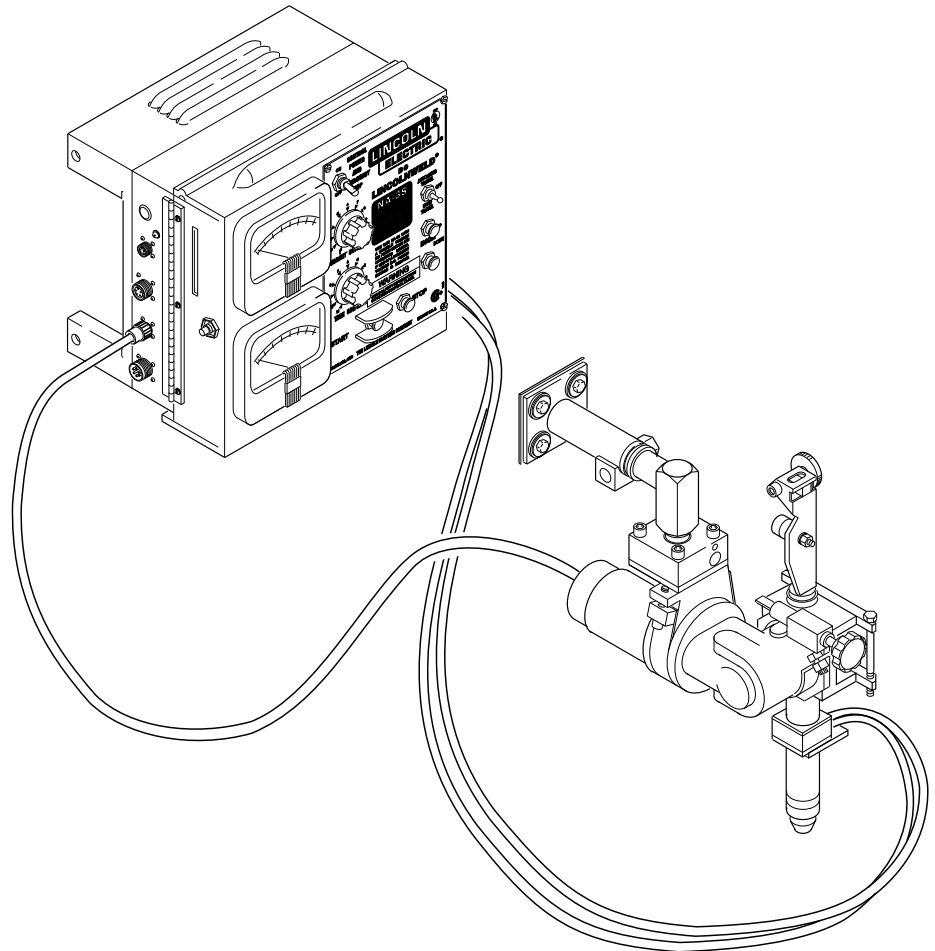


# NA-3 AND NA-4 AUTOMATIC WELDING SYSTEMS

For use with machines having Code Numbers: **NA-3N**  
**NA-3S**  
**NA-4**

## 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.



## SERVICE MANUAL



World's Leader in Welding and Cutting Products

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Sales and Service through Subsidiaries and Distributors Worldwide  
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## WARNING

**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.**



### ELECTRIC SHOCK can kill.

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

1.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.

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

1.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.

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

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

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

1.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.

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

1.j. Also see Items 4.c. and 6.



### ARC RAYS can burn.

2.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87.1 standards.

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

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



### FUMES AND GASES can be dangerous.

3.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding 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.**

3.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.

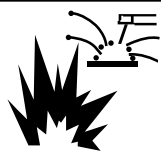
3.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to ensure breathing air is safe.

3.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.

3.e. Also see item 7b.

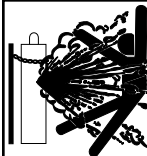
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NA-3 AND NA-4



### WELDING SPARKS can cause fire or explosion.

- 4.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.
- 4.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.
- 4.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.
- 4.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to ensure 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).
- 4.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- 4.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.
- 4.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.
- 4.h. Also see item 7c.



### CYLINDER may explode if damaged.

- 5.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.
- 5.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- 5.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.
- 5.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.
- 5.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- 5.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.
- 5.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



### FOR ELECTRICALLY powered equipment.

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

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## FOR ENGINE powered equipment.

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



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



7.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.



7.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.

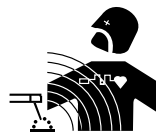
7.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

7.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.

7.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.



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



## ELECTRIC AND MAGNETIC FIELDS may be dangerous

8.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

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

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

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

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

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

8.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.

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

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

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## PRÉCAUTIONS DE SÛRETÉ

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

### Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
  - a. Les circuits à l'électrode et à la pièce sont sous tension quand la machine à souder est en marche. Éviter toujours tout contact entre les parties sous tension et la peau nue ou les vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
  - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique ou des grilles métalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
  - c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état de fonctionnement.
  - d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
  - e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
  - f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces précautions pour le porte-électrode s'appliquent aussi au pistolet de soudage.
2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas où on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.
3. Un coup d'arc peut être plus sévère qu'un coup de soleil, donc:
  - a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
  - b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
  - c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.
4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.
5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans latéraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.
7. Quand on ne soude pas, poser la pince à un endroit isolé de la masse. Un court-circuit accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaînes de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'échauffement des chaînes et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées toxiques.
10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgène (gas fortement toxique) ou autres produits irritants.
11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

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

1. Relier à la terre le châssis du poste conformément au code de l'électricité et aux recommandations du fabricant. Le dispositif de montage ou la pièce à souder doit être branché à une bonne mise à la terre.
2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.
3. Avant de faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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NA-3 AND NA-4



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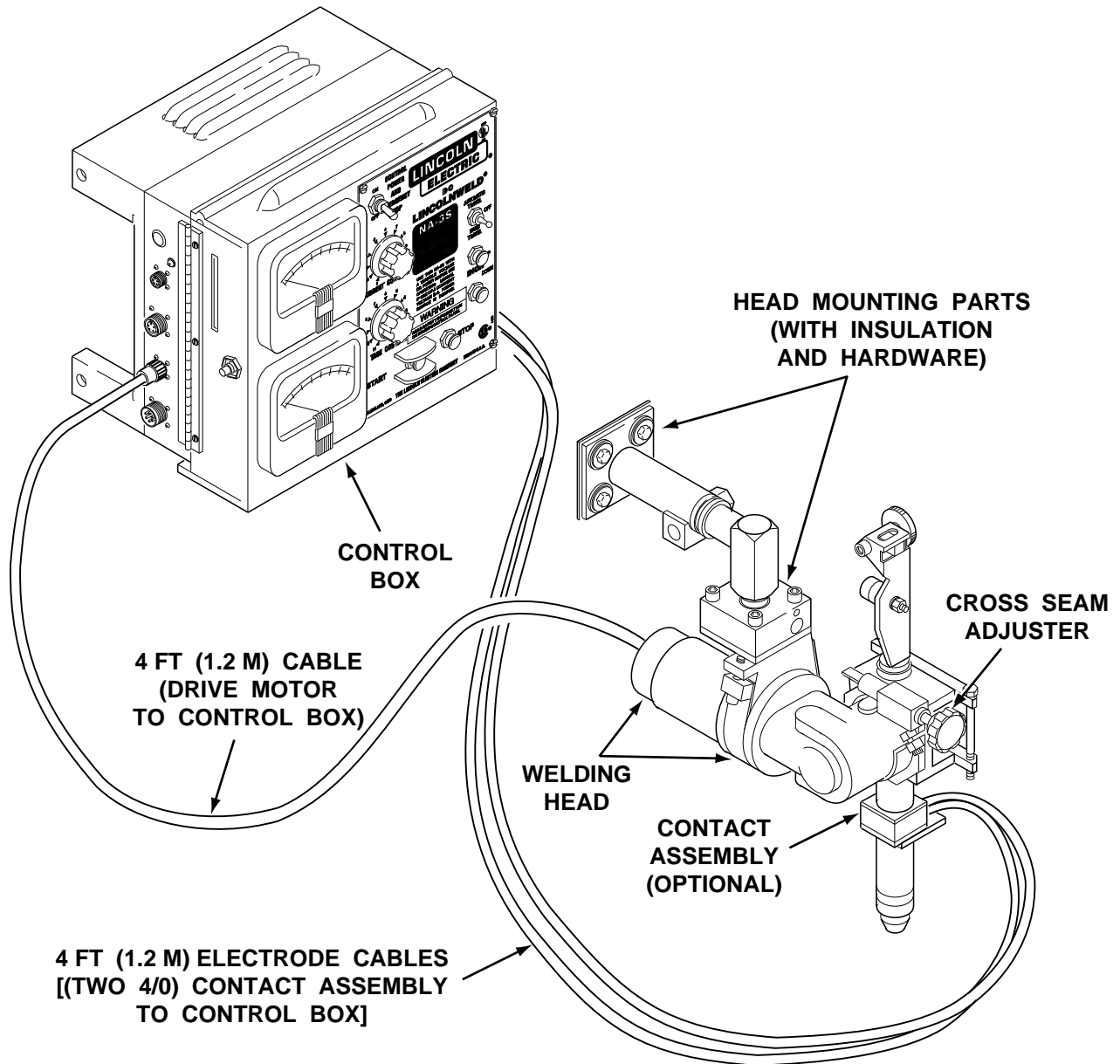
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## TECHNICAL SPECIFICATIONS – NA-3 AND NA-4

MINIMUM ELECTRICAL INPUT REQUIREMENTS				
115 VAC @ 3 amps 50/60 Hz power				
REQUIRED WELDING POWER SOURCE				
NA-3N	DC Constant Voltage			
NA-3S	DC Constant Current or DC Constant Voltage			
NA-4	AC Constant Current			
WIRE FEED SPEED and GEAR RATIOS				
GEAR RATIO	FEED SPEED RANGE in./min (m/min)	MAX. WIRE SIZE in. (mm)		
		CORED WIRE	SOLID WIRE	
57:1	40 - 650 (12 - 198)	0.120 (3.0)	3/32 (2.4)	
95:1	25 - 400 (7.5 - 122)	5/32 (4.0)	1/8 (3.2)	
142:1	17 - 268 (5.2 - 82)	—	7/32 (5.6)	
PHYSICAL DIMENSIONS				
MODEL	LENGTH in. (mm)	WIDTH in. (mm)	HEIGHT in. (mm)	WEIGHT lbs (kg)
NA-3 Control Box	12.31 (313)	13.46 (342)	11.04 (280)	44 (20)
NA-4 Control Box	9.70 (246)	13.46 (342)	11.04 (280)	35 (16)

FIGURE A.1 – BASIC CONTROL AND WIRE DRIVE SYSTEM.



NA-3 AND NA-4

## MECHANICAL INSTALLATION

### ⚠ WARNING



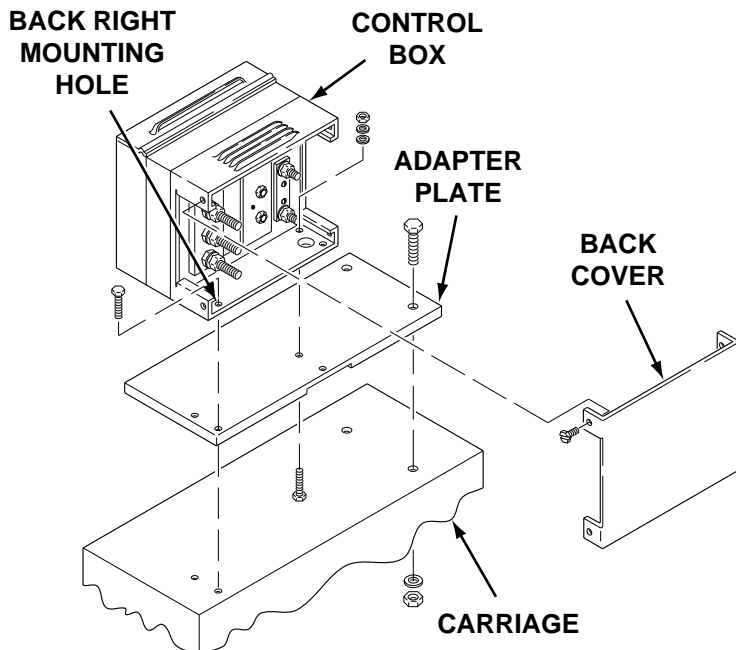
**ELECTRIC SHOCK  
can kill.**

- Turn off input power to the welding power source using the disconnect switch before working on this equipment.

## INTRODUCTION

This section covers the basic requirements to install the control box and welding head. This section will give you mounting hole alignments, component mounting clearances, and any special instructions or precautions that must be followed when installing the control box and mounting head.

**FIGURE A.2 – CONTROL BOX  
CARRIAGE MOUNTING.**



## CONTROL BOX INSTALLATION

The control box can be mounted either on the standard travel carriage or on a separate fixture. It is electrically grounded by a lead in the input cable assembly.

To install the control box on the standard travel carriage, perform the following steps and refer to Figure A.2. Also see IM278 sec. L.2.2.4.

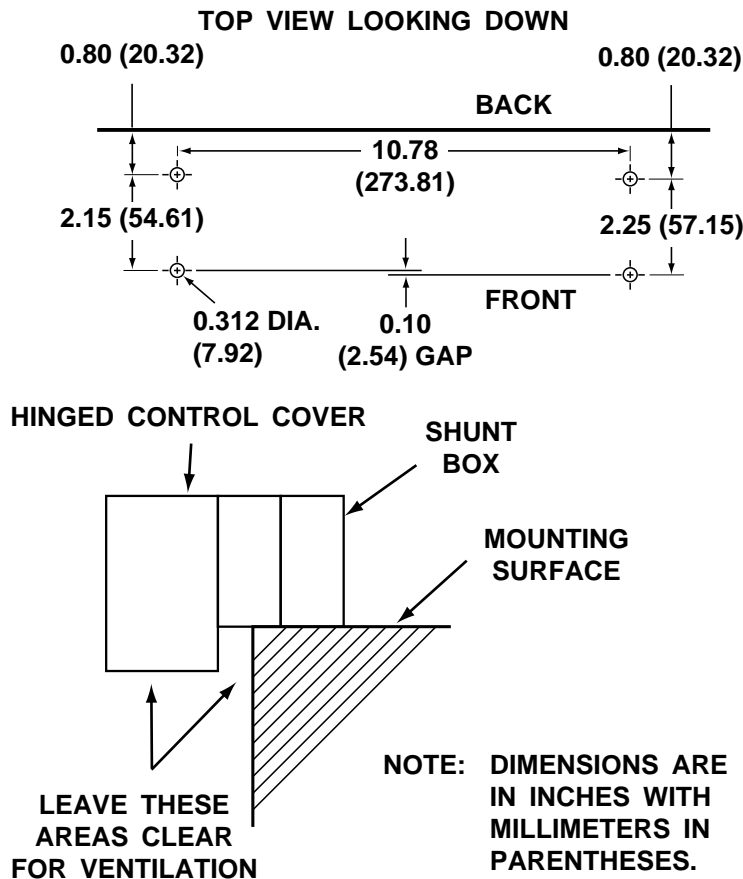
1. Remove the back cover from control box. Also see IM 278 Sec. L.2.2.4
2. Install a hex head screw up through the bottom of the adapter plate and the front left mounting hole in the control box.
3. Secure the control box to the adapter plate with a flat washer, lock washer, and hex nut.
4. Place the control box/adapter plate assembly onto the carriage and secure it in place with a hex head screw through the back right mounting hole of the control box.
5. Secure the adapter plate to the carriage with two hex head screws through the front and back mounting holes on the left side of the adapter plate.
6. Install the back cover of the control box.

Before you can mount the control box onto a fixture, you must provide mounting holes in the fixture per the measurements provided in Figure A.3. When placing the mounting holes, make sure you leave adequate ventilation space below the front cover to allow for the free circulation of cooling air.

To install the control box on a fixture, perform the following steps and refer to Figure A.3.

1. Remove the back cover from control box.
2. Align the mounting holes in the control box with the holes you placed in the fixture according to the measurements provided in Figure A.3.
3. Secure the control box to the fixture.
4. Install the back cover of the control box.

**FIGURE A.3 – CONTROL BOX FIXTURE MOUNTING.**



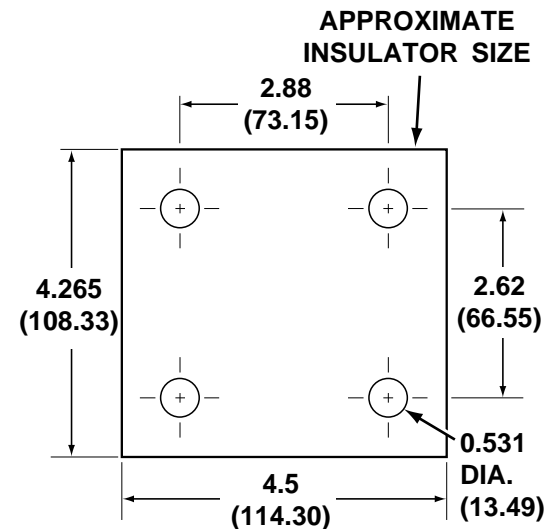
**WELDING HEAD INSTALLATION**

The welding head can be mounted either with the standard head mounting hardware or with the horizontal head and/or vertical lift adjusters. Design the installation of your welding head so it meets the adjustability requirements of your welding application. Refer to Section C, Accessories, for more information regarding the adjustable mounting hardware.

The welding head and electrode are electrically “hot” when welding. **They must be insulated from ground.**

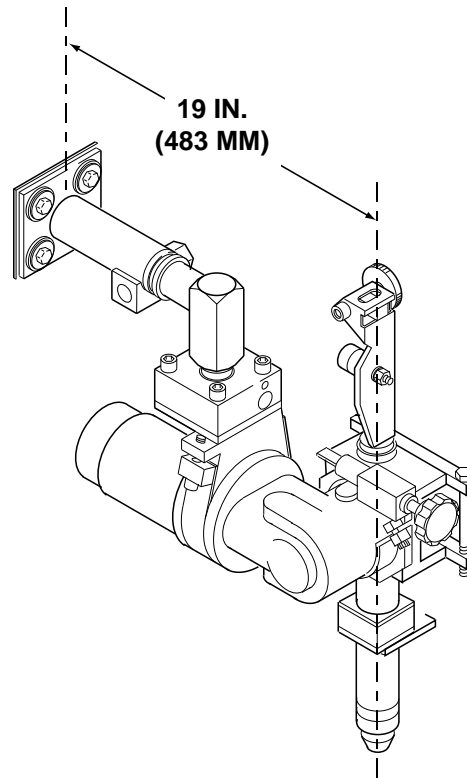
Standard head mounting hardware and insulation are shipped with the NA-3 and NA-4 welding heads. If you are mounting the welding head on a separate fixture, provide the mounting holes for the standard head mount as specified in Figure A.4. For best arc striking, use a rigid mounting that prevents the head from moving when the electrode strikes the work.

**FIGURE A.4 – WELDING HEAD MOUNTING HOLES.**



When mounting the welding head to the standard travel carriage, (see IM278 sec. L2.2.4) mount it so only a minimum of overhang weight exists. Mount the head so it stays within the dimension shown in Figure A.5.

**FIGURE A.5 – MOUNT TO CARRIAGE OVERHANG DIMENSION.**



## ELECTRICAL INSTALLATION

### ⚠ WARNING



**ELECTRIC SHOCK can kill.**

- Do not touch electrically live parts such as output terminals or internal wiring.

This section provides information on proper wiring procedures for the NA-3 and NA-4 welding systems. This section also provides

basic connection diagrams for connecting automatic welding systems to various welding power sources.

## INPUT POWER REQUIREMENTS

350 volt-amperes of 115 VAC 50/60 Hz power is required for the wire feed motor and controls. Another 250 volt-amperes may be required depending on the travel circuit.

## CONTROL BOX TO WELDING HEAD CONNECTIONS

**NOTE:** All electrode cables connected to the rear of the control box must be manufactured by Lincoln Electric to ensure the terminations comply with the applicable U.L. standard for safety.

All welding heads include a 4 ft (1.2 m) motor cable, and when applicable, a 4 ft (1.2 m) flux hopper cable. Insert the plug on this cable into the matching receptacle on the side of the control box. If the 4 ft (1.2 m) cable is not sufficient, install the separate extension cable assembly at the length ordered, up to 75 ft (22.8 m). The extension cable has plugs on both ends for easy installation.

The NA-3 and NA-4 also include two 4 ft (1.2 m) lengths of electrode cable. Bolt one end to the contact assembly and bolt the other end to the right side (when facing the front of the control box) of the shunt on the NA-3 or to the current transformer on the NA-4 as shown in Figure A.6. When the K234 or K235 extension cables are used between the control box and welding head(s), the 4 ft (1.2 m) lengths of electrode cable are not used. If currents or duty cycles higher than 1000 amps at 80% duty cycle will be used, add additional electrode cables per Table A.1.

**TABLE A.1**

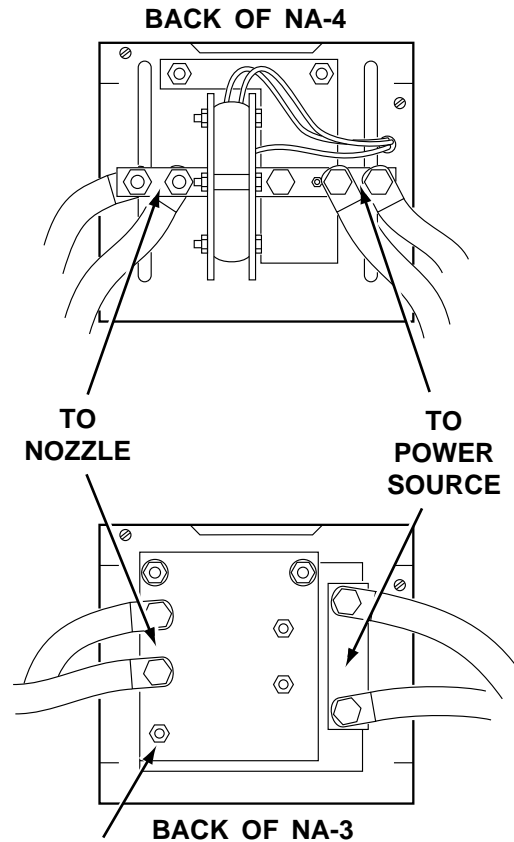
	80% Duty Cycle
Below 1000 amps	Two 4/0
1000 to 1300 amps	Three 4/0
1300 to 1500 amps	Four 4/0

NA-3 AND NA-4



For the NA-3NF or NA-3SF, order an appropriate length of the needed electrode cable. Connect it between the contact assembly and shunt as described previously.

**FIGURE A.6 – CONTROL BOX WIRING.**



3RD OR 4TH  
CABLES PER  
TABLE A.1

## POWER SUPPLY TO CONTROL BOX CONNECTIONS

Refer to Figures A.7 to A.18 for diagrams on how to connect the control box to a particular power source. If it is not a Lincoln Electric power source, refer to Figure A.19 at the end of this section.

**NOTE:** All electrode cables connected to the rear of the control box must be manufactured by Lincoln Electric to ensure the terminations comply with applicable U.L. standards for safety.

### NA-3N

1. Use a constant voltage type power source.
2. If using a multi-process power source (SAM, SA-800, SAF-600, DC-400, DC-600, DC-1500), be sure it is properly set for constant voltage welding per the instructions in the power source operating manual.
3. Connect the input cable to the power source exactly as specified on the connection diagram in this section. Include all jumpers on the terminal strips as shown in the diagrams.

**NOTE:** Paralleling two power sources of the same model may be practical. Request bulletin E1.30 from Lincoln Electric for instructions.

4. Connect the work leads of sufficient size and length (per Table A.1) between the "To Work" stud on the power source and the work. Be sure the connection to the work makes tight, clean, metal-to-metal contact.
5. Connect the two electrode cables of the input cable assembly to the left side (when facing the front of the control box) of the shunt/current relay assembly located on the back of the control box. (Refer to Table A.1)
6. Insert the polarized connector of the control cable into the matching receptacle on the side of the control box.

## NA-3S

1. Use either a constant current or constant voltage power supply as required for the application. Be sure the power source is set for constant current or constant voltage welding as appropriate per instructions in the power source operating manual.
2. Set the wire feeder for constant current or constant voltage as appropriate per the applicable diagram, Figures A.7 to A.18.
3. Connect the input cable to the power source exactly as specified on the appropriate wiring diagram, Figures A.7 to A.18. Include all jumpers on the terminal strips as shown on the applicable wiring diagram.

**NOTE:** Paralleling two power sources of the same model may be practical. Request bulletin E1.30 from Lincoln Electric for instructions.

4. Connect the work leads of sufficient size and length (per Table A.1) between the "To Work" stud on the power source and the work. Be sure the connection to the work makes tight, clean, metal-to-metal contact.
5. Connect the two electrode cables of the input cable assembly to the left side (when facing the front of the control box) of the shunt/current relay assembly located on the back of the control box. (Refer to Table A.1)
6. Insert the polarized connector of the control cable into the matching receptacle on the side of the control box.

## NA-4

1. Present NA-4s with a potentiometer-type current control (K248 above code 7560) are designed for use with the AC-1200 power source. They may be used with the discontinued AC-1000s or AC-750s but would require an external switch to control transformer output. See the diagram in Figure A.15.
2. Discontinued NA-4s equipped with a toggle switch type current control (K211 below code 7560) may be connected directly to the discontinued AC-1000s or AC-750s provided the proper control cable is available (K216). Contact the factory for connection diagram S15269. These units also may be used with the AC-1200 but would require an external rheostat for current control (K775). Refer to diagram S15667 in the IM-283 manual or request it from the factory.
3. Connect the input cable to the power source exactly as specified on the appropriate wiring diagram, Figures A.7 to A.18. Include all jumpers on the terminal strips as shown on the applicable wiring diagram.

**NOTE:** Paralleling two power sources of the same model may be practical. Request bulletin E1.30 from Lincoln Electric for instructions.

4. Connect the work leads of sufficient size and length (per Table A.1) between the "To Work" stud on the power source and the work. Be sure the connection to the work makes tight, clean, metal-to-metal contact.

5. Connect the two electrode cables of the input cable assembly to the left side (when facing the front of the control box) of the current transformer assembly located on the back of the control box.
6. Insert the polarized connector of the control cable into the matching receptacle on the side of the control box.

**NOTE:** Obey special cable routing precautions to avoid possible erroneous meter readings due to induced voltages or magnetic fields caused by the current flowing in the weld cables.

- a. Separate the K215 input control cable assembly so the control cable is kept spaced from the weld cables by at least 12 in. (305 mm) to avoid induced voltages.
- b. Route the weld cables into the control box on the opposite side from the control cable connector to avoid magnetic field influence on the control box meters.

When welding with more than one AC arc, space all control cables at least 12 in. (305 mm) from all weld cables.

On critical applications, to reduce arc voltage change and to keep meter discrepancy to a minimum, disconnect lead #21 on the control cable from the power source terminal strip. Extend lead #21 so it can be connected directly to the work piece. Remove lead #67 from the NA-4 connection bar. Extend and

connect lead #67 directly to the electrode contact assembly on the head. Use #16 AWG conductors and keep leads #21 and #67 as far as possible from electrode and work leads.

115 volt AC power to drive the standard Lincoln travel carriage or for starting and stopping other travel mechanisms is obtained from a receptacle on the control box. The travel receptacle has been changed on NA-3 and NA-4 controls above code 8300. The 3-slot receptacle has been replaced with a 4-socket receptacle which provides a grounding lead connection for TC-3 carriage travel controls.

## POWER SOURCE CONNECTION DIAGRAMS

The following section contains the wiring diagrams necessary to connect the applicable power source to the control box. If it is not a Lincoln Electric power source, refer to Figure A.19 at the end of this section.

### WARNING

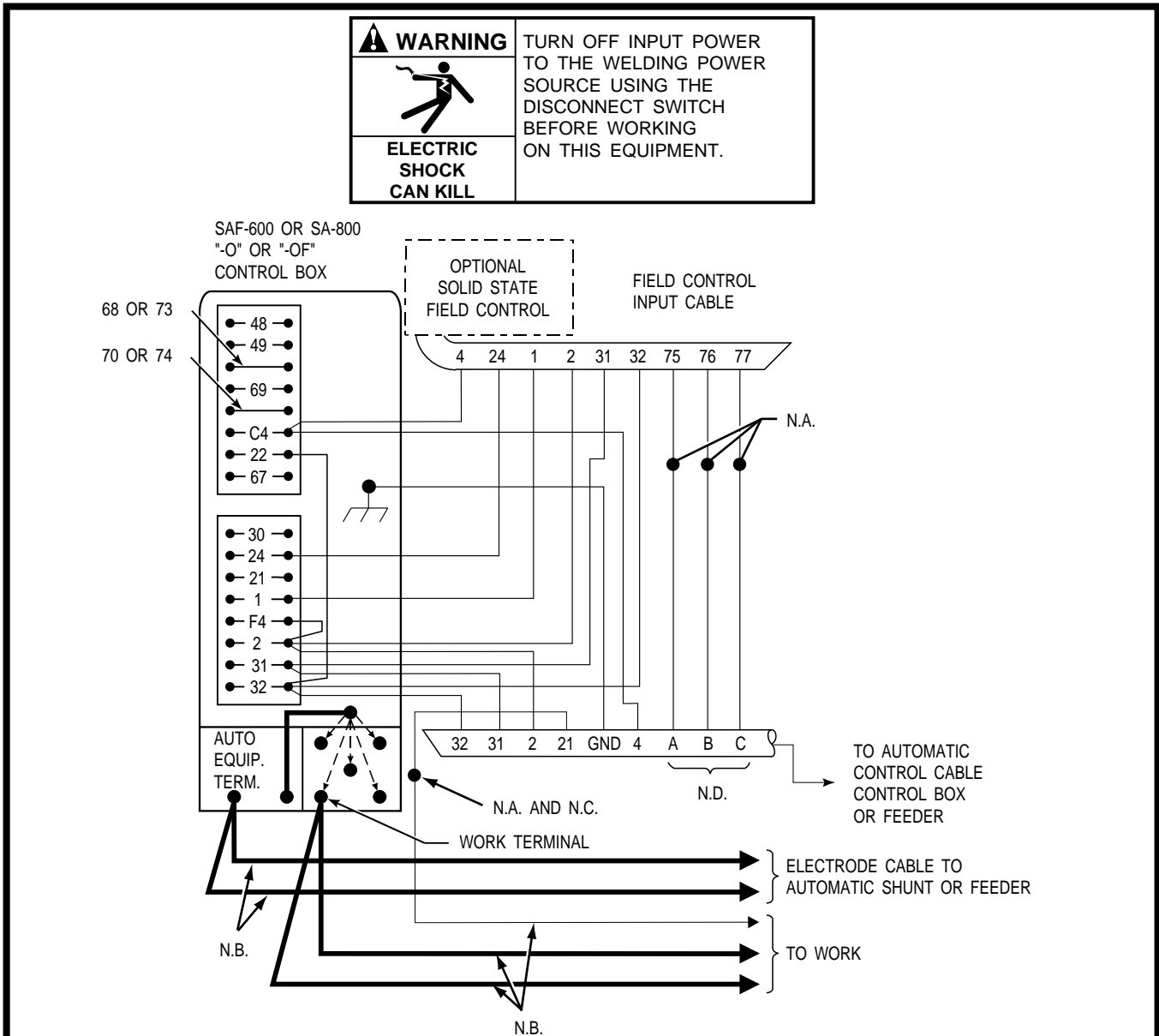


#### ELECTRIC SHOCK can kill

- Turn off input power to the welding power source using the disconnect switch before working on this equipment.



**FIGURE A.7 – CONNECTION OF NA-3 (ALL) TO A SAF-600 OR SA-800, TYPES “-O” OR “-OF” AND M.G. SOLID STATE FIELD CONTROL.**



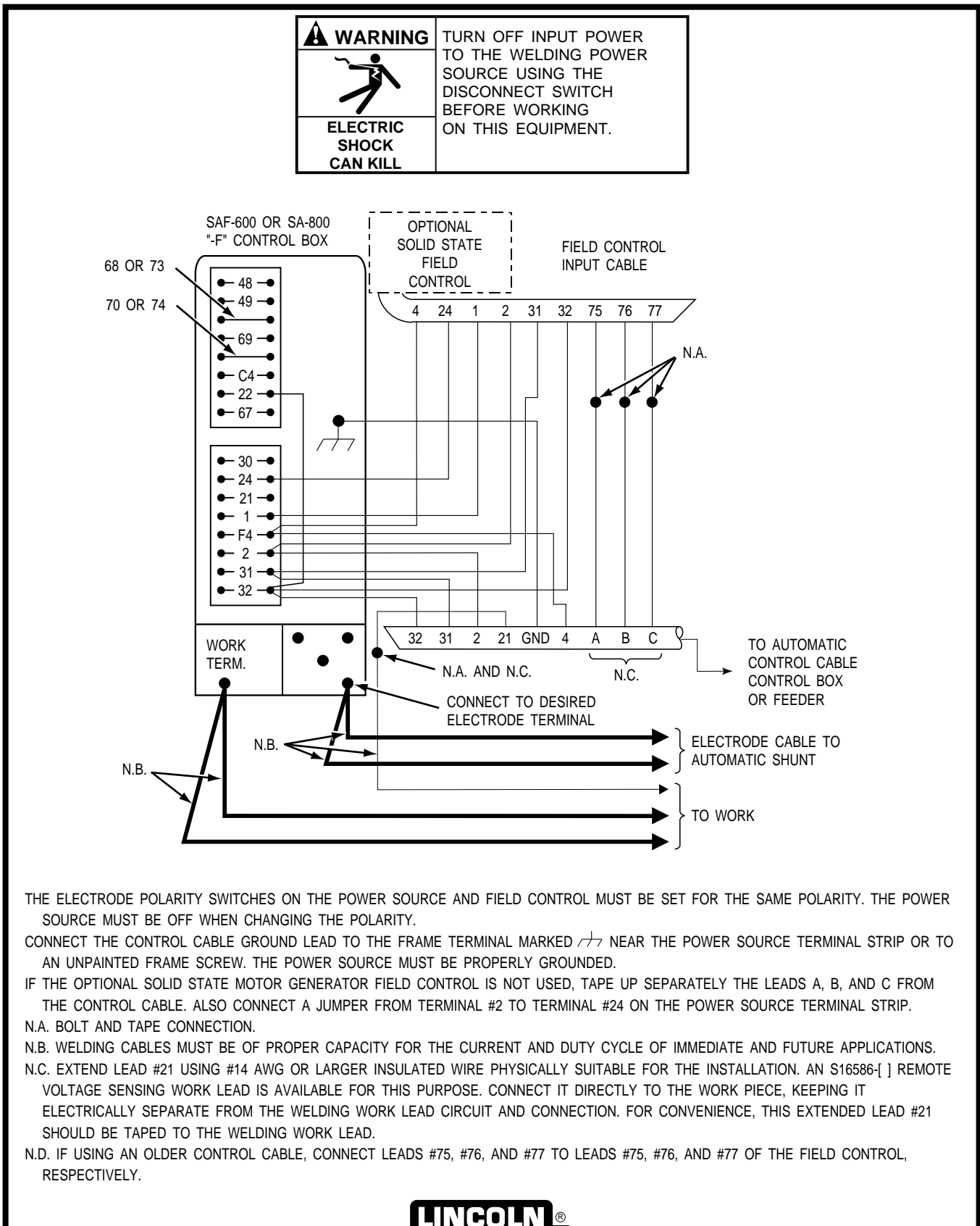
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NA-3 AND NA-4

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**FIGURE A.8 – CONNECTION OF NA-3 (SET FOR CONSTANT CURRENT WELDING) TO A SAF-600 OR SA-800, TYPE “-F” AND M.G. SOLID STATE FIELD CONTROL.**



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FIGURE A.9 – CONNECTION OF NA-3 (ALL) TO AN SAN.

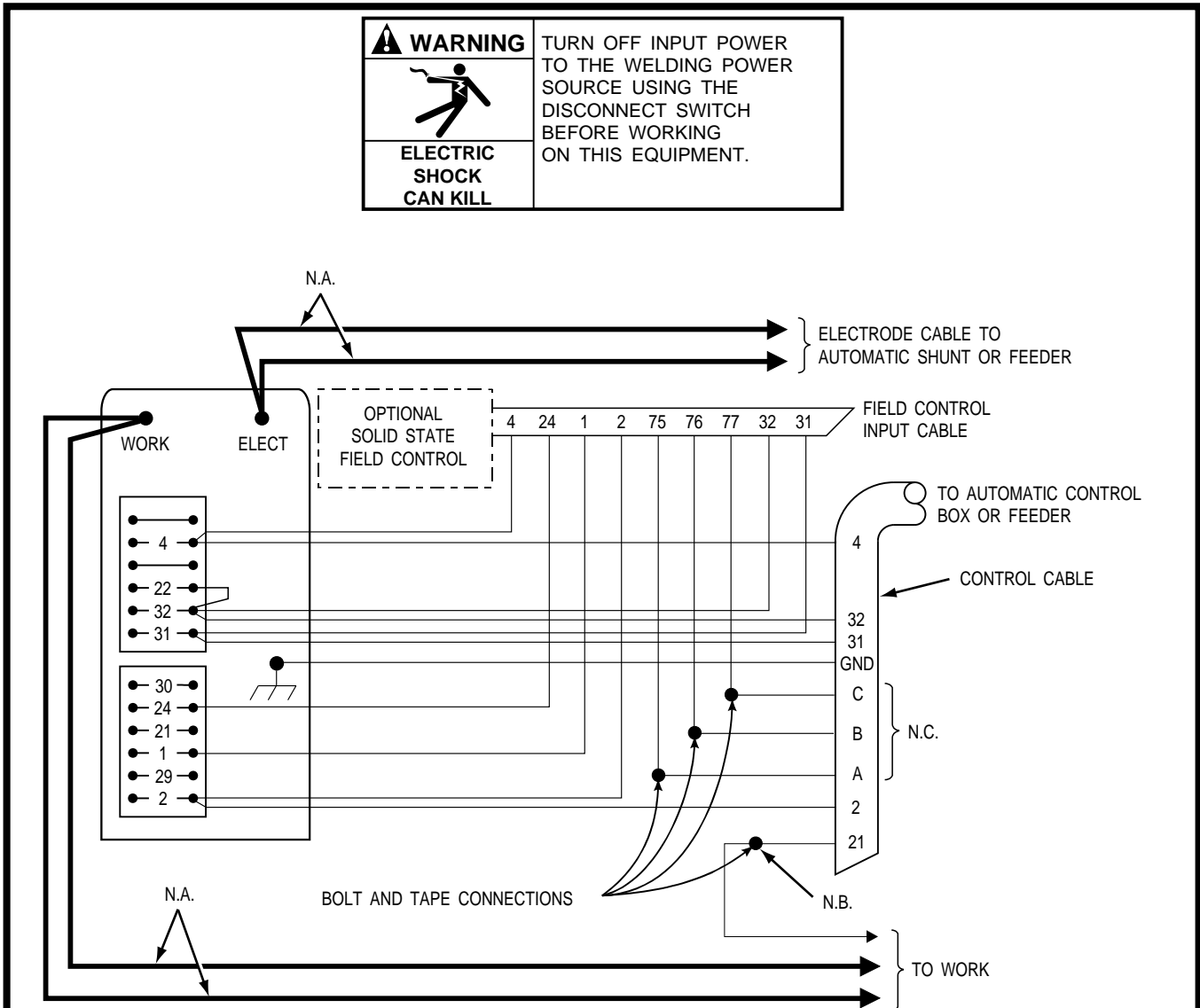
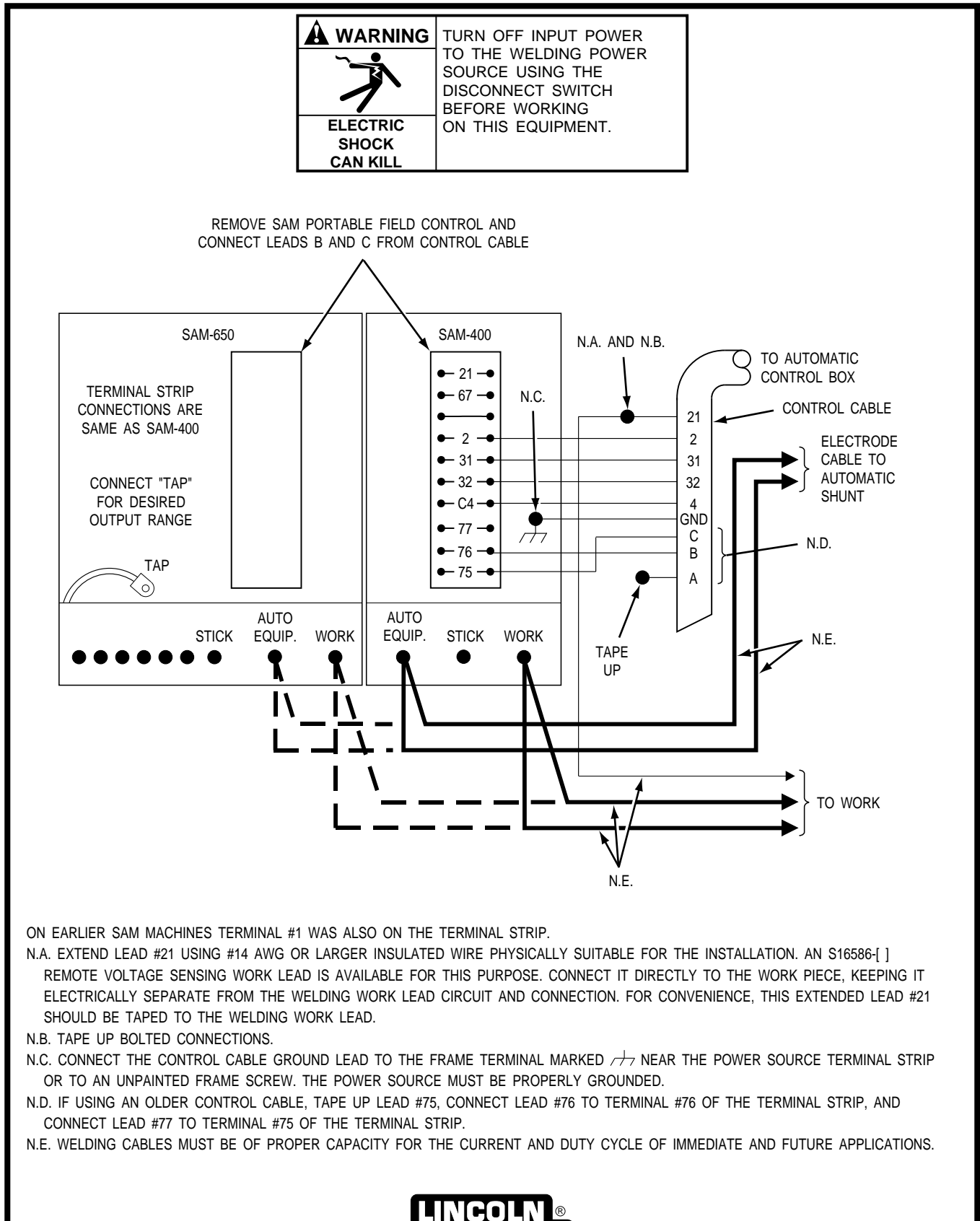


FIGURE A.10 – CONNECTION OF NA-3 (ALL) TO A SAM MOTOR-GENERATOR OR ENGINE DRIVEN WELDER.



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FIGURE A.11 – CONNECTION OF NA-3 TO R3S-400, 600, OR 800 WITH LINE VOLTAGE COMPENSATOR.

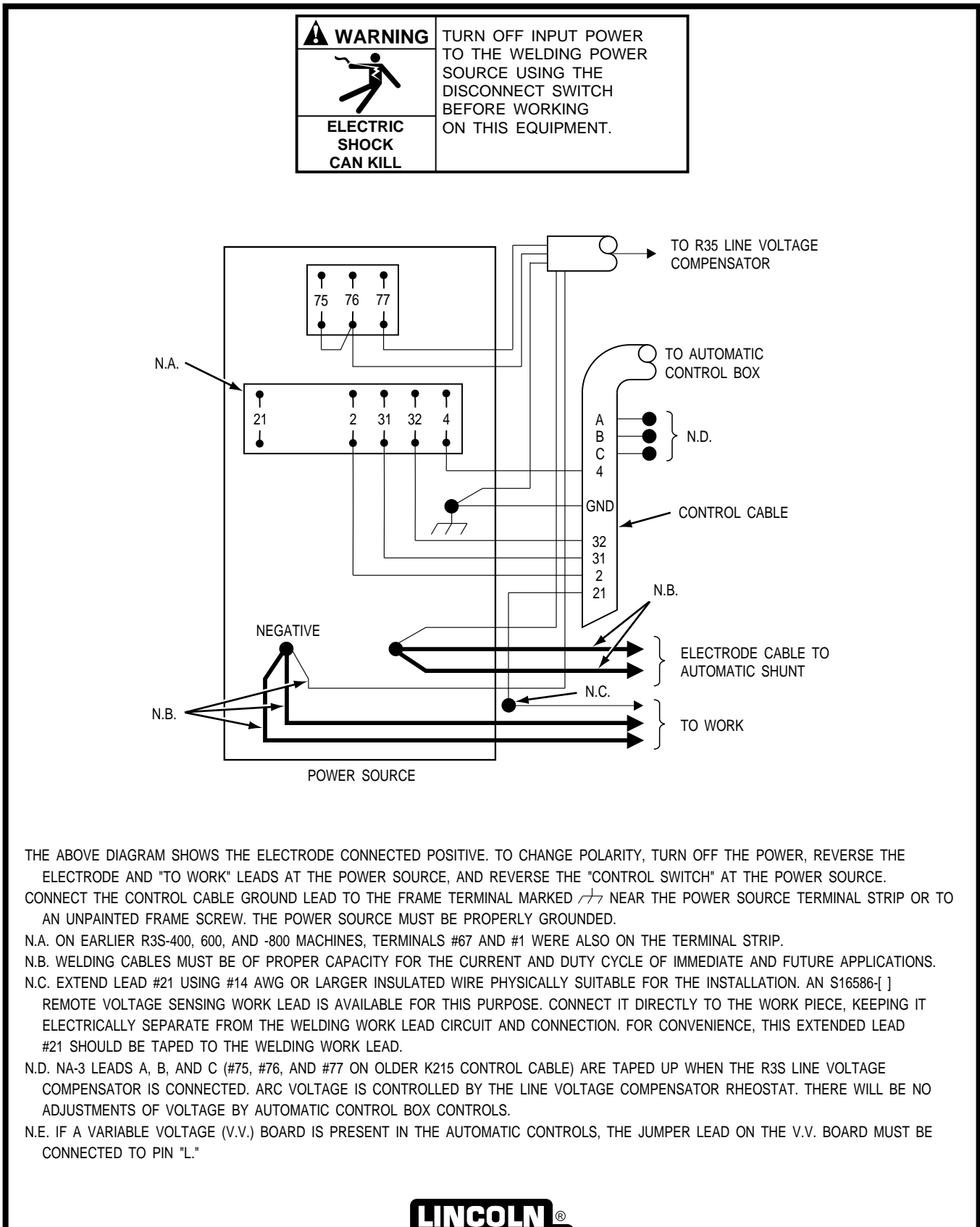
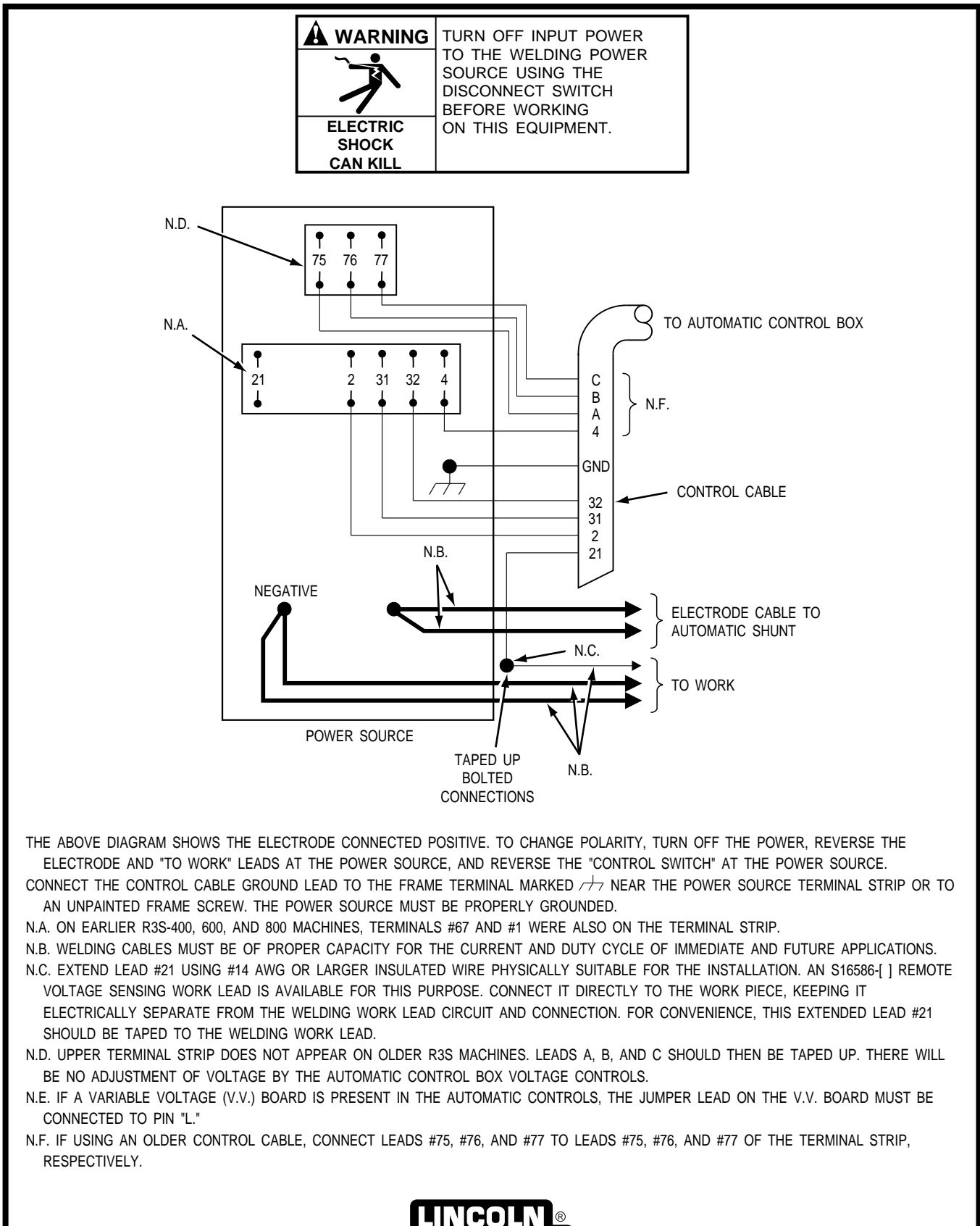



FIGURE A.12 – CONNECTION OF NA-3 TO R3S-400, 600, OR 800 WITH NO LINE VOLTAGE COMPENSATOR.



THE ABOVE DIAGRAM SHOWS THE ELECTRODE CONNECTED POSITIVE. TO CHANGE POLARITY, TURN OFF THE POWER, REVERSE THE ELECTRODE AND "TO WORK" LEADS AT THE POWER SOURCE, AND REVERSE THE "CONTROL SWITCH" AT THE POWER SOURCE. CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED  NEAR THE POWER SOURCE TERMINAL STRIP OR TO AN UNPAINTED FRAME SCREW. THE POWER SOURCE MUST BE PROPERLY GROUNDED.

N.A. ON EARLIER R3S-400, 600, AND 800 MACHINES, TERMINALS #67 AND #1 WERE ALSO ON THE TERMINAL STRIP.

N.B. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.C. EXTEND LEAD #21 USING #14 AWG OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE, KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED LEAD #21 SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.D. UPPER TERMINAL STRIP DOES NOT APPEAR ON OLDER R3S MACHINES. LEADS A, B, AND C SHOULD THEN BE TAPED UP. THERE WILL BE NO ADJUSTMENT OF VOLTAGE BY THE AUTOMATIC CONTROL BOX VOLTAGE CONTROLS.

N.E. IF A VARIABLE VOLTAGE (V.V.) BOARD IS PRESENT IN THE AUTOMATIC CONTROLS, THE JUMPER LEAD ON THE V.V. BOARD MUST BE CONNECTED TO PIN "L."

N.F. IF USING AN OLDER CONTROL CABLE, CONNECT LEADS #75, #76, AND #77 TO LEADS #75, #76, AND #77 OF THE TERMINAL STRIP, RESPECTIVELY.

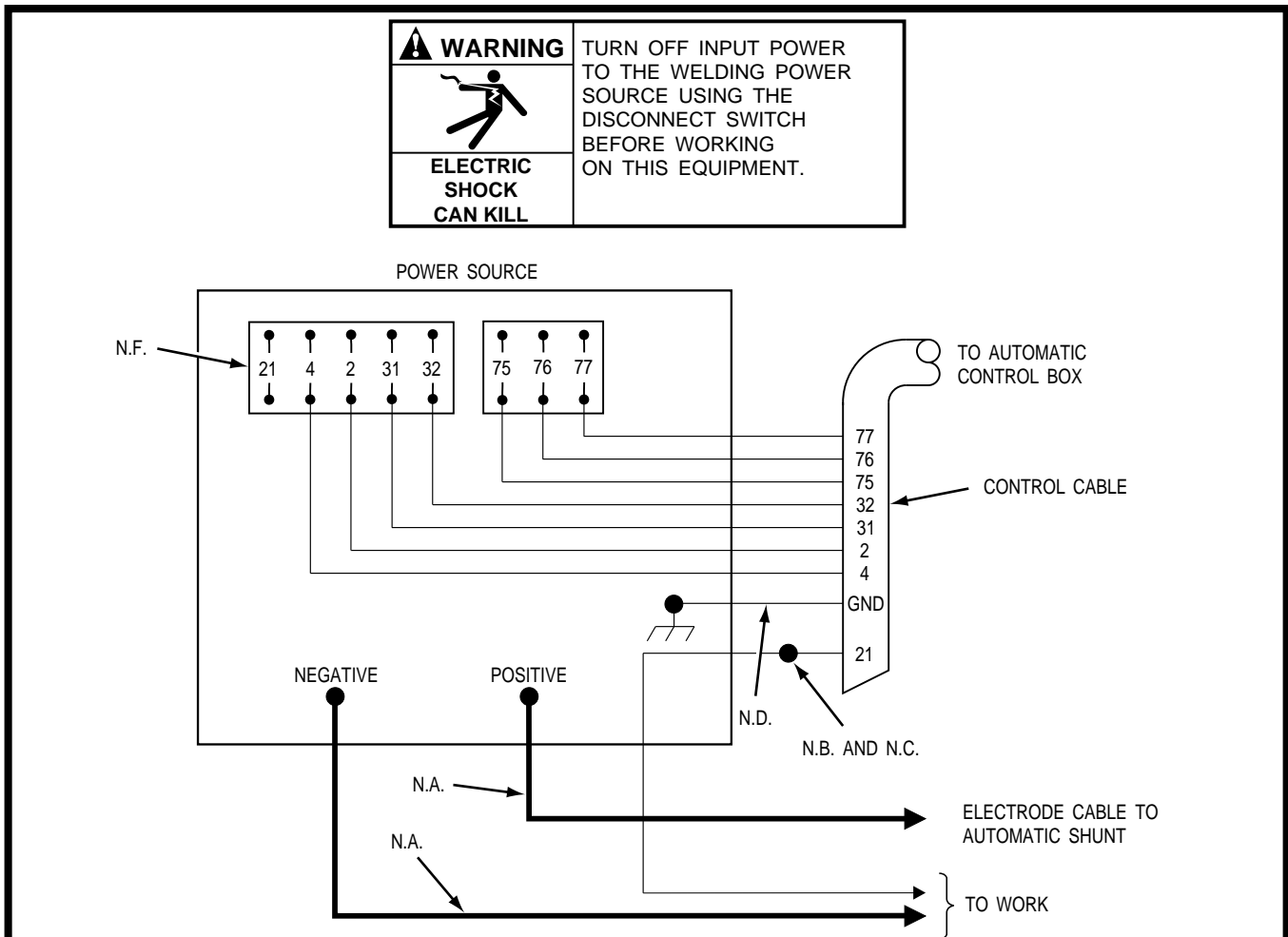
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NA-3 AND NA-4

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FIGURE A.13 – CONNECTION OF NA-3 TO IDEALARC DC-400  
AND TO CV/CVI POWER SOURCES.





THE ABOVE DIAGRAM SHOWS THE ELECTRODE CONNECTED POSITIVE. TO CHANGE POLARITY, TURN OFF THE POWER, REVERSE THE ELECTRODE AND "TO WORK" LEADS AT THE POWER SOURCE, AND POSITION THE SWITCH ON THE POWER SOURCE (IF EQUIPPED) TO PROPER POLARITY. REVERSE THE LEADS ON THE BACK OF THE AMMETER AND VOLTMETER IN THE AUTOMATIC CONTROL BOX. ALSO REFER TO NOTE N.F.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.B. EXTEND LEAD #21 USING #14 AWG OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE, KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED LEAD #21 SHOULD BE TAPED TO THE WELDING WORK LEAD. IF THE LENGTH OF THE WORK LEAD CIRCUIT IS SHORT, AND CONNECTIONS CAN BE EXPECTED TO BE RELIABLE, THEN CONTROL CABLE LEAD #21 DOES NOT NEED TO BE EXTENDED AND CAN BE DIRECTLY CONNECTED TO TERMINAL #21 ON THE TERMINAL STRIP. NOTE THAT THIS IS NOT THE PREFERRED CONNECTION BECAUSE IT ADDS ERRORS TO THE WIRE FEEDER VOLTMETER READING.

N.C. TAPE UP BOLTED CONNECTION.

N.D. CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED  NEAR THE POWER SOURCE TERMINAL STRIP. THE POWER SOURCE GROUNDING TERMINAL STIP (MARKED  AND LOCATED NEAR THE POWER SOURCE INPUT POWER CONNECTION) MUST BE PROPERLY CONNECTED TO ELECTRICAL GROUND PER THE POWER SOURCE OPERATING MANUAL.

N.E. IF A VARIABLE VOLTAGE BOARD IS PRESENT IN THE AUTOMATIC CONTROLS AND THE DC-400 DIODE KIT OR CV-400 OR CVI-500 DIODE OPTION IS NOT USED, THE JUMPER LEAD ON THE V.V. BOARD MUST BE CONNECTED TO PIN "L" TO PERMIT THE INCH DOWN BUTTON TO OPERATE. THIS JUMPER, HOWEVER, WILL DISABLE THE COLD START/AUTOSTOP FEATURE OF THE AUTOMATIC CONTROLS, PERMITTING ONLY HOT STARTING TECHNIQUES TO BE USED.

N.F. IF LEAD #21 IS TO BE CONNECTED TO THE TERMINAL STRIP, CONNECT TO TERMINAL #21 THAT MATCHES WORK POLARITY. THIS CONNECTION MUST BE CHANGED WHENEVER THE ELECTRODE POLARITY IS CHANGED. THIS DOES NOT APPLY TO DC-400S BELOW CODE 9200 WITH POLARITY SWITCH.

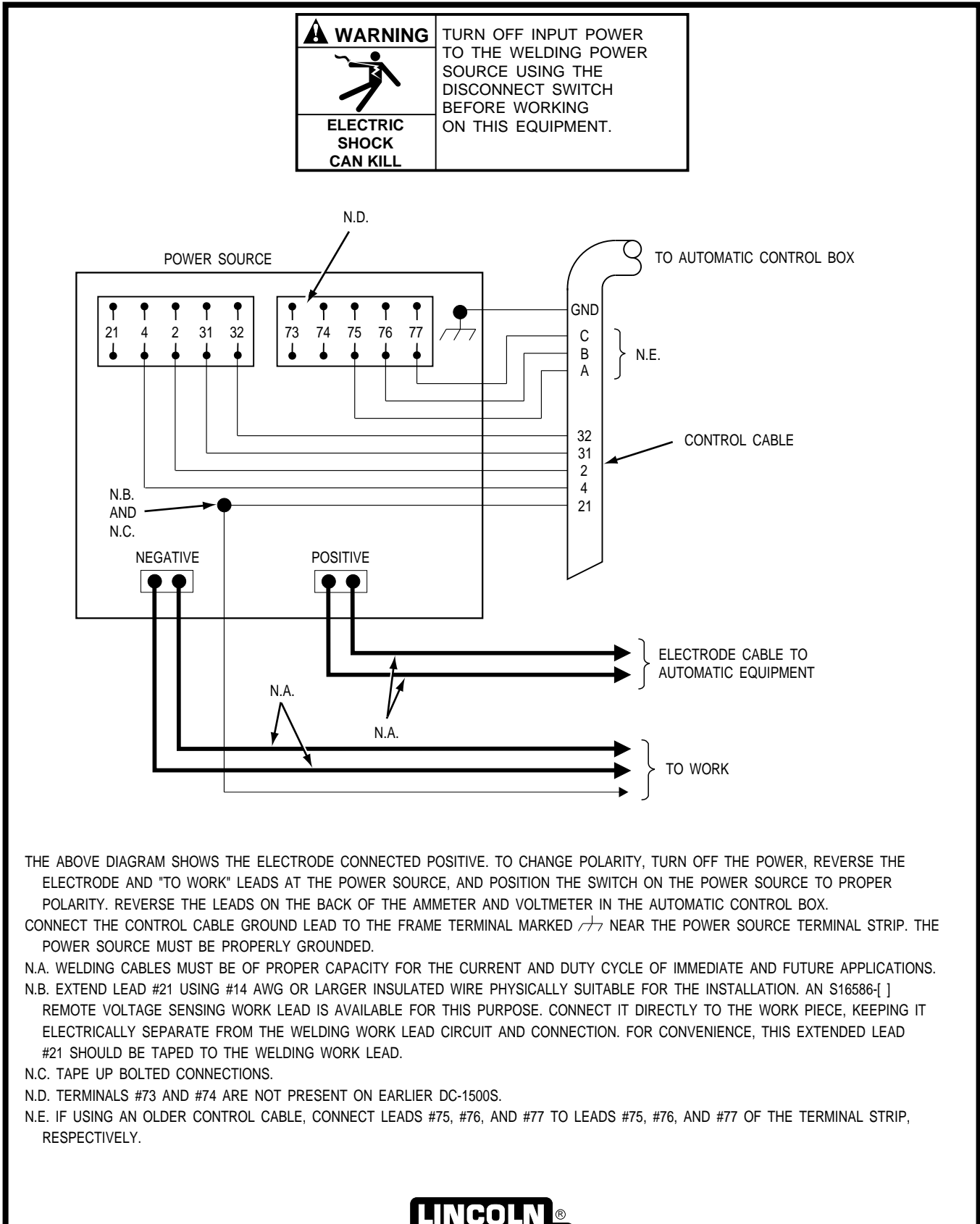
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
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NA-3 AND NA-4

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FIGURE A.14 – CONNECTION OF NA-3 TO IDEALARC DC-1000 AND DC-1500.



THE ABOVE DIAGRAM SHOWS THE ELECTRODE CONNECTED POSITIVE. TO CHANGE POLARITY, TURN OFF THE POWER, REVERSE THE ELECTRODE AND "TO WORK" LEADS AT THE POWER SOURCE, AND POSITION THE SWITCH ON THE POWER SOURCE TO PROPER POLARITY. REVERSE THE LEADS ON THE BACK OF THE AMMETER AND VOLTMETER IN THE AUTOMATIC CONTROL BOX. CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED  NEAR THE POWER SOURCE TERMINAL STRIP. THE POWER SOURCE MUST BE PROPERLY GROUNDED.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.B. EXTEND LEAD #21 USING #14 AWG OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S16586-[ ]

REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE, KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED LEAD #21 SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.C. TAPE UP BOLTED CONNECTIONS.

N.D. TERMINALS #73 AND #74 ARE NOT PRESENT ON EARLIER DC-1500S.

N.E. IF USING AN OLDER CONTROL CABLE, CONNECT LEADS #75, #76, AND #77 TO LEADS #75, #76, AND #77 OF THE TERMINAL STRIP, RESPECTIVELY.

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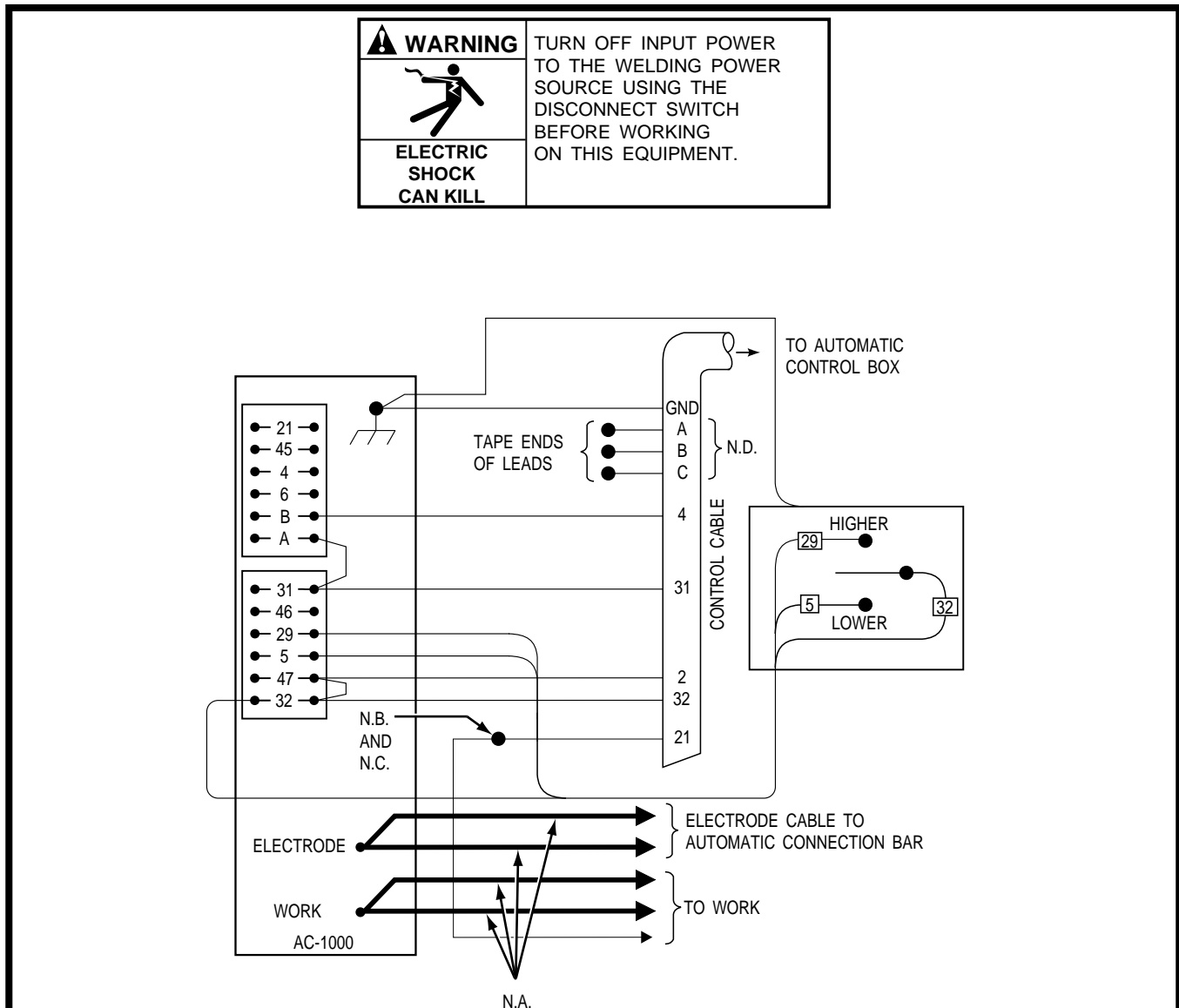
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NA-3 AND NA-4

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**FIGURE A.15 – CONNECTION OF NA-4 (WHICH HAS RHEOSTAT FOR CURRENT CONTROL) TO AN AC-1000.**



ALL CURRENT CONTROL RHEOSTATS ON THE CONTROL BOX WILL BE INOPERATIVE. TO AVOID CONFUSION, THE KNOBS SHOULD BE REMOVED.

CURRENT CONTROL SWITCH SPDT, CENTER OFF, MOMENTARY CONTACT TOGGLE SWITCH, 10 AMP, 250 VAC RATING. (LINCOLN ELECTRIC CO. PART NO. S9826.)

THE SWITCH IS TO BE LOCATED IN A SUITABLE GROUNDED ENCLOSURE AT THE AUTOMATIC CONTROL BOX. LEADS TO THE POWER SOURCE SHOULD BE 18GA OR LARGER.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.B. EXTEND LEAD #21 USING #14 AWG OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE, KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED LEAD #21 SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.C. TAPE UP BOLTED CONNECTIONS.

N.D. IF USING AN OLDER CONTROL CABLE, TAPE ENDS OF LEADS #75, #76, AND #77.

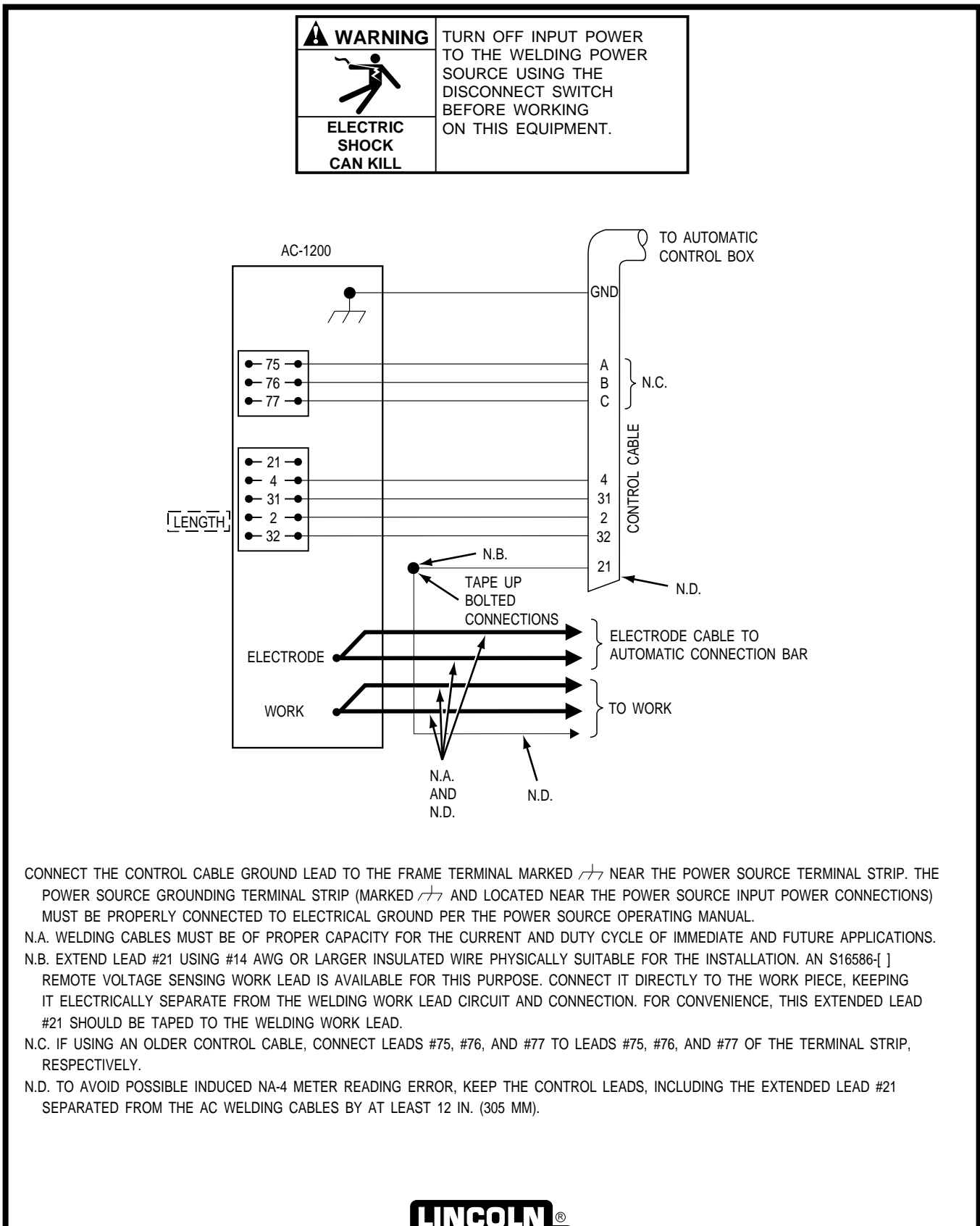
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NA-3 AND NA-4

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FIGURE A.16 – CONNECTION OF NA-4 (WHICH HAS RHEOSTAT FOR CURRENT CONTROL) TO AN AC-1200.



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NA-3 AND NA-4

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FIGURE A.17 – CONNECTION OF NA-3 TO SAF-600 “F” OR SA-800 “F” AND M.G. SOLID STATE FIELD CONTROL AND K240 CONTACTOR KIT.

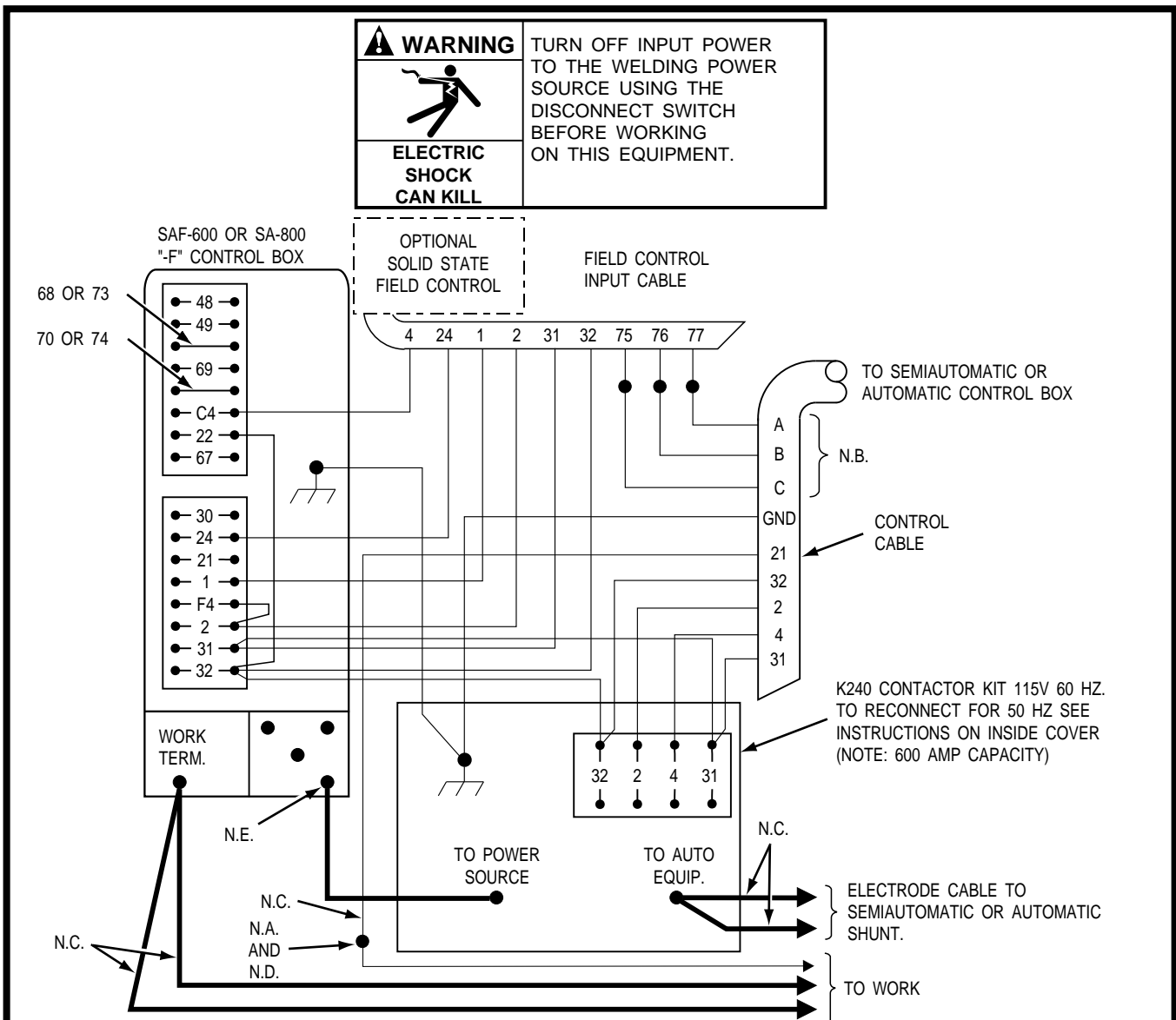
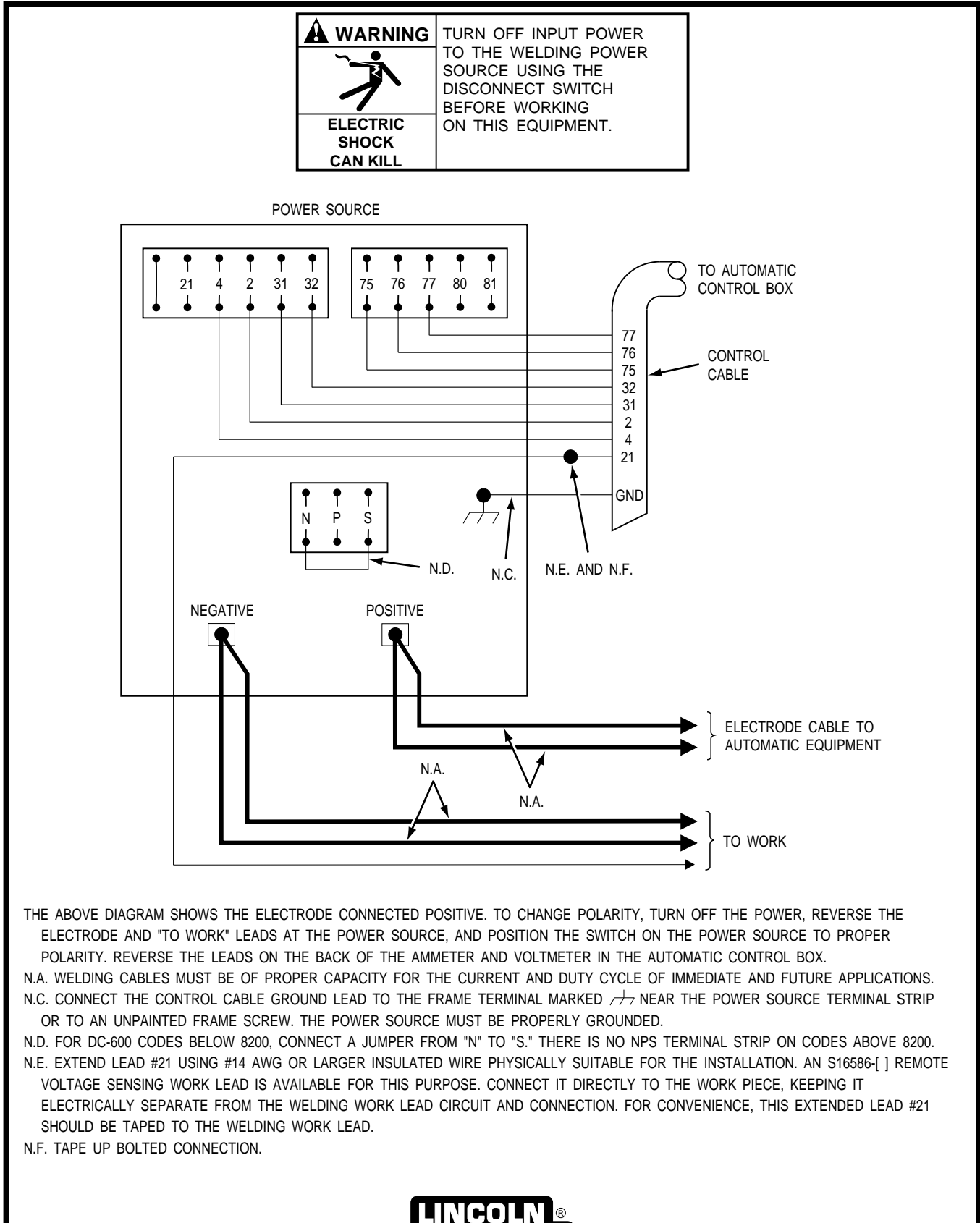



FIGURE A.18 – CONNECTION OF NA-3 TO IDEALARC DC-600.



THE ABOVE DIAGRAM SHOWS THE ELECTRODE CONNECTED POSITIVE. TO CHANGE POLARITY, TURN OFF THE POWER, REVERSE THE ELECTRODE AND "TO WORK" LEADS AT THE POWER SOURCE, AND POSITION THE SWITCH ON THE POWER SOURCE TO PROPER POLARITY. REVERSE THE LEADS ON THE BACK OF THE AMMETER AND VOLTMETER IN THE AUTOMATIC CONTROL BOX.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS. N.C. CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED  NEAR THE POWER SOURCE TERMINAL STRIP OR TO AN UNPAINTED FRAME SCREW. THE POWER SOURCE MUST BE PROPERLY GROUNDING.

N.D. FOR DC-600 CODES BELOW 8200, CONNECT A JUMPER FROM "N" TO "S." THERE IS NO NPS TERMINAL STRIP ON CODES ABOVE 8200.

N.E. EXTEND LEAD #21 USING #14 AWG OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE, KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED LEAD #21 SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.F. TAPE UP BOLTED CONNECTION.

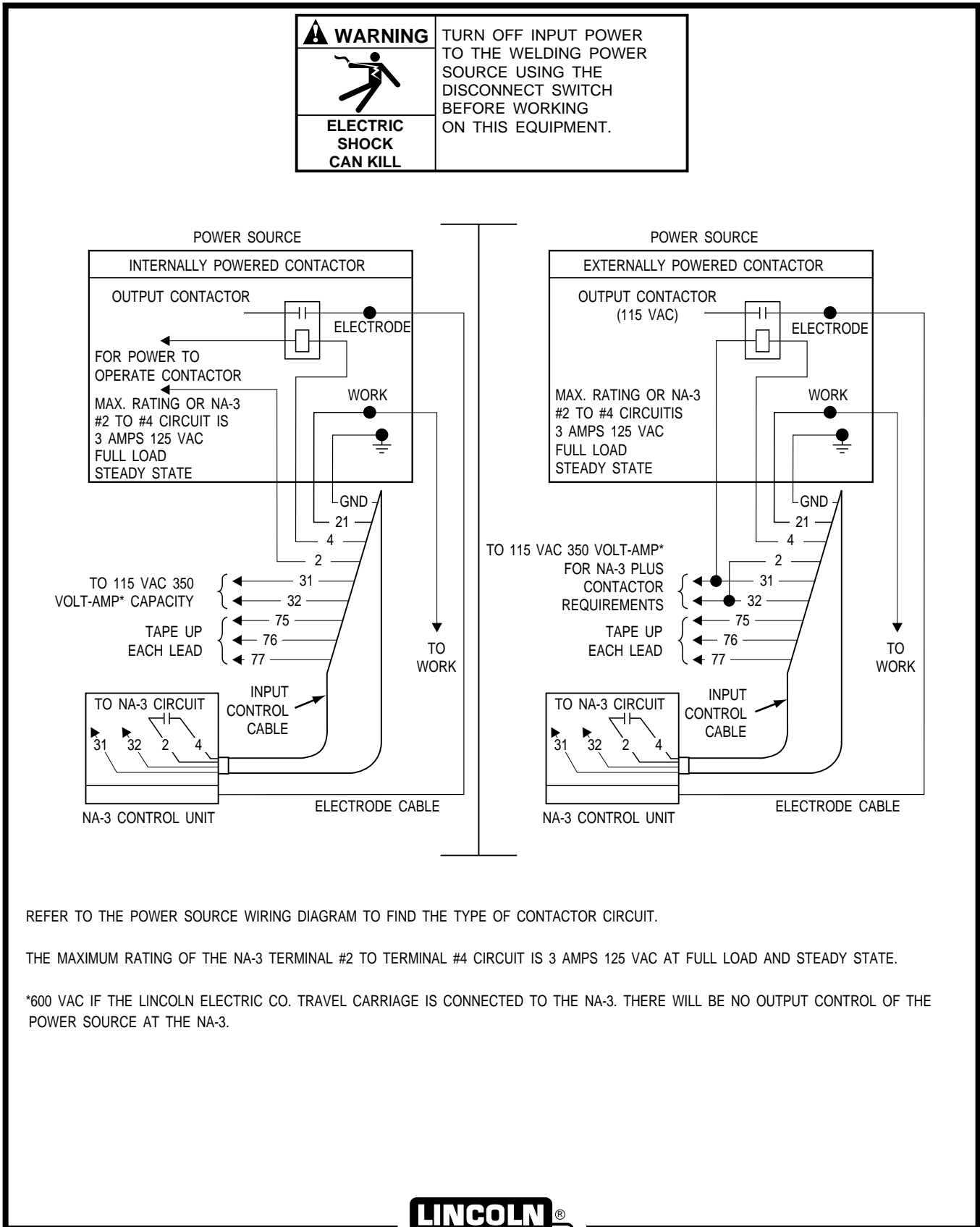
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NA-3 AND NA-4

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FIGURE A.19 – CONNECTION OF NA-3 TO NON-LINCOLN ELECTRIC POWER SOURCES.



REFER TO THE POWER SOURCE WIRING DIAGRAM TO FIND THE TYPE OF CONTACTOR CIRCUIT.

THE MAXIMUM RATING OF THE NA-3 TERMINAL #2 TO TERMINAL #4 CIRCUIT IS 3 AMPS 125 VAC AT FULL LOAD AND STEADY STATE.

\*600 VAC IF THE LINCOLN ELECTRIC CO. TRAVEL CARRIAGE IS CONNECTED TO THE NA-3. THERE WILL BE NO OUTPUT CONTROL OF THE POWER SOURCE AT THE NA-3.



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NA-3 AND NA-4



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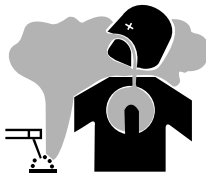
## SAFETY PRECAUTIONS

### ⚠ WARNING



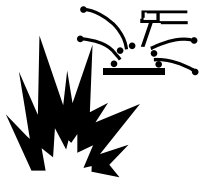
#### ELECTRIC SHOCK can kill.

- Do not touch electrical-ly live parts or electrode with skin or wet clothing.
- Insulate yourself from work or 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.

## OPERATOR'S INSTRUCTIONS

Once the system is properly set up, the operator can make production welds *without readjusting the controls* using the following simple instructions:

1. Be sure enough electrode is in the machine to complete the weld.
2. If submerged arc welding, fill flux hopper with new or freshly screened flux. All reused flux must be screened 100% through an eight mesh screen [a 0.065 to 0.075 in. (1.6 to 1.9 mm) opening]. Turn the switch on the hopper to "On."
3. Start the power source.
4. Turn the "Power Control" switch on the wire feeder control to "On."
5. Position the welding head at the start of the weld. Be sure the travel carriage or other travel mechanism is set to move in the proper direction.
6. Set the travel switch to "Automatic Travel." When set to "Hand Travel", the travel system operates without welding.
7. For best starts, cut the electrode to a sharp point.
8. Press the "Inch Down" button to feed the electrode out of the nozzle.
  - a. For most applications, when hot starting, position the electrode 1/4 in. (6.4 mm) or more away from the work.
  - b. When cold starting some submerged arc welding, inch the electrode down until it touches the work and the flux valve opens.
9. Press the "Start" button.
10. While welding, turn the cross seam adjuster hand wheel as needed to keep the arc in the joint.
11. At the end of the weld, press the "Stop" button.
12. If needed, press the "Inch Up" button to get the electrode up and out of the way. Remove the work and reload the fixture.

**NOTE:** When the contact tip in the end of the nozzle wears during repetitive welding, it must be replaced. Check the contact tip for wear if weld quality seems to be deteriorating.

NA-3 AND NA-4

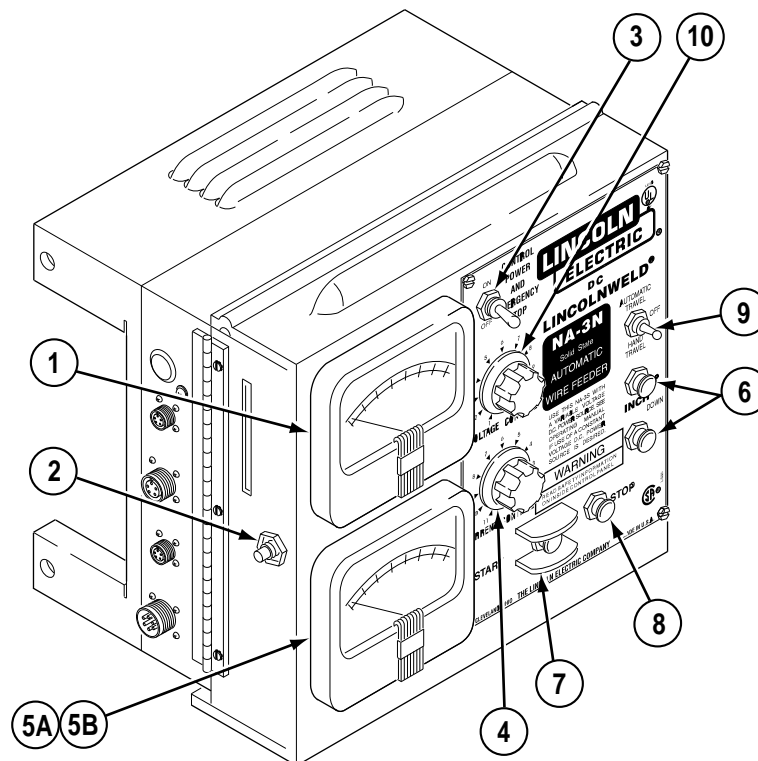
## CONTROLS AND THEIR FUNCTIONS

### NA-3N

The operator controls for the NA-3N are illustrated in Figure B.1. Refer to the figure and the following explanations of the controls.

1. **AMMETER.** Indicates current only while welding.
2. **CIRCUIT BREAKER.** Protects the circuit from severe wire feed motor overloads and short circuits. Press to reset. Locate and correct the cause of overloading.
3. **CONTROL POWER.** Turns input control power "On" and "Off." Also used as an emergency "Off" in case of malfunction.
4. **CURRENT CONTROL.** Adjusts wire feed speed to control welding current.
- 5A. **VOLTMETER (STANDARD).** Indicates voltage only while welding. Also indicates OCV below 60 volts.
- 5B. **ELECTRONIC VOLTMETER (OPTIONAL).** Replaces the standard voltmeter when precise monitoring of the arc voltage is required. See the section on this voltmeter for operating information.
6. **INCH UP AND INCH DOWN.** Inches the electrode at the speed set by the "Inch Speed" control on the inner panel.
7. **START.** Begins welding cycle.
8. **STOP.** Initiates the stopping cycle at the end of the weld.
9. **TRAVEL.** Controls speed and direction of travel. Turn to "Off" for no travel, "Hand Travel" for travel without welding, or "Automatic Welding" for welding operations.
10. **VOLTAGE CONTROLS.** Adjusts arc volts by controlling power source output voltage.

FIGURE B.1 – NA-3N CONTROLS.

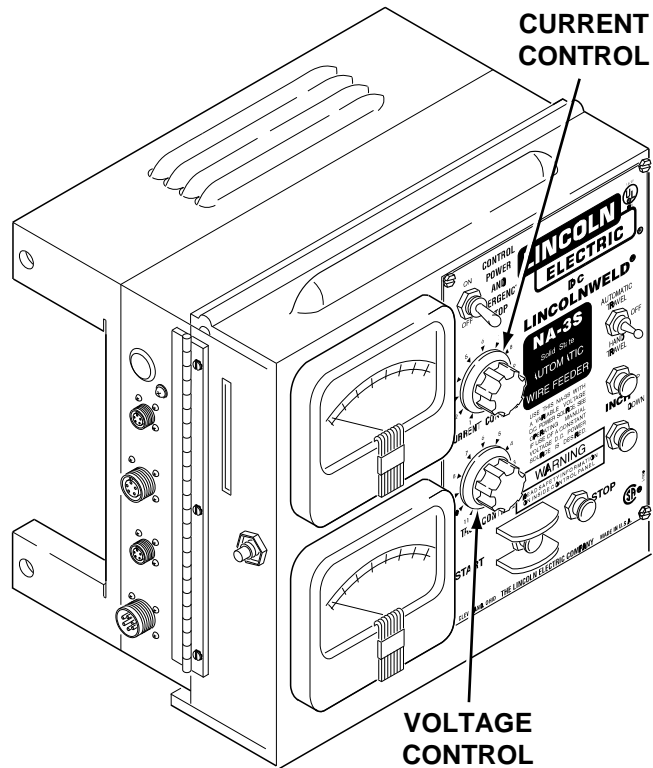


NA-3 AND NA-4





FIGURE B.2 – NA-3S CONTROLS.



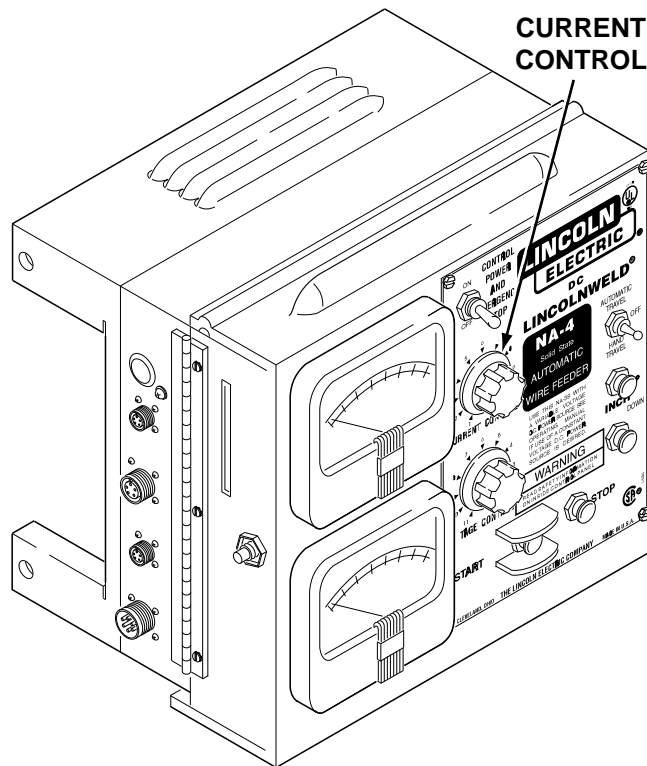
### NA-3S (WHEN CONNECTED TO A CONSTANT CURRENT POWER SOURCE)

The NA-3S operator controls that differ from the NA-3N are described below and illustrated in Figure B.2. Refer to the NA-3N control descriptions and Figure B.1 for all other controls.

**CURRENT CONTROL.** Adjusts welding current by controlling power source output.

**VOLTAGE CONTROL.** Adjusts arc voltage by controlling wire feed speed.

FIGURE B.3 – NA-4 CONTROLS.



### NA-4

When connected to a constant current output source, the NA-4 controls are the same as those for the NA-3S with the exception described below and shown in Figure B.3. Refer to the NA-3N and NA-3S control descriptions and Figures B.1 and B.2 for all other controls. Older NA-4s used with AC-1000 power sources use a toggle switch instead of a rheostat for current control.

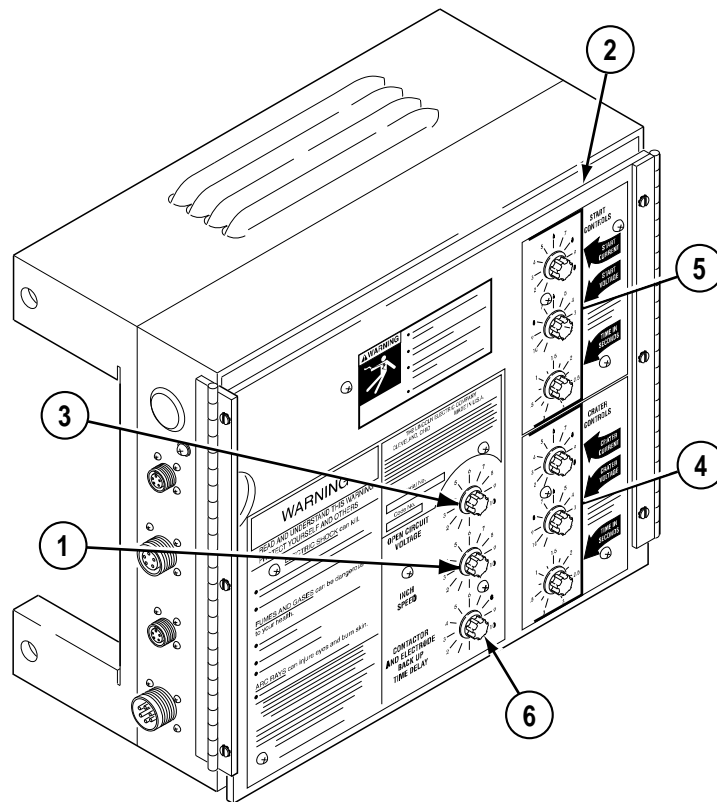
**CURRENT CONTROL.** Adjusts welding current by controlling power source output.

## INNER CONTROL PANEL

The inner control panel controls and components are illustrated in Figure B.4. Refer to the figure and the following descriptions of the controls and components.

1. **INCH SPEED.** Sets electrode feeding speed when not welding. It is independent of the other feed speed controls and permits inch speeds faster or slower than welding feed speeds.
2. **FUSES.** Located on the control PC board behind the inner panel door.
3. **OPEN CIRCUIT VOLTAGE.** Adjusts OCV of most CV Lincoln power sources to control starting characteristics.
4. **OPTIONAL CRATER CONTROLS.** Sets ending current and voltage for an adjustable period of time.
5. **OPTIONAL START CONTROLS.** Sets starting current and voltage for an adjustable period of time.
6. **TIME DELAY.** Prevents crater sticking by adjusting the time for electrode burnback and/or retraction from the puddle.

FIGURE B.4 – INNER CONTROL PANEL.

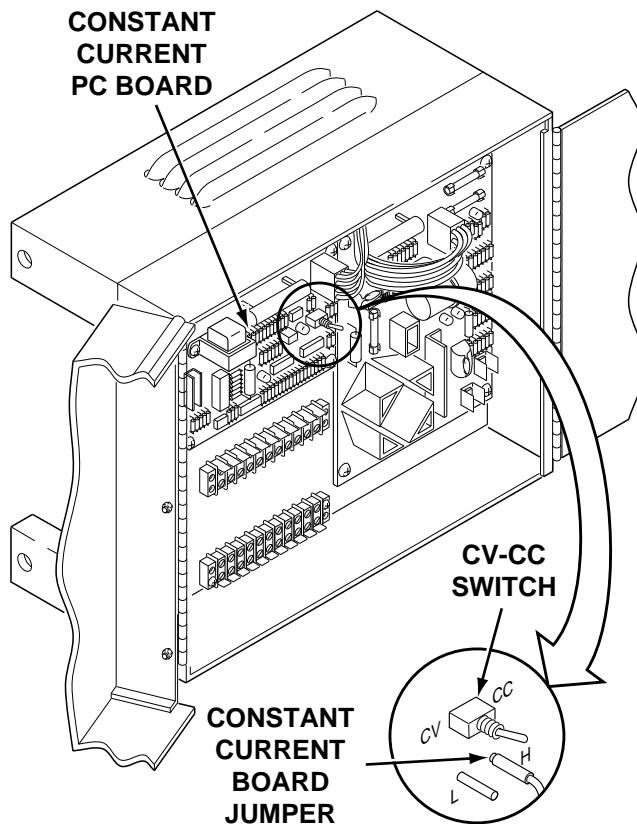


NA-3 AND NA-4

### OPTIONAL ELECTRONIC VOLTMETER OPERATION

Set the desired arc voltage on the meter dial and start to weld. The green light glows when actual voltage matches the preset voltage. Either red light will glow when the welding voltage is higher or lower than the preset voltage. Adjust the "Voltage Control" selector in the appropriate direction until the green light glows. The NA-4 only welds with a constant current AC power source. Make sure the "CV-CC" switch on the constant current PC board inside the control box is always set on "CC" and the constant current board jumper is on the correct pin.

FIGURE B.5 – CV-CC SWITCH.



When Innershield® welding, connect the jumper on the back of the meter between A and B. The red lights will glow when the welding voltage is 1/2 volt above or below the preset voltage.

When submerged arc welding, connect the jumper between B and C. The red lights will glow when the welding voltage is 1 volt above or below the preset voltage.

### SETTING FOR CV OR CC POWER SOURCES

The NA-3N welds only with a constant voltage (CV) power source. This machine can be converted for constant current (CC) welding by installing the proper parts.

The NA-3S welds with either a CV or CC power source. Set the equipment for either "CV" or "CC" as appropriate per the following:

1. If using a multi-process power source, set it up per the instructions in the operating manual shipped with the power source.
2. Turn the input power off and open the inner panel. Set the "CV-CC" switch located on the constant current PC board inside the control box as shown in Figure B.5. When using an RS3 power source with the triangle plate (for major voltage adjustments), the constant current board jumper must be on Pin L.
3. There are two nameplates on top of each other on the front of the wire feeder control box. Make sure the correct nameplate for the power source being used is on top.
4. If the optional start controls or crater controls PC boards are installed, make sure the correct nameplates for the power supply being used are on top.

NA-3 AND NA-4

## WELDING WITH DC CONSTANT VOLTAGE (CV)

### MECHANICAL SETUP

1. Set the head position relative to the work as required for the fixture, application, and procedures.
2. Rotate the wire straightener, if used, until the top of the wire straightener faces the wire reel. This is required for smooth feeding of the electrode into the straightener.
3. If using a K148 Contact Assembly, rotate the assembly relative to the direction of travel as shown in Figure B.6.
4. The mount for standard 50 and 60 lb (22.7 and 27.2 kg) electrode coils includes a two-position brake assembly. Generally the brake should be at the inner position (nearest the wire reel shaft) for wire speeds below 400 in./min (10.0 m/min). It should be at the outer position for faster wire speeds. To adjust the brake position, the wire reel must be removed. Pull the cotter pin that holds the brake shoe to the arm; move the shoe and replace the cotter pin. Do not bend

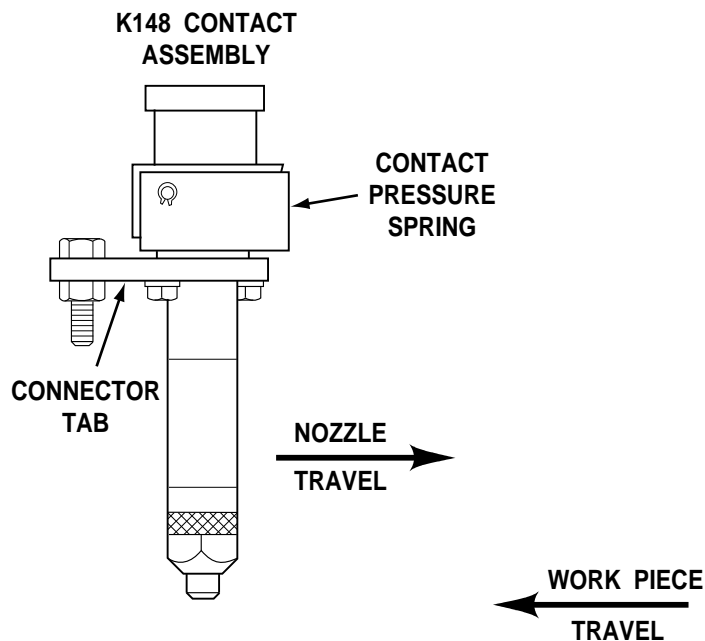
the cotter pin; it is held in place by a friction fit.

5. Load the wire reel or install the speed drum or reel.

### ELECTRICAL SETUP

1. If using a multi-process power source (SAM, SAF, SA-800, DC-600, DC-1000, or DC-1500), set the power source for constant voltage (CV) welding per the instructions in each of the power source manuals.
2. Set the wire feeder for constant voltage (CV) welding.
3. Set the power source for the electrode polarity [DC(+) or DC(-)] specified by the procedures. Interchange the NA-3 voltmeter and ammeter leads if the polarity was changed. If using the discontinued solid state remote field control with a motor-generator power source, be sure to set the power source *and* field control to the same polarity *before* starting the power source. Opposite polarity settings will blow the fuse in the field control.
4. Depending on the procedures and applications, the following must be decided:
  - a. Whether to use "hot" or "cold" starting. Cold starting requires the use of a constant voltage board and cannot be used when connected to an R3S power source.
  - b. Whether to start the travel with the "Start" button or the arc.
  - c. If control of the initial bead size or penetration requires use of the optional start controls PC board.

FIGURE B.6 – K148 CONTACT ASSEMBLY.



NA-3 AND NA-4

TABLE B.1 – WIRE FEED SPEED SETTINGS.

Gear Ratio 142-1*		Gear Ratio 95-1*		Gear Ratio 55-1*		
Approx. WFS in./min (m/min)	Setting	Approx. WFS in./min (m/min)	Setting	Approx. WFS in./min (m/min)	Setting	
50 (1.25)	<b>CV only</b>	1-3/4	100 (2.5)	2-1/2	200 (5.0)	3
100 (2.5)		3-1/2	200 (5.0)	5	400 (10)	6
150 (3.8)		5-1/4	300 (7.6)	7-1/2	600 (15)	8
200 (5.0)		7	400 (10)	10		
250 (6.4)		8-3/4				

\*Gear Ratio is stamped on the gear box

- b. Decide if control of the ending bead size or crater filling requires the use of the optional crater controls PC board.

See **Setting Travel Starting and Stopping** section later in this chapter for descriptions of the various starting sequences and the rewiring needed to accomplish them.

## CONTROL ADJUSTMENTS AND TEST WELDING

1. Set the wire feed speed (WFS) specified by the procedures using the NA-3 "Current Control." For initial test welds, choose the setting from Table B.1.
2. Set the power source and wire feeder for the voltage specified using the following procedures as they apply:

### Idealarc® R3S

- a. Set the power source for the voltage range desired per the instructions in the R3S operating manual. The OCV is fixed.
- b. Make the final voltage adjustments using the "Voltage Control" on the NA-3. This control varies the voltage over the range set by the power source.

### Idealarc DC-600, DC-1000, and DC-1500

- a. Set the toggle switch on the front of the DC-600, DC-1000, or DC-1500 to "Output Control Remote."

- b. Set the "Electrode Negative - Electrode Positive" switch to correspond to the polarity of the electrode cable connection.

- c. Set the 3-position toggle switch to "CV Innershield" or "CV Submerged Arc" as appropriate for the process and procedure.

- d. Set the NA-3 "Inch Speed" control at "2".

- e. DC-600 – Set the "OCV Control" at approximately the same dial setting as the NA-3 voltage control for the procedure being used.

- f. DC-1500 – Set the "OCV Control" at "4".

- g. Set the arc voltage using the NA-3 "Voltage Control." For initial test welds, choose a setting from Table B.2.

TABLE B.2 – DC-600 AND DC-1500 VOLTAGE CONTROL SETTINGS.

Power Source	Approximate Voltage	NA-3 Voltage Control Setting
DC-600	18 - 22	4
	28 - 32	6
	38 - 42	8
DC-1500	22 - 24	2
	34 - 36	4
	46 - 48	6
	56 - 60	8

For further information on using these power sources with NA-3, refer to the DC-600, DC-1000, or DC-1500 operating manuals.

#### Idealarc DC-400

Consult the operating manual for this power source.

#### SAF-600 and SA-800 with Discontinued Solid State Remote Field Control

- Set the "Voltage Range" switch on the power source to "Low."
- Set the power source "Voltage" rheostat to maximum.
- Connect the cable from the power source contactor box to the power source Innershield stud.
- Set the arc voltage using the NA-3 "Voltage Control." For initial test welds, choose a setting from Table B.3.

**TABLE B.3 – SAF-600 AND SA-800 VOLTAGE CONTROL SETTINGS.**

Approximate Voltage	Voltage Control Setting
18 - 22	1
28 - 32	3
38 - 42	6

#### SAM Motor-Generator or Engine Welder

- Set the power source "Constant Voltage Control" to "High."
- Set the arc voltage using the "Voltage Control" on the NA-3. For initial test welds, choose a setting from Table B.4.

**TABLE B.4 – MOTOR-GENERATOR VOLTAGE SETTINGS.**

Approximate Voltage	Voltage Control Setting
18 - 22	1
28 - 32	5
38 - 42	10

#### SAN with Discontinued Solid State Remote Field Control

- Set the power source "Voltage" rheostat to maximum.
- Set the arc voltage using the "Voltage Control" on the NA-3. For initial test welds, choose a setting from Table B.5.

**TABLE B.5 – SAN VOLTAGE SETTINGS.**

Approximate Voltage	Voltage Control Setting
18 - 22	1
28 - 32	5
38 - 42	10

- Unless previously instructed, set the "Inch Speed" for good arc striking. For an inch speed slower than welding feed speed, which is usually required for good striking, set the "Inch Speed" control on the inner panel one or two dial numbers below the setting of the "Current Control" on the front panel.
- If using a motor-generator type power source with the recommended (discontinued) solid state remote field control installed, the power source OCV is controlled by the "Open Circuit Voltage" control on the inner panel of the NA-3. Set the "OCV Control" to "4" and the "Inch Control" to "2". To read OCVs under 60 volts on the NA-3 voltmeter, inch the electrode up from the work and press the "Start" button before the electrode reaches the work.
- If installed, set the "Start Controls" and "Crater Controls" on the inner panel. For initial test welds, set both "Time in Seconds" to "1" and both "Current" and "Voltage" controls to the same dial numbers (to produce about the same output) as the "Current Control" and "Voltage Control" on the front panel.

6. Set the “Contactor and Electrode Back Up Time Delay” on the inner control panel to prevent crater sticking and to provide the stopping characteristics required by the application. For initial test welds, set it to “5”.
7. Straighten the first 6 in. (152.40 mm) of the electrode and push it through the wire straightener to the drive rolls. Press the “Inch Down” button and feed the electrode down through the nozzle. Adjust the wire straightener hand wheel. With contact nozzles installed, except for the K231 Contact Nozzle, adjust the hand wheel until the electrode is straight as it comes out of the nozzle. Do not *completely* straighten the wire when using the K231 Contact Nozzle because the nozzle relies on the small curvature of the electrode for proper electrical contact within the contact tip.
8. Set the travel speed as specified by the procedures. With the wire speed “Travel” switch set to “Hand Travel,” the travel runs without welding, permitting accurate measurements of travel speed. When using a Lincoln Electric travel carriage, adjust the speed with the rheostat and the direction with the toggle switch on the carriage control panel.
9. Connect the work lead to the work or a suitable piece of scrap. Clip the end of the electrode to a sharp point.

**⚠ WARNING**

**When using an open arc process, it is necessary to use correct eye, head, and body protection.**

10. Make a test weld and adjust the wire feeder “Voltage Control” and “Current Control” until the meters indicate the output specified by the procedure.
11. Make several test welds and readjust the starting and stopping controls in the following order:
  - a. Set the “Inch Speed” control for optimum arc striking. If using long stickout techniques, see the IM278 operating manual on using the Linc-Fill™ extension.
  - b. If installed, adjust the “Start Controls” to set the welding procedures during the first 0 to 3 seconds of welding in order to provide the bead size, penetration, or other factors as needed for the application.
  - c. If installed, adjust the “Crater Controls” to set the welding procedures during the first 0 to 3 seconds after the “Stop” button is pressed in order to provide the bead size or to fill the crater as needed for the application.
  - d. Set the “Contactor and Electrode Back Up Time Delay” to provide the stopping characteristics needed.

## WELDING WITH DC OR AC CONSTANT CURRENT (CC)

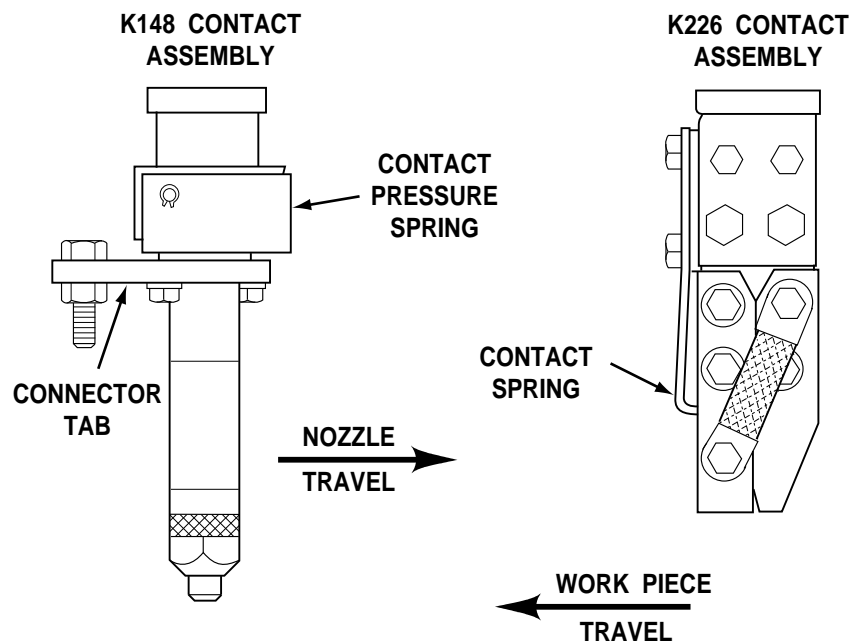
### MECHANICAL SETUP

1. Set the head position relative to the work as required for the fixture, application, and procedures.
2. Rotate the wire straightener until the hand wheel faces the wire reel. This is required to smoothly feed the electrode into the straightener.
3. If using a K148 or K226 Contact Assembly, rotate the assembly relative to the direction of travel as shown in Figure B.7.
4. The mount for standard 60 lb (27.2 kg) electrode coils includes a two-position brake assembly. Generally, when submerged arc welding, the brake should be left at the inner position (nearest the wire reel shaft.)
5. Load the wire reel or install the speed drum or reel.
6. Fill the flux hopper with new or freshly screened flux.

### ELECTRICAL SETUP

1. If using a multi-process power source (SAM, SAF, SA-800, DC-600, DC-1000, or DC-1500), set the power source for constant current (CC) welding per the instructions in the power source manual.
2. Set the wire feeder for constant current (CC) welding.
3. Set the power source for the electrode polarity [DC(+) or DC(-)] specified by the procedures. Reverse the NA-3 or NA-4 voltmeter and ammeter leads if the polarity was changed. If using the discontinued solid state remote field control with a motor-generator power source, be sure to set the power source *and* field control to the same polarity *before* starting the power source. Opposite polarity settings will blow the fuse in the field control.
4. Depending on the procedures and application, the following must be decided:
  - a. Whether to use "hot" or "cold" starting.
  - b. Whether to start the travel with the "Start" button or the arc.

FIGURE B.7 – K148 AND K226 CONTACT ASSEMBLY POSITIONING.



NA-3 AND NA-4



- c. If control of the initial bead size or penetration requires use of the optional start control PC board.

See ***Starting and Stopping Sequences*** later in this chapter for descriptions of the various starting sequences and the rewiring needed to accomplish them.

- 5. Depending on the procedures and application:
  - a. Select the arc and travel stopping sequence.
  - b. Decide if control of the ending bead size or crater filling requires the use of the optional crater controls PC board.

See ***Setting Travel Starting and Stopping*** section later in this chapter for descriptions of the various starting sequences and the rewiring needed to accomplish them.

## CONTROL ADJUSTMENTS AND TEST WELDING

- 1. Set the power source and wire feeder current and voltage controls for the outputs specified using the following procedures as they apply:

### SAF-600 and SA-800 with Discontinued Solid State Remote Field Control

- a. Set the "Voltage Range" switch on the power source to "High."
- b. Set the power source "Voltage" rheostat to maximum.
- c. Set the arc voltage with the "Voltage Control" on the NA-3. For the initial test welds, set the control at "6".
- d. Connect the cable from the power source contactor box to the power source sub-arc stud with the lowest current range that still permits welding at the current specified in the procedures. For

example, if you want 500 Amps welding current, use the "300-575" stud and not the "450-Max" stud.

- e. Make final current adjustments with the NA-3 "Current Control." This control varies the current over the entire range controlled by the stud connection. For initial test welds, set the control at "6".

### SA-750 (Discontinued)

Follow the instructions for the SA-800, except the SA-750 does not have a "Voltage Range" switch or a power source contactor box. For power sources without a contactor box, connect the electrode cable from the NA-3 input cable assembly to the appropriate stud.

### Idealarc DC-600, DC-1000, and DC-1500

- a. Set the toggle switch on the front of the DC-600, DC-1000 or DC-1500 to "Output Control Remote."
- b. Set the "Electrode Negative - Electrode Positive" switch to correspond to the polarity of the electrode cable connection.
- c. Set the 3-position toggle switch to "VV Submerged Arc."
- d. Set the NA-3 "Inch Speed" at "2".
- e. Set the "OCV Control" near minimum.

**NOTE:** Most submerged arc welding can be done with the DC-600, DC-1000, and DC-1500 power sources set for "CV Submerged Arc" and the NA-3S set for constant voltage "CV" wire feed. Constant current would normally only be required for high current, large puddle type applications. Refer to the DC-600, DC-1000, or DC-1500 operating manuals for further information.

**AC-1200 (or Discontinued AC-1000 or AC-750)**

- a. Set the current with the “Current Control” on the NA-4. For initial test welds with the AC-1200, set the control to “5”. Be sure to choose the correct current range stud on the AC-1200. The discontinued AC-1000 or AC-750 output is indicated on the dial on the front of the power source.
  - b. Set the voltage with the “Voltage Control” on the NA-4. For initial test welds, set the control to “6”. The power source OCV is fixed.
2. Unless previously instructed, set the “Inch Speed” for good arc striking as follows:
    - a. When “hot” starting, set the “Inch Speed” to one or two dial numbers lower than the setting on the “Voltage Control” on the front panel. This provides an inch speed slower than the welding feed speed usually recommended.
    - b. When “cold” starting, set the “Inch Speed” at about “2” for a slow inching speed to prevent jamming the electrode against the work before striking.
  3. If using a motor-generator type power source, set the “Voltage Range” switch on the power source to “High.” If using a motor-generator power source with the discontinued solid state remote field control installed, the OCV is controlled by the “Open Circuit Voltage” control on the inner panel of the NA-3. Set the “OCV Control” for good striking at about 3 to 8 volts higher than the welding voltage. To read OCVs under 50 volts on the NA-3 voltmeter, inch the electrode up from the work and press the “Start” button. Press the “Stop” button before the electrode reaches the work.
  4. If installed, set the “Start Controls” and “Crater Controls” on the inner panel. For initial test welds, set both “Time in Seconds” to “1” and the “Current” and “Voltage” controls to the same dial numbers (to produce about the same output) as the “Current Control” and “Voltage Control” on the front panel.
  5. The setting on the “Contactor and Electrode Back Up Time Delay” on the inner control panel is not generally critical to submerged arc welding. For initial test welds, set it to “5”.
  6. Straighten the first 6 in. (152.40 mm) of the electrode and push it through the wire straightener to the drive rolls. Press the “Inch Down” button and feed the electrode down through the nozzle. Adjust the wire straightener hand wheel. With contact nozzles installed, except for the K231 Contact Nozzle, adjust the hand wheel until the electrode is straight as it comes out of the nozzle. Do not *completely* straighten the wire when using the K231 Contact Nozzle because the nozzle relies on the small curvature of the electrode for proper electrical contact within the contact tip.
  7. Set the travel speed as specified by the procedures. With the wire speed “Travel” switch set to “Hand Travel,” the travel runs without welding, permitting accurate measurements of travel speed. When using a Lincoln Electric travel carriage, adjust the speed with the rheostat and the direction with the toggle switch on the carriage control panel.
  8. Mount and properly connect the work lead to the work or a suitable piece of scrap. Clip the end of the electrode to a sharp point.

## ⚠ WARNING

**When using an open arc process, it is necessary to use correct eye, head, and body protection.**

9. Make a test weld and adjust the wire feeder “Voltage Control” and “Current Control” until the meters indicate the output specified by the procedure.
10. Make several test welds and readjust the starting and stopping controls in the following order:
  - a. Set the “Inch Speed” control for optimum arc striking. If using long stickout techniques, see the IM278 operating manual on using the Linc-Fill extension.
  - b. If installed, adjust the “Start Controls” to set the welding procedures during the first 0 to 3 seconds of welding in order to provide the bead size, penetration, or other factors as needed for the application.
  - c. If installed, adjust the “Crater Controls” to set the welding procedures during the first 0 to 3 seconds after the “Stop” button is pressed in order to provide the bead size or to fill the crater as needed for the application.
  - d. Set the “Contactor and Electrode Back Up Time Delay” to provide the stopping characteristics needed.

## STARTING AND STOPPING SEQUENCES

### AVAILABLE STARTING SEQUENCES

The NA-3N utilizes “hot start” arc striking. The NA-3s and NA-4 can use either “hot start” or “cold start” arc striking without any rewiring.

#### Hot Starting

1. With the electrode not touching the work, press the “Start” button.

2. The electrically “hot” electrode inches down at the preset inching speed.
3. When the electrode touches the work, the arc strikes and the circuit automatically switches from inching to welding wire feed speed.

Use either the standard “on-the-fly” travel starting or rewire the controls for “standstill” travel starting as described in the Setting Travel Starting and Stopping section.

#### Cold Starting

Cold starting is recommended primarily for submerged arc welding with a constant current power source when the weld must start at a precise location. It can be used on DC-600 and DC-1500 power sources.

1. Inch the electrode down with the “Inch Down” button. When it touches the work, inching automatically stops and the flux valve opens (the switch on the flux hopper must be “On”).
2. Press the “Start” button to begin the weld.

#### Optional Start Controls PC Board

This starting sequence is recommended for applications in which penetration, bead size, and other characteristics must be carefully controlled at the start. It is required when using Linc-Fill long stickout procedures.

The starting sequence is as described in the “hot starting” procedure except that when the arc strikes, the machine welds at the current\* and voltage set by the start controls panel until the time set on the “Time in Seconds” control elapses. The circuit then automatically switches to the welding current and voltage. Actual settings depend on application requirements.

### SETTING TRAVEL STARTING AND STOPPING

When shipped, all models are connected so travel starts when the “Start” button is pressed and stops when the “Stop” button is pressed. Standard machines can be connected for a variety of starting and stopping sequences.

*\*With the NA-4 and discontinued AC-1000 or AC-750 combination, the current is not adjustable.*

NA-3 AND NA-4



### “On-the-Fly” Travel Starting

When shipped, all models are connected for “on-the fly” travel starting. The starting sequence is as follows:

1. With the electrode NOT touching the work, press the “Start” button. This starts both the wire feed and travel motors.
2. When the electrically “hot” electrode touches the work to start the arc, there is relative motion between the end of the electrode and the work. This “scratching” type contact helps assure consistent arc striking.

This sequence is recommended for most welding applications including:

1. Roundabouts and any other weld that ends at its starting point. A timer can also be installed to control the welding cycle.
2. Welds started on a run-out tab.
3. Any application for improved arc striking.

### “Standstill” Travel Starting

All models can be reconnected so the travel remains at a standstill until the arc starts.

“Standstill” travel starting is used when the electrode *must* be started at a precise location.

For consistent arc striking with “standstill” travel starting, always clip the end of the electrode to a sharp point before starting.

### Setting Stopping Sequences

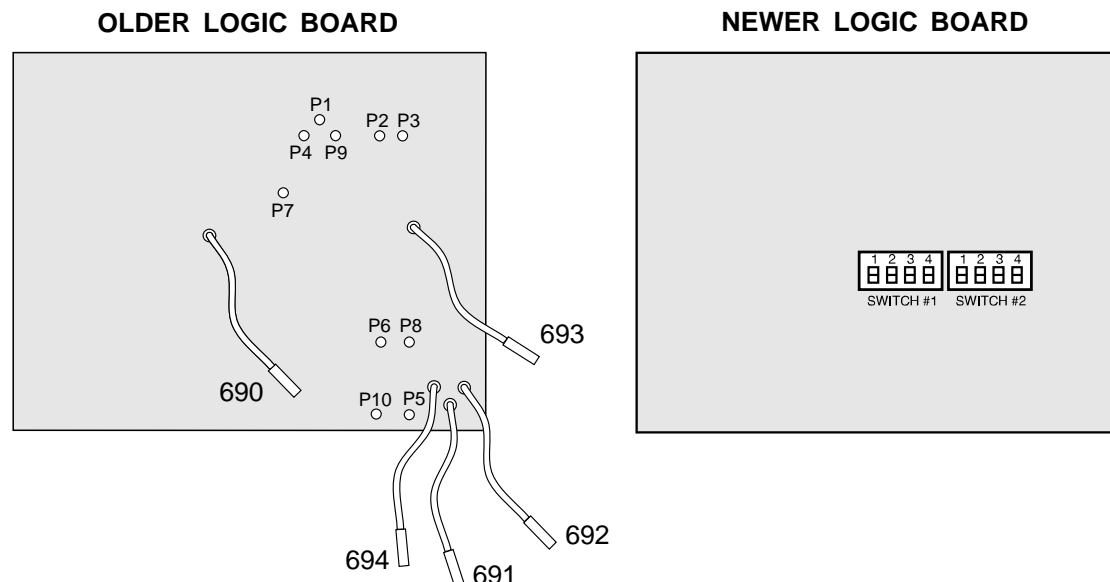
As shipped, travel stops when the “Stop” button is pressed, which produces a small crater area.

When the end of the weld overlaps the beginning, changing the stopping sequence to stop the travel later spreads the crater over a longer area.

### Changing the Travel Sequence

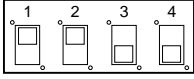
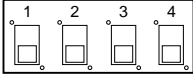
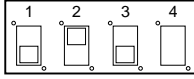
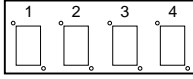
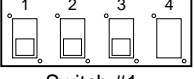
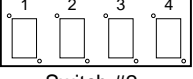
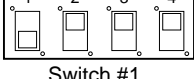
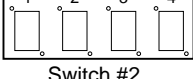
To change the travel sequence, turn the input AC power off at the power source, remove the screw holding the inner panel, and swing the panel open. Change the connections (older models) or the switch positions (newer models) on the logic board as shown in Figure B.8 and Table B.6.

**FIGURE B.8 – LOGIC BOARD TRAVEL SEQUENCE CONNECTIONS OR SWITCH POSITIONS.**



NA-3 AND NA-4

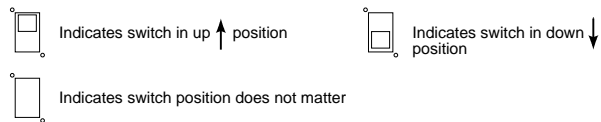
TABLE B.6 – TRAVEL SEQUENCE LEAD AND SWITCH POSITIONS.

Travel Starts	Travel Stops	Older Models	Newer Models*
With "Start" button	With "Stop" button	Lead #691 to pin #6 <sup>a</sup> Lead #692 to pin #5	 
With arc striking	With arc stopping	Lead #691 to pin #6 <sup>a</sup> Lead #692 to pin #7	 
With arc striking	With "Stop" button	Lead #691 to pin #5 Lead #692 to pin #7	 
With "Start" button	With end crater fill time <sup>b</sup>	Lead #691 to pin #8 Lead #692 to pin #9 Lead #694 to pin #10	 

(a) On machines below code 7432, connect to pin #8.

(b) With crater fill board installed.

**\*NOTE:**



### Setting the Arc Stopping Sequence

The primary consideration in setting the arc stopping sequence is to prevent the electrode from sticking in the puddle. This is easily done with the machine as shipped.

The standard stopping sequence is as follows:

1. Press the "Stop" button.
2. The wire feed motor stops and the "Contactor and Electrode Back Up Time Delay" starts.
3. The arc continues to burn the electrode back from the puddle until the time set on the "Contactor and

Electrode Back Up Feed Delay" elapses. This control should be set for a minimum burnback time that still prevents crater sticking.

When it is necessary to retract the electrode for easy fixture unloading or to assure restriking with Linc-Fill long stickout striking procedures, the standard machines can be reconnected so that, when the "Stop" button is pressed, the wire feed motor reverses to inch the electrode away from the crater. This can be done with or without burnback. The distance the electrode retracts depends primarily on the time set on the "Contact and Electrode Back Up Time Delay." The "Inch Speed" set for good arc striking also affects the distance the wire is retracted.

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**Changing the Stopping Sequence**

To change the stopping sequence, turn the AC power off at the power source, remove the screw holding the inner panel and swing the panel open. Change the connections (older models) or switch positions (newer models) on the logic board as follows in Table B.7.

the start as well as applications in which the ending bead size must be controlled or the crater must be filled.

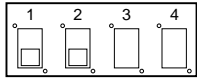
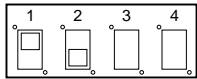
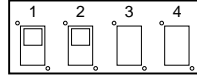
When the “Stop” button is pressed, the machine welds at the current\* and voltage set by the “Crater Controls” until the time set on the “Time in Seconds” control elapses. The circuit then automatically switches to the arc sequence described above.

**Optional Crater Controls PC Board**

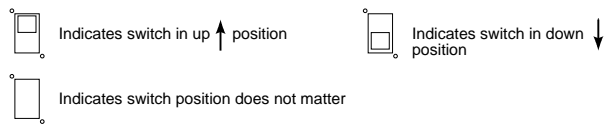
This option is recommended for roundabouts and any other welds where the end overlaps

*\*With the NA-4 and discontinued AC-1000 or AC-750 combination, the current is not adjustable.*

**TABLE B.7 – STOPPING SEQUENCE SWITCH POSITIONS.**

When “Stop” Button is Pressed	Older Models	Newer Models**
Feed motor stops and electrode burns back (standard)	Lead #693 to pin #3 Lead #690 to pin #4	 Switch #2
Feed motor inches up and electrode burns back	Lead #693 to pin #1 Lead #690 to pin #4	 Switch #2
Feed motor inches up and contactor opens (no burnback)	Lead #693 to pin #1 Lead #690 to pin #2	 Switch #2

**\*\*NOTE:**



THE POSITIONS OF SWITCH #1 DO NOT AFFECT THE STOPPING SEQUENCE.

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## GENERAL

This section contains a listing and short description of the accessories that are available with the NA-3 and NA-4 automatic welding systems.

**TABLE C.1 – NA-3 AND NA-4 AUTOMATIC WELDING SYSTEMS ACCESSORIES.**

<b>Product Number</b>	<b>Product Name</b>
K29	VERTICAL LIFT ADJUSTER
K58	MAGNETIC SEPARATOR
K96	HORIZONTAL ADJUSTER
K129	SUBMERGED ARC SMALL WIRE TWINARC
K148	CONTACT NOZZLE
K149	LINC-FILL LONG STICKOUT EXTENSION
K218	HORIZONTAL FILLET/LAP ATTACHMENT
K219	FLUX HOPPER KIT
K221	START CONTROLS PC BOARD
K223	SOLENOID KIT
K225	SUBMERGED ARC TWINARC KIT
K237	LINC-FILL STARTING RELAY
K238	HIGH FREQUENCY UNIT
K239	TWINARC KIT FOR INNERSHIELD ELECTRODES
K245	CRATER CONTROL BOARD
K263	DC ELECTRONIC VOLTMETER
K278	SPREADARC
K281	SOLID WIRE STRAIGHTENER FOR TINY TWINARC
K299	WIRE REEL ASSEMBLY
K310	FLUX SCREEN
K325	TC-3 TRAVEL CARRIAGE
K386	NARROW GAP, DEEP GROOVE NOZZLE
K391	HIGH CAPACITY SUBMERGED ARC NOZZLE
K405	AUTOMATIC INNERSHIELD NOZZLE

## LISTING OF ACCESSORIES

### K29 VERTICAL LIFT ADJUSTER

When mounted in the NA-3 or NA-4 head mounting system, the K29 Vertical Lift Adjuster provides quick hand crank adjustment of the vertical head position. It also has some horizontal adjustability as described in Sec. L3.2.3 of operator's manual IM278. Installation instructions are shipped with each K29 Vertical Lift Adjuster kit, are contained in the IM278 manual, and can be ordered as Sec. L2.2.11.

### K58 MAGNETIC SEPARATOR

Useful with any submerged arc equipment. The unit removes foreign magnetic particles from reused submerged arc welding flux. Operating instructions are included with the kit.

### K96 HORIZONTAL ADJUSTER

When mounted in the NA-3 or NA-4 head mounting system, the K96 Horizontal Adjuster provides quick hand crank adjustment of the horizontal head position. Installation instructions are shipped with each K96 Horizontal Adjuster kit, are contained in the IM278 manual, and can be ordered as Sec. L2.2.12.

### K129 SUBMERGED ARC SMALL WIRE TWINARC®

The Twinarc system provides for the feeding of two small solid wires through a single wire feeder. The Twinarc assembly includes a wire reel, reel brake, shaft and mounting bracket, drive roll, idle roll assembly, dual wire guides, and nozzle and contact tip or

contact tip holder. Instructions are shipped with each kit, are contained in the IM278 manual, and can be ordered as Sec. L2.5.3 K129.

### K148 CONTACT NOZZLE AND K149 LINC-FILL™ LONG STICKOUT EXTENSION

This Innershield and submerged arc nozzle is designed for 0.062 through 3/16 in. (1.57 through 4.76 mm) wire at high currents. When long stickout [2 to 5 (50.80 to 127.00 mm)] is required, the K149 Linc-Fill Long Stickout Extension is recommended along with the K237 Linc-Fill Starting Relay. Instructions are contained in the IM278 manual and can also be ordered as Sec. L2.2.7 for the IM278.

### K218 HORIZONTAL FILLET/LAP ATTACHMENT

This special contact assembly automatically guides the electrode when making submerged arc horizontal fillet and lap welds to ensure accurate bead placement without expensive fixtures and clamps. Installation, operating, and maintenance instructions are shipped with each kit, are contained in the IM278 manual, and can also be ordered as Sec. L2.5.4.

### K219 FLUX HOPPER KIT

This flux hopper, which has an electric flux valve, can be mounted on NA3-3N and NA3-3NF heads for submerged arc welding. Installation instructions are included with each kit. The operator and maintenance instructions are contained in the IM278 manual and can also be ordered as Sec. L2.7.7.

### **K221 START CONTROLS PC BOARD**

When this PC board is installed on the inner panel of the control box, the circuit adjusts starting current and voltage for an adjustable period of time, as needed, to control penetration, bead size, or other factors at the start of a weld. The K221 Start Controls PC Board must be used when using the K237 Linc-Fill Starting Relay. Installation instructions are shipped with each kit. The operating sequence is contained in the IM278 manual and can be ordered as Sec. L3.4.1.

### **K223 SOLENOID KIT**

The solenoid kit includes a valve to control water flow when using the cooling attachment on the K148 or K239 contact nozzle assembly. It opens when the start button is pressed and can be wired to close either when the stop button is pressed or when the arc goes out. Installation instructions are shipped with each kit.

### **K225 SUBMERGED ARC TWINARC KIT**

The Twinarc kit provides for the feeding of two 5/64, 3/32, or 1/8 in. (1.98, 2.38, or 3.18 mm) solid wires through a single wire feeder. The electrode wire must be the same size. The assembly includes a wire reel, insulated reel mounting bracket, wire straightener, dual wire guides, nozzle, and contact block. Installation, operating, and maintenance instructions are shipped with each kit, are contained in the IM278 manual, and can be ordered as Sec. L2.5.3 K225.

### **K237 LINC-FILL STARTING RELAY**

This relay improves starting characteristics when using the K149 Linc-Fill Long Stickout

Nozzle Extension assembly. The K221 Start Controls PC Board is required. The K237 Linc-Fill Starting Relay can be mounted on either the standard travel carriage or in a convenient location near the feeding head in accordance with the instructions shipped with each kit.

### **K238 HIGH FREQUENCY UNIT**

This unit supplies high frequency to the welding leads for more positive starts, which may be required for certain difficult starting applications. Factory-installed insulation is required. Instructions are shipped with each unit. Installation instructions are contained in the IM278 manual and can be ordered as Sec. L2.3.3.

### **K239 TWINARC KIT FOR INNERSHIELD® ELECTRODES**

This kit provides for welding with two Innershield electrodes. Two 3/32 in. (2.38 mm) flux-cored electrodes are fed through a single wire feeder. Both wires must be the same size. The K239 kit includes the nozzle equipped for water cooling, drive rolls, drive roll locating collar, idle roll assembly, ingoing and outgoing guide tubes, wire straightener, wire reel, and wire reel mounting shaft and insulation. Instructions are included in the kit, are contained in the IM278 manual, and can also be ordered as Sec. L2.5.3 K239.

### **K245 CRATER CONTROL BOARD**

When this PC board is installed on the inner panel of the control box, the circuit adjusts the current and voltage for an adjustable period of time to control bead size or fill craters at the end of the weld. Installation instructions are shipped with each kit. The operating sequence is contained in the IM278 manual and can be ordered as Sec. L3.4.2.

### **K263 DC ELECTRONIC VOLTMETER**

This meter replaces the standard analog-type voltmeter shipped with the NA-3 when precise monitoring of voltage is required. It includes red lights to show high or low voltage and a green light to show when the arc voltage matches the desired voltage preset on the dial. Installation instructions are shipped with the kit.

### **K278 SPREADARC™**

The primary application for this accessory is for hardfacing buildup using a Twinarc nozzle. The combination "Spreadarc-Twinarc" covers large areas quickly with smooth beads of minimum admixture with the base metal. Flux cored electrode, open arc, and submerged arc procedures can be used. Instructions are shipped with the kit, are contained in the IM278 manual, and can also be ordered as Sec. L2.5.6.

### **K281 SOLID WIRE STRAIGHTENER FOR TINY TWINARC**

This wire straightener will straighten 0.045 through 3/32 in. (1.14 through 2.38 mm) wire diameters. It is recommended for welding procedures requiring long stickout and where wire position accuracy is essential. Instructions are shipped with the kit, are contained in the IM278 manual, and can be ordered as Sec. L2.5.5.

### **K299 WIRE REEL ASSEMBLY**

This kit contains a wire reel for 50 to 60 lb (22.7 to 27.2 kg) coils and wire reel mounting and brake assembly. Mounting instructions are included with the kit. The K299HF is the same as the K299 but has high frequency mounting insulation.

### **K310 FLUX SCREEN**

Useful for any submerged arc equipment. It removes foreign magnetic particles from reused submerged arc welding flux. Operating instructions are included in the kit.

### **K325 TC-3 TRAVEL CARRIAGE**

The K325 Travel Carriage carries the control box and wire drive head, in either direction on a beam of suitable length and mechanical specifications. Two models are available: Standard and High Capacity.

### **K386 NARROW GAP, DEEP GROOVE NOZZLE**

This 750 Amp, water-cooled, automatic nozzle is designed for narrow gap, deep groove, submerged arc welding procedures using a single 3/32 in. (2.38 mm) diameter LC-72 or 3/32 in. (2.38 mm) solid electrode fed by a standard NA-4 head. Instructions are included with the kit.

### **K391 HIGH CAPACITY SUBMERGED ARC NOZZLE**

This nozzle is an extremely rugged assembly designed to meet the high amperage, duty cycle, and heat input requirements of heavy automatic submerged arc welding. The nozzle is rated for welding with a 1/8 to 7/32 in. (3.18 to 5.56 mm) diameter solid wire electrode.

### **K405 AUTOMATIC INNERSHIELD NOZZLE**

This nozzle offers a more slender and low cost alternative to the K148 Contact Nozzle. K405 nozzle assemblies are available for welding with 0.062 through 0.120 in. (1.57 through 3.05 mm) diameter Innershield electrodes and are rated for procedures up to 600 Amps at 80% duty cycle.

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## CONTROL BOX

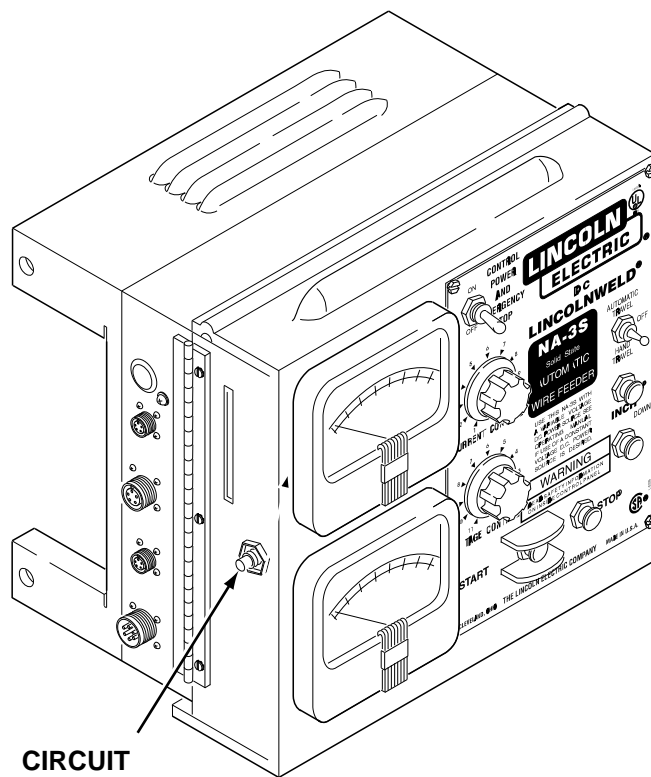
### GENERAL

Inspect the control box every 3 months. If needed, blow dirt out using *low* pressure air. No further maintenance should be required.

### CIRCUIT PROTECTION

The circuit breaker mounted on the left side of the control box protects the control circuit from short circuit conditions and from severe wire feed overloads. If it is open, determine and correct the cause for the overload. To reset the circuit breaker, push in the red button shown in Figure D.1.

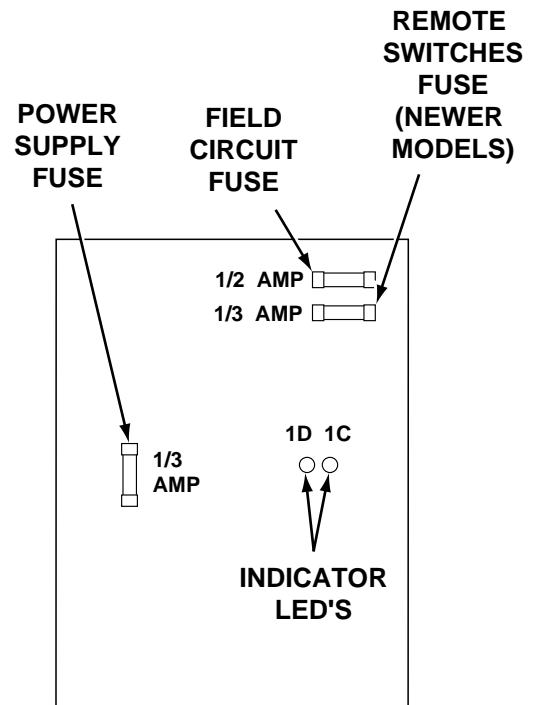
FIGURE D.1 – CIRCUIT BREAKER RESET BUTTON.



CIRCUIT BREAKER RESET BUTTON

The field circuit fuse, shown in Figure D.2, is a 1/2 amp, slo-blo fuse. It is located on the control PC board and protects the field circuit. The following conditions could cause this field circuit fuse to open:

FIGURE D.2 – CONTROL BOARD FUSE AND LED LOCATIONS.

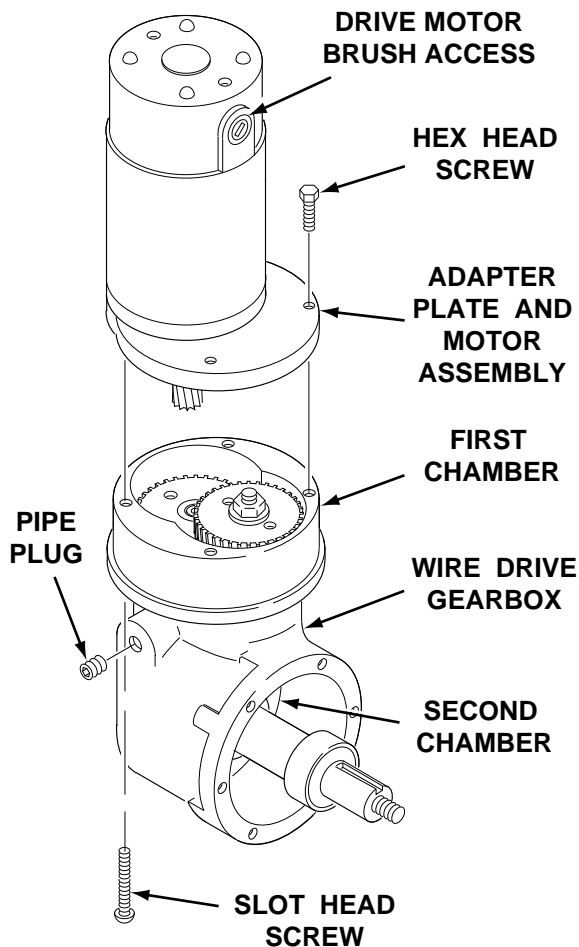


1. Complete or partial wire feed motor field short. Normal field resistance is approximately 700 ohms.
2. A welding procedure with a lot of electrode-to-puddle shorting. This rapid arc shorting may cause the field voltage polarity to change frequently and blow the fuse. (Indicator LEDs 1C and 1D will *both* flicker when welding.)
3. Too low of an impedance when idle across terminals #21 to #67. Condition may be caused by the following:
  - a. Something external to the NA controls and power source causing a partial short across terminals #21 to #67.
  - b. Use of a non-Lincoln Electric power source.
  - c. A defective Lincoln Electric power source.
4. A defective control board.

The control PC board is located behind the inner panel door.

The PC board power supply fuse, shown in Figure D.2, is a 3/10 Amp fuse. It is located on the control PC board and is designed to protect the DC-regulated power supply from overload. This fuse will blow if a PC board component fails and overloads the 24 VDC power supply. A second 3/10 Amp fuse is added to the control board on newer models to protect the board against faulted remote switches.

**FIGURE D.3 – WIRE DRIVE MOTOR GEAR BOX.**



## WELDING HEAD

### WIRE DRIVE GEAR BOX

Once a year, recoat all gear teeth with a non-fluid molydisulfide grease such as Non-Fluid Oil Corporation's A-29 Special/MS Lubricant. For access to the gears in the first chamber, remove the adapter plate and motor assembly as shown in Figure D.3. To lubricate the gears in the second chamber, remove one of the pipe plugs and feed grease until it comes in contact with the bevel gear teeth. Then, rotate the output shaft by hand until all teeth are lubricated.

### WIRE DRIVE MOTOR

Periodically inspect the wire drive motor brushes, Figure D.3. Replace the brushes as needed.



TABLE D.1 – WIRE FEED GEAR RATIOS.

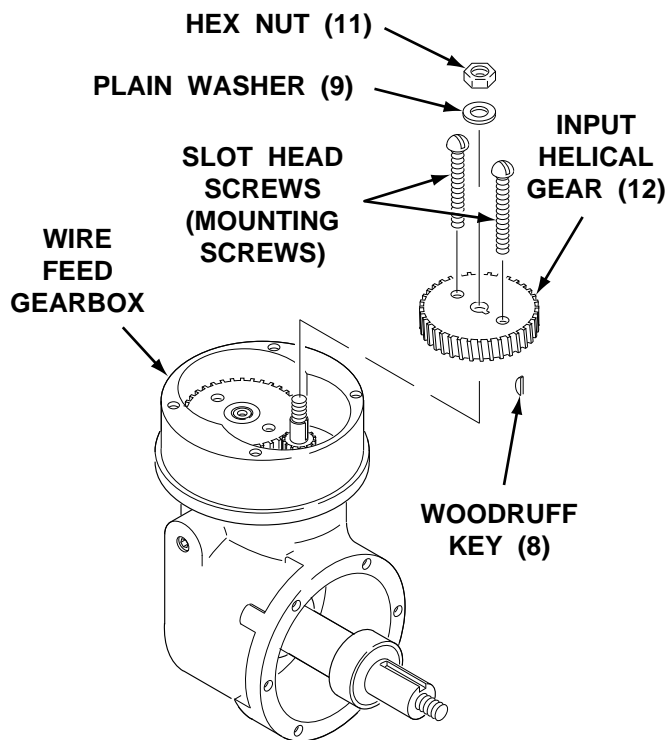
Gear Ratio	Feed Speed* Range in./min (m/min)	Max Wire Size in. (mm)	
		Cored Wire	Solid Wire
57:1	40-650 (12-198)	0.120 (3.0)	3/32 (2.4)
95:1	24-400 (7.5-122)	5/32 (4.0)	1/8 (3.2)
142:1	17-268 (5.2-82)		7/32 (5.6)

\*Using constant wire feed speed (CV mode).

## CHANGING WIRE FEED GEAR RATIOS

Refer to Table D.1. Three gear ratios are available: 57:1, 95:1, and 142:1. To change the gear ratio, replace the motor pinion and the first reduction gear per the following instructions (Refer to Figure D.4).

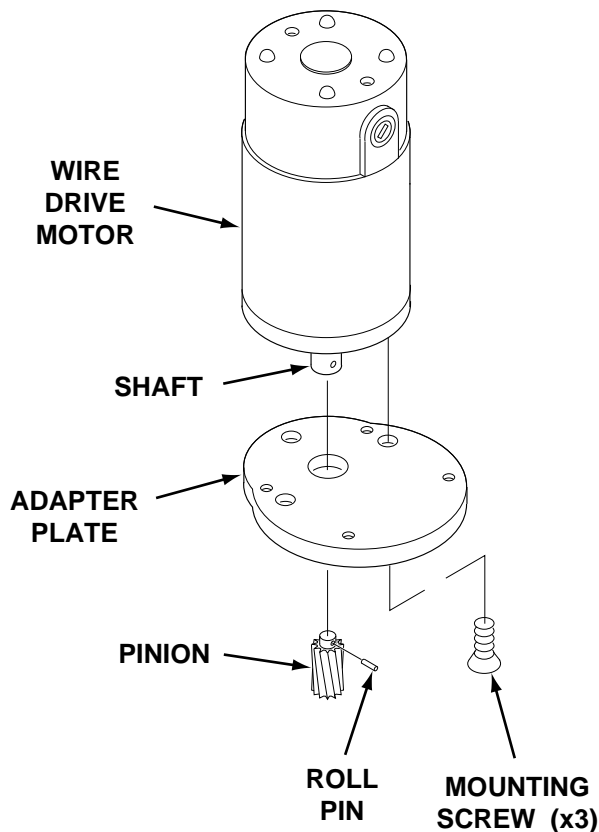
FIGURE D.4 – CHANGING THE WIRE FEED GEAR RATIO.



**NOTE:** Any item numbers in parentheses on Figure D.4 refer to item numbers in the task description breakdown.

1. Remove the four screws that mount the adapter plate and motor assembly to the gear box. Remove the adapter plate and motor assembly from the gear box.
2. Take the two long screws removed in step 1 and screw one into each of the tapped holes located on the face of fiber input helical gear (12). Insert the screws through the full thickness of the gear, and using a screwdriver wedged between the screws to prevent rotation, remove hex nut (11) that holds the gear to the shaft. Remove plain washer (9).
3. Pull the gear from the shaft using the screws as a pulling device.
4. Be certain woodruff key (8) is properly located on the shaft. Screw the adapter plate and motor assembly mounting screws into the new fiber input helical gear from the stenciled side and place the gear on the shaft. Replace plain washer (9), tighten the hex nut (1), and remove the adapter plate and motor assembly mounting screws from the gear.

**FIGURE D.5 – DRIVE MOTOR PINION  
GEAR REMOVAL.**



5. After noting the relation of the adapter plate with the motor leads, remove the adapter plate from the wire drive motor. See Figure D.5. Support the pinion properly and, with the proper size punch, drive the roll pin that holds the pinion out of the shaft. Pull the pinion off. Install the new pinion and replace the roll pin. Replace the adapter plate in its original location.
6. Cover the teeth of the motor pinion and the input gear with a non-fluid molydisulfide grease such as Non-Fluid Corporation's A-29 Special/MS Lubricant. This grease can be scooped from the cavity of the gear case.
7. Reassemble the motor on the gear box; make sure the gears mesh properly and the adapter plate locating bead is in its cavity. Replace and tighten the four screws removed in step 1.

## WIRE DRIVE MECHANISM

Drive mechanisms for three wire size ranges are available: 0.035 through 0.052 in. (0.9 through 1.3 mm), 1/16 through 3/32 in. (1.6 through 2.4 mm), and 3/32 through 7/32 in. (2.4 through 5.6 mm). If changing to wire sizes outside this range, change the drive rolls and the incoming and outgoing guide tubes. Also change the gear ratio as necessary.

The electrode is driven by gripping between the grooved drive rolls and spring-loaded idle roll. Replace the drive rolls when they become worn. The drive rolls for 1/16 in. (1.6 mm) and larger diameter electrodes have two sets of teeth so they can be reversed once before they must be replaced.

## WIRE STRAIGHTENERS

### SOLID ELECTRODE

Periodically inspect the slide bushing at the top of the straightener and the ingoing wire guide at the bottom of the straightener for signs of wire milling. If necessary, rotate the guide to present an unworn surface. To reverse the slide bushing for a fresh wear surface, remove the cross adjustment screw and turn the bushing over.

### FLUX-CORED ELECTRODE

Severe wear at the "V" groove in the curved arm of the straightener can result in wire wander at the arc. Periodically check the groove and replace the arm when badly worn. Also replace the ingoing guide at the top of the straightener if it shows signs of wire milling.

## OPTIONAL FEATURES

### CONTACT ASSEMBLIES

A dirty or rusty electrode and excessively high currents cause rapid wear of the contact tips. The nozzle contact tip must be replaced when it no longer provides accurate wire location or good electrical contact. See Sec. L2.2.6, Sec. L2.2.7, or Sec. L2.5.3 of the IM278 manual for specific instructions to replace contact tips and to perform maintenance on other various contact assemblies.

### WIRE REEL MOUNTING FOR 50 OR 60 LB (22.7 OR 27.2 KG) COILS

Periodically coat the reel shaft with a thin layer of grease. No maintenance of the two-position adjustable brake is needed except to replace the shoe assembly if it wears through.

### TRAVEL CARRIAGE

Periodically oil the following parts with a light machine oil:

1. Clutch handle bearings
2. Travel gear box pivot pins

3. Pins and bearings on the mechanism that raise and lower the welding head.

Every 3 months, clean and inspect the control box. No further maintenance should be required.

### VERTICAL LIFT ADJUSTER

Every month, add a few drops of SAE-140 oil or equivalent to the oil cup on the back of the vertical lift housing. Every year, replace the grease in the top section gear cavity with a medium grease. If the unit is disassembled for cleaning, apply a layer of medium grease to the screw threads of the head lift tube and head lift screw. Apply a thin layer of grease to the outside diameter of the head lift tube and the inside diameter of the long hole in the head lift body. Slide the head lift tube into the head lift body and screw in the head lift screw. Fill the upper section gear cavity one-half full of grease. Be sure the needle bearings are packed in grease.

### HORIZONTAL ADJUSTER

Twice a year, apply a thin coat of grease to all sliding surfaces. Every year, replace the grease in the gear cavity with a medium grease.

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## GENERAL DESCRIPTION

The NA-3 and NA-4 are fully automatic wire feed control units. The NA-3 can be used with either a constant current or a constant voltage DC power source. The NA-4 is to be used only with a constant current AC power source.

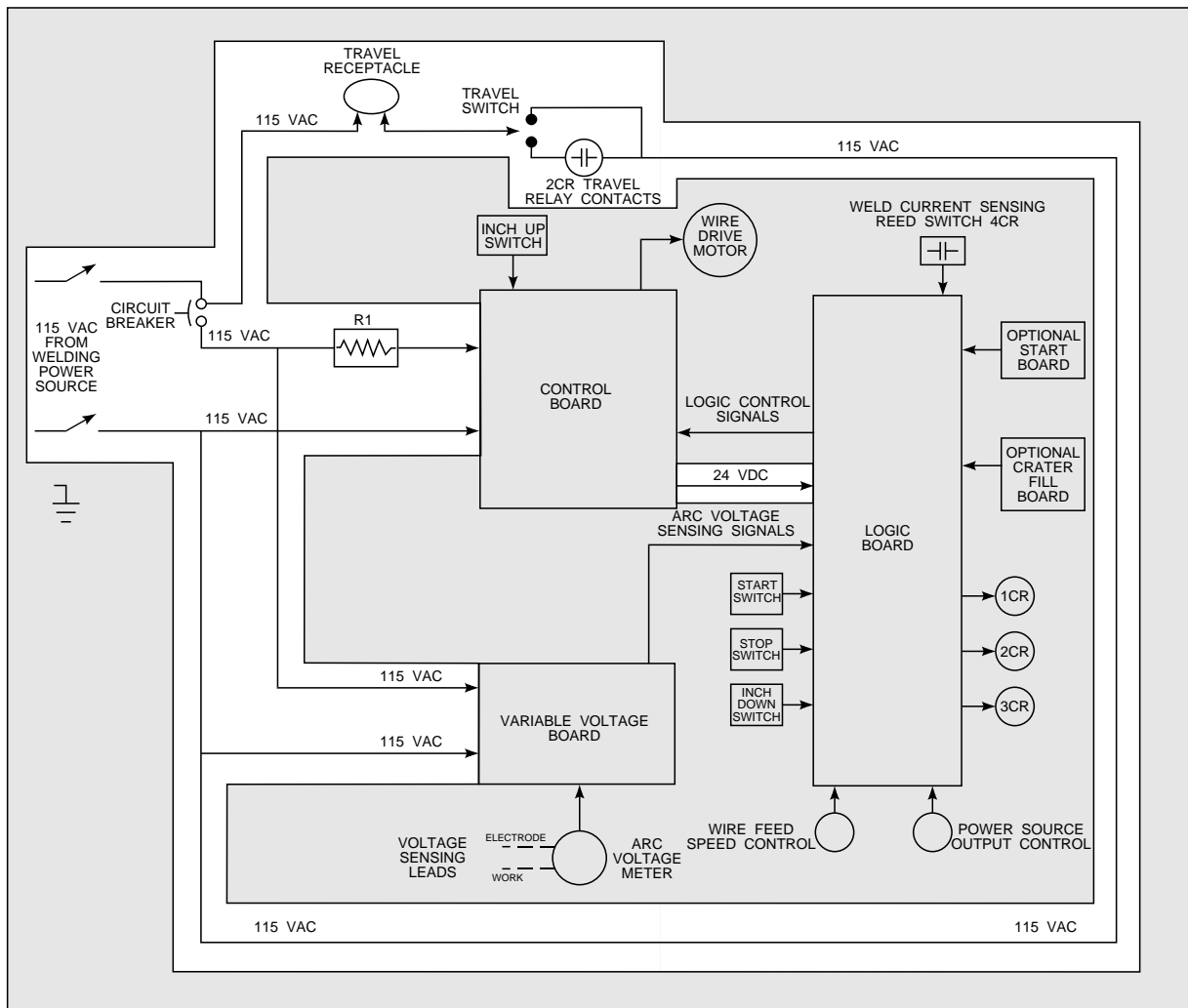
These control boxes are designed to be used with a variety of wire feeder heads, contact nozzles, and welding processes.

## INPUT POWER CIRCUITS

The NA-3 and NA-4 control units are supplied with 115 VAC power usually from the welding power source. The 115 VAC power is connected to the control box circuitry through the on/off "Control Power" switch and a 5 Amp circuit breaker. The input power is then applied to the variable voltage board and through resistor R1 to the control board. The 115 VAC is rectified and regulated by the control board, which supplies 24 VDC to the logic board. The 115 VAC is also coupled to the travel receptacle through the travel relay (2CR) and the travel switch. See Figure E.1.

The 115 VAC input power is also coupled to the travel receptacle through the travel relay (2CR) and the travel switch. See Figure E.1.

FIGURE E.1 – INPUT POWER CIRCUIT.



NA-3 AND NA-4

**LINCOLN**  
ELECTRIC

## CONTROL AND LOGIC BOARDS

In general, the control board houses two SCR-controlled 115 VDC power supplies that power the field and armature circuits in the wire drive motor. Also incorporated in the control board is a regulated 24 VDC control circuit power supply.

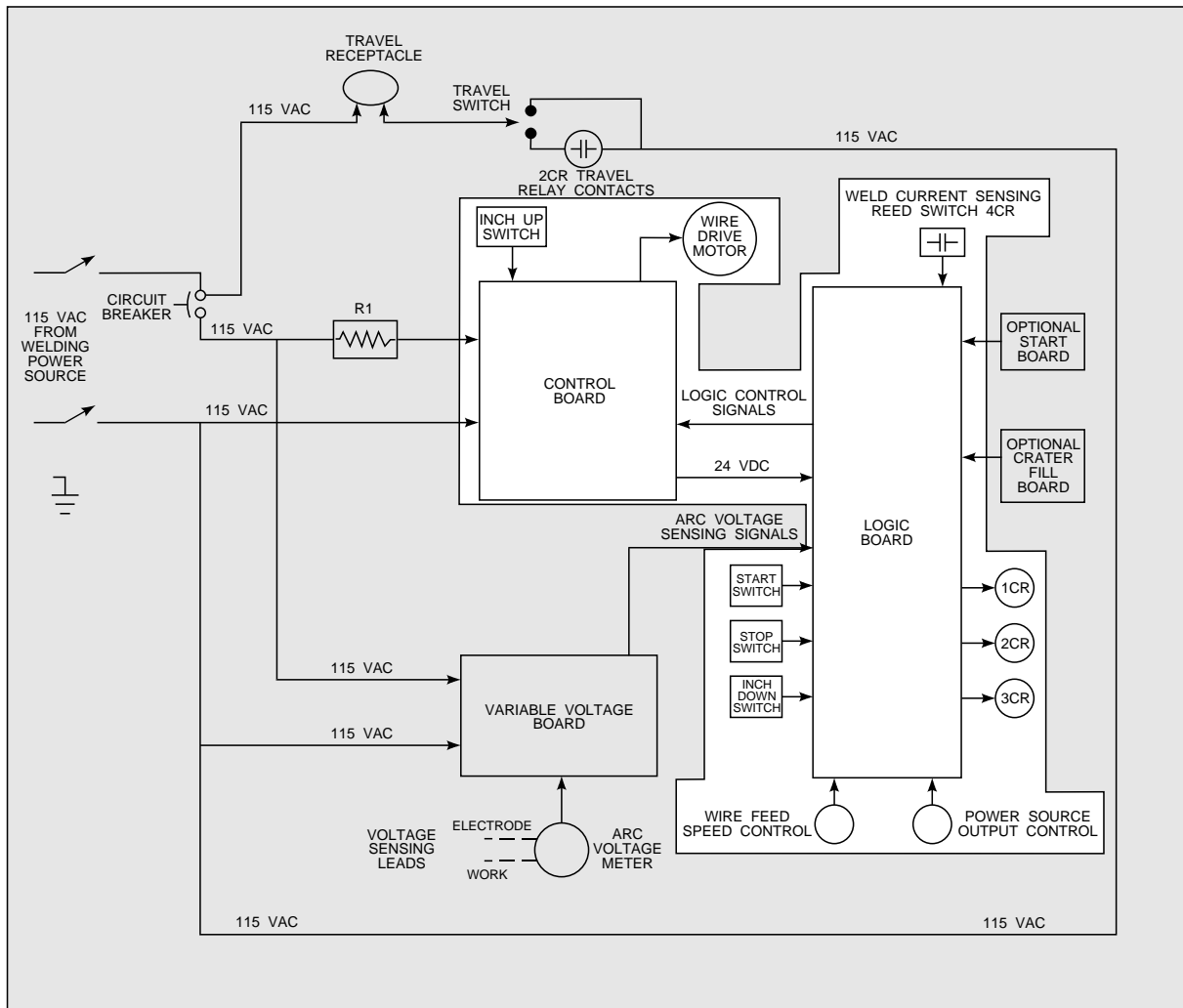
The logic board incorporates a 15 VDC regulated supply, which is derived from the 24 VDC received from the control board. The logic board interprets and processes the signals received from the various switches and controls.

Upon receiving commands from the user-operated switches or potentiometers, the logic board sends the appropriate signal to the control board, driving the wire feed motor at the correct speed and in the proper

direction. When the start signal is received by the logic board, the power source contact relay (3CR) is energized along with the travel relay (2CR) and the flux relay (1CR). When the weld current closes the reed switch (4CR), the logic board directs the control board to change the wire drive motor from the preset inch speed to the welding feed speed set by the wire speed control potentiometer. Also, output control of the power source is transferred from the strike setting to the weld output setting. The "Inch Down" and "Stop" switches signal the logic board, sending the appropriate command to the control board, which sets the wire drive motor to the correct mode.

The "Inch Up" switch, which is connected directly to the control board, dictates that the wire drive motor reverse direction, backing the electrode wire away from the work piece. See Figure E.2.

FIGURE E.2 – CONTROL AND LOGIC BOARD.



NA-3 AND NA-4

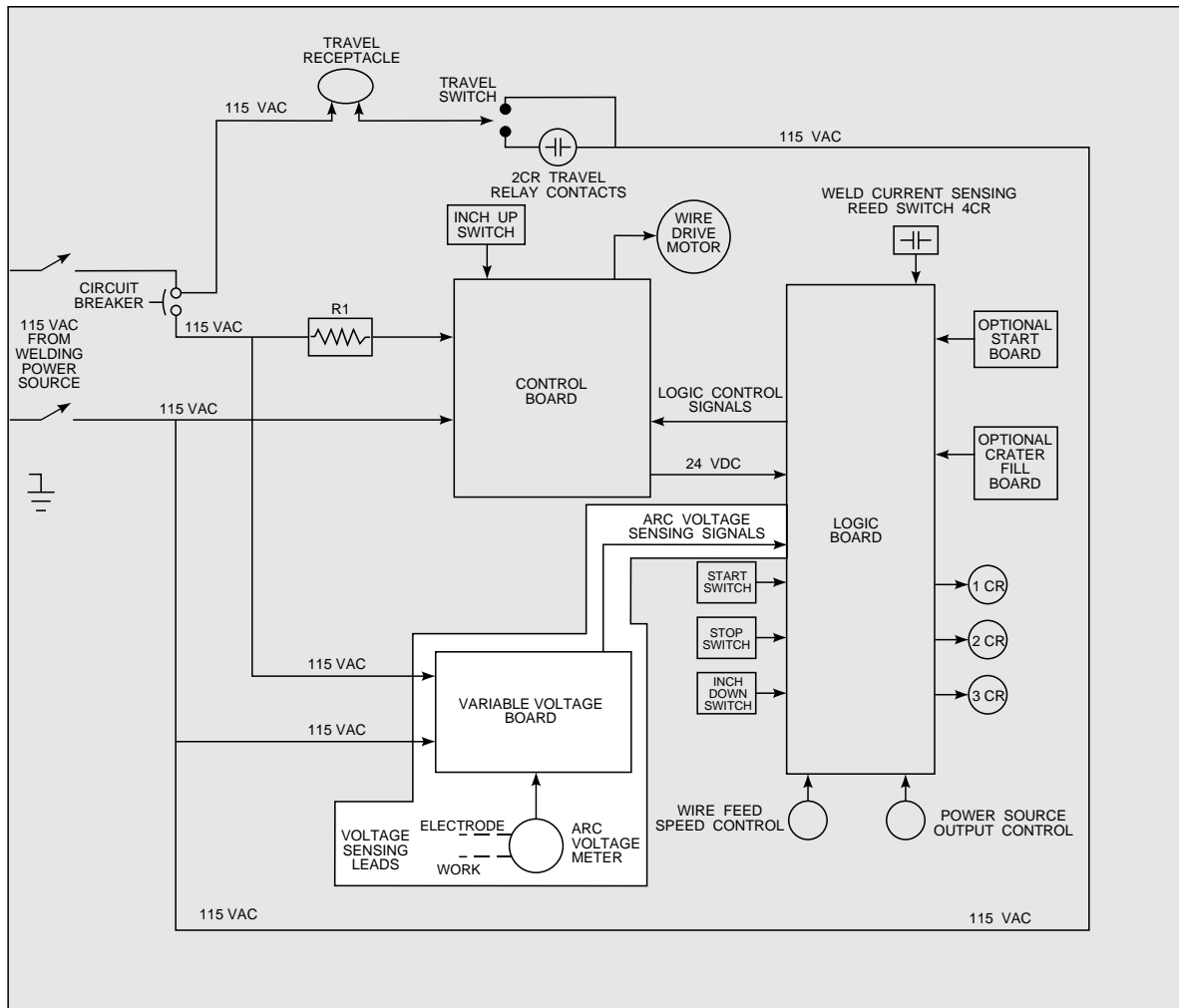
## VARIABLE VOLTAGE BOARD

Arc voltage is monitored by the voltmeter and variable voltage board. When the NA-3 and NA-4 are being operated in the constant current mode, the variable voltage board is essential in the control of the wire feed speed. As the arc length changes, the arc voltage will also change. The variable voltage board recognizes this change and signals the logic board to either increase or decrease the wire feed speed depending on

the arc length. This function is necessary to maintain a constant electrode arc length and a stable, high quality weld.

The variable voltage board also generates a low DC voltage that is applied to the electrode during the inch down mode. When the electrode makes contact with the work piece, this low voltage is “loaded down”, signaling the control circuitry to stop the wire feed motor. This feature allows the operator to utilize “work touch sensing”. See Figure E.3.

FIGURE E.3 – VARIABLE VOLTAGE BOARD.

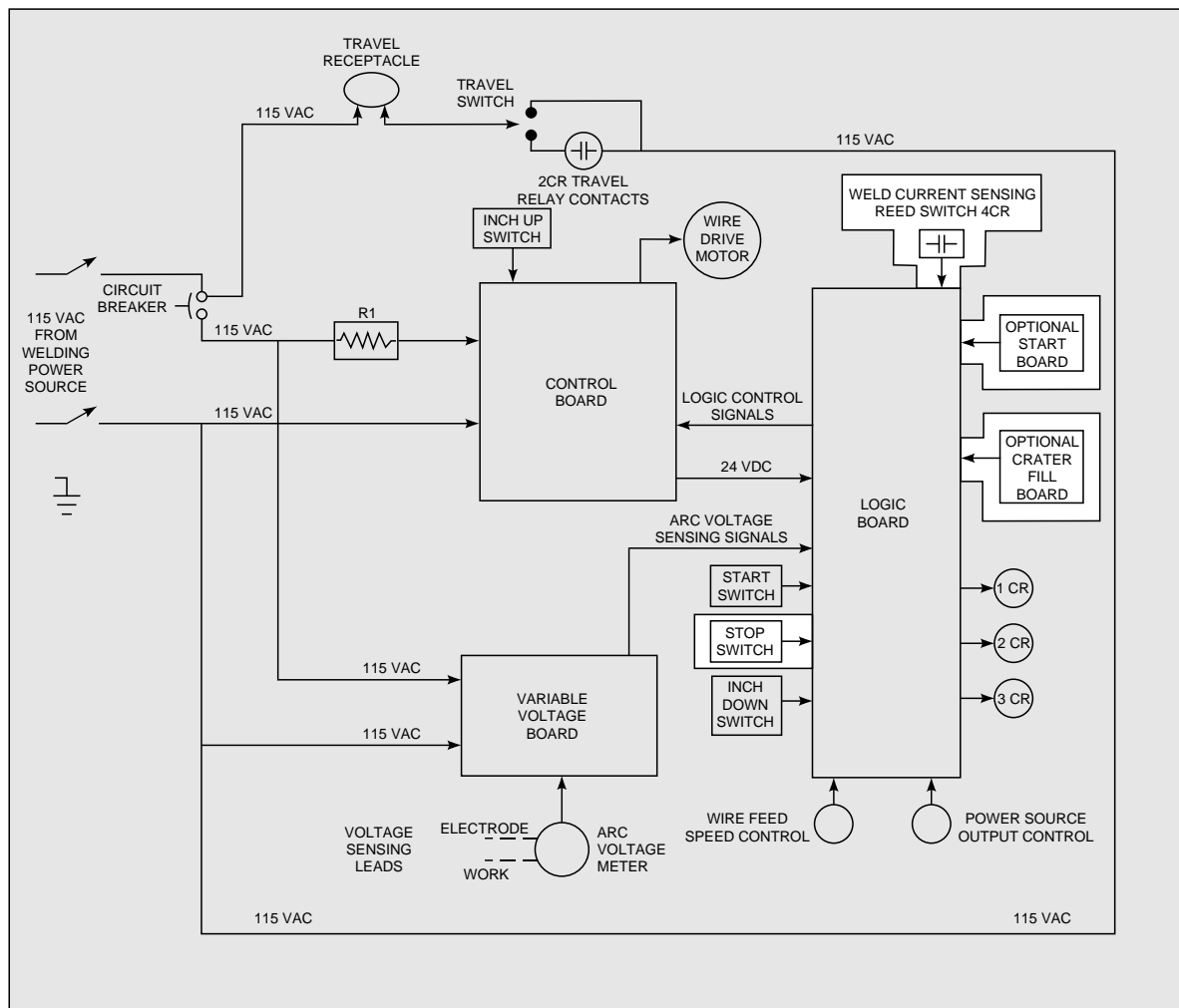


## OPTIONAL START AND CRATER FILL BOARDS

When installed, the optional start board as shown in Figure E.4 dictates to the logic board the starting weld current and arc voltage. This condition can be operator set for a predetermined period of time. These parameters can be set either higher or lower than those of the welding procedure to control penetration, bead shape, or other factors at the start of the weld. The start circuit becomes active when the weld current sensing reed switch (4CR) is closed.

The crater fill board, as shown in Figure E.4, is used by the operator to adjust the finishing and voltage either higher or lower than that of the welding procedure for an adjustable period of time. This circuit becomes active when the "Stop" switch is pressed. The crater fill board then dictates to the logic board the appropriate signals. This feature is helpful in controlling bead shape and filling craters at the end of a weld.

FIGURE E.4 – OPTIONAL START AND CRATER FILL BOARDS.





## SCR OPERATION

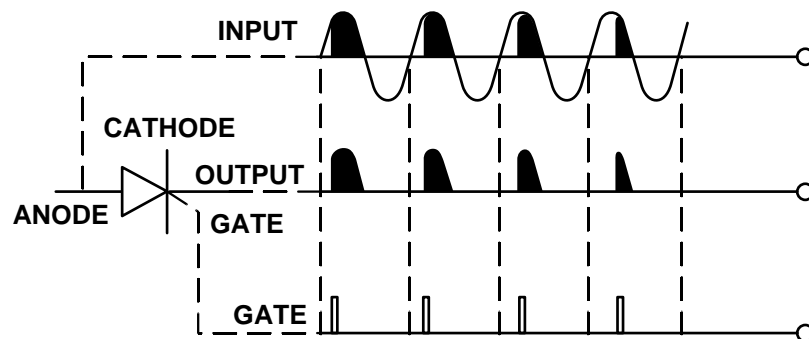
Since the wire speed of the NA-3 and NA-4 is controlled by silicon-controlled rectifier (SCR) circuitry, a basic understanding of how an SCR functions is important. An SCR is a three-terminal semiconductor device used to control currents to a load. An SCR acts very much like a switch. When a gate signal is applied to the SCR, it is turned on and there is current flow from anode to cathode. In the on state, the SCR acts like a closed switch. When the SCR is turned off, there is no current flow. Thus, the device acts like an open switch. As the name suggests, the SCR is a rectifier, so it passes current only during positive half cycles of the AC supply. The positive half cycle is the portion of the sine wave in which the anode of the SCR is more positive than the cathode.

When an AC supply is applied to the SCR, the device spends a certain portion of the AC cycle time in the on state and the

remainder of the time in the off state. The amount of time spent in the on state is controlled by the gate.

An SCR is fired by a short burst of current into the gate. This gate pulse must be more positive than the cathode voltage. Since there is a standard pin junction between the gate and cathode, the voltage between these terminals must be slightly greater than 0.6 VDC. Once the SCR has fired, it is not necessary to continue the flow of the gate current. As long as the current continues to flow from anode to cathode, the SCR will remain on. When the anode to cathode current drops below a minimum value, called the holding current, the SCR will shut off. This normally occurs as the AC supply voltage passes through zero into the negative portion of the sine wave. If the SCR is turned on early in the positive half cycle, the conduction time is longer, resulting in greater SCR output. If the gate firing time is later in the cycle, the conduction time is less, resulting in lower SCR output. See Figure E.5.

FIGURE E.5 – SILICON-CONTROLLED RECTIFIER OPERATION.



**NOTE:** AS THE GATE PULSE IS APPLIED LATER IN THE CYCLE, THE SCR OUTPUT IS DECREASED.

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### ⚠ WARNING



#### **ELECTRIC SHOCK can kill.**

- Never work on the inside of the machine without turning off the input power. You can receive a life threatening electrical shock if you fail to do this. Only qualified technicians should perform installation, maintenance, and troubleshooting work on the machine.
-

## How To Use Troubleshooting Guide

### ⚠ WARNING

Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three step procedure below.

**Step 1. LOCATE PROBLEM (SYMPTOM).** Look under the column labeled "PROBLEM (SYMPTOMS)". This column describes possible symptoms the machinery may exhibit. Find the listing that best describes the symptom the machine is exhibiting. Symptoms are grouped according to function problems, travel function problems, and flux/solenoid valve function problems.

**Step 2. PERFORM EXTERNAL TESTS.** The second column, labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)", lists the obvious external possibilities that may contribute to the machine symptom. Perform these tasks/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

**Step 3. PERFORM COMPONENT TESTS.** The last column, labeled "RECOMMENDED COURSE OF ACTION", lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify if the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All the necessary test specifications and repair procedures are described in detail following the troubleshooting guide. All electrical test points, terminal strips, junctions, etc., can be found on the electrical wiring diagrams and schematics in the Electrical Diagram Section.

## PC BOARD TROUBLESHOOTING PROCEDURES

**⚠ WARNING****ELECTRIC SHOCK  
can kill.**

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

**⚠ CAUTION**

Sometimes machine failures appear due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and repairing PC boards, please use the following procedure:

1. Determine, to the best of your technical ability, if the PC board is the most likely component causing the failure symptom.
2. Check loose connections at the PC board to make sure the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

**PC board can be  
damaged by static elec-  
tricity.**

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 megohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded part of the equipment frame. Keep touching the frame to prevent static buildup. Be sure not to touch any electrically live parts at the same time.

- Tools that come in contact with the PC board must either be conductive, anti-static, or static-dissipative.

- Remove the PC board from the static-shielding bag and place it directly into the equipment. Do not set the PC board on or near paper, plastic, or cloth that could have a static charge. If the PC board can not be installed immediately, put it back in the static-shielding bag.

- If the PC board uses protective shorting jumpers, do not remove them until installation is complete.

- If you return a PC board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow for proper analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement of the PC board.

**NOTE:** It is desirable to have a spare (known good) PC board available for PC board troubleshooting.

**NOTE:** Allow the machine to heat up so all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
  - a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
  - b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.

6. Always report that this procedure was followed when the warranty reports are to be submitted.

**NOTE:** Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM", will help avoid denial of legitimate PC board warranty claims.

NA-3 AND NA-4

**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS</b>		
<p>The wire feeds whenever “Control Power” switch (S1) is turned “ON”.</p>	<ol style="list-style-type: none"> <li>1. Check the “Start” switch (S5). Make certain it is not stuck closed.</li> <li>2. Check the “Inch Down” switch (S4). Make certain it is not stuck closed.</li> <li>3. Check the “Inch Up” switch (S3). Make certain it is not stuck closed.</li> </ol>	<ol style="list-style-type: none"> <li>1. If light 1B on the control board is NOT “On”, the control board may be faulty. Replace.</li> <li>2. If light 1B is “On” and 1A, 2B, and 2J are “Off”, check jumper lead #693 on logic board for proper connection. If connection is correct, the logic board may be faulty.</li> <li>3. If lights 1B and 1A are both “On”, then remove lead #593 from the “Inch Up” switch (S3). If the problem is resolved, the lead or the switch is faulty. If light 1A stays on when lead #593 is removed from the “Inch Up” switch, the control board may be faulty. Replace.</li> <li>4. If lights 1B on the control board and 2B on the logic board are both “On”, then remove lead #581 from the “Start” switch (S5). If the problem is resolved, the lead or the switch is faulty. If light 2B stays on when lead #581 is removed from the “Start” switch, the logic board may be faulty. Replace.</li> <li>5. If lights 1B on the control board and 2J on the logic board are both “On”, then remove lead #592 from the “Inch Down” switch (S4). If the problem is resolved, the lead or the switch is faulty. If light 2J stays on when lead #592 is removed from the “Inch Down” switch, the logic board may be faulty. Replace.</li> </ol>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
<p>The wire does not feed. No inch up or down. Wire does NOT feed when "Start" switch is activated.</p>	<ol style="list-style-type: none"> <li>1. Make sure the "Control Power" switch (S1) is on and functioning properly.</li> <li>2. Check the circuit breaker located on the front cover. If tripped, reset. If circuit breaker repeatedly trips, consult appropriate PROBLEMS (SYMPTOMS.)</li> <li>3. Check field fuse F1 (1/2 Amp) on the control board.</li> <li>4. Open the front cover and inner panel to check if any of the LEDs on the printed circuit boards are lit. If no LEDs are lit, this is an indication that the NA-3/NA-4 is NOT receiving any power. Check fuse F2 (2/10 Amp but may be a 3/10 Amp fuse) on the control board. Also make sure 115 VAC is being received on leads #531 and #532. See wiring diagram. If fuse F2 repeatedly fails, control board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check lights 1C and 1D on the control board. If both lights are lit at the same time, replace the control board.</li> <li>2. Press the "Inch Up" switch. Lights 1D and 1E on the control board should be lit. If they are NOT lit, the control board may be faulty.</li> <li>3. If light 1D and 1E are lit and the wire drive motor does not turn, check the continuity of leads #539, #541, #626, and #627 from the control board to the wire drive motor.</li> <li>4. Perform the <b>Wire Feed Drive Motor Test</b>.</li> </ol>

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NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
<p>The wire will not feed and circuit breaker trips when "Inch" or "Start" switches are pressed.</p>	<ol style="list-style-type: none"> <li>1. Reset the circuit breaker and observe lights 1C and 1D on the control board with the unit at idle (not attempting to feed wire). Light 1C should be "Off" and light 1D should be "On". If both lights are "Off" remove power and check field fuse F101 (1/2 Amp).</li> <li>2. If both lights are "On", the control board may be faulty.</li> <li>3. The following conditions may cause fuse F101 to fail. <ul style="list-style-type: none"> <li>-Faulty wire drive motor</li> <li>-Incorrect welding procedure.</li> <li>-A low impedance across the arc voltage sensing leads #21 and #67.</li> <li>-A defective control board.</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>1. If when at idle light 1D is "On" and light 1C is "Off", then perform the <b>Wire Feed Drive Motor Test</b>.</li> </ol>
<p>The wire will not feed when "Start" switch is pressed. There is not a voltage indicated on the NA-3/NA-4 voltmeter. Wire does inch up and down properly.</p>	<ol style="list-style-type: none"> <li>1. If light 2B is on when the "Start" switch is pressed, the logic board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. While pressing the "Start" switch, observe light 2B. It should be lit. If not, the "Start" switch (S5) or associated wires may be faulty. See wiring diagram.</li> </ol>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
<p>The wire will NOT inch down but does inch up properly. When the "Start" switch is pressed, the wire feeds down properly.</p> <p><b>NOTE:</b> When using DC-400, CV-400, and Pulse Power 500 power sources, diode kits must be installed if auto stop circuit is required. If auto stop circuit is not required, move jumper on variable voltage board to pin "L". See wiring diagram.</p>	<ol style="list-style-type: none"> <li>1. While pressing the "Inch Down" switch, observe light 2J. It should be lit. If not, the "Inch Down" switch (S4) or associated wires may be faulty. See wiring diagram.</li> <li>2. If the NA-3 is in the constant voltage (CV) mode and light 2J does light, the logic board may be faulty.</li> <li>3. If troubleshooting the NA-4, the variable voltage board may be faulty. Make sure the switch is in the "VV" position and the jumper wire is connected to pin "L".</li> </ol>	<ol style="list-style-type: none"> <li>1. If the NA-3/NA-4 is in the variable voltage (VV) mode and a variable voltage board is installed, disconnect lead #21 from the terminal strip. Turn on input power and while pressing the "Inch Down" switch, observe light 3A. If light 3A does NOT light, the variable voltage board may be faulty. Replace board and reconnect lead #21.</li> </ol> <p>If light 3A does light, with lead #21 disconnected, the resistance across leads #21 and #67 is too low. The resistance must be above 500 ohms. The low resistance could be caused by the following:</p> <ul style="list-style-type: none"> <li>-A lead or object external to the power source or NA-3/NA-4 causing a low resistance between leads #21 and #67.</li> <li>-A non-Lincoln Electric power source not designed with the required impedance.</li> <li>-A defective power source.</li> </ul>
<p>The wire will NOT inch down but inches up properly. When the "Start" switch is pressed, the wire does not feed.</p>	<ol style="list-style-type: none"> <li>1. Press the "Inch Down" switch and observe light 1B on the control board. If light 1B is lit and the motor does not activate, the control board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. If light 1B does NOT light when the "Inch Down" switch is pressed, measure the DC voltage from lead #586 to lead #539 while pressing the "Inch Down" switch. Normal voltage is 12 to 15 VDC.</li> </ol> <ul style="list-style-type: none"> <li>-If normal voltage is indicated, the control board may be faulty.</li> <li>-If normal voltage is not present, the logic board may be faulty.</li> </ul>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4





**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
<p>The wire will not inch down but inches up properly. When the "Start" switch is pressed, the wire feeds up instead of down.</p>	<ol style="list-style-type: none"> <li>1. Check the connections between the power source and NA-3/NA-4 for loose or incorrect connections.</li> <li>2. Check lead #21 for continuity (zero ohms) to "work".</li> <li>3. Check lead #67 for continuity (zero ohms) to electrode.</li> <li>4. If while pressing the "Inch Down" switch light 3A does light, also check light 2E on the logic board. <ul style="list-style-type: none"> <li>-If lights 3A and 2E are both lit, the control board may be faulty.</li> <li>-If light 3A is lit but light 2E is NOT lit, the logic board may be faulty.</li> </ul> </li> </ol>	<ol style="list-style-type: none"> <li>1. While pressing the "Inch Down" switch, observe light 3A on the variable voltage board. <ul style="list-style-type: none"> <li>-If light 3A is NOT lit, check leads #21 and #67 for continuity to the variable voltage board. See wiring diagram.</li> </ul> </li> </ol>
<p>When attempting to "cold start", the wire does not stop feeding when it touches the work piece.</p>	<ol style="list-style-type: none"> <li>1. Make certain a variable voltage board is installed and connected correctly.</li> <li>2. The jumper on the variable voltage board must be connected to pin "H". <p><b>NOTE:</b> Older variable voltage boards do not have pins "H" and "L". These older boards must be switched to the "VV" position to utilize the cold starting feature.</p> </li> <li>3. Check lead #21 for continuity (zero ohms) to "work". See wiring diagram.</li> <li>4. Check lead #67 for continuity (zero ohms) to electrode. See wiring diagram.</li> </ol>	<ol style="list-style-type: none"> <li>1. Locate lead #21 on the terminal strip and temporarily disconnect it from the terminal strip. Insulate the terminal on this lead. Jumper lead #21 to terminal #67 at the voltmeter. Press the "Inch Down" switch. If wire feeds, check light 3A. If light 3A is "On", the variable voltage board may be faulty. If light 3A is "Off", the logic board may be faulty.</li> </ol> <p>Reconnect lead #21 to the terminal strip.</p>

### ⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
The wire will not inch up but inches down properly.	<ol style="list-style-type: none"> <li>1. With the NA-3/NA-4 at idle (not feeding wire), observe light 1D on the control board. The light should be lit. If light 1D is NOT lit, the control board may be faulty.</li> <li>2. While pressing the "Inch Up" switch, observe light 1A on the control board. If light 1A does NOT light, check the "Inch Up" switch and associated leads #593 and #539. See wiring diagram. If light 1A is lit, the control board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <i>Wire Feed Drive Motor Test</i>.</li> </ol>
The wire feeds up with either inch switch.	<ol style="list-style-type: none"> <li>1. While pressing the "Inch Down" switch, observe light 2E on the logic board. If light 2E does NOT light, the logic board may be faulty.</li> </ol> <p>If light 2E does light, the control board may be faulty.</p>	<ol style="list-style-type: none"> <li>1. Check the wiring to the "Inch Down" switch. See wiring diagram.</li> <li>2. Check the wiring between the logic board and the control board. See wiring diagram.</li> </ol>
The wire feeds down with either inch switch.	<ol style="list-style-type: none"> <li>1. With the NA-3/NA-4 at idle (not feeding wire), observe light 2E on the logic board. It should be "Off". If light 2E is "On", the logic board may be faulty.</li> </ol> <p>If light 2E is "Off", the control board may be faulty.</p>	<ol style="list-style-type: none"> <li>1. Check the wiring to the "Inch Up" switch. See wiring diagram.</li> <li>2. Check the wiring between the logic board and the control board. See wiring diagram.</li> </ol>

### ⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
The wire feeds at full speed during the inch mode (only).	<ol style="list-style-type: none"> <li>1. With the unit at idle, check light 2D on the logic board. If the light is NOT lit, the logic board may be faulty.</li> <li>2. If light 2D is lit, the current sensing reed switch (4CR) on the NA-3 may be faulty or stuck closed. In the NA-4, the current sensing PC board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the wiring between the logic board and the control board. See wiring diagram.</li> <li>2. Perform the <b>Wire Feed Drive Motor Test</b>.</li> </ol>
The wire feeds at full speed in both inch and weld modes.	<ol style="list-style-type: none"> <li>1. If the optional start and crater boards are NOT installed, check the NA-3/NA-4 at idle (not feeding wire). Observe light 2A on the logic board. If light 2A is lit, the control board may be faulty.  If light 2A is not lit, the logic board may be faulty.</li> <li>2. If the optional start and crater boards ARE installed, set the current controls to minimum. Check the wire feed speed in the start and/or crater modes. If the wire feeds at minimum, replace the logic board. If not, replace the control board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b>Wire Feed Drive Motor Test</b>.</li> </ol>
The wire has limited or erratic speed control in one or more modes.	<ol style="list-style-type: none"> <li>1. Make sure the "CV-VV" switch is in the "CV" mode. If the problem is solved, the variable voltage board may be faulty.</li> <li>2. If the problem is in the start mode only, replace the start board (if used).</li> <li>3. If the problem is in the crater mode only, replace the crater board (if used).</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b>Wire Feed Drive Motor Test</b>.</li> <li>2. Check the wire feed speed control (R3) for resistance and smooth operation. Normal resistance is 5000 ohms.</li> <li>3. The logic board may be faulty.</li> <li>4. The control board may be faulty.</li> </ol>

### ⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
<p>The wire feeds up instead of down when the "Start" switch is pressed. There is no voltage reading on NA-3/NA-4 voltmeter. The wire inches up and down properly.</p>	<ol style="list-style-type: none"> <li>1. Check for proper connection of electrode leads and control cable leads from power source to NA-3/NA-4.</li> <li>2. On Lincoln Electric power sources, put a jumper from leads #2 to #4 on the terminal strip. This activates the output from the power source. Test for voltage at the output terminals of the power source. If no voltage is indicated, the power source is faulty.</li> <li>3. If voltage is present at the power source output terminals, it should also be present at the NA-3/NA-4 voltmeter. If not, check leads #21 and #67 for breaks or faulty connections.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check lead #21 for continuity (zero ohms) to "work".</li> <li>2. Check lead #67 for continuity (zero ohms) to electrode.</li> <li>3. Check lead #690 on the logic board for proper connection. See wiring diagram.</li> <li>4. Check leads #2 and #4 for loose or faulty connections between relay 1CR and the control cable receptacle.</li> <li>5. Remove electrode from drive rolls and press the "Start" switch. Observe light 2K on the logic board. It should be lit. If light 2K does NOT light when the "Start" switch is pressed, remove power to unit. Remove lead #682 from relay 3CR. Check the resistance of the coil from that terminal on the relay to lead #510. Normal resistance is approximately 10,000 ohms. See wiring diagram.</li> <li>6. If the relay coil resistance is correct, the logic board may be faulty.</li> <li>7. If light 2K does light, make sure relay 3CR contacts are making electrical contact.</li> </ol>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
No control of power source output from NA-3/NA-4. Power source does have output.	<ol style="list-style-type: none"> <li>1. Check control cable leads for proper connection to power source.</li> <li>2. Make sure the Lincoln Electric power source is in the remote control mode.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the continuity of leads #75, #76, and #77 in the control cable.</li> <li>2. Check the resistance and operation of the open circuit voltage control rheostat (R223). See operating schematic. Normal resistance is 10,000 ohms.</li> <li>3. Check the resistance and operation of the control rheostat (R2).</li> <li>4. The optional start board may be faulty (if used).</li> </ol>
The circuit breaker trips while the NA-3/NA-4 is at idle (not feeding wire).	<ol style="list-style-type: none"> <li>1. Remove the input power and isolate the problem by unplugging the printed circuit boards one at a time (control, logic, and variable voltage boards) checking to see if the circuit breaker trips when power is reapplied. Replace the board that causes the breaker to trip.</li> </ol>	<ol style="list-style-type: none"> <li>1. If the circuit breaker continues to trip with all of the circuit boards unplugged, the problem is not in a printed circuit board. Check the wiring harness for "shorted" or grounded leads.</li> <li>2. The circuit breaker may be faulty. Check or replace.</li> </ol>
The circuit breaker trips while feeding wire.	<ol style="list-style-type: none"> <li>1. Check for possible excessive loading on the drive motor. Check for bent or dirty electrode, milling guide tubes, or a clogged nozzle.</li> </ol>	<ol style="list-style-type: none"> <li>1. Set the "Inch Speed" approximately the same as the weld speed. While inching down, check the motor armature current in lead #539. This current should not exceed 2 Amps DC. If the armature current is high and there is no evidence of excessive loading on the wire feed motor, perform the <b>Wire Feed Drive Motor Test</b>.</li> <li>2. The circuit breaker may be faulty. Check or replace.</li> </ol>

### ⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
The power source output contactor does NOT “drop out”. The power source output terminals are always electrically hot.	<ol style="list-style-type: none"> <li>1. With the NA-3/NA-4 at idle (not feeding wire), observe light 2K on the logic board. It should NOT be “On”. If light 2K is “On”, the logic board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. If light 2K is NOT lit (with the NA-3/NA-4 at idle), locate and remove lead #2 on relay 3CR. If the power source output contactor drops out, relay 3CR may be faulty.</li> <li>2. If the power source contactor stays “On” (output terminals electrically hot) with lead #2 removed from relay 3CR, the problem is in the control cable or the power source.</li> </ol>
The welding and travel do not stop when the “Stop” switch is pressed.	<ol style="list-style-type: none"> <li>1. While pressing the “Stop” switch, observe light 2C. If light 2C is “On”, the logic board may be faulty.</li> <li>2. If installed, the crater board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. If light 2C is NOT lit (while pressing the “Stop” switch), check the “Stop” switch (S6) and associated leads. See wiring diagram.</li> </ol>
There is no control of voltage and current in the weld mode only.	<ol style="list-style-type: none"> <li>1. If a start board is installed, remove and replace with jumper plug. If problem is resolved, the start board may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove the input power and place a jumper wire from lead #528 to lead #539 on the terminal strip. Reapply input power, and with the “Start” switch pressed, light 2D should be lit bright. If it is not, check continuity of lead #528 from terminal strip to logic board.</li> <li>2. With the start board removed and the jumper plug installed, light 2L on the logic board should also be lit when the “Start” switch is pressed. If both lights are lit, the reed switch of the NA-3 or the current sensor PC board of the NA-4 may be faulty.</li> <li>3. The logic board may be faulty. Replace.</li> </ol>

### ⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS (Continued)</b>		
The welding does not stop when the "Stop" switch is pressed.	1. If a crater board is installed, remove and replace with the jumper plug. If the problem is resolved, the crater board may be faulty.	1. While pressing the "Stop" switch, observe light 2C on the logic board. If light 2C is lit, the logic board may be faulty.  2. If light 2C does not light when the "Stop" switch is pressed, the switch or associated leads may be faulty. See wiring diagram.
The burnback time cannot be set properly.	1. The logic board may be faulty.	1. Replace the logic board.

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>TRAVEL FUNCTION PROBLEMS</b>		
<p>The travel circuit will not function in either "Automatic Travel" or "Hand Travel" mode of operation.</p>	<ol style="list-style-type: none"> <li>1. Make sure the travel unit is connected to the control box properly.</li> <li>2. The travel unit may be defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the "Travel" switch for proper operation. See wiring diagram.</li> <li>2. Check the travel connector and associated wiring. See wiring diagram.</li> </ol>
<p>The travel circuit will not operate with the "Travel" switch in the "Hand Travel" position. The travel circuit operates properly when the "Travel" switch is in the "Automatic Travel" position.</p>	<ol style="list-style-type: none"> <li>1. The "Travel" switch may be faulty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the "Travel" switch and associated wires for loose or faulty connections. See wiring diagram.</li> </ol>
<p>The travel circuit runs continuously when the "Travel" switch is set to the "Automatic Travel" mode.</p>	<ol style="list-style-type: none"> <li>1. Make sure the jumper leads or DIP switches on the logic board are connected properly for the automatic travel desired. See wiring diagram.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check light 2H on the logic board. It should be "Off" when automatic travel is NOT called for. If the light is "Off", and the travel circuit is running, relay 2CR may be faulty. Replace.</li> <li>2. If light 2H is "On" and automatic travel should not be active, the logic board may be faulty. Replace.</li> </ol>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4





**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>TRAVEL FUNCTION PROBLEMS (Continued)</b>		
<p>The travel circuit will not operate with the "Travel" switch in the "Automatic Travel" position. Works properly in the "Hand Travel" position.</p>	<ol style="list-style-type: none"> <li>1. Check to make sure the jumper leads on the logic board are connected properly for the automatic travel desired. See wiring diagram.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check light 2H on the logic board when the automatic travel should be active. The light should be lit.</li> <li>2. If light 2H is NOT lit, check the coil resistance of relay 2CR. Normal coil resistance is 10,000 ohms. If the coil resistance is not correct, relay 2CR may be faulty.</li> <li>3. If light 2H is NOT lit and the coil resistance of relay 2CR is normal, check wires #589 and #510 between the relay and the logic board. If the wiring is good, the logic board may be faulty.</li> <li>4. If light 2H on the logic board IS lit, remove the input power and also remove leads #532 and #625 from the contacts on relay 2CR. Apply power and, with light 2H lit, check the resistance of relay 2CR contacts. The resistance should be zero or very low. If the contact resistance is high, the relay is faulty. Replace.</li> <li>5. The "Travel" switch or associated wiring may be faulty. Check and replace if necessary.</li> </ol>

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FLUX (SOLENOID) VALVE FUNCTIONAL PROBLEMS</b>		
The flux valve does not open.	1. Make sure the flux hopper switch is in the "ON" position.	1. When the flux valve or solenoid should normally be OPEN, check light 2G on the logic board. Light 2G should be lit.  2. If light 2G IS lit, check the AC voltage between leads #31 and #87, on the terminal strip. Normal voltage is 102 to 130 VAC. If the voltage is normal, the flux valve/solenoid or associated leads may be faulty.  If the correct AC voltage is not at leads #31 to #87, relay 1CR or associated wiring may be faulty. See wiring diagram.  3. If light 2G is NOT lit, check relay 1CR coil resistance. Normal resistance is 10,000 ohms. If the coil resistance is not correct, the relay may be faulty. Replace.  4. If the coil resistance is normal, the logic board may be faulty. Replace.

**⚠ CAUTION**

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4



**Troubleshooting Guide** — See the Wiring Diagrams Section for location of specified components and when troubleshooting specific circuits.

Observe Safety Guidelines detailed at the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FLUX (SOLENOID) VALVE FUNCTIONAL PROBLEMS</b>		
<p>The flux/solenoid valve remains open continuously. The flux/gas will not shut off.</p>	<p>1. When the flux/solenoid valve should normally be "Off", check light 2G on the logic board. If the light is "On", the logic board may be faulty. Replace.</p>	<p>1. If light 2G is operating normally, relay 1CR may be faulty. Replace. 2. The flux/solenoid valve may be stuck open. Check and replace if necessary.</p>
<p>The flux/solenoid valve does not open when the "Start" switch is pressed. The flux/solenoid valve works correctly during "Inch Down" when the electrode touches the work. The wire feeds normally.</p>	<p>1. The logic board may be faulty.</p>	<p>1. Replace the logic board.</p>
<p>When "cold" inching, the electrode stops feeding but the flux/solenoid does not operate when the electrode touches the work piece. The flux/solenoid operates correctly when the "Start" switch is pressed.</p>	<p>1. The logic board may be faulty.</p>	<p>1. Replace the logic board.</p>

**⚠ CAUTION**

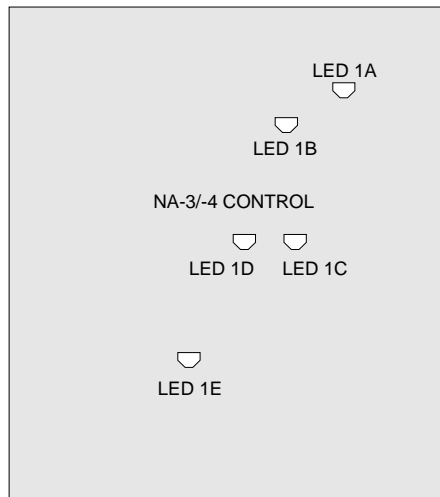
If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

NA-3 AND NA-4

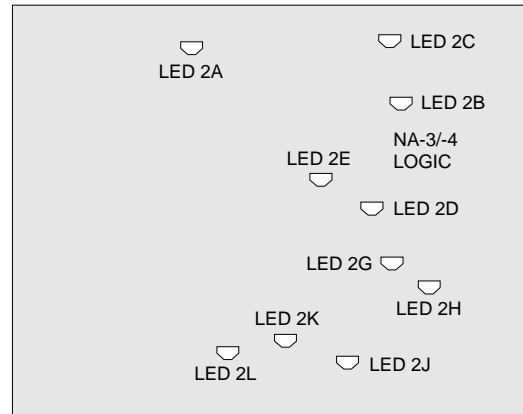
**PC BOARD LED DEFINITIONS**

LED Number	Functions Indicated By PC Board LEDs
1A	"Inch Up" switch pressed
1B	Logic signal for motor to run
1C	Down field voltage applied
1D	Up field voltage applied
1E	Armature voltage applied
2A	"OCV Control" and "Inch Speed" control operative
2B	"Start" switch pressed
2C	"Stop" switch pressed
2D	Weld current present
2E	Signal to apply down field voltage
2G	Signal to operate flux or water solenoid
2H	Signal to energize travel circuit
2J	"Inch Down" switch pressed
2K	Signal to operate power source contactor
2L	Weld "Current" control and weld "Voltage" control operative
3A	Electrode voltage (output from VV board)
3B	Electrode voltage (input to VV board)
4A	"Start Current" and "Start Voltage" controls operative
4B	Start cycle ready
4A	"Crater Current" and "Crater Voltage" controls operative
4B	Crater fill cycle ready

**FIGURE F.1 – CONTROL BOARD LED LOCATIONS.**



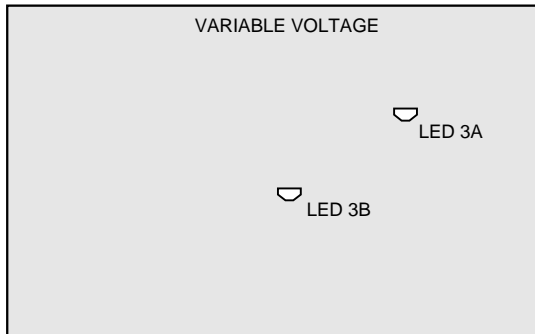
**FIGURE F.2 – LOGIC BOARD LED LOCATIONS.**



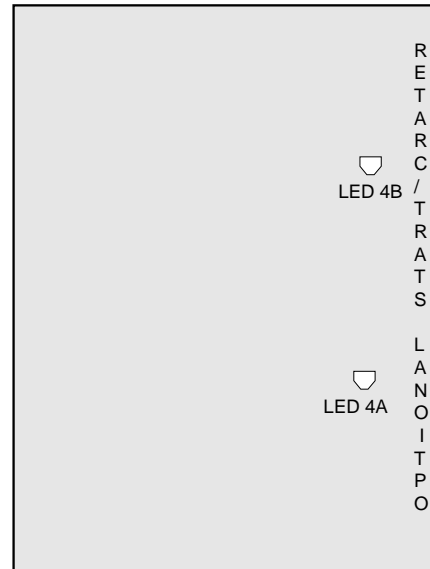
**PC BOARD LED DEFINITIONS**

*(continued)*

**FIGURE F.3 – VARIABLE VOLTAGE BOARD LED LOCATIONS.**



**FIGURE F.4 – START/CRATER BOARD LED LOCATIONS.**



Indicator Lights		Conditions for Light "On" (NA-3 Set for CV)						
Light No.	Location	Idle Mode	"Inch Up" Switch Pressed	"Inch Down" Switch Pressed	"Start" Switch Pressed	"Stop" Switch Pressed	Burnback Mode	Weld Arc Established
1A	Ctrl. Bd.		ON					
1B	Ctrl. Bd.			ON	ON			ON
1C	Ctrl. Bd.			ON	ON			ON
1D	Ctrl. Bd.	ON	ON			ON	ON	
1E	Ctrl. Bd.		ON	ON	ON			ON
2A	Logic Bd.	ON	ON	ON	ON		ON#	
2B	Logic Bd.				ON**			ON**
2C	Logic Bd.					ON**	ON**	
2D	Logic Bd.	ON*	ON*	ON*	ON	ON	ON*	ON
2E	Logic Bd.			ON	ON			ON
2G	Logic Bd.				ON			ON
2H	Logic Bd.				ON			
2J	Logic Bd.			ON				
2K	Logic Bd.				ON		ON	ON
2L	Logic Bd.				ON			ON
3A	Volt Bd.			ON	ON		ON	ON
3B	Volt Bd.			ON	ON		ON	ON

ON\* indicates light is dim.      ON# is dependent on code number.      ON\*\* only while switch is pressed.

## WIRE FEED DRIVE MOTOR TEST

### **WARNING**

Service and repair should only be performed by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric service department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353(WELD).

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### TEST DESCRIPTION

This test will determine if the wire drive motor is able to function when supplied with the correct voltages.

### MATERIALS NEEDED

Variable DC voltage supply 0 to 90 VDC  
Isolated DC voltage supply 120 VDC  
Volt/ohmmeter

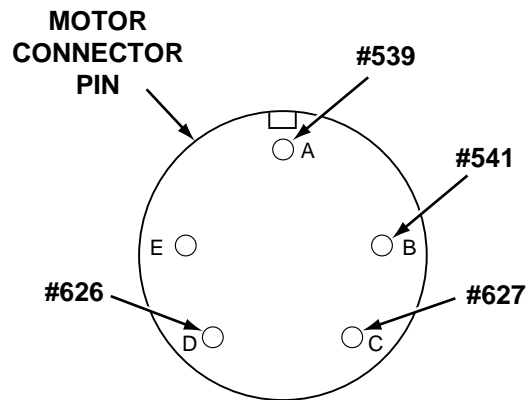
## WIRE FEED DRIVE MOTOR TEST

(continued)

### TEST PROCEDURE

1. Remove the wire feed motor connector from the NA-3/NA-4 control box.
2. Using the ohmmeter, measure the resistances per Table F.1. Also see Figure F.5.
3. If the motor resistance test is good, proceed to the **Motor Applied Voltage Test**.

**FIGURE F.5 – WIRE FEED DRIVE MOTOR CONNECTOR PINS.**



### MOTOR APPLIED VOLTAGE TEST

1. Carefully connect the isolated 120 VDC supply (**SUPPLY TURNED OFF**) to pins C and D on the motor connector.
2. Carefully connect the variable 0 to 90 VDC supply (**SUPPLY TURNED OFF**) to pins A and B on the motor connector. (See Table F.1.)
3. Apply field voltage first (pins C and D) to the motor. Then, slowly apply the armature voltage to pins A and B. (See Table F.1.)
4. The motor should run, and the speed should vary with changes to the armature voltage.
5. If the motor does NOT run and change speed correctly, the motor or gear box may be faulty.
6. To stop the motor, **REMOVE THE ARMATURE VOLTAGE FIRST** (pins A and B).

**TABLE F.1 – DRIVE MOTOR POINTS.**

TEST POINTS	RESISTANCE	DC VOLTAGE
Lead #539 to lead #541 armature	4 to 5 ohms	0 to 90 VDC
Lead #626 to lead #627 field winding	750 to 850 ohms	90 to 120 VDC
All leads to motor shell	500,000 ohms min.	Not Applicable

## REED SWITCH (4CR) AND SHUNT ASSEMBLY REMOVAL AND REPLACEMENT (NA-3 ONLY)

### WARNING

Service and repair should only be performed by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric service department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353(WELD).

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### PROCEDURE DESCRIPTION

The following procedure will aid the technician in accessing, removing, and installing the reed switch and shunt assembly for maintenance or replacement.

### MATERIALS NEEDED

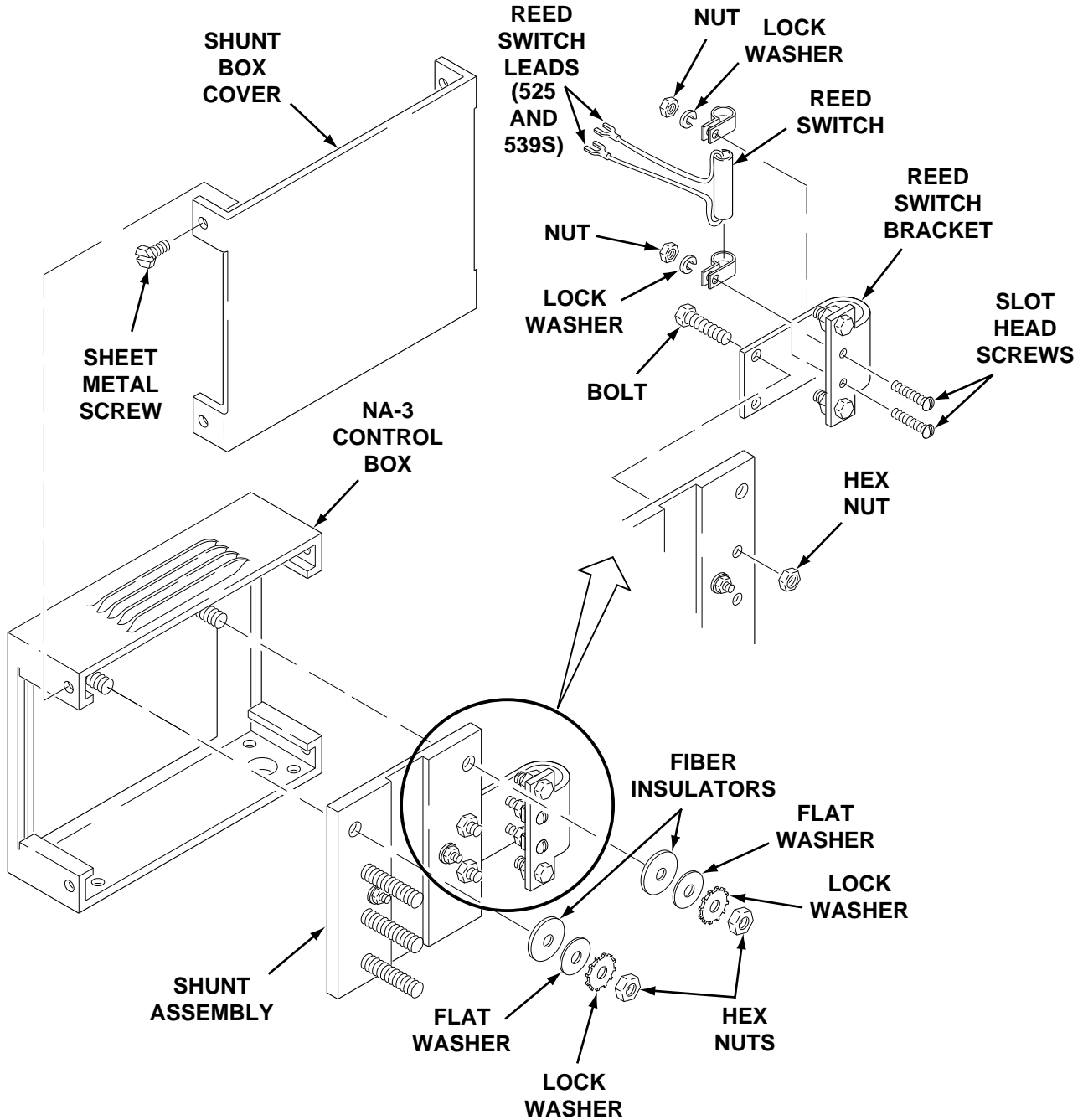
5/16 in. nutdriver  
3/4 in. wrench  
3/4 in. socket wrench  
Slot head screwdriver  
3/8 in. wrench



REED SWITCH (4CR) AND SHUNT ASSEMBLY  
REMOVAL AND REPLACEMENT (NA-3 ONLY)

(continued)

FIGURE F.6 – REED SWITCH REMOVAL.



NA-3 AND NA-4

## REED SWITCH (4CR) AND SHUNT ASSEMBLY REMOVAL AND REPLACEMENT (NA-3 ONLY)

*(continued)*

### REMOVAL PROCEDURE

1. Remove input power to the NA-3 control box.
2. Using the 5/16 in. nutdriver, remove the four sheet metal screws holding the shunt box cover to the control box sheet metal.
3. Using the slot head screwdriver, remove leads #539s and #525 from the terminal strip inside the control box.
4. Using the 3/4 in. wrench, remove the two hex nuts, lockwashers, flat washers, and fiber insulators holding the shunt assembly to the mounting studs. Note placement of insulators.
5. Carefully remove the shunt assembly and be careful when pulling the reed switch leads (#539s and #525) through the grommet in the control box.
6. Using the 3/4 in. socket and socket wrench, remove the two nuts and bolts mounting the reed switch bracket to the shunt.
7. Using the slot head screwdriver and 3/8 in. wrench, remove the two screws, lockwashers, and nuts

mounting the reed switch to the reed switch bracket.

8. Carefully remove the reed switch.

### INSTALLATION PROCEDURE

1. Attach the reed switch to the reed switch bracket with two nuts, lock washers, and screws using the slot head screwdriver and 3/8 in. wrench.
2. Mount the reed switch bracket to the shunt with two nuts and bolts, using the 3/4 in. socket and socket wrench.
3. Feed reed switch leads 539s and 525 through the grommet in the control box.
4. Mount the shunt assembly to the mounting studs with two fiber insulators, lock washers, flat washers, and hex nuts, using the 3/4 in. wrench. Ensure that the insulators are positioned as noted during removal.
5. Connect leads 539s and 525 to the terminal strip using the slot head screwdriver.
6. Install the shunt box cover onto the control box with four sheet metal screws using the 5/16 in. nutdriver.

NA-3 AND NA-4



## AC CURRENT TRANSFORMER AND SENSOR PC BOARD REMOVAL AND REPLACEMENT (NA-4 ONLY)

### WARNING

Service and repair should only be performed by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric service department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353(WELD).

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### PROCEDURE DESCRIPTION

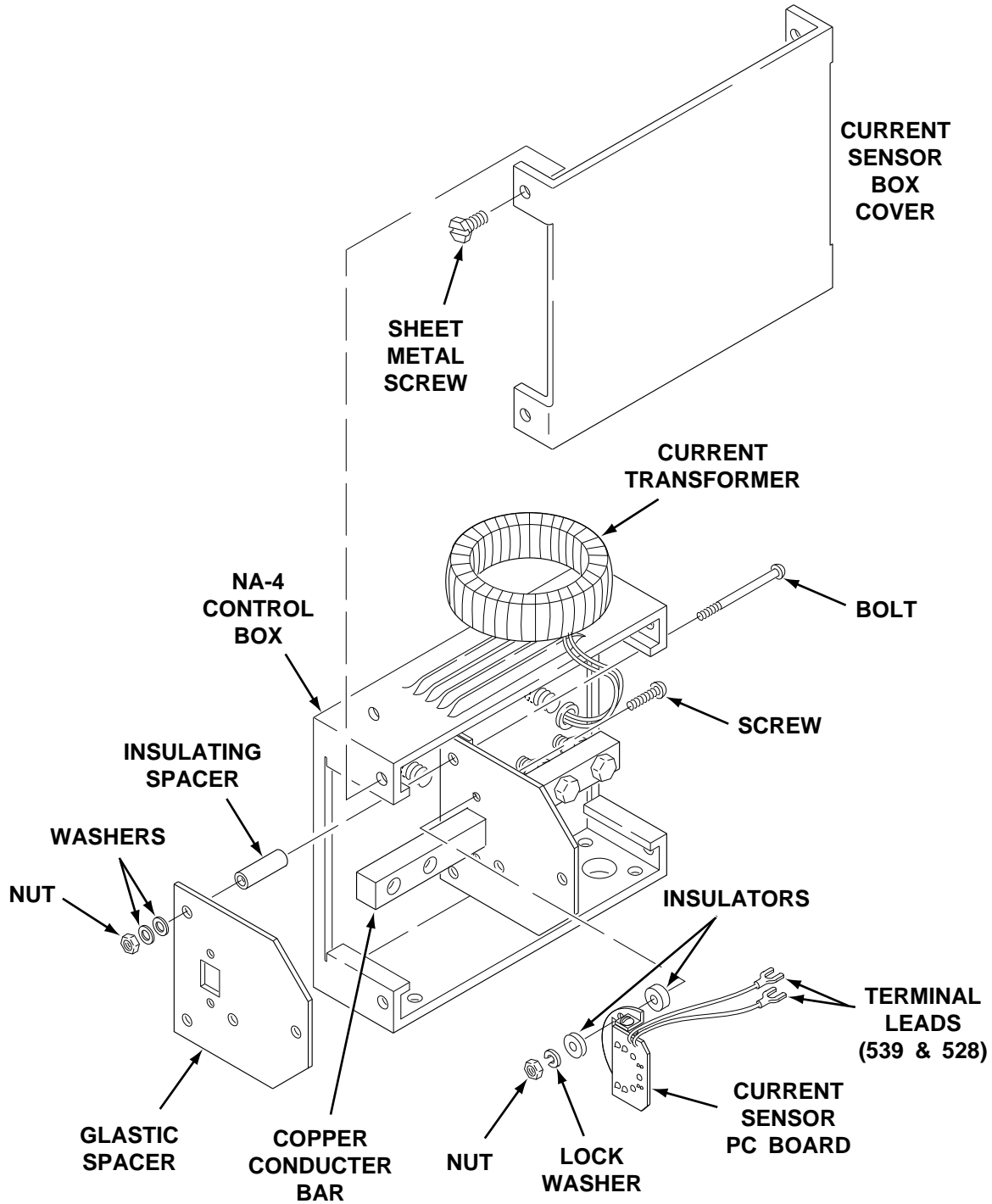
The following procedure will aid the technician in accessing, removing, and installing the current transformer and AC current sensor PC board for maintenance or replacement.

### MATERIALS NEEDED

5/16 in. nutdriver  
7/16 in. wrench  
Slot head screwdriver  
3/8 in. wrench

**AC CURRENT TRANSFORMER AND SENSOR PC BOARD REMOVAL AND REPLACEMENT (NA-4 ONLY)**  
*(continued)*

FIGURE F.7 – AC CURRENT TRANSFORMER AND PC BOARD REMOVAL.



NA-3 AND NA-4



## AC CURRENT TRANSFORMER AND SENSOR PC BOARD REMOVAL AND REPLACEMENT (NA-4 ONLY)

*(continued)*

### REMOVAL PROCEDURE

1. Remove the input power to the NA-4 control box.
2. Using the 5/16 in. nutdriver, remove the four sheet metal screws holding the current sensor box cover to the control box sheet metal.
3. Using the slot head screwdriver, remove leads #539 and #528 from the terminal strip inside the control box.
4. Using the 7/16 in. wrench, remove the three nuts, washers, insulating spacers, and bolts that hold the current transformer in place.
5. Carefully slide the glastic spacer and current transformer off of the copper conductor bar.
6. To remove the current sensor PC board, remove the screw, 3/8 in. nut, lockwasher, and insulators mounting the PC board coil to the metal bracket on the other glastic spacer.
7. Carefully remove the PC board; be careful when pulling leads #539 and #528 free from the grommet in the back of the control box.

### INSTALLATION PROCEDURE

1. Feed leads 539 and 528 through the grommet in the back of the control box.
2. Install the current sensor PC board and PC board coil onto the glastic spacer with the insulators, lock washer, 3/8 in. nut, and screw.
3. Slide the current transformer and the other glastic spacer onto the copper conductor bar.
4. Secure the current transformer and glastic spacers with three bolts, insulating spacers, washers and nuts using the 7/16 in. wrench.
5. Connect leads 539 and 528 to the terminal strip using the slot head screwdriver.
6. Install the shunt box cover onto the control box with four sheet metal screws using the 5/16 in. nutdriver.

## WIRE DRIVE MOTOR REMOVAL AND REPLACEMENT

### **WARNING**

Service and repair should only be performed by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric service department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353(WELD).

---

### **MATERIALS NEEDED**

7/16 in. wrench  
Large slot head screwdriver

## WIRE DRIVE MOTOR REMOVAL AND REPLACEMENT

(continued)

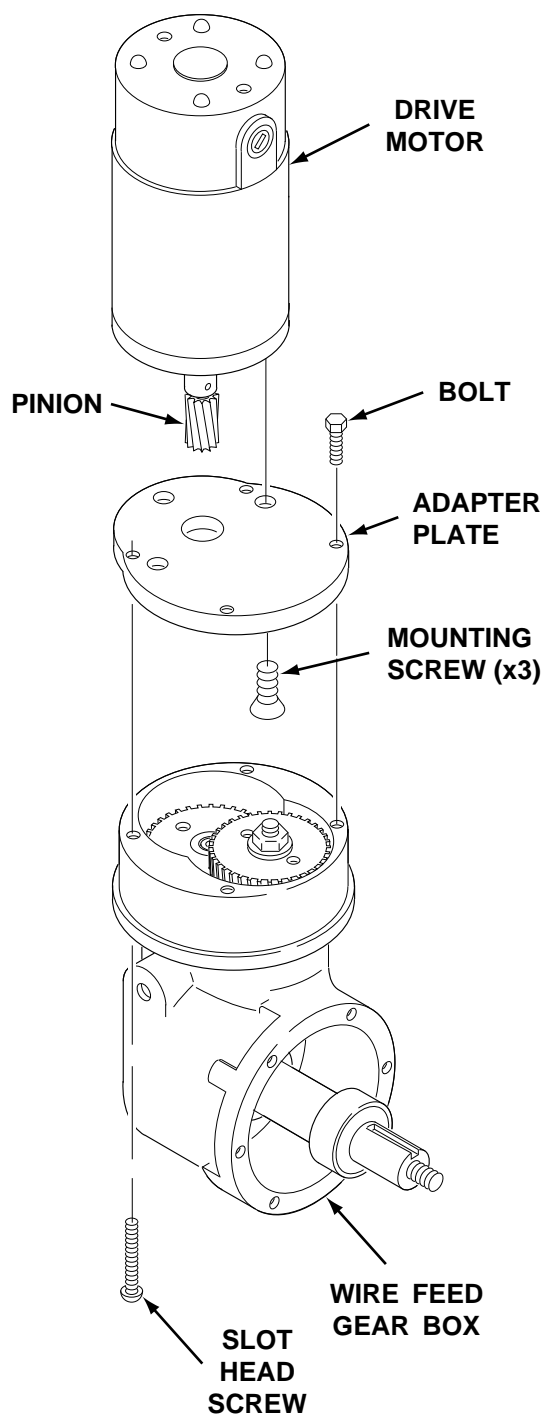
### MOTOR REMOVAL PROCEDURE

1. Remove the wire drive motor cable from the NA-3/NA-4 control box.
2. Using the 7/16 in. wrench, remove two 1/4-20 bolts holding the adapter plate and motor assembly to the wire feed gear box. (Older models may have slot head 1/4-20 bolts.)
3. Using the large slot head screwdriver, remove the two slot head screws that go through the wire feed gear box and into the adapter plate.
4. Carefully remove the adapter plate and motor assembly (with pinion attached).
5. With a slot head screwdriver, remove the adapter plate from the drive motor.

### MOTOR REPLACEMENT PROCEDURE

1. Attach the adapter plate to the drive motor using the slot head screwdriver.
2. Carefully install the replacement motor (with correct pinion) and mount the adapter mounting plate using the 1/4-20 bolts and slot head screws previously removed.
3. Attach the wire drive motor cable to the NA-3/NA-4 control box receptacle.

FIGURE F.8 – WIRE DRIVE MOTOR REMOVAL AND REPLACEMENT.





## PC BOARD(S) REMOVAL AND REPLACEMENT

### WARNING

Service and repair should only be performed by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric service department for technical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353(WELD).

---

### PROCEDURE DESCRIPTION

The following procedure will aid the technician in removing and replacing the printed circuit boards for maintenance or replacement.

### MATERIALS NEEDED

Phillips head screwdriver  
Slot head screwdriver

## PC BOARD(S) REMOVAL AND REPLACEMENT

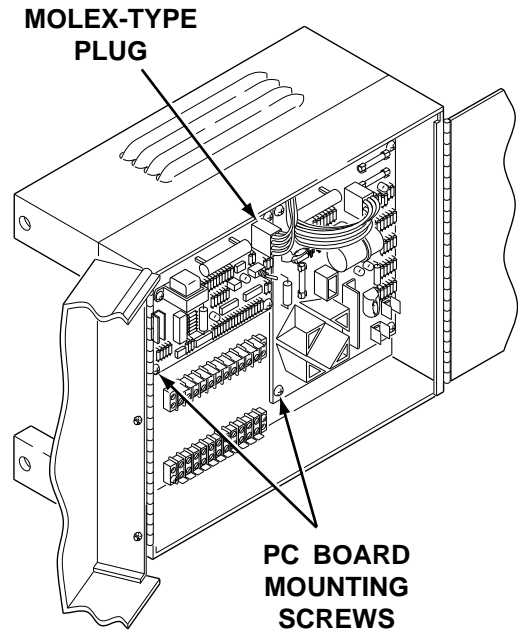
*(continued)*

### TEST PROCEDURE

Before starting the following procedure, refer to the PC Board Troubleshooting Procedures at the beginning of this section.

1. Remove the input power to the NA-3/NA-4 control box.
2. Loosen the thumb screw and swing open the outer control panel.
3. Using the slot head screwdriver remove the locking screw and swing open the inner control panel.
4. Carefully remove the molex-type plugs connected to the PC board that is to be removed.
5. Using the Phillips head screwdriver, remove the PC board mounting screws.
6. Carefully remove the PC board.

**FIGURE F.9 – CIRCUIT BOARD  
REMOVAL AND REPLACEMENT.**



**RETEST AFTER REPAIR**

If a failed test indicates that any mechanical part that could affect the machine's electrical characteristics must be replaced or if any electrical components are repaired or replaced, the machine must be retested and must meet the following standards.

Wire Feed Speed (per table - NA-3 CV only) . . . . .

<b>Gear Ratio</b>	<b>Wire Speed Range in/min (m/min)</b>
57 : 1	40 - 650 (1.01-16-51)
95 : 1	25 - 400 (0.64-10.16)
142 : 1	17 - 268 (0.43-6.81)

Flux or Water Solenoid . . . . . Must operate when "Start" switch is pressed.

LEDS on PC Boards . . . . . Must operate per table in troubleshooting section.

Relay 3CR . . . . . Must operate and "close" power source contactor.

Relay 2CR . . . . . Must operate and activate external travel circuit, if used.



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# NOTES

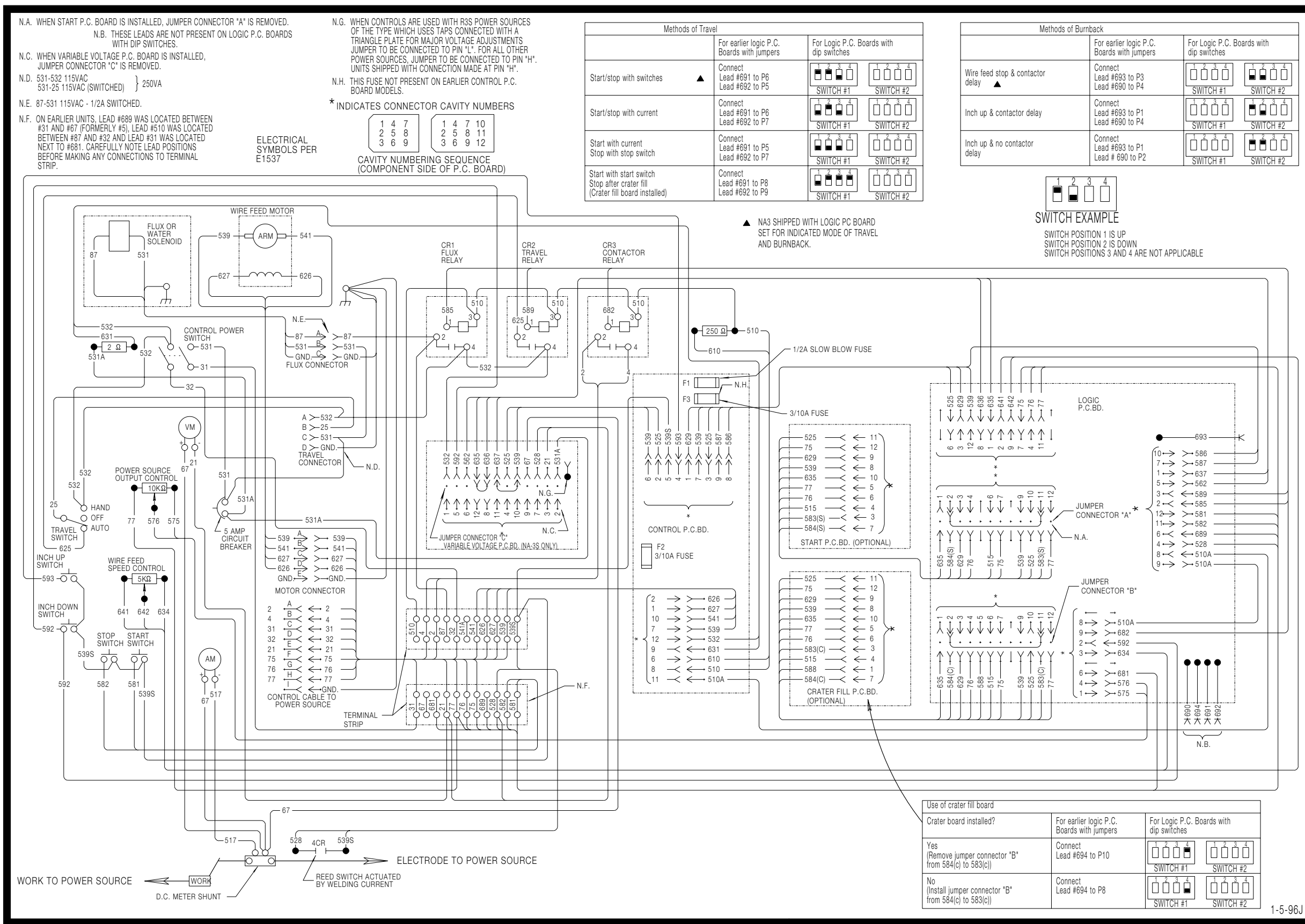
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NA-3 AND NA-4



Wiring Diagram (NA-3)

NA-3N AND NA-3S WIRING DIAGRAM



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

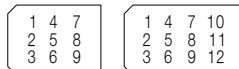
Wiring Diagram (NA-4)

NA-4 WITH CURRENT CONTROL RHEOSTAT

- N.A. WHEN START P.C. BOARD IS INSTALLED, JUMPER CONNECTOR 'A' IS REMOVED.
- N.B. THESE LEADS ARE NOT PRESENT ON LOGIC P.C. BOARDS WITH DIP SWITCHES.
- N.C. 531-532 115VAC; 531-25 115VAC (SWITCHED) - 250 VA
- N.D. 87-531 115VAC - 1/2A SWITCHED.
- N.E. ON EARLIER UNITS, LEAD #689 WAS LOCATED BETWEEN #31 and #67 (FORMERLY #5). LEAD #510 WAS LOCATED BETWEEN #87 & #32, AND LEAD #31 WAS LOCATED NEXT TO #681. CAREFULLY NOTE LEAD POSITIONS BEFORE MAKING ANY CONNECTIONS TO TERMINAL STRIP.
- N.F. JUMPER LEAD TO BE CONNECTED TO PIN 'H' AT ALL TIMES. UNIT SHIPPED WITH LEAD IN THIS POSITION.
- N.G. THIS FUSE NOT PRESENT ON EARLIER CONTROL P.C. BOARD MODELS.

ELECTRICAL SYMBOLS PER E1537.

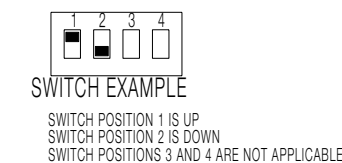
\* INDICATES CONNECTOR CAVITY NUMBERS



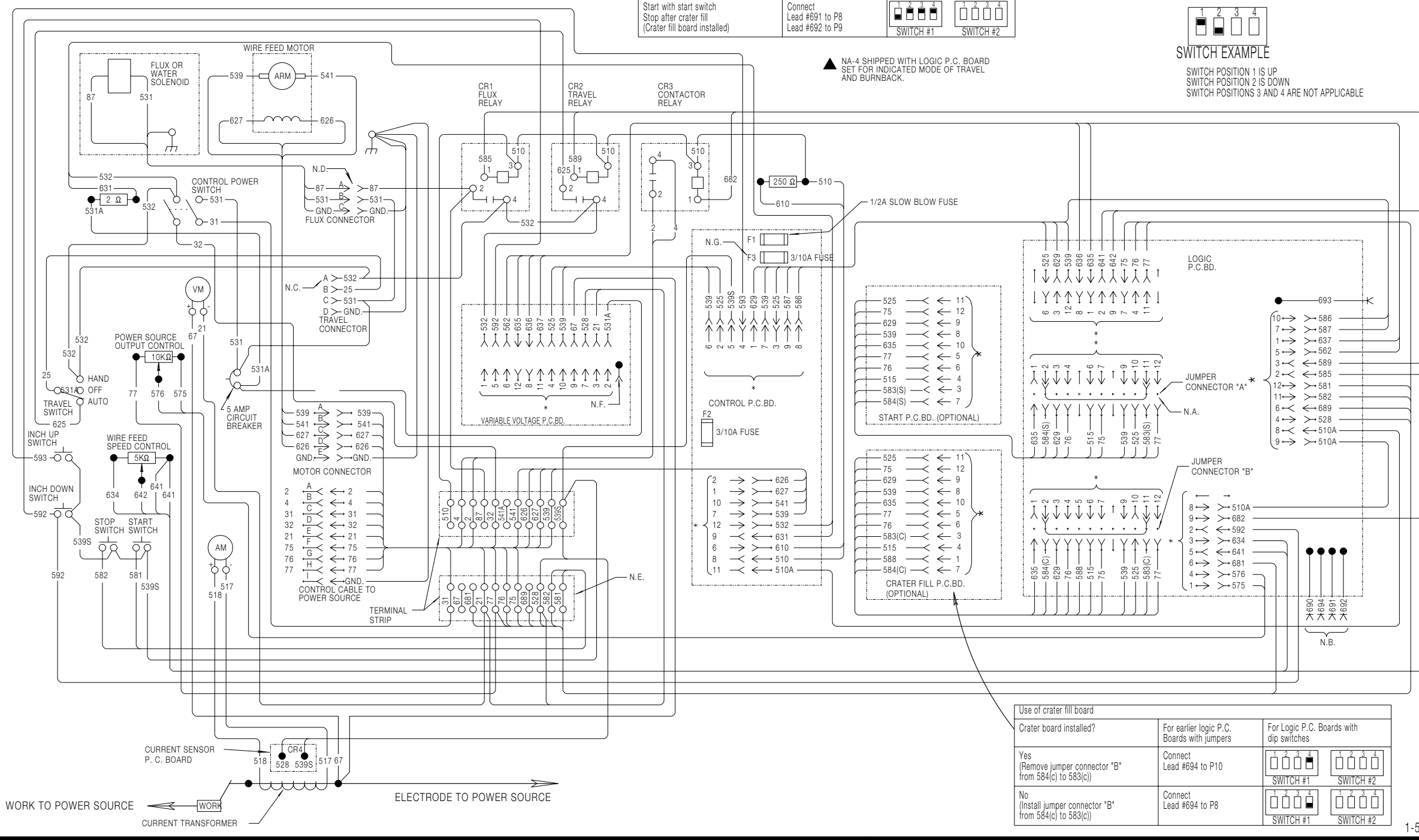
CAVITY NUMBERING SEQUENCE (COMPONENT SIDE OF P.C. BOARD)

Methods of Travel	For earlier logic P.C. Boards with jumpers	For Logic P.C. Boards with dip switches
Start/stop with switches	Connect Lead #691 to P6 Lead #692 to P5	SWITCH #1 SWITCH #2
Start/stop with current	Connect Lead #691 to P6 Lead #692 to P7	SWITCH #1 SWITCH #2
Start with current Stop with stop switch	Connect Lead #691 to P5 Lead #692 to P7	SWITCH #1 SWITCH #2
Start with start switch Stop after crater fill (Crater fill board installed)	Connect Lead #691 to P8 Lead #692 to P9	SWITCH #1 SWITCH #2

Methods of Burnback	For earlier logic P.C. Boards with jumpers	For Logic P.C. Boards with dip switches
Wire feed stop & contactor delay	Connect Lead #693 to P3 Lead #690 to P4	SWITCH #1 SWITCH #2
Inch up & contactor delay	Connect Lead #693 to P1 Lead #690 to P4	SWITCH #1 SWITCH #2
Inch up & no contactor delay	Connect Lead #693 to P1 Lead #690 to P2	SWITCH #1 SWITCH #2



▲ NA-4 SHIPPED WITH LOGIC P.C. BOARD SET FOR INDICATED MODE OF TRAVEL AND BURNBACK.



Use of crater fill board	For earlier logic P.C. Boards with jumpers	For Logic P.C. Boards with dip switches
Crater board installed?		
Yes (Remove jumper connector 'B' from 584(c) to 583(c))	Connect Lead #694 to P10	SWITCH #1 SWITCH #2
No (Install jumper connector 'B' from 584(c) to 583(c))	Connect Lead #694 to P8	SWITCH #1 SWITCH #2

1-5-96J

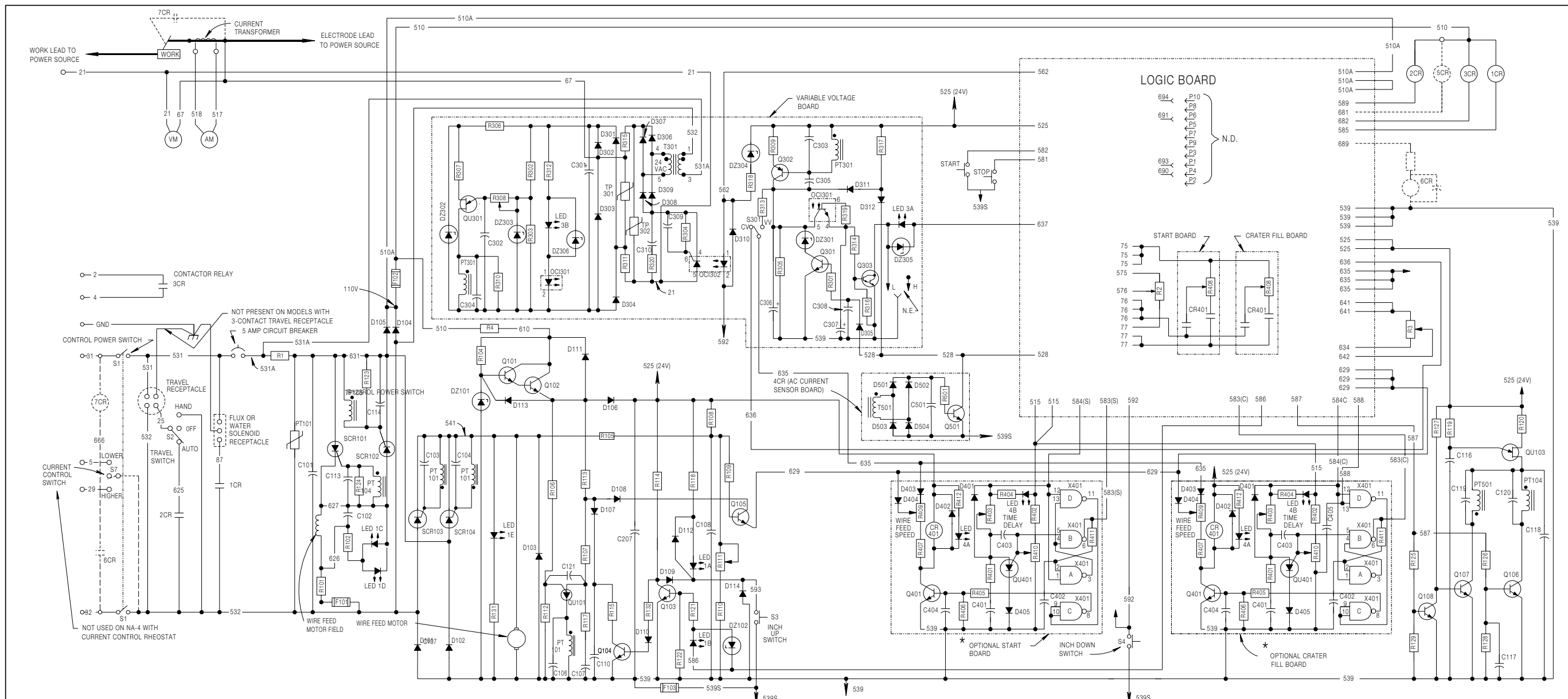
L6489

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.





Operating Schematic (NA-4)



FOR CONTROL P.C. BOARDS L5224-5 OR HIGHER USE L8939 SCHEMATIC FOR COMPONENT VALUES AND CIRCUIT CONNECTIONS.

CONTROL CIRCUIT			
C101	.47 MFD	R101	40 OHM 1/2 W
C102	.50 MFD	R102	68K OHM
C103	.047 MFD	R104	10K OHM 2 W
C104	.047 MFD	R105	27K OHM
C106	.047 MFD	R106	4.7K OHM
C107	.1 MFD	R107	15K OHM
C108	4.7 MFD	R108	22K OHM
C110	1 MFD	R109	10K OHM
C113	.15 MFD	R110	1.5K OHM
C114	.15 MFD	R111	5K OHM TRIMMER
C116	.047 MFD	R112	4.7K OHM
C117	.02 MFD	R113	33K OHM
C118	.02 MFD	R114	10K OHM
C119	.02 MFD	R115	100 OHM
C120	.02 MFD	R117	47 OHM
C121	.02 MFD	R118	6.8K OHM
		R119	6.8K OHM
		R120	680 OHM
		R121	2.7K OHM
		R122	47K OHM
		R123	100 OHM
		R124	100 OHM
		R125	10K OHM
		R126	680 OHM
		R127	4.7K OHM
		R128	47K OHM
		R129	47K OHM
		R131	10K OHM 2 W
		R132	10K OHM

VARIABLE VOLTAGE CIRCUIT  
FOR VARIABLE VOLTAGE P.C. BOARDS L5394-2 OR HIGHER USE M1696 SCHEMATIC FOR COMPONENT VALUES AND CIRCUIT CONNECTIONS.

C301	2 MFD	R308	10K OHM TRIMMER
C302	.1 MFD	R309	15 OHM
C303	.01 MFD	R310	75 OHM
C304	.02 MFD	R311	68 OHM
C305	.01 MFD	R312	5.6K OHM 2 W
C306	2 MFD	R313	6.8K OHM
C307	.47 MFD	R314	10K OHM
C308	.22 MFD	R315	1K OHM 1/2 W
C309	.02 MFD	R316	33K OHM
C310	.01 MFD	R317	10K OHM
		R318	560 OHM
		R319	2.7M OHM
		R320	100 OHM

FOR START P.C. BOARD L9917-1 AND UP USE M17939 SCHEMATIC FOR COMPONENT VALUES AND CIRCUIT CONNECTIONS.  
FOR CRATER FILL P.C. BOARDS L5222-2 AND UP, USE M17939 SCHEMATIC FOR COMPONENT VALUES AND CIRCUIT CONNECTIONS.

OPTIONAL CIRCUIT		COMPONENTS NOT ON P.C. BOARD	
C401	18 MFD	R1	2 OHM 50 W
C402	.02 MFD	R2	10K OHM 2 W (USED ONLY ON NA-4 WITH CURRENT CONTROL RHEOSTAT)
C403	.02 MFD	R3	5K OHM 2 W WIRE SPEED CONTROL
C404	.02 MFD	R4	250 OHM 25 W
C405	.02 MFD (CRATER CKT. ONLY)	S1	DPST CONTROL POWER SWITCH
		S2	SPDT TRAVEL SWITCH
		S3	SPST INCH UP SWITCH
		S4	SPST INCH DOWN SWITCH
		S5	SPST START SWITCH
		S6	SPST STOP SWITCH
		S7	SPDT CURRENT CONTROL SWITCH (NOT USED ON NA-4 WITH CURRENT CONTROL RHEOSTAT)

AC CURRENT SENSOR CIRCUIT

C501	1 MFD
D501	1 A
D502	1 A
D503	1 A
D504	1 A
R501	10K OHM
Q501	2N4123

METHODS OF TRAVEL

METHODS OF TRAVEL	FOR EARLIER LOGIC P.C. BOARDS WITH JUMPERS	FOR LOGIC P.C. BOARDS WITH DIP SWITCHES
START/STOP WITH SWITCHES	CONNECT LEAD #691 TO P8 LEAD #692 TO P5	SWITCH #1 SWITCH #2
START/STOP WITH CURRENT	CONNECT LEAD #691 TO P7 LEAD #692 TO P6	SWITCH #1 SWITCH #2
START WITH CURRENT STOP WITH STOP SWITCH	CONNECT LEAD #691 TO P5 LEAD #692 TO P7	SWITCH #1 SWITCH #2
START WITH START SWITCH STOP AFTER CRATER FILL (CRATER FILL BOARD INSTALLED)	CONNECT LEAD #691 TO P8 LEAD #692 TO P9	SWITCH #1 SWITCH #2

METHODS OF BURNDACK

METHODS OF BURNDACK	FOR EARLIER LOGIC P.C. BOARDS WITH JUMPERS	FOR LOGIC P.C. BOARDS WITH DIP SWITCHES
WIRE FEED STOP & CONTRACTOR DELAY	CONNECT LEAD #693 TO P3 LEAD #690 TO P4	SWITCH #1 SWITCH #2
INCH UP & CONTRACTOR DELAY	CONNECT LEAD #693 TO P1 LEAD #690 TO P4	SWITCH #1 SWITCH #2
INCH UP & NO CONTRACTOR DELAY	CONNECT LEAD #693 TO P1 LEAD #690 TO P2	SWITCH #1 SWITCH #2

USE OF CRATER FILL BOARD

CRATER BOARD INSTALLED?	FOR EARLIER LOGIC P.C. BOARDS WITH JUMPERS	FOR LOGIC P.C. BOARDS WITH DIP SWITCHES
YES (REMOVE JUMPER CONNECTOR 'B' FROM 584(C) TO 583(C))	CONNECT LEAD #694 TO P10	SWITCH #1 SWITCH #2
NO (INSTALL JUMPER CONNECTOR 'B' FROM 584(C) TO 583(C))	CONNECT LEAD #694 TO P8	SWITCH #1 SWITCH #2

A.N.S.I. ELECTRICAL SYMBOLS PER E1537.

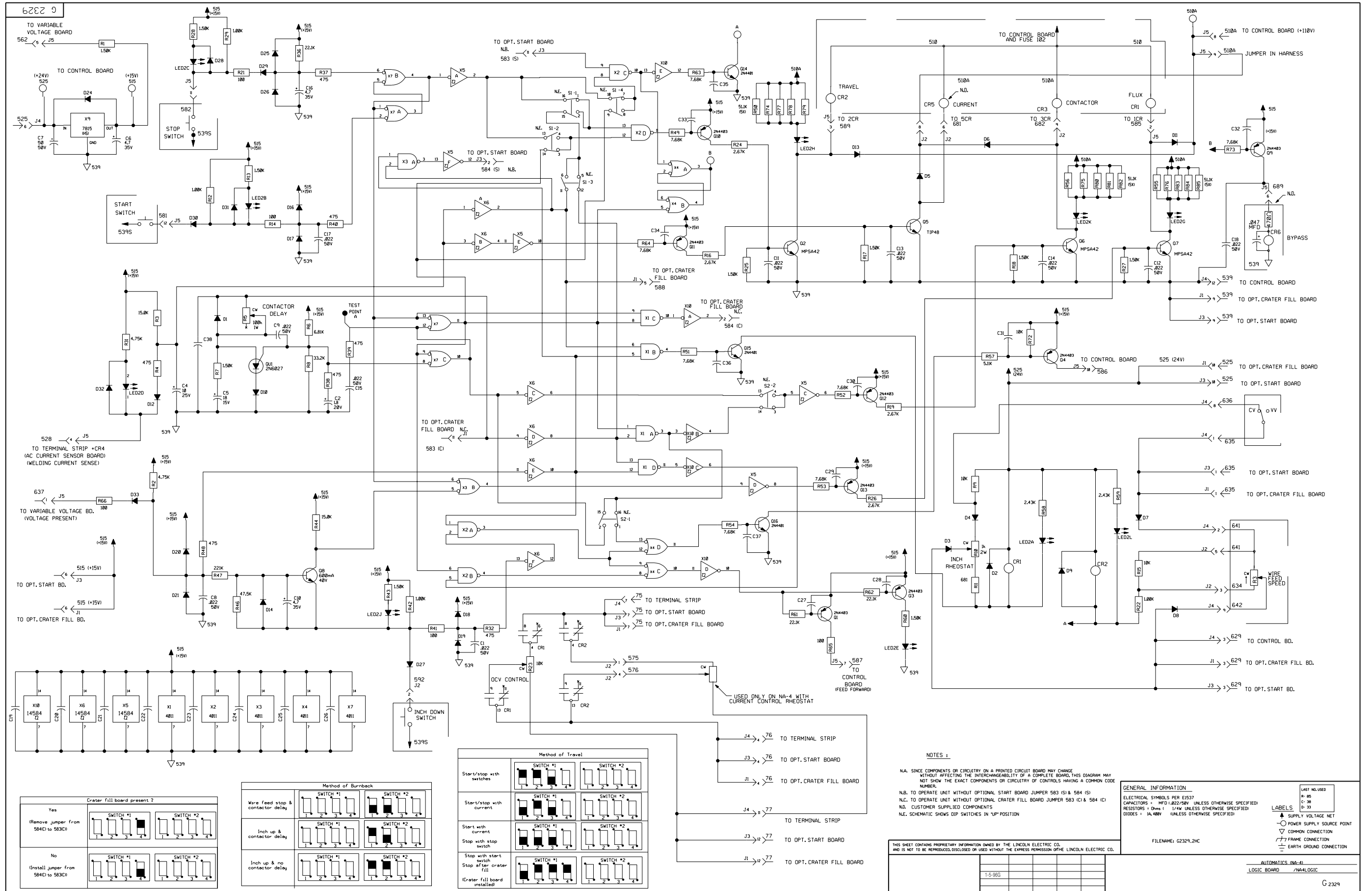
N.A. TO OPERATE UNIT WITHOUT OPTIONAL START BOARD JUMPER 583 (S) AND 584 (S)  
 N.B. TO OPERATE UNIT WITHOUT OPTIONAL CRATER FILL BOARD JUMPER 583 (C) AND 584 (C)  
 N.C. X201 THRU X207 AND X401 - PIN 7 CONNECTED TO 539 - PIN 14 CONNECTED TO 515  
 N.D. THESE JUMPER LEADS ARE NOT PRESENT ON LOGIC P.C. BOARDS WITH DIP SWITCHES.  
 N.E. JUMPER LEAD TO BE CONNECTED TO PIN "H" AT ALL TIMES.

NOTE: SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

TABLES:  
 SAMPLE SWITCH  
 SWITCH POSITION 1 IS UP  
 SWITCH POSITION 2 IS DOWN  
 SWITCH POSITIONS 3 AND 4 ARE NOT APPLICABLE

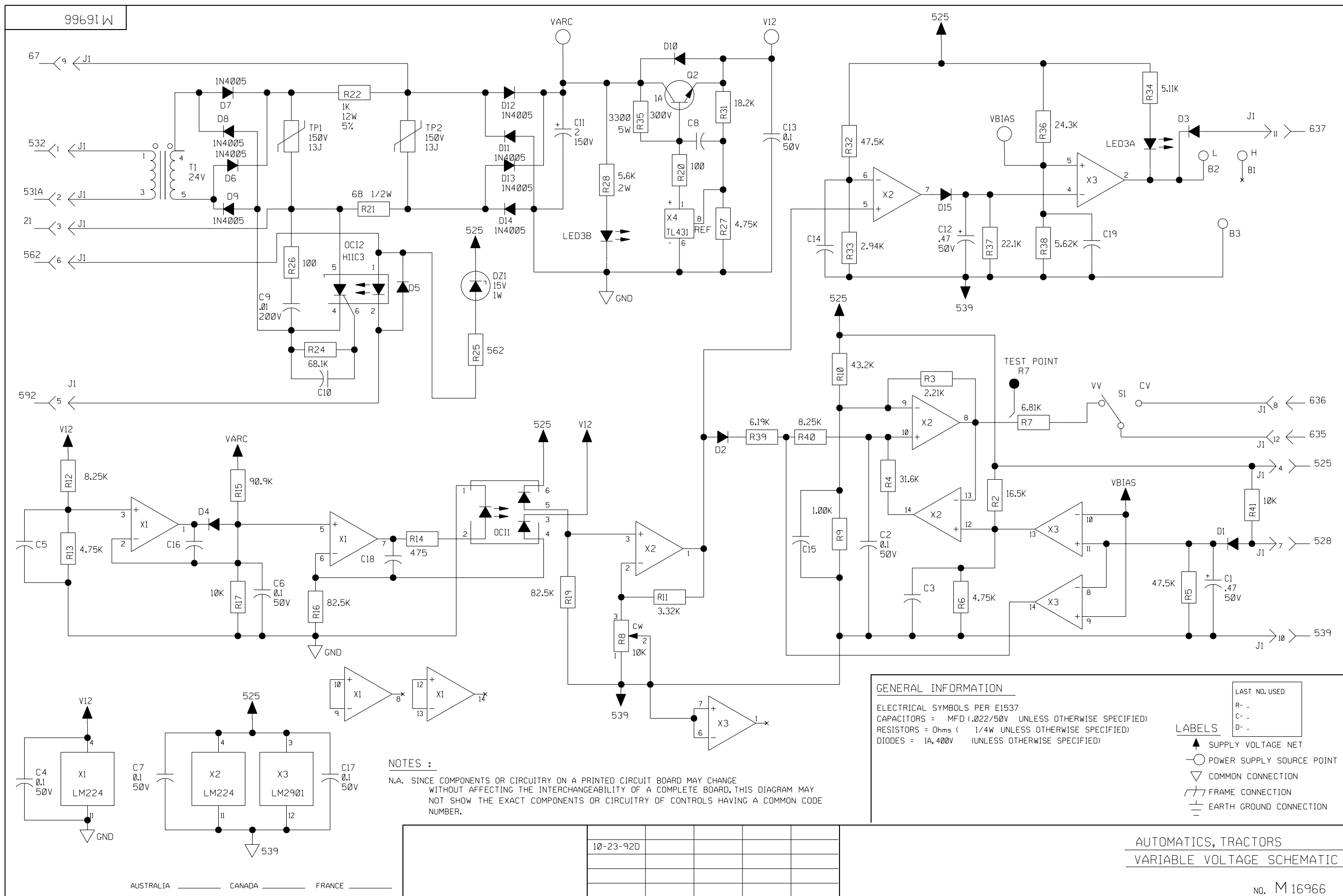
NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Logic PC Board (G1379-2 & above) Schematic



**NOTE:** Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

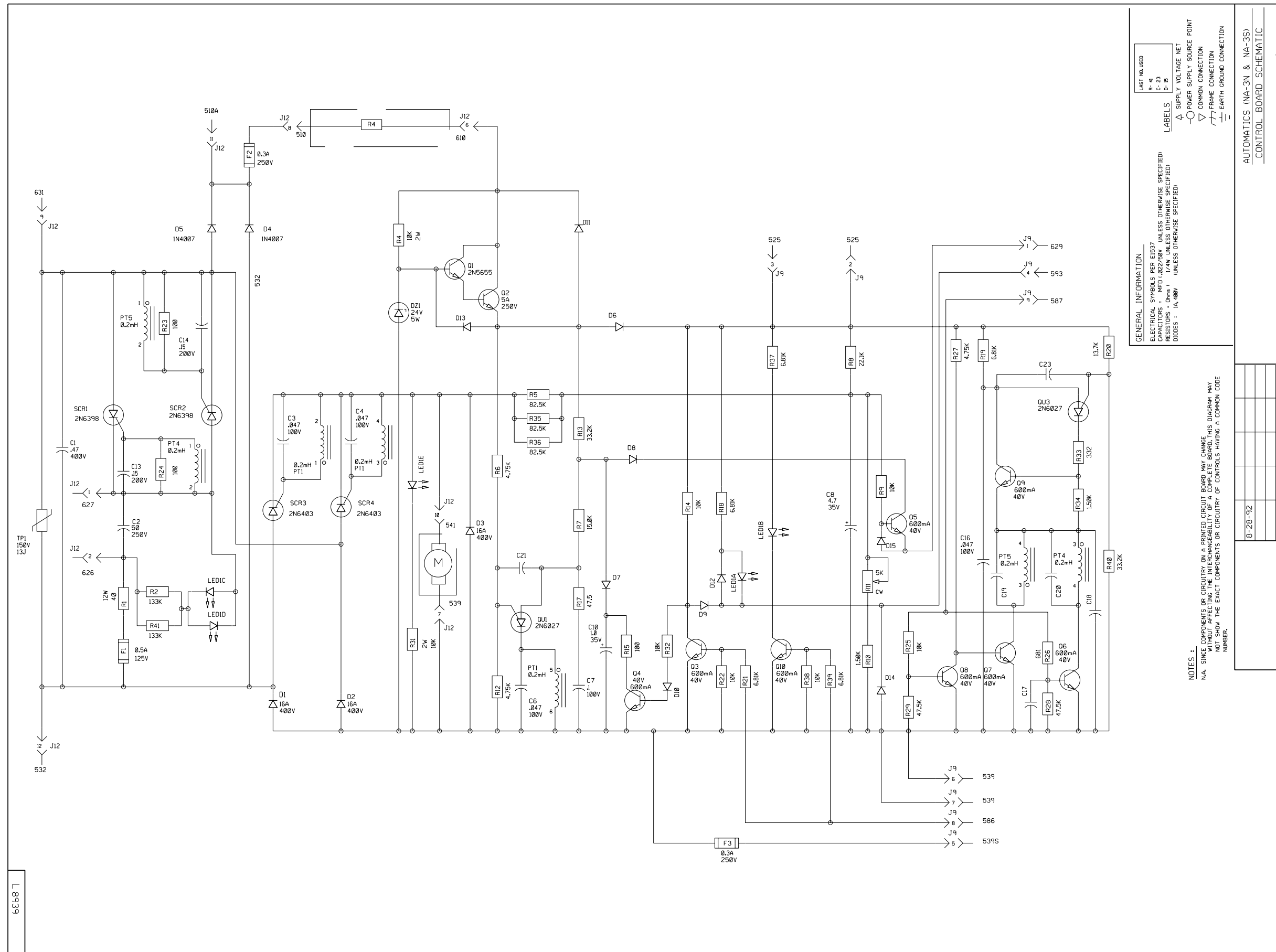
Variable Voltage PC Board (L5394-2 & above) Schematic



**NOTE:** Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



Control PC Board (L5224-5 & above) Schematic



LAST REVISED  
 R-41  
 C-23  
 D-19

GENERAL INFORMATION  
 ELECTRICAL SYMBOLS PER E1537  
 CAPACITORS = MFD (A22/50V UNLESS OTHERWISE SPECIFIED)  
 RESISTORS = Ohms | 1/4W UNLESS OTHERWISE SPECIFIED  
 DIODES = 1A, 400V UNLESS OTHERWISE SPECIFIED

LABELS  
 Δ SUPPLY VOLTAGE NET  
 ○ POWER SUPPLY SOURCE POINT  
 ⊕ COMMON CONNECTION  
 ⊖ FRAME CONNECTION  
 ⊕⊖ EARTH GROUND CONNECTION

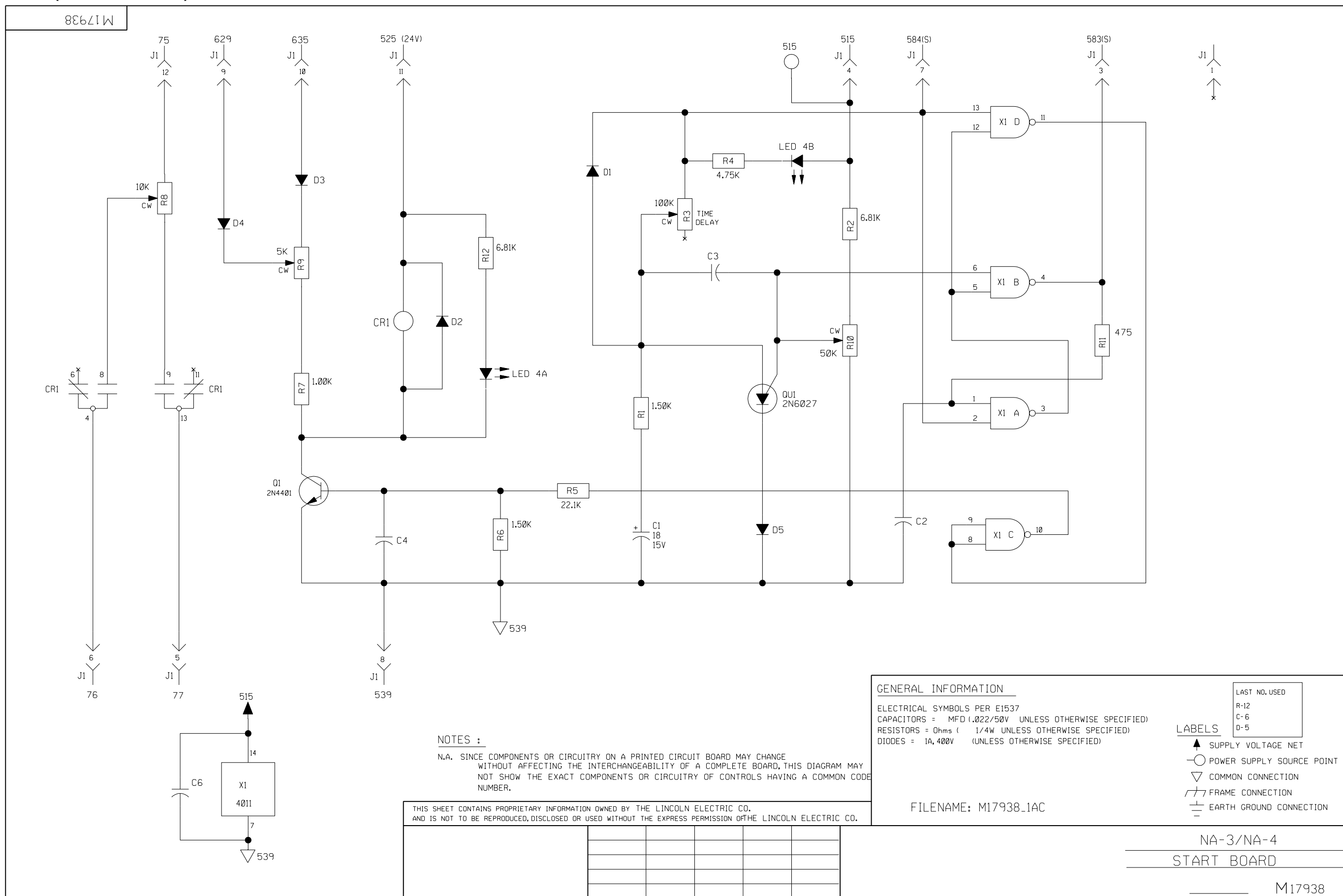
NOTES :  
 N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

AUTOMATICS (NA-3N & NA-3S)	
CONTROL BOARD SCHEMATIC	
8-28-92	L 8939

**NOTE:** Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



Start PC Board (L9917-1 & above) Schematic



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

**GENERAL INFORMATION**

ELECTRICAL SYMBOLS PER E1537  
 CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)  
 RESISTORS = Ohms ( 1/4W UNLESS OTHERWISE SPECIFIED)  
 DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

**LABELS**

- ▲ SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- ⎓ FRAME CONNECTION
- ⊥ EARTH GROUND CONNECTION

FILENAME: M17938\_1AC

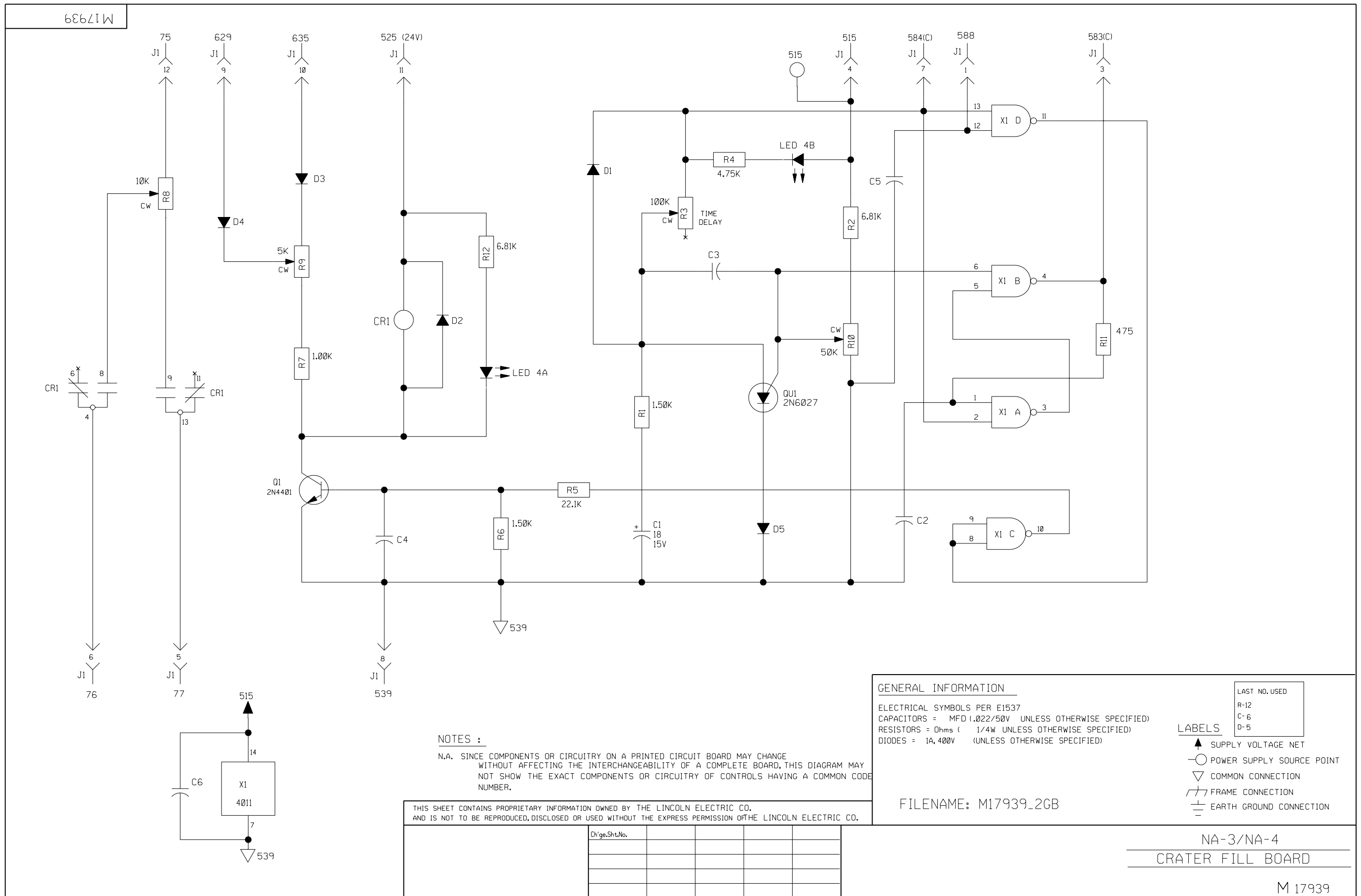
LAST NO. USED
R-12
C-6
D-5

NA-3/NA-4  
 START BOARD  
 M17938

**NOTE:** Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



Crater Fill PC Board (L5222-2 & above) Schematic



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

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Ch'ge.	Sh't.No.				

**GENERAL INFORMATION**

ELECTRICAL SYMBOLS PER E1537  
 CAPACITORS = MFD 1.022/50V UNLESS OTHERWISE SPECIFIED)  
 RESISTORS = Ohms ( 1/4W UNLESS OTHERWISE SPECIFIED)  
 DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

**LABELS**

- ▲ SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- ⎓ FRAME CONNECTION
- ⊥ EARTH GROUND CONNECTION

FILENAME: M17939\_2GB

LAST NO. USED
R-12
C-6
D-5

NA-3/NA-4  
 CRATER FILL BOARD

M 17939

**NOTE:** Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

