



**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.

## ***X-TRACTOR® 3A***

For use with machines having Code Numbers:  
**K3965-1 & K3965-2**

# ***SERVICE MANUAL***



**SAFETY DEPENDS ON YOU**

Service and repair should be performed by only 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.

**WARNING**

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

**CAUTION**

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

**KEEP YOUR HEAD OUT OF THE FUMES.**

**DON'T** get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

**READ** and obey the Material Safety Data Sheet (MSDS) and the warning label that appears on all containers of welding materials.

**USE ENOUGH VENTILATION** or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

**IN A LARGE ROOM OR OUTDOORS**, natural ventilation may be adequate if you keep your head out of the fumes (See below).

**USE NATURAL DRAFTS** or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.

**WEAR CORRECT EYE, EAR & BODY PROTECTION**

**PROTECT** your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).



**PROTECT** your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

**PROTECT** others from splatter, flash, and glare with protective screens or barriers.

**IN SOME AREAS**, protection from noise may be appropriate.

**BE SURE** protective equipment is in good condition.

**Also, wear safety glasses in work area AT ALL TIMES.**

**SPECIAL SITUATIONS**

**DO NOT WELD OR CUT** containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

**DO NOT WELD OR CUT** painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

**Additional precautionary measures**

**PROTECT** compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

**BE SURE** cylinders are never grounded or part of an electrical circuit.

**REMOVE** all potential fire hazards from welding area.

**ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.**





## SECTION A: WARNINGS



### CALIFORNIA PROPOSITION 65 WARNINGS

#### Diesel Engines

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

#### Gasoline Engines

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

**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.



## 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 Z87.1 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.



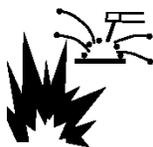
## FUMES AND GASES CAN BE DANGEROUS.



- 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.



## 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-1, “Precautions for Safe Handling of Compressed Gases in Cylinders,” available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



## FOR ELECTRICALLY POWERED EQUIPMENT.



- 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.



Welding Safety  
Interactive Web Guide  
for mobile devices

Get the free mobile app at  
<http://gettag.mobi>

# ELECTROMAGNETIC COMPATABILITY (EMC)

## CONFORMANCE

Products displaying the CE mark are in conformity with European Community Council Directive of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (89/336/EEC). 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 assess 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.

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 manufacturer's 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 work piece 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 work piece, 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.

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

As a rule of thumb, for many mild steel electrode, if the air is visibly clear and you are comfortable, then the ventilation is generally adequate for your work. The most accurate way to determine if the worker exposure does not exceed the applicable exposure limit for compounds in the fumes and gases is to have an industrial hygienist take and analyze a sample of the air you are breathing. This is particularly important if you are welding with stainless, hardfacing or Special Ventilation products. All Lincoln MSDS have a maximum fume guideline number. If exposure to total fume is kept below that number, exposure to all fume from the electrode (not coatings or plating on the work) will be below the TLV.

There are steps that you can take to identify hazardous substances in your welding environment. Read the product label and material safety data sheet for the electrode posted in the work place or in the electrode or flux container to see what fumes can be reasonably expected from use of the product and to determine if special ventilation is needed. Secondly, know what the base metal is and determine if there is any paint, plating, or coating that could expose you to toxic fumes and/or gases. Remove it from the metal being welded, if possible. If you start to feel uncomfortable, dizzy or nauseous, there is a possibility that you are being overexposed to fumes and gases, or suffering from oxygen deficiency. Stop welding and get some fresh air immediately. Notify your supervisor and co-workers so the situation can be corrected and other workers can avoid the hazard. Be sure you are following these safe practices, the consumable labeling and MSDS to improve the ventilation in your area. Do not continue welding until the situation has been corrected.

NOTE: The MSDS for all Lincoln consumables is available on Lincoln's website: [www.lincolnelectric.com](http://www.lincolnelectric.com)

Before we turn to the methods available to control welding fume exposure, you should understand a few basic terms:

**Natural Ventilation** is the movement of air through the workplace caused by natural forces. Outside, this is usually the wind. Inside, this may be the flow of air through open windows and doors.

**Mechanical Ventilation** is the movement of air through the workplace caused by an electrical device such as a portable fan or permanently mounted fan in the ceiling or wall.

**Source Extraction (Local Exhaust)** is a mechanical device used to capture welding fume at or near the arc and filter contaminants out of the air.

The ventilation or exhaust needed for your application depends upon many factors such as:

- Workspace volume
- Workspace configuration
- Number of welders
- Welding process and current
- Consumables used (mild steel, hardfacing, stainless, etc.)
- Allowable levels (TLV, PEL, etc.)
- Material welded (including paint or plating)
- Natural airflow

Your work area has adequate ventilation when there is enough ventilation and/or exhaust to control worker exposure to hazardous materials in the welding fumes and gases so the applicable limits for those materials is not exceeded. See chart of TLV and PEL for Typical Electrode Ingredients, the OSHA PEL (Permissible Exposure Limit), and the recommended guideline, the ACGIH TLV (Threshold Limit Value), for many compounds found in welding fume.

## Ventilation

There are many methods which can be selected by the user to provide adequate ventilation for the specific application. The following section provides general information which may be helpful in evaluating what type of ventilation equipment may be suitable for your application. When ventilation equipment is installed, you should confirm worker exposure is controlled within applicable OSHA PEL and/or ACGIH TLV. According to OSHA regulations, when welding and cutting (mild steels), natural ventilation is usually considered sufficient to meet requirements, provided that:

1. The room or welding area contains at least 10,000 cubic feet (about 22' x 22' x 22') for each welder.
2. The ceiling height is not less than 16 feet.
3. Cross ventilation is not blocked by partitions, equipment, or other structural barriers.
4. Welding is not done in a coned space.

Spaces that do not meet these requirements should be equipped with mechanical ventilating equipment that exhausts at least 2000 CFM of air for each welder, except where local exhaust hoods or booths, or air-line respirators are used.

### **Important Safety Note:**

**When welding with electrodes which require special ventilation such as stainless or hardfacing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce hazardous fumes, keep exposure as low as possible and below exposure limit values (PEL and TLV) for materials in the fume using local exhaust or mechanical ventilation. In coned spaces or in some circumstances, for example outdoors, a respirator may be required if exposure cannot be controlled to the PEL or TLV. (See MSDS and chart of TLV and PEL for Typical Electrode Ingredients.) Additional precautions are also required when welding on galvanized steel.**

**BIBLIOGRAPHY AND SUGGESTED READING**

ANSI Z87.1, Practice for Occupational and Educational Eye and Face Protection, American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

Arc Welding and Your Health: A Handbook of Health Information for Welding. Published by The American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031-4319.

NFPA Standard 51B, Cutting and Welding Processes, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9146, Quincy, MA 02269-9959.

OSHA General Industry Standard 29 CFR 1910 Subpart Q. OSHA Hazard Communication Standard 29 CFR 1910.1200. Available from the Occupational Safety and Health Administration at <http://www.osha.org> or contact your local OSHA office.

The following publications are published by The American Welding Society, P.O. Box 351040, Miami, Florida 33135. AWS publications may be purchased from the American Welding society at <http://www.aws.org> or by contacting the AWS at 800-443-9353.

ANSI, Standard Z49.1, Safety in Welding, Cutting and Allied Processes. Z49.1 is now available for download at no charge at <http://www.lincolnelectric.com/community/safety/> or at the AWS website <http://www.aws.org>.

AWS F1.1, Method for Sampling Airborne Particulates Generated by Welding and Allied Processes.

AWS F1.2, Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes.

AWS F1.3, Evaluating Contaminants in the Welding Environment: A Strategic Sampling Guide.

AWS F1.5, Methods for Sampling and Analyzing Gases from Welding and Allied Processes.

AWS F3.2, Ventilation Guide for Welding Fume Control.

AWS F4.1, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances.

AWS SHF, Safety and Health Facts Sheets. Available free of charge from the AWS website at <http://www.aws.org>.

**LISTED BELOW ARE SOME TYPICAL INGREDIENTS IN WELDING ELECTRODES AND THEIR TLV (ACGIH) GUIDELINES AND PEL (OSHA) EXPOSURE LIMITS**

INGREDIENTS	CAS No.	TLV mg/m <sup>3</sup>	PEL mg/m <sup>3</sup>
Aluminum and/or aluminum alloys (as Al)*****	7429-90-5	10	15
Aluminum oxide and/or Bauxite*****	1344-28-1	10	5**
Barium compounds (as Ba)*****	513-77-9	****	****
Chromium and chromium alloys or compounds (as Cr)*****	7440-47-3	0.5(b)	.005(b)
Fluorides (as F)	7789-75-5	2.5	2.5
Iron	7439-89-6	10*	10*
Limestone and/or calcium carbonate	1317-65-3	10	15
Lithium compounds (as Li)	554-13-2	10*	10*
Magnesite	1309-48-4	10	15
Magnesium and/or magnesium alloys and compounds (as Mg)	7439-95-4	10*	10*
Manganese and/or manganese alloys and compounds (as Mn)*****	7439-96-5	0.2	5.0(c)
Mineral silicates	1332-58-7	5**	5**
Molybdenum alloys (as Mo)	7439-98-7	10	10
Nickel*****	7440-02-0	1.5	1
Silicates and other binders	1344-09-8	10*	10*
Silicon and/or silicon alloys and compounds (as Si)	7440-21-3	10*	10*
Strontium compounds (as Sr)	1633-05-2	10*	10*
Zirconium alloys and compounds (as Zr)	12004-83-0	5	5

**Supplemental Information:**

(\*) Not listed. Nuisance value maximum is 10 milligrams per cubic meter. PEL value for iron oxide is 10 milligrams per cubic meter. TLV value for iron oxide is 5 milligrams per cubic meter.

(\*\*) As respirable dust.

(\*\*\*\*) Subject to the reporting requirements of Sections 311, 312, and 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR 370 and 372.

(b) The PEL for chromium (VI) is .005 milligrams per cubic meter as an 8 hour time weighted average. The TLV for water-soluble chromium (VI) is 0.05 milligrams per cubic meter. The TLV for insoluble chromium (VI) is 0.01 milligrams per cubic meter.

c) Values are for manganese fume. STEL (Short Term Exposure Limit) is 3.0 milligrams per cubic meter. OSHA PEL is a ceiling value.

(\*\*\*\*) There is no listed value for insoluble barium compounds. The TLV for soluble barium compounds is 0.5 mg/m<sup>3</sup>.

TLV and PEL values are as of April 2006. Always check Material Safety Data Sheet (MSDS) with product or on the Lincoln Electric website at <http://www.lincolnelectric.com>



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**Figure E.1 - Block logic diagram**

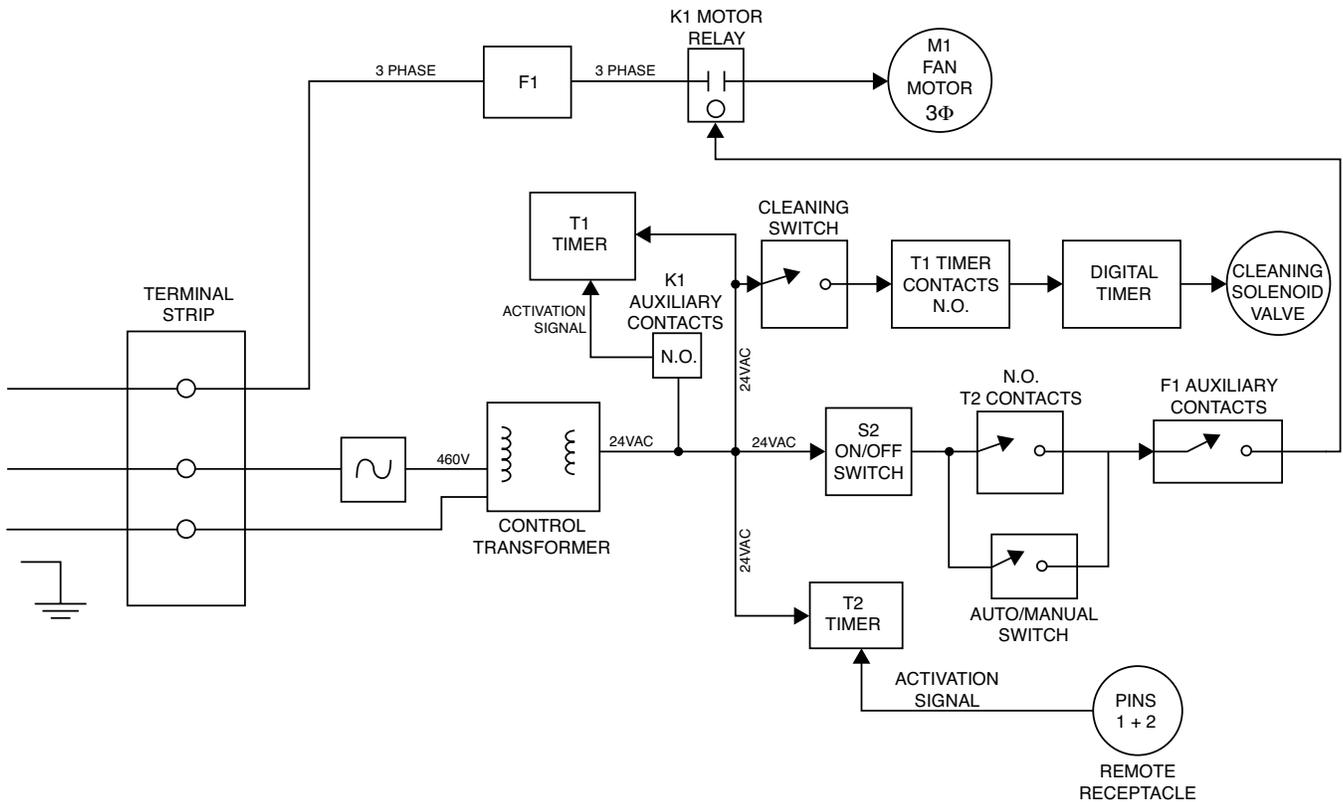
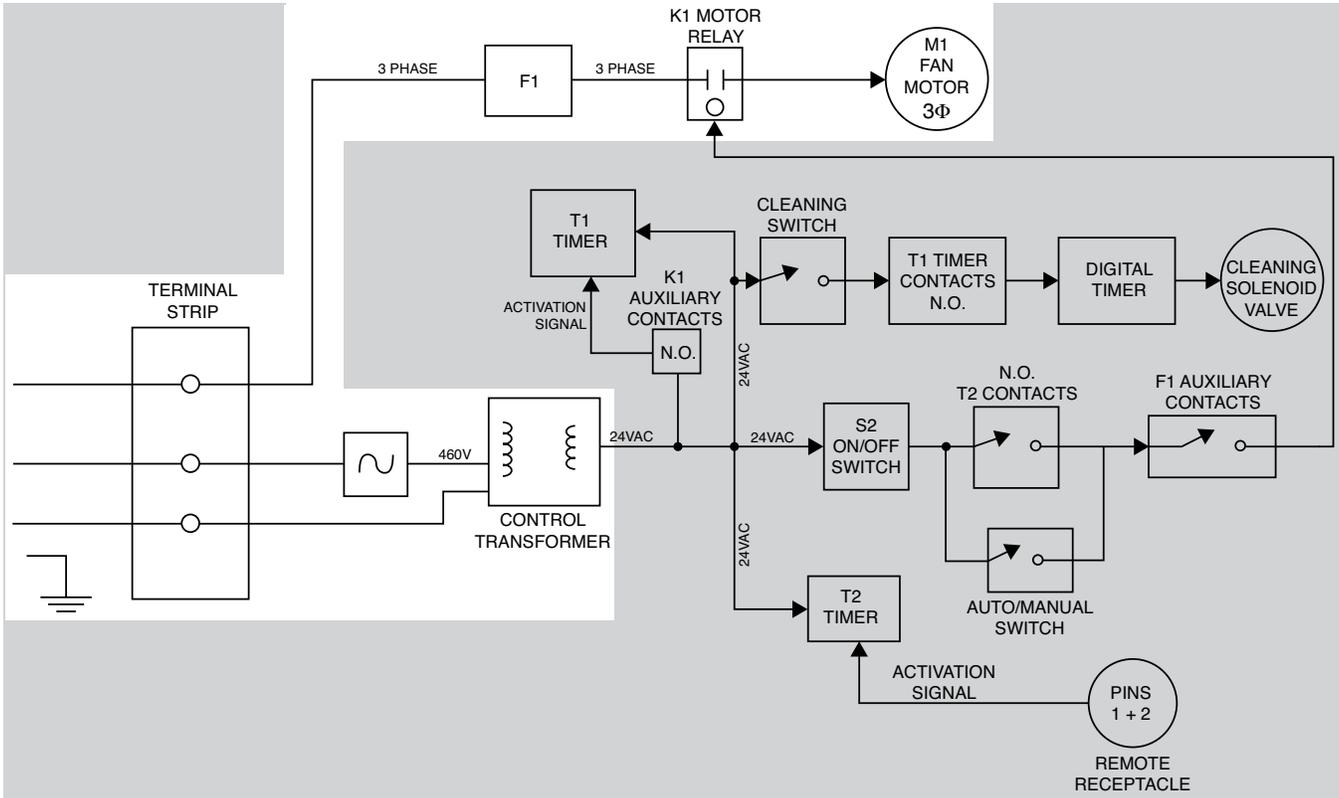


Figure E.2 - Input



**INPUT**

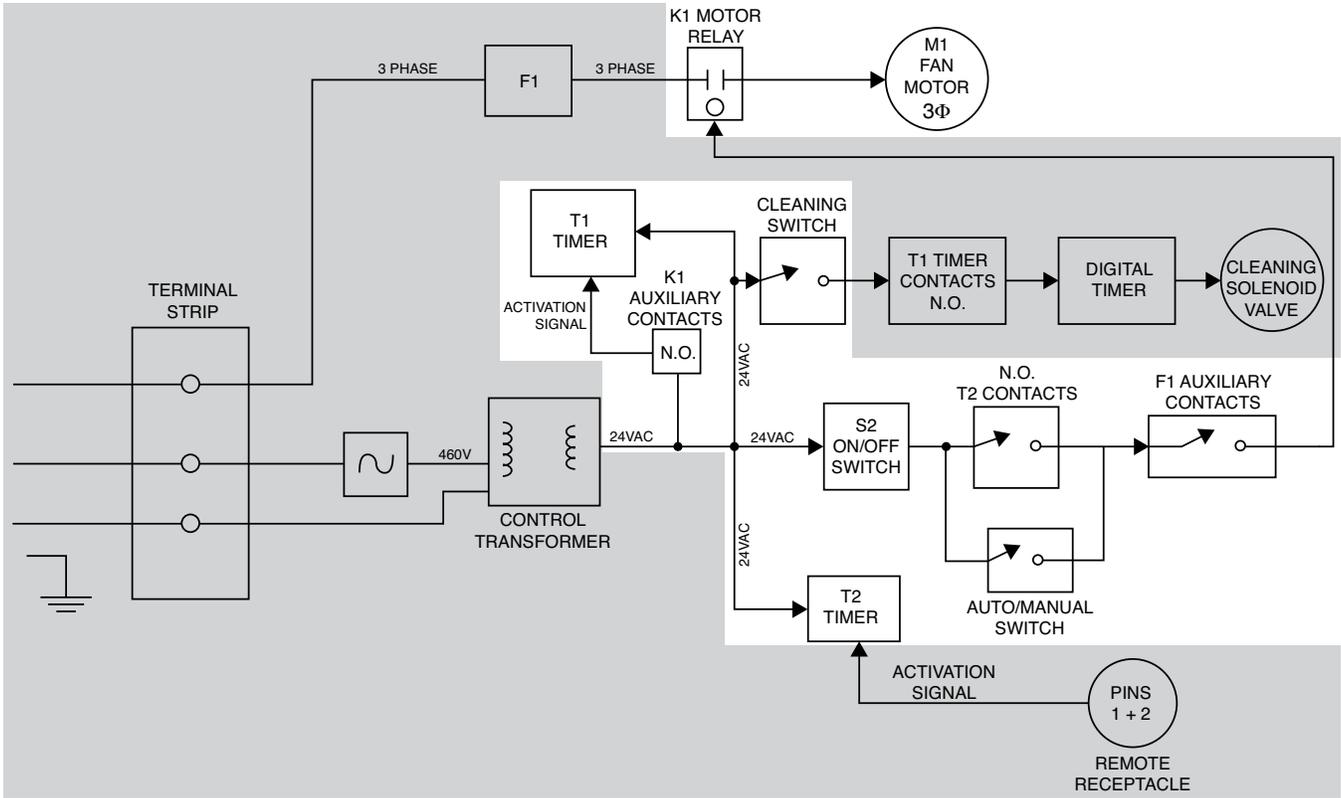
Three phase 460 volts is applied through a terminal strip to a three phase thermal circuit breaker (F1). 460 volt three phase voltage is also applied to the motor relay (K1). When this motor relay (K1) is activated, the 460 volt three phase power is applied to the fan motor (M1).

In summary, the thermal circuit breaker (F1) must be closed and the motor relay (K1) must be activated in order for the fan motor (M1) to be energized. When the fan is energized, the high vacuum, low volume system is functioning.

Two phases of the three phase input is also applied through a fuse to the step down control transformer. The 24 volt secondary supplies power to the control circuitry and to the X-Tractor 3A machine.

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

Figure E.3 - Motor control circuitry



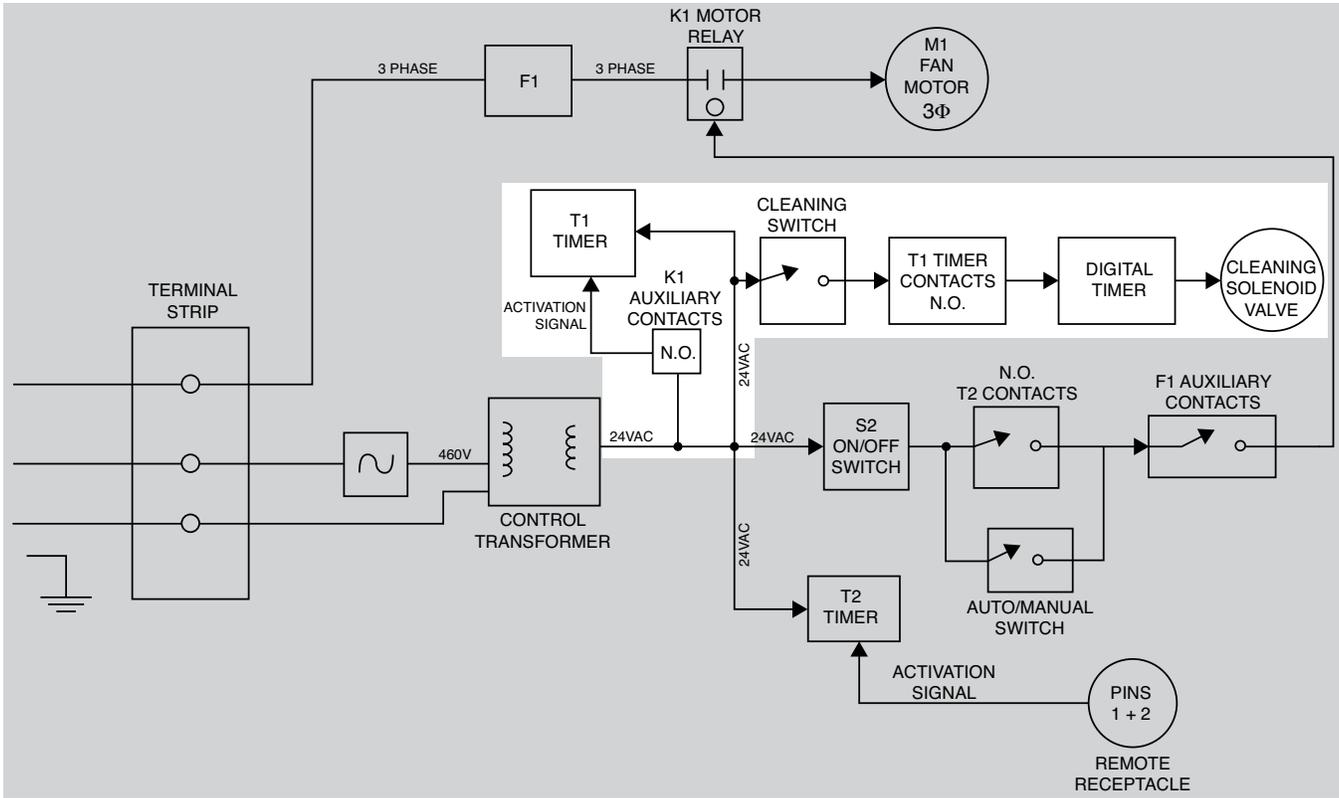
### MOTOR CONTROL CIRCUITRY

24 VAC is applied to several components. 24 VAC is applied to the on/off switch (S2), timer (T1), timer (T2), cleaning switch and to a set of auxiliary contacts located on motor relay (K1). When the on/off switch (S2) is turned on, 24 VAC is applied to the auto/manual switch and the N.O. contacts on timer (T2).

When the auto/manual switch is closed or timer (T2) is activated from an external closure at the remote receptacle, 24 VAC is applied through a set of auxiliary contacts (F1) to motor relay (K1). The motor relay (K1) is then energized and three phase power is applied to fan motor (M1).

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

Figure E.4 - Cleaning circuitry



**CLEANING CIRCUITRY**

24 VAC is applied to timer (T1) and the cleaning switch. When motor relay (K1) is energized, a 24 VAC activation signal is applied to timer (T1) via a set N.O. auxiliary contacts located on motor relay (K1). When the cleaning switch is closed, 24 VAC is applied to a digital timer module via a set of N.O. contacts on timer (T1). The digital module timer controls the cleaning solenoid valve. When the cleaning solenoid valve is opened, a pulse of compressed air shakes the particulate from the outside surface of the air filter.

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

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# HOW TO USE TROUBLESHOOTING GUIDE

## WARNING

Service and repair should be performed by only 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 two main categories: Motor and Function Problems.

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

**Step 3. PERFORM COMPONENT TESTS.** The last column, labeled "Recommended Course of Action" lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify 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 section. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to 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 test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Return to Section TOC

Return to Master TOC

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>MOTOR AND FUNCTION PROBLEMS</b>		
Major physical or electrical damage is evident when the X-Tractor case is removed.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
The input fuses repeatedly fail or the input circuit breakers keep tripping.	<ol style="list-style-type: none"> <li>1. Make certain the fuses or breakers are properly sized.</li> <li>2. Make sure the three phase input line voltage is correct for the machine.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b><i>M1 Three-Phase Fan Resistance Test.</i></b></li> <li>2. Perform the <b><i>F1 Thermal Circuit Breaker and Auxiliary Contacts Resistance Test.</i></b></li> <li>3. Perform the <b><i>K1 Contactor Test.</i></b></li> <li>4. Perform the <b><i>Control Transformer (TR1) Test.</i></b></li> </ol>
The machine will not power up. No fan.	<ol style="list-style-type: none"> <li>1. Make sure the proper input voltage is being applied to the machine (check fuses or breakers).</li> <li>2. Make sure the Thermal Circuit Breaker is not tripped. Reset if necessary. See the Wiring Diagram.</li> <li>3. Make certain the input power switch (SW2) is in the ON position.</li> <li>4. Check the F2 fuses that are in series with the control transformer (TR1) primary. See the Wiring Diagram.</li> <li>5. Check the F3 fuse that is in series with the control transformer (TR1) secondary. See the Wiring Diagram.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b><i>Control Transformer (TR1) Test.</i></b></li> <li>2. Perform the <b><i>F1 Thermal Circuit Breaker and Auxiliary Contacts Resistance Test.</i></b></li> <li>3. Perform the <b><i>K1 Contactor Test.</i></b></li> </ol>

 **CAUTION**

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.

Observe Safety Guidelines detailed in the beginning of this manual.

**TRUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>MOTOR AND FUNCTION PROBLEMS</b>		
<p>The filter cleaning function does not work. The motor (M1) operates normally.</p>	<ol style="list-style-type: none"> <li>1. Make sure the Cleaning Switch S1 is in the ON position.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the operation of the S1 switch. See the Wiring Diagram.</li> <li>2. Perform the <b>K1 Contactor Test</b>.</li> <li>3. Perform the <b>Timer T1 Test</b>.</li> <li>4. Perform the <b>Cleaning Solenoid Resistance Test</b>.</li> <li>5. The Digital Timer may be faulty.</li> </ol>
<p>The external start/stop function does not work.</p>	<ol style="list-style-type: none"> <li>1. Make sure the external start/stop switches are connected to pins 1 and 2 on the remote receptacle. See the Wiring Diagram.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b>Timer T2 Test</b>.</li> </ol>
<p>There is poor suction from the machine.</p>	<ol style="list-style-type: none"> <li>1. The filter may be clogged. Clean or replace as required.</li> <li>2. The hoses may be too long or damaged.</li> <li>3. The motor may be running in the wrong direction. Change two phases of the three phase input.</li> <li>4. There may be leakage in the system.</li> </ol>	<ol style="list-style-type: none"> <li>1. The motor may not be functioning. Perform the <b>M1 Three-Phase Fan Resistance Test</b>.</li> </ol>

 **CAUTION**

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.

## CASE COVER 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**

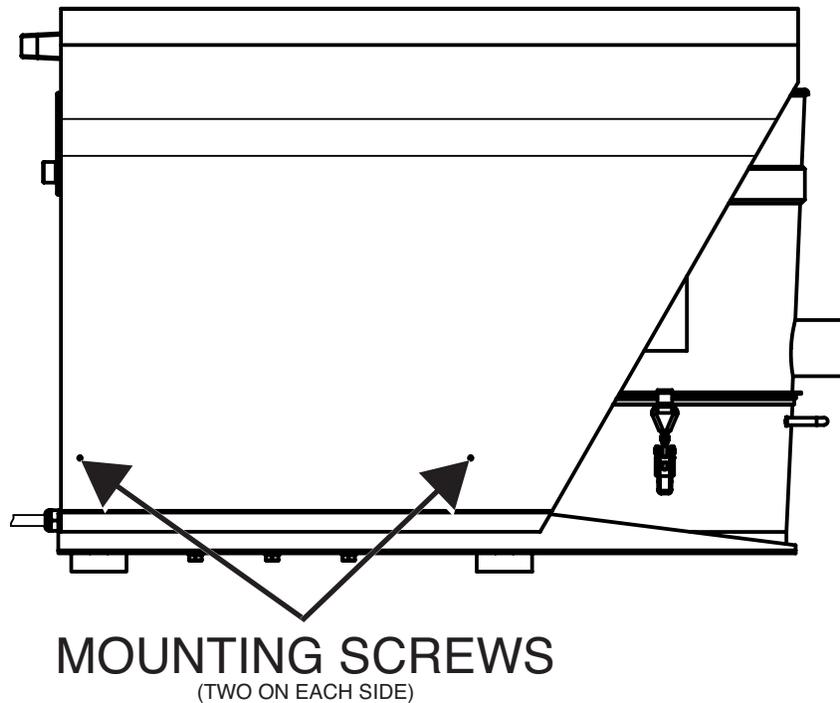
This procedure will aid the technician in the removal and replacement of the Case Cover.

### **MATERIALS NEEDED**

1/4" Nutdriver

## CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.1 – Case cover removal



### REMOVAL PROCEDURE

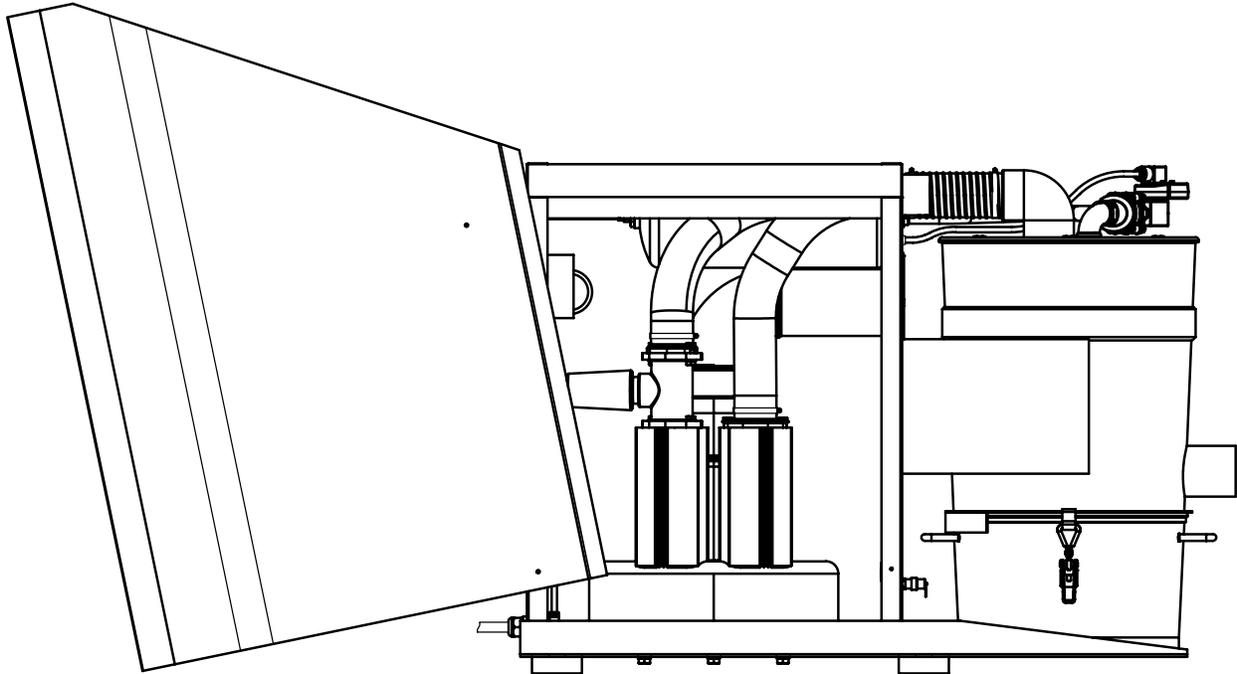
1. Remove input power to the X-Tractor 3A.
2. Using a 1/4" nutdriver, remove the four screws (two on each side) securing the case cover. See Figure F.1.

**NOTE:** For fast access to internal components only remove the two front screws (one on each side) from the case cover. The cover can now be carefully tilted to rest on the floor. See **Figure F.2**.

3. Carefully remove cover from machine.

## CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.2 – Case cover tilted



### REPLACEMENT PROCEDURE

1. Carefully position cover on to machine.

**NOTE:** Skip step two if cover was simply tilted for internal component access. See Figure F.2.

2. Using a 1/4" nutdriver, attach the two screws securing front of the case cover to the machine.
3. Using a 1/4" nutdriver, attach the two screws securing the rear of the case cover.



## CONTROL TRANSFORMER (TR1) RESISTANCE TEST (460V MACHINE)

### **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**

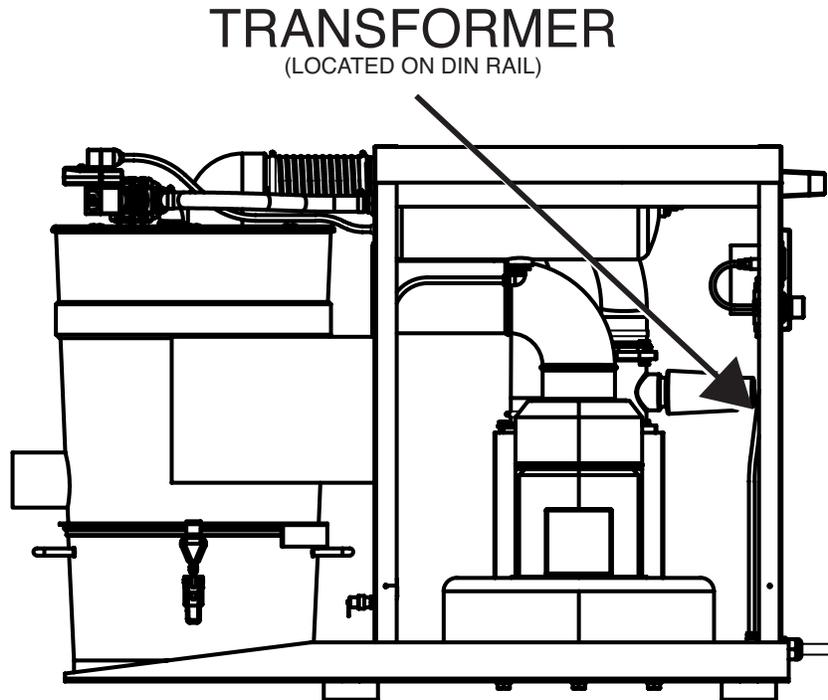
This test will help determine if the Primary and Secondary Transformer Windings are open or grounded.

### **MATERIALS NEEDED**

- Voltmeter/Ohmmeter (Multimeter)
- Small Slotted Screwdriver
- Wiring Diagram

## CONTROL TRANSFORMER (TR1) RESISTANCE TEST (460V MACHINE) *(continued)*

Figure F.3 – Control transformer location

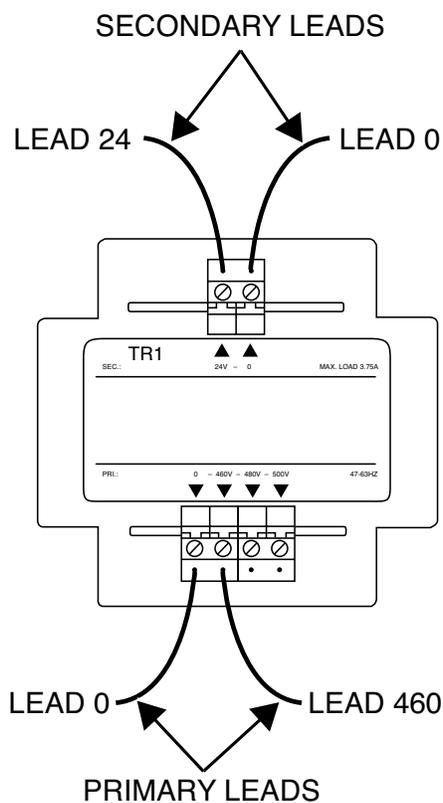


### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the ***Case Cover Removal Procedure***.
3. Locate the control transformer on the DIN rail. See Figure F.3.
4. Using a small slotted screwdriver, label and remove the two secondary leads from the control transformer (Leads 0 and 24). See ***Figure F.4***. See the Wiring Diagram.
5. Using a small slotted screwdriver, label and remove the two primary leads from the control transformer (Leads 0 and 460). **Lead numbers will vary with 230 Volt X-Tractor 3A machine.** See ***Figure F.4***. See the Wiring Diagram.
6. Check the resistance of the 24 Volt secondary winding in the control transformer. Normal resistance is approximately 0.2 ohms. **This resistance may vary if testing an 230 Volt X-Tractor 3A machine.**
7. Check the resistance of the 460 Volt primary winding in the control transformer. Normal resistance is approximately 61 ohms. **This resistance may vary if testing an 230 Volt X-Tractor 3A machine.**
8. Check the resistance between the primary and secondary windings. Normal resistance should be at least 500,000 ohms.
9. Also check the resistance from the primary and secondary windings to ground. Normal resistance should be at least 500,000 ohms to ground.
10. If further testing is required carefully apply the correct input voltage (230VAC or 460VAC) to the correct primary terminals of the control transformer and verify that 24VAC is being generated at the secondary terminals of the control transformer.
11. Connect all leads previously removed.
12. Perform the ***Case Cover Replacement Procedure***.

# CONTROL TRANSFORMER (TR1) RESISTANCE TEST (460V MACHINE) *(continued)*

Figure F.4 – Primary and secondary locations





## M1 THREE-PHASE FAN RESISTANCE TEST (460V MACHINE)

### **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**

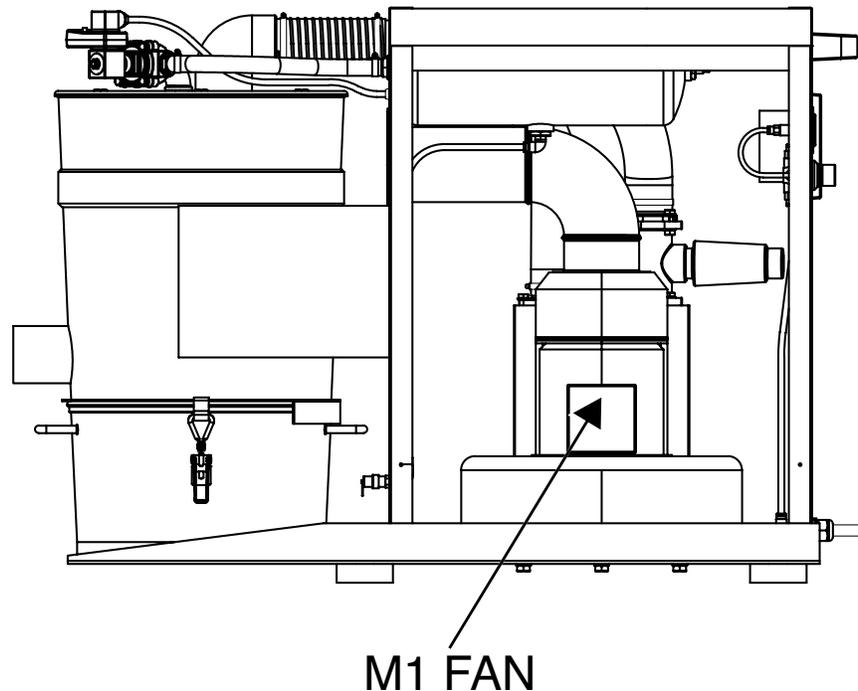
This test will help determine if the M1 Fan Windings are open or grounded.

### **MATERIALS NEEDED**

Voltmeter/Ohmmeter (Multimeter)  
Phillips Screwdriver  
Wiring Diagram

## M1 THREE-PHASE FAN RESISTANCE TEST

Figure F.5 – M1 three-phase fan location

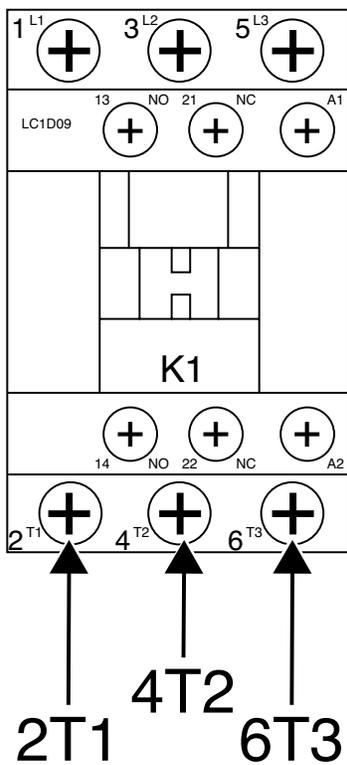


### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the M1 three-phase fan inside the machine. See Figure F.5.
4. Using a phillips screwdriver, label and remove the three M1 fan leads from the K1 contactor. The M1 fan leads are connected to terminals 2T1, 4T2 and 6T3 on the K1 contactor. See **Figure F.6**. See the Wiring Diagram.
5. Using the ohmmeter, check the resistances between the three input leads to the M1 fan. Normal resistance between phases should be approximately 4.5 ohms. **This value may be different if testing the fan in an 230 Volt X-Tractor 3A machine.**
6. Also check the resistance between the three input leads and ground. Normal resistance should be at least 500,000 ohms to ground.
7. Connect all previously removed leads.
8. Perform the **Case Cover Replacement Procedure**.

### M1 THREE-PHASE FAN RESISTANCE TEST (460V MACHINE) *(continued)*

Figure F.6 – M1 fan lead location





## F1 THERMAL CIRCUIT BREAKER AND AUXILIARY CONTACTS RESISTANCE 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**

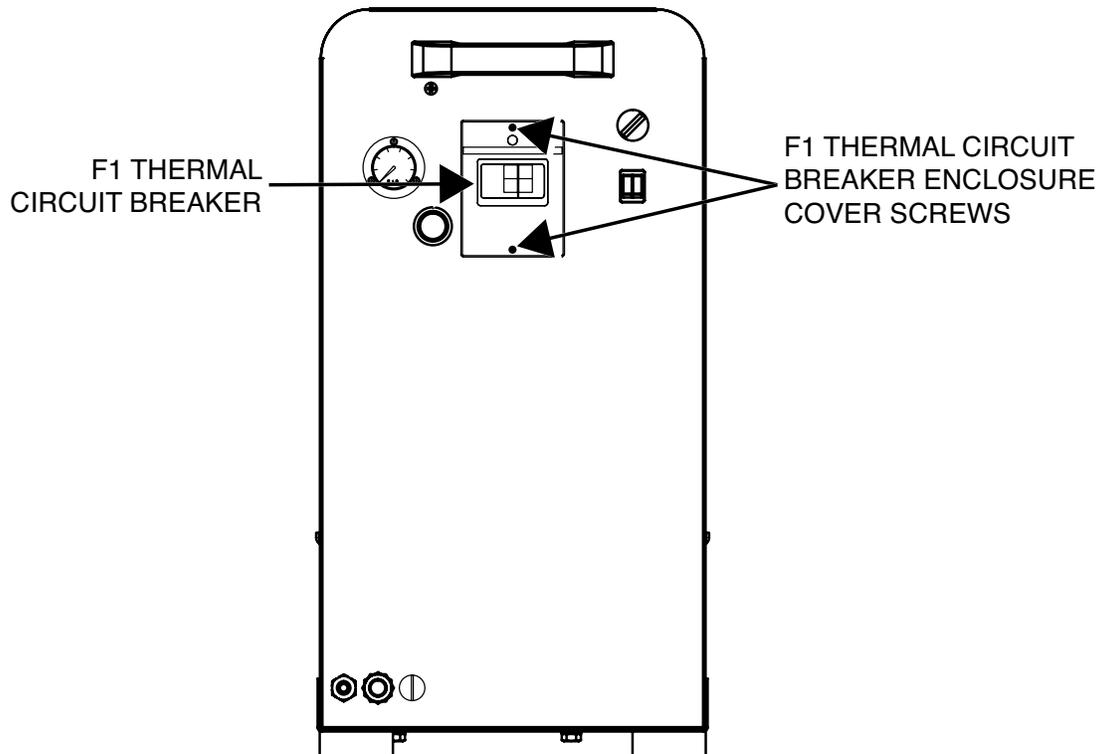
This test will help determine if the F1 Thermal Circuit Breaker is functioning properly and if the Auxiliary Contacts are opening and closing correctly.

### **MATERIALS NEEDED**

- Voltmeter/Ohmmeter (Multimeter)
- Phillips Screwdriver
- Wiring Diagram

## F1 THERMAL CIRCUIT BREAKER AND AUXILIARY CONTACTS RESISTANCE TEST *(continued)*

Figure F.7 – F1 thermal circuit breaker location



### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the F1 thermal circuit breaker on the back of the machine. See Figure F.7.
4. Using a phillips screwdriver, remove the two screws securing the F1 thermal circuit breaker enclosure cover. See Figure F.7.
5. Locate terminals numbered 1L1, 2T1, 3L2, 4T2, 5L3 and 6T3. See **Figure F.8**. See Wiring Diagram.
6. Locate the two auxiliary contact leads #43 and #44. See the Wiring Diagram. See **Figure F.8**.
7. Perform the resistance checks per **Table F.1**.
8. If the resistances are correct, the testing is complete.
9. If the resistances are not correct, the thermal circuit breaker or auxiliary contact may be faulty.
10. Using a phillips screwdriver, attach the two screws securing the F1 thermal circuit breaker enclosure cover. See Figure F.7.
11. Perform the **Case Cover Replacement Procedure**.

## F1 THERMAL CIRCUIT BREAKER AND AUXILIARY CONTACTS RESISTANCE TEST *(continued)*

Figure F.8 – F1 thermal circuit breaker lead location

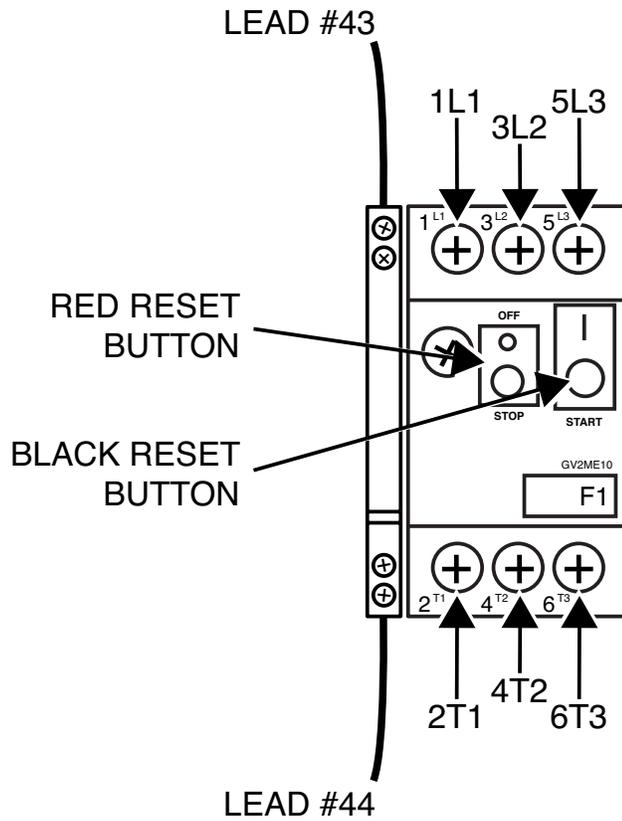


Table F.1 – F1 contact resistance checks

TEST DESCRIPTION	TEST POINT	TEST POINT	CONDITIONS	EXPECTED READING
MAIN LINE CONTACTS	1L1	2T1	BLACK RESET BUTTON DEPRESSED	ZERO OHMS
MAIN LINE CONTACTS	3L2	4T2	BLACK RESET BUTTON DEPRESSED	ZERO OHMS
MAIN LINE CONTACTS	5L3	6T3	BLACK RESET BUTTON DEPRESSED	ZERO OHMS
MAIN LINE CONTACTS	1L1	2T1	RED RESET BUTTON DEPRESSED	INFINITE OHMS
MAIN LINE CONTACTS	3L2	4T2	RED RESET BUTTON DEPRESSED	INFINITE OHMS
MAIN LINE CONTACTS	5L3	6T3	RED RESET BUTTON DEPRESSED	INFINITE OHMS
AUXILIARY CONTACTS	TERMINAL WITH LEAD #43	TERMINAL WITH LEAD #44	BLACK RESET BUTTON DEPRESSED	ZERO OHMS
AUXILIARY CONTACTS	TERMINAL WITH LEAD #43	TERMINAL WITH LEAD #44	RED RESET BUTTON DEPRESSED	INFINITE OHMS



## TIMER T1 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**

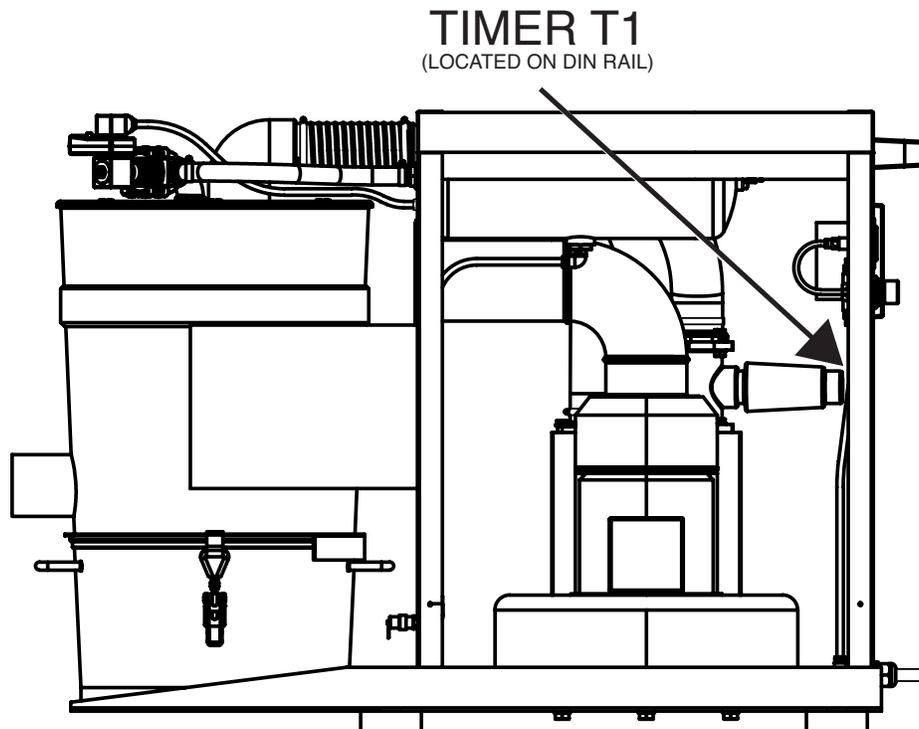
This test will help determine if the Timer T1 is operating correctly.

### **MATERIALS NEEDED**

- Voltmeter/Ohmmeter (Multimeter)
- 24VAC External Supply
- Phillips Screwdriver
- Wiring Diagram

## TIMER T1 TEST *(continued)*

Figure F.9 – Timer T1 location



### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the timer T1 on the DIN rail. See Figure F.9.
4. Using a phillips screwdriver, label and disconnect leads A1 and A2 from the timer T1. See **Figure F.10**. See Wiring Diagram.
5. Carefully apply the external 24VAC supply to terminals A1 and A2 on the timer T1. The green LED should come on. If it does not illuminate with the 24VAC applied to terminals A1 and A2, the timer T1 may be faulty.
6. With the 24VAC applied to terminals A1 and A2 check the resistance between the contact terminals 18 and 15. The terminals should be “open”.
7. Carefully jumper terminals A1 and Y1 together. The yellow LED should illuminate and the contact terminals 18 and 15 should close and the resistance between the two should be zero ohms.
8. Carefully remove the jumper from terminal Y1. The yellow LED should then start to flash and the contact terminals 18 and 15 should still be closed with zero resistance between the two for approximately 5 minutes.
9. If the timer T1 does not pass any of the above tests check the settings on the timer. If the settings are correct the timer T1 may be faulty. See **Figure F.11** for the correct settings.
10. Connect all leads previously removed.
11. Perform the **Case Cover Replacement Procedure**.

### TIMER T1 TEST (continued)

Figure F.10 – Timer T1 lead locations

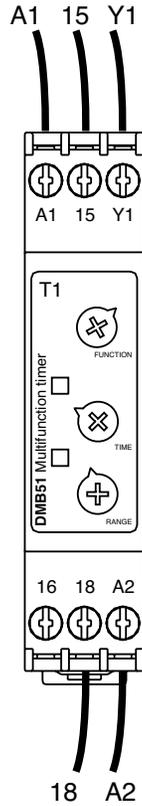
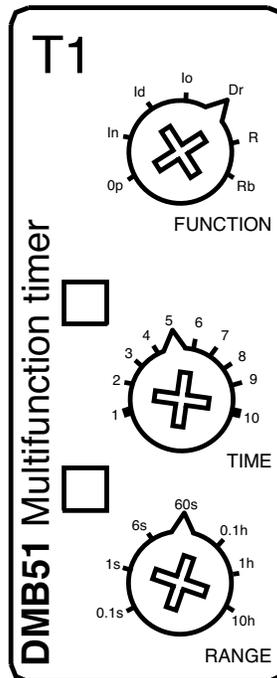


Figure F.11 – Timer T1 settings





## TIMER T2 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**

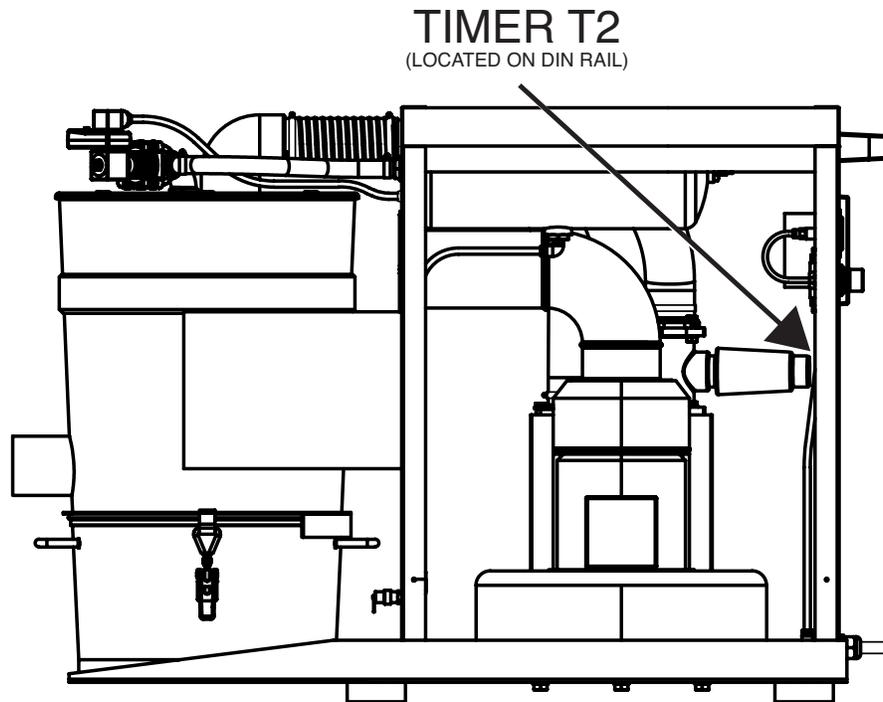
This test will help determine if the Timer T2 is operating correctly.

### **MATERIALS NEEDED**

- Voltmeter/Ohmmeter (Multimeter)
- 24VAC External Supply
- Phillips Screwdriver
- Wiring Diagram

## TIMER T2 TEST *(continued)*

Figure F.12 – Timer T2 location



### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the timer T2 on the DIN rail. See Figure F.12.
4. Using a phillips screwdriver, label and disconnect leads A1 and A2 from the timer T2. See **Figure F.13**.
5. Carefully apply the external 24VAC supply to terminals A1 and A2 on the timer T2. The green LED should come on. If it does not illuminate with the 24VAC applied to terminals A1 and A2, the timer T2 may be faulty.
6. With the 24VAC applied to terminals A1 and A2 check the resistance between the contact terminals 18 and 15. The terminals should be “open”.
7. Carefully jumper terminals A1 and Y1 together. The yellow LED should illuminate and the contact terminals 18 and 15 should close and the resistance between the two should be zero ohms.
8. Carefully remove the jumper from terminal Y1. The yellow LED should then start to flash and the contact terminals 18 and 15 should still be closed for approximately 30 seconds with zero resistance between the two. The contact terminals should then open and yellow LED should go out.
9. If the timer T2 does not pass any of the above tests check the settings on the timer. If the settings are correct the timer T2 may be faulty. See **Figure F.14** for the correct settings.
10. Connect all leads previously removed.
11. Perform the **Case Cover Replacement Procedure**.

### TIMER T2 TEST (continued)

Figure F.13 – Timer T2 location

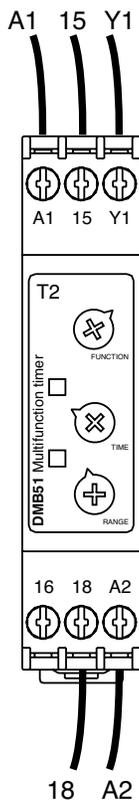
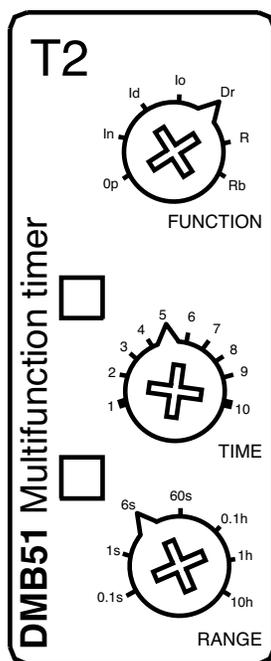


Figure F.14 – Timer T2 settings





## K1 CONTACTOR TESTS

### **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.

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### **TEST DESCRIPTION**

This test will help determine if the K1 contactor is functioning properly and if its contacts are opening and closing correctly.

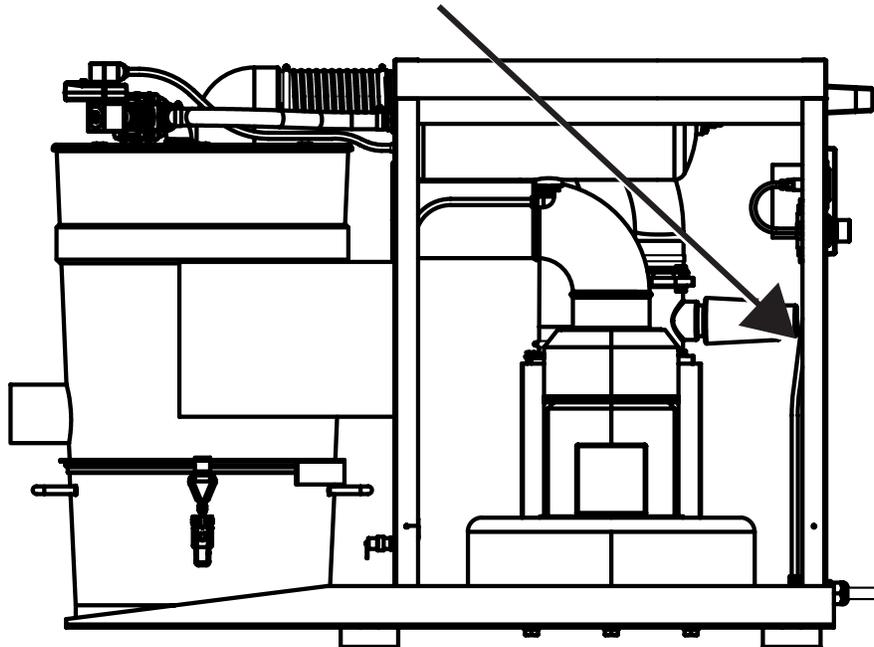
### **MATERIALS NEEDED**

- Voltmeter/Ohmmeter (Multimeter)
- Small Slotted Screwdriver
- 24VAC External Power Supply
- Wiring Diagram

## K1 CONTACTOR TESTS *(continued)*

Figure F.15 – K1 contactor location

### K1 CONTACTOR (LOCATED ON DIN RAIL)

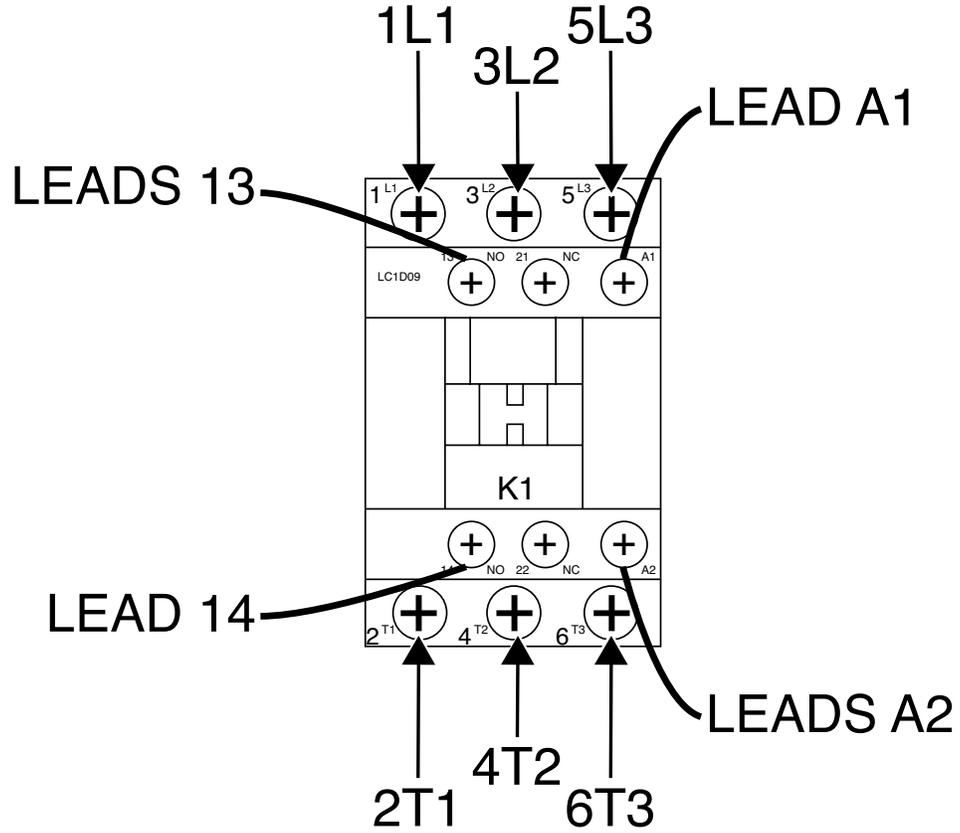


#### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the K1 contactor on the DIN rail. See Figure F.15.
4. Using a phillips screwdriver, label and remove the A1 and A2 leads from the K1 contactor. These are the leads that supply 24VAC to the K1 contactor coils. See the Wiring Diagram. See **Figure F.16**.
5. Check the resistance of the coil of K1. Normal resistance is approximately 5.4 ohms. See the Wiring Diagram. See **Figure F.16**.
6. If the resistance is normal, carefully apply the external 24VAC to the contactor coil of K1. The contactor should activate. If not, the contactor may be faulty.
7. With 24VAC applied, check the contact resistance between K1 terminals 1L1 and 2T1. It should be zero ohms with the contactor activated. If not, the contacts may be faulty. See **Figure F.16**. See the Wiring Diagram.
8. Check the resistance between K1 terminals 3L2 and 4T2. It should be zero ohms with the contactor activated. See **Figure F.16**. See the Wiring Diagram.
9. Check the resistance between K1 terminals 5L3 and 6T3. It should be zero ohms with the contactor activated. If not, the contacts may be faulty. See **Figure F.16**. See the Wiring Diagram.
10. Check the resistance between terminals 13 and 14. It should be zero ohms with the contactor activated. If not contactor may be faulty.
11. Carefully remove the external 24VAC from the K1 contactor coil. The contactor should deactivate.
12. Recheck the resistances in Steps 7, 8, and 9. The resistances should now be infinite. If not, the contactor contacts may be stuck closed.
13. Connect all leads previously removed.
14. Perform the **Case Cover Replacement Procedure**.

### K1 CONTACTOR TESTS *(continued)*

Figure F.16 – K1 contactor test points and lead location





## CLEANING SOLENOID RESISTANCE 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.

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### **TEST DESCRIPTION**

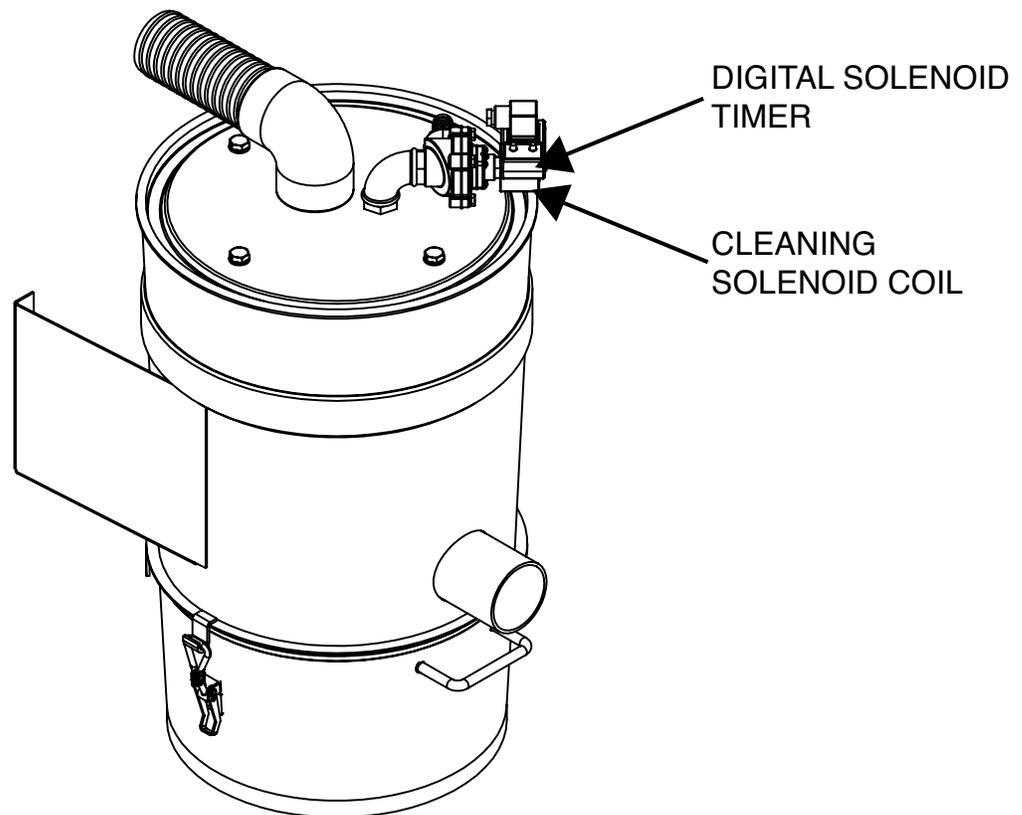
This test will help determine if the Coil in the Solenoid is open or grounded.

### **MATERIALS NEEDED**

Voltmeter/Ohmmeter (Multimeter)  
Slotted Screwdriver

## CLEANING SOLENOID RESISTANCE TEST *(continued)*

Figure F.17 – Cleaning solenoid and digital timer location

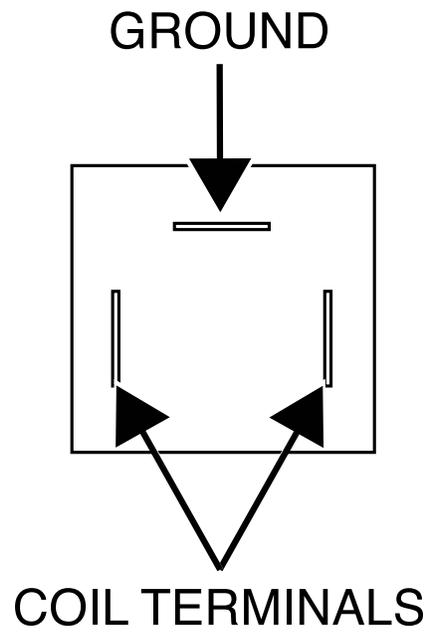


### PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the cleaning solenoid. See Figure F.17.
4. Perform the **Digital Solenoid Timer Removal Procedure**.
5. Check the resistance of the cleaning solenoid coil. Normal coil resistance is approximately 12.5 ohms. Also check the resistance from one of the coil terminals to the ground terminal. It should be very high. At least 500,000 ohms. See **Figure F.18**.
6. If the coil resistance is not correct or the coil is grounded, the cleaning solenoid is faulty.
7. Perform the **Digital Solenoid Timer Replacement Procedure**.
8. Perform the **Case Cover Replacement Procedure**.

### CLEANING SOLENOID RESISTANCE TEST *(continued)*

Figure F.18 – Cleaning solenoid coil terminals





## DIGITAL SOLENOID TIMER 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**

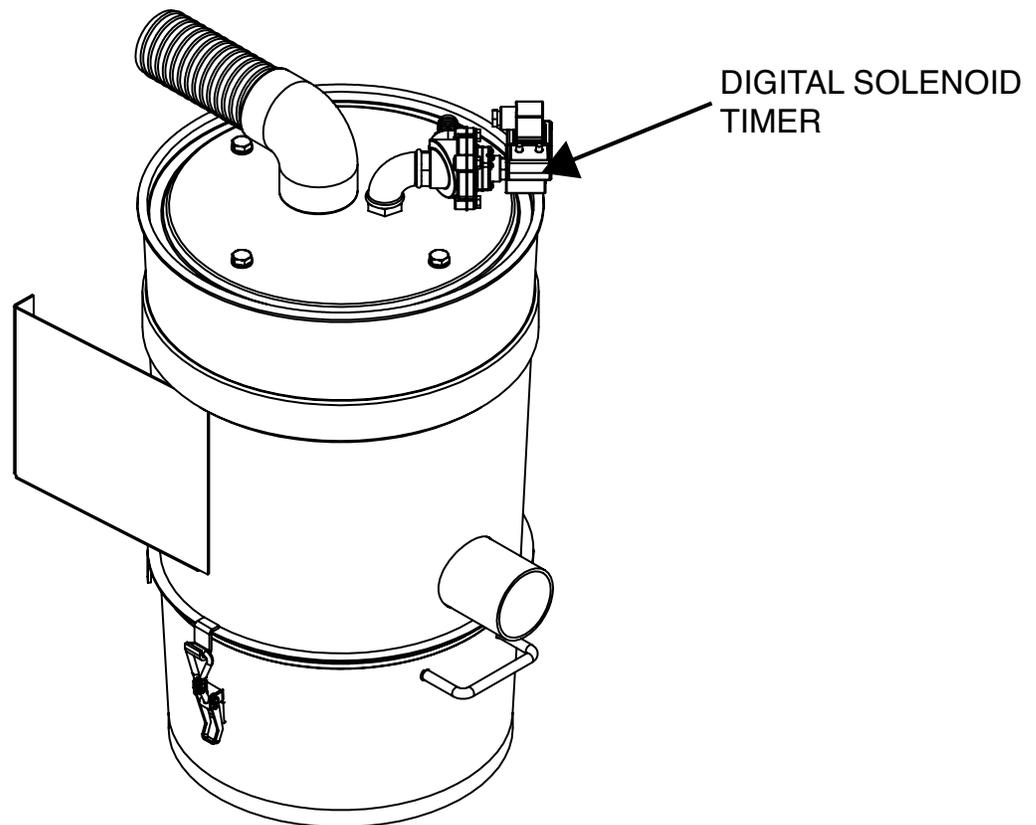
This procedure will aid the technician in the removal and replacement of the Digital Solenoid Timer.

### **MATERIALS NEEDED**

Slotted Screwdriver

## DIGITAL SOLENOID TIMER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.19 – Digital solenoid timer location



### REMOVAL PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the digital solenoid Timer. See Figure F.19.
4. Using a slotted screwdriver, loosen the screw securing the digital solenoid timer plug. See **Figure F.20**.
5. Disconnect the digital solenoid timer plug.
6. Disconnect the digital solenoid timer from the solenoid coil. See **Figure F.21**. Note rubber washer placement for reassembly.
7. Remove digital solenoid timer from machine.

## DIGITAL SOLENOID TIMER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.20 – Digital solenoid timer plug screw location

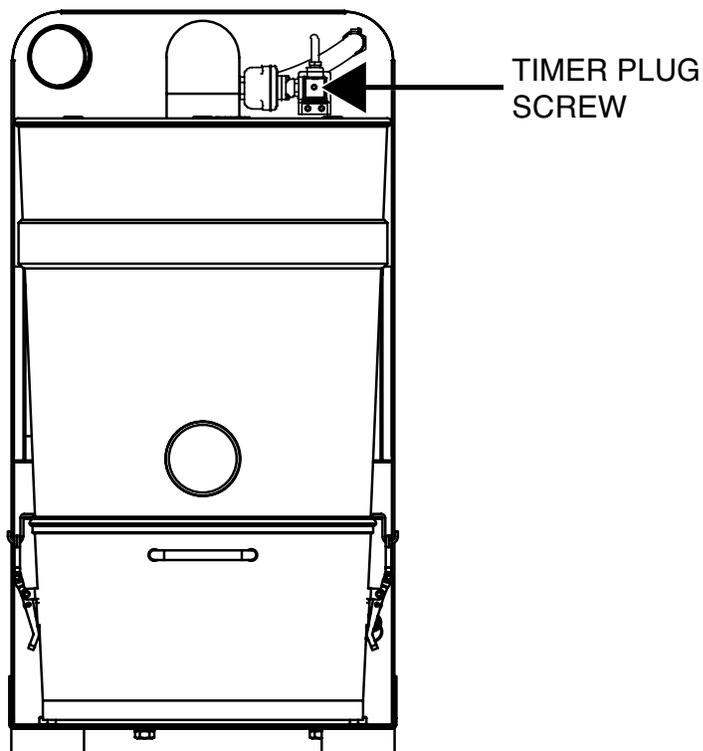
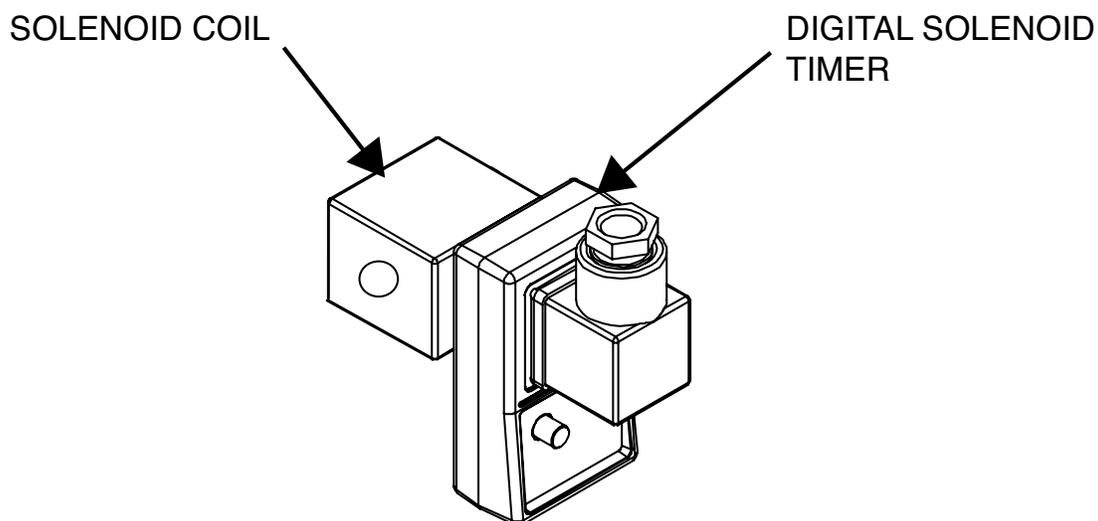


Figure F.21 – Solenoid coil location



## DIGITAL SOLENOID TIMER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

### REPLACEMENT PROCEDURE

1. Position the new digital solenoid timer on to the solenoid coil.  
Note rubber washer placement.
2. Attach digital solenoid timer plug to digital solenoid timer.
3. Using a slotted screwdriver, attach the screw securing the digital solenoid timer plug.
4. Perform the ***Case Cover Replacement Procedure***.

## M1 THREE-PHASE FAN ASSEMBLY 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.

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### **TEST DESCRIPTION**

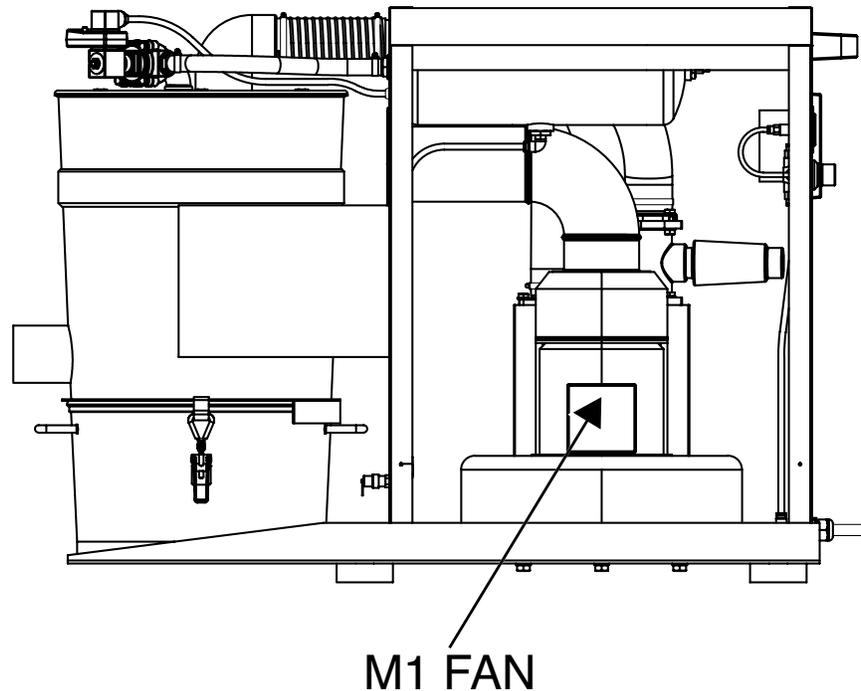
This procedure will aid the technician in the removal and replacement of the M1 Three-Phase Fan Assembly.

### **MATERIALS NEEDED**

- 13mm Nutdriver (with extension)
- 17mm Nutdriver (deepwell)
- Phillips Screwdriver
- Hoist And Straps
- Wiring Diagram

## M1 THREE-PHASE FAN ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.22 – M1 fan location



### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 3A.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the fan assembly in the machine. See Figure F.22.
4. Using a 13mm nutdriver, remove the two bolts and washers securing the hose flange to the fan assembly. See **Figure F.23**. Note washer and gasket placement for reassembly.
5. Using a 13mm nutdriver, remove the two bolts and washers securing the vacuum valve t-piece to the fan assembly. See **Figure F.23**. Note washer and gasket placement for reassembly.
6. Using a phillips screwdriver, label and disconnect fan leads (2T1, 4T2 and 6T3) from K1 contactor and ground lead from ground terminal. See **Figure F.24**. See Wiring Diagram.
7. Using a hoist and straps, carefully lift the X-Tractor 3A high enough so the fan assembly mounting nuts on the bottom of the machine are easily accessible.



### WARNING

FALLING EQUIPMENT can cause injury.

- Lift only with equipment of adequate lifting capacity.
  - Be sure machine is stable when lifting.
  - Well trained personnel must execute all lifting operations.
  - Make sure to use only approved lifting gear.
8. Once the X-Tractor 3A is lifted and stabilized use a 17mm deepwell nutdriver and remove the three fan assembly mounting nuts and associated washers from the bottom of the machine. See **Figure F.25**.
  9. Carefully lower the machine onto a level and sturdy surface.
  10. The fan assembly can now be removed and replaced.



### M1 THREE-PHASE FAN ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.23 – Hose flange and vacuum valve t-piece location

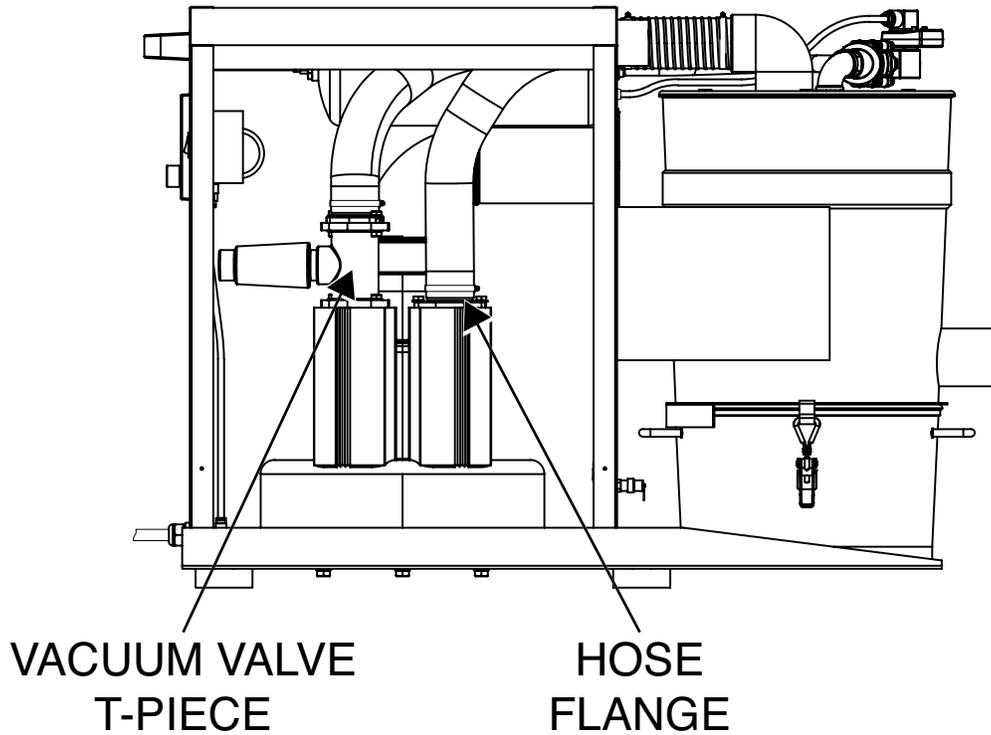
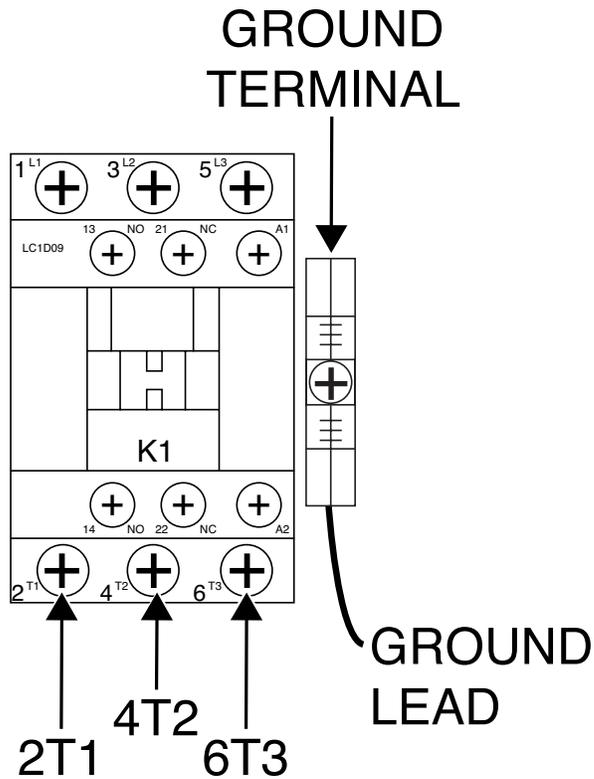
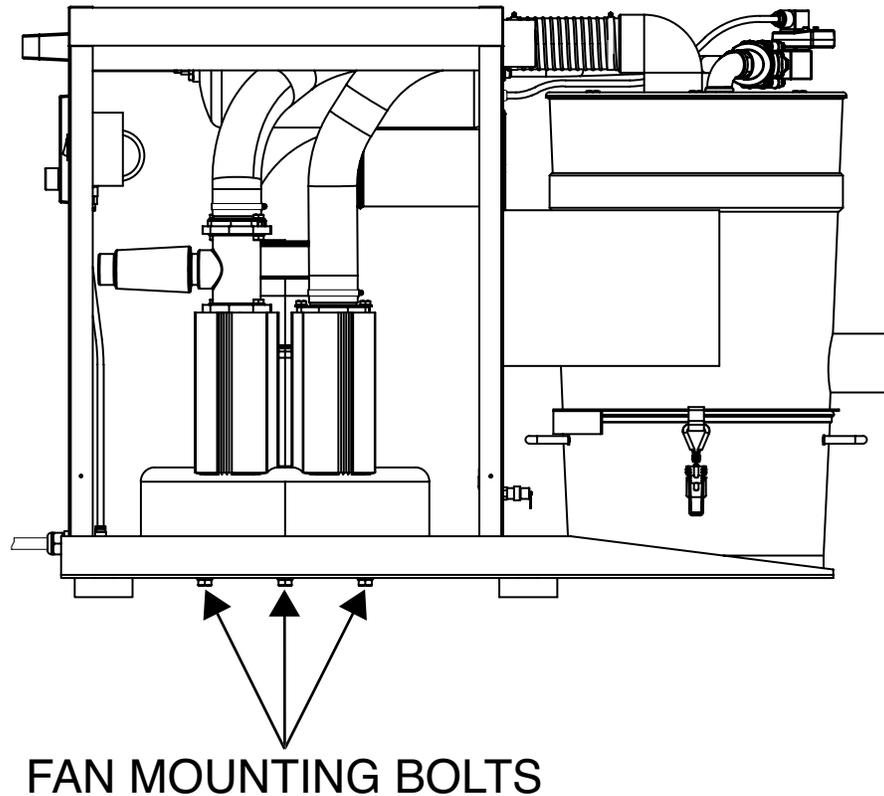


Figure F.24 – Fan leads



## M1 THREE-PHASE FAN ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.25 – Fan mounting bolt location



### REPLACEMENT PROCEDURE

1. Carefully position new fan assembly into the machine.
2. Using a hoist and straps, carefully lift the X-Tractor 3A so the fan assembly mounting nuts can be easily accessible.
3. Once the X-Tractor 3A is lifted and stabilized, use a 17mm deepwell nutdriver and attach the three fan assembly mounting nuts and associated washers to the bottom of the machine.
4. Carefully lower the machine onto a level and sturdy surface.
5. Using a phillips screwdriver, attach fan leads (2T1, 4T2 and 6T3) to K1 contactor and attach ground lead to ground terminal. See Wiring Diagram.
6. Using a 13mm nutdriver, attach the two bolts, washers and gasket securing the hose flange to the fan assembly.
7. Using a 13mm nutdriver, attach the two bolts, washers and gasket securing the vacuum valve t-piece to the fan assembly.
8. Perform the ***Case Cover Replacement Procedure***.

## TRANSFORMER 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.

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### **TEST DESCRIPTION**

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

### **MATERIALS NEEDED**

- Small Slotted Screwdriver
- Slotted Screwdriver
- Wiring Diagram

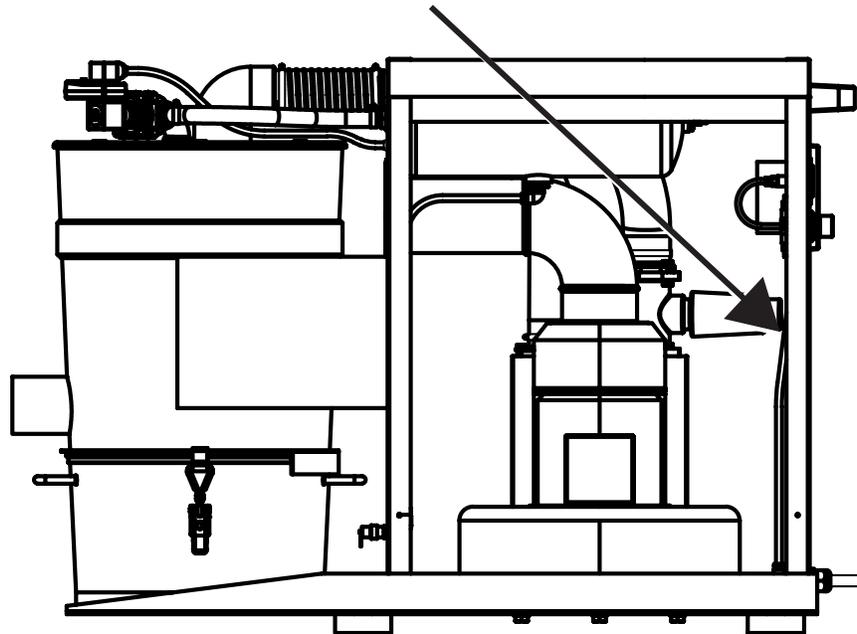
## TRANSFORMER REMOVAL AND REPLACEMENT PROCEDURE

(continued)

Figure F.26 – Transformer location

### TRANSFORMER

(LOCATED ON DIN RAIL)



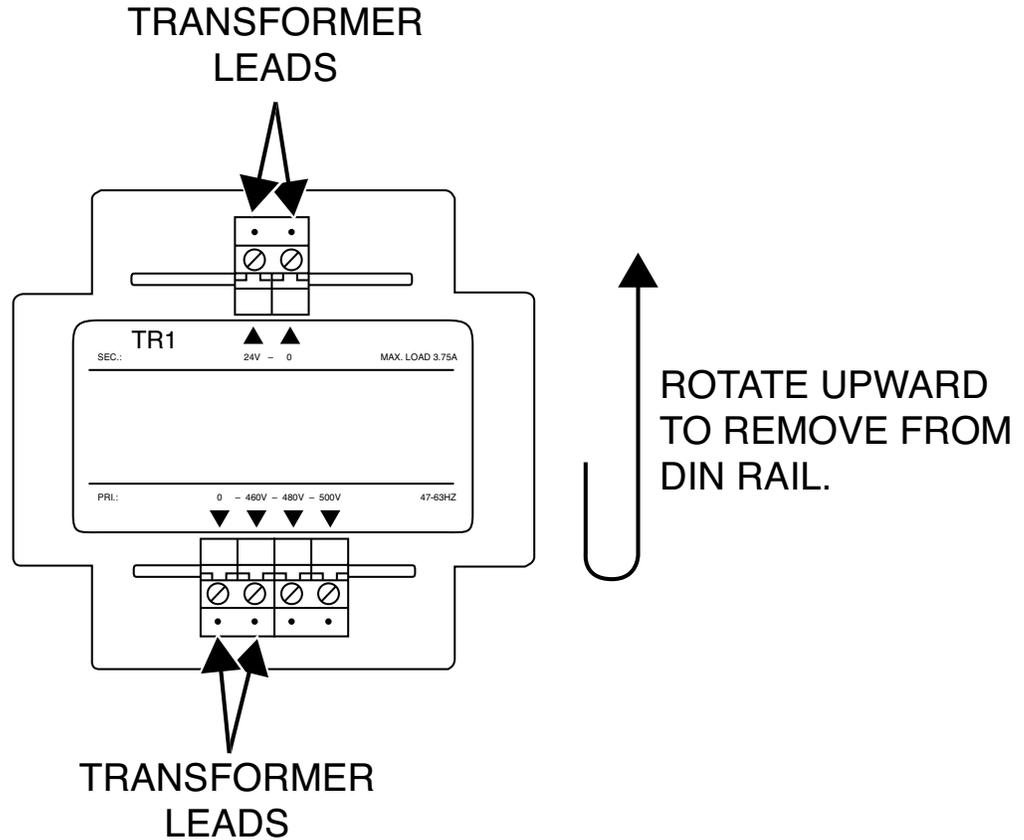
### REMOVAL PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform **Case Cover Removal Procedure**.
3. Locate transformer on DIN rail. See Figure F.26.
4. Unscrew the vacuum relief valve to gain access to the transformer leads. See **Figure F.27**.
5. Using a small slotted screwdriver, label and disconnect the four leads (two on top and two on bottom) connected to the transformer. See **Figure F.27**. See Wiring Diagram.
6. Simply grab the transformer and lift up on the lower leading edge. Rotate the transformer upward and it will disengage from the DIN rail.
7. The transformer can be removed and replaced.

## TRANSFORMER REMOVAL AND REPLACEMENT PROCEDURE

(continued)

Figure F.27 – Transformer leads and removal



### REPLACEMENT PROCEDURE

1. Carefully attach transformer on to the DIN rail by resting the upper groove of transformer on the top tongue of the DIN rail. Carefully rotate the transformer downward so it becomes parallel with the back of the machine. An audible “click” will be heard when the transformer has been properly attached to the DIN rail.
2. Using a small slotted screwdriver, attach the four leads (two on top and two on bottom) to their proper terminals on the transformer. See Wiring Diagram. See Figure F.27.
3. Perform the **Case Cover Replacement Procedure**.



## F1 THERMAL CIRCUIT BREAKER 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**

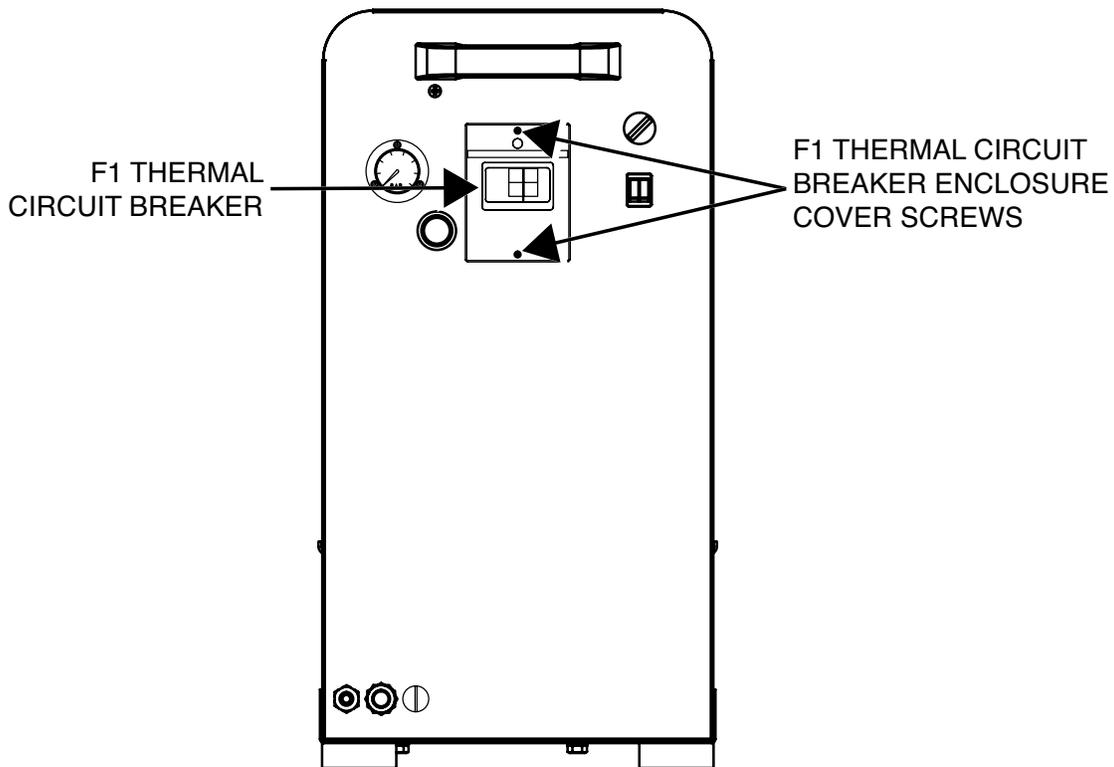
This procedure will aid the technician in the removal and replacement of the F1 Thermal Circuit Breaker.

### **MATERIALS NEEDED**

- Phillips Screwdriver
- Slotted Screwdriver
- Wiring Diagram

## F1 THERMAL CIRCUIT BREAKER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.28 – F1 thermal circuit breaker location

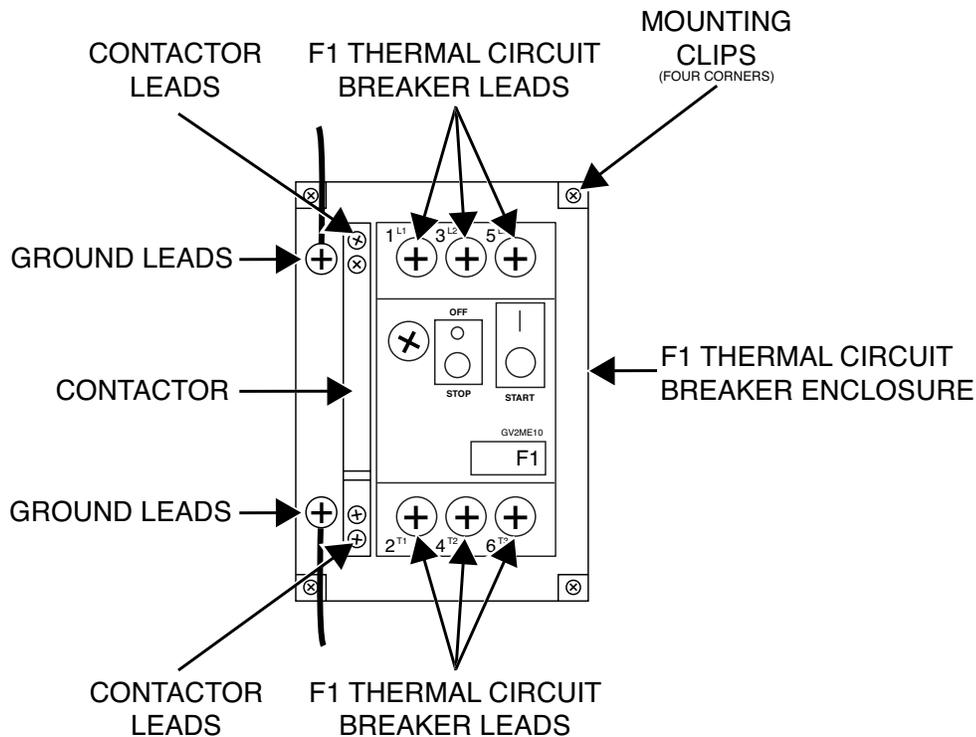


### REMOVAL PROCEDURE

1. Remove input power to the X-Tractor 3A.
2. Perform **Case Cover Removal Procedure**.
3. Locate F1 thermal circuit breaker on the back of the machine. See Figure F.28.
4. Using a phillips screwdriver, remove the two screws securing the F1 thermal circuit breaker enclosure cover to the machine. See Figure F.28.
5. Using a phillips screwdriver, label and disconnect the six leads (three on top and three on bottom) connected to the thermal circuit breaker. See **Figure F.29**. See Wiring Diagram.
6. Using a phillips screwdriver, label and disconnect the two contactor leads. See **Figure F.29**. See Wiring Diagram.
7. Using a phillips screwdriver, label and remove the two ground leads to the left of the contactor. See **Figure F.29**. See Wiring Diagram.
8. Using a phillips screwdriver, loosen and remove the four bracket mounting clips on the F1 thermal circuit breaker enclosure. Note position of clips for reassembly.
9. Remove any necessary cable ties and route lead wires through mounting bracket before removal. Note lead routing prior to removal.
10. The F1 thermal circuit breaker can be removed and replaced.

## F1 THERMAL CIRCUIT BREAKER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.29 – F1 thermal circuit breaker lead and mounting clip locations



### REPLACEMENT PROCEDURE

1. Carefully position the new F1 thermal circuit breaker in to the F1 thermal circuit breaker enclosure.
2. Route lead wires through the mounting bracket.
3. Using a phillips screwdriver, tighten the four bracket mounting clips on the F1 thermal circuit breaker enclosure.
4. Using a phillips screwdriver, attach the two ground leads to the left of the contactor. See Wiring Diagram.
5. Using a phillips screwdriver, attach the two contactor leads. See Wiring Diagram.
6. Using a phillips screwdriver, attach the six leads (three on top and three on bottom) to the thermal circuit breaker. See Wiring Diagram.
7. Using a phillips screwdriver, attach the two screws securing the F1 thermal circuit breaker enclosure cover to the machine.
8. Perform the **Case Cover Replacement Procedure**.

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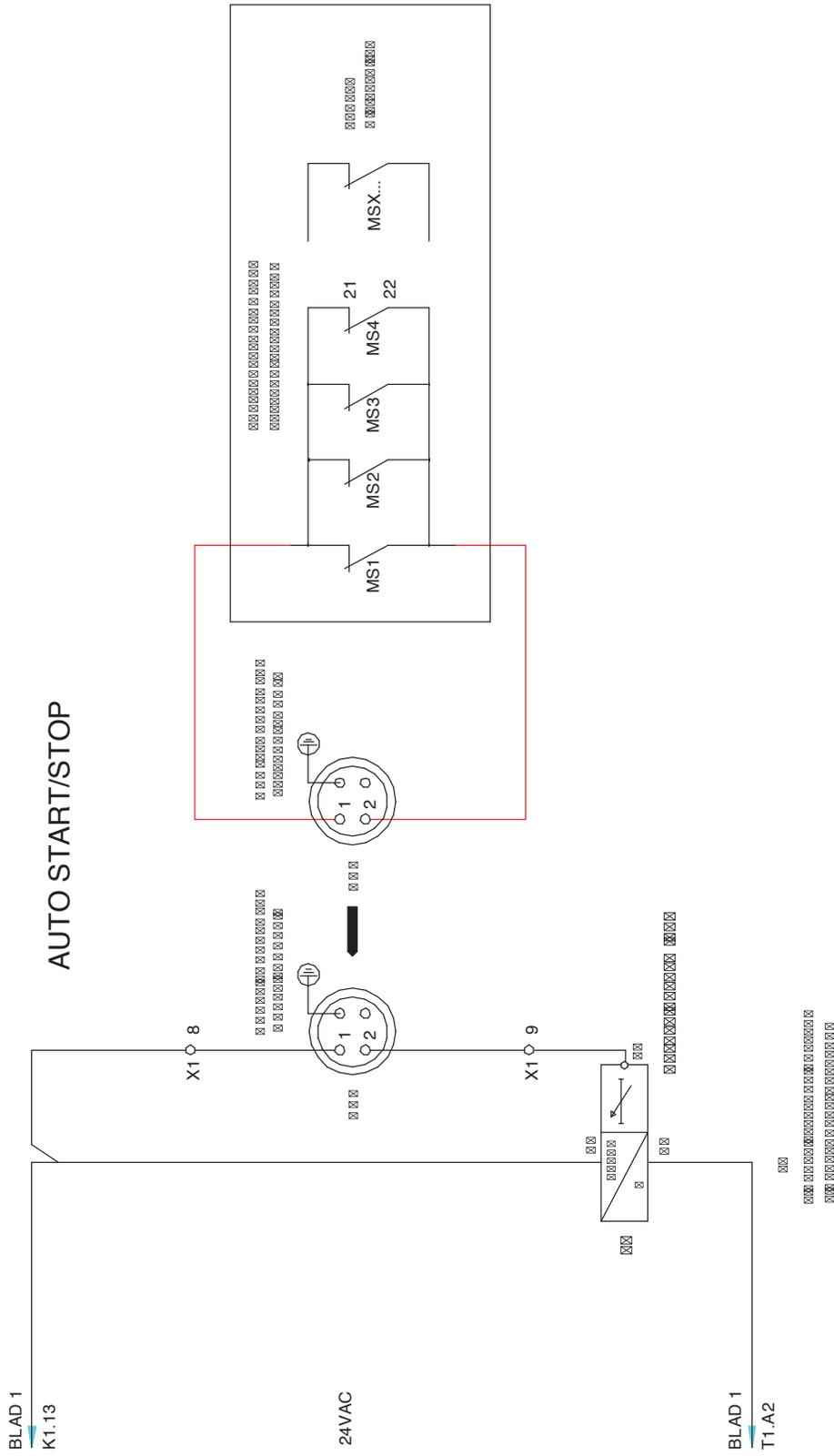
Return to Master TOC

Return to Master TOC

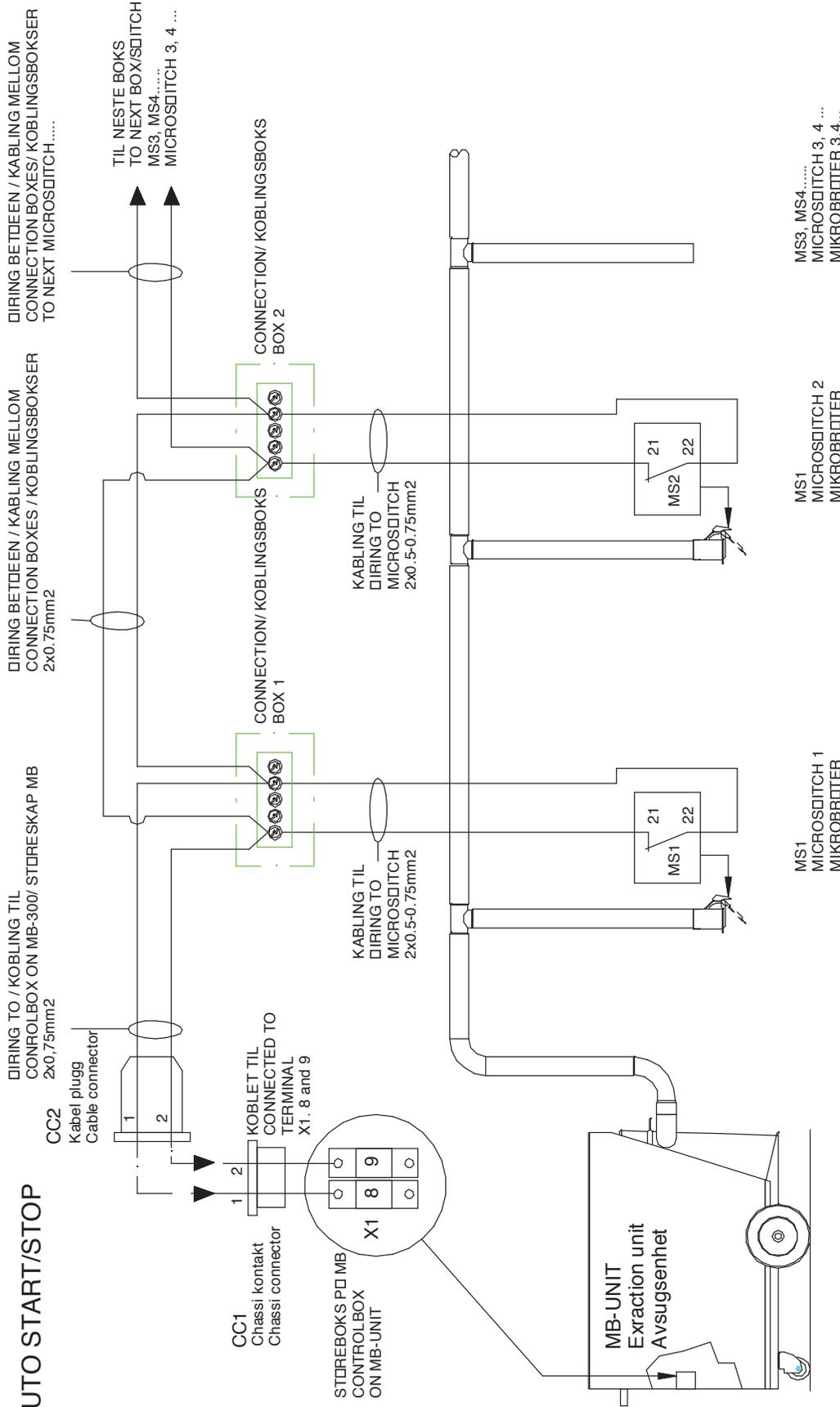
Return to Master TOC







# AUTO START/STOP



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