Instruction manual

Number 0-2031

PWM 300 WELDING TORCH

THERMAL DYNAMICS CORPORATION

9/21/94

Thermal Dynamics™
CORPORATION

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MANUAL NO. 0-2031

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This manual is divided into five sections:

SECTION 1. **General Information,** describes the Thermal Arc PWM-300 Plasma Welding Torch. It also gives theory of operation and specifications of system components.

SECTION 2. **Installation,** provides detailed instructions for assembling and inspecting new torches.

SECTION 3. **Operation,** lists the operating procedures which will include detailed instructions for using the equipment and tips for safe, efficient welding.

SECTION 4. **Service,** contains detailed service procedures for torch and components.

SECTION 5. **Parts List,** lists all parts of the torch.

The information contained in this manual represents our best judgment but Thermal Dynamics Corporation assumes no liability for its use.

NOTES, CAUTIONS AND WARNINGS

Throughout this manual, notes, cautions and warnings are used to call attention to particular information.

The method used to identify these highlights, and the purpose for which each is used, are as follows:

NOTE:

An operation, procedure and background information which aids the operator in efficient use of the machine, helps the serviceman in performing maintenance or requires additional emphasis.

CAUTION

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

WARNING

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

PRECAUTIONS

Operation and maintenance of any plasma arc equipment involves potential hazards. Personnel should be alerted to the following hazards and precautions taken to prevent possible injury.

GASES AND FUMES can be dangerous and hazardous to your health.

Ventilation must be adequate to remove the smoke during welding. (Threshold limit values and how to measure the amounts to assure adequate ventilation are found in publication (A) below).

Vapors of chlorinated solvents can form the toxic gas Phosgene when exposed to ultraviolet radiation from an electric arc. All solvents, degreasers, and potential sources of these vapors must be removed from the welding area.

- Keep all fumes and gases from your breathing area.
- Use downdraft table or other ventilation system to capture and remove fumes and gases.
- Use air supplied respirator if ventilation is not adequate to remove all fumes and gases.

ELECTRIC SHOCK can kill.

- Install and maintain equipment according to USA Standard C1, National Electric Code.
- Proper grounding procedures must be adhered to when using plasma welding equipment. The work or metal upon which a person welds must be grounded to a good electrical ground.
- Do not contact electrically live parts.
- Insulate yourself from work and ground.
- Replace any cracked or damaged insulating parts- including torch bodies and hoses.
- Turn off primary power before working on torch parts- including changing cups and tips.
- When operating plasma arc welding apparatus in a damp or wet area, extra care should be taken.

ARC RAYS can injure eyes and burn skin.

- Use welding shield with #10 or darker filter.
- Wear proper clothing.
- Make sure others are protected from arc rays.

COMPRESSED GAS CYLINDERS

Compressed gas cylinders are potentially dangerous- refer to supplier for proper handling procedures.

FIRE can be caused by sparks.

- Remove combustibles from the working area or provide a fire watch.
- Do not weld containers that have held combustibles. All flammable and combustible materials in the welding area that might be ignited by welding sparks should be removed.

WARNING

Read and Understand this Instruction Manual and Your Employer's Safety Practices.

PRECAUTIONS

The following publications provide additional information on safety precautions:

(A) Bulletin No. A6.1-66 "Recommended Safe Practices for Gas-Shielded Arc Welding."

(B) American National Standard ANSI Z49.1-1973 "Safety in Welding and Cutting".

Both are available from:

American Welding Society Inc., 2501 Northwest 7th Street, Miami, Florida 33125, Tel. (305) 642-7090.

(C) OSHA Safety and Health Standards, 29CFR 1910, available from the U.S. Department of Labor, Washington, D.C. 20210

Declaration of Conformity

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

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EEU) and to the National legislation for the enforcement of this Directive.

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

National Standard and Technical Specifications

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

* CSA (Canadian Standards Association) standard C22.2 number 60-M1990 for Arc welding equipment.

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

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

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process. 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: David Ashworth
Vice President & Managing Director
Thermadyne Europe
Chorley England.

Statement of Warranty

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

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

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

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

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

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

The limited warranty period for 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).

PAK UNITS, POWER SUPPLIES	PARTS STAK PAK II	PARTS 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	N/A		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 May 19, 1998

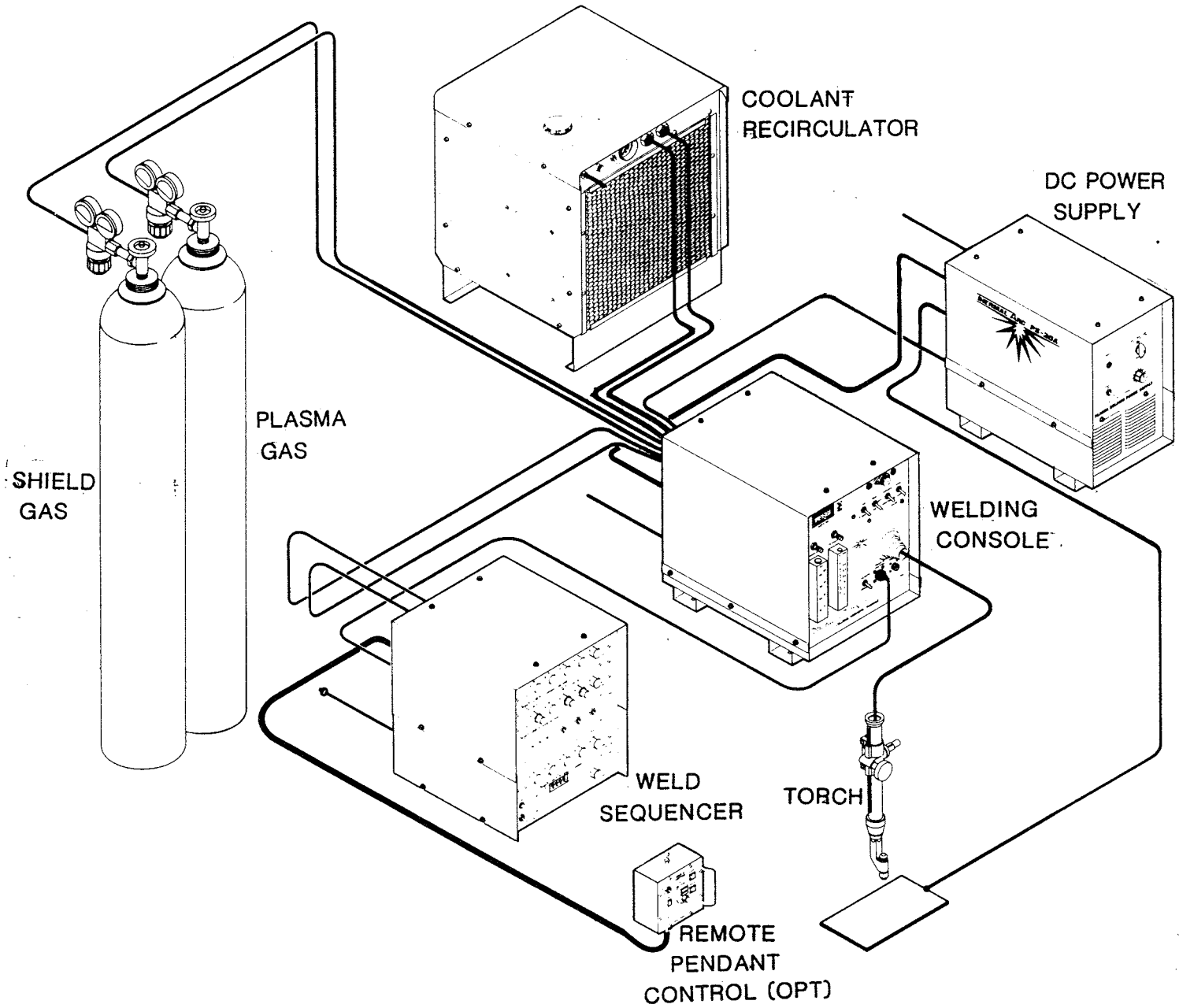


Figure 1-A Plasma Welding System

1.1. DESCRIPTION OF EQUIPMENT

The Thermal Arc PWM-300 Plasma Welding Torch is designed for direct current plasma arc welding of ferrous and non-ferrous metals using the transferred arc plasma process. It is used as part of a welding system that includes a control console, a direct current power source, a coolant supply and a gas supply (Figure 1-A).

1.2. SPECIFICATIONS

- Straight Polarity Current Rating: 300 amperes DC maximum.
- Plasma Gas: Argon (Consumption: 1.5-3.5 SCFH (.71-1.65 lpm).
- Shield Gas/Straight Polarity: Argon or Argon/Hydrogen (Consumption: 10-20 SCFH (3.8-7.1 lpm).
- Shipping Weight: Machine mounted torch PWM-300- 3 lbs. (1.4 kg).
- Cooling Requirements: 12,000 BTU/hr; .75 gpm of TDC Torch Coolant @ 100 psi.

TORCH DIMENSIONS

A		B		C		D		E	
Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)
22.19	(56.4)	2.50	(6.35)	12.44 20.19	(31.6) (51.3)	1.38	(3.5)	1.63	(4.14)

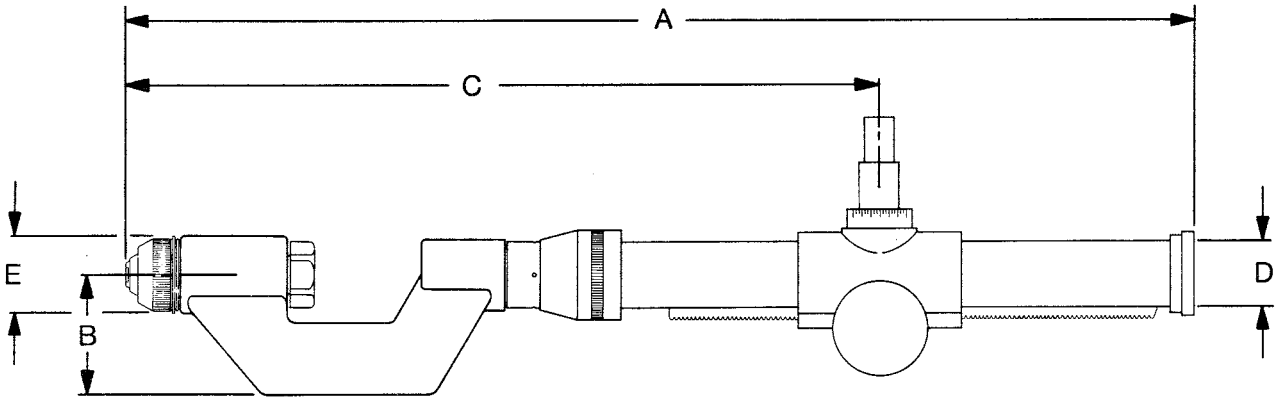


Figure 1-B

1.3. THERMAL ARC PLASMA

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

In a Thermal Arc plasma torch, a cool gas such as Argon enters in Zone A, Figure 1-C. 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.

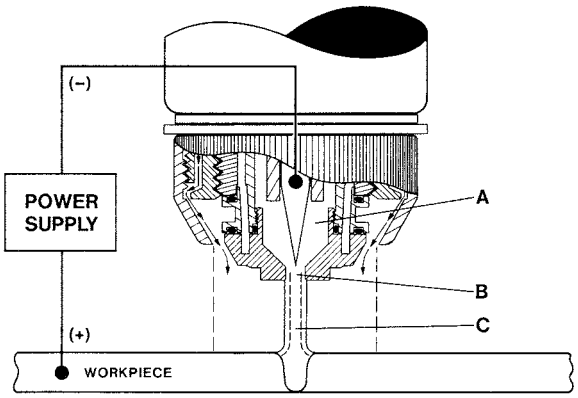


Figure 1-C Thermal Arc Plasma

By forcing the plasma gas and electric arc through a small orifice, Thermal Arc 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 most plasma welding, as shown in the illustration.

The Dual-Flow design of Thermal Arc welding torches uses a shield gas, shown by the small arrows. The shield gas surrounds the plasma arc and channels it to the workpiece, thus improving weld characteristics and shielding the weld puddle from atmospheric contamination.

Coolant from the coolant recirculator flows through the liquid cooled power leads to the torch head and back.

The plasma arc is infinitely variable from soft to stiff. Most applications can best be accomplished with a softer arc, i.e. lower plasma gas flow. Full penetration or "Keyhole" welds require a stiff arc, i.e. high plasma gas flow.

1.4. THEORY OF OPERATION

TORCH CONNECTIONS

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

The shield gas flows through the yellow torch lead, around the torch front end and out through the shield cup.

The torch coolant and negative (-) power flow to the torch through the green (color coded) lead.

The coolant return and positive (+) power for the pilot arc flow through the red (color coded) lead.

PILOT ARC

When the torch is started, an arc is established between the electrode and welding tip. This pilot arc appears as a small "flame" at the front of the torch. This serves to

illuminate the workpiece and assists in starting the main (welding) arc. It can also be left on while welding at low current levels to stabilize the welding arc.

HIGH FREQUENCY

A high voltage, high frequency current is superimposed on the direct current to establish the pilot arc.

WELDING ARC

The power supply provides the direct current (DC) for welding. The negative output is connected to the torch electrode through the negative liquid cooled lead. The positive output is connected to the workpiece through the work cable. The electrically charged plasma gas serves to close this electrical circuit and thus becomes the welding arc.

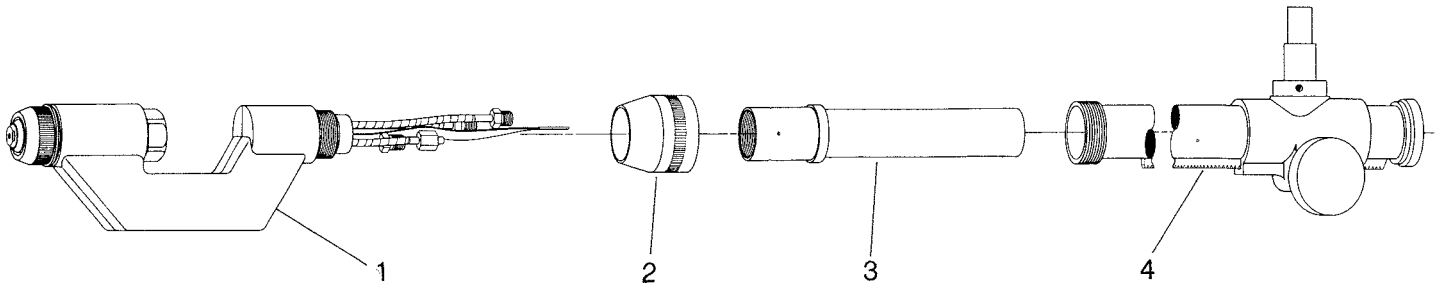


Figure 2-A

2.1. UNPACKING NEW EQUIPMENT

Unpack the equipment, check for possible damage during shipment. Check to be sure all items on the packing list are identified and accounted for.

WARNING

Check to be sure the main disconnect switch supplying power to the welding system is open.

2.2. TORCH INSTALLATION (Figure 2-A)

If the torch is not already attached to the leads, assemble as follows:

1) Loosen the nut (2) and remove the positioning tube assembly (4).

2) Unscrew the sleeve adaptor (3).

3) Feed the end of the leads with the torch fittings through Items 4, 3 and 2 connect to the torch, matching the color coded lead to the color coded torch fitting. Do not overtighten.

4) Pass the sleeve adaptor through the nut and screw onto the torch.

5) Slide the positioning tube onto the sleeve adaptor and secure with the nut (2).

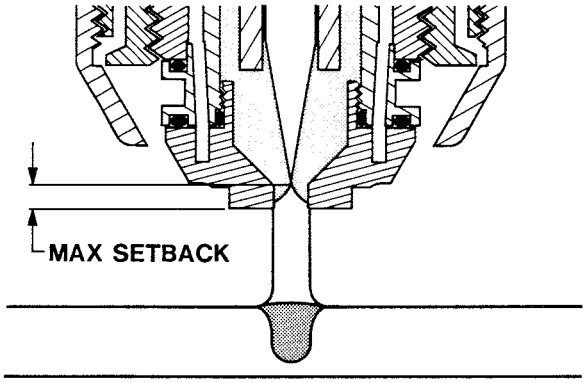
6) Connect the other end of the leads to the appropriate fittings on the plasma welding console.

Check the instructions for the other components of the welding system to insure they are installed properly.

3.1. PRE-OPERATION SET-UP

The selection of specific parameters for a given welding application depend on the type of material, configuration of the joint and type of weld desired. Proper settings for a given joint have to be developed on the job.

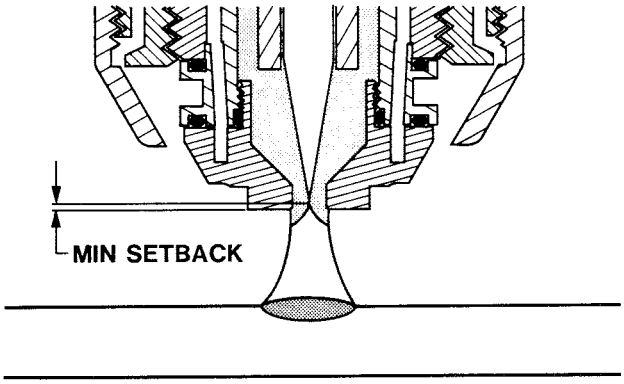
The information sheets at the end of the manual will aid in the selection of proper plasma and shield gases. Tables 3-A and 3-B give the maximum operating range of the various tips.



The electrode gauge values given in Table 3-A will result in maximum electrode setback for the given tip. This setback, when used with the given values for current and plasma gas flow will produce a stiff collimated arc that results in a narrower weld bead.

Figure 3-A

These values are for a stiff collimated arc with the electrode setback at its maximum (see Fig. 3-A). A softer, less constricted arc can be obtained by decreaseing the electrode setback (see Fig. B). The minimum and maximum setbacks for the electrode are set by using the electrode gauge (see Fig. 3-C). By decreasing the electrode setback the plasma gas flow can be decreased while maintaining the higher current ratings of the tip. This gives a wider weld bead and in most cases allows for faster travel speeds.



When the electrode is at minimum setback the plasma gas flow rate can be reduced below the levels given in Table 3-A while maintaining the given current levels. This produces a softer arc that results in less depth of penetration, giving a wider weld bead, and allowing faster travel speeds.

Figure 3-B

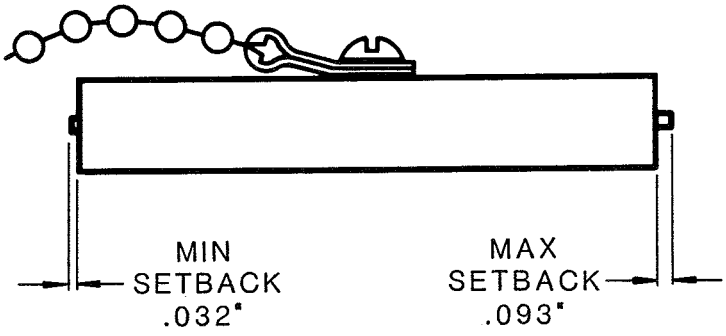


Figure 3-C Electrode Gauge

Table 3-A Suggested Starting Parameters for Mechanized Keyhole Welding - Thermal Arc PWM-300 Torch

Tip		Electrode		Max Current (Amps)	Plasma Gas (Argon) Flow		Shield Gas 10-20 SCFH 4.7-9.4 LPM
Cat. No.	Orifice Dia. In.	Cat. No.	Setback		SCFH	LPM	
9-4370	.093	9-1827	Max	200	See Chart 3-B		Argon or Ar/H_2 (95%/5%)
9-4371	.113	9-1827	Max	250			
9-4372	.125	9-1827	Max	300			

The Plasma Gas flow rates that are indicated in Chart 3-B are obtained using the .093" orifice. These same flow rates can be used for the other orifices listed in Table 3-A. Higher flow rates may be required if higher current levels are being used.

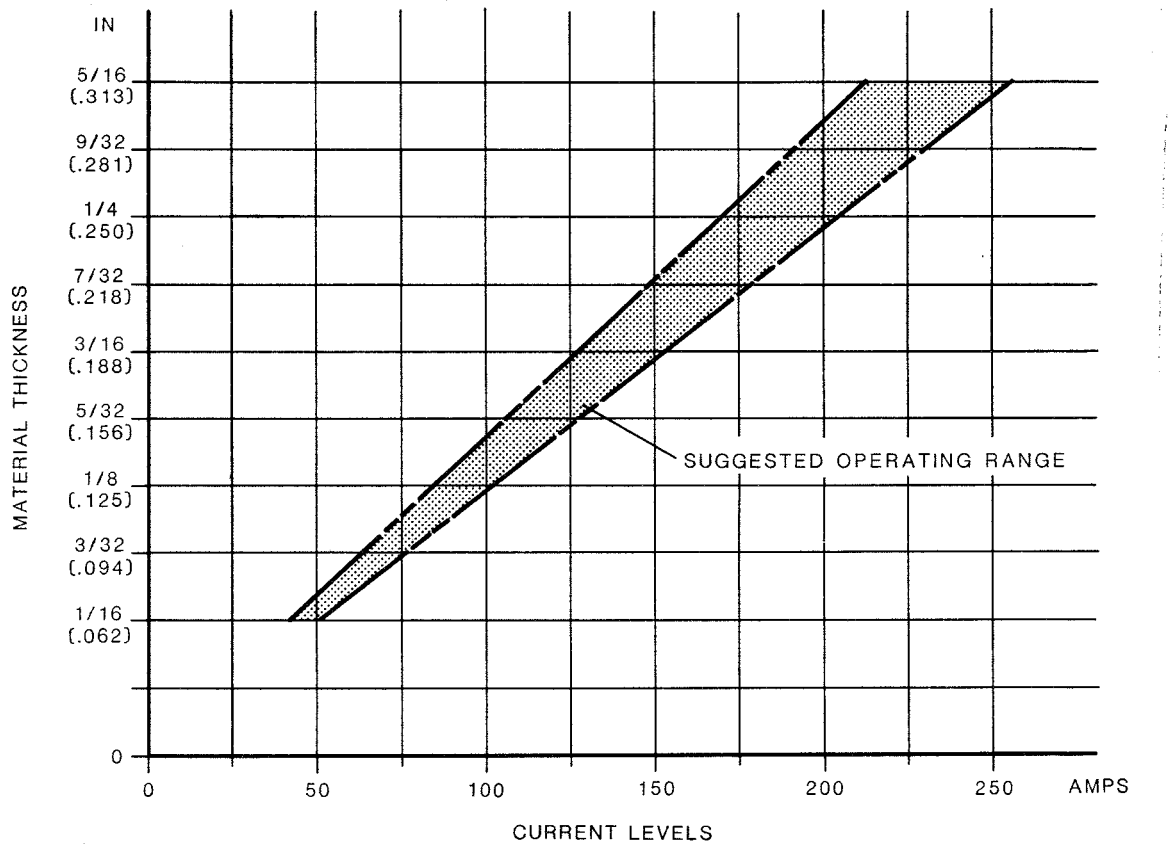


Chart 3-A

NOTE: This information represents our best judgement but Thermal Dynamics Corporation assumes no liability for its use. The parameters listed above may be varried to otimize performance.

Suggested Starting Parameters for Mechanized (Non-Keyhole) Circumferential, Seam, and Spot Fusion Welds

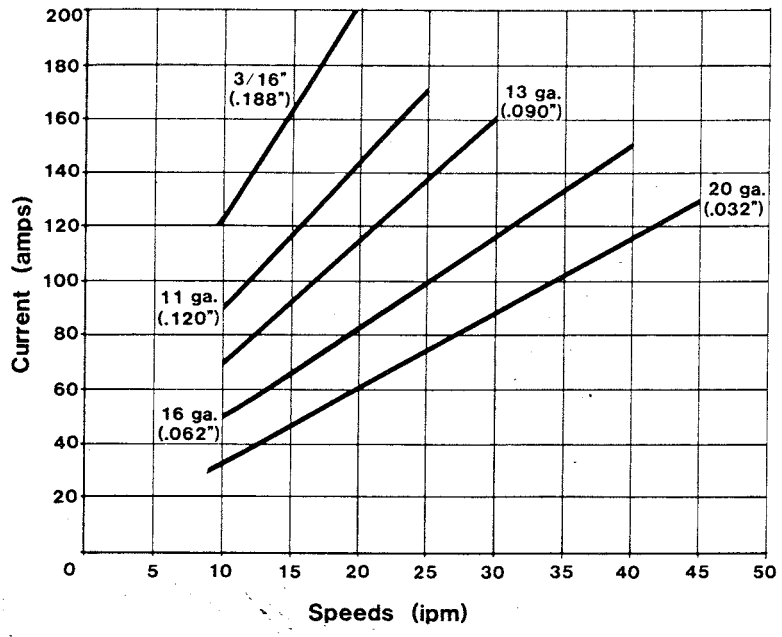


Figure 3-C Current Levels

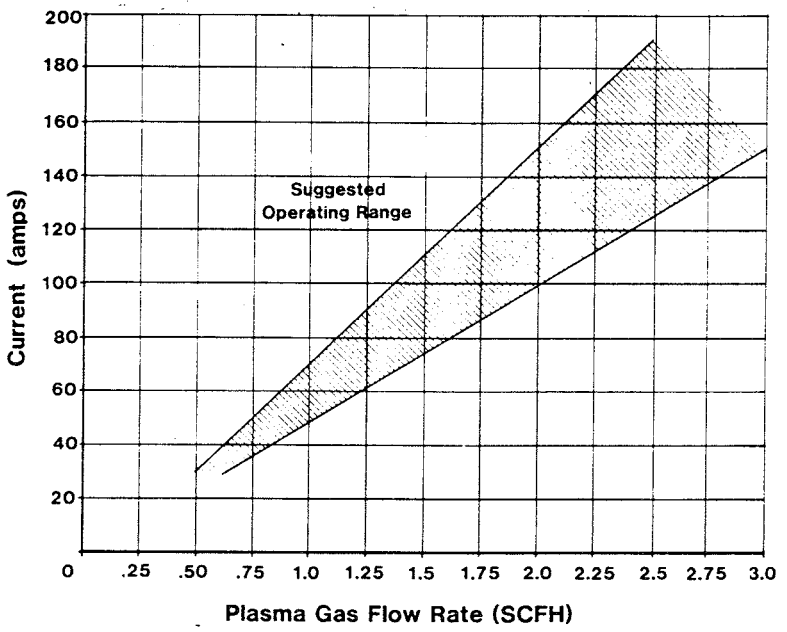


Figure 3-D Plasma Gas Flow Rates

Materials

Stainless Steels
Carbon Steels
Alloy Steels
Nickels

Joint Types

Butts
Corner*
Edge*
Flanged*

Electrode setback at minimum.

Standoff from work at 3/32-5/32".

Use .093 tip up to 125 amps, above 125 amps use .125 tip.

Argon- Plasma Gas
Argon-Hydrogen- Shield Gas (10-20 SCFH)

Most steels require approximately 10-15% higher current at equal travel speed.

* Faster travel speeds may be required for these welds.

See page 10 for gas selection information.

The maximum current rating of each tip is established using maximum electrode setback and maximum plasma gas flow rates. Lower plasma gas flow rates can be used with the maximum current rating of the tip if the electrode setback is set at minimum.

Charts 3-A and 3-B indicate results when using the .093" orifice and electrode at maximum setback with Argon as the Plasma Gas and Argon/Hydrogen (95/5) at 10-20 SCFH as the Shield Gas. Travel speed was approximately 10-12 ipm while making square butt welds on 304 stainless plate. These are suggested parameters and they may have to be varied to achieve optimum performance.

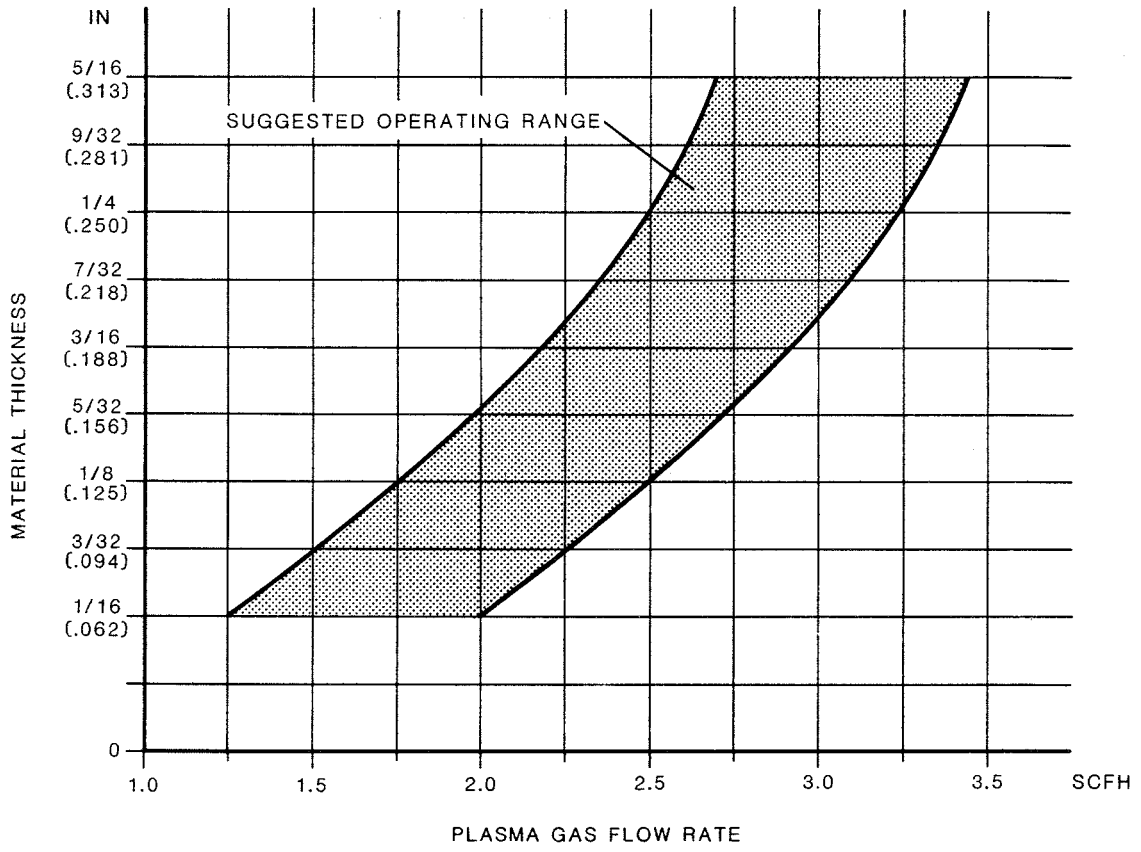


Chart 3-B

NOTE: This information represents our best judgement but Thermal Dynamics Corporation assumes no liability for its use. The parameters listed above may be varried to otimize performance.

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

WARNING

Check to be sure the main disconnect switch is open.

1) Check the torch to be sure that it has the proper components (see Section 4.1) and is adjusted properly (see Table 3-A).

2) Close the main disconnect switch supplying power to the welding system.

3) Turn the system on.

4) Set the gas supply pressure regulator at 30 psig. Adjust the gas flow rates as required (see Table 3-A).

5) Purge for approximately 3 minutes by letting the plasma gas run. This will remove any condensation of moisture that may have accumulated in the torch while it was shut down.

NOTE

Only the plasma gas line needs to be purged.

6) Select the welding mode.

7) Set the current to the selected amperage level.

The torch is now ready for operation.

WARNING

Read and understand the precautions listed in the front of this manual. Be sure the operator is equipped with proper gloves, clothing and eye protection and that proper ventilation is provided.

3.2. TORCH OPERATION

1) Locate the torch at the required starting position for the weld. Adjust the height as required.

2) Activate control switch.

3) Rate of travel of the torch will depend on the material and type of weld. This will have to be determined by the operator.

4) After the weld is completed, deactivate the control switch.

5) Put the welding system in the standby (SET) mode (post purge).

6) Wait 5 minutes before shutting the system down to allow the torch to cool.

When welding with a machine torch, the torch can be set perpendicular to the workpiece using a square as shown in Figure 3-D.

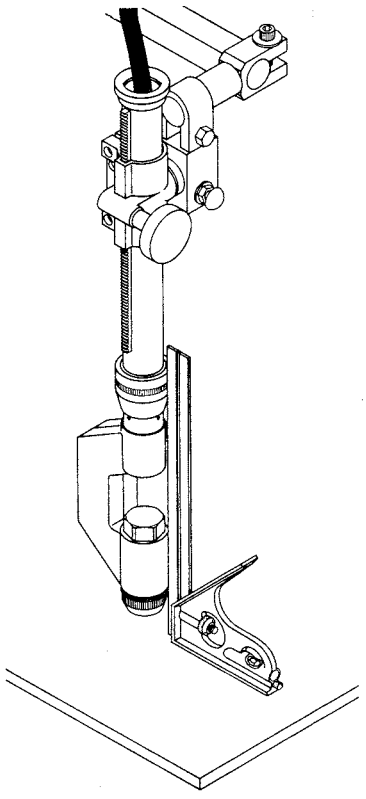


Figure 3-D Using a square to set up torch

The Service Section is divided into two parts:

4.1. Torch Maintenance
4.2. Torch Leads

4.1. TORCH MAINTENANCE

WARNING

Check to be sure the main disconnect to the welding system is open before disassembling the torch.

Torch Disassembly and Inspection

CAUTION

The back cap and liner have an O-ring seal to prevent gas leakage. It is important to observe the following precautions for the O-ring:

A) Make sure that the groove and the surface that the O-ring will seal against are clean and free of nicks and scratches.

B) Check to see that the O-ring is not cut or cracked.

C) Lubricate O-ring with a light coating of Cat. No. 8-4025 O-ring lubricant. This should be used sparingly, just enough to make the O-ring slippery, but not enough to accumulate in the torch.

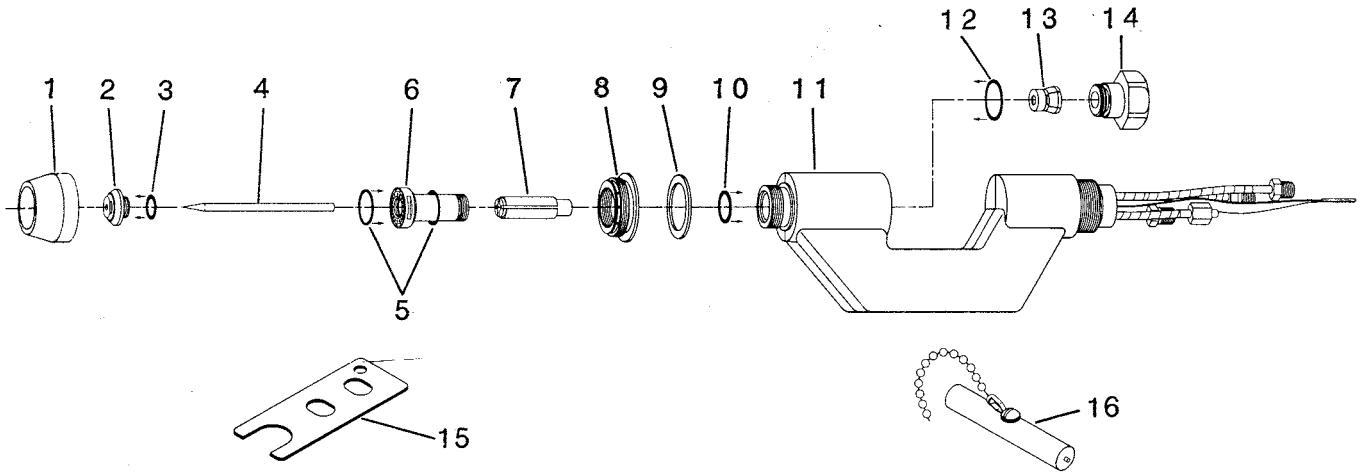
Disassemble the torch as follows:

1) Unscrew the end cap (1) or shield cup (1a).

2) Using the tip/liner wrench (15), unscrew the tip (2).

3) To remove the electrode (4), loosen the back cap (14) then gently push the electrode back. This will free the electrode from the collet (13) and the electrode can be easily pulled out of the torch.

4) The collet can be removed by unscrewing the back cap, pushing gently back on the electrode,



1. End Cap
   Shield Cup
2. Tip
3. O-ring
4. Electrode
5. O-ring
6. Liner
7. Insulating Sleeve
8. Shield Cup Adapter
9. Gasket
10. O-ring
11. Basic Head Assembly
12. O-ring
13. Collet
14. Back Cap
15. Tip/Liner Wrench
16. Electrode Gauge

Figure 4-A Torch Parts Explosion

which will unseat the collet allowing for its removal from the rear of the torch head.

NOTE:

It is not necessary to further disassemble the torch for normal parts change. Check the tip (2) and electrode (4). If the tip of the orifice is out of round or appreciably deformed, the tip should be replaced. The electrode should be resharpened if there is a flat larger than 1/4 of the diameter of the eletrode on the end. The point is 10° (20° included angle) and must be concentric with outside diameter of electrode.

To completely diassemble the torch:

5) Use the tip/liner wrench (15) to unscrew the liner (6).

6) The liner, along with the insulating sleeve (7), should be free to slide out of the torch. The insulating sleeve can now be pulled out the back of the liner.

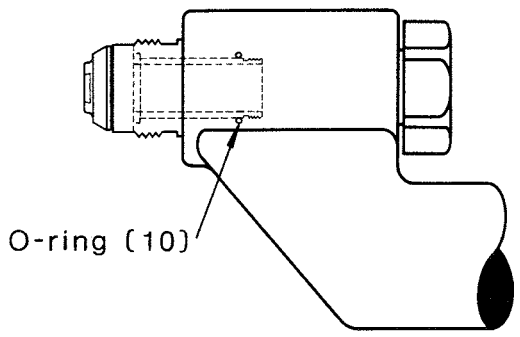


Figure 4-B O-Ring Location

7) Remove the O-ring (10) from the inside of the torch (Fig. 4-B) by spearing it with the point of the O-ring removal tool and dislodging it from the groove. Using the hooked end of the O-ring tool pull the O-ring out of the torch.

NOTE:

To get the point of the O-ring removal tool into position, slide the point down the inside of the torch from the front end. To miss other slots in the torch, hold the tool against the side of the torch.

8) The shield cup adapter (8 or 8a) simply unscrews from the torch head, leaving the gasket (9) accessable for inspection and if needed, replacement.

Torch Assembly

1) Lightly coat O-ring (10) with lubricant (Spare Parts Kit) and install in groove just before the internal threads in torch body.

2) Slide the insulating sleeve (7) into the rear of the liner (6), larger outside diameter first. Make sure that both O-rings (5) are properly lubricated. Install the O-ring on the rear face (external thread side) of liner first. Hold torch tip down and insert liner, screwing down snug using tip/liner wrench (15).

3) Insert the collet (13) into the back of the torch. Hold in place with fingers.

4) Guide the electrode (4) into front end of torch and into collet so that the tip of the electrode does not extend past the face of the liner.

5) Screw the back cap (14) firmly into place, holding the electrode until it is secured by the collet.

6) Check O-ring (3) for proper lubrication and installation on tip (2). Screw tip into liner (6), using tip/liner wrench (15) tighten gently until tip is snug.

7) Slide gasket (9) over torch tip end until it fits against the torch head.

8) Screw shield cup adapter (8 or 8a) onto torch end, by hand, until it fits firmly against gasket.

9) Screw the end cap (1) or shield cup (1a) onto the shield cup adapter.

10) Insert the electrode gauge (16) into the front of the torch and loosen the back cap (14) slightly. Push back on the electrode with the gauge until the shoulder of the gauge seats against the front of the torch. Tighten the back cap securely while holding the gauge in this position. (Figure 4-C).

The torch is now assembled and ready to be checked for possible leakage before operating. Turn on the torch coolant recirculator and observe the tip and orifice of the torch for possible sign of moisture.

Turn on the plasma gas and watch the gas stream for possible signs of moisture in the stream before operating. Do not attempt to operate the torch until the source of the moisture has been identified and corrected.

4.2. TORCH LEADS REPLACEMENT

Machine Mounted Torch

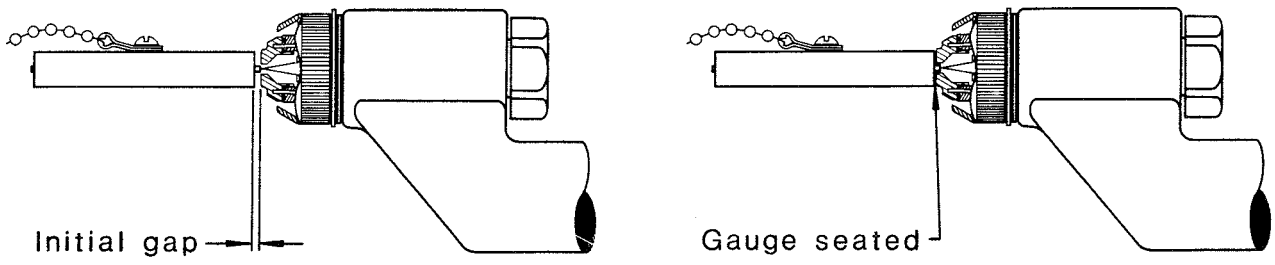
1) Unscrew the nut holding the positioning tube to the torch assembly. Slide the positioning tube back away from the torch.

2) Unscrew the sleeve adaptor from the torch. Slide the adapter up the leads until the torch fittings are accessible.

3) Disconnect the four hoses from the torch.

4) Remove the nut, sleeve adaptor and positioning tube from the old leads and install on the new leads at the torch end in the same order as they were on the old leads.

5) Connect the new leads to the torch making sure the color coded leads mate with their color coded torch fittings. Do not overtighten.



Step 1 Step 2

Figure 4-C

6) Screw the sleeve adaptor back onto the torch.

7) Slide the positioning tube over the sleeve adaptor and secure with the nut.

Torch Leads Repair

WARNING

Power to the system must be turned off.

If repair is needed to the console end of the leads, then disconnect at the console. To repair the leads at the torch end, disconnect as in the preceeding steps, then proceed as follows:

Positive and Negative Leads (Torch End, see Figure 4-D)

1) To replace the fittings at the torch end, cut the hose (only) just behind the ferrule. Grip the fitting and slide the hose back 4 to 6 inches. Clamp the wire lead at the end of the hose to prevent the hose from sliding back down over the fitting. Cut the old fitting off where the wire lead goes in.

2) Slide the new ferrule onto the wire lead.

3) Insert the wire lead into the small end of the new fitting up to but not beyond the stop.

4) Crimp the wire lead into place with a 18-22 AWG crimping tool. It is important to crimp the whole length of the solid diameter from the slot to the end.

5) Use the same crimping tool to crimp the wire stop in the slot out of the way. This is necessary to insure proper coolant flow.

6) Remove the clamp from the wire lead and push the hose over the glands onto the fitting.

7) Slide the ferrule onto the hose and fitting until it rests over the glands. Crimp using a 3/8 diameter crimping die, Scovill No. 44 or equivalent.

Positive and Negative Leads (Console End, see Figure 4-D)

1) To replace the fittings on the console end, cut the hose (only) just behind the ferrule. Grip the fitting and slide the hose back 4 to 6 inches. Clamp the wire lead at the end of the hose to prevent the hose from sliding back down over the fitting. Cut the old fitting off where the wire lead goes in.

2) Slide the new ferrule onto the wire lead and then the nut (in the right direction).

3) Insert the wire lead into the small end of the new fitting up to but not beyond the stop.

4) Crimp the wire lead into place with a 10-12 AWG crimping tool. It is important to crimp the whole length of the solid diameter from the slot to the end.

5) Use the same crimping tool to crimp the wire stop in the slot out of the way. This is necessary to insure proper coolant flow.

6) Slide the nut onto the fitting.

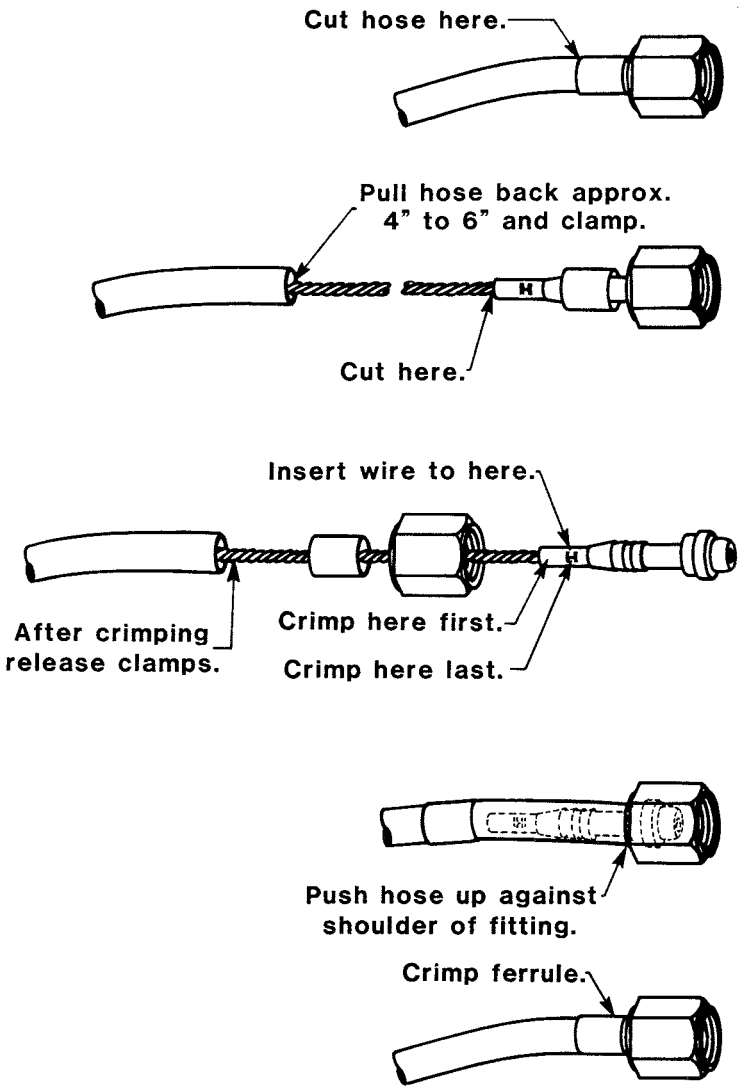


Figure 4-D Leads Fitting Replacement

7) Remove the clamp from the wire lead and push the hose over the glands, onto the fitting.

8) Slide the ferrule onto the hose and fitting until it rests over the glands. Crimp using a 7/16 diameter crimping die, Scovill No. 42 or equivalent.

Gas Hoses (Torch End, see Fig. 4-E)

1) Cut the gas hose just behind the ferrule.

2) Assemble the nut (threaded end first) over the fitting.

3) Slide the new ferrule over the hose and then slide the hose onto the fitting until it is approximately 1/4" past the last gland on the fitting.

4) Slide the ferrule over the hose and fitting until it rests over the glands. Crimp in place using a 1/4" diameter crimping die, Scovill No. 47 or equivalent.

Gas Hoses (Console End, see Figure 4-E)

Follow Steps 1 through 3 for the torch end.

4) Slide the ferrule over the hose and fitting until it rests over the glands. Crimp in place using a 5/16 diameter crimping die, Scovill No. 46 or equivalent.

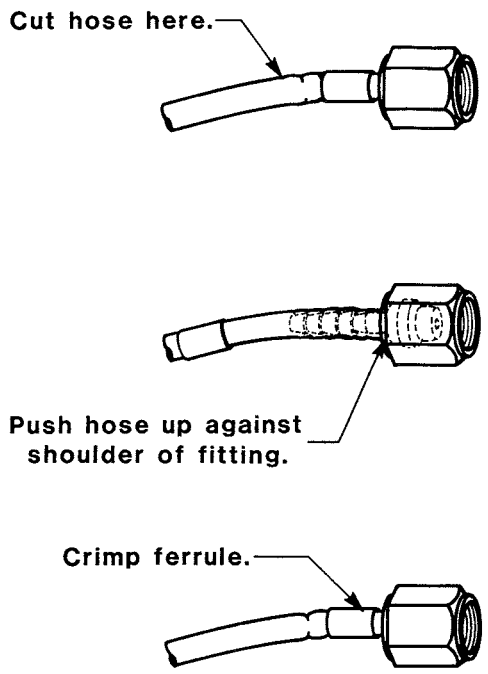


Figure 4-E Gas Fitting Replacement

4.3. TROUBLE SHOOTING GUIDE

This Trouble Shooting Guide lists the most common problems encountered with a plasma welding torch. The TROUBLE is listed in the sequence of operation of the torch. The POSSIBLE CAUSE and REMEDY are listed begining with the easiest to check and progressing to the more difficut to check. This guide is for the torch only, problems with the other components of the welding system should be checked in their respective instruction manuals. Most problems related to the torch can be corrected using this Trouble Shooting Guide.

TROUBLE	POSSIBLE CAUSE	REMEDY
A. Eratic or poor apearing pilot arc	1. Worn torch parts	1. Check and replace with new parts
	2. Improper electrode setting	2. Adjust electrode setting according to manual
	3. Contaminated plasma gas	3. Check (see B, page 18)
	4. Moisture in torch or leads	4. Check (see D, page 18)
B. Welding arc will not transfer	1. Torch standoff too high	1. Reduce standoff (approx. 1/8-3/16" standoff for most applications)
	2. Power supply not properly connected	2. Check work lead, NEGative lead and contactor control cable
	3. Faulty electrode in torch	3. Check for sharp point and clean appearance of electrode
C. Welding tip damaged on start up	1. Improper installation of torch parts	1. Check (see torch service section 4.1)
	2. Incorrect polarity	2. Check NEG and POS leads for proper connection; check power supply range switch (see C, page 18)
	3. Plasma gas flow rate too low	3. Increase flow rate
	4. Excessive current level	4. Reduce current or use larger orificed tip
	5. Inadequate coolant flow	5. Check (see A, page 18)
	6. Contaminated gas	6. Check torch and system (see B, page 18)

TROUBLE	POSSIBLE CAUSE	REMEDY
	7. Moisture in torch	7. Check torch O-rings for coolant leaks; check gas hoses (see D, page 18)
D. Tip damaged after a period of welding	1. Excessive current level	1. Reduce current or use larger orifice tip
	2. Plasma gas flow rate too low	2. Increase flow rate of plasma gas
	3. Inadequate coolant flow	3. Check (see torch requirements)
	4. Moisture in torch leads	4. Check torch O-rings for leaks; check gas hoses
E. Not getting required penetration	1. Plasma gas flow too low	1. Increase gas flow
	2. Current too low	2. Increase current
	3. Electrode setback at minimum	3. Set electrode to max setback (see torch operation)
F. Porosity in welds	1. Contaminates on material	1. Clean material
	2. Plasma gas flow rate too high	2. Reduce (if plasma gas flow is too high but 100% penetration is not occuring, gas porosity may appear)
	3. Inadequate shield gas coverage	3. Increase flow rate or use additional "trailer" shield to provide adequate gas shielding
G. Slight undercutting (in toe area of weld)	1. Travel speed too high	1. Reduce travel speed
	2. Plasma gas flow too high	2. Reduce flow rate
	3. Tip orifice size too small	3. Use larger orificed tip.
	4. Electrode set at max setback	4. Reduce the setback distance (see torch operating instructions)

4.4. TEST PROCEDURES

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

A. Inadequate coolant flow can cause excessive damage to the tip and liner. Check the "return" flow rate of the coolant against the torch requirements.

B. Contaminated plasma gas normally causes the electrode to have a bluing tint toward the front. Check for leaks in the plasma gas line by plugging the tip and letting the gas flow while the console is in the SET position. Check all connections on the plasma gas line using a soaply water solution on the connection. If bubbles appear then there is a leak at this point.

C. Reverse polarity operation will cause excessive electrode deterioration which may cause a large ball to appear at the end of electrode.

D. Moisture in the plasma gas may cause a black sooty material to appear on the electrode or in the tip. This can be due to the use of rubber hoses which may cause moisture entrapment. For best results use tygon tubing.

To remove moisture from the torch, plug the tip and let the gas build pressure, then release. It may be necessary to repeat this step three or four times to remove the contaminants.

5.1. GENERAL ARRANGEMENT

Assembly Parts List

The Assembly Parts List consists of illustrated parts lists of the following:

Figure 5-1.	PWM-300 Series Welding Torch
Figure 5-2	PWM-300 Torch Assembly
Figure 5-3	PWM-300 Torch Leads Assembly

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 INFORMATOIN

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. Address all inquiries to your authorized Thermal Dynamics' distributor.

RETURNS

In the event that a Thermal Dynamics' product must be returned for service, contact your Thermal Arc distributor. Material returned to Thermal Dynamics without proper authorization will not be accepted.

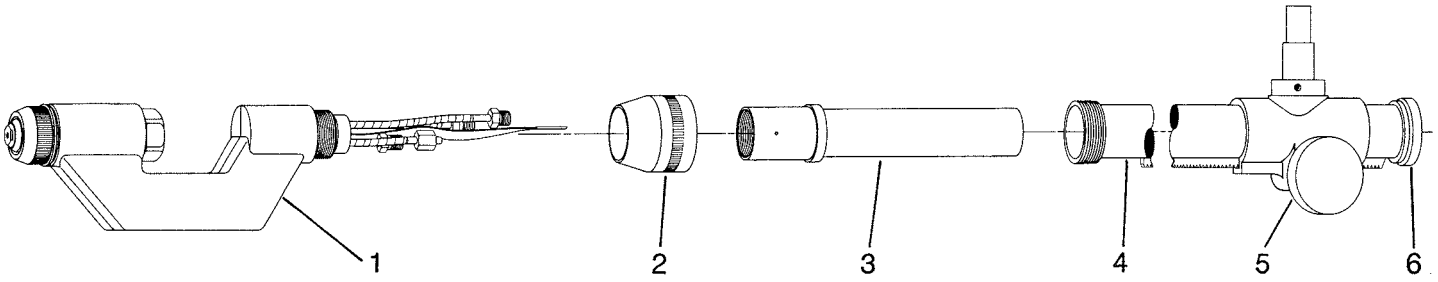


Figure 5-1 PWM-300 Welding Torch

Fig.	Item No.	Qty.	Catalog Number	Description
5-1	1	1	8-6649	Torch Head Assembly
5-1	2	1	8-4018	Nut
5-1	3	1	9-1901	Sleeve Adapter
5-1	4	1	8-5005	Positioning Tube
5-1	5	1	7-2827	Pinion Assembly
5-1	6	1	8-4204	Bushing
		1	2-2845	PWM-300 Torch with 12.5 ft. Leads (includes items 1-6)
		1	2-2846	PWM-300 Torch with 25 ft. Leads (includes items 1-6)

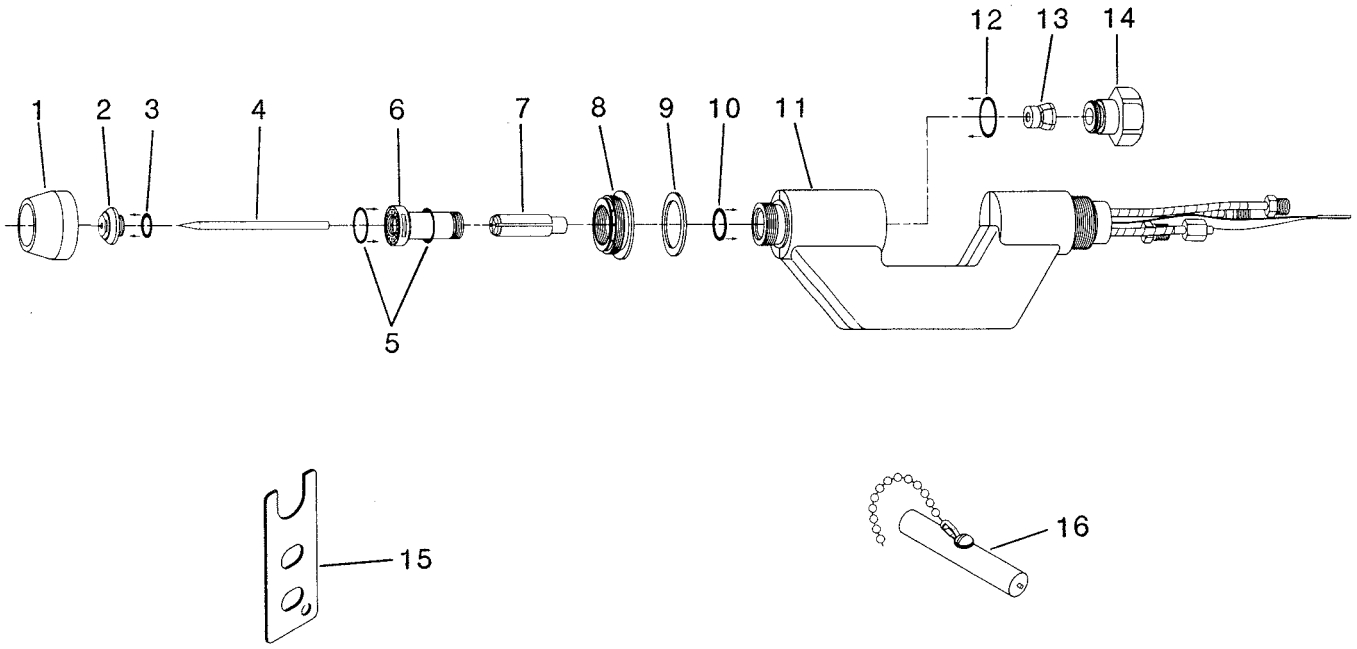


Figure 5-2 PWM-300 Torch Explosion

Fig.	Item No.	Qty.	Catalog Number	Description
5-2	1	1	8-4373	End Cap (Brass)
5-2	2	1		Tip (Packaged in Lots of 5)
	Long:		8-4370	Tip - .093, 200 amp (includes 3 & 5)
			8-4371	Tip - .113, 250 amp (includes 3 & 5)
			8-4372	Tip - .125, 300 amp (includes 3 & 5)
5-2	3	1	9-2863	O-ring
5-2	4	1	9-1827	Electrode
5-2	5	2	9-2956	O-ring
5-2	6	1	8-6509	Liner (includes 5 & 10)
5-2	7	1	8-6651	Insulating Sleeve
5-2	8	1	8-6652	Shield Cup Adapter (for use w/item 1)
5-2	9	1	8-6512	Gasket
5-2	10	1	8-0531	O-ring
5-2	11	1	8-6649	Basic Head Assembly
5-2	12	1	8-0534	O-ring
5-2	13	1	8-6650	Collet
5-2	14	1	8-6654	Back Cap
5-2	15	1	8-6517	Tip/Liner Wrench
5-2	16	1	8-6653	Electrode Gauge
		1	8-4025	Lubricant

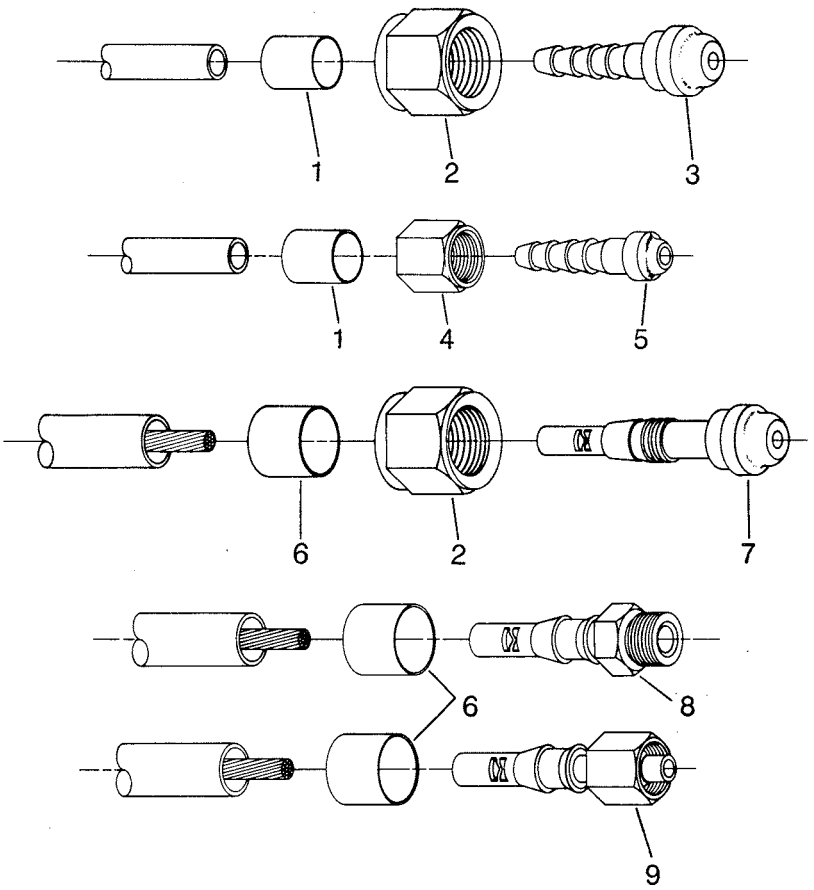


Figure 5-3 PWM-300 Torch Leads and Hose Fittings

Fig.	Item No.	Qty.	Catalog Number	Description
5-3		1	4-2525	PWM-300 Torch Leads - 12.5 ft.
5-3		1	4-2544	PWM-300 Torch Leads - 25 ft.
5-3		1	9-2079	Negative Torch Lead - 12.5 ft.
5-3		1	8-1398	Negative Torch Lead - 25 ft.
5-3		1	9-2081	Positive Torch Lead - 12.5 ft.
5-3		1	8-1399	Positive Torch Lead - 25 ft.
5-3		1	8-0142	Plasma Gas Hose - 12.5 ft.
5-3		1	8-1505	Plasma Gas Hose - 25 ft.
5-3		1	9-3086	Shield Gas Hose - 12.5 ft.
5-3		1	9-3088	Shield Gas Hose - 25 ft.
5-3		1	8-3138	Torch Leads Sleeving - 12.5 ft.
5-3		1	8-3139	Torch Leads Sleeving - 25 ft.
5-3	1	1	8-5012	Ferrule - Console End
5-3	2	1	8-5015	Nut - Console End (+ & -)
5-3	3	1	8-0328	Fitting, Console End
5-3	4	1	8-0339	Nut, Torch End
5-3	5	1	8-0338	Fitting, Torch End
5-3	6	1	8-5013	Ferrule - Console End
5-3	7	1	8-5010	Fitting - Console End (+ & -)
5-3	8	1	8-5008	Fitting - Torch End (+)
5-3	9	1	8-5009	Fitting - Torch End (-)

PLASMA ARC WELDING

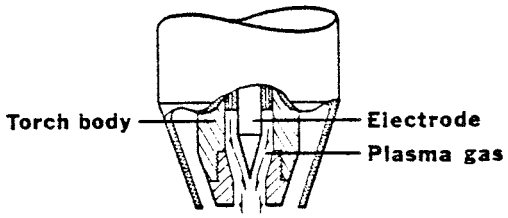
PLASMA GAS

ARGON:

- -NORMALLY USED
- -RELIABLE STARTING
- -DEPENDABLE PILOT ARC
- -MOST STABLE WELDING ARC
- -EFFECTIVE CLEANING ACTION AT LOWER CURRENT LEVELS
- -UNIFORM HIGH QUALITY WELDS

ARGON/HYDROGEN (95%/5%):

- -PROVIDES HOTTER ARC
- -BETTER PENETRATION ON HIGH ALLOYED NICKELS



PLASMA ARC WELDING

SHIELD GASES

ARGON

- -CAN BE USED ON ALL METALS
- -GOOD ARC STABILITY AT LOW CURRENT LEVELS
- -EFFECTIVE CLEANING AT LOW CURRENT LEVELS
- -HIGH QUALITY WELDS ON TITANIUM AND REACTIVE METALS
- -MAY NOT OPTIMIZE AT HIGHER ARC VOLTAGES
- -FLOW RATES - 10--20 S.C.F.H.

ARGON/HYDROGEN (95%/5%)

- -MOST POPULAR
- -HIGHER HEAT INPUT
- -MORE FLUID WELD PUDDLE
- -RECOMMENDED FOR SS, MS, NICKLE
- -ASSIST IN REDUCING SURFACE TENSION
- -CAN USE UP TO 15% H_2
- -INCREASED TRAVEL SPEEDS
- -CLEANER WELDS
- -NOT RECOMMENDED FOR ALUM, COPPER ALLOYS, TITANIUM OR REACTIVE METALS
- -FLOW RATES - 10--20 S.C.F.H.

HELIUM

- -PROVIDES HOTTER ARC
- -BETTER PENETRATION
- -FASTER SPEED @ EQUAL CURRENT LEVELS
- -USED FOR ALUM, COPPER ALLOYS, THICKER TITANIUM AND REACTIVE MATERIALS

Shield Gases - continued

Argon/Helium (25%/75%)

- Higher heat input
- Used where argon & helium alone do not optimize
- Less than 40% helium - characteristics of argon
- Over 75% helium - characteristics of helium
- Flow rates - 15--40 S.C.F.H.

Additional Shielding

- Trailing shield
- Chamber