WARNING

Disconnect primary power before assembling the torch.

1. PCM-4BT: Insert the spring assembly (13) into the collet (12) and install the collet in the torch cavity. Tighten down with collet wrench (17).
2. Insert the sleeve (6) in the liner (4). The sleeve should be clean and dry and may be either end up.
3. O-ring (5) should be lightly lubricated with O-ring lubricant (Cat. No. 8-4025) and installed just past the threads on the liner. Install the liner (4) in the torch using the liner wrench (16).
4. PCH-4B: Insert the spring assembly (13) in the collet (12) and install the collet in the back of the torch with the end with the O-ring toward the front.
5. PCH-4B: Check the O-ring (11) that seals the back cap to be sure it is lightly lubricated (Cat. No. 8-4025) and in good condition.

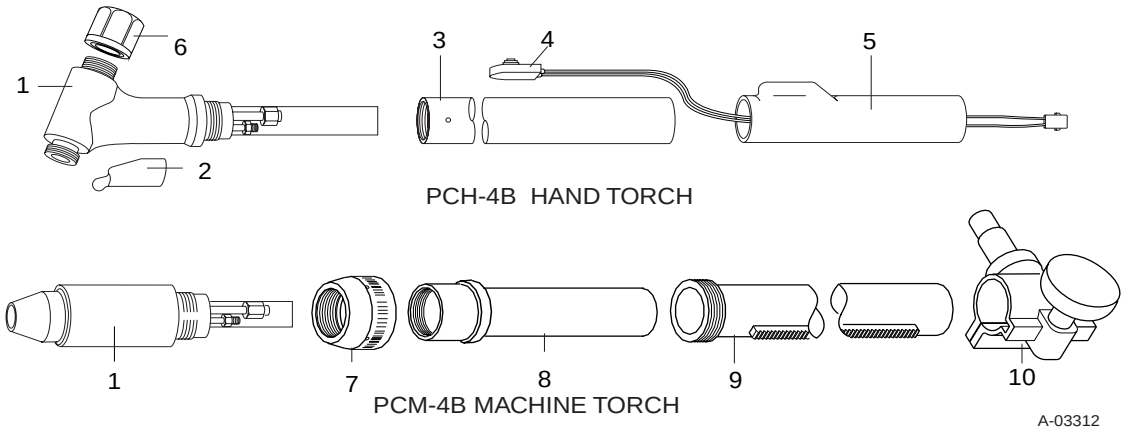


Figure 4-B Hand and Machine Torch Heads, Exploded View

1. Head
2. Heat Shield
3. Handle
4. Torch Switch
5. Torch Switch Sheath
6. Back cap
7. Nut
8. Insulating Sleeve
9. Mounting tube
10. Pinion assembly

6. PCH-4B: Install the back cap (14) and tighten it securely.

CAUTION

Use care to see that the back cap is turned all the way down to hold the collet (12) securely. On the machine torches this cap goes down inside and may seem tight, but still may not be holding the collet tightly. Arcing may result, welding the collet to the torch and causing irreparable damage.

7. Insert the electrode (7) in the torch from the front. Push it back against the spring to make sure it slides freely back and forth.
8. Install a gas distributor (3) in the tip (2) and install the tip in the front of the torch. Tighten it securely with a tip wrench (16).
9. Install a gasket (9) and two O-rings (8) on the front of the torch. The O-rings must be lubricated with O-ring lubricant (Cat. No. 8-4025).
10. Install the cup (1) on the front of the torch.

The torch is now ready for operation.

4.2 TORCH LEADS AND LEADS EXTENSION PACKAGES

Torch Leads Replacement

To replace the torch leads on a hand torch separate the leads covering from the torch handle by pulling the torch switch sheath (5, Fig. 4-B) back over itself to expose where the leads covering is secured to the handle. Remove the tape securing the covering to the handle. Pull the covering away from the handle and disconnect the switch from the leads package. Unscrew the handle from the torch and slide back to expose the leads connections. Leads are connected to the appropriate fittings on the torch in accordance with the color coding-red / yellow for secondary gas and green / black for plasma gas. A plastic insulator is located between the fittings in the handle.

The fittings (Figure 4-C) on the ends of the torch leads may be replaced. Cut the hose close to the old fitting. Cut the wire inside the hose and discard the old fitting. Attach new fittings to the wire by crimping the tube, on the fitting, onto the wire. Crimp the tube with a Stakon size C crimping tool. It is important to crimp the tube all the way back to the first hole to ensure adequate gas passage.

Use a ferrule (1) to secure the hose to the fitting or lock the hose in place with a twisted wire. If a ferrule is used, crimp (1) in place with 1 / 2 inch diameter crimping dies, Scovill No. 39 or equal. Crimp (1a) in place with 5 / 8 inch diameter crimping dies, Scovill No. 34 or equal.

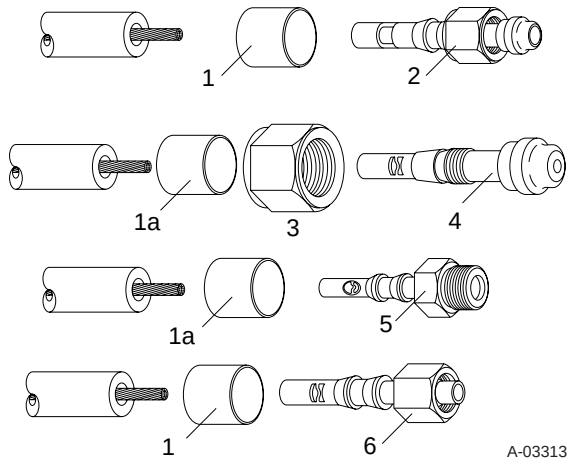


Figure 4-C Torch Lead Fittings

l. Ferrule
2. Fitting, console end (-)
3 Nut, console end (+)
4. Fitting, console end (+)
5. Fitting, torch end (+)
6. Fitting, torch end (-)

LEADS EXTENSION PACKAGES

Leads extension packages are available to extend the torch leads in increments of 25 and 50 feet. The packages are available as follows:

PCH-4B 25': Cat. No. 4-2739 50': Cat. No. 4-2740

PCM-4BT 25': Cat. No. 4-2741 50': Cat. No. 4-2742

1. Lead Adapter
2. Insulator
3. Leads (25' or 50')

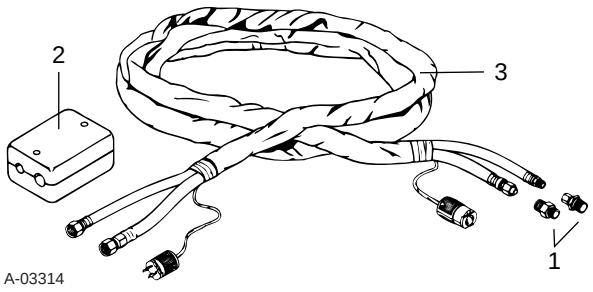


Figure 4-D Leads Extension Package

WARNING

Disconnect primary power before installing the leads extension package. Do not turn on primary power to unit until all connections are made and insulators are in place.

The leads that are furnished with the extension packages are the same as standard leads with the exception of the control switch leads for the hand torch. On the extension package the control switch leads terminate in a receptacle for the 2 prong "Twist-Loc" plug. The standard leads have a square plastic connector that mates with the one on the torch leads.

NOTE

For leads extension over 100 feet the two-second gas purge is not adequate. Replacement of TD2 Relay (Catalog No. 9-2694) with a Catalog No. 9-3528 Relay will increase the purge time to ten seconds.

4.3 PAK UNIT MAINTENANCE

The only routine maintenance required for the PAK 10 system is a thorough cleaning and inspection of the unit. This should be done on a regular basis, the frequency depending on the amount of usage and the environment in which the unit is operated.

WARNING

Removing the cover of a PAK 10 with a Running Gear also removes the retaining chains making the gas cylinder free-standing. This cylinder must be restrained by some temporary means until the cover and retaining bar are replaced and the retaining chains reconnected.

To clean the PAK unit, first make sure that the power is disconnected and AC Power Light (LT1) off. Remove the cover and side panels of the unit and blow out any accumulated dirt and dust with compressed air. The unit should also be wiped clean. If necessary, solvents that are recommended for cleaning electrical apparatus may be used.

While the covers are off, inspect the wiring in the unit, looking for any frayed wires or loose connections that should be corrected. When cleaning the unit pay particular attention to the area around the high frequency spark gap points since accumulated dirt in that area can weaken the high frequency starting current.

4.4 GAS PRESSURE REGULATORS

The Thermal Arc gas pressure regulators provide a means of conveniently selecting and maintaining the required working pressures of the gases. The regulator will hold this pressure constant. Inlet pressure is reduced in one step to the working pressure by means of a pressure balanced poppet valve controlled by a spring loaded piston in a low pressure chamber. A large adjusting knob (6, Figure 4-E) provides for adjusting spring pressure against the piston. A sintered stainless steel filter, in the inlet connector (1), prevents dirt from entering the regulator mechanism.

No regular maintenance of the gas pressure regulators is required, except an occasional lubrication of the adjusting screw thread and on its end, where it contacts the adjusting spring. Lubricant is available from Thermal Dynamics for this purpose (Catalog No. 9-2871).

Replaceable parts in the regulator include the pressure gauges, the O-ring seals on the piston and above the poppet valve, and the poppet valve. (See Assembly Parts List Fig. 5-10 for replacement parts).

CAUTION

Do not attempt to remove the sintered metal filter in the inlet connection. This is not a serviceable item.

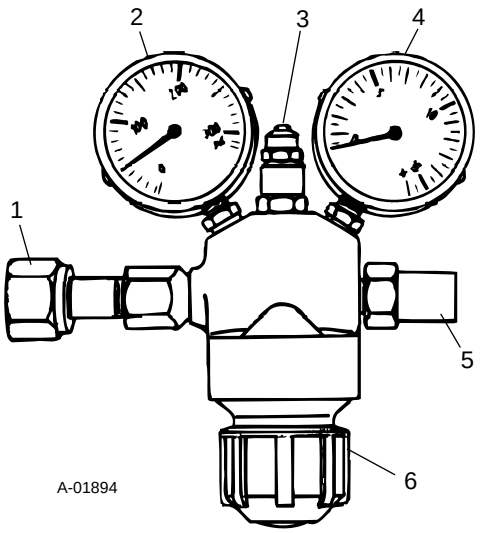


Figure 4-E Components of Gas Pressure Regulator

1. Inlet Connection
2. Inlet Pressure Gauge
3. Safety Valve
4. Working Pressure Gauge
5. Hose Connection
6. Adjusting Knob

4.5 TROUBLE SHOOTING GUIDE

If the unit malfunctions, the following table will be helpful in correcting the problem. Since the malfunction may be due to a faulty connection rather than a faulty component, be sure to check all connections to a component that appears to be malfunctioning.

The trouble shooting table is arranged in the normal operating sequence of the unit for easy reference. Each problem has listed next to it the possible causes and the remedy.

In some cases the remedy is too complex to fit in the table, in which case there is a reference to one of the TEST PROCEDURES.

WARNING

Removing the cover of a PAK 10 with a Running Gear also removes the retaining Chains making the gas cylinders free standing. These cylinders must be restrained by some temporary means until the cover and the retaining bar are replaced and the retaining chains reconnected.

When the external disconnect switch is closed, the red "AC POWER" light goes on and the fan starts. When the ON/OFF switch goes ON, the amber "READY" light goes on and the gases flow for two seconds. If this does not happen, check as follows:

A. No "AC POWER" light

1. Blown fuse or open circuit breaker at disconnect

a. Replace fuse or reset breaker.

B. No "READY" Light

1. Door interlock switch (LS) not actuated

a. Check switch and actuator tab.

2. Blown fuse 2FU

a. Check fuse.

3. Main transformer overheated

a. Allow unit to cool down.

C. Gases do not flow when READY light comes on

1. Gas supply not on

a. Open valves.

D. Gases flow more than 2 seconds

1. RUN/SET Switch in SET position

a. Switch to RUN.

2. Faulty post flow time delay (TD1)

a. Check time delay TD1 (See A, Test Procedures).

E. Cannot set desired gas pressure

1. Empty cylinder

a. Replace.

2. Faulty regulator

a. Repair or replace.

3. Faulty solenoid valve

a. Replace.

When the torch switch is pressed, the gas and red "DC POWER" light should come on. If this does not happen, check as follows:

F. Gas does not flow when torch switch pressed

1. *Torch switch not connected*
   a. Check wires to plug, switch, and receptacle.
2. *Torch switch not closing*
   a. Check for continuity when pressed.
3. *Faulty control relay 1CR*
   a. Check relay (See C, Test Procedures).
4. *No 24 volt power*
   a. Check output of transformer T2 (See B, Test Procedures).

G. No red "DC POWER" light

1. *Pressure switch PS1 or PS2 not satisfied*
   a. Check and adjust gas pressure regulator Plasma should be 30 psi (2.0 bar), secondary should be 50 psi (3.4 bar).
2. *Faulty main contactor (W)*
   a. Check contactor (See D, Test Procedures).
3. *Failed diodes in main rectifier*
   a. Check diodes (see E, Test Procedures).

The Pilot Arc should start two seconds after the red "DC Power" light comes on. If it does not, check the torch parts to make sure they are in good condition and properly assembled. Check to see if:

1. PCR relay energizes at the time the pilot arc should start (two seconds after pressing switch).
2. There is any reading of the ammeter (normal Pilot Arc is 8 to 12 amps).
3. There is any light visible inside the torch.

H. No PCR movement two seconds after torch switch pressed

1. *Faulty time delay TD2*
   a. Check TD2 (See A, Test Procedures).

I. No pilot but ammeter reads 40 amps

1. *Torch assembled without gas distributor*
   a. Assemble torch with correct parts (See Section 4.1.)
2. *Shorted torch head*
   a. Replace.
3. *Shorted torch leads*
   a. Repair or Replace.

J. No spark can be seen in torch

1. *High frequency points shorted*
   a. Clean and dry area around high frequency points, adjust gap to 0.015".
2. *Shorted capacitor C-1*
   a. Check (See F, Test Procedures).
3. *CSR closing with no cut*
   a. Check for shorted toroid (See G, Test Procedures). Replace CSR.
4. *Broken conductor in torch leads*
   a. Repair or replace.
5. *High frequency transformer T3 failed*
   a. Check (See H, Test Procedures).
6. *Dirty or wet torch leads*
   a. Clean and dry leads.

K. Spark in torch but no pilot (ammeter reads 0)

1. *Insufficient DC voltage*
   a. Check for 205 volts open circuit (See J, Test Procedures).
2. *Pilot contactor (PCR) not closing*
   a. Check for DC at torch (See L, Test Procedures).
3. *Pilot resistor failed*
   a. Check resistor (See K, Test Procedures).

The Cutting Arc should start as soon as the torch, with the pilot arc running, is brought to within about 3/8 inch (10 mm) of the workpiece. If it does not, check:

L. No cutting arc

1. *Work cable not connected*
   a. Connect.
2. *One leg of 3-phase primary out*
   a. Check all 3 input phases for voltage.
3. *One leg of main contactor (W) not closing*
   a. Check voltage at diodes (See M, Test Procedures).

4. *Current control circuit inoperative (A cutting arc can be established on very thin material if the torch is held very close)*

    a. See next section (Problem M).

Once the cutting arc is established, the cutting current should be equal to the setting of the CURRENT adjust knob (unless the remote current control is in use). If it is not, there is a problem in the current regulating circuit as follows:

M. Unit only puts out minimum current

1. *Fuse 1FU blown*

    a. Replace.

2. *Fuse blows again*

    a. Check diodes, varistor and SCR's in control bridge (See N & V, Test Procedures).

3. *Reactor disconnected*

    a. Check (See P, Test Procedures).

4. *Printed circuit card failed*

    a. Check (See Q, Test Procedures).

5. *Potentiometer failed*

    a. Check (See 0, Test Procedures).

6. *T5 transformer failed.*

    a. Check for 12VAC at each sec. coil.

N. Unit only puts out max. current-100+ A

1. *Pilot arc remains on during cut*

    a. Check CSR circuit (See R, Test Procedures).

2. *Shunt disconnected*

    a. Check (See T, Test Procedures).

3. *Printed circuit card failed*

    a. Check P.C. card (See Q, Test Procedures).

O. Unit can only put out about 70 amps maximum

1. *P.C. card failed*

    a. Check P.C. Card.

2. *One SCR failed*

    a. Check SCR's (See U, Test Procedures).

P. Unit output does not match potentiometer setting

1. *Remote Control resistance open*

    a. Check circuit (See S, Test Procedures).

Q. Short torch parts life

1. *Pilot arc remains on during cut*

    a. Check CSR circuit (See R, Test Procedures).

2. *No pre-purge gas flow*

    a. Check time delay TD2.

3. *No post purge gas flow*

    a. Check time delay TD1.

4. *Misuse of torch*

    a. Use torch within ratings for current and work thickness.

R. Arcing in collet area

1. *Back cap not tight*

    a. Replace collet and tighten cap securely.

2. *Dirt in collet area*

    a. Clean electrode, collet and collet seating area.

S. Discolored electrode

1. *Gas hoses switched*

    a. Check.

2. *Contaminated gas*

    a. Check plasma gas system for leaks.

3. *No pre/post purge*

    a. Check TD1 and TD2.

4.6 TEST PROCEDURES

The following tests are suggested for specific problems listed in the preceding trouble shooting chart. The letter designations correspond to those listed in the "Remedy" section of the trouble shooting chart.

WARNING

Several of these tests involve voltage measurements that must be made with power on. In order to make these measurements, the leads access door interlock switch must be propped closed or by-passed. Use extreme care when making these tests and be sure to return the interlock switch to proper operation after work is completed.

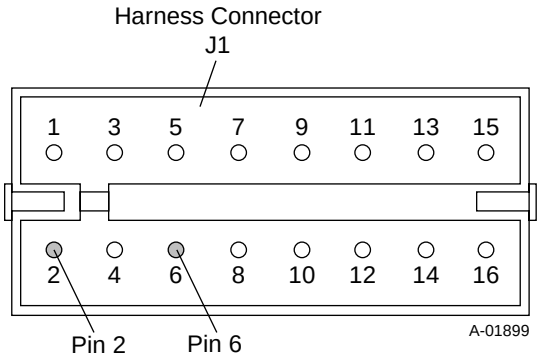
Tests requiring voltage measurements are marked with the warning symbol:

All other tests are to be made with the primary power to the machine turned off.

NOTE

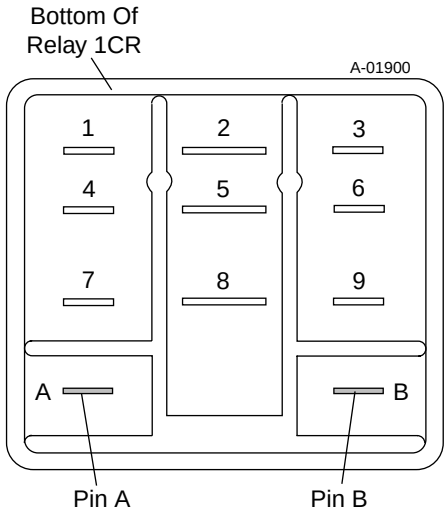
A. The two time delay relays, TD1 and TD2, are interchangeable and can normally be checked by swapping them. They are the "delay on operate" type with a fixed 2 second delay.

B. The 24 volt transformer and switch circuit can be checked with an AC voltmeter. The meter probes should be on J1-2 and J1-6 which are pin connections on the printed circuit card that holds the relays. These pin connections can be located by finding J-1 and counting from the four corner pins which are numbered as shown.



Measure 24 volts AC here when torch switch is closed.

C. Relay 1CR has a 24 volt AC coil. The coil resistance should be approximately 80 ohms measured from pin A to pin B (on bottom of relay).



D. To check the main contactor remove the left side panel of the machine. The contactor should close when 115 volt AC is applied to lines 1 and 15 (when the torch switch is closed). At this time, 150 volt 3 phase power should be present at lines 33, 34, and 35. (150 volt 3 phase power should always be present at lines 38, 39, and 40 when the primary power is turned on).

E. A "quick check" can be made on the main diodes without removing them from the circuit as follows: Using an ohmmeter with the RX1 or RX10 scale, measure the resistance of each diode in both directions. The readings should differ by at least a factor of 10. If they do not differ (both high or both low) the diode has failed and must be replaced. If a diode fails it is important to check several things to make sure that the replacement diode will not fail. There are four potential causes of diode failures:

1. An in-rush current surge is the most probable cause of main diode failure. The in-rush surge is absorbed by capacitor C-5 and resistor R-1 in series with each other across the output of the bridge rectifier. The capacitor and resistor, as well as the wires connecting them to the circuit, should be completely checked in any case of diode problems. The capacitor is a polarized capacitor, and it is important to be sure that the side marked + is connected to the positive side of the circuit.

2. High frequency protection for the diodes is provided by capacitors C-2, C-3, and C-4 which are installed between each side of the bridge rectifier and ground, and across the output of the bridge rectifier. These capacitors and their connections should be checked.

3. Overheating of the diode can occur if air flow over the heat sink is inadequate or if the diode is not properly fastened to the heat sink. Check to see that the diodes are torqued to 125 inch pounds (15 Nm) and that electrically conductive heat sink compound (this is a white grease) is present between the diode and heat sink. Also check for normal operation of the fan and to be sure that the air passages into and out of the unit are not obstructed.

4. The diode that was faulty at the time of manufacture is difficult to diagnose. This usually fails during the first few hours of operation. Before deciding that this was the case, be sure to check out the other three possibilities.

F. To check the high frequency capacitor, it is necessary to try to start the torch. The spark between the spark gap points should be bright blue. If the spark appears to be weak or nonexistent, disconnect the wire between the spark gap and the capacitor and try to start the torch again. If the spark is stronger with this wire disconnected, the high frequency capacitor is faulty and must be replaced.

G. To check the toroid coil, measure the AC voltage supplied to relay CSR (measured between pins J1-14 to J2-15). This voltage is measured with the torch switch closed (2 seconds after closing the switch) and should read approximately 40 VAC. If it reads 115 VAC the toroid coil winding(s) is shorted and the toroid must be replaced.

H. The high frequency transformer has too much voltage (6000 volts AC) to check under power. The resistance of the primary coil should be 5 ohms and the resistance of the secondary coil should be about 20 K ohms.

J. The open circuit voltage can be checked between the two heat sinks of the main bridge rectifier. This should be 205 volts DC.

K. The pilot arc resistor is located horizontally at the back of the unit. It should read 3.5 ohms.

L. To check for DC voltage at the torch leads it is necessary to disconnect the high frequency first to avoid damage to the voltmeter. The 115 volt primary to the high frequency transformer is connected through two push-on connectors at the high frequency transformer (near the front panel of the unit). These are lines 1 and 18, and the high frequency can be disconnected by removing one of these wires.

Once the high frequency is disconnected, the torch switch should be closed. 205 volts DC will immediately be present between the negative lead and ground. After 2 seconds relay PCR should close and 205 volts can then be measured between the negative lead and the positive lead. If no voltage is present check the PCR coil and contacts.

M. The 3 phase AC input to the main bridge rectifier is 150 volts. This can be measured at the top of the main bridge rectifier where the diode pigtails join together (lines 30, 31, and 32) at any time that the DC power light is on.

N. Locate the control bridge near the top of the unit (2 SCR's and 3 diodes on three aluminum heat sinks, Item No. 2 & 3, Fig. 5-3). Disconnect the multi-conductor plug next to this component. Using an ohmmeter with the RX10 scale, all three diodes should be checked for high resistance in one direction and low resistance in the other direction. If diode D8 (middle heatsink) is shorted see T below. The SCR's should read a high resistance in both directions. (This is a "quick check" - diodes and SCR's may be checked as described in test F.)

O. Remove the current regulating printed circuit card (Item No. 7, Fig. 5-2) from the machine and measure the resistance between the 3rd and 7th pins on the receptacle (counting from the bottom). This should read 0 ohms with the dial set at "MIN" and increase smoothly to 5,000 ohms as the dial is rotated to "MAX".

P. With the control bridge (see N above) connected to the circuit, measure the resistance across the diode on the center heat sink in both directions. It should read about 5 ohms both ways.

Q. The best way to check the printed circuit control card is to replace it with one known to be good. The same card is used in the PAK 10, 22, 44 and 350.

R. Watch the high frequency points during a cut. If the high frequency remains on, check the resistance of the toroid coil (See test G) and of the relay CSR. The coil of relay CSR should read about 3K ohms measured from pin A to pin B (bottom view same as time delay - See test C).

S. The remote control jack has a switch and a 10,000 ohm resistor which is switched out of the circuit when the remote control potentiometer is plugged in. Performing Test O checks that this resistor is properly connected.

T. Remove the printed circuit card from the machine and check for continuity from the 1st and 6th pins on the receptacle (counting as in O above). If there is no continuity, the shunt is not properly connected.

U. With a soldering pencil, disconnect the "pigtail" lead to the SCR's one at a time. When more than one wire is connected to the pigtail, the two wires should be connected to each other. Operate the unit with one and then the other SCR disconnected and note the maximum amperage. The output will remain unchanged when the bad SCR is disconnected and will drop to minimum when the good SCR is disconnected.

V. A bad varistor (VR) is difficult to detect by itself. It will, however, cause the D8 diode on the control bridge to short and burn out. If this happens, or if the varistor looks burnt, replace both.

This concludes the test procedures.

PARTS LISTS

General Arrangement

The Assembly Parts List consists of illustrated Parts Lists of the following:

- Complete PAK 10 Cutting System
- Equipment Board Assembly
- Control P.C. Board Assembly
- Control Bridge & Main Bridge Assemblies
- Torch Connection Panel Assembly
- Pilot Resistor and Rear Panel Assembly
- Front Panel Components Assembly
- Base Components Assembly
- Leads and Leads Fittings, Remote Control Assembly, Leads Extensions, Torch Guide & Circle Cutting Attachment
- Series 4B Gas Cooled Torches
- Gas Pressure Regulators

An item number in parentheses indicates the item is located behind the item pointed to. An asterisk beside the item number indicates the part is a main assembly, not a component. Parts listed without item numbers are not illustrated, but may be ordered by the catalog number shown.

ORDERING INFORMATION

When ordering replacement parts, order by catalog number and complete description of the part or assembly, as given in the description column of the Assembly Parts List. In addition, give the model number of the machine, the machine serial number and its operating voltages, as given on the plate attached to the front panel of the power supply and control unit. Address all inquiries to your authorized Thermal Dynamics' distributor.

PAK 10 Cutting System

Fig.	Item No.	Qty.	Catalog Number	Description
5-1		(1)	3-2617	PAK 10 POWER SUPPLY and CONTROL, Complete
5-1		(1)	7-2914	CYLINDER RACK
5-1		(2)	7-2891	SWIVEL CASTER (Front)
5-1		(2)	7-2892	RIGID CASTERS (Back)
5-1		(1)	2-2714	PCH-4B (70°) TORCH ASS'Y (Without Leads)
5-1		(1)	2-2715	PCH-4B (90°) TORCH ASS'Y (Without Leads)
5-1		(1)	2-2771	PCM-4BT MACHINE TORCH ASS'Y (Without Leads)
5-1	1	(1)	9-2146	10' GAS HOSE, Plasma
5-1	2	(1)	9-2147	10' GAS HOSE, Secondary Gas
5-1	3	(1)	9-2325	25' WORK CABLE
5-1	4	(1)	3-2618	PAK 10 POWER SUPPLY and CONTROL, Without Supply Hoses and Work Cable
5-1	5	(1)	2-2708	PCH-4B HAND TORCH (70°) with 25' LEADS
5-1	5	(1)	2-2709	PCH-4B HAND TORCH (90°) with 25' LEADS
5-1	5	(1)	2-2712	PCH-4B HAND TORCH (90°) with 50' LEADS
5-1	5	(1)	2-2711	PCH-4B HAND TORCH (70°) with 50' LEADS
5-1	6	(1)	2-2780	PCM-4BT MACHINE TORCH with 25' LEADS
5-1	6	(1)	2-2781	PCM-4BT MACHINE TORCH with 50' LEADS
5-1	7	(1)	7-2968	REMOTE CONTROL & CURRENT CONTROL ASS'Y
5-1		(1)	7-2800	REMOTE CONTROL ASSY (ON / OFF)
5-1	8	(1)	9-2722	REGULATOR (Nitrogen)
5-1	9	(1)	9-2759	REGULATOR (Carbon Dioxide)
5-1	9	(1)	9-3022	REGULATOR (Compressed Air)
5-1	9	(1)	9-3053	REGULATOR (Argon / Hydrogen)
5-1	10	(1)	5-2880	LO-AMP SPARE PARTS (Introductory)
5-1	10	(1)	5-2881	LO-AMP SPARE PARTS (Standard)
5-1	11	(1)	9-2531	LIFTING EYE BOLT
5-1	12	(1)	9-4302	PAK 10 COVER (GRAY)
5-1	13	(1)	9-3113	INTERLOCK SWITCH BRACKET
5-1	14	(1)	9-4300	PAK 10 LH SIDE PANEL (GRAY)
5-1	15	(1)	9-4301	PAK 10 RH SIDE PANEL (GRAY)

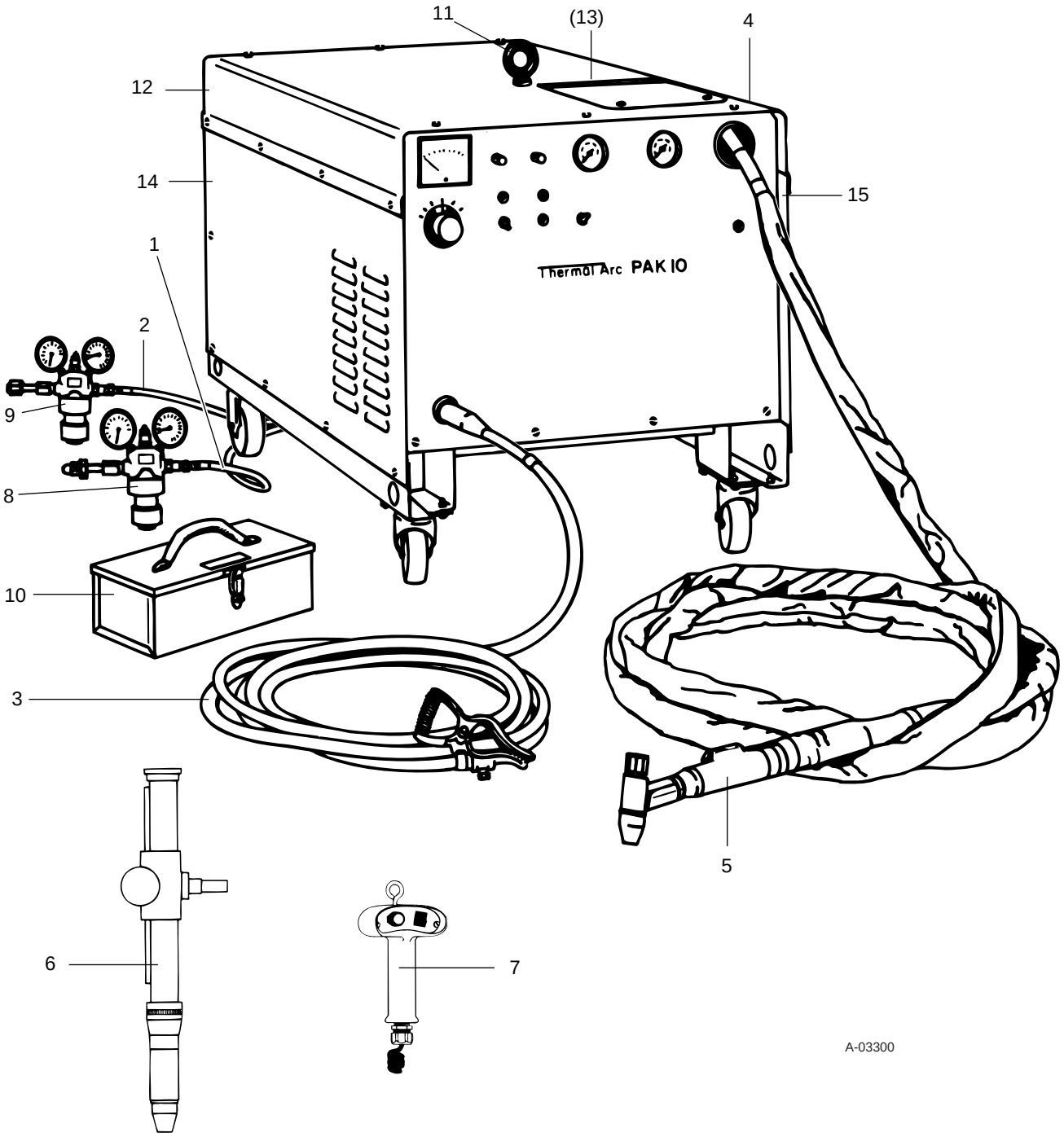


Figure 5-1 Complete PAK 10 Cutting System

Equipment Board Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-2	1	(1)	9-3118	EQUIP. MOUNTING BOARD	
5-2	2	(1)	8-1459	CAPACITOR BRACKET	
5-2	3	(1)	8-1310	CAPACITOR, 1400 mfd	C6
5-2	4	(1)	9-2390	RESISTOR, 2.5K ohm	R8
5-2	5	(1)	8-0001	HI-FREQUENCY TRANSFORMER	T3
5-2	6	(1)	9-3117	BRACKET	
5-2	7	(1)	8-1538	COIL	COIL
5-2	8	(3)	9-2504	SPARK GAP ELECTRODE	
5-2	9	(3)	8-1715	SPARK GAP BLOCK	
5-2	10	(1)	8-1951	CAPACITOR, 0.25 mfd	C7
5-2	*	(1)	9-2886	HIGH FREQUENCY ASSEMBLY	
5-2	11	(1)	9-2847	CAPACITOR, 0.002 mfd	C1
5-2	12	(1)	9-3292	24V TRANSFORMER	T2
5-2	13	(1)	8-1373	CONTACTOR	PCR
5-2	14	(2)	9-3175	ELECTRICAL CONNECTOR	P1, P2
5-2	15	(1)	9-2848	RELAY BOARD ASSEMBLY	
5-2	16	(1)	9-2693	RELAY- DPDT, 24VAC	1CR
5-2	17	(2)	9-2694	RELAY- DPDT, 120VAC	TD1, TD2
5-2	18	(1)	9-2790	RELAY- DPDT, 120VAC	CSR
5-2	19	(1)	9-2780	RESISTOR, 56K ohm	R4

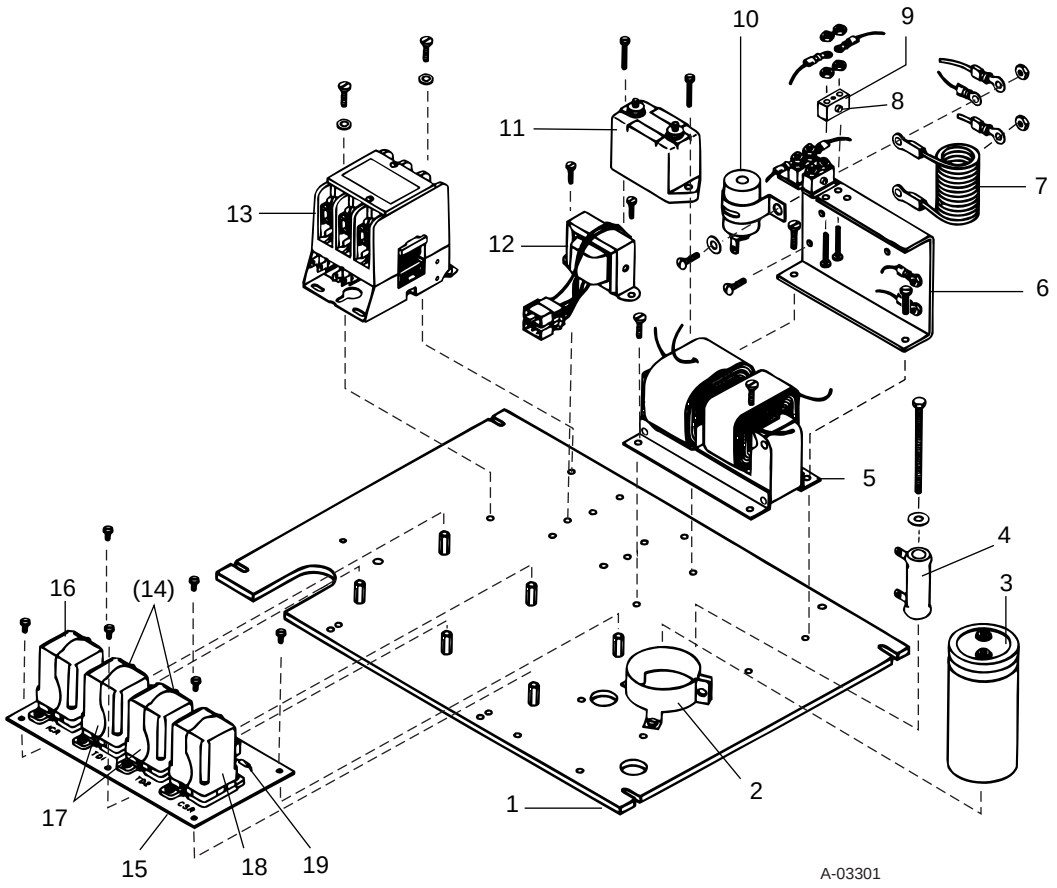


Figure 5-2 Equipment Board Assembly

Control P.C. Board Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-3	1	(1)	9-2918	PRINTED CIRCUIT BOARD COVER	
5-3	2	(1)	9-3l74	GROUNDING LEAD	
5-3	3	(1)	9-2687	TRANSFORMER	T5
5-3	4	(1)	9-3114	RECEPTACLE	
5-3	5	(1)	9-2689	RESISTOR, 3.9K ohm	R7
5-3	6	(1)	9-3115	BRACKET	
5-3	7	(1)	9-2688	PRINTED CIRCUIT BOARD (Control Cir.)	
5-3	8	(1)	9-3116	BOARD MOUNTING BRACKET	
5-3	9	(1)	9-3119	MOUNTING BRACKET	
5-3	10	(1)	9-3592	FORK TERMINAL (for 9-3114)	
5-3	11	(1)	9-3568	RESISTOR, 100 ohm	R9

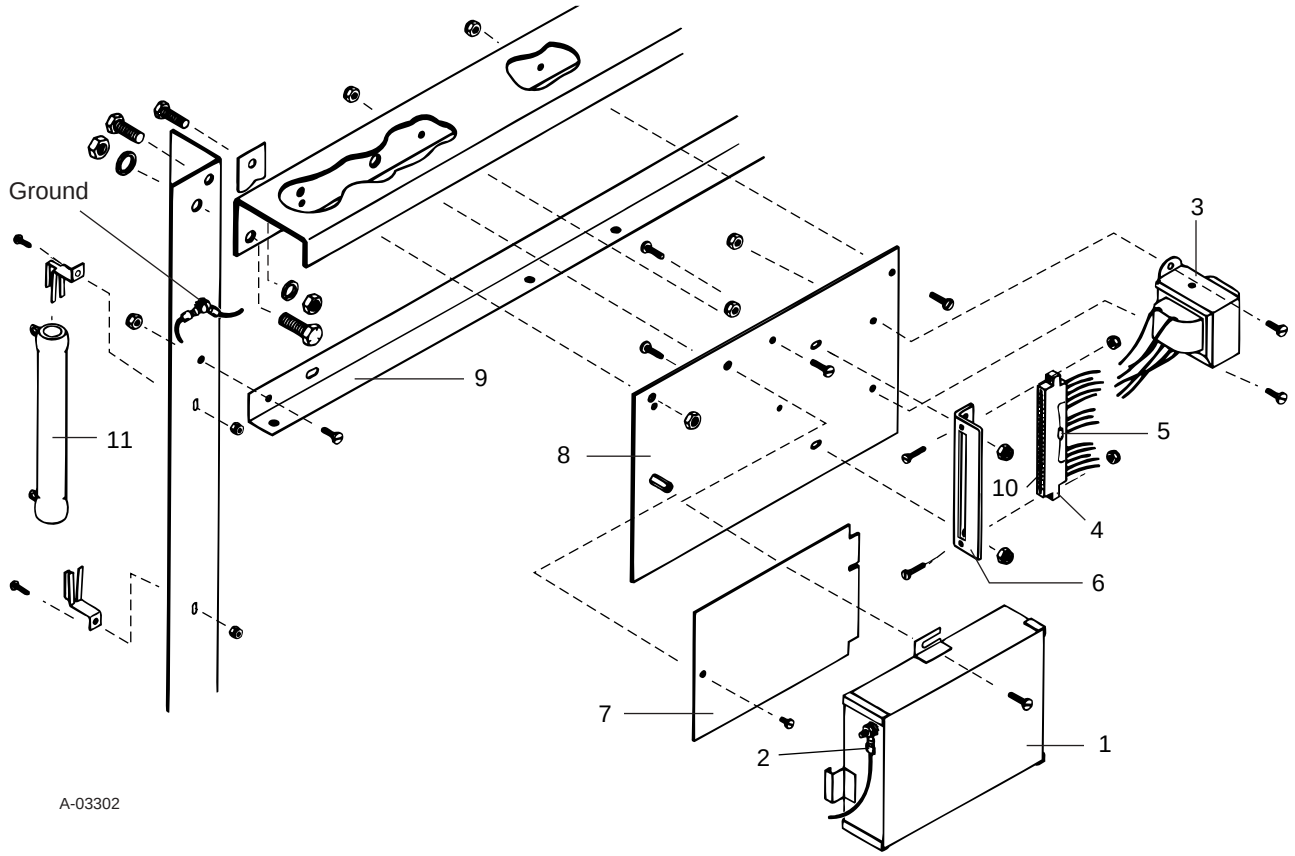


Figure 5-3 Control P.C. Board Assembly

Control Bridge and Main Bridge Assemblies

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-4	1	(1)	9-3004	CONTROL BRIDGE ASSEMBLY	
5-4	2	(3)	8-1562	DIODE- str., 40A, 600V	D1, D2, D3
5-4	3	(2)	9-2686	RECTIFIER- 40A, 600V	SCR1, SCR2
5-4	4	(2)	9-3120	HEAT SINK	
5-4	5	(1)	9-3121	HEAT SINK	
5-4	6	(1)	9-4028	VARISTOR ASSEMBLY	VR
5-4	7	(2)	9-3245	RESISTOR, 22 ohm	R22
5-4	8	(1)	9-3393	CABLE (No. 30 for 50 Hz.)	
5-4	9	(1)	9-3395	CABLE (No. 31 for 60 Hz.)	
5-4	10	(1)	9-3397	CABLE (No. 32 for 60 Hz.)	
5-4	11	(1)	9-3129	TERMINAL BOARD	
5-4	12	(1)	9-3131	HEAT SINK	
5-4	13	(3)	9-2006	DIODE, Str., 150A, 600V	D7, D8, D9
5-4	14	(4)	8-1951	CAPACITOR, .25 mfd	C2,C3,C4,C8
5-4	15	(1)	9-3130	HEAT SINK	
5-4	16	(3)	9-2008	DIODE, Rev., 150A, 600V	D4, D5, D6
5-4	17	(2)	9-3132	MOUNTING BRACKET	
5-4	18	(1)	9-2537	RESISTOR, 27K ohm	R5
5-4	19	(1)	9-2390	RESISTOR, 2.5K ohm	R2
5-4	20	(1)		MOUNTING BOLT	
5-4	21	(2)	9-3134	THREAD STUD	
5-4	22	(1)	8-1392	CAPACITOR, 2000 mfd	C5
5-4	23	(1)	9-3135	CAPACITOR BRACKET	
5-4	24	(1)	8-1299	RESISTOR, 5 ohm	R1
5-4	25	(1)		MOUNTING BOLT	
5-4	26	(3)	9-3137	TERMINAL STRIP	
5-4	27	(1)	9-3138	MOUNTING BOARD	
5-4	28	(1)	9-3398	CABLE (No. 28)	
5-4	29	(1)	9-3399	CABLE (No. 25)	
5-4	30	(1)	9-3390	MAIN BRIDGE SUPPORT BRACKET (Left Hand)	
5-4	31	(1)	9-3391	MAIN BRIDGE SUPPORT BRACKET (Right Hand)	

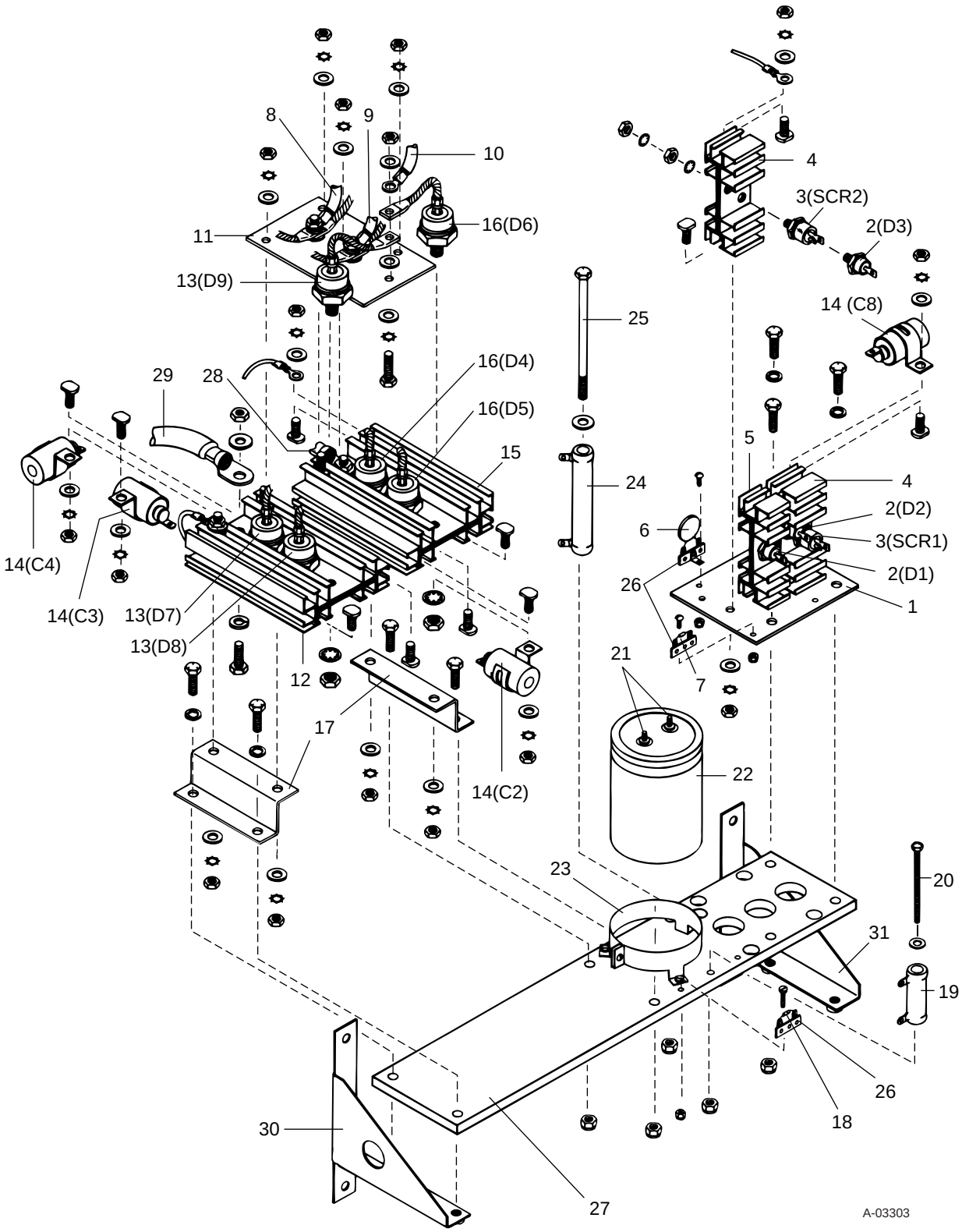


Figure 5-4 Control Bridge and Main Bridge Assemblies

Torch Connection Panel Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-5	1	(1)	9-2335	SWITCH	SW3
5-5	2	(1)	9-3157	BRACKET	
5-5	3	(1)	8-0220	TWIST-LOCK BASE	CONTROL
5-5	4	(2)	8-0260	O2B-1/4 NPT STR. ADAPTER	
5-5	5	(2)	9-3158	1/4 NPT BULKHEAD	
5-5	6	(2)	9-2023	1/4-1/8 NPT REDUCER BUSHING	
5-5	7	(1)		HIGH FREQ. WIRE (POS)	
5-5	8	(2)	8-0352	1/8 NPT STREET TEE	
5-5	9	(4)	8-0257	#4 JIC-1/8 NPT STR. ADAPTER	
5-5	10	(1)	9-3336	HIGH FREQ. WIRE (NEG)	
5-5	11	(1)		CABLE (NO. 25)	
5-5	12	(1)		BULKHEAD INSULATOR	
5-5	13	(1)	9-3160	SPILL TRAY	
5-5	14	(1)	9-3161	MOUNTING BRACKET	
5-5	15	(1)	9-3162	SUPPORT BRACKET	

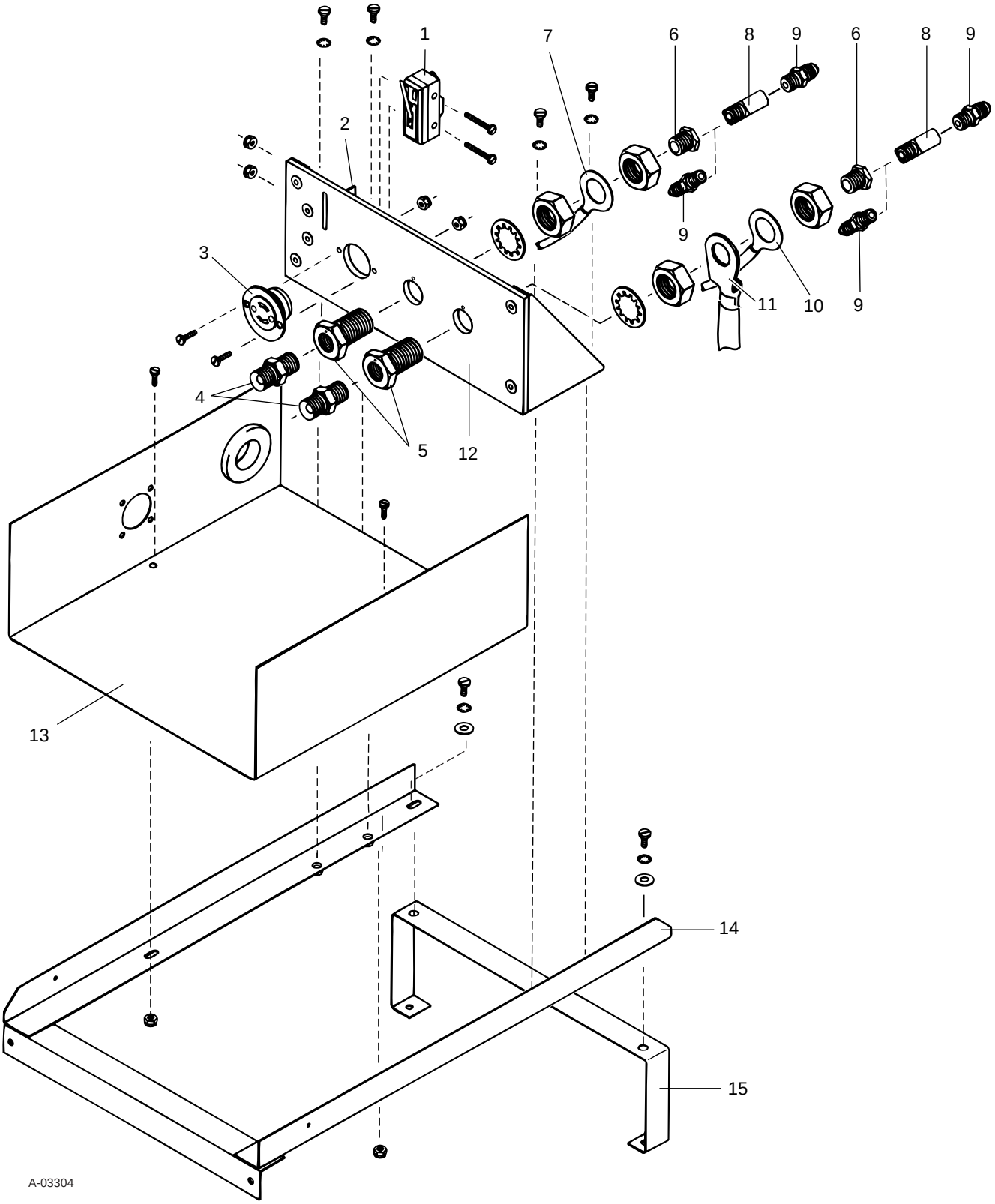


Figure 5-5 Torch Connection Panel Assembly

Pilot Resistor and Rear Panel Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-6	1	(1)	9-2966	RESISTOR, 3.5 ohm	R3
5-6	2	(2)	9-3163	MOUNTING BRACKET	
5-6	3	(2)	8-0330	INERT “B” ADAPTER	
5-6	4	(2)	8-0256	1/4 NPT BULKHEAD	
5-6	5	(2)	9-2023	1/4-1/8 NPT REDUCER BUSHING	
5-6	6	(2)	8-0354	1/8 NPT CLOSE NIPPLE	
5-6	7	(2)	8-1786	SOLENOID VALVE	SOL1, SOL2
5-6	8	(2)	8-0312	1/8 NPT TEE	
5-6	9	(2)	8-0257	#4 JIC-1/8 NPT STR. ADAPTER	
5-6	10	(1)	8-5118	PRESSURE SWITCH	PS1
5-6	11	(1)	9-2968	FAN/MOTOR ASSEMBLY	M
5-6	12	(1)	9-2391	CONNECTOR	
5-6	13	(1)	9-3165	BRACKET	
5-6	14	(1)	9-3402	REAR PANEL	
5-6	15	(1)	9-3166	LABEL- FUSING REQUIREMENT (not shown)	
5-6	16	(1)	8-5119	PRESSURE SWITCH	PS2

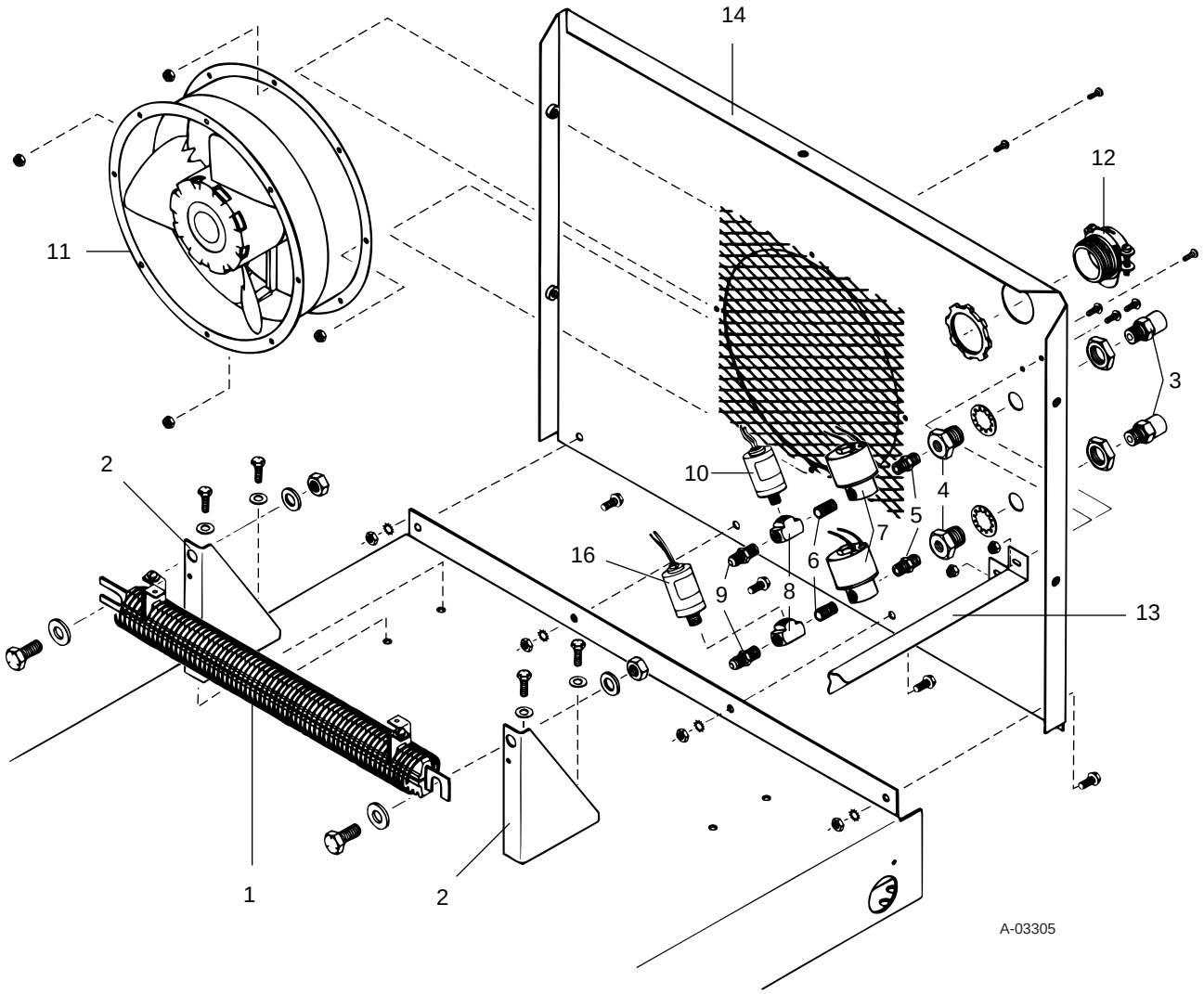


Figure 5-6 Pilot Resistor and Rear Panel Assembly

Front Panel Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-7	1	(1)	9-3406	FRONT PANEL	
5-7	2	(1)	8-0241	ADALET FITTING	
5-7	3	(1)	8-0246	PHONE JACK	REMOTE
5-7	4	(1)	9-3400	RESISTOR- 10K ohm	R6
5-7	5	(1)	9-2730	SOCKET	WORK
5-7	6	(1)	8-1394	AMMETER	A
5-7	7	(1)	9-2685	POTENTIOMETER	POT
5-7	8	(1)	9-2709	CONTROL KNOB	
5-7	9	(1)	9-2854	FUSE- 10A	1FU
5-7	10	(1)	8-1025	FUSE- 5A	2FU
5-7	11	(2)	9-2936	FUSE HOLDER	
5-7	12	(1)	9-3325	TOGGLE SWITCH- SPST	SW1
5-7	13	(1)	8-1886	PANEL INDICATOR	LT3
5-7	14	(2)	8-1885	PANEL INDICATOR	LT1, LT2
5-7	15	(1)	9-3405	TOGGLE SWITCH- DPDT	SW2
5-7	16	(2)	9-2851	PRESSURE GAUGE	
5-7	17	(2)	8-0257	FITTING	
5-7	18	(2)	9-2984	COUPLING	

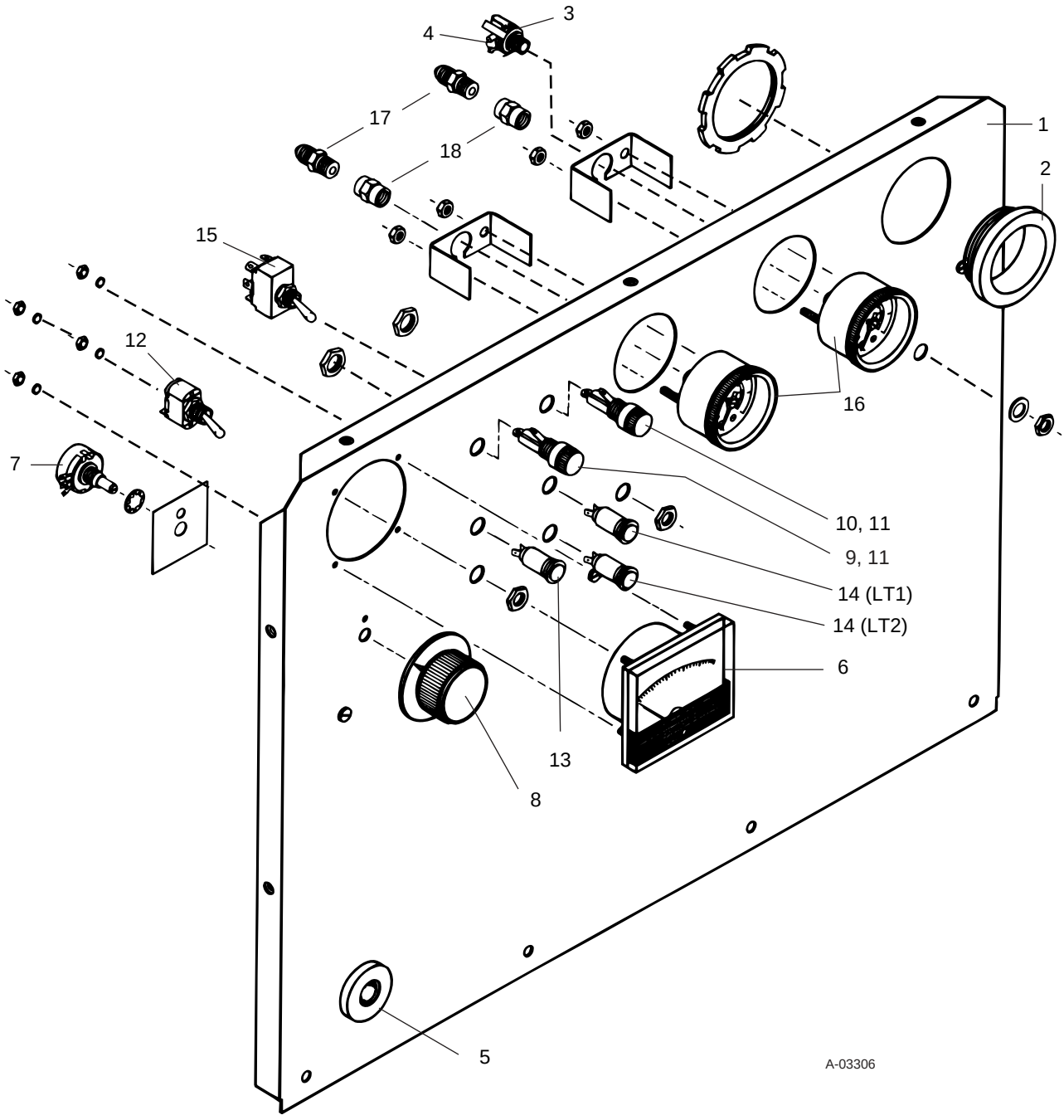


Figure 5-7 Front Panel Assembly

Base Components Assembly

Fig.	Item No.	Qty.	Catalog Number	Description	Reference Designator
5-8	1*	(1)	9-2967	TOROID TRANSFORMER ASSEMBLY	T4
5-8	2	(1)	9-3144	TERMINAL BOARD- Toroid	
5-8	3	(2)	9-3145	SOLDER TERMINAL	
5-8	4	(2)	9-3146	TAB	
5-8	5	(1)	9-3147	INSULATOR	
5-8	6	(1)	9-3148	TOROID MOUNTING BRACKET	
5-8	7	(1)	8-1012	SHUNT	
5-8	8	(1)	9-3401	CABLE (NO. 24)	
5-8	9	(1)	8-1373	CONTACTOR	W
5-8	10	(1)	9-3150	MOUNTING BRACKET	
5-8	11	(1)	9-2733	REACTOR	
5-8	12	(1)	9-3061	TRANSFORMER (208/230/460V)	T1
5-8	12	(1)	9-3062	TRANSFORMER (230/460/575V)	T1
5-8	12	(1)	9-3063	TRANSFORMER (380/415/460V)	T1
5-8	12	(1)	9-3064	TRANSFORMER (380/460/500V)	T1
5-8	12	(1)	9-3065	TRANSFORMER (200/220/400V)	T1
5-8	12	(1)	9-3066	TRANSFORMER (220/380/500V)	T1
5-8	12	(1)	9-3067	TRANSFORMER (230/380/415V)	T1
5-8	12	(1)	9-3068	TRANSFORMER (180/200/220V)	T1
5-8	13	(1)	9-3615	TEMPERATURE ACTIVATING SWITCH	
5-8		(1)	9-3384	CABLE (NO. 38)	
5-8		(1)	9-3385	CABLE (NO. 39)	
5-8		(1)	9-3386	CABLE (NO. 40)	
5-8		(1)	9-3387	CABLE (NO. 33)	
5-8		(1)	9-3388	CABLE (NO. 34)	
5-8		(1)	9-3389	CABLE (NO. 35)	

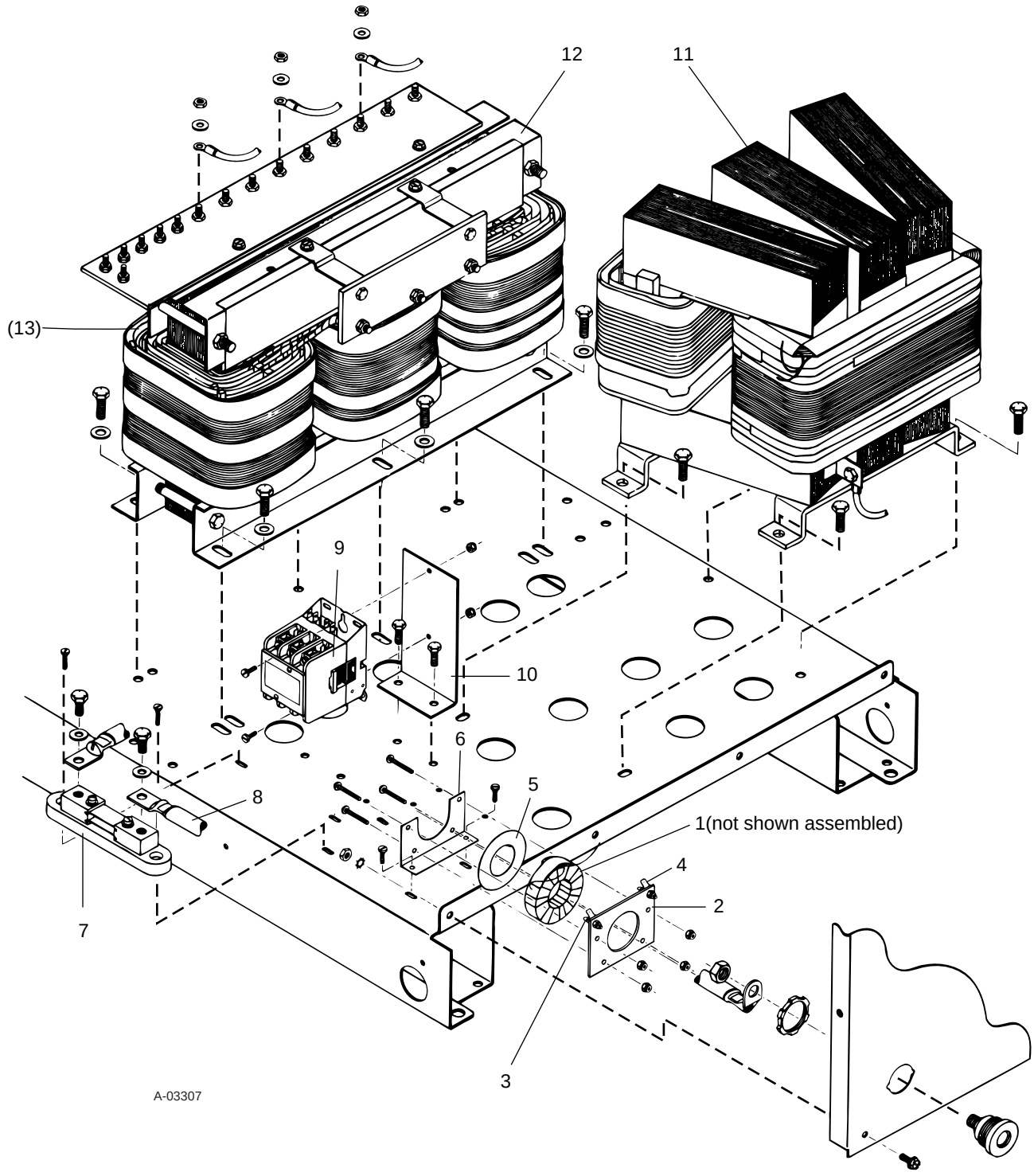


Figure 5-8 Base Components Assembly

Torch Leads, Leads Extension Packages, Torch Guide and Circle Cutting Attachment, Remote Control Assembly

Fig.	Item No.	Qty.	Catalog Number	Description
5-9		(1)	8-4033	50' TORCH LEADS SLEEVING
5-9		(1)	8-1001	25' TORCH LEADS SLEEVING
5-9		(1)	8-1205	3" SHRINK-ON TUBING (Console End)
5-9		(1)	4-2728	25' LEADS PACKAGE for Machine Torch
5-9		(1)	9-3266	25' RED / YELLOW POSITIVE LEAD ASSEMBLY
5-9		(1)	9-3265	25' GREEN / BLACK NEGATIVE LEAD ASSEMBLY
5-9		(1)	4-2727	25' LEADS PACKAGE for Hand Torch
5-9		(1)	4-2729	50' LEADS PACKAGE for Hand Torch
5-9		(1)	4-2730	50' LEADS PACKAGE for Machine Torch
5-9		(1)	9-3268	50' RED / YELLOW POSITIVE LEAD ASSEMBLY
5-9		(1)	9-3267	50' GREEN / BLACK NEGATIVE LEAD ASSEMBLY
5-9	1	(2)	8-5014	FERRULE (Positive)
5-9	1a	(1)	8-5085	FERRULE (Negative)
5-9	2	(1)	8-7033	FITTING, Console End (Negative)
5-9	3	(1)	8-5015	NUT, Console End (Positive)
5-9	4	(1)	8-5010	FITTING, Console End (Positive)
5-9	5	(1)	8-5008	FITTING, Torch End (Positive)
5-9	6	(1)	8-4190	FITTING, Torch End (Negative)
5-9	7	(1)	7-2949	CIRCLE CUTTING ATTACHMENT Only
5-9	8	(1)	7-2939	4B (70°) TORCH GUIDE
5-9	8	(1)	7-2952	4B (90°) TORCH GUIDE
5-9	9	(1)	7-2947	TORCH GUIDE w / Circle Cutting Attachment (70°)
5-9	9	(1)	7-2954	TORCH GUIDE w / Circle Cutting Attachment (90°)
5-9	10	(1)	9-4228	GRIP, CORD
5-9	11*	(1)	7-2968	REMOTE ON / OFF & CURRENT CONROL ASSEMBLY for Machine Torch
5-9	12	(1)	9-3094	POTENTIOMETER
5-9	13	(1)	9-3095	KNOB, CONTROL
5-9	14	(1)	9-3096	EYE BOLT
5-9	15	(1)	9-3093	SWITCH PLATE (FOR 7-2968)
5-9	16	(1)	9-4229	SWITCH, TOGGLE
5-9	17	(1)	4-2739	PCH-4B 25' LEADS EXTENSION PACKAGE
5-9	17	(1)	4-2741	PCM-4BT 25' LEADS EXTENSION PACKAGE
5-9	17	(1)	4-2740	PCH-4B 50' LEADS EXTENSION PACKAGE
5-9	17	(1)	4-2742	PCM-4BT 50' LEADS EXTENSION PACKAGE
5-9		(1)	9-3107	CONTROL CABLE WITH SWITCH (25')
5-9		(1)	9-3108	CONTROL CABLE WITH SWITCH (50')
5-9	18	(1)	7-2800	REMOTE CONTROL (ON / OFF)
5-9	20	(1)	8-1712	SWITCH PLATE (FOR 7-2800)
5-9	21	(1)	8-1662	HANDLE, CONTROL
5-9	22	(1)	9-3173	TWIST-LOCK PLUG (FOR 7-2968 AND 7-2800)
5-9	23	(1)	8-1374	PHONE PLUG (FOR 7-2968)

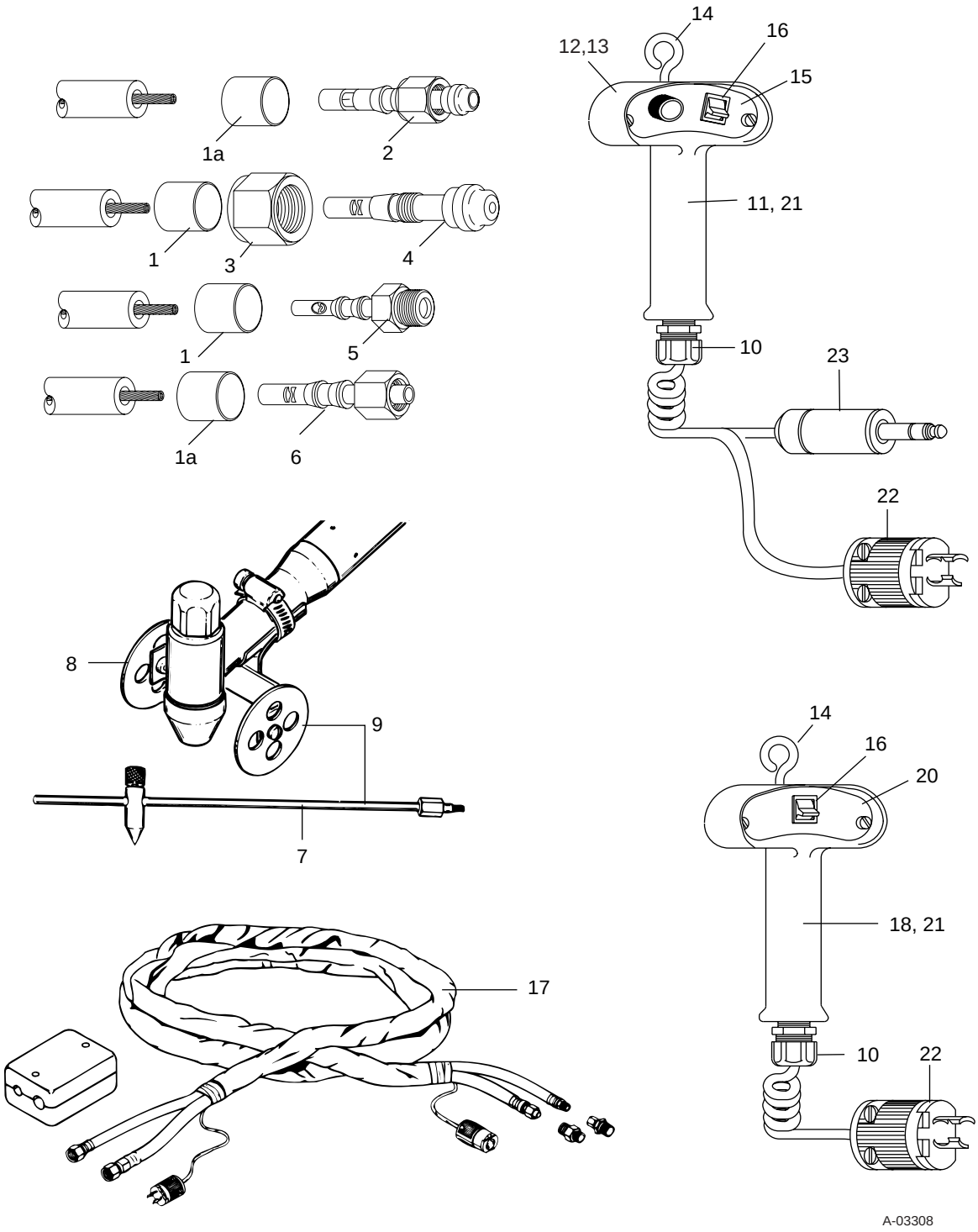
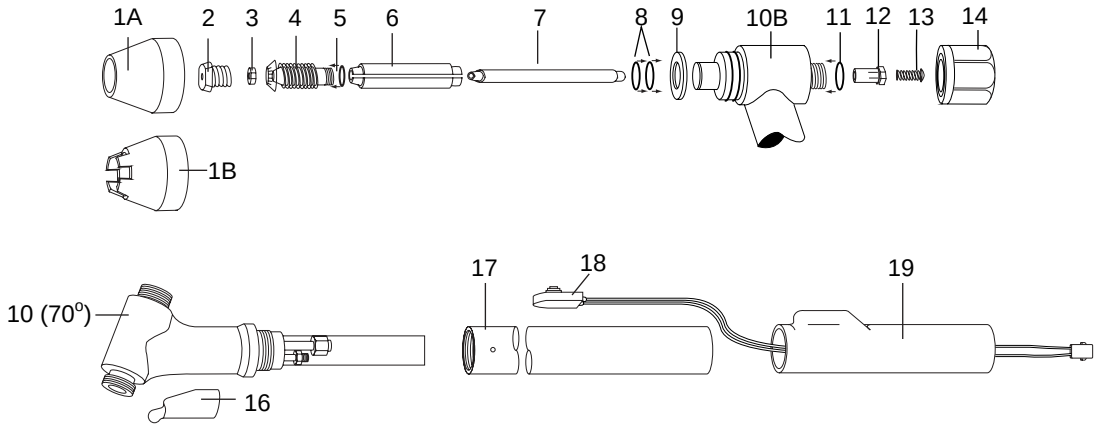


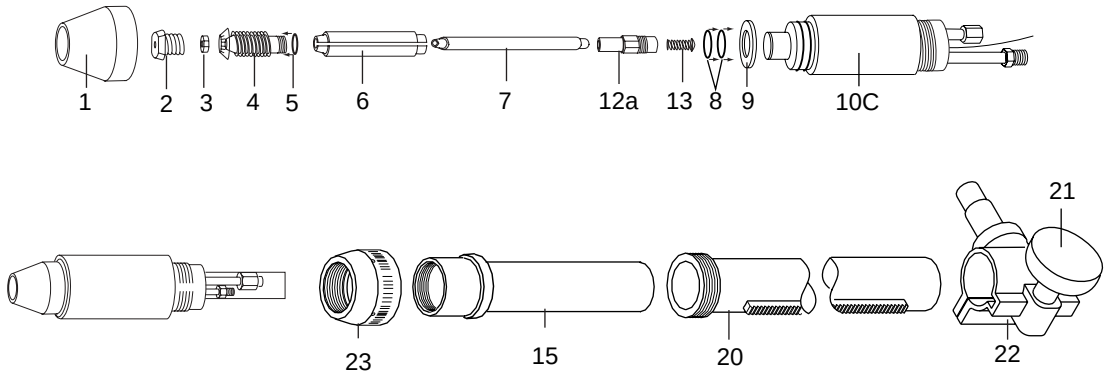
Figure 5-9 Torch Leads, Leads Extension Packages, Torch Guide and Circle Cutting Attachment, Remote Control Assembly

Series 4B Gas-Cooled Torches

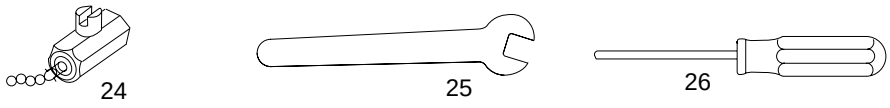
Fig.	Item No.	Qty.	Catalog Number	Description
5-10	1A	(1)	8-4088	SHIELD CUP
5-10	1B	(1)	8-4213	SHIELD CUP
5-10	2	(1)	8-4153	0.059” LO-AMP TIP
5-10	2	(1)	8-4170	0.070” LO-AMP TIP (For use with Argon / Hydrogen Gas)
5-10	2	(1)	8-4172	0.059” LO-AMP TIP (Reverse Swirl)
5-10	2	(1)	8-4173	0.070” LO-AMP TIP (Reverse Swirl)
5-10	3	(1)	9-2421	GAS DISTRIBUTOR
5-10	4	(1)	8-4154	LINER (Includes 9-2960 O-Ring)
5-10	5	(1)	9-2960	O-Ring (Included with liner)
5-10	6	(1)	8-4182	SLEEVE
5-10	7	(1)	8-4073	ELECTRODE
5-10	8	(2)	8-0554	O-RING
5-10	9	(1)	8-4069	GASKET
5-10	10A	(1)	8-4161	MODEL PCH-4B (90°) TORCH HEAD ASSEMBLY
5-10	10B	(1)	8-4160	MODEL PCH-4B (70°) TORCH HEAD ASSEMBLY
5-10	10C	(1)	8-4196	MODEL PCM-4BT TORCH HEAD ASSEMBLY
5-10	11	(1)	8-0530	O-RING (PCH-4B)
5-10	12	(1)	8-4156	COLLET (with 8-0525 O-Ring) - for PCH-4B
5-10	12a	(1)	8-4197	COLLET (with 8-0525 O-Ring) - for PCM-4BT
5-10	13	(1)	8-4050	SPRING
5-10	14	(1)	8-4158	BACK CAP
5-10	15	(1)	9-1901	INSULATING SLEEVE
5-10	16	(1)	8-5011	HEAT SHIELD
5-10	17	(1)	8-5007	HANDLE
5-10	18	(1)	8-4218	SWITCH ASSEMBLY
5-10	19	(1)	8-4216	SWITCH RETAINING SHEATH
5-10	20	(1)	8-5005	MOUNTING TUBE with Rack, 1-3/8” dia.
5-10	21	(1)	7-2827	PINION ASSEMBLY (for 1-3/8” dia. Rack)
5-10	22	(1)	8-4204	BUSHING
5-10	23	(1)	8-4018	NUT
5-10	24	(1)	8-4091	TIP WRENCH
5-10	25	(1)	8-4157	LINER WRENCH
5-10	26	(1)	8-4198	COLLET WRENCH (4BT)



PCH-4B HAND TORCH



PCM-4B MACHINE TORCH



WRENCHES

A-03263

Figure 5-10 Series 4B Gas-Cooled Torches

Gas Pressure Regulators

Fig.	Item No.	Qty.	Catalog Number	Description
5-11		(1)	9-2871	LUBRICANT
5-11	*	(1)	9-2759	REGULATOR, CARBON DIOXIDE
5-11	*	(1)	9-3022	REGULATOR, COMPRESSED AIR
5-11	*	(1)	9-2722	REGULATOR, NITROGEN
5-11	*	(1)	9-3053	REGULATOR, ARGON / HYDROGEN
5-11	1	(1)	9-2821	GAUGE, INLET PRESSURE (0-315 KG / CM)
5-11	2	(1)	9-2820	GAUGE, OUTLET PRESSURE (0-16 KG / CM)
5-11	3	(1)	9-2825	ADJUSTING SCREW, WITH KNOB
5-11	4	(1)	9-2823	SEAL, O-Ring
5-11	5	(1)	9-2822	VALVE
5-11	6	(1)	9-2824	SEAL, O-Ring
5-11	7	(1)	9-3010	NIPPLE for use with Nitrogen Regulator
5-11	7	(1)	9-3012	NIPPLE for use with Carbon Dioxide Regulator
5-11	8	(1)	9-3011	NUT for use with Nitrogen Regulator
5-11	8	(1)	9-3014	NUT for use with Carbon Dioxide Regulator
5-11	9	(1)	9-3013	WASHER, for use with Carbon Dioxide Regulator
5-11	10	(1)	9-3009	HOSE ADAPTER, for use with Nitrogen and Carbon Dioxide Regulators
5-11	11	(1)	9-3518	INLET ADAPTER

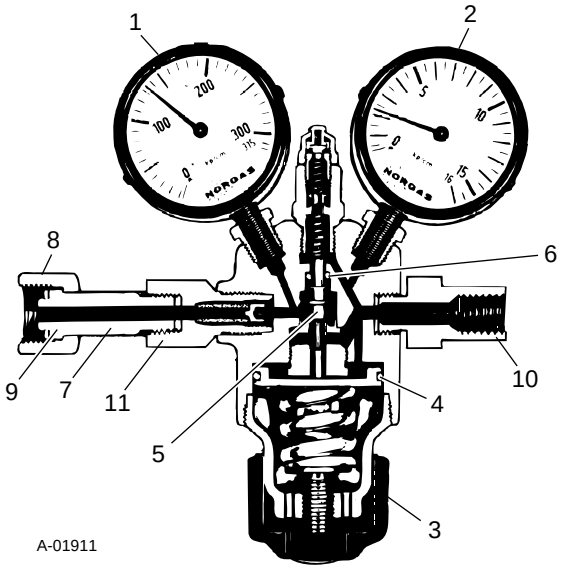


Figure 5-11 Gas Pressure Regulators