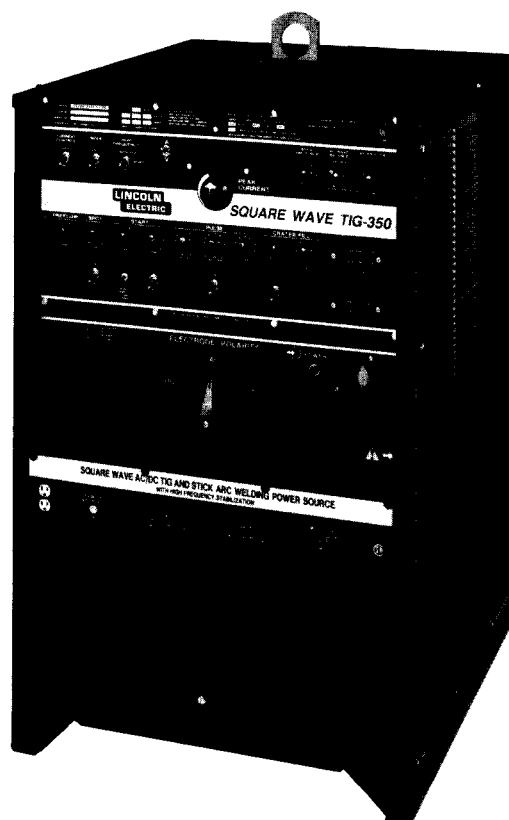


OPERATING MANUAL

SQUARE WAVE TIG 350

CODE 9492



This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

DAMAGE CLAIMS

When this equipment is purchased, 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 equipment is received.

SAFETY DEPENDS ON YOU

Lincoln welders are 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 OPERATING MANUAL AND THE ARC WELDING SAFETY PRECAUTIONS ON PAGES 2, 3 AND 4.** And, most important, think before you act and be careful.

ARC WELDING SAFETY PRECAUTIONS



WARNING: PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH.



ELECTRIC SHOCK can kill.

1. 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.
- b. Insulate yourself from workpiece 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 Welder
 - DC Manual (Stick) Welder.
 - AC Welder with Reduced Voltage Control.
- c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".
 - 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.
 - e. Ground the work or metal to be welded to a good electrical (earth) ground.
 - f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
 - g. Never dip the electrode in water for cooling.
 - 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.
 - i. When working above floor level, protect yourself from a fall should you get a shock.
 - j. Also see Items 4c and 6.



ARC RAYS can burn.

2. 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 Z87.1 standards.

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

3. 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 on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
- 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.
- 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.
- 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.
- e. Also see item 7b.



WELDING SPARKS can cause fire or explosion.

4. 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. Have a fire extinguisher readily available.
- 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.
- 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.
- 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 F4.1-80 from the American Welding Society (see address below).

- e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- 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.
- 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.
- h. Also see item 7c.



CYLINDER may explode if damaged.

- 5. 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.
- b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- 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.
- d. Never allow the electrode, electrode holder, or any other electrically "hot" parts to touch a cylinder.
- e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- f. Valve protection caps should always be in place and handtight except when the cylinder is in use or connected for use.
- g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "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.

- 6. a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.
- b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.
- c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.



FOR ENGINE powered equipment.

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



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



- 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.



- 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.
- 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.
- 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.
- 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.



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

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR WORK performed by qualified people.

For more detailed 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.

PRÉCAUTIONS DE SÛRETÉ

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

Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
 - a. Les circuits à l'électrode et à la pièce 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 vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
 - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique, ou des grilles métalliques, 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 de fonctionnement.
 - 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 précautions pour le porte-électrode s'appliquent 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 soleil, 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 latéraux 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 accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près 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'échauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées 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 phosgène (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 conformément au code de l'électricité et aux recommandations 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 faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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SPECIFICATION SUMMARY

Type		K1370 ⁽¹⁾	K1371 ⁽¹⁾
Input Frequency		60 Hertz	50 Hertz
Rated Output	AC & DC, Stick & TIG 50 & 60 Hz	NEMA Class II (40)	
Additional Output Capacity		350A/34V/40%	375A/35V/35%
		300 Amps, 32 Volts, 60% Duty Cycle 220 Amps, 29 Volts, 100% Duty Cycle 300 Amps, 40 Volts (Lincoln Plus Rating)	
Current Range: Maximum OCV: Normal OCV:		2-400 Amps AC and DC 80 60-70	
INPUT POWER Standard Voltage Nameplate Amps ⁽²⁾ at Rated Output		208/230/460/1/60 110/100/50	200/220/440/1/50 115/104/52
Other Voltages		230/460/575/1/60 100/50/40	220/380/440/1/50 104/61/52 380/415/500/1/50 61/56/47
Idle Current ⁽³⁾ Idle Power Power Factor ⁽³⁾ @ Rated Load		62 Amps @ 230V/60 Hz 1.10 kW Max. 0.88 Min.	50 Amps @ 220V/50 Hz 1.10 kW Max. 0.76 Min.
Auxiliary Power		115 Volts AC, 15 amps continuous Duplex Grounded NEMA 5-15R Receptacle Plus 15 Amp Circuit Breaker	
OPTIONAL FEATURES (All Field Installed)		See page 11.	
Amptrol, Hand Foot Arc Start Switch		K812 K870 K814	
Pump Mtg. Platform Undercarriage Water Valve Option		K827 K841 K844	
Interface Kit Interface Relays		K846 K847-AC and K847-DC	
Net Weight Dimensions, H x W x D, inches (mm)		510 Lbs. (232 Kg) 34.81 x 22.25 x 26.00 – Lift Hook, add 3.44 (884 x 565 x 660) – (Lift Hook, add 87)	
Wiring Diagram		G2097	

⁽¹⁾ Several standard input voltages are available. They are specified by type number. See price book or your local distributor.

⁽²⁾ Unbalanced AC TIG welding above 230 amps will draw higher input currents; see page 10.

⁽³⁾ Power factor correction capacitors are standard on all models, the capacitors cause high idle currents but idle power is low.

PRODUCT DESCRIPTION AND FEATURES

The Square Wave TIG 350 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. It is available from the factory in one model only; there are no factory installed options other than different input voltages and frequency.



The Square Wave TIG 350 allows full control of the welding current by the operator plus the ability to preset weld and start currents. It includes a gas and water preflow timer, a spot timer, a start time control, pulsing controls, crater fill controls and status indicator lights. These controls allow all or part of the weld cycle to be preset or “programmed”.

- Excellent arc starting and stability from 2 through 400 amps.
- High resistance to AC arc rectification.
- No tungsten spitting within current range of electrode.
- “Hot Start” stick welding capability.
- Choice of start only or continuous high frequency for AC welding of aluminum above 60 amps.
- Compact size, requires only a 22" x 26" (560 x 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.
- Simple control panel layout allows each function group to be turned on or off by a switch.
- Unused controls are automatically locked out to simplify setup. Examples: the Stick Arc Force control has no effect in TIG mode; 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 function controls are locked out in 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.
- Submersion dipping of assembled transformer, choke, rectifier and base unit in special sealing/insulating material gives added protection against moisture and corrosive atmospheres.

INSTALLATION



Read **all** of the Installation section, pages 8-10.

Safety Precautions

 WARNING	
	<ul style="list-style-type: none">• Have an electrician install and service this equipment.• Turn the input power off at the fuse box before working on equipment.• Do not touch electrically hot parts.• Connect the grounding terminal located on the bottom of the input connection box to a good electrical earth ground.
ELECTRIC SHOCK can kill.	

Location

Place the welder where clean cooling air can freely circulate in through the side louvers and out through the rear louvers. Dirt, dust or any foreign material that can be drawn into the welder should be kept at a minimum. Failure to observe these precautions can result in excessive operating temperatures and nuisance welder trips off the line. Before planning the installation, read the section entitled “High Frequency Interference Protection”.

 WARNING	
	<ul style="list-style-type: none">• Do not lift this machine using lift bail if it is equipped with a heavy accessory such as trailer or gas cylinder.• Lift only with equipment of adequate lifting capacity.• Be sure machine is stable when lifting.
FALLING EQUIPMENT can cause injury.	

Square Wave TIG 350's may be stacked two-high provided the bottom machine is on a stable, hard, level surface. Be sure the two pins in the roof fit into the holes in the base of the Square Wave TIG 350 above it.

High Frequency Interference Protection

Since the spark gap oscillator in the high frequency generator in the welder is similar to a radio transmitter, improper welder installation can result in radio and TV interference or problems with nearby electronic equipment. The Square Wave TIG 350 has been field tested under recommended installation conditions and has been found to comply with the F.C.C. allowable radiation limits. A certificate is being sent with each welder for customer convenience. If certification of compliance with F.C.C. RF Energy Radiation Limits is required, this certificate can be used. It is the customer's responsibility to obtain this certification. This welder has also been found to comply 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 reradiation 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 (15.2 m). 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 feet (7.6 m). 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 (3.0 m) of the welder, using one of the following methods:
 - a. A metal underground water pipe in direct contact with the earth for ten feet (3.0 m) or more.
 - b. A 3/4" (19 mm) galvanized pipe or conduit or a 5/8" (16 mm) solid galvanized iron or steel or copper rod driven at least eight feet (2.4 m) 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 reradiation, effectively making these members radiating antennas.

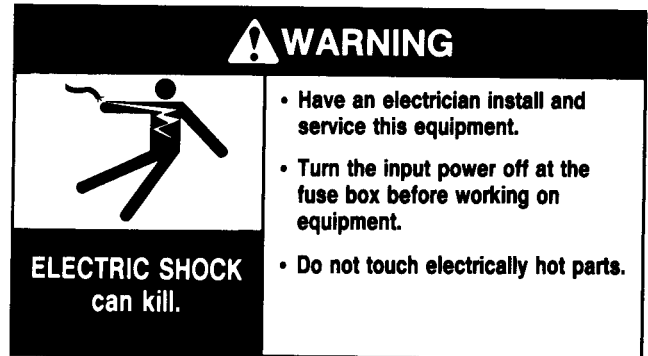
NOTE: The welder frame MUST also be grounded – see paragraph under "Input Connections". The work terminal ground does not ground the welder frame.

6. Keep all access panels and covers securely in place.
7. All electrical conductors within 50 feet (15.2 m) of the welder should be enclosed in grounded rigid metallic conduit or equivalent shielding. Flexible helically-wrapped metallic conduit is generally not suitable.
8. When the welder is enclosed in a metal building, several good earth driven electrical grounds (see 5b. 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 welder nameplate.

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

Have a qualified electrician connect the input leads to L1 and L2 of the input contactor in accordance with the U.S. National Electrical Code, all local codes and the connection diagram located on the inside of the cover. Use a single phase line or one phase of a two or three phase line.

The frame of the welder must be grounded. A grounding terminal marked with the symbol \equiv located at the bottom of the input box is provided for this purpose. See the U.S. National Electrical Code for details on proper grounding methods. Follow other grounding instructions per the paragraph under "High Frequency Interference Protection".

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

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE IMMEDIATE FAILURE OF COMPONENTS WITHIN THE WELDER.

Welders are shipped connected for the highest nameplated input voltage. To change this connection for a different input voltage, reconnect both 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 nameplated 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. Choose an input and grounding wire size according to local codes or use the following tables. "Delay type"⁽¹⁾ circuit breakers may be used in place of fuses. Using fuses or circuit breakers smaller than recommended may result in "nuisance" tripping 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 per Table 2.

⁽¹⁾ Also called "inverse time" or "thermal/magnetic" circuit breakers; circuit breakers which have a delay in tripping action that decreases as the magnitude of the current increases.

TABLE 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

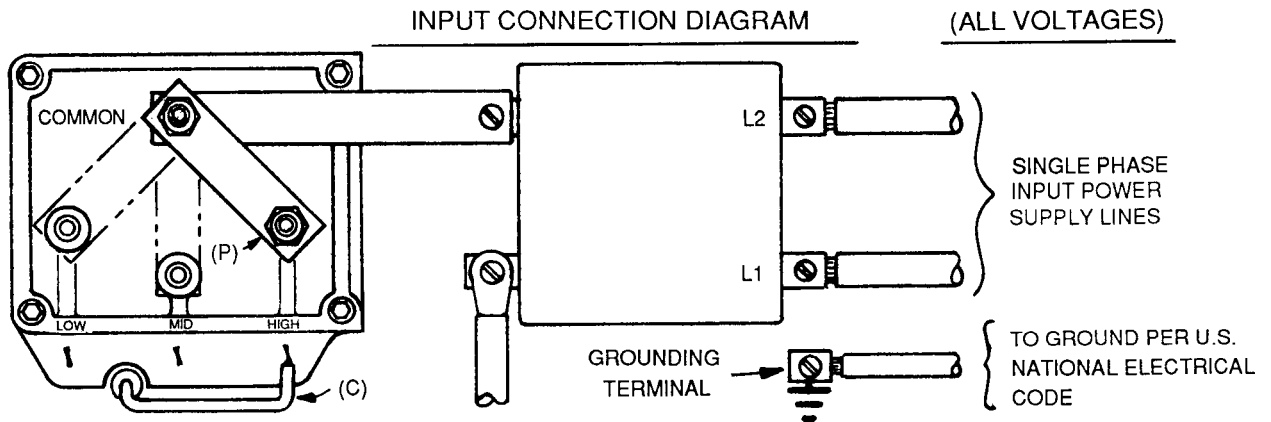
Input Volt/Freq.	Input Ampere Rating on Nameplate	Type 75°C Wire in Conduit AWG Copper Cond.	Grounding Wire AWG Copper Cond.	Fuse Size (Super Leg)
208/60	110	4	6	150
230/60	100	4	6	125
460/60	50	8	10	60
200/50	115	4	6	150
220/50	104	4	6	125
440/50	52	8	10	60

TABLE 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⁾ 40% 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 Leg)
208/60	148	3	6	200
230/60	134	3	6	175
460/60	67	8	8	80
200/50	154	3	6	200
220/50	140	3	6	200
440/50	70	8	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.



WARNING: BEFORE CONNECTING THE INPUT POWER LEADS TO THE MACHINE, TURN THE POWER OFF USING THE DISCONNECT SWITCH AT THE FUSE BOX. CHECK THE NAMEPLATE AND CONNECT ONLY RATED INPUT VOLTAGES AND FREQUENCY TO THE MACHINE.

(FAILURE TO FOLLOW THESE INSTRUCTIONS CAN CAUSE IMMEDIATE FAILURE OF THE ELECTRONIC COMPONENTS WITHIN THE WELDER.)

1. CONNECT THE INPUT POWER SUPPLY LEADS TO TERMINALS L1 AND L2, AND A GROUNDING LEAD TO THE GROUNDING TERMINAL. FOR PROPER OVERCURRENT PROTECTION, INPUT & GROUNDING CONDUCTOR SIZES, SEE THE OPERATING MANUAL, THE NATIONAL ELECTRICAL CODE AND APPLICABLE LOCAL CODES.
2. DESIGNATIONS ON RECONNECT PANEL, LOW, MID AND HIGH CORRESPOND TO THE NAMEPLATED INPUT VOLTAGES OF A TRIPLE-VOLTAGE WELDER. DUAL VOLTAGE WELDERS USE ONLY LOW AND HIGH. SINGLE VOLTAGE WELDERS USE ONLY HIGH. WELDERS ARE SHIPPED CONNECTED FOR THE HIGHEST NAMEPLATED INPUT VOLTAGE.
3. TO CHANGE THIS CONNECTION FOR A DIFFERENT INPUT VOLTAGE, RECONNECT BOTH POWER STRAP (P) AND CONTROL LEAD (C) TO THEIR RESPECTIVE TERMINALS CORRESPONDING TO THE INPUT VOLTAGE USED.

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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 350 "off" before connecting or disconnecting output cables or other equipment.

Tig Torch Connection

TIG welding torches come with 12.5 ft. (3.8 m) or 25 ft. (7.6 m) cables. Use the shorter length whenever possible to minimize possible radio interference problems. With power source off, connect the torch cable to the 'Electrode' stud on the welder. Connect a separate work cable to the 'To Work' stud of the welder. Both work and electrode cables should be routed through the cable strain relief holes provided in the base directly below the welding output terminals.

TIG torches include the necessary gas and, when designed for water cooling, water hoses. Connect the fittings on these hoses to the welder. Any torch conforming to Compressed Gas Association (CGA) standards can be connected. The fittings have the following threads: Gas Inlet and Outlet: 5/8"-18 right-hand female; Optional Water Inlet and Outlet: 5/8"-18 left-hand female.

WARNING

**CYLINDER
may explode if
damaged.**

- Keep cylinder upright and chained to support.
- Keep cylinder away from areas where it may be damaged.
- Never lift welder with cylinder attached.
- Never allow welding electrode to touch cylinder.
- Keep cylinder away from welding or other live electrical circuits.

The cylinder of inert shielding gas must be equipped with a pressure regulator and flowmeter. Install a hose between the flowmeter and gas inlet on the welder.

DO NOT operate a water-cooled torch unless water is flowing.

If using a water-cooled torch with a water recirculator, connect the recirculator water outlet directly to the torch

water hose. Do not install the optional Water Valve Kit; the welder water valve would unnecessarily stop the recirculator water flow, possibly damaging the recirculator pump.

If using a water-cooled torch with a free-running water supply, install the optional K844 Water Valve Kit. 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 Outlet" fitting. Use a nonmetallic drain line from the electrode connection to the drain or water recirculating pump.

Stick Electrode Cable Connection

Select cable size according to Table 3.

1. Turn the power source off.
2. Route the electrode and work cables through the strain relief holes below the welding output terminals. This strain relief prevents damage to the terminals if the cables are pulled excessively.
3. Connect the cables to the proper terminals.

WARNING: DISCONNECT STICK ELECTRODE WELDING CABLE WHEN TIG WELDING AS IT WILL BE ELECTRICALLY HOT.

**TABLE 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)
350A/40%	#1 (45 mm ²)	1/0 (55 mm ²)	2/0 (70 mm ²)

OPTIONAL FIELD INSTALLED KITS Amptrol™ (K870 or K812)

The Amptrol remote current control is used for most TIG welding applications. It is available in either hand (K812) or foot (K870) operated models. Both plug into the Remote Receptacle. With the Current Control Switch in the LOCAL position, the output current is controlled by the rheostat on the front panel of the welder. With the Current Control Switch in the REMOTE position, the output current is controlled by the Amptrol. The range of control by the Amptrol is from 2 amps up to the current set on the control panel. The Amptrols also contain a switch which starts the welding sequence. Both hand and foot Amptrols have 25 ft. (7.6 m) of cable. It is recommended that any excess length be tucked under the welder.

Depress the Amptrol to start the welding sequence. Depressing the pedal increases the current. Depress it fully to get the maximum set current. Raise the foot to reduce the current. Fully raising the pedal stops the weld and starts the Afterflow time.

Tape the Hand Operated Amptrol to the TIG torch in a position so the control can be extended conveniently by the thumb. A slight movement starts the gas and the water flow and allows output current. Extending the control raises the

current. Extend the control fully to get the maximum set current. Reducing thumb pressure allows the spring-loaded control to return, reducing the current. Completely returning to the start position stops the weld and starts the Afterflow time.

CAUTION: SINCE THE FULL OUTPUT OF THE CURRENT SETTING IS AVAILABLE WHEN THE AMPCTRL 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.

NOTE: STARTING DIFFICULTIES MAY OFTEN BE DUE TO NOT PRESSING THE AMPCTRL FAR ENOUGH. WHEN THE AMPCTRL IS JUST "CRACKED", THE MINIMUM CURRENT (2 AMPS) IS PRODUCED. PRESSING THE AMPCTRL MORE AT THE START OF THE WELD WILL OFTEN SOLVE STARTING PROBLEMS.

With the Current Control Switch in the LOCAL position, only the switch in the Amptrol is active — it functions as an Arc Start switch but does not control current.

Arc Start Switch (K814)

The Arc Start Switch, complete with 25 ft. (7.6 m) cable, is available if remote current control for TIG welding is not desired. It plugs into the Remote Receptacle and serves the purpose of starting the welding sequence. The Current Control switch must be in the LOCAL position; if in REMOTE, only minimum current (2 amps) will be available.

Tape the Arc Start Switch to the TIG torch where it can be conveniently pressed by the finger or thumb when holding the torch in position for welding.

Pump Mounting Platform (K827)

A formed metal platform, which fits on top of the welder and provides a mounting surface suitable for certain water recirculating pumps.

Undercarriage (K841)

Includes platform wheels and brackets for supporting the welder and two gas cylinders.

Interface Kit (K846)

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

below) and are plugged into the sockets of those functions for which a remote status indication is needed.

Solid State Relays (SSR): Single pole, normally open, optically isolated SSR modules plug into K846 Interface Kit. Customer must provide current and voltage limiting of circuitry connected to relay.

K847-DC: Can switch up to 40 VDC, 2 Amp Maximum Load. Package of two DC SSR modules.

K847-AC: Can switch up to 130 VAC, 2 Amp Maximum Load. Package of two AC SSR modules.

Water Valve Kit (K844)

Includes all parts needed to add a water valve.

UPPER CONTROL PANEL

The Upper Panel Controls are used for manual TIG and stick welding.

A. CURRENT CONTROL SWITCH

A two-position toggle switch:

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

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

B. 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.

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.

C. 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.

D. 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, the switch must be held in the 'Volts' position. This spring-loaded switch always returns to the 'AMPS' position when released.

E. DIGITAL VOLTMETER/AMMETER

Displays the output voltage of the welder when the VOLTS/AMPS switch is held in the 'VOLTS' position.

When the VOLTS/AMPS switch is in the 'AMPS' position, this display functions as an ammeter.

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

When not welding, and the Start Current Display pushbutton is pressed, the ammeter will display the preset Start current (see Section 4.3).

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

While welding, the ammeter displays the actual welding current. The ammeter is accurate within $\pm 3\%$ 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.

F. 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 not welding.

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

If an Amptrol is used, it will control the current from 2 amps up to the current preset by the Peak Current control. See Section on "Hand and Foot Amptrol Operation" on page 34, for proper use of hand and foot Amptrols.

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

G. ARC FORCE

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

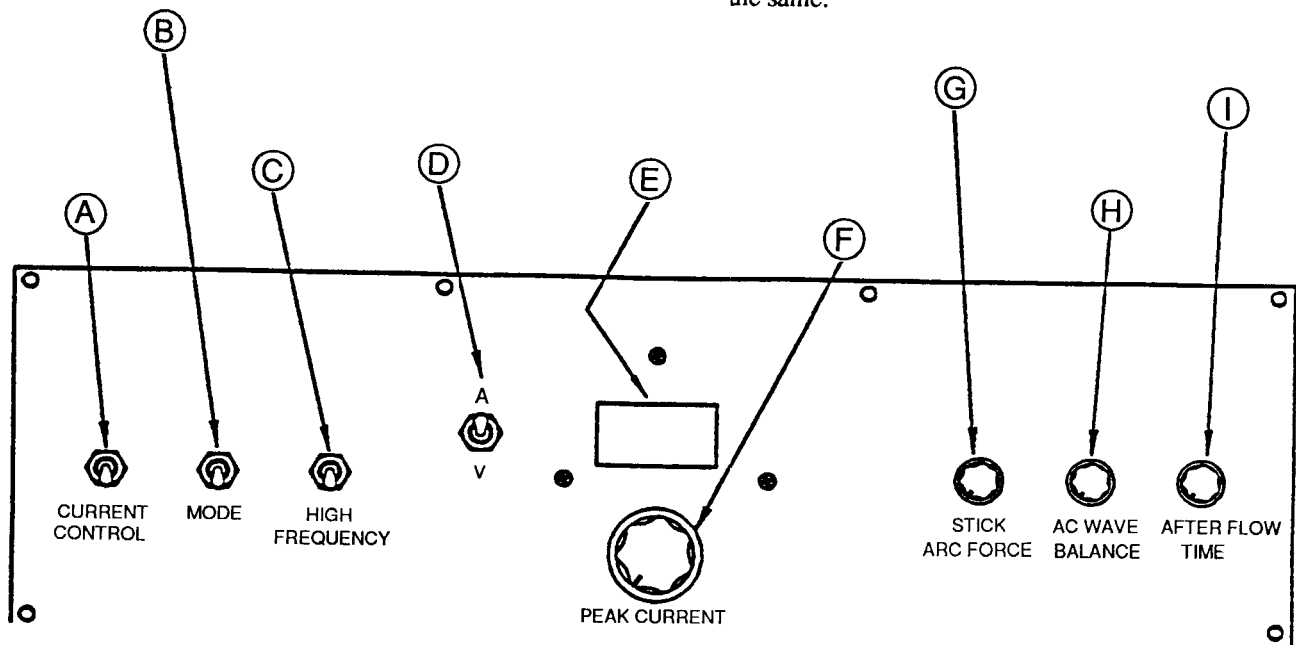
At Minimum, no extra short circuit current is added. The arc will be softer and will have less spatter, but may be more prone to sticking.

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

H. 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.

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



UPPER CONTROL PANEL

MAX CLEANING: 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 because the greater amount 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.

MAX PENETRATION: 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.

I. 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 which still gives good protection.

PREFLOW

All machines have an adjustable Preflow time (see page 21).

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.

LOWER CONTROL PANEL

A. PREFLOW TIMER

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.

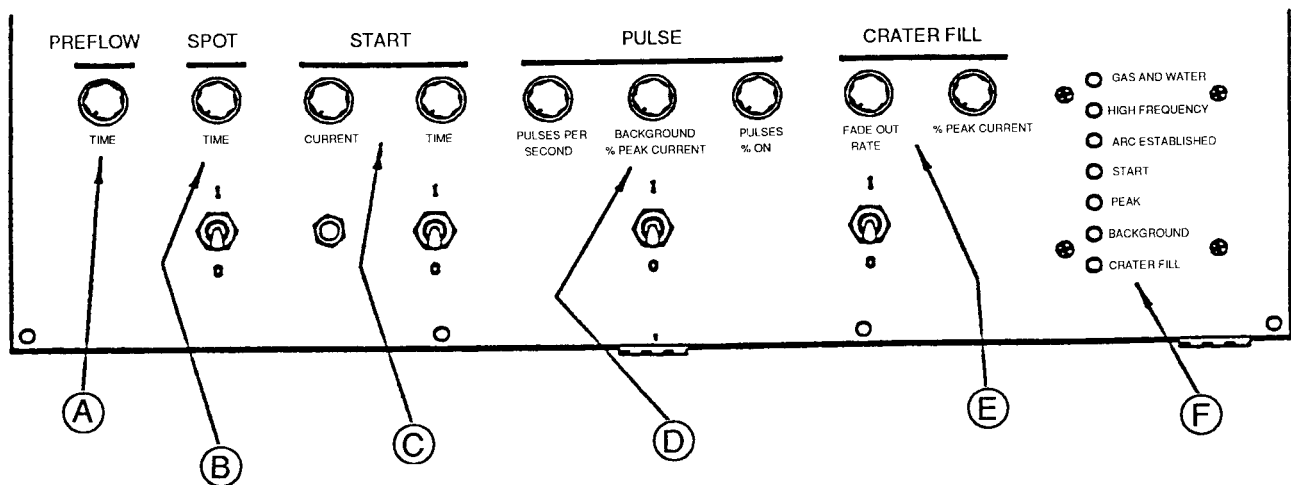
B. SPOT CONTROLS

Spot Switch A two-position toggle switch:

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 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).



LOWER CONTROL PANEL

C. 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. The 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 must be in the “AMPS” position to read preset current, see page 18, “Volts/Amps Switch”.

Start Current Control

Locked out if the Start switch is off.

Presets the current which 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 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 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 towards, and thus 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.

D. PULSE CONTROLS

Pulse Switch – A two-position toggle switch:

ON: Pulsing will begin as soon as an arc is established and continue until the Arc Start Switch or Amptrol is released. If using Start Controls, pulsing begins after the Start Current. If 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 and Amptrol.

Example: If the Peak Current Control is preset at 50 amps and the Amptrol is partially down, giving a peak current of 30 amps, and 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: If 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.

E. CRATER FILL CONTROLS

Use the Crater Fill controls to automatically control current fade-out at the end of a weld. LOCAL current control 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 (or at end of Spot time if Spot switch is on). The Current Control switch must be in LOCAL when using Crater Fill.

OFF: Locks out Crater Fill controls.

Fade-Out Control – Controls how fast the current will fade when the Arc Start switch is released. 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.

F. STATUS INDICATOR LED's – Seven Light Emitting Diodes (LED's) which light when that function is commanded by the control circuit to be active:

- GAS & WATER LED is on when the solenoid valves are commanded to be open, from the beginning of Preflow to the end of Afterflow.
- HIGH FREQUENCY LED is on when the high frequency circuit is commanded to be on.
- 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's will alternate when pulsing.
- BACKGROUND LED is on when in the Background (low pulse) period of pulsing.
- CRATER FILL LED is on during the Fade-Out downslope and final current periods.

NOTE: The 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 LED's are useful for understanding which functions are active during a welding sequence and for how long. They are useful for setting times of the controls on the Function Panel.

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

STATUS INDICATOR LIGHT SEQUENCE SQUARE WAVE TIG 350

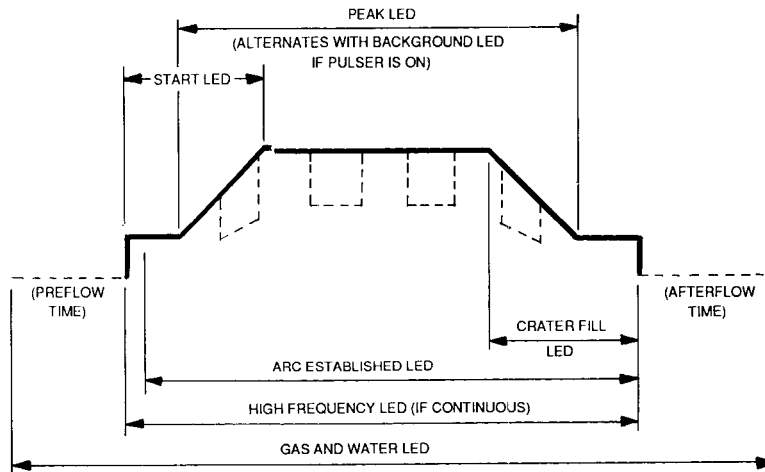
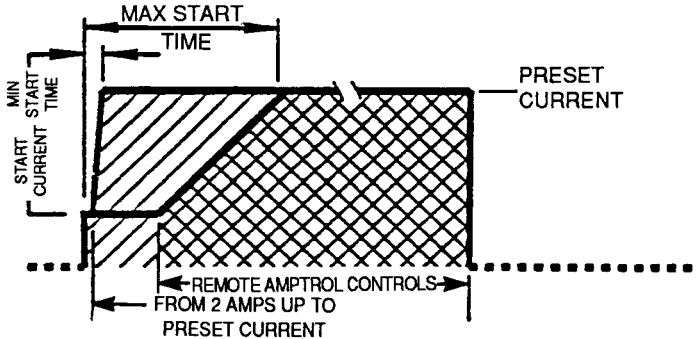
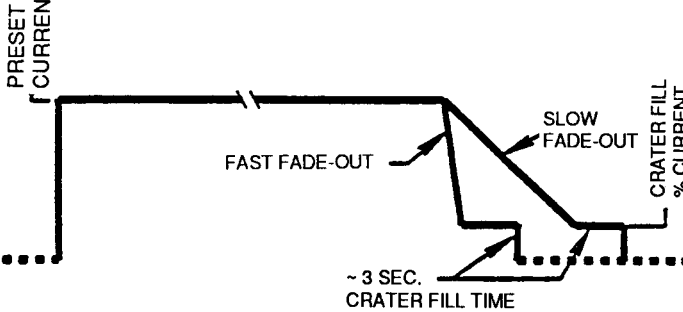
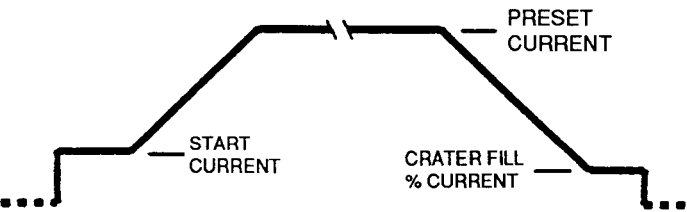
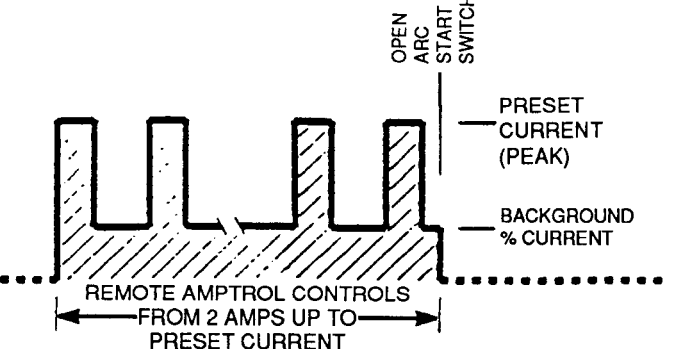


Figure 1

SPECIFIC EFFECTS OF CONTROLS

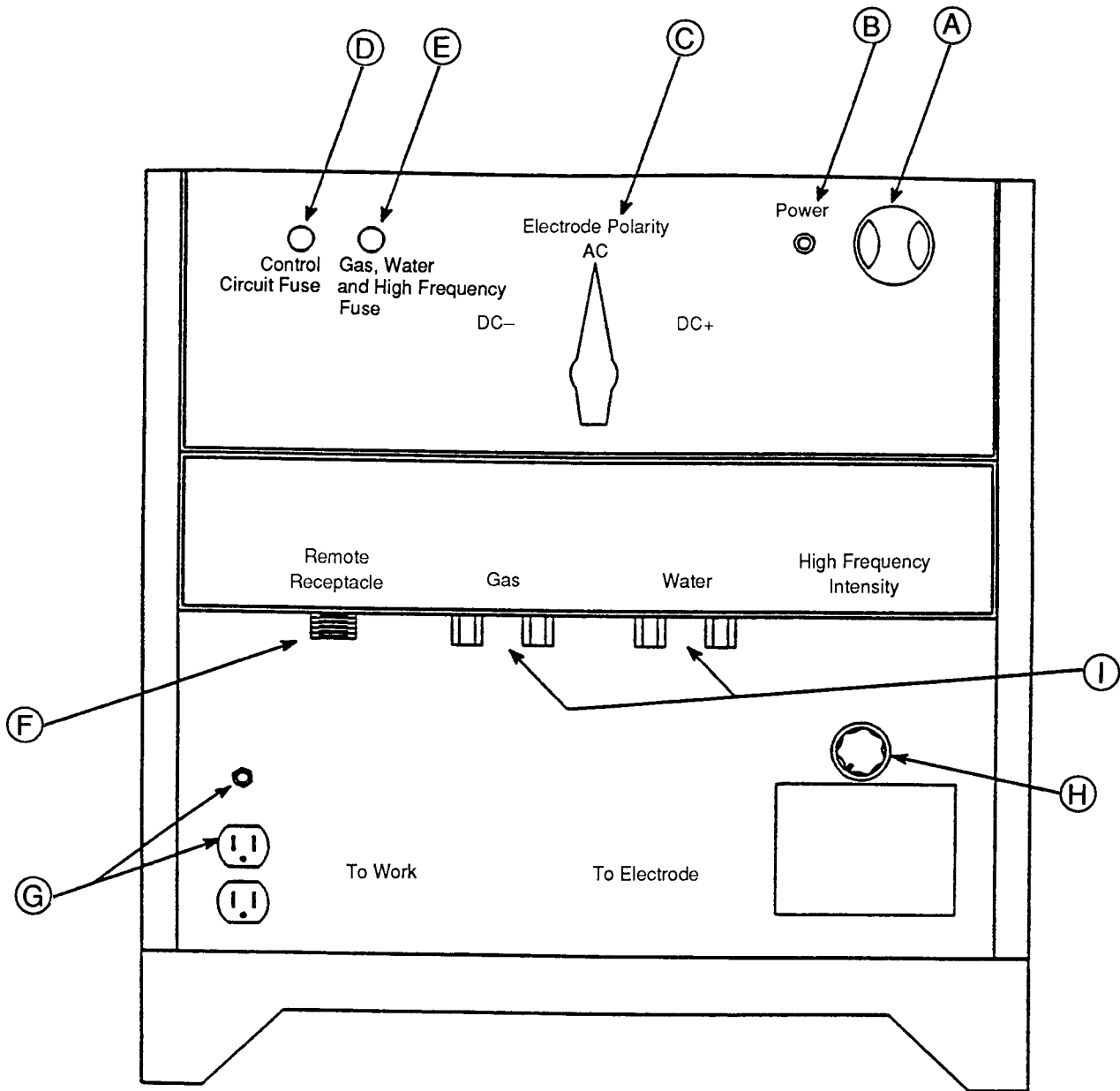
CLOSE ARC START SWITCH WELD BEGINS	OPEN ARC START SWITCH	EFFECT OF CONTROLS ON TIG WELDING
	<p>PRESET CURRENT</p> <p>AFTERFLOW</p>	<p>LOCAL CURRENT CONTROL ALL LOWER PANEL SWITCHES OFF</p>
	<p>PRESET CURRENT</p> <p>REMOTE AMPPTROL CONTROLS FROM 2 AMPS UP TO PRESET CURRENT</p>	<p>REMOTE CURRENT CONTROL ALL LOWER PANEL SWITCHES OFF</p>
	<p>START TIME</p> <p>START CURRENT</p> <p>PRESET CURRENT</p> <p>REMOTE AMPPTROL CONTROLS FROM 2 AMPS UP TO PRESET CURRENT</p>	<p>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</p>

HOT START

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

<p>CLOSE ARC START SWITCH WELD BEGINS</p> <p>OPEN ARC START SWITCH</p>	<p>EFFECT OF CONTROLS ON TIG WELDING</p>		
	<p>LOCAL CURRENT CONTROL START SWITCH ON (SHORT HOT START SHOWN) PULSE SWITCH ON CRATER FILL SWITCH ON (SLOW FADE-OUT SHOWN) SPOT SWITCH OFF</p>	<p>START & PULSE & CRATER FILL</p>	
<p>REMOTE AMP TROL CONTROLS CURRENT FROM 2 AMPS UP TO PRESET CURRENT</p>	<p>LOCAL OR REMOTE SPOT SWITCH ON ALL OTHER LOWER PANEL SWITCHES OFF</p> <p>(SPOT TIME IS CUT SHORT IF ARC START SWITCH IS OPENED BEFORE END OF SPOT TIME)</p>	<p>SPOT</p>	
<p>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.</p>			<p>SPOT & START & PULSE & CRATER FILL</p>

LOWER PANEL CONTROLS




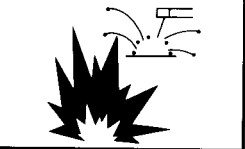



LOWER FRONT CONTROLS

- A. 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.
- B. PILOT LIGHT** – Indicates when the input contactor is energized (power is on).
- C. POLARITY SWITCH** – Selects DC-/AC/DC+
- CAUTION: DO NOT SWITCH UNDER LOAD.**
- D. 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.
- E. FUSE F2** – 1.5 amp Gas & Water & High Frequency Fuse protects the circuitry which 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 LED's for Gas & Water and High Frequency will still light.
- F. REMOTE RECEPTACLE** – A six-pin circular connector for an Arc Start switch or an Amptrol™ remote current control.
- G. 115 VOLT RECEPTACLE & CIRCUIT BREAKER** – A duplex 15 amp grounded NEMA 5-15R receptacle and 15 amp circuit breaker. 15 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.
- H. HIGH FREQUENCY INTENSITY CONTROL & SPARK GAP** – This control changes the high frequency intensity. Use the lowest intensity which still gives good arc starting to minimize Radio Frequency Interface (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.
- I. GAS & OPTIONAL WATER VALVES** – Solenoid valves which open at the beginning of the Prewflow time and close at the end of the Afterflow time.

The gas valve inlet and outlet are standard 5/8-18 right-hand female fittings. The optional 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.

SETUP AND OPERATION

 WARNING	
	<ul style="list-style-type: none">• Do not touch electrically live parts or electrode with skin or wet clothing.• Insulate yourself from work and ground.
ELECTRIC SHOCK can kill.	
	<ul style="list-style-type: none">• Keep your head out of fumes.• Use ventilation or exhaust to remove fumes from breathing zone.
FUMES AND GASES can be dangerous.	
	<ul style="list-style-type: none">• Keep flammable material away.
WELDING SPARKS can cause fire or explosion.	
	<ul style="list-style-type: none">• Wear eye, ear and body protection.
ARC RAYS can burn.	

Initial Start-Up

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

If TIG welding, connect a K870 or K812 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 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. If 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 if in TIG mode, or from 60 to 70 if 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 that block (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. Pages 17, 18 and 19 give examples of the effects of the Function controls on TIG welding.

Duty Cycle

The Square Wave TIG 350 is NEMA Class II (40) rated 350 amps at 34 volts, 40% duty cycle. The duty cycle is based upon a 10 minute time period; i.e., 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.

Stick Welding Operation

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). Select DC± or AC electrode polarity.
4. Preset the current with the Current control and the Ammeter.
5. Set the desired Arc Force (see page 13, "Arc Force"). (The AC 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 page 15, "Start Controls").
7. Strike an arc and weld. (There will be a buzzing sound from the arc if 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 4. 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. All other control settings will be made 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. See page 13, "AC Wave Balance," for use of the AC Wave Balance control.

TABLE 4
TYPICAL CURRENT RANGES⁽¹⁾ FOR TUNGSTEN ELECTRODES⁽²⁾

Tungsten Electrode Diameter in. (mm)			AC				Approximate Argon Gas Flow Rate C.F.H. (l/min)		TIG Torch Nozzle Size #, ⁽⁵⁾
	DCEN (-)	DCEP (+)	Balanced Wave		Unbalanced Wave		Aluminum	Stainless Steel	
	1%, 2% Thoriated Tungsten	1%, 2% Thoriated Tungsten	Pure Tungsten	1%, 2% Thoriated Tungsten Zirconiated	Pure Tungsten	1%, 2% Thoriated Tungsten Zirconiated			
.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):

PureEWP
 1% ThoriatedEWTh-1
 2% ThoriatedEWTh-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. (8 mm)
 # 6 = 3/8 in. (10 mm)
 # 7 = 7/16 in. (11 mm)
 # 8 = 1/2 in. (12.5 mm)
 #10 = 5/8 in. (16 mm)

(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.

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 tungsten 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.

TIG Welding Sequence Of Operation

WARNING: DO NOT LEAVE STICK ELECTRODE WELDING CABLE CONNECTED AS 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 so 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:

**TABLE 5
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 page 13, "AC Wave Balance" This control has no effect in DC.)
7. Set Afterflow time.
8. Set Function Panel controls as needed. (See page 14.)
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 setting of the Prewflow control, 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.

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.

Hand And Foot Amptrol Operation

Both the Hand and Foot Amptrol work in a similar manner. They are meant to be used for remote current control when the Square Wave TIG Current Control switch is in the REMOTE position. As explained below, both can also be used as arc start switches if the Current Control switch is in the LOCAL position.

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. See the diagram which follows.

The Amptrol is capable of controlling the output current from 2 amps to whatever current is preset on the digital 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 to weld at 2 amps. At the Amptrol's maximum position, the output will be near 200 amps.

It is important to note that, for many applications, the tungsten will not start an arc at only 2 amps. (Refer to the chart on page 22 for recommended tungsten currents.) 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. 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 will 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. Upon depressing 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 arc start switch to open. The Amptrol will have no effect on the welding current when used as an arc start switch.

MAINTENANCE

⚠ WARNING



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

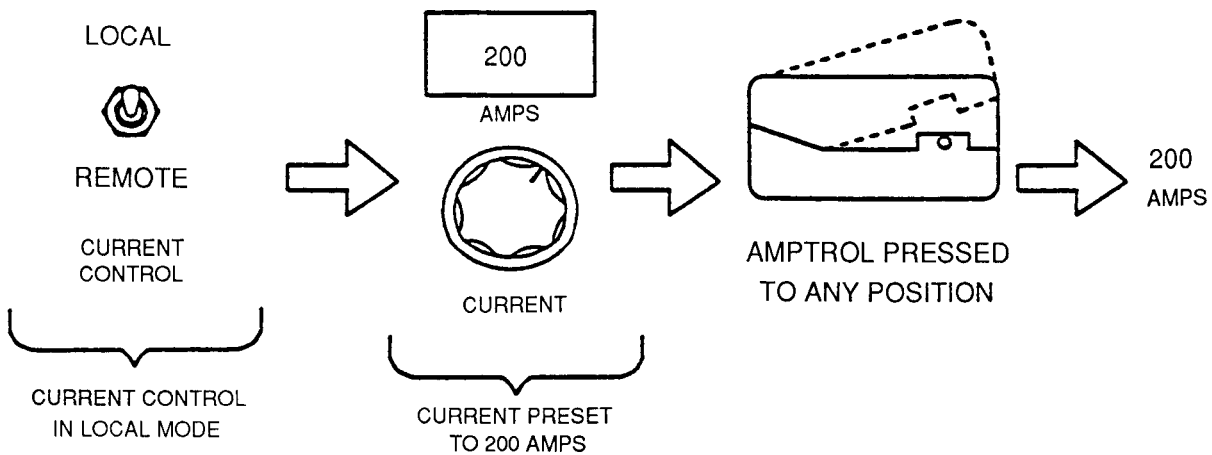
ELECTRIC SHOCK
can kill.

Routine Maintenance

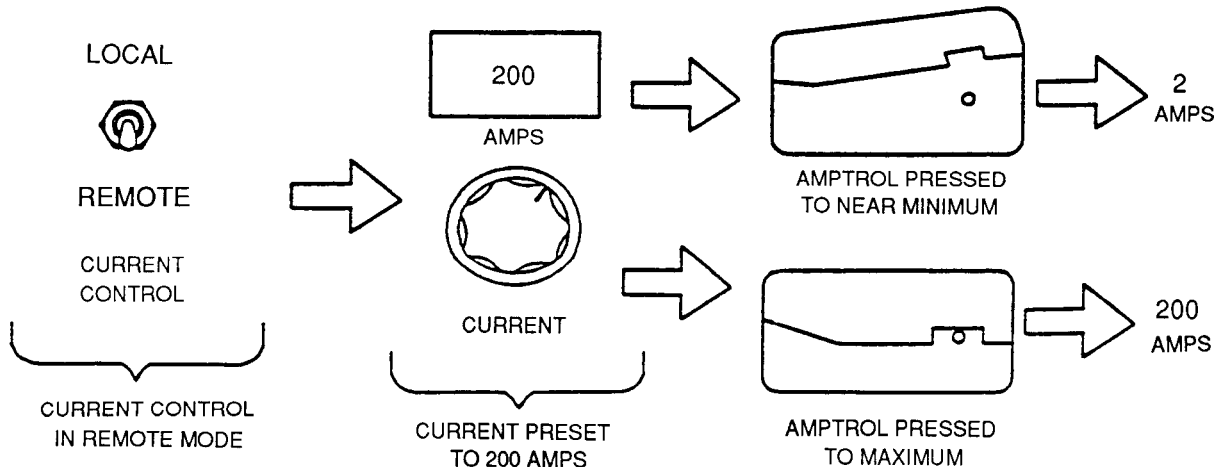
WARNING: Keep the electrode holder, TIG torch and cable insulation in good condition and in place.

1. Periodically blow out dust and dirt which may accumulate within the welder using an airstream.

AMPTROLS USED WITH CURRENT CONTROL IN LOCAL POSITION



AMPTROLS USED WITH CURRENT CONTROL IN THE REMOTE POSITION



2. Inspect welder output and control cables for fraying, cuts, and bare spots.
3. Inspect spark gap spacing at regular intervals to maintain gap marked on cover plate. If more intensity is needed than is available with the "High Frequency" set to MAXIMUM; the spark gap may be increased as noted on the cover plate. (Smallest possible air gap consistent with good welding is desirable to minimize R.F.I. problems.) Removal of the nameplate located on the lower right section of the output panel provides access to the spark gap. Dressing or any refinishing of the spark gap contacts is not recommended. If the contact surfaces become irregular or completely eroded, replacement of both electrodes is recommended.
4. The fan motor has sealed ball bearings which require no maintenance.

Overload Protection

This welder 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 motor running. When the primary thermostat cools and resets, normal output current will be available.


SQUARE WAVE TIG 350 TROUBLESHOOTING GUIDE

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

 **WARNING**



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

ELECTRIC SHOCK
can kill.

GENERAL MACHINE TROUBLE

SYMPTOM	CAUSE AND REMEDY
Machine will not turn on.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 1. Defective Meter PC board. Replace. 2. Defective Control PC board. Replace.
Accessories plugged into 115 volt receptacle do not work.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> a) The Meter PC board may be defective. Replace. b) The Control PC Board may be defective. Replace. 2. If machine does not weld: <ol style="list-style-type: none"> a) Current control pot may be defective. Replace. b) The Control PC board may be defective. Replace.

STICK WELDING

SYMPTOM	CAUSE AND REMEDY
Machine shuts off in Stick mode.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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 pot does not help.	<ol style="list-style-type: none"> 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 pot setting.	<ol style="list-style-type: none"> 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 pot setting.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.

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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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 <i>not</i> pressed.	<ol style="list-style-type: none"> 1. Defective Arc Start Switch. There should be <i>no</i> continuity between pins D and E of cable connector when Arc Start Switch or Amptrol is <i>not</i> pressed. 2. Defective Current Control pot. Replace. 3. Defective Control PC board. Replace. 4. Defective Feedthru PC board. Replace.

TIG WELDING (Continued)

SYMPTOM	CAUSE AND REMEDY
<p>Machine has gas flow and high frequency but no open circuit voltage when the Arc Start Switch or Amptrol is pressed.</p>	<ol style="list-style-type: none"> 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.
<p>Difficulty in getting tungsten to "light off".</p>	<ol style="list-style-type: none"> 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.
<p>Machine welds only at minimum output when the Current Control switch is in the REMOTE position.</p>	<ol style="list-style-type: none"> 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.
<p>Arc goes out soon after it is lit.</p>	<ol style="list-style-type: none"> 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 AMPPTROL FAR ENOUGH. WHEN THE AMPPTROL IS JUST "CRACKED", THE MINIMUM CURRENT (2 AMPS) IS PRODUCED. PRESSING THE AMPPTROL MORE AT THE START OF THE WELD WILL OFTEN SOLVE STARTING PROBLEMS. Refer to page 23 for proper use of amptrols.

TIG WELDING (Continued)

SYMPTOM	CAUSE AND REMEDY
Tungsten is eroding quickly.	<ol style="list-style-type: none"> 1. Current pot 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.

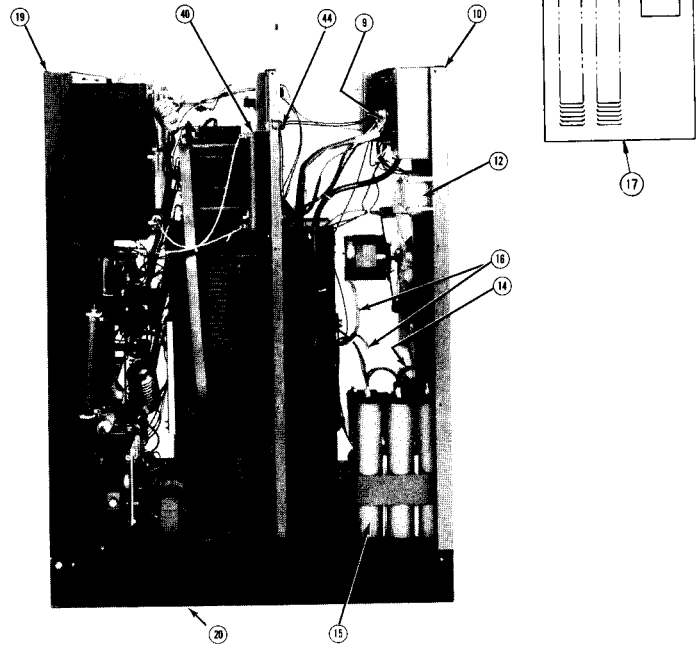
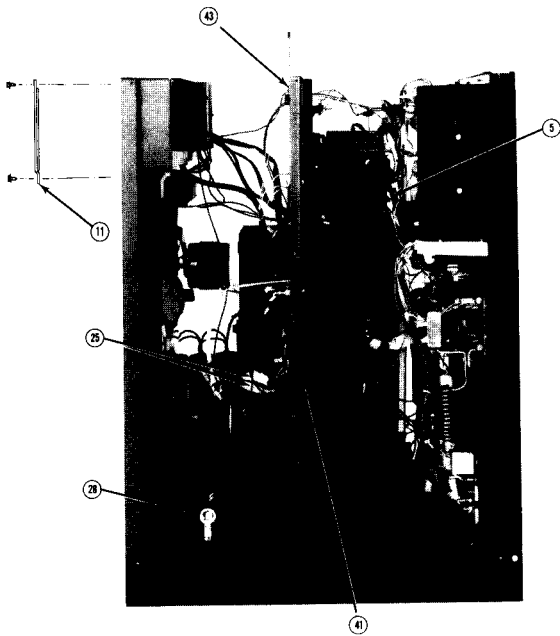
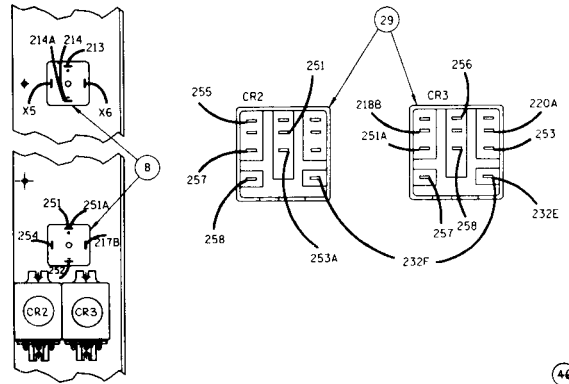
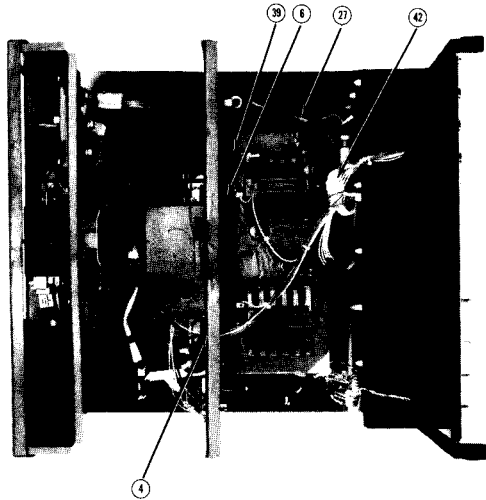
LOWER PANEL CONTROLS

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.	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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.

ACCESSORIES

SYMPTOM	CAUSE AND REMEDY
<p>K870 Foot Amptrol or K812 Hand Amptrol. Amptrol does not control welder output with Current Control switch in REMOTE and Mode switch in TIG.</p>	<ol style="list-style-type: none"> 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.
<p>K814 Arc Start Switch Arc Start Switch does not start welder output in TIG Mode and LOCAL Current Control.</p>	<p>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.</p>
<p>K846 Interface Kit Solid State Relay Module output does not close when corresponding Status PC board LED lights.</p>	<ol style="list-style-type: none"> 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.
<p>Solid State Relay Module output seems to make contact at wrong times.</p>	<ol style="list-style-type: none"> 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.

GENERAL ASSEMBLY



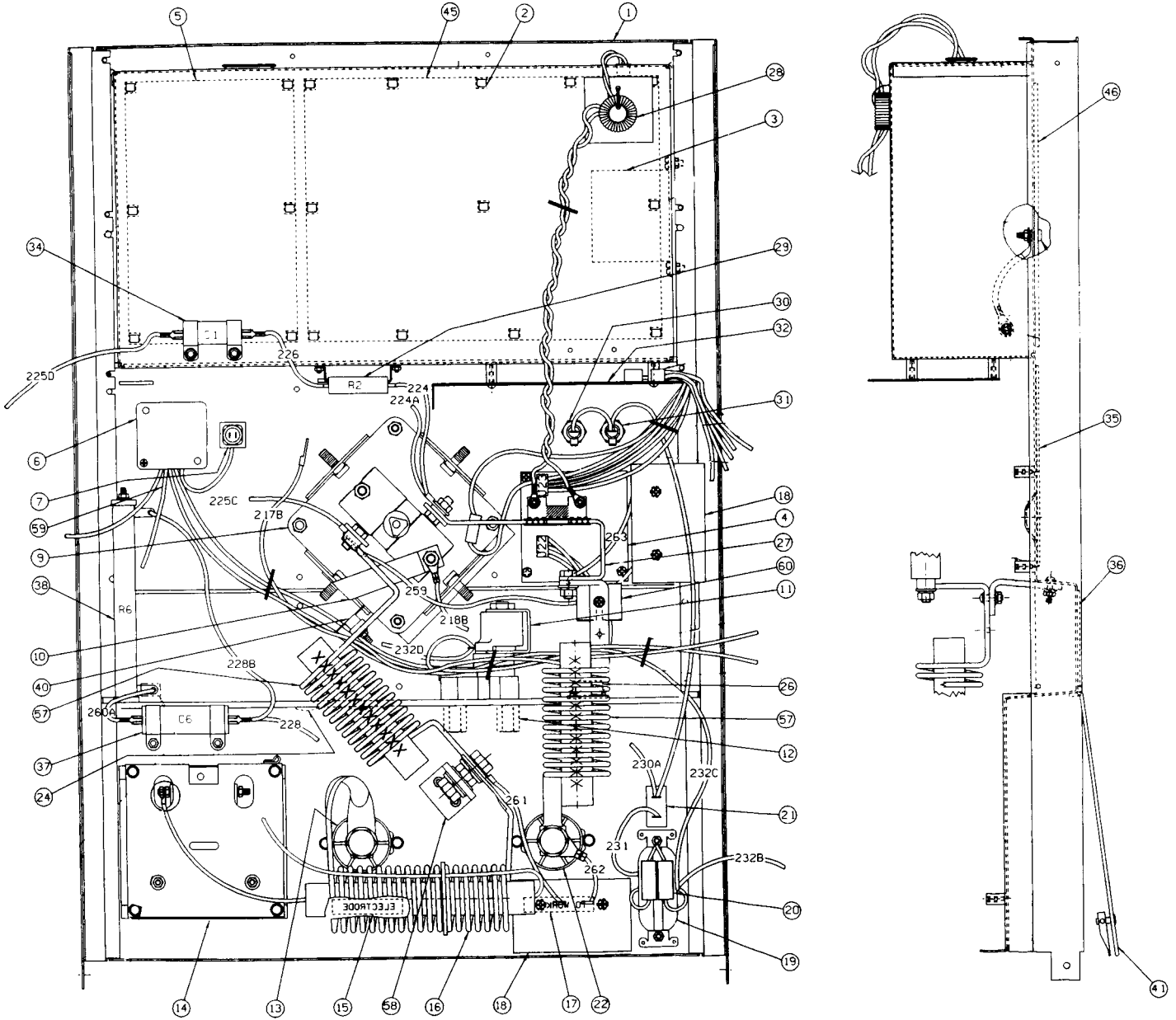
G2094
5-25-90SPA

Parts List P-196-C

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Left Case Side (Not Shown) Self Tapping Screw	1 11
2	Cover Seal (Not Shown)	1
3	Roof (Not Shown) Self Tapping Screw	1 8
4	Grommet	2
6	Resistor (R3) Mounting Bracket Set	1 1
8	Self Tapping Screw	2
10	Rectifier Bridge Case Back Assembly	2 1
11	Self Tapping Screw Input Access Door Self Tapping Screw	4 1 3
12	Pilot Transformer (T2)	1
15	Self Tapping Screw Power Factor Capacitor	4 3
17	Mounting Strap Self Tapping Screw Right Case Side	1 4 1
19	Self Tapping Screw Case Front Assembly Self Tapping Screw	11 1 4
20	Center Assembly (See P-196-E)	1
22	Insulated Splice (Not Shown)	4
28	Resistor (R8)	1
29	Mounting Bracket Set Self Tapping Screw Relay CR3, CR2	1 2 2
	Self Tapping Screw Identification Sticker (CR2) Identification Sticker (CR3)	4 1 1
39	Resistor (R7)	1
40	Insulating Washer Resistor (R1)	2 1
41	Mounting Bracket Set Self Tapping Screw Grommet	1 2 1
44	Cable Hanger	1
46	Warning Decal	1
	Field Installed Options: Hand Amptrol (For Parts Orders See P-66-K) Foot Amptrol (For Parts Orders See P-66-J)	
	Arc Start Switch Pump Mounting Platform Interface Kit	
	DC Solid State Relay Module AC Solid State Relay Module Water Valve Option Kit	

12-18-90

CASE FRONT ASSEMBLY



G2093
10-26-90A

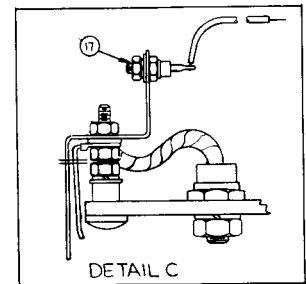
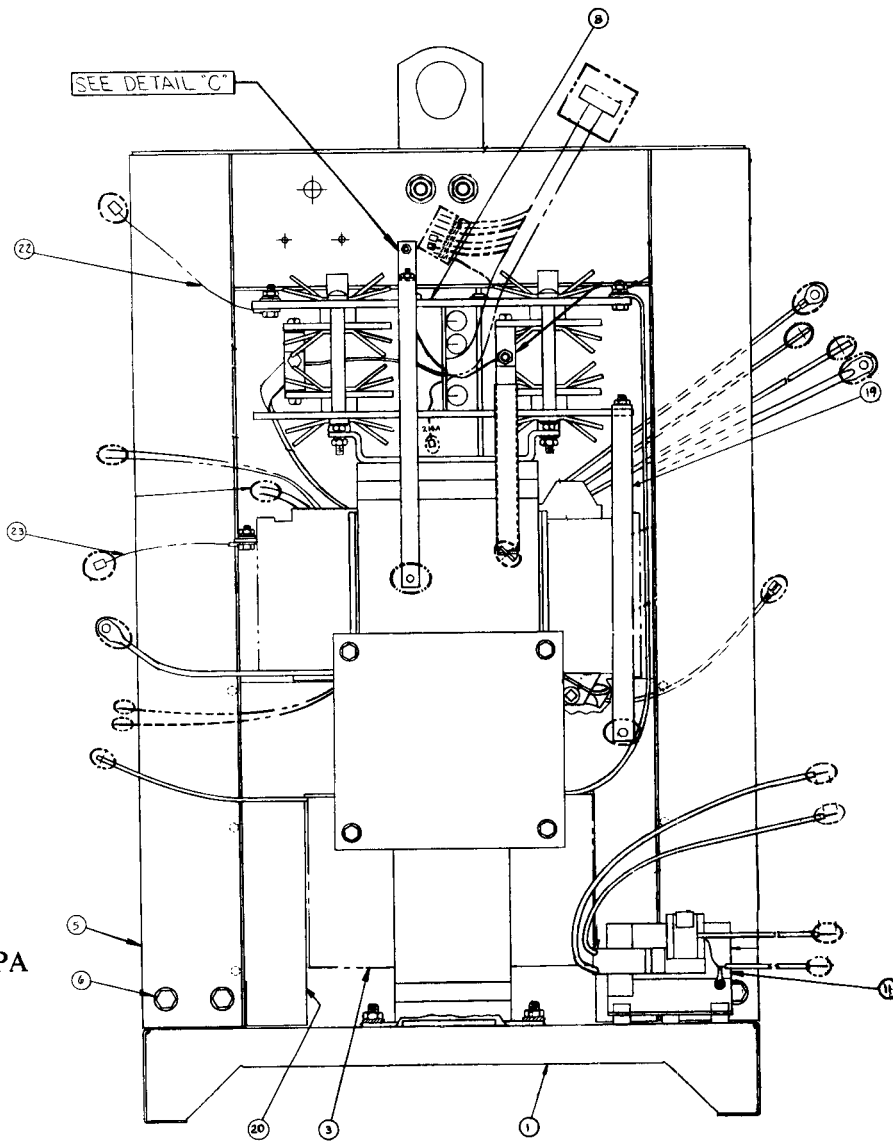
Parts List P-196-D

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Case Front Welded Assembly	1
2	Expansion Nut	18
3	Control Transformer Assembly (T5)	1
4	Sems Screw Protection P.C. Board	2 1
5	Sems Screw Power P.C. Board Self Tapping Screw	4 1 6
6	Push Button (S2)	1
7	Cover Plate Pilot Light (PL1)	1 1
9	Polarity Switch (S1, S1A) Handle Self Tapping Screw	1 1 1
10	Jumper	1
11	Solenoid Valve Assembly (SV1) Self Tapping Screw	1 2
12	Connector (R.H.) (Gas)	2
13	Output Terminal Assembly (Elect.) Self Tapping Screw	1 2
14	High Freq. Circuit Assembly Spark Gap Cover Self Tapping Screw	1 1 6
15	Knob Cable Hanger "Electrode" Marker	1 1 1
16	Fastener Button	2
17	Hi Freq. Transformer Assembly (T4) "To Work" Marker	1 1
18	Fastener Button Bypass P.C. Board Sems Screw	2 2 4
19	115V Receptacle (J1)	1
20	Thread Forming Screw 115V Receptacle Bypass Assembly	2 1
21	Circuit Breaker (CB1)	1
22	Output Terminal Assembly (Work) Self Tapping Screw	1 2
24	Plug Button	2
26	Connector & Lead Assembly (P22) Self Tapping Screw	1 4

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
27	Shunt Assembly	1
28	Plug & Lead Assembly (Shunt)	1
29	Mylar Insulation Sheet Sems Screw Resistor (R2)	1 2 1
30	Mounting Bracket Set Fuse (F2) Fuse Holder	1 1 1
31	Fuse (F1)	1
32	Fuse Holder Feed Thru P.C. Board	1 1
34	Sems Screw Mylar Sheet Capacitor (C1)	4 1 1
35	Clamp Self Tapping Screw Nameplate	2 2 1
36	Fastener Button Nameplate Fastener Button	8 1 7
37	Capacitor (C6) Clamp Thread Forming Screw	1 2 2
38	Resistor (R6)	1
40	Insulating Washer Thermostat	2 1
41	Output Cover Assembly — Includes: Cover Hinge	1 1 1
45	Latch Self Tapping Screw Control P.C. Board	1 2 1
46	Self Tapping Screw Control Panel Assembly Self Tapping Screw	11 1 10
57	RF Choke Coil Assembly	2
58	Support Angle Thread Forming Screw	1 2
59	Start/Stop Harness	1
60	Support Angle Thread Forming Screw	1 3

11-29-90

CENTER ASSEMBLY



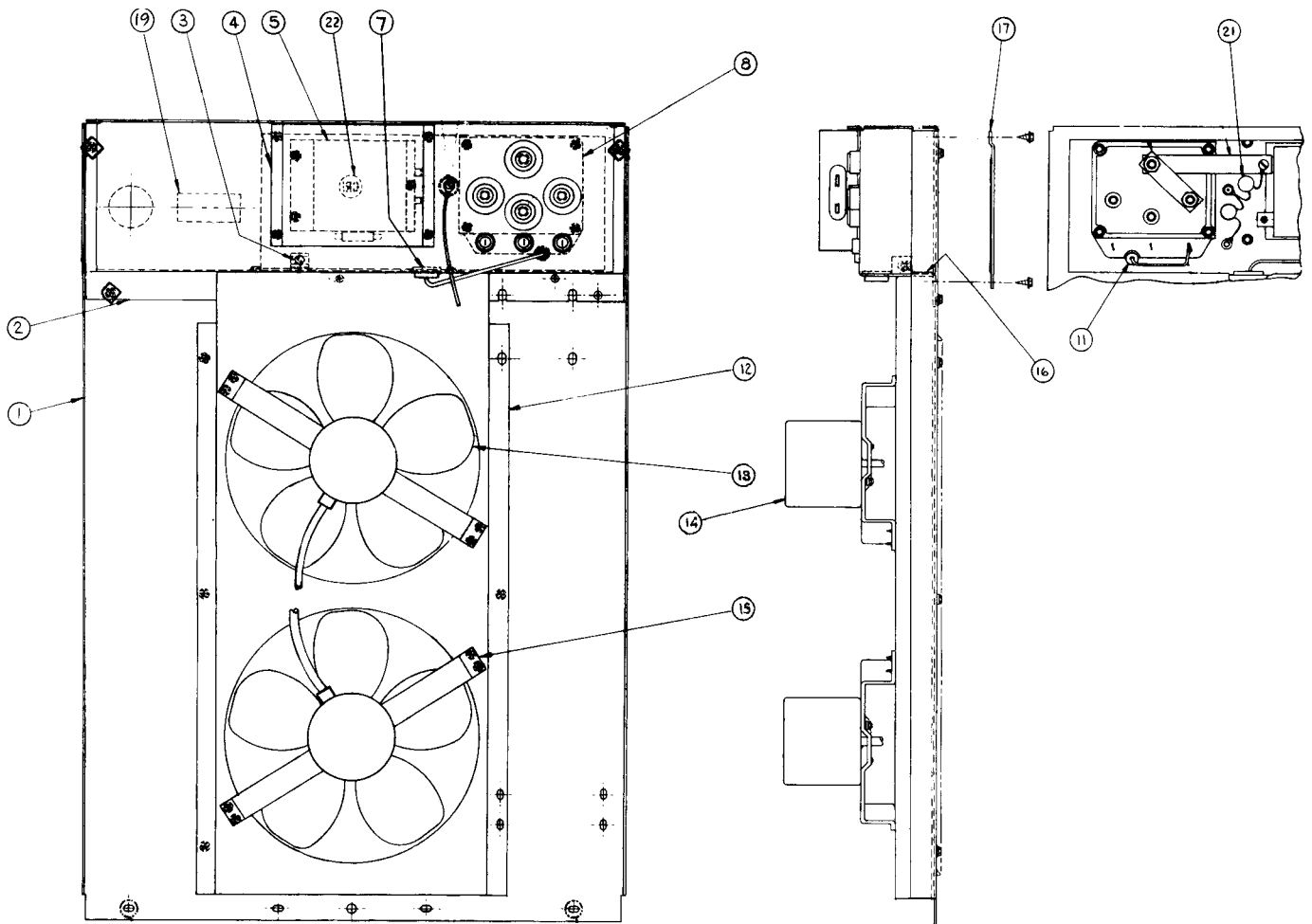
G2089
 5-25-90SPA

Parts List P-196-E

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Base Welded Assembly	1
3	Transformer and Choke Assembly	1
5	Lift Bail Welded Assembly	1
6	Thread Forming Screw	4
8	Rectifier Assembly	1
11	High Voltage Transformer	1
	Standoff	3
	Self Tapping Screw	3
17	Diode (D2)	1
20	Baffle	2
	Self Tapping Screw	6

11-29-90

CASE BACK ASSEMBLY



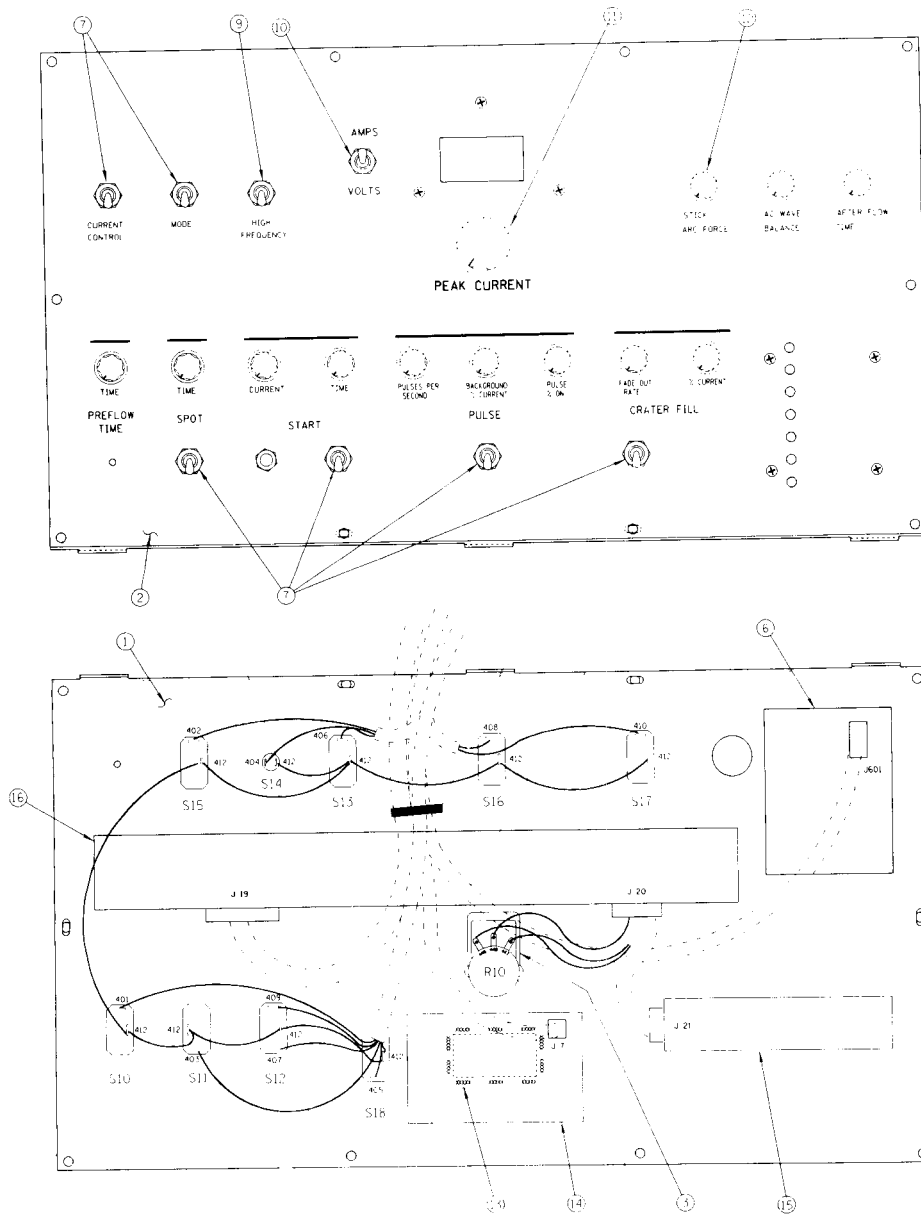
G1767
9-16-88E

Parts List P-196-F

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Rear Panel	1
2	Input Box Assembly	1
3	Self Tapping Screw	6
	Set Screw	1
4	Contactor Mounting Bracket	1
5	Self Tapping Screw	4
	Contactor	1
	Self Tapping Screw	3
7	Grommet	1
8	Reconnect Panel Assembly	1
	Self Tapping Screw	4
11	Grommet	1
12	Fan Baffle	1
	Self Tapping Screw	4

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
13	Fan	2
14	Fan Motor	2
15	Fan Mounting Bracket	2
	Self Tapping Screw	8
16	Decal (Ground)	1
17	Input Access Door	1
	Self Tapping Screw	3
19	Decal	1
21	Bypass Assembly	1
22	Identification Sticker	1

CONTROL PANEL ASSEMBLY



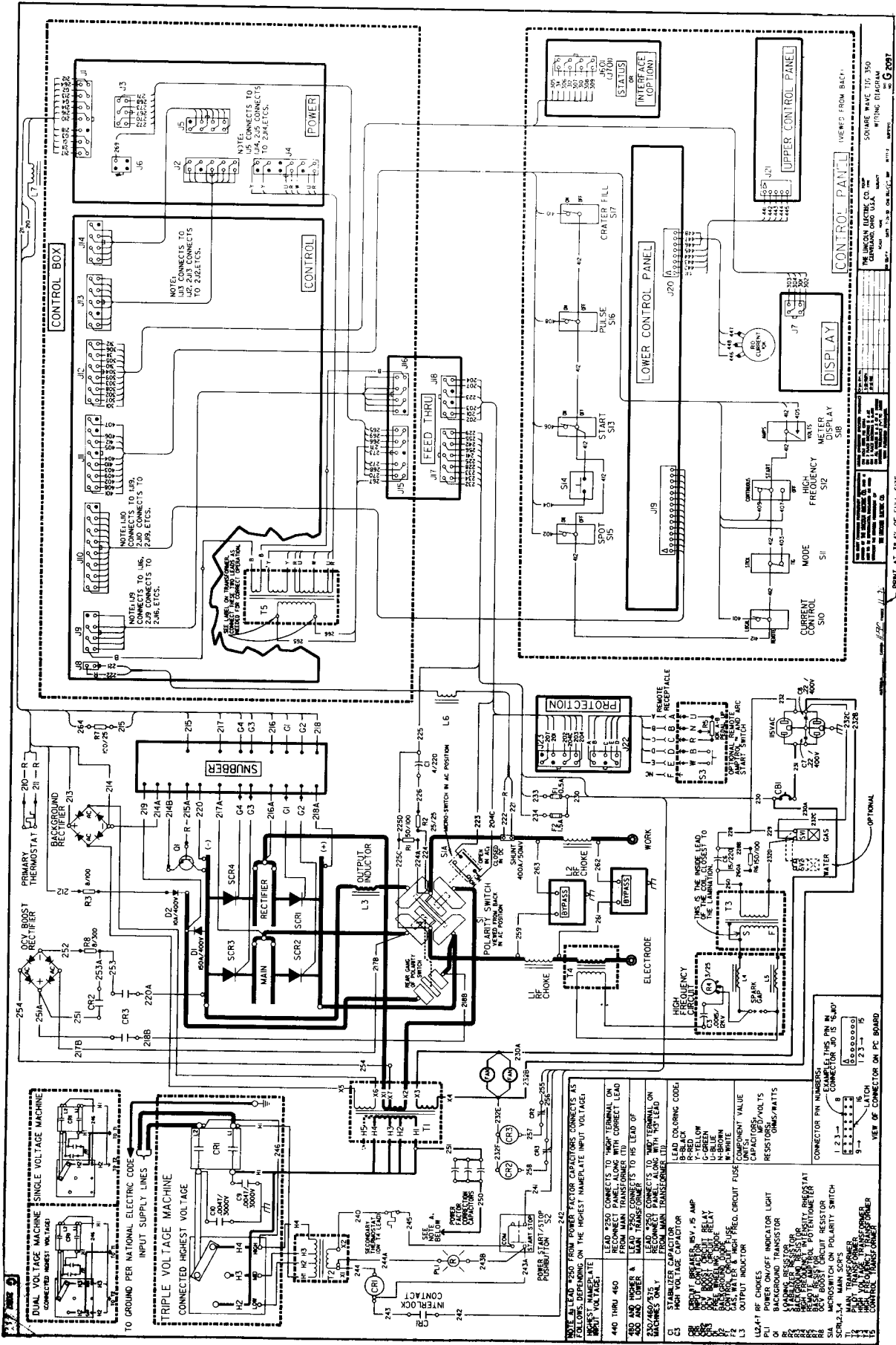
G2085
5-25-90SPA

Parts List P-196-G

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Control Panel	1
2	Nameplate	1
3	Spacer	1
6	Status P.C. Board Self Tapping Screw	4
7	Switch (S10, S11, S13, S15, S16, S17)	6
9	Switch (S12)	1
10	Switch (S18)	1

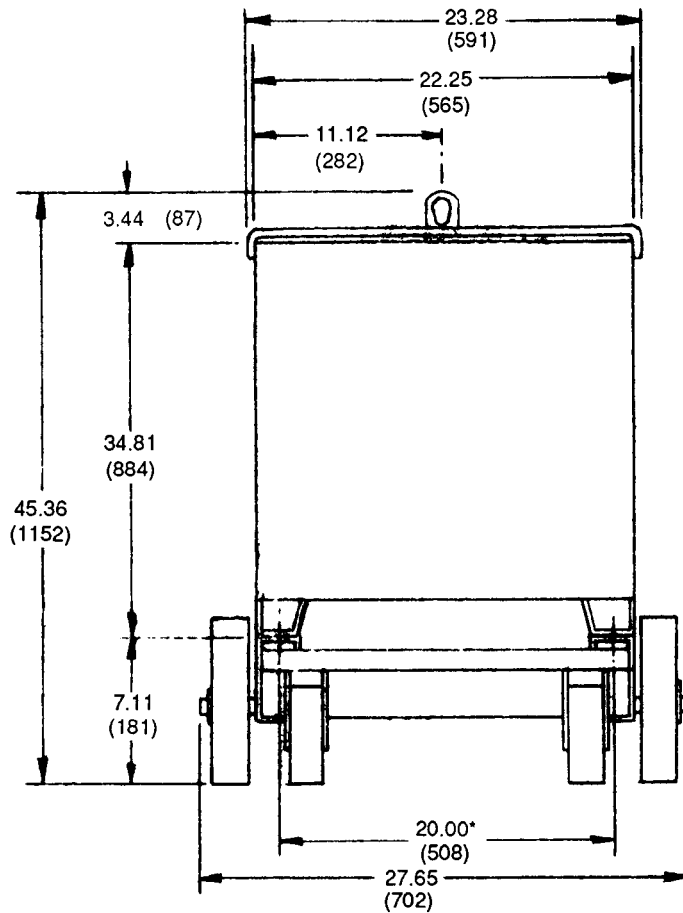
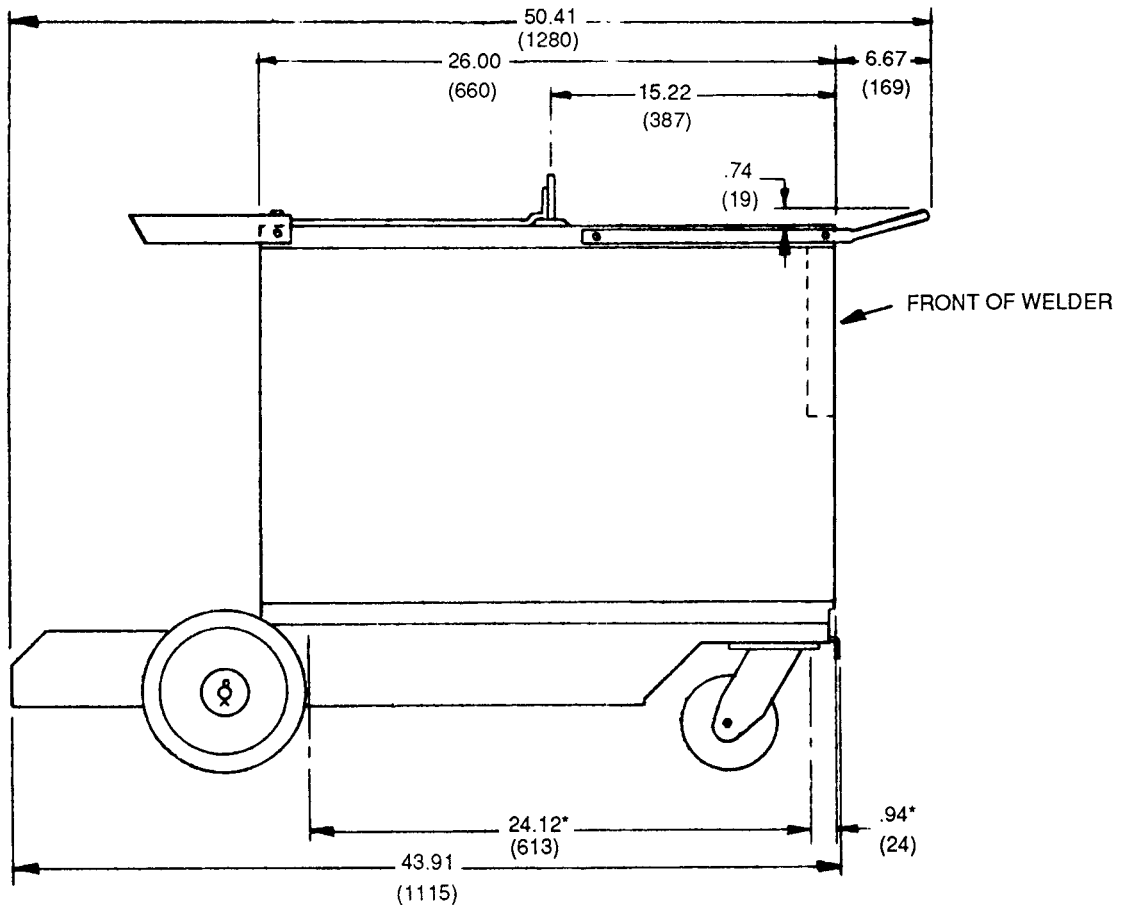
ITEM	PART NAME & DESCRIPTION	NO. REQ'D
11	Knob	1
12	Knob	12
13	Filter Lens	1
14	Meter P.C. Board Self Tapping Screw	3
15	Upper Control Panel P.C. Board	1
16	Lower Control Panel P.C. Board	1

NOTE: This diagram is for reference only. It is not accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels. If the diagram is illegible, write to the Service Department for a replacement. Give the welder code number.



SQUARE WAVE TIG 350 WIRING DIAGRAM

G2097
10-12-90E



M15200-8
1-20-89B

Dimension drawing in inches and (mm)
*Location of .406 (10) dia. mounting holes

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 and attach to 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 operating 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 and Title _____

Date _____

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

S-14929

9-2-83E


WARNING	<ul style="list-style-type: none"> ● Do not touch electrically live parts or electrode with skin or wet clothing. ● Insulate yourself from work and ground. 	<ul style="list-style-type: none"> ● Keep flammable materials away. 	<ul style="list-style-type: none"> ● Wear eye, ear and body protection.
Spanish AVISO DE PRECAUCION	<ul style="list-style-type: none"> ● No toque las partes o los electrodos bajo carga con la piel o ropa mojada. ● Aíslese del trabajo y de la tierra. 	<ul style="list-style-type: none"> ● Mantenga el material combustible fuera del área de trabajo. 	<ul style="list-style-type: none"> ● Protéjase los ojos, los oídos y el cuerpo.
French ATTENTION	<ul style="list-style-type: none"> ● 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. 	<ul style="list-style-type: none"> ● Gardez à l'écart de tout matériel inflammable. 	<ul style="list-style-type: none"> ● Protégez vos yeux, vos oreilles et votre corps.
German WARNUNG	<ul style="list-style-type: none"> ● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung! ● Isolieren Sie sich von den Elektroden und dem Erdboden! 	<ul style="list-style-type: none"> ● Entfernen Sie brennbares Material! 	<ul style="list-style-type: none"> ● Tragen Sie Augen-, Ohren- und Körperschutz!
Portuguese ATENÇÃO	<ul style="list-style-type: none"> ● Não toque partes elétricas e electrodos com a pele ou roupa molhada. ● Isole-se da peça e terra. 	<ul style="list-style-type: none"> ● Mantenha inflamáveis bem guardados. 	<ul style="list-style-type: none"> ● Use proteção para a vista, ouvido e corpo.
Japanese 注意事項	<ul style="list-style-type: none"> ● 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。 	<ul style="list-style-type: none"> ● 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。 	<ul style="list-style-type: none"> ● 目、耳及び身体に保護具をして下さい。
Chinese 警告	<ul style="list-style-type: none"> ● 皮肤或湿衣物切勿接触带电部件及焊条。 ● 使你自已与地面和工件绝缘。 	<ul style="list-style-type: none"> ● 把一切易燃物品移离工作场所。 	<ul style="list-style-type: none"> ● 佩戴眼、耳及身体劳动保护用具。
Korean 위험	<ul style="list-style-type: none"> ● 전도체나 용접봉을 젖은 헝겍 또는 피부로 절대 접촉치 마십시오. ● 모재와 접지를 접촉치 마십시오. 	<ul style="list-style-type: none"> ● 인화성 물질을 접근 시키지 마시오. 	<ul style="list-style-type: none"> ● 눈, 귀와 몸에 보호장구를 착용하십시오.
Arabic تحذير	<ul style="list-style-type: none"> ● لا تلمس الاجزاء التي يسري فيها التيار الكهربائي أو الألتروتود بجند الجسم أو بالملايس المبللة بالماء. ● ضع عازلا على جسمك خلال العمل. 	<ul style="list-style-type: none"> ● ضع المواد القابلة للاشتعال في مكان بعيد. 	<ul style="list-style-type: none"> ● 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.

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.

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.

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

			
<ul style="list-style-type: none"> ● Keep your head out of fumes. ● Use ventilation or exhaust to remove fumes from breathing zone. 	<ul style="list-style-type: none"> ● Turn power off before servicing. 	<ul style="list-style-type: none"> ● Do not operate with panel open or guards off. 	WARNING
<ul style="list-style-type: none"> ● Los humos fuera de la zona de respiración. ● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases. 	<ul style="list-style-type: none"> ● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio. 	<ul style="list-style-type: none"> ● No operar con panel abierto o guardas quitadas. 	Spanish AVISO DE PRECAUCION
<ul style="list-style-type: none"> ● Gardez la tête à l'écart des fumées. ● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail. 	<ul style="list-style-type: none"> ● Débranchez le courant avant l'entretien. 	<ul style="list-style-type: none"> ● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés. 	French ATTENTION
<ul style="list-style-type: none"> ● Vermeiden Sie das Einatmen von Schweißrauch! ● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes! 	<ul style="list-style-type: none"> ● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!) 	<ul style="list-style-type: none"> ● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen! 	German WARNUNG
<ul style="list-style-type: none"> ● Mantenha seu rosto da fumaça. ● Use ventilação e exaustão para remover fumo da zona respiratória. 	<ul style="list-style-type: none"> ● Não opere com as tampas removidas. ● Desligue a corrente antes de fazer serviço. ● Não toque as partes elétricas nuas. 	<ul style="list-style-type: none"> ● Mantenha-se afastado das partes moventes. ● Não opere com os painéis abertos ou guardas removidas. 	Portuguese ATENÇÃO
<ul style="list-style-type: none"> ● 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。 	<ul style="list-style-type: none"> ● 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して下さい。 	<ul style="list-style-type: none"> ● パネルやカバーを取り外したまま機械操作をしないで下さい。 	Japanese 注意事項
<ul style="list-style-type: none"> ● 頭部遠離煙霧。 ● 在呼吸區使用通風或排風器除煙。 	<ul style="list-style-type: none"> ● 維修前切斷電源。 	<ul style="list-style-type: none"> ● 儀表板打開或沒有安全罩時不準作業。 	Chinese 警告
<ul style="list-style-type: none"> ● 얼굴로부터 용접가스를 멀리하십시오. ● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시오. 	<ul style="list-style-type: none"> ● 보수전에 전원을 차단하십시오. 	<ul style="list-style-type: none"> ● 판넬이 열린 상태로 작동치 마십시오. 	Korean 위험
<ul style="list-style-type: none"> ● ابعد رأسك بعيداً عن الدخان. ● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها. 	<ul style="list-style-type: none"> ● القطع التيار الكهربائي قبل القيام بأية صيانة. 	<ul style="list-style-type: none"> ● لا تشغيل 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說明以及應該使用的銀擇材料，並請遵守貴方的有關勞動保護規定。

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.

LIMITED WARRANTY

STATEMENT OF WARRANTY:

The Lincoln Electric Company (Lincoln) warrants to the original purchaser (end-user) of new equipment that it will be free of defects in workmanship and material.

This warranty is void if Lincoln finds that the equipment has been subjected to improper care or abnormal operation.

WARRANTY PERIOD:

All warranty periods date from the date of shipment to the original purchaser and are as follows:

Three Years:

Transformer Welders
Motor-generator Welders
Semiautomatic Wire Feeders
Plasma-cutting Power Source
Engine Driven Welders (except engine and engine accessories) with operating speed under 2,000 RPM

Two Years:

Engine Driven Welders (except engine and engine accessories) with operating speed over 2,000 RPM

All engine and engine accessories are warranted by the engine or engine accessory manufacturer and are not covered by this warranty.

Equipment not listed above such as torches and cable assemblies, automatic wire feeders and field installed optional equipment is warranted for one year.

TO OBTAIN WARRANTY COVERAGE:

You are required to notify Lincoln Electric, your Lincoln Distributor, Lincoln Service Center or Field Service Shop of any defect within the warranty period. Written notification is recommended.

WARRANTY REPAIR:

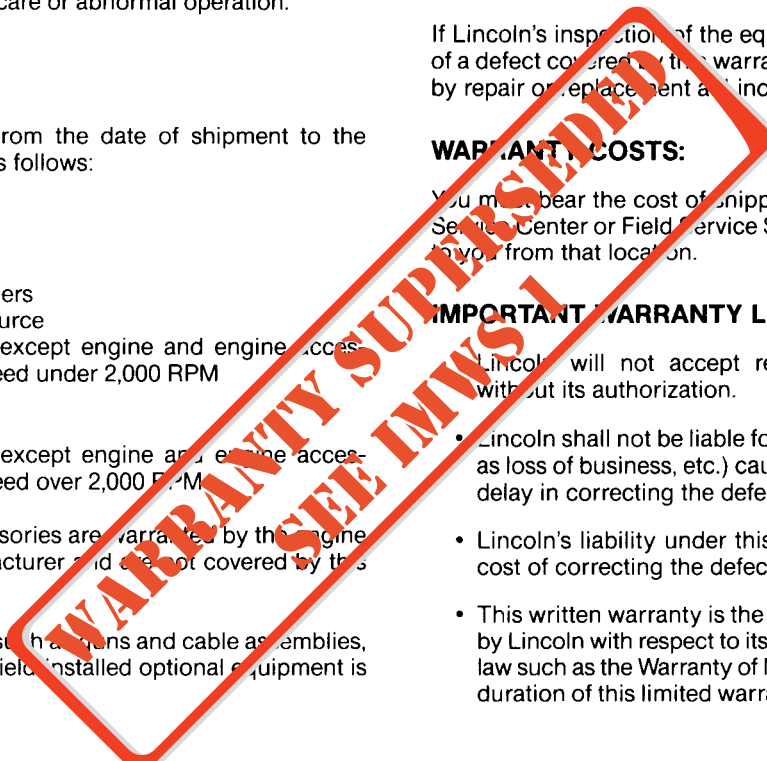
If Lincoln's inspection of the equipment confirms the existence of a defect covered by this warranty, the defect will be corrected by repair or replacement at Lincoln's option.

WARRANTY COSTS:

You must bear the cost of shipping the equipment to a Lincoln Service Center or Field Service Shop as well as return shipment to you from that location.

IMPORTANT WARRANTY LIMITATIONS:

- Lincoln will not accept responsibility for repairs made without its authorization.
- Lincoln shall not be liable for consequential damages (such as loss of business, etc.) caused by the defect or reasonable delay in correcting the defect.
- Lincoln's liability under this warranty shall not exceed the cost of correcting the defect.
- This written warranty is the **only** express warranty provided by Lincoln with respect to its products. Warranties implied by law such as the Warranty of Merchantability are limited to the duration of this limited warranty for the equipment involved.



THE LINCOLN ELECTRIC COMPANY

World's Leader in Welding and Cutting Products • Premier Manufacturer of Industrial Motors

Sales and Service through Subsidiaries and Distributors Worldwide

Cleveland, Ohio 44117-1199 U.S.A.

Eff. May '91

Ram

Litho in U.S.A.