MODEL 107- 4A
OPERATION MANUAL

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The information in this document has been carefully reviewed and is believed to be accurate. However, no responsibility is assumed for inaccuracies.

Information and instructions in this document are subject to change and Arc Machines, Inc. reserves the right to change specifications and data without notice.

WARNING

The nature of the GTAW process creates some POTENTIAL HAZARDS. In accordance with international safety regulations the EXCLAMATION SYMBOL indicates that this equipment is considered HAZARDOUS until an operator has been made aware of these POTENTIAL HAZARDS by **READING THIS MANUAL**. The LIGHTNING FLASH SYMBOL indicates that there are potential electrical hazards. The use and display of these symbols make it the OPERATOR'S RESPONSIBILITY TO INSURE THAT HE HAS READ AND/OR BEEN MADE AWARE OF ALL OF THE SAFETY-RELATED ITEMS CONTAINED IN THIS MANUAL.

Publication date : First Edition - December 8, 1982

REV.	DCO #	CHANGE DESCRIPTION	DATE	APR
A	2365	Revised to include required IEC-974 information	10/22/97	GPE

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SECTION I - INTRODUCTION

1.0 INTRODUCTION

The Model 107-4A Welding Power Supply is designed for use with the Model 9 series Tube Welding Heads. This combination forms a tube welding system for fusion welding of metal tubes, pipes and fittings (figure 1). This complete system consists of the Power Supply, Weld Head, Adapter Cable, Gas Lines, Remote Pendant (optional), Water Cooler (optional), and Extension Cables (optional).

The Model 107-4A Power Supply provides tungsten inert gas (TIG) welding current with pulsation, high frequency arc starting, Weld Head arc rotation, purge gas control and automatic timing functions.

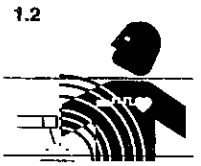
This manual is intended to assist users of this equipment in set up and basic operation. Automatic fusion welding requires a good deal of operator expertise which requires AMI supplied training. THIS MANUAL IS NOT INTENDED AS A SUBSTITUTE FOR THAT TRAINING.

NOTE

In-depth weld development, weld head set-up, maintenance and troubleshooting are contained in other manuals, documents and training classes and are not included in this manual. Contact your AMI representative for more information about these items.

1.1 SAFETY PRECAUTIONS

This section contains cautions and warnings concerning the operation of this equipment and welding equipment in general. However, in addition to reading this manual and before operating this or any welding equipment, users should reference and be familiar with ***"ANSI-49.1 Safety in Welding and Cutting"***. This standard is published by the American National Standards Institute and the American Welding Society.

	**WARNING**: Touching energized electrical parts can cause fatal shocks and burns. When in weld sequence the electrode and work are electrically energized. Incorrectly installed or improperly grounded equipment is a hazard.
	**WARNING**: This equipment is authorized to use a type of arc starter that produces a High Frequency Radio Wave (sometimes called HF and/or RF Starting). It can cause interference and sometimes even damage to nearby electronic equipment (such as computers) that are un-protected or poorly protected against such interference.
	**WARNING**: Magnetic Fields from High Currents can affect pacemakers. PACEMAKER WEARERS KEEP AWAY UNTIL CONSULTING YOUR DOCTOR.

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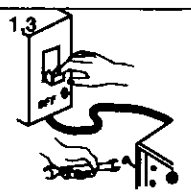
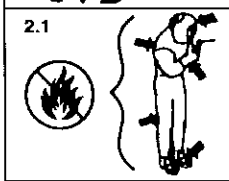
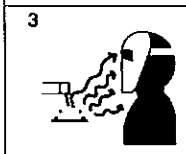
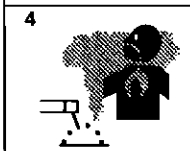
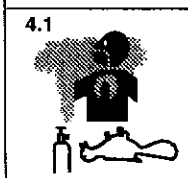
SECTION I - INTRODUCTION

1.1 SAFETY PRECAUTIONS (continued)

1.3 	**WARNING**: Disconnect the input power to the machine before opening or servicing. Discharge all circuits that store high voltage such as capacitor packs. Only QUALIFIED service personnel should open this equipment.
2 	**WARNING:** Welding can cause fires or explosions. Do not weld near FLAMMABLE or EXPLOSIVE MATERIALS. Watch for fire. Have the proper types of extinguishers in the work area.
2.1 	**WARNING**: Welding Operators should wear non-flammable protective clothing, footwear and head gear.
2.2 	**WARNING**: Never weld on sealed containers or pipes. This may result in an EXPLOSION.
2.3 	**WARNING**: Welding produces high temperatures in both the welded components and the welding equipment. Both can cause severe burns. Do not touch recently welded components. Avoid touching internal components of the welding system soon after use. Avoid touching torch components and welding fixtures soon after welding.
3 	**WARNING**: The welding arc emits ultra-violet (UV) radiation and the molten weld gives off infra-red. Both can burn eyes and skin if unprotected. Suitable eye and skin protection must be worn.
4 	**WARNING**: Weld materials can emit toxic fumes during welding. WELD ONLY IN AREAS WITH ADEQUATE VENTILATION.
4.1 	**WARNING**: Most GTAW gases like Argon are non-toxic, however, Argon is heavier than air and will displace the normal atmosphere in enclosed areas. DO NOT WELD IN ENCLOSED AREAS WITHOUT PROPER VENTILATION OR RESPIRATORS.

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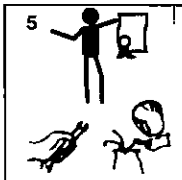
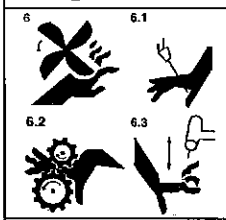
SECTION I - INTRODUCTION

1.1 SAFETY PRECAUTIONS (continued)

	**WARNING**: AMI factory training is essential for all Welding Operators and Maintenance Technicians who operate AMI equipment.
	**WARNING**: Before operating, storing or handling, always make sure that the M-107-4A and M107-RP Remote Pendant, weld heads and cables are not exposed to rain or standing water. SYSTEM COMPONENTS ARE NOT WEATHER-PROOF.
	**WARNING**: Keep hands and fingers clear from moving parts such as fans, gears rotors, Wire Feed, Rotation and AVC Mechanisms.
	WARNING: The M-107-4A Power Supply is not intended for pipe thawing or heating in any form.
	WARNING: The M-107-4A weighs in excess of 100 lbs. Be sure to follow local, OSHA, International or employers guidelines for proper methods of lifting and re-locating this equipment.

1.2 OPERATIONAL PRECAUTIONS

The following is a check list for operating personnel to follow to insure minimum system down-time due to improper operation and handling:

1. TOO AVOID severe equipment damage VERIFY that the M-107-4A is connected to the correct Input AC power.

2. Before operating, check all fittings and connectors for proper seating and that all protective boots are in place. If not properly seated or protected, short circuits, poor connections or inert gas leaks could occur.

3. The M-107-4A is intended for typical GTAW gases ONLY. *NEVER CONNECT OXYGEN OR ACETYLENE TO THE M-107-4A.*

4. Before operating, insure that all cables are routed or protected in such a way that they will not be subject to heat, equipment and/or personnel traffic. Insure that the cables DO NOT come in contact with HOT PIPE.

SECTION I - INTRODUCTION

1.2 OPERATIONAL PRECAUTIONS (continued)

5. When storing or handling cables, always keep the protective boots and dust caps on all connectors and fittings until ready to install. A major cause of downtime in any automatic welding system is improper care and use of cables.

6. Before operating, insure that the M-107-4A has adequate air flow. Do not restrict the intakes or exhaust vents of the power supply.

7. Before operating, always insure that there is bare metal contact between the weld head components which connect to GROUND (clamp inserts, etc.) and the tube or pipe to be welded.

8. When storing or handling weld heads, always keep them in the protective containers they are shipped in, or optional carrying case, until ready to install.

9. When operating, storing or handling, insure that the system is protected against dirt, dust, etc. NEVER GRIND NEAR AN EXPOSED WELD HEAD OR THE M-107-4A.

10. Do not use acid, corrosives, liquid "Easy Out" or any liquid substance on the M-107-4A or any AMI weld head. When cleaning, use only a light solution of Isopropyl alcohol on a soft cloth .

11. When handling, take extreme care to avoid dropping the M-107-4A, weld heads, cables or any accessories.

12. Do not attempt to move tube end into position using the weld head as a lever.

13. Do not add any lubrication like graphite, oil or grease to the weld heads or power supply unless it is specified in the operation or maintenance manual for that equipment.

1.3 SHOCK HAZARD WARNING

As already stated in this manual "High Voltage" is present on exposed internal terminals. The ELECTRODE (tungsten and M-9 rotors) is also an "terminal" and by its nature the GTAW process requires electrical potential to be present on the electrode during arc starting and of course during the welding.

All AMI Power Supplies contain a "bleeder" circuit to ground any residual potential after welding or after an aborted or bad "arc start" attempt. However, these circuits take a few seconds to operate or COULD FAIL.

"THE ELECTRODE SHOULD ALWAYS BE CONSIDERED A POSSIBLE SHOCK HAZARD". This is especially true when ever the system is in "weld sequence" ready to weld, is welding or has just finished welding. However, equipment/component failure, system abuse, or improper maintenance could result in electrical potential at the weld head "even when not in weld sequence".

SECTION I - INTRODUCTION

1.3 SHOCK HAZARD WARNING (continued)

The users/operators of this equipment must take all precautions necessary to avoid contact with the ELECTRODE at "ALL TIMES". The only exception is when actually replacing or adjusting the electrode and this should be done "WITH THE POWER TURNED OFF".

If performed with the power "ON" the system must be in test mode out of weld sequence and the USER MUST OBSERVE COMMON SAFETY PRACTICES such as grounding the electrode to insure discharge before actually touching it.

REMEMBER, there is a "POSSIBLE" shock hazard in all welding power supplies at "ALL" times.

Most AMI Power Supplies feature High Frequency (HF) Arc Starting. This is a High Voltage - High Frequency electrical transmission process. To eliminate any HF shock possibility "AVOID ALL CONTACT" with the Welding WORK (ground), the ELECTRODE or the WELD HEAD during arc start.

1.4 RF AND EMI EMISSIONS

1. WHY RF?

"It has long been recognized that in the practice of welding and cutting, there are circumstances where it is required to assist the process using radio frequency voltage. In order to arc weld an electric arc must be created, because of safety and economic concerns, the no load voltage of arc power sources is kept as low as practical. Thus, a source of high voltage with a high safety factor must be utilized. Radio Frequency voltage is the best method of meeting these criteria for many reasons." (quoted from CISPR/B/63).

2. RF REGULATION

The FCC regulates the RF emission limitations for welding equipment by the use of an IEC (international) regulation created by the Special Committee on Radio Interference (known as CISPR) subcommittee B. The regulation of record is:

CISPR/B/63

"CODE OF PRACTICE FOR THE USE OF WELDING AND CUTTING POWER SOURCES UTILIZING RADIO FREQUENCY VOLTAGE FOR STARTING OR STABILIZING THE ARC."

The regulation states that due to the variety of work requirements and conditions it is virtually impossible to establish fixed, normalized and predictable tests and test setups for RF limits that would actually mean something. Instead of limits they state the following:

"The manufacturer must design and produce equipment that is functional but at the same time, design this equipment to keep electromagnetic radiation at a minimum."

SECTION I - INTRODUCTION

1.4 RF AND EMI TRANSMISSIONS

2. RF REGULATION (continued)

"The user has the responsibility to install and use the power source per the instructions of the manufacturer. Through this practice, it is reasonable to assume that the probability of electromagnetic disturbances will be significantly reduced. However, if some electromagnetic disturbances are felt, then it is the responsibility of the USER of the equipment to resolve the situation."

3. RF PROTECTION

AMI policy is to comply with the IEC (and thus FCC) regulations. Our design rules and procedures include testing and observing this area.

We can assure our customers that every effort has been made to reduce RF emissions to the absolute minimum from our power sources.

However, this does not mean that a user will not have occasional problems with RF interference with other equipment due to the use of our equipment. This is the nature of RF starting.

Most RF noise interference problems are going to be either set-up related or caused by poor or no filtering on the behalf of the equipment that is being interfered with. Most problems are easily correctable but each one must be looked at on a "case by case basis."

4. EMI SUPPRESSION

The M-107-4A is equipped with a heavy-duty Pi-Network filter, connected to the input power line, to prevent propagation of EMI either into or out of the M-107-4A. The all-metal enclosures and internal shields prevent radiated EMI.

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MODEL 107 PORTABLE POWER SUPPLY AND MODEL 9 TUBE-TO-TUBE WELD HEADS
Power Supply Features: 99 ampere DC output, four-level programming, current pulsation, pulse synchronization, rotation controls, arc starter, downslope, and gas controls.
Weld Heads accomodate tube or thinwall pipe (0.180″ max. wall thickness) in a range from 0.125″ to 7.500″. Also capable of welding automatic weld fittings.

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SECTION II - SPECIFICATIONS

The following contains only general specifications about the M-107-4A Power Supply. More detailed information is available in AMI Specification No. 107.

2.0 ELECTRICAL

1. RATING PLATE DEFINITIONS

1) Company: **ARC MACHINES, INC.** Country: **USA**		3) Model: **Model 107- 4A**
4) **S/N:**	**DATE:**	
8) Process: **G.T.A.W.**	10) Type: **DC**	6) Standards: **NEMA EW1 IEC 974-1 IEC 204-1: 1992**
9) Output: Minimum **3A / 5V** Maximum **99A / 20V**	11) No-load Voltage: **U_0 = 59V**	12) Duty Cycle: **X = 100%** ALL RATED OUTPUTS
15) Input: **1~ 50/60 HZ**	18) Voltage: **U_1 = 220V**	19) Input Current: **I_{1max} = 20A** **I_{1eff} = 20A**
		21) Rating **IP21**

1) - Manufacturer and Country of Origin
3) - Model Number Rating Plate applies to.
4) - Serial Number and Date of manufacture
6) - International and USA Standards that the equipment meets.
8) - Weld Process symbol for GTAW welding.
9) - Rated minimum output amperes and output voltage (same all models).
10) - Symbol that output is Direct Current (DC) only.
11) - Rated No Load Output Voltage (open circuit voltage)
12) - All M-107-4A models are 100 % Duty Cycle for their rated outputs (9).
15) - Input Voltage type contains symbol for single (1) phase Alternating Current (AC) input at 50 or 60 Hz frequency.
18) - Nominal Input Voltage value is 110 VAC or 220 VAC
19) - Rated maximum required supply current. Given for both I1 maximum (I1max) and I1 effective (I1eff).
21) - International Protection (IP) rating. M-107-4A is rated IP21which includes protection against a limited amount of exposure to rain (does not make it weather proof or intended for all weather usage).

2. INPUT POWER REQUIREMENTS

1. Input Power Requirements (Figures 2A and 2B)

	Voltage	Tol.	Phase	Freq.	Service
Option 1*	115 VAC	+/- 10%	1	60 Hz	30 Amps
Option 2*	200 VAC	+/- 10%	1	50/60 Hz	30 Amps
Option 3*	220 VAC	+/- 10%	1	50/60 Hz	20 Amps

*Specified at time of purchase.

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SECTION II - SPECIFICATIONS

2.0 ELECTRICAL

3. OUTPUT

Amperage - 5 to 99 Amps., DC straight polarity
Regulation -Constant current
Open Circuit Voltage - 59 VDC

4. CIRCUIT BREAKER

Power ON/OFF, 30 Amp., two pole instantaneous trip.

2.1 PHYSICAL CONSTRUCTION - (power supply only)

Cabinet material	-	aluminum	
Height	-	18.0 in	(457.2 mm)
Width	-	22.0 in	(558.8 mm)
Depth	-	18.0 in	(457.2 mm)
Weight	-	120 lbs	(54.4 kg)

2.2 OPERATIONAL TEMPERATURE REQUIREMENTS

32 degrees F (0 degree C) to 110 degrees F (45 degrees C).

2.3 WATER COOLING PACKAGE, MODEL 107-CW (Optional)

1. Electrical Requirements - supplied from the 107-4A Power Supply.

2. Coolant Capacity - 3.0 gallons.

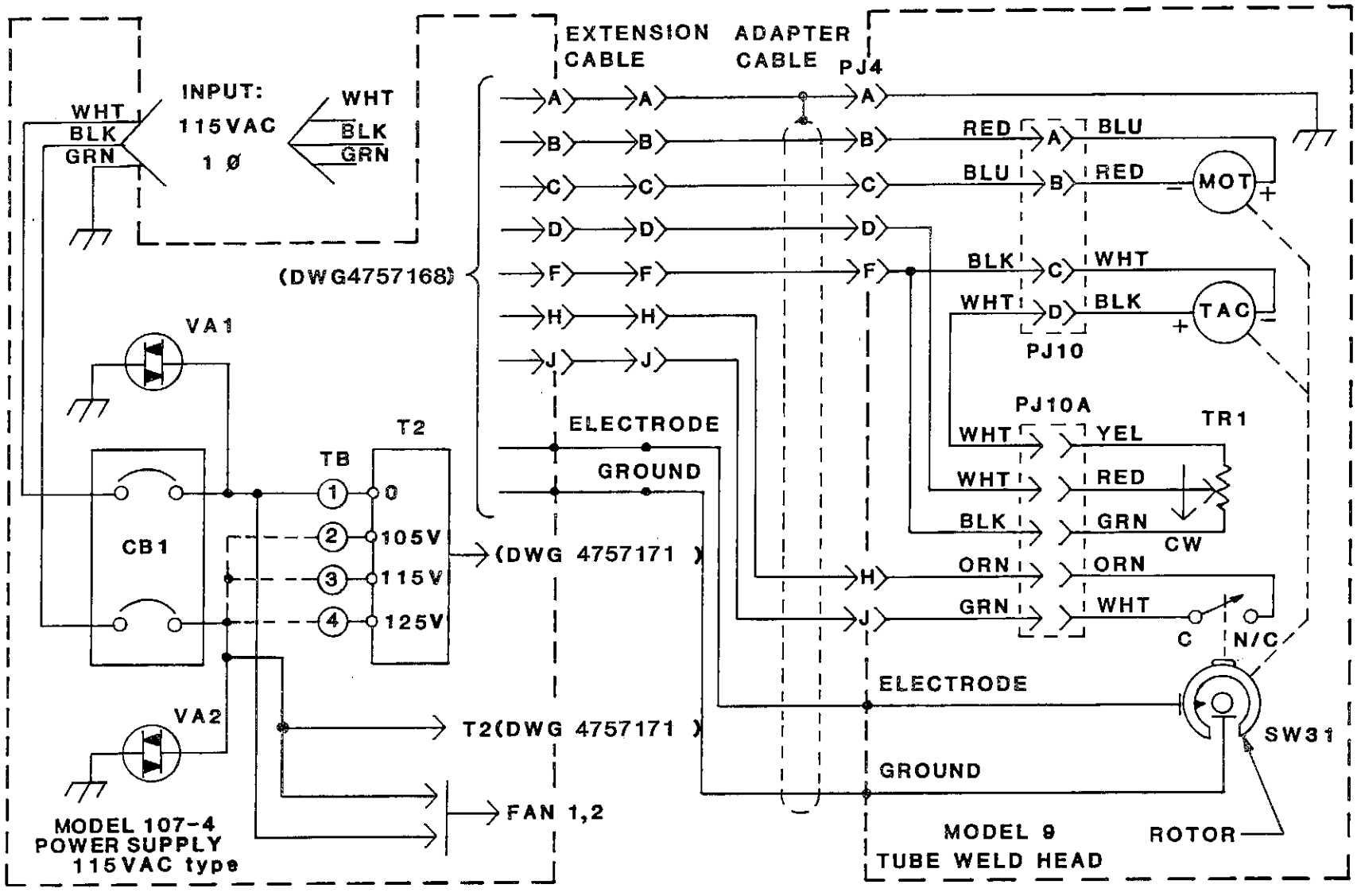
3. Circulation - 0.3 gallons per minute with Weld Head and cabling connected.

4. Physical Construction

Material	-	aluminum cabinet
Height	-	9 in (228.6 mm)
Width	-	22 in (558.8 mm)
Depth	-	18 in (457.2 mm)
Weight	-	55 lbs. (24.9 kg) filled

5. Pump

Magnetic-coupled, seal free, built-in pressure regulator set at 60 PSI (413.7 kPa).

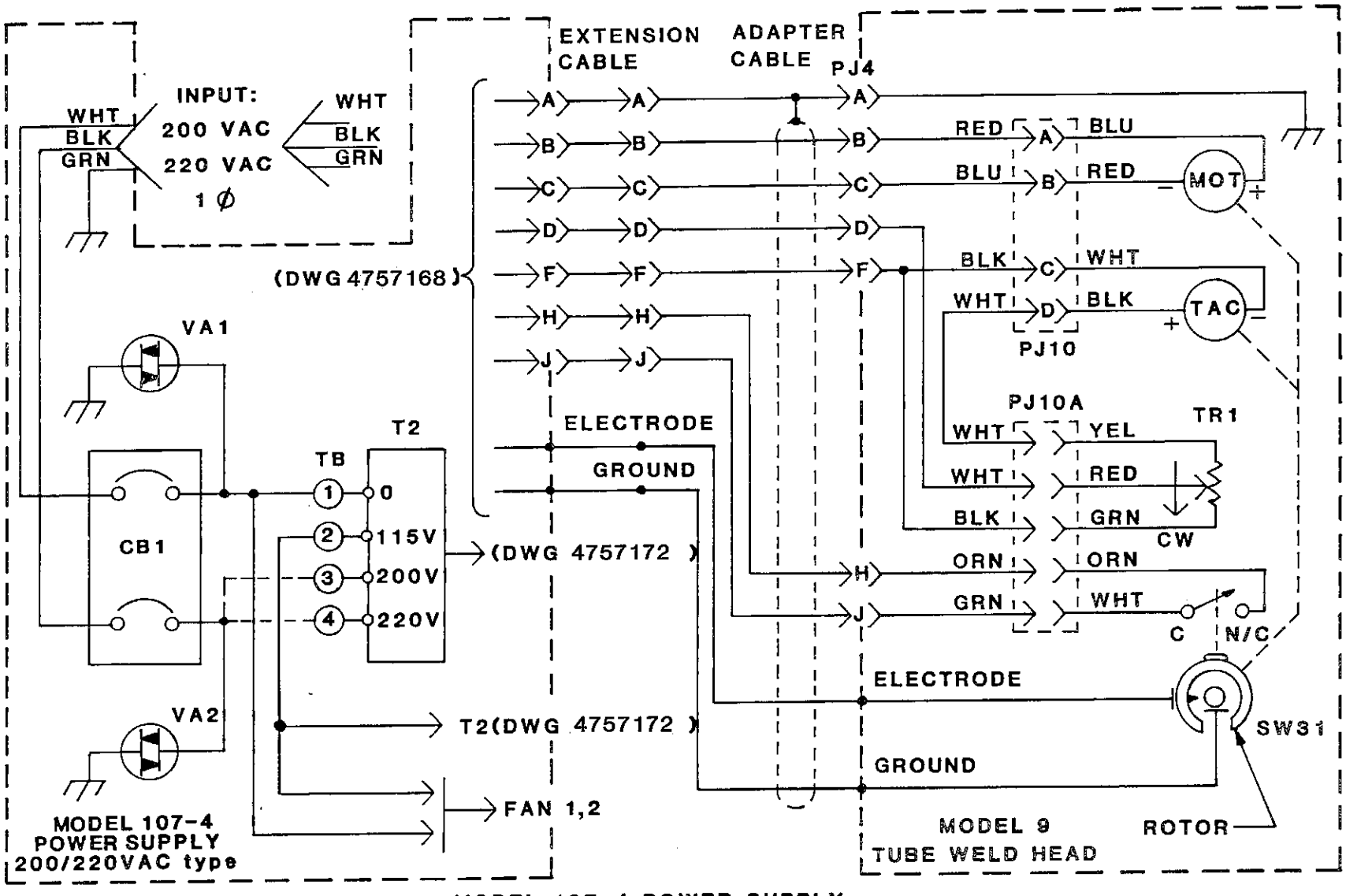


MODEL 107-4 POWER SUPPLY
ELECTRICAL INPUT/OUTPUT
115 VAC MODELS

FIGURE 2A

ARC MACHINES INC.

8 December 1982
7 July 1987



MODEL 107-4 POWER SUPPLY
ELECTRICAL INPUT/OUTPUT
200 / 220VAC MODELS

ARC MACHINES INC.

FIGURE 2B

8 December 1982
7 July 1987

III. INSTALLATION

3.0 Inspection:

A. After uncrating, inspect all items for obvious physical damage and loose parts. If damage is evident, contact a factory representative before using.

B. If water condensation is apparant, dry the unit before using.

C. Check that all items of the operator's kit sent with each Model 9 Weld Head are complete. They will be needed for operation. They are listed below:

1. 1 set of allen wrenches
2. 2 1/4" open-end wrenches
3. 1 calibration screw driver
4. 1 tungsten
5. 4 tungsten set screws
6. 6 clamp insert screws
7. 1 exploded view and parts list and wiring drawing
8. 1 instruction sheet on what length to grind electrode

3.1 Power Hook Up:

A. Check that the circuit breaker CB-1 is in the "OFF" position.

B. Check the voltage requirement label located below CB-1. The Model 107-4 Power Supply is supplied with a 25-ft. Power Cord with only the power supply side plug attached. A suitable line plug or disconnect must be supplied and installed by the user. Color coding of the power cord is as follows and is also noted on Figures 2A and 2B.

Black - Hot (High line side)
White - Neutral (Low line side)
Green - Ground

WARNING: Do not connect the Model 107-4 Welding Power Supply to any AC power source other than one rated the same as the unit's label.

3.2 Water Cooling Unit: (Optional Model 107-CW)

A. Initial Installation

1. The Water Cooling unit requires three (3) gallons of CLEAN water. In areas where freezing temperatures are expected, add 2 gallons of CLEAN water and 1 gallon of pure ethylene glycol (user supplied).

   Note: If the local water is high in mineral or chemical content, it is recommended using distilled water.

3. DO NOT USE ANTI-FREEZE THAT CONTAINS "STOP LEAK ADDITIVES".

B. Adding Water

1. Remove the Power Cord from the Model 107-4 Power Supply and set the Cooling Unit ON/OFF switch to the OFF position (located on side of Water Cooling Unit).

   Note: Water Cooling Units from the factory are shipped separate from the 107-4 Power Supply. Steps 1 through 3 of Section 3.2,B do not apply on new units; only on units being checked for water level or adding water.

2. Unlatch the Model 107-4 Power Supply (Figure 3) from the Cooling Unit (four hinged latches).

3. Lift the Power Supply unit a few inches off the Water Cooling Unit and disconnect the Water Cooling Unit's connecting Plug and Cable, located on the underside of the Power Supply. The Power Supply can then be set on the floor next to the Cooling Unit.

4. Remove the top access panel of the Water Cooling Unit by turning the four retaining pins a quarter turn.

5. Unscrew the water filler port on the water tank.

6. Add water as required.

3.2,B Continued

7. Replace tank plug.

8. Replace access panel.

9. Lift the Power Supply back onto the Water Cooling Unit and relatch. Be sure to reconnect the Cooling Unit Cable and Plug to the bottom of the Power Supply.

WARNING: DO NOT OPERATE THE WATER COOLING UNIT WITHOUT COOLANT IN THE TANK OR WITHOUT A WATER FLOW PATH (WATER OUT TO WATER IN THROUGH A WELD HEAD).

3.3 Welding Gas Connections:

A. Two color coded 10-foot Gas Hoses and one 25-foot Gas Hose are furnished. The yellow hose is for "ARC GAS" from the Regulator, the green hoses are for "BACK-UP GAS", one 10-foot to the Power Supply from the Regulator and the 25-foot for a Purge line.

B. Connect the fitting of the yellow ARC GAS Hose to a gas flowmeter and regulator (user supplied). Connect the other fitting to the inlet on the side of the Power Supply labeled "ARC GAS".

C. Connect the green hose in similar fashion to "BACK-UP" inlet and outlets.

D. Tighten the retaining nuts slightly with a wrench.

E. Ensure that inlet gas supply pressure does not exceed 50 PSIG.

3.4 Adapter Cable Installation (Model 107/9-ADP):

WARNING: Always turn the Power Supply off before making any cable or connection changes to the 107-4 Power Supply.

A. The Adapter Cable must be used with all Model 9 series Weld Heads.

3.4 Continued

B. One end of the Adapter Cable always connects to the Weld Head. The other end connects to the Model 107-4 Power Supply or to a Weld Head Extension Cable. The Weld Head Extension Cable would then connect to the Power Supply. Steps C to G describe connection to the Power Supply, but the same procedure should be followed except connect the Adapter Cable to the Extension Cable.

C. The connector types and keys are different for each item (Adapter, Extension, and Weld Head Cables) and can only be properly hooked up one way.

D. Unscrew the protective dust cap on the Electrical Connector. Insert into mating connector labeled "weld head" (PJ-4) (on Power Supply front side). Note the positioning keyway, and NEVER FORCE cable connections. Hand tighten the connecting ring after pins are firmly seated.

E. Connect the Ground and Electrode Cables to their respective terminals, labeled "GROUND" and "ELECTRODE". These are keyed connections; be certain the key is aligned, then push in and twist 1/4 turn right to lock.

F. Plug in the male push-in connector of the clear (white) gas supply line to the receptacle labeled "ARC GAS".

G. If Water Cooling Unit is used, plug in the male push-in connectors to the receptacles on the front of the Cooling Unit. These connectors are interchangeable, and may be reversed without affecting function.

3.5 Weld Head Installation

A. The Weld Head Cable plugs directly into the Adapter Cable.

B. Unscrew the protective dust cap on the Electrical Connector. Connect to the mating connector of the Adapter Cable. After pins are firmly seated, hand tighten the retaining ring.

C. Connect the Ground, Electrode, and Gas Connectors to their respective mating connectors.

3.5,C Continued

Note: The Electrode Cable carries water to the Weld Head, and the Ground Cable returns it to the Cooling Unit. These are keyed quick disconnect fittings: one is male and one is female, to avoid misconnection.

D. After connections are secure and checked, slide the rubber boots together to cover the electrical connections and to hold the Gas Connector in place.

E. The remaining Weld Head set-up instructions are in Section 4.3.

3.6 Remote Pendant Installation (Optional Model 107-RP)

A. Remove the protective dust cap on the Electrical Connector.

B. Insert into mating connector labeled "REMOTE" (PJ-3 on front side of Power Supply). Note the positioning keyway, and NEVER FORCE cable connections. Hand tighten the connecting ring after pins are firmly seated.

3.7 Extension Cable Installation (Optional 107/9-EXT)

A. The Weld Head extension cable is inserted between the 107-4 Power Supply and the Adapter cable.

B. The connector types and keys are different for each item (Adapter, Extension, and Weld Head Cables) and can only be properly hooked up one way.

C. Unscrew the protective dust cap on the Electrical Connector. Insert into mating connector labeled "Weld Head" (on Power Supply front side). Note the positioning keyway, and NEVER FORCE cable connections. Hand tighten the connecting ring after pins are firmly seated.

D. Connect the Ground and Electrode Cables to their respective terminals, labeled "GROUND" and "ELECTRODE". These are keyed connections; be certain the key is aligned, then push in and twist right to lock.

3.7 Continued

E. Plug in the male push-in connector of the clear (white) gas supply line to the receptacle labeled "ARC GAS".

F. If Water Cooling Unit is used, plug in the male push-in connectors to the receptacles on the front of the Cooling Unit. One hose goes to the receptacle labeled "WATER RETURN" and the other hose goes to the receptacle labeled "WATER-OUT".

G. The Weld Head Adapter cable connections that were normally connected to the Power Supply will now connect to the corresponding connectors on the open end of the Extension Cable.

WARNING: When setting up or relocating the Power Supply, take care not to block the Cooling Fans located on the sides of the Power Supply.

3.8 Remote Pendant Extension Cable (Optional Model 107-RPX)

A. The Remote Extension Cable is located between the 107 Power Supply and the Remote Pendant.

B. Remove both end caps of the cable.

C. Insert male connector into connector labeled "Remote" (PJ-3 on front side of Power Supply).

D. Note positioning of keyway, and never force connection. Hand tighten the connecting ring after pins are firmly seated.

E. Insert the Remote Pendant into the female end of the Remote Extension Cable, note 3.8,D.

3.9 Manual Torch "Gas Cooled" (Optional Model 107-MT)

A. The Manual Torch comes equipped to plug directly into the 107 Power Supply or the Extension Cable.

B. Connect the Electrode cable to its respective terminal labeled "Electrode" on the Power Supply. These are keyed connections; be certain the key is aligned, then push in and twist 1/4 turn right to lock.

3.9 Continued

C. Plug in the male push-in connector of the gas supply line to the receptacle labeled "ARC GAS" on the Power Supply.

Note: A separate Ground Cable must be used (optionally supplied), and can be plugged into the Power Supply directly (proper Camlok connector required) or to the Adapter Cable (proper connector required).

3.10 Manual Torch "Water Cooled" (Optional 107-MTW)

A. The Manual Torch comes equipped to plug directly into the Model 107 Adapter Cable.

B. Connect the Electrode, Gas, and Water connections to their respective mating connectors.

Note: The Electrode Cable carries water to the Weld Head, and the Return connector returns it to the Cooling Unit. These are quick disconnects; one is male and one is female, to prevent misconnection.

C. Slide the rubber boots together to cover the electrical connection and to hold the gas connector in place.

D. A separate Ground Cable must be used (optionally supplied), and can be plugged into the Power Supply directly (proper Camlok connector required) or to the Adapter Cable (proper connector required).

3.11 Manual Torch Foot Pedal Control (Optional Model 107-MC)

A. The Foot Pedal Control plugs directly into the "REMOTE" electrical connector on the Power Supply (PJ-3) or to a Remote Pendant Extension Cable.

B. See Section 6.2 for operating instructions.

3.12 Manual Torch Foot Switch (Optional Model 107-FS)

A. The Foot Switch plugs directly into the "Remote" electrical connector on the Power Supply (PJ-3) or to a Remote Pendant Extension Cable.

IV. OPERATION

4.0 General

A. Before proceeding with a description of the Model 107-4 Power Supply controls and initial operation, it is important to understand what this Welding System actually does, and the sequence that it follows.

When the Welding Operation is started by the Operator, the following sequence will occur automatically (ref. Figure 4):

GAS FLOW (Pre-Purge)
ARC START
WELD CURRENT (with Pulsation)
ARC ROTATION (with Delay)
DOWNSLOPE
POST-PURGE
ROTATION RETURN

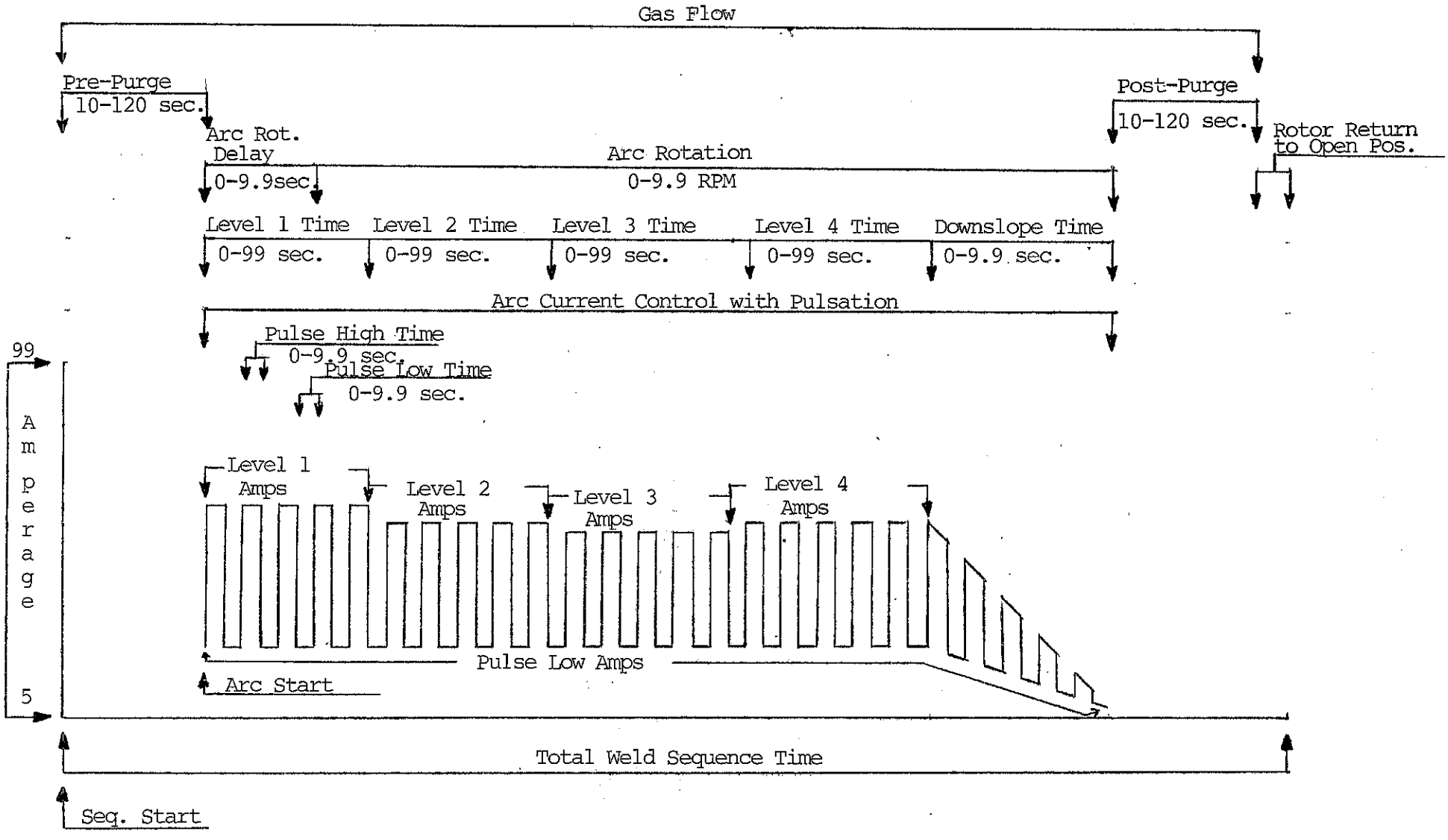
A more detailed description of each separate step follows below.

1. GAS FLOW - Welding gas will start flowing from the gas source (user supplied) through the Power Supply to the Tube Weld Head Gas Chamber. Gas will continue to flow for the entire welding operation. However the length of time it flows until the next step of the sequence is called PRE-PURGE and is set at the Power Supply prior to welding (10 to 120 seconds).

2. ARC START - A high frequency pulse will be used by the Power Supply to start an arc in the Weld Head Gas Chamber between the Tungsten Electrode and the metal to be welded.

3. WELDING CURRENT - When the arc is created, the arc current (amperage) will rise to whatever "LEVEL" has been set at the Power Supply prior to welding.

Note: The Current Control goes hand-in-hand with the Timing and Pulsation functions mentioned in the Introduction (Section 1.0). Further information on the Current Control options, Pulsation and Timing (weld duration) will be in Section 4.1.



MODEL 107-4 POWER SUPPLY WELD SEQUENCE

ARC MACHINES INC.

8 Dec. 1982
Rev. 30 Nov. 1983

FIGURE 4

4.0,A Continued

4. ARC ROTATION - The arc created in the Tube Weld Head will be rotated around the tube to be welded. This is done by rotating the Tungsten Electrode with a motor located in the Head. (The tube to be welded and the Weld Head itself remain stationary). This rotation will begin after the arc is created (also see Rotation Delay, Section 4.1,F and Rotation Synchro, Section 4.1,G) and the speed will be set at the Power Supply in "RPM" (revolutions per minute).

5. DOWNSLOPE - When the weld is complete, the arc current will decrease to less than 5 amperes and the arc will go out. The length of time this takes is call "DOWNSLOPE" and is set at the Power Supply before welding.

6. POST-PURGE - When the arc goes out, the welding gas will continue to flow. The length of time it flows is set at the Power Supply and is called "POST-PURGE".

7. ROTATION RETURN - After the POST-PURGE gas flow has ended, the Power Supply will move the Tungsten Electrode Rotor to the open position so the Weld Head can be removed from the material that was welded.

4.1 Welding Sequence Control Panel Switches

A. The following steps describe the switches and controls that set the values for each function of the welding sequence described in Section 4.0. All the welding sequence controls are located on the main control panel (Figure 5). These controls must all be set prior to the welding operation, and their values determine what the power supply does during the automatic sequence.

B. PRE-PURGE Selector Switch - This 5-position rotary switch controls the time (10, 20, 30, 60, 120 seconds) the arc gas flows into the purge chamber within the Weld Head before an arc is established. The yellow LED above the switch glows when PRE-PURGE is active.

4.1 Continued

C. POST-PURGE Selector Switch - This 5-position rotary switch controls the time (10, 20, 30, 60, 120 seconds) the arc gas continues to flow in the purge chamber after the arc has gone out. The yellow LED above the switch glows when POST-PURGE is active.

D. ROTATION ON/OFF Switch - In the "ON" position, this switch enables rotation of the Tungsten. In the "OFF" position, it stops Tungsten rotation. The green LED above the switch glows when in the "ON" position.

E. R.P.M. Switch - This digital thumbwheel switch sets the Tungsten rotation speed in revolutions per minute. The yellow LED next to the switch glows when Tungsten is rotating.

F. ROTATION DELAY Switch - This digital thumbwheel switch sets the amount of time (0 to 9.9 seconds) that the Tungsten rotation will delay after the arc has been started (used to achieve weld penetration). The yellow LED next to the switch glows when this function is active.

G. SYNCHRO ON/OFF Switch - In the "ON" position, this switch turns on the arc rotation SYNCHRO (see SYNCHRO LOW/HIGH Switch). In the "OFF" position, the arc rotation speed is exactly what the RPM switch is set at.

H. SYNCHRO LOW/HIGH Switch - With PULSATION ON (see PULSATION Switch) and SYNCHRO ON, this switch allows arc rotation only during PULSE LOW time ("LOW" position of switch) or during PULSE HIGH time ("HIGH" position of switch).

I. LEVEL 1, 2, 3, and 4 AMPS Switch]
LEVEL 1, 2, 3, and 4 TIME Switch]

After the arc is started, the Power Supply will control the arc current to the amount (5-99 amps) set in the LEVEL 1 AMPS Switch. The current will be controlled at this amount for the length of time (0-99 seconds) set in the LEVEL 1 TIME Switch (time starts counting at arc start). When the LEVEL I TIME has elapsed, the Power Supply will automatically change the arc current to the setting of the LEVEL 2 AMPS Switch and maintain this current the length of time set in the LEVEL 2 TIME Switch (starts counting when

4.1,I Continued

LEVEL 1 TIME is complete). This process continues through LEVEL 4 AMPS and LEVEL 4 TIME. When LEVEL 4 TIME is complete, the DOWNSLOPE will begin. The yellow LED next to each switch will glow when that switch is active.

J. PULSATION ON/OFF Switch - Turns on the PULSE HIGH TIME Switch, PULSE LOW TIME Switch, PULSE LOW AMPS Switch, and the ROTATION SYNCHRO Timing signal. A LED above the switch glows when this switch is in the "ON" position.

K. PULSE LOW AMPS Switch]
PULSE HIGH TIME Switch]
PULSE LOW TIME Switch]

When turned on by the Pulsation ON/OFF Switch, these switches control how fast the Power Supply will PULSE (change back and forth) the arc current from the LEVEL AMPS to the value of the PULSE LOW AMPS Switch. When the PULSE HIGH TIME Switch is active (LED glowing), the arc current will be the value of the LEVEL 1, 2, 3, or 4 AMPS Switch (depending on which switch is active). When the PULSE LOW TIME Switch is active (LED glowing), the arc current will be the value of the PULSE LOW AMPS Switch.

Note: Do not set these switches to 0.0.

L. DOWNSLOPE TIME Switch - This digital thumbwheel switch sets the amount of time (0 to 9.9 seconds) for the arc current to reduce from LEVEL 4 AMPS setting down to Zero. The yellow LED next to the switch glows when this function is active.

4.2 Control Panel Indicators and Set-Up Switches

A. The following switches and indicators are used for set-up or status indicators and do not determine what happens during the welding cycle.

B. ROTATION JOG Switch - This 3-position switch allows manual FORWARD/REVERSE rotation of the Weld Head Tungsten Electrode. The speed that it rotates will be the same as set on the "RPM" Switch.

4.2 Continued

C. SEQUENCE START Switch - This lighted momentary ON pushbutton starts the welding operation. The button will glow green when in the ON position, indicating the welding operation is in progress.

D. SEQUENCE STOP Switch - This lighted momentary ON pushbutton manually terminates the weld program and starts the POST-PURGE TIMER. The button will glow white in the ON or active position.

E. PURGE MANUAL Switch - This lighted pushbutton, in the "ON" position, permits a continuous arc gas flow into the Gas Chamber of the Weld Head. This button will glow yellow when active.

F. THERMAL LOCK-OUT INDICATOR - This red LED, when lit, indicates that the heat sink or the transformer is too hot and that SEQUENCE START is inhibited.

G. WELD/TEST RUN Switch - This 2-position locking lever switch, in the "TEST RUN" position, allows all functions to be exercised without initiating an arc. In the "WELD" position, the system will deliver weld current to the torch at whatever program value is selected upon initiation of SEQUENCE START.

H. Meters - These three panel meters respectively indicate the arc current, the voltage between the Tungsten and the work, and the Weld Head rotor RPM.

I. REMOTE PENDANT Switches (Optional) - When the Remote Pendant is connected, all the switches on the Pendant and their duplicates on the control panel are functional (SEQUENCE START, SEQUENCE STOP, MANUAL PURGE, ROTATION JOG). The only exception is the TEST RUN/ WELD Switch. Both switches (panel and pendant) must be in the WELD position in order to strike an arc.

4.3 Tube Weld Heat Set-Up

A. After connection of the Tube Weld Head to the Power Supply (Section 3.0), the following must be selected and installed.

4.3 Continued

B. Tube Clamp Inserts - The beryllium copper Tube Clamp Inserts are made to grip a nominal diameter tube and will flex sufficiently to accommodate approximate tube O.D. tolerance of:

+/-0.006 in. for tubes 0.50 in. dia. or less, increasing to:

+/-0.010 in. for 1.500 in. and larger dia. tubes.

An oversize out-of-tolerance tube can not be clamped without damaging the Head. The Clamp Inserts are designed with a positive stop to prevent permanent deformation of the flexible fingers in case an attempt is made to use oversize tubes.

C. Tube Clamp Insert Installation - Measure the tube or pipe O.D. for the proper Clamp Inserts (Figure 6, Item 4).

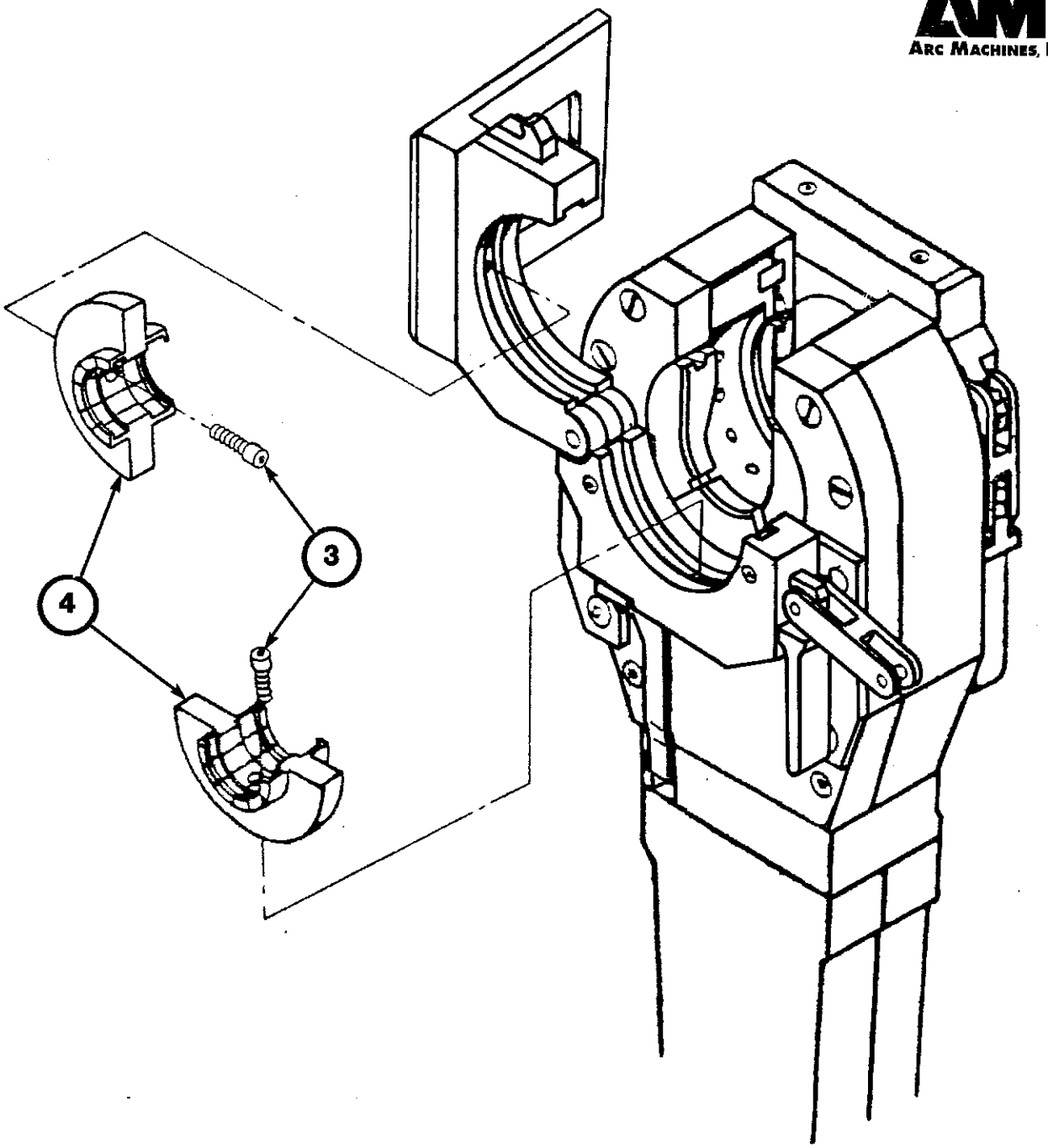
Unlatch the Clamp Insert Housing Assemblies and open the Housings.

Install the proper Clamp Inserts into the Clamp Insert Housings and secure with the socket-head screw (Figure 6, Item 3).

D. Auto Fitting (AF) Clamp Insert Installation - Weld Heads designated 9AF-XXXX are designed to weld tube-to-tube and tube-to-auto butt weld fittings (Cajon, Parker-Hannifin, etc.). For tube-to-tube applications, the Clamp Insert installation is the same as Step 4.3,C.

Model 9 auto fitting Weld Heads have an off-set Tungsten that allows precise alignment to the short auto butt weld fittings.

When welding fittings-to-tubes, only one set of Tube Clamp Inserts is required. One set of Fitting Clamp Inserts is also required. The Fitting Clamp Inserts mount on the Weld Head Clamp Housing closest to the Electrode. Actual installation is the same as Step 4.3,C. When properly installed, the Fitting Clamp Inserts clamping area will actually be recessed into the Weld Head slightly (amount depends on the type of Fitting Clamp Insert).



INSTALL CLAMP INSERTS (4) WITH SCREWS (3).

FIGURE 6

4.3 Continued

E. Electrode Preparation - The length and shape of the Tungsten Electrode is as important as any step in the welding operation. The Tungsten must be sized (length) for the size of the Model 9 series Weld Head and the size of the tube, pipe, or fitting being welded in that Head. The Tungsten shape must also be within certain parameters, but most importantly, replacement Tungstens must be of the same shape and size as the one previously used. This will help to ensure that the Power Supply settings make the same quality weld every time.

F. Tungsten Shape and Size - Use the following procedure for all Tungstens used in the Model 9 series Tube Weld Heads (ref. Figure 7):

1. Material - Tungsten - 2% thorium oxide, ground finish.

2. Diameter - 1/16 in. or 3/32 in.

3. Tip - Grind to a 18 degree taper included angle with a 0.010 in. to 0.030 in. blunt tip before cutting to length.

4. Length - The length of the Tungsten is determined by the outside diameter (O.D.) of the Weld Head Rotor,* the outside diameter of the tube being welded, and the amount of arc gap desired. Use the following formula to determine this:

Rotor O.D.* minus Tube O.D. divided by 2 minus the desired arc gap.

$$\frac{\text{Rotor O.D.* - Tube O.D.}}{2} - \text{Arc Gap} = \text{Tungsten Length}$$

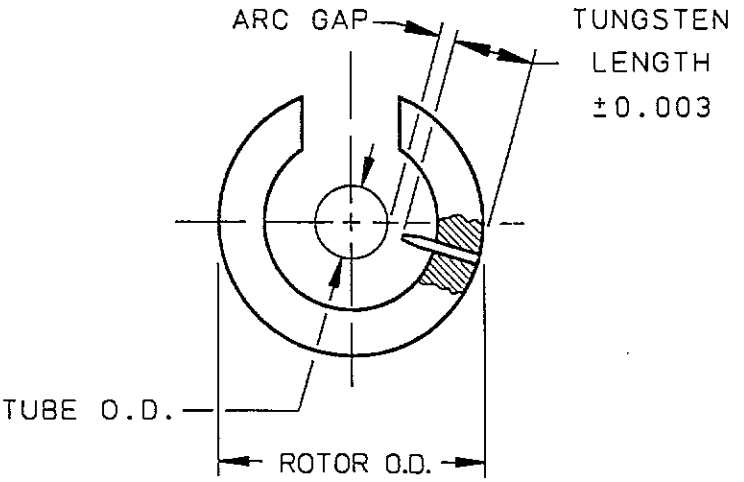
*O.D. for various heads are listed on Fig. 7.

Note: Length, tip, and taper are critical for reproducible results.

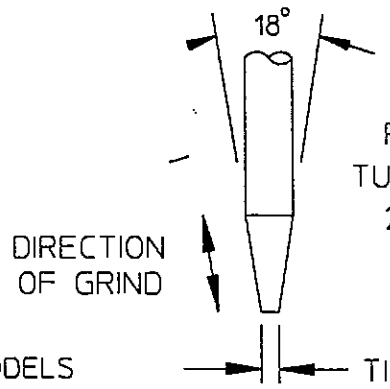
MODEL 9 ELECTRODE DIMENSIONS

ROTOR DIAMETER	
MODEL NO.	ROTOR O.D
9-250	0.802
9-500	1.388
9AF-750	2.000
9AFM-750	1.312
9-900 INACTIVE	2.000
9/AF-900	1.875
9-1500	3.187
9AF-1500	2.252
9E-1500	2.687
8-2000	3.450
9-2500	4.380
9AF-2500	3.156
9E-2500	4.280
* 9-3500	5.380
9E-3500	5.310
8-4000	5.310
* 9-4500	6.875
9E-4500	6.280
* 9-7500	10.440
9E-7500	9.375
* FOR AF HEADS USING OPTIONAL TUNGSTEN EXTENDER, SEE PAGE 2.	

$$\frac{\text{ROTOR O.D.} - \text{TUBE O.D.}}{2} - \text{ARC GAP} = \text{TUNGSTEN LENGTH}$$



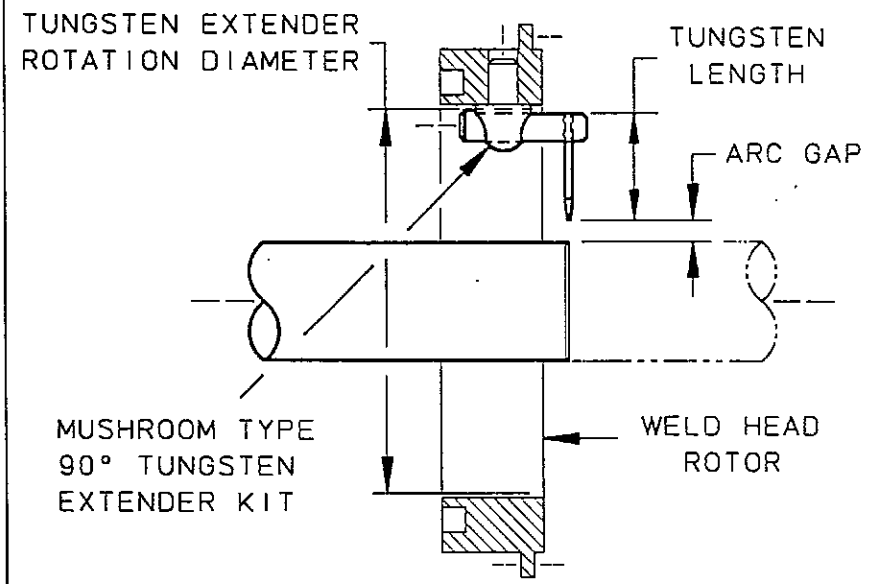
TUBE/PIPE WALL THICKNESS	RECOMMENDED ARC GAP	RECOMMENDED TIP DIA.
0.020/0.035	0.030	0.020
0.049/0.085	0.050	0.030
0.091/0.154	0.070	0.040

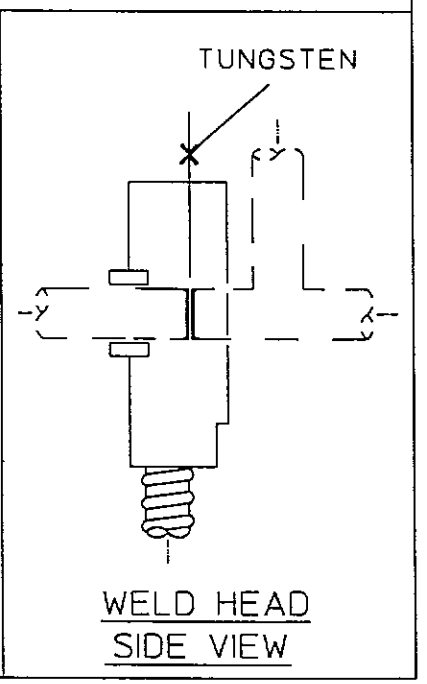


NOTES:
1. RECOMMENDED ARC GAP FOR MODELS 9-250 & 9-500 IS 0.045 MAXIMUM.
2. IN INSTANCES WHERE OUT-OF-ROUNDNESS ON THIN-WALLED TUBING OCCURS (NORMALLY 2.500 O.D. OR LARGER), A 0.070 ARC GAP IS RECOMMENDED.
3. DIMENSIONS ARE IN INCHES.

TUNGSTEN LENGTH CALCULATION FOR TUNGSTEN EXTENDERS

$$\frac{\text{EXT. ROTATION DIA} - \text{TUBE O.D.}}{2} - \text{ARC GAP} = \text{TUNGSTEN LENGTH} \pm 0.003$$





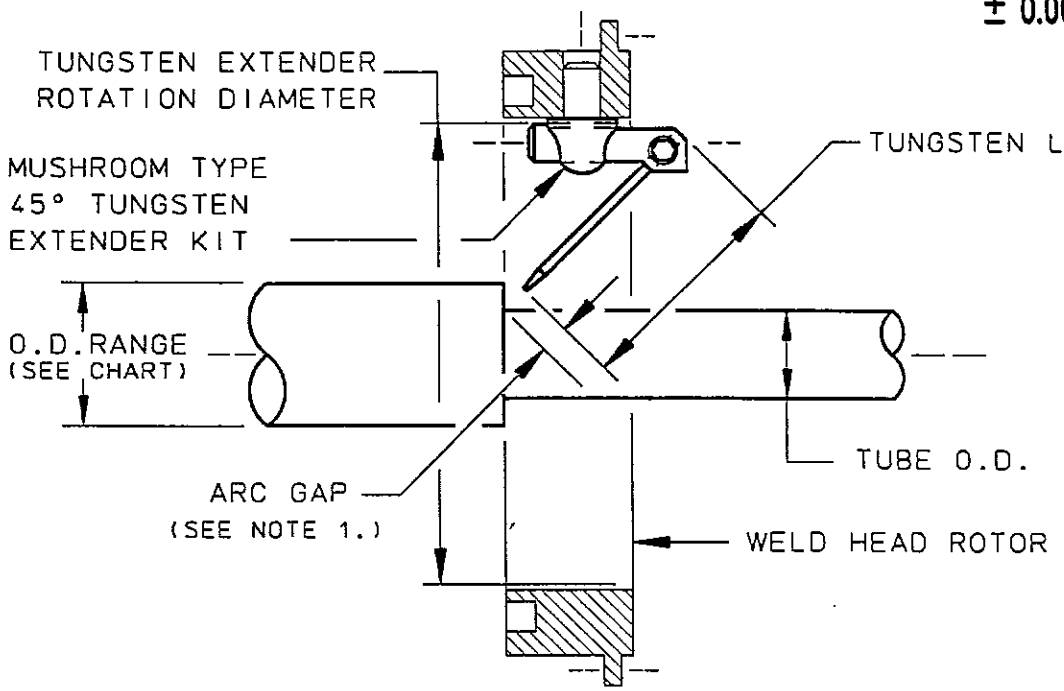
WELD HEAD MODEL NO.	KIT WITH 1/16 TUNGSTEN HOLDER PART NO.	KIT WITH 3/32 TUNGSTEN HOLDER PART NO.	TUNGSTEN EXTENDER ROTATION DIA.
9-1500	13090796-01	13090796-02	2.031
9-2500	13090796-05	13090796-06	3.156
9-3500	13090796-05	13090796-06	4.031
9-4500	13090796-03	13090796-04	4.920
9-7500	13090796-05	13090796-06	8.280

NOTES:

1. PART NUMBERS SHOWN ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.
2. CONTACT AMI SALES OR SERVICES FOR SPECIFIC PART NUMBER.

TUNGSTEN LENGTH CALCULATION FOR 45° SOCKET WELD EXTENDERS

$$\frac{\text{EXT. ROTATION DIA} - \text{TUBE O.D.}}{2} \times 1.414 - \text{ARC GAP} = \text{TUNGSTEN LENGTH} \pm 0.003$$



MODEL NO.	TUNGSTEN EXTENDER ROTATION DIAMETER	O.D. RANGE	
		MIN	MAX
MODEL 9-1500 45° EXTENDER P/N 13090796-10	1.932	0.250	0.750
MODEL 9-2500 45° EXTENDER P/N 13090796-11	3.057	0.750	1.870
MODEL 9-3500 45° EXTENDER P/N 13090796-11	4.000	1.000	2.790
MODEL 9-4500 45° EXTENDER P/N 13090796-11	5.000	1.500	3.790
MODEL 9-7500 45° EXTENDER P/N 13090796-11	8.250	4.615	7.040
MODEL 9-7500 45° EXTENDER P/N 13090796-13	6.510	2.875	5.300

NOTES:

1. ALIGNMENT TOOLING WILL BE REQUIRED FOR SPECIFIC APPLICATIONS.
2. PART NUMBERS SHOWN ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE.
3. CONTACT AMI SALES OR SERVICES FOR SPECIFIC PART NUMBER.

4.3,F Continued

The degree of taper also affects weld penetration; decreasing the included angle of the Electrode taper tends to reduce the width of the weld bead and increase weld penetration.

The Electrode should be properly cut and ground. Improper breaking may cause a jagged end or a bent or split Electrode which usually results in a poorly shaped arc and Electrode overheating. Electrodes should be carefully handled and kept as clean as possible. Inconsistent Electrode length will result in inconsistent welds due to the resulting arc gap variations.

Arc Gap - rule of thumb:

Use 0.030 in. to 0.050 in. for thin wall tube (0.020 in. to 0.090 in.).

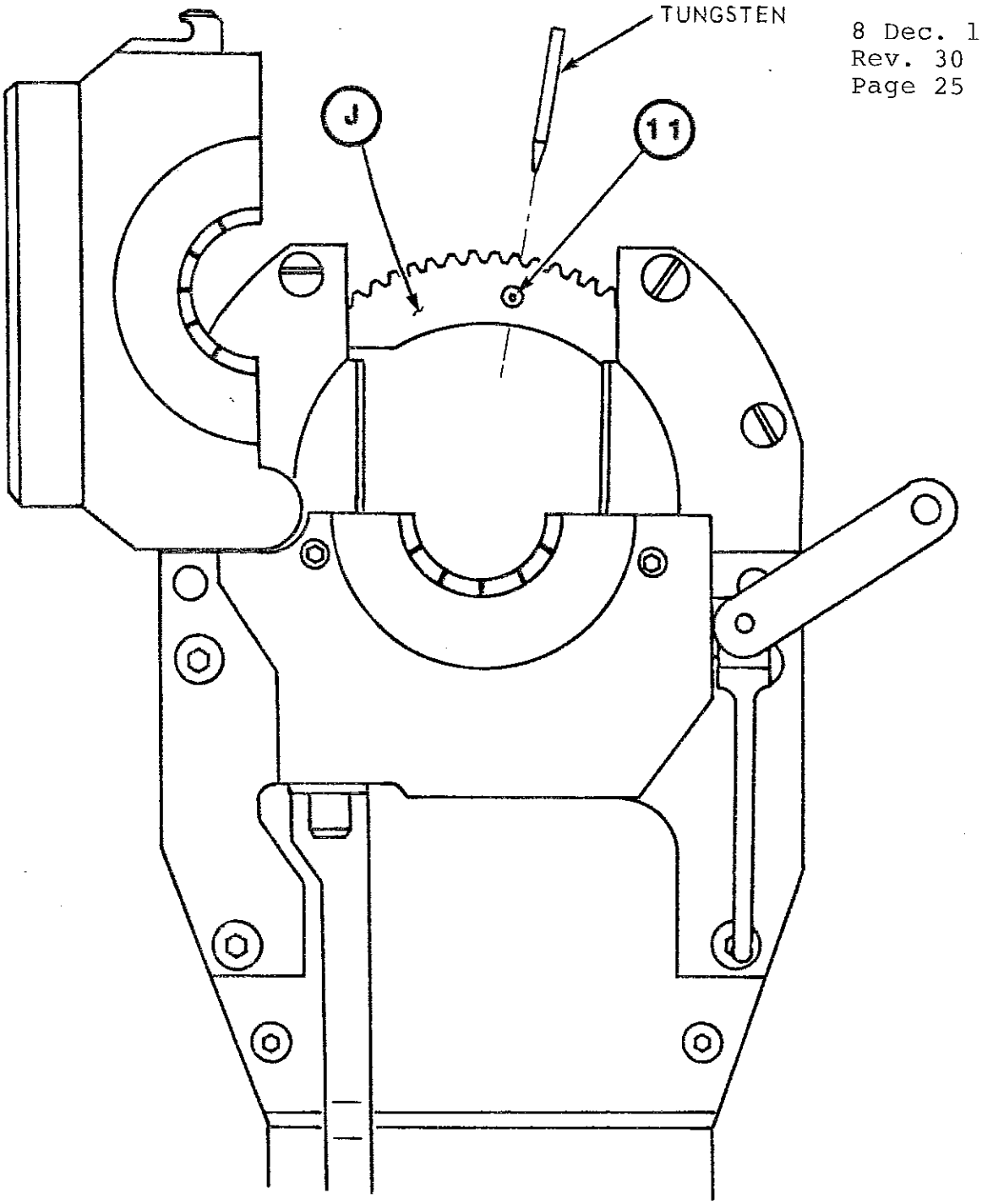
Use 0.060 in. to 0.080 in. for heavy wall tube (0.100 in. to 0.160 in.).

G. Electrode Installation

The Weld Head Cable must be attached to the Power Supply, and the power must be on.* Set the TEST RUN Switch to the TEST RUN position. Rotate the electrode gear (Figure 8, Item 1) by using the JOG FWD/REV Switch until the Electrode mounting hole (either 1/16 in. or 3/32 in. diameter) is accessible through the top opening in the Weld Head. Loosen the set screw on the side of the Rotor (Figure 8, Item 2).

Insert a suitably prepared Electrode (Section 4.3) into the Electrode mounting hole, flush with the outside of the gear. Tighten the set screw with an Allen Wrench just enough to prevent the Electrode from dropping out. Check the position: use a straight edge ruler to check if flush with the top of the socket. Now tighten socket head screw firmly but without excessive force; that can fracture the Electrode.

Note: If during operation an Electrode becomes loose, it may fuse to the pipe or drop into the gear train. Observe what has happened if this problem arises to avoid damage to the Weld Head during removal from the pipe. An Electrode



A. JOG ROTOR (J) AROUND UNTIL TUNGSTEN SET SCREW (11) IS EXPOSED, AND LOOSEN SET SCREW.

B. INSTALL TUNGSTEN TO CORRECT ARC GAP AND TIGHTEN TUNGSTEN SET SCREW (11).

FIGURE 8

4.3,G Continued

lost in the gear train should not damage the mechanism but may cause gears to jam.

Rotate the Electrode gear back to the OPEN position by using the JOG FWD/REV Switch and you are ready to weld. As a double check, it is advisable to visually check the arc gap to make sure that it is approximately correct.

The Tungsten Electrode should be free of any oxides or contamination.

* - If performing initial installation of Power Supply, read and perform Section 4.6 before installing Tungsten and/or welding material (Section 4.4 and 4.5).

4.4 Preparation of Weld Joint

A. The joint to be welded must meet certain minimum requirements:

1. Cut square to tube axis within +/-0 degrees 15-foot maximum.

2. Burr-free.

3. Wall thickness variation in the weld zone to be +/-5% maximum of nominal.

4. When the two tube ends are butted together for welding, any gap must be less than 5% of wall thickness.

5. Cleaned of all scale, rust, grinding compound, oil, grease, paint, or other contaminants.

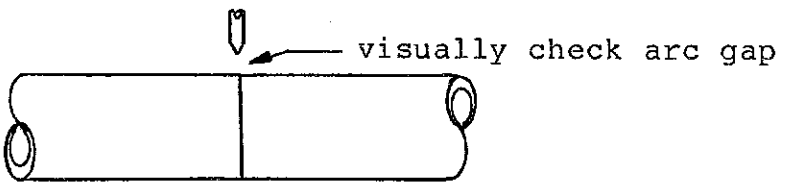
B. Tube and pipe end prep tooling is suggested. Further details on weld preparation will be found in Section 4.9 (Welding Operation) as part of the Weld Schedule Sheet, and weld preparation is also discussed in Section 6.0 (Weld Development).

4.5 Weld Head Installation to Weld Joint - (Ref. Figure 9)

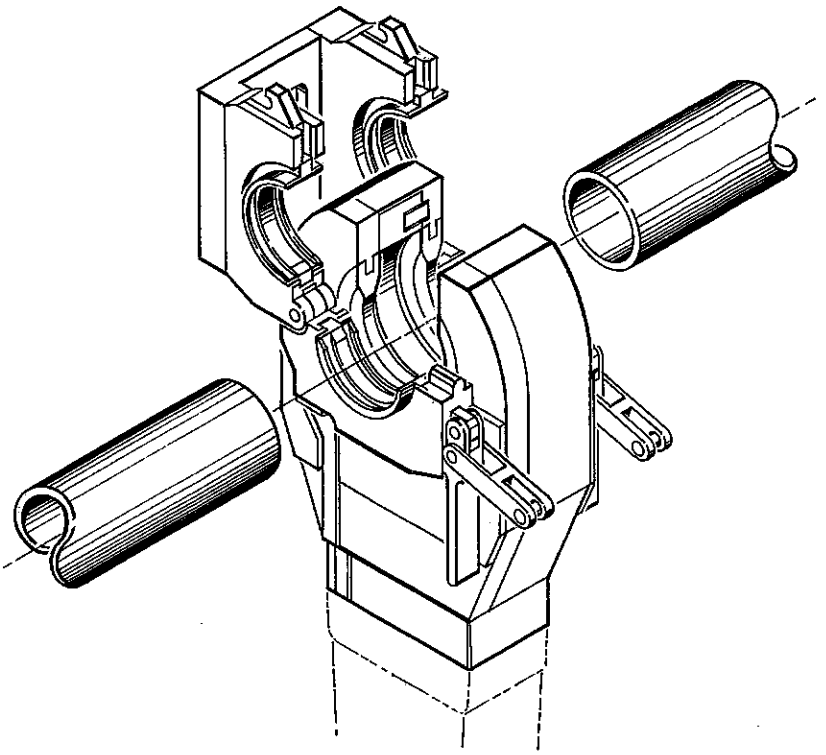
CAUTION: DO NOT USE THE WELD HEAD AS AN ALIGNMENT TOOL TO FIT UP THE TUBE TO BE WELDED.

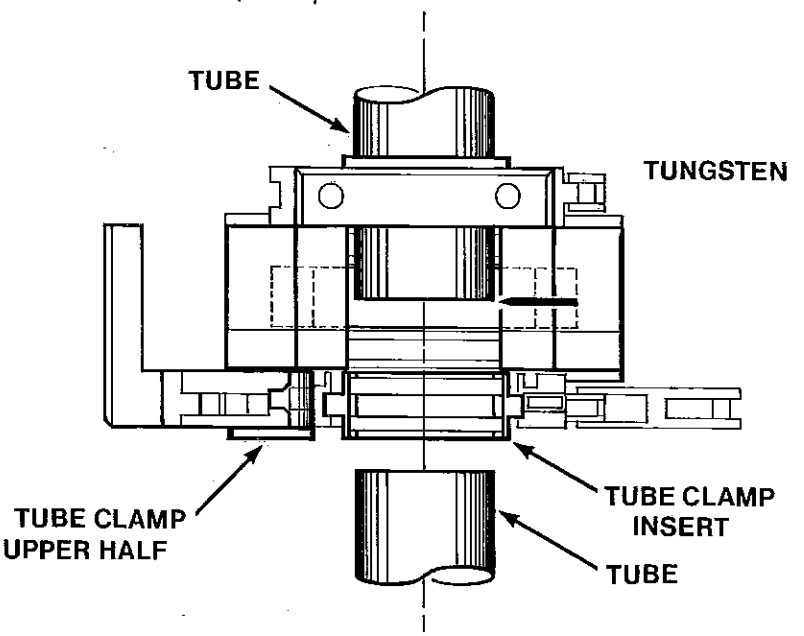
Note: To install any Model 9 Weld Head to the weld joint, the Electrode gear must be in the OPEN position. With the power on, set the WELD/TEST RUN Switch to the "TEST RUN" position. Use the JOG FWD/REV Switch to rotate the gear to the OPEN position.

To install the Weld Head to the weld joint, open both sides of the Clamp Insert Housings on the Weld Head and mount the weld joint. Close the side of the Clamp Insert without the clear plastic viewport and hook the latch mechanism. Visually align the weld joint with the Electrode centerline. Clamp the tube in place. Insert the opposite end of the tube to be welded into the opposing side of the Welding Head. Press the two ends firmly together and clamp the tube in place. Recheck the Tungsten alignment to joint. It should look like this:



Visual inspection of Electrode-to-joint alignment is possible after the Head is applied to the joint to be welded, through the clear viewport.





TOP VIEW

Align tube end to tungsten and latch, then butt other tube firmly against the tube in position and latch other side. Latch short closure first.

FIGURE 9

4.6 Auto Fitting (AF) Weld Head Installation

Note: This step applies only to Weld Heads designated 9AF-XXXX.

To install the Weld to a fitting and tube, open both sides of the Clamp Insert Housings on the Weld Head. Place the fitting to be welded into the lower Fitting Clamp Insert (see Section 4.3,D). The alignment rib on the fitting goes into the groove cut in the Fitting Clamp Insert. Close the top housing over the fitting and hook the latch mechanism. Visual alignment of the tube end and the Tungsten is not necessary. The design of the Insert and the offset Rotor automatically position the fitting end with the Tungsten. Insert the opposite end of the tube to be welded into the opposite side of the Welding Head. Press the tube ends together firmly and clamp the tube in place.

4.7 Initial Operation

The following steps should be followed to check the Model 107-4 Power Supply for proper operation:

A. Ensure circuit breaker CB1 is off.

B. Install all Hoses, Cables, Heads and Pendants per installation instruction (Section 3).

C. Set the WELD/TEST RUN switch to the "TEST RUN" position (if using Remote Pendant, set both switches).

D. Set ROTATION ON/OFF switch to "ON".

E. Set SYNCHRO ON/OFF switch to "OFF".

F. Set SYNCHRO HIGH/LOW switch to "HIGH".

G. Set RPM switch to "1.0" RPM.

H. Set ROTATION DELAY switch to "00" seconds.

I. Set POST-PURGE switch to "10".

J. Set PRE-PURGE switch to "10".

K. Set PULSATION switch to "OFF".

L. Set PULSE HIGH TIME to "1.0" seconds.

4.7 Continued

M. Set PULSE LOW TIME to "1.0" seconds.

N. Set PULSE LOW AMPS to "10" amperes.

O. Set LEVEL 1, 2, 3 and 4 AMPS to "50" amperes.

P. Set LEVEL TIME 1, 2, 3 and 4 switches to "15" seconds each (total of 60 seconds).

Q. Set DOWNSLOPE TIME switch to "0.0".

R. Put Weld Head in a secure position (hand-held is O.K.) with top (Rotor and Clamps) "UP". Keep hands and objects out of Weld Head Rotor area.

S. Turn circuit breaker CB1 to the "ON" position.

T. Move JOG switch to "FORWARD" and "REVERSE" positions. The Weld Head Rotor should move.

U. Perform Tungsten and Tube Clamp Insert installation procedure (Section 4.3).

V. Depress SEQUENCE START switch.

W. System should follow the sequence described in Section 4.0 except there should be no arc. (In "TEST RUN" position this does not occur).

X. If all functions of all steps are working, the Head is now ready to be calibrated and welding operations started.

Y. If using Cooling Unit, turn to "ON" position and check for water flow. This can be done by pinching a water line (gently) and listening for the pump to change tone.

4.8 Weld Head Rotation Calibration

A. Set the Control Panel switches the same as in Section 4.7,A through S.

B. Set Electrode Rotor gear to the "OPEN" position, using the JOG switch.

C. Depress SEQUENCE START switch.

4.8 Continued

D. The Rotor will move one (1) revolution and then stop. If it does not, note how short or long it is. (When POST-PURGE TIME is complete, Rotor will move to the "OPEN" position automatically). If the gear travels more or less than one revolution, calibration is required.

E. The calibration adjustment is located on the Weld Head. Turn the speed adjustment screw clockwise to increase speed (Rotor ended up short of one revolution) and counterclockwise to reduce speed (Rotor ended up past one revolution).

F. Perform Steps C, D, and E after each adjustment until a repeatable one revolution is obtained.

G. Once the Model 107-4 Power Supply and Tube Weld Head is put in production, the revolution calibration does not need to be checked before every use.

Note: However, for proper operation, Weld Heads must be calibrated to the Power Supply it is connected to. If Weld Heads are switched to a different Power Supply, they must be re-calibrated to that Power Supply.

4.9 Welding Operation

A. The operator's responsibility is to use switch settings for the Model 107-4 Power Supply that have already been determined for a particular weld (pipe size, wall thickness, and material).

B. These switch settings should be written on a Weld Schedule sheet (reference Figure 5) with all the switch settings and welding data (Tungsten size, shape, Gas flow, etc.,) included.

C. Actual welding should be done as follows:

1. Set all Panel switches to the same settings stated on the Weld Schedule sheet for the weld to be performed (Figure 5).

2. Set up material to be welded, Tungsten, and Gas as described on the Weld Schedule sheet.

4.9,C Continued

3. Install material to be welded per instructions in Section 4.5.

4. Set WELD/TEST RUN switch to "WELD" position (if using Remote Pendant, set both switches to "WELD" position).

5. Turn on Gas source.

6. Depress MANUAL PURGE; check flow rate and clear lines for a few seconds.

7. Turn MANUAL PURGE "OFF".

8. Depress SEQUENCE START switch.

9. Wait until Weld Sequence is complete and Rotor returns to "OPEN" position.

10. Remove Weld Head from tube.

WARNING: The welding arc emits ultra-violet radiation and the molten weld gives off infra-red. Both can burn the eyes and skin. Suitable eye and skin protection must be worn. Operator should avoid physical contact with the Electrode during this period, since a shock hazard does exist. Common sense procedures must be followed for personal protection and operating efficiency.

4.10 Manual Welding

See Section 3, Figures 3A and 3B for parts and installation.

While the 107 Power Supply is designed for automatic fusion welding, it can also double as a hand TIG welding system.

In operation, the Model 107-4 can operate in several different ways. When using the Manual Torch, we recommend that the Rotation Control Switch be turned to the "OFF" position.

A. With the Pulsation Switch "OFF", and the level timers set to their maximum time of 99 seconds each, the operation of the Model 107-4 and Manual Torch is very similar to that of a standard manual welding power supply. First, check arc gas flow by actuating the manual purge button on the control panel (usually set to 15 to 20 CFH). Then the "WELD/TEST RUN" switch is put in the "WELD" position. Stepping down on the foot control initiates Pre-Purge. The minimum Pre-Purge time in the machine is 10 seconds, to permit arc gas to flow prior to initiation of the arc. Following Pre-Purge, the arc will strike automatically and the Power Supply will supply welding current up to the maximum dialed into the Level I, II, III and IV amperage controls. If the amperage controls are set lower than the 99 amps maximum, then the highest current available will be what is dialed in, regardless of how far down the pedal is depressed. Please note that the amperage dials can be turned while the Power Supply is in operation to assist the welder in determining the maximum current required to penetrate the material, without over-penetration. At the end of the weld, the welder eases up on the foot control to Downslope the weld and prevent cratering. When the foot pedal is released, the unit will go into Post-Purge. Alternatively, if the maximum time dialed into the timers times out, the unit will automatically Downslope, if Downslope time is dialed into the unit. If Downslope time is not dialed in, the arc will extinguish and the unit will go to the Post-Purge time.

4.10 Continued

B. With the Pulsation Switch "ON", and time dialed into "Pulse High Time" and "Pulse Low Time", the Power Supply will pulse between the Level Amperage and the Low Amperage. Manipulating the foot pedal will vary both the Level Amperage and the Low Amperage.

C. The last method of use of the Model 107-4 and the Manual Torch is its ability to run a short program, similar to a tube weld program, but using the Manual Torch. If the problem is to weld or to tack two thin pieces of material together, the Power Supply can be set to a pulsed weld program of limited amperage and perhaps 4 seconds duration. The welder initiates the weld by stepping down on the pedal and holding it down. The control over the weld is done by the Power Supply which will Pre-Purge, initiate the arc, pulse between a level current and a background current, Downslope and Post-Purge. The welder holds the Torch with the tungsten at an appropriate gap, pointed at the weld joint. This method permits the welder to tack thin material without blowing a hole, or overpenetrating.

V. MAINTENANCE INSTRUCTIONS

-- CAUTION --

Always disconnect the AC Power Cable from the line voltage before attempting to work with this Welding Power Supply.

5.0 Air Filter - The Model 107-4 Power Supply uses two (2) foam air filters. Inspect air filters regularly. The foam filters may be washed in water and detergent, dried and reused or replaced. Do not operate unit without filters in place. The same procedure is used for the 107-CW (Cooling Unit) air filter.

5.1 Coolant - The water tank in the optional 107-CW Unit holds approximately three (3) U.S. gallons. Check water level periodically (reference Section 3.2,B). Using different Weld Heads will remove water from tank over a period of time. Fill the tank with a water/antifreeze mixture.

Be sure the antifreeze has NO LEAK-STOPPING ADDITIVES.

Note: Do not turn Power Switch on the 107-CW "ON" without water in the tank, as this may damage the water pump.

5.2 Cleaning Exterior and Interior Surfaces.

Always disconnect the Power Input Cable from the junction box or wall-plug before cleaning.

After prolonged use in dusty shop or outside environments, the parts and surfaces inside the machine may accumulate a coating of dust. Do not use shop air to blow dust particles away from the program panel. Either wipe it off with a damp cloth or use a vacuum cleaner. Where a vacuum brush can not reach, use a clean paint brush and then vacuum.

DO NOT USE ANY SOLVENTS, SPRAY-ON CLEANERS OR WATER on any of the inside parts.

5.2 Continued

If a solvent is required, use only Isopropanol. All other outside surfaces may be cleaned with a soft cloth or sponge, damp, NOT SOAKED, with a mild detergent solution.

5.3 Front Panel Connections

Periodic inspection of the Electrode, Gas and Water return quick-disconnects should be performed. Damaged, dented or deformed connectors may result in Water or Gas leakage: the "O" ring inside the Electrode connector and the Gas and Water connectors should be periodically cleaned and re-greased.

5.4 Water Cooling Unit

For proper operation of the water pump, the manufacturer recommends adding oil (a few drops), SAE #20 Non-Detergent Oil, every three months.

5.5 Safety Precautions

WARNING: The welding arc emits ultra-violet radiation and the molten weld gives off infrared. Both can burn the eyes and skin. Suitable eye and skin protection must be worn. Operator should avoid physical contact with the Electrode during this period since a shock hazard does exist. Common sense procedures must be followed for personal protection and operating efficiency.

5.6 DO'S AND DON'TS

The following listings provide a check list for operating personnel to ensure minimum down time.

DO'S

1. Check all cable and quick-disconnect fittings to ensure proper seating and that the protective boots are in place.

2. Check for Gas leaks on all external Gas fittings.

3. Keep Weld Head in shipping container when not in use.

5.6 Continued

4. Keep protective covers on the motor cable connectors when not in use.

5. Ensure that the proper Electrode is installed in the Weld Head.

DON'TS

1. Don't grind near the Weld Head or Power Supply without protecting them.

2. Don't use acid or other corrosives on or near the Weld Head.

3. Don't attempt to weld without a secure Work (ground) connection.

4. Don't attempt to weld without a mechanically cleaned contact area between tubes.

5. Don't drop the Weld Head, Remote Pendant, or Cables.

6. Don't restrict the intake or exhaust air flow to the Power Supply or Water Cooling Unit.

7. Don't route Cables where they will be subject to damage from traffic or equipment.

8. Don't expose the Weld Head, Cable, Pendant, or Power Supply to rain or standing water.

9. Don't pull on the Cables.

10. Don't attempt to move tube end into position using the Weld Head as a lever.

11. Don't add oil or grease to the Weld Head except on internal gears and drive chains.

VI. WELD SCHEDULE DEVELOPMENT

6.0 General

In order for a weld schedule to be successfully applied in production, it must be "forgiving" enough to minimize the effects of:

A. Material chemistry variations.
B. Joint fit-up and geometry tolerances.
C. Welding position.
D. Operator errors and tracking variations.
E. Other physical effects such as temperature, humidity, wind, and surface contaminations.

While there may be many different approaches to develop a specific procedure, the following paragraphs will describe techniques which are successful and avoid some of the pit-falls that may result in an "unforgiving" procedure.

6.1 Where to Start

A. WELD JOINT PREPARATION

The success of a weld procedure is highly dependent on the weld joint geometry and fit-up. Joint preparation and cleaning prior to welding with the Model 107-4 Power Supply and Model 9 Heads is the most important factor in obtaining excellent quality autogenous welds.

The following steps should be taken as part of the fit-up process to help ensure that the welding process is successful.

1. Determine the suitability for autogenous welding of tube/pipe prior to application of the Model 9 Weld Head. Some materials do not weld readily without the addition of filler materials. In some cases, insert rings can be used as filler metal.

2. Machine or cut the tube/pipe ends square to the axis. A facing tool is a useful tool to ensure proper facing. This either clamps to the outside or to the inside of the tubing by means of an arbor which expands inside the tubing and holds the facing tool firmly. This allows the end of the tubing to be faced firmly and square. Remove burrs without leaving a chamfer or radius.

6.1,A Continued

3. Mechanically clean all rust, scale, or paint at least one inch from the edge of the joint on both the I.D. and O.D. The surface in contact with the Clamp Inserts must be free of oxides and other non-conductive materials. The solvent Trichlorethane is recommended for final cleaning. This or any solvent to be used should not leave any oil residue. The cloth or paper used to wipe the surface should be free of oil or other contaminants.

4. The tube/pipe to be welded must be round and straight for a minimum distance equal to the overall (Clamp-to-Clamp) width of the Weld Head.

5. For process development, it is recommended to prep 6 to 10, 3" long pieces to use for samples and gang them together as progression through weld development is achieved.

B. BACK-PURGE GAS

Many autogenous fusion welds require that the I.D. of the tube or pipe be purged with inert gas during the welding process. The Model 107-4 Power Supply is equipped with inlet and outlet BACK-PURGE fittings, and should be used for this purpose. It is important to note a few things about BACK-PURGE.

1. BACK-UP Gas connections on the Model 107-4 Power Supply are not under Program Control; the Gas will flow continuously when the gas source is turned on.

2. BACK-UP Gas connections must be air-tight to prevent aspiration of air into the tube I.D.

CAUTION: BACK-PURGE Gas flow must be only sufficient to expel air from the tube without pressurizing the tube.

C. ROTATION SPEED AND TRAVEL TIME

In order for weld development to proceed, an arc rotation speed must be selected. Depending on tube diameter and wall thickness, optimum welding speeds can vary greatly, but a good rule of thumb for autogenous butt fusion welding is 4.5 to 7.5 inches per minute (IPM), measured on the circumference of the tube O.D.

6.1,C Continued

Because each type of Model 9 Weld Head can accommodate different sized tubes and the arc rotation is from a fixed circular position, the Power Supply is programmed in revolutions per minute (RPM) and not IPM. In order to set the rotation speed in RPM, it is necessary to convert the desired IPM into RPM. This is accomplished by measuring the tube O.D. circumference (or multiply the O.D. x Pi (3.14) and dividing it (the circumference) into the desired IPM.

Example

Desired Speed = 5 IPM
Tube Circumference = 10 inches

$$\frac{5 \text{ IPM}}{10 \text{ inches}} = 0.5 \text{ RPM} = 5 \text{ IPM}$$

The Model 107-4 RPM switch should be set to "0.5" RPM.

Once the rotation speed has been selected, the total rotation time for one revolution can be obtained. The 107-4 is an automatic system, and all timing factors need to be programmed for weld development.

The rotation time is obtained by dividing the RPM into 60 seconds.

Example

$$\text{Programmed Speed} = 0.5 \text{ RPM} = \frac{60}{0.5} = 120 \text{ seconds rotation time}$$

This rotation time is set into the WELD LEVEL TIMERS and will be discussed in the Timing Section 6.1,E.

Another important factor of ROTATION speed is that IPM of travel works hand-in-hand with CURRENT and CURRENT PULSATION. Both factors are equally important in controlling size and penetration of the weld puddle.

6.1 Continued

D. ROTATION DELAY

It is critical to have achieved full penetration of the weld joint before starting the arc rotation. Achieving penetration after arc rotation has started will lead to inconsistent and incomplete welds, and it is impossible to time the weld for 360 degree fusion.

The ROTATION DELAY setting will hold the arc in place after arc start and until penetration is achieved. This setting will be determined by the wall thickness of the tube, the type of PURGE GAS, and the amount of CURRENT and PULSATION rate. Generally with most weld settings, 1 to 3 seconds is adequate, but this can vary greatly and must be determined during the weld development. The amount of time programmed will also be added to the total WELD LEVEL TIME and will be discussed in the Weld Timer Section, 6.1,E.

E. SETTING WELD TIMERS

The total time set into the four WELD LEVEL TIMERS will equal the rotation time (Step 6.1,C) and the rotation delay time (Step 6.1,D). How the time is divided among the four LEVEL TIME switches will depend on the current control needed in different areas of the weld. Because of heat build up and gravitational forces (in the 5G or tube horizontal position), the Weld Current can be programmed to change four times. Each Current LEVEL will be the controlling factor of the time which has been dialed into the LEVEL TIMER for that LEVEL of Current. In addition, the ROTATION DELAY time portion of the total weld LEVEL TIME is generally added to the first LEVEL TIME.

Example

Rotation time	=	120 seconds
ROTATION DELAY	=	3 seconds
First LEVEL AMPS	=	83 amperes and is needed from start through the first 25% of the weld.

6.1,E Continued

Second LEVEL AMPS	=	80 amperes and is needed until 50% of the weld is complete.
Third LEVEL AMPS	=	78 amperes and is needed until 75% of the weld is complete.
Fourth LEVEL AMPS	=	80 amperes and is needed until 100% of the weld is complete.

The above parameters demand that the weld LEVEL TIMERS be set as follows:

LEVEL I	TIME =	33 seconds (first 25% of the weld plus ROTATION DELAY
LEVEL II	TIME =	30 seconds
LEVEL III	TIME =	30 seconds
LEVEL IV	TIME =	30 seconds
	TOTAL TIME =	123 seconds

F. SETTING CURRENT LEVELS AND PULSATION

1. LEVEL I, II, III, IV AMPS - Although this setting will probably be the first to change during schedule development, a good rule of thumb for starting is to set all four LEVEL AMP switches at 1 AMP per 0.001 in. of wall thickness:

Example:

Wall thickness	=	0.083 in.
LEVEL I, II, III, IV AMPS	=	83 Amps

Note: For the purposes of this development section, it is assumed that PULSATION will be used, and the rules of thumb used only apply if PULSATION is used and that PULSE TIMES are set equal.

6.1,F Continued

2. PULSE LOW AMPS - The PULSE LOW AMPS will be used as the puddle control factor and generally should be set at least 25% of, but not greater than 50% of, the LEVEL I AMPS setting.

   Example

   LEVEL I AMPS = 83 amps
   PULSE LOW AMPS = 42 amps

3. PULSE LOW and PULSE HIGH TIME - PULSE TIMES determine the duration of the intervals the LEVEL AMPS (used for welding current penetration) and the LOW AMPS (background current used for control.) These switch settings will differ, according to ROTATION Speed and Weld AMPS.

   For ROTATION speeds of 4.5 to 7.5 IPM, use PULSE TIMES of 0.3 to 0.1 seconds. The faster the speed, the shorter the PULSE TIME.

   Example

   Programmed Speed = 5 IPM
   PULSE HIGH TIME = 0.2 seconds
   PULSE LOW TIME = 0.2 seconds

Note: In order for the AMP setting rule of thumb to work, the PULSE HIGH TIME and PULSE LOW TIME should be set equal to start. A change in the ratio between the two settings makes a large change in actual weld penetration.

For refinement of PULSE TIMES, the weld programmer should look for PULSATIONS that overlap each other somewhere between 50% and 80%.

G. SETTING DOWNSLOPE

At the completion of weld LEVEL TIME, the DOWNSLOPE TIME will decrease the Arc Current from the Program LEVELS down to 0 amperes and arc extinguish. The DOWNSLOPE TIME needs to be of sufficient length to prevent cratering of the weld puddle as it chills. A good starting time for DOWNSLOPE is 4.0 to 9.0 seconds. Smaller tubes with faster ROTATION speeds will require shorter DOWNSLOPE times.

6.1 Continued

H. PRE- AND POST-PURGE

PRE-PURGE time must be long enough to fill the Weld Head Chamber with inert gas. For most applications 30 to 60 seconds is adequate.

POST-PURGE time maintains the Gas PURGE after the arc is extinguished and must be long enough to prevent oxygen contamination of the hot metal. Again, 30 to 60 seconds is usually adequate.

I. WELD PROCESS DOCUMENTATION

Good documentation practices can streamline and enhance the procedure development cycle. Documenting even bad results can identify the parameter configurations which did not work. A good practice is to utilize the procedure sheets and mark the settings used as each weld is completed, along with remarks about what looks O.K. and what needs refinement. Use the program sheet provided with this manual (Figure 5).

As the procedure is refined to an acceptable level, a production procedure sheet can be prepared, along with any supplemental instructions which will be needed by the production welders.

J. SAMPLE WELD REFINEMENT

After all the previous parameters and steps have been completed, a sample weld is ready to be made. After completion of the weld, a section-by-section visual examination of the weld should be made. The following is a brief description of typical areas of refinement after a rough schedule has been developed.

1. Penetration too wide (entire weld) -

    a. Reduce HIGH PULSE TIME
    b. Increase LOW PULSE TIME

2. Penetration too narrow (entire weld) -

    a. Increase HIGH PULSE TIME
    b. Decrease LOW PULSE TIME

6.1,J Continued

3. Penetration too deep (entire weld) -

   a. Decrease LEVEL AMPS all four levels, or
   b. Speed up ROTATION SPEED

4. Penetration too shallow (entire weld) -

   a. Increase LEVEL AMPS all four levels, or
   b. Slow ROTATION SPEED

5. Penetration O.K. but spotty or spread apart (entire weld) -

   a. Increase PULSE RATE (HIGH and LOW), or
   b. Slow ROTATION SPEED

6. Too much or too little penetration at "X" o'clock, rest of weld O.K. -

   a. Change LEVEL AMPS setting I, II, III, or IV, whichever is being used during ROTATION, over that position of the weld.

VII. CALIBRATION PROCEDURE

7.0 CAUTION: All personnel attempting to calibrate, troubleshoot, or repair the Welding System must be familiar with its operation and must understand the circuits; and a complete understanding of the controls and their interrelationship is mandatory.

All personnel must be aware of the location of hazardous voltage-carrying conductors, terminals, heat sinks, etc., and must employ safety precautions when working with the welding machine.

Any instruments or recording instruments connected to any points in the machine or to the Welding Head may be exposed to extremely high transient voltage at the time the arc starter operates. ENSURE THAT ALL TEST EQUIPMENT IS DISCONNECTED DURING ARC START TIME.

7.1 EQUIPMENT REQUIRED FOR CALIBRATION

1. Digital Multimeter (DMM), minimum 4-digit readout.

   Suggested: Data Precision Model 248
   Fluke Model 8060A

2. Precision Shunt, 100 amperes = 100 millivolts +/-0.25%

3. Stopwatch

Note: All test instruments used must have floating inputs (not connected to line ground) of minimum 1 megohm input impedance. Battery operated devices are recommended.

7.2 LOW VOLTAGE POWER SUPPLIES and CLOCK OSCILLATOR (PC2)

Low Voltage Supplies PC2 (P/B 475745-02)

1. Ensure the Model 107-4 Power Supply is turned "OFF". Remove the Program Panel screws and lift the Program Panel up and set at a 90 degree angle with the Power Supply. This will allow access to PC1 and PC2 as shown on figure 11.

Note: Ensure the Program Panel is in a safe position to turn on power.

2. Turn the Model 107-4 Power Supply "ON".

3. Set the DMM up to read DC volts.

4. Insert the negative probe of the DMM into Testpoint (TP) marked "GND REF".

5. Insert the positive probe into PC2-TP1. The DMM should indicate +5.000 VDC +/-0.1% (4.995 VDC minimum to 5.005 VDC maximum.)

6. If out-of-tolerance, adjust PC2 trim resistor TR1.

Note: Steps 7, 8, and 9 measure non-adjustable voltages. If they are out-or-tolerance, contact a factory service representative for further information before proceeding with the calibration.

7. Insert the positive probe into PC2-TP2. The DMM should indicate +6.00 VDC +/-5% (5.7 VDC minimum to 6.3 VDC maximum).

8. Insert the positive probe into PC2-TP3. The DMM should indicate +15.0 VDC +/-5% (14.25 VDC minimum to 15.75 VDC maximum).

9. Insert the positive probe into PC2-TP4. The DMM should indicate -15.0 VDC +/-5% (-14.25 VDC minimum to -15.75 VDC maximum).

7.2.2 Clock Oscillator PC2

1. Set up the Program Panel switches as follows:

   PULSATION "ON/OFF" switch to "OFF"
   PREPURGE TIME select switch to "10" seconds
   POSTPURGE TIME select switch to "10" seconds
   ROTATION delay timer to "00" seconds
   ROTATION RPM dial to "0.0" RPM
   ROTATION "ON/OFF" switch to "OFF"
   ROTATION SYNCHRO "ON/OFF" switch to "OFF"
   ROTATION SYNCHRO "HIGH/LOW" switch to "LOW"
   PULSE HIGH TIME to "1.0" seconds
   PULSE LOW TIME to "1.0" seconds
   PULSE LOW AMPS to "10" amperes
   LEVEL I AMPS to "10" amperes
   LEVEL II AMPS to "10" amperes
   LEVEL III AMPS to "10" amperes
   LEVEL IV AMPS to "10" amperes
   LEVEL I TIME to "15" seconds
   LEVEL II TIME to "15" seconds
   LEVEL III TIME to "15" seconds
   LEVEL IV TIME to "15" seconds
   DOWNSLOPE TIME to "0.0" seconds
   WELD/TEST switch to "TEST RUN".

2. Prepare a stopwatch to time the interval between the time the LEVEL I LED lights and the time the LEVEL IV LED goes out.

3. Press SEQUENCE START.

4. Time the LEVEL TIMER interval; it should be 60 seconds +/-1%.

5. If out-of-tolerance, contact a factory service representative for further information to correct the malfunction.

7.3 WELD CURRENT SERVO and DOWNSLOPE TIME (PC1)

7.3.1 Weld Current Servo PC1 (P/N 4757102)

1. Connect a Precision Shunt (100 amperes = 100 MV +/-0.25%) in series with the Weld Head Ground Cable.

Note: A load bank of 0.05 ohms resistance is preferred over the Weld Head. A Hand Torch can also be used, but some method of sustaining Welding Current must be used; whether it is a Load Bank, Weld Head or Hand Torch makes no difference.

2. If the Weld Head or Hand Torch is used, Arc Gas at 20 CFH will be required and a suitable Work Piece used that can handle 99 amperes of Welding Current.

3. Set all Program Panel dials and switches as follows:

PULSATION "ON/OFF" switch to "OFF"
PREPURGE TIME select switch to "10" seconds
POSTPURGE TIME select switch to "10" seconds
ROTATION delay timer to "00" seconds
ROTATION RPM dial to "1.0" RPM
ROTATION "ON/OFF" switch to "ON"
ROTATION SYNCHRO "ON/OFF" switch to "OFF"
ROTATION SYNCHRO "HIGH/LOW" switch to "LOW"
PULSE HIGH TIME to "1.0" seconds
PULSE LOW TIME to "1.0" seconds
PULSE LOW AMPS to "10" amperes
LEVEL I AMPS to "10" amperes
LEVEL II AMPS to "10" amperes
LEVEL III AMPS to "10" amperes
LEVEL IV AMPS to "10" amperes
LEVEL I TIME to "99" seconds
LEVEL II TIME to "99" seconds
LEVEL III TIME to "99" seconds
LEVEL IV TIME to "99" seconds
DOWNSLOPE TIME to 9.0 seconds
WELD/TEST switch to "WELD"

(Also set WELD/TEST switch to "WELD" on Remote Pendant if Remote Pendant is used).

7.3.1 Continued

4. Press SEQUENCE START.

5. After the PREPURGE TIME, an Arc should be initiated and WELD CURRENT should flow (no arc, if using a Load Bank).

6. Connect the DMM probes across the Precision Shunt, positive probe to the Ground Terminal side, negative probe to the Weld Head, Hand Torch or Load Bank sides.

7. The DMM should indicate +10.00 millivolts +/-0.5% (+9.95 mv minimum to +10.05 mv maximum).

8. If out-of-tolerance, adjust PC1-TR1 for a correct indication.

9. Press SEQUENCE STOP.

10. Set all Program Panel LEVEL AMPS switches as follows:

    LEVEL I AMPS to "99" amperes
    LEVEL II AMPS to "99" amperes
    LEVEL III AMPS to "99" amperes
    LEVEL IV AMPS to "99" amperes
    PULSE LOW AMPS to "99" amperes

11. Disconnect the DMM.

12. Press SEQUENCE START.

13. After the Arc is initiated, connect the DMM across the Precision Shunt as in Step 6.

14. The DMM should indicate 99 millivolts +/-0.5% (98.5 mv minimum to 99.5 mv maximum).

15. If out-of-tolerance, adjust PC1-TR2 for a correct indication.

16. Press SEQUENCE STOP.

17. Disconnect the DMM probes.

7.3.2 Weld Current Meter

1. Set all Program Panel Amp switches as follows:

   LEVEL I AMPS to "50" amperes
   LEVEL II AMPS to "50" amperes
   LEVEL III AMPS to "50" amperes
   LEVEL IV AMPS to "50" amperes
   PULSE LOW AMPS to "50" amperes

2. Press SEQUENCE START.

3. After Arc is initiated, the Weld Current Meter should indicate 50 amperes. If it does not, adjust the potentiometer on the rear of the meter.

4. Press SEQUENCE STOP.

7.3.3 Downslope Timer

1. Using the stopwatch, prepare to time the interval between the time the DOWNSLOPE LED lights and the time it goes out.

2. Ensure the DOWNSLOPE switch is set to "9.0" seconds.
   Set the WELD/TEST RUN switch to "TEST RUN".
   Set each WELD LEVEL TIME switch to "01" seconds.

3. Press SEQUENCE START.

4. Observe the DOWNSLOPE TIME. It should be 9.0 seconds +/-1%.

5. If out-of-tolerance, adjust PC1-TR3 and repeat Steps 3 to 5 until correct.

7.4 WELD HEAD ROTATION SPEED

7.4.1 Weld Head Calibration

1. Connect the Model 9 Weld Head to the Model 107-4 Power Supply.

2. Set all Program Panel settings as follows:

   PULSATION "ON/OFF" switch to "OFF"
   PREPURGE TIMER switch to "10" seconds
   POSTPURGE TIMER switch to "10" seconds
   ROTATION DELAY TIMER to "00" seconds
   ROTATION RPM to "1.0" RPM
   ROTATION "ON/OFF" switch to "ON"
   ROTATION SYNCHRO switch to "LOW"
   ROTATION SYNCHRO switch to "OFF"
   PULSE HIGH TIME to "1.0" seconds
   PULSE LOW TIME to "1.0" seconds
   PULSE LOW AMPS to "00" amperes
   LEVEL I AMPS to "00" amperes
   LEVEL II AMPS to "00" amperes LEVEL III AMPS to "00" amperes
   LEVEL IV AMPS to "00" amperes
   LEVEL I TIME to "15" seconds
   LEVEL II TIME to "15" seconds
   LEVEL III TIME to "15" seconds
   LEVEL IV TIME to "15" seconds
   DOWNSLOPE TIME to "00" seconds
   WELD/TEST RUN switch to "TEST RUN"

3. Ensure the Electrode Rotor is in the full "OPEN" position (JOG into place if needed).

4. Press SEQUENCE START.

5. After the PREPURGE TIME, the Rotor should move for 60 seconds and ROTATE one (1) revolution +/-1% (3.6 degrees).

6. If it does not, adjust the Weld Head Calibration Potentiometer located on the Weld Head. Turning the Potentiometer Clockwise (CW) will speed up the rotation. Repeat Steps 4 to 6 until correct.

7.4.1 Continued

7. Change the LEVEL I and II TIME switches to "10" seconds.
   Change the LEVEL III TIME to "05" seconds.
   Change the LEVEL IV TIME to "05" seconds.
   Change the RPM switch to 2.0 RPM.

8. Press the SEQUENCE START.

9. After the PREPURGE TIME, the Rotor should move for 30 seconds and ROTATE one (1) revolution.

CUSTOMER: _____

S/N: _____

ARC MACHINES, INC.

SHEET: 1 OF 1

DATE : _____

M107-4 CALIBRATION SUMMARY SHEET

NO.	LOC.	TP	TR	PARAMETER	SPEC.	TOL	READING	FIG	PARA	NOTES
1	PCB2	1	1	POWER SUPPLY	+5.000VDC	±0.1%			7.2.1	REF. R GND (TP6)
2	PCB2	2		POWER SUPPLY	+6.0VDC	±5%			7.2.1	REF. P GND (TP7)
3	PCB2	3		POWER SUPPLY	+15VDC	±5%			7.2.1	REF. R GND (TP6)
4	PCB2	4		POWER SUPPLY	-15VDC	±5%			7.2.1	REF. R GND (TP6)
5	PCB2	5		CLOCK OSCILLATOR	10KHZ				7.2.2	WAVE FORM AMPLITUDE = +6.0VDC
6	PCB1	1		MAIN CONTROL	0.00	---				SYSTEM NOT IN SEQ. REF. P GND (TP7)
7	PCB1	3		MAIN CONTROL	-0.005 TO +0.005 V	---				SYSTEM NOT IN SEQ.
8	VOLT MTR	VOLT MTR	NOTE	ARC VOLT METER @ 10 ARC VOLTS	10.0V	---				ADJ. ON BACK OF VOLT METER
9	PCB1	SHNT	1	WELD CURRENT @ 10A	+9.95MV TO +10.05MV	±0.5%			7.3.1	SYSTEM IN SEQ. @ 13 ARC VOLTS
10	PCB1	SHNT	2	WELD CURRENT @ 99A	+98.5MV TO +99.5MV	±0.5%			7.3.1	SYSTEM IN SEQ. @ 10 ARC VOLTS
11	CUR MTR	SHNT	NOTE	WELD CURRENT METER @ 50A	50 AMPS	---			7.3.2	ADJ. ON BACK OF CURRENT METER
12	PCB1	NOTE	3	DOWN SLOPE @ 9.9 SEC.	9.9 SEC.	±1%			7.3.3	CONNECT TO TERMINALS ON DOWNSLOPE LAMP
13	FRONT PANEL	RPM MTR	WELD HEAD	ROTATION SPEED @ 5 RPM	+2.40V TO +2.50V				7.4.1	
14	RPM MTR	RPM MTR	NOTE	R.P.M. METER @ 5 RPM	5.0 RPM	---				ADJ. ON BACK OF TRAVEL METER
15	PCB1	PIN 71		POWER SUPPLY	+28V TO +30V					REF. R GND (TP7)

COMPLETED FORM ON FILE IN QC DEPT.

E134 REV. 2 03/17/86

ARC MACHINES, INC.

ELECTRICAL DRAWINGS

APPLICABLE DRAWING LIST FOR MODEL: 107-4A (P/N 760031)

The following drawings are supplied as part of this manual for purposes of maintenance, calibration and repair.

DWG. NO.	REV.	DESCRIPTION
4757171	B	TRANSFORMER CONNECTION 115VAC INPUT
4757172	B	TRANSFORMER CONNECTION 220VAC INPUT
4757168	E	POWER SECTION WIRING DIAGRAM
4557207	E	BASE PLATE ASSY
4757169	B	INTERTIE HARNESS CONNECTION
4757160	K	RELAY AND INTERTIE BOARD SCHEMATIC
4557159	G	RELAY PCB ASSY
4557158	F	INTERTIE PCB ASSY
4757156	F	BANK DRIVER AND HEAT SINK SCHEMATIC
4557156	C	BANK DRIVER AND HEAT SINK ASSY
4757157	C	BANK DRIVER SCHEMATIC
4557157	D	BANK DRIVER ASSY
2757173	A	CURRENT SENSOR SCHEMATIC
4557173	B	CURRENT SENSOR ASSY
4557208	B	CURRENT SENSOR INSTALLATION
2757133-01	C	ARC STARTER SCHEMATIC
2557133	C	ARC STARTER PCB ASSY
455781	A	ARC STARTER BOX ASSY
4557179	B	ARC GAP ASSY
1557205	A	RESISTOR ASSY (R-13)
4757170	D	CONTROL PANEL SCHEMATIC
4757199	D	DOWNSLOPE START AND LATCH SCHEMATIC
1557199	A	DOWNSLOPE START AND LATCH PCB ASSY
4757102	N	MAIN CONTROL CARD SCHEMATIC PCB1
4557102	K	MAIN CONTROL PCB ASSY
475745-02	C	CLOCK & POWER SUPPLY SCHEMATIC PCB2
455745-02	G	CLOCK & POWER SUPPLY PCB ASSY
455790	C	PCB-1 & PCB-2 INSTALLATION
1757209	A	VOLTAGE DIVIDER ASSY
1757210	A	RESISTANCE DECADE ASSY

CUSTOMER: _____ **DATE COMPILED:** 19 JULY 2000

JOB NUMBER: _____ **SERIAL NUMBER:** _____

ELECTRICAL DRAWINGS

APPLICABLE DRAWING LIST FOR MODEL: 107-4A (P/N 760031)

The following drawings are supplied as part of this manual for purposes of maintenance, calibration and repair.

DWG. NO.	REV.	DESCRIPTION
4557209	A	THUMBWHEEL SWITCH ASSY
4751111	B	DIGITAL TIMER SCHEMATIC
1757126-01	A	WELD CURRENT METER BOARD SCHEMATIC
2557126-01	B	WELD CURRENT METER PCB ASSY
1757126-02	A	ARC VOLTAGE METER BOARD SCHEMATIC
2557126-02	C	ARC VOLTAGE METER PCB ASSY
1757126-03	A	RPM METER BOARD SCHEMATIC
2557126-03	D	RPM METER PCB ASSY
4757201	C	REMOTE PENDANT SCHEMATIC
4557101-01	G	WATER COOLING SYSTEM ASSY
175144-02	B	MODEL 9 WELD HEAD WIRING DIAGRAM
175144-04	B	MODEL 9 WELD HEAD WIRING DIAGRAM
175144-05	C	MODEL 9 WELD HEAD WIRING DIAGRAM
175144-06	D	MODEL 9 WELD HEAD WIRING DIAGRAM

CUSTOMER: _____ **DATE COMPILED:** 19 JULY 2000

JOB NUMBER: _____ **SERIAL NUMBER:** _____.

IX. MODEL 107-DX, DUAL HEAD SWITCH BOX

9.0 Introduction

1. The following text describes major aspects of the Model 107-DX Dual Head Switch Box. This device allows the user to have two (2) Weld Heads (or Weld Head and Manual Torch) connected to the Model 107-4 Power Supply at the same time. The user then selects which Weld Head or Torch is activated.

2. The Switch Box allows a multiple size Head user (or Head or Manual Torch user) to save a good deal of production time by not having to disconnect and reconnect different Weld Heads during a production shift.

9.1 Description

The Model 107-DX Dual Head Switch Box consists of the following:

1. Switch Box, consisting of:

   A. ARC GAS and BACK UP GAS Switching solenoid network.

   B. Torch Water Cooling Switching solenoid network.

   C. ELECTRODE SWITCHING contactors.

   D. Remote Pendant Switching relay network.

   E. Rotation Drive Switching network.

2. Intertie Cable, one (1) each, 15-foot (Model 107-4 Power Supply to Model 107-DX Box).

3. ADAPTER CABLE, one (1) each, 15-foot (for Head Position No. 2). Head Position No. 1 uses the Model 107-4 ADAPTER CABLE.

4. Model 107-DXR Remote Pendant.

5. Model 107-RP Remote Pendant (optional).

9.1 Continued

Note: The 107-RP is only required if Head Position No. 2 is to be a Weld Head. Not required if Head Position No. 2 is to be a Manual Torch or if a 107-RP was purchased with the Model 107-4 Power Supply.

9.2 Installation

The following should be performed in connecting the Model 107-DX Box to the Model 107-4 welding system.

1. Ensure the Model 107-4 Power Supply is turned off.

2. Connect the Intertie Cable between the Model 107-4/107-CW (Power Supply and Water Cooling Unit) and the Model 107-DX Switch Box.

Note: If a Model 107-CW unit with Model 107-DX provisions is not available or purchased, then a Model 107-DX INSTALLATION KIT must be purchased and the Model 107-DX INTERTIE CABLE Power Plug will be plugged into the 107-DX Installation Kit instead of the 107-DX power outlet on the 107-CW unit. The 107-DX installation Kit would then be plugged into an available 115V source.

3. Connect the Model 107-4 Weld Head adapter cable (or extension cable) into the Weld Head No. 1 connectors on the Model 107-DX Box.

4. Connect the No. 1 Weld Head to the No. 1 adapter cable.

5. Connect the No. 2 Weld Head adapter cable, manual torch or No. 2 extension cable to the Model 107-DX No. 2 Head connectors.

6. Connect the Model 107-DXR Remote Pendant to the Model 107-DX Box No. 1 Remote Pendant connector.

7. If the No. 2 switch position is to be a Weld Head, connect the Model 107-RP Remote Pendant to the No. 2 Remote Pendant connector on the Model 107-DX Box.

8. If the No. 2 position is to be a manual torch, connect the optional 107-MC Manual Foot Controller to the No. 2 Remote Pendant connector on the Model 107-DX Box.

9.2 Continued

Note: The Model 107-MT Manual Torch and Model 107-MC Foot Controller should always be connected to Switch Position No. 2.

9.3 Check Out and Operation

After installation, perform the following:

1. Set up the Model 107-4 Power Supply per Figure 1.

2. Set up the Model 107-DXR Remote Pendant as follows:

   A. WELD/TEST RUN switch set to "TEST".

   B. WELD HEAD 1/WELD HEAD 2 switch to "WELD HEAD 1".

Note: When in "WELD HEAD NO. 1" position, the Weld Head No. 2 Model 207-RP Remote Pendant WELD/TEST RUN, SEQ. START, SEQ. STOP, MANUAL PURGE and JOG functions are disabled.

   C. For safety purposes, ensure the Weld Head No. 2 Model 107-RP Remote Pendant is in the "TEST RUN" position.

3. Verify that all cable connections are correct and tight.

4. Turn the Model 107-4 Power Supply "ON".

5. Check that all meters and indicators are indicating as in normal Model 107-4 operation (Model 107-4 Manual, Sections 3 and 4).

6. The Model 107-DXR Remote Pendant Weld Head No. 1 light should be lit and the No. 2 light should be out.

7. If not correct, check connections and Model 107-DX Installation Kit if required. If correct, proceed to Step 8.

8. Press SEQUENCE START. Operation should be the same as in normal operation (Section 4.0).

9.3 Continued

9. After POST-PURGE has timed out, switch the Model 107-DXR Remote Pendant Weld Head Switch to the Weld Head No. 2 position.

Note: Until POST-PURGE and ROTATION return has been completed, the system is locked to the Weld Head selected. Weld Head No. 2 can not be selected during a sequence that was started while in the Weld Head No. 1 position.

10. Depress the SEQUENCE START. Operation in Weld Head No. 2 position should be normal.

11. System is now ready to be operated.

Note: The Model 107-DX Dual Head Switch Box should not affect rotation calibration. However, it is recommended that rotation calibration, per Section 4.8 or Section 7.0 be checked prior to actual welding.

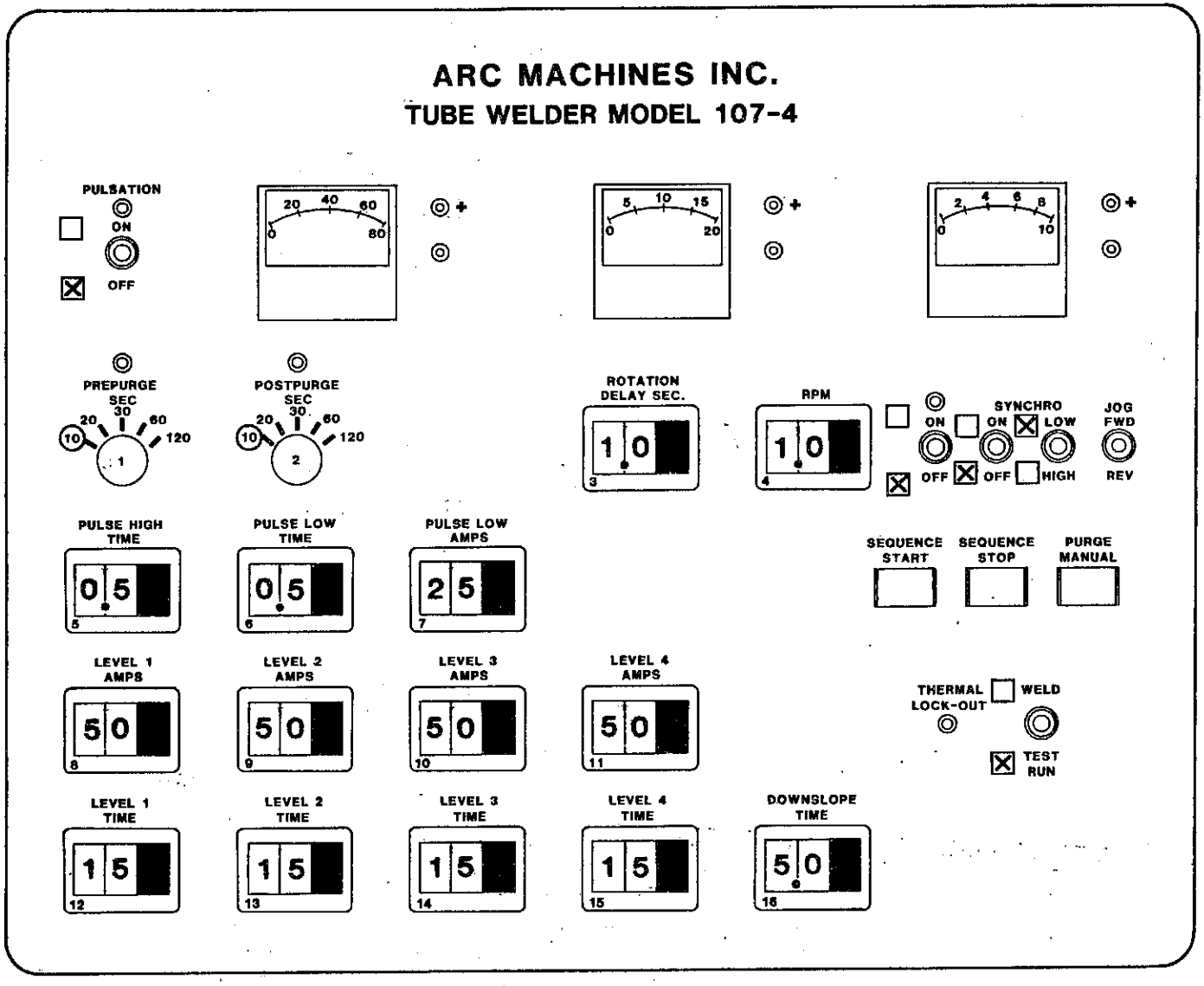


FIGURE 1

8 Dec. 1982
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SPECIFICATION NO. 107-4

MODEL 107-4 PORTABLE POWER SUPPLY

PRELIMINARY

1.0 Purpose

This specification describes the Model 107-4 Portable Power Supply and controls. This Power Supply is a transistorized, feedback regulated, automatically programmed constant current source, and includes arc shielding gas ON/OFF sequenced controls, motor controls, pulsation controls, and arc start system. The small size of this system makes it especially useful in field applications where portability is required, and is intended for autogenous welding of tubing, pipe, and fittings using the Arc Machines, Inc. Model 9 tube welding heads.

2.0 General Description

The Model 107-4 is a complete, self-contained system requiring only input power and inert gas for operation. All controls are accurate and repeatable to better than ±1%, regardless of line voltage fluctuations, ambient temperature, cable length, or welding parameters. All programmed values are entered by means of direct-reading digital thumbswitches, eliminating operator error and the need for interpolations. Four-level current controls allow establishment of optimum welding programs, and current pulsation as well as incremental electrode rotation enable welding of a large variety of materials, sizes, and wall thicknesses.

The Power Supply is air-cooled, and may be operated by itself when placed near the weld station, or may be operated by means of a remote pendant.

The enclosure is so constructed that it may be closed for protection from the environment and still be operated.

Specification No. 107-4 (continued)

3.0 Input Power Requirements

3.1 Line input power shall be 115 VAC, 1 phase, 50/60 Hz, 30 amps, or optionally 220/200 VAC, 50/60 Hz, 20 amps.

3.2 The allowed line voltage variation is ±10% from nominal.

4.0 Welding Current Source

4.1 The output current shall be 5 to 99 amperes, constant current, straight polarity.

4.1.1 The maximum allowed duty cycle shall be 100% up to 50 amperes, and 50% at 99 amperes, based on 5 minimum on and 5 minimum off times.

4.1.2 Current regulation, repeatability and accuracy shall be ±1% or 0.5 amperes, whichever is greater, with line input variation of ±10% from nominal, load (arc) voltage 0 to 15 volts, and ambient temperature of 0 degrees C (32 degrees F) to 45 degrees C (110 degrees F).

4.1.3 Open-circuit voltage shall be approximately 40 volts.

4.2 Current Controls

4.2.1 Four (4) welding current levels shall be provided, weld level 1, 2, 3 and 4. Each level shall be independently adjustable over the range of 5 to 99 amperes in increments of 1 ampere.

4.2.2 Four (4) weld duration timers shall be provided: Weld 1 Time, Weld 2 Time, Weld 3 Time, and Weld 4 Time. Weld level 1 timer and Weld level 4 timer shall be independently adjustable over the range of 0 to 99 seconds in increments of 1 second. Weld level 2 timer and Weld level 3 timer shall be independently adjustable over the range of 0 to 999 seconds in increments of 1 second.

4.2.3 A single Pulse Low current setting shall be provided, independently adjustable over the range of 5 to 99 amperes in increments of 1 ampere.

Specification No. 107-4 (continued)

4.2.4 Pulsed current time settings shall be provided. Pulse Low Time shall be the duration of current level as set on Pulse Low dial, and Pulse High Time shall be the duration of current level as set on any Weld Level 1, 2, 3, or 4 dial. Pulse Low Time and Pulse High Time shall each be independently adjustable over the range of 0.1 to 9.9 seconds in increments of 0.1 second.

Optional range may be provided of 0.01 to 0.99 seconds.

4.2.5 A single Downslope time setting shall be provided, independently adjustable over the range of 0 to 9.9 seconds in increments of 0.1 second.

Optional range may be provided of 99 seconds.

The Downslope function shall linearly slope the current from the Weld Level 4 at the end of the time set on Weld 4 Time dial towards zero current. The arc will extinguish near zero (less than 5 amperes) and will terminate all weld functions except gas post-flow. Manual actuation of Downslope will do the same but from that weld current level which was in sequence at the time of actuation.

4.2.6 See Figure 1 for a graphic representation of the Weld Level, Current Pulsation and Downslope relationships.

5.0 Fixture Rotation

5.1.1 A Fixture Speed setting dial shall be provided, adjustable over the range of 0 to 9.9 RPM. Actual control range shall be 0.5 to 9.9 RPM. Adjustment shall be in increments of 0.1 RPM.

Optional range may be provided of 0 to 0.99 RPM.

5.1.2 A Fixture Delay time setting shall be provided, adjustable over the range of 0 to 9.9 seconds in increments of 0.1 second.

Optional range may be provided of 0 to 99 seconds.

Specification No. 107-4 (continued)

6.0 Arc Start System

6.1.1 An HF-type Arc Starter shall be provided, with a booster to momentarily increase the open circuit voltage during Arc Start.

6.1.2 The Arc Start System shall reliably start the arc at current levels of 5 amperes in Argon and 10 amperes in Helium, using a suitably prepared Thoriated Tungsten Electrode at an arc gap of 0.08 in. with welding head cables of 200 feet or less.

6.1.3 Protective devices shall be installed in the Arc Starter and at suitable points in the machine to prevent HF feedthrough to power lines or to internal sensitive components.

7.0 Inert Gas System

7.1.1 An Arc Gas solenoid-controlled system shall be provided.

7.1.2 One PRE-PURGE and one POST-PURGE Time setting dial shall be provided, adjustable over the range of 20 to 120 seconds.

7.1.3 All inert gas plumbing shall be of impermeable materials to eliminate water or oxygen diffusion into the inert gas streams.

7.1.4 Inert gas inlet connections shall be 5/8-16 female. Inlet gas pressure requirement shall be 50 ±5 psig. Matching hose fittings shall be provided.

8.0 Instrumentation

8.1.1 The following 2" scale length analog meters shall be provided:

Amperes:	0 to 100 amperes	±2% accuracy
AVC Volts:	0 to 30 V	±2% accuracy
Fixture Speed:	0 to 10 RPM	±2% accuracy

Specification No. 107-4 (continued)

9.0 Switches and Sequence Pushbutton Switches

9.1.1 The following toggle switches shall be provided on the control panel:

Fixture Drive	ON/OFF
Current Pulsation	ON/OFF
Fixture Synchronize	ON/OFF
Fixture Jog	FWD/REV

9.1.2 The following illuminated pushbutton switches shall be provided on the control panel:

Gas Purge	Manual/Automatic
Sequence Start	
Sequence Stop	

10.0 Miscellaneous

10.1.1 An overcurrent circuit breaker for the incoming AC power shall be provided. This circuit breaker shall serve as the power ON/OFF switch.

10.1.2 Incoming AC power cable shall be heavy duty, three conductor, and shall be 25 feet long. This cable shall be removable from the Power Supply and shall be provided with a suitable connector.

Optional power cable lengths of 50, 75, or 100 feet may be provided.

10.1.3 One set of operating, calibration and troubleshooting manuals, with one set of drawings and schematics for maintenance purposes, shall be provided.

10.1.4 Shipping Data:

Approximate Weight:	120 lbs.
Height:	18 in.
Width :	28 in.
Depth :	18 in.

SUBJECT TO CHANGE WITHOUT NOTICE

B107-06-03

MANUAL TORCH FOOT CONTROL

(107-MC)

MANUAL TORCH FOOT SWITCH

(107-FS)

REMOTE PENDANT EXTENSION (OPTIONAL)

(107-RPX)

107-4 POWER SUPPLY CONNECT PANEL

REMOTE CONTROL | BACK-UP GAS QDF-2 | GROUND | ELECTRODE | ARC GAS QDF-1 | WELD HEAD

EXTENSION CABLE (OPTIONAL)

(107/ EXT)

GROUND

IN | OUT

(107-CW)

WATER COOLING UNIT (OPTIONAL)

WATER OUT | WATER IN | *GROUND | ELECTRODE | ARC GAS | WELD HEAD

ADAPTER CABLE

(107/ -ADP)

GROUND WATER | ARC GAS | WELD HEAD | ELECTRODE WATER

MANUAL TORCH (WATER COOLED)

(107-MTW)

BACK PURGE LINE (GREEN) 25 FOOT

GROUND CABLE

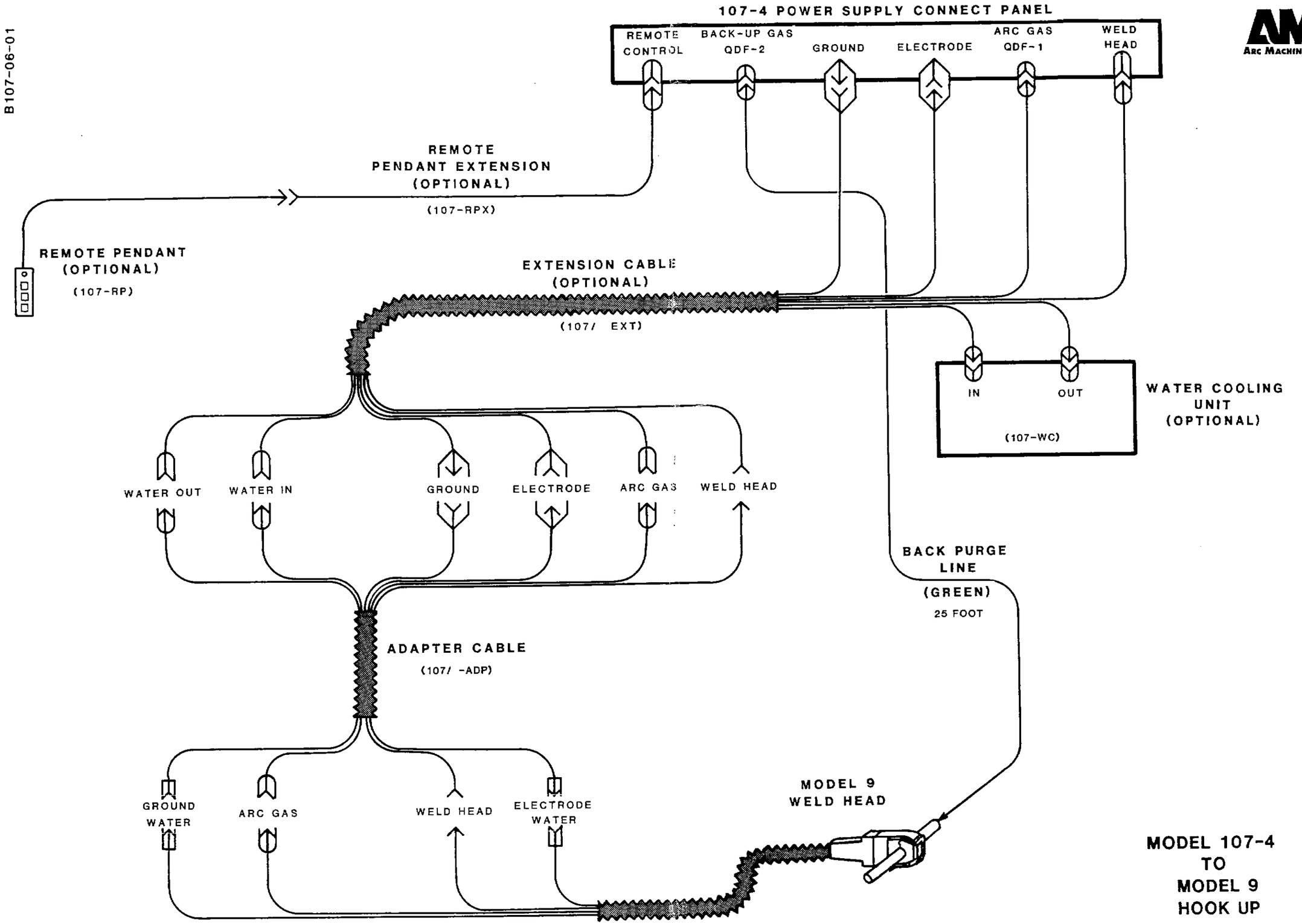
(107-GC)

*NOTE

THE GROUND DOES NOT RUN THROUGH THIS CONNECTION.

MODEL 107-4 TO MANUAL TORCH (WATER COOLED) HOOK UP

B107-06-01



MODEL 107-4 TO MODEL 9 HOOK UP