LINCOLN ELECTRIC

GENUINE LINCOLN PARTS™

NOTE: This manual will cover most of the troubleshooting and repair procedures for the code numbers listed. Some variances may exist when troubleshooting/repairing later code numbers.

TOMAHAWK® 625

For use with machines having Code Numbers:

11580

SERVICE MANUAL

SVM222-A | Issue Date 12-Jul

THE LINCOLN ELECTRIC COMPANY
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⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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

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

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

FOR ENGINE powered equipment.

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

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

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

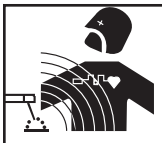
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

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

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

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

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



ELECTRIC AND MAGNETIC FIELDS may be dangerous

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

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

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

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

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

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

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

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

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

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ELECTRIC SHOCK can kill.

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

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

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

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

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

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

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

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

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

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

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

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

ARC RAYS can burn.

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

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

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

FUMES AND GASES can be dangerous.

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

5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

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

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

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

5.f. Also see item 1.b.

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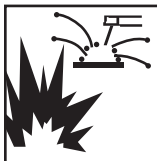

WELDING and CUTTING SPARKS can cause fire or explosion.

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

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

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

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

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

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

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

6.h. Also see item 1.c.

6.I. Read and follow NFPA 51B “ Standard for Fire Prevention During Welding, Cutting and Other Hot Work”, available from NFPA, 1 Batterymarch Park,PO box 9101, Quincy, Ma 022690-9101.

6.j. Do not use a welding power source for pipe thawing.

CYLINDER may explode if damaged.

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

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

7.c. Cylinders should be located:

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

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

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

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

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

FOR ELECTRICALLY powered equipment.

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

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

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

Refer to **http://www.lincolnelectric.com/safety** for additional safety information.

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PRÉCAUTIONS DE SÛRETÉ

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

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Electromagnetic Compatibility (EMC)

Conformance
Products displaying the CE mark are in conformity with European Community Council Directive of 15 Dec 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility, 2004/108/EC. It was manufactured in conformity with a national standard that implements a harmonized standard: EN 60974-10 Electromagnetic Compatibility (EMC) Product Standard for Arc Welding Equipment. It is for use with other Lincoln Electric equipment. It is designed for industrial and professional use.

Introduction
All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment; other nearby welding equipment, radio and TV reception, numerical controlled machines, telephone systems, computers, etc. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

Installation and Use
The user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit, see Note. In other cases it could involve construction of an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Note: The welding circuit may or may not be earthed for safety reasons according to national codes. Changing the earthing arrangements should only be authorized by a person who is competent to access whether the changes will increase the risk of injury, e.g., by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

Assessment of Area
Before installing welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a) other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment;

b) radio and television transmitters and receivers;

c) computer and other control equipment;

d) safety critical equipment, e.g., guarding of industrial equipment;

e) the health of the people around, e.g., the use of pacemakers and hearing aids;

f) equipment used for calibration or measurement

g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;

h) the time of day that welding or other activities are to be carried out.

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Electromagnetic Compatibility (EMC)

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of Reducing Emissions

Mains Supply
Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment
The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturers instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables
The welding cables should be kept as short as possible and should be positioned close together, running at or close to floor level.

Equipotential Bonding
Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the Workpiece
Where the workpiece is not bonded to earth for electrical safety, not connected to earth because of its size and position, e.g., ships hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding
Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications. [1]

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[1] Portions of the preceding text are contained in EN 60974-10: "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

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TECHNICAL SPECIFICATIONS -TOMAHAWK® 625

INPUT - SINGLE PHASE 50 / 60 HERTZ

Standard Voltage

208V, 230V ±10% / 1 / 50 / 60Hz

RATED OUTPUT AT 40° C

Duty Cycle	CURRENT AMPS	VOLTAGE AMPS
100%	24 A	89.6VDC
60%	29 A	91.8VDC
35%	40 A	96.0VDC

OUTPUT

Current Range	Open Circuit Voltage	Pilot Current
10-40 Amps	460 VDC	12 Amps

REQUIRED GAS FLOW RATE

70 PSI @ 125-200 SCFH
(5 Bar. @ 80±20 LITERS/MIN.)

REQUIRED GAS INLET PRESSURE

80 to 110 PSI
(6 Bar. to 7.5 Bar.)

RECOMMEND INPUT WIRE AND FUSE SIZES

For all plasma cutting applications
Based on U.S. National Electrical Code
Ambient Temperature 30°C or Less

Output	AC Input Voltage at 50/60 Hertz	Input Cord Plug Size	Fuse (Super Lag) Circuit Breaker (Delay Type)	Type 75°C Copper Wire in Conduit AWG (IEC) Sizes	
				2 Input Supply Wires	1 Ground Wire
40 A	230V-1Ø 208V-1Ø	6-50P	30 AMPS	#12 (3.3 mm²)	#12 (3.3 mm²)

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight Including Torch Cable
15.2 in. 385 mm	8.5 in. 215 mm	18.9 in. 480 mm	34.0 lbs. 15.4 kg.

TEMPERATURE RANGES

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
-10°C to +40°C	-10°C to +40°C

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Read entire Installation Section before installing the TOMAHAWK® 625.

SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

- **Only qualified personnel should install this machine.**
- **Turn the input power OFF at the disconnect switch or fuse box and discharge input capacitors before working inside the equipment.**
- **Do not touch electrically hot parts.**
- **Turn the TOMAHAWK® 625 Power Switch OFF when connecting power cord to input power.**

SELECT PROPER LOCATION

Place the TOMAHAWK® 625 where clean cool air can freely circulate in and out of the side louvers. Dirt, dust or any foreign material that can be drawn into the machine should be kept at a minimum. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdown of the machine.

A source of clean, dry air or nitrogen must be supplied to the TOMAHAWK® 625 when using external air supply. Oil in the air is a severe problem and must be avoided. The supply pressure must be between 80 and 150 psi. The flow rate is approximately 4.0 cfm (113 l/min.). Failure to observe these precautions could result in excessive operating temperatures or damage to the torch.

STACKING

The TOMAHAWK® 625 cannot be stacked.

TILTING

The TOMAHAWK® 625 must be placed on a stable, level surface so it will not topple over.

HIGH FREQUENCY INTERFERENCE PROTECTION

The TOMAHAWK® 625 employs a touch start mechanism for arc initiation which eliminates high frequency emissions from the machine as compared with spark gap and solid state type high frequency generators. Keep in mind, though, that these machines may be used in an environment where other high frequency generating machines are operating. By taking the following steps, high frequency interference into the TOMAHAWK® 625 can be minimized

(1) Make sure the power supply chassis is connected to a good earth ground. The work terminal ground does NOT ground the machine frame.
(2) Keep the work clamp isolated from other work clamps that have high frequency.
(3) If the work clamp cannot be isolated, then keep the clamp as far as possible from other work clamp connections.
(4) When the machine is enclosed in a metal building, several good earth driven electrical grounds around the periphery of the building are recommended.

Failure to observe these recommended installation procedures may cause improper function of the TOMAHAWK® 625 or possibly even damage to the control system or power supply components.

INPUT ELECTRICAL CONNECTIONS

The TOMAHAWK® 625 is rated for 208VAC and 230VAC input voltage. Before installing the machine, check that input supply voltage, phase, and frequency are the same as the machine's voltage, phase, and frequency as specified on the machine's rating plate.

- The TOMAHAWK® 625 should be connected only by a qualified electrician. Installation should be made in accordance with local codes.

For use on engine drives, keep in mind the above input draw restrictions and the following precaution.

The TOMAHAWK® 625 can be operated on engine driven generators as long as the 230 volt auxiliary meets the following conditions:

- The AC waveform peak voltage is below 400 volts.
- The AC waveform frequency is between 45 and 65 Hz.
- The RMS voltage of the AC waveform is always greater than 208VAC.

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The following Lincoln engine drives meet these conditions when run in the high idle mode:
Ranger 250, 250LPG, 305G and 305D engine drives.
Vantage 300, 400, 500 and Air Vantage engine drives.

Some engine drives do not meet these conditions. Operation of the TOMAHAWK® 625 is not recommended on engine drives not conforming to these conditions. Such combinations may overvoltage the TOMAHAWK® 625 power source.

GAS INPUT CONNECTIONS

(External Air Supply)

Supply the TOMAHAWK® 625 with clean compressed air or nitrogen.

- Supply pressure must be between 80 psi and 110 psi.
- Flow rate should be approximately 4.0 cfm (113 l/min.).

NOTE: Oil in the air supply to the TOMAHAWK® 625 can cause severe problems. Use only a clean air supply.

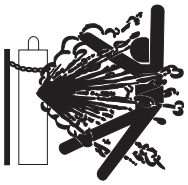
- Compressed gas can be supplied either through the air fitting supplied with the machine or through the 1/4-19 BSPP thread at the rear of the machine. To use the air fitting supplied with the machine (packaged in the consumable kit), apply teflon tape to the fitting threads and install the fitting in the port at the rear of the machine.
- If compressed air is being used, it is highly recommended that an in line filter be installed in the air supply line ahead of the air connection to the TOMAHAWK® 625.
- A standard nominal 5 micron in line filter is recommended; however, for optimum performance, select a prefilter with a 3 micron absolute rating.

If these filter ratings are unavailable, anything with a rating less than, or equal to, 20 micron would be acceptable to use. In line filter elements will generally filter the air with little restriction to the airflow until the element is about 75% contaminated. After this point, there will be a noticeable pressure drop in the line. Filter elements should be replaced when a pressure drop of 8-10 psi is indicated; however, for optimum performance of the TOMAHAWK® 625, the filter element should be replaced at or before the pressure drop reaches 8 psi. Be sure to select a filter that will accommodate the necessary flow rating for the TOMAHAWK® 625 as specified in the Installation section of this instruction manual under the Gas Input Connections heading.

NOTE: When using nitrogen gas from a cylinder, the cylinder must have a pressure regulator.

- Maximum psi from a nitrogen gas cylinder to the TOMAHAWK® 625 regulator should never exceed 110 psi.
- Install a hose between the nitrogen gas cylinder regulator and the TOMAHAWK® 625 gas inlet.

⚠ WARNING



CYLINDER could explode if damaged.
- **Keep cylinder upright and chained to a fixed support.**
- **Keep cylinder away from areas where it could be damaged.**
- **Never lift machine with cylinder attached.**
- **Never allow the cutting torch to touch the cylinder.**
- **Keep cylinder away from live electrical parts.**
- **Maximum inlet pressure 110 psi.**

OUTPUT CONNECTIONS

Torch

The TOMAHAWK® 625 is sent from the factory with a cutting torch and work clamp included. The work clamp must be securely connected to the work piece. If the work piece is painted or extremely dirty it may be necessary to expose the bare metal in order to make a good electrical connection.

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SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

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

FUMES AND GASES can be dangerous.

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

WELDING, CUTTING and GOUGING SPARKS can cause fire or explosion

- Keep flammable material away.
- Do not weld, cut or gouge on containers that have held combustibles.

ARC RAYS can burn.

- Wear eye, ear and body protection.

PLASMA ARC can injure

- Keep your body away from nozzle and plasma arc.
- Operate the pilot arc with caution. The pilot arc is capable of burning the operator, others or even piercing safety clothing.

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

DESCRIPTION

The TOMAHAWK® 625 is a constant current, continuous control plasma cutting power source. It provides superior and reliable starting characteristics, cutting visibility and arc stability. The control system has a safety mechanism to insure that the nozzle and electrode are in place before cutting or gouging. This is extremely important due to the high voltages involved.

The TOMAHAWK® 625 comes standard with an air regulator and pressure gauge. The machine also comes with an input power cord, Hand-held torch with a 20' cable length. Consumables are included with each TOMAHAWK® 625 purchase so that cutting can begin right out of the box. Consumables can also be ordered as individual packages.

The TOMAHAWK® 625 initiates the plasma arc with a simple, yet reliable, touch start mechanism. This system eliminates many of the failure problems associated with hi-frequency start systems.

PREHEAT TEMPERATURE FOR PLASMA CUTTING

Preheat temperature control is not necessary in most applications when plasma arc cutting or gouging. Preheat temperature control may be necessary on high carbon alloy steels and heat treated aluminum for crack resistance and hardness control. Job conditions, prevailing codes, alloy level, and other considerations may also require preheat temperature control. The following minimum preheat temperature is recommended as a starting point. Higher temperatures may be used as required by the job conditions and/or prevailing codes. If cracking or excessive hardness occurs on the cut face, higher preheat temperature may be required. The recommended minimum preheat temperature for plate thickness up to 1/2" (12.7mm) is 70°F (21.1°C).

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USER RESPONSIBILITY

Because design, fabrication, erection and cutting variables affect the results obtained in applying this type of information, the serviceability of a product or structure is the responsibility of the user. Variation such as plate chemistry, plate surface condition (oil, scale), plate thickness, preheat, quench, gas type, gas flow rate and equipment may produce results different than those expected. Some adjustments to procedures may be necessary to compensate for unique individual conditions. Test all procedures duplicating actual field conditions.

DESIGN FEATURES AND ADVANTAGES

The TOMAHAWK® 625 design makes plasma cutting uncomplicated. This list of design features and advantages will help you understand the machine's total capabilities so that you can get maximum use from your machine.

- Light weight and portable design for industrial use.
- Continuous control, 10 - 40 amps.
- Reliable touch start mechanism for plasma arc initiation.
- Rapid arc restrike for fast cutting of expanded metal.
- Input over voltage protection.
- Bright 3.0 second timed pilot arc.
- Purge section on output dial.
- Air regulator and pressure gauge included.
- Internal water separator included.
- Parts-in-Place mechanism to detect proper installation of consumables and torch.
- Preflow/Postflow timing. Preflow is eliminated if arc is re-initiated in Postflow.
- Thermostatic Protection.
- Solid state over-current protection.
- Unique electrode and nozzle design for optimum cooling and long life.

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CUTTING CAPABILITY

The TOMAHAWK® 625 is rated at 40 amps, at 35% duty cycle on a 10 minute basis. If the duty cycle is exceeded, a thermal protector will shut off the output of the machine until it cools to the normal operating temperature.

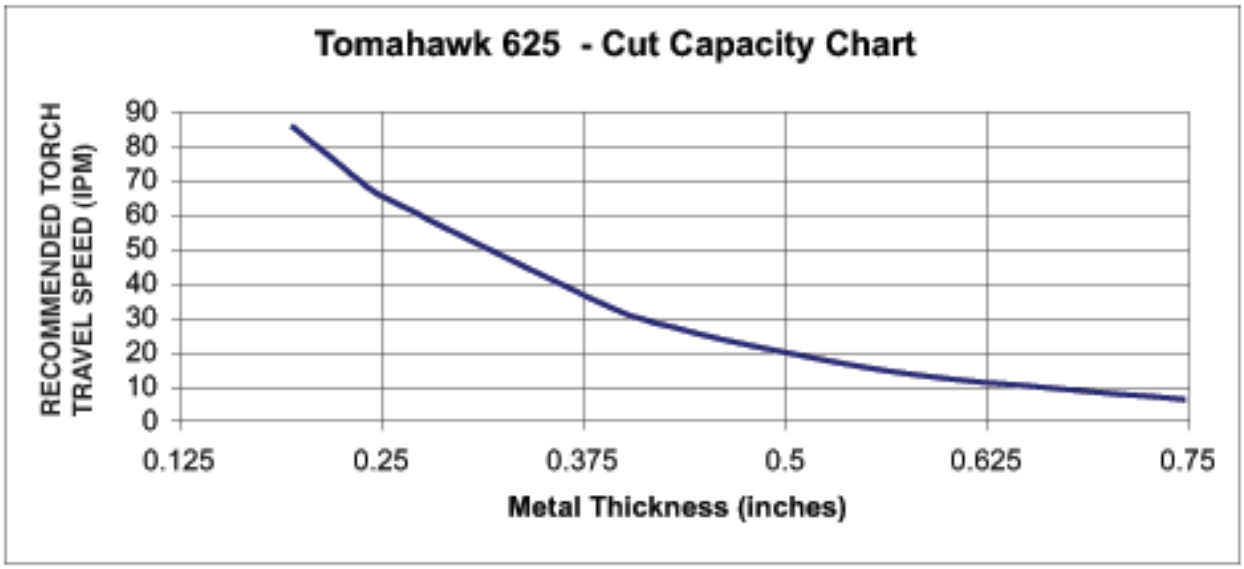
Figure B.1 shows the cut capacity of the TOMAHAWK® 625 when cutting mild steel. (The graph plots cut thickness vs. torch travel speed with a torch standoff of 0.15".)

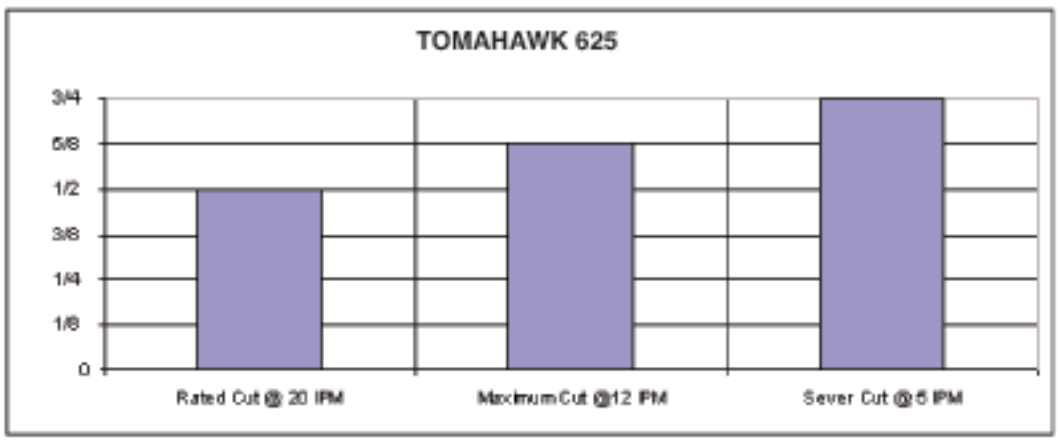
CONSUMABLE LIFE

The expected life for the TOMAHAWK® 625's electrode under normal operating conditions is approximately 1000 starts/cuts. An erosion of .060" is typical for end of electrode life, however, the electrode life may last longer. A green and erratic arc will indicate definite electrode failure and the electrode should be replaced immediately.

It is recommended that consumables be replaced in complete sets. (Example: Electrode and Nozzle). This will maximize the performance of the TOMAHAWK® 625 system.

Figure B.1





LIMITATIONS

Do not exceed output current and duty cycle rating of machine. Do not use the TOMAHAWK® 625 for pipe thawing.

CONTROLS AND SETTINGS

(Figure B.2)

TOMAHAWK® 625 front command panel.

FIGURE B.2

1. **Output Current Knob:** Potentiometer used to set the output current used during cutting. Refer to the Technical Specification section for more information about the machine's rated current range.

   Air Purge: The Output Current Knob completely rotated counterclockwise enables the air purge function. A five minute timeout stops the purge function; this will occur only if the Output Current Knob remains in the purge mode for an extended time.

2. **Power ON/OFF green LED:** Illuminates when the machine is ON.

3. **Output red LED:** See the following table.

4. **Thermal yellow LED:** See the following table.

LEDs Output (Red)	LEDs Thermal (Yellow)	Description
On	Off	The cutting torch is energized.
On	On	**Part in place error:** the retaining cap is not properly Attached. To restore the machine: • Install the torch retaining cap firmly in place. • Wait for 5 seconds; during this time the output and thermal LED's blinks alternately. • After 5 seconds the machine is automatically restored and ready to operate.
Off	On	The machine is overheated and the output has been disabled. This usually occurs when the duty cycle of the machine has been exceeded. Leave the machine On to allow the internal components to cool. When the thermal LED turns off, normal operation is again possible.
Off	Blink	**Power undervoltage error:** the machine is disabled. When the power returns to the correct range, the machine will restart automatically.
Blink	Off	Low air pressure error. To check / adjust the air pressure (see recommended values in the Technical Specifications of this manual): • Put the machine in Purge mode [1]. • Check and adjust the air pressure using the pressure gauge and air pressure regulator knob [6]. • If necessary, check and adjust also the inlet air pressure by adjusting the external compressor.

See more information in the ***Troubleshooting Section under Error Codes***.

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5. **Air Pressure Gauge and Regulator Knob**: Allows regulation and monitoring of the air pressure.

Items 6 thru 9 on the back of the TOMAHAWK® 625 (See Figure B.3)

6. **Fan:** Provides machine cooling. When the machine is switched ON, the fan runs continuously.

7. **Power Switch:** Turns ON / OFF the input power to the machine.

8. **Input cable:** Connects unit to the input power.

9. **Air Inlet**: External Air operating mode only. Compressed Air Connection.

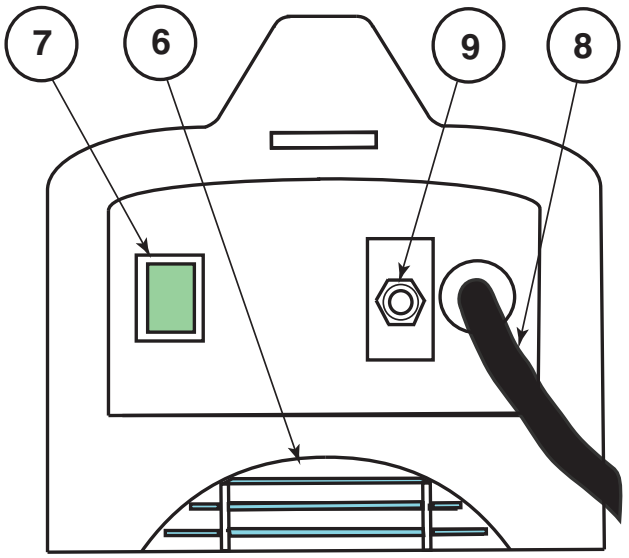
⚠ WARNING

Clean, dry air must be supplied to the machine. A pressure setting above 110 PSI (7.5 bar) could damage the torch. Failure to observe these precautions could result in excessive operating temperatures or damage to the torch.

CUTTING PROCESS

When preparing to cut, position the machine as close to the work as possible. Make sure to have all materials needed to complete the job and have taken all safety precautions. It is important to follow these operating steps each time the machine is used.

FIGURE B.3



Turn the machine's ON/OFF POWER SWITCH to the OFF position.

- Connect the air supply to the machine.
- Turn the main power on and the machine power switch to the ON position.
  - The fan will start.
  - The pre-charge circuit will operate for 3 seconds, then the green "Power" LED will illuminate.
- Attach the work lead clamp to the workpiece before cutting.
- Set the output current control knob to maximum position for higher cutting speed and less dross formation. Reduce the current, if desired to reduce the kerf (cut) width, heat affected zone, or travel speed as required.

  NOTE: If the circuit breaker trips while cutting at higher amperages - reduce the cutting amperage on the unit, or provide an input circuit with higher current capacity.

- Rotate the output knob into the purge zone to check or set the gas pressure. Pull the pressure regulator cap out and turn it to set the pressure.
  - Adjust the gas regulator for 75-80 PSI (0.50-0.55 MPa).
  - Turn the output knob out of the purge zone.
  - The gas will immediately turn off. The pressure gauge may show an increase in pressure after the air turns off but this is normal. Do NOT reset the pressure while the air is NOT flowing.

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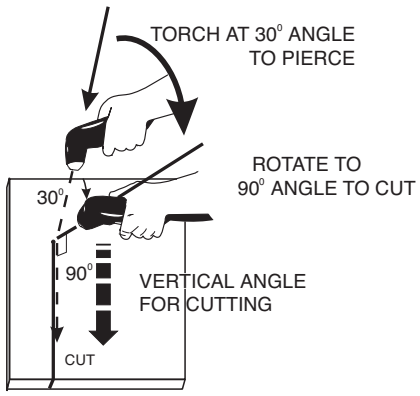
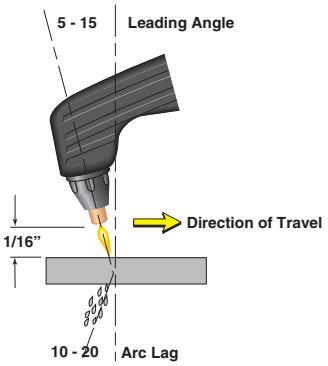
- When ready to cut, place the torch near the work, make certain all safety precautions have been taken and pull the trigger.
  - The air will flow for a preflow time of 2 seconds and the pilot arc will start. (Exceptions: the first time that the trigger is pulled after the machine is turned on, or after a thermal trip out, initial trigger will be ignored. This is a safety feature to prevent the pilot arc from firing unexpectedly or if the torch trigger is inadvertently pressed. The other exception is if the machine is in postflow, then the preflow time is skipped and the pilot arc will start immediately.)
  - The pilot arc will run for 3.0 seconds and shut off unless the arc is brought in contact with the work and the arc is transferred. Avoid excessive pilot arc time by transferring the arc to the workpiece quickly. This will extend consumable life.
  - When the arc is brought within 1/8" - 1/4" from the work piece: the arc will transfer, the current will ramp to the setting on the control panel, and the cut can last indefinitely (or until the duty cycle of the TOMAHAWK® 625 is exceeded).

- Pierce the work piece by slowly lowering the torch onto the metal at a 30° angle away from the operator. This will blow the dross away from the torch tip. Slowly rotate the torch to vertical position as the arc becomes deeper.



- Keep moving while cutting. Cut at a steady speed without pausing. Maintain the cutting speed so that the arc lag is 10° to 20° behind the travel direction.



- Use a 5° - 15° leading angle in the direction of the cut.

- Finish the cut to be made and release the trigger.

- When the trigger is released, the arc will stop.
  - The gas will continue to flow for 15 seconds of postflow. If the trigger is activated within this time period, the pilot arc will immediately restart.

- If the dross is difficult to remove, reduce the cutting speed. High speed dross is more difficult to remove than low speed dross.

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

- **Turn off machine at the disconnect switch on the rear of the machine before tightening, cleaning or replacing consumables.**

- Clean spatter and scale from the nozzle frequently.

TORCH

- During operation, if the Red and Yellow LED's light together:

- Check the assembly of the torch consumables. If they are not properly in place, the machine will not start. **Make sure that the shield cup is hand tight. Do not use pliers or over tighten.**

- Check the conditions of the inside of the nozzle. If debris has collected, rub the electrode on the inside bottom of the nozzle to remove any oxide layer that may have built up. Refer to "Suggestions for Extra Utility from the TOMAHAWK® 625 system".

- Check the condition of the electrode. If the end has a crater-like appearance, replace it along with the nozzle. The maximum wear depth of the electrode is approximately .062". A green and erratic arc will indicate definite electrode failure and the electrode should be replaced immediately.

- Replace the nozzle when the orifice exit is eroded away or oval shaped.
- After the problem is found, or if there is nothing apparently wrong, reset the machine by turning the power switch OFF and then ON again. (It is possible for electrical noise to trip the safety circuit on rare occasions. This should not be a regular occurrence.)
- If the machine does not reset or continues to trip, consult the Troubleshooting Section.
- Use the proper cutting procedures referred to in Procedure Recommendations.

PILOT ARC DISCUSSION

The TOMAHAWK® 625 has a smooth, continuous pilot arc. The pilot arc is only a means of transferring the arc to the workpiece for cutting. Repeated pilot arc starts, in rapid succession, is not recommended as these starts will generally reduce consumable life. Occasionally, the pilot arc may sputter or start intermittently. This is aggravated when the consumables are worn or the air pressure is too high. Always keep in mind that the pilot arc is designed to transfer the arc to the workpiece and not for numerous starts without cutting.

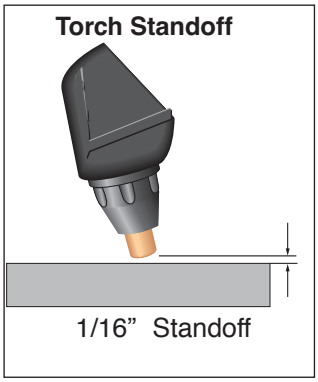
The TOMAHAWK® 625 does not utilize high frequency starting. When the pilot arc is started, a slight impulse will be felt in the torch handle. This occurrence is normal and is the mechanism which starts the plasma arc. This impulse can also be used to help troubleshoot a "no start" condition.

PROCEDURE RECOMMENDATIONS

When properly used, plasma arc cutting is a very economical process. Improper use will result in a very high operating cost.

General - In All Cases

- Follow safety precautions as printed throughout this operating manual and on the machine.
- If piercing is required, slowly lower the torch at an angle of about 30° to blow the dross away from the torch tip and slowly rotate the torch to a vertical position as the arc becomes deeper. This process will blow a lot of molten metal and dross. Be careful! Blow the dross away from the torch, the operator and any flammable objects.
- The nozzle should not be dragged on the metal surface. A drag spacer is provided to maintain a consistant touch height. Refer to Touch Parts Configurations in this Section.



- Where possible, start the cut from the edge of the work piece.
- Keep moving! A steady speed is necessary. Do not pause.

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Suggestions for Extra Utility from the TOMAHAWK® 625 System:

⚠ WARNING

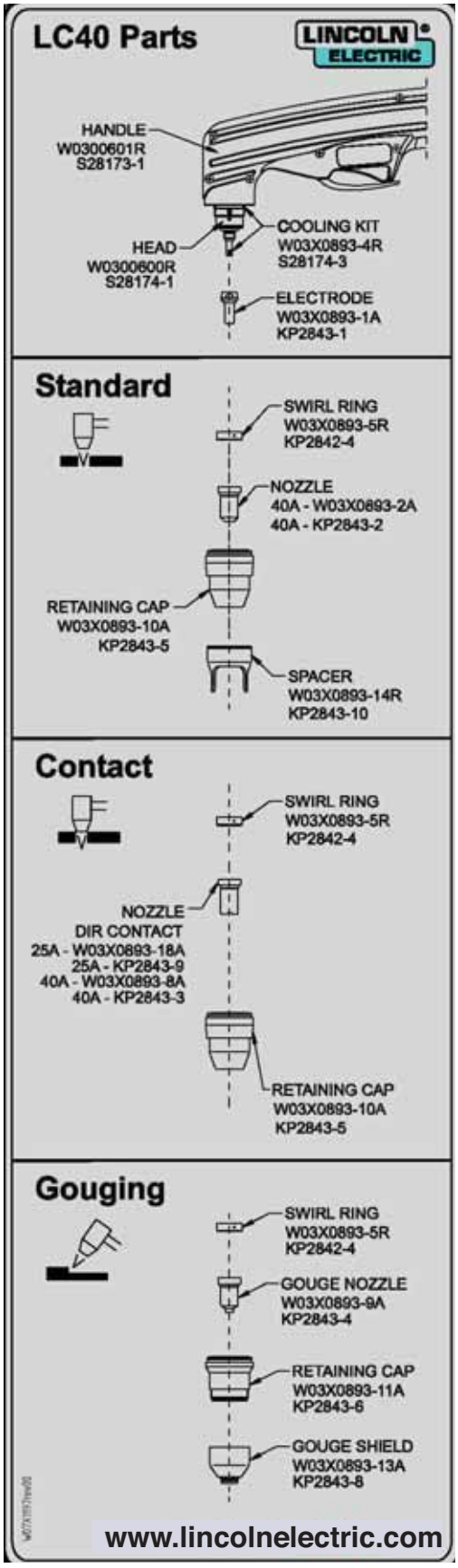
ELECTRIC SHOCK CAN KILL.

- Turn off machine at the disconnect switch on the rear of the machine before tightening, cleaning or replacing consumables.

1. Occasionally an oxide layer may form over the tip of the electrode, creating an insulating barrier between the electrode and nozzle. This will result in the tripping of the TOMAHAWK® 625's safety circuit. When this happens turn the power off, remove the nozzle and electrode and use the electrode to rub against the inside bottom surface of the nozzle. This will help remove any oxide buildup. Replace the nozzle, turn on the power and continue cutting. If the safety circuit continues to trip after cleaning the consumables, then replace them with a new set. Do not continue to try and cut with excessively worn consumables as this can cause damage to the torch head and will degrade cut quality. Do not allow torch cable or body to contact hot surface.

2. To improve consumable life, here are some suggestions that may be useful:

   - Make sure the air supply to the TOMAHAWK® 625 is clean and free of oil. Use several extra in line filters if necessary.
   - Minimize dross buildup on the nozzle tip by starting the cut from the edge of the plate when possible.
   - Pierce cutting should be done only when necessary. If piercing, angle torch about 30° from the plane perpendicular to the work piece, transfer the arc, then bring the torch perpendicular to the work and begin parallel movement.
   - Reduce the number of pilot arc starts without transferring to the work.
   - Reduce the pilot arc time before transferring to the work.
   - Set air pressure to recommended setting. A higher or lower pressure will cause turbulence in the plasma arc, eroding the orifice of the nozzle tip.
   - Use only Lincoln consumable parts. These parts are patented and using any other replacement consumables may cause damage to the torch or reduce cut quality.

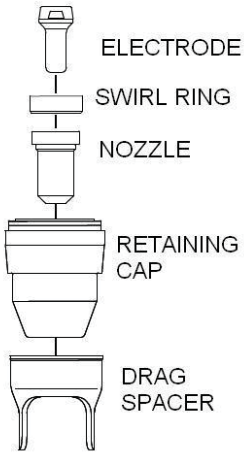


TORCH PART CONFIGURATIONS

There are different torch configurations depending on the cutting or gouging application.

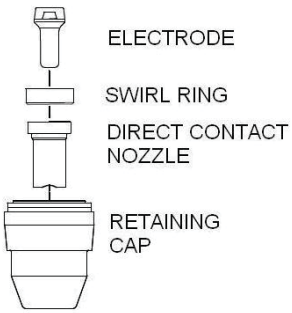
Standard Cutting Setup:
In the Standard Cutting configuration the nozzle is designed not to touch the work piece. The advantage of this cutting method is good visibility of the arc. However it requires a steady hand to avoid touching the nozzle to the work piece which will cause premature nozzle wear and a jagged cut. An optional drag spacer can be attached to the retaining cap to maintain a consistent arc height.

STANDARD



Contact Cutting Setup:
Contact Cutting uses special expendable parts that allow the torch to touch the work piece. The advantage of contact cutting is that the torch can touch the work piece, steadily dragging it across the surface. The disadvantage of contact cutting is the plasma arc is not as visible as with a standard torch set-up. Since this machine cuts at 40 amps or less it uses the direct contact torch configuration which allows a special nozzle to come in contact with the work piece.

DIRECT CONTACT



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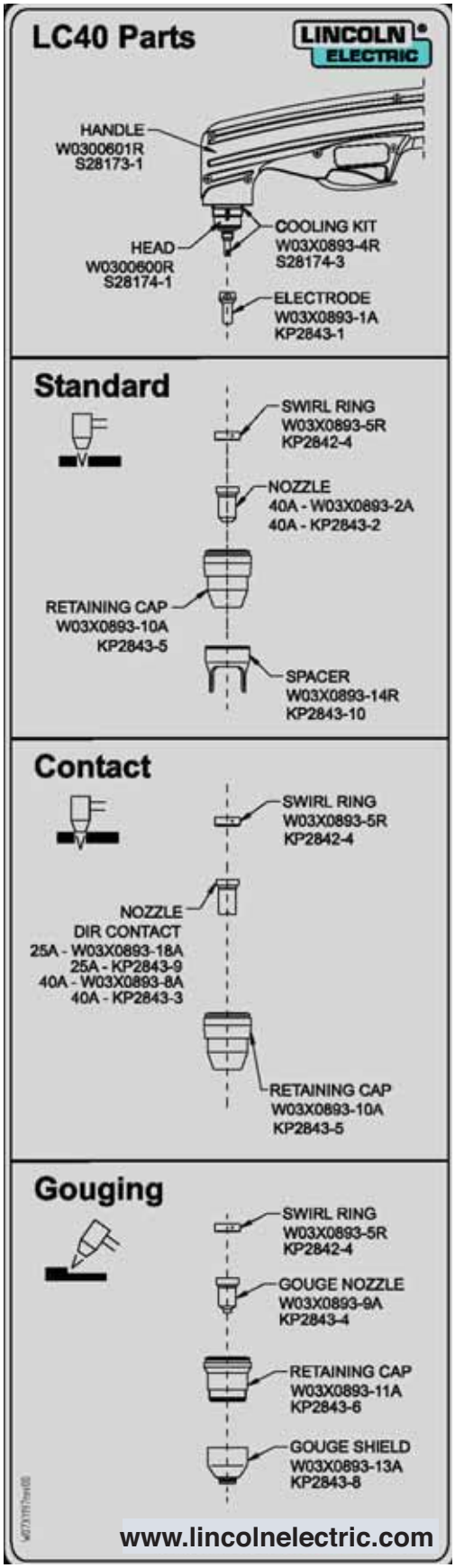
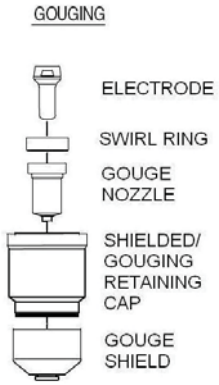


Gouging Setup:

If gouging metal and not cutting completely through the part is required, a special gouging nozzle is used in conjunction with a gouge shield to protect the nozzle from molten metal blow back.



Refer to the torch parts decal located on your machine or the parts pages at the back of this manual for the specific part numbers required for each of these setups.

ALWAYS USE GENUINE LINCOLN ELECTRIC ELECTRODES, NOZZLES, AND EXPENDABLE PARTS FOR THE BEST CUTTING PERFORMANCE.

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GENERAL OPTIONS /ACCESSORIES

The following options/accessories are available for your Tomahawk® Plasma cutter from your local Lincoln Distributor.

K2377-1 - Small Canvas Cover
Protect your machine when not in use. Made from attractive red canvas that is flame retardant, mildew resistant and water repellent. It includes a convenient side pocket to hold the plasma torch.

K2886-1 - Plasma Circle Cutting Kit
For cutting circles from 3” to 33” in diameter (77mm to 838mm).

TORCHES

The following replacement torch is available:

K2847-1 LC40 Handheld Plasma Torch 20' (6m)

EXPENDABLE PARTS

Refer to the torch parts decal located on your machine or the parts pages at the back of this manual for the specific part numbers required for each of the available setups.

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⚠ 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.**

ROUTINE MAINTENANCE

1. Keep the cutting or gouging area and the area around the machine clean and free of combustible materials. No debris should be allowed to collect which could obstruct air flow to the machine.

2. Every 6 months or so, the machine should be cleaned with a low pressure airstream. Keeping the machine clean will result in cooler operation and higher reliability. Be sure to clean these areas:

   - Printed circuit boards and heat sinks
   - Power switch

⚠ CAUTION

- **When using a low pressure air stream, wear appropriate eye protection.**

3. Examine the sheet metal case for dents or breakage. Repair the case as required. Keep the case in good condition to insure that high voltage parts are protected and correct spacings are maintained. All external sheet metal screws must be in place to insure case strength and electrical ground continuity.

4. Inspect the cable periodically for any slits or puncture marks in the cable jacket. Replace if necessary. Check to make sure that nothing is crushing the cable and blocking the flow of air through the air tube inside. Also, check for kinks in the cable periodically and relieve any so as not to restrict the flow of air to the torch.

PERIODIC MAINTENANCE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.
- **Turn off machine at the disconnect switch on the rear of the machine before tightening, cleaning or replacing consumables.**

Change consumables as required.

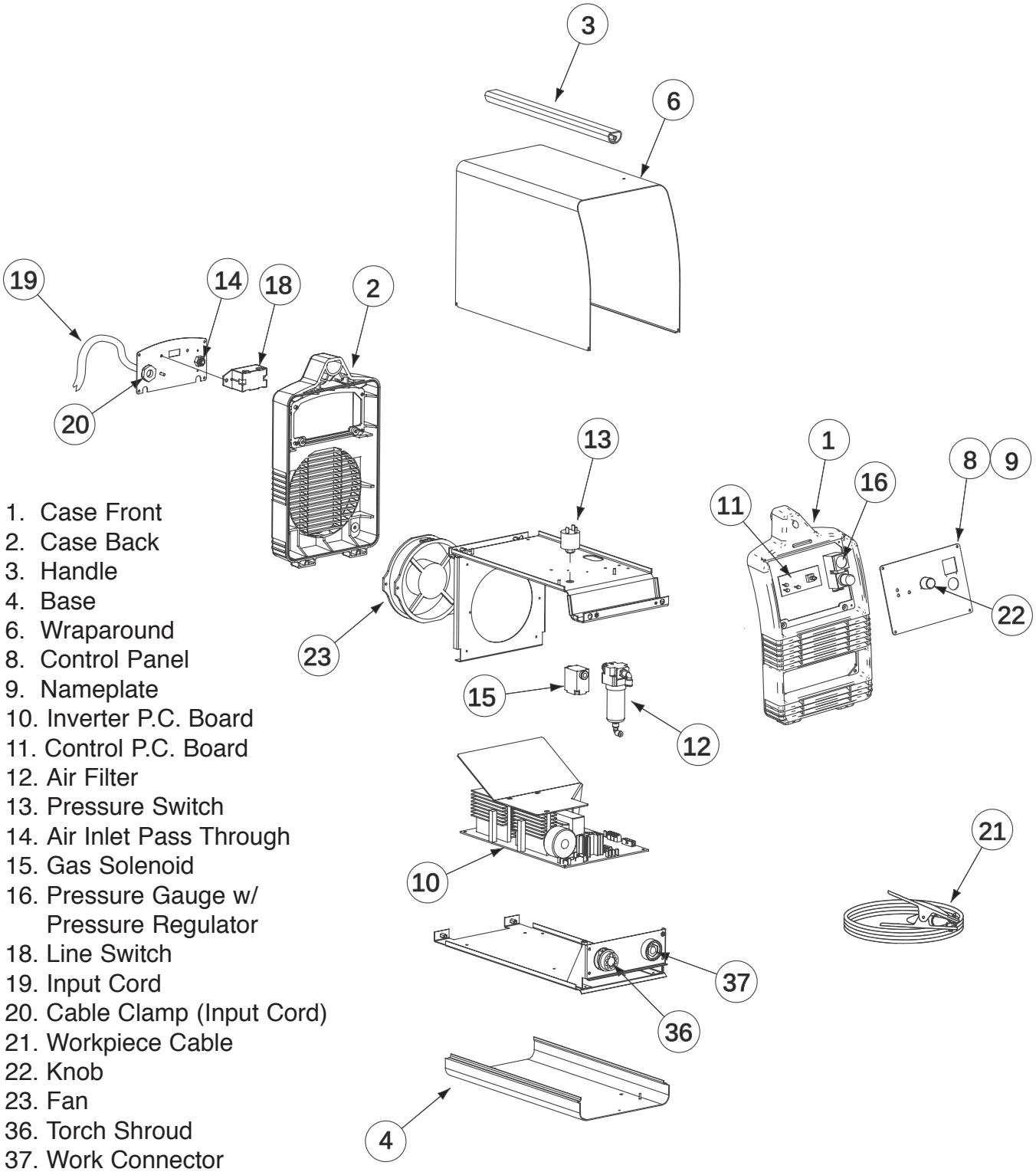
THERMAL PROTECTION

Thermal Detection Devices protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperatures should occur, the yellow thermal LED will light and the Detection Devices will prevent output voltage or current.

These Detection Devices are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating normally, the Power Switch may be left on and the reset should occur within a 15 minute period. If the fan is not turning or the air intake louvers were obstructed, then the power must be switched off and the fan problem or air obstruction must be corrected.

A protection circuit is included to monitor the voltage across filter capacitors. In the event that the capacitor voltage is too high, the protection circuit will prevent output.

FIGURE D.1 MAJOR COMPONENT LOCATIONS



1. Case Front
2. Case Back
3. Handle
4. Base
6. Wraparound
8. Control Panel
9. Nameplate
10. Inverter P.C. Board
11. Control P.C. Board
12. Air Filter
13. Pressure Switch
14. Air Inlet Pass Through
15. Gas Solenoid
16. Pressure Gauge w/ Pressure Regulator
18. Line Switch
19. Input Cord
20. Cable Clamp (Input Cord)
21. Workpiece Cable
22. Knob
23. Fan
36. Torch Shroud
37. Work Connector

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FIGURE E.1 BLOCK LOGIC DIAGRAM

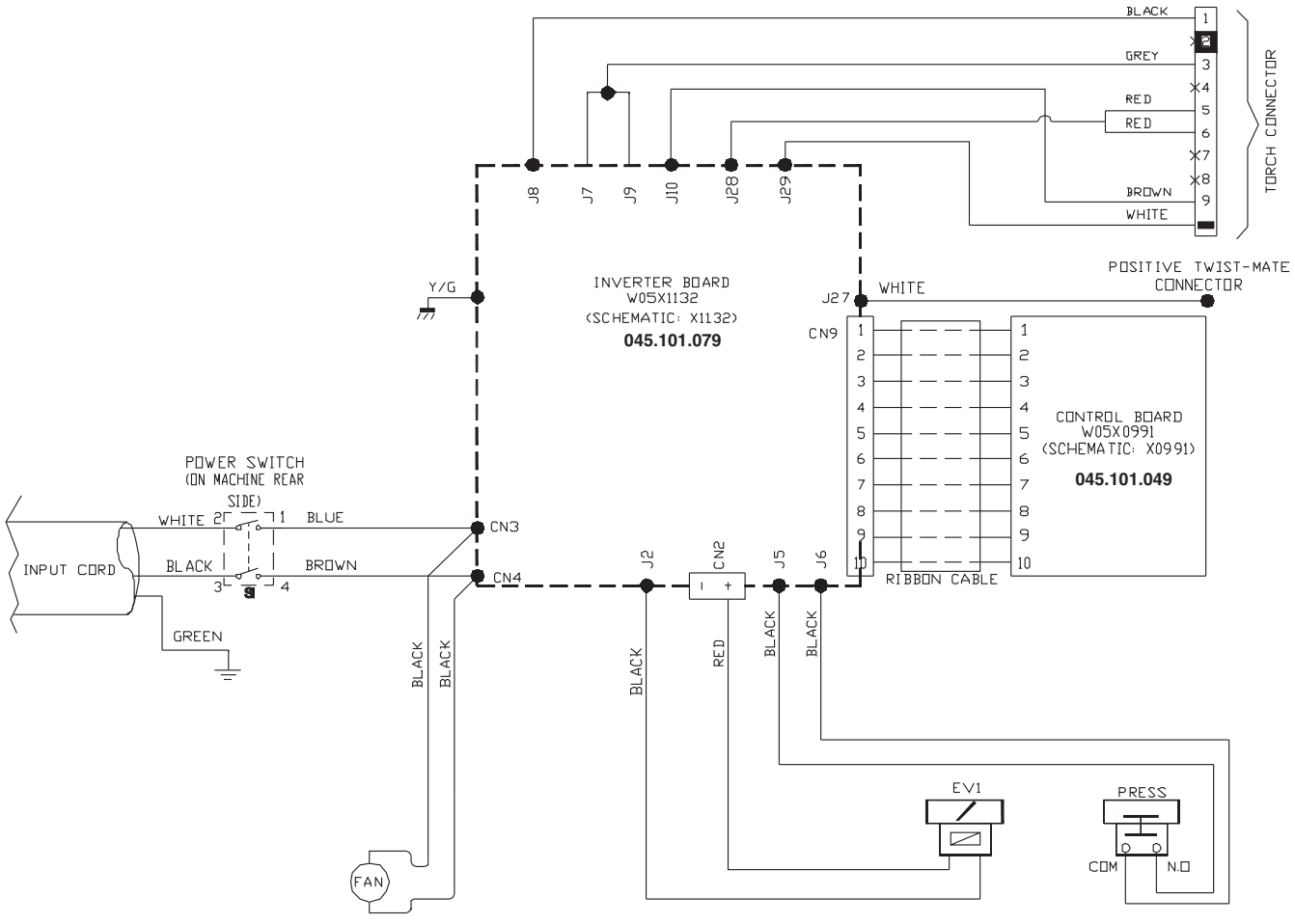
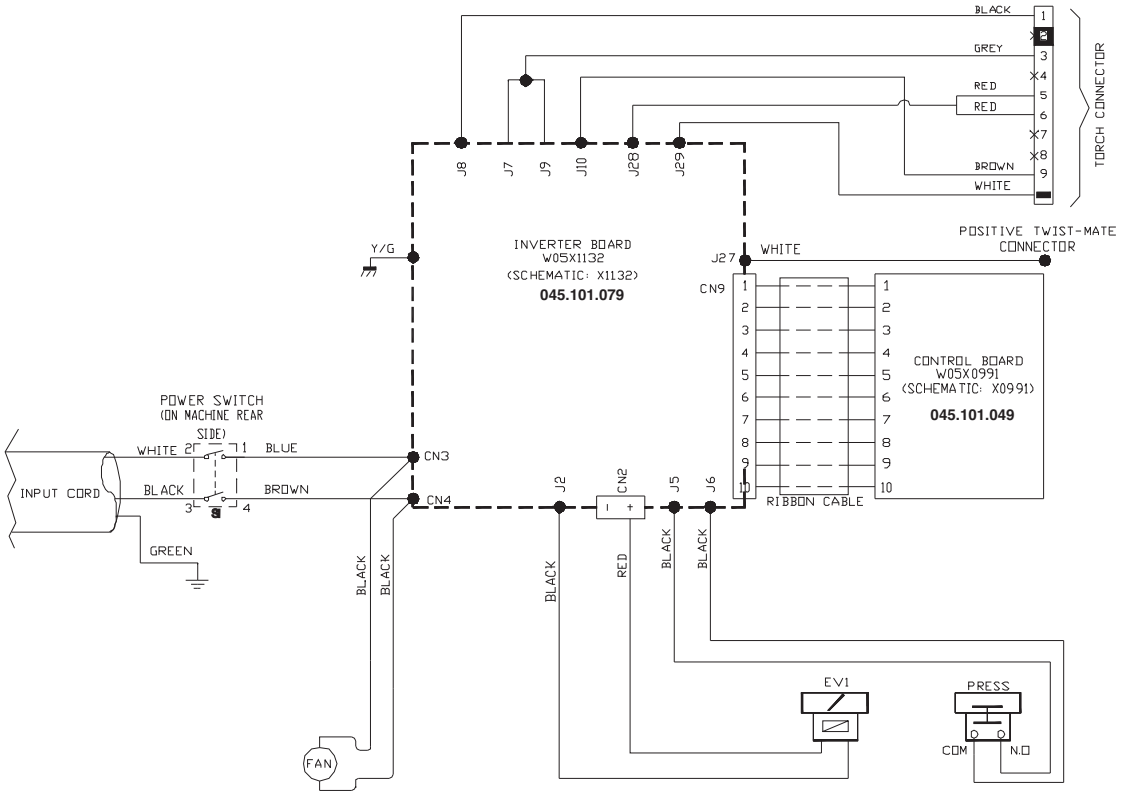


FIGURE E.2 - GENERAL DISCRIPTION



GENERAL DESCRIPTION

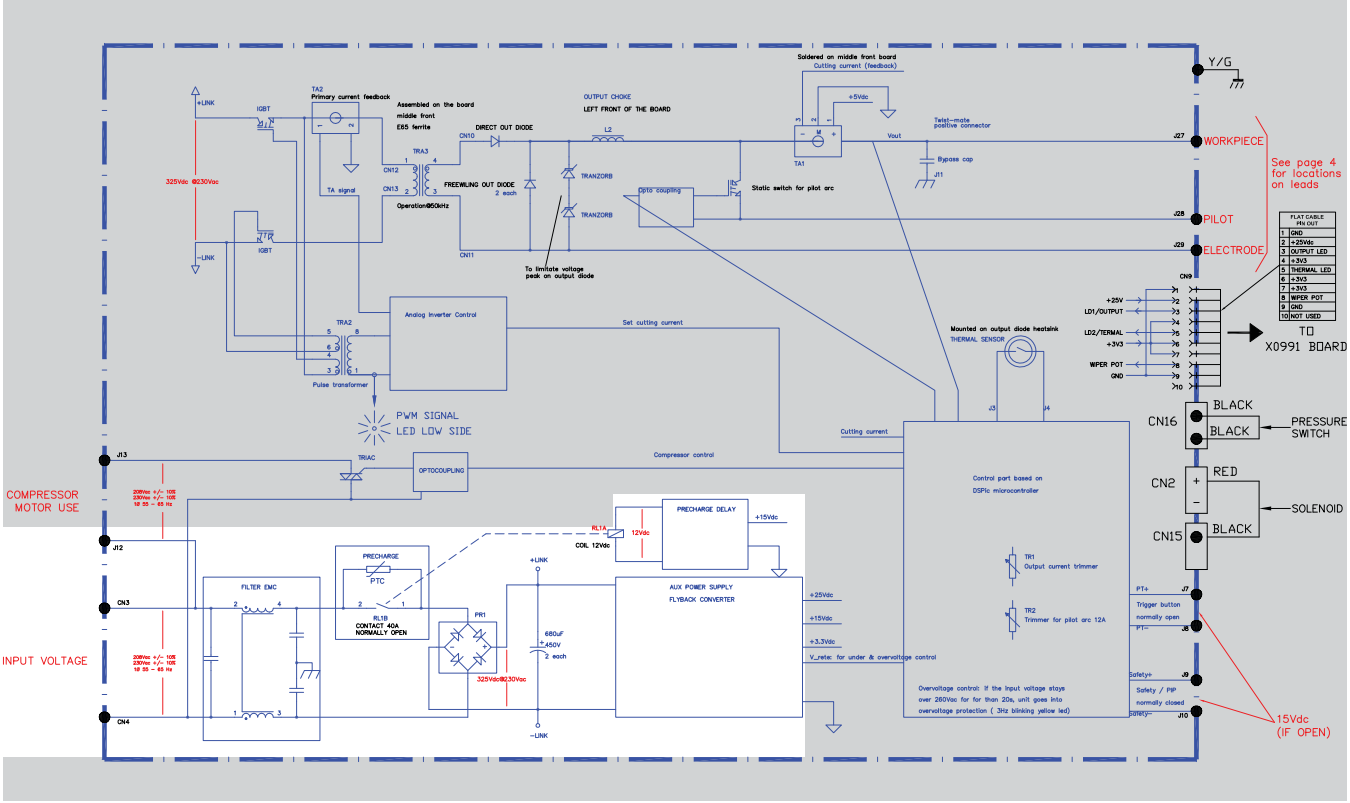
The Tomahawk® 625 is an inverter based constant current, continuous control, plasma cutting power source. The control system has a safety mechanism to insure that the torch nozzle and electrode are correctly in place before cutting or gouging. The Tomahawk® 625 has the capabilities to cut metal material such as mild steel, aluminum or stainless steel up to 5/8 inch thick. The input voltage requirement is 208-230VAC at 60Hz. The output voltage is DC positive on the work piece and torch nozzle.

The main elements of the machine are:

- Inverter Board
- Control Board
- Torch

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

FIGURE E.3 - INVERTER BOARD



INVERTER BOARD

This machine is designed on the “single board” concept in which all of the electronic devices are housed on one printed circuit board.

The single phase input voltage (208-230VAC) is connected to the Tomahawk® inverter board via an input cord and power switch located on the back of the machine. The input power is applied first to a filter circuit and then to a pre-charge relay circuit. This pre-charge circuit limits the in-rush current through the input rectifier so that the input capacitors are charged in a controlled manner. When the pre-charge sequence is completed the pre-charge relay closes connecting full input power to the filter capacitors. This rectified and filtered DC voltage (325VDC @ 230VAC input) is used to power the half-wave bridge circuit and generate several DC voltages for the on board CPU and electronics.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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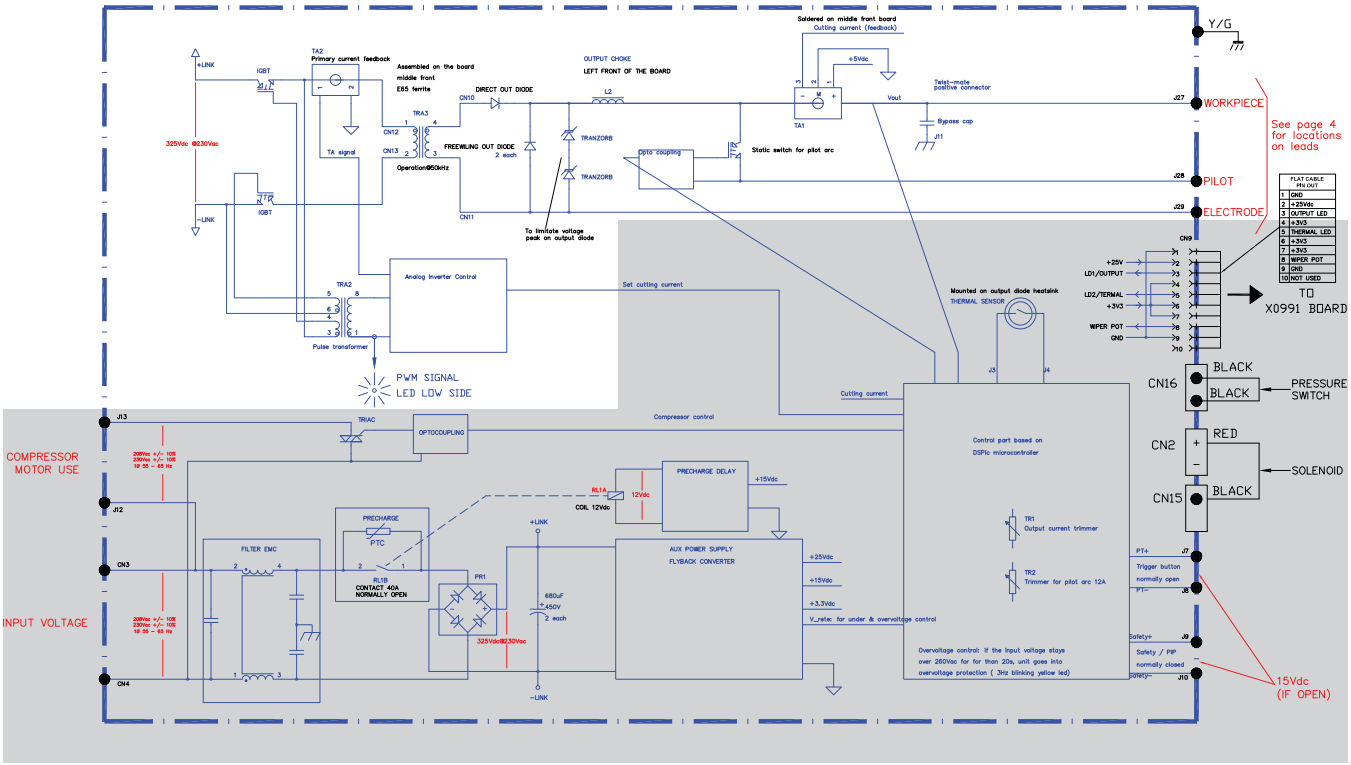
FIGURE E.4 - INVERTER BOARD



INVERTER BOARD (continued)

The 325VDC developed at the input bridge and filter capacitors is applied to a half–bridge inverter circuit that utilizes high speed switching transistors. These Insulated Gated Bipolar Transistors (IGBT) operate at 50kHz. and are controlled by the analog inverter control circuit. A green LED provides an indication that the analog inverter control is sending a firing signal to the IGBTs. The output of the IGBTs is pulse width modulated and applied to the primary winding of the ferrite core power transformer. When the current is pulsed through this primary winding, a resultant current is produced on the secondary winding of the power transformer. The DC current flow through the primary winding is redirected or “clamped” back to the filter capacitors when the IGBTs are turned off. This function is required due to the inductance of the transformer’s primary winding.

The secondary winding supplies the electrode-to-nozzle (pilot arc) and the electrode-to-work (cutting arc) voltages and the resulting currents. The secondary voltage is rectified and filtered and applied to the torch and work piece for cutting and pilot arc. The pilot arc is turned on and off by an IGBT. The cutting output is regulated via the pulse width modulation applied to the primary winding.

The primary current passes through the primary current feedback device that sends a signal to the analog inverter control circuit. This feedback information and the analog inverter control signal limit the maximum primary current flow through the IGBTs.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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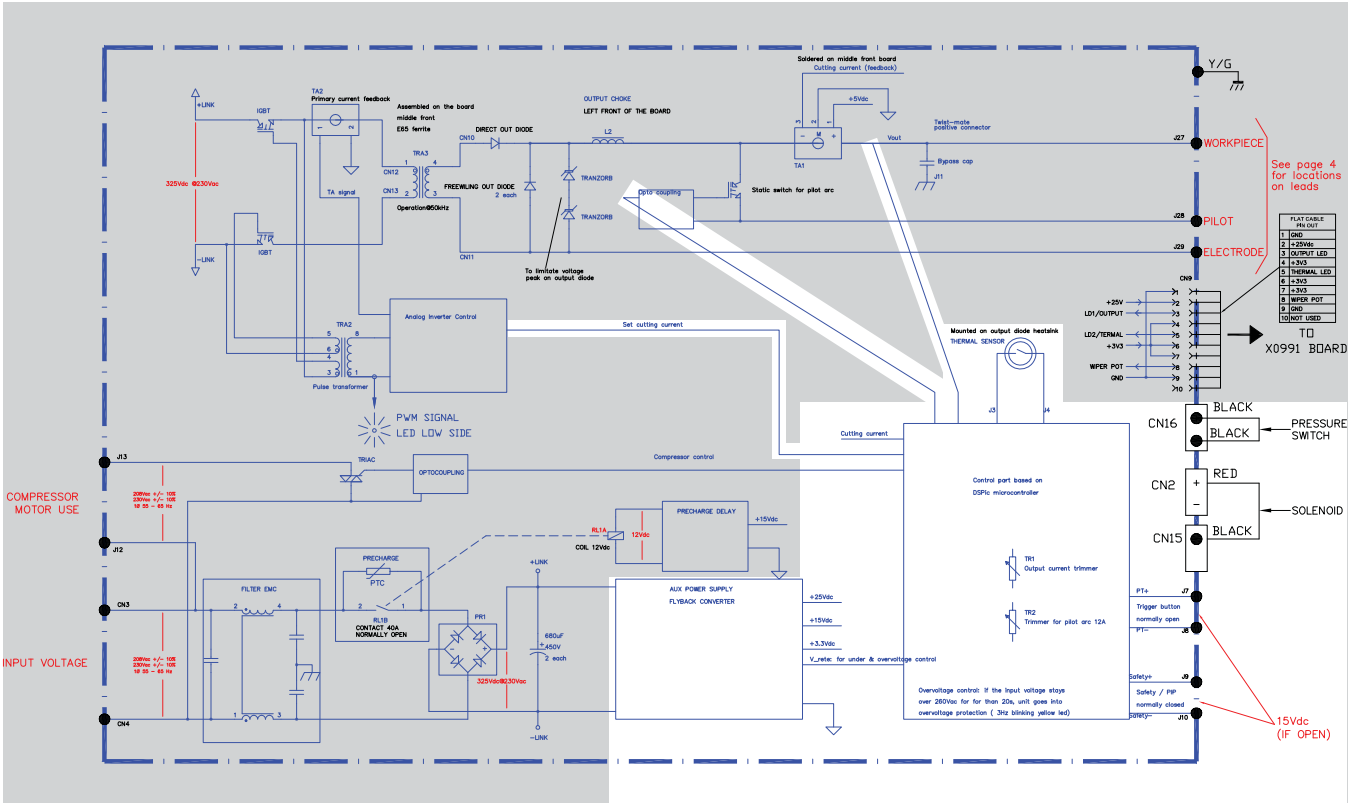
FIGURE E.5 - INVERTER BOARD



INVERTER BOARD (continued)

There are several other functions and circuits housed on the Inverter Board. The flyback circuit utilizes the (325VDC @ 230VAC) input to generate the auxiliary power supplies (25VDC, 15VDC, and 3.3VDC) for the machine's internal electronic circuitry.

The output cutting current is monitored on the Inverter Board by the TA current transformer. This output feedback information is sent to the Digital Signal Processor Microcontroller where it is compared to the output command signal received from the control board. The cutting output signal is then sent to the Analog Inverter Control. The circuitry associated with the Digital Signal Processor also monitors the input voltage for over or under input voltage conditions. The torch safety "parts-in-place" and trigger circuits are also connected to and monitored by the Inverter Board.

In the case of an overheating condition the thermal sensor (located on the output diode heatsink) will shut down the machine and prevent output.

The Inverter Board monitors the air pressure and controls the air solenoid.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

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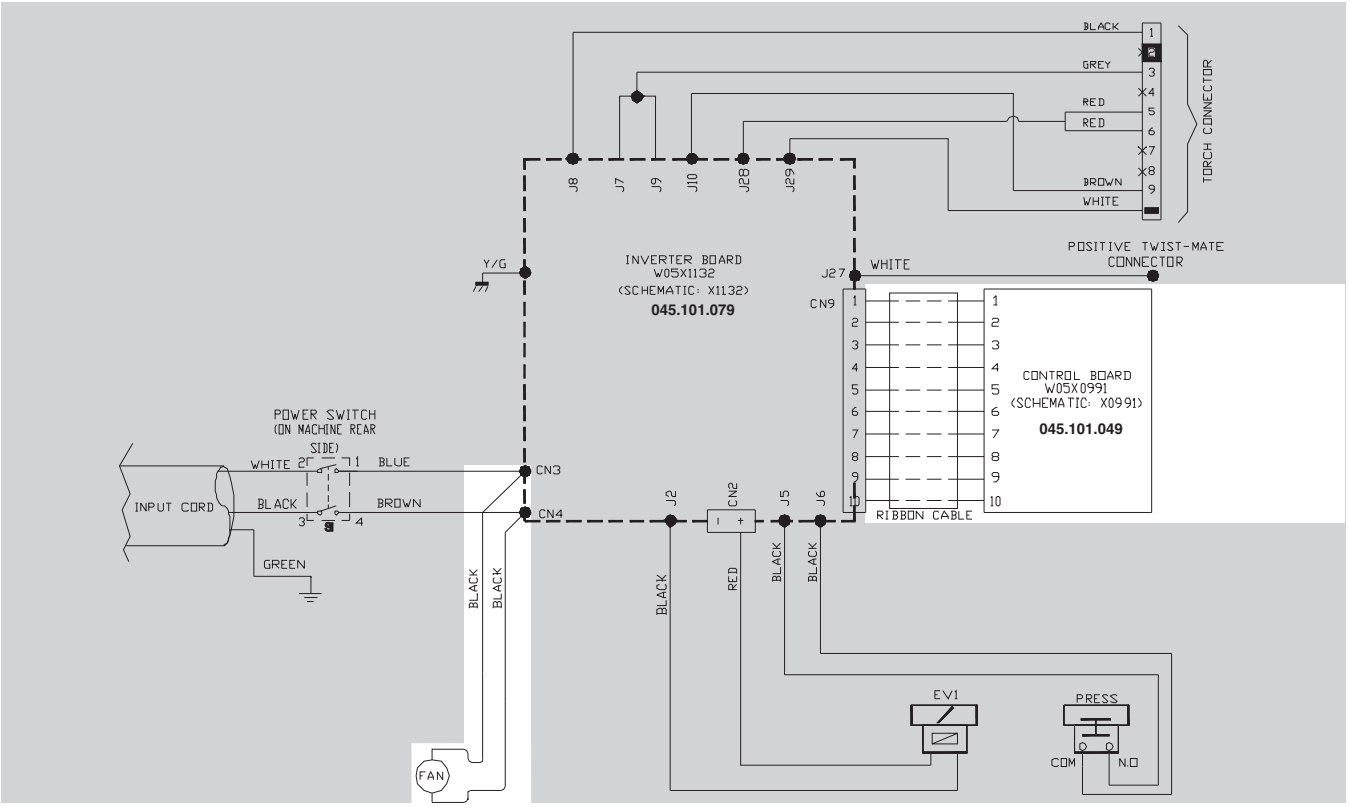
FIGURE E.6 - CONTROL BOARD AND FAN MOTORS



CONTROL BOARD AND FAN MOTORS

The control board is located on the front panel of the Tomahawk® 625 machine. The function of this board is to house the current setting potentiometer and three signal LED's. The supply voltages and signals are communicated between the control board and the inverter board by a flat ten lead cable.

The different combinations of a steady or blinking LED provides the user with several conditions of the machine's operation and status.

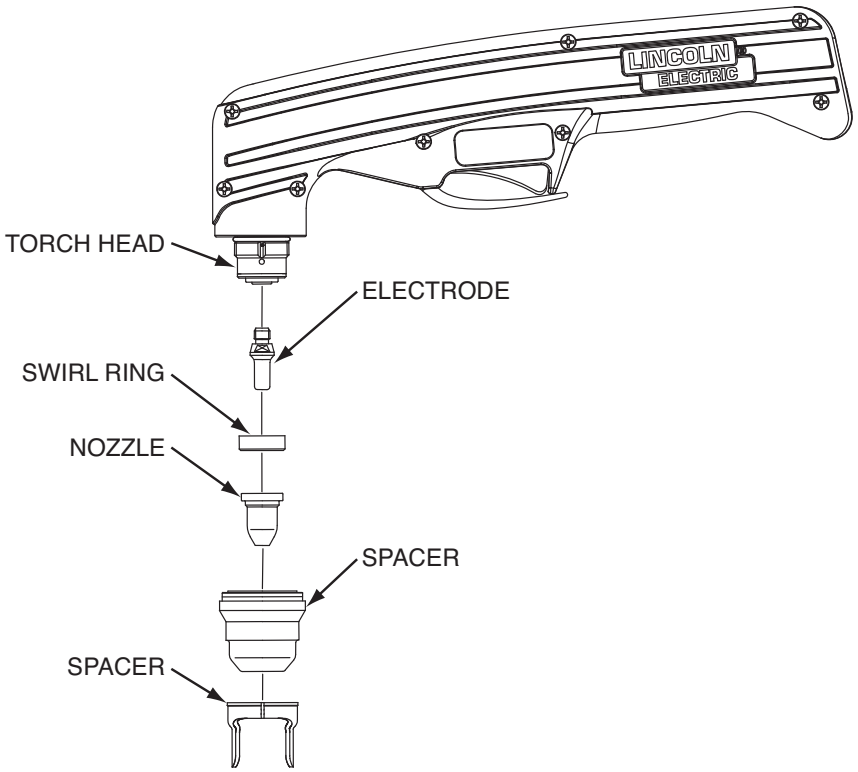
The steady green LED indicates that the input power is applied and the machine is on.

The cooling fan is operated by the input line voltage and is energized whenever the power switch is turned on.

RED LED	YELLOW LED	MEANING
ON	OFF	The cutting torch is energized.
ON	ON	Torch parts in place error.
OFF	ON	The machine is over-heated and the output has been disabled.
OFF	BLINKING	Input under or over voltage. Output has been disabled.
BLINKING	OFF	Low air pressure error. Output has been disabled.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

FIGURE E.7 - TORCH ASSEMBLY AND WORK LEAD



TORCH ASSEMBLY AND WORK LEAD

The torch assembly and work lead are connected to the machine via the front panel. This torch is designed to provide the best cutting performance and excellent consumable life.

The torch head components are the electrode, swirl ring, nozzle, retaining cap and spacer. This torch has a lift pilot arc striking system which means that during the idle state the electrode and nozzle are touching and shorted together. As soon as the torch trigger is activated the pilot current flows through the electrode and nozzle. When the air flow arrives at the torch head the electrode is “pulled” back and the pilot arc is established between the electrode and nozzle. As the torch is brought closer to the work the pilot arc transfers to the work piece and the cutting arc is established.

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TABLE OF CONTENTS - TROUBLESHOOTING AND REPAIR

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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 listed below.

Step 1. LOCATE PROBLEM (SYMPTOM).
Look under the column labeled "PROBLEM (SYMPTOMS)". This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into the following categories: output 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 tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. RECOMMENDED COURSE OF ACTION
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 that 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 of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the specified test points, components, terminal strips, etc. can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ 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 1-888-935-3877.

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

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that 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 electricity.

ATTENTION Static-Sensitive Devices Handle only at Static-Safe Workstations

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.

- If you don't have a wrist strap, touch an un-painted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.

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

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

- If the PC board uses protective shorting jumpers, don't 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 proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement 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 that 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 indicate that this procedure was followed when 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.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Input circuit breaker trips repeatedly.	1. This may be normal. If output is set to maximum, a 30 amp circuit is required. See ***Technical Specification*** page. 2. Install a larger input circuit or turn the output control to a lower amperage.	1. Perform the ***Inverter Board Test***.
No Status indicators light and the fan does not operate 5 seconds after the power switch is turned on.	1. Check the input power to be sure it is on and correct (208 - 230VAC). 2. Check the power line fuses, breakers and machine connection.	1. Disconnect input power at fuse/breaker panel and check line switch continuity. Replace line switch if bad.
No Status indicators light 5 seconds after the power switch is turned on, but the fan operates.	1. Possible faulty Inverter Board.	1. Perform the ***Inverter Board Test***.
The Thermal LED does not go out.	1. Make sure the fan is operating properly. 2. Check consumables - Thermal and output LED's light when an unsafe condition exists at the torch.	1. Perform the ***Torch LC40 Test***. 2. Possibly faulty Inverter 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 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The TOMAHAWK® 625 powers up properly but there is no response when the trigger is pulled and only the POWER LED is lit.	1. Turn the output knob to purge zone on the front of the TOMAHAWK® 625. If air does not flow, then: • The main gas solenoid assembly/pressure sensor may be faulty. Check or replace. 2. Remove the handles (or barrel) of the torch and examine all the connections.	1. Perform the ***Air Solenoid Test***. 2. Perform the ***Inverter Board Test***. 3. Perform the ***Torch LC40 Test***. 4. Perform the ***Control Potentiometer Test***.

⚠ 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 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
When the trigger is pulled air begins to flow, but there is no pilot arc after at least 3 seconds.	1. Check the torch consumables to be sure they are not dirty or greasy, and are in good shape. Replace the consumables if necessary. 2. Make sure the air pressure is set correctly. 3. Try increasing & decreasing the pressure. Gauge may not be reading correctly. Test in both cases. 4. Make sure there are no kinks or restrictions for air flow in the torch cable. Replace cable as needed. 5. If a slight thump cannot be felt in the torch when the trigger is pulled, check for loose connection in the torch head.	1. Perform the ***Inverter Board Test***. 2. Perform the ***Torch LC40 Test***.
The air begins to flow and there is a very brief arc that snaps out consistently with repeated trigger pulls.	1. Check the torch consumables to be sure they are in tight, not dirty or greasy and in good shape. Replace if necessary. 2. Make sure the air pressure is set correctly.	1. Perform ***Inverter Board Test***. 2. Perform the ***Torch LC40 Test***.
The arc starts but sputters badly.	1. Check the torch consumables to be sure they are in tight, not dirty or greasy and in good shape. Replace if necessary. 2. Check air supply for oil or a great deal of water. If there is oil or a great deal of water, the air must be filtered or the machine switched to nitrogen or bottled air. 3. Make sure the air pressure is set correctly.	1. Perform the ***Pressure Switch Test***.

⚠ 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 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Pilot arc starts but will not transfer when brought near work.	1. Check work lead for clean, secure connection. 2. Plasma will only cut conductive material. Do not attempt to cut fiberglass, plastic, rubber, PVC or any other non-conductive material. 3. Make sure work piece is clean and dry. Remove any scale, rust or dross. 4. Check all connections to inverter board.	1. Inspect or replace the work lead & clamp if looks defective or questionable for current carrying abilities. 2. Possible faulty inverter board.
Poor consumable life.	1. Check for moisture/oil in air.	1. Go to external, bottled or nitrogen air supply.
Poor cutting performance.	1. Check internal air line (filter should be the color white) located in the oil water trap. Replace if necessary. 2. Try bottled air or a bottle of nitrogen gas to purge line inside machine.	1. Check all air lines for blockages or restrictions.

⚠ 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 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No pilot arc or hard to establish a pilot arc. No thumping is felt in the torch when air is supplied.	1. Check for air supply to drop around .05 MPA (15PSI) during purge mode or a trigger pull. If the pressure only drops a few PSI, there is a clog in the air supply to the torch head.	1. Torch head may be clogged. Try the suspected bad torch on a known good machine to see if it is a torch head problem or torch cable. 2. Check for loose, disconnected or kinked air lines. Look for a dirty air line filter. See "The arc starts but sputters badly" symptoms course of actions. 3. Perform the ***Torch LC40 Test.***
Excessive dross (slug) on bottom of plate or cut plate does not drop off smoothly.	See provided chart for correct travel speed. ***See Figure B.1***.	

⚠ 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 1-888-935-3877.

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ERROR SIGNALS

Alarm (abnormal condition)	RED LED	YELLOW LED	Blinking frequency (Hz)	Reset mode	NOTE
Undervoltage	**OFF**	**Blink**	1	Autoreset with hysteresis.	Error and shutdown when the input voltage is less than 187Vac.
Overvoltage signal	**Blink**	**OFF**	4	Autoreset with hysteresis.	Error when the input voltage is greater than 270Vac.
Underpressure	**Blink**	**OFF**	1	Autoreset.	Error and shutdown when the input air pressure is low.
PIP (Parts In Place)	**ON**	**ON**	steady on	Autoreset after 5sec.	Error and shutdown when the retaining cap is not attached properly.
Thermal Shutdown	**OFF**	**ON**	steady on	Autoreset after cooling time.	Normal thermal response due to overheating.
OCV	**Blink**	**Blink**	1	Autoreset after trigger release.	Safe Mode - if trigger is pulled while turning the machine on, or attaching consumables with the trigger pulled.
Overvoltage shutdown	**OFF**	**Blink**	3	Autoreset after 2min of cooling time.	This shutdown occurs if the machine cuts for more than 20sec in overvoltage condition (Vin>270Vac).

Signal (normal operation)	GREEN LED	RED LED	Blinking frequency (Hz)	Reset mode	NOTE
Power on	**ON**	**OFF**	steady on	Always on when the machine is energized.	Normal operating condition when trigger is off.
Inverter on	**ON**	**ON**	steady on	When the torch trigger is released.	Normal operating condition when trigger is pulled.

Observe Safety Guidelines detailed in the beginning of this manual.

STATUS BOARD INDICATORS

SYMPTOM	CHECK
Red output LED is blinking or steady with no air flow at trigger pull.	1. Make sure there is at least 80 psi connected to the gas connection at the back of the machine. 2. Turn the output knob to the purge zone and set the regulator to the correct pressure. The pressure may increase when air stops flowing but this is normal. Do not reset the pressure while the air is OFF. 3. Possible faulty Pressure Switch. Perform ***Pressure Switch Test***. 4. Possible faulty Inverter board.
The Green, Red and Yellow LED's are lit and steady. Indicates safety circuit is open.	1. Turn the power OFF and then ON. If torch and consumables are properly installed and they are the correct parts, the Red and Yellow LED's should turn off. Normal cutting or gouging can resume.
The Thermal LED is lit.	1. The machine's thermostat has tripped due to exceeded duty cycle limits. Do NOT turn the power off. Allow the machine to cool for 15 - 30 minutes and the thermostat will reset itself. 2. The machine's air louvers or fans are obstructed such that air cannot flow to properly cool the machine. Remove any foreign material that may block air flow. Blow the machine out with a clean, dry air stream. 3. The input voltage is not within ±10% of rated values. 4. Possible faulty Inverter board.
When the trigger is pulled the Red and Yellow LED's are blinking together and the Green light is on.	1. Check that nozzle and swirl ring are properly installed and they are the correct parts. **NOTE:** Swirl ring can only go in one way, must fit snug in torch head.
When the trigger is pulled the Red LED is lit, air flows and no pilot arc occurs.	1. Check that the swirl ring is properly installed. **NOTE:** Swirl ring can only go in one way.
The Red and Yellow LED's are blinking alternately.	1. The torch safety circuit has been opened, when reconnected this condition should reset automatically.
When the trigger is pulled no air flows, Red LED is lit, no pilot arc. Then LED goes out.	1. Check that the pressure gauge shows pressure. Air supply may not be connected or properly installed.

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CASE WRAPAROUND REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Case Wraparound.

MATERIALS NEEDED

Phillips Screwdriver

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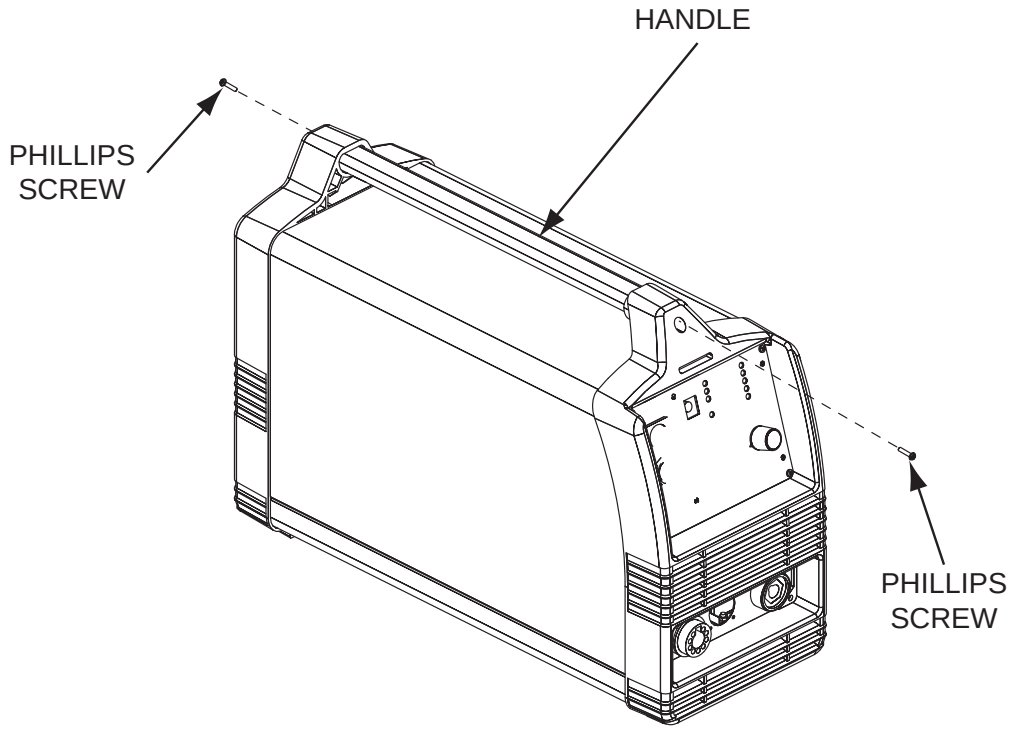
CASE WRAPAROUND REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.1 – TOP HANDLE SCREW LOCATIONS



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Using a phillips screwdriver, remove the two screws holding the top handle to the Casefront and Caseback. See Figure F.1.
3. Using a phillips screwdriver, remove the four mounting screws on the rear panel. ***See Figure F.2***.
4. Swing the rear panel slightly out of the way. **NOTE:** Wiring remains connected.
5. Remove handle by gently pulling away from front panel while holding rear panel slightly to the side.
6. Remove Wraparound panel by slowly lifting up and away from front of machine.
7. Disconnect ground wire from front right side of machine before completely removing Wraparound.

⚠ CAUTION

When remove any case grounding type leads as removing the Case wraparound. Make sure to reconnect this ground lead to the Wraparound sheet metal when reassembling machine. Important for noise emissions and safety frame ground requirements.

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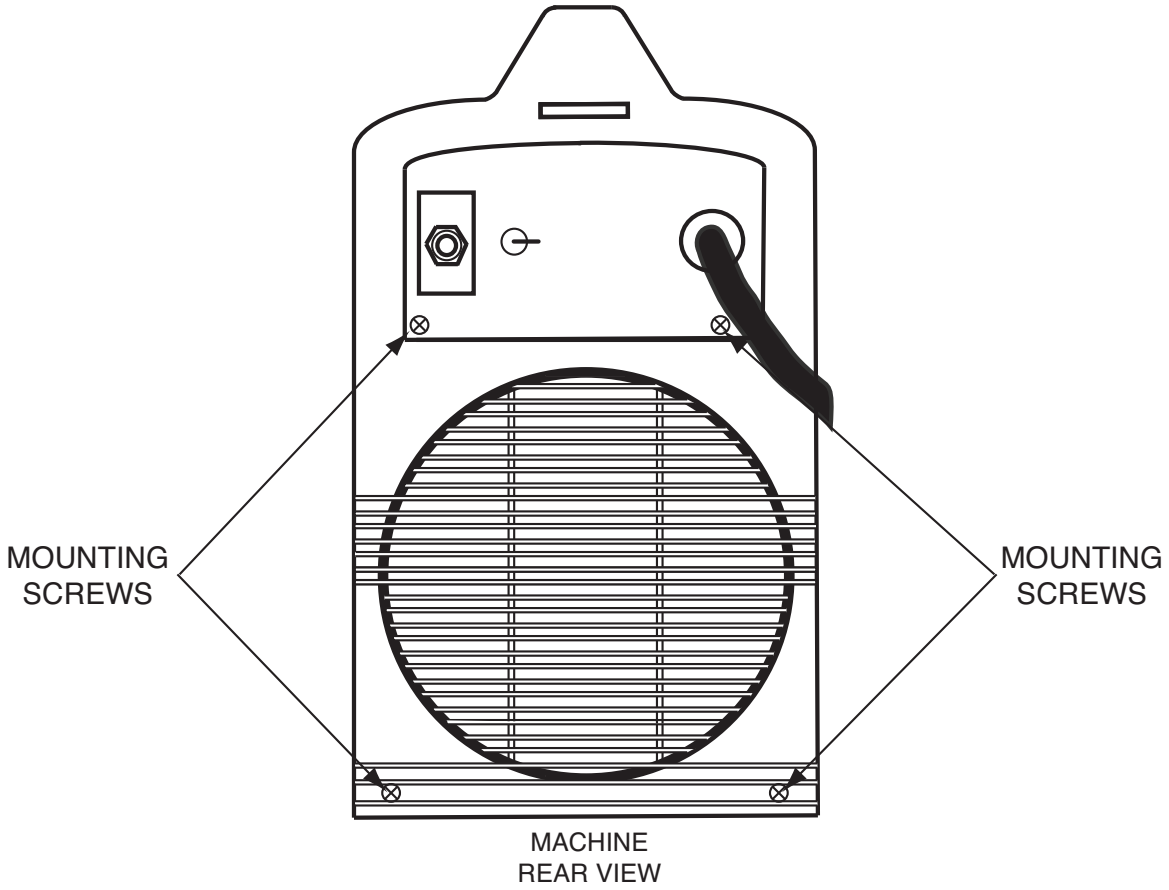
CASE WRAPAROUND REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.2 – REAR PANEL SCREW LOCATIONS



REPLACEMENT PROCEDURE

1. Reconnect ground wire from Case Wraparound to machine.
2. Replace Case Wraparound by sliding into position and pressing firmly into place against front panel.
3. Replace handle by firmly pressing into front and rear panels.
4. Using a phillips screwdriver, replace the four mounting screws previously removed from the rear panel.
5. Using a phillips screwdriver, replace the two screws holding the center handle in place.

NOTES

CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in making sure the Capacitors are discharged.

MATERIALS NEEDED

25 Ohm / 25 Watt Resistor
Insulated Gloves
Insulated Pliers

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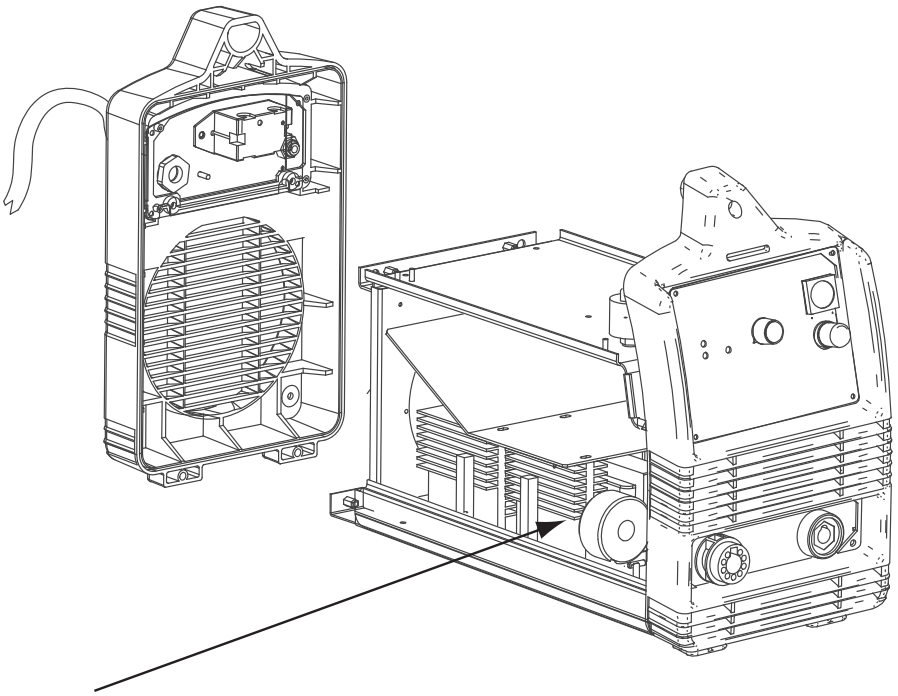
CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.3 – INVERTER BOARD LOCATION



PROCEDURE

⚠ WARNING

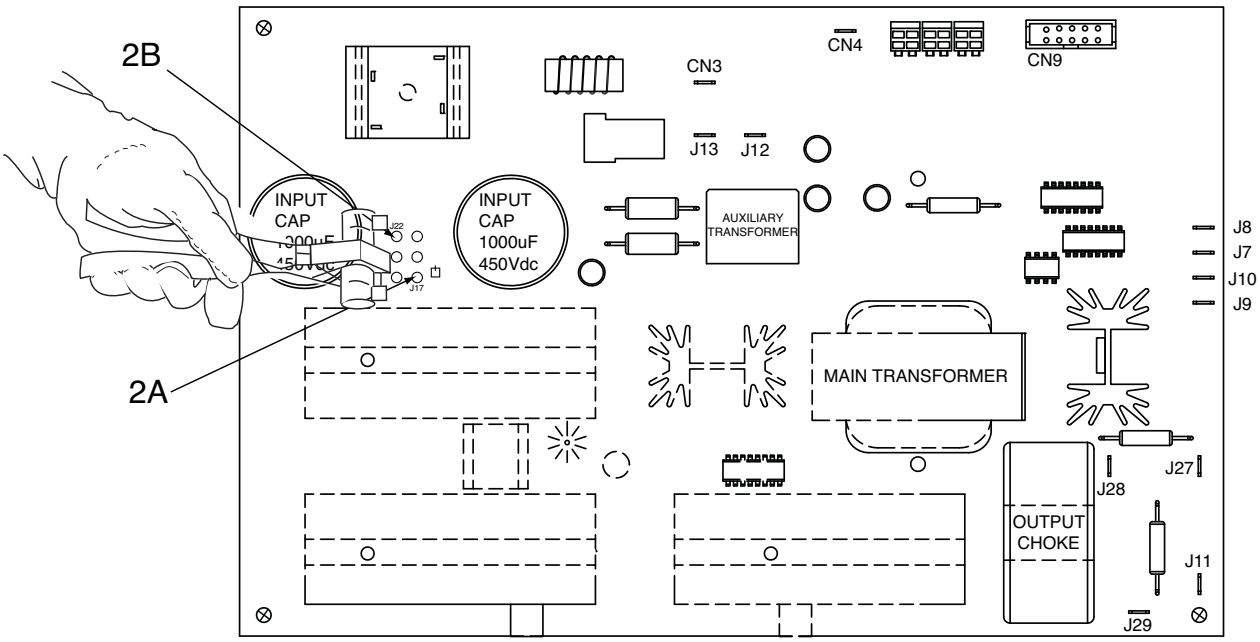
ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Locate the Inverter Board. See Figure F.3.
4. Check for voltage as indicated at test points 2B (J17) and 2A (J22) on the Inverter Board. ***See Figure F.4***.
5. Carefully apply a resistor with insulated leads at the indicated points to discharge. Use a 25 ohm 25 Watt type resistor. ***See Figure F.4***.
6. Using a 25 ohm 25 Watt type resistor, make sure the Capacitors are completely discharged. The voltage must be 0 VDC.

CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.4 – INVERTER BOARD TEST POINTS



NOTES

TORCH LC 40 TEST

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will help determine if the Torch LC 40 is functioning properly.

MATERIALS NEEDED

Digital Volt / Ohmmeter
Air Supply

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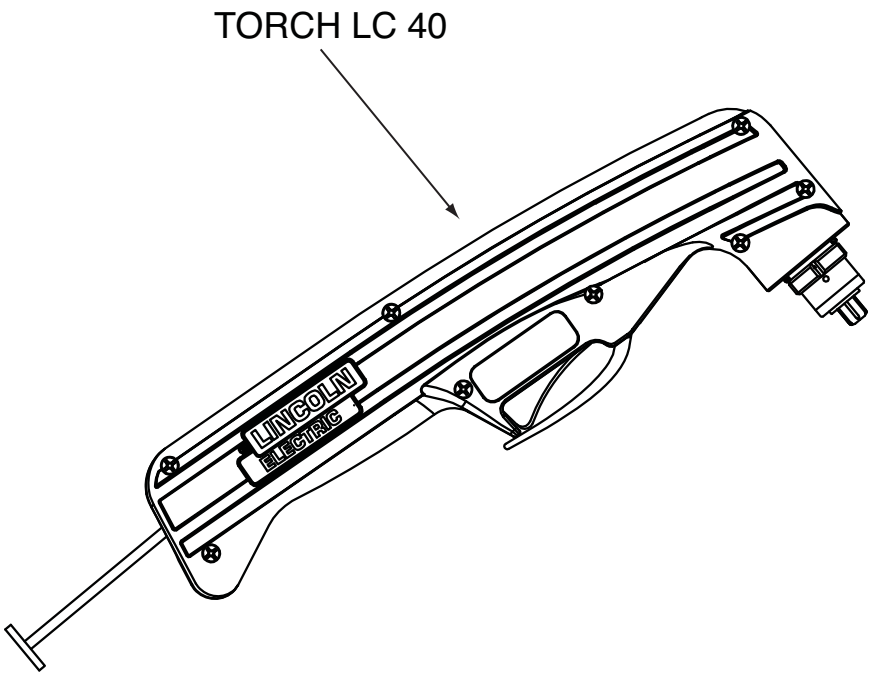
TORCH LC 40 TEST (continued)

FIGURE F.5 – TORCH LC 40



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Disconnect torch from the machine.
3. Perform the test outlined in ***Table F.1***.

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TORCH LC 40 TEST (continued)

TABLE F.1 – TORCH TEST CONDITIONS AND RESULTS

TEST:	TORCH CONDITION:	EXPECTED RESULTS:
TRIGGER	TRIGGER PULLED; Remove retaining cap on torch end. ***See Figure F.6***.	There should be continuity “0 Ohms” between Pin 3 (Grey) to Pin 1 (Brown) trigger wires. Meg ohms to all other wires/pin ends, copper center stud of quick torch connector end. Note: Exception Yellow wire (Safety) it is on the same pin as the grey wire Pin 3.
	RELEASE TRIGGER;	There should be Meg ohms between Pin 3 (Grey) to Pin 1 (Brown) trigger wires. Note: Exception Yellow wire (Safety) it is on the same pin as the grey wire Pin 3.
	New consumables IN PLACE in torch head	***See Figure F.6*** for help. MUST BE ASSEMBLED per ***Figure F.6*** diagram and the **correct parts used for the LC 40 torch ONLY:**
SAFETY		Continuity “0 ohms” between Pin 3 (Yellow & Grey wire) and Pin 9 (Black wire). Meg ohms to all other wires pins and copper center stud.
CUT / PILOT Current PATH		Continuity “0 ohms” between Pin 5 & 6 (Red wire) to copper center stud (Black wires). Same torch conditions as above test (consumables in place).
	Remove Electrode & Nozzle	No continuity, Meg ohms should be between Pins 5 & 6 (Red Wire) to copper center stud (Black wire).
TORCH HEAD Mechanical - Need a supply of 70 Psi @ 125 to 200 SCFH	Electrode and Nozzle in place	The torch when connected to this clean air supply (bottled nitrogen or air) should have a thumping felt in side the handle anytime the air is applied abruptly to the torch. This thump, is the piston of the electrode moving back slightly when the air applied. This action is required to create a pilot arc **inside** the torch electrode nozzle area when in circuit. The same action can be obtained when going to the Purge setting on the Tomahawk current dial (Blue Dial).
	Remove the Nozzle, Swirl Ring, and Retaining Cap.	Push the electrode in. The distance the electrode should move is approximately 1/8 inch and a spring action back to the original position.

All of the above testing is not a definitive test that the torch is good or bad. Best to always try the torch on a different and known good Tomahawk® to confirm that the torch operates properly or that the original Tomahawk® unit is good or bad. The above testing does not provide the elevated dangerous levels of voltages that may be causing the torch to break down internally and not function correctly when its connected to the Tomahawk®.

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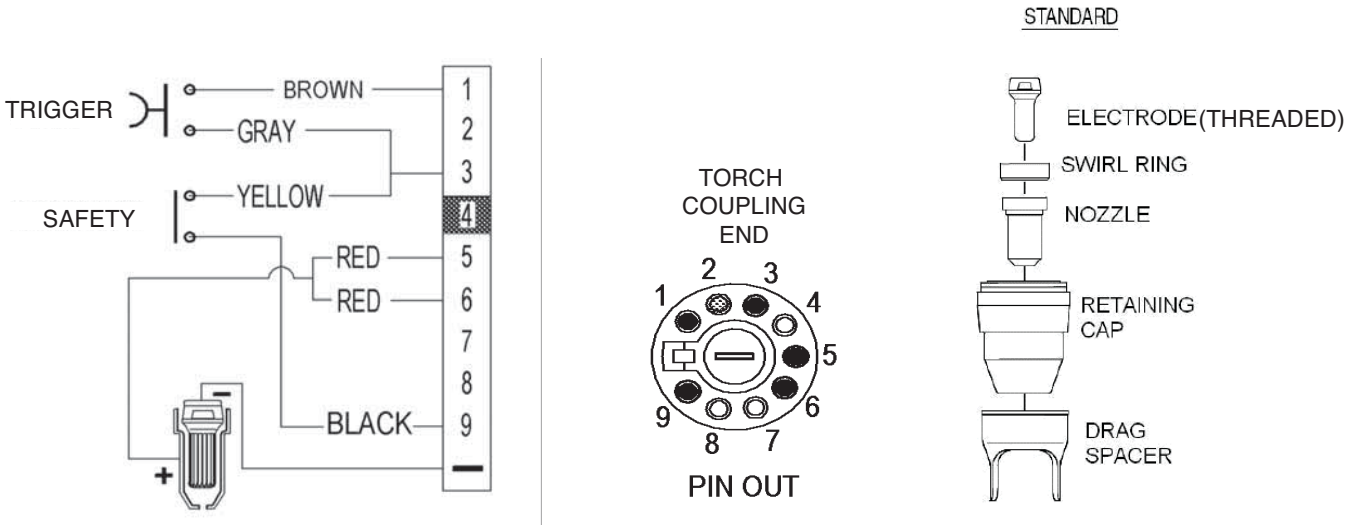
TORCH LC 40 TEST (continued)

FIGURE F.6 – TORCH COMPONENTS AND LEADS



Return to Section TOC
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INVERTER BOARD TEST

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

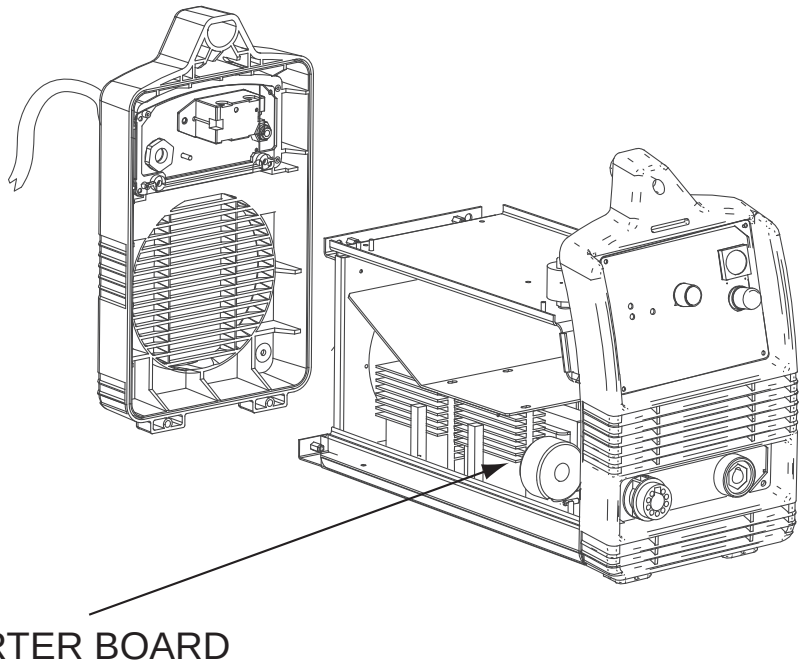
This procedure will help determine if the Inverter Board is functioning properly.

MATERIALS NEEDED

Volt / Ohmmeter

INVERTER BOARD TEST (continued)

FIGURE F.7 – INVERTER BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Locate the Inverter Board. See Figure F.7.
5. Give the Inverter Board a good visual check on both sides. Look for any burnt, darkened or sooty damaged areas and or components. No further test is required to this board if signs of damage are evident. Replace the board if anything has been found. ***See Inverter Board Removal and Replacement***.
6. Before turning on the Tomahawk® with the new Inverter Board installed perform the tests for the Torch and Air Solenoid (resistance only).
7. Perform the tests outlined in ***Tables F.2 and F.3*** and test points in ***Figure F.8***.
8. Meter Settings: Use a Fluke 87 or equivalent. Select "diode test" on meter. Other parts of the test will require “Resistance Test” as noted.

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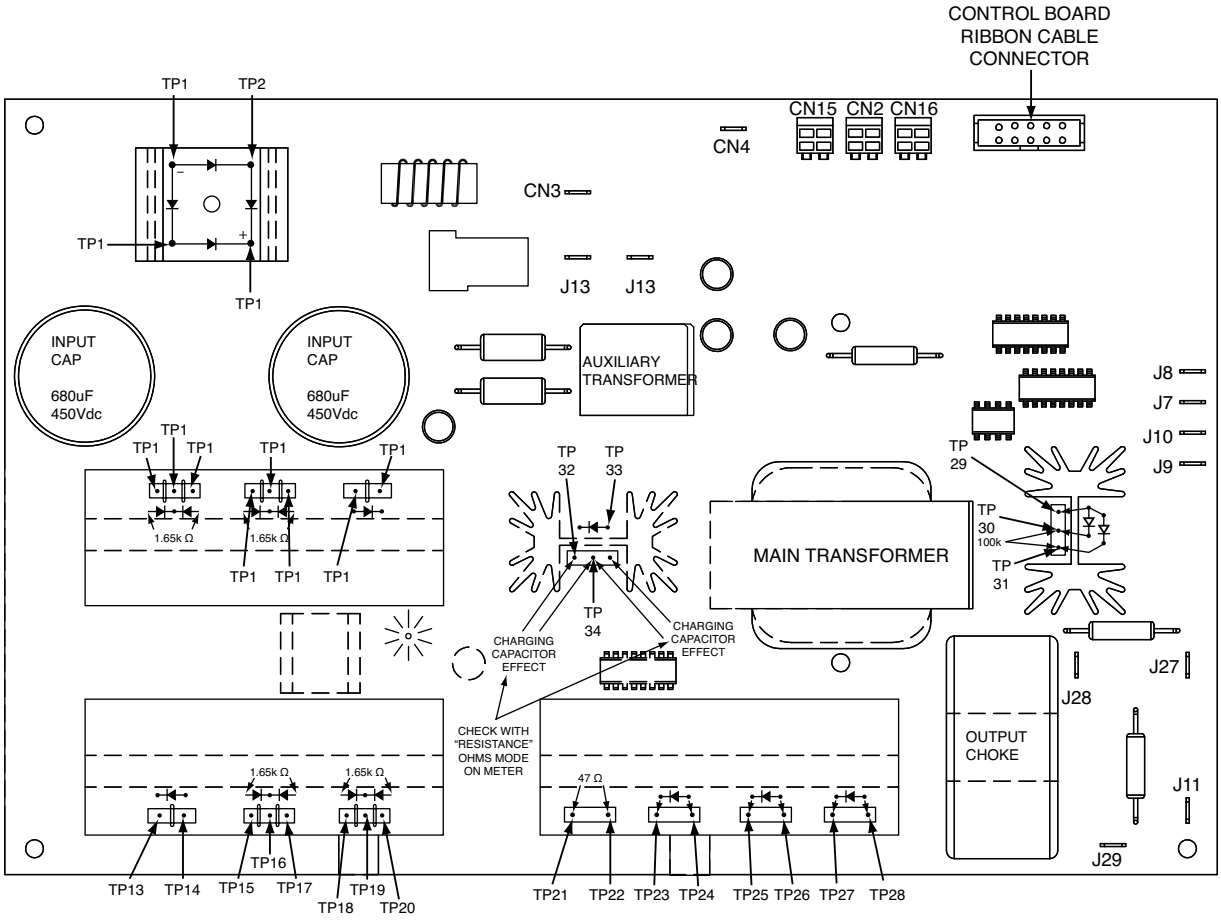
INVERTER BOARD TEST (continued)

FIGURE F.8 – INVERTER BOARD TEST POINTS



Objective of this test method:

Look for a difference between readings for component tested when the meter leads are swapped across the component test points as indicated. A difference indicates a good component. (20 components total of IGBT & diode type). ***See Figure F.9***.

If there is conduction (beeping from meter) in both meter lead swapping tests, the device is shorted. If there is no conduction (no beeping from the meter) after the lead swapping test the device is open.

On some components a resistance reading is required. Switch the meter to "resistance test" and check readings per provided Table. ***See Table F.3***. Swap the meter leads to the indicated test points. The resistance values should be the same. If not, replace the board after checking the questionable component on the board again with all the boards leads disconnected.

INVERTER BOARD TEST (continued)

FIGURE F.9 – METER PROBE CONNECTIONS

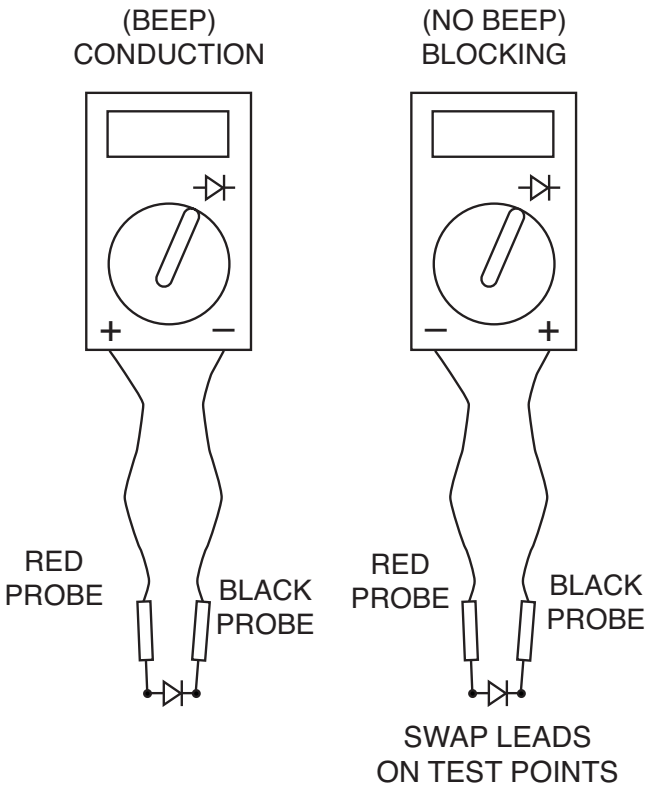


TABLE F.2-A – INVERTER BOARD DIODE CHECKS

CONDITIONS	TEST POINT	TEST POINT	EXPECTED READING	COMMENTS
MACHINE OFF	TP1 + PROBE	TP2 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP2 + PROBE	TP1 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP2 + PROBE	TP3 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP3 + PROBE	TP2 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP4 + PROBE	TP3 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP3 + PROBE	TP4 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP1 + PROBE	TP4 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP4 + PROBE	TP1 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP5 + PROBE	TP6 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING

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INVERTER BOARD TEST (continued)

TABLE F.2-B – INVERTER BOARD DIODE CHECKS

CONDITIONS	TEST POINT	TEST POINT	EXPECTED READING	COMMENTS
MACHINE OFF	TP6 + PROBE	TP5 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP7 + PROBE	TP6 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP6 + PROBE	TP7 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP8 + PROBE	TP9 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP9 + PROBE	TP8 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP10 + PROBE	TP9 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP9 + PROBE	TP10 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP11 + PROBE	TP12 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP12 + PROBE	TP11 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP14 + PROBE	TP13 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP13 + PROBE	TP14 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING

TABLE F.2-C – INVERTER BOARD DIODE CHECKS

CONDITIONS	TEST POINT	TEST POINT	EXPECTED READING	COMMENTS
MACHINE OFF	TP15 + PROBE	TP16 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP16 + PROBE	TP15 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP17 + PROBE	TP17 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP16 + PROBE	TP17 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP18 + PROBE	TP19 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP19 + PROBE	TP18 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP20 + PROBE	TP19 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP19 + PROBE	TP20 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP24 + PROBE	TP23 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP23 + PROBE	TP24 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP26 + PROBE	TP25 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING

INVERTER BOARD TEST (continued)

TABLE F.2-D – INVERTER BOARD DIODE CHECKS

CONDITIONS	TEST POINT	TEST POINT	EXPECTED READING	COMMENTS
MACHINE OFF	TP25 + PROBE	TP26 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP28 + PROBE	TP27 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP27 + PROBE	TP28 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP29 + PROBE	TP30 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP30 + PROBE	TP29 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP29 + PROBE	TP31 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP31 + PROBE	TP29 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING
MACHINE OFF	TP33 + PROBE	TP32 – PROBE	"BEEP" CONDUCTION	FORWARD DIODE READING
MACHINE OFF	TP32 + PROBE	TP33 – PROBE	NO "BEEP" NO CONDUCTION	REVERSE DIODE READING

TABLE F.3 – INVERTER BOARD RESISTANCE CHECKS

CONDITIONS	TEST POINT	TEST POINT	EXPECTED READING	COMMENTS
MACHINE OFF	TP21 + PROBE	TP22 – PROBE	47 Ohms	Resistance Reading
MACHINE OFF	TP31 + PROBE	TP30 – PROBE	100K Ohms	Resistance Reading
MACHINE OFF	TP32 + PROBE	TP34 – PROBE	Variable	Charging Capacitor Effect
MACHINE OFF	TP34 + PROBE	TP33 – PROBE	Variable	Charging Capacitor Effect

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AIR SOLENOID TEST

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in determining if the Air Solenoid is functioning properly.

MATERIALS NEEDED

Volt / Ohmmeter
12 VDC External Supply

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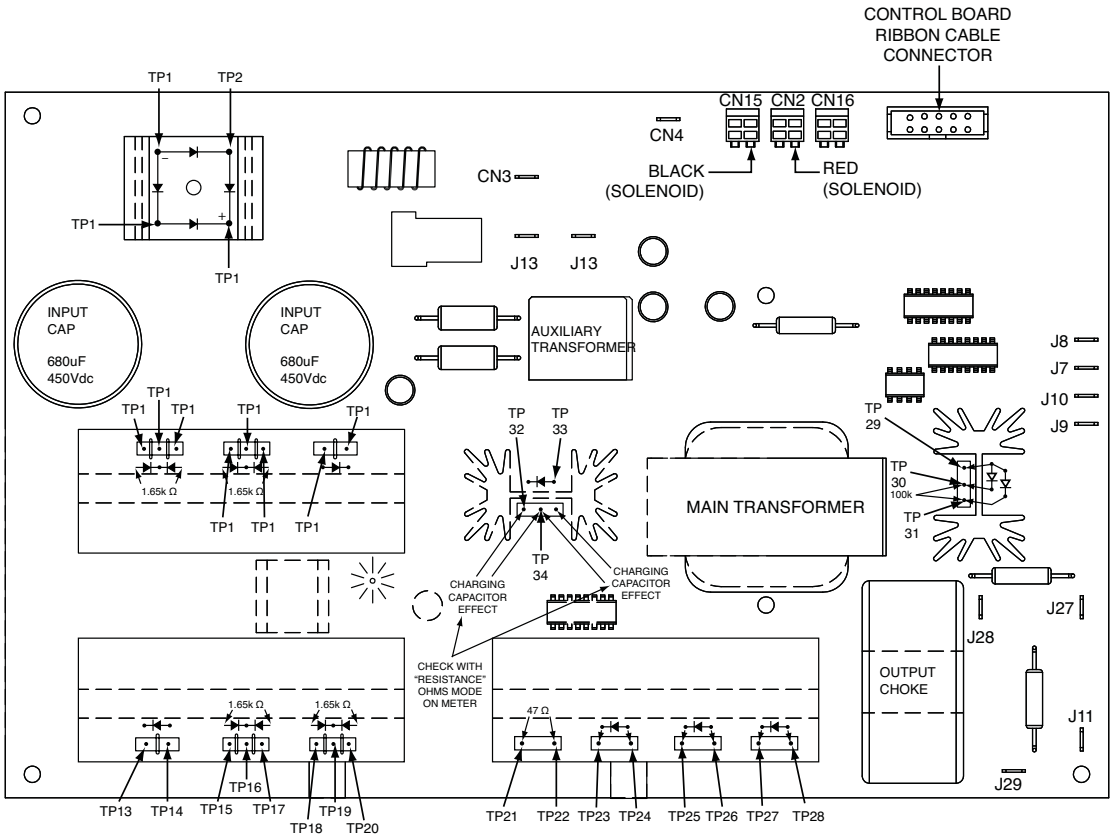
AIR SOLENOID TEST (continued)

FIGURE F.10 – INVERTER BOARD



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Locate the red and black air/gas solenoid leads. See Figure F.10.
5. Carefully remove the leads from terminals CN2 (+Red) and CN15 (-Black).
6. Using the volt/ohmmeter, check the solenoid coil. Put the positive meter probe on the red solenoid lead and the negative meter probe on the black solenoid lead. Then reverse the meter leads with the negative meter probe on the red solenoid lead and the positive meter probe on the black solenoid lead. The test results should be similar to testing a diode. The resistance should be higher in the negative polarity and lower when the positive meter probe is on the red solenoid lead.
7. If the resistance is low or is very high in both polarities the solenoid may be faulty.
8. The solenoid may be further tested by applying an external 12VDC supply to the solenoid coil leads. (Positive to the red lead and negative to the black lead). The solenoid should activate. If not, the solenoid is faulty.
9. When the torch trigger is pulled 12VDC should be present at terminals CN2 (+) and CN15 (-).
10. When testing is complete replace the two solenoid leads to their respective terminals. CN2 (Red) and CN15 (Black).
11. Replace the case wraparound cover.

Return to Section TOC
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PRESSURE SWITCH TEST

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in determining if the Pressure Switch is functioning properly.

MATERIALS NEEDED

Air Supply

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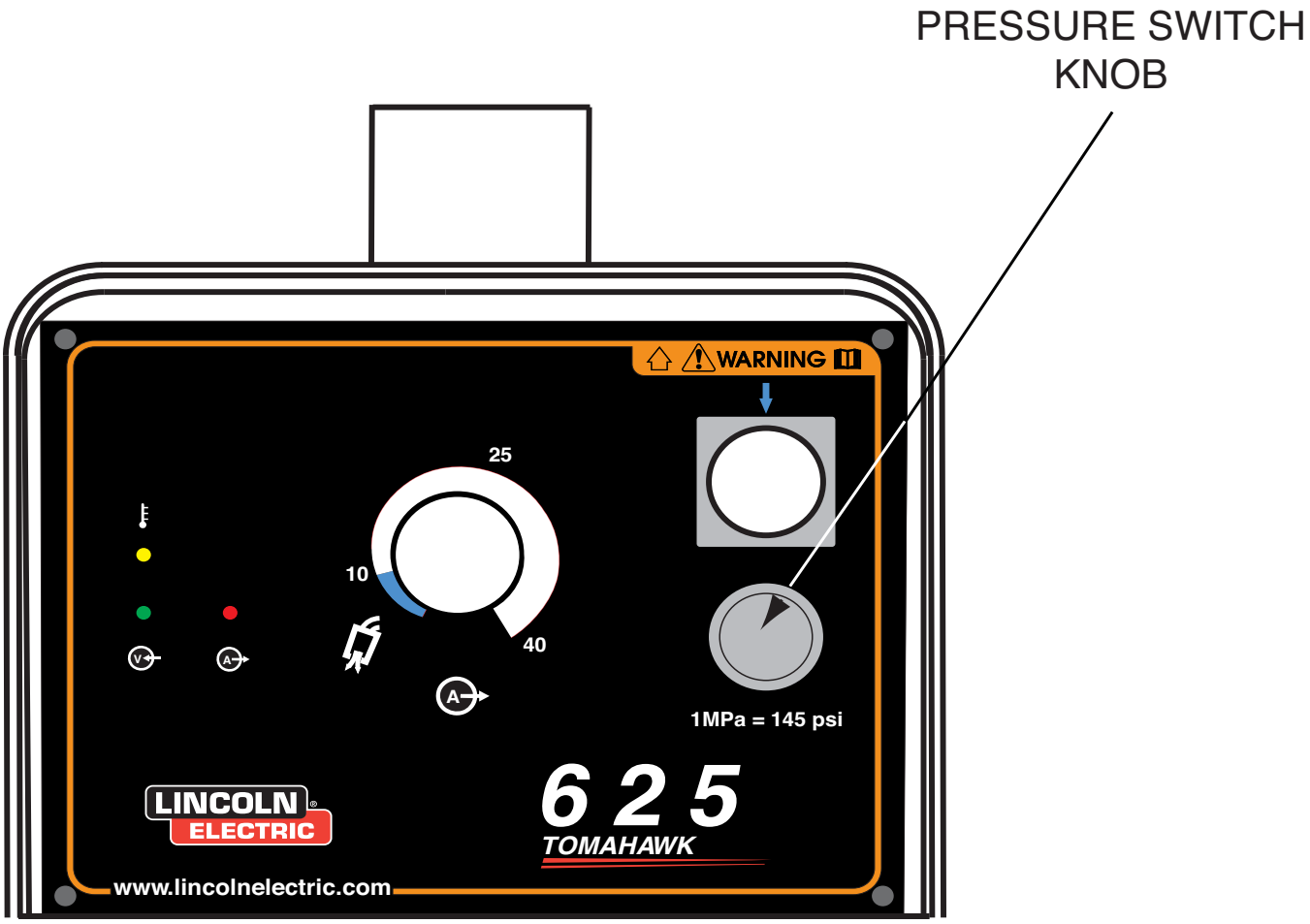
PRESSURE SWITCH TEST (continued)

FIGURE F.11 – PRESSURE SWITCH KNOB LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove the input power.
2. Perform the ***Case Wraparound Removal Procedure***.
3. Carefully apply the correct input power and air source.
4. Turn on the machine.
5. Using the pressure regulator on the front of the Tomahawk®, pull knob and adjust the pressure up and down to see when the pressure switch opens an closes. The Pressure Switch connections are on the "normally open" terminals. Typically closes at 52 psi opens at 46psi. See Figure F.11.
6. Perform the ***Case Wraparound Replacement Procedure***.

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CONTROL POTENTIOMETER TEST

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

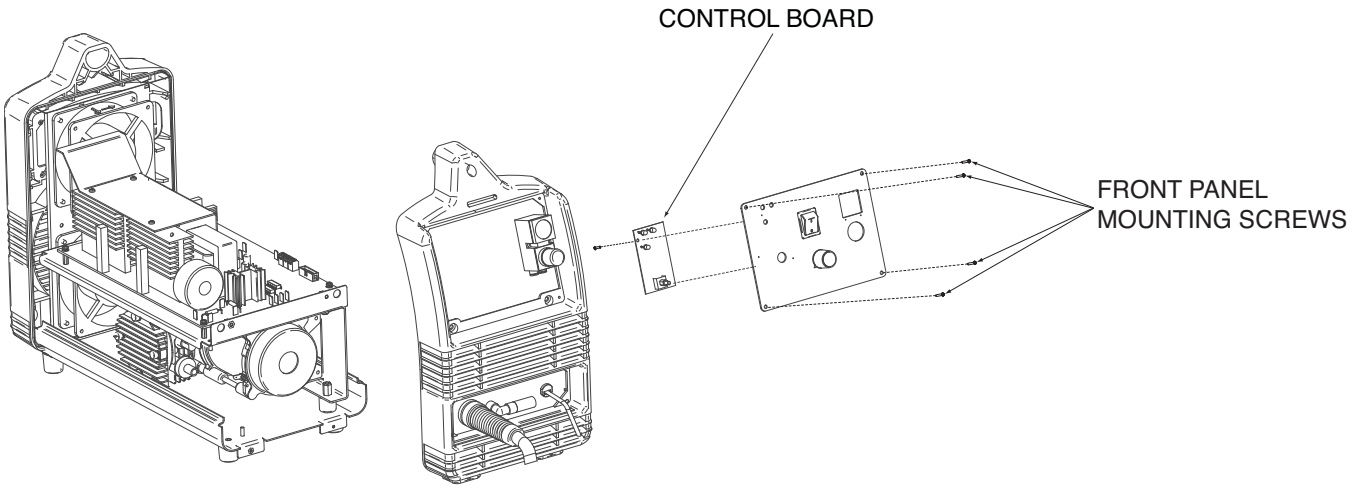
This procedure will aid the technician in determining if the Control Potentiometer is functioning properly.

MATERIALS NEEDED

Volt / Ohmmeter
Phillips Screwdriver

CONTROL POTENTIOMETER TEST (continued)

FIGURE F.12 – CONTROL BOARD TEST POINTS



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform the ***Case Wraparound Removal Procedure***.
3. Perform the ***Capacitor Discharge Procedure***.
4. Test Condition: The control board disconnected from the inverter board.
5. Locate the control board. See Figure F.12.
6. Using the phillips screwdriver, remove the four front panel mounting screws from the nameplate assembly and carefully tilt the nameplate assembly forward. See Figure F.12.

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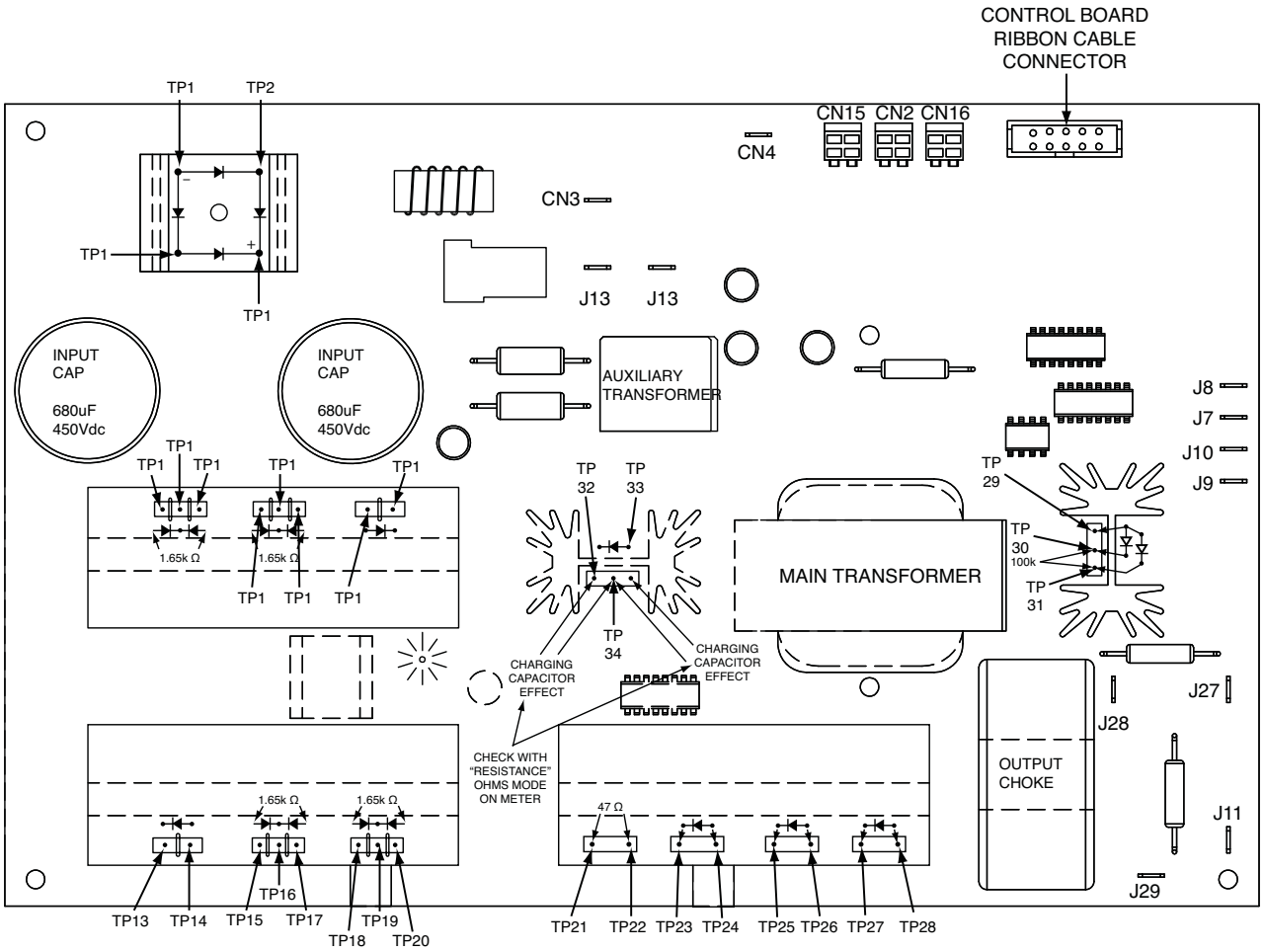
CONTROL POTENTIOMETER TEST (continued)

FIGURE F.13 – CN9 CONTROL BOARD RIBBON CABLE CONNECTOR LOCATION



7. Carefully remove the control board ribbon cable from the inverter board. See Figure F.13.
8. Using the volt/ohmmeter, measure the resistance on the Control Potentiometer that is mounted on the control board. When the Potentiometer shaft is rotated the resistance reading should vary from 0 to 2500 ohms from either outer terminal to the center (wiper) terminal. Measuring at the two outer terminals the resistance reading should be approximately 2500 ohms. ***See Figure F.14***.
9. When testing is complete replace the ribbon cable into the inverter board.
10. Replace the nameplate assembly with the four screws previously removed.
11. Replace the case wraparound cover.

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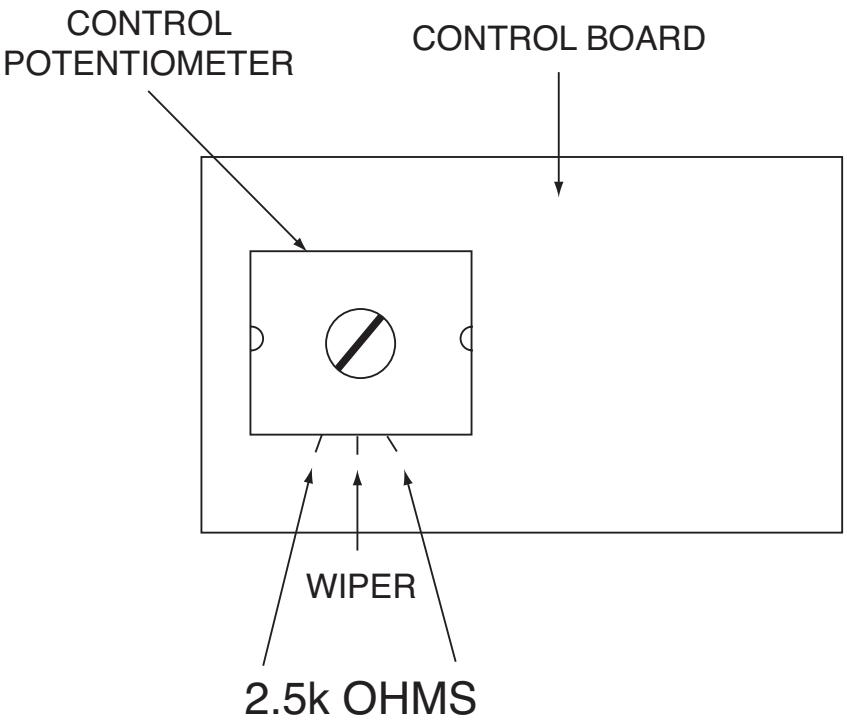
CONTROL POTENTIOMETER TEST (continued)

FIGURE F.14 – CONTROL BOARD TEST POINTS



FAN REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Fan Assembly.

MATERIALS NEEDED

Phillips Screwdriver

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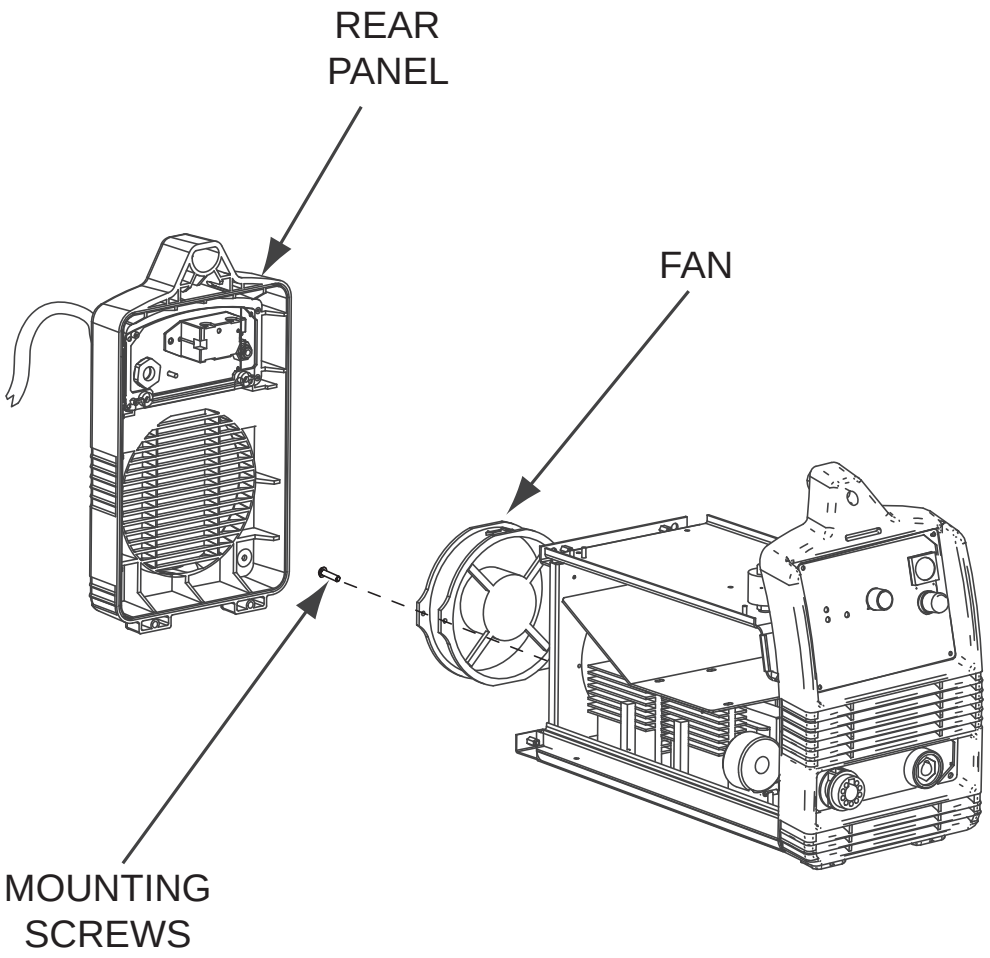
FAN REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.15 – FAN MOUNTING SCREW LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Using a phillips screwdriver, remove the two screws holding Fan to internal rear case. See Figure F.15.
5. Label and disconnect the two power leads from the Fan.
6. Remove Fan from machine.

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FAN REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Position Fan in machine so air flow direction is from rear to front.
   NOTE: Use arrows on side of fan for guidance.
2. Replace power leads to Fan.
3. Using a phillips screwdriver, replace the two screws holding Fan in place.
4. Perform ***Case Wraparound Replacement Procedure***.

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NOTES

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INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Inverter Board Assembly.

MATERIALS NEEDED

Phillips Screwdriver
Pliers

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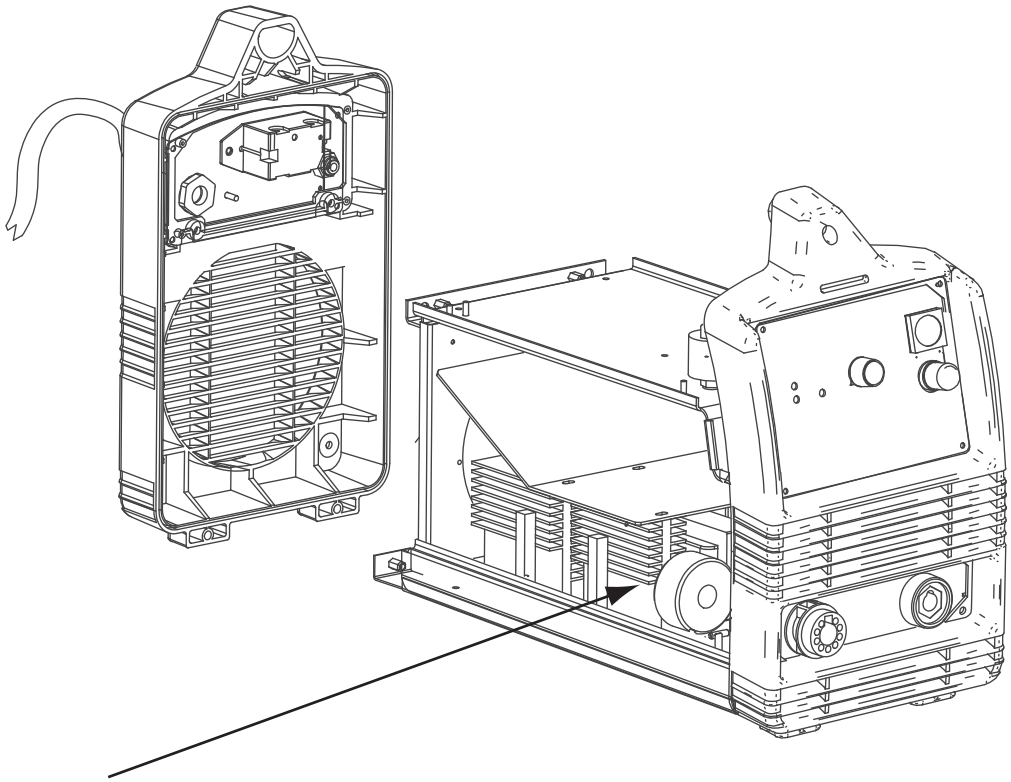
INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.16 – INVERTER BOARD LOCATION



PROCEDURE

⚠ WARNING

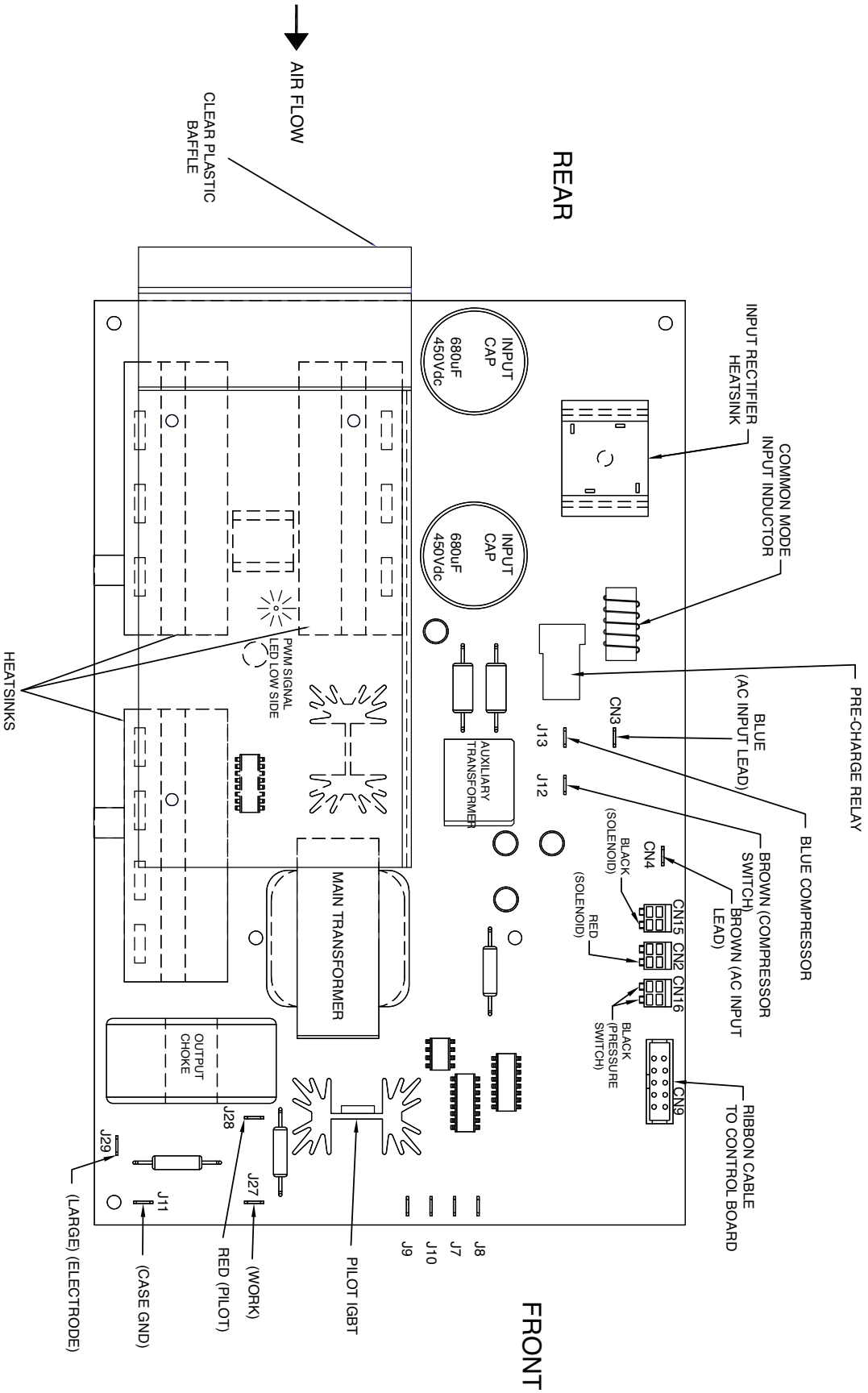
ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Locate Inverter Board. See Figure F.16.
5. Label and remove leads J29, J27, J28, J8, J7, J10, J9, CN2, CN3, CN4, CN9, CN15 and CN16. ***See Figure F.17***.
6. Remove the outside (black) sheet metal base by sliding it toward the rear of the machine. Carefully remove the grounding lead. This exposes the inner base area. ***See Figure F.18***.
7. Using a phillips screwdriver, remove the four bottom mounting screws holding the Inverter Board standoffs to the sheet metal. ***See Figure F.18.***
8. There are two plastic inner board standoffs that need to be depressed and pushed in during the board removal.
9. The inverter board can now be removed from the left side of the machine.
10. Remove the two plastic standoffs when the old board is out of the plasma cutter and reuse them on the new board for the re-install.
11. Remove all the old board's metal standoffs and save to use with new board.
12. Remove the clear plastic baffle for use on the new board.

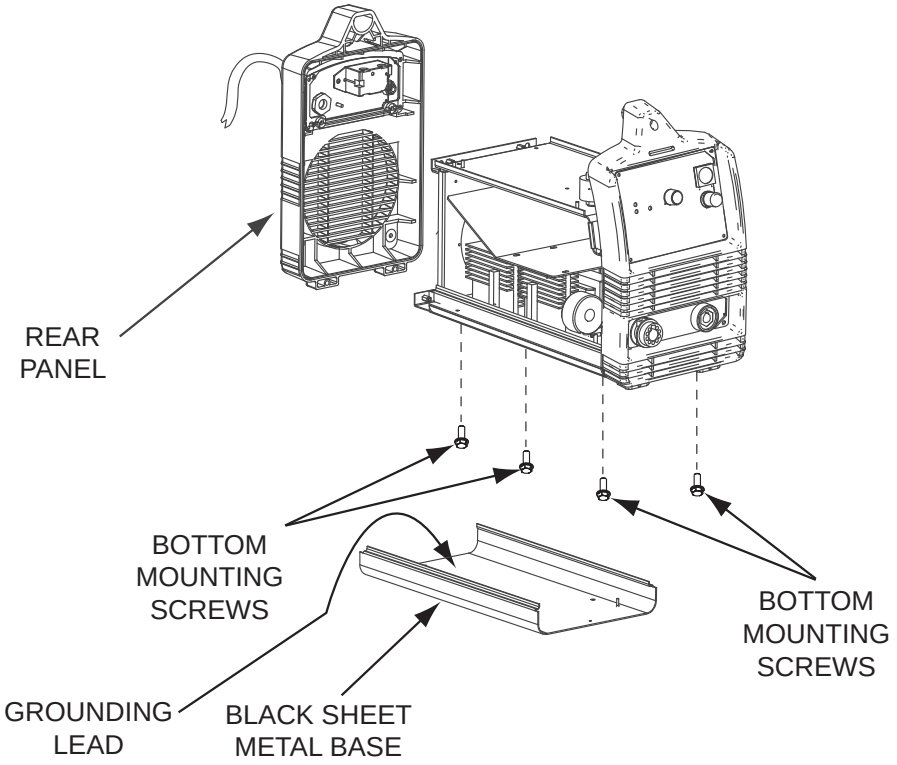
INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.17 – INVERTER BOARD LEAD LOCATIONS AND TOP MOUNTING SCREWS



INVERTER BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.18 – BLACK SHEET METAL BASE AND BOTTOM MOUNTING SCREW LOCATIONS



REPLACEMENT PROCEDURE

1. Install the metal standoff onto the new board.
2. Mount the clear plastic baffle onto the new board.
3. Connect the two plastic standoffs into new board.
4. Position Inverter Board into place on machine by sliding in through the left side.
5. Snap in the two plastic standoffs to machine base.
6. Flip the machine on its side to access bottom screw mounting locations.
7. Using a phillips screwdriver, secure the four bottom mounting screws previously removed.
8. Connect all case grounds, torch leads and other wiring previously removed from the board. See machine diagram to help. ***See Figure F.17***.
9. Slide the black sheet metal base back into position on bottom of machine. Connect the grounding lead.
10. Perform ***Case Wraparound Replacement Procedure***.

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CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Control Board.

MATERIALS NEEDED

3/32” Allen Wrench
1/4” Nutdriver
Small Knife Or Flathead Screwdriver

Return to Section TOC
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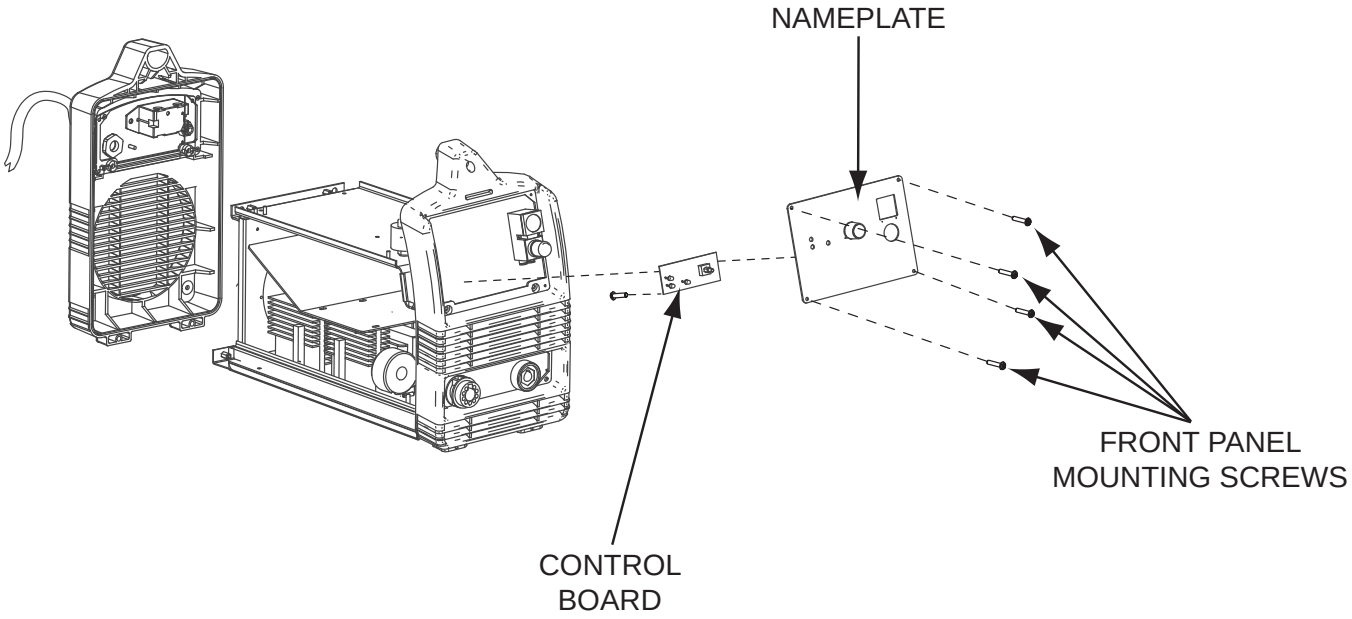
CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.19 – CONTROL BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Locate Control Board, attached to rear of nameplate assembly. See Figure F.19.
5. Disconnect the ribbon cable connected to the inverter board at CN9.
6. Using a 3/32” allen wrench, remove the two cap screws holding the Control Board to its standoffs.
7. Turn output current knob counter-clockwise to zero.
8. Using a small knife or flathead screwdriver, remove plastic knob cover. This exposes the 1/4” nut holding output current knob in place. ***See Figure F.20***.
9. Using 1/4” nutdriver, remove nut while holding Control Board in place. Note washer placement for reassembly.
10. Remove output current knob and remove the Control Board.
11. Route the ribbon cable accordingly to keep from getting caught on components when board is removed.

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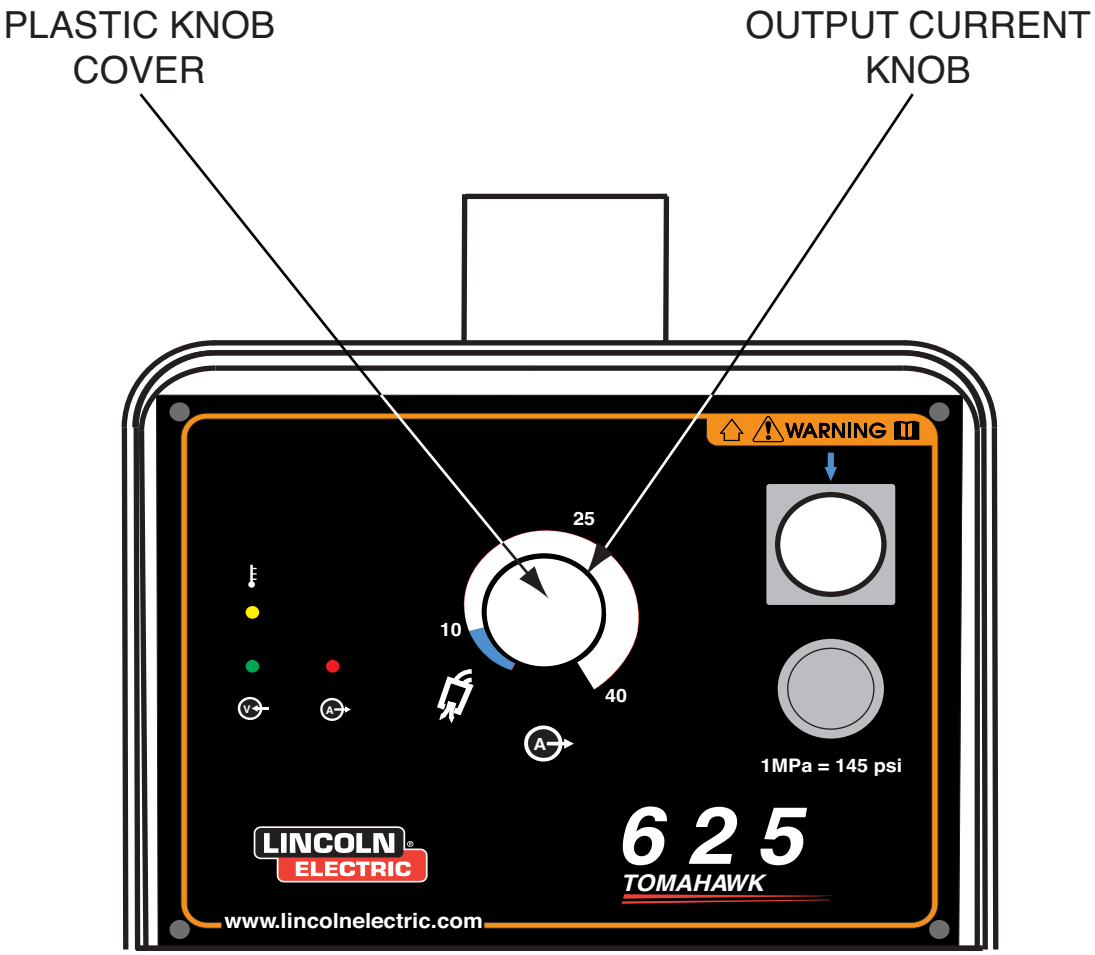
CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.20 – NAMEPLATE



REPLACEMENT PROCEDURE

1. While holding the Control Board in place, slide output current knob back into place.
   NOTE: Be sure output current knob is aligned with printed setting on nameplate.
2. Using a 1/4" nutdriver and nuts and washers previously removed, secure output current knob to machine.
3. Using a 3/32" allen wrench, replace the two Control Board mounting screws.
4. Route ribbon cable through center divider panel.
5. Connect ribbon cable to inverter board at CN9.
6. Perform ***Case Wraparound Replacement Procedure***.

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REGULATOR / PRESSURE GAUGE REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Regulator / Pressure Gauge Assembly.

MATERIALS NEEDED

7/32” Nutdriver
Needlenose Pliers
Phillips Screwdriver

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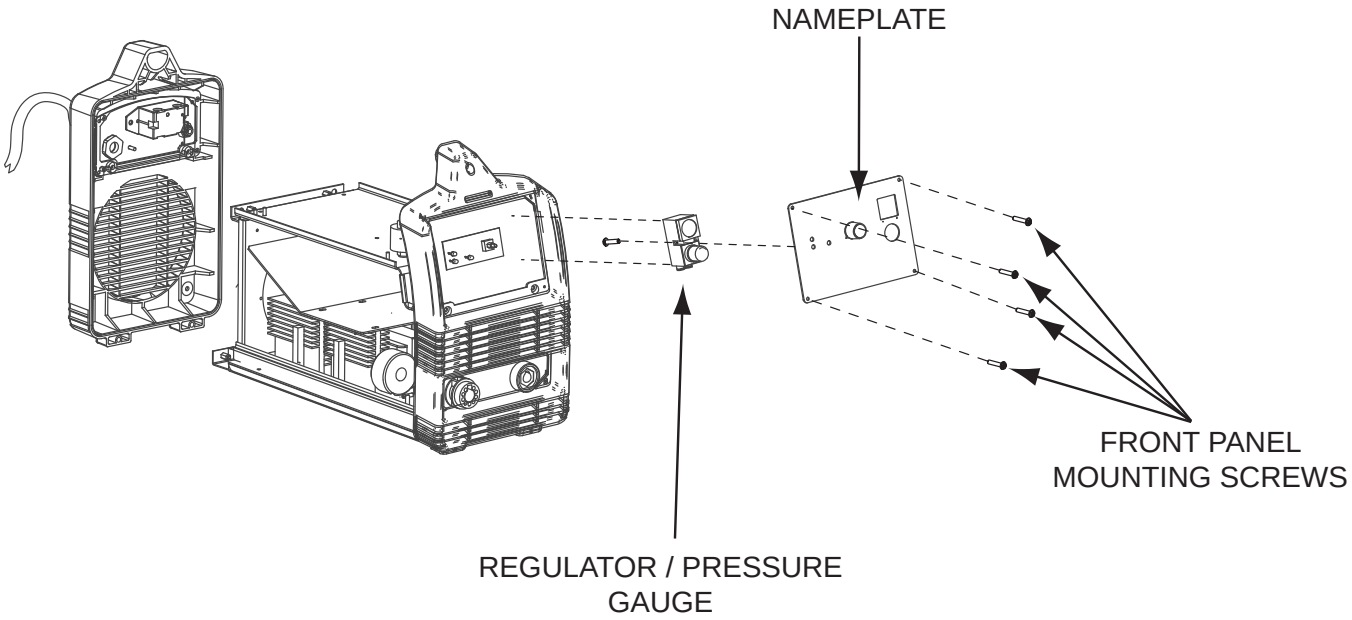
REGULATOR / PRESSURE GAUGE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.21 – REGULATOR / PRESSURE GAUGE AND FRONT PANEL MOUNTING SCREWS LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Perform ***Case Wraparound Removal Procedure***.
3. Perform ***Capacitor Discharge Procedure***.
4. Remove the input air supply.
5. Locate the Regulator / Pressure Gauge Assembly, attached to rear side of nameplate. See Figure F.21.
6. Label and remove ground lead from nameplate.
7. Remove the large plastic nut on case front around the adjuster knob of regulator. ***See Figure F.22***.
8. Label and disconnect the air hoses from the press release fittings. Use needlenose pliers if necessary. ***See Figure F.22***.
9. Using a phillips screwdriver, remove the four mounting screws holding the nameplate in place. See Figure F.21.
10. Using a 7/32” nutdriver, remove the two small nuts on the back side of the body of the Regulator. Note washer placement for reassembly.
11. Tilt nameplate outwards so Regulator and Gauge Assembly can be removed.

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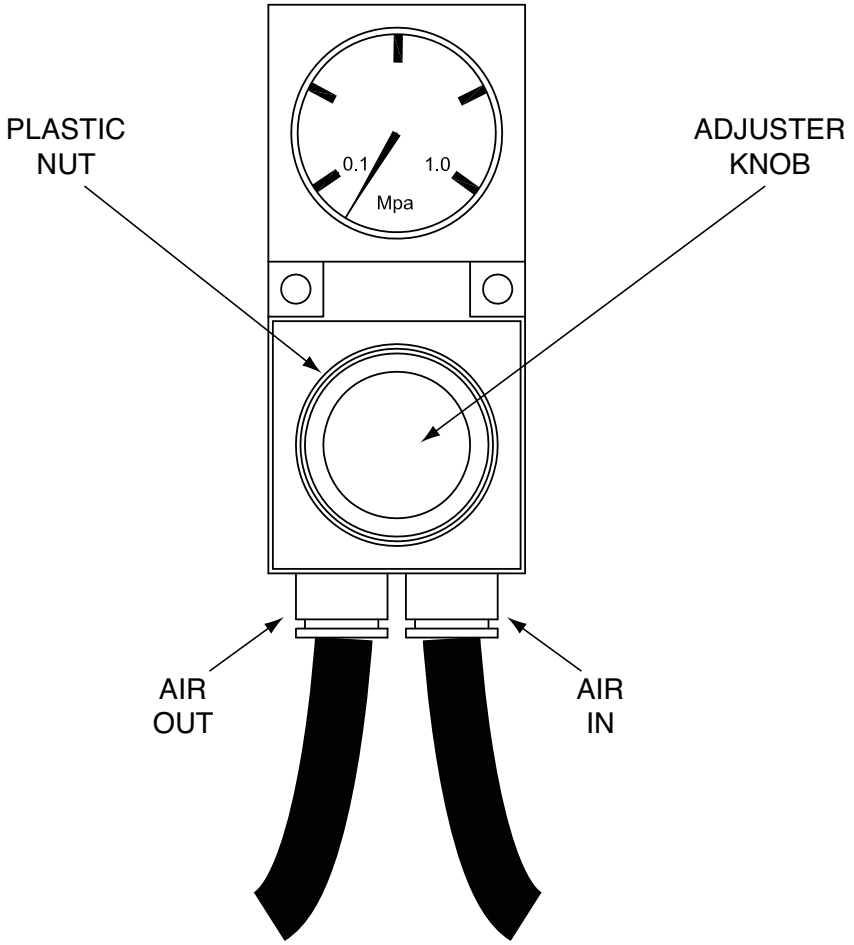
REGULATOR / PRESSURE GAUGE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.22 – REGULATOR / PRESSURE GAUGE ASSEMBLY



REPLACEMENT PROCEDURE

1. Position Regulator / Pressure Gauge Assembly into its proper position on the nameplate.
2. Using 7/32” nutdriver, secure Regulator / Pressure Gauge Assembly to backside of nameplate.
3. Position nameplate on machine.
4. Connect input and output air hoses to their proper locations.
5. Using a phillips screwdriver, replace the four mounting screws securing nameplate to machine.
6. Replace large plastic nut on case front around the adjuster knob of regulator.
7. Connect ground lead.
8. Perform ***Case Wraparound Replacement Procedure***.

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PRESSURE SWITCH REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Pressure Switch.

MATERIALS NEEDED

Needlenose Pliers
11/16” Wrench

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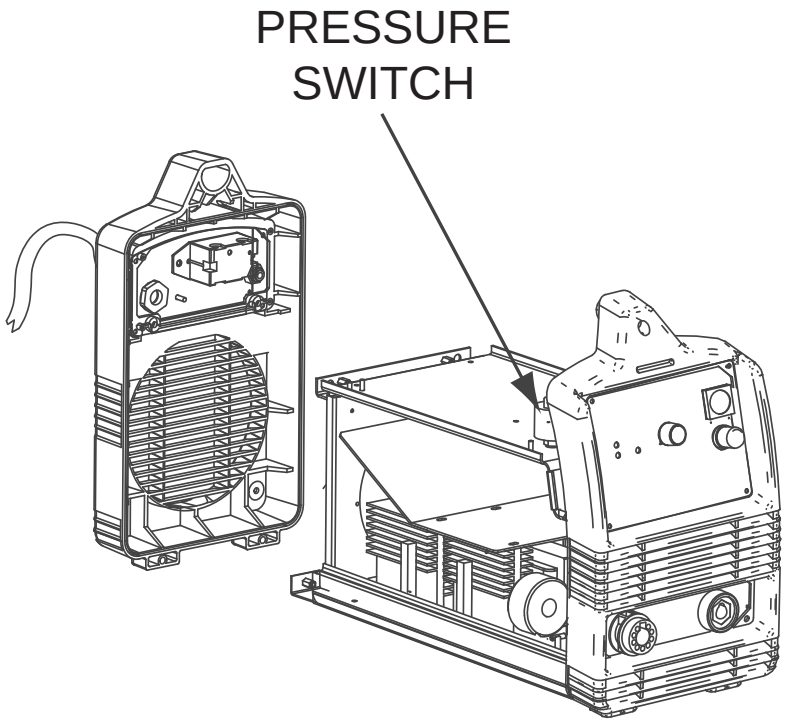
PRESSURE SWITCH REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.23 – PRESSURE SWITCH LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Remove input air supply.
3. Perform ***Case Wraparound Removal Procedure***.
4. Perform ***Capacitor Discharge Procedure***.
5. Locate the Pressure Switch on top of center divider panel. See Figure F.23.
6. Label and disconnect the two leads from the top of the Pressure Switch. Note lead placement.
7. Disconnect air hose from press release fitting using needlenose pliers if necessary. ***See Figure F.24***.
8. Using an 11/16” wrench. remove nut on bottom side of Pressure Switch and remove from center assembly.

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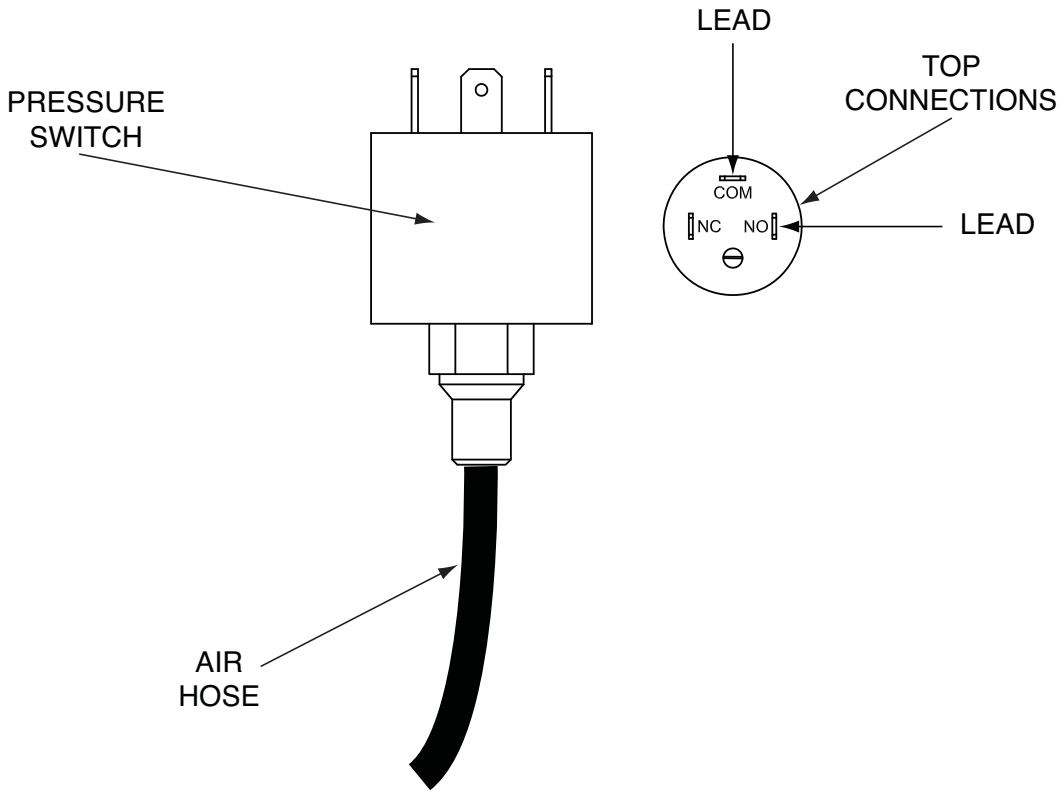
PRESSURE SWITCH REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.24 – PRESSURE SWITCH ASSEMBLY



REPLACEMENT PROCEDURE

1. Place Pressure Switch in it's proper position on top of center divider panel.
2. Using an 11/16" wrench, secure nut on bottom side of Pressure Switch.
3. Connect air hose previously removed to press release fittings.
4. Connect the two leads previously removed from the Pressure Switch.
5. Perform ***Case Wraparound Replacement Procedure***.
6. Replace input air supply.

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SOLENOID VALVE REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Solenoid Valve Assembly.

MATERIALS NEEDED

Needlenose Pliers
90º Phillips Screwdriver Or Phillips Fitting Socket And Ratchet

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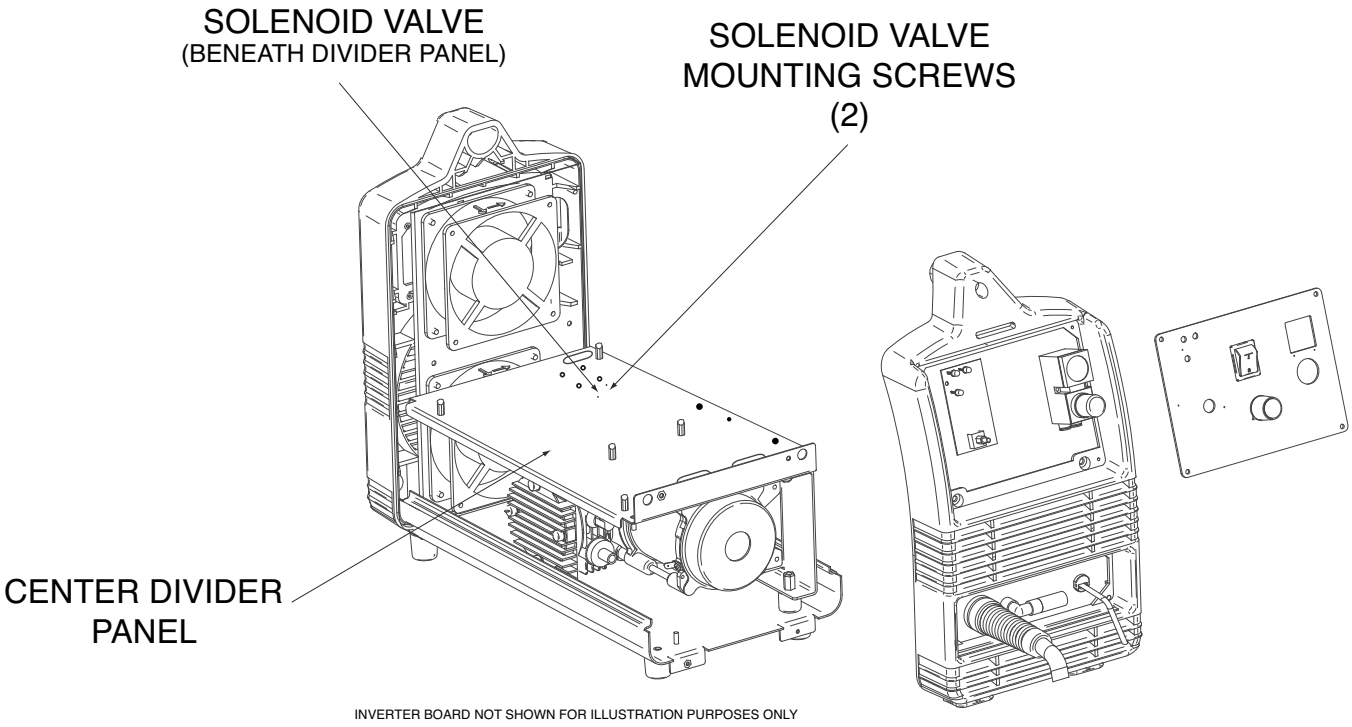
SOLENOID VALVE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.25 – SOLENOID VALVE



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Remove input air supply.
3. Perform ***Case Wraparound Removal Procedure***.
4. Perform ***Capacitor Discharge Procedure***.
5. Locate Solenoid Valve, attached to underside of center divider panel next to oil and water trap assembly. See Figure F.25.
6. Label and disconnect the Black (negative) and Red (positive) wires from the inverter board. ***See Figure F.27***.
7. Label and remove the air hoses from the solenoid press release fittings, use needlenose pliers if necessary. ***See Figure F.26***.
8. Cut wire ties if necessary.
9. Using a 90º phillips screw driver or phillips fitting socket & ratchet, remove the two larger phillips type screws (under solenoid). ***See Figure F.26***.
10. Carefully remove the Solenoid Valve from center panel.

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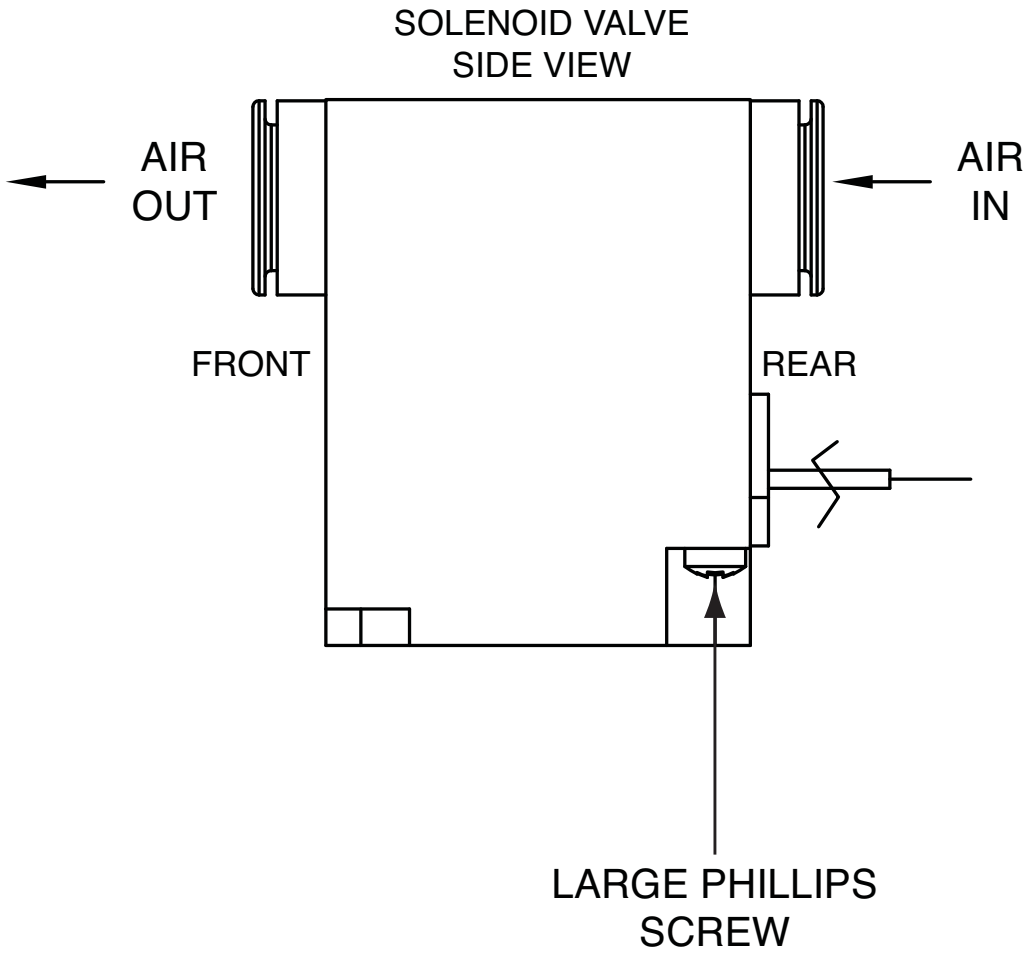
SOLENOID VALVE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.26 – SOLENOID VALVE TERMINAL LOCATIONS

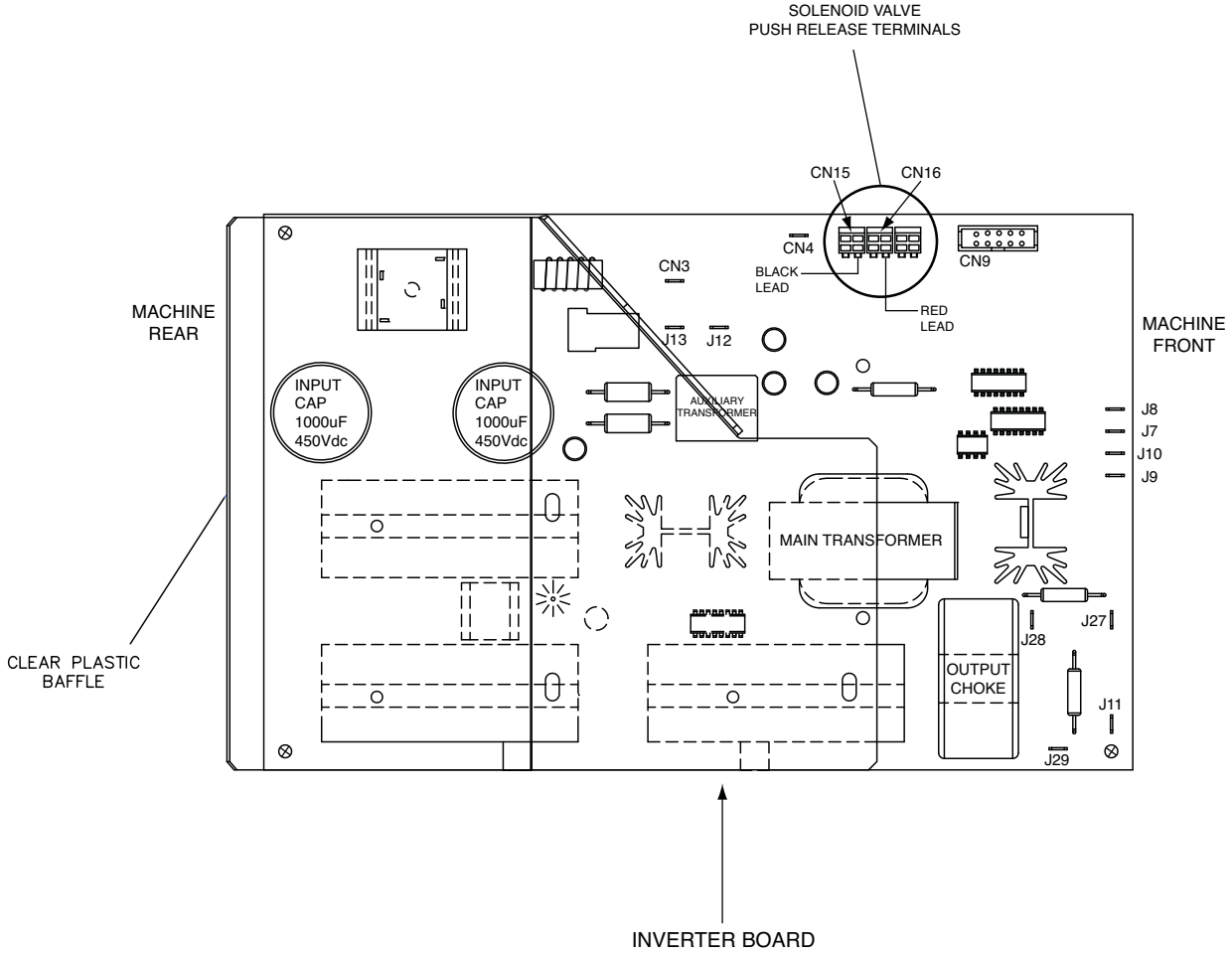


REPLACEMENT PROCEDURE

1. Using a 90º phillips screw driver or phillips fitting socket & ratchet, install the two larger phillips type screws previously removed.
2. Route wires to the solenoid side and secure to adjacent wires via wire ties.
3. Connect air hoses to solenoid press release fittings, use needlenose pliers if necessary.
4. Connect the Black (negative) and Red (positive) wires to the inverter board. See Wiring Diagram and ***Figure F.27***.
5. Perform ***Case Wraparound Replacement Procedure***.
6. Replace input air supply.

SOLENOID VALVE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.27 – SOLENOID VALE LEAD CONNECTION LOCATION



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OIL AND WATER TRAP REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Oil and Water Trap Assembly.

MATERIALS NEEDED

3mm Allen Wrench

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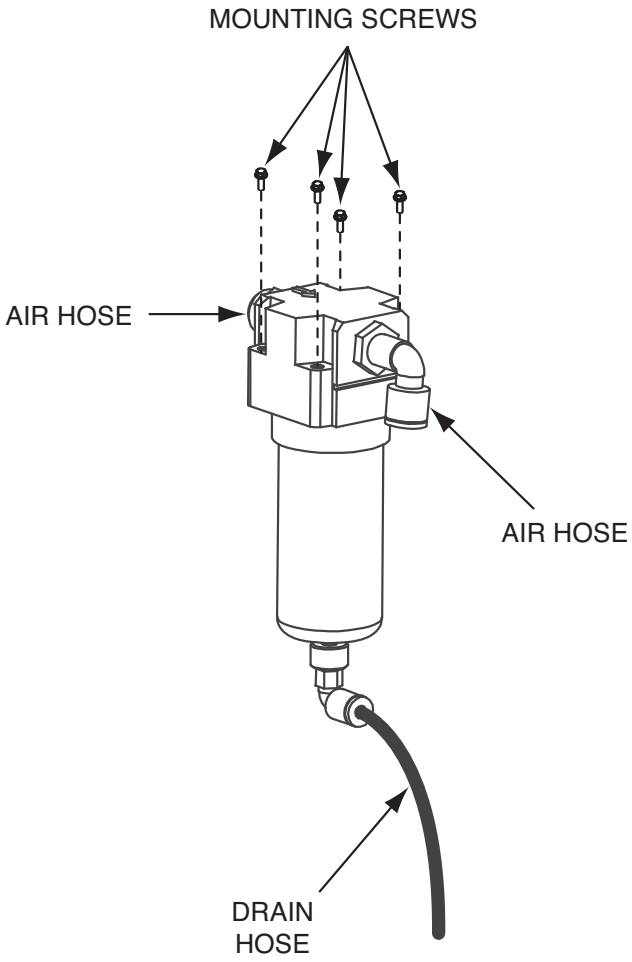
OIL AND WATER TRAP
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.28 – OIL AND WATER TRAP ASSEMBLY



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Remove input air supply.
3. Perform ***Case Wraparound Removal Procedure***.
4. Perform ***Capacitor Discharge Procedure***.
5. Locate Oil and Water Trap Assembly, on right front side of machine attached to center divider panel. See Wiring Diagram.
6. Label and disconnect the air hoses from the solenoid press release fittings. Use needlenose pliers if necessary. See Figure F.28.
7. Using a 3mm allen wrench, remove the four mounting screws located on top of the center divider panel. See Figure F.28.
8. Remove Oil and Water Trap Assembly from the right side of machine. Note routing of drain hose for reassembly.

OIL AND WATER TRAP
REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Mount the Oil and Water Trap to the center divider panel using the four previously removed screws..
2. Connect hoses to solenoid press release fittings, using needlenose pliers if necessary.
3. Route the drain hose through base of machine.
4. Perform ***Case Wraparound Replacement Procedure***.
5. Replace input air supply.

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OIL AND WATER AIR FILTER REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only 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 electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Oil Water Air Filter.

MATERIALS NEEDED

90º Phillips Screwdriver Or Phillips Fitting Socket And Ratchet

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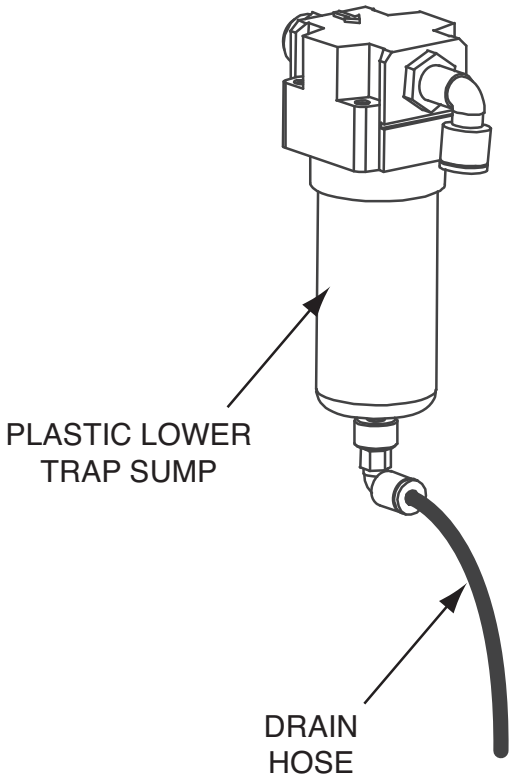
OIL AND WATER AIR FILTER REPLACEMENT PROCEDURE (continued)

FIGURE F.29 – PLASTIC LOWER TRAP SUMP LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK CAN KILL.

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

1. Remove input power.
2. Remove input air supply.
3. Perform ***Case Wraparound Removal Procedure***.
4. Perform ***Capacitor Discharge Procedure***.
5. Locate oil and water trap assembly, on right front side of machine attached to center divider panel. See Wiring Diagram.
6. Unscrew the clear plastic lower trap sump to expose the Air Filter. See Figure F.29.
7. Using a 90º phillips screw driver or phillips head socket & ratchet, remove the screw holding the Filter in place. ***See Figure F.30***.

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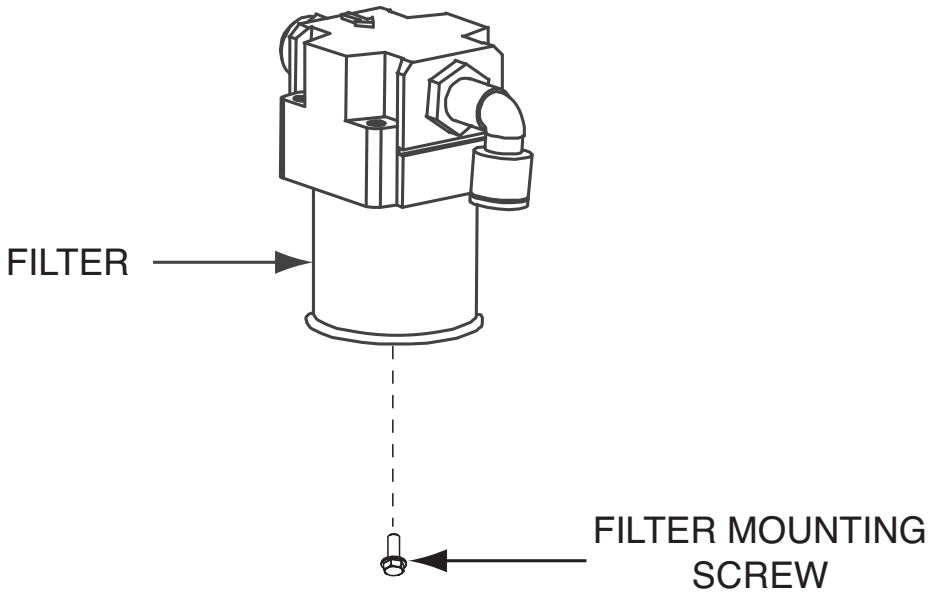
OIL AND WATER AIR FILTER REPLACEMENT PROCEDURE (continued)

FIGURE F.30 – OIL WATER AIR FILTER LOCATION



REPLACEMENT PROCEDURE

1. Replace filter.
2. Using a 90º phillips screw driver or phillips head socket & ratchet, replace the screw securing the Air Filter in place.
   NOTE: Make sure o-ring on plastic bowl surface is back in its slot upon replacing bowl.
3. Screw the clear plastic lower trap sump into housing assembly.
4. Route the drain hose to the base area. Be sure the hose is not kinked.
5. Perform ***Case Wraparound Replacement Procedure***.
6. Replace input air supply

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RETEST AFTER REPAIR

Should a machine under test be rejected for any reason requiring the removal of any mechanical part that could affect the machine's electrical characteristics, or if any electrical components are repaired or replaced, the machine must be retested.

Machine Input and Output

Input Volts/Hertz	Input Current	Rated Output
230/1/60HZ ±10%	17.6 Amps	24A @ 100% Duty Cycle
230/1/60HZ ±10%	31.0 Amps	40A @ 35% Duty Cycle

Output Current Range	10 - 40 Amps DC

Maximum Open Circuit Range	460 Volts DC

Pilot Current	12 Amps

1. Connect the machine to 208/230VAC input power and an air supply (80psi minimum).
2. Turn on the machine and verify the following:

   -The fan is functional.

   -The green power LED is lit on the front name plate.
3. Test the pressure switch in the following way:

   -Turn the output control knob to the blue purge area till the air starts flowing from torch.

   NOTE: If left in Purge, Purge will shut off after 5 minutes.

   Using the regulator on the machine, slowly lower the air pressure and verify that the output red LED turns on blinking at approximately 45 to 48 psi. ≈ (.31MPa to .33MPa)

   With the output red LED blinking on, move from Purge on dial to cut area of dial (RED) then pull the trigger on the torch. Verify that a pilot arc does NOT occur. Release the trigger.

   While in Purge mode increase the regulator back to the blue arrow above gauge for proper air pressure for cutting levels, 80 psi (.55MPa)

   Move dial out of Purge area.
4. Test the Purge safety function by dialing into Purge blue region and get air flowing from torch, and then pull the trigger on the torch. Verify that a pilot arc does NOT occur. Release the trigger and move from Purge on dial to the red area to turn off air flow.
5. With no air flowing (postflow), pull the trigger on the torch. Verify that the air flows and the pilot arc is initiated. While continuing to hold the trigger, verify that the pilot arc remains lit for 4 to 6 seconds then turns off automatically. Release the trigger and verify that the air continues to flow for approximately 20 seconds (postflow).
6. Unscrew the shield cup from the torch and verify that the yellow and red LEDs come on. Pull trigger, pilot arc should not occur. Re-tighten the shield cup on the torch and verify that the yellow and red LEDs alternately flash. After the yellow and red LEDs go out pull Tomahawk® 625. Pull the trigger of the torch and verify that a pilot arc does occur. **NOTE:** There is a delay in re-strike during post-flow time of pilot arc at times.
7. Test cut with Tomahawk® at its maximum material thickness with 5/8" steel max. Turn current dial to maximum.
8. Turn the Tomahawk® off. Test complete.

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TABLE OF CONTENTS - DIAGRAM SECTION

*** NOTE:** Many PC Board Assemblies are now totally encapsulated, surface mounted and or multi-layered and are therefore considered to be unserviceable. Assembly drawings of these boards are no longer provided.

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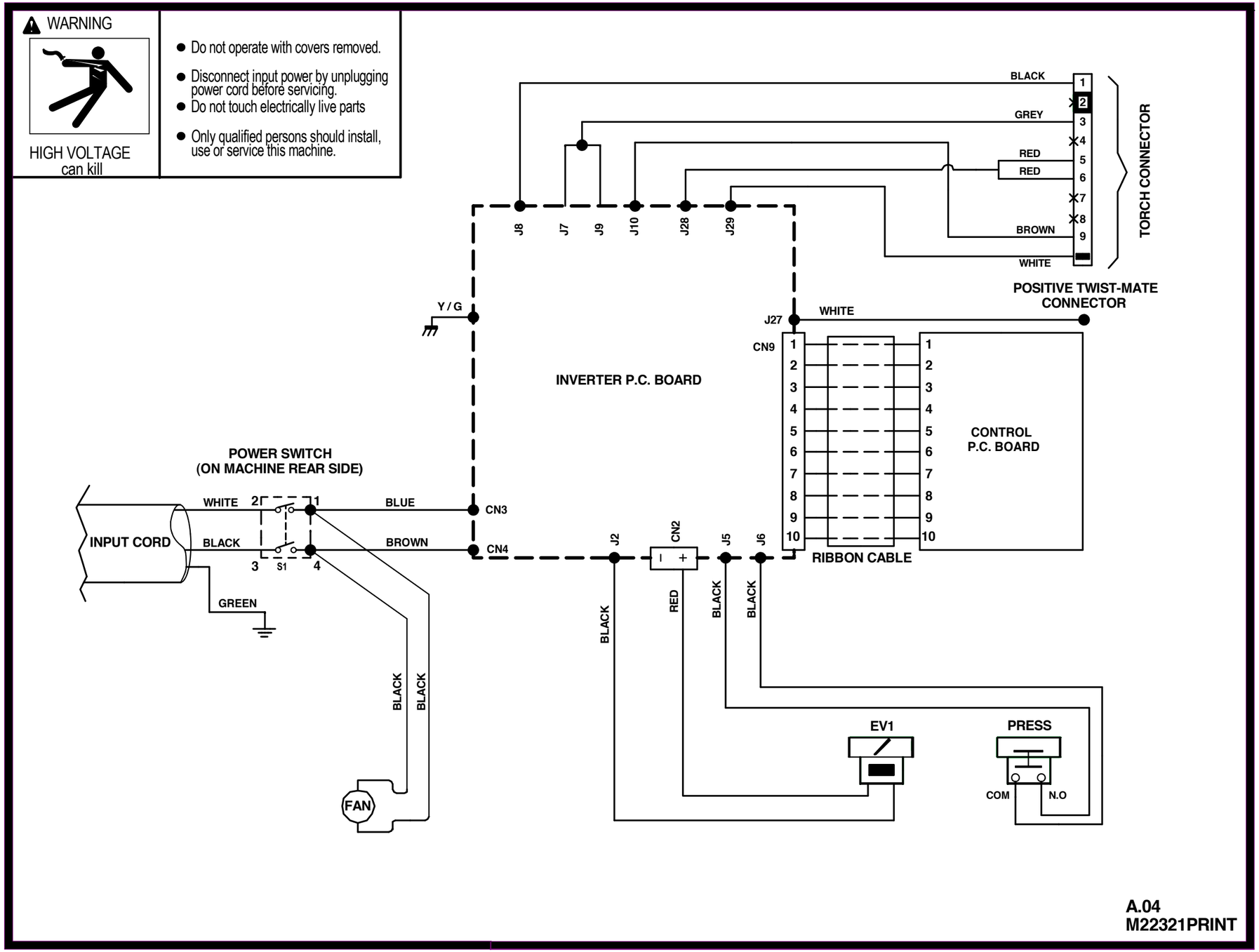
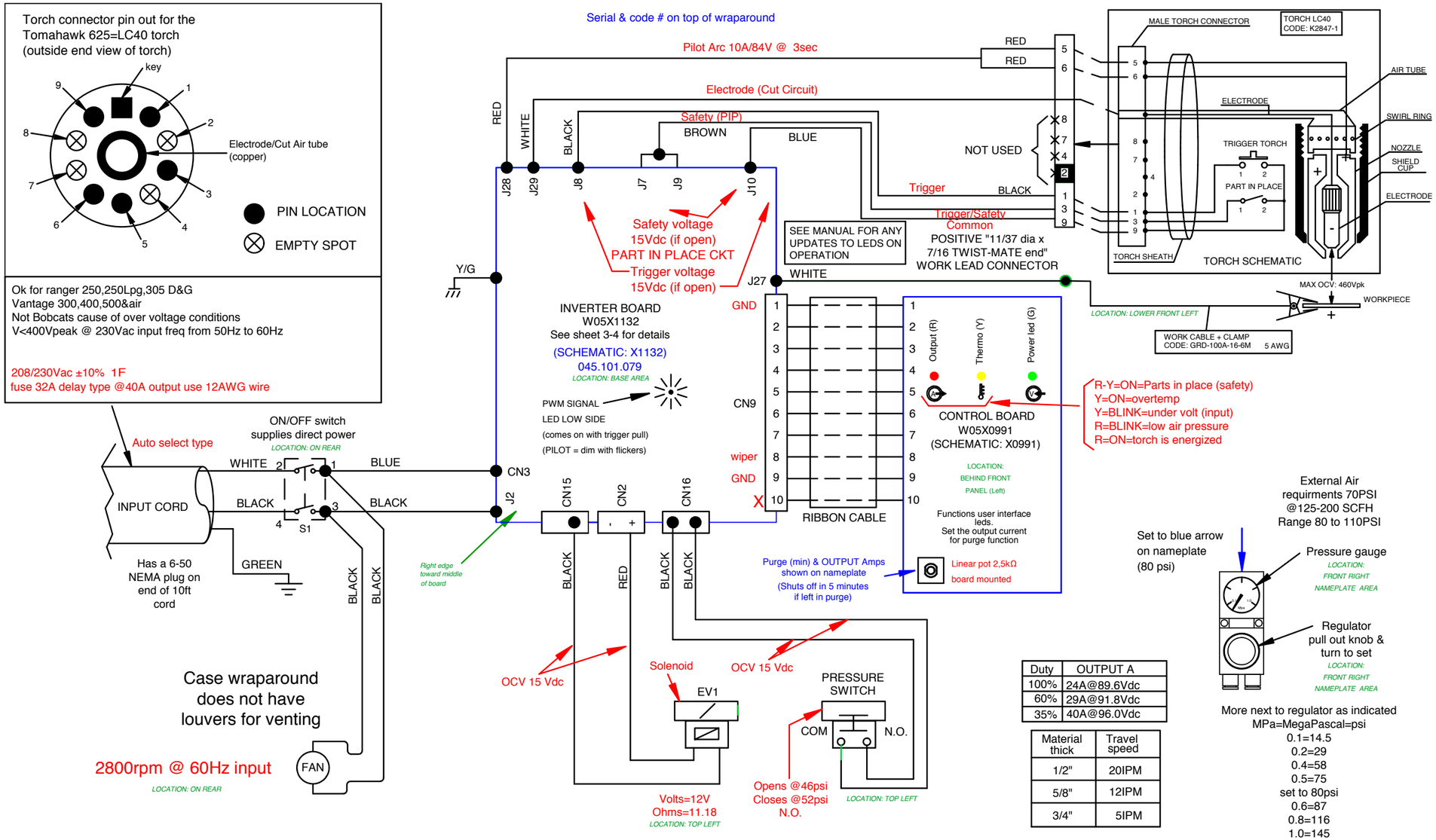
WIRING DIAGRAM



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

SCHEMATIC - COMPLETE MACHINE (M22292) PG 1

M22292	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND SHEETS 2, 3 AND 4.



Duty	OUTPUT A
100%	24A@89.6Vdc
60%	29A@91.8Vdc
35%	40A@96.0Vdc

Material thick	Travel speed
1/2"	20IPM
5/8"	12IPM
3/4"	5IPM

MANUFACTURING TOLERANCE PER E2056
UNLESS OTHERWISE SPECIFIED TOLERANCE:
ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm)
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

CONTROL:	CLEVELAND
DRAWN BY:	jmilligan
ENGINEER:	S. McQUERRY
APPROVED:	-
SCALE:	NONE IF PRINTED @ A3 SIZE
UNITS:	INCH
EQUIPMENT TYPE:	TOMAHAWK 625
SUBJECT:	SCHEMATIC
MATERIAL DISPOSITION:	NA
APPROVAL DATE:	-
PROJECT NUMBER:	5036380-B
REFERENCE:	-
PAGE	1 OF 4
DOCUMENT NUMBER:	M22292
DOCUMENT: REVISION:	A.02

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SOLID EDGE

Insight

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

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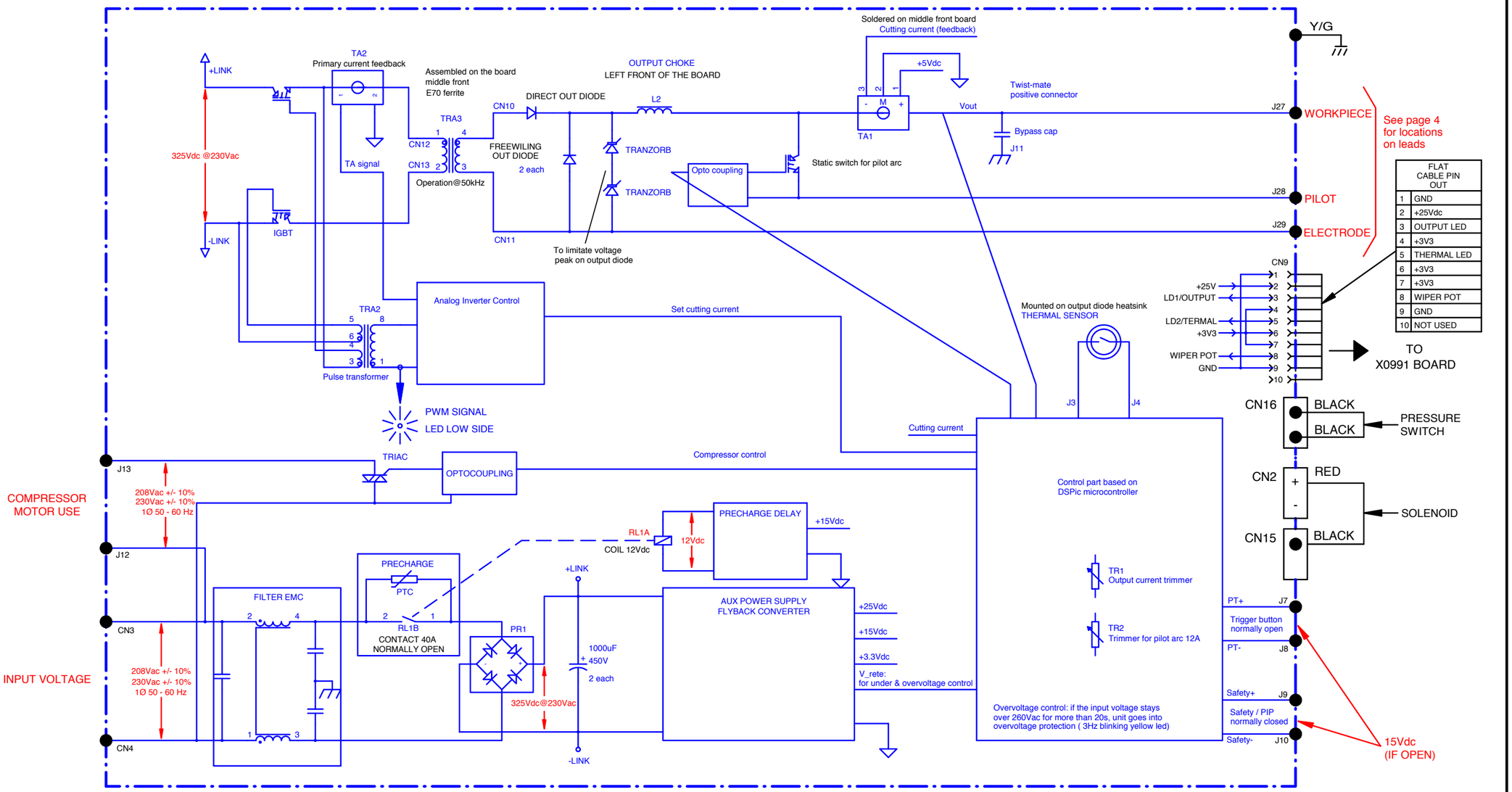
SCHEMATIC - COMPLETE MACHINE (M22292) PG 2

M22292	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND SHEETS 2, 3 AND 4.



Inverter Board functions:

The board manage the precharge system; create a 325Vdc for the half bridge inverter configuration; create by flyback conf all auxiliary voltage supply;

receive a PWM control signal for output cutting current; manage lift torch strike and avoid the arc to switch off when your're going out of the work piece;

Manage all errors and alarms signals; manage air compressor working;

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MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE: ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm) ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.	CONTROL: CLEVELAND	SCALE: NONE IF PRINTED @ A3 SIZE	EQUIPMENT TYPE: TOMAHAWK 625			PAGE 2 OF 4	
	DRAWN BY: jmilligan		SUBJECT: SCHEMATIC			DOCUMENT NUMBER: M22292	DOCUMENT: REVISION: A.02
	ENGINEER: S. McQUERRY						
DO NOT SCALE THIS DRAWING	APPROVED: -	UNITS: INCH	MATERIAL DISPOSITION: NA	APPROVAL DATE: -	PROJECT NUMBER: 5036380-B	REFERENCE: -	

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

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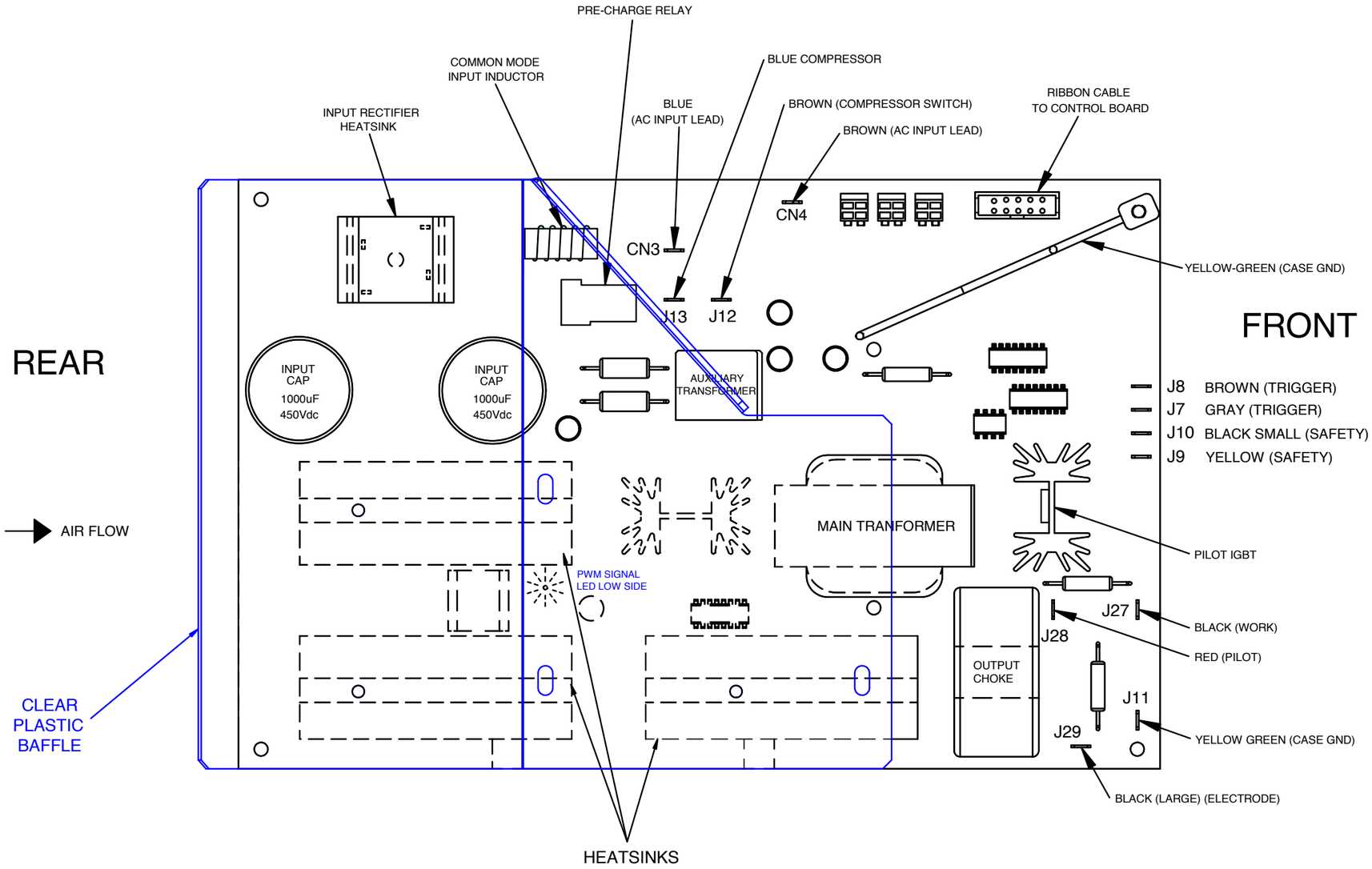
SCHEMATIC - COMPLETE MACHINE (M22292) PG 3

M22292	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND SHEETS 2, 3 AND 4.



MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE: ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm) ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.	CONTROL: CLEVELAND	SCALE: NONE IF PRINTED @ A3 SIZE	EQUIPMENT TYPE: TOMAHAWK 625			PAGE 3 OF 4	
	DRAWN BY: jmilligan		SUBJECT: SCHEMATIC			DOCUMENT NUMBER: M22292	DOCUMENT: REVISION: A.02
	ENGINEER: S. McQUERRY						
DO NOT SCALE THIS DRAWING	APPROVED: -	UNITS: INCH	MATERIAL DISPOSITION: NA	APPROVAL DATE: -	PROJECT NUMBER: 5036380-B	REFERENCE: -	

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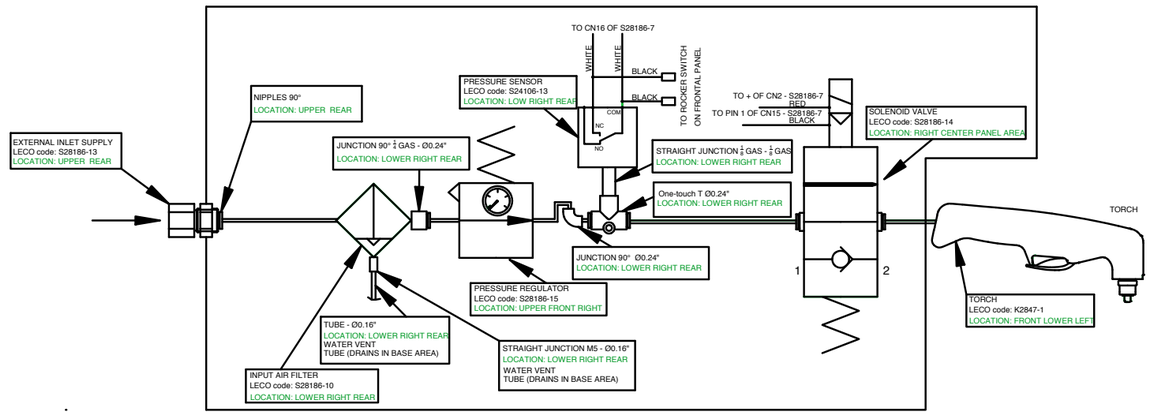
SCHEMATIC - COMPLETE MACHINE (M22292) PG 4

M22292	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND SHEETS 2, 3 AND 4.

AIR SYSTEM PATH

AIR TUBE: POLYURETANE TUBE Ø6 x 4
LEI code: W8800320

DRAIN TUBE: POLYURETANE TUBE Ø4 x 2.5mm
LEI code: W8800205



INPUT FILTER FUNCTIONS AND REQIREMENTS

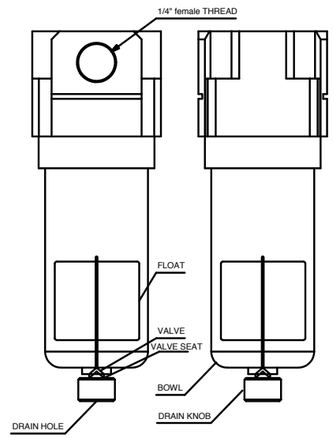
Nominal filtration rating: 5µm
Maximun input pressure: 1Mpa (145 psi); set pressure range: 0.05 - 0.8Mpa (7.2 - 116 psi)

Drain off; normally close type (see below)

The input filter has double function: filter the dust and dry the water present into the air supply, auto drain system.

Working principle: float type auto drain. When there is an accomulation of the condensate water inside the bowl the FLOAT rises due to its own buoyancy and the seal at valve seat is interrupted. The condensate inside the bowl drains out through the knob.

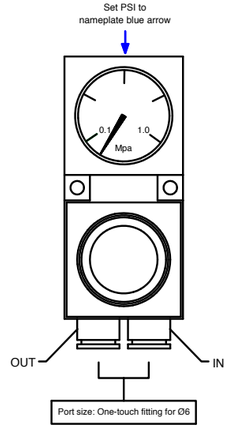
Turning knob manually ccw lowers it causes the sealing action of valve seat to be interrupted, thus allowing the condensate to drain of.



PRESSURE REGULATOR FUNCTIONS AND REQIREMENTS

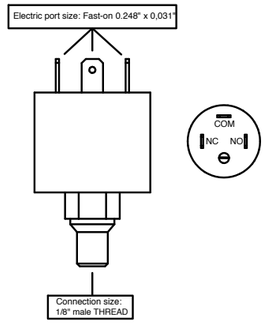
Compact mainfold regulator with adj. relief mechanism and manometer
Maximun input pressure: 1Mpa (145 psi); set pressure range: 0.05 - 0.7Mpa (7.2 - 101 psi)
Ambient and operating fluid temperature: +5 to 60°C
Typical flow rate with inlet 0.7Mpa (101 psi): outlet: 0.4Mpa (58 psi) @ 115 l/min
Mpa = Mega Pascal
PSI = pound per square inch

Mpa = PSI see page1 for conversion



PRESSURE SWITCH FUNCTIONS AND REQUIREMENTS

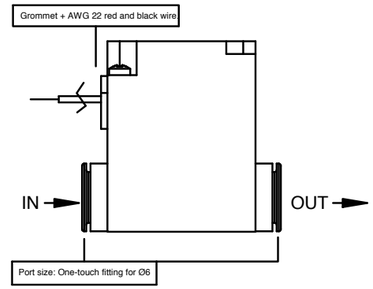
Type: N.O. and N.C. contacts - USED COM + N.O.
Max. electric ratings: N.C. 15A 250Vac N.O. 9A 250Vac
Electrical entry: FAST-ON 6.3 X 0.8 mm
Max. working temperature: + 90°C (UL)
Pressure range: 0.2 - 0.8 Mpa (29 - 116 psi)
High setting pressure: 0.36 Mpa (52 psi) ± 5%
Low setting pressure: 0.32 Mpa (46 psi) ± 5%



SOLENOID VALVE FUNCTIONS AND REQIREMENTS

Type: 2 way
Nominal electric ratings: For typical Ohms see page 1, Holding: 0.6W
Electrical entry: Grommet + AWG 22 red and black wire.
Coil insulation type: Class B
Ambient and fluid temperature working: -10 + 50°C

Min. operating pressure: 0.01Mpa (1.45 PSI)
Max. operating pressure: 0.6 Mpa (87 PSI)



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