IM542-D
October, 2001

INVERTEC POWER WAVE™ 450 ROBOTIC

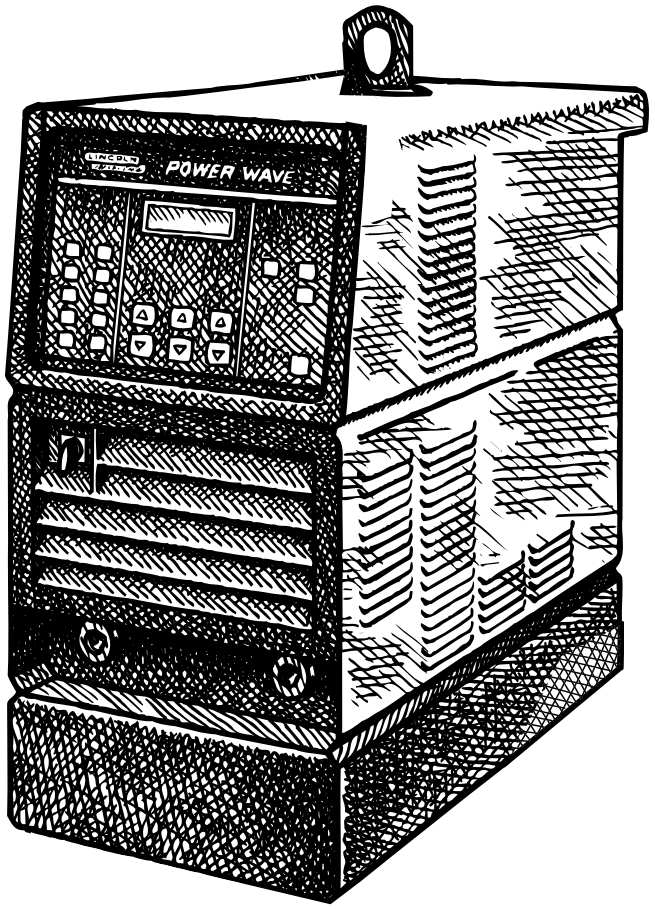
For use with machines having Code Numbers:

10344	10513	10611
10345	10514	
10346	10515	
10347	10516	
10431	10608	
10432	10609	

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

Safety Depends on You

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



OPERATOR'S MANUAL

ISO 9001

Designed and Manufactured Under a Quality Program Certified by ABS Quality Evaluations, Inc. to ISO 9001 Requirements.
CERTIFICATE NUMBER: 30273

LINCOLN® ELECTRIC

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

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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

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

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

FOR ENGINE powered equipment.

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

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

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

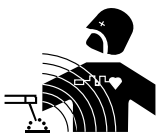
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

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

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

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

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



ELECTRIC AND MAGNETIC FIELDS may be dangerous

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

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

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

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

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

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

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

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

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

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ELECTRIC SHOCK can kill.

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

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

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

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

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

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

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

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

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

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

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

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

ARC RAYS can burn.

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

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

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

FUMES AND GASES can be dangerous.

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

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

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

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

5.e. Also see item 1.b.

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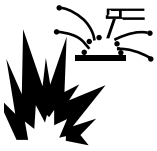


WELDING SPARKS can cause fire or explosion.

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

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

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

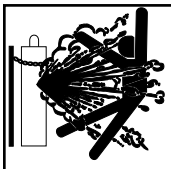
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”. For information, purchase “Recommended Safe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

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

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

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

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

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

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

7.c. Cylinders should be located:

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

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

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

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

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

FOR ELECTRICALLY powered equipment.

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

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

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

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PRÉCAUTIONS DE SÛRETÉ

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

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Mar. '93

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

Please Examine Carton and Equipment For Damage Immediately

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

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

Model Name & Number _____

Code & Serial Number _____

Date of Purchase _____

Whenever you request replacement parts for or information on this equipment always supply the information you have recorded above.

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

⚠ WARNING

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

⚠ CAUTION

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

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INSTALLATION

TECHNICAL SPECIFICATIONS - POWER WAVE 450

INPUT - THREE PHASE 50/60 HZ. ONLY

Input Voltages:	200	230	400	460	575
Input Currents					
@ 500A/40 VDC	87	76	44	38	32
@ 450A/38 VDC	75	65	38	32	28

RATED OUTPUT

Duty Cycle	Amps	Volts at Rated Amperes
200 - 60% Duty Cycle	500	40 VDC
230/400/460 - 60% Duty Cycle	500	40 VDC
460/575 - 60% Duty Cycle	500	40 VDC
200 - 100% Duty Cycle	450	38 VDC
230/400/460 - 100% Duty Cycle	450	38 VDC
460/575 - 100% Duty Cycle	450	38 VDC

OUTPUT

Constant Open Circuit Voltage	Continuous Current Range	Process Current Ranges
75 Volts	5-540 Amps	GMAW 50-540 Amps FCAW 40-540 Amps STICK 30-540 Amps

Pulse Current Range	Pulse Voltage Range	Pulse and Background Time Range	Pulse Frequency
5-750 Amps	5-55 Volts	100 Microsec - 3.3 Sec	0.15 - 1000 Hz

RECOMMENDED INPUT WIRE AND FUSE SIZES

Input Voltage/ Freqency	Duty Cycle	Input Ampere Rating on Nameplate	Type 75°C Copper Wire in Conduit AWG[IEC] Sizes (MM^2)	Type 75°C Ground Wire in Conduit AWG[IEC] Sizes (MM^2)	Type 75°C (Super Lag) or Breaker Size (Amps)
200/50-60	60%	87	4 (25)	8 (10)	120
230/50-60	60%	76	4 (25)	8 (10)	100
400/50-60	60%	44	8 (10)	10 (6)	50
460/50-60	60%	38	8 (10)	10 (6)	50
575/50-60	60%	32	8 (10)	10 (6)	50
200/50-60	100%	75	4 (25)	8 (10)	100
230/50-60	100%	65	4 (25)	8 (10)	100
400/50-60	100%	38	8 (10)	10 (6)	50
460/50-60	100%	32	8 (10)	10 (6)	50
575/50-60	100%	28	8 (10)	10 (6)	40

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight
905 mm 35.6 in.	515 mm 20.3 in.	1010 mm 39.8 in.	138 kg 304 lbs.

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

INSTALLATION

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

- Only qualified personnel should perform this installation.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.
- Always connect the Power Wave grounding terminal (located inside the reconnect input access doors).

SELECT SUITABLE LOCATION

Place the welder where clean cooling air can circulate in through the rear louvers and out through the side and front louvers. Dirt, dust, or any foreign material that can be drawn into the welder should be kept at a minimum. Using filters on the air intake to prevent dirt from building up restricts air flow. Do not use such filters. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdowns.

The Power Wave may be used outdoors. Power Wave power sources carry an IP23 enclosure rating. They are rated for use in damp, dirty environments subject to occasional falling water such as rain. However, the best practice is to keep the machine in a dry, sheltered area, since a wet environment speeds corrosion of parts. Do not place the machine in puddles or otherwise submerge parts of the machine in water. This may cause improper operation and is a possible safety hazard.

STACKING

Power Wave machines cannot be stacked.

TILTING

Each machine must be placed on a secure, level surface. The machine may topple over if this procedure is not followed.

LIFTING

Lift the machine by the lift bail only. Do not attempt to lift the machine by the push handle.

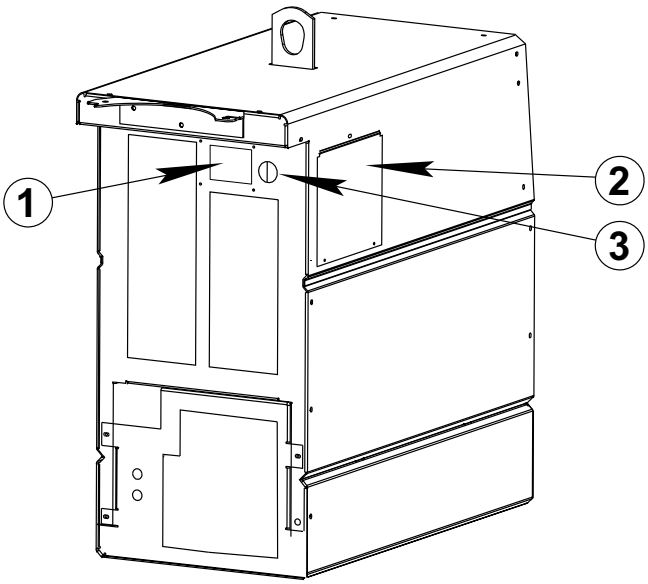
HIGH FREQUENCY PRECAUTIONS

If possible, locate the Power Wave away from radio controlled machinery. The normal operation of the Power Wave may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

INPUT CONNECTIONS

Be sure the voltage, phase, and frequency of the input power is as specified on the rating plate, located on the rear of the machine. See Figure A.1 for the location of the rating plate.

FIGURE A.1 - RATING PLATE LOCATION



1. RATING PLATE
2. RECONNECT/INPUT ACCESS DOOR
3. INPUT CORD ACCESS HOLE

⚠ WARNING

Only a qualified electrician should connect the input leads to the Power Wave. Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

Use a three-phase supply line. The Power Wave has a 1.375” (35 mm) access hole for the input cord, but the input cord is not supplied.

⚠ CAUTION

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

GROUND CONNECTIONS

The frame of the welder must be grounded. A ground terminal marked with the symbol is located inside the reconnect/input access door for this purpose. See your local and national electrical codes for proper grounding methods. See example Figure A.2 for the location of the reconnect/input access door and your specific connection diagram.

INPUT POWER CONNECTIONS

Connect L1, L2, L3 according to the Input Supply Connection Diagram decal located on your reconnect/input access door. See example Figure A.2.

INPUT FUSE AND SUPPLY WIRE CONSIDERATIONS

Refer to the Technical Specifications at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuses or delay type circuit breakers. Choose an input and grounding wire size according to local or national electrical codes. Using fuses or circuit breakers smaller than recommended may result in "nuisance" shut-offs from welder inrush currents, even if the machine is not being used at high currents.

INPUT VOLTAGE RECONNECT PROCEDURE

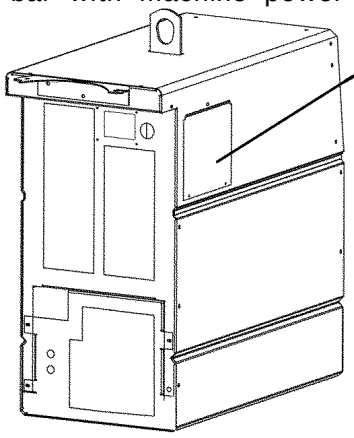
⚠ WARNING

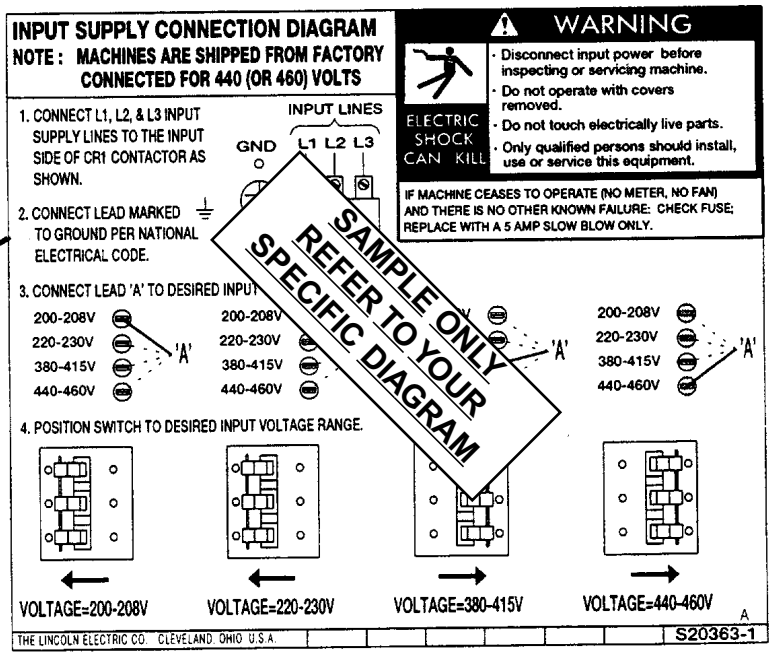
Only a qualified electrician should connect the input leads to the Power Wave. Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

Welders are shipped connected for the highest input voltage listed on the rating plate. To change this connection for a different input voltage, refer to reconnect instructions which follow and to the reconnect diagram supplied with your machine, located inside your reconnect access door. See example Figure A.2.

FIGURE A.2 - CONNECTION DIAGRAM ON RECONNECT/INPUT ACCESS DOOR

NOTE: Turn main input power to mthe machine OFF before performing reconnect procedure. Failure to do so will result in damage to the machine. DO NOT switch the reconnect bar with machine power ON.

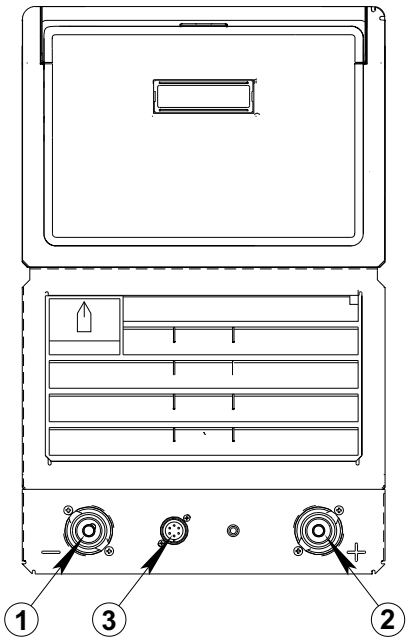




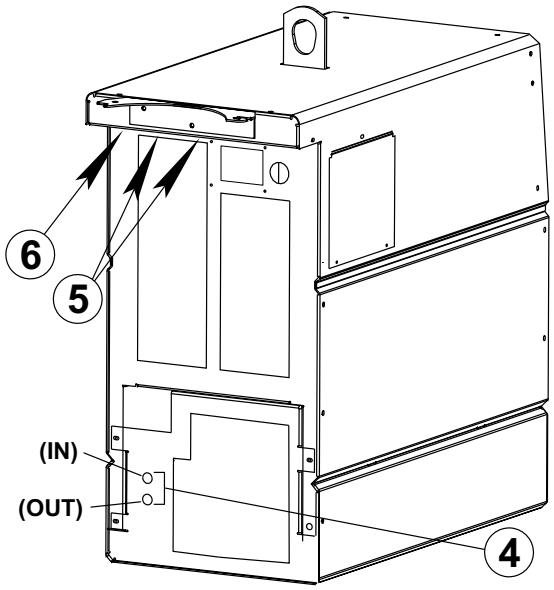
Note: The above connection diagram is a sample of what may be found on the reconnect/input door. If it is not the correct diagram for your machine use the one on the reconnect/input access door. See the written connection instructions in this section.

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

FIGURE A.3 – FRONTPANEL/BACK PANEL



1 WORK TERMINAL
2 ELECTRODE TERMINAL
3 REMOTE CONTROL AMPHENOL RECEPTACLE



4 WATER COOLING FITTINGS (ON ACCESS PANEL)
5 WIRE FEEDER CONNECTIONS (ON BACK PANEL)
6 ELECTRODE TERMINAL

To reconnect your machine for the proper input voltage, see the reconnect instructions on your input access door and:

1. Move the large input voltage switch to the proper position according to your input voltage, and the labels near the switch.

2. Move the auxiliary “A” lead to the appropriate terminal, according to your input voltage and the labels near the terminals.

OUTPUT CONNECTIONS

See Figure A.3 for the location of the work terminal, electrode terminal, remote control amphenol receptacle, water cooler fittings and wire feeder connections.

WORK AND ELECTRODE CABLE CONNECTIONS

Size

Use the largest welding (electrode and ground) cables possible — at least 70mm^2 (#2/0) copper wire — even if the output current does not require it. When pulsing, the pulse current often exceeds 650 amps with the Power Wave 450. Voltage drops can become excessive if undersized welding cables are used.

Routing

To avoid interference problems with other equipment and to achieve the best possible operation, route all cables directly. Avoid excessive lengths, bundle the electrode and ground cables together where practical, and do not coil excess cable.

WATER COOLER CONNECTIONS

The water cooler fittings are a quick-connect type. Refer to the Accessories and Maintenance sections of this manual for water cooler operation and recommended coolants.

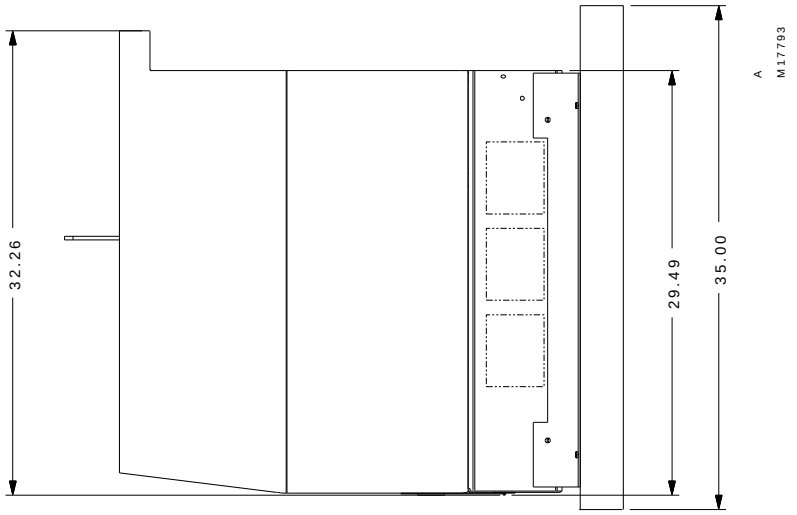
WIRE FEEDER CONNECTIONS

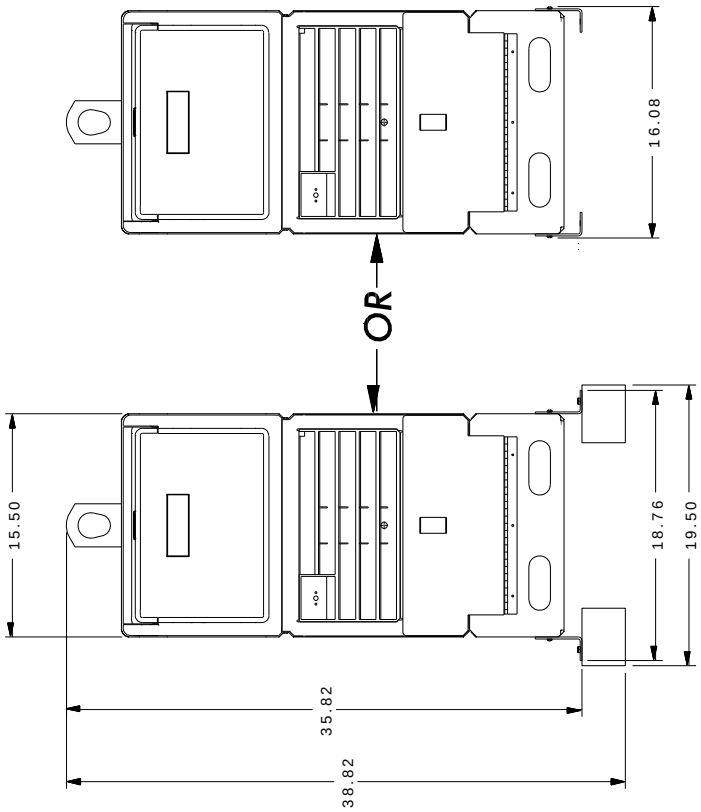
Refer to the ***Accessories*** section for Wire Feeder Connections.

Refer to Setup overlay in ***Operation*** section for Wire Feeder Configuration.

INSTALLATION

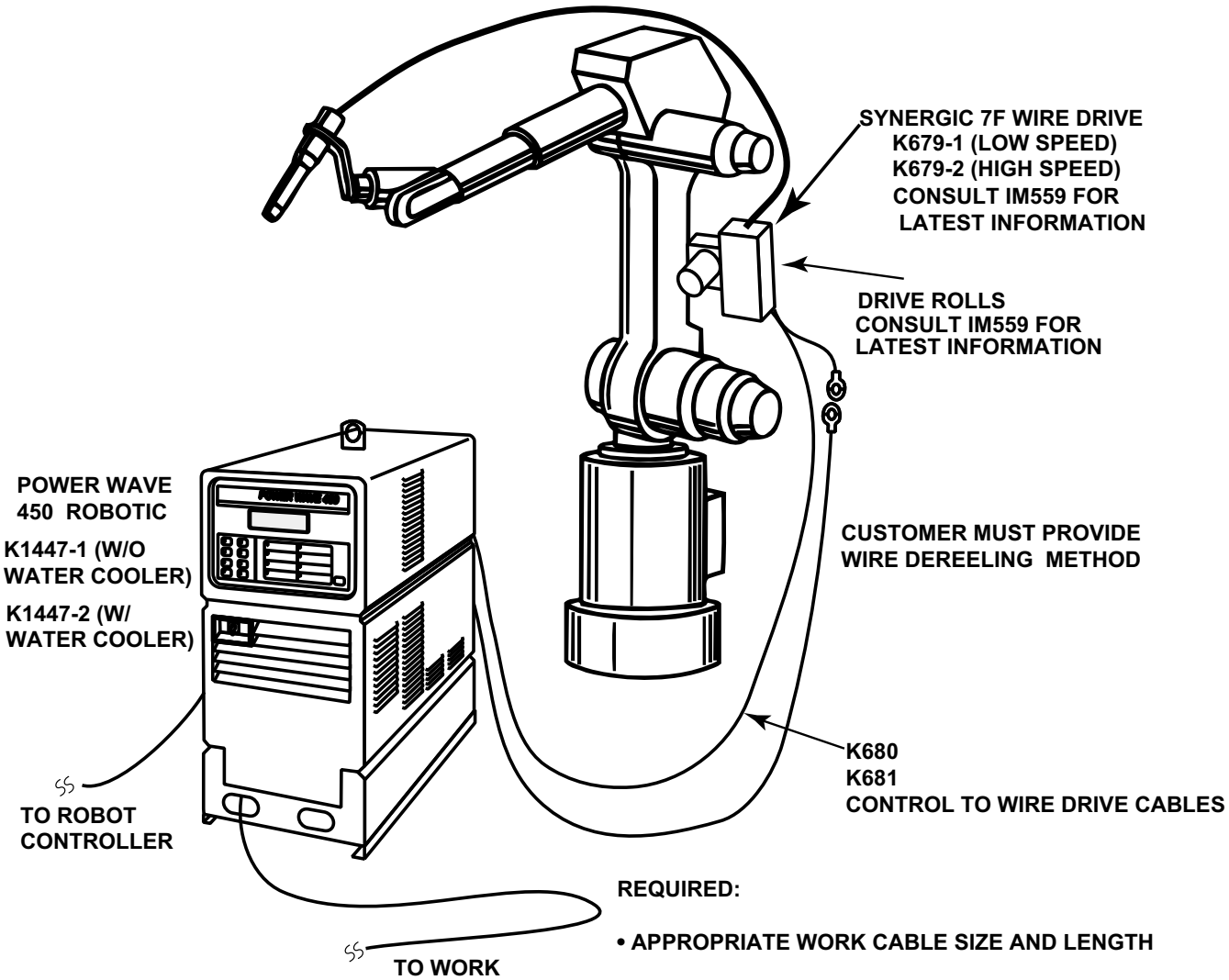
POWER WAVE 450 ROBOTIC DIMENSIONS





POWER WAVE 450 ROBOTIC / SYNERGIC 7F DRIVE UNIT COMPONENTS DIAGRAM

POWER WAVE 450 ROBOTIC / SYNERGIC 7F DRIVE UNIT COMPONENTS DIAGRAM



REQUIRED:

- **APPROPRIATE WORK CABLE SIZE AND LENGTH**
- **APPROPRIATE MAGNUM GUN AND CABLE ASSEMBLY AND ADAPTER IF REQUIRED.**
- **WIRE FEEDER CONTROLS ARE LOCATED WITHIN THE POWER WAVE 450 ROBOTIC POWER SOURCE.**

OPERATION

OPERATING INSTRUCTIONS

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

SAFETY INSTRUCTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

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

FUMES AND GASES can be dangerous.

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

WELDING SPARKS can cause fire or explosion.

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

ARC RAYS can burn.

- Wear eye, ear, and body protection.

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

HOT COOLANT can burn skin

- Always be sure coolant is not hot before doing any work on cooler parts.

QUICK START REFERENCE FOR USING THE PROCESS SELECTION OVERLAY

Read and understand the “Controls and Settings” and “Operating Overlays” sections of this manual before using the following Quick Start Reference procedure to operate the Power Wave.

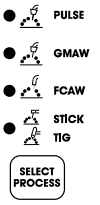
NOTE: Selection of certain options may limit the selection of subsequent options.

Step 1: Select your process information:

a. Install the desired PROCESS OVERLAY.

b. Turn the machine ON.

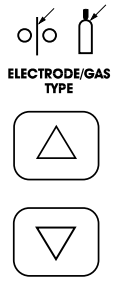
c. Select the desired welding PROCESS[1].



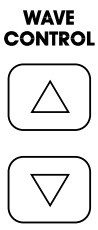
d. Select ELECTRODE CLASS.

e. Select ELECTRODE SIZE.

f. Select ELECTRODE/GAS TYPE.



g. Press the WAVE CONTROL UP or DOWN keys to see the present setting. Press the WAVE CONTROL UP or WAVE CONTROL DOWN keys to adjust[2].



Step 2: Adjust the wire feed to speed “WFS” and voltage “V” or arc length “T” (if necessary).

a. Press the DISPLAY RECALL key (DISPLAY RECALL) to view additional procedure information.

b. Adjust wire feed speed and voltage or arc length trim through the controls on your wire feeder. The new values appear on both the wire feeder and the Power Wave display.

Step 3: Save process information (if desired).

a. Press the SAVE TO MEMORY key (SAVE) .

b. Press one of the MEMORY LOCATION keys (1-8).

You can recall your procedure later by pressing the RECALL FROM MEMORY key (RECALL) and the appropriate MEMORY LOCATION key.

[1] The electrode class, electrode size, and electrode/gas type you can select for your process will be limited to the machine’s programmed recommendations. Therefore, selecting certain options may limit other option selections.

[2] The wave control scale displayed shows the default setting. (The higher the setting, the softer the arc.) If you change the setting, your new setting will be displayed.

GENERAL DESCRIPTION

The INVERTEC Power Wave power source is a high performance, digitally controlled inverter welding power source capable of complex, high-speed waveform control. It uses three-phase input power only. The Power Wave is designed to be used as a synergic welding system in conjunction with a wire feeder.

SYNERGIC WELDING

The Power Wave system is designed primarily as a synergic welding system. The word “synergic” comes from the word “synergism,” which means “two or more things working together to achieve an effect which neither can achieve individually.”

The Power Wave and wire feeder operate as a team. Each “knows” what the other is doing at all times. They each also know what process, wire type, wire size, and gas combination are being used. In a synergic system, the wire feeder and power source must “talk” together. This means that only certain wire feeders can work in a synergic setup. A synergic feeder has special circuitry to “talk” with and “listen” to the Power Wave power source.

Welding experts have preprogrammed the system for the best range of process settings according to wire type, wire size, and gas combination. When the wire feed speed is changed, the system automatically adjusts the current and voltage waveforms to give the best weld characteristics. This improves the soundness, appearance, and repeatability of welds.

Refer to the ***Accessories*** section of this manual for available wire feeders.

RECOMMENDED PROCESSES

The Power Wave is designed to be used as a multiple process machine. It comes preprogrammed with GMAW pulse, GMAW (short arc and spray) FCAW (Innershield™ and Outershield™), and stick procedures.

OPERATIONAL FEATURES AND CONTROLS

The Power Wave, through use of a keypad overlay system, provides various options and controls such as Multiple Process/Procedure Selection; Memory Storage of Procedures; Weld from Memory Only operation; Dual Process/Dual Feeder capability.

DESIGN FEATURES AND ADVANTAGES

- Designed to NEMA Standards.
- Multiple process output ranges 5 - 540 amps.
- 2-line LCD display.
- Easy access for input connections. Connections are simple strip and clamp (no lugs required).
- Modular construction for easy servicing.
- Thermostatically protected.
- Electronic overcurrent protection.
- Overvoltage protection.
- Digital signal processor and microprocessor control.
- RS232 interface for future welding application updates.
- Simple, reliable reconnection for various input voltages.
- New accessories and wire feeders communicate using a digital current loop to transfer information.
- Auto device recognition simplifies accessory cable connections.
- Direct support of two wire feeders.
- Auto-configurable for either metric or English mode.
- Multiprocess control: Stick, short arc, GMAW spray, GMAW pulse, and flux cored arc welding (FCAW).
- Simple control through use of overlays that limit access to only those keys required for a given application.

WELDING CAPABILITY

The Power Wave 450 is rated at 500 amps, 40 volts at 60% duty cycle based on a ten minute time period. It is capable of higher duty cycles at lower output currents. If the duty cycles are exceeded, a thermostat will shut off the output until the machine cools to a reasonable operating temperature.

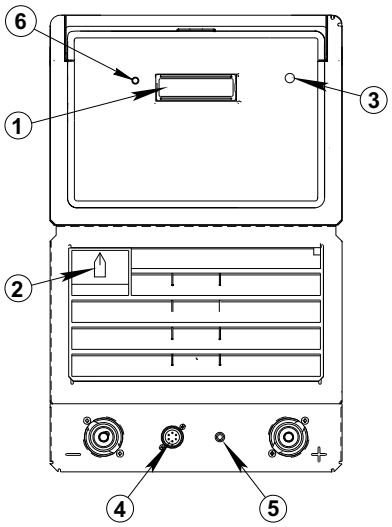
LIMITATIONS

- The Power Wave is not recommended for processes other than those specified by available overlays.
- The Power Wave is not recommended for pipe thawing.

CONTROLS AND SETTINGS

All operator controls and adjustments are located on the case front of the Power Wave. Refer to Figure B.1 and corresponding explanations.

FIGURE B.1 – CASE FRONT CONTROLS



1 LCD DISPLAY
2 POWER SWITCH
3 HIGH TEMPERATURE LIGHT
4 REMOTE CONTROL AMPHENOL RECEPTACLE
5 5 AMP CIRCUIT BREAKER
6 LCD DISPLAY ADJUSTMENT

CASE FRONT CONTROLS

Refer to Figure B.1 for the location of the following controls:

1. LCD DISPLAY: Provides welding procedure information and parameters such as wire type, gas type, WFS, trim, etc.
2. POWER SWITCH: Controls input power to the Power Wave. When the switch is turned to the ON position, the connected wire feeder meters light up and the LCD display on the Power Wave shows the following:

   LINCOLN ELECTRIC
   Version X.X

   This display is shown for a few seconds followed by another display that depends on the overlay placed on the machine. At this point, the machine is ready for operation.
3. HIGH TEMPERATURE LIGHT (thermal overload): A yellow light that comes on when an over temperature situation occurs. Output is disabled until the machine cools down. At that point the light goes out and output is enabled again.
4. REMOTE CONTROL AMPHENOL RECEPTACLE: Allows remote current control during stick welding via a hand or foot Amptrol accessory.
5. 5 AMP CIRCUIT BREAKER: Protects two auxiliary power circuits: the 24V supply used by the trigger circuits and the 42V supply used by the internal machine circuits and the wire feeders.
6. LCD DISPLAY ADJUSTMENT: Use a small flat blade screw driver to adjust the viewing angle of the LCD display.

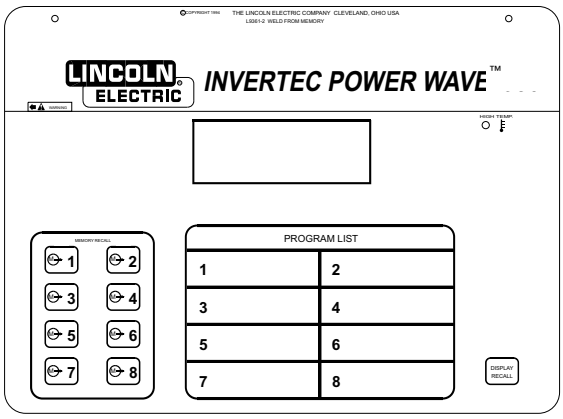
OPERATING OVERLAYS

OVERVIEW

The Power Wave is controlled by a panel of keys (keypad) located on the front of the machine. The operator can access controls by placing an overlay over the keys.

An OVERLAY is a special plastic sheet with a number of keys and symbols printed on one side and a bar code printed on the other. See Figure B.2. The printed keys allow the operator to communicate with the machine for a specific set of functions. The bar code allows the machine to identify the overlay.

FIGURE B.2 – TYPICAL POWER WAVE OVERLAY

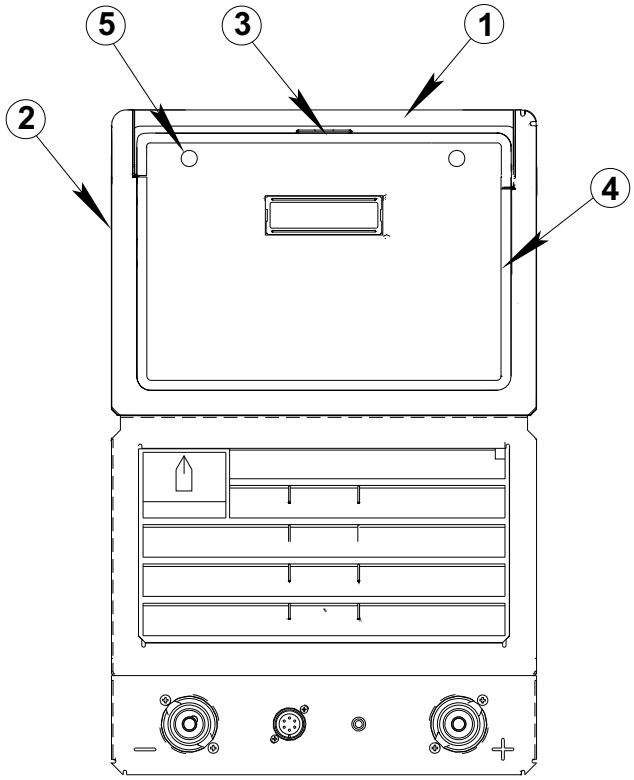


Before the Power Wave is turned ON, the operator selects the desired overlay and mounts it in the overlay frame on the front of the machine. Then, when the machine is turned ON, it reads the overlay bar code and configures the machine accordingly, allowing the operator to access only certain keys. The machine must be powered up each time an overlay is changed.

INSTALLING AN OVERLAY

1. Open the ACCESS DOOR by grasping the provided indent on the door and pulling the door forward. See Figure B.3 for door location.

FIGURE B.3 – OVERLAY ACCESS DOOR



1 OVERLAY ACCESS DOOR
2 OVERLAY FRAME
3 ACCESS DOOR INDENT
4 TRACKS
5 LOCATING PINS

2. Select the desired overlay from the storage compartment located behind the access door.
3. Remove any overlay already in the overlay frame and place it in the storage compartment.
4. Slide the new overlay into the overlay frame. Align the overlay with the two tracks on the sides of the frame. Be sure the overlay is seated in the bottom lip of the frame and on the top two locating pins. Close the access door securely.

OVERLAY TYPES

Four types of overlays can be used with the Power Wave.

1. Process Overlays. These overlays are used to create, save and recall specific welding procedures by selecting and adjusting the various welding settings that have been programmed into the Power Wave at the factory.
2. Weld From Memory Overlays. These overlays (also called Shop Overlays) provide a simple way for operators to recall and use any of the welding procedures that have been stored in the memory of the Power Wave.
3. Setup Overlays. These overlays provide specific machine setup information, such as operating limits for the welding procedures stored in memory.
4. Special Purpose Overlays. These are custom overlays for specific customer applications.

Detailed information on how to use currently available Power Wave overlays follows.

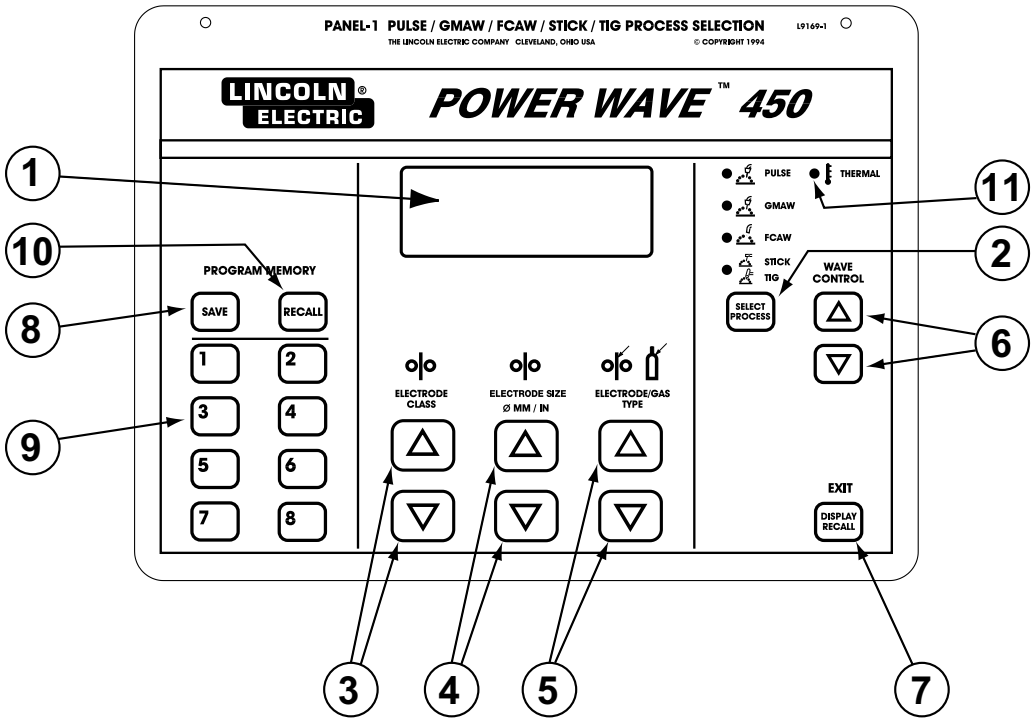
Overlay Type	Overlay Name	Figure No.
1	GMAW PULSE, GMAW FCAW, STICK PROCESS SELECTION OVERLAY	B.4
2	ROBOTIC INTERFACE, WELD FROM MEMORY, DUAL PROCEDURE OVERLAY	B.5
3	*LIMITS OVERLAY	B.6
3	SETUP OVERLAY	B.7

*This overlay is optional. See Accessories Section for Order Numbers.

PULSE, GMAW, FCAW, AND STICK/TIG PROCESS SELECTION OVERLAY

An operator can use this overlay to create a new welding procedure, save a newly created welding procedure, view an existing welding procedure, recall an existing welding procedure, and clear a memory location. See Figure B.4. The steps for performing each of these functions are given below.

FIGURE B.4 – PULSE, GMAW, FCAW, STICK/TIG PROCESS SELECTION OVERLAY



1 LCD DISPLAY WINDOW
2 PROCESS SELECT KEY
3 ELECTRODE CLASS UP/DOWN KEYS
4 ELECTRODE SIZE UP/DOWN KEYS
5 ELECTRODE/GAS TYPE UP/DOWN KEYS
6 WAVE CONTROL UP/DOWN KEYS
7 DISPLAY RECALL KEY
8 SAVE TO MEMORY KEY
9 MEMORY LOCATION NUMBER KEYS
10 RECALL FROM MEMORY KEY
11 HIGH TEMPERATURE LIGHT

1. LCD DISPLAY WINDOW: Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears on the display for a few seconds:

LINCOLN ELECTRIC
VERSION X.X

This display is followed by:

OVERLAY ID
NUMBER = 1

A welding procedure is made up of seven components: process, material type, wire diameter, program, wire feed speed, voltage or arc length trim, and wave control. A new welding procedure is created by selecting a combination of these components from the ones that have been programmed into the Power Wave. See Figure B.4 for key locations.

NOTE: The following four selections should always be performed in this order: process, electrode class, electrode size, electrode/gas type. Selecting a setting for one component narrows your choice of available settings in remaining components. This is why the order of performing the steps is important. However, if you make component selections out of order, the machine will prompt you to make a new selection for any settings that do not apply.

2. PROCESS SELECT KEY: Use the PROCESS SELECT key to select from the processes available in the machine. Press the PROCESS SELECT key until the light by the desired process is lit.

3. ELECTRODE CLASS UP/DOWN: Use the ELECTRODE CLASS UP or DOWN keys to select from the material types available for the selected process. Press the ELECTRODE CLASS UP or DOWN key until the desired material type is displayed.

4. ELECTRODE SIZE UP/DOWN: Use the ELECTRODE SIZE UP or DOWN keys to select from the wire diameters available for the selected process and material type. Press the ELECTRODE SIZE UP or DOWN key until the desired wire diameter is displayed.

5. ELECTRODE/GAS TYPE UP/DOWN KEYS: Use the ELECTRODE/GAS TYPE UP or DOWN keys to select from the programs available for the selected process, material type, and wire diameter. Press the ELECTRODE/GAS TYPE UP or DOWN Key until the desired program is displayed.

6. WAVE CONTROL UP/DOWN KEYS: Press one of the two WAVE CONTROL keys to display the present wave control. This is shown on a scale from LO to HI. Use the WAVE CONTROL UP or WAVE CONTROL DOWN key to change the wave control to the desired level. When this scale is shown, the WAVE CONTROL setting can also be changed while welding (on the fly). Press the DISPLAY RECALL key to exit the wave control function. For a description of how the wave control setting affects the welding procedure, refer to the Overview of Welding Procedures sub-section of the Operation section of this manual.

   The wire feed speed and voltage or arc length trim desired for the new procedure can be changed from the wire feeder.

7. DISPLAY RECALL KEY: Since not all the information about the procedure can be seen on the 2-line LCD display window at the same time, use the DISPLAY RECALL key to display and verify all of the selected procedure information. The normal default display window shows the Procedure Description, WFS, and preset voltage or arc length trim values. Press and hold the DISPLAY RECALL key, and the window shows the procedure description and gas type for as long as the key is held depressed. Release the DISPLAY RECALL key, and the window shows wire size, material type, and process description. After a few seconds, the window changes back to the default display.

8. SAVE TO MEMORY KEY: This key is used to save a newly created welding procedure. The Power Wave has eight memory locations which can be used to store all the settings of up to eight welding procedures. Once stored in a memory location, a procedure can be recalled for later use with the RECALL FROM MEMORY key. To save a newly created welding procedure:

   Press the SAVE TO MEMORY key (SAVE) and then one of the MEMORY LOCATION NUMBER keys. Keep a record of this number for future reference.

   Any previously created welding procedure stored in that location will be erased.

   If you press the SAVE TO MEMORY key but decide not to save the procedure, you can exit this function by pressing the DISPLAY RECALL key.

9. MEMORY LOCATION NUMBER KEYS: To view information about any stored welding procedure, simply press its MEMORY LOCATION NUMBER key.

   As you hold down the selected key, the procedure description and gas type of the procedure appear in the display window. The process type is shown by the indicating light opposite the appropriate process symbol.

   When you release the selected key, the wire size, material type and process description appear for a few seconds.

   This function does not display the wire feed speed and voltage or arc length trim settings. To view these, you must recall the procedure from memory with the RECALL FROM MEMORY key.

10. RECALL FROM MEMORY KEY: This key is used to recall an existing procedure from memory. You can recall and use any of the previously created welding procedures that are stored in one of the eight memory locations. Simply press the RECALL FROM MEMORY key (RECALL) and then the appropriate MEMORY LOCATION NUMBER key.

    If you press the RECALL FROM MEMORY key and then change your mind, you can exit this function by pressing the DISPLAY RECALL key. If the memory location you select does not contain a stored welding procedure, this will be indicated in the display window. Select another memory location. It is not necessary to save a procedure back to memory after it is recalled from memory. When a procedure is saved into a memory location, it can be recalled from there until another procedure is stored in that location or the location is cleared.

    The RECALL FROM MEMORY and SAVE TO MEMORY keys can be used to clear a memory location.

    Press the SAVE TO MEMORY key (SAVE) and then the RECALL FROM MEMORY key (RECALL). (Do not press both keys at the same time.) A message in the display window will ask you to press the MEMORY LOCATION NUMBER key of the memory location you want to clear.

    If you press the SAVE TO MEMORY and RECALL FROM MEMORY keys and then change your mind, you can exit this function by pressing the DISPLAY RECALL key.

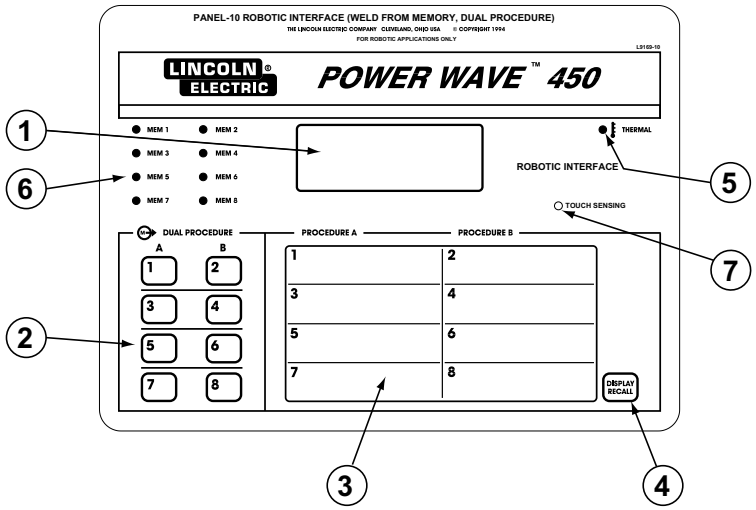
11. HIGH TEMPERATURE LIGHT: The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

ROBOTIC INTERFACE WELD FROM MEMORY, DUAL PROCEDURE OVERLAY

The Weld From Memory, Dual Procedure Overlay lets an operator recall and use any welding procedure stored in one of eight memory locations. See Figure B.5.

FIGURE B.5 – ROBOTIC INTERFACE WELD FROM MEMORY, DUAL PROCEDURE OVERLAY

1 LCD DISPLAY WINDOW
2 MEMORY RECALL KEYS
3 PROGRAM LIST
4 DISPLAY RECALL KEY
5 HIGH TEMPERATURE LIGHT
6 MEMORY LIGHTS
7 TOUCH SENSING LIGHT



1. LCD DISPLAY WINDOW: Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 10

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. MEMORY RECALL KEYS: The following four memory pairs are available on this overlay:
   Memory 1 and Memory 2
   Memory 3 and Memory 4
   Memory 5 and Memory 6
   Memory 7 and Memory 8

   Select a memory location PAIR for the two desired welding procedures by pressing either of the two corresponding MEMORY RECALL NUMBER keys.

   If no procedure was saved to one of the memory pair locations, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   In this case select another memory pair.

   Set the dual procedure switch or gun trigger to the position for PROCEDURE A or PROCEDURE B. Position A activates the welding procedure from the odd numbered memory locations (1, 3, 5 or 7). Position B activates the welding procedure from the corresponding even numbered memory locations (2, 4, 6 or 8). For example, if memory location 3 was selected, Position A activates the procedure from memory location 3; Position B activates the procedure from memory location 4.

   When a pair of welding procedures are recalled from memory, the display window will show the procedure description, wire feed speed, and the preset voltage or arc length trim of the LAST procedure welded with.

   With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the robot controller. The new values will replace the previous values and become a permanent part of the procedure.

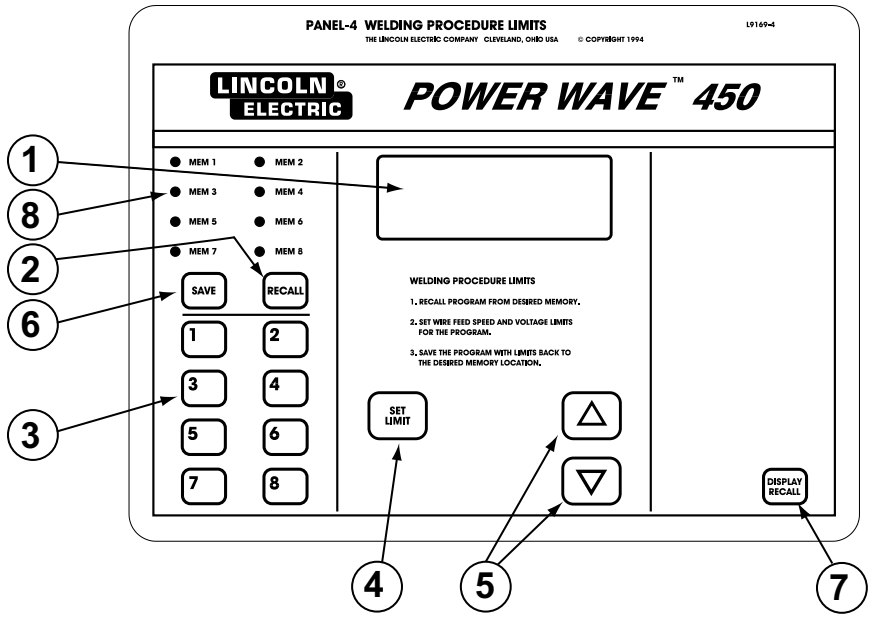
   If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedure, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. PROGRAM LIST: The PROGRAM LIST block in the center of this overlay provides a convenient place to record a brief description of each welding procedure stored in memory. A “Dry Erase” marker should be used for this purpose.
4. DISPLAY RECALL KEY: To view other information about the selected procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the selected procedure for as long as the key is held depressed. When the key is released, material type, wire size, and process descriptions will be displayed for a few seconds.
5. HIGH TEMPERATURE LIGHT: The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.
6. MEMORY LIGHTS: A memory light is on when its corresponding memory is selected. This tells you what memory is active at any given time.
7. TOUCH SENSE LED: This light comes on during the touch sensing sequence when a touch sensing robot controller is used

LIMITS OVERLAY (OPTIONAL)

The Limits Overlay is used to set the maximum and minimum limits of the wire feed speed and voltage or arc length trim for any welding procedure stored in memory. See Figure B.6.

FIGURE B.6 – LIMITS OVERLAY



1 LCD DISPLAY WINDOW
2 RECALL FROM MEMORY KEY
3 MEMORY LOCATION NUMBER KEYS
4 SET LIMIT KEY
5 LIMIT UP/DOWN KEYS
6 SAVE TO MEMORY KEY
7 DISPLAY RECALL KEY
8 MEMORY LIGHTS

1. LCD DISPLAY WINDOW: Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 4

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. RECALL FROM MEMORY KEY:

   AND

3. MEMORY LOCATION NUMBERS:

   The RECALL FROM MEMORY key (RECALL) is used to recall a welding procedure from memory.

   Determine the memory location number of the welding procedure for which you want to set limits. Then press the RECALL FROM MEMORY key (RECALL) followed by the MEMORY LOCATION NUMBER key for the selected procedure.

   If no procedure was saved in the selected memory location, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   Select another memory location.

4. SET LIMIT KEY:

   AND

5. LIMIT UP / DOWN KEYS:

   The SET LIMIT key and LIMIT UP / LIMIT DOWN keys are used to set the maximum and minimum allowed wire feed speed, and voltage trim or arc length trim values of the procedure that was recalled from memory.

Use the LIMIT UP and LIMIT DOWN keys to change the maximum wire feed speed to the desired value.

Press the SET LIMIT key again. The new maximum and old minimum wire feed speeds will be displayed.

Use the LIMIT UP and LIMIT DOWN keys to change the minimum wire feed speed to the desired value.

Press the SET LIMIT key. The present maximum and minimum voltage trim or arc length trim will be displayed. (Refer to Table B.3 to see how voltage trim affects preset voltage. Refer to Table B.6 to see how arc length trim affects preset arc length.)

Use the LIMIT UP and LIMIT DOWN keys to change the maximum value. The maximum for either type is 1.5.

Press the SET LIMIT key. The new maximum and old minimum voltage trim or arc length trim will be displayed.

Use the LIMIT UP and LIMIT DOWN keys to change the minimum value. The minimum for either type is 0.5.

6. SAVE TO MEMORY KEY: The SAVE TO MEMORY KEY is used to save the procedure with the newly set limits to memory. Press the SAVE TO MEMORY key (SAVE) followed by the MEMORY LOCATION NUMBER key of the desired memory location. This does not have to be the original location from which the procedure was recalled.

   Step 6 can be performed any time during the limit-setting process. You do not have to set all the available limits. When you have set all the desired limits, save the procedure to memory.

   To clear any previously set limits, recall the procedure from memory and change the limits to the maximum range available. Then save the procedure to memory.

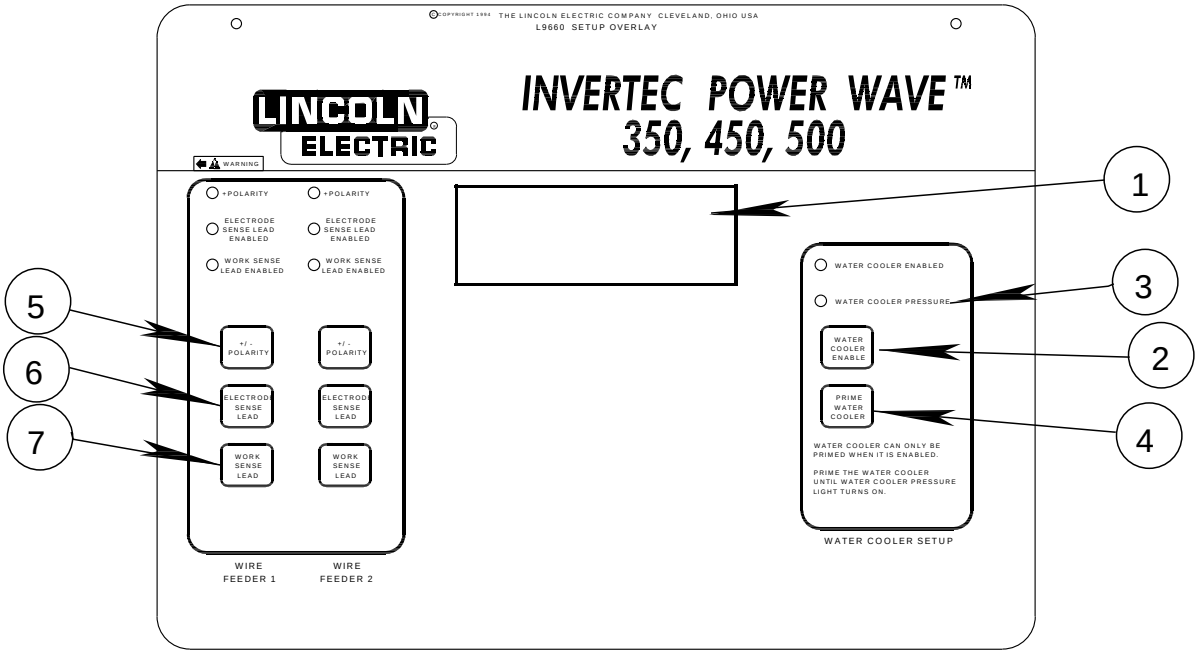
7. DISPLAY RECALL KEY: To view other information about the active welding procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the last active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions will be displayed for a few seconds.

6. MEMORY LIGHTS: A memory light is on when its corresponding memory is selected. This tells you what memory is active at any given time.

SETUP OVERLAY

The Setup Overlay is used to control the water cooler operation (on/off and prime the water cooler), and to set up the voltage sensing configuration of the machine and wire feeder(s) connected to the Power Wave. See Figure B.7.

FIGURE B.7 – SETUP OVERLAY



1 LCD DISPLAY WINDOW
2 WATER COOLER ON/OFF KEY
3 WATER COOLER PRESSURE LIGHT
4 PRIME WATER COOLER KEY
5 WIRE FEEDER 1+/- POLARITY KEY
6 WIRE FEEDER 1 ELECTRODE SENSE LEAD KEY
7 WIRE FEEDER 1 WORK SENSE LEAD KEY

1. LCD DISPLAY WINDOW: Power up the machine with this overlay in place. When the Power Wave is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 0

   This message is then replaced by the following message:

   POWER WAVE
   SETUP

2. WATER COOLER ON/OFF KEY: Press this key to toggle the water cooler between being enabled and disabled. The present status of the water cooler is indicated by the “WATER COOLER ON” light.

3. WATER COOLER PRESSURE LIGHT: This light indicates whether enough coolant pressure exists for normal water cooler operation. If the water cooler loses the required pressure it will shut down within a couple of seconds and the water cooler pressure light will turn off.

   If the water cooler does not have enough pressure to operate when enabled, the machine also sounds a buzzer.

4. PRIME WATER COOLER KEY: The water cooler may have to be primed if there is not enough pressure in the water cooler hose for operation. Make sure that the water cooler has been turned on before it is primed. (The “WATER COOLER ON” light should be turned on.) Check reservoir for proper coolant level - See Water Cooler information in ACCESSORIES section. To prime the water cooler, hold the PRIME WATER COOLER key down. While this key is pressed, the display will show:

   PRIME WATER
   COOLER

When the “WATER COOLER PRESSURE” light turns on, release the key.

5. WIRE FEEDER 1 +/- POLARITY KEY: Press this key to change the present voltage sensing polarity of wire feeder 1. The present polarity of wire feeder 1 is indicated by the “WIRE FEEDER 1+ POLARITY” light. If wire feeder 1 is set for positive voltage sensing polarity, this light is turned on.
6. WIRE FEEDER 1 ELECTRODE SENSE LEAD KEY: Press this key to enable or disable the electrode sense lead (lead #67) of wire feeder 1. When enabled, voltage sensing is done by the electrode sense lead. When disabled, voltage sensing is done at the Power Wave output terminal. When enabled, the “WIRE FEEDER 1 ELECTRODE SENSE LEAD ENABLED” light will be illuminated.
7. WIRE FEEDER 1 WORK SENSE LEAD KEY: Use this key to disable work sense (21) lead sensing in all robotic applications. Press this key until the “WIRE FEEDER 1 WORK SENSE LEAD ENABLED” LED is OFF.
8. WIRE FEEDER 2: controls are used for touch sensing. They must be set to + polarity, electrode sense lead enabled and work sense lead disabled.

WIRE FEEDER SETUP DESCRIPTION

The Power Wave may be set up for either positive or negative arc voltage sensing using any two of the following places:

1. the positive output terminal of the Power Wave
2. the negative output terminal of the Power Wave
3. the electrode sense lead (67 lead) of the wire feeder

The SETUP Overlay allows you to select between which two places arc voltage will be sensed. Once the selection is made it is not necessary to reconfirm the selection every time a new overlay is used or a wire feeder is replaced with another one. The selection will remain until it is changed with the SETUP Overlay.

When welding with a stick procedure, the arc voltage is automatically measured between the Power Wave’s output studs.

I. Select arc voltage sensing polarity first.

+/- POLARITY KEY

A. Positive Polarity Voltage Sensing :

In most welding applications the electrode cable is connected to the + output terminal and the work cable is connected to the - output terminal of the power source. This is positive polarity voltage sensing. When the Power Wave and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of two ways. These two ways are shown in Table B.1.

Table B.1: Positive Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
+ Output Terminal	- Output Terminal
Electrode Sense (67) Lead	- Output Terminal

Use the ELECTRODE SENSE LEAD KEY to select either the + output terminal or the electrode sense (67) lead for the positive voltage reference.

B. Negative Polarity Voltage Sensing:

In some welding applications (such as Innershield®) the electrode cable is connected to the - output terminal and the work cable is connected to the + output terminal of the power source. This is negative polarity voltage sensing. When the Power Wave and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of two ways. These two ways are shown in Table B.2.

Table B.2: Negative Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
– Output Terminal	+ Output Terminal
Electrode Sense (67) Lead	+ Output Terminal

Use the ELECTRODE SENSE LEAD KEY to select either the - output stud or the electrode sense (67) lead for the positive voltage reference.

OVERVIEW OF WELDING PROCEDURES

FLUX CORED ARC WELDING (FCAW) AND GMAW PROCEDURES

For each wire feed speed, a corresponding voltage is preprogrammed into the machine by welding experts. This preprogrammed voltage is the best average voltage for the procedure at the given wire feed speed. If the wire feed speed is changed on the wire feeder, the voltage automatically changes with it.

In some cases, the operator may want to change the preprogrammed voltages; for example, to compensate for cable and fixture voltage drops. The preset voltages can be adjusted on the wire feeder's Voltage display. When a change is made to the voltage at one wire feed speed, this change is applied to all other wire feed speed settings. For example, if the operator turns up the voltage by 10 percent, the machine automatically increases the preset voltages at all the other wire feed speeds by 10 percent. In the GMAW and FCAW process, the display shows The Procedure Description, WFS and Preset Voltage. The preset voltage which was pro-grammed at the factory, may be changed on the wire feeder voltage display. Note that if you change the default preset voltage up or down a respective " " or " " sign will be dis-played after the preset value. When the gun trigger is pulled note that the display changes to show WFS, Actual Arc Volt-age and Actual Arc Current. See Table B.4 for display summary.

PULSE PROCEDURES

In these procedures, the actual voltage greatly depends on the waveform used. The peak currents, background currents, rise times, fall times, and pulse times all affect the actual volt-age. The actual voltage for a given wire feed speed is not directly predictable unless the waveform is known. In this case, it is not practical to preset an actual voltage for the pro-cedure. Instead, an arc length adjustment is provided. The machine "knows" what the best arc length is at the given wire feed speed but allows the operator to change it.

The arc length can be adjusted between 0.5 and 1.5 on the wire feeder's Voltage display. An arc length trim of 1.0 means that no adjustments will be made to the pre-set arc lengths. An arc length trim greater than 1.0 increases the preset arc lengths. An arc length trim less than 1.0 decreases the pre-set arc lengths. The arc length adjustment is factored in at all wire feed speed settings.

Increasing the arc length by 10 percent at a given wire feed speed also increases all the other arc length settings of the procedure by 10 percent. In the Pulse process, the display shows the Procedure Description, WFS and Arc Length Trim. Arc length trim is programmed to a default at the factory and may be adjusted on the wire feeder. When the trigger is pulled, the WFS, Actual Arc Voltage and Actual Arc Current are dis-played.

WAVE CONTROL

The wave control settings of all procedures can be changed on the Power Wave 450 GMAW Pulse, GMAW and FCAW, Stick Process Selection Overlay. The wave control is a setup parameter that may be adjusted when the welding procedures are set. This feature pro-vides an easy way to change the arc behavior without creating a new procedure. The wave control setting of a procedure limits the speed at which the current waveform of that procedure can change. Typically, each procedure is programmed to have average wave con-trol (at the center of the scale).

In Pulse processes:

The wave control adjustment allows the frequency setting to vary. Increasing the wave control allows the frequency setting to increase, and decreasing the wave control allows the frequency setting to decrease. Varying the wave control setting affects the droplet trans-fer and allows fine-tuning for different welding positions.

In GMAW and FCAW processes:

The wave control adjusts the inductance. (Inductance is inversely proportional to pinch.) Increasing the wave control setting decreases the inductance, which results in the arc getting colder and pinched tighter. Decreasing the wave control setting increases the induc-tance, which results in the arc getting wider.

TABLE B.3 – ADJUSTBLE PARAMETERS

Adjustable Parameters	Pulse	GMAW FCAW
WFS Display	Wire Feed Speed	Wire Feed Speed
Voltage Display	Arc Length Trim	Preset Voltage
Power Wave 450 Display (with GMAW Pulse, GMAW and FCAW Selection Overlay)	Wave Control (Frequency)	Wave Control (Inductance)

TABLE B.4 – DISPLAYS OF THE POWER WAVE AND WIRE FEEDERS FOR DIFFERENT PROCESSES IN BOTH TRIGGER POSITIONS

Trigger Position	Power Wave 450	
	Pulse	GMAW FCAW
Open	WFS and Arc Length Trim	WFS and Preset Voltage
Closed	WFS, Actual Arc Voltage, Actual Arc Current	WFS, Actual Arc Voltage, Actual Arc Current

PULSE WELDING

Some people have trouble getting used to the behavior of the pulsing arc. The parameters programmed into the Power Wave have been thoroughly tested for their ability to deliver a sound weld with good appearance. There are, however, a few things to keep in mind when pulse welding.

Spatter levels are often very low with the pulse welding process. Pulsing is often used to eliminate cleaning operations necessary when using other welding processes.

Fume levels are sometimes lower with the pulsing process. Whether or not you will get lower fume levels depends on the pulsing programs used. Certain waveform characteristics are necessary to get low fume levels. Unfortunately, low fume procedures are harder to weld with than procedures designed to optimize the welding process.

The pulsing process is not slower than other processes. The process is sometimes less forgiving when the arc gets on or ahead of the puddle. More attention must be paid to the weld to avoid losing the puddle. Speed is a matter of deposition rate. All things being equal regarding the joint being welded, the speed will depend on the wire feed speed. The travel speed is maximized by maintaining a very short arc. Often the process is "trimmed" down until the arc "crackles." The spatter increases slightly, but many of the advantages of pulsing are retained. When welding steel, the Power Wave is designed to run well in this region between pulse and short arc.

The pulsing process greatly affects the heat input to the workpiece. This can be a valuable tool for either increasing or decreasing the heat input with a given process. For instance, it is possible to greatly increase the heat input when welding steel at high deposition rates. On the other hand, it is possible to reduce the heat input using the pulsing process. For example, heat input is reduced greatly with some of the low current stainless steel procedures using the processes programmed into the Power Wave. In all cases, the Power Wave procedures have been checked for their ability to deliver a sound weld. However, the fusion of the weld metal into the workpiece may be affected. It is the responsibility of the user to determine if the welds produced are suitable and sound.

The Power Wave is optimized for use with a 0.75" (1.9 cm) stickout. The adaptive behavior is programmed to support a stickout range from 0.5" to 1.25" (1.3 to 3.2 cm). In the low and high end of the wire feed speed ranges of most processes, the adaptive behavior may be restricted. This is a physical restriction due to reaching the edge of the operating range for the process. It is possible to achieve adaptive behavior for longer stickout lengths. However, shielding gas is often lost when the stickout is too long.

A longer electrical stickout is often used with the puls-ing process at higher deposition rates. A long stickout will increase the melt-off rate of the wire. In pulse welding, like other wire welding processes, the arc length is determined by the voltage setting. This voltage is programmed at the factory for each process and wire feed speed. It may be changed using the Voltage setting on the wire feeder.

When adaptive processes are used, the voltage will vary with stickout. The machine must change the voltage to keep a stable arc. It is very important to recognize this. "Actual" arc voltage when welding will vary because the stickout will seldom be held at the nominal 0.75" (1.9 cm) value.

OVERLOAD PROTECTION

Thermal Protection

The Power Wave has thermostatic protection from excessive duty cycles, overloads, loss of cooling, and high ambient temperatures. When the power source is subjected to any of the conditions mentioned above, a thermostat will open. The yellow high temperature light on the case front comes on. See Figure B.1 for location. Machine output is disabled, and welding is not possible until the machine is allowed to cool and the High Temperature Light goes out.

Current Protection

The Power Wave is limited to producing 750 amps peak current. If the average current exceeds 540 amps, the peak current will automatically be cut back to 100 amps until the average current decreases to 50 amps.

1. INTERFACE DESCRIPTION

This interface is designed for a Power Wave 450 and a Fanuc robot using ArcTool software (V1.30P) with touch sensing and through arc tracking. The interface responds to all of the ArcTool welding inputs and outputs except wire fault and wire stick alarm. All of the circuitry for touch sensing is internal to the Power Wave, no external power supply is required. The current signal for through arc tracking is supplied by the Power Wave, no external current sensor is required.

The interface does not control wire feed speed and welding voltage independently. Rather, the Power Wave is always operating in a synergic mode and the welding voltage is programmed as a function of the wire feed speed. ArcTool software was designed to control wire feed speed and voltage independently. Since the Power Wave system uses an **arc length trim,** the voltage cannot be directly controlled. The welding voltage settings in the robot controller are interpreted by the Power Wave as a **trim** setting. Any ArcTool function which tries to set the voltage to zero and control the wire feed speed is actually only setting the arc length **trim** to the minimum. Refer to the Operation section for a complete description of arc length trim. Any function which tries to set the wire feed speed to zero and control the voltage is actually only setting the wire feed speed to the minimum speed of the selected process. The following is a list of functions which do not work as intended by Fanuc due to the synergic operation of the Power Wave:

1.1 WELDING VOLTAGE

In this interface all welding voltage settings must be thought of as an arc length trim. This arc length trim will increase or decrease the arc voltage for a specific wire feed speed setpoint. The scaling in the robot controller is setup to allow voltage numbers between 50 and 150. A voltage number in the robot controller of 100 equals the nominal voltage (no trim adjustment) for the selected wire feed speed. If the arc length needs to be increased then the voltage trim number is increased. For example, if a voltage number of 115 is used then the arc voltage will increase too approximately 15% above the nominal voltage for the wire feed speed setpoint in use.

1.2 WIRE BURNBACK FUNCTION

The burnback function controlled by the robot controller will not operate properly. The function was setup to use a wire feed speed of zero while setting the welding voltage to some level. The system will produce the minimum wire feed speed for the selected procedure and a voltage trim for that selected wire feed speed setpoint. The solution to this problem is already built into the Power Wave. At every “arc end” the Power Wave automatically goes through its own burnback routine.

1.3 WIRE STICK RESET FUNCTION

The wire stick reset function controlled by the robot controller will not operate properly. This function is very similar to the burnback function. It was intended to use a wire feed speed of zero while setting the welding voltage to some level. For the same reasons as wire burnback it will not operate properly. The burnback routines in the Power Wave have been optimized for each welding procedure and are very reliable. If any wire stick problems occur, the burnback routines in the Power Wave can be programmed to correct the problem.

1.4 COLD WIRE INCHING FUNCTION

The cold inching wire feed speed cannot be changed by the robot controller. It is always set to 80 IPM. A variable cold inching speed is not possible with the current architecture of the interface.

2. ROBOT SIGNAL DESCRIPTIONS

2.1 VOLTAGE COMMAND

This is an analog output from the robot controller with a range of 0 to 10V. Since the Power Wave is always running in the synergic mode an output voltage cannot be set. The voltage command is used as a voltage trim for the active workpoint. The voltage command limits in the robot controller are entered as 50 to 150V. This is done so that the nominal trim setting (100V) is not confused with a welding voltage.

2.2 WIRE FEED SPEED COMMAND

This is an analog output from the robot controller with a range of 0 to 10V. The wire feed speed command sets both the wire feed speed and the synergic output of the Power Wave. The wire feed speed command limits in the robot controller are entered as 50 to 770I PM for a standard drive head and 80 to 1100 IPM for a high speed drive head.

2.3 TOUCH SENSE SIGNAL

This is an active low input to the robot controller which indicates that the welding electrode has touched the work piece. To start touch sensing the touch sensing command must be held low by the robot controller. Then the Power Wave monitors the current through the electrode to determine if it is touching the work piece. If the touch sense command is held low and the electrode is touching the work piece then the touch sense signal will be held low to report a “touch” to the robot controller.

2.4 ARC DETECT

This is an active low input to the robot controller which indicates that a welding arc has been detected. The Power Wave monitors the arc voltage and current to determine if an arc is established. If an arc is not established then the arc detect signal is held high to report an error to the robot controller.

2.5 GAS FAULT

This is an active low input to the robot controller which indicates that the shielding gas is missing. The Power Wave has external connections available for a normally open gas pressure or flow switch. If a switch is installed and the gas fault function is enabled then gas loss errors will be reported to the robot controller.

2.6 WIRE FAULT

This is an active low input to the robot controller which indicates a wire feeding problem or the lack of welding wire. This signal is not connected in the Power Wave.

2.7 WATER FAULT

This is an active low input to the robot controller which indicates a water cooling problem. The Power Wave monitors the water cooling pressure to decide if a water fault has occurred. If the water cooling pressure drops below 5-8psi then the water fault signal is held low to report an error to the robot controller.

2.8 POWER FAULT

This is an active low input to the robot controller which indicates a power fault in the Power Wave. If for some reason the 15V power supply in the Power Wave is below 15V then the power fault signal is held low to report an error to the robot controller.

2.9 VOLTAGE FEEDBACK

This is an analog input to the robot controller with a range of 0 to 10V. The internal arc voltage signal in the Power Wave is multiplied by 2 and isolated to produce the voltage feedback signal. A voltage feedback signal of 7.620V is equal to an arc voltage of 80.0V.

2.10 CURRENT FEEDBACK

This is an analog input to the robot controller with a range of 0 to 10V. The internal arc current signal in the Power Wave is multiplied by 4 and isolated to produce the current feedback signal. A current feedback signal of 8.317V is equal to an arc current of 750A.

2.11 WELD START

This is an active low output from the robot controller which commands the Power Wave to start an arc.

2.12 GAS START

This is an active low output from the robot controller which commands the Power Wave to open the shielding gas solenoid.

2.13 TOUCH SENSE COMMAND

This is an active low output from the robot controller which commands the Power Wave to turn on touch sensing. When touch sensing is enabled the Power Wave regulates a pulse voltage wave form while monitoring the current through the electrode. If current flows through the electrode then the touch sense signal is held low to report a “touch” to the robot controller.

2.14 WIRE+

This is an active low output from the robot controller which commands the Power Wave to cold inch wire at 80 IPM.

2.15 WIRE-

This is an active low output from the robot controller which commands the Power Wave to cold inch wire at -80 IPM.

2.16 WIRE STICK ALARM

This is an active low output from the robot controller used to indicate a wire stick. This signal is not connected in the Power Wave.

2.17 DUAL PROCEDURE SWITCH COMMAND

This is an active low output from the robot controller used to activate the dual procedure switch. When the Power Wave is running a dual procedure overlay this output is used to switch between procedures. If the output is held high by the robot controller then procedure A is active, and if the output is held low then procedure B is active.

2.18 WIRE STICK DETECT

This is a resistance measuring input to the robot controller used to detect a wire stick. The intended use for this resistance check is to measure the resistance between the output terminals of the weld equipment. This is not directly possible with a Power Wave because the resistance between the output studs is always 40 Ohms or less. Additional circuits have been added to allow the wire stick detect to work properly although it is not directly measuring the resistance between the output studs. If a resistance of approximately 100 Ohms or less is found then a wire stick error is reported by the robot controller.

3. INTERFACE CIRCUIT DESCRIPTIONS

⚠ CAUTION

All of the signals between the Power Wave and the robot controller were designed to operate in a shielded cable. No surge or high frequency protection has been added to the circuitry.

3.1 ROBOT CONTROLLER ELECTRICAL CHARACTERISTICS

The following signals are referenced to the robot controller's 24V supply unless otherwise noted. The total allowable load on the 24V supply is 0.7A.

The following is a brief description of the electrical characteristics, for a full description see the Fanuc electrical connections manual.

3.1.1 DIGITAL OUTPUTS

Rated Voltage:	24VDC
Maximum Applied Voltage:	30VDC
Maximum Load Current:	0.2A
Transistor Type:	Open collector NPN

3.1.2 DIGITAL INPUTS

Maximum Input Voltage:	28VDC
High Input Voltage:	20 to 28VDC
Low Input Voltage:	0 to 4VDC
Input Impedance:	3.3K Ohms
Response Time:	5 to 20mS

3.1.3 ANALOG OUTPUTS

Weld equipment analog outputs are isolated from the robot controller 24V supply.

Maximum Output Range:	0 to 10V
Load Impedance:	3.3K Ohms or more

3.1.4 ANALOG INPUTS

Maximum Input Range:	0 to 10V

3.1.5 WIRE STICK DETECT

The wire stick detect output is isolated from the robot controller 24V supply.

Maximum Output Voltage:	15VDC
Maximum Output Current:	85mA

4. POWER WAVE CIRCUITS

4.1 VOLTAGE COMMAND

The voltage command from the robot controller (DACH1) is directly connected to the TIG analog input on the display board of the Power Wave. This signal is not connected to the robot or control ground.

Maximum Input Range:	0 to 10V
Typical Zero Offset:	0.55 to 0.65V
Typical Range:	9.0V
Input Impedance:	200KΩ

4.2 WIRE FEED SPEED COMMAND

The wire feed speed command from the robot controller (DACH2) is directly connected to the WF1 analog input on the display board of the Power Wave. This signal is not connected to the robot or control ground.

Maximum Input Range:	0 to 10V
Typical Zero Offset:	0.55 to 0.65V
Typical Range:	9.0V
Input Impedance:	200KΩ

4.3 TOUCH SENSE SIGNAL

The touch sense signal is generated by active high miscellaneous output #4 (bit #3) on the control board. The signal is then isolated from the control ground, inverted, and tied to the robot controller welding input 1 (WDI1). The active state table is responsible for set-

ting and clearing the miscellaneous output #4.

4.4 ARC DETECT

The arc detect signal is generated from the voltage and current signals on the control board. The arc detect circuit is calibrated to detect a minimum arc of 15V and 30A. The signal is isolated from the control ground and tied to the robot controller welding input 2 (WDI2).

4.5 GAS FAULT

This signal is not connected to anything on the interface board. The signal (WDI3) is simply re-routed from the robot connector (P82) to the miscellaneous connector (P84). A gas fault is generated when this signal is tied to the robot ground.

4.6 WATER FAULT

The water fault signal is generated by an active high (w/low water pressure reading) signal on the display board. The signal is then isolated from the display ground, inverted, and tied to the robot controller welding input 5 (WDI5).

4.7 POWER FAULT

The power fault signal is generated by checking the 12.8V supply on the interface board. If the supply voltage on the interface board drops below ≈11.2V then a power fault signal is generated. The signal is then isolated from the control ground and tied to the robot controller welding input 6 (WDI6).

4.8 VOLTAGE FEEDBACK

The arc voltage feedback signal is generated on the control board. The interface board then filters, multiplies by 2, and isolates the signal from the control ground. The signal is then tied to the robot controller analog input 1 (ADCH1). A voltage feedback signal of 7.62V is equal to an arc voltage of 80V.

4.9 CURRENT FEEDBACK

The arc current feedback signal is generated on the control board. The interface board then filters, multiplies by 4, and isolates the signal from the control ground. The signal is then tied to the robot controller analog input 2 (ADCH2). A current feedback signal of 8.32V is equal to an arc current of 750A.

4.10 WELD START

The weld start command is generated by active low welding output 1 (WDO1). The signal is then isolated from the robot ground, inverted, and tied to the interface trigger input.

4.11 GAS START

The gas start command is generated by active low welding output 2 (WDO2). The signal is then isolated from the robot ground and tied to the gas solenoid driver.

4.12 TOUCH SENSE COMMAND

The touch sense command is generated by active low welding output 3 (WDO3). The signal is then inverted and isolated from the robot ground with an output made to conduct 24VAC. The 24VAC connection is the wire feeder 2 trigger.

4.13 WIRE+ & WIRE-

These two signals work together to cold inch the wire at ±80IPM. The forward wire inch command is generated by active low welding output 4 (WDO4). The reverse wire inch command is generated by active low welding output 5 (WDO5). When either of the two signals is received an isolated inch command is generated and tied to the interface wire inching input. At the same time the motor drive relays switch to the correct direction. The default direction for the motor drive relays is forward, if both the signals are low at the same time then the motor drive relays are set for reverse. No damage will be caused by driving both signals low at the same time.

4.14 DUAL PROCEDURE SWITCH COMMAND

The dual procedure switch command is generated by active low welding output 7 (WDO7). The signal is then isolated from the robot ground and tied to the interface dual procedure input.

4.15 WIRE STICK DETECT

The wire stick detect signal is generated by a voltage check across the output studs. The robot controller samples this signal a predetermined time after the Arc Enable signal changes from enabled to disabled. The signal is then isolated from the control ground and tied to the robot controller wire stick detect inputs (WDI+ & WDI-).

5. ROBOT CONTROLLER SETUP

5.1 WELD SYSTEM SETUP

MONITORING FUNCTIONS		
1	Arc loss	ENABLED
2	Gas shortage	DISABLED
3	Wire shortage	DISABLED
4	Wire stick	ENABLED
5	Power supply failure	ENABLED
6	Coolant shortage	ENABLED
WELD RESTART FUNCTION		
7	Return to path	DISABLED
8	Overlap distance	0mm
9	Return to path speed	200mm/s
SCRATCH START FUNCTION		
10	Scratch start	DISABLED
11	Distance	5mm
12	Return to start speed	12mm/s
ON-THE-FLY FUNCTION		
13	On-The-Fly	ENABLED
14	Voltage increment	1.0V
15	Wire feed increment	5.0IPM
16	Current increment	5.0A
OTHER FUNCTIONS		
17	Weld from teach pendent	ENABLED
18	Run in	DISABLED
19	Wire burnback/retract	DISABLED

5.2 WELD EQUIPMENT SETUP

1	Weld process	MIG
2	Remote arc enable	DI 0
3	Weld power control	Wire FD
4	Wire feed control	AO
5	Wire+ Wire- speed	80IPM
6	Wire feed speed units	IPM
WELD RUN IN		
7	Voltage	50.0V
8	Current	250.0A
9	Wire feed	200IPM
10	Time	0.00s
WIRE BURNBACK/RETRACT		
11	Voltage	50.0V
12	Current	250.0A
13	Wire feed	0IPM
14	Time	0.00s
TIMING		
15	Arc start error time	2.00s
16	Arc detect time	0.10s
17	Arc loss error time	0.30s
18	Gas detect time	0.05s
19	Gas purge time	1.00s
20	Gas preflow time	0.50s
21	Gas postflow time	0.00s

WIRE STICK FUNCTION

22	Reset	DISABLED
23	Reset tries	1
24	Voltage	50.0V
25	Time	0.00s
VOLTAGE OUTPUT SCALING		
26	Minimum reference	0.60V
27	Maximum reference	9.60V
28	Minimum output	50.0V
29	Maximum output	150.0V
CURRENT OUTPUT SCALING		
30	Minimum reference	0.00V
31	Maximum reference	10.00
32	Minimum output	0.0A
33	Maximum output	400.0A
WIRE FEED SPEED OUTPUT SCALING		
34	Minimum reference	0.60V
35	Maximum reference	9.60V
36	Minimum output	50IPM
37	Maximum output	770IPM
VOLTAGE INPUT SCALING		
38	Minimum reference	0.0219V
		R = 7.268 (7.620)
39	Maximum reference	7.289V
		ZERO ~ 0.020
40	Minimum output	0.0V
41	Maximum output	80.0V
CURRENT INPUT SCALING		
42	Minimum reference	0.7848V
		R = 8.32 (8.317)
43	Maximum reference	9.104V
		ZERO =0.58 - 0.80
44	Minimum output	0.0A
45	Maximum output	750A

5.3 SYSTEM VARIABLES

$AWEUPR	$WSTK_ENA_DLY	0.10s

5.4 TOUCH SENSING SETUP

Sensor port type	WI
Sensor port number	1
Circuit port type	WO
Circuit port number	3

6. CONNECTIONS

6.1 POWER WAVE INTERFACE BOARD

J101-1	+Serial loop	CTRL J27-1
J101-2	High speed sense 1	P83-K
J101-3	High speed sense 2	P83-L
J101-4	-Serial loop	CTRL J27-4

J103-1	+42VDC	Full wave bridge
J103-2	-42VDC	Full wave bridge
J103-3	Touch 2-4 output (2)	PROT J34-4
J103-4	Touch 2-4 output (4)	PROT J34-7
J103-5	Tach PWR	P83-G
J103-6	Tach signal	P83-F
J103-7	Tach GND	P83-H
J103-8	Motor+	P83-A
J103-9	Motor-	P83-B
J103-10	Weld 2-4 output (2)	PROT J34-11
J103-11	Weld 2-4 output (4)	PROT J34-14
J103-12	Gas solenoid+	P83-C
J103-13	Gas solenoid-	P83-D
J103-14	67 Sense lead	P83-N
J103-15		
J103-16		

J104-1	Voltage signal	CTRL J21-4
J104-2	Current signal	CTRL J21-7
J104-3	Water PWR	D.K. J16-4
J104-4	+output signal	SNUB J60-3
J104-5	-output signal	SNUB J61-4
J104-6	Water signal	D.K. J16-5
J104-7	Control GND	CTRL J24-11
J104-8	TRIM command	D.K. J10-12 (TIG)
J104-9	WFS command	D.K. J10-2 (WF1)
J104-10	Display analog GND	D.K. J10-13
J104-11	Water GND	D.K. J16-12
J104-12	67 Sense lead	SNUB J60-8

J105-1	Isolated voltage signal	P82-J (ADCH1)
J105-2	Isolated current signal	P82-L (ADCH2)
J105-3	Abnormal operation signal	P82-h (WDI6)
J105-4	Arc start command	P82-[ ]* (WDO1)
J105-5	Arc detect signal	P82-d (WDI2)
J105-6	Gas flow command	P82-S (WDO2)
J105-7	Gas shortage signal	P82-e (WDI3)
J105-8	DPS command	P82-X (WDO7)
J105-9	Positive inch command	P82-U (WDO4)
J105-10	Negative inch command	P82-V (WDO5)
J105-11	Short detect signal (+)	P82-N (WDI-)
J105-12	Short detect signal (-)	P82-P (WDI-)
J105-13	Isolated water signal	P82-g (WDI5)
J105-14	Touch sense command	P82-T (WDO3)
J105-15	Voltage command	P82-A (DACH1)
J105-16	WFS command	P82-E (DACH2)

J106-1	Touch sense signal	CTRL J24-4
J106-2	Isolated touch sense signal	P82-c (WDI1)
J106-3	Robot +24V	P82-r (+24E)
J106-4	Robot GND	P82-a (0V)
J106-5	Robot analog GND	P82-F (COMDA2)
J106-6	Spare robot output	P82-Z (WDO8)
J106-7	Gas shortage input	P84-A
J106-8	Gas shortage GND	P84-B

6.2 ARCTOOL WELDING INPUTS AND OUTPUTS

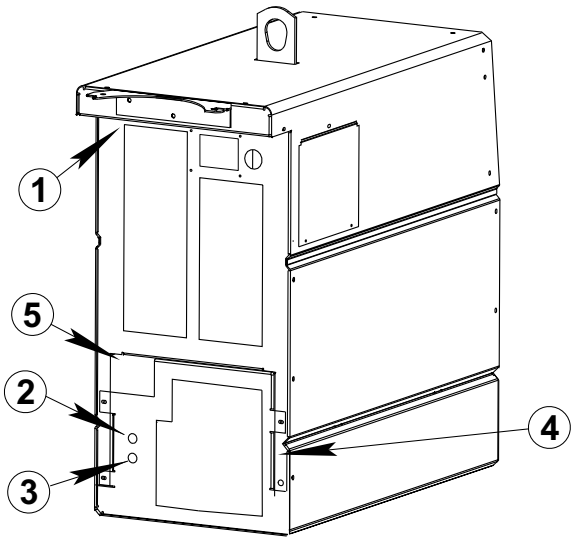
CRW1-1	DACH1	Voltage command	P82-A
CRW1-2	COMDA1		P82-F
CRW1-3	DACH2	WFS command	P82-E
CRW1-4	COMDA2	WFS command GND	P82-F
CRW1-5	WDI1	(Touch sense signal)	P82-c
CRW1-6	WDI2	Arc detect	P82-d
CRW1-7	WDI3	Gas fault	P82-e
CRW1-8	WDI4		P82-f
CRW1-9	WDI5	Water fault	P82-g
CRW1-10	WDI6	Power fault	P82-h
CRW1-11	WDI7		P82-j
CRW1-12	WDI8		P82-k
CRW1-13	ADCH1	Voltage feedback	P82-J
CRW1-14	COMAD1		P82-K
CRW1-15	ADCH2	Current feedback	P82-L
CRW1-16	COMAD2		P82-M
CRW1-17			
CRW1-18			
CRW1-19	0V	Robot GND	P82-a
CRW1-20	0V		P82-b
CRW1-21	0V		P82-m
CRW1-22	0V		P82-n
CRW1-23	WDO1	Weld start	P82-R
CRW1-24	WDO2	Gas start	P82-S
CRW1-25	WDO3	(Touch sense command)	P82-T
CRW1-26	WDO4	Wire+	P82-U
CRW1-27	WDO5	Wire-	P82-V
CRW1-28	WDO6		P82-W
CRW1-29	WDO7	(Dual procedure switch command)	P82-X
CRW1-30	WDO8	(Spare robot output)	P82-Z
CRW1-31	WDI+	Wire stick detect	P82-N
CRW1-32	WDI-	Wire stick detect	P82-P
CRW1-33	+24V	Robot PWR	P82-r
CRW1-34	+24V	Robot PWR	P82-r
			P82-H
			P82-s

* P82-R Fanuc models
P82-C Motoman models

6.3 MISCELLANEOUS CONNECTIONS

P84-A	Gas shortage input
P84-B	Gas shortage GND

FIGURE D.1 – WIRE FEEDER AND WATER COOLER CONNECTIONS



1 WIRE FEEDER CONNECTIONS (LOCATION)
2 WATER COOLER LINE (IN)
3 WATER COOLER LINE (OUT)
4 CIRCUIT BREAKER (WATER COOLER)
5 FILL SPOUT (WATER COOLER)

WATER COOLER USAGE

The Power Wave is equipped with an optional internal water cooler. We recommend using the water cooler when welding above 300 amps with argon blends on a regular basis. The gun heating from pulsing above 300 amps average current is often excessive and leads to reduced consumable life, reduced gun life, and operator discomfort. Water cooling greatly increases the durability of the gun and parts at high current.

There are two water connections on the rear of the Power Wave. See Figure D.1. Connect the water lines between these connectors and those on the wire feeder. The water is fed through the feeder into the gun. When a water cooler is used, the water cooler must be enabled by using the Setup Overlay.

The water cooler contains a pressure switch, which is closed when there is adequate pressure in the water cooler hose for normal operation. If this pressure drops below the switch manufacturer's set point, the pressure switch opens. A couple of seconds after the pressure switch opens the water cooler shuts down. If the water cooler is enabled and the pressure switch opens, the machine beeps loudly indicating that there is a problem with the water cooler operation.

RECOMMENDED COOLANTS

1. The following coolants have been determined to be compatible with the wetted materials used in the G3503-[ ] cooler assembly:
   - Distilled or deionized water
   - Potable tap water
   - Sediment-free mixtures containing a maximum of 50% ethylene glycol or automotive-grade antifreeze and the balance of distilled or deionized water.

2. Ethylene glycol mixtures should be selected if the cooler may be exposed to a temperature below the freezing point of water.

3. Consult gun, torch, and wire feeder manuals for coolant recommendations and select one from the above list.

4. Pure solutions and mixtures of, or materials (i.e. towels) wetted with ethylene glycol are toxic to humans and animals. They must not be haphazardly discarded, especially by pouring liquids down the drain. Contact the local EPA office for responsible disposal methods or for recycling information.

5. The cooler's reservoir has a nominal liquid capacity of 1.6 gallons.

PRIMING THE COOLER

1. Select a recommended coolant and fill cooler to specified level (see Fig. D.2).

2. Attach desired water-cooled accessory (gun and wire feeder or TIG torch) to cooler's QDs.

3. Prime the cooler:

   a. Install the Set-up overlay.

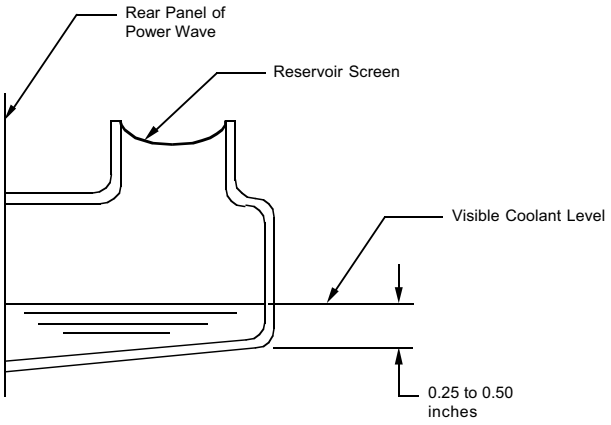
   b. Keep accessories' hose lengths horizontal, either coiled or straight, and no higher than 4 feet of the specified coolant level.

   c. Switch on the Power Wave machine.

   d. Press the "WATER COOLER ENABLE" button so that the "WATER COOLER ENABLED" light is illuminated.

   e. Press the "PRIME WATER COOLER" button until the "WATER COOLER PRESSURE" light is steadily illuminated.

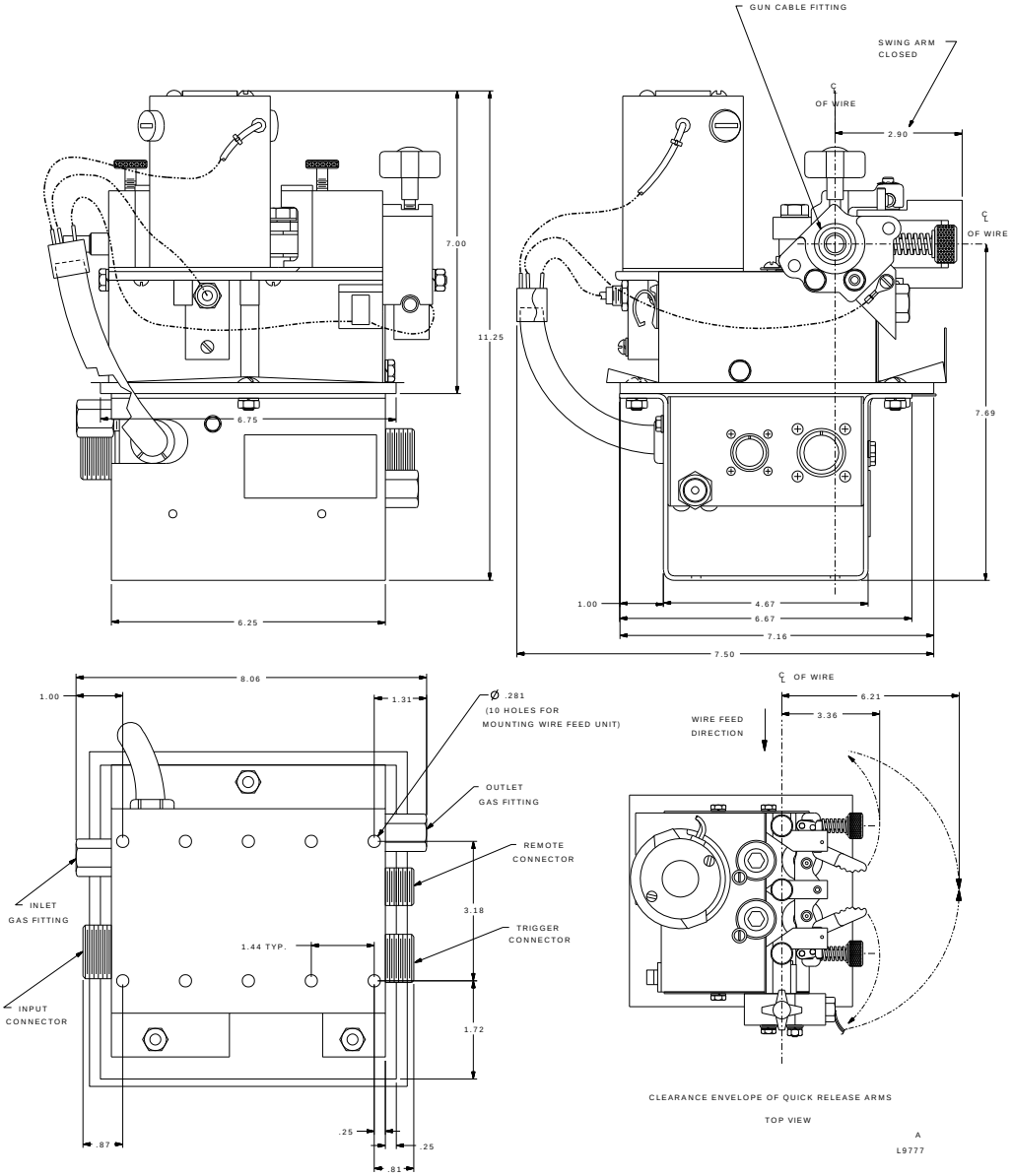
4. Check coolant level. Add more if required.



Do Not Use: Any prepacked welding industry coolant mixture, such as those offered by Miller, OKI, Bernhard, or Dynaflux. These coolants contain substances which attack plastic components and may shorten the life of the system. Once added, these substances are virtually impossible to purge from the system. **DO NOT USE OIL-BASED COOLANTS OF ANY TYPE.**

Figure D.2

L9777 WIRE FEED UNIT DIMENSION PRINT



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MOUNTING THE WIRE FEED UNIT

Mount the wire feed unit by means of the insulated mounting bracket attached to the bottom of the gearbox. See L9777 Dimension Print following, to find the size and location of the mounting holes. The gearbox assembly is electrically “hot” when the gun or nozzle is energized. Therefore, make certain the gearbox does not come in contact with the structure on which the unit is mounted.

The wire feed unit should be mounted so that the drive rolls are in a vertical plane so dirt will not collect in the drive roll area. Position the mechanism so it will point down at about a 45˚ angle so the wire feed gun cable will not be bent sharply as it comes from the unit.

CONNECTING WIRE FEED UNIT TO POWER SOURCE

The Feeder to Control cable assemblies are available in two types:

K680-”L” Includes a control cable with 14 pin MS-style connectors on each end, and a 4/0 weld cable to route between the Wire Drive and the Control Box. Available in lengths “L” og 16ft. (4.9m) and 25ft. (7.6m).

K681-”L” Same as K680, but does not include weld cable. Available in lengths “L” of12ft. (3.6m), 16ft. (4.9m) and 25ft. (7.6m).

1. Making certain the cables are protected from any sharp corners which may damage their jackets, mount the cable assembly along the boom so the end with the female MS-style connector pins is at the wire feed unit.

2. Connect the 14-socket cable connector to the receptacle on the back of the wire feed unit connection box.

3. At the same end, connect the electrode lead to the connection stud of the brass gun connection block on the front of the wire feed unit.

4. At the control box end, connect the 14-pin connector of the cable to the mating receptacle on the bottom of the control box.

ELECTRODE ROUTING

The electrode supply may be either from reels, Readi-Reels, spools or bulk packaged drums or reels. Observe the following precautions:

1. The electrode must be routed to the wire feed unit so that the bends in the wire are at a minimum, and also that the force required to pull the wire from the reel into the wire feed unit is kept at a minimum.

2. The electrode is “hot” when the gun is energized and must be insulated from the boom and structure.

3. If more than one wire feed unit shares the same boom, their wire and reels must be insulated from each other and insulated from their mounting structure.

See later in this section for mounting of the K299 wire reel assembly.

DRIVE ROLL AND GUIDE TUBE KITS:

Steel Wire Sizes:	4-Roll
* .068 - 3/32" (1.7 - 2.4mm) Cored	KP655-3/32
* 1/16" (1.6mm) Cored or Solid	KP655-1/16
.045 - .052" (1.2 - 1.4mm) Solid	KP655-052S
.045 - .052" (1.2 - 1.4mm) Cored	KP655-052C
.035" (0.9-1.0mm) Cored	KP655-035C
.035" (0.9-1.0mm) Solid	KP655-035S
.030" (0.8mm) Solid	KP655-030S
.023" (0.6mm) Solid	KP655-025S
Aluminum Wire Sizes:	
1/16" (1.6mm)	KP656-1/16A
	KP647-1/16A**
3/64" (1.2mm)	KP656-3/64A
	KP647-3/64A**
.040" (1.0mm)	KP647-040A**
.035" (0.9mm)	KP656-035A

Drive rolls for only cored electrode sizes are stencilled with a "C" suffix to the wire sizes.

Drive rolls for only solid electrode sizes are stencilled with an "S" suffix to the wire sizes.

Drive rolls for aluminum wire sizes are stencilled with an "A" suffix to the wire sizes.

* Not for Synergic 7FH model.

** For use with Binzel European guns. Installation instructions are included with these kits. Also requires K489-2 Fast-Mate Adapter.

PROCEDURE TO INSTALL DRIVE ROLL AND GUIDE TUBES

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Do not touch electrically live parts such as output terminals or internal wiring.**
- **When inching with gun trigger, electrode and drive mechanism are "hot" to work and ground.**
- **Turn OFF welding power source before installing or changing drive roll and/or guide tubes.**
- **Welding power source must be connected to system ground per the National Electrical Code or any applicable local codes.**
- **Only qualified personnel should perform this installation.**

Observe all additional Safety Guidelines detailed throughout this manual.

Standard 4-Roll Kits (KP655 and KP656)

1) Turn off welding power source.

2) Release both quick release levers by sliding the levers sideways into the open positions.

3) Remove clamping screw & clamping collar from the drive shaft closest to the incoming side of the feeder.

4) Install drive roll onto keyed shaft. (Do not exceed the maximum wire size rating of the wire drive.) Replace collar and tighten clamping screw.

5) Back out the set screw for the middle guide tube. Install the middle guide tube and slide it up against the drive roll. DO NOT TIGHTEN THE MIDDLE GUIDE AT THIS TIME.

6) Install the outgoing drive roll following the same procedure as steps 3 & 4.

7) Center the middle guide between the two drive rolls and tighten in place.

8) Back out the screws for the incoming and outgoing guide tubes.

9) Install the longer guide tube in the rear hole near the incoming drive roll. Slide the tube in until it almost touches the roll. Tighten in place.

10) Install the remaining guide tube in the front hole. Be certain that the proper plastic insert is used. Fine wire chisel point tube must have largest radius next to drive roll. Tighten in place.

11) Re-latch both quick release levers.

12) To start new electrode, straighten the first 6" (150mm) and cut off the first 1" (25mm). Insert free end through the incoming tube. Press gun trigger & push wire into the drive roll.

Idle Roll Pressure Setting

The idle roll pressure is set at the factory, backed out three turns from full pressure on 4-roll feeders. This is an approximate setting. For small wire sizes and aluminum wire up to 9 or 10 turns out may be required to minimize “birdnesting”. The optimum idle roll pressure varies with type of wire, surface condition, lubrication, and hardness. The optimum idle roll setting can be determined as follows:

1) Release the incoming idle roll pressure arm, then press end of gun against a solid object that is electrically isolated from the welder output and press the gun trigger for several seconds.

2) If the wire “birdnests”, jams, or breaks at the drive roll, the idle roll pressure is too great. Back the pressure setting out 1/2 turn, run new wire through gun, and repeat above steps.

3) If the only result is drive roll slippage, disengage the gun locking nut, and pull the gun cable forward about 6” (150mm). There should be a slight waviness in the exposed wire. If there is no waviness, the pressure is too low. Increase the pressure setting 1/4 turn, reconnect the gun, tighten the locking nut, and repeat the above steps.

4) After the outgoing pressure is set, determine how many turns away from full pressure the setting is. Set both idle roll tensions to this setting. Engage both idle rolls before welding. In most applications, best wire feeding will occur when both idle roll pressures are set the same.

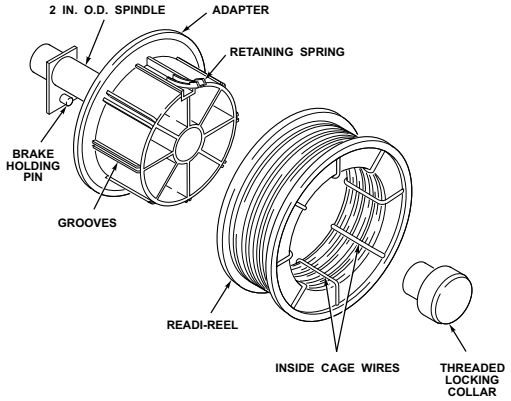
K659-1 - Gas Guard Regulator

Adjustable flow regulator with removable adjustor key for CO_2 and Argon blend gases. Mounts onto wire feed unit inlet, and reduces gas waste and arc start “blow” by reducing surge caused by excess pressure in supply hose.

Gas Guard Regulator Setting (Optional K659-1)

1) With the gas supply shut off, the Gas Guard regulator flow adjusting key should be set to maximum (full clockwise) which is rated to be 60 SCFH (28 lts/min).

2) Adjust gas supply flow rate for a level higher than will be required, then adjust Gas Guard flow adjusting key counterclockwise to the desired gas flow rate.



Wire Reel Loading - Readi-Reels and Spools (using K162H Spindle Kit with 2” (51mm) spindle)

TO MOUNT A 30 LB (14 KG) READI-REEL PACKAGE USING THE MOLDED PLASTIC K363-P TYPE ADAPTER:

1) Make certain that the threaded locking collar is tight and securely locks the adapter on the spindle (see figure above).

2) Rotate the spindle and adapter so the retaining spring is at the 12 o’clock position.

3) Position the Readi-Reel so that it will rotate in a clockwise direction when feeding (wire is to be dereeled from bottom of the coil).

4) Set one of the Readi-Reel inside cage wires on the slot in the retaining spring tab.

5) Lower the Readi-Reel to depress the retaining spring and align the other inside cage wires with the grooves in the molded adapter.

6) Slide cage all the way onto the adapter until the retaining spring “pops up” fully.

⚠ WARNING

Check to be sure the Retaining Spring has fully returned to the locking position and has SECURELY locked the Readi-Reel Cage in place. Retaining Spring must rest on the cage, not the welding electrode.

7) To remove Readi-Reel from Adapter, depress retaining spring tab with thumb while pulling the Readi-Reel cage from the molded adapter with both hands. Do not remove adapter from the spindle.

To Mount 10 to 44 lb (4.5-20kg) Spool (12"/300mm Diameter): (For 8" (200mm) spools, a K468 spindle adapter must be used.)

REQUIRES INSTALLATION OF 2" (51MM) K162H SPINDLE KIT.

1) Remove the locking collar on the 2" (51mm) diameter spindle.

2) Place the spool on the spindle making certain the brake holding pin enters one of the holes in the back side of the spool. Be certain the wire comes off the reel in a clockwise direction when de-reeled from the bottom of the coil.

3) Replace and tighten the locking collar.

Feeding Electrode and Brake Adjustment

1) Turn the Readi-Reel or spool until the free end of the electrode is accessible.

⚠ WARNING

When feeding with the gun energized, the electrode and drive mechanism are always "HOT" to work and ground and could remain "HOT" several seconds after the gun trigger is released.

---

2) While tightly holding the electrode, cut off the bent end and straighten the first 6" (150mm). Cut off the first 1" (25mm). (If the electrode is not properly straightened, it may not feed or may not go into the outgoing guide tube causing a "birdnest".)

3) Insert the free end through the incoming guide tube.

4) Press the Cold Inch key or the gun trigger and push the electrode into the drive roll.

5) Feed the electrode through the gun.

6) Adjust the brake tension with the thumbscrew on the spindle hub, until the reel turns freely but with little or no overrun when wire feeding is stopped. Do not overtighten.

Wire Reel Loading - 50-60lb (22.7-27.2kg) Coils (K299 Wire Reel Mounting Kit)

Adjustable Wire Reel Brake

The mount for standard 50-60 lb (22.7-27.2 kg) electrode coils includes a two-position brake assembly. Generally the brake should be at the inner position (nearest to the wire reel shaft) for wire feed speeds below 400 in/min. (10m/m). It should be at the outer position for the faster wire speeds often used when feeding small diameter electrode.

To adjust the brake position, remove the wire reel. Pull the cotter pin that holds the brake shoe to the arm, move the shoe and replace the cotter pin. Do not bend the cotter pin - it is held in place by a friction fit.

To Mount a 50-60lb (22.7-27.2kg) Coil:

1) To remove the wire reel from its shaft, grasp the spring loaded knob and pull it out. This straightens the knob so it seats into the shaft when released. Remove the reel.

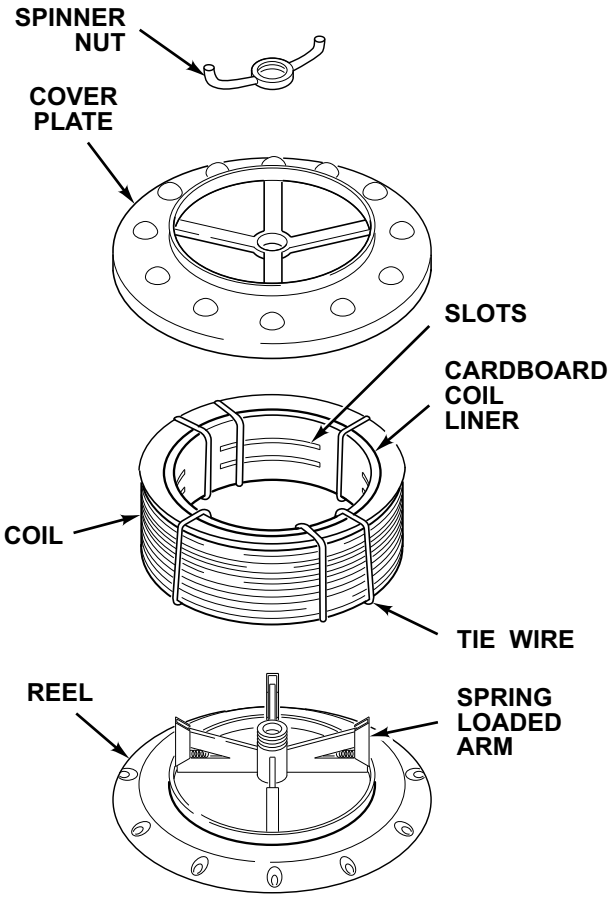
2) Lay the reel flat on the floor, loosen the spinner nut and remove the cover plate.

3) Before cutting the tie wires, place the coil of electrode on the reel so it unwinds as the reel rotates clockwise.

   a) Be sure the coil is placed so the spring loaded arms will not interfere with the later removal of the coil tie wires (see illustration below).

   b) When loading .030-.045" (0.8-1.2mm) electrode, be certain the coil is placed on the reel so the spring loaded arms are at the center of the slots in the cardboard coil liner. This provides the positive compression of the coil sides needed for trouble-free wire feeding (see illustration).

   c) Put the cover plate on the reel so that the four arms of the cover straddle and are in line with the spring loaded arm of the reel proper.



4) Tighten the cover as much as possible by hand. **DO NOT** hammer on the spinner nut arms.

5) Cut and remove only the tie wire holding the free end of the coil. Insert the free end into one of the holes in the cover and secure it by bending it back. Cut and remove the remaining tie wires.

⚠ CAUTION

Always be sure the free end of the coil is securely held while the tie wires are being cut and until the wire is feeding through the drive rolls. Failure to do this will result in "backlashing" of the coil, which may tangle the wire. A tangled coil will not feed so it must either be untangled or discarded.

6) Replace the reel on the wire feeder. Grasp the shaft knob, pull it out and swing it across the reel hub, locking the reel in place.

Feeding Electrode

1) Turn the reel until the free end of the electrode is accessible. While tightly holding the electrode, cut off the bent end.

2) Straighten the first 6" (150mm) and cut off the first 1" (25mm). Insert the free end through the incoming guide tube. Press the Cold Inch key or the gun trigger and push the electrode into the drive roll. Feed the electrode through the gun. (If the electrode is not properly straightened, it may not feed or may not go into the outgoing guide tube causing a "birdnest".)

⚠ WARNING

When feeding with the gun trigger, the electrode and drive mechanism are always "HOT" to work and ground and could remain "HOT" several seconds after the gun trigger is released.

Wire Loading of 13-14lb (6kg) Innershield Coils

Requires use of K162H Spindle Kit and K435 14 lb. Coil Adapter.

Routine Maintenance of Wire Feed Unit

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Do not touch electrically live parts such as output terminals or internal wiring.**
- **When inching with gun trigger, electrode and drive mechanism are "hot" to work and ground.**
- **Turn OFF welding power source before installing or changing drive roll and/or guide tubes.**
- **Welding power source must be connected to system ground per the National Electrical Code or any applicable local codes.**
- **Only qualified personnel should do maintenance or troubleshooting work.**

Observe all additional Safety Guidelines detailed throughout this manual.

Drive Rolls and Guide Tubes

After feeding every coil of wire, inspect the drive roll section. Clean it as necessary. Do not use a solvent for cleaning the idle roll because it may wash the lubricant out of the bearing. The driver roll and guide tubes are stamped with the wire sizes they will feed. If a wire size other than that stamped on the roll(s) is to be used, the roll(s) and guide tubes must be changed.

The drive rolls for .045" (1.2mm) and .052" (1.3mm) cored electrode and 1/16" (1.6mm), .068 (1.7mm), 5/64" (2.0mm), and 3/32" (2.4mm) electrode have a double set of teeth so they can be reversed for additional life. Between the two knurled rolls **(**except 1/16" (1.6mm)**)** and smaller roll(s) is a shim washer which limits the damage to the electrode if wire feeding problems occur. Drive rolls for .023" (0.6mm) through .052" (1.3mm) solid electrodes have no teeth.

See section on Wire Feed Drive Roll and Guide Tube Kits for roll changing instructions.

Wire Reel Mounting - 50 (22.7kg) and 60lb (27.2kg) Coils

To prolong the life of the reel shaft, periodically coat it with a thin layer of grease.

No maintenance of the two-position adjustable brake is needed. If the brake shoe wears through to the metal, replace the brake assembly.

Wire Reel Mounting - Readi-Reels and 10 through 30lb (4.5-14kg) Spools

No routine maintenance required. Do not lubricate 2" (51mm) spindle.

Avoiding Wire Feeding Problems

Wire feeding problems can be avoided by observing the following gun handling procedures:

a) Do not kink or pull cable around sharp corners.

b) Keep the electrode cable as straight as possible when welding or loading electrode through cable.

c) Do not allow dolly wheels or trucks to run over cables.

d) Keep cable clean by following maintenance instructions.

e) Use only clean, rust-free electrode. The Lincoln electrodes have proper surface lubrication.

f) Replace contact tip when the arc starts to become unstable or the contact tip end is fused or deformed.

g) Do not use excessive wire spindle brake settings.

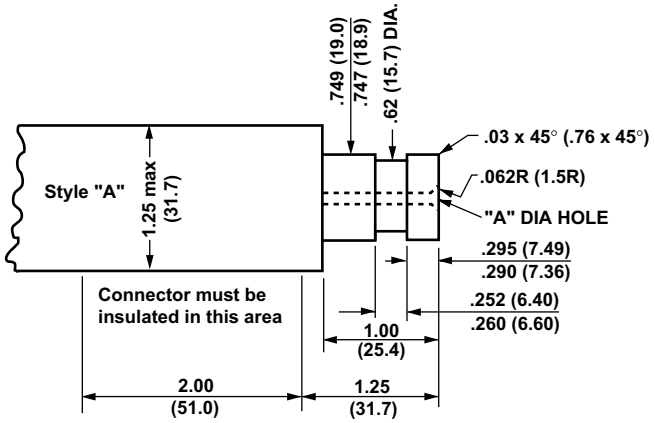
Periodic Maintenance of Wire Drive Unit

Wire Drive Motor and Gearbox

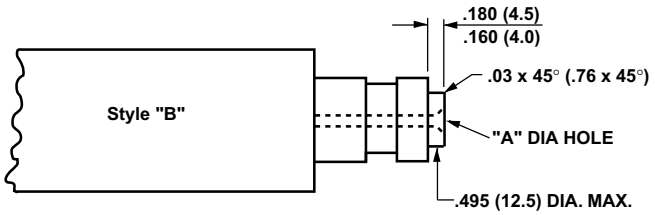
Every year inspect the gearbox and coat the gear teeth with a moly-disulfide filled grease. Do not use graphite grease.

Every six months check the motor brushes. Replace them if they are less than 1/4" long.

Gun Cable Connector Requirements to Permit Proper Connection to Wire Feed Units



Connector for 1/16 - 5/64" (1.6 - 2.0 mm) Wire



Connector for .023 - .052" (19.0 / 18.9 mm) Wire (For all other dimensions, See Diagram above).

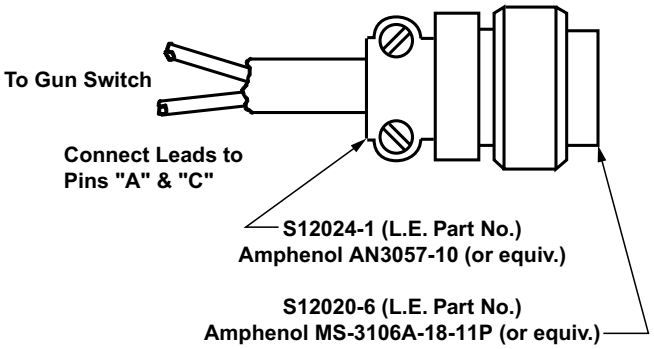
NOTE: Connector part with .749/.747 (19.0/18,9 mm) diameter should be made from brass if it is to be part of the welding current carrying circuit.

Wire Size in. (mm)	"A" Diameter Hole to be Concentric to .749/.747 (19.0/18.9 mm) Diameter Within .008 (.20) F.I.M.
.068- 5/64 (1.7-2.0)	.125 [1/8 (3.2 mm) Drill]
1/16 (1.6)	.078 [5/64 (2.0 mm) Drill]
.045 & .052 (1.1 & 1.3)	.062 [1/16 (1.6 mm) Drill]
.023-.035 (0.6-0.9)	.055 [(1.4 mm) #54 Drill]

All dimensions in inches and (millimeters)

Switch Requirements

1/2 Amp AC 24 Volts - Inductive
1/2 Amp DC 24 Volts - Inductive



MAINTENANCE

E-1

SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

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

ROUTINE AND PERIODIC MAINTENANCE

Perform the following preventive maintenance at least once every six months.

⚠ WARNING

Prior to performing preventive maintenance it is important to perform the following capacitor discharge procedure to avoid electric shock.

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

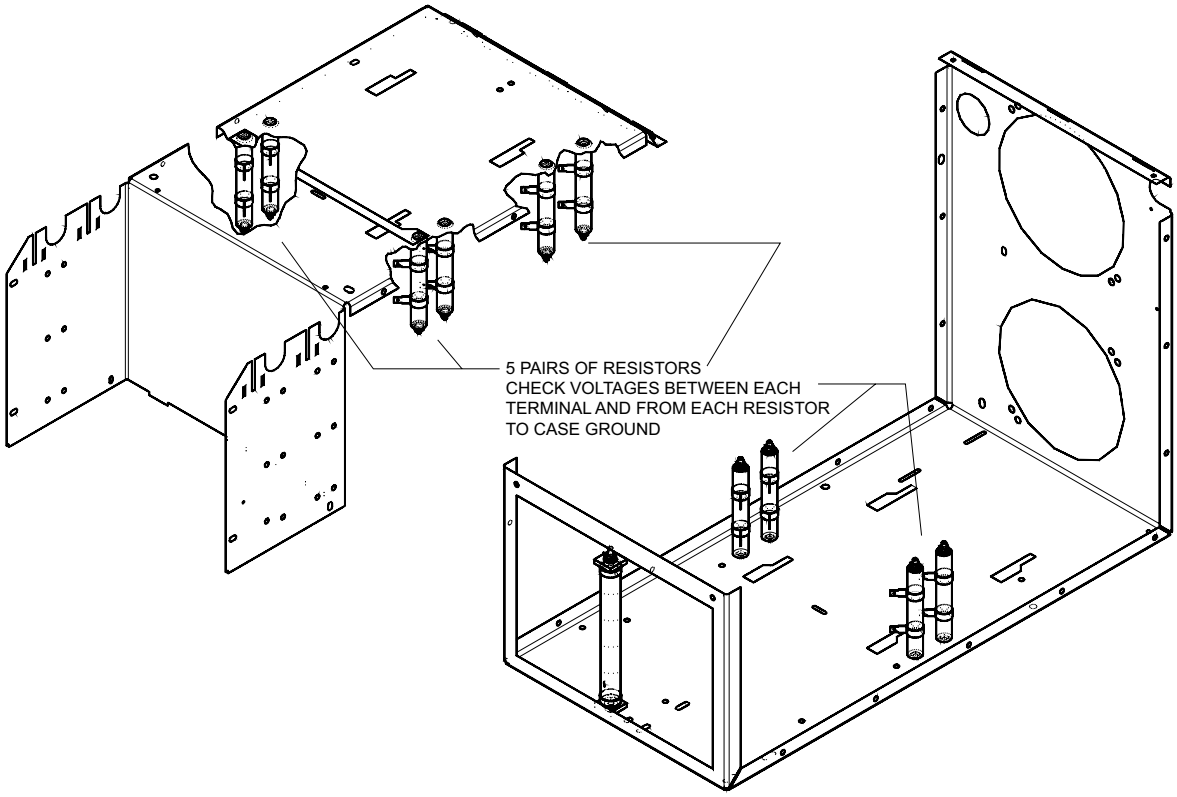
1. Turn off input power and disconnect input power lines.
2. Remove the hex head screws from the top and the sides of the machine. Remove the handle bar and the wrap-around machine cover.
3. Remove the two case sides. There are hex head screws on each side.

⚠ CAUTION

TO PREVENT DAMAGE TO MACHINE, AVOID UNNECESSARY MOVEMENT OF FRONT PANEL.

4. Obtain a high resistance and high wattage resistor (25-1000 ohms and 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. See Figure D.3. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

FIGURE D.1 – RESISTOR LOCATIONS



5. Locate two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure D.1. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.

⚠ WARNING

ELECTRIC SHOCK can kill.

- Proceed with caution being careful not to touch any internal machine components during the discharge procedure.

6. Locate the #9 and #12 terminals, identified by the "Discharge" labels, on each of the four Switch Boards. See Figure D.2.
7. Using insulated, needle nose-type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 4. Connect the other jumper lead to the other end of the resistor.
8. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See Figure D.3. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENT DURING THIS PROCEDURE!

FIGURE D.2 – DISCHARGE LABEL

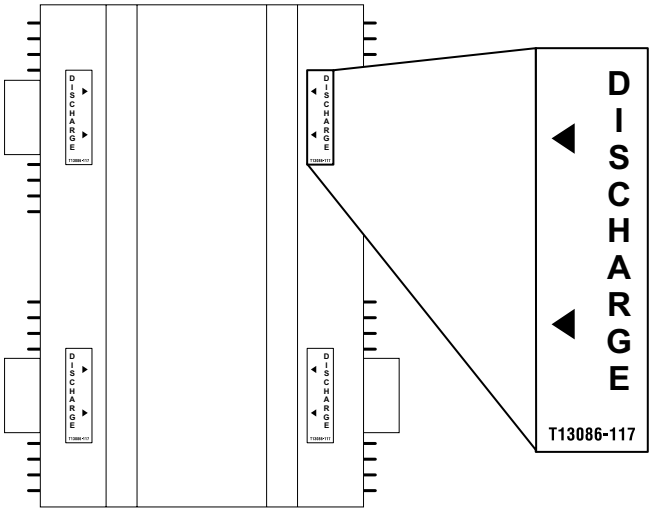
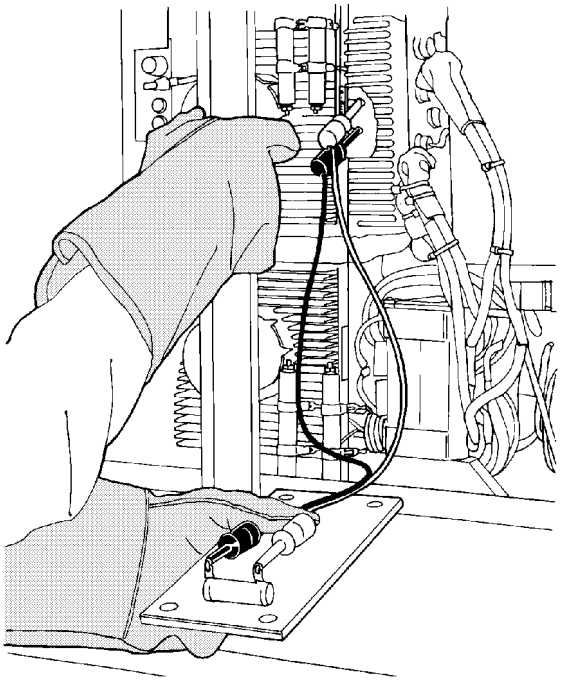


FIGURE D.3 – RESISTORS WITH LEADS CONNECTED



9. Check voltage across terminals (9 and 12) with a DC voltmeter. Terminal 9 has positive polarity and terminal 12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.
10. Repeat discharge procedure (steps 7, 8 and 9) for each of the other three Switch Boards.

PREVENTIVE MAINTENANCE

Perform the following preventive maintenance procedures at least once every six months. It is good practice to keep a preventive maintenance record; a record tag attached to the machine works best.

1. Remove the hex head screws from the sides and top of the machine. Remove the handle bar and the machine wrap-around cover. Remove the two case sides. There are hex head screws on each side.
2. Perform the input filter capacitor discharge procedure described at the beginning of the Maintenance Section.
3. Disconnect the shunt from the negative (-) output terminal. Failure to do this could cause damage to the shunt circuitry.
4. Clean the inside of the machine with a low pressure airstream. Be sure to clean the following components thoroughly (Refer to Figure D.4):
   - Display, Snubber, and Shunt printed circuit boards
   - Power Switch
   - Main Transformer
   - Auxiliary Transformers
   - Input Rectifier
   - Heat Sink Fins
   - Input Filter Capacitors
   - Output Terminals
   - Terminal Strip
5. Examine the capacitors for leakage or oozing. Replace if needed.
6. Examine the wrap-around and side covers for dents and breakage. Repair them as needed. The covers must be kept in good condition to assure that high voltage parts are protected and that correct spacings are maintained.
7. Remove welding cables and check the electrical ground continuity. Use an ohmmeter to measure the resistance between each output terminal and an unpainted surface of the machine case. The meter reading should be 500,000 ohms or more. If the meter reading is less than 500,000 ohms, check for electrical components that are not properly insulated from the case. Correct component insulation, if needed.
8. Reconnect the shunt and wire #467 to the negative (-) output terminal. Make sure the connection is tight.
9. Replace and secure the machine covers and handle bar.
10. Remove the overlay from the front panel of the machine. Clean the plastic case with a low pressure airstream. Wipe the sensors (Fig D.4 Item 8) with a clean, soft cloth. Make sure the sensors are not scratched in the process.
11. Check the back of the overlays. If the bar code (black square(s)) on the back of the overlay is scratched, apply a dull black spray finish to the scratched-off areas only. If a large area of the bar code is scratched off, the machine either will not recognize the overlay or will mistake the overlay for another one.
12. Inspect gun and cables for good condition.

RECOMMENDED TOOLS FOR INSTALLATION OR SERVICE OF COOLER:

- absorbent towels
- alcohol wipe
- 3 mm allen wrench (G3503 only)
- socket wrench
- 4 inch long minimum socket extension
- 1/4, 5/16, and 3/8 hex standard depth sockets
- 5/32 allen socket
- medium blade slotted screwdriver
- large blade slotted screwdriver, 8 inches long minimum
- two 7/16 open or box end wrenches
- one 7/8 open or box end wrench
- needlenose pliers
- two 10 inch long adjustable wrenches
- wire cutter
- molex pin removal tools
- tape measure
- small mechanic's mirror
- flashlight
- dental pick
- digital multimeter (DMM)

G3503-[ ] INSTALLATION OR SERVICE TOOL USAGE

Fastener Usage	Qty.	Tool
Shroud to cooler base Quick Disconnect (QD) bracket Heat exchanger to cooler base Relay to cooler base	4 2 2 2	all use 5/16 hex screw and 3/8 hex nut. Relay may require large blade slotted screwdriver 8 in. long min.
Screw to fasten reservoir to cooler base	4	3 mm allen wrench (G3503 only) 5/16 Hex Socket (G3503-1 only)
Hose Clamp	10	1/4 hex or medium slotted screwdriver
Fan set screw	1	5/32 allen socket with wrench and 4 in. min. extension
Pump carbonator clamp screw	1	5/16 hex socket with ratchet wrench
Motor mounting bolts	4	two 7/16 open or box end wrenches
Motor access door	2	1/4 hex socket with wrench
Motor harness ground at motor terminals	1 2	1/4 hex socket with wrench needlenose pliers
relay terminals 1 and 2	2	large blade slotted screwdriver 8 in. minimum long.
relay terminals 3 and 4	2	medium slotted screwdriver
All plumbing components	N/R	two 10 inch adjustable wrenches

REMOVING AND INSTALLING THE G3503-[ ] COOLER

1. Preparation:
   - Always switch off the Power Wave machine power.
   - Always disconnect the Power Wave machine from service input power.

2. Remove cooler assembly G3503-[ ]:
   a. remove gas cylinder(s) from tray.
   b. remove cooler access panel.
   c. Remove both fasteners from base that hold cooler in place. Remove ground lead, if present. Carefully pull cooler assembly rearward, until cooler's Molex connectors are visible.
   d. disconnect cooler's connectors from the P3 and P4 harnesses. Continue pulling the cooler out of the Power Wave.

3. If necessary, perform periodic maintenance or service on the cooler.

4. Reinstall cooler by reversing tasks in step 2. Be sure to reattach ground lead, if previously removed.

5. If necessary, fill cooler with selected coolant to specified level (see Fig. 1).
6. Attach desired water-cooled accessory (gun and wire feeder or TIG torch) to cooler's QDs.

7. Reconnect service input power to the Power Wave:
   - verify that the reconnect panel setting and lead placement match the service voltage.

8. Prime the cooler:
   a. Install the Set-up overlay.
   b. Keep accessories' hose lengths horizontal, either coiled or straight, and no higher than 4 feet of the specified coolant level (Fig. 1).
   c. Switch on the Power Wave machine.
   d. Press the "WATER COOLER ENABLE" button so that the "WATER COOLER ENABLED" light is illuminated .
   e. Press the "PRIME WATER COOLER" button until the "WATER COOLER PRESSURE" light is steadily illuminated.

9. Check coolant level. Add more if required.

G3503-[ ] COOLER PERIODIC MAINTENANCE

1. Preparation:
   - Always switch off the Power Wave machine power.
   - Always disconnect the Power Wave machine from service input power.
   - Do not remove the pump relief valve's 3/4 in. acorn hex nut or attempt to adjust the relief valve setting.

2. Remove the G3503-[ ] cooler from the Power Wave machine.

3. Clean the pump's inlet strainer:
   - Drain the reservoir of coolant and dispose of it in an environmentally responsible manner (see Recommended Coolants).
   - Place absorbent towels underneath pump head.
   - Hold pump head to apply countertorque when loosening strainer's 7/8 acorn nut. Do not confuse with 3/4 acorn nut. Remove nut and slide inlet strainer down and out from pump head.
   - Gently rinse strainer under running water to thoroughly clean it.
   - Use the mirror to inspect inside of pump for contamination. Carefully remove hardened debris with dental pick if necessary, without scratching inside of the pump.
   - Reinstall strainer and acorn nut, tightening with 75±15 in.-lbs. of torque. Wipe dry all areas wetted by coolant. Dispose of towels in an environmentally responsible manner (see Recommended Coolants).

4. Gently rinse the reservoir's strainer under running water to thoroughly clean it.

5. Remove fan shroud and inspect hoses and electrical harnesses for kinking or damage (cut, abrasion, swelling, etc.). Replace if necessary.

6. Remove accumulated dust from cooler, especially from the motor and heat exchanger, by blowing it off with shop air or vacuuming it out.
   - The heat exchanger fins are sharp but can be easily bent. Treat them with care to avoid personal injury and damaging them.
   - Remove the cooler from the machine for a more thorough cleaning job.

7. Motor lubrication is recommended once a year:
   - Remove plug over lube port at top of motor near fan end.
   - Add 20 drops of electric motor or SAE 10 oil then reinstall plug.

8. Flush coolant from the system and replace with fresh, recommended coolant at least once a year. More frequent flushing may be necessary, depending upon a user's particular system or its usage.

NOTE: Never run the pump dry. Always use a recommended coolant, otherwise pump damage may result.

9. Reinstall the G3503-[ ] cooler into the Power Wave machine.

G3503-[ ] COOLER SERVICE

1. Preparation:
   - Always switch off the Power Wave machine power.
   - Always disconnect the Power Wave machine from service input power.
   - Do not remove the pump relief valve's 3/4 in. acorn hex nut or attempt to adjust the relief valve setting.

2. Remove the G3503-[ ] cooler from the Power Wave machine whenever:
   - replacing major cooler components (i.e. pump, motor, heat exchanger, etc.).
   - replacing hoses and electrical harnesses that are kinked or damaged (cut, abraded, deteriorated or swollen, etc.).
   - investigating suspect coolant leakage.

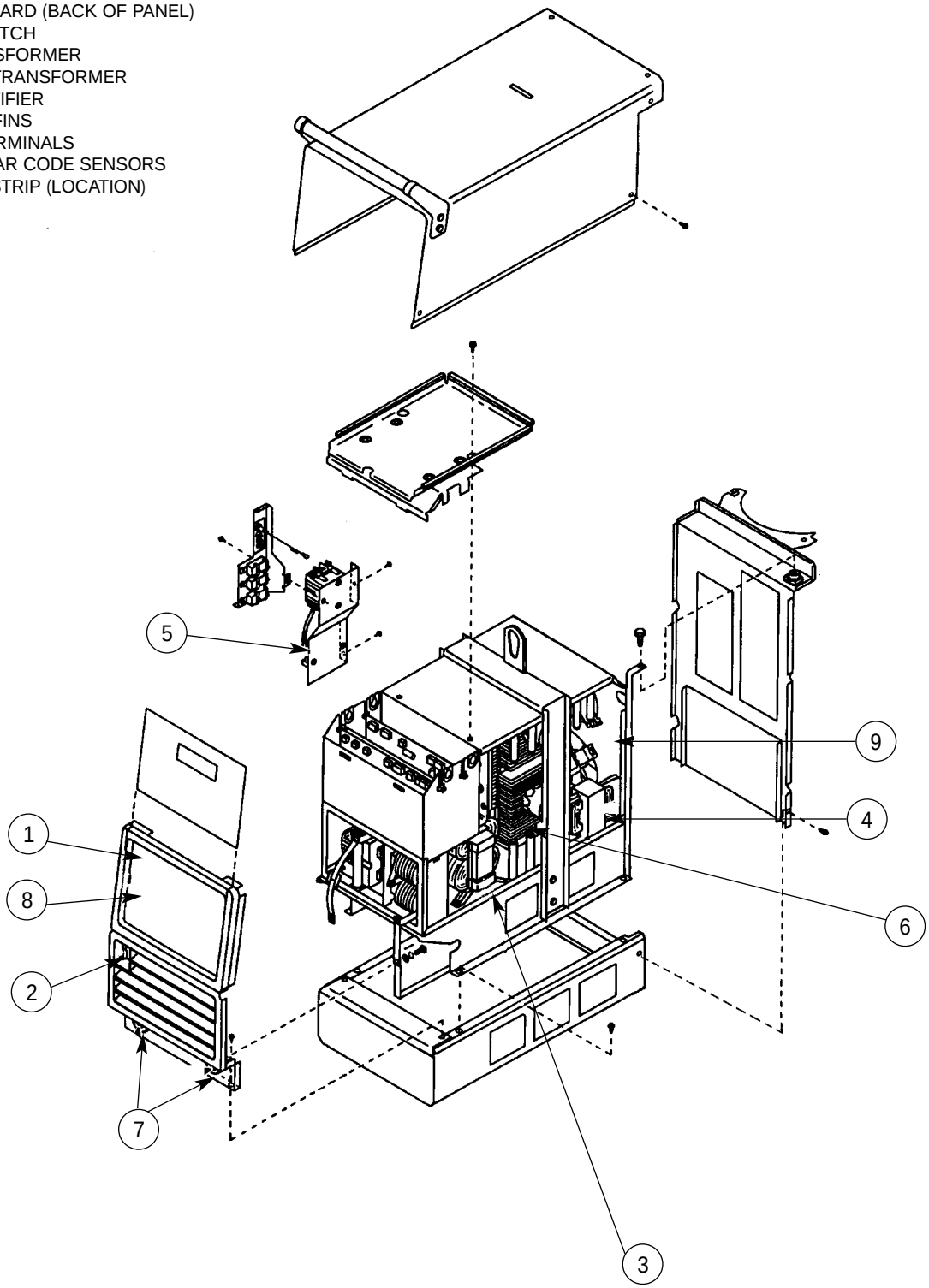
3. Pump replacement:
   a. Drain the reservoir of coolant and dispose of it in an environmentally responsible manner (see Recommended Coolants).
   b. Remove fan shroud.
   c. Place absorbent towels underneath pump head and wherever coolant system is opened.
   d. Carefully pull pump inlet hose and its elbow from reservoir (bottom).
   e. Loosen pump outlet hose clamp at QD then carefully remove from fitting.
   f. Disconnect v-band clamp from motor and remove pump:
      - Do not drop or lose drive coupling between pump and motor.
      - Do not discard old pump. Remove both fittings, Keep v-clamp, Seal old pump in a waterproof bag, Package into protective container, and Return to nearest Lincoln Electric FSS center.
   g. Install new pump and v-band clamp:
      - Do not apply any lubricant to pump's drive coupling.
      - Pump body is properly oriented with its strainer at the 6:00 position.
      - Tighten v-clamp with 15 to 30 in-lbs. of torque.
   h. Attach coolant lines to QD and reservoir.
   i. Wipe dry all areas wetted by coolant. Dispose of towels in an environmentally responsible manner (see Recommended Coolants).
   j. Reinstall cooler into machine.

4. Motor removal or replacement:
   - Do not reuse the 4 internal-tooth star washers. Replace with new parts..

5. Installing the fan:
   - Slide onto motor shaft until the fan is located between 0.25 to 0.50 inches from the heat exchanger.
   - Tighten set screw with 65 to 75 in-lbs of torque against motor shaft's flat.
   - Fan rotation is counterclockwise, as viewed from fan-end of motor's shaft.
   - Fan pulls air through the heat exchanger, blows it over the motor, then exhausts it through the reservoir.

FIGURE D.4 – GENERAL COMPONENT LOCATIONS

1 DISPLAY BOARD (BACK OF PANEL)
2 POWER SWITCH
3 MAIN TRANSFORMER
4 AUXILIARY TRANSFORMER
5 INPUT RECTIFIER
6 HEAT SINK FINS
7 OUTPUT TERMINALS
8 OVERLAY BAR CODE SENSORS
9 TERMINAL STRIP (LOCATION)



TROUBLESHOOTING

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

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

This Troubleshooting Guide is provided to help you lo-cate and correct possible machine misad-justments. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM)

Look under the column labeled “PROBLEM (SYMP-TOMS).” This column describes possible symptoms that your machine may exhibit. Find the listing that best describes the symptom that your machine is exhibiting.

Step 2. PERFORM EXTERNAL RECOMMEND-ED TESTS

The second column labeled “POSSIBLE AREAS OF MISADJUSTMENT(S)” lists the obvious exter-nal pos-sibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In gen-eral, these tests can be conducted without removing the case wraparound cover.

Step 3. CONSULT LOCAL AUTHORIZED FIELD SERVICE FACILITY

If you have exhausted all of the recommended tests in step 2, consult your local Authorized Field Service Facility.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
Machine is dead – no output – no fans – no displays.	1. Make certain that the input power switch (S1) is in the “ON” position. 2. Check for proper input voltage – must match the rating on the machine nameplate. 3. Make certain the reconnect panel is configured properly for the applied voltage. 4. Check fuse (F1) in the reconnect panel. If faulty, replace with 5-amp slow-blow fuse.	
Machine has no output – fans are running – display is on – a “clicking” sound is heard coming from the machine.	1. Turn power OFF immediately. 2. Check for proper input voltage (per machine nameplate). 3. Make certain the reconnect panel is configured properly for the applied voltage.	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no output – no fans – no display. Main input fuses are open, indicating excessive input current draw.	1. Check for proper input voltage connections. 2. Make certain the reconnect panel is configured properly for the applied voltage. 3. Replace the input fuses with proper size and ratings. If the fuses fail again, contact your local Lincoln Authorized Field Service Facility.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
Machine has no output – no display – fans run.	1. Check circuit breaker (5-amp) located on the front panel. Reset if necessary.	
Machine has no output – no display – fans run – circuit breaker (5-amp) repeatedly trips.	1. Remove the feeder control cable from the machine. If symptoms disappear, feeder or control cable is faulty.	

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no output – fans run – display is on.	1. Make sure that the machine was powered up with a properly installed overlay. (With no overlay on the machine or an invalid overlay, the machine will have no output.) 2. Check to see if the Limits or Setup overlay is installed on the front panel. These two overlays can not be used for welding. 3. Check for proper input voltage (per machine nameplate). 4. Make certain the reconnect panel is configured properly. 5. Check that when the trigger is pulled on the wire feeder, the wire feeder's voltage display changes to indicate arc voltage. If this does not happen, feeder may be faulty. 6. Check feeder control cable for loose or faulty connections. 7. If the machine is connected for 380 VAC or higher and has not been used for a long period of time, the capacitors may require "conditioning." Let the machine run at an idle state (no load) for 30 minutes.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
Machine regularly overheats – yellow light (LED) on the front panel glows, indicating a thermal overload. The fans run and the display is on.	1. Welding application may exceed recommended duty cycle. 2. Dirt and dust may have clogged the cooling channels inside the machine. Refer to the Maintenance Section of this manual. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around machine.	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The voltage and/or wire feed speed will not adjust to user satisfaction.	1. Certain limits may have been imposed on the welding parameters. Refer to the Limits Overlay section in the Operations section of this manual to change the set limits.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
The voltage and/or wire feed speed can be adjusted on the wire feeder but the changes are not shown on the Power Wave.	1. When the Limits Overlay or the Setup Overlay is placed on the machine, the Power Wave's and feeder's displays do not match. These overlays can not be used for welding. 2. If two wire feeders are connected to the Power Wave, only one of the feeder's settings can be displayed on the Power Wave at one time. Pull the trig-ger of the wire feeder whose settings you want displayed on the Power Wave.	
The Dual Procedure overlay is installed. The user cannot change from procedure "A" to procedure "B," or vice versa.	1. Check for proper installation of the Dual Procedure overlay. 2. Check the Dual Procedure Gun Trigger or separate Dual Procedure switch.	
The display can not be seen clearly or can not be seen at all.	1. Adjust the viewing angle of the display. Follow the instructions provided in the Operation Section of this manual. (Look under the "LCD DISPLAY ADJUSTMENT" in the "CONTROLS AND SETTINGS" sub-section of the Operation section.)	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine does not respond to keys being pressed, or the machine has improper displays.	1. Each time an overlay is changed make certain that the machine is powered-up with the new overlay in place. 2. Make certain that the correct overlay ID number is displayed on power-up. Refer to the Operation Section of this manual. 3. In some cases, some of the keys on the overlay may be locked out. Refer to the Operation Section of this manual for the overlay descriptions.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
Machine display reads “Error Invalid Overlay,” or it displays an incorrect overlay ID number on power-up.	1. Make certain the overlay is installed properly. 2. Inspect the overlay bar code sensors on the front panel (Fig 17 Item 8). If they are dirty, blow them out with low pressure air and clean with soft cloth. 3. Inspect for damage to the Bar Code(s) on the back of the overlay.	
Machine displays “ERROR: S.L. NOT INITIALIZED” on power-up.	1. Contact your local Lincoln authorized Field Service Facility for Technical assistance.	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The Beeper (Piezoelectric Buzzer) cannot be heard – machine operating normally.	1. Background noise may be too loud for user to hear beeper.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
The welding parameters that were saved in memory are different when recalled.	1. Make certain that a remote control unit is not connected. When a remote control unit is used, the weld parameters are set by the remote control potentiometers.	
The water cooler does not turn on.	1. Make sure that the water cooler has been enabled. Refer to the Setup Overlay description in the Operation Section of this manual. 2. The cooler's circuit breaker may have tripped. 3. If the water cooler is enabled but generates insufficient coolant pressure, the machine will beep loudly and the water cooler will shut down. In this case, prime the water cooler. Refer to the Setup Overlay description in the Operation Section of this manual.	
The machine beeps without the keys being pressed.	If the water cooler is enabled and the pressure switch inside the water cooler opens (due to inadequate coolant pressure), the machine indicates this by beeping. This happens regardless of the overlay placed on the machine. In this case do the following: 1. Turn the machine off and on a couple of times and see if the beeping continues. If the pressure dropped momentarily then turning the machine off and on eliminates the beeping. A momentary pressure drop could be due to someone stepping on the water cooler hose, for example. 2 Check the water cooler and accessory hoses for kinks, internal obstructions or blockage, or ruptures. If such problems were found then correct them and turn the machine off and on to check if the beeping has been eliminated. 3. Check the water cooler fluid level. Low coolant level could cause the pressure to drop. 4. Prime the water cooler. Refer to the Setup Overlay section of this manual for instructions.	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine loses output while welding. Fans and display are functioning properly.	1. Check for proper input voltages (per machine nameplate). 2. Check for balanced three-phase input supply voltage. 3. Check electrode and work cables for loose or poor connections.	If all recommended possible areas of misadjustments have been checked and the problem persists, contact your local Lincoln Authorized Field Service Facility.
For no apparent reason the weld characteristics have changed.	1. Check for proper wire feed speed setting. In the MIG/ MAG and FCAW Modes, check for proper voltage settings. In the MIG/MAG Pulse Modes, check the arc length trim setting. These controls are on the wire feeder. 2. Check for proper shielding gas and gas flow. 3. Check for loose or faulty welding cables.	
Machine often “noodle welds” with a particular procedure.	1. The machine may be trying to deliver too much power. When the average output current exceeds a maximum limit, the peak current is drastically cut back. Lower the welding parameter settings and/or increase the stickout length to eliminate this problem.	

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your local authorized Lincoln Electric Field Service Facility for technical assistance.

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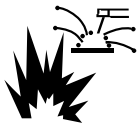	
WARNING	● Do not touch electrically live parts or electrode with skin or wet clothing. ● Insulate yourself from work and ground.	● Keep flammable materials away.	● Wear eye, ear and body protection.
Spanish **AVISO DE PRECAUCION**	● No toque las partes o los electrodos bajo carga con la piel o ropa mojada.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

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

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

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

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

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

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

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

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