IM467-B

May, 2003

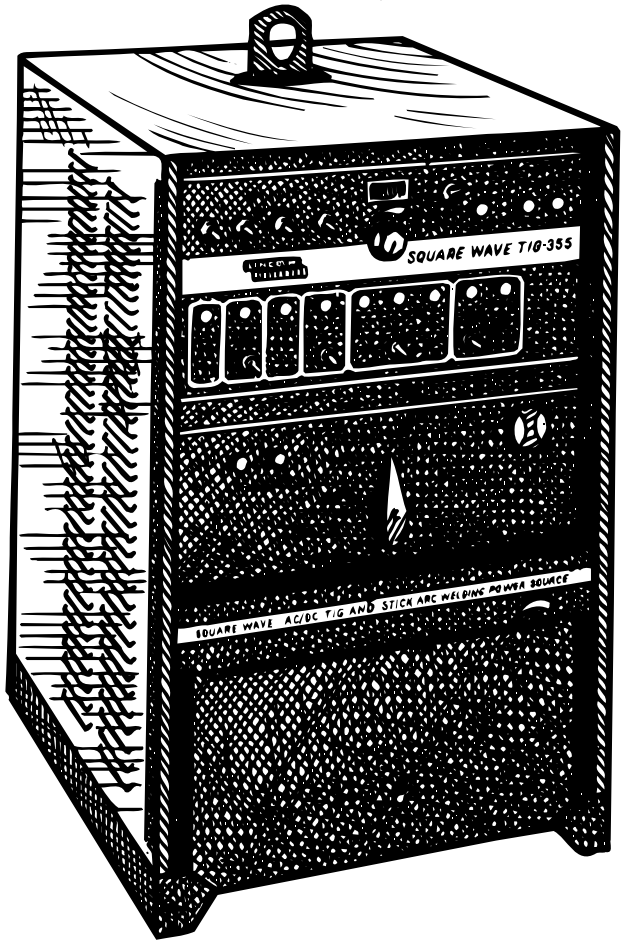
SQUARE WAVE TIG 355

For use with machines having Code Numbers: **9951, 10056, 10389**
9952, 10057, 10390
9953, 10058
9954, 10059
9955, 10060

This manual covers equipment which is no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.



OPERATOR'S MANUAL

LINCOLN® ELECTRIC

• World's Leader in Welding and Cutting Products •
• Sales and Service through Subsidiaries and Distributors Worldwide •
Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

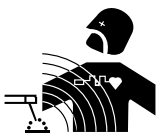
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

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ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases.When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.e. Also see item 1.b.

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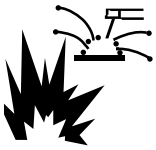


WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to “Safety in Welding and Cutting” (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

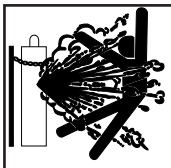
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”. For information, purchase “Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances”, AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically “hot” parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-I, “Precautions for Safe Handling of Compressed Gases in Cylinders,” available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer’s recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer’s recommendations.

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PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d.Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

Mar. '93

Thank You —— for selecting a **QUALITY** product by Lincoln Electric. We want you to take pride in operating this Lincoln Electric Company product ••• as much pride as we have in bringing this product to you!

Please Examine Carton and Equipment For Damage Immediately

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, Claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

Please record your equipment identification information below for future reference. This information can be found on your machine nameplate.

Product _____

Model Number _____

Code Number or Date Code_____

Serial Number_____

Date Purchased_____

Where Purchased_____

Whenever you request replacement parts or information on this equipment, always supply the information you have recorded above. The code number is especially important when identifying the correct replacement parts.

On-Line Product Registration

- Register your machine with Lincoln Electric either via fax or over the Internet.

• For faxing: Complete the form on the back of the warranty statement included in the literature packet accompanying this machine and fax the form per the instructions printed on it.

• For On-Line Registration: Go to our **WEB SITE at www.lincolnelectric.com.** Choose "Quick Links" and then "Product Registration". Please complete the form and submit your registration.

Read this Operators Manual completely before attempting to use this equipment. Save this manual and keep it handy for quick reference. Pay particular attention to the safety instructions we have provided for your protection. The level of seriousness to be applied to each is explained below:

⚠ WARNING

This statement appears where the information **must** be followed **exactly** to avoid **serious personal injury** or **loss of life**.

⚠ CAUTION

This statement appears where the information **must** be followed to avoid **minor personal injury** or **damage to this equipment**.

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INSTALLATION

TECHNICAL SPECIFICATIONS - SQUARE WAVE TIG 355

INPUT - SINGLE PHASE ONLY

Input Voltages:	208	230	460	575
Input Currents @ 350A/34 VDC	110	100	50	40

RATED OUTPUT

Duty Cycle	Amps	Volts at Rated Amperes
40% Duty Cycle	350	34 v
60% Duty Cycle	300	32 v
100% Duty Cycle	220	29 v

OUTPUT

Maximum Open Circuit Voltage	Continuous Current Range	Auxiliary Power
80 Volts Max.	2-400 Amps AC and DC	115 VAC 15 Amps Continuous

RECOMMENDED INPUT WIRE AND FUSE SIZES

		For all Stick, DC TIG, and Balanced AC TIG Welding at 350A/34V/40% Duty Cycle Based on the 1990 U.S. National Electrical Code			For Unbalanced AC TIG Welding Above 230 Amps, 300/32V/60% Duty Cycle, Unbalance Based on the 1990 U.S. National Electrical Code			
Input Voltage / Frequency	Fuse (Super Lag) or Breaker Size	Input Ampere Rating on Nameplate	Type75°C Copper Wire in Conduit AWG (IEC) Sizes	Type 75°C Copper Ground Wire in Conduit AWG (IEC) Sizes	Input Amperes	Type 75°C Copper Wire in Conduit AWG (IEC) Sizes	Type 75°C Copper Ground Wire in Conduit AWG (IEC) Sizes	Fuse (Super LAG) or Breaker Size
208/60	150	110	4 (25mm²)	6 (16mm²)	148	2 (35mm²)	6 (16mm²)	200
230/60	125	100	6 (16mm²)	6 (16mm²)	134	2 (35mm²)	6 (16mm²)	175
460/60	60	50	8 (10mm²)	10 (6mm²)	67	6 (16mm²)	8 (10mm²)	80
575/60	50	40	8 (10mm²)	10 (6mm²)	54	6 (16mm²)	8 (10mm²)	70

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight
884 mm 34.84 in.	565 mm 22.25 in.	660 mm 26.00 in.	232 kg 510 lbs.

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
0° to 40°C	-50° to 85°C

INSTALLATION

A-2

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

WARNING

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.

Only qualified personnel should install, use, or service this equipment.

SELECT SUITABLE LOCATION

Place the Square Wave TIG 355 where clean, cooling air can flow freely in through the side louvers and out through the rear louvers. Keep dust, dirt, and other foreign materials that can be drawn into the machine to a minimum. Failure to observe these precautions can lead to excessive operating temperatures and nuisance shut-downs. Read the section, "High Frequency Interference Protection" before planning the installation.

STACKING

Square Wave TIG 355s may be stacked two high. The bottom machine must be on a stable, hard, level surface. Be sure that the two pins in the roof of the bottom machine fit into the holes in the base of the top machine.

LIFTING

WARNING

CYLINDER MAY EXPLODE if damaged.

- Do not lift the welder with a cylinder attached.

The Square Wave TIG 355 weighs 510 lbs. (232 kg) without a gas cylinder. Lift the machine by the lift bail only. **Never lift the machine with a cylinder attached.**

TILTING

Place the machine on a secure, level surface or on a recommended undercarriage. Any surfaces you place it on other than the ground must be firm, non-skid, and structurally sound.

HIGH FREQUENCY INTERFERENCE PROTECTION

The spark gap oscillator in the high frequency generator, being similar to a radio transmitter, can be blamed for many radio, TV and electronic equipment interference problems. These problems may be the result of radiated interference. Proper grounding methods can reduce or eliminate radiated interference.

The Square Wave TIG 355 has been field tested under recommended installation conditions. It complies with FCC allowable limits for radiation. For convenience, a certificate of compliance is packed with the welder. It can be used to prove FCC RF Energy Radiation Limits compliance if necessary. (It is the owner's responsibility to obtain this certification.) The Square Wave TIG 355 also complies with NEMA standards for high frequency stabilized power sources.

Radiated interference can develop in the following four ways:

1. Direct interference radiated from the welder.
2. Direct interference radiated from the welding leads.
3. Direct interference radiated from feedback into the power lines.
4. Interference from re-radiation of “pickup” by ungrounded metallic objects.

Keeping these contributing factors in mind, installing equipment per the following instructions should minimize problems.

1. Keep the welder power supply lines as short as possible and completely enclose them in rigid metallic conduit or equivalent shielding for a minimum distance of 50 feet (15.2m). There should be good electrical contact between this conduit and the welder. Both ends of the conduit should be connected to a driven ground and the entire length should be continuous.
2. Keep the work and electrode leads as short as possible and as close together as possible. Lengths should not exceed 25 ft (7.6m). Tape the leads together when practical.

3. Be sure the torch and work cable rubber coverings are free of cuts and cracks that allow high frequency leakage. Cables with high natural rubber content, such as Lincoln Stable-Arc® better resist high frequency leakage than neoprene and other synthetic rubber insulated cables.
4. Keep the torch in good repair and all connections tight to reduce high frequency leakage.
5. The work terminal must be connected to a ground within ten feet of the welder, using one of the following methods.
   a) A metal underground water pipe in direct contact with the earth for ten feet or more.
   b) A 3/4" (19mm) galvanized pipe or a 5/8" (16mm) solid galvanized iron, steel or copper rod driven at least eight feet into the ground.

   The ground should be securely made and the grounding cable should be as short as possible using cable of the same size as the work cable, or larger. Grounding to the building frame electrical conduit or a long pipe system can result in re-radiation, effectively making these members radiating antennas.
6. Keep all access panels and covers securely in place.
7. All electrical conductors within 50 ft (15.2m) of the welder should be enclosed in grounded, rigid metallic conduit or equivalent shielding. Flexible metallic conduit is generally not suitable.
8. When the welder is enclosed in a metal buidling, several good earth driven electrical grounds (as in 5 (b) above) around the periphery of the building are recommended.

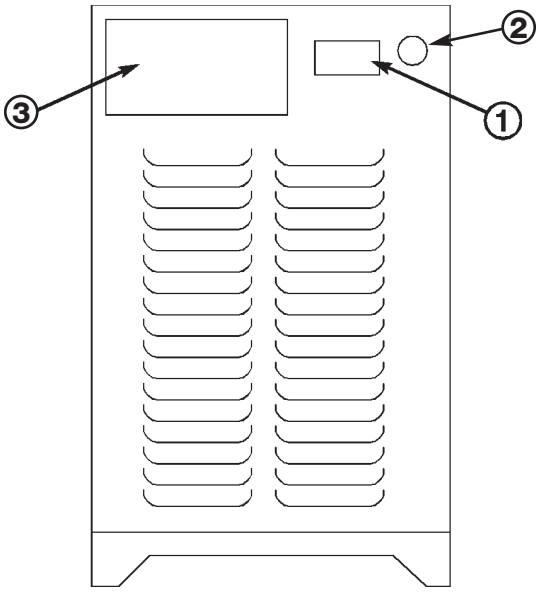
   Failure to observe these recommended installation procedures can cause radio or TV interference problems and result in unsatisfactory welding performance resulting from lost high frequency power.

INPUT CONNECTIONS

Be sure the voltage, phase, and frequency of the input power is as specified on the rating plate, located on the front of the machine.

Welder supply line entry provision is in the case rear panel with a removable cover over the input connection panel area. See Figure A.1.

FIGURE A.1 – REAR PANEL



1. WARNING DECAL
2. INPUT POWER ENTRY
3. RECONNECT PANEL COVER

GROUND CONNECTION

The frame of the welder must be grounded. A ground terminal marked with the symbol is located at the bottom of the input box for this purpose. See your local and national electrical codes for proper grounding methods. Also follow other grounding instructions given in the section "High Frequency Interference Protection."

INPUT SUPPLY CONNECTION

Be sure the voltage, phase, and frequency of the input power is as specified on the welder nameplate.

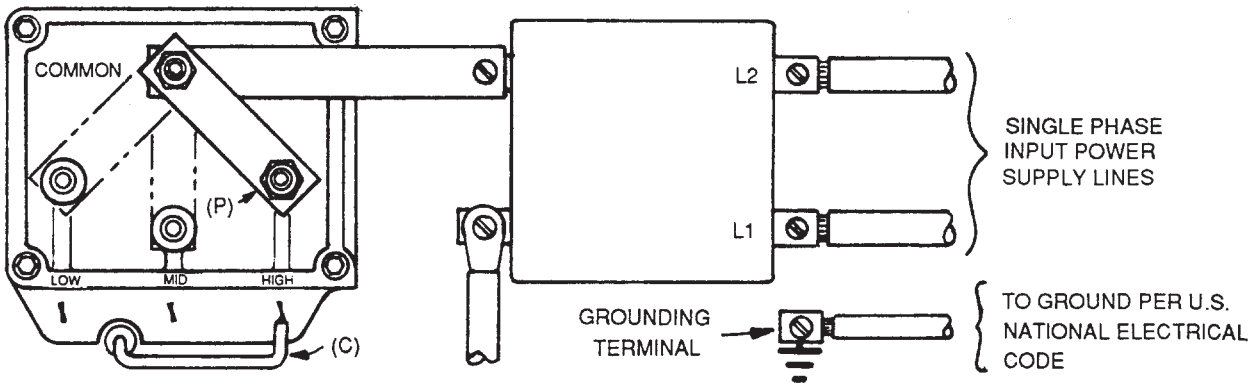
WARNING

ELECTRIC SHOCK can kill.

- Have a qualified electrician install and service this equipment.
- Turn the input power off at the fuse box before working on this equipment.
- Do not touch electrically hot parts.

Have a qualified electrician connect the input power leads to L1 and L2 of the input contactor in accordance with all local codes and national electrical codes. Use a single phase line or one phase of a two or three phase line. Refer to the connection diagram located on the inside of the cover of the Reconnect Panel. Also see Figure A.2.

FIGURE A.2 – INPUT SUPPLY CONNECTIONS



WARNING

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.

RECONNECT PROCEDURE

On multiple input voltage welders, be sure the reconnect panel is connected according to the following instructions for the voltage being supplied to the welder.

CAUTION

Failure to follow these instructions can cause immediate failure of components within the welder.

Refer to Figure A.2 for the following procedure. Welders are shipped connected for the highest input voltage listed on the rating plate. To change this connection for a different input voltage, reconnect both the power strap (P) and control lead (C) to their respective terminals corresponding to the input voltage used. Designations on reconnect panel, LOW, MID and HIGH, correspond to the nameplate input voltages of a triple voltage welder. Dual voltage welders use only LOW and HIGH. Single voltage welders use only HIGH.

EXAMPLE: On a 208/230/460 volt welder, LOW is 208V, MID is 230V, and HIGH is 460V.

Fuse the input circuit with the recommended super lag fuses or delay type[1] circuit breakers. Choose an input and grounding wire size according to local or national codes or refer to Tables A.1 and A.2. Using fuses or circuit breakers smaller than recommended may result in “nuisance” shut-offs from welder inrush currents even if not welding at high currents.

Unbalanced AC TIG welding draws higher input currents than those for stick, DC TIG, or Balanced AC TIG welding. The welder is designed for these higher input currents. However, where unbalanced AC TIG welding above 230 amps is planned, the higher input currents require larger input wire sizes and fuses. See Table A.2.

[1]Also called “inverse time” or “thermal/magnetic” circuit breakers. These circuit breakers have a delay in tripping action that decreases as the magnitude of the current increases.

INSTALLATION

The Square Wave TIG 355 should be permanently wired into the power system. Plugs or connectors are not recommended.

TABLE A.1
RECOMMENDED INPUT WIRE AND FUSE SIZES
For all Stick, DC TIG, and Balanced AC TIG Welding

Based on the 1990 U.S. National Electrical Code[2] **40% Duty Cycle**

Input Volt/Freq.	Input Ampere Rating on Nameplate	Type 75°C Wire in Conduit AWG Copper Cond.	Grounding Wire AWG Copper Cond.	Fuse Size (Super Lag)
208/60	110	4	6	150
230/60	100	6	6	125
460/60	50	8	10	60
200/50	137	4	6	150
220/50	124	4	6	125
440/50	65	8	10	60

TABLE A.2
RECOMMENDED INPUT WIRE AND FUSE SIZES
For Unbalanced AC TIG Welding Above 230 AMPS

Based on the 1990 U.S. National Electrical Code[2] **60% Duty Cycle**

Input Volt/Freq.	Input Amperes at 300 Amp Unbalanced AC Output	Type 75°C Wire in Conduit AWG Copper Cond.	Grounding Wire AWG Copper Cond.	Fuse Size (Super Lag)
208/60	148	2	6	200
230/60	134	2	6	175
460/60	67	6	8	80
200/50	154	1	6	200
220/50	140	2	6	200
440/50	70	6	8	90

[2] Article 630 of the 1990 U.S. National Electrical Code allows the rated ampacity of the supply conductors to be determined by multiplying the nameplate rating by the appropriate multiplier, depending on the duty cycle of the welder.

OUTPUT CONNECTIONS

WARNING

ELECTRIC SHOCK can kill.

- Keep the electrode holder, TIG torch and cables insulation in good condition and in place.
- Do not touch electrically live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground.
- Turn the power off pushbutton on the Square Wave TIG 355 "off" before connecting or disconnecting output cables or other equipment.

See Figure A.3 for the location of the work and electrode terminals, the gas and optional water solenoids, and the Remote Receptacle.

TIG TORCH CONNECTION

TIG welding torches come with 15 ft (4.6m) and 25 ft (7.6m) cables. Use the shorter length whenever possible to minimize possible radio interference problems. With power source off, connect the torch cable to the "Electrode" terminal on the welder. Connect a separate work cable to the "Work" terminal of the welder. See Table A.3 for recommended work cable sizes. Both work and electrode cables should be routed through the cable strain relief holes provided in the base directly below the welding ouput terminals.

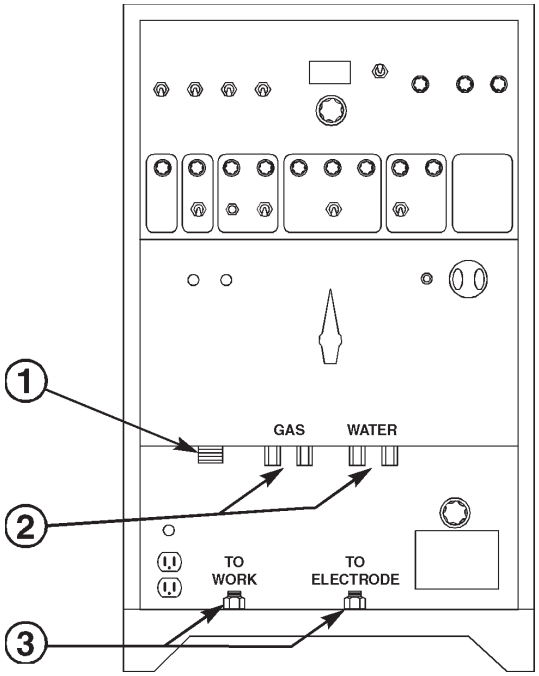
Connect the TIG torch gas and water fittings to the welder fittings. any torch with fittings that conform to Compressed Gas Association (CGA) standards can be used.

The welder fittings have the following threads: Gas Inlet and Outlet: 5/8"-18 right-hand female; Water inlet and Outlet: 5/8"-18 left-hand female. The cylinder of inert shielding gas must be equipped with a pressure regulator and flow meter. Install a hose between the flow meter and gas inlet on the welder.

WARNING

Observe the safety precautions necessary for handling and using compressed gas containers. Contact your supplier for specific information.

FIGURE A.3 – FRONT PANEL



1. REMOTE RECEPTACLE
2. WATER AND GAS SOLENOIDS
3. WORK (LEFT) AND ELECTRODE TERMINALS

TABLE A.3
CABLE SIZES FOR COMBINED LENGTHS OF COPPER ELECTRODE AND WORK CABLE

Machine Size	Lengths up to 100 ft (30 m)	100 to 200 ft (30 to 61 m)	200 to 250 ft (61 to 76 m)
350 Amp 40% Duty Cycle	#1 (45mm^2)	1/0 (55mm^2)	2/0 (70mm^2)

DO NOT operate a water-cooled torch unless water is flowing. Water doesn't flow until the solenoid is actuated.

If using a water-cooled torch with a Magnum water cooler, connect the cooler water outlet to the "Water Valve In" fitting. Connect the TIG torch inlet to the "Water Valve Out" fitting.

If using a water-cooled torch with a free-running water supply, install a water line between the welder "Water Inlet" and the supply. Include a strainer in the water supply line to prevent dirt particles from obstructing water flow in the valve and cooling chamber of the TIG torch. Failure to do so could result in water valve malfunction and overheating of the water-cooled torch. Connect the torch water line to the welder "Water Out" fitting. Use a nonmetallic drain line from the electrode connection to the drain or water recirculating pump.

For other water coolers or torches, consult the manufacturer's instructions for the water cooler or TIG torch being used.

STICK ELECTRODE CABLE CONNECTION

Turn the Power switch Off. Run the electrode and work cables through the strain relief holes below the welding output terminals and connect the cables to the proper terminals. This strain relief prevents damage to the welding output terminals if the cables are pulled excessively. Select cable size according to Table A.3

WARNING

Do not connect a TIG torch and stick electrode cable at the same time. They will both be electrically HOT whenever the output terminals are energized.

OPERATING INSTRUCTIONS

Read and understand this entire section of operating instructions before operating the machine.

SAFETY INSTRUCTIONS

WARNING

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.

FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.

WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.

ARC RAYS can burn.

- Wear eye, ear, and body protection.

Observe additional Safety Guidelines detailed in the beginning of this manual.

GENERAL DESCRIPTION

The Square Wave TIG 355 is a constant current, single range square wave AC/DC TIG (GTAW) arc welding power source with built-in high frequency stabilization. It also has stick (SMAW) capability. The Square Wave TIG 355 gives the operator full control of the welding current plus the ability to preset weld and start currents. Preflow and postflow timers are included for shielding gas and cooling water control. Altogether the many features of the machine allow part or all of a weld cycle to be preset or "programmed," which simplifies the TIG welding process.

The Square Wave TIG 355 includes advanced features such as Auto-Balance™ 2-Step/4-Step Arc Start Switch Operation, start controls, crater controls, spot timer, and status LEDs. Preflow and postflow timers allow control of shielding gas and cooling water.

RECOMMENDED PROCESSES

The Square Wave TIG 355 is recommended for TIG (GTAW) and stick (SMAW) welding processes within its output capability of 2 to 400 amps on both AC and DC polarity. It is compatible with all Magnum TIG accessories as well as many industry standard TIG torches, hoses, and water coolers. (See the ***Accessories*** section of this manual.)

OPERATIONAL FEATURES AND CONTROLS

The following operational controls are standard on the Square Wave TIG 355: Local/Remote current control switch, Stick/TIG mode selection switch, TIG 2-Step/TIG 4-Step mode selection switch, High Frequency Continuous/Start/Off switch, Peak Current control, Volts/Amps switch for the digital ammeter reading, AC Wave Balance control, Afterflow timer for shielding gas and water flow, Arc Force current control for stick welding, Preflow timer for shielding gas and water flow, Spot Time Controls, Start current/time controls, Pulse controls (pulses per second, background % peak current, pulse % on), and Crater Fill controls (fade-out, % peak current).

The following additional features are also standard: Digital ammeter selectable for either volts or amps; Status Indicator LEDs for gas and water, high frequency, arc established, start, peak, background, crater fill.

DESIGN FEATURES AND ADVANTAGES

- Designed to NEMA EW-1 and International IEC-974 Standards.
- Single output range of 2-400 amps covers the majority of TIG welding applications.
- Solid State Output Contactor: no noise, no parts to wear.
- Digital Ammeter and Voltmeter for precise readings from 2-400 amps welding.
- Welding current limit can be preset from 2-400 amps and is displayed on the ammeter when not welding.
- Auto Balance™ circuitry automatically provides the proper amount of cleaning and penetration when AC TIG welding. Manual AC wave balance adjustment is also possible.
- 2-Step/4-Step Arc Start switch capability.
- Spot control for 2-Step Arc Start switch mode.
- TIG Pulser with On/Off selection, and Pulses Per Second adjustment. Background current and duty cycle are automatically adjusted according to the peak welding current.
- Crater Fill control for current fade-out at the end of a weld.
- Adjustable preflow time from 0 to 10 seconds. Preflow time is eliminated if welding restarts during gas afterflow of previous weld. This avoids unnecessary delays when making repeated welds.
- Adjustable afterflow time control.
- Locate/Remote current selection.
- Stick/TIG selection.
- Arc Force control of added current when electrode shorts to the work in stick mode.
- Continuous/Start/Off High Frequency selection.
- DC+/AC/DC- Polarity switch.
- Power Factor Correction for lower input currents and smaller input wire sizes.
- Remote Receptacle for Amptrol™ or Arc Start switch.
- Low Voltage Arc Start switch circuit (24 VAC) for maximum operator safety.
- Gas and optional water valves: Inlet and outlet fittings conform to Compressed Gas Association (CGA) standards.
- Built-In High Frequency Generator.

OPERATION

- 115 Volt receptacle with 15 amp circuit breaker.
- Excellent arc starting and stability up through 400 amps.
- High resistance to AC arc rectification.
- No tungsten spitting within current range of electrode.
- Compact size, requires only a 22.25 in x 26 in (565 mm 660 mm) footprint.
- Strain relief holes in base for welding cables, gas and water hoses and control cables.
- Easy access for input connections. Connections are simple strip and clamp of input wires (no lugs required).
- Low fan noise at idle.
- Modular construction for easy servicing.
- Unused controls are automatically locked out to simplify setup. Examples: the AC Wave Balance control has no effect in DC; the High Frequency and gas and water valves do not operate in Stick mode; TIG Pulser is locked out in the Stick mode.
- Recessed panels protect controls, output terminals, gas and water fittings.
- Large safety margins and protective circuits protect rectifiers from transient voltages and high currents.
- Line voltage compensated.
- Thermostatically protected.
- Electronic over current protection.

WELDING CAPABILITY

The Square Wave TIG 355 is NEMA Class II (40) Power Source rated 350 amps at 34 volts, 40% duty cycle. The duty cycle is based upon a 10 minute time period. (For 40% duty cycle, it is 4 minutes on and 6 minutes off.) The overload capacity is 375 amps at 35 volts, 30% duty cycle.

The “Lincoln Plus” rating of 300 amps at 40 volts provides additional voltage to overcome voltage drops in long cables when stick welding at high currents.

LIMITATIONS

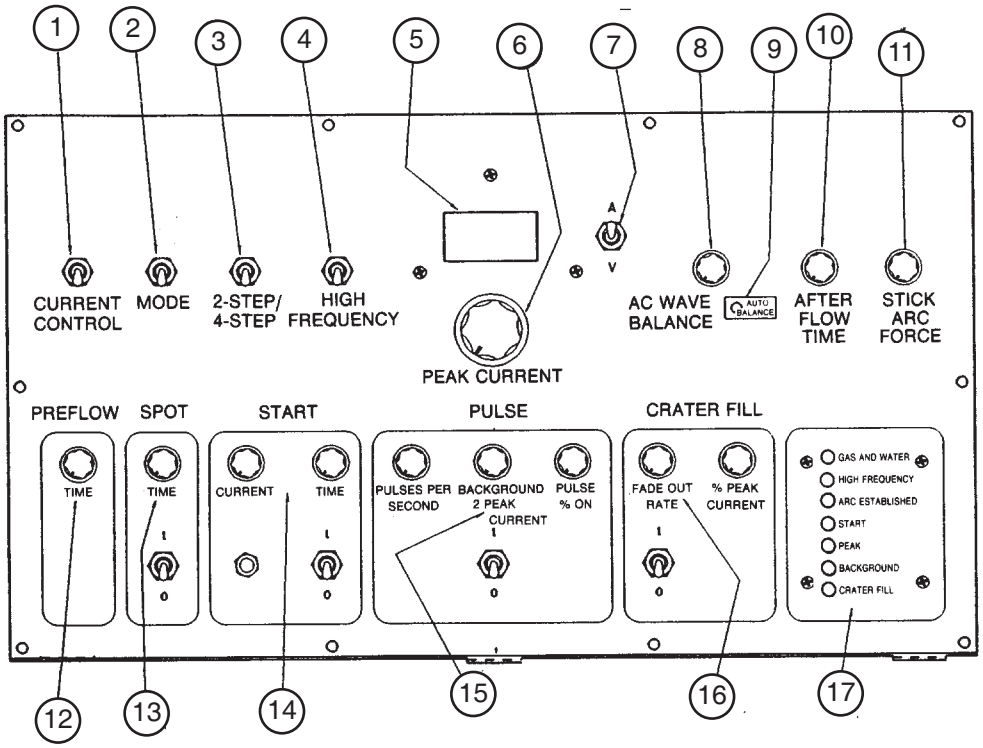
- The Square Wave TIG 355 is not recommended for arc gouging. The machine's output capacity is too limited.
- The Square Wave TIG 355 is not recommended for AC TIG welding with high concentrations of helium shielding gas. Starting problems and arc rectification may occur.
- The Square Wave TIG 355 is not recommended for pipe thawing.

CONTROLS AND SETTINGS

UPPER CASE FRONT CONTROLS

Controls on the upper case front control panel are used for manual TIG and stick welding. Their functions are described below. Some controls are active in both TIG and stick welding, while others are active in TIG only. Refer to Figure B.1 for control locations.

FIGURE B.1 – UPPER CASE FRONT CONTROLS



1. REMOTE/LOCAL CURRENT CONTROL SWITCH
2. MODE SWITCH (STICK/TIG)
3. 2-STEP/4-STEP SWITCH
4. HIGH FREQUENCY SWITCH
5. DIGITAL VOLTMETER/AMMETER
6. PEAK CURRENT CONTROL
7. VOLTS/AMPS METER SWITCH
8. AC WAVE BALANCE
9. AUTO-BALANCE™ LED
10. AFTERFLOW
11. STICK ARC FORCE
12. PREFLOW TIMER
13. SPOT CONTROLS
14. START CONTROLS
15. PULSE CONTROLS
16. CRATER FILL CONTROLS
17. STATUS INDICATOR LEDs

UPPER CASE FRONT CONTROL PANEL

The upper case front panel controls are used for manual TIG and stick welding.

1. CURRENT CONTROL SWITCH

A two-position toggle switch:

LOCAL (PANEL): Current is controlled by the machine settings; remote Amptrol has no affect on current.

REMOTE: Current is controlled by a remote Amptrol up to the current set on the machine.

2. MODE SWITCH

A two-position toggle switch:

STICK: For stick electrode welding (SMAW), this position makes the Stick Arc Force control active. This switch locks out high frequency, the gas and water valves, and the AC Wave Balance control. The STICK position also locks out the Spot Time, Start Time and Crater Fill controls. The Pulse controls are locked out except when an Arc Start switch connected to the Remote receptacle is closed.

TIG: For TIG welding (GTAW), this position locks out the Stick Arc Force control. It makes all other controls active. To start and stop the welding sequence and to get output current, an Amptrol or Arc Start switch must be used when this switch is in the TIG position.

3. 2-STEP/4-STEP SWITCH

A two-position toggle switch: (Locked out in the STICK mode.)

2-STEP: For use with an Arc Start switch or an Amptrol remote current control. The Arc Start switch must be held down during the entire weld cycle. Pressing the Arc Start switch starts the Preflow cycle, and releasing the switch ends the weld cycle.

NOTE: If the Crater Fill switch (Item 16) is ON, welding will continue after the Arc Start switch is released. (See Crater Fill controls.)

4-STEP: For use with an Arc Start switch only. The Arc Start switch must be pressed and released to start the weld cycle. Pressing and releasing the Arc Start switch a second time ends the weld cycle. This eliminates the need to continuously hold down the Arc Start switch during a weld. If the Preflow timer (Item 12) is being used, the Arc Start switch must be held down during the Preflow time. The Arc switch can be released once an arc is established.

NOTE: If the Crater Fill switch (Item 16) is ON, welding will continue after the Arc Start switch is pressed and released the second time. (See Crater Fill Controls.)

NOTE: If the arc goes out while welding in the 4-Step mode, the machine will try to re-establish an arc for a period of two seconds. The output contactor will remain closed, and the High Frequency, if in the Start Only or continuous mode, will be activated. If an arc does not re-establish within two seconds, the weld cycle is automatically ended.

4. HIGH FREQUENCY SWITCH

A three-position toggle switch: (Locked out in STICK mode).

CONTINUOUS: High frequency will come on after the gas Preflow time and remain on until the weld is stopped.

START : High Frequency will come on for 1-2 seconds after an arc is established, then go off. (When AC TIG welding, the high frequency will stay on until after the Start period and come on again during the Crater Fill period.)

OFF: No high frequency.

5. DIGITAL VOLTMETER/AMMETER

Displays the output voltage of the welder when the VOLTS/AMPS switch (Item 7) is held in the “VOLTS” position.

When the VOLTS/AMPS SWITCH IS IN THE “AMPS” position, this display functions as an ammeter.

When you are not welding, the ammeter displays the value preset by the Peak Current control.

When you are not welding and the Start Current Display pushbutton is pressed, the ammeter will display the preset Start (Item 14). (See Start Controls)

NOTE: The ammeter display is an indicator of the preset current. Actual welding current will be slightly different.

While you are welding, the ammeter displays the actual welding current. The ammeter is accurate within ±3% of its reading or ±2 amps, whichever is greatest. The ammeter displays RMS current. (RMS current is the actual “heating value” of the arc.) NOTE: Some types of ammeters will not accurately read true RMS currents, particularly when AC TIG welding aluminum. AC only ammeters may read as much as 40% low when measuring AC TIG welding currents.

6. PEAK CURRENT CONTROL

Presets the maximum welding current the machine will produce, from 2 through 400 amps. The preset current is displayed on the digital ammeter when you are not welding.

NOTE: The ammeter display is an indicator of the preset current. Actual welding current will be slightly different.

If you use an Amptrol, it will control the current from 2 amps up to the current preset by the Peak Current control. See the section, "Hand and Foot Amptrol Operation" for proper use of hand and foot Amptrols.

If pulsing, the peak current is the current set and controlled by the Peak Current control (Item 6) and the Amptrol.

7. VOLTS/AMPS SWITCH

A two-position, spring-loaded toggle switch for selecting either arc voltage or welding current/preset current to be displayed on the digital meter.

To read the arc voltage, you must hold the switch in the "Volts" position. This spring-loaded switch always returns to the "AMPS" position when released.

8. AC WAVE BALANCE

This control is active only in AC TIG mode. It controls the amounts of positive and negative current in the AC output. It has no effect on stick or DC TIG welding.

AUTO BALANCE™: This setting provides automatic adjustment of the AC wave balance, and it is the preferred balance setting for most welding conditions. This setting gives the ideal amount of cleaning and penetration, based on the welding current output. When the control is set to the Auto Balance position, the Auto Balance LED (Item 9) will light. This feature operates only in the AC TIG mode.

For those procedures when manual adjustment of the Wave Balance control is necessary, use the following as a guide:

BALANCED: The amounts of positive and negative are the same.

CLEANING (Below "3" on the dial): Provides more positive current than negative current. Since the positive current produces the "cleaning" or oxide removal on aluminum, this setting is used for heavily oxidized aluminum.

CAUTION

Use only the amount of "cleaning" required. Greater amounts of positive current will heat the tungsten more and possibly cause it to melt or "spit." Also, the arc is usually more flared and less stable with more positive "cleaning" current.

PENETRATION (Above "3" on the dial): Provides more negative current than positive current. The "cleaning" effect will be reduced, but the arc plasma will be more concentrated and more easily directed to where the heat is needed. The reduced amount of positive current allows the tungsten to run cooler at a given current than when set balanced.

In general, use just enough "cleaning" to remove oxides and to give good wetting of the puddle.

9. AUTO BALANCE™ LED

Illuminates only when the Auto Balance function is active. The welder must be in the AC TIG mode, with the AC Wave Balance control fully clockwise.

10. AFTERFLOW

This control adjusts the amount of time the gas and water valves stay open after the end of a weld. Minimum time is approximately 5 seconds; maximum is approximately 55 seconds. Use enough Afterflow time to protect the hot tungsten with gas shielding until it cools. Too short of a time will cause the tungsten to oxidize and become contaminated. When in doubt, set a longer time, then reduce it to a time that still gives good protection.

PREFLOW

All machines have an adjustable Preflow time.

If a new weld is started during the Afterflow time of a previous weld, the Preflow time is bypassed, since gas shielding is already present. This allows new welds to start immediately, with no preflow delay.

11. ARC FORCE

This control is active only in Stick mode. It controls the amount of current added to the welding current when the electrode shorts to the work.

At Minimum, no extra short circuit current is added. The arc will be softer and will have less spatter but may be more prone to sticking.

At Maximum, the arc will be more forceful and less prone to sticking but will produce more spatter.

12. PREFLOW

This control adjusts the amount of time the gas and water valves are open before the arc starts. It is adjustable from 0 to 10 seconds.

The Preflow time occurs only if the valves were closed (no gas flow) when the Arc Start switch or Amptrol was pressed. If a new weld is started while the gas valve is still on during the Afterflow time of a previous weld, the Preflow time is bypassed since gas shielding is already present. This allows new welds to start immediately with no preflow delay.

Note that since the arc cannot start during the Preflow time, a long Preflow setting can cause complaints about arc starting. In general, a Preflow time of 0.5 seconds is satisfactory for most applications.

13. SPOT CONTROLS

Spot Switch — A two-position toggle switch:

Recommended for use in the 2-step Arc Start Switch mode only.

ON: Spot Time control is active. Once the arc is established, the Spot time begins. At the end of the Spot time (or if the Arc Start switch/Amptrol is released sooner), the arc stops. (If Crater Fill [Item 16] is on, downslope begins.)

OFF: Locks out the Spot Time control.

Spot Time Control: Not active if the Spot switch is off. Adjusts weld time from 0.1 to 5 seconds. Weld time is the time from when the arc is fully established until the arc is turned off (or when Crater Fill downslope is started). The Arc Start switch or Amptrol must be held down during the Spot time; if it is released before the end of the Spot time, the arc will be turned off (or Crater Fill started).

14. START CONTROLS

Start Switch — A two-position toggle switch:

ON: Start Current control is active. At the beginning of the weld, current will be the value preset by the Start Current control. Th position of the Amptrol has no effect on this current.

OFF: Locks out Start Current and Time controls.

Start Current Display Pushbutton

Press and hold in this pushbutton to display the Start Current preset by the Start Current control. (The Volts/Amps switch (Item 7) must be in the "AMPS" position to read preset current.)

Start Current Control

Locked out if the Start switch is off.

Presets the current that will be provided at the start of the weld. The current can be preset from 2 to 400 amps. The position of the amptrol has no effect on the initial current. The present Start Current is displayed on the Ammeter when the pushbutton is pressed before welding.

A "hot" start is used to quickly heat the tungsten and work, usually on DC TIG welding. Set the Start Current higher than what the welding current will be. After the time is set on the Start Time control, the current will step down to the current set and controlled by the Peak Current control (Item 6) and the Amptrol.

A "soft" start is used to preheat the tungsten and work, usually on AC TIG welding. Set the Start Current lower than what the welding current will be. The arc will establish at the Start Current and then ramp up to the current set and controlled by the Peak Current control (Item 6) and the Amptrol. The time to get up to welding current is set by the Start Time control. During the ramp up, the Amptrol will affect the current that the ramp is going toward and therefore the rate at which the current increases.

Start Time Control

Locked out if the Start switch is off. Adjusts the Start Time from approximately 0.1 to 10 seconds.

15. PULSE CONTROLS

Pulse Switch — A two-position toggle switch:

ON: Pulsing will begin as soon as an arc is established and will continue until the weld is completed. If you are using Start Controls, pulsing begins after the Start Current. If you are using Crater Fill, pulsing will continue during the downslope period.

OFF: Locks out Pulse controls.

Pulses per Second Control — Controls the number of pulses per second from approximately 0.1 to 10 pps. 0.1 pulses per second is slow pulsing (one pulse every 10 seconds); 10 pulses per second is fast pulsing.

Background % Peak Current Control — Controls the background (low pulse) current from zero to 100% of the peak current set and controlled by the Peak Current control (Item 6) and the Amptrol.

Example: The Peak Current control is preset at 50 amps and the Amptrol is partially down, giving a peak current of 30 amps. If the Background Current control is set at 50%, the Background (low pulse) current will be 15 amps.

The Amptrol raises and lowers the Peak current. Since Background current is always a percentage of Peak current, the Amptrol also raises and lowers the Background current.

Pulse % On — Controls the percentage of the pulse cycle that is at the Peak current.

Example: You are pulsing at 1 Pulse per second with a 30% Pulse % On setting. The welding current would be at the Peak current for 0.3 seconds and at the Background current for the remainder of the cycle, 0.7 seconds.

16. CRATER FILL CONTROLS

Use the Crater Fill controls to automatically control current fade-out at the end of a weld. LOCAL current control (Item 1) MUST be used when Crater Fill is used.

Crater Fill Switch — A two-position toggle switch.

ON: Crater Fill Fade-out will begin when the Arc Start Switch or Amptrol is released (2-Step mode) or pressed and released a second time (4-Step mode). If used with Spot Time (item 13), Crater Fill begins at the end of the Spot Time. The current control (item 1) switch must be in LOCAL when using Crater Fill.

OFF: Locks out Crater Fill controls.

Fade-out Control — Controls how slowly the current fades out. The FAST setting will cause current to ramp down from the welding current toward 2 amps in approximately 1/2 second; the SLOW setting, in approximately 20 seconds. The time for downslope to the Crater Fill Current level depends on the difference between the weld current and the Crater Fill Current.

Crater Fill % Peak Current Control — Controls the final Crater Fill current from zero to 100% of the weld current preset on the Peak Current control.

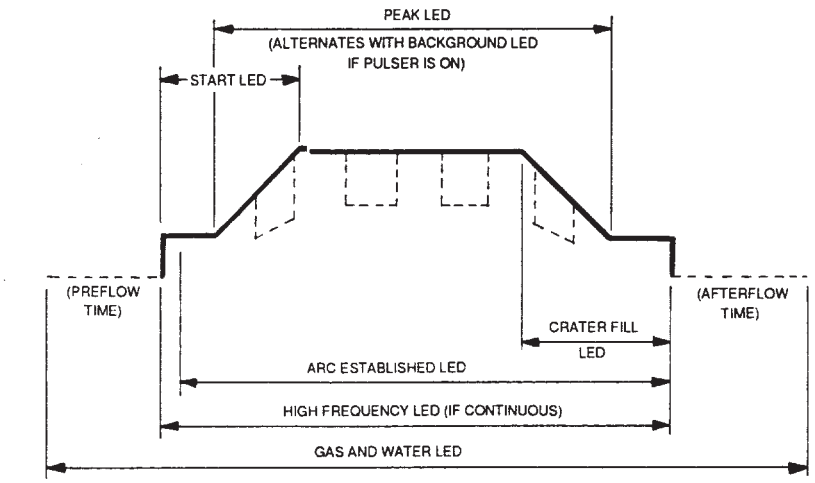
Example: WIth a Crater Fill % Current setting of 20% and a weld current preset at 100 amps, the current will fade from 100 amps to 20 amps and then dwell at 20 amps for about 1-1/2 seconds before the arc goes out.

The final Crater Fill current dwell time is approximately 1-1/2 seconds, regardless of Crater Fill control settings.

17. STATUS INDICATOR LEDs — Seven Light Emitting Diodes (LEDs) which light when their function is active.

- GAS & WATER LED is on when the solenoid valves are open, from the beginning of Preflow to the end of Afterflow.
- HIGH FREQUENCY LED is on when the high frequency circuit is on.

FIGURE B.2 – STATUS INDICATOR LIGHT SEQUENCE SQUARE WAVE TIG 355



- ARC ESTABLISHED LED goes on when the arc is fully established and goes out if the arc goes out.
- START LED is on from the time the arc is established until current begins to go up (soft start) or down (hot start). Note that the Start LED is off during upslope if a soft start is used.
- PEAK LED goes on after the Start period. If the Pulse switch is on, the Peak LED goes off during the Background periods. The Peak LED and Background LED will alternate when pulsing.
- BACKGROUND LED is on during the Background (low pulse) period of pulsing.
- CRATER FILL LED is on during the Fade-Out downslope and final current periods.

NOTE: An LED will light in response to the control circuit command, even if other components do not work. For example, if the gas supply is turned off or the gas solenoid valve malfunctions or the fuse is blown, the gas will not flow even though the Gas and Water LED lights up. Another example is the High Frequency LED which can light, yet there will not be high frequency due to a blown fuse or defective high frequency circuit or spark gaps set too large.

The Status Indicator LEDs are useful for understanding which functions are active during a weld sequence and for how long. They are useful for setting times of the controls on the Function Panel. See Figure B.2.

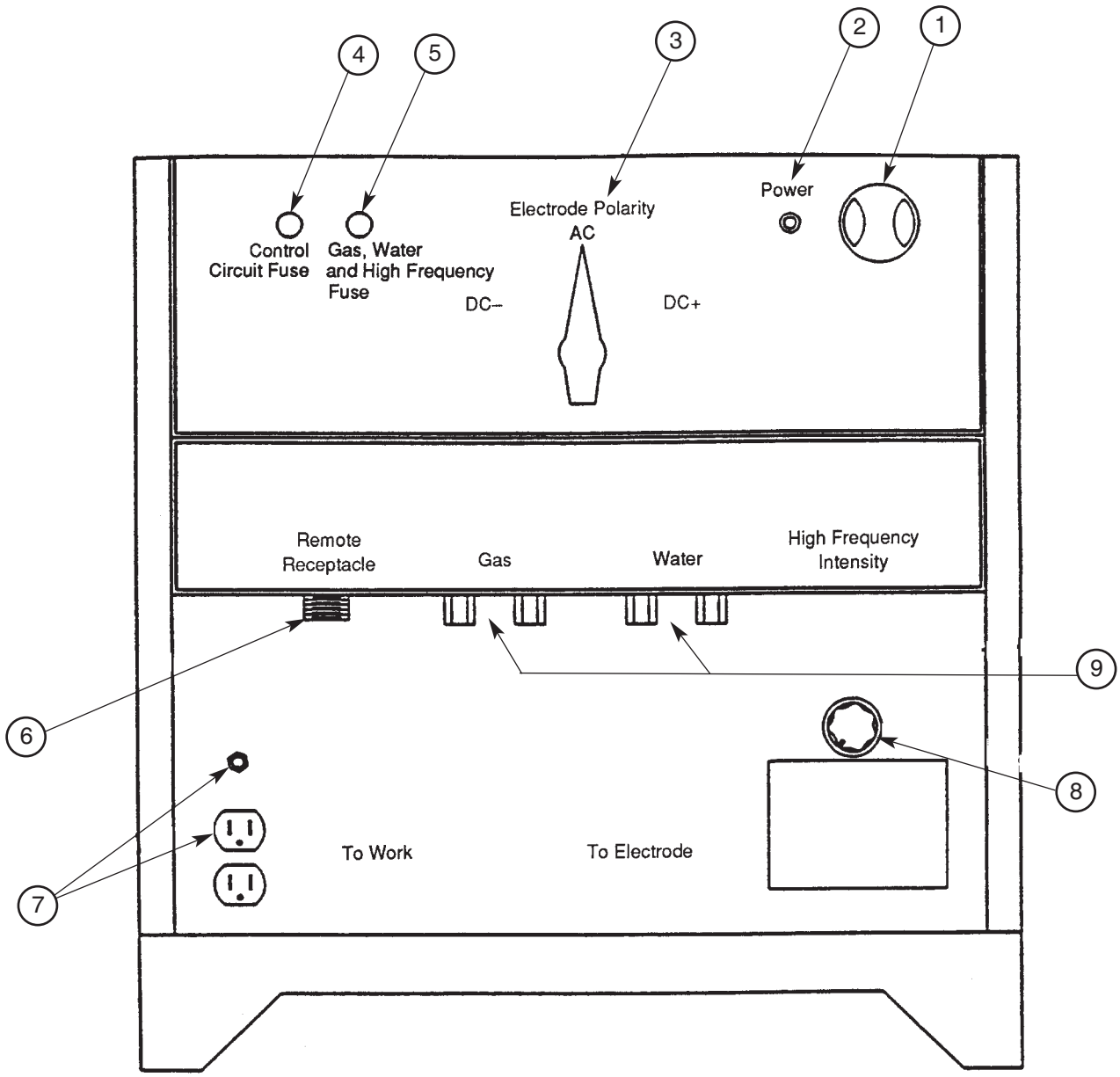
The Status Indicator LED circuit board includes a receptacle for plugging in the circuit board included with the Optional Interface Kit.

OPERATION

LOWER CASE FRONT CONTROLS

Refer to Figure B.3 for the location of the following controls.

FIGURE B.3 – LOWER CASE FRONTCONTROLS



OPERATION

1. **POWER ON/OFF** — A momentary start/stop pushbutton, which controls the input contactor. If the input power supply goes off or if the thermostat in the welder trips, the start pushbutton must be pressed to restart the welder.
2. **PILOT LIGHT** — Indicates when the input contactor is energized (power is on).

CAUTION

Do not switch polarity under load.

3. **POLARITY SWITCH** — Selects DC-/AC/DC+
4. **FUSE F1** — 0.5 amp control circuit fuse protects the control transformer from overloads. Input overvoltage protection circuitry will blow this fuse to protect electronic components if the input voltage to the welder is too high (more than 40% over rated voltage). If this fuse blows, the digital meters will not light and the input contactor will not latch when the Power On/Off Start pushbutton is pressed and released.
5. **FUSE F2** — 1.5 amp gas, water, and high frequency fuse protects the circuitry that drives the gas and water valves and the high frequency supply transformer. If this fuse blows, the valves and high frequency will not work. However, the LEDs for Gas and Water and High Frequency will still light.
6. **REMOTE RECEPTACLE** — A six-pin circular connector for an Arc Start switch or an Amptrol remote current control.
7. **115 VOLT RECEPTACLE AND CIRCUIT BREAKER** — A duplex 15 amp grounded NEMA 5-15R receptacle and 15 amp circuit breaker. Fifteen amps of 115 volt AC power is available continuously whenever the power is on. The circuit breaker button will pop out if it trips. Reset by pushing it in after the circuit breaker cools and the overload has been removed.
8. **HIGH FREQUENCY INTENSITY CONTROL AND SPARK GAP** — This control changes the high frequency intensity. Use the lowest intensity which still gives good arc starting to minimize Radio Frequency Interference (RFI). The spark gap is set at the factory to the normal setting marked on the cover plate. Instructions for larger or smaller gap settings are also on the cover plate.
9. **GAS AND OPTIONAL WATER VALVES** — Solenoid valves that open at the beginning of the Preflow time and close at the end of the Afterflow time.

   The gas valve inlet and outlet are standard 5/18-18 right-hand female fittings. The water valve inlet and outlet are standard 5/8-18 left-hand female fittings. The fittings conform to CGA (Compressed Gas Association) standards. Use a water line strainer to prevent particles from jamming the water valve.

HAND AND FOOT AMPTROL OPERATION

Both the Hand and Foot Amptrol (optional kits K870 or K963) work in a similar manner. They are meant to be used for remote current control when Remote Current control is selected. The TIG 2-Step mode must be selected when using an Amptrol for remote current control. As explained below, Amptrols can also be used as arc start switches if Local Current control is selected.

For simplicity, the following explanation will refer only to “Amptrols,” meaning both Foot and Hand models. The term “minimum” refers to a Foot pedal in the “up” position, as it would be with no foot pressure, or a Hand Amptrol in the relaxed position, with no thumb pressure. “Maximum” refers to a fully depressed Foot Amptrol, or a fully extended Hand Amptrol.

The Amptrol is capable of controlling the output current from 2 amps to whatever current is preset on the ammeter. For example, if the ammeter is preset for 200 amps and the Current Control switch is in the Remote position, the Amptrol, when depressed just past its minimum position, will cause the Square Wave TIG 355 to weld at 2 amps. At the Amptrol’s maximum position, the output would be near 200 amps. See Figure B.4.

CAUTION

Since the full output of the current setting is available when the Amptrol is fully depressed, care must be taken not to set a current which will exceed the current carrying capacity of the tungsten. When in doubt, use a lower current setting first, then increase.

It is important to note that, for many applications, the tungsten will not start an arc at only 2 amps. To start an arc reliably, it is important to depress the Amptrol far enough so that the machine output current is near the tungsten operating range. (See Table B.2 for recommended tungsten currents.) In the example above, a 3/32” (2.4 mm) tungsten may be used on DC- to weld near 200 amps. To start the weld, the operator may have to depress the Amptrol approximately 1/4 of the way down, or to nearly 70 amps, in order to start the arc. Merely depressing the Amptrol to its 2 amp minimum position will not start the arc.

A similar situation occurs when the Start controls are used. For example, a 3/32” (2.4 mm) tungsten is again used for welding DC- up to 200 amps (preset on the ammeter). A Start current of 50 amps is set on the Start Level control. When you depress the Amptrol, the start circuitry sets the output current to 50 amps. If the Amptrol is kept near the minimum position, at the end of the start period the output current will drop to 2 amps, causing the arc to go out in most cases. Depress the Amptrol at least 1/4 of the way down, or to around 70 amps, so that the tungsten remains lit when the start period ends.

The same holds true for a “hot” start, or one in which the Start current is set to a current higher than the current preset on the ammeter. Again, at the end of the start period, the Amptrol must be depressed far enough so that the machine output will be high enough to keep the arc lit.

The best technique when using the start controls and an Amptrol is to press the Amptrol to maximum at the beginning of the weld, wait until the end of the start period, and then back off on the amptrol only if the current is too high.

If the Current Control switch is set to the Local position, an Amptrol can be used as an arc start switch. Depressing the amptrol just past minimum will cause the Amptrol’s built-in arc start switch to close, and backing off completely causes the built-in start switch to open. The Amptrol will have no effect on the welding current when used as an arc start switch. See Figure B.5.

FIGURE B.4 – AMPTROLS USED WITH CURRENT CONTROL IN THE LOCAL POSITION

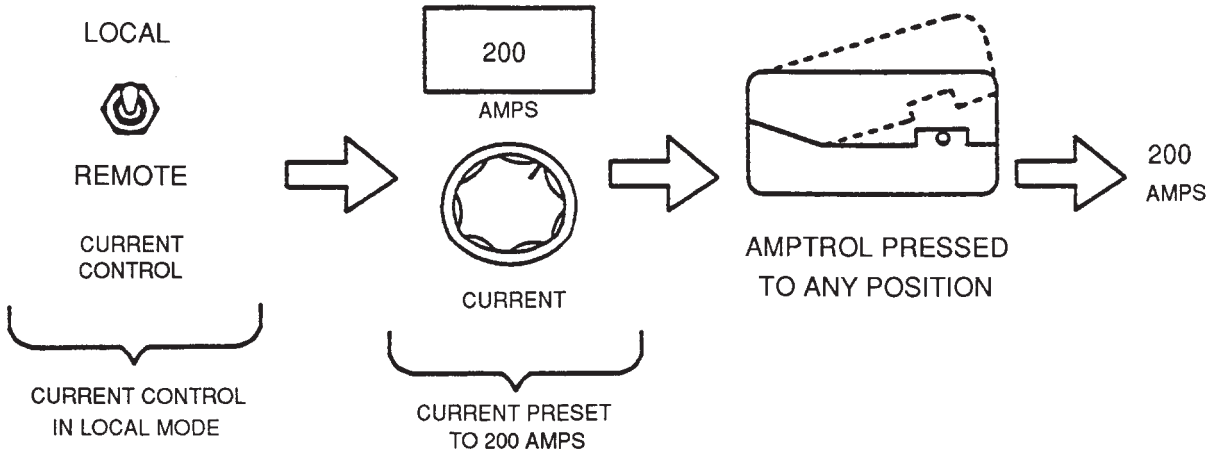
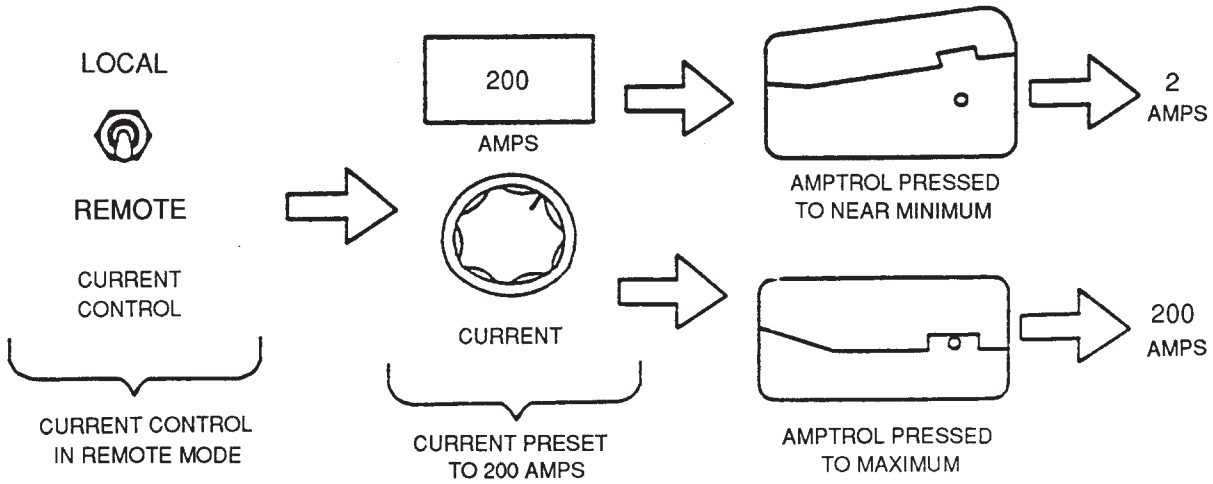


FIGURE B.5 – AMPTROLS USED WITH CURRENT CONTROL IN REMOTE POSITION



WELDING OPERATION

INITIAL START-UP

Be sure the Square Wave TIG 355 has been installed correctly with respect to location, high frequency protection, input power, and output connections.

If you are TIG welding, connect a K870 or K963 Amptrol or a K814 Arc Start switch to the Remote Receptacle. Check that the gas supply is on. Check for the correct type and size of tungsten electrode, gas cone size and torch size. If you are using a water cooled torch, check that the water supply is on.

Press the Start (green) Power pushbutton. The input contactor will pull in, the pilot light will come on, the meter displays will light up, and the fans will start. In TIG mode, the gas and water valves will open for one Afterflow period to purge the lines. The ammeter will display the preset current (if there is no load on the welder output terminals). The voltmeter will read zero in TIG mode, or from 60 to 70 in STICK mode.

Select the Electrode Polarity needed (DC-/AC/DC+) .

Set the controls by going from left to right across the top row and then the bottom row, choosing the correct setting for each. Note that the bottom row of controls includes on/off switches to easily lock out the controls within blocks (Spot, Start, Pulse, or Crater Fill) without changing the settings. Also, note that some of the controls are automatically locked out internally if they do not apply in STICK mode or do not apply in TIG mode. This reduces the number of controls which must be set. See Table B.1 for examples of the effects of the Function controls on TIG welding.

STICK WELDING

1. Remove the Amptrol or Arc Start switch from the Remote Receptacle.
2. Turn the welder on. The pilot light on the front panel indicates when the power is on.
3. Select LOCAL current control;

   Select STICK mode. (High Frequency switch has no effect in STICK mode.)
4. Preset the current with the Current control and the Ammeter.
5. Set the desired Arc Force. (See CONTROLS AND SETTINGS, item 11, “Arc Force.”) (The Wave Balance and Afterflow controls have no effect in STICK mode.)
6. Turn the Start switch OFF, or set the START controls for a hot start if needed. (See CONTROLS AND SETTINGS, item 14, “Start Controls.”)
7. Strike an arc and weld. (There will be a buzzing sound from the arc if you are AC welding, due to the faster rate of current reversal of the Square Wave.

TIG WELDING GUIDELINES

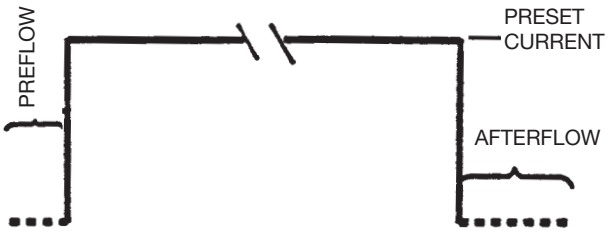
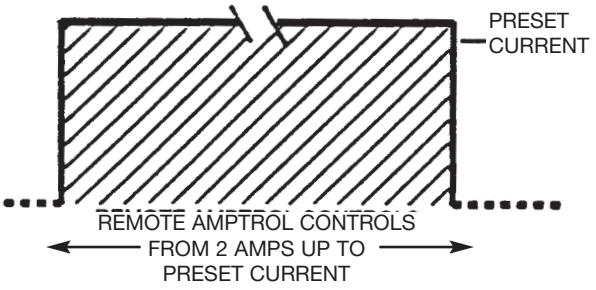
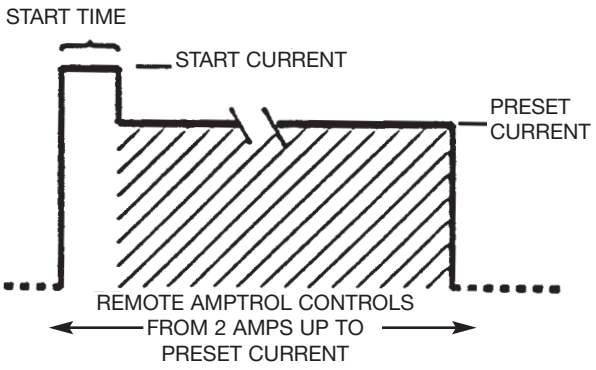
Recommended tungsten electrode sizes, stickouts, currents, cup or nozzle sizes and gas flow are shown in Table B.2. SINCE TIG APPLICATIONS CAN VARY, THIS TABLE IS INTENDED AS A GUIDE ONLY.

Aluminum Welding: Set the Electrode Polarity switch to AC, the High Frequency switch to CONTINUOUS, and the Mode switch to TIG. Make all other control settings to suit the size tungsten and current. In general, pure or zirconiated tungsten electrode is best for aluminum and should have a “balled” end not exceeding the diameter of the tungsten. A buzzing sound will occur in the arc when AC TIG welding aluminum. We recommend that you set the AC Wave Balance control to the Auto Balance position. For more information see CONTROLS AND SETTINGS, item 8, “AC Wave Balance.”

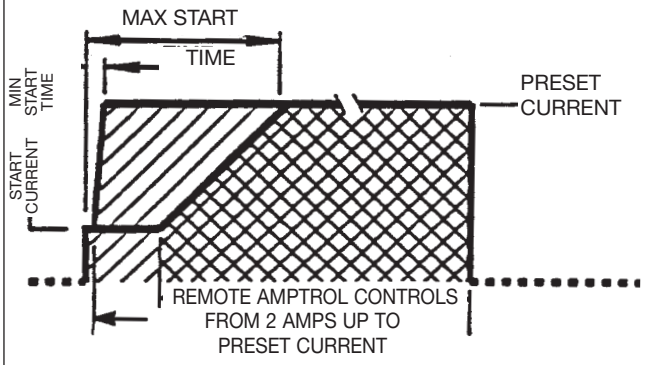
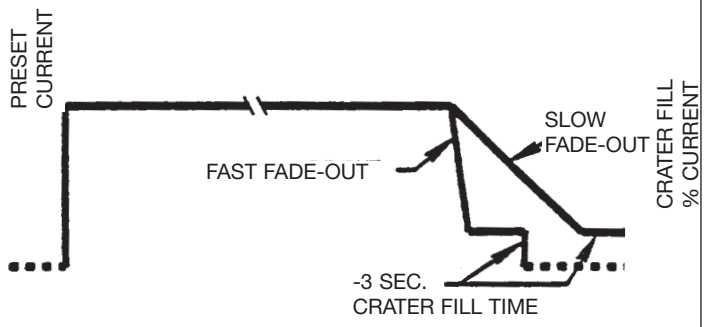
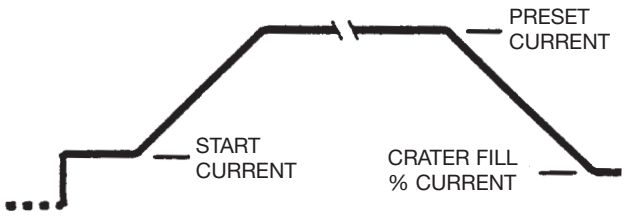
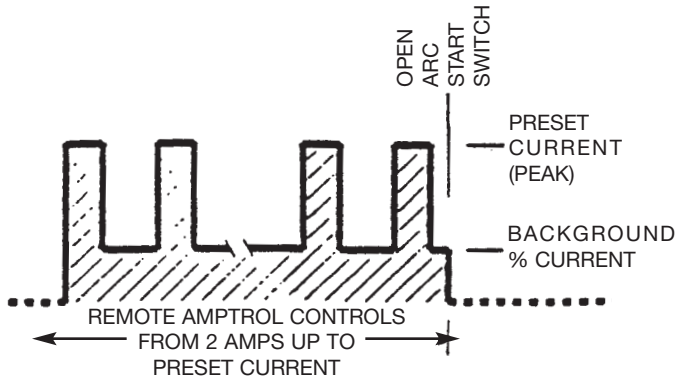
Stainless or Mild Steel Welding: Set the Electrode Polarity switch to DC-, the High Frequency switch to START, and the Mode switch to TIG. In general, 1% or 2% thoriated tungsten electrode is best for stainless or mild steel and should have the end ground to a point. If there is difficulty starting the arc, the tunsten may be contaminated, or it may be too large to get up to operating temperature.

Note: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just “cracked,” the minimum current (2 amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.

TABLE B.1
SPECIFIC EFFECTS OF CONTROLS
(illustrated in the 2-Step Mode for clarity)

CLOSE ARC START SWITCH / WELD BEGINS / OPEN ARC START SWITCH	EFFECT OF CONTROLS ON TIG WELDING	
	**LOCAL** CURRENT CONTROL ALL LOWER PANEL SWITCHES **OFF**	
	**REMOTE** CURRENT CONTROL ALL LOWER PANEL SWITCHES **OFF**	
	**LOCAL** OR **REMOTE** CURRENT CONTROL **START** SWITCH **ON** **START CURRENT** SET HIGHER THAN PRESET CURRENT (HOT START) **START TIME:** VARIABLE ALL OTHER PANEL SWITCHES **OFF**	HOT START

OPERATION

CLOSE ARC START SWITCH / WELD BEGINS / OPEN ARC START SWITCH	EFFECT OF CONTROLS ON TIG WELDING	
	**LOCAL** OR **REMOTE** CURRENT CONTROL **START** SWITCH **ON** **START CURRENT** SET LOWER THAN PRESET CURRENT (SOFT START) **START TIME:** VARIABLE ALL OTHER PANEL SWITCHES **OFF**	SOFT START
	**LOCAL** CURRENT CONTROL **CRATER FILL** SWITCH **ON** **CRATER FILL % CURRENT** VARIABLE **FADE-OUT** VARIABLE ALL OTHER LOWER PANEL SWITCHES **OFF**	CRATER FILL
	**LOCAL** CURRENT CONTROL **START** SWITCH **ON** (SOFT START SHOWN; MAY HAVE HOT START) **CRATER FILL** SWITCH **ON** ALL OTHER PANEL SWITCHES **OFF**	START & CRATER FILL
	**LOCAL** OR **REMOTE** CURRENT CONTROL **PULSE** SWITCH **ON** PULSES PER SECOND BACKGROUND % DUTY CYCLE PULSE % ON ALL OTHER LOWER PANEL SWITCHES **OFF**	PULSE

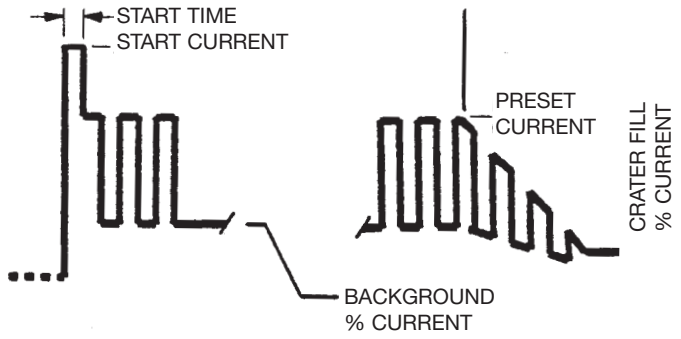
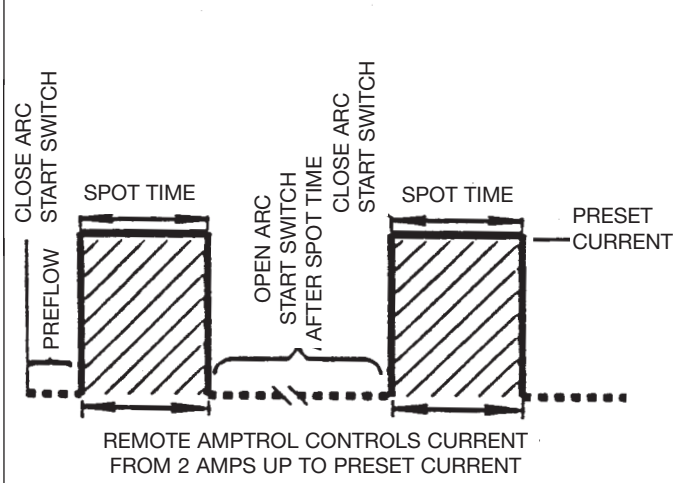
CLOSE ARC START SWITCH / WELD BEGINS / OPEN ARC START SWITCH	EFFECT OF CONTROLS ON TIG WELDING	
	**LOCAL** CURRENT CONTROL **START** SWITCH **ON** (SHORT HOT START SHOWN) **PULSE** SWITCH **ON** **CRATER FILL** SWITCH **ON** (SLOW FADE-OUT SHOWN) **SPOT** SWITCH **OFF**	START & PULSE & CRATER FILL
	**LOCAL** OR **REMOTE** **SPOT** SWITCH **ON** ALL OTHER LOWER PANEL SWITCHES **OFF** (SPOT TIME IS CUT SHORT IF ARC START SWITCH IS OPENED BEFORE END OF SPOT TIME)	SPOT
THE **SPOT** TIMER CAN BE USED TO TIME A PROGRAMMED SEQUENCE OF **START** AND/OR **PULSE** UP TO 5 SECONDS LONG, OPTIONALLY FOLLOWED BY **CRATER FILL.** IF **CRATER FILL** IS USED, **FADE-OUT** BEGINS AT THE END OF THE **SPOT** TIME.		SPOT & START PULSE & CRATER FILL

TABLE B.2
TYPICAL CURRENT RANGES[1] FOR TUNGSTEN ELECTRODES[2]

Tungsten Electrode Diameter in. (mm)	DCEN (-)	DCEP (+)	AC				Approximate Argon Gas Flow Rate C.F.H. (l/min)		
			Unbalanced Wave		Balanced Wave				
	1%, 2% Thoriated Tungsten	1%, 2% Thoriated Tungsten	Pure Tungsten	1%, 2% Thoriated Tungsten Zirconated	Pure Tungsten	1%, 2% Thoriated Tungsten Zirconiated	Aluminum	Stainless Steel	TIG Torch Nozzle Size [4], [5]
.010 (.25)	2-15	[3]	2-15	2-15	2-15	—	3-8 (2-4)	3-8 (2-4)	4,5,6
0.020 (.50)	5-20	[3]	5-15	5-20	10-20	5-20	5-10 (3-5)	5-10 (3-5)	
0.040 (1.0)	15-80	[3]	10-60	15-80	20-30	20-60	5-10 (3-5)	5-10 (3-5)	
1/16 (1.6)	70-150	10-20	50-100	70-150	30-80	60-120	5-10 (3-5)	9-13 (4-6)	5,6
3/32 (2.4)	150-250	15-30	100-160	140-235	60-130	100-180	13-17 (6-8)	11-15 (5-7)	6,7,8
1/8 (3.2)	250-400	25-40	150-210	225-325	100-180	160-250	15-23 (7-11)	11-15 (5-7)	
5/32 (4.0)	400-500	40-55	200-275	300-400	100-240	200-320	21-25 (10-12)	13-17 (6-8)	8,10
3/16 (4.8)	500-750	55-80	250-350	400-500	190-300	290-390	23-27 (11-13)	18-22 (8-10)	
1/4 (6.4)	750-1000	80-125	325-450	500-630	250-400	340-525	28-32 (13-15)	23-27 (11-13)	

(1) When used with argon gas. The current ranges shown must be reduced when using argon/helium or pure helium shielding gases.

(2) Tungsten electrodes are classified as follows by the American Welding Society (AWS):

Pure .....EWP
1% Thoriated EWTh-1
2% Thoriated EWTh-2

Though not yet recognized by the AWS, Ceriated Tungsten is now widely accepted as a substitute for 2% Thoriated Tungsten in AC and DC applications.

(3) DCEP is not commonly used in these sizes.

(4) TIG torch nozzle "sizes" are in multiples of 1/16ths of an inch:

4 = 1/4 in. (6mm)
5 = 5/16 in. (8mm)
6 = 3/8 in. (10mm)
7 = 7/16 in. (11mm)
#8 = 1/2 in. (12.5mm)
#10 = 5/8 in. (16mm)

(5) TIG torch nozzles are typically made from alumina ceramic. Special applications may require lava nozzles, which are less prone to breakage, but cannot withstand high temperatures and high duty cycles. Currents above 350 amps require metal nozzles on water cooled torches.

OPERATION

TIG WELDING SEQUENCE OF OPERATION (2-STEP MODE)

WARNING

Do not leave stick electrode welding cable connected. It will be electrically "hot" when TIG welding.

1. Connect an Amptrol or Arc Start switch to the Remote Receptacle.
2. Turn the welder, water supply (if equipped) and gas supply on. The pilot light on the front panel indicates when the power is on.
3. Select REMOTE or LOCAL current control (REMOTE requires an Amptrol).

   Select TIG mode.
   Select CONTINUOUS or START high frequency.
   Select AC or DC- electrode polarity. See Table B.3 for recommended polarity settings.

TABLE B.3
RECOMMENDED SETTINGS FOR TIG WELDING

Type of Welding	Electrode Polarity	High Frequency Switch
Stainless Steel	DC-	Start
Aluminum and Magnesium	AC	Continuous
Other Metals	DC-	Start

4. Preset the maximum current with the Current control and the Ammeter.
5. (Arc Force control has no effect in TIG mode.)
6. If in AC, set AC Wave Balance control. (See CONTROLS AND SETTINGS, item 8, "AC Wave Balance." This control has no effect in DC.)
7. Set Afterflow time.
8. Set Function Panel controls as needed. (See CONTROLS AND SETTINGS.)
9. Press the Arc Start switch or Amptrol and set the gas flowmeter. The welder is now ready for welding.
10. Position the tungsten electrode at the start of the weld at a 65° to 75° angle with the horizontal so that the electrode is approximately 1/8" (3.2 mm) above the workpiece. Press the Arc Start switch or operate the Amptrol. This opens the gas and water valves to automatically purge air from the hose and torch. After a time determined by the Preflow control setting, the high frequency becomes available to strike the arc.
11. Hold the Arc Start Switch down or operate the Amptrol until the weld is completed. Release the Arc Start switch or the Amptrol to stop the arc. When the Afterflow timer completes the cycle, the gas and water valves close. To make another weld, repeat steps 10 and 11.

TIG WELDING SEQUENCE OF OPERATION (4-STEP MODE)

WARNING

Do not leave stick electrode welding cable connected. It will be electrically "hot" when TIG welding.

1. Connect an Arc Start switch to the Remote Receptacle.
2. Turn the welder, water supply (if so equipped) and gas supply on. The pilot light on the front panel indicates when the power is on.
3. Select LOCAL current control. Select TIG mode. Select CONTINUOUS or START high frequency. Select AC or DC- electrode polarity (See Table B.3 for recommended polarity settings).
4. Preset the maximum current with the Peak Current control and the Ammeter.
5. (Arc Force Control has no effect in TIG mode.)
6. If in AC, set AC Wave Balance control. (See CONTROLS AND SETTINGS, item 8, "AC Wave Balance. This control has no effect in DC.)
7. Set Afterflow time.
8. Set Function Panel controls as needed. (See CONTROLS AND SETTINGS, "Lower Case Front Controls")
9. Press the Arc Start switch and set the gas flowmeter. The welder is now ready for welding.
10. Position the tungsten electrode at the start of the weld at a 65° to 75° angle with the horizontal so that the electrode is approximately 1/8" (4 mm) above the workpiece. Press the Arc Start switch. This opens the gas and water valves to automatically purge air from the hose and torch. After a time determined by the Preflow control setting, the high frequency becomes available to strike the arc.

11. Hold the Arc Start switch down until an arc is established. At this point, the Arc Start Switch can be released, and the weld will continue. Press and release the Arc Start switch a second time to stop the arc. When the Afterflow timer completes the cycle, the gas and water valves close. To make another weld, repeat steps 10 and 11.

Note: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked," the minimum current (2 amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.

OVERLOAD PROTECTION

The Square Wave TIG 355 has thermostatic protection from overloads, loss of cooling, and high ambient temperatures. When the welder is subjected to an overload or loss of cooling, a thermostat will open.

If the *secondary* thermostat opens, the effect will be the same as pushing the Stop power pushbutton: the power will go off, the pilot light and meters will go out, and the fans will stop. Pressing the Start power pushbutton after the thermostat cools and resets will restart the welder.

If the *primary* thermostat opens, the power will stay on (pilot light and meters on and fans running), but no more than 5 amps DC output current will be available. This allows the fans to cool the machine. Depending on the amount of welder overload, the thermostat should reset within five minutes with the fan motors running. When the primary thermostat cools and resets, normal output current will be available.

AUXILIARY POWER

ALL MACHINES

The Square Wave TIG 355 provides 15 amps of 115 volt AC power at a standard NEMA 5-15R receptacle, located on the lower case back of the machine. This circuit is protected from shorts and overloading by a 15 amp circuit breaker, located next to the receptacle. The auxiliary circuit is intended for running water coolers and small power tools, whose current draw is within the 15 amp rating.

CAUTION

Note that some types of equipment, especially pumps and motors, have starting currents significantly higher than their running currents. These higher starting currents may cause the circuit breaker to open. If this situation occurs, the user should avoid using the Square Wave TIG 355 auxiliary for that equipment.

OPTIONS/ACCESSORIES

The following options/accessories are available for your Square Wave TIG 355 from your local Lincoln Electric Distributor.

Undercarriage (K841) – Includes a platform, wheels, and brackets for supporting the welder and two gas cylinders.

Pump Mounting Platform (K827) – Mounts on top of the welder to provide a mounting surface suitable for water recirculating pumps.

Arc Start Switch (K814) – Starts the welding sequence if remote control for TIG welding is not desired. Plugs into the Remote Receptacle. The Current Control switch must be in the LOCAL position when using the Arc Start switch; only a minimum current (2 amp) is available in REMOTE. Includes 25 ft. (7.6 m) cable.

Interface Kit (K846) – Mounts to the back of the LED status PC board. Provides six isolated circuits that can be closed to provide status indication when each of the following functions is active: High Frequency, Arc Established, Start, Pulse Peak, Pulse Background, and Crater Fill. Each circuit occupies two positions on a terminal strip and consists of a fuse, fuse holder, and sockets for an industry standard, optically isolated Solid State Relay (SSR) module (purchased separately, see below).

Solid State Relays (SSRs):

K847-DC – Can switch up to 40VDC, 2 amps maximum load. Package of two.

K847-AC – Can switch up to 130VAC, 2 amp maximum load. Package of two.

Amptrol™ (K870 or K963) – Provides a remote current control for most TIG welding applications. Model K870 is a foot operated control; model 812 is hand operated. Both models plug into the remote control receptacle. A separate switch on the Amptrol starts the welding sequence. When the Current Control switch on the welder is set in the LOCAL position, the Amptrol works as an arc start switch only; it does not control current. (Current is controlled by the rheostat on the front panel.) When the Current Control switch on the welder is set to the REMOTE position, current is controlled by the Amptrol, in a range from 2 amps up to the current set on the control panel. For a more detailed explanation of Amptrol operation, see the Operation Section of this manual.

[1]Use of the Synergic 7 wire feeder requires appropriate input cable assembly, wire stand, and drive roll kit. Refer to Synergic 7 Operator's Manual for available options.

MAINTENANCE

D-1

SAFETY PRECAUTIONS

WARNING

- Only Qualified personnel should perform this maintenance.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

INPUT POWER FACTOR CAPACITOR DISCHARGE PROCEDURE

This procedure ensures that the power factor capacitors are discharged, for greater safety when you are working on the Square Wave TIG 355 with INPUT POWER REMOVED.

1. Remove input power to the machine.
2. With a 5/16" nut driver, remove the sheet metal screws that hold the right case side in place. Remove the right case side.
3. With a volt/ohmmeter, carefully check the voltage across the input power factor capacitors. When input power is removed, the voltage across each capacitor should be zero. (Normally, the capacitors discharge through the primary winding in the main transformer.)
4. If capacitor voltage is zero, you may begin working on the Square Wave TIG 355.

5. If any voltage is present, DISCHARGE EACH INDIVIDUAL CAPACITOR as follows:

   a. Obtain a 500 Ohm resistor. Grip the 500 ohm resistor with insulated gloves and insulated gripping pliers and hold the resistor across the terminals on each capacitor for 20 seconds. See Figure D.1.

   b. With the volt/ohmmeter, recheck each capacitor for voltage.

6. After all the capacitors are discharged completely, check for broken capacitor leads or an open primary winding on the main transformer, which would have prevented the capacitors from discharging normally.

ROUTINE AND PERIODIC MAINTENANCE

WARNING

To avoid receiving a high frequency shock, keep electrode holders, TIG torches and cable insulation in good condition.

1. Disconnect power supply lines to the machine before performing periodic maintenance.

2. Periodically blow out dust and dirt from the inside of the machine with a low pressure air system. Be sure to clean the following components thoroughly. See Figure D.2 for their location.

   - Main transformer
   - Output terminals (located on case front)
   - Polarity switch (located on case front)
   - Rectifier assembly
   - Control box assembly
   - Spark gap assembly
   - Protection PC board

3. Inspect the welder output terminals and control cables for fraying, cuts, and bare spots.

4. Inspect the spark gap spacing at regular intervals. To access the spark gap, remove the nameplate located on the lower right section of the output panel. **Maintain the gap marked on the machine cover plate.** Please note the following:

   - If more intensity is needed than is available with the "High Frequency" set to MAXIMUM, increase the spark gap according to the intervals on the cover plate. (To minimize RFI problems, use the smallest possible spark gap setting that still provides good welding.)

   - Do not dress or refinish the spark gap contacts. Replace the electrodes if the contact surfaces become irregular or completely eroded.

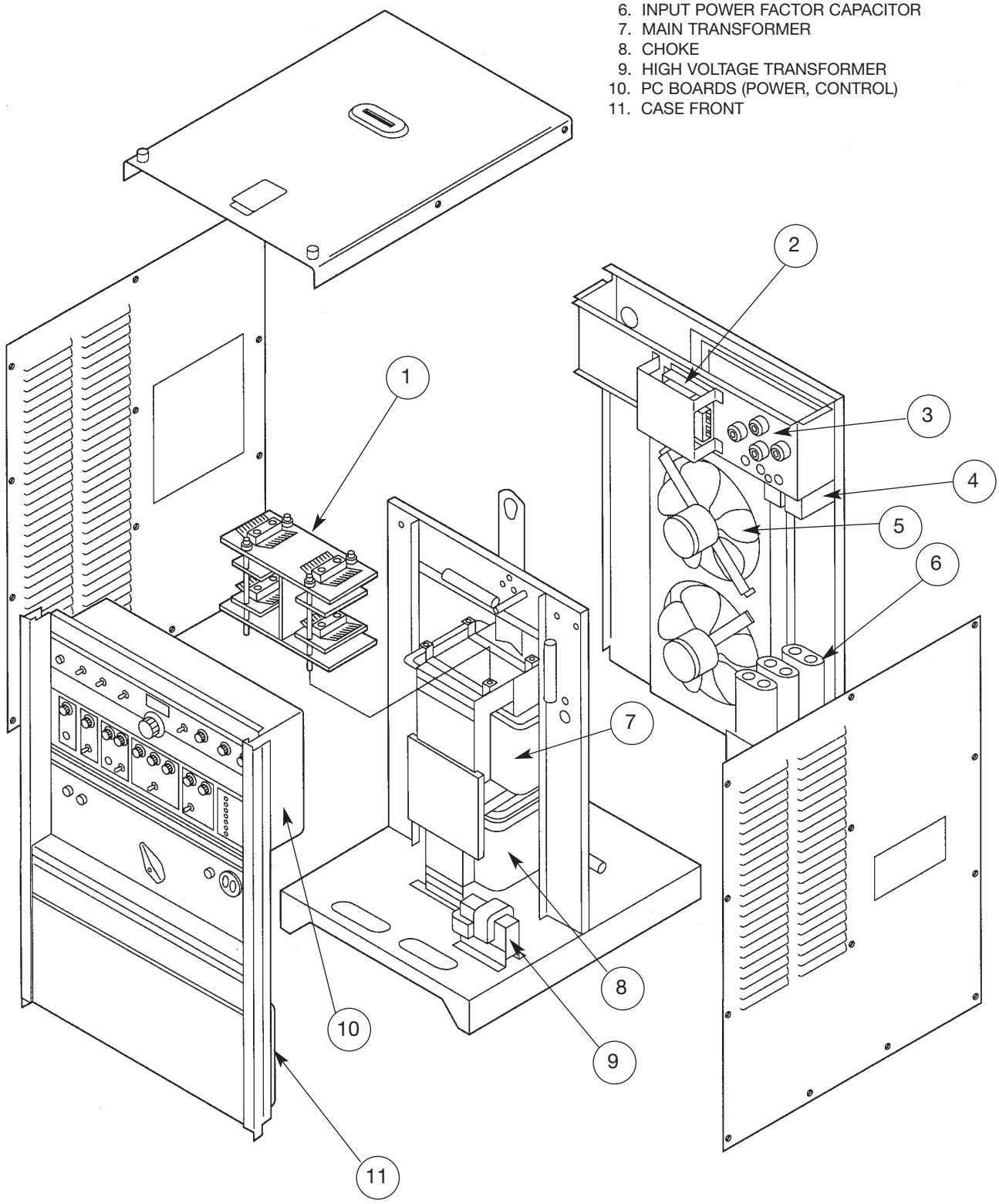
5. The fan motors have sealed ball bearings and require no maintenance.

FIGURE D.1 – POWER FACTOR CAPACITOR DISCHARGE DETAILS

MAINTENANCE

FIGURE D.2 – GENERAL COMPONENT LOCATIONS

1. OUTPUT RECTIFIER/SCR BRIDGE ASSEMBLY
2. INPUT CONTACTOR
3. RECONNECT PANEL
4. PILOT TRANSFORMER
5. FAN AND FAN MOTOR
6. INPUT POWER FACTOR CAPACITOR
7. MAIN TRANSFORMER
8. CHOKE
9. HIGH VOLTAGE TRANSFORMER
10. PC BOARDS (POWER, CONTROL)
11. CASE FRONT



TROUBLESHOOTING

E-1

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed throughout this manual.

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Do not touch electrically live parts such as output terminals or internal wiring.**
- **Turn the input power off at the fuse box before working on equiptment.**
- **Only qualified personnel should perform this installation.**

HOW TO USE THIS GUIDE: Carefully read through each applicable section listed below. Remember that most problems are caused by improper setup, such as switch settings, control settings, electrode sizes, improper shielding gases, etc.

If you believe the setup is correct and the trouble still exists, first check for the obvious: input power, blown fuses, loose PC board connectors, broken wires and the like. The sections listed below are intended to help you find the less obvious sources of trouble.

General Troubleshooting

Stick Welding Trouble

TIG Welding Trouble

Lower Panel Controls Trouble

Accessory Troubles

GENERAL MACHINE TROUBLE

SYMPTOM	CAUSE AND REMEDY
Machine will not turn on.	1. Input supply lines not “hot”. Check input supply line fuses. 2. Blown control circuit fuse (F1). Replace. 3. Thermostat (secondary) has opened. Allow machine to cool before restarting.
Control circuit fuse (F1) keeps blowing.	1. Machine reconnect panel hooked up for wrong voltage. Connect per connection diagram in this manual. 2. Fuse is too small. Use 1/2 amp fuse. 3. Shorted control transformer T5. Replace. 4. Defective Power, Meter, Control, or Protection PC board. Replace PC boards one by one in this order until fuse no longer blows.
Digital meter does not light, but welder turns on as indicated by the Pilot Light and fan operation.	1. Defective Meter PC board. Replace. 2. Defective Control PC board. Replace.
Accessories plugged into 115 volt receptacle do not work.	1. Is accessory defective? Plug it into a known “hot” receptacle to check if it works. 2. Circuit Breaker CB1 is open. Before resetting the Circuit Breaker, find out why it opened. Is the accessory exceeding the 15 amp maximum load? Is the accessory defective?
Cannot preset a current, but meter lights up.	1. Set control knob to 12 o’clock position. Switch Start function OFF. Machine should weld at approximately 80 amps. If machine welds okay but ammeter does not display the welding current while welding: a) The Meter PC board may be defective. Replace. b) The Control PC Board may be defective. Replace. 2. If machine does not weld: a) Current control pot may be defective. Replace. b) The Control PC board may be defective. Replace.

⚠ WARNING

This Troubleshooting Guide is designed to be used by the machine Owner/Operator. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety, please observe all safety notes and precautions detailed in the Safety Section of this manual to avoid electrical shock or danger while troubleshooting this equipment.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed throughout this manual.

STICK WELDING

SYMPTOM	CAUSE AND REMEDY
Machine shuts off in Stick mode.	1. Welder has overheated and secondary thermostat has opened. Allow welder to cool before attempting to turn on. Be sure to provide adequate ventilation around welder to prevent recurrence.
Stick electrode “blasts off” when touched to workpiece.	1. Weld current is set too high for electrode size. Reduce weld current. 2. Start Switch is “On”, and Start Current is set too high for electrode size. Either turn Start Switch OFF, or reduce Start Current. 3. Arc Force control is set too high. Turn to minimum.
Arc seems too hot, and reducing current potentiometer does not help.	1. Arc Force control is set too high. Turn to minimum. 2. Start Switch is ON and Start Current is set too high. Start time may be set too long. Reduce or turn Start Switch OFF.
Machine welds at very low output, regardless of Current potentiometer setting.	1. Current Control switch is in REMOTE. Switch to LOCAL. 2. Start Switch is ON, and Start Current is set too low for the electrode size. Either turn Start Switch OFF, or set Start Current to proper level for the electrode size. 3. Does machine have correct output in TIG mode? If not, see “Machine welds at low output” in TIG troubleshooting section. 4. If TIG welding output is OK, Control PC board is defective. Replace.
Machine welds at very high output, regardless of Current potentiometer setting.	1. Are the Start controls set correctly? See “Stick electrode blasts off” above. 2. Are the TIG welding outputs OK? If not, see TIG troubleshooting section. 3. If TIG welding output is OK, Control PC board may be defective. Replace.
Arc Force control has no effect.	1. The effect of the Arc Force Control will be less noticeable at high welding currents. Weld at low current (less than 150 amps) and check Arc Force effect. 2. If no effects are seen at low currents, the Arc Force control potentiometer may be defective. Replace. 3. Control PC board may be defective. Replace.
Gas and water do not flow even though Gas and Water LED is lit in Stick mode.	Machine is operating properly; gas and water solenoids, as well as the high frequency circuit, are disabled in the Stick mode.

⚠ WARNING

This Troubleshooting Guide is designed to be used by the machine Owner/Operator. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety, please observe all safety notes and precautions detailed in the Safety Section of this manual to avoid electrical shock or danger while troubleshooting this equipment.

TROUBLESHOOTING

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TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed throughout this manual.

TIG WELDING

SYMPTOM	CAUSE AND REMEDY
Machine does not respond (no gas flow, no high frequency, no open circuit voltage) when Arc Start Switch or Amptrol is pressed.	1. Defective Arc Start Switch or Amptrol. Check for continuity between pins D and E on cable connector when Arc Start Switch or Amptrol is pressed. 2. Defective Protection PC board. Replace. 3. Defective Control PC board. Replace.
No gas or water flow when Arc Start Switch is closed in TIG mode.	1. Gas supply is empty or not turned on. 2. Pinched gas or water hose. 3. Gas and High Frequency fuse (F2) blown. Replace fuse. 4. Gas and High Frequency fuse (F2) is too small. Use 1.5 amp fuse. 5. Gas and water lines or solenoids are blocked with dirt. Clean out and use filters to prevent recurrence. 6. Power PC board is defective. Replace.
No High Frequency.	1. High Frequency switch S12 must be in either START or CONTINUOUS position for high frequency to function. 2. Preflow control is set too long. Reduce Preflow setting. (High Frequency does not come on until end of preflow period.) 3. Gas and High Frequency fuse (F2) blown. Replace fuse F2. 4. Gas and High Frequency fuse (F2) is too small. Use 1.5 amp fuse. 5. Spark Gap is too large. Set to gap specified on cover plate. 6. Power PC board is defective. Replace.
Weak high frequency.	1. Spark gap is set too close. Set to 0.015 inches (0.381 mm) gap for most applications. 2. High Frequency Intensity control set too low. Increase to suit. 3. Work and electrode cables in poor condition, allowing high frequency to “leak” to ground. Use good quality cables, preferably those with a high natural rubber content, as short as possible. 4. No shielding gas. Adjust gas flow for 10 to 30 CFH (4.7 to 14.1 l/min.) for most applications. (High frequency will not jump from the tungsten to the work without shielding gas.)
Machine shuts down (pilot light goes out and fans stop) when Arc Start Switch or Amptrol is pressed.	1. If open circuit voltage is greater than 80 volts before shutdown occurs, Control PC board is defective. Replace.
Cannot preset a current on Ammeter when the Arc Start Switch or Amptrol is *not* pressed.	1. Defective Arc Start Switch. There should be *no* continuity between pins D and E of cable connector when Arc Start Switch or Amptrol is *not* pressed. 2. Defective Current Control potentiometer. Replace. 3. Defective Control PC board. Replace. 4. Defective Feedthrough PC board. Replace.

TROUBLESHOOTING

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed throughout this manual.

TIG WELDING (Continued)

SYMPTOM	CAUSE AND REMEDY
Machine has gas flow and high frequency but no open circuit voltage when the Arc Start Switch or Amptrol is pressed.	1. Turn High Frequency Switch OFF. Look at the two LED's in the upper left corner of the Power PC board. They should glow when the Arc Start Switch is pressed. If the LED's do glow, leads 232A and 233A may be reversed on the primary of control transformer T5 in control box. Turn the machine off. Reverse the leads. Turn back on and check for open circuit voltage. If this does not fix the problem, restore wires 232A and 233A to their original positions. If the LED's do not glow, the Power PC board may be defective. Replace. If the problem still exists, the Control PC board may be defective. Replace.
Difficulty in getting tungsten to "light off".	1. Current Control switch is in REMOTE but machine is being used with an Arc Start Switch and no Amptrol. Set switch to LOCAL. 2. Start switch is ON, and Start Current is set too low for tungsten size. Either turn Start switch OFF, or increase Start Current to proper level for tungsten size. 3. Current control is set too low. Amptrol is not being pressed far enough for the tungsten size being used. Try in LOCAL Current Control at a higher current setting. SEE NOTE BELOW. 4. Contaminated tungsten. If tungsten becomes contaminated with foreign materials, grind off end of tungsten to expose fresh electrode. Grind to a point for DC work and leave an end for AC work. 5. Incorrect tungsten type. Pure or zirconiated is recommended for AC welding; thoriated is required for DC welding. 6. No shielding gas (or not enough). Adjust gas flow for 10 to 30 CFH (4.7 to 14.1 l/min) for most applications.
Machine welds only at minimum output when the Current Control switch is in the REMOTE position.	1. Current Control switch is in REMOTE but machine is being used with an Arc Start Switch and no Amptrol. Set switch to LOCAL. 2. Use LOCAL Current Control. If problem goes away, Amptrol may be defective. Replace or repair Amptrol. 3. Current Control switch may be defective. Replace. 4. Can machine be preset for currents from 2 to 400 amps? If not, see "Cannot preset a current" in General Troubleshooting section.
Arc goes out soon after it is lit.	1. Current Control is set too low, or Amptrol is not being pressed far enough for the tungsten size being used. SEE NOTE BELOW. 2. In AC, use Continuous High Frequency.

NOTE: STARTING DIFFICULTIES MAY OFTEN BE DUE TO NOT PRESSING THE AMPTROL FAR ENOUGH. WHEN THE AMPTROL IS JUST "CRACKED", THE MINIMUM CURRENT (2 AMPS) IS PRODUCED. PRESSING THE AMPTROL MORE AT THE START OF THE WELD WILL OFTEN SOLVE STARTING PROBLEMS. Refer to page 23 for proper use of amptrols.

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TROUBLESHOOTING

TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed throughout this manual.

TIG WELDING (Continued)

SYMPTOM	CAUSE AND REMEDY
Tungsten is eroding quickly.	1. Current potentiometer is set too high for tungsten size. Reduce welding current or increase tungsten size. 2. In AC, Wave Balance control may be set too far towards CLEANING. Turn Balance pot towards PENETRATION, or increase tungsten size.
Tungsten seems to “spit” when Arc Start Switch or Amptrol is pressed at high currents.	High welding current is thermally “shocking” the cold tungsten causing pieces of the end to spall off. Turn Start Switch ON, and set Start Current to a value lower than the welding current to give a “soft” start.

LOWER PANEL CONTROLS

SYMPTOM	CAUSE AND REMEDY
Machine does not always wait for Preflow time when starting arc.	Machine is operating correctly; it does not go through a Preflow period if the Arc Start Switch or Amptrol is pressed during the Afterflow period.
The Spot Time does not last as long as the nameplate setting.	When in the 2-Step mode, be sure to keep the Arc Start Switch or Amptrol pressed until the Spot Time is completed. Releasing the Arc Start Switch before the Spot Timer has timed out will cause the arc to go out.
The Spot Time lasts much longer than the nameplate setting.	The Crater Fill switch should be turned OFF. If it is left ON, the actual weld time will be the spot time plus the crater fill time.
The Start Current seems very hot.	The Start Current dial is labeled MIN to MAX of the welder output or, 2 to 400 amps. Always be sure to use the Start Read pushbutton to check the Start Current preset reading on the digital ammeter before welding.
The Pulser does not seem to operate.	1. If Start Controls are used, pulsing does not begin until the end of the start time, which can be as much as 10 seconds. 2. Check the Pulses Per Second control. If it is set near minimum, each pulse may be as long as ten seconds. Set all three of the pulse controls near the midpoints to see the Pulser’s effects. 3. The Pulse % On control may be set at either extreme. If that is the case, the pulses may be too short to be seen, depending on the settings of the Current and Background % Current controls. Set all three of the pulse controls near the midpoints to see the Pulser’s effects.
When using Crater Fill, the arc goes out before the final Crater Fill Current level is reached.	1. The Crater Fill % Current control may be set too low for the tungsten being used. Increase the Crater Fill % Current control until the final Crater Fill current is within the tungsten’s operating range. 2. If using the Pulser in conjunction with the Crater Fill, the Background % Current may be too low for the tungsten as the current is downsloping in Crater Fill. The best solution is to increase the Background % Current level. 3. If welding with AC use CONTINUOUS High Frequency. The high frequency will stabilize the arc as the current goes down.

TROUBLESHOOTING

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed throughout this manual.

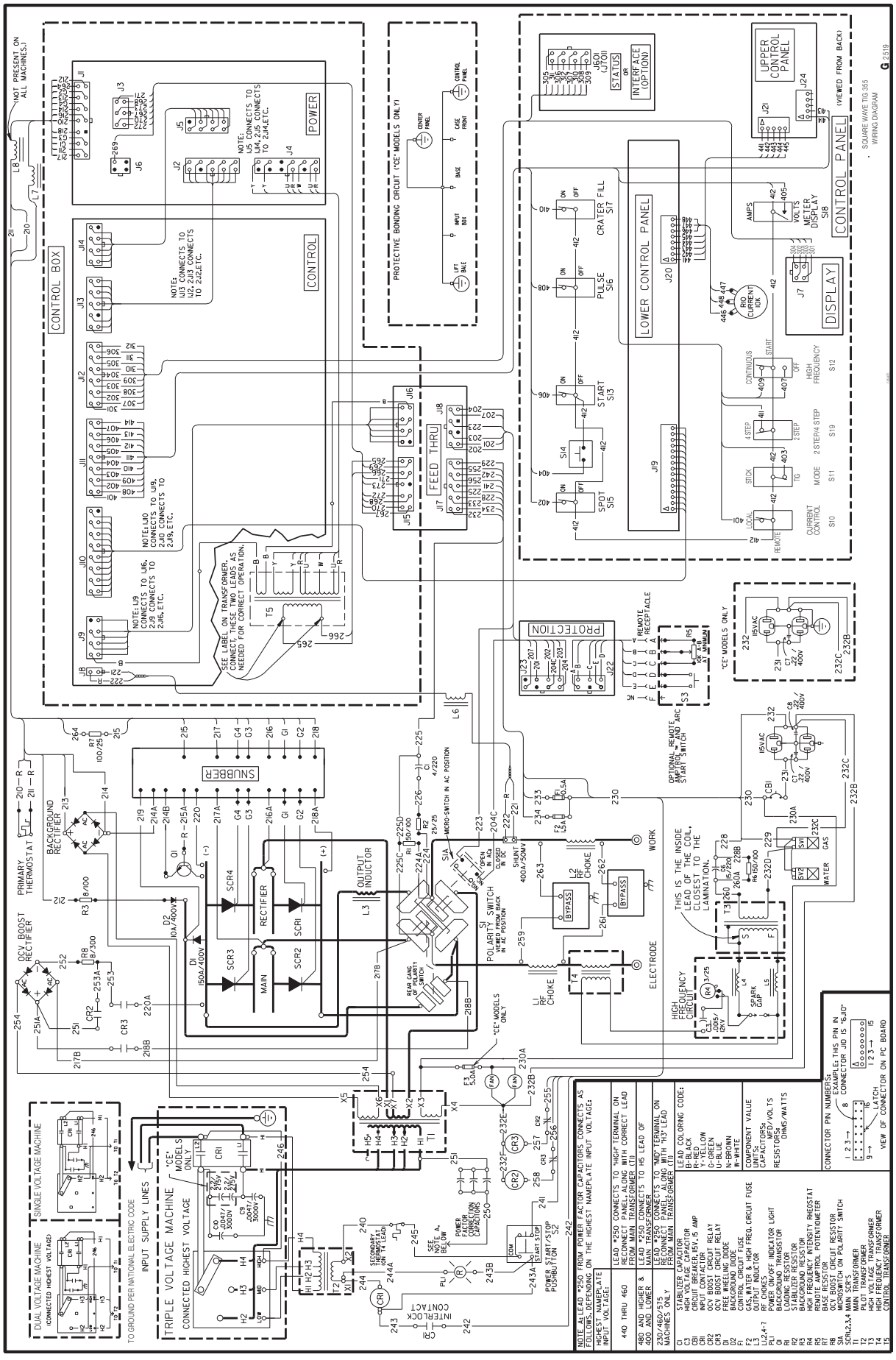
ACCESSORIES

SYMPTOM	CAUSE AND REMEDY
K870 Foot Amptrol or K963 Hand Amptrol. Amptrol does not control welder output with Current Control switch in REMOTE and Mode switch in TIG.	1. Check continuity between pins D and E in the cable connector. There should be an open circuit when the Amptrol is not pressed and a short circuit when it is pressed part way. If this is not the case, check the Amptrol cable for breaks. The microswitch in the Amptrol may not be operating properly. Repair or replace as necessary. 2. Using an ohmmeter, check the resistance between pins A and B in the Amphenol connector. The resistance should be 10K ohms when the pedal is up, and near zero ohms when the pedal is fully depressed. An open circuit would indicate a bad cable or defective potentiometer. Check for breaks and repair or replace the damaged cable or potentiometer.
K814 Arc Start Switch Arc Start Switch does not start welder output in TIG Mode and LOCAL Current Control.	1. Check continuity between pins D and E of the cable connector. There should be an open circuit when the switch is not pressed, and a short circuit when the switch is pressed. Check the cable for breaks, and repair or replace as necessary. Check the switch and its connections. 2. Be sure the 2-Step/4-Step Switch is set correctly.
K846 Interface Kit Solid State Relay Module output does not close when corresponding Status PC board LED lights.	1. Is the correct type of solid state relay module installed? AC modules work only for AC circuits, and DC modules only for DC circuits. 2. Is the corresponding fuse (F1 for CR1, F2 for CR2, etc.) blown? If so, find cause and replace with a 4 amp fuse. 3. Are the Interface and Status PC boards correctly mated to one another? Be sure that all 10 pins on P701 are inserted into J602 on the Status PC board. 4. Is harness connector P601 plugged into J701 on the Interface PC board? 5. Is Terminal Strip (TS701) wired correctly (terminals 3 and 4 for CR1, terminals 5 and 6 for CR2, etc.)? 6. Is DC polarity of terminal strip connection correct? Odd numbers (+), even numbers (–). 7. Defective solid state relay. Replace.
Solid State Relay Module output seems to make contact at wrong times.	1. High Frequency pickup may be a problem. Reroute leads going to Interface terminal strip away from welding cables which carry high frequency. 2. Use shielded cables to make connections to the Interface PC board terminal strip. Ground the shield to terminal 1 or 2 on TS701. 3. Be sure that the white ground lead is on the Interface PC board tab terminal and is connected to the welder chassis screw.

DIAGRAMS

F-1

WIRING DIAGRAM - Square Wave TIG355



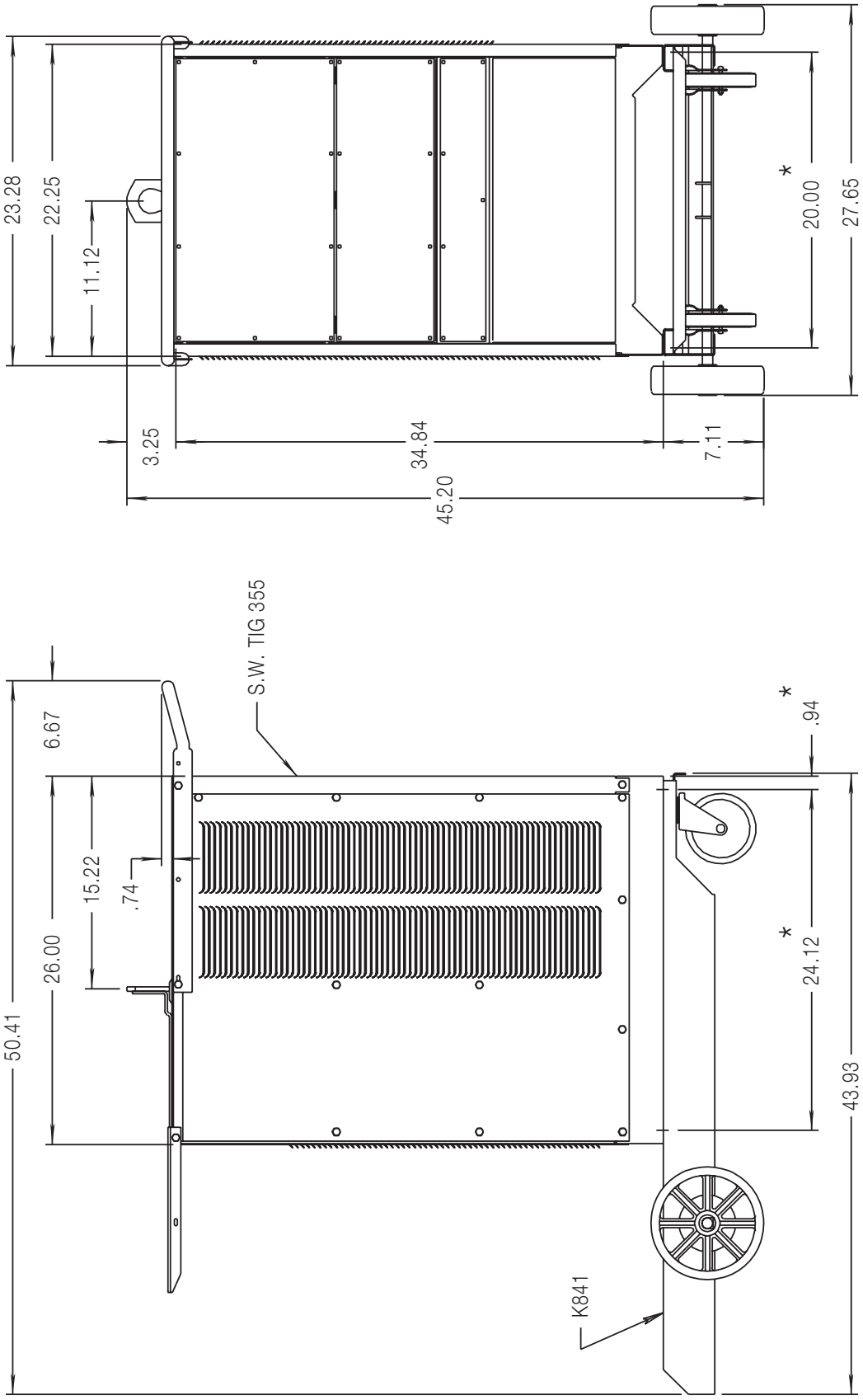
SQUARE WAVE TIG 355

LINCOLN ELECTRIC

M 17275

6-18-93C

DIMENSION PRINT - Square Wave TIG355



SQUARE WAVE TIG 355

LINCOLN ELECTRIC

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EQUIPMENT MANUFACTURER'S CERTIFICATION

Type of Equipment _____
Model Number _____
Code Number _____
Serial Number _____
Operating Instruction Manual Number _____

This certificate indicates manufacturer's conformity to FCC Rules & Regulations. User's compliance with these regulations requires he fill out this certificate & attach it to the equipment or other location where it will be conveniently available for inspection.

The High Frequency Generator of the above identified equipment has been tested under field test condition standards recommended by the Joint Industry Committee on High Frequency Stabilized Arc Welding Machines. It was found to comply with the Federal Communications Commission established maximum allowable R. F. energy radiation limit of 10 micro volts per meter at a distance of 1 mile.

If this equipment is installed, operated and maintained as recommended in the accompanying manual, it may reasonably be expected to meet the Federal Communications Commission established R. F. energy radiation limitation.

The Lincoln Electric Company

EQUIPMENT INSTALLATION CERTIFICATION

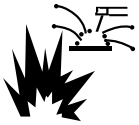
The above identified equipment has been installed and will be operated and maintained in compliance with manufacturer's recommendations made in the accompanying operating manual.

Certifying Signature & Title _____

Date _____

THE LINCOLN ELECTRIC COMPANY CLEVELAND, OHIO U.S.A. S14929 (9-2-83E)

Notes

			
WARNING	● Do not touch electrically live parts or electrode with skin or wet clothing. ● Insulate yourself from work and ground.	● Keep flammable materials away.	● Wear eye, ear and body protection.
Spanish **AVISO DE PRECAUCION**	● No toque las partes o los electrodos bajo carga con la piel o ropa mojada. ● Aislese del trabajo y de la tierra.	● Mantenga el material combustible fuera del área de trabajo.	● Protéjase los ojos, los oídos y el cuerpo.
French **ATTENTION**	● Ne laissez ni la peau ni des vêtements mouillés entrer en contact avec des pièces sous tension. ● Isolez-vous du travail et de la terre.	● Gardez à l'écart de tout matériel inflammable.	● Protégez vos yeux, vos oreilles et votre corps.
German **WARNUNG**	● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung! ● Isolieren Sie sich von den Elektroden und dem Erdboden!	● Entfernen Sie brennbarres Material!	● Tragen Sie Augen-, Ohren- und Körperschutz!
Portuguese **ATENÇÃO**	● Não toque partes elétricas e electrodos com a pele ou roupa molhada. ● Isole-se da peça e terra.	● Mantenha inflamáveis bem guardados.	● Use proteção para a vista, ouvido e corpo.
Japanese **注意事項**	● 通電中の電気部品、又は溶材にヒフやぬれた布で触れないこと。 ● 施工物やアースから身体が絶縁されている様にして下さい。	● 燃えやすいものの側での溶接作業は絶対にしてはなりません。	● 目、耳及び身体に保護具をして下さい。
Chinese **警 告**	● 皮肤或濕衣物切勿接觸帶電部件及銲條。 ● 使你自己與地面和工件絕緣。	● 把一切易燃物品移離工作場所。	● 佩戴眼、耳及身體勞動保護用具。
Korean **위 험**	● 전도체나 용접봉을 젖은 헝겁 또는 피부로 절대 접촉치 마십시요. ● 모재와 접지를 접촉치 마십시요.	● 인화성 물질을 접근 시키지 마시요.	● 눈, 귀와 몸에 보호장구를 착용하십시요.
Arabic **تحذير**	● لا تلمس الاجزاء التي يسري فيها التيار الكهربائي أو الالكترود بجلد الجسم أو بالملابس المبللة بالماء. ● ضع عازلا على جسمك خلال العمل.	● ضع المواد القابلة للاشتعال في مكان بعيد.	● ضع أدوات وملابس واقية على عينيك وأذنيك وجسمك.

READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTION FOR THIS EQUIPMENT AND THE CONSUMABLES TO BE USED AND FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES.

SE RECOMIENDA LEER Y ENTENDER LAS INSTRUCCIONES DEL FABRICANTE PARA EL USO DE ESTE EQUIPO Y LOS CONSUMIBLES QUE VA A UTILIZAR, SIGA LAS MEDIDAS DE SEGURIDAD DE SU SUPERVISOR.

LISEZ ET COMPRENEZ LES INSTRUCTIONS DU FABRICANT EN CE QUI REGARDE CET EQUIPMENT ET LES PRODUITS A ETRE EMPLOYES ET SUIVEZ LES PROCEDURES DE SECURITE DE VOTRE EMPLOYEUR.

LESEN SIE UND BEFOLGEN SIE DIE BETRIEBSANLEITUNG DER ANLAGE UND DEN ELEKTRODENEINSATZ DES HERSTELLERS. DIE UNFALLVERHÜTUNGSVORSCHRIFTEN DES ARBEITGEBERS SIND EBENFALLS ZU BEACHTEN.

● Keep your head out of fumes. ● Use ventilation or exhaust to remove fumes from breathing zone.	● Turn power off before servicing.	● Do not operate with panel open or guards off.	**WARNING**
● Los humos fuera de la zona de respiración. ● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases.	● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio.	● No operar con panel abierto o guardas quitadas.	Spanish **AVISO DE PRECAUCION**
● Gardez la tête à l'écart des fumées. ● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail.	● Débranchez le courant avant l'entretien.	● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés.	French **ATTENTION**
● Vermeiden Sie das Einatmen von Schweibrauch! ● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes!	● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!)	● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen!	German **WARNUNG**
● Mantenha seu rosto da fumaça. ● Use ventilação e exhaustão para remover fumo da zona respiratória.	● Não opere com as tampas removidas. ● Desligue a corrente antes de fazer serviço. ● Não toque as partes elétricas nuas.	● Mantenha-se afastado das partes moventes. ● Não opere com os paineis abertos ou guardas removidas.	Portuguese **ATENÇÃO**
● ヒュームから頭を離すようにして下さい。 ● 換気や排煙に十分留意して下さい。	● メンテナンス・サービスに取りかかる際には、まず電源スイッチを必ず切って下さい。	● パネルやカバーを取り外したままで機械操作をしないで下さい。	Japanese **注意事項**
●頭部遠離煙霧。 ●在呼吸區使用通風或排風器除煙。	●維修前切斷電源。	●儀表板打開或沒有安全罩時不準作業。	Chinese **警 告**
● 얼굴로부터 용접가스를 멀리하십시요. ● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시요.	● 보수전에 전원을 차단하십시요.	● 판넬이 열린 상태로 작동치 마십시요.	Korean **위 험**
● ابعد رأسك بعيداً عن الدخان. ● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها.	● اقطع التيار الكهربائي قبل القيام بأية صيانة.	● لا تشغل هذا الجهاز اذا كانت الاغطية الحديدية الواقية ليست عليه.	Arabic **تحذير**

LEIA E COMPREENDA AS INSTRUÇÕES DO FABRICANTE PARA ESTE EQUIPAMENTO E AS PARTES DE USO, E SIGA AS PRÁTICAS DE SEGURANÇA DO EMPREGADOR.

使う機械や溶材のメーカーの指示書をよく読み、まず理解して下さい。そして貴社の安全規定に従って下さい。

請詳細閱讀並理解製造廠提供的説明以及應該使用的銀焊材料，並請遵守貴方的有関勞動保護規定。

이 제품에 동봉된 작업지침서를 숙지하시고 귀사의 작업자 안전수칙을 준수하시기 바랍니다.

اقرأ بتمعن وافهم تعليمات المصنع المنتج لهذه المعدات والمواد قبل استعمالها واتبع تعليمات الوقاية لصاحب العمل.

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