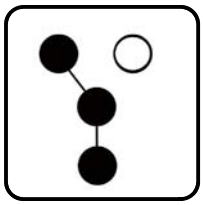
Service

Automatic Transfer Switches



Models:

KBS/KBP

KCC/KBC

KCS/KCP

Power Switching Device:
Standard and Bypass/Isolation
30 to 4000 Amperes

Electrical Controls:

MPAC™ 1500

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6460 4/10b

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IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

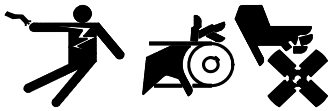
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Battery

WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING

Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery. Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Hazardous Voltage/ Moving Parts

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause severe injury, death, or property damage.

Before energizing the transfer switch, verify that both the normal and emergency contacts are not left in the closed position.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Welding on the generator set. Can cause severe electrical equipment damage. Before welding on the generator set perform the following steps: (1) Remove the battery cables, negative (–) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

Installing the battery charger. Hazardous voltage can cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Making line or auxiliary connections. Hazardous voltage can cause severe injury or death. To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Use adequate lifting capacity.
Never leave the transfer switch standing upright unless it is securely bolted in place or stabilized.

Notice

NOTICE

Hardware damage. The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

NOTICE

Foreign material contamination. Cover the transfer switch during installation to keep dirt, grit, metal drill chips, and other debris out of the components. Cover the solenoid mechanism during installation. After installation, use the manual operating handle to cycle the contactor to verify that it operates freely. Do not use a screwdriver to force the contactor mechanism.

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

Notes

This manual provides service and parts information for Kohler® Model KCS/KCP/KCC transfer switches and Model KBS/KBP/KBC Bypass/Isolation switches with MPAC™ 1500 electrical controls. It includes operation, troubleshooting, repair, and maintenance procedures for the transfer switches and electrical controls.

The information included in this manual is intended solely for use by trained and qualified service personnel of authorized service distributors/dealers.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.

List of Related Materials

Figure 1 lists the part numbers for related literature. Separate operation and installation manuals contain operation and installation information not provided in this manual. Refer to the parts catalog for instructions to obtain replacement parts.

Document	Document Part Number
Model KCT/KCP ATS Operation and Installation Manual	TP-6446
Model KBS/KBP Bypass/Isolation Switch Operation and Installation Manual	TP-6448
Model KCC/KBC Closed-Transition Switch Operation and Installation Manual	TP-6737
MPAC 1500 Controller Operation Manual	TP-6714
Model KC/KB Parts Catalog	TP-6433
Model KCS/KCP Wiring Diagram Manual	TP-6434
Model KBS/KBP Wiring Diagram Manual	TP-6452
Model KCC/KBC Wiring Diagram Manual	TP-6743
Monitor III Software Operation Manual	TP-6347
Modbus Protocol Manual	TP-6113

Figure 1 Related Materials

Service Assistance

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

Headquarters Europe, Middle East, Africa (EMEA)
Kohler Power Systems
3 rue de Brennus
93200 Saint Denis
France
Phone: (33) 1 49 178300
Fax: (33) 1 49 178301

Asia Pacific
Power Systems Asia Pacific Regional Office
Singapore, Republic of Singapore
Phone: (65) 6264-6422
Fax: (65) 6264-6455

China
North China Regional Office, Beijing
Phone: (86) 10 6518 7950
(86) 10 6518 7951
(86) 10 6518 7952
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

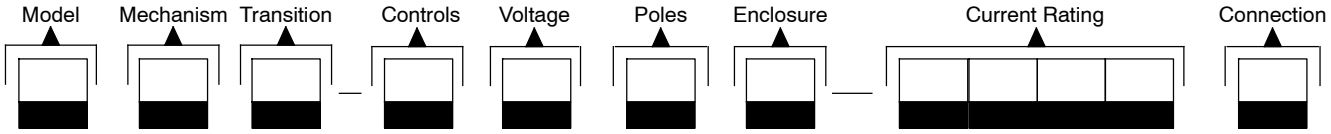
India, Bangladesh, Sri Lanka
India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

Japan, Korea
North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

Latin America
Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

Model Designation

The transfer switch model designation defines characteristics and ratings as explained below. Some combinations are not available.



Sample Model Designation: KCS-DNTA-0400B

Model
K: Kohler Transfer Switch

Mechanism
B: Bypass/Isolation
C: Standard

Transition
C: Closed
S: Standard
P: Programmed

Controls
D: MPAC™ 1500
Microprocessor Controls, Automatic
F: MPAC™ 1500
Microprocessor Controls, Non-Automatic

Voltage/Frequency
C: 208 Volts/60 Hz
D: 220 Volts/50 Hz
F: 240 Volts/60 Hz
G: 380 Volts/50 Hz
H: 400 Volts/50 Hz
J: 416 Volts/50 Hz
K: 440 Volts/60 Hz
M: 480 Volts/60 Hz
N: 600 Volts/60 Hz §
P: 380 Volts/60 Hz
R: 220 Volts/60 Hz

§ Some models are not available at 600 volts.

Number of Poles/Wires
N: 2-pole, 3-wire, solid neutral
T: 3-pole, 4-wire, solid neutral
V: 4-pole, 4-wire, switched neutral
W: 4-pole, 4-wire, overlapping neutral
Z: 3-pole, 4-wire, integral solid neutral *

* Integral solid neutral is mounted on the contactor. Not available on all amperages.

Enclosure †
A: NEMA 1
B: NEMA 12
C: NEMA 3R
D: NEMA 4
F: NEMA 4X
G: Open unit
H: NEMA 3R SS

† Refer to the transfer switch specification sheets for enclosure availability.

KCS/KCP Current Rating: Numbers indicate the current rating of the switch in amperes:

0030	0230 (KCS)	1200
0070	0260	1600
0104	0400	2000
0150	0600	2600
0200 (KCS)	0800	3000
0225 (KCP)	1000	4000

KBS/KBP Current Rating: Numbers indicate the current rating of the switch in amperes:

0150	0800	2000
0225	1000	2600
0260	1200	3000
0400	1600	4000
0600		

KCC/KBC Current Rating: Numbers indicate the current rating of the switch in amperes:

0150	0800	1600
0260	1000	2000
0400	1200	3000
0600		

Connection
S: Standard Connections
F: Front Connections (optional for 1600 and 2000 amp model KCS and 800 amp KBS only)
B: 150–600 Amp Bypass Isolation
260–600 Amp Standard Transition
150–600 Amp Programmed-Transition
150–600 Amp Closed-Transition

Notes

1.1 Introduction

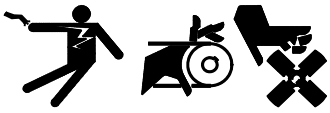
Regular preventive maintenance ensures safe and reliable operation and extends the life of the transfer switch. Preventive maintenance includes periodic testing, cleaning, inspecting, and replacing of worn or missing components. Section 1.5 contains a service schedule of recommended maintenance tasks.

A local authorized distributor/dealer can provide complete preventive maintenance and service to keep the transfer switch in top condition. Unless otherwise specified, have maintenance or service performed by an authorized distributor/dealer in accordance with all applicable codes and standards.

Keep records of all maintenance or service.

Replace all barriers and close and lock the enclosure door after maintenance or service and before reapplying power.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

⚠ WARNING

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Servicing the transfer switch controls and accessories within the enclosure. Hazardous voltage can cause severe injury or death. Disconnect the transfer switch controls at the inline connector to deenergize the circuit boards and logic circuitry but allow the transfer switch to continue to supply power to the load. Disconnect all power sources to accessories that are mounted within the enclosure but are not wired through the controls and deenergized by inline connector separation. Test circuits with a voltmeter to verify that they are deenergized before servicing.

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

NOTICE

Hardware damage. The transfer switch may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

1.2 General Inspection

External Inspection. Inspect the transfer switch weekly.

- Look for any signs of vibration, leakage, excessive noise, high temperature, contamination, or deterioration.
- Remove accumulations of dirt, dust, and other contaminants from the transfer switch's exterior with a vacuum cleaner or by wiping with a dry cloth or brush. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and damage the switch.*
- Replace any worn, missing, or broken external components with manufacturer-recommended replacement parts. Contact a local authorized distributor/dealer for part information and ordering.
- Tighten loose external hardware.

Contact an authorized distributor/dealer to inspect and service the transfer switch when any wear, damage, deterioration, or malfunction of the transfer switch or its components is evident or suspected.

1.3 Internal Inspections and Maintenance

Internal Inspection. Have an authorized distributor/dealer perform an annual inspection of the transfer switch. Inspect the switch more frequently if it is located in a dusty or dirty area or when any condition noticed during an external inspection may have affected internal components. Disconnect all power sources, open the transfer switch enclosure, and inspect internal components. Look for:

- Accumulations of dirt, dust, moisture, or other contaminants
- Signs of corrosion
- Worn, missing, or broken components
- Loose hardware
- Wire or cable insulation deterioration, cuts, or abrasions
- Signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor
- Other evidence of wear, damage, deterioration, or malfunction of the transfer switch or its components

Cleaning. Use a vacuum cleaner or a dry cloth or brush to remove contaminants from internal components. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and damage the switch.*

Lubrication. Maintain the transfer switch lubrication. If the transfer switch is subject to extremely dusty or abnormal operating conditions, relubricate all movements and linkages yearly. Relubricate the solenoid operator if the TS coil is replaced. Do not use oil; order the lubrication kit shown in the parts catalog.

Disconnect power and manually operate the transfer switch mechanism to verify that it operates smoothly without binding. If lubricating the outer mechanism of the transfer switch does not eliminate binding, replace the transfer switch assembly. When servicing closed-transition switches, check that both contacts are not left in the closed position before energizing the switch.

Periodically oil the enclosure door locks and screws.

Checking and Tightening Connections. Loose connections on the power circuits can lead to overheating or explosion. Tighten all lugs to the torque values on the label on the switch. See Figure 1-1 for a typical label.

Tighten engine start, input/output, and auxiliary connections to the torque indicated on the decals affixed to the unit.

Part Replacement and Tightening. Replace worn, missing, broken, deteriorated, or corroded internal components with manufacturer-recommended replacement parts. Contact a local authorized distributor/dealer for part information and part ordering. Tighten loose internal hardware.

Signs of Overheating. Replace components damaged by overheating and locate the cause of the overheating. Overheating could be caused by loose power connections, overloading, or a short circuit in the system. After tightening the power terminals, perform a millivolt drop test to locate areas with high contact resistance. See Section 1.4.3. Check the line circuit breakers in the system to be sure that they do not allow the load to exceed the switch rating. Use the controller troubleshooting and schematics to locate a control circuit short.

Wire Repair or Replacement. Replace wiring when there is any doubt about its condition, or when there is extensive damage or deterioration. If the damaged or deteriorated wires are part of a wiring harness, replace the entire wiring harness.

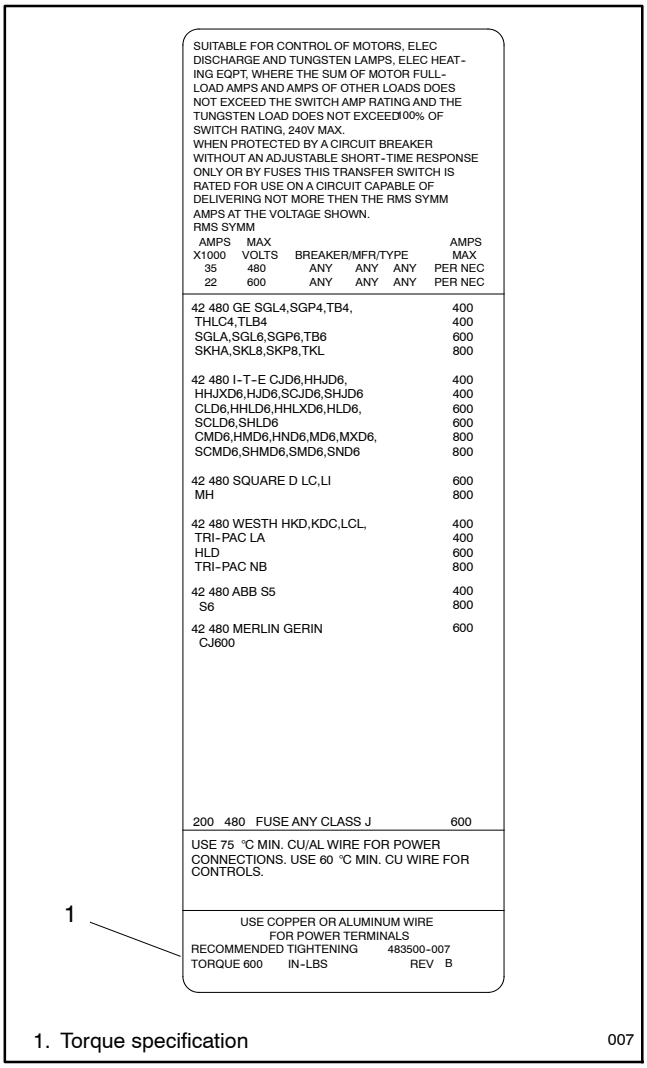
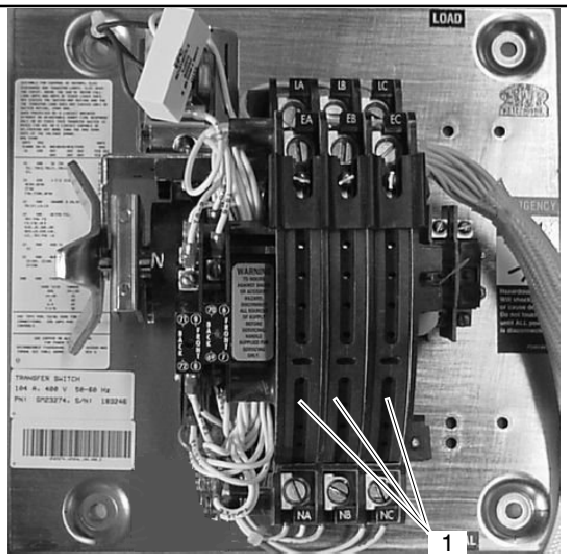


Figure 1-1 Typical Rating/Torque Label

Power Circuit Wiring. Have damage to line voltage and power circuit wiring evaluated and repaired or replaced by a qualified electrician.

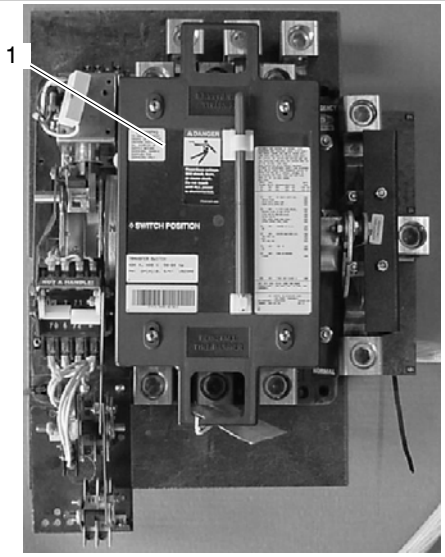
Control Circuit Leads. Repair minor damage to leads in low power and control circuits operating up to 250 volts. Carefully splice and insulate the connections. Tape minor control circuit wire insulation cuts or abrasions. Repair moderately damaged leads, where conductors are cut or insulation is damaged over sections shorter than about 100 mm (4 in.) or less than about 25% of the length of the wire, by cutting out the damaged section and splicing in wire of the same type. Use UL-listed insulated (250-volt minimum) connectors and follow the connector manufacturer's instructions. Fabricate new leads using the same type of wire and UL-listed insulated (250-volt minimum) connectors and follow the connector manufacturer's instructions.

Transfer Switch Inspection. Remove the arc chute assemblies or covers at the front of the transfer switch and inspect the main contacts inside the transfer switch. See Figure 1-2 and Figure 1-3. Remove surface deposits with a clean cloth. *Do not use an emery cloth or a file.* Discoloration of the contact surface does not affect performance. If the contacts are pitted, show signs of overheating, or are worn, replace the contacts. The contacts are worn if the contact surface material, a layer of silvery-colored metal, is worn through to the metal below. Check the condition of the arc chutes. If the arc chutes show signs of disintegration, replace the arc chute assembly.



1. Arc chute assemblies

Figure 1-2 150 Amp Model Transfer Switch



1. Barrier/pole cover

Figure 1-3 400 Amp Model Transfer Switch

1.4 Testing

Periodic testing is important in any transfer switch application. It helps to ensure that the generator set will start and the transfer switch mechanisms and control circuits will operate when needed.

1.4.1 Weekly Generator Set Exercise

Use the plant exerciser to start and run the generator set once a week to maximize the reliability of the emergency power system. See the transfer switch operation and installation manual for additional information about the exerciser.

1.4.2 Monthly Automatic Operation Test

Test the transfer switch's automatic control system monthly by running a loaded or auto-load test. See Section 4.4.6 or the transfer switch operation and installation manual for the test procedure. Verify that the expected sequence of operations occurs as the switch transfers the load to the emergency source when a normal source failure occurs or is simulated. After the switch transfers the load to the emergency source, end the test and verify that the expected sequence of operations occurs as the transfer switch retransfers to the available normal source and signals the generator set to shut down after a cooldown period.

1.4.3 Other Tests

Every Year

Measure the voltage drop to help locate high-resistance contacts in the ATS. The test procedure measures the voltage drop across a contact and the current in the circuit, then uses those measured values to find the contact resistance.

The purpose of the test is to locate any contact that has significantly higher resistance than others. An unusually high voltage across one set of contacts may signal unacceptably high resistance in the contacts.

Run the test with the ATS under a moderate and balanced load. Use the following procedure to take voltage measurements and calculate resistances for each phase of both Source N and Source E.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Millivolt Drop Test Procedure

1. Apply a balanced load of at least 10% of the switch rating. (Currents of 10 amps or greater will give more accurate results than lower currents.)

2. Carefully measure the voltage on each phase of both sources from the source lug to the load lug. Take several readings to ensure accuracy. The readings may be erratic because of the small voltage measured, load fluctuations, and meter circuit contact resistances.

   Note: To obtain accurate readings, keep the meter as far as possible from current-carrying conductors and the meter leads as short, direct, and at right angles to current-carrying conductors as possible. This minimizes the effect of induced voltages (transformer effect) in the vicinity of the current-carrying conductors.

3. Use an ammeter to measure the current flow through the circuit.

4. Calculate the contact resistance using the following formula:

   R = V ÷ I

   Where:
   V = measured voltage in *millivolts*
   I = measured current in amps
   R = calculated resistance in milliohms

Compare the calculated values for resistance (R) to the values in the table in Figure 1-4. If the calculated resistance is significantly higher (2 times larger or more) than the value shown in the table, disconnect power, check the connections and lug torques, and repeat the test. If the second measurement also indicates that the resistance is too high, replace the contact. See the ATS parts catalog for replacement part ordering information. Refer to the Table of Contents in the front of this manual to locate the contact replacement procedure for your switch.

Transfer Switch Rating, Amps	Maximum Contact Resistance, Milliohms (mΩ)
30–200	0.250
225–400	0.200
600–800	0.175
1000–1200	0.085
1600–3000	0.050

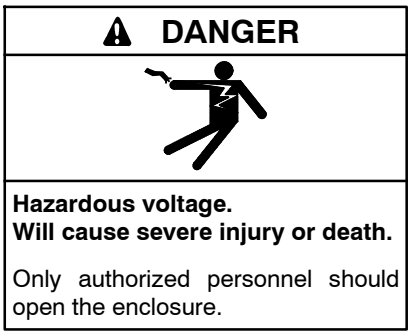
Figure 1-4 Maximum Contact Resistance

Every Three Years

Test the wire insulation. Use the following procedure to check for insulation breakdown and replace any faulty components.

Wire Insulation Breakdown Test Procedure

1. Disconnect all power sources by opening upstream circuit breakers or switches to the transfer switch. Disconnect the load from the transfer switch by opening circuit breakers or switches leading from the transfer switch. Disconnect the transfer switch wiring harness from the controller at connector P1.



Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

2. Use a hi-pot tester or meggar to check the insulation resistance phase-to-phase and phase-to-neutral, and phase-to-ground if neutral and ground are isolated. For a hi-pot tester, the maximum potential is 500 VAC and the maximum test time is 1 second.

3. Verify that the measured insulation resistance exceeds 1.24 megohms (MΩ).

4. If the hi-pot tester indicates wire insulation breakdown or if the measured resistance is less than 1.24 MΩ, isolate the leakage current using an instrument designed for this purpose. Replace the faulty components.

   Note: You may need to disconnect power conductors from the lugs to isolate the problem. If you disconnect the power conductors, see the transfer switch operation and installation manual for reconnection instructions.

Every Five Years

Check the normal and emergency source setpoint calibration according to the procedures in Section 2.5, System Settings.

1.5 Service Schedule

Follow the service schedule below for the recommended service intervals. The transfer switch operator can perform tasks marked by an X. Have an authorized distributor/dealer inspect the switch annually and perform all service marked by a D.

System Component or Procedure	See Section	Visually Inspect	Check	Adjust, Repair, or Replace	Clean	Test	Interval
Electrical System							
Check for signs of overheating or loose connections: discoloration of metal, melted plastic, or a burning odor.	1.3	X	X				Y
Check the transfer switch's external operating mechanism for cleanliness. Clean and relubricate if dirty.*	1.3	X		D	D		Y
Check wiring insulation for deterioration, cuts, or abrasion. Repair or replace wiring to regain the properties of the original wiring.	1.3	X					Y
		D	D	D			Y
Check the transfer switch's main power switching mechanisms' mechanical operation and integrity.	1.3	D	D			D	Y
Tighten control and power wiring connections to specifications.	1.3		D	D			Y
Check the transfer switch's main power switching contacts' condition. Clean or replace the main contacts or replace the transfer switch assembly as necessary.	1.3	D		D	D		Y
Perform a millivolt drop test to check for high contact resistances on power circuits. Tighten connections, clean main contacts, or adjust or replace main contacts or transfer switch assembly to eliminate high contact resistances.	1.4.3		D	D	D	D	Y
Test wire and cable insulation for electrical breakdown.	1.4.3					D	Every 3 Years
Check calibration of voltage-sensing circuitry and setpoints, and recalibrate circuitry as necessary.	1.4.3		D			D	Every 5 Years
Control System							
Exercise the generator set without load.	1.4.1, O/I/M					X	W
Test the transfer switch's automatic control system.	O/I/M	X				X	M
Test all LED indicators, time delays, and remote control systems for operation.	O/I/M	D	D	D		D	Y
General Equipment Condition							
Inspect the outside of the transfer switch for any signs of excessive vibration, leakage, high temperature, contamination, or deterioration.*	1.2	X			X		M
Check that all external hardware is in place, tightened, and not badly worn.	1.2	X	X	X			M
Inspect the inside of the transfer switch for any signs of vibration, leakage, noise, high temperature, contamination, or deterioration. Check for metal discoloration, melted plastic, or a burning odor.*	1.3	X					M
		D	D		D		Y
Check that all internal hardware is in place, tightened, and not badly worn.	1.3	X					M
		D	D				Y

***** Service more frequently if the ATS operates in extremely dusty or dirty areas.

See Section: Read these sections carefully for additional information before attempting maintenance or service.
Visually Inspect: Examine these items visually.
Check: Requires physical contact with or movement of system components, or the use of nonvisual indications.
Adjust, Repair, or Replace: Includes tightening hardware and lubricating the mechanism. May require replacement of components depending upon the severity of the problem.
Clean: Remove accumulations of dirt and contaminants from external transfer switch's components or enclosure with a vacuum cleaner or by wiping with a dry cloth or brush. *Do not use compressed air to clean the switch because it can cause debris to lodge in the components and cause damage.*
Test: May require tools, equipment, or training available only through an authorized distributor/dealer.

Symbols used in the chart:

O/I/M=See the transfer switch operation/installation manual.
X= The transfer switch operator can perform these tasks.
D=An authorized distributor/dealer must perform these tasks.
W=Weekly
M=Monthly
Q=Quarterly
S=Semiannually (every six months)
Y=Yearly (annually)

Notes

2.1 Initial Checks

When troubleshooting a problem, check the following things first.

- Check the Service Required LED and the transfer switch controller display for fault or warning indications. If a fault or warning is indicated, proceed to Section 2.10.
- Disconnect power to the transfer switch and check for loose connections. Check the source lugs, controller harnesses, and generator set engine start connection.
- Check the event history log. The log lists the 100 most recent transfer switch events, including transfers and DIP switch setting changes as well as faults and alarms. See Section 2.2 for instructions to view the event history log.
- Check the system settings and time delays. See Section 2.5, System Settings.

Read and follow all safety precautions in this manual and on labels on the switch. Only trained and qualified personnel should service the transfer switch and connected equipment.

Refer to the wiring diagrams provided with the switch or the wiring diagram manual when troubleshooting the transfer switch and controller.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

2.2 View Event History

When troubleshooting, check the event history for faults, transfer attempts, or other events leading to the current condition. The history lists the 100 most recent transfer switch events, including transfers and DIP switch setting changes as well as faults and alarms.

From the main screen, step to View Event History and display recent events as shown in Figure 2-1. Possible event descriptions are listed in Figure 2-2.

If a fault condition or alarm is displayed, proceed to Section 2.10.

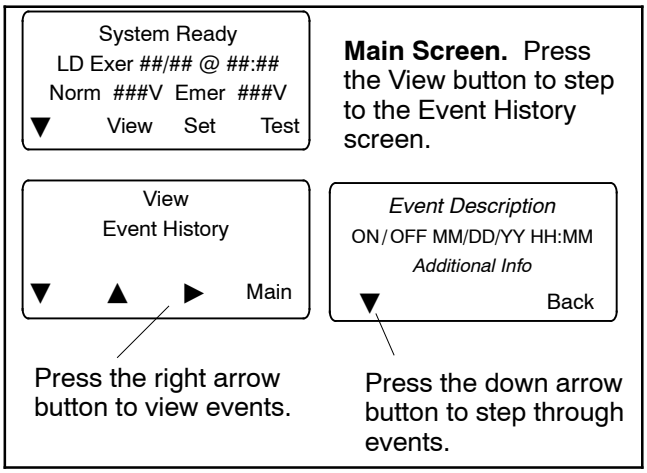


Figure 2-1 Viewing Event History

Event Descriptions	
End Time Delay Btn	Low Battery Voltage
Test Btn	Remote Common Alarm
Exercise Btn	Bypass Contactor Dis
Lamp Test	3 Src System Disable
Service Req'd Reset	Over Frequency
Maint DIP Switch	Under Frequency
Pwd DIP Switch	Phase Loss
Manual Option Switch	Phase Rotation Error
New Module	Over Voltage L1-L2
Contactor in Off	Over Voltage L2-L3
Contactor in Src N	Over Voltage L3-L1
Contactor in Src E	Under Voltage L1-L2
Low Battery	Under Voltage L2-L3
Exerciser Active	Under Voltage L3-L1
Fail to Acquire Pref	Voltage Imbalance
Fail to Acquire Stby	Save History To File
Fail to Sync	Auto Loaded Test End
Fail to Transfer	Test Loaded Changed
I/O Module Lost Comm	Pref Source Changed
Aux Switch Fault	Reload Dflt Params
Aux Switch Open	MODBUS Peak Shave
Breaker Trip	MODBUS Forced to OFF
Battery Backup Low	MODBUS System Test
Rem End Time Delay	Battery Control Out
Forced Trans to Off	USB Connected
Peak Shave Mode	USB Disconnected
Inhibit Transfer	Minimum Values
Remote Test	Maximum Values

Figure 2-2 Events

2.3 Data Log Files

The data log files listed in this section are available on MPAC™ 1500 controllers with version 2.0.0 or later application code. The data log files can be viewed using spreadsheet software and used to help troubleshoot ATS operation problems.

Data log files are generated by the MPAC 1500 controller as described below. See TP-6714, MPAC™ 1500 Operation Manual, for detailed instructions to create the following data files.

USB Data Logger

Use the USB Data Logger function in the MPAC 1500 controller's Set System menu to create a DataLog file. The file contains time- and date-stamped readings of voltage, frequency, and contactor position (source 1 or 2). Data log files have the form DataLogYYMMDDHHMMSS.csv where YYMMDD is the date (year/month/day), and HHMMSS is the time that the file was created in hours:minute:seconds. Figure 2-3 shows a sample file.

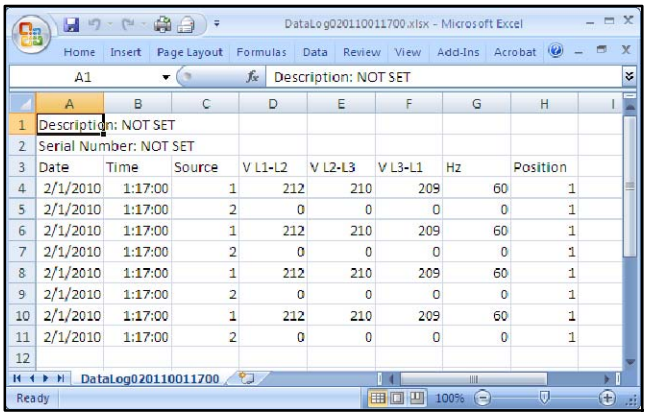


Figure 2-3 Sample Data Log File

MinMax Files

Use the MinMax function, which is found in the MPAC 1500 controller's Set System menu under USB Data Logger, to create a MinMax.csv file. The file contains minimum and maximum readings of voltage and current supplied to the load over a selected time period. The MinMax file is overwritten each time the MinMax operation is performed.

SyncData Files

The SyncDataLog file is generated during a synchronization check test sequence on a closed-transition transfer switch. See Section 4.4.5 for instructions to run a sync check. The source1 and source2 voltages, frequencies, and relative phase angle are monitored and recorded approximately once per second for one minute during the sync check sequence.

2.4 System Power

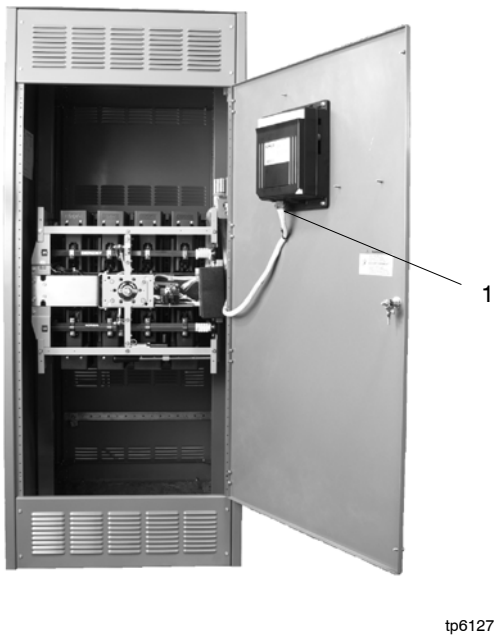
2.4.1 Verify Power to ATS

If the transfer switch display is off, check for power to the transfer switch. If the utility source is not available, check for emergency power. Follow the voltage check procedure in Section 2.4.2, Voltage, Frequency, and Phase Rotation Checks, to check voltage at the Source N (normal) or Source E (emergency) lugs.

If utility power is not available and the emergency generator set is not running, check that the generator set master switch is in the AUTO position. Verify that the generator set runs when the master switch is moved to the RUN position. If the engine does not start, troubleshoot the generator set as described in the generator set documentation. Otherwise, check the engine start circuit. See Section 4.6.

If the utility source is available but the transfer switch display is off, check for open source circuit breakers or switches. Disconnect power and verify that the transfer switch wiring harness is connected to the controller. See Figure 2-4.

An LED on the controller power board lights to indicate power to the board. See Figure 4-5.



1. Transfer switch harness connection to controls, controller connector P1

Figure 2-4 Transfer Switch Harness Connection to Control Board, Typical

2.4.2 Source Voltage, Frequency, and Phase Rotation Checks

The voltage, frequency, and phasing of the transfer switch and the power sources must be the same to avoid damage to loads and the transfer switch. Compare the voltage and frequency ratings of the utility source, transfer switch, and generator set, and verify that the ratings are all the same.

Read and understand all instructions on installation drawings and labels on the switch. Note any optional accessories that have been furnished with the switch and review their operation.

Note: Source N is the source connected to the normal side of the transfer switch. Source E is the source connected to the emergency side of the transfer switch.

The voltage check procedure requires the following equipment:

- A digital voltmeter (DVM) with electrically insulated probes capable of measuring the rated voltage and frequency
- A phase rotation meter

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

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(600 volts and under)

Voltage, Frequency, and Phase Rotation Measurement Procedure

Note: Perform voltage checks in the order given to avoid damaging the transfer switch.

1. Verify that the generator set master switch is in the OFF position and both power sources are disconnected from the transfer switch.

2. Disconnect the power switching device and controller wiring harnesses at the inline disconnect plug, if they are connected.
3. Manually operate the transfer switch to position E. See the transfer switch operation and installation manual for manual operation instructions.
4. If Source N is a generator set, move the generator set master switch to the RUN position. The generator set should start.
5. Close the Source N circuit breaker or switch.
6. Use a voltmeter to check the Source N (normal) phase-to-phase and phase-to-neutral (if applicable) terminal voltages and frequency.
   a. If Source N is the utility and the measured input does not match the voltage and frequency shown on the transfer switch nameplate, *STOP!* The transfer switch does not match the application—order the correct transfer switch.
   b. If Source N is a generator set and the generator set output voltage and frequency do not match the nominal system voltage and frequency shown on the transfer switch nameplate, follow the manufacturer's instructions to adjust the generator set. The automatic transfer switch will only function with the rated system voltage and frequency specified on the nameplate.
7. Use a phase rotation meter to check the phase rotation at the Source N (normal) terminals. Rewire the transfer switch Source N terminals to obtain the correct phase sequence if necessary.

   Note: The default setting for the phase rotation on the controller is ABC. If the application uses a phase rotation of CBA, use the Set Sources screen to change the phase rotation setting on the controller. See the operation/installation manual for instructions.
8. If the source is a generator set, stop the generator set by moving the master switch to the OFF position.
9. Disconnect Source N by opening upstream circuit breakers or switches.
10. Manually operate the transfer switch to position N.
11. Repeat steps 4 through 8 for Source E. Then proceed to step 12.
12. Disconnect both sources to the transfer switch by opening the circuit breakers or switches.
13. Connect the power switching device and controller wiring harnesses together at the inline disconnect plug.

    Note: Do not connect or disconnect the controller wiring harness when power is connected.
14. Close and lock the transfer switch enclosure door.
15. Reconnect both power sources by closing the circuit breakers or switches.
16. Move the generator set master switch to the AUTO position.

    Note: If the engine cooldown time delay setting is not set to zero (default setting), the generator set may start and run until the Time Delay Engine Cooldown (TDEC) ends.

2.4.3 Controller Backup Battery

The transfer switch controller uses a backup battery for power when no source is available. A Low Backup Battery message on the screen indicates that this battery needs to be replaced. See Section 4.3.3 for instructions.

Note: Units built after 2/5/2009 do not use the backup battery.

2.5 System Settings

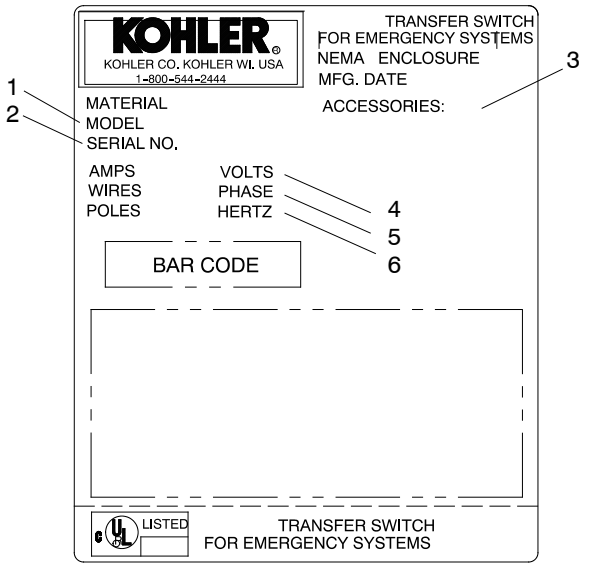
If the ATS does not recognize the source, check that the source voltage and frequency settings on the controller match the actual source parameters. Compare the controller settings to the ratings on the ATS nameplate and to the measured source parameters.

2.5.1 Controller Source Settings

Check the controller's source voltage, frequency, and phase settings. See the transfer switch operation and installation manual for instructions.

Check the controller settings and compare them to the voltage rating, frequency rating, and number of phases shown on the ATS nameplate. The nameplate is attached to the cover of the controller assembly, which is mounted on the inside of the transfer switch door. See Figure 2-5 for an illustration of the nameplate.

Note: The system voltage and frequency shown on the ATS nameplate must match the Source N and Source E voltage and frequency settings. Do not enter settings that do not match the nameplate ratings of the ATS.



1. Model designation
2. Serial number
3. Factory-installed accessory numbers
4. Voltage rating
5. Frequency rating
6. Number of phases (single or three)

Figure 2-5 Typical Transfer Switch Nameplate

Use the procedure in Section 2.4.2 to measure the source voltage, frequency, and phase rotation, and compare the measured values to the controller settings. Follow the instructions in the transfer switch operation and installation manual to change the controller settings if they do not match the measured source parameters.

2.5.2 Voltage and Frequency Pickup and Dropout Settings

Figure 2-6 illustrates the relative values of the voltage pickup and dropout settings. Typical frequency pickup and dropout settings relate to the nominal source frequency in a similar way.

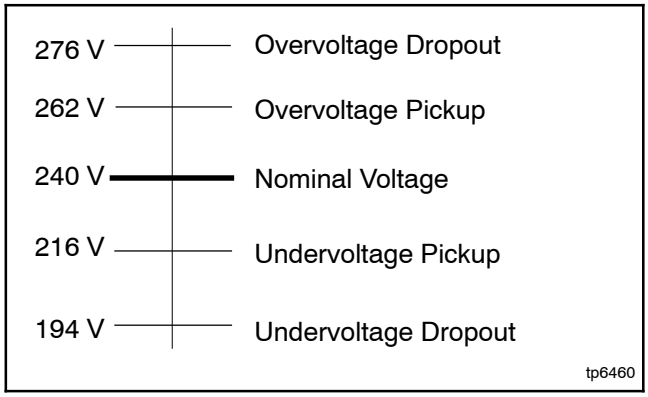


Figure 2-6 Relationship Between Voltage Pickup and Dropout Settings (default settings for 240-volt system shown)

If the source voltage rises above the overvoltage dropout setting or falls below the undervoltage dropout setting for a time longer than the debounce time, the controller will consider the source as failed. The source voltage must return to a level within the range of the pickup values for the controller to recognize the source as restored.

Choose pickup and dropout settings that allow a tolerable variation in the source parameters to prevent nuisance transfers caused by small changes in the source voltage and frequency.

Voltage and Frequency Sensing		
Parameter	**Default**	**Adjustment Range**
Undervoltage dropout	90% of pickup	75%–98%
Undervoltage pickup	90% of nominal	85%–100%
Overvoltage dropout *	115% of nominal*	106%–135%
Overvoltage pickup	95% of dropout	95%–100%
Unbalance enable	Disable	Enable/Disable
Unbalance dropout	20%	5%–20%
Unbalance pickup	10%	3%–18%
Voltage dropout time	0.5 sec.	0.1–9.9 sec.
* 690 volts, maximum. Default = 110% for 600 volt applications.		

Figure 2-7 Voltage Settings

Parameter	Default	Adjustment Range
Underfrequency dropout	99% of pickup	95%–99%
Underfrequency pickup	90% of nominal	80%–95%
Overfrequency dropout	101% of pickup	101%–115%
Overfrequency pickup	110% of nominal	105%–120%
Frequency dropout time	3 sec.	0.1–15 sec.

Figure 2-8 Frequency Settings

2.6 Time Delays

Check the time delays when troubleshooting problems with transfer switch operation.

Use the View Time Delays screen to check the settings for the adjustable time delays. Figure 2-9 shows the factory settings and adjustment ranges for the adjustable time delays. See the Operation Manual for more information.

Observe the controller's display to identify which time delay is executing at any given time. Initiate a test and observe as each programmed time delay executes. Compare the operation to the test sequence illustrated in the flowcharts in Figure 4-12 or Figure 4-13.

Time Delay Description	Description/Note	Default Time	Adjustment Range
Engine Start, Source S2	Source S2 – Util/Gen and Gen/Gen modes	3 sec	0–6 sec*
Engine Start, Source S1	Source S1 – Use for Gen/Gen mode	3 sec	
Engine Cooldown, Source S2	Source S2 – Util/Gen and Gen/Gen modes	5 sec	0–60 min
Engine Cooldown, Source S1	Source S1 – Gen/Gen mode	2 sec	
Xfr Pref>Stby	Transfer delay, preferred to standby	3 sec	
Xfr Stby>Pref	Transfer delay, standby to preferred	15 min	
Xfr Off>Stby	Time in the OFF position (Preferred to Standby for programmed transition models only)	1 sec	
Xfr OFF>Pref	Time in the OFF position (Standby to Preferred for programmed transition models only)	1 sec	
Fail to Acquire Pref	If the preferred source does not reach acceptable voltage and stabilize within the allowed time, the Fail to Acquire Preferred Source fault is activated.	1 min	
Fail to Acquire Stby	If the standby source does not reach acceptable voltage and stabilize within the allowed time, the Fail to Acquire Standby Source fault is activated.	1 min	0–60 min
In-Phase Xfr Fail (found in the Set Sources menu)	For in-phase monitoring: the time allowed for the two sources to come into synchronization within specified phase angle before a Fail to Sync fault is activated.	30 sec	0–60 min
Load # Disc N>E	Disconnect load before-transfer to standby source. Used for time-based and current-based load control.	0 sec	0–60 min
Load # Rec N>E	Reconnect load after-transfer to standby source. Used for time-based load control.	0 sec	0–60 min
Load # Disc E>N	Disconnect load before-transfer to preferred source. Used for time-based and current-based load control.	0 sec	0–60 min
Load # Rec E>N	Reconnect load after-transfer to preferred source. Used for time-based load control.	0 sec	0–60 min
Load # Add Source1/Source2	For current-based load control.	0 sec	0–60 min
Load # Remove Srce1/Srce2	For current-based load control.		
* The optional external battery module allows extended engine start time delays from 0–60 min.			

Figure 2-9 Time Delays

2.7 Reset Data

Be sure to read and understand the information in this section before resetting.

2.7.1 Reset Maintenance Records

Reset the maintenance records after transfer switch service to update the last maintenance date and totals since reset that are displayed in the maintenance records screen.

2.7.2 Reset Event History

Resetting the event history clears the events from the event history log. The event history can be saved to a file before reset. See Section 2.7.5, File Maintenance.

2.7.3 Reset Default Parameters

Resetting to the default parameters will reset **all** parameters, **including the system voltage and frequency**, to a factory default setting. The default system voltage and frequency settings may not match the settings for your application.

The transfer switch will not operate correctly if the system voltage and frequency do not match the sources. Use the Set Sources screen to set the system voltage and frequency after resetting to the default parameters. See the operation/installation manual for instructions.

2.7.4 Reset and Disable Test Password

Reset the Test password to return the test password to the default, 0000.

Disable the test password to allow the user to start a test without entering a password.

Note: Disable the test password only during service unless the transfer switch is installed in a secure location.

2.7.5 File Maintenance

Use the File Maintenance screens to remove unneeded files or save the event history. See Figure 2-10 and Figure 2-11.

Files can also be transferred to a mass storage device connected to the USB port on the logic board. Refer to the transfer switch operation/installation manual for instructions to transfer files.

File Name	Description
MPAC1500_#######.cfg	Parameter settings (configuration)
present*yymmdd*.his	Event history
alarm_settings.alm	Common alarms
MPAC1500_cal.cal	Calibration
history_param.hstp	Internal use only
Param_back.bak	Internal use only
present*yymmdd*.raw	Internal use only
history_pback.hbak	Internal use only

Figure 2-10 Files listed under File Maintenance>Delete Files

2.7.6 Reset Data Procedure

Use the Reset Data menus to set records or parameters back to factory default settings. See Figure 2-11.

1. Use the black arrow buttons to step to the desired screen. See the following sections for information about each reset screen.
2. Press the open up arrow button to toggle Yes or No until Yes is displayed.
3. Press Save to reset the displayed records to the factory defaults. Pressing Back exits the screen without resetting.

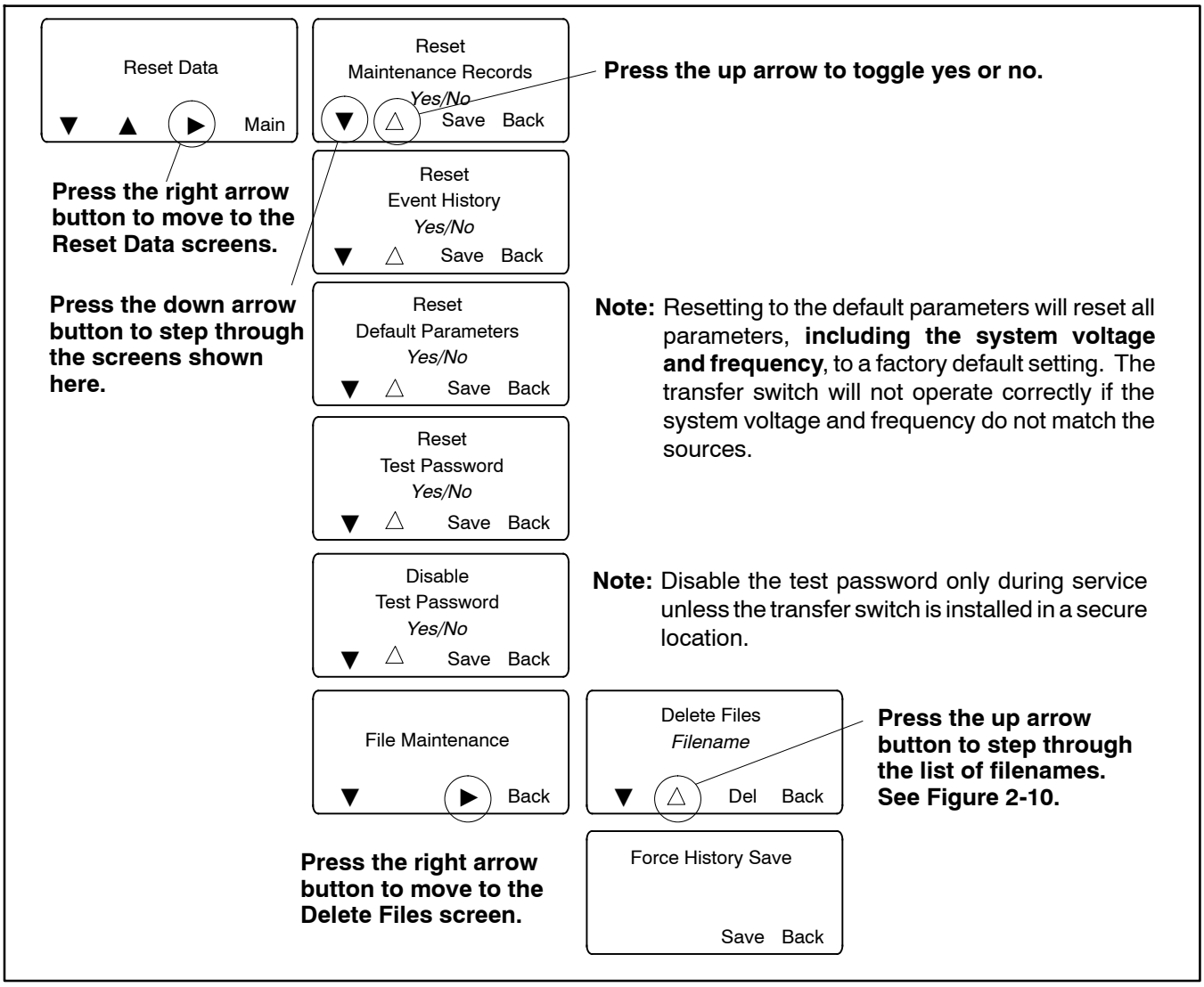


Figure 2-11 Reset Data

2.8 Warnings and Faults

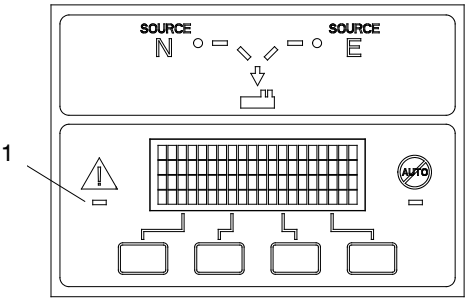
When a fault exists, the System Alert indicator lights, a designated output and the common fault output are turned on, and an appropriate message is displayed to indicate the fault. See Figure 2-12 for the location of the System Alert indicator.

ATS warnings and faults are shown in Figure 2-13. There are three types of warning/fault conditions:

Warning. Warnings automatically reset with a source availability change or a transfer request.

Fault Requiring Manual Reset. Under these conditions, normal ATS operation is halted. Active modes are turned off. If the contactor is in the preferred source position, the engine cooldown time delay executes and the engine start contacts open, allowing the generator set to shut down. See Section 2.8.1 for instructions to reset faults.

Self Resetting Faults. Under these conditions, active modes are turned off. If the contactor is in the preferred source position, the engine cooldown time delay executes and the engine start contacts open, allowing the generator set to shut down. When the fault condition is corrected, the fault is automatically cleared from the controller and normal ATS operation continues.



1. System Alert LED

GM46892

Figure 2-12 Fault Indication

Condition	Type	Description
Failure to Acquire Standby Source	Warning	The source voltage did not reach the acceptable range within a set time (see Time Delays). For example, the standby source generator set did not start.
Failure to Acquire Preferred Source	Warning	
IPM Synching (In-Phase Monitor Synching)	Warning (status)	The two sources did not come into phase within the Fail to Synchronize time delay. **Note:** If the sources do become in phase, the warning is automatically cleared and normal ATS operation continues.
Battery Backup Low	Warning	The ATS backup battery voltage is low. Replace the battery on the main logic board. See Section 4.3.3.
External Battery Low	Warning	The voltage of the battery connected to the external battery supply module (EBSM) is low.
Failure to Transfer	Warning	The signal to transfer is sent to the contactor and the main shaft auxiliary switch fails to indicate a complete ATS position change. The controller will attempt to transfer the unit three times before the fault is indicated.
Auxiliary Switch Fault	Manual Reset Fault	The main shaft auxiliary switches indicate that the ATS is in more than one position, or the position changed when no signal was sent to initiate the change.
Auxiliary Switch Open	Manual Reset Fault	The main shaft auxiliary switches indicate that the ATS is in neither position (all inputs are open).
Src N (or Src E) Rotation Err	Self-Resetting Fault	The detected phase rotation of one or both sources does not match the preselected setting.
I/O Module Lost Comm	Self-Resetting Fault	An I/O device has stopped communicating or does not have a correct address specified. Fault resets if communication is reestablished.
Module Status Change	Self-Resetting Fault	An accessory module has been disconnected OR a new module is detected. See Section 2.8.2 to reset.
Module Status Conflict	Self-Resetting Fault	An accessory module has been replaced with a different type of module. See Section 2.8.3 to correct.
External Fault (Remote Common Alarm)	Self-Resetting Fault	The input contact assigned to the remote common alarm input function is closed.

Figure 2-13 Warnings and Faults

2.8.1 Fault Reset

To clear a fault or warning condition and reset the System Alert LED, go to the Main screen and press the down arrow button to open the Reset screen. See Figure 2-12 and Figure 2-14. Then press the button labelled Reset. A fault reset does not change the controller settings.

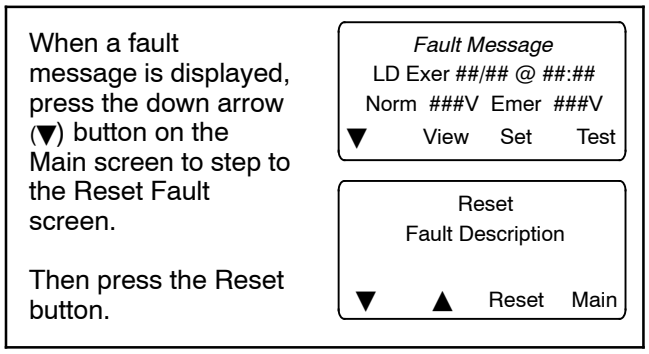


Figure 2-14 Fault Reset

2.8.2 Module Status Change

If the Module Status Change message appears on the controller display, first verify that the cable from the controller to the accessory module assembly is not loose or disconnected.

The Module Status Change message automatically clears if the fault condition is corrected (self-resetting fault).

Module Connection (new or reconnected module)

Installing or reconnecting one or more accessory modules triggers the Module Status Change message.

1. If the ATS display shows Module Status Change, press the Reset button. See Figure 2-15.

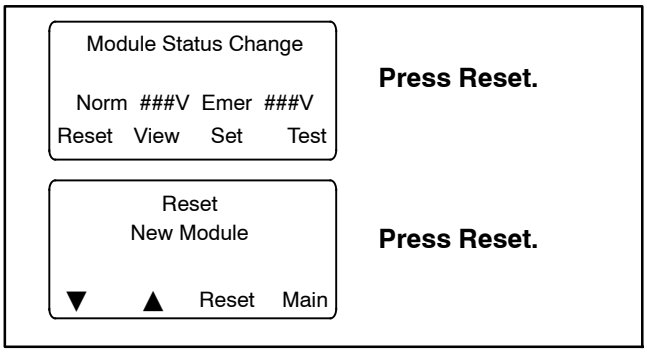


Figure 2-15 Screens after Module Connection

2. The ATS display will show Reset New Module. Press the Reset button from that screen. The controller recognizes the module type(s).

3. Navigate to the Set Input/Outputs>Set Aux I/O screen to check that the controller has recognized the connected modules. See Figure 2-16.

See the transfer switch operation/installation manual for instructions to assign programmable inputs and outputs to I/O modules or assign functions to the audible alarm for an Alarm Module.

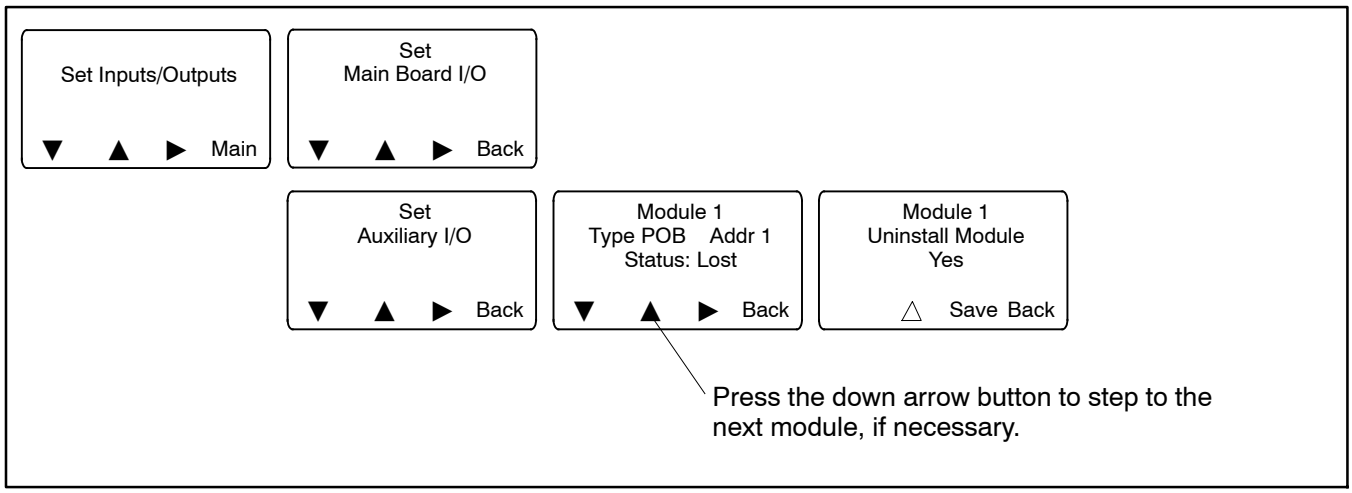


Figure 2-16 Uninstall Module

Disconnected Module

If one or more accessory modules are disconnected from the controller, the message Module Status Change appears. See Figure 2-17. Pressing the Reset button displays the message Check Module Setup to Clear Fault.

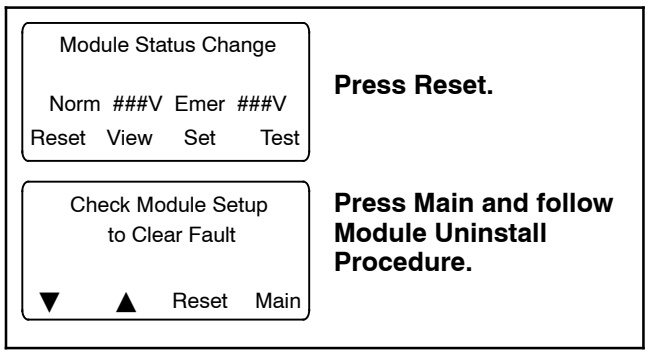


Figure 2-17 Screens after Module Disconnection

When modules are physically disconnected from the transfer switch, they must be uninstalled through the controller keypad. Use the following procedure to uninstall modules after disconnection.

Module Uninstall Procedure

1. If the ATS display shows Module Status Change, press the button labelled Reset.
2. If the ATS display shows Check Module Setup to Clear Fault,, press Main to return to the main screen.
3. Press Set to enter setup mode.
4. Enter the setup password.
5. Press the down arrow to step to the Set Inputs/Outputs screen. See Figure 2-16.
6. Navigate to the Set Auxiliary I/O screen. See Figure 2-16. Press the right arrow button to see the status of module 1. Press the down arrow to step to the next module, if necessary, until the screen shows Status: Lost.
7. Press the right arrow button to move to the Uninstall Module screen. Verify that the screen says Uninstall Module Yes. (Press the open arrow button to toggle no/yes, if necessary.)
8. When Yes is displayed, press Save to uninstall the module.
9. Repeat the uninstall procedure for additional modules, if necessary.

Other Module Status Change Conditions

A Module Status Change message that cannot be cleared as described above may indicate a failure of the controller's real-time clock. Carefully follow the procedures above to attempt to reset the fault. If the fault cannot be reset, replace the controller's logic board. See Section 4.13.

2.8.3 Module Status Conflict

The message Module Status Conflict appears if one type of module is replaced with another type of module that has the same address. Follow the procedure below to resolve the conflict.

Procedure to Clear a Module Status Conflict

1. Disconnect power to the transfer switch.
2. Disconnect the module.
3. Close the enclosure door and reconnect power to the ATS. The display will show Module Status Change.
4. Press the button labelled Reset. The display will show Check Module Setup to Clear Fault.
5. Follow the procedure in Section 2.8.2 to uninstall the module through the ATS controller keypad.
6. Disconnect power to the ATS.
7. Connect the new module.
8. Close the enclosure door and reconnect power to the ATS. The display will show Module Status Change. See Figure 2-15.
9. Press the button labeled Reset to display Reset New Module. Press the reset button from that screen. The controller will now recognize the new module type.
10. Navigate to the Set Auxiliary I/O screen to check the status and settings for the new module. See Figure 2-16. Press the right arrow button to see the status of module 1. Press the down arrow to step to the next module, if necessary,

See the transfer switch operation/installation manual for instructions to assign programmable inputs and outputs to I/O modules or assign functions to the audible alarm for an Alarm Module.

2.9 Common Alarms

Any of the functions listed in Figure 2-18 can be assigned to Common Alarms 1 and 2. Common alarms 1 and 2 can then be assigned to output functions which activate when any of the conditions assigned to the common alarm are present. Common Alarms 1 and 2 can also be set to sound the alarm horn on the optional Alarm Module.

Functions that can be Assigned to Common Alarms	
Aux Switch Fault *	Src E Over Freq
Aux Switch Open *	Src E Over Voltage
Battery Backup Low *	Src E Rotation Err *
Contactor in Off	Src E Under Freq
Contactor in Pref	Src E Under Voltage
Contactor in Src E	Src E Voltage Unbal
Contactor in Src N	Src N Loss of Phase
Contactor in Stby	Src N Over Freq
Exerciser Active	Src N Over Voltage
Fail to Acquire Pref *	Src N Rotation Err *
Fail to Acquire Stby *	Src N Under Freq
Fail to Transfer *	Src N Under Voltage
IPM Synching	Src N Voltage Unbal
Load Bank Control	Stby Src Available
Load Control Active	System Ready
Low Battery *†	Test Mode Active
Non-Emergency Trans	Critical Service Required
Not in Auto	Man Transfer Waiting
Peak Shave Active †	Module Lost Comm *
Pref Src Available	Non-Critical Service Req
Remote Common Alarm *	Source E Available
Remote Monitor In #1–4	Source N Available
Fail to Sync	Breaker Trip
Src E Loss of Phase	Modbus-Controlled RDO #1–4
* Assigned to Critical Service Required † Assigned to Non-Critical Service Required	

Figure 2-18 Common Alarm Functions

If the common alarm is activated, the specific condition that triggered the alarm will be shown on the ATS controller display screen. Check the display to identify the problem and then refer to the troubleshooting tables in Sections 2.10 and 2.11.

Use the View Common Alarms screen to identify which functions have been assigned to each common alarm. See the operation and installation manual for instructions to check the view screens and to change the settings, if necessary.

Selected functions as noted in Figure 2-18 are grouped into the Critical Service Required and Non-Critical Service Required functions. The Critical Service Required and Non-Critical Service Required functions can be assigned to activate the alarm horn on the optional Alarm Module. If any of the conditions included in the Critical Service Required or Non-Critical Service Required function occurs, the alarm horn will sound. The message on the ATS display will identify which condition (for example, Fail to Acquire Standby) triggered the alarm and caused the horn to sound.

2.10 Events and Faults

The following tables list the faults and alarms that may be shown on the controller's display screen or listed in the event history log. The tables also list the possible causes for each problem and suggested procedures to identify and correct the source of the problem.

The event history log also lists transfers and other normal events not shown in these tables. The event history log can be saved to an electronic file. Refer to the transfer switch operation/installation manual for instructions to save the event log to a file.

Fault or Event Message	Possible Cause	Check	See Section
Overfrequency, Underfrequency	Frequency settings	Check that the system frequency setting matches the actual source frequency (50 or 60 Hz).	2.5
		Check the over/underfrequency pickup and dropout settings. See Section 2.5.2 and the Setup Program Operation Manual.	2.5
		Check that the frequency debounce setting is long enough to prevent nuisance faults caused by brief frequency variations.	2.5
	Source availability, stability	Check that the source frequency matches the nominal system frequency and stays within the range of the pickup and dropout settings.	2.4.2 2.5
	Source connections	Check for loose connections. Check wiring.	W/D
Overvoltage, Undervoltage	Voltage settings	Check that the system voltage setting matches the actual source voltage.	2.4.2 2.5
		Check the over/undervoltage pickup and dropout settings.	2.5 2.5.2
		Check that the voltage debounce setting is long enough to prevent nuisance faults caused by brief voltage dips or spikes.	2.5
	Source availability, stability	Check that the source voltage matches the nominal system voltage and stays within the range of the pickup and dropout settings.	2.4.2 2.5
	Source connections	Check for loose connections. Check wiring.	W/D
	Calibration error	Check the ATS calibration.	4.8
Loss of Phase	Single/three phase setting does not match source	Check that the controller single/three phase setting matches the source.	2.5
	One phase of the source has been lost	Check that all phases of the source are available.	2.4.2
	Source connections	Check for loose connections.	
Source Rotation Error	Phase rotation setting (ABC or BAC) does not match source	Check that the controller phase rotation setting matches the source phase rotation (ABC or BAC). Check the source connections to the transfer switch and verify that A,B, and C are connected to the appropriate lugs. Change the controller phase rotation setting or rewire the source connections if necessary.	2.5
Failure to Transfer	Transfer switch mechanism problem	See Section 2.11, Troubleshooting.	2.11

Fault or Event Message	Possible Cause	Check	See Section
Auxiliary Switch Fault or Auxiliary Switch Open	Controller cannot determine the transfer switch position	Check wiring and connections to position microswitches. See the schematic drawing for connections.	W/D
		Test position microswitch operation. Replace microswitch if necessary.	
		Transfer switch in intermediate position. Manually operate the transfer switch, following safety precautions and instructions for your model. See the Table of Contents for manual operation procedures for your unit.	TOC
		Check the control contact operation. Inspect for signs of coil damage or overheating and replace coil if necessary. See the Table of Contents for coil control contact test procedures for your unit.	TOC
Failure to Acquire Standby	Generator set did not start	See Failure to Start Generator Set, below.	
	Open circuit breaker	Check and close ATS source and generator set circuit breakers.	—
	ATS does not recognize the standby source	Check source voltage, frequency, phase rotation settings and compare to actual values.	2.4.2 2.5
		Check for loose source connections. Check the labels on the switch for tightening torques.	1.3
		Check for open switch or circuit breaker to the source.	—
		Check ATS calibration.	4.8
		Check voltage sensing. See Figure 2-19, Voltage Sensing Troubleshooting flowchart.	2.12
Failure to Acquire Preferred	Open circuit breaker	Check and close ATS source and generator set circuit breakers.	
	ATS does not recognize the source	Check source voltage, frequency, phase rotation settings and compare to actual values.	2.4.2 2.5
		Check for loose source connections. Check the labels on the switch for tightening torques.	1.3
		Check for open switch or circuit breaker.	—
		Check ATS calibration.	4.8
		Check voltage sensing. See Figure 2-19, Voltage Sensing Troubleshooting flowchart.	2.12
External Battery Low	Low generator set engine starting battery voltage	Check battery connections and voltage. Charge or replace battery if voltage is low.	Generator set manuals
Battery Backup Low	Controller backup battery voltage is low	Replace the controller battery.	4.3.3
Inphase Monitor (IPM) Synching	The two sources did not synchronize within the Fail to Sync time delay. The ATS will continue to monitor for synchronization.	Adjust inphase monitor angle.	ATS O/I/M
		It may be necessary to adjust the generator set frequency in order to achieve source synchronization.	Generator set manuals
Fail to Sync (closed-transition models)	The two sources did not synchronize within the Fail to Sync time delay. The ATS will continue to monitor for synchronization.	Check the synchronization settings for voltage differential, frequency differential, and phase angle. See TP-6714, MPAC 1500 Controller Operation Manual. The programmed-transition override function can be set to allow a programmed-transition transfer in the event that the sources do not synchronize. See TP-6714 for instructions. The IPM Synching output can be connected to customer-supplied equipment to boost the generator set if the sources do not synchronize.	Controller Manual TP-6714

Fault or Event Message	Possible Cause	Check	See Section
Module Status Change	A new accessory module is detected	Press the reset button to open Reset New Module screen. Then press Reset again.	2.8.2
	A module has been disconnected	Check connections from the controller to the I/O module assembly and at the top of each I/O module. Verify that the module is securely installed. If a module has been removed, go to Set Inputs/Outputs screen and uninstall the module.	2.8.2
	Communication to an installed I/O module has been lost	Check I/O module connections.	2.8.2
	Real-time clock failure on logic board	If the procedures in Section 2.8.2 fail to clear the error message, replace the controller's logic board.	2.8.2 4.13
Module Status Conflict	One type of module was replaced with another type of module that has the same address	Follow the procedure in Section 2.8.3 to uninstall the old module and then install the new module.	2.8.3
External Fault	Fault condition in customer- supplied equipment connected to external input	Identify and correct the cause of the fault condition.	Manuals for connected equipment
	Loose or faulty connection	Check connection to external input.	ATS OIM

2.11 Troubleshooting Table

The following table lists potential problems with possible causes and suggested remedies. Section numbers in the last column refer to other sections of this manual. TOC refers to the Table of Contents in this manual; check the table of contents for service procedures for your size (amps) and type (standard or programmed-transition, standard or bypass/isolation) of transfer switch in Sections 5 through 13.

Always follow the safety precautions at the beginning of this manual when troubleshooting and servicing the transfer switch.

Problem	Possible Cause	Check	See Section
Generator set engine does not start	Engine start time delay is running	Check for active time delays on the controller display. Press End Delay button to end the delay, if necessary.	2.6
		Use View Time Delay screen to check time delay settings.	ATS O/I/M
	Loose engine start connection	Check connections. Tighten connections and/or replace wiring if necessary.	ATS O/I/M
	No engine start signal from the ATS	Test the engine start contact operation.	4.6
	Generator set master switch not in the AUTO position	Move generator set master switch to the AUTO position.	Generator set manuals
	Generator set problem	Troubleshoot the generator set.	
Generator set engine runs when it should not	ATS does not recognize the Normal source	Check connections. Check voltage and frequency settings, phase rotation, calibration. Check for open switches or circuit breakers.	— 2.5
	ATS not in the expected position	Check the ATS position LEDs. Check the position of the preferred source selector switch, if equipped.	4.1
	Exerciser is running	Check the controller display for Exerciser Active message. Press the END button to end an exercise run, if necessary.	ATS O/I/M
	Test sequence is running	Check the controller display for indication that a test sequence is active. Press the END TEST button to end a test sequence, if necessary.	ATS O/I/M
	Engine cooldown time delay operating	Check for Engine Cooldown message on the controller display. Press End Delay button to end the cooldown delay, if necessary. Check the ATS controller engine cooldown time delay setting.	2.6 ATS O/I/M
		Check generator set controller engine cooldown setting, if applicable.	Generator O/M
	Engine start connection closed	Check wiring and connections.	ATS O/I/M W/D
		Check that the 40-pin ribbon cable connector between the logic and power boards on the ATS controller is connected.	4.2 Figure 4-5
		Test the engine start contact operation.	4.6

O/I/M= Operation and Installation Manual; O/M = Operation Manual; TOC = Table of Contents, this manual; W/D = Wiring Diagrams

Problem	Possible Cause	Check	See Section
Generator set engine runs when it should not (continued)	Generator set master switch not in AUTO	Move the generator set master switch to the AUTO position. Wait for the generator set engine cooldown delay, if necessary.	Generator set manuals
	Other generator set problem	Disconnect the engine start leads from the ATS. If the engine continues to run, troubleshoot the generator set.	
Inphase monitor does not operate	Inphase monitor function not enabled	Check that the inphase monitor option on the ATS controller is selected.	ATS O/I/M
	Transfer angle setting	Check the transfer angle setting.	ATS O/I/M
	Inphase monitor option not available (programmed-transition models)	Not available on programmed-transition models. Center-OFF position makes the inphase monitor option unnecessary.	—
Exerciser does not start generator set	Exerciser not set	Use View Exercise Setup screen to check exerciser settings.	ATS O/I/M
	Check that exercise run duration is not set to zero	Use View Exercise Setup screen to check exerciser settings.	ATS O/I/M
	Loose or open engine start connection	Check wiring and connections.	ATS O/I/M
	Engine start problem	Test engine start operation. Also see *Generator set engine does not start* in this table.	4.6
Exerciser does not run regularly or at all	Exerciser not set	Use View Exercise Setup screen to check exerciser settings.	ATS O/I/M
	Maintenance DIP switch SW1B closed	Check for Maintenance Mode message on controller display.	—
		Check the DIP switch setting.	4.7
	Exercise interval different than expected	Use View Exercise Setup screen to check exerciser settings.	ATS O/I/M
Failure to transfer	Alternate source is not available	Check source connections.	1.3
		Check source voltage and frequency.	2.4.2
		Check source settings.	2.5
	AC voltage sensing is incorrect	Perform troubleshooting procedures in Figure 2-19.	2.12
	Unloaded exercise selected	Use View Exercise Setup screen to check exerciser settings.	ATS O/I/M
	Unloaded test sequence selected	Press the End Test button, wait for the test sequence to stop, and then select a Loaded or Auto Loaded test sequence.	ATS O/I/M
	Pre-transfer time delays operating	Check controller display for time delay indication. See the operation manual for information on time delays during normal operation.	ATS O/I/M
		Check the time delay settings.	2.6
	Maintenance DIP switch enabled	Check DIP switch setting.	4.7
	Connected source available	Check the Source Available LEDs.	4.1
	Preferred source selection set to emergency and emergency source is available	Check the preferred source selection and the Source Available LEDs.	—
	Supervised transfer control switch (optional) in manual position	Check the position of the supervised transfer control switch, if equipped. Move the switch to the TRANSFER or AUTO position, as appropriate for the application.	ATS O/I/M
Slow or no transfer to utility	Perform the troubleshooting procedures in the Transfer Troubleshooting flowchart in Figure 2-21 and Figure 2-22.		2.12

O/I/M= Operation and Installation Manual; O/M = Operation Manual; TOC = Table of Contents, this manual; W/D = Wiring Diagrams

Problem	Possible Cause	Check	See Section
Failure to transfer Transfer switch mechanical binding	Jammed or damaged solenoid	Inspect and test solenoid coil.	3.3
	Faulty or worn core spring	Inspect and replace damaged parts.	TOC
	Bent main contact shaft	Inspect and replace damaged parts.	TOC
	Jammed main contacts	Check for foreign object.	
	Contact lever or pushbutton jammed against solenoid counterweight	Test control contacts. See the Table of Contents for test procedures for your model transfer switch.	TOC
	Loose hardware.	Check for and tighten loose hardware.	1.3
	Accumulation of dirt or other foreign material	Clean. Lubricate if necessary.	1.3
Failure to transfer Transfer switch electrical malfunction	Damaged or wrong coil	Check for signs of overheating. Measure the coil resistance to check for damaged coil. Verify that the coil voltage rating matches the transfer switch voltage rating and source voltage.	3.3
	Damaged or wrong rectifier and/or snubber	Inspect for damage. Replace the snubber when replacing the rectifier (240 volt and above)	3.3
	Damaged or wrong resistor (Not used on all models. See the coil replacement procedures for your model to identify resistor.)	Inspect/test resistor (not used on all models). Replace resistor if damaged.	3.3 TOC
	Corroded or fused contacts	Inspect contacts. Clean or replace. Do not use an emery cloth or file. See the Table of Contents for contact replacement procedures for your model.	1.3 TOC
	Coil control contact operation	Test coil control contact operation. See the Table of Contents for control contact test procedures for your model transfer switch.	TOC
	Faulty connections	Check leads and harnesses for loose connections, broken leads, or incorrect connections.	W/D
	Wrong voltage	Check system voltage, controller system voltage and over/undervoltage pickup and dropout settings, and controller meter calibration.	2, 4
Chattering noise when attempting to transfer	Coil control contact operation	See the Table of Contacts for control contact test procedures for your model transfer switch.	TOC
	Low voltage	Check source voltage and connections.	2.4.2
	Incorrect spring	See the Table of Contents for coil replacement instructions for your model transfer switch.	TOC
	Wrong coil	Check coil voltage rating and verify that it matches the transfer switch voltage rating.	—

O/I/M= Operation and Installation Manual; O/M = Operation Manual; TOC = Table of Contents, this manual; W/D = Wiring Diagrams

Problem	Possible Cause	Check	See Section
No LEDs illuminated and/or display is blank	No power to the transfer switch	Check that source switches or circuit breakers are closed.	—
		Verify that at least one source is available. Check for utility or gen set voltage to the ATS.	2.4.2
		Check source connections.	
	No power to the controller	Check that the transfer switch harness is connected to the controller.	Figure 2-4
		Check the harness for loose connections or broken leads (continuity check).	W/D
	One or more faulty LEDs	Press the Lamp Test button to check the operation of all LEDs.	4.1.3
		Replace the controller if one or more LEDs do not light during the lamp test.	4.13
		If no LEDs light during the lamp test, troubleshoot power and connections to the controller.	4.3
	See Figure 2-20, Blank Display Troubleshooting.		2.12
Strange characters on controller display or controller lockup	See Figure 2-23, Troubleshooting Display Errors or Controller Lockup.		2.12
Source available LED off when Source is available	Malfunctioning LED	Press the Lamp Test button to check the operation of all LEDs. Replace the controller if one or more LEDs do not light. If no LEDs light, troubleshoot power and connections to the controller.	4.1.3
	Source settings do not match actual source parameters	Check settings.	2.5
	Incorrect ATS meter calibration	Check calibration.	4.8
Position LED not lit	Position microswitch malfunction	Check the operation of the position microswitches.	4.9
	Transfer switch in intermediate position	Manually operate the transfer switch and check the position LED operation.	TOC
		Check the control contact operation.	TOC
		Check for evidence of solenoid coil damage. Test solenoid coil resistance and operation.	3.3 3.4
		Replace the coil if necessary.	TOC
	LEDs not functioning	See *No LEDs illuminated* in this table.	—
O/I/M= Operation and Installation Manual; O/M = Operation Manual; TOC = Table of Contents, this manual; W/D = Wiring Diagrams			

2.12 MPAC 1500 Controller Troubleshooting Flowcharts

Problems with the MPAC™ 1500 controller can often be traced to incorrect controller settings, faulty wiring, or a bad circuit board. Use the troubleshooting flowcharts in this section to diagnose problems and identify the parts that require service or replacement. Do not replace the entire controller assembly.

Use the troubleshooting flowcharts in Figure 2-19 through Figure 2-23 to diagnose and correct the following problems on the MPAC 1500 controller.

- Incorrect voltage sensing
- Blank display
- Slow or no transfer to utility
- Strange characters on display or controller lockup

Refer to the operation/installation manual and wiring diagrams provided with the transfer switch during the procedure. See Figure 2-24 for an illustration of the controller's main logic board and power supply board.

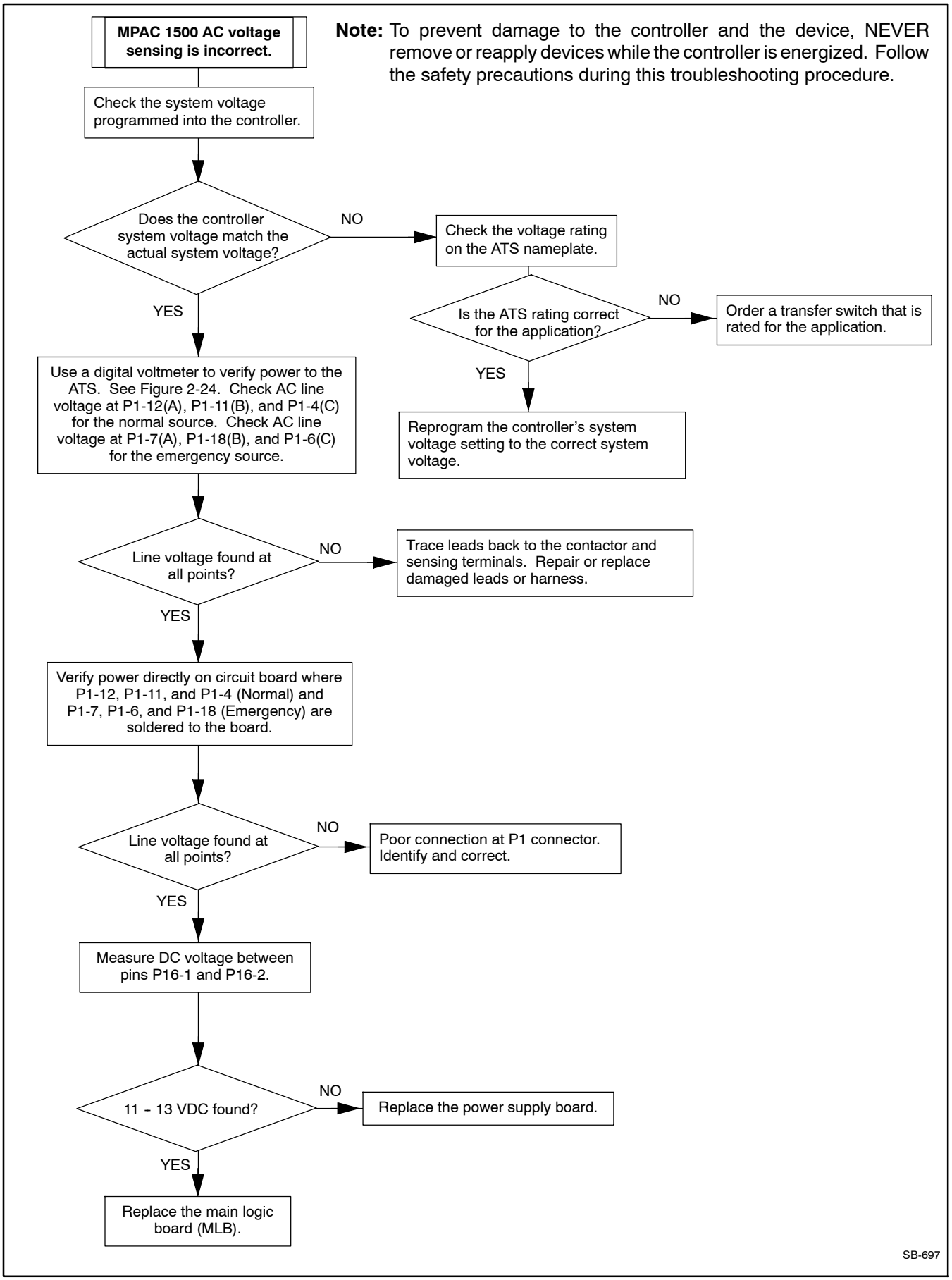


Figure 2-19 Voltage Sensing Troubleshooting

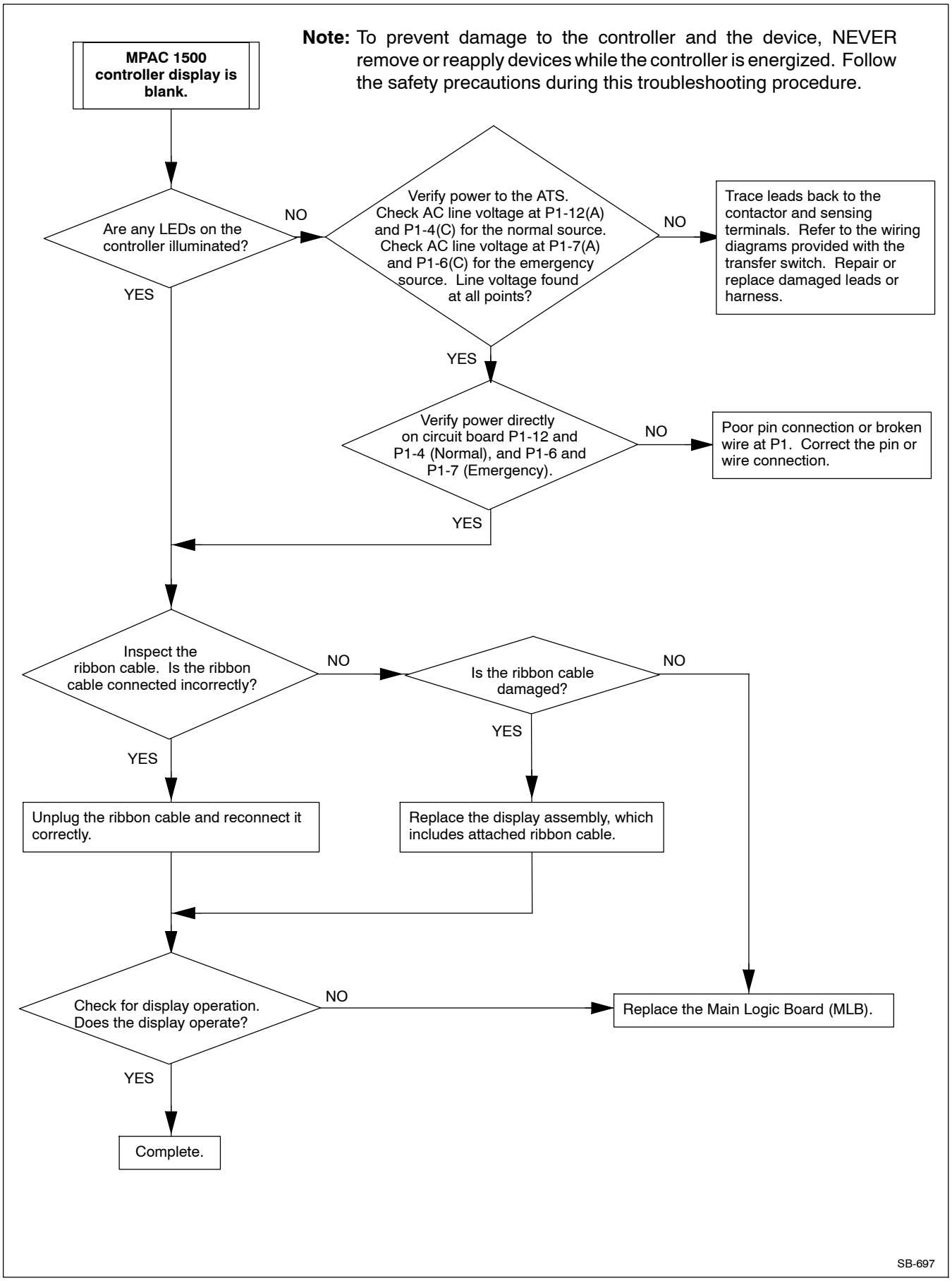


Figure 2-20 Blank Display Troubleshooting

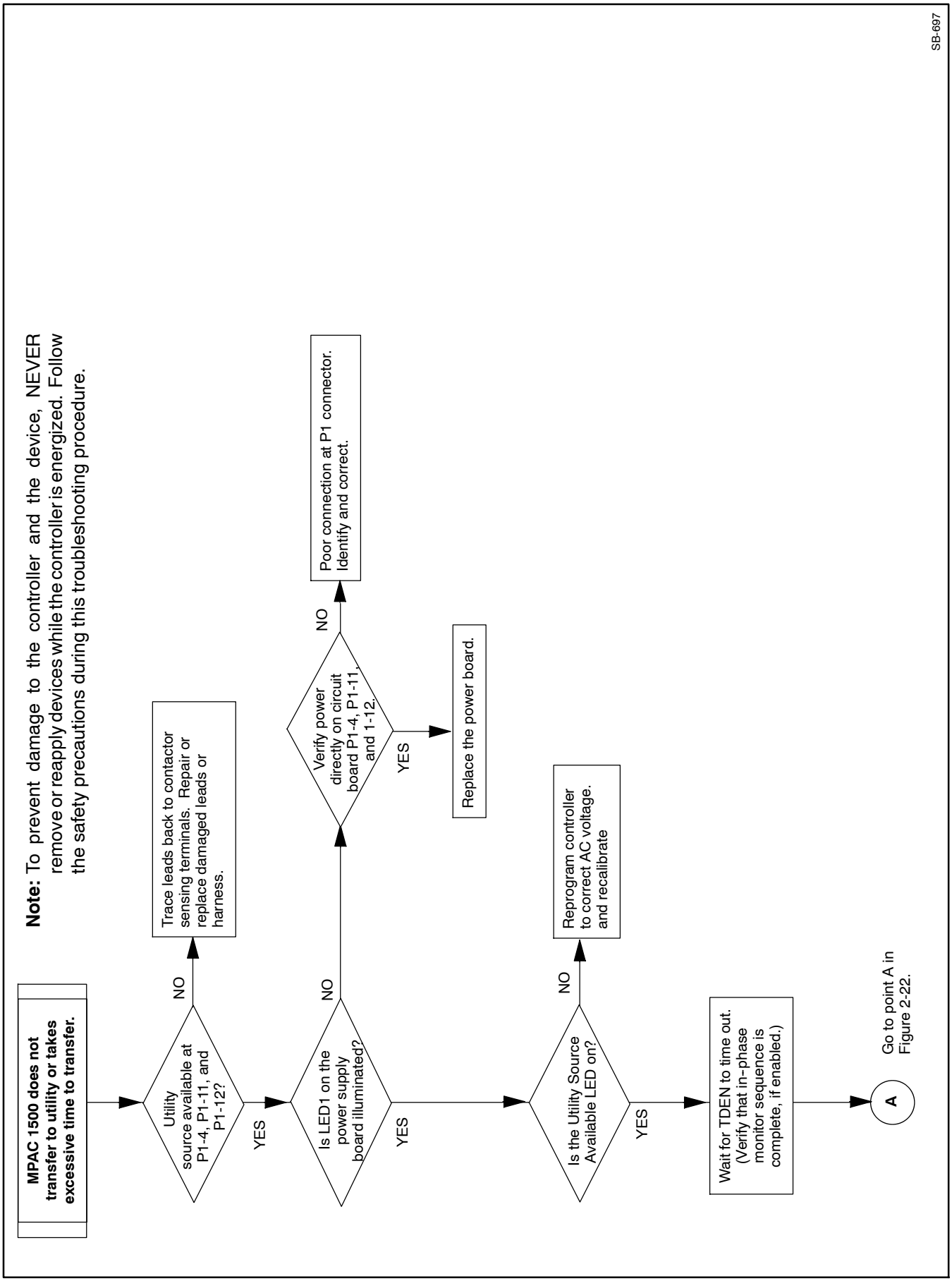


Figure 2-21 Transfer Troubleshooting, Part 1

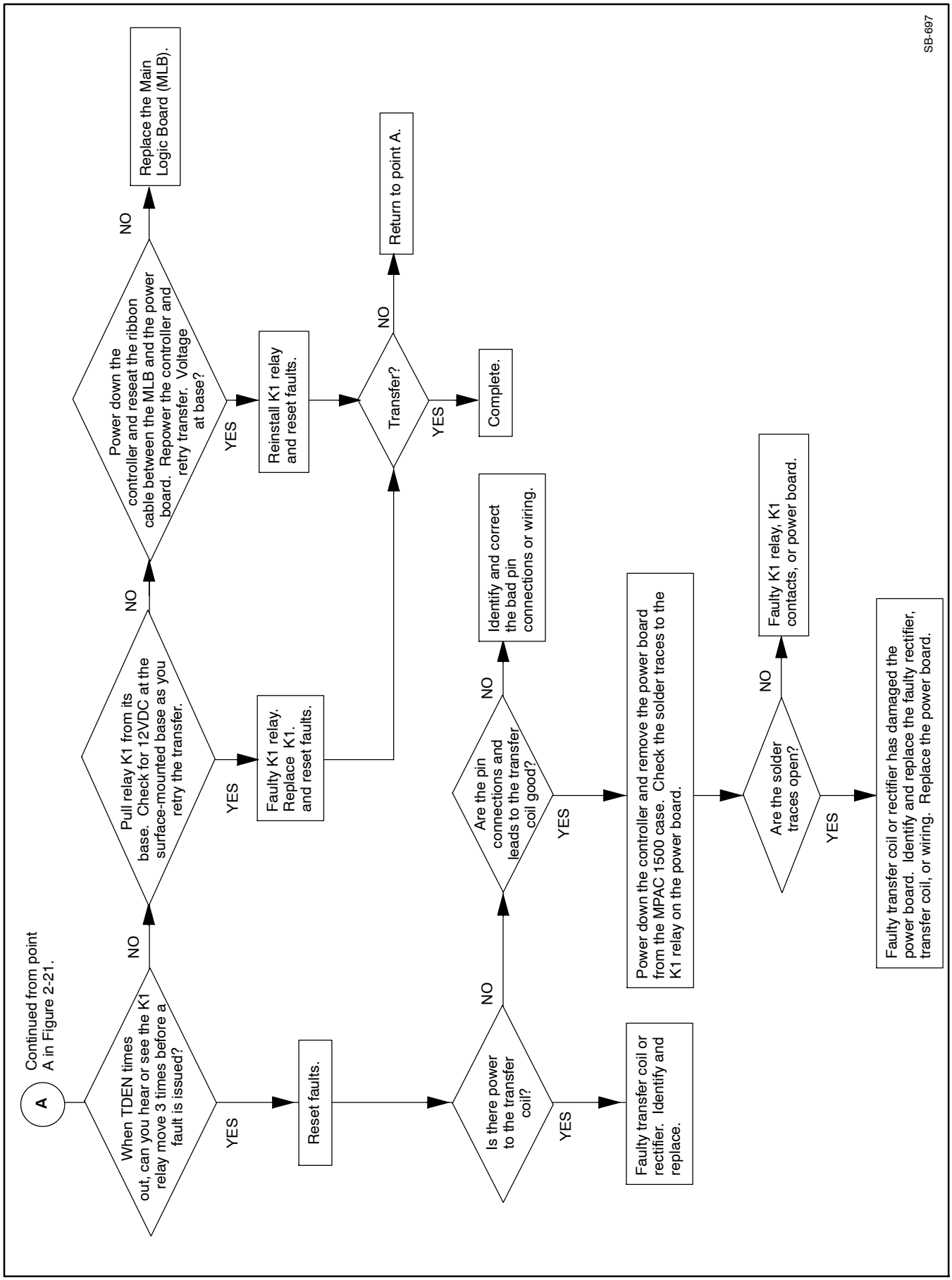


Figure 2-22 Transfer Troubleshooting, Part 2

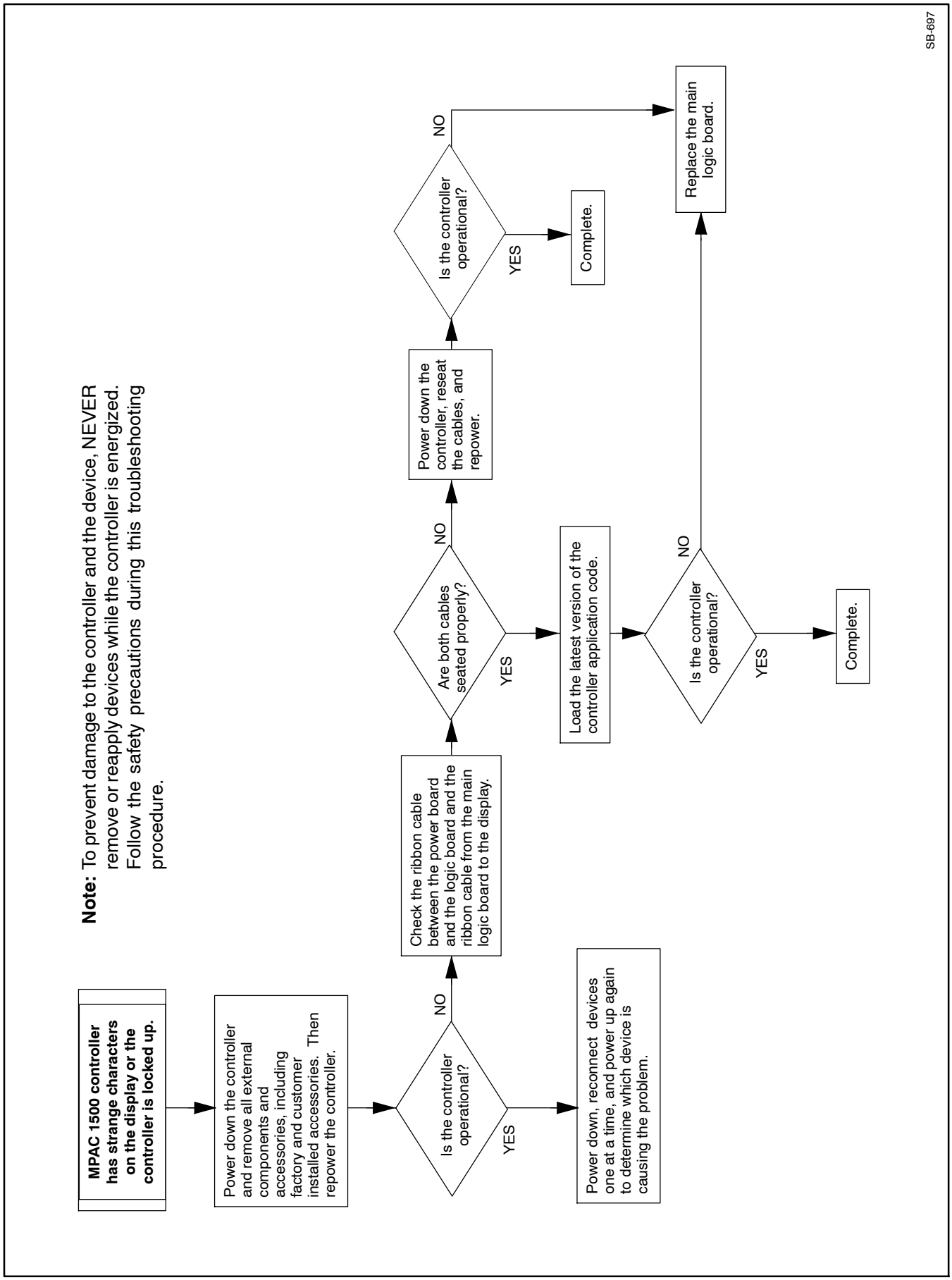


Figure 2-23 Troubleshooting Display Errors or Controller Lockup

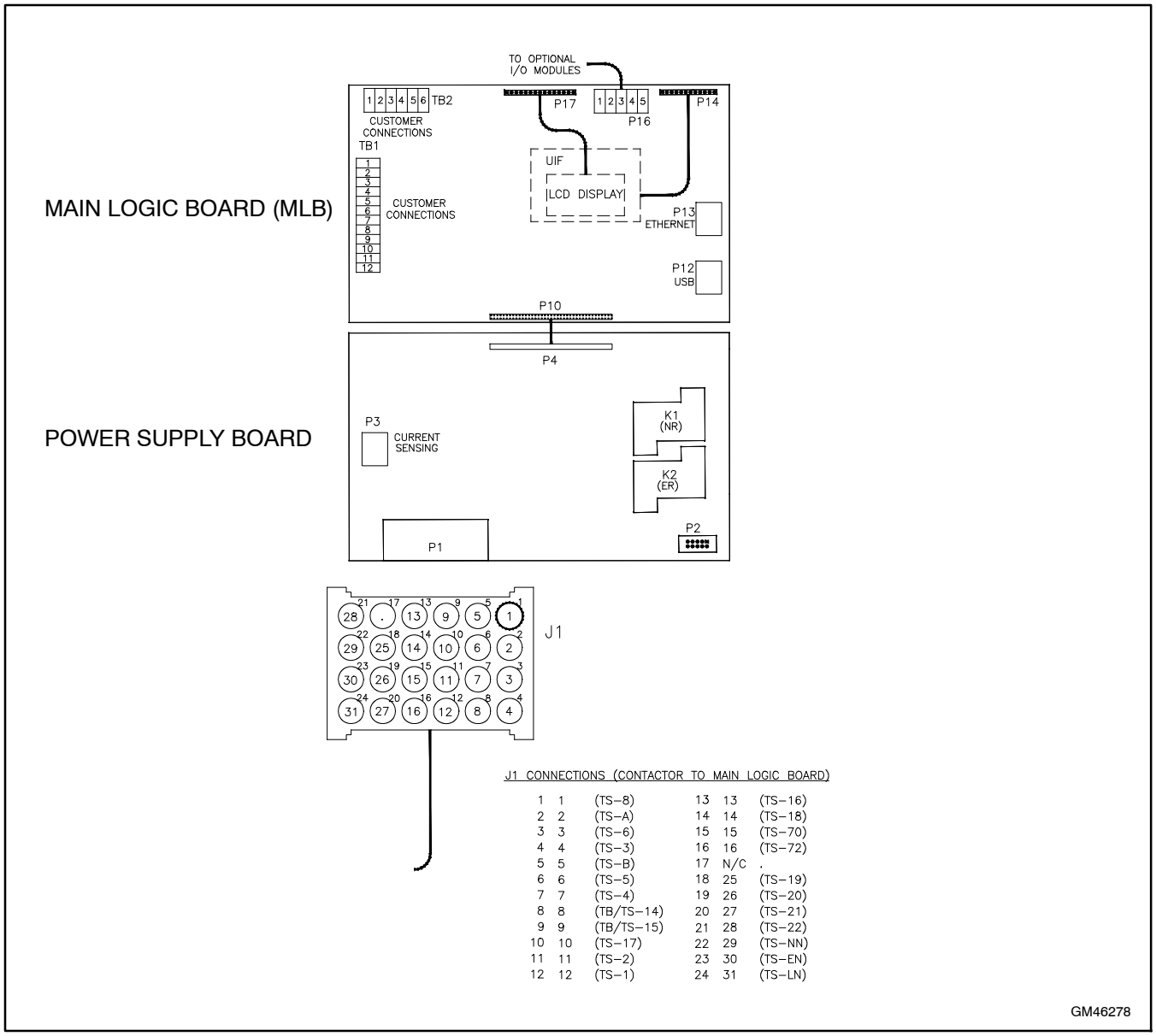


Figure 2-24 MPAC 1500 Controller Circuit Boards and P1/J1 Connections

Notes

3.1 Transfer Switch Troubleshooting

When troubleshooting the transfer switch mechanism, always check for simple causes first: broken or loose wires, corroded contacts, exposure to dirt or foreign material, etc.

Check the time delays, source settings, and other system parameters as described in Sections 2 and 4 before concluding that there is a mechanical problem with the transfer switch. Many transfer problems can be traced to inappropriate controller settings.

Verify that the voltage on the nameplate matches the actual nominal source voltage. Use the procedure in Section 2.4.2, Voltage, Frequency, and Phase Rotation Checks, to measure the source voltage. Observe all Safety Precautions when taking voltage measurements. Verify that the measured voltage matches the transfer switch rated voltage.

Use the table in Section 2.11 to diagnose transfer switch problems. Refer to the Table of Contents to find the transfer switch test and service procedures for your unit.

3.2 Contacts

Use the millivolt drop test in Section 1.4.3 to identify damaged contacts. Replace contacts that have high resistance.

Refer to the Table of Contents to find the contact replacement procedures for your model transfer switch.

3.3 Solenoid Coil, Rectifier, and Snubber

3.3.1 Solenoid Coil

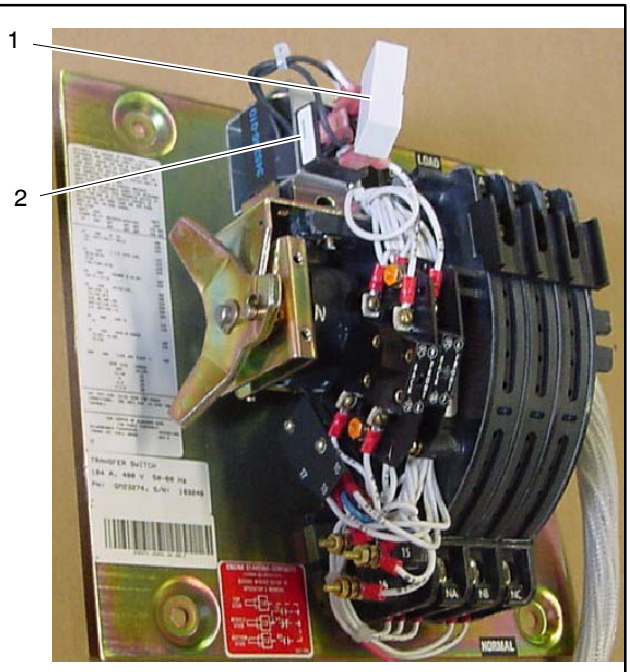
Measure the coil resistance to check for a damaged coil. Coil resistances are listed in Figure 3-2. Most damaged coils will result in an open circuit (very high resistance). Replace the coil if an open circuit or a resistance value significantly different from the resistance shown in the table is found. Replace the rectifier and snubber (if used) whenever the coil is replaced. See Section 3.3.2.

Refer to the Table of Contents to find the coil replacement procedures for your model transfer switch.

3.3.2 Rectifier and Snubber

Early models rated over 240 volts included a snubber to protect the rectifier. See Figure 3-1 for the snubber location. An improved rectifier design has eliminated the need for a snubber.

A damaged rectifier or coil probably indicates a damaged snubber as well. Replace the snubber and rectifier with the new rectifier. See the transfer switch Parts Catalog for the new rectifier part number.



tp6158

1. Snubber, typical
2. Rectifier, typical

Figure 3-1 Snubber and Rectifier Locations (typical; 30–104 amp model shown)

Type (ATS or Bypass Switch)	Type	Amps	Number of Poles and Type	Voltage	Coil DC Resistance (ohms) ±10% @ 20ºC
ATS	Standard Transition Connection S	30–200	2-Pole	208	41.4
				240	67.8
				415	212
				480	256
				600	343
			3-Pole, Switched Neutral, Overlapping Neutral	208	25.7
				240	41.4
				415	133.7
				480	168.3
				600	256
ATS	Standard, Programmed, and Closed Transition Connection B	150–600	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	8.2
				240	8.2
				415	28
				480	42
				600	70
ATS	Programmed Transition Connection S	150/225/260/400	2-Pole	208	15.02
				240	25.7
				415	67.8
				480	102.3
				600	102.3
			3-Pole	208	15.02
				240	15.02
				415	41.4
				480	67.8
				600	102.3
			Switched Neutral, Overlapping Neutral	208	11.3
				240	11.3
				415	41.4
				480	67.8
				600	102.3
ATS	Standard Transition Connection S	225/260/400	2-Pole	208	15.02
				240	25.7
				415	67.8
				480	102.3
				600	102.3
			3-Pole	208	15.02
				240	15.02
				415	41.4
				480	67.8
				600	102.3
			Switched Neutral, Overlapping Neutral	208	11.3
				240	11.3
				415	41.4
				480	67.8
				600	102.3
ATS	Standard, Programmed, and Closed Transition Connection S	600/800/1000/1200	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	4.8
				240	6.1
				415	19
				480	28
				600	43
		1600/2000/3000	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	2.2
				240	3.4
				415	8.5
				480	13.5
				600	21.3

Type (ATS or Bypass Switch)	Type	Amps	Number of Poles and Type (2), (3), (B3), (C3)	Voltage	Coil DC Resistance (ohms) ±10% @ 20ºC
Bypass/ Isolation Switch	Standard Transition Connection S	150/225/260/400	2-Pole	208	15.02
				240	25.7
				415	67.8
				480	102.3
				600	102.3
			3-Pole	208	15.02
				240	15.02
				415	41.4
				480	67.8
				600	102.3
			Switched Neutral, Overlapping Neutral	208	11.3
				240	11.3
				415	41.4
				480	67.8
				600	102.3
Bypass/ Isolation Switch	Programmed Transition Connection S	150/225/260/400	2-Pole	208	15.02
				240	25.7
				415	67.8
				480	102.3
				600	102.3
			3-Pole	208	15.02
				240	15.02
				415	41.4
				480	67.8
				600	102.3
			Switched Neutral, Overlapping Neutral	208	11.3
				240	11.3
				415	41.4
				480	67.8
				600	102.3
Bypass/ Isolation Switch	Standard, Programmed, and Closed Transition Connection B	150–600	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	8.2
				240	8.2
				415	28
				480	42
				600	70
Bypass/ Isolation Switch	Standard, Programmed, and Closed Transition Connection S	600/800	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	9.8
				240	11.9
				415	37.4
				480	49.8
				600	84.4
		1000/1200/1600/ 2000/3000	2-Pole, 3-Pole, Switched Neutral, Overlapping Neutral	208	2.2
				240	3.4
				415	8.5
				480	13.5
				600	21.3

Figure 3-2 Coil Resistances

3.4 Solenoid Operation

This section contains descriptions and diagrams of the solenoid coil operation. For complete diagrams, refer to the schematic diagrams provided with the transfer switch.

The ATS controller monitors the connected source and detects source failure, either a complete loss of the source or a source parameter that is outside the acceptable range. The controller starts the engine start time delay. If power is restored before the time delay ends, the controller resets the time delay and continues to monitor the source. If the source failure persists and the time delay ends, the controller closes the engine start contacts to signal the Source E generator set to start.

When Source E (or the standby source) becomes available, the controller starts the preferred-to-standby time delay (if not set to zero). When the time delay ends, relay K2 (ER) in the controller closes, applying power to the solenoid coil and initiating transfer.

Note: The K1 (NR) and K2 (ER) relays are energized for only 200 milliseconds to initiate transfer.

The solenoid power circuits vary for different ATS models. The following sections describe and illustrate the transfer sequence for the different models.

Control contacts (TS or CN and CE) control the amount of time that power is applied to the solenoid coil. The contacts open before the operating mechanism reaches Top Dead Center (TDC). Inertia carries the mechanism through TDC, and a spring in the solenoid assembly (or a second coil on some larger models) moves the mechanism into the Source E (or standby) position.

When Source N (or the preferred source) is restored, the controller starts the standby-to-preferred time delay. When the time delay ends, the controller's K1 (NR) relay closes, applying power to the solenoid coil and initiating transfer back to Source N (or the preferred source).

Programmed-transition models stop in the OFF position for a programmed length of time during transfer. The transfer-to-OFF sequence is controlled by the NR1 and ER1 relays on the programmed-transition interface interface board (PTIB).

The controller K1 and K2 relays and the PTIB relays are replaceable.

Note: Always check all wiring and connections before replacing parts.

Figure 3-3 explains the notation used in the solenoid operation diagrams in Figure 3-5 through Figure 3-14.

Legend:

K1 (NR), K2 (ER): Controller relays. Energized for 200 milliseconds to initiate transfer.

ERR, SER: Transfer switch relays.

K1' (NR1), K2' (ER1): Programmed-transition interface board relays.

TS (MUS), CN, CE: Coil control contacts (microswitches)

P Coil, S Coil: Solenoid operator coils

Power through the coil circuit.

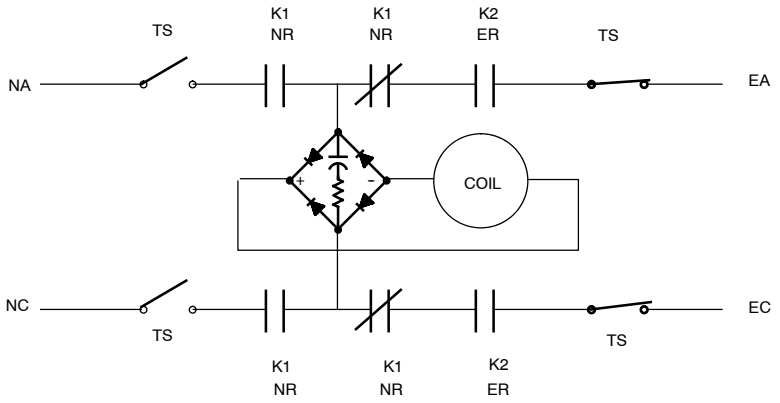
Figure 3-3 Legend for Solenoid Operation Diagrams

Transfer Switch			Solenoid Operation Diagrams see Section:
Size, Amps	Transition	Connection	
30–1200	Standard	S	3.4.1
260–600	Standard	B	3.4.1
1600–3000	Standard	S	3.4.2
4000	Standard	S	3.4.1
150–1200	Programmed	S, B	3.4.3
1600–3000	Programmed	S, B	3.4.4
150–1200	Closed	S, B	3.4.5
1600–3000	Closed	S	3.4.6

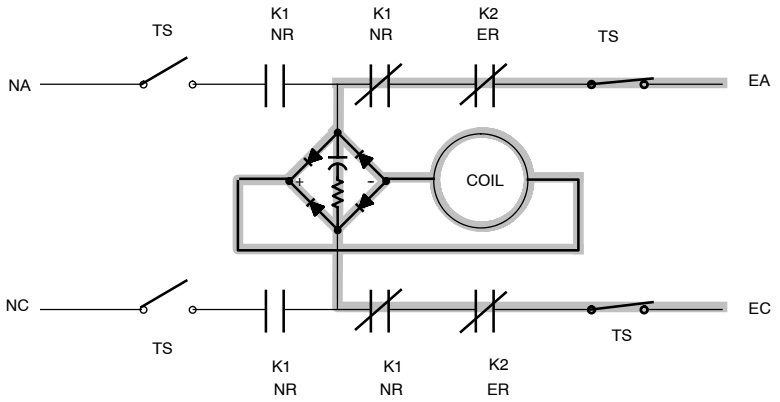
Figure 3-4 Operation Diagram Identification

3.4.1 30–1200 Amp and 4000 Amp Standard Transition Models

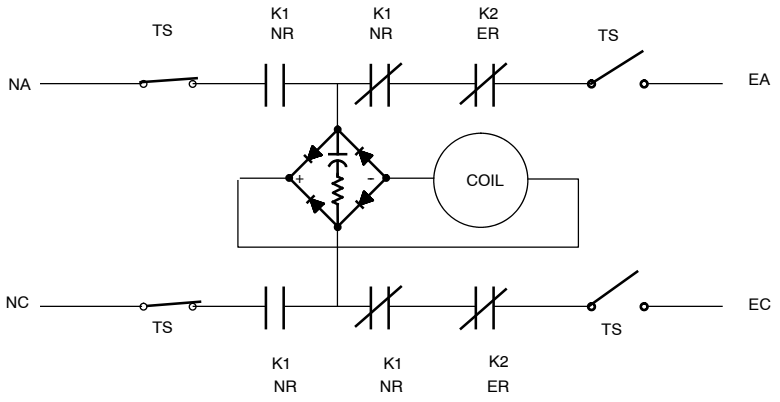
Source N position, Source N available. The solenoid coil is not energized.



Source N position, Source N lost. The coil is energized if Source E is available. The transfer switch is ready to transfer to Source E.



Source E position, Source E available. The solenoid coil is not energized.



Source E position, Source N available. The controller is calling for transfer to Source N. The coil is energized and the transfer switch will transfer to Source N.

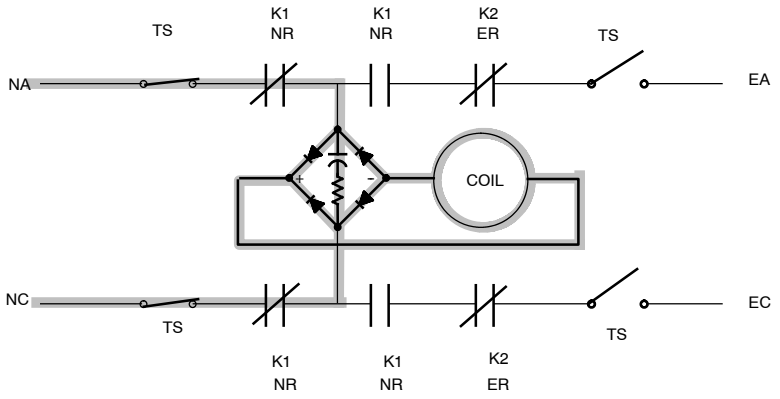


Figure 3-5 30–1200 Amp and 4000 Amp Connection S and 260–600 Amp Connection B Standard-Transition Models, Transfer to Source N and Transfer Back to Source E

3.4.2 1600–3000 Amp Standard-Transition Models

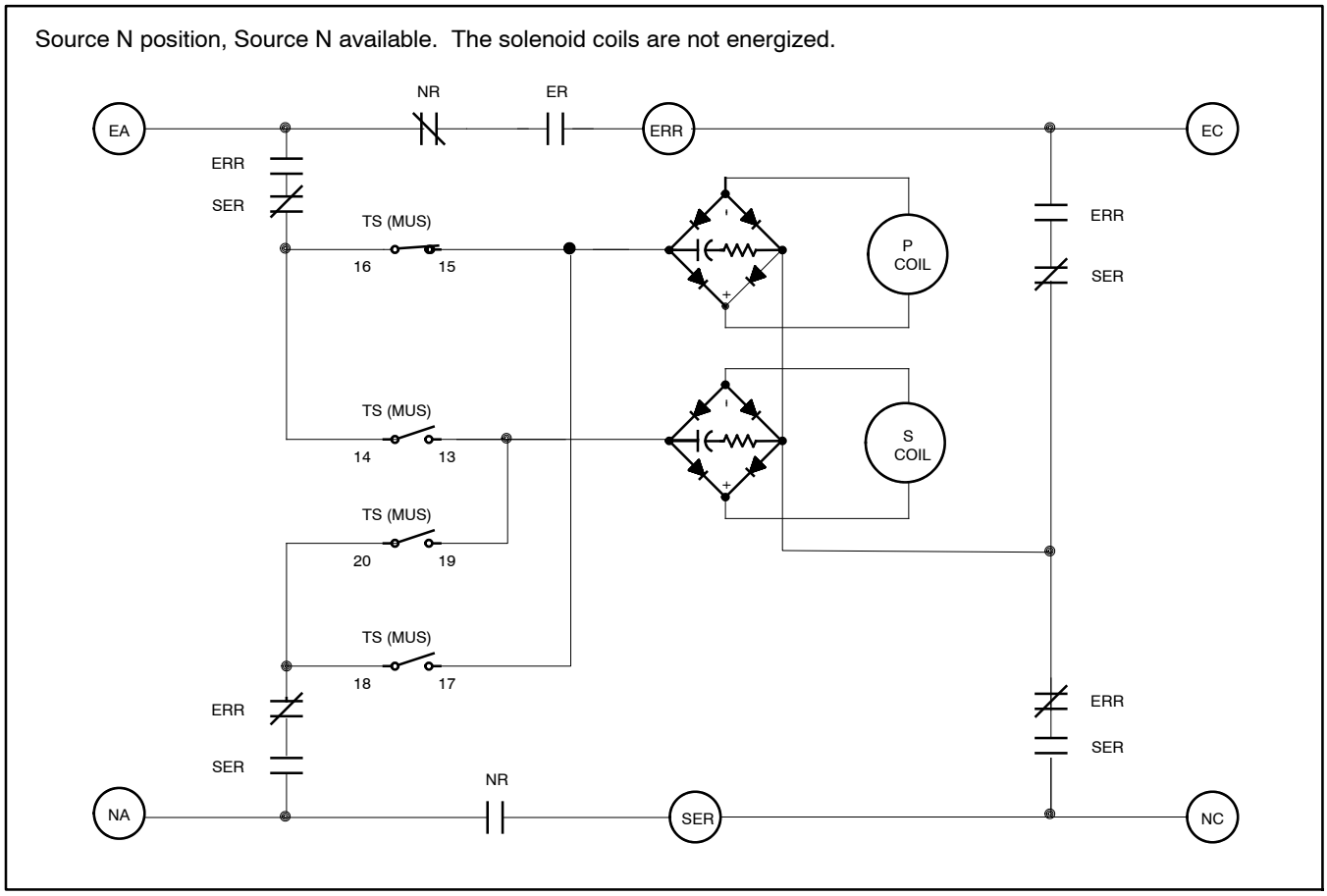
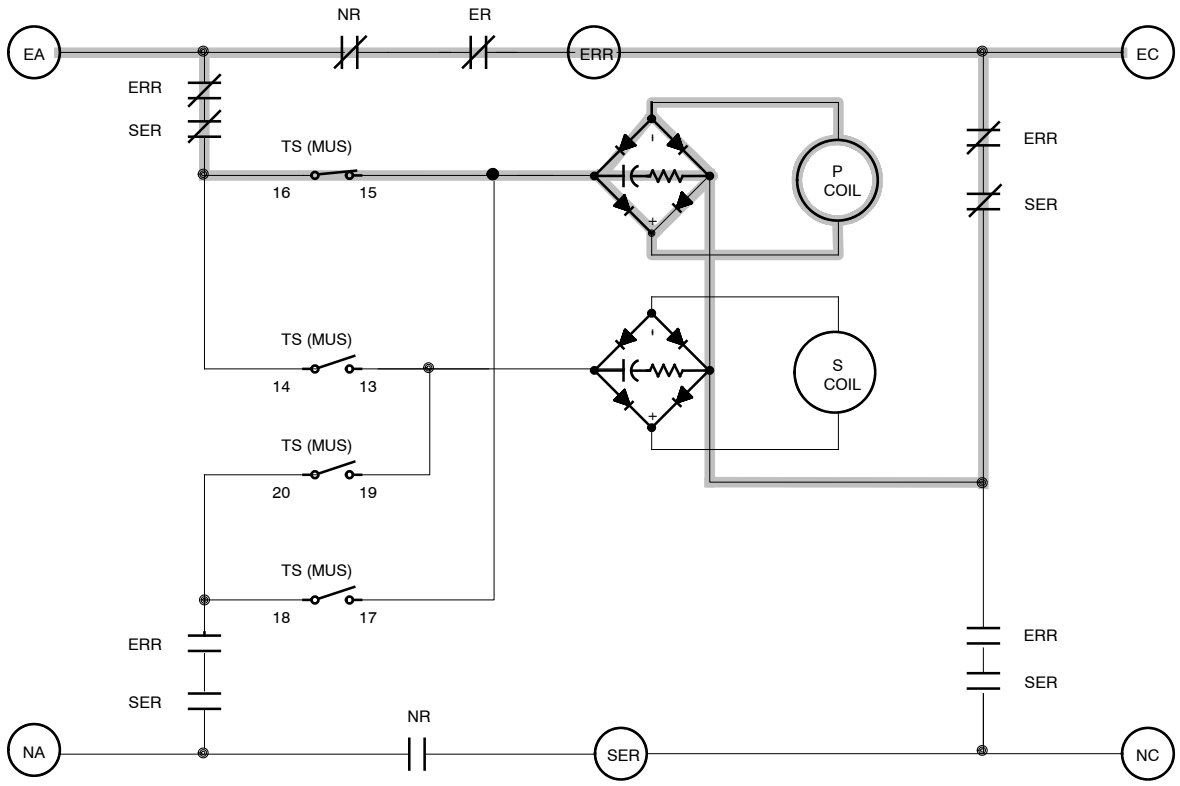


Figure 3-6 1600–3000 Amp Standard-Transition Models, Source N Position

Transfer to Source E, step 1. Source N lost, Source E available. ERR is energized for 200 mseconds. TS 15-16 closes to energize the P coil. TS 15-16 reopens just before Top Dead Center (TDC).



Transfer to Source E, step 2. After Top Dead Center, TS 13-14 closes to energize the S Coil.

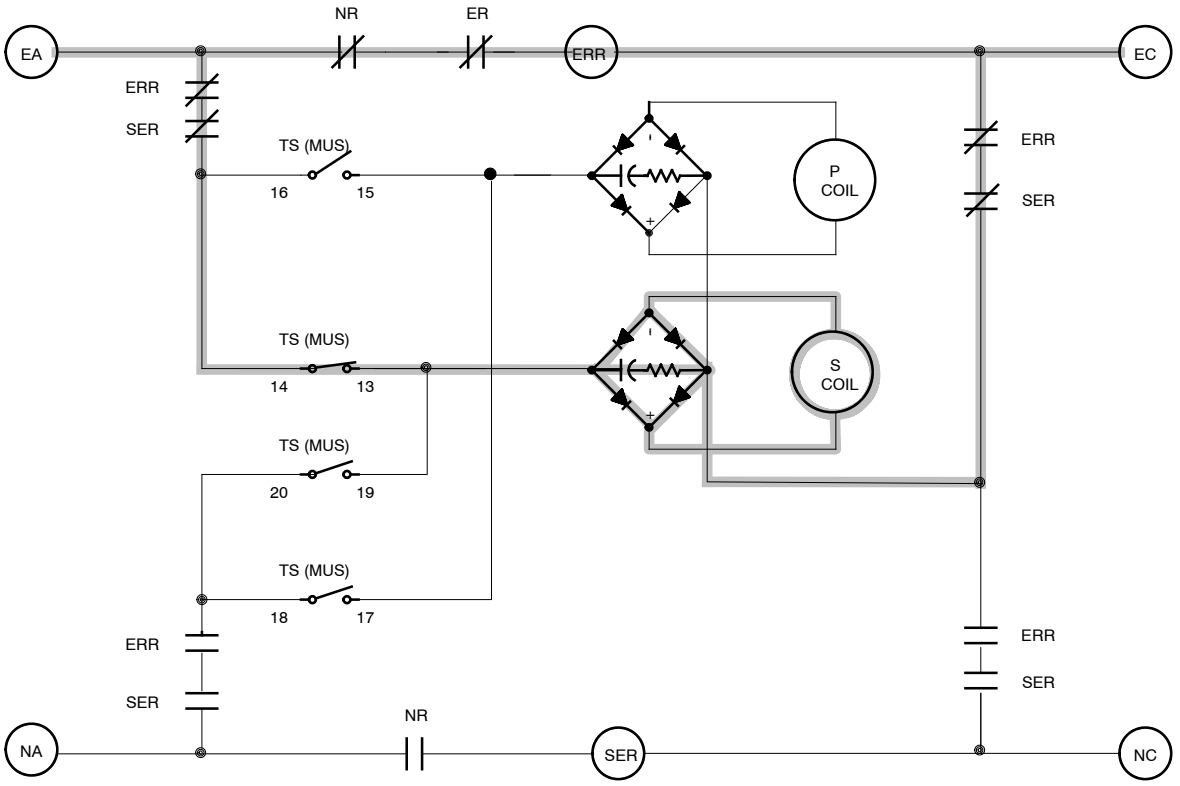


Figure 3-7 1600-3000 Amp Standard-Transition Models, Transfer to Source E

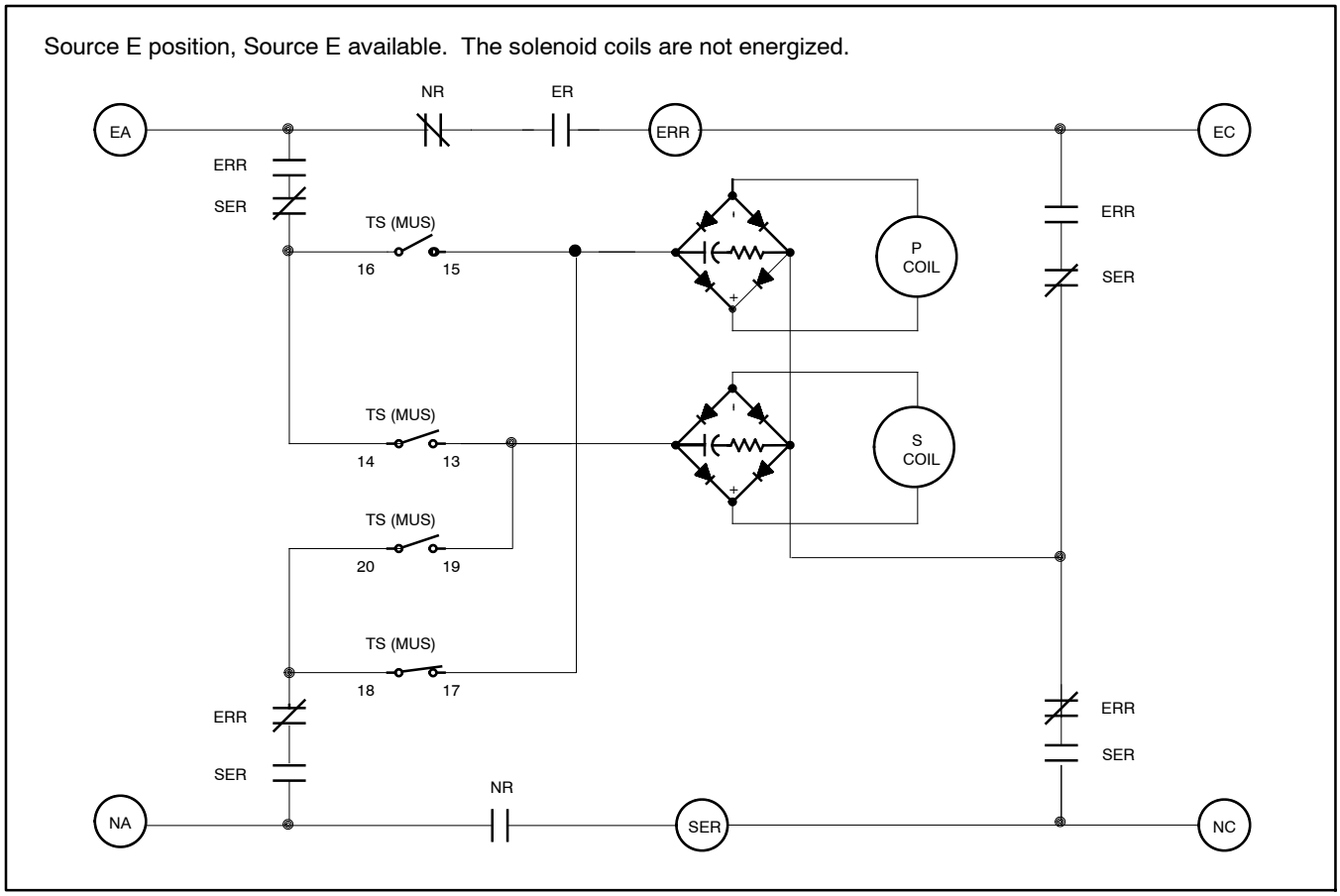
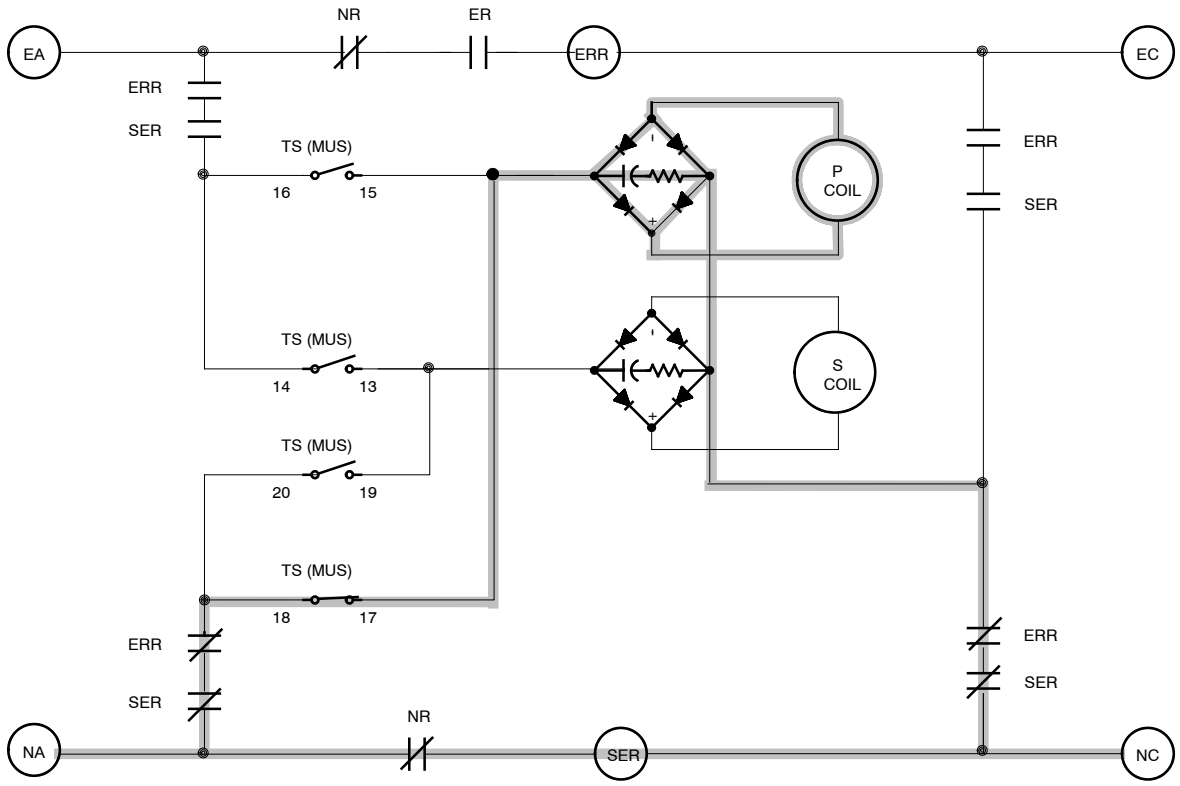


Figure 3-8 1600–3000 Amp Standard-Transition Models, Source E Position, Source E Available

Transfer to Source N, step 1. Source N available. SER is energized for 200 mseconds. TS 17–18 closes to energize the P coil. TS 17–18 reopens just before Top Dead Center (TDC).



Transfer to Source N, step 2. After Top Dead Center, TS 19–20 closes to energize the S Coil.

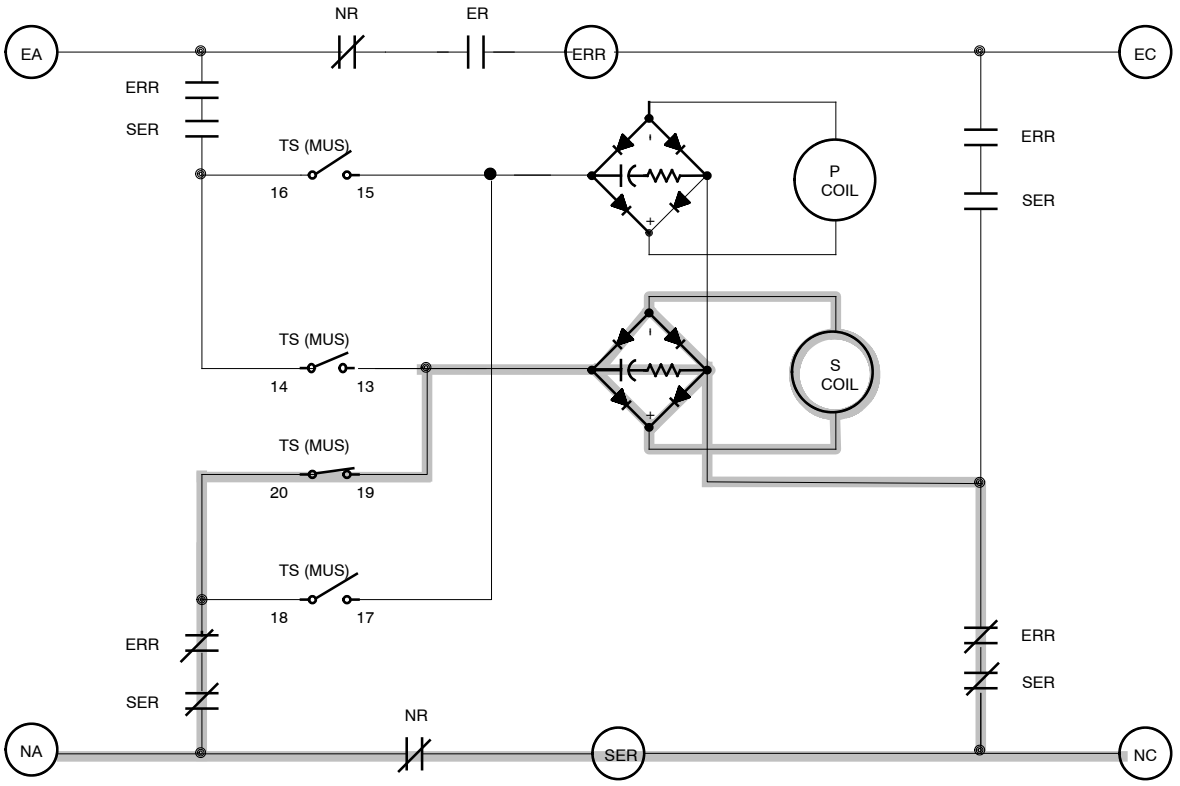


Figure 3-9 Standard-Transition 1600–3000 Amp Models, Transfer to Source N

3.4.3 150–1200 Amp Programmed-Transition Models

Replaceable relays ER1 and NR1 are mounted on the programmed-transition interface board (PTIB). Relays ER1 and NR1 are energized for only 200 msec during the transfer sequence.

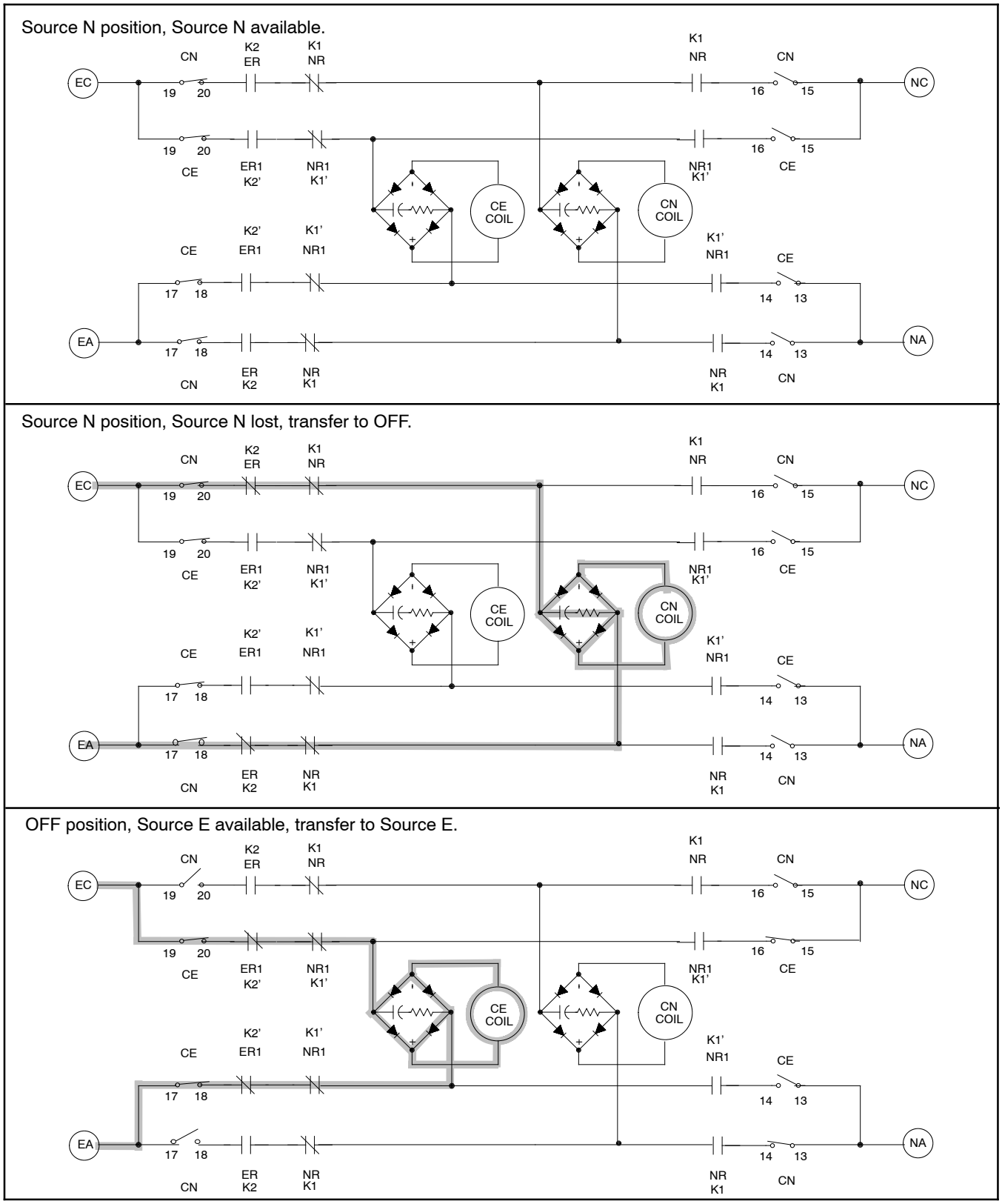


Figure 3-10 150–1200 Amp Programmed-Transition Models, Transfer from Source N to Source E

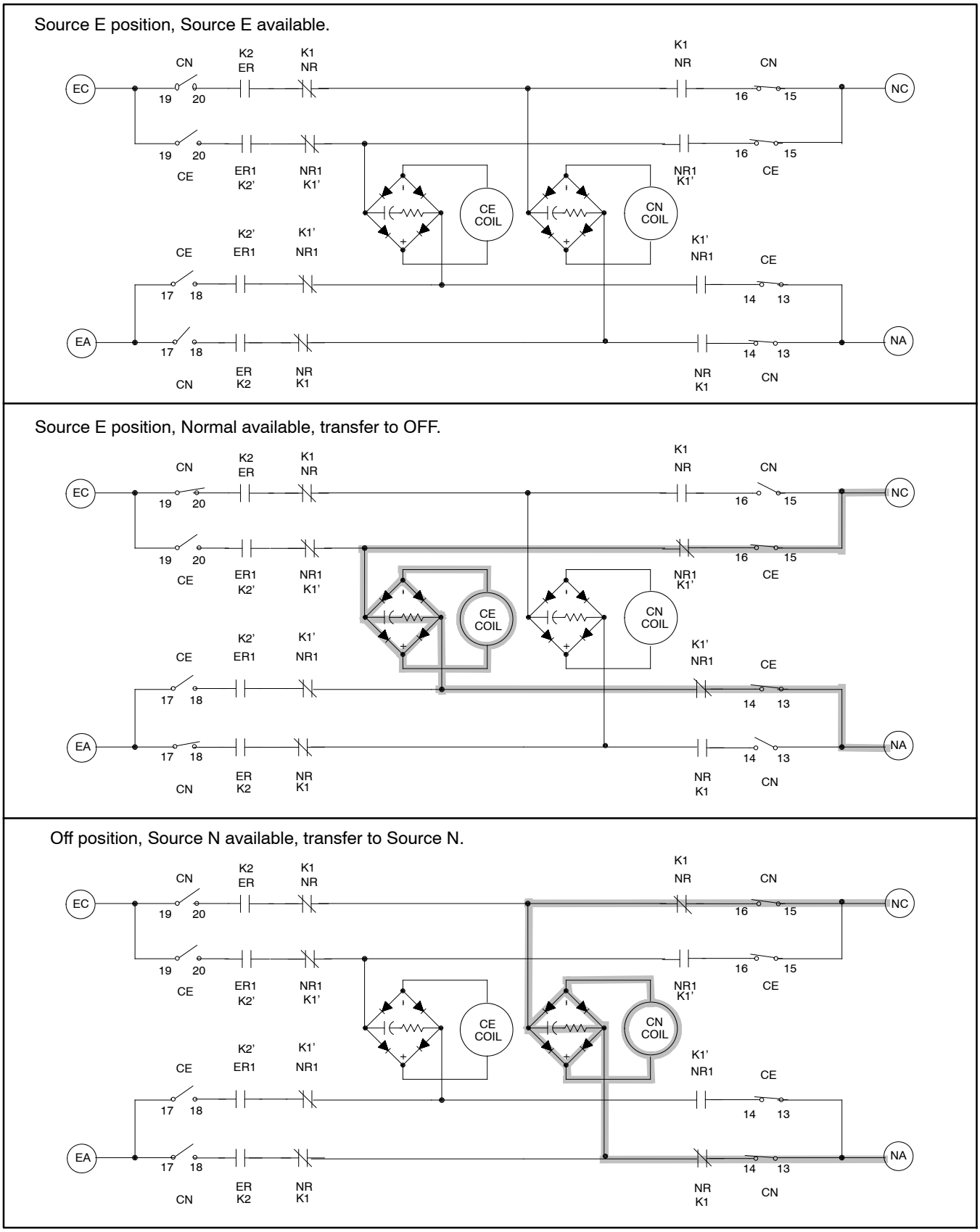


Figure 3-11 150–1200 Amp Programmed-Transition Models, Transfer from Source E to Source N

3.4.4 1600–3000 Amp Programmed-Transition Models

The 1600–3000 amp programmed-transition models use two pairs of solenoid coils. Only the P coil is energized during transfers to the OFF position. During transfers from OFF to either source, the two coils in the pair are energized in sequence, the P coil first and then the S coil after the weight passes through top dead center (TDC).

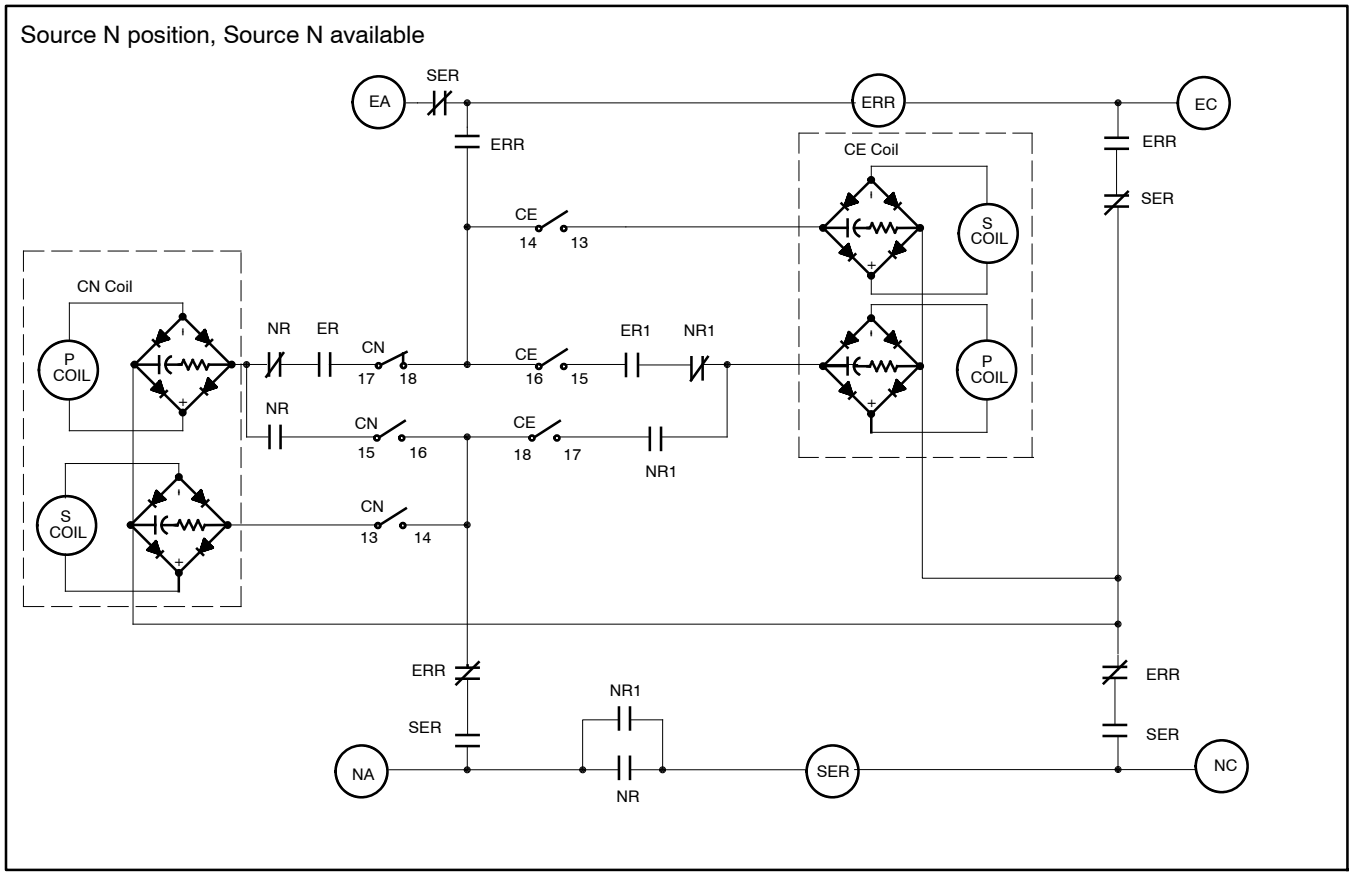


Figure 3-12 1600–3000 Amp Programmed-Transition, Source N Position

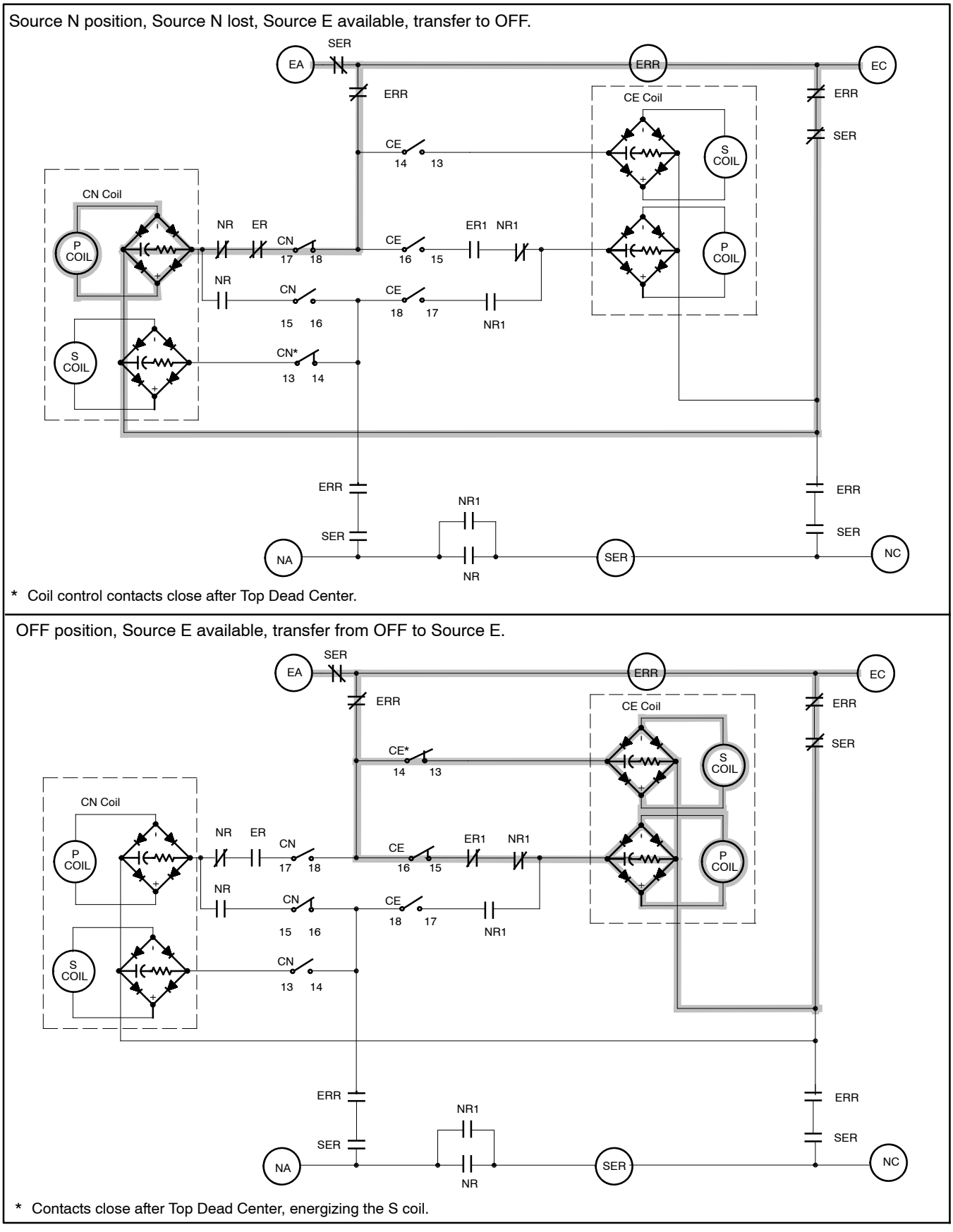
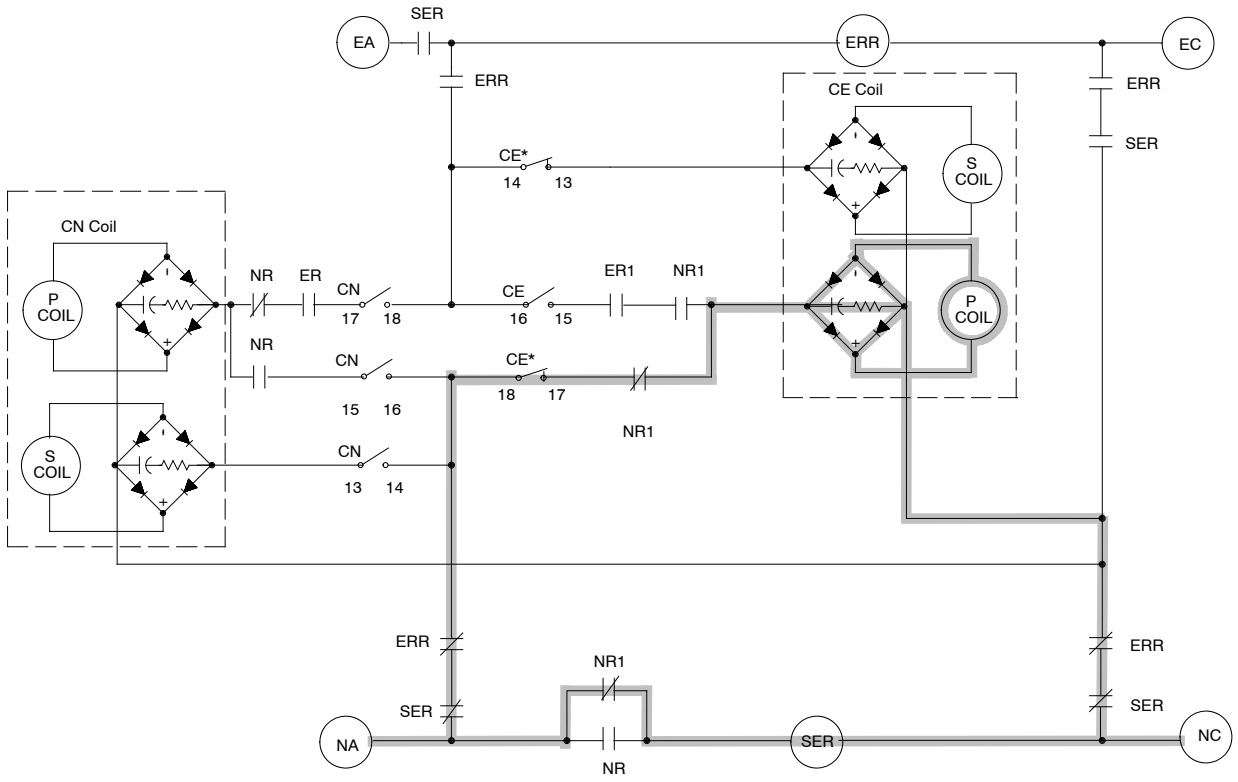


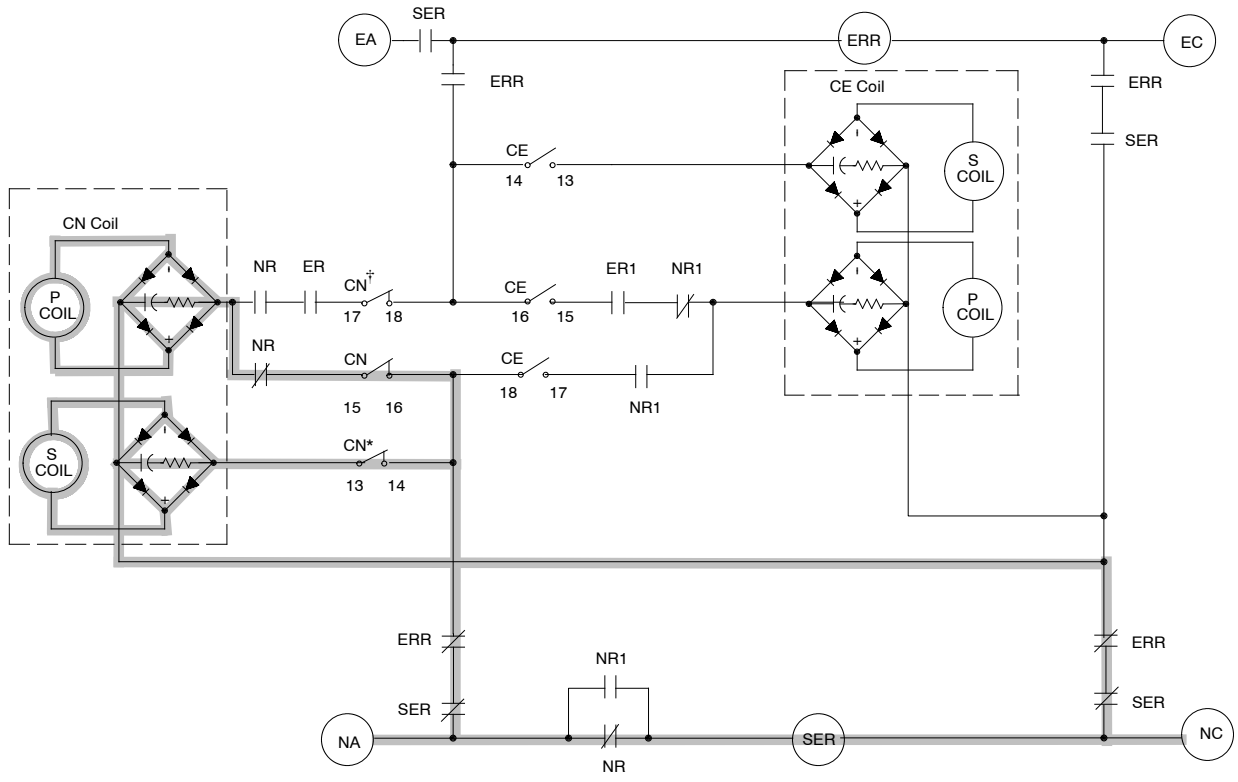
Figure 3-13 1600–3000 Amp Programmed-Transition, Transfer to Source E

Source E position, Source N available, transfer from Source E to OFF.



* Contacts close after Top Dead Center. The S coil is not energized during transfer to OFF.

OFF position, Source N available, transfer from OFF to Source N.



* Contacts close after Top Dead Center, energizing the S coil.

† Closes when Source N position is reached.

Figure 3-14 1600–3000 Amp Programmed-Transition, Transfer to Source N

3.4.5 150–1200 Amp Closed-Transition Models

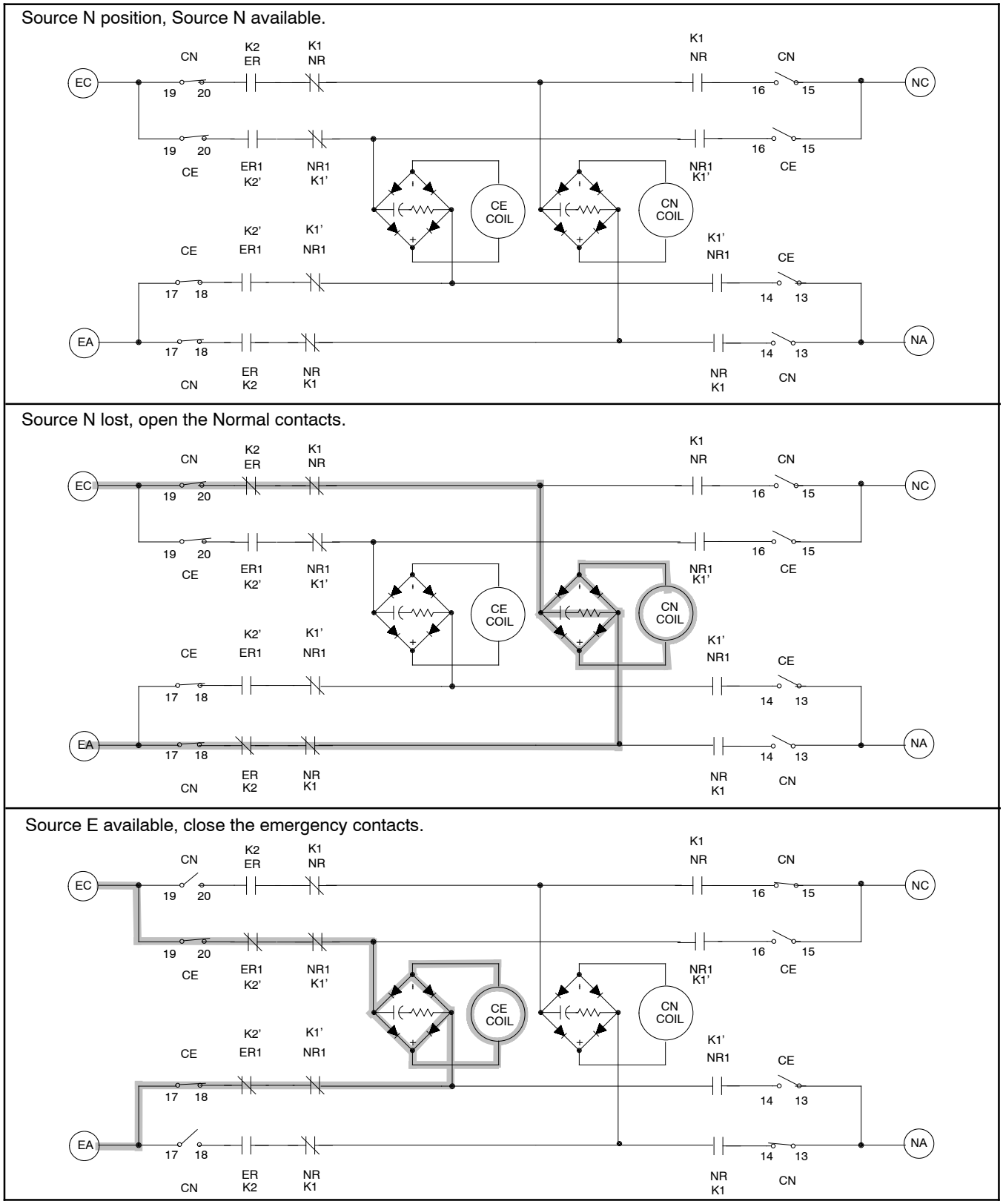


Figure 3-15 150–1200 Amp Closed-Transition Models, Transfer from Source N to Source E

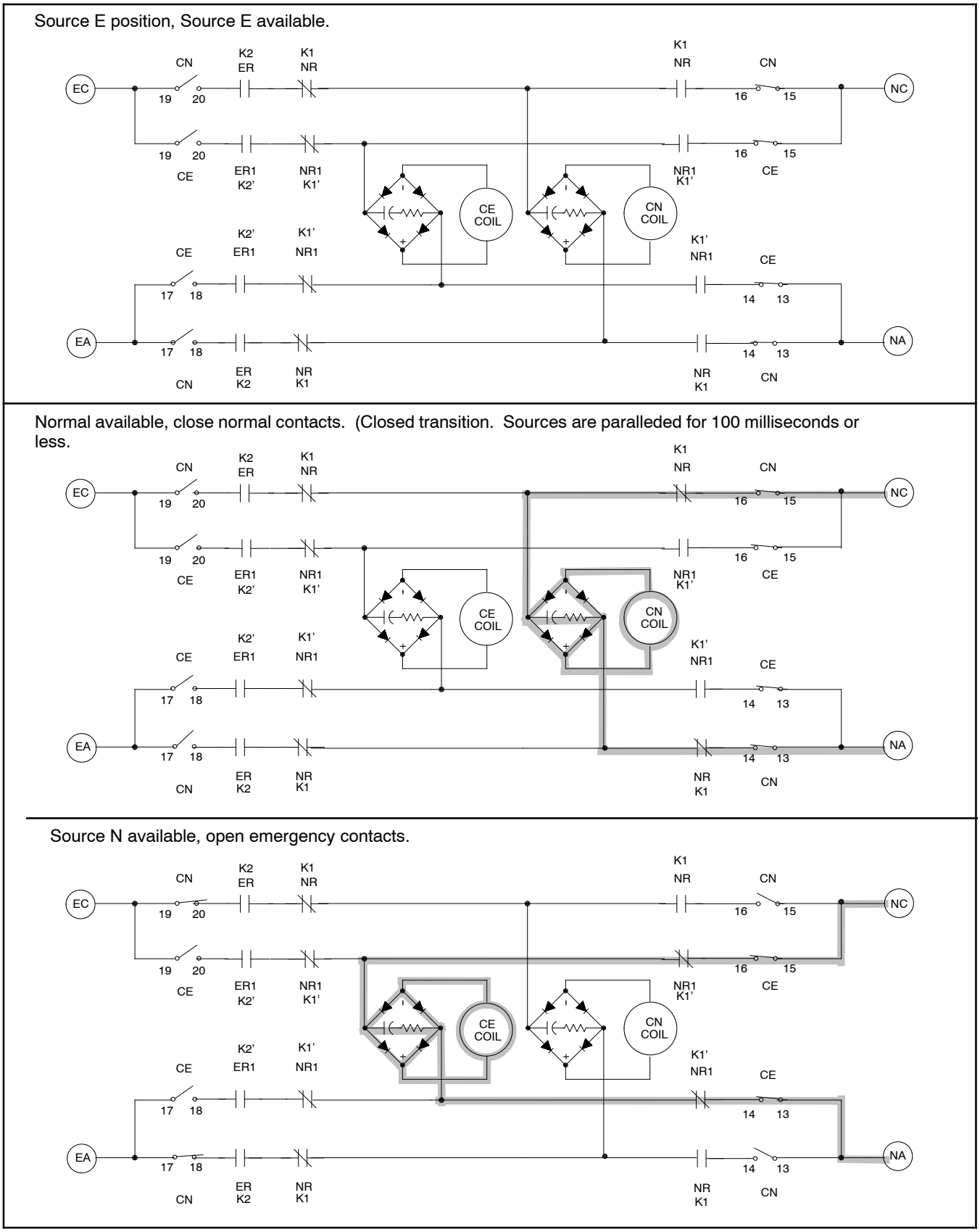


Figure 3-16 150–1200 Amp Closed-Transition Models, Transfer from Source E to Source N

3.4.6 1600–3000 Amp Closed-Transition Models

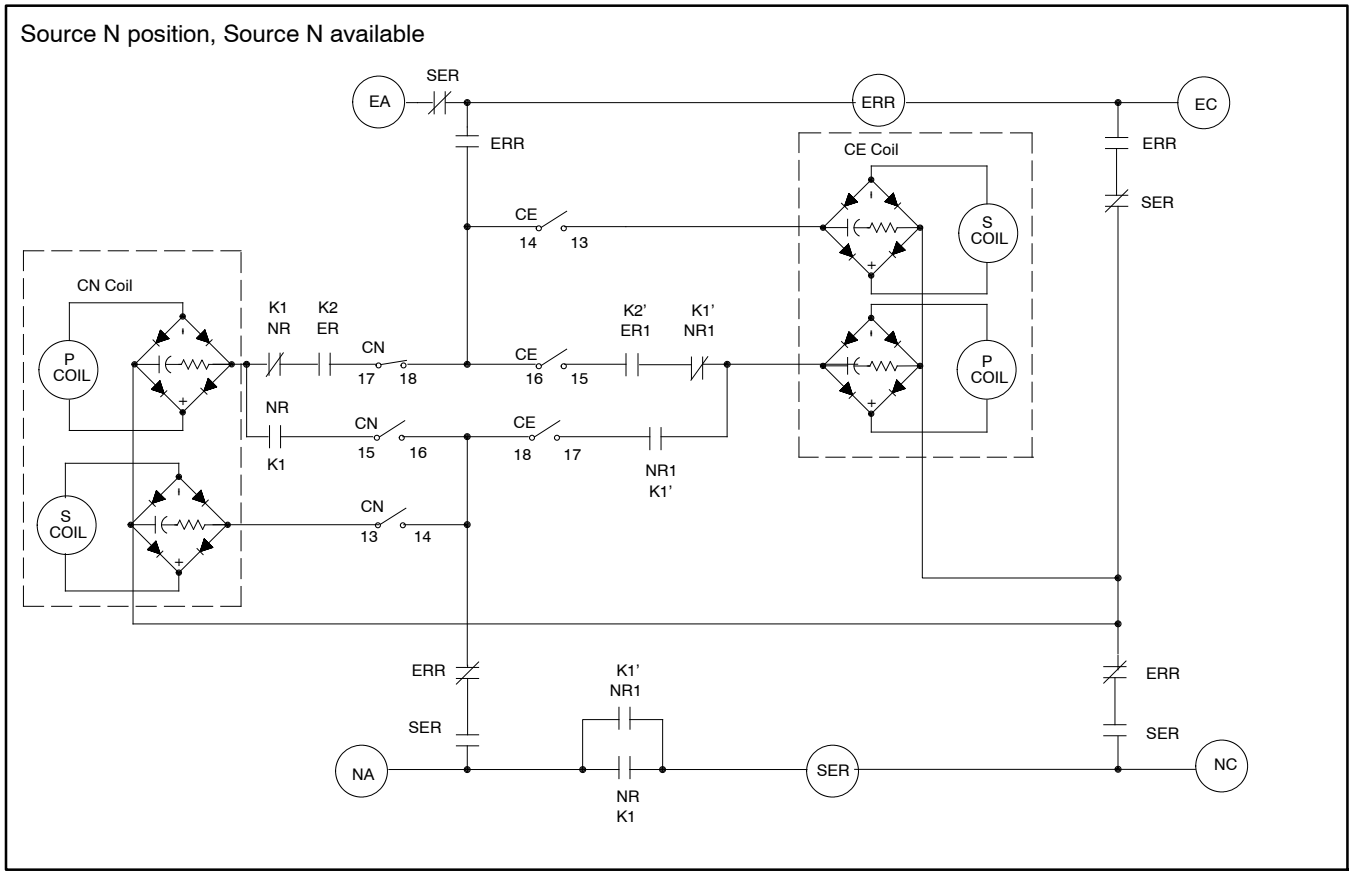


Figure 3-17 1600–3000 Amp Closed-Transition, Source N Position

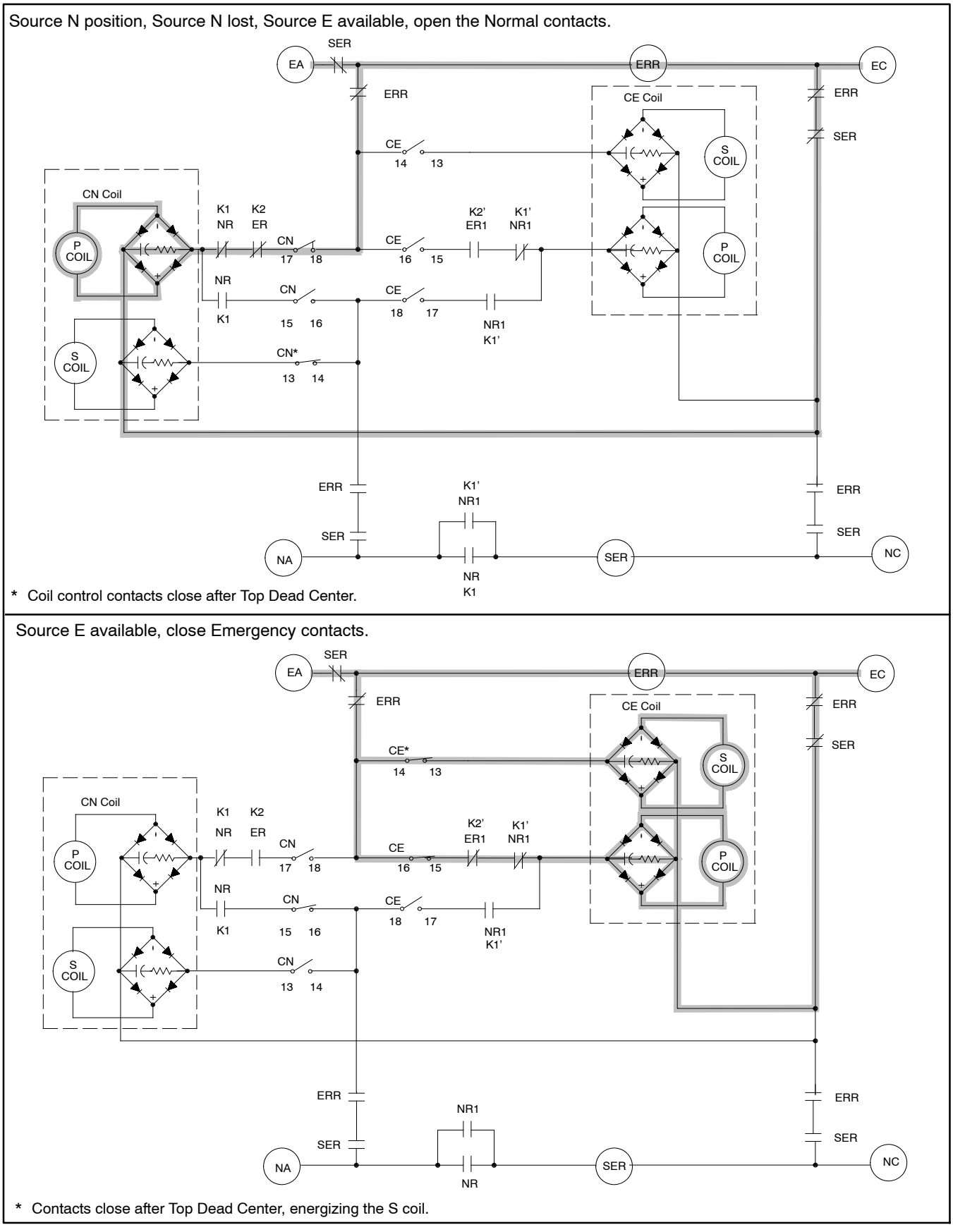
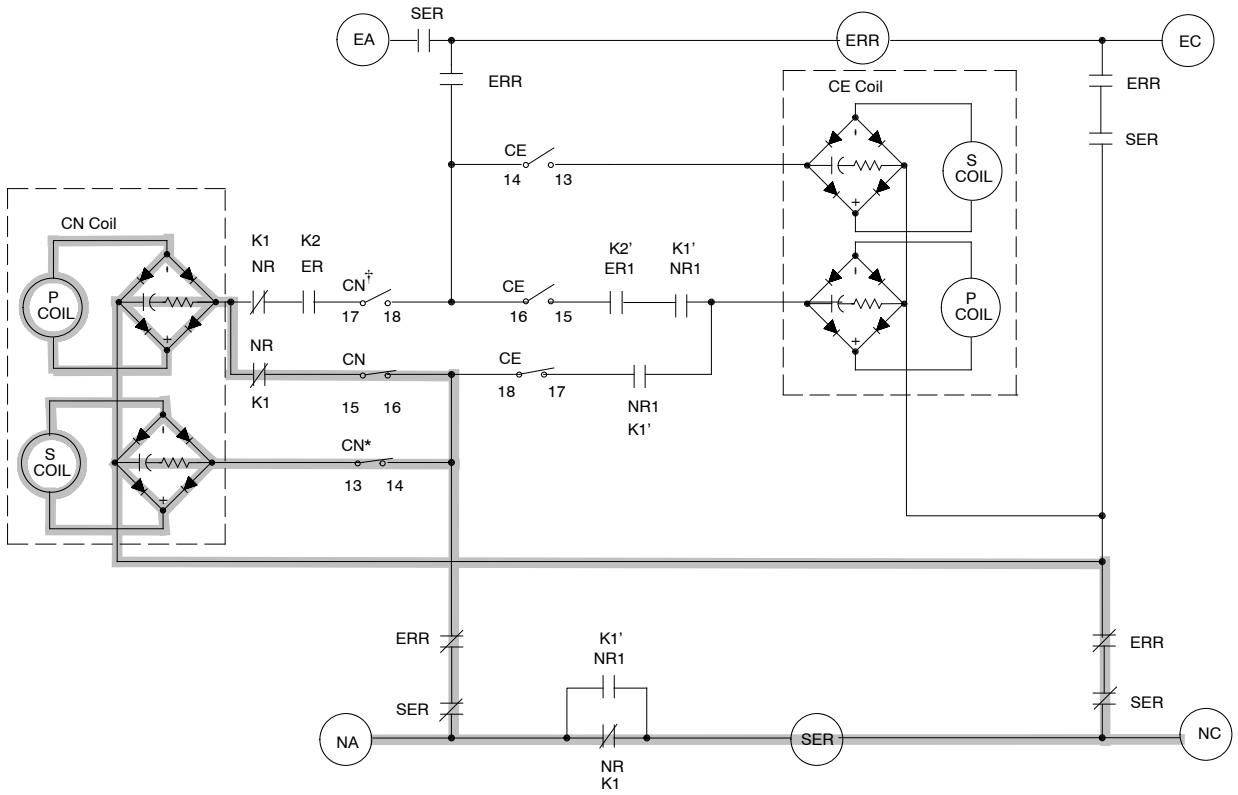


Figure 3-18 1600–3000 Amp Closed-Transition, Transfer to Source E

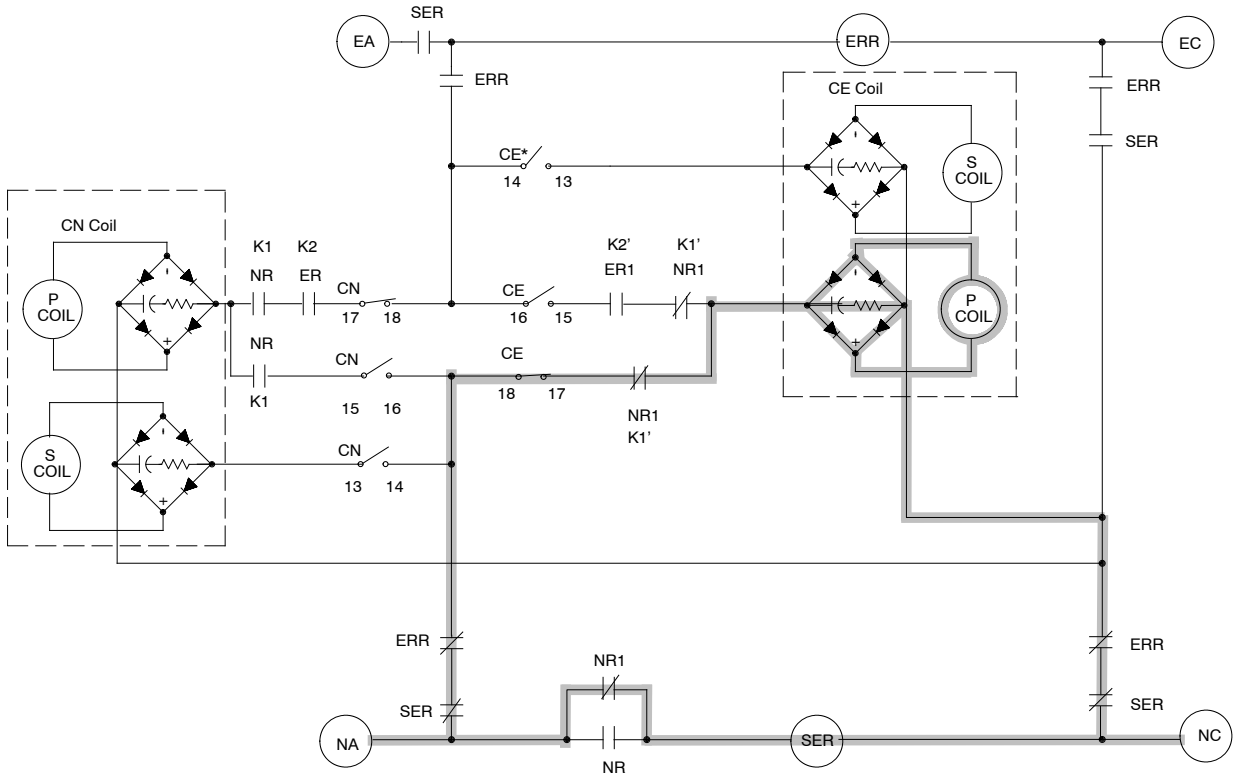
Source N available, close Normal contacts. (Closed transition. Sources are paralled for less than 100 milliseconds.)



* Contacts close after Top Dead Center, energizing the S coil.

† Closes when Source N position is reached.

Source N available, transfer to source N, open Emergency contacts.



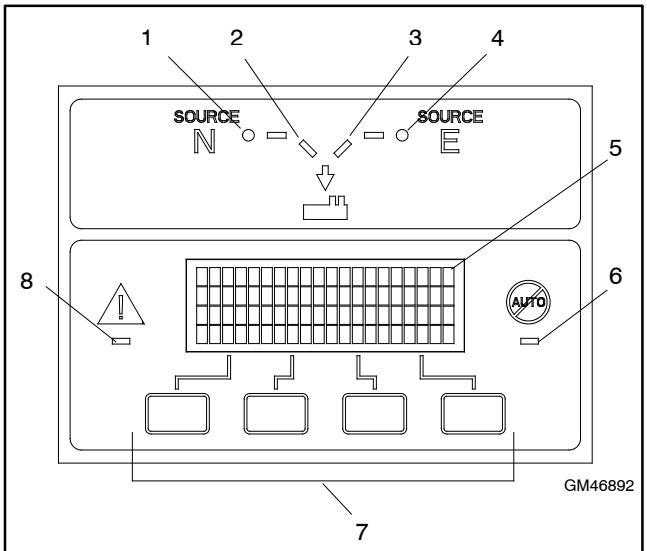
* Contacts close after Top Dead Center. The S coil is not energized during transfer to OFF.

Figure 3-19 1600–3000 Amp Closed-Transition, Transfer to Source N

Notes

4.1 User Interface Panel

The user interface panel is located on the transfer switch door. Figure 4-1 shows the user interface pushbuttons and LED indicators.



1. Source N Available LED
2. Source N Position LED
3. Source E Position LED
4. Source E Available LED
5. Display
6. Not in Auto LED
7. Pushbuttons (4)
8. System Alert LED

Figure 4-1 User Interface Panel

4.1.1 Display

The four-line display indicates transfer switch status and setup, including the following:

- System status
- Faults and warnings
- Active time delays
- Source voltages
- Source frequency (Hz)
- Current (amps)
- Source setup information
- Time and date
- Time and date of next scheduled exercise

The display also identifies the pushbutton functions, which can change from screen-to-screen.

4.1.2 LED Indicators

LEDs on the user interface indicate contactor position, source availability, faults, and other conditions. Figure 4-2 describes the functions of the LED indicators. See Section 2.8 for more information about warnings and faults.

LED Indicator	Condition
Source N Available, Green	Source N is available.
Source E Available, Red	Source E is available.
Position A, Green	Contactor is in Normal position.
Position B, Red	Contactor is in Emergency position.
System Alert, Red	Fault. Identify and correct the cause of the fault condition, then reset faults at the controller. See Section 2.8.
	Input active: Low Battery Voltage or Remote Common Alarm.
Not in Auto, Red	ATS is not set for automatic operation or a load shed (forced transfer to OFF) sequence is active.
	Flashes for manual transfer waiting.
	Input active: Inhibit Transfer or Forced Transfer to OFF.

Figure 4-2 User Interface LED Indicators

4.1.3 Lamp Test

To test the LEDs on the controller's user interface, go to the Main screen. Press the down arrow button once, then press the Lamp Test button and verify that all 6 LEDs on the user interface illuminate. See Figure 4-3.

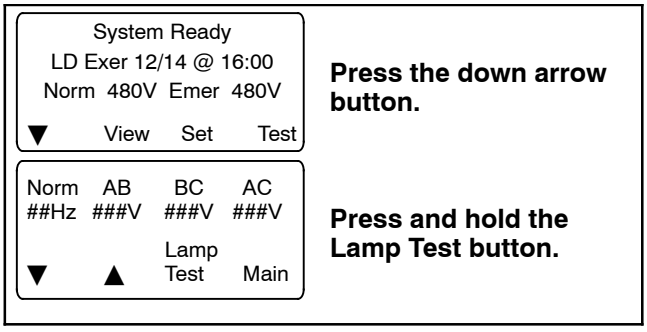


Figure 4-3 Lamp Test

4.1.4 Pushbuttons

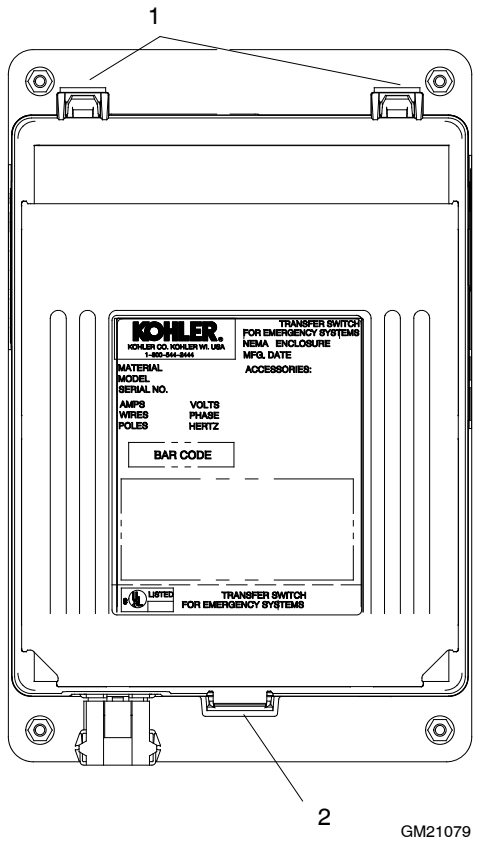
The user interface panel has four pushbuttons below the display. Pushbutton functions are shown above each button in the last line of the display and can change from screen-to-screen.

The pushbutton functions are defined in Figure 4-4.

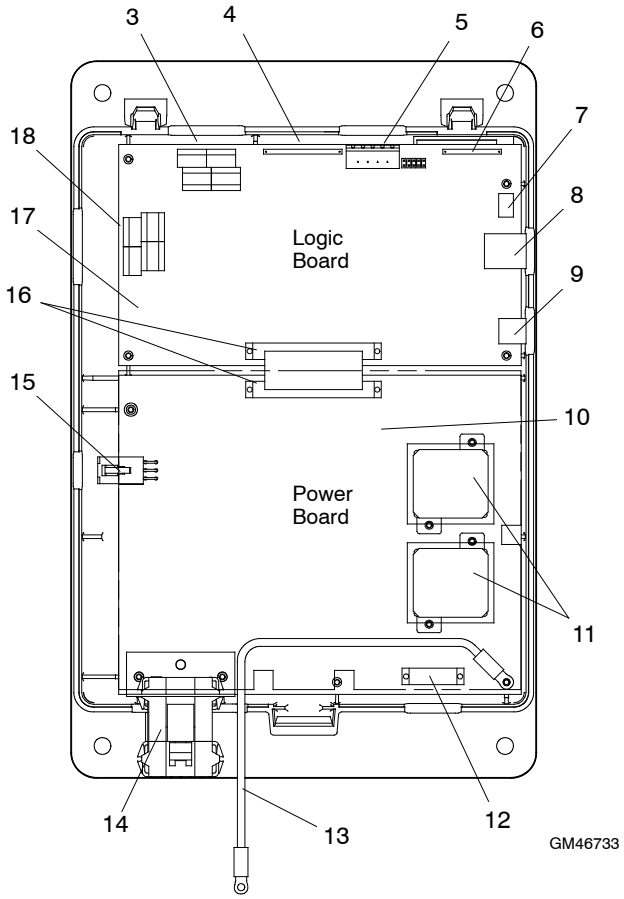
▼	Down arrow (closed). Step down to the next screen or scroll through a list.
▲	Up arrow (closed). Step back to the previous screen.
▶	Right arrow (closed). Move to the next submenu.
△	Up arrow (open). Increases the selected numerical value.
▽	Down arrow (open). Decreases the selected numerical value.
▷	Right arrow (open). Steps to the next digit in a selected numerical value.
Back	Steps back to the previous screen or submenu.
End Delay	Ends the current time delay.
End Test	Ends an active test sequence. See Section 4.4.7.
OK	Enters the displayed numerical value (password or setting).
Main	Returns to the main screen.
Next	Steps to the next parameter in an item with multiple settings (for example, in Exerciser Setup).
Reset	Reset the fault condition shown on the display, or reset an accessory module after connection.
Save	Saves settings shown on the display.
Set	From the main screen, moves to the first setup screen.
Start	From the Test screen, starts the test sequence.
Test	From the main screen, moves to the test sequence screens.
View	From the main screen, moves to the first view screen.
File transfer commands (USB device connected):	
Sel	Select the displayed file.
Del	Delete the displayed file.
Upload	Load the displayed file to the USB device.
Download	Load the displayed file to the controller.

Figure 4-4 Pushbutton Functions

4.2 Controller Circuit Boards and Connectors



With Cover



Cover Removed

1. Hinges
2. Latch
3. RS-485 Modbus connections TB2
4. User interface LCD display connection P17
5. Accessory module assembly connection P16
6. User interface connection P14
7. DIP switches SW1
8. Ethernet connector P13
9. USB port P12
10. LED1 (ON = 12VDC)
11. Relays
12. Programmed-transition interface board (PTIB) connection P2 (factory connection)
13. Ground wire
14. Transfer switch harness connection P1
15. Current sensing kit connection P3 (optional)
16. Ribbon cable connection
17. Controller backup battery
18. Logic board input and output connections TB1

Figure 4-5 Controller

4.3 Controller Power

DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

4.3.1 Controller Power Supply

The controller power board converts AC line voltage to DC voltage for the logic board. Line voltage or DC voltage from an external battery connected through an External Battery Supply Module (EBSM) will cause LED1 on the controller's power board to light. See Figure 4-5 for the LED location.

- If the Normal or Emergency source is available but the controller display is dark, check LED1 on the controller power board. LED1 lights when voltage is available for the logic board.
- If the transfer switch is equipped with an EBSM, disconnect the I/O module assembly at connector P16 on the controller to remove the external battery supply. Then check LED1 with the Normal or Emergency source available.
- If LED1 lights but the controller display is dark, check the ribbon cable connections between the controller's power board and logic board and from the logic board to the display.
- If LED1 does not light when the Normal or Emergency source is available, check for line voltage to the controller using the following procedure:

Check for Line Voltage to the Controller

1. Disconnect power to the transfer switch by opening circuit breakers or switches.
2. Disconnect the transfer switch wiring harness from the controller at the 24-pin connector.
3. Reapply power to the transfer switch.
4. Check for voltage across the wiring harness pins. Observe all Safety Precautions when checking the voltage.
   a. If Source N is available, check for line voltage across pins 4 and 12 of the transfer switch wiring harness connector.
   b. If Source E is powering the transfer switch, check for line voltage across pins 6 and 7 of the connector.

If there is no power to the pins checked in step 4, check the wiring harness continuity. Replace the harness if necessary.

If there is power to the pins checked in step but LED1 on the power board does not light when power is connected, replace the power board.

4.3.2 Controller Powerup Reset Sequence of Operation

Following is an explanation of the sequence of operation for the MPAC™ 1500 ATS Controller when power is initially applied to the controller or a controller reset occurs.

1. Controller self test is executed.
2. System parameters are downloaded from non-volatile memory.
3. Contactor position and source availability are determined.
4. If neither source is acceptable, the contactor does not change position.
5. If both sources are available, the controller immediately transfers the contactor to the preferred source.
6. If only one source is available, the controller immediately transfers the contactor to that source, executing only the off-position and load control time delays.

If the available source is the preferred source, and the contactor was in the standby position, the contactor transfers to preferred, the engine cooldown time delay runs, and then the engine start contacts open.

If the available source is the preferred source and the contactor was already in the preferred position, the engine start contacts open immediately, bypassing the engine cooldown time delay.

4.3.3 Controller Backup Battery

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Note: Disconnect power to the controller before installing or replacing the battery.

Units built after 2/5/2009 do not use the backup battery.

The transfer switch controller uses a 4.1-volt backup battery for power when no source is available. A Low Backup Battery message on the screen indicates that this battery needs to be replaced. See Figure 4-5 for the battery location.

Note: Do not use a standard AA battery; the voltage is not correct and the specifications are not adequate for this equipment. Obtain replacement battery GM47057 from the manufacturer.

Note: Do not use a metal tool to remove or install the battery.

When installing the battery, follow the polarity (+/−) markings on the circuit board.

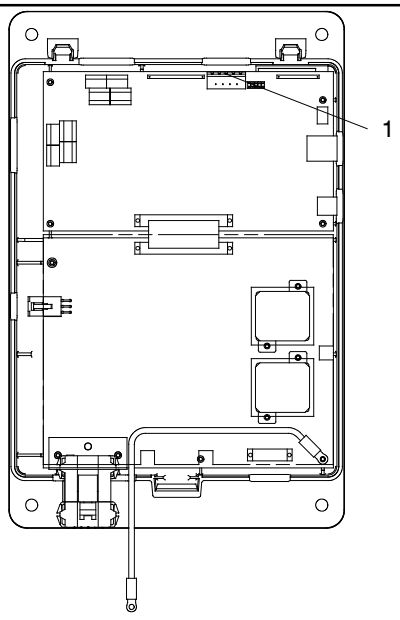
Set the controller's current time and date after installing the battery. See the transfer switch operation and installation manual for instructions.

4.3.4 Powering Controller Directly (Service Kit GM52407)

On occasion it is necessary to supply 120 VAC power directly to the controller for testing. Service Kit GM52407 contains a cable with a transformer to supply power to the controller from a 120 VAC wall outlet. Disconnect the controller from the transfer switch. Disconnect the I/O module assembly (if equipped) and connect the cable to the controller's P16 connector. See Figure 4-6.

The cable can also be connected to the I/O module assembly, if desired. Plug the cable into a 120 VAC wall outlet to power the controller during testing.

Note: Do not connect 120 VAC power to any other location on the controller.



1. Connect service kit power cable to controller connector P16 (I/O module connection)

Figure 4-6 Service Kit GM52407 Connection (controller cover removed for illustration only)

4.4 System Test

Use the system test feature to:

- Start and run the generator set, or
- Simulate a preferred source failure, resulting in a transfer to the standby source.

A password is required to activate the system test, ensuring that only authorized personnel can start a test. Pressing the Test pushbutton signals the controller to initiate the system test sequence.

An Auto-Loaded test executes for a set length of time and then ends automatically. Press the End Test pushbutton to end a Loaded or Unloaded test. Time delays will execute as programmed after the end test button is pressed. Pressing the End Delay button will end the currently displayed time delay.

To check the source voltage and frequency while a test is running, press the Main button. Press the Test button to return to the test sequence screens.

During a system test, if the emergency source becomes unavailable based on its preset operating parameters, the fail to acquire standby signal is indicated immediately, and the test is terminated. If the contactor is in the standby position, it transfers immediately to the preferred position.

4.4.1 Unloaded System Test

When an unloaded test is initiated, the controller immediately signals the generator to start, without waiting for time delay engine start to timeout. The contactor does not change position during an unloaded test, but if the normal source should fail, the contactor will transfer to the emergency source.

4.4.2 Loaded System Test

A loaded test actually simulates a preferred source failure, except that the engine start time delay is bypassed. The generator set is signaled to start immediately upon test activation. Load control signals are issued prior to transfer with their associated time delays. Since the loaded test transfer will be between two live sources, the in-phase monitor will be activated if it is enabled.

If the preferred source is lost during a loaded test with the contactor in the standby position, the test will continue to be active, even on restoration of preferred. If the standby source is lost and the preferred source is available, the test will be terminated, and the transfer switch will immediately transfer to the preferred source position, bypassing all time delays except the off-position requirements in a programmed-transition system.

When a loaded test is terminated normally, the retransfer sequence operates as though the preferred source has been restored after a failure. All time delays will be executed and an in-phase transfer will occur if enabled.

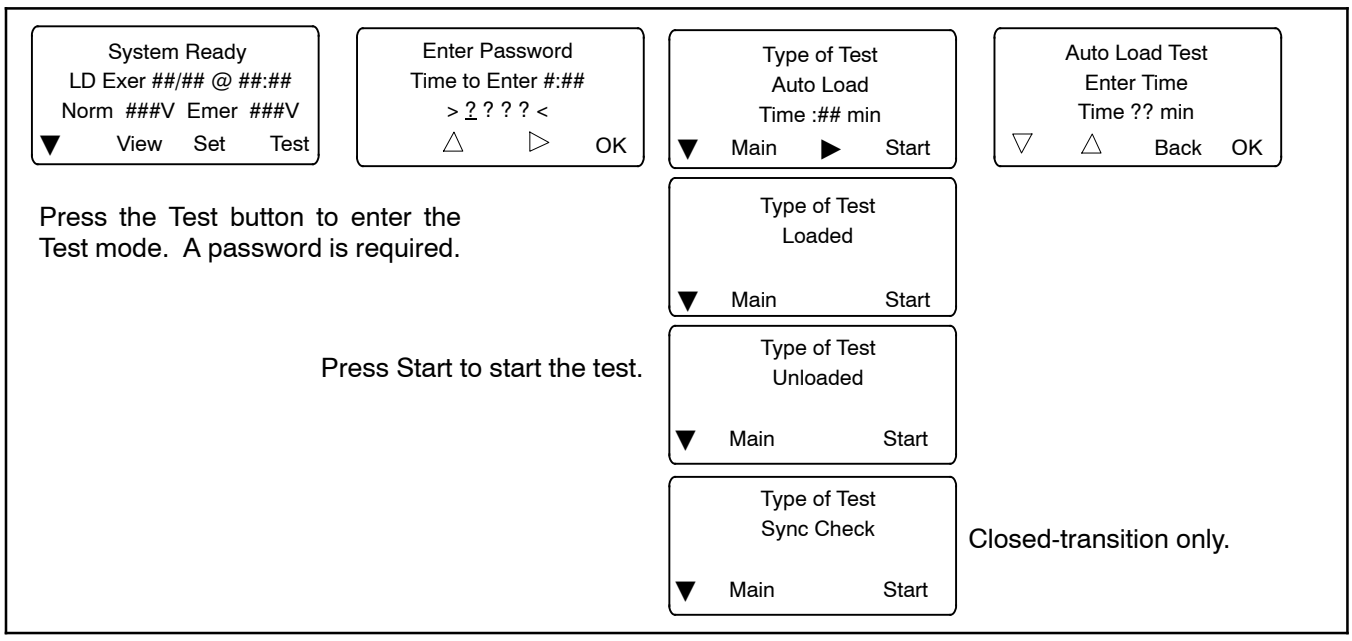


Figure 4-7 Test Screens

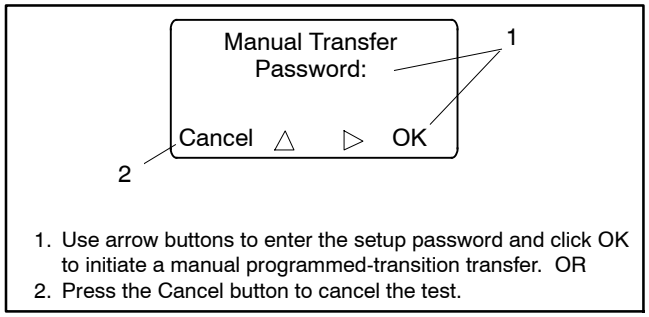
4.4.3 Closed-Transition Loaded Test

When a loaded test is initiated on a closed-transition model, the generator set is signaled to start and the controller monitors the sources for synchronization. The load is transferred when the sources are synchronized.

If the sources do not sync before the Fail to Sync time delay expires, the programmed-transition override function operates.

- If the override function is set to Automatic, a programmed-transition transfer will occur when the Fail to Sync time delay expires. The contactor stops in the OFF position for the length of the off-to standby time delay before proceeding to transfer to the standby source.
- If the override function is set to manual, the user can either initiate a programmed-transition type transfer (setup password required) or cancel the test sequence. See Figure 4-8. If neither action is taken, the controller will continue to check for synchronization and transfer if the sources synchronize.

See TP-6714, MPAC™ 1500 Controller Operation Manual, for instructions to set the programmed-transition override function.

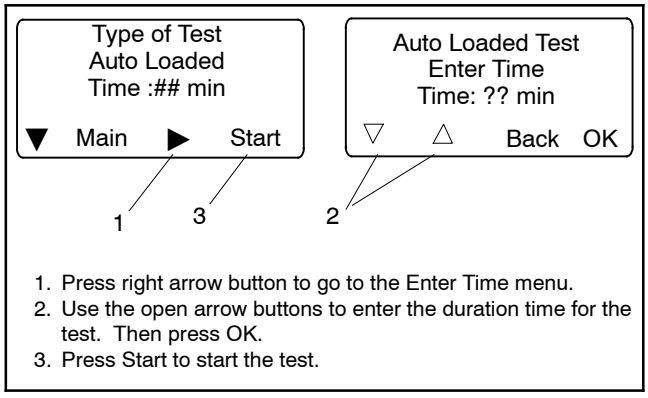


1. Use arrow buttons to enter the setup password and click OK to initiate a manual programmed-transition transfer. OR
2. Press the Cancel button to cancel the test.

Figure 4-8 Manual Transfer Screen for Programmed-Transition Override

4.4.4 Auto-Loaded System Test

The auto-loaded test feature is a timed loaded test. The auto-loaded time delay determines how long after the transfer to standby to terminate the test and transfer back to the preferred source. The time is defaulted to 30 minutes and can be adjusted from 1 minute to 60 minutes.



1. Press right arrow button to go to the Enter Time menu.
2. Use the open arrow buttons to enter the duration time for the test. Then press OK.
3. Press Start to start the test.

Figure 4-9 Auto Loaded Test Menus

4.4.5 Sync Check (closed-transition)

On closed-transition models, the Sync Check allows a test of the synchronization of two available sources without initiating a transfer. Navigate to the Type of Test, Sync Check menu and press the Start button to begin the test. The controller displays *Syncing* during the test, and the phase angle difference is shown between two arrows. For example, > 10 < indicates that the sources are 10 degrees out of phase. The arrows move closer together as the sources approach synchronization. When the sources synchronize, the controller indicates *Synced* and continues to monitor the source synchronization. The load is not transferred. Press the End Test button to end the test.

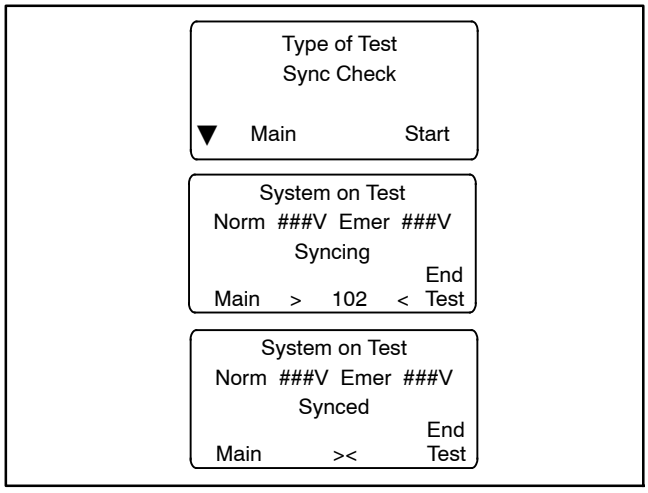


Figure 4-10 Sync Check Screens

4.4.6 Test Procedure

Use the following procedure to run a test to check the transfer switch operation. Watch the LEDs on the controller's user interface as the time delays run and Source E becomes available when the generator set starts. For a loaded test, watch the position LEDs to verify that the ATS transfers the load.

The test sequence simulates a loss of the normal source, starts the generator set, and transfers the load to the emergency source (loaded test), executing all time delays that are set up to operate during a loss of the normal source. Pressing the End Delay button during the test sequence ends the time delay shown on the screen.

Press the End Test button to end the test sequence. The transfer switch transfers the load back to the normal source and removes the engine start signal, executing all programmed time delays.

Refer to Figure 4-12 and Figure 4-13 for flowcharts showing the test sequence of operation without and with load. Load control time delay settings may affect the operation sequences.

Note: If the standby source fails during a test, the ATS will immediately attempt to transfer to the preferred source.

Check the preferred source selection. The test procedure assumes that Source N is the preferred source.

If the transfer switch is equipped with a supervised transfer switch, verify that it is set to the Auto position.

Note: Close and lock the enclosure door before starting the test procedure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Automatic Operation Test Procedure

1. Check the controller LED indicators to verify that the Position N and Source N Available indicators are lit.

2. Verify that the generator set master switch is in the AUTO position.

3. Refer to Figure 4-7. From the main screen, press the Test button. Enter the test password when prompted and press OK.

4. Press the down arrow button to display Type of Test Loaded.

5. Press the Start button.

6. Verify that the generator set starts and the Source E Available LED lights.

7. Verify that the switch transfers the load to Source E. Observe the controller LEDs and display as the time delays execute and the load is transferred.

   a. Standard-Transition Models: After the preferred-to-standby transfer time delay, verify that the Position N LED turns off and the Position E LED lights, indicating that the switch has transferred the load to Source E.

   b. Programmed-Transition Models: After the preferred-to-off time delay, verify that the Position N LED turns off. After the off-to-standby time delay, check that the Position E LED lights, indicating that the switch has transferred the load to Source E.

   c. Closed-Transition Models: See Section 4.4.3. After the preferred-to-standby time delay, the controller monitors the sources for synchronization. When the sources are in sync, the ATS transfers the load to Source E and the Position E LED lights. Both sources will be connected for less than 100 milliseconds before Source N is disconnected and the Position N LED turns off.

      If the sources do not synchronize before the fail to sync time delay expires, operation depends on the programmed transition override setting. If automatic override is enabled, the ATS will transfer the load using a programmed-transition transfer. If automatic override is not enabled, the ATS will continue to monitor the source synchronization and transfer when/if the sources synchronize. The operator can initiate a programmed-transition transfer (password required) or cancel the transfer.

8. Press the End Test button.

9. Verify that the switch transfers the load back to Source N.

   a. Standard-Transition Models: After the standby-to-preferred time delay, verify that the Position E LED goes out and the Position N LED lights, indicating that the switch has transferred the load to Source N.

   b. Programmed-Transition Models: After the standby-to-off time delay, verify that the Position E LED goes out. After the off-to-preferred time delay, check that the Position N LED lights, indicating that the switch has transferred the load to Source N.

   c. Closed-Transition Models: See Section 4.4.3. After the standby-to-preferred time delay, the controller monitors the sources for synchronization. When the sources are in sync, the ATS transfers the load to Source N and the Position N LED lights. Both sources will be connected for less than 100 milliseconds before Source E is disconnected and the Position E LED turns off.

      If the sources do not synchronize before the fail to sync time delay expires, operation depends on the programmed transition override setting. If automatic override is enabled, the ATS will transfer the load using a programmed-transition transfer. If automatic override is not enabled, the ATS will continue to monitor the source synchronization and transfer when/if the sources synchronize. The operator can initiate a programmed-transition transfer (password required).

10. After the engine cooldown time delay expires, the engine start signal is removed. Verify that the generator set stops.

    Note: The generator set may have an engine cooldown time delay that causes the generator set engine to run after the transfer switch engine start signal is removed.

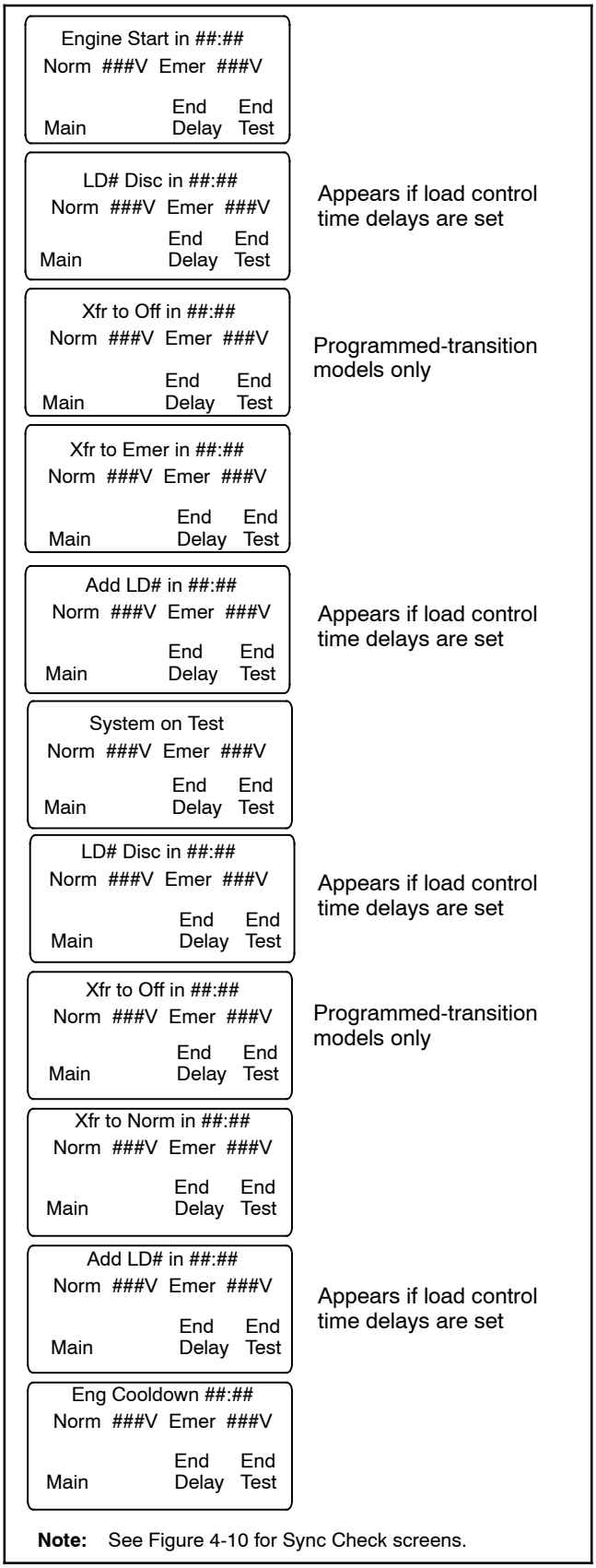


Figure 4-11 Test Sequence Screens

4.4.7 Test Sequence

The following figures show the steps in the normal test sequences. Load control time delay settings may affect the operation sequences.

- Figure 4-12: unloaded test sequence for all models
- Figure 4-13: loaded test for standard and programmed-transition switches
- Figure 4-14: loaded test for closed-transition switches

Faults such as failure to acquire the standby source or failure to transfer will affect the test sequence. Refer to the troubleshooting tables and flowcharts in Section 2 for instructions to diagnose and correct faults.

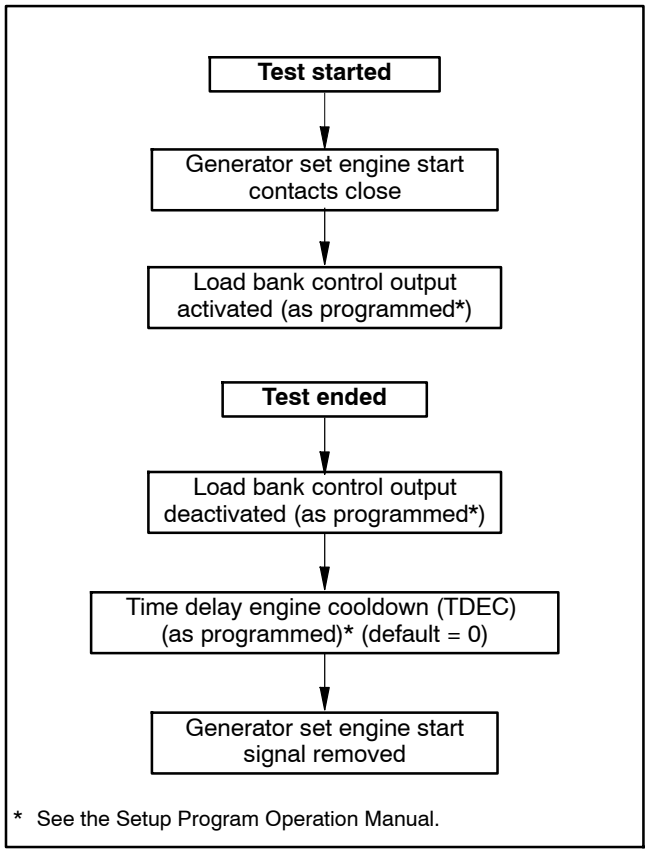


Figure 4-12 Test Without Load Sequence

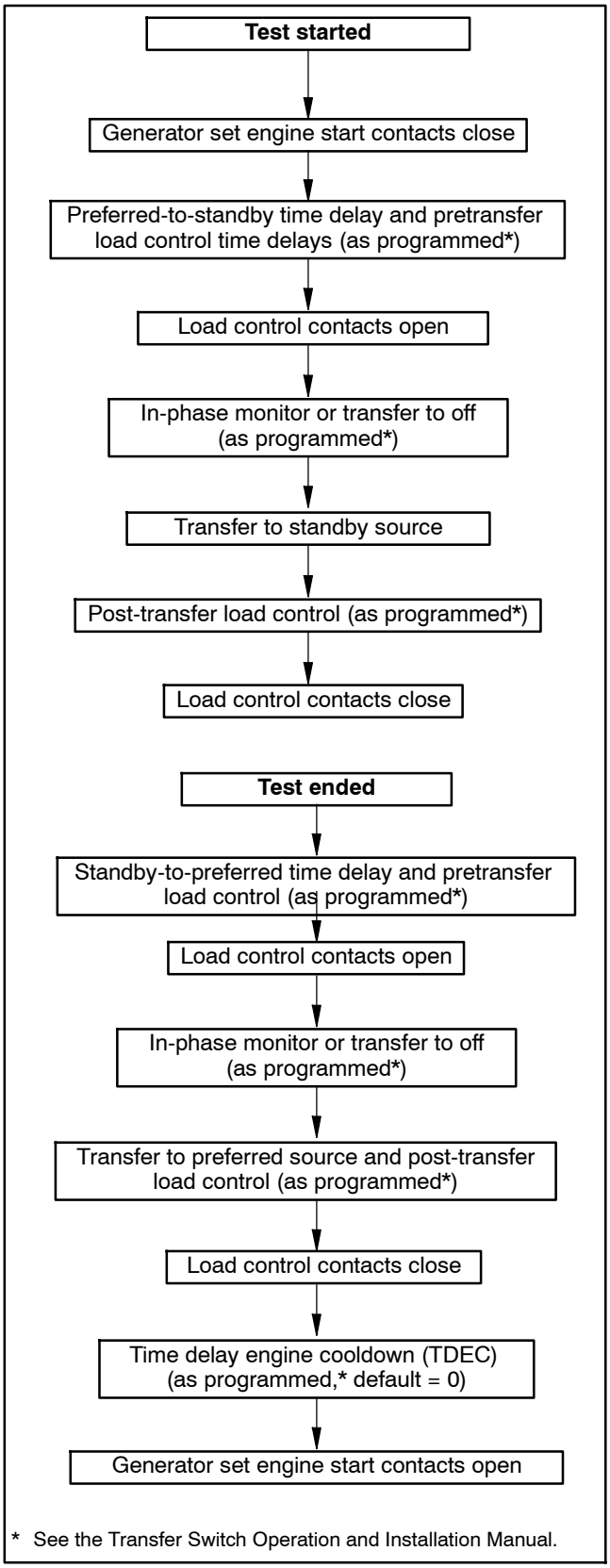


Figure 4-13 Loaded Test Sequence, Standard and Programmed-Transition

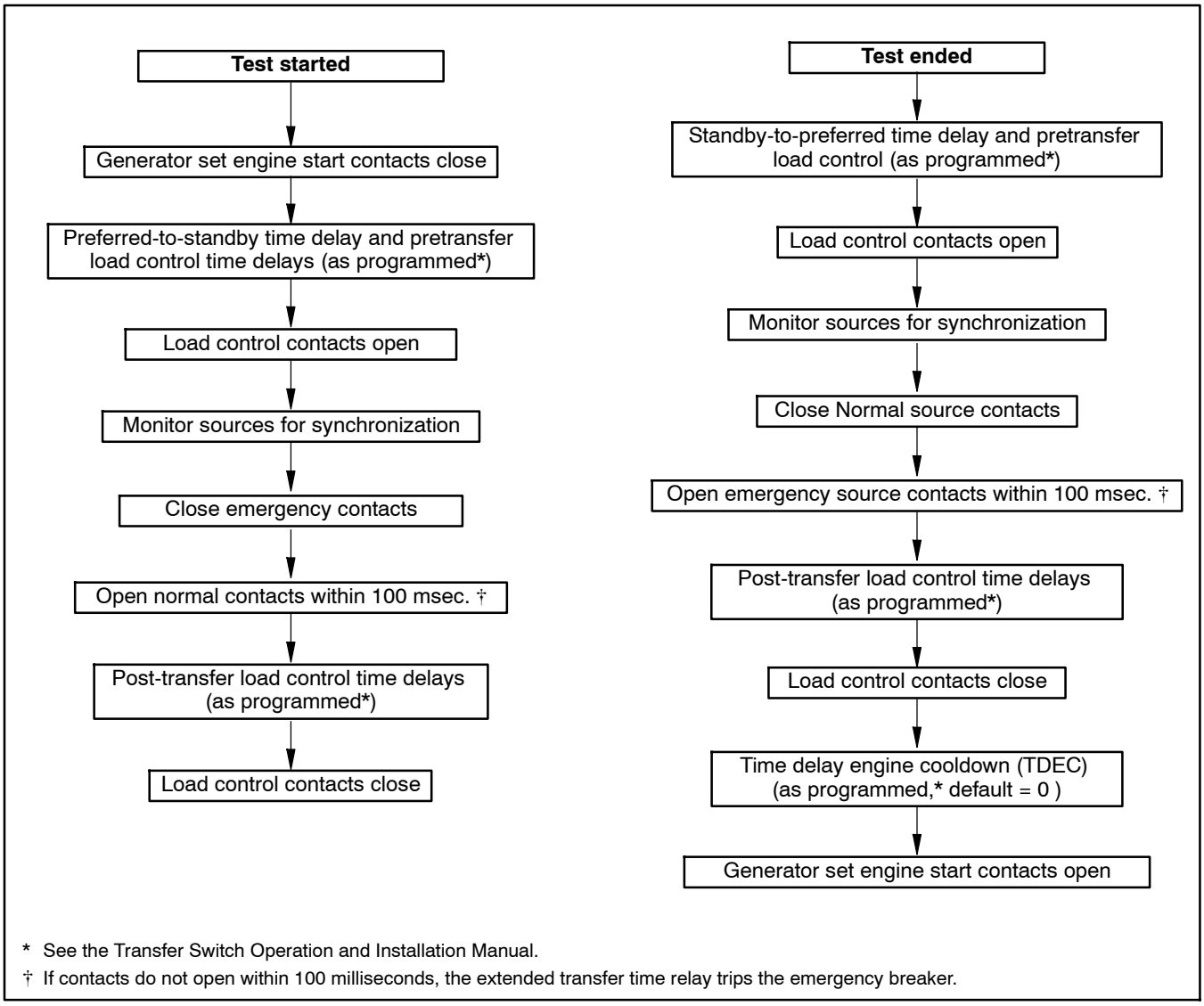


Figure 4-14 Loaded Test Sequence, Closed-Transition

4.5 Exercise

4.5.1 Exercise Scheduling

Schedule exercise runs through the Set Exercise screen. See the transfer switch operation and installation manual for instructions. To run the generator set at a time other than a scheduled exercise sequence, use the Test function. See Section 4.4 for instructions.

When a scheduled exercise is running, the screens shown in Figure 4-15 appear. Press Main to return to the main screen, if desired.

4.5.2 Stopping an Exercise

Press the End button to end the exercise sequence before the scheduled stop time, if necessary.

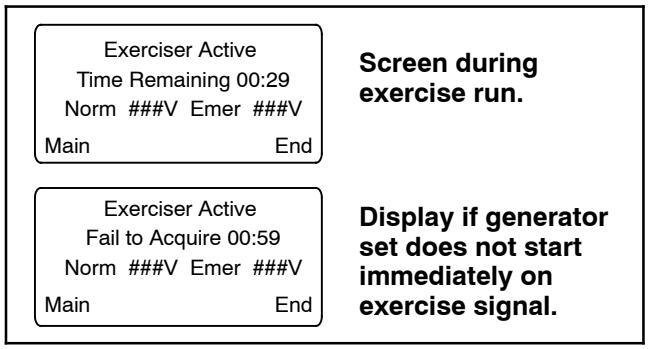


Figure 4-15 Exercise Sequence Screens

4.5.3 Exerciser Sequence

Figure 4-16 and Figure 4-17 illustrate the exercise sequences for standard and programmed-transition switches.

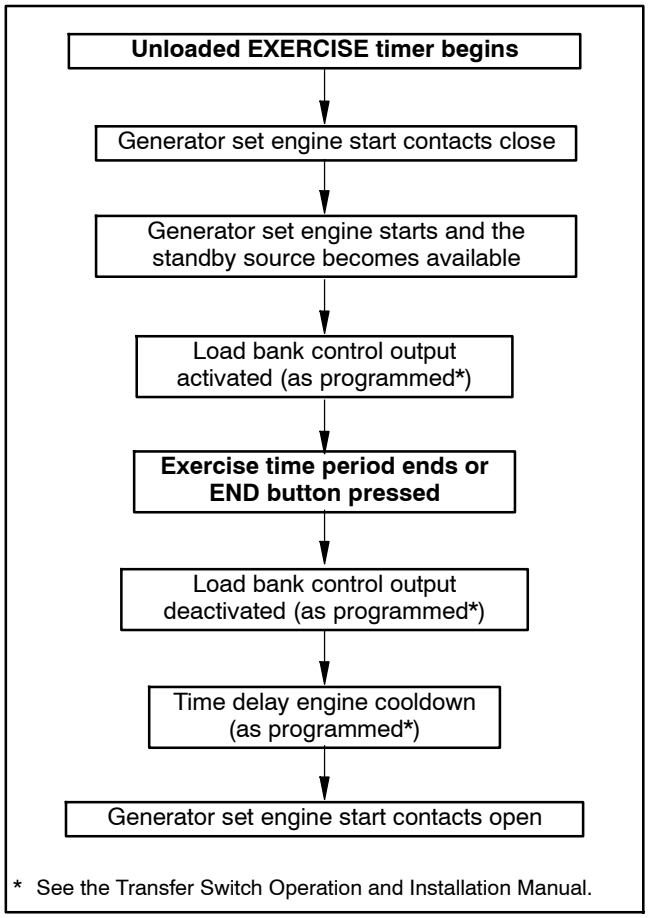


Figure 4-16 Exercise without Load Sequence

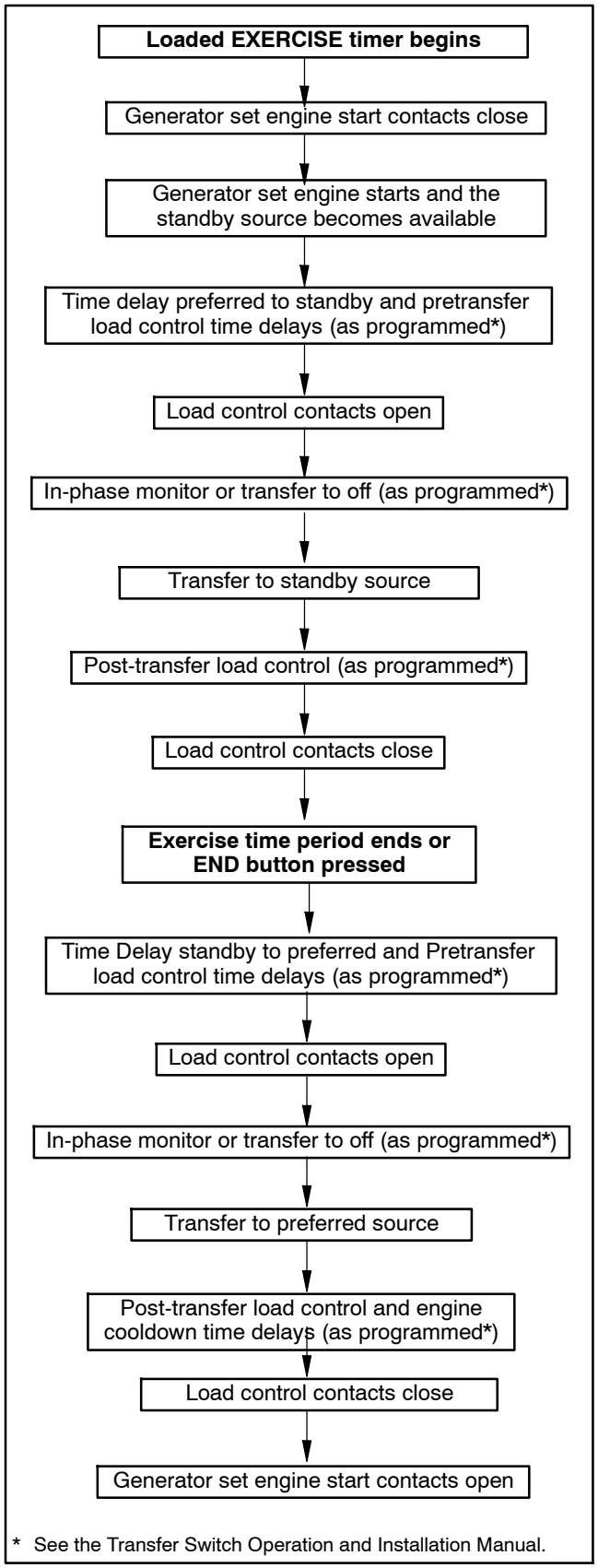


Figure 4-17 Exercise with Load Sequence, standard and programmed-transition

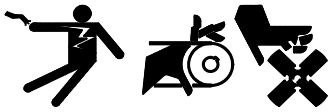
4.6 Engine Start Troubleshooting

The engine start contacts should close when the Normal source is lost and when the ATS controller starts a test or exercise sequence. The engine start contacts are labeled with a decal. Check the operation/installation manual or the dimension drawing for the contact location, if necessary.

Use the following procedure to check for continuity across the engine start contacts when the Normal source is disconnected and during a test sequence. Allow time for the engine start and engine cooldown time delays during the test. Refer to the operation manual for the applicable time delays.

Be sure to read and follow the safety precautions when performing the test procedure.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

Engine Start Test Procedure

Start with the transfer switch in the Source N position.

1. Connect an ohmmeter or test lamp across the engine start contacts at one of the following locations:

   a. Pins 8 and 9 of connector J1 (the transfer switch harness-to-controller connection). See Figure 4-18.

   b. The engine start contacts on the transfer switch contactor or field-connection terminal block. See the decal on the transfer switch or the transfer switch operation and installation manual for the engine start contact location.

   c. The generator set engine start leads. See the generator set documentation for engine start lead identification and location.

2. Disconnect Normal power from the transfer switch and verify that the engine start contacts close.

3. Reconnect Normal power to the transfer switch and verify that the engine start contacts open after applicable time delays.

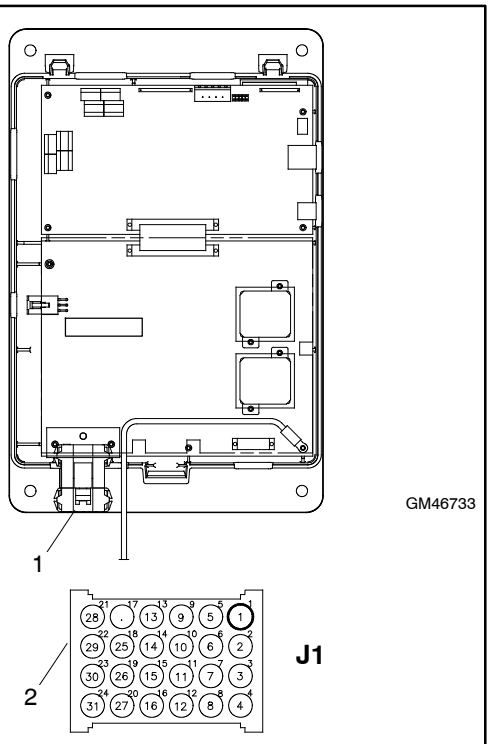
4. If the engine start contacts do not operate as indicated in steps 2 and 3 when power is disconnected and reconnected, replace the ATS controller's power board. See Section 4.13.

5. Press the Test button to initiate a test sequence and verify that the engine start contacts close.

6. Press the End button to end the test. Verify that the engine start contacts open after the engine cooldown time delay (which may be set to zero).

7. If the ATS engine start contacts do not close during the Test Procedure, replace the ATS controller's logic board. See Section 4.13.

If the generator set engine does not start, check the engine start connections to the generator set. Verify that the generator set master switch is in the AUTO position. Troubleshoot the generator set if the engine start connections are good but the engine does not start.



1. Transfer switch harness connection, P1
2. Connector J1 pin numbering

Figure 4-18 Transfer Switch Harness-to-Controller Connection

4.7 Controller DIP Switches

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Two DIP switches on the main logic board are assigned functions. Switches 3 and 4 are not used. The DIP switches are located on the controller's main logic board on the inside of the enclosure door. Figure 4-19 shows the locations of the switches on the controller circuit board. It is not necessary to remove the logic assembly cover to see or adjust the DIP switches.

SW1-1, Password Disable. Closing the password disable DIP switch SW1-1 disables the setup password and resets it to the factory defaults. When the switch is closed, system setup and programming is allowed without the need to enter a password.

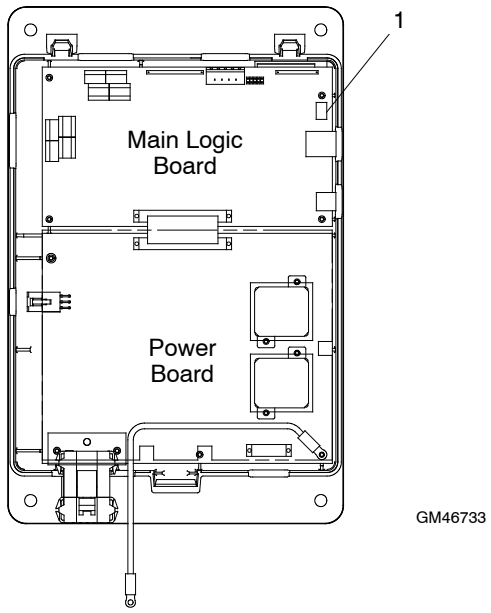
Note: Disable the setup password only during service unless the transfer switch is installed in a secure location.

Closing and then reopening DIP switch SW1-1 resets the password to the default value, 0000.

The test password is not affected by this DIP switch. Use the Reset Data screen to disable the test password.

SW1-2, Maintenance. The maintenance DIP switch inhibits transfer during ATS service. When this switch is in the closed position, contactor functions are disabled. The Not in Auto LED flashes red and the message Maintenance Mode is indicated on the LCD screen. In addition, a programmable digital output is turned on and an entry in the event log indicates that the maintenance mode has been activated. System monitoring and setup are allowed while in maintenance mode.

Close and lock the enclosure door before energizing the transfer switch.



1. DIP switches SW1

Figure 4-19 DIP Switch Location (cover removed for illustration only)

4.8 Calibration

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically.
(600 volts and under)

The transfer switch controls are calibrated at the factory and should not require recalibration in the field. However, if recalibration is necessary, measure the source voltages as instructed in Section 2.4.2, record the measured values, and use the Setup Screen-Calibration to enter the measured values. See Figure 4-20.

The current sensing accessory is required in order for the transfer switch to measure and display the current values. Use a clamp-on current sensing meter to measure the current and enter the measured values through the Setup Screen–Calibration shown below.

4.9 Position Microswitch Test

Disconnect power to the transfer switch and use an ohmmeter or test lamp to check the operation of the position microswitches. Manually operate the switch and check for continuity across pins 10 and 13 of the connector P1 for Source E and pins 10 and 14 for Source N.

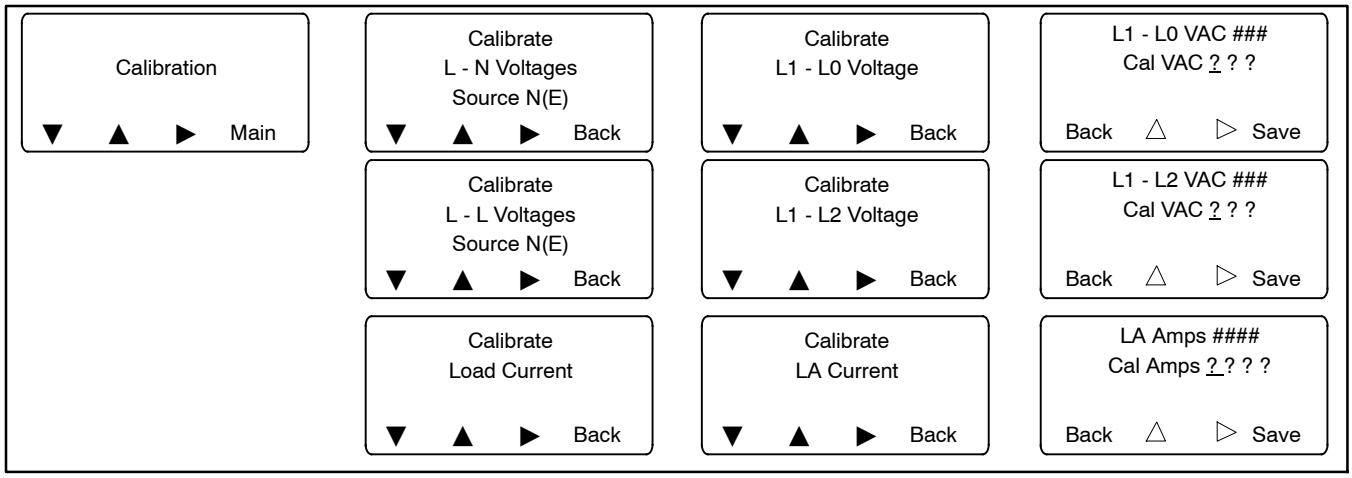
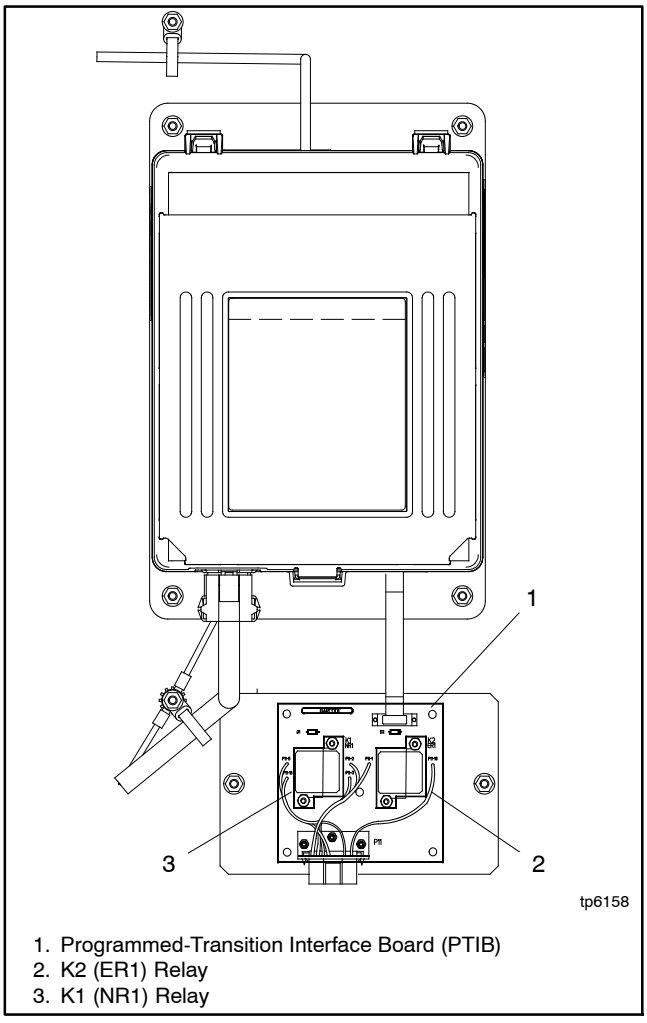


Figure 4-20 Calibration

4.10 Programmed-Transition Interface Board

The programmed-transition interface board (PTIB) contains two replaceable 10-amp relays, K1 (NR1) and K2 (ER1). See Figure 4-21. Refer to the operation sequence diagrams in Section 3.4 and to the schematic diagram provided with the transfer switch to troubleshoot the relays.



1. Programmed-Transition Interface Board (PTIB)
2. K2 (ER1) Relay
3. K1 (NR1) Relay

Figure 4-21 Programmed-Transition Interface Board

4.11 File Transfer through USB Port

The Universal Serial Bus (USB) port on the main logic board allows file transfer to and from a USB mass storage device (removeable drive). Figure 4-22 shows a typical device. The removeable drive must be compatible with the USB 2.0 and USB Mass Storage Device Class specifications.

The controller application code can be updated through the USB port. Parameter settings, event history, and other information files can be saved to the storage device.

The controller recognizes the types of files shown in Figure 4-23.

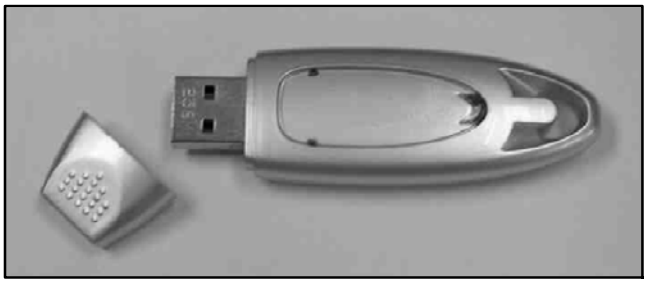


Figure 4-22 Typical Mass Storage Device

4.11.1 Configuration files

The configuration (.cfg) file contains the transfer switch settings, including:

- System setup
- Source setup, including voltage and frequency pickup and dropouts
- Time delays
- Inputs and outputs
- Communications settings
- Calibration factors

Configuration files from one transfer switch can be saved to a mass storage device and then loaded onto other transfer switches for quick setup of multiple switches. Serial numbers and descriptions entered through Monitor III software (or other Modbus application) are not changed by downloading configuration files to a transfer switch.

Check the settings and run a test sequence after loading the configuration file to verify correct operation. Refer to the ATS operation and installation manual for instructions to view settings. See Section 4.4 for instructions to run a test.

4.11.2 Loading Settings when Controller is Replaced

If the controller needs to be replaced, the configuration file from the old controller (if available) can be loaded onto the new controller for quick setup.

Note: Operation problems can be caused by incorrect controller settings. Do not load the old configuration file onto the new controller unless you are certain that all the settings in the file are correct.

Note: When replacing the ATS controller, record the contactor and ATS serial numbers from the old controller before removing it, or from the ATS decals.

Serial numbers are not transferred through the configuration file and cannot be entered through the controller's user interface. Use Monitor III (or a customer-provided Modbus driver designed for the system) to enter the contactor and ATS serial numbers after the new controller is installed. A distributor-level password is required to enter serial numbers. Refer to the Monitor III Operation Manual or the Modbus Protocol Manual for instructions, if necessary. Do not attempt to change the controller serial number.

File name	Description	Size (approx.)	Download to Control	Upload to USB
MPAC1500v###.bin	Controller application program	950 KB	X	
MPAC1500_#######.cfg	Configuration (parameter settings)	3 KB	X	X
present*yymmdd*.his	Event history	varies		X
alarm_settings.alm	Common alarms	1 KB		X
MPAC1500_cal.cal	Calibration	1 KB		X
DataLogyyddmmhhmmss.csv *	Data log. File name includes date and time.			X
MinMax.csv *	Minimum/maximum values	1 KB		X
SyncDataLog.csv *	Source synchronization data from sync test (closed-transition only)			X
* MPAC™ 1500 controllers with application code version 2.0.0 or later can create these data files. See Section 2.3 and TP-6714.				

Figure 4-23 File Types

4.11.3 Data Log Files

Data log files are available on MPAC™ 1500 controllers with version 2.0.0 or later application code. The data log files can be viewed using spreadsheet software and used to help troubleshoot ATS operation problems. See Section 2.3. See TP-6714, MPAC™ 1500 Operation Manual, for detailed instructions to create the data files.

4.11.4 File Transfer

The USB Access screen opens automatically when a device is connected to the controller's USB port. See Figure 4-24. Select Upload or Download as described below.

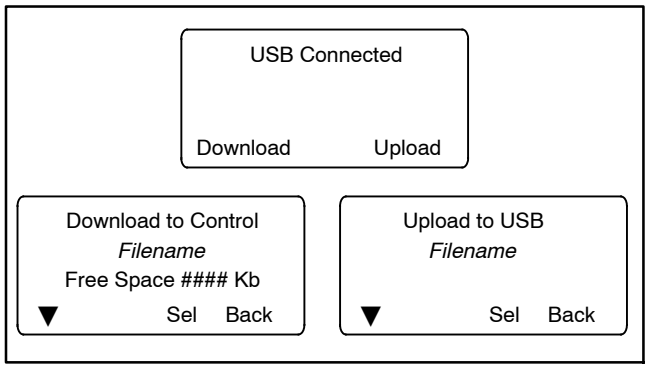


Figure 4-24 USB Access Screens

Procedure to Transfer Files

1. Insert the USB mass storage device into the USB port on the controller's main logic board. See Figure 4-5 for the port location.

2. Press the Download button to load new files from a memory device to the controller. Or, press the Upload button to load files from the controller through the USB port to a memory device.

3. Use the down button to scroll through the list of available files.

4. When the desired file is displayed, press the Sel button to select the file and start transferring the file.

   Note: Do not disconnect the device from the USB port during file transfer.

   A message on the display indicates when file transfer is complete.

5. Wait for the message indicating that file transfer is complete before removing the mass storage device from the USB port.

4.12 Controller Application Program

The manufacturer occasionally releases new versions of the controller application code. The new code can be downloaded from the Tech Tools section of the KOHLERnet website (www.Kohlernet.com) and loaded onto the controller through the USB port.

Program Loader software is *not* required for loading code onto the 1500 controller.

To download the latest version of the controller application code:

1. Use your SecurID to go to www.Kohlernet.com and click on Tech Tools.

2. Click on Software and then ATS Controllers.

3. Click on MPAC™ 1500 controller and then click on the link to download the latest software version. The file name will be of the form MPAC1500v####.bin, with v#### indicating the version number.
   For example, MPAC1500v105.bin contains version 1.05 of the application code.

4. Copy the file onto a mass storage device through the computer's USB port.

5. Load the application code file onto the controller as described in Section 4.11.4, File Transfer.

Loading new code does not change the system settings. After loading a new version of code, check the system settings, input/output assignments, time delays, and other parameters to verify that they are correct for the application.

After loading new code, run a loaded test to verify that the system operates correctly. See Section 4.4, System Test.

4.13 Controller Replacement

Always check for open switches or circuit breakers, loose connections, or faulty wiring before replacing any parts. Replace the controller only if the troubleshooting and test procedures in this manual indicate conclusively that the controller is damaged or inoperative.

The controller contains two circuit boards, the logic board and the power board, which can be replaced individually. The entire controller and plastic housing can also be obtained as a complete assembly. Save the old controller's plastic cover, which includes the transfer switch nameplate, for use with the new controller.

4.13.1 Controller Configuration (Settings)

New controllers are shipped with the factory default settings for the system settings, including voltage, frequency, number of phases, phase rotation, and other user-adjustable settings. After installation, the system parameters must be set for the application.

If the old controller is operable, it may be possible to save the configuration file (MPAC1500_######.cfg) to a USB storage device before removing the controller from the transfer switch. The configuration file contains the system parameter settings, including system setup, source setup, time delays, input and output assignments, and communications settings. The configuration file can be loaded onto the new controller after it is installed. See Section 4.11 for instructions to download and upload files through the controller's USB port.

Note: Operation problems can be caused by incorrect controller settings. Do not load the old configuration file onto the new controller unless you are certain that all the settings in the file are correct.

If the configuration settings file is not available, use the controller user interface to check and adjust the system settings for the application. Refer to the transfer switch operation and installation manual for instructions.

4.13.2 Circuit Board and Electronic Component Handling

Improper removal, installation, transportation, storage, or service can damage sensitive electronic components. Observe the following guidelines to prevent damage when working with circuit boards or electronic components.

Circuit Board and Electronic Component Handling

- Keep circuit boards or electronic components inside the antistatic, cushioned factory packaging until installation.
- Store circuit boards or electronic components in a clean environment away from moisture, vibration, static electricity, corrosive chemicals, and solvents.
- Disconnect all power sources before removing or installing circuit boards or electronic components.
- Wear an approved, grounded, antistatic wrist strap when handling circuit boards or electronic components.
- Carefully hold the circuit board by its edges and not by any of its components or electrical contacts.
- Do not drop the circuit board or electronic components.
- Do not bend the circuit board, electronic components, or electronic component leads.
- Do not strike the circuit board or electronic components using or against a hard object.
- Clean dusty or dirty circuit boards with a vacuum cleaner or soft, dry brush.
- Never attempt circuit board repairs, adjustments, or modifications other than replacing plug-in service parts or performing manufacturer-approved installation or service procedures.

4.13.3 Replacement Procedure

Before removing the old controller, refer to Section 4.13.1. It may be possible to download the system settings from the controller to a file that can later be loaded onto the new controller for more efficient system setup.

Disconnect power to the transfer switch before starting to disconnect the controller. Observe the following safety precautions to avoid injury or equipment damage.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Controller Replacement Procedure

1. Move the generator set master switch to the OFF position.
2. Disconnect the generator set engine starting battery, negative (–) lead first.
3. Disconnect power to the transfer switch by opening switches or circuit breakers to the switch.

Remove the old controller.

4. Open the transfer switch enclosure.
5. Check the voltage at the source lugs to verify that the power is off.
6. Disconnect the transfer switch harness at the P1 connector at the bottom of the controller. See Figure 4-5.
7. Disconnect the programmed-transition board, if equipped, from the controller at connector P2.
8. Disconnect the controller ground wire at the ring terminal on the enclosure door.
9. Disconnect the accessory module assembly at connector P16 at the top of the controller, if connected.
10. Remove the plastic cover from the old controller and save it to install on the new controller assembly.

    Note: The cover includes the transfer switch nameplate, which must remain with the transfer switch.

    To remove the cover, depress the latch at the bottom of the cover. Swing the cover open on its hinges and lift it off.

11. Label and then disconnect any input and output leads connected to terminal strip TB1 on the logic board. See Figure 4-5.
12. Label and then disconnect the RS-485 communication cable from terminal strip TB2 on the logic board (if connected). See Figure 4-5.
13. Disconnect any other communications connections to the ethernet port or the USB port. See Figure 4-5 for connector identification.
14. Disconnect the current sensing accessory at connector P3, if equipped.

15. **To replace the entire controller assembly:**

    a. Support the controller assembly and remove four nuts at the corners.

    b. Carefully remove the entire controller assembly, including the user interface panel, which is part of the assembly.

    c. Replace the entire assembly with a new controller. Secure the four nuts at the corners and tighten them to no more than 6.8 Nm (5 ft. lb. or 60 in. lb.) torque.

    d. Proceed to step 18.

16. **To replace the logic circuit board:**

    a. Disconnect the ribbon cable connecting the two circuit boards.

    b. Disconnect the ribbon cables to the user interface at connectors P14 and P17.

    c. Remove the four mounting screws near the corners of the board and pull the circuit board straight off the carrier.

    d. Set the new circuit board in place and secure with four mounting screws.

    e. Reconnect the ribbon cables.

    f. Proceed to step 18.

17. **To replace the power board:**

    a. Disconnect the ribbon cable connecting the two circuit boards.

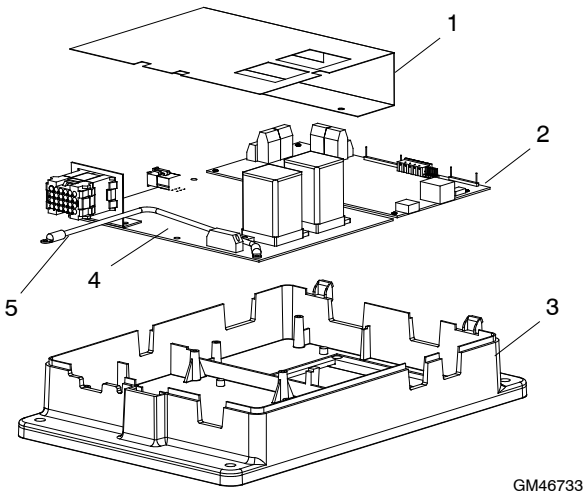
    b. Remove the three mounting screws plus the P1 connector bracket screws and four screws securing the power relays must be removed.

    c. Set the new power board and insulating cover in place. Install the mounting screws, making sure to reinstall the ground lead and the P1 connector with mounting bracket.

    Note: Be sure to reinstall the insulating cover for the power board. See Figure 4-25.

    d. Reconnect the ribbon cable between the boards.

    e. Proceed to step 18.



1. Insulator, power board
2. Logic board
3. Carrier
4. Power board
5. Ground lead

Figure 4-25 Controller Circuit Board Assembly

Reconnect the controller assembly.

18. Connect the controller ground wire to the terminal on the enclosure door. See Figure 4-5.

19. Connect the programmed-transition board, if equipped, to the controller at connector P2. See Figure 4-5.

20. Connect the I/O leads to logic board terminal strip TB1, using the labels attached in step 11 to connect the leads to the appropriate terminals. See Figure 4-5.

21. Connect RS-485 communication cable, if used, to logic board terminal strip TB2, using the labels attached in step 12 to connect the leads to the appropriate terminals. See Figure 4-5.

22. Connect the accessory module assembly (if equipped) at connector P16.

23. Reconnect any other items that were disconnected from the controller. See Figure 4-5 for connector identification.

24. Connect the transfer switch harness to the connector on bottom of the controller.

25. Check the controller's DIP switch settings and adjust them if necessary. See Section 4.7, Controller DIP Switches.

26. Close and lock the transfer switch enclosure door.

27. Reconnect power to the transfer switch by closing circuit breakers or switches.

    Note: Power to the controller is required in order to check and adjust the controller settings. If all the power sources are generator sets, reconnect the normal source generator set engine starting battery and move the generator set master switch to the AUTO position.

Set up the new controller.

28. If the configuration settings (.cfg) file for the transfer switch was downloaded from the old controller, load it onto the new controller through the USB port. See Section 4.13.1. See Section 4.11 for instructions to load the file.

29. If the configuration settings file cannot be loaded through the USB port, use the controller user interface to check and adjust the system settings for the application. Refer to the transfer switch operation and installation manual for setup instructions.

    Note: Contactor and ATS serial numbers can only be entered through Modbus using Monitor III or a customer-supplied Modbus driver and the distributor-level password.

Check settings and verify operation.

30. Check the system settings and adjust them, if necessary. Check the system voltage, frequency, number of phases, phase rotation, time delays, and other user-adjustable settings. Refer to the transfer switch operation and installation manual for instructions.

31. Reconnect the generator set engine starting battery, negative (–) lead last.

32. Move the generator set master switch to the AUTO position.

33. From the main screen, press the down arrow button and then press the LAMP TEST button to verify that all LEDs light.

34. Run a loaded test to check the system operation. See Section 4.4, System Test.

5.1 Introduction

This section contains test and service procedures for the following transfer switches.

- 30–200 amp Model KCS

Use the troubleshooting and test procedures in Sections 2 through 3 to diagnose problems before replacing parts. Use the instructions in this section if inspection, troubleshooting, or other test procedures reveal damaged or defective components that require replacement.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

5.2 Manual Operation

The service procedures in this section call for manual operation of the transfer switch. Refer to the instructions in this section to manually operate the switch. Verify that the power to the transfer switch is disconnected before operating it manually.

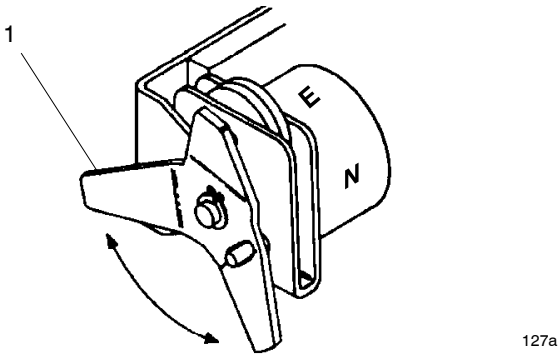
Note: A manual operation handle is provided on the transfer switch *for maintenance purposes only*. Do not use the manual operation handle to transfer the load with the power connected.

The 30–200 amp switches have a star-shaped handle for manual operation. The handle is not detachable.

Manual Operation Procedure

1. Verify that the power sources to the transfer switch are OFF.
2. Turn the attached handle to manually operate the transfer switch. See Figure 5-1. It should operate smoothly without any binding. If it does not, check for shipping damage or construction debris.

   Note: Do not attempt to rotate the U-shaped floating weight or permanent damage may occur.
3. Return the transfer switch to the Normal (or Source N) position.



1. Handle

Figure 5-1 ManuaL Operation Handle, 30–200 Amp Switches

5.3 Operator Coil Replacement

The following tools are needed for this procedure:

- Blade screwdriver
- Nutdriver, 5/16 in.
- Pliers
- Voltmeter

Note: Always check wiring and connections before replacing components.

Operator Coil Disassembly Procedure

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine starting battery charger, if installed; and disconnecting all generator engine start batteries, negative (–) leads first.

2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch.

3. Locate the coil assembly at the top left corner of the power switching device. See Figure 5-2.

4. Disconnect the rectifier:

   a. Locate the square rectifier mounted on the coil yoke or L-bracket.

   b. Note the connections and disconnect the coil leads and the control wires from the rectifier's push-on terminals.

5. Release the coil assembly. Use a screwdriver to pry the retaining ring out of the groove in the stub core, which extends through the steel L-bracket. Then use a 5/16 in. nutdriver to remove two hex-head screws from the front of the L-bracket.

6. Remove the steel L-bracket and slide the coil and coil washers off the core tube.

   Note: If the coil has burned out, also replace the core tube and core spring. These parts could be damaged from overheating.

7. Remove the core tube: Use a 5/16 in. nutdriver to remove three hex-head screws. Then remove the core tube, core tube retainer, and spacer ring (if used).

8. Remove the core spring from the core.

Operator Coil Assembly Procedure

Note: Lubricate new parts with lubrication kit GM24237.

1. Insert the stub core into the core tube.

2. Lubricate the new core tube and core spring. Apply the lubricant mixture to the inside of the new core, the new core spring, and the core.

3. Install the new core spring: Place the lubricated core spring onto the core shoulder.

4. Install the new core tube:

   a. Slide the core tube retainer onto the core tube.

   b. Place the core tube onto the core spring and core and press the core tube against the steel bracket.

   c. Use three hex-head screws with lock washers to secure the core tube retainer. Be sure that the stub core extends through the end of the core tube.

5. Install the new coil assembly: Slide the spacer ring, then the spring washer, two insulating washers, and the coil onto the core tube. The coil leads must be on the left and extend toward the operator mechanism.

6. Secure the coil assembly:

   a. Place the steel L-bracket onto the stub core and secure it with two hex-head screws.

   b. Use pliers to slide the retaining ring into the groove in the stub core to secure the stub core in the frame.

7. Replace the rectifier, if necessary: Remove the center screw to remove the old rectifier. Install the new rectifier so that the terminal with the red dot is on the upper left.

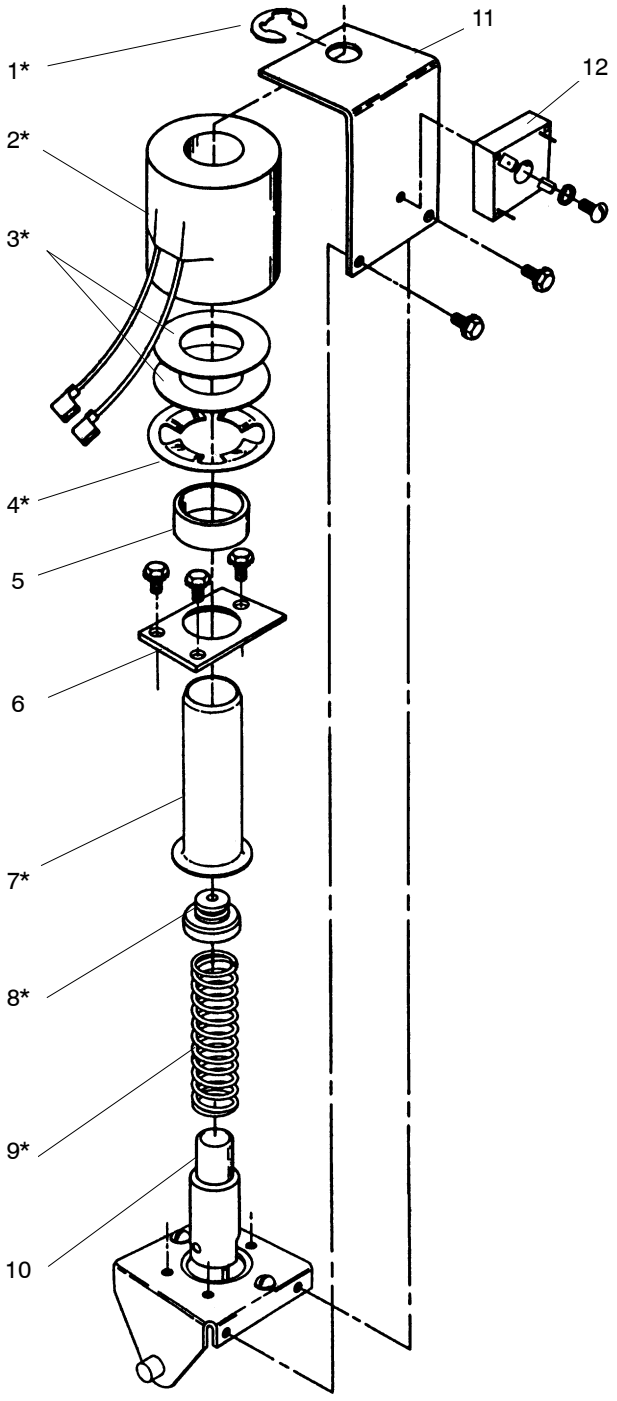
8. Reconnect the coil leads: Connect the coil leads to the rectifier's push-on terminals marked with red dot and no dot (DC + and – output).

9. Reconnect the rectifier: Connect the control wires (AC input) to the rectifier's push-on terminals marked with yellow dots.

10. Manually operate the switch: Use the manual operating handle to operate the switch to check the solenoid assembly. The action should be smooth, without any binding. If not, recheck the solenoid operator part alignment and lubrication. Return the switch to the normal position.

11. Reconnect power supplies to the transfer switch.

12. Reconnect the generator engine starting battery cables, negative (–) leads last; reconnect power to the generator engine starting battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator set may start and run until the ATS time delay engine cooldown (TDEC) expires.



1. Retaining ring*
2. Coil*
3. Spacer washers*
4. Spring washer*
5. Spacer ring
6. Core tube retainer
7. Core tube*
8. Stub core*
9. Core spring*
10. Core
11. L -bracket
12. Rectifier

* Parts included in coil kit

Figure 5-2 Coil Assembly for 30–200 Amp Switches

5.4 Main Contact Inspection

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine starting battery charger, if installed; and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch.
3. Remove the arc chutes. For each arc chute:
   a. Use a screwdriver to loosen the screws adjacent to the Emergency source terminal lugs.
   b. Slide or lift the arc chute retainer up to release the arc chute.
   c. Pull the arc chute out of the switch.
4. Inspect the main contacts. Use the manual operating handle to operate the switch and inspect all contact surfaces. Discoloration of the contact surface does not affect performance. If the main contacts are severely eroded due to abnormal operating conditions, repair or replace the switch.
5. Reconnect power supplies to the transfer switch.
6. Reconnect the generator engine starting battery cables, negative (–) leads last, reconnect power to the generator engine starting battery charger, if installed, and move the generator set master switch to the AUTO (automatic) position. The generator set may start and run until the ATS time delay engine cooldown (TDEC) expires.

5.5 Coil Control Contact Test and Replacement

The manufacturer sets the TS coil control contacts so that the switch can operate satisfactorily over a voltage range of 80 to 110% of the nominal system voltage. The coil control contact settings may vary from switch to switch to accommodate minor variances in friction and tolerances.

The adjustments are factory-sealed and usually do not require any change over the life of the switch. If it becomes necessary to check the settings in the field, follow the instructions in the test procedure below. The settings can vary to the extremes and still provide acceptable operation. However, it is necessary that the coil control contacts always open *before* top dead center (TDC) is reached by the solenoid core. This feature is inherent to the basic design of the switch.

5.5.1 Coil Control Contact Test

The TS coil control contacts on this size transfer switch are not field-adjustable. If the following test procedure shows that the coil control contacts are not functioning as described, replace them.

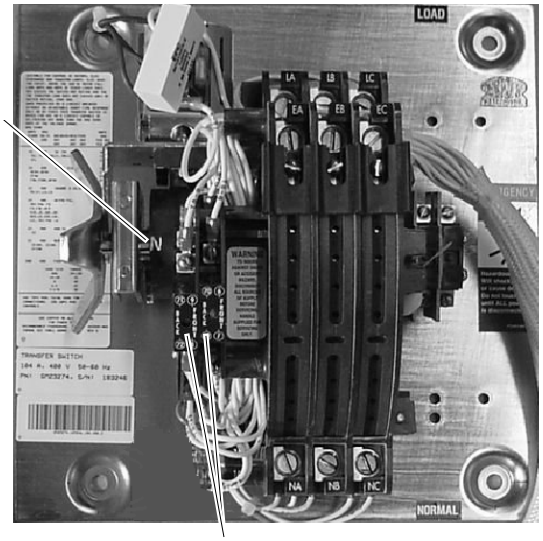
⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

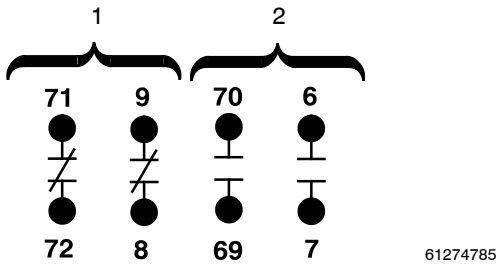
Coil Control Contact Test Procedure

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position, disconnecting power to the generator engine starting battery charger, if installed, and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect all power. Then use a voltmeter to verify that no voltage is present at the switch terminal lugs on both power sources.
3. Locate the TS coil control contact assemblies (see Figure 5-3).
4. To verify the settings of the TS coil control contacts, proceed as follows:
   a. Refer to Figure 5-4 and Figure 5-6. Two sets of contacts interrupt the control current to the operator coil (TS) in each direction (transfer to emergency and retransfer to normal). In Figure 5-4, the transfer switch is in the Normal position and the coil control contacts for the emergency side are closed, ready to allow current to flow to the TS coil to transfer to the Emergency source if the controller signals for transfer.



1. Main contact position indicator
2. Coil control contact assemblies

Figure 5-3 30–200 Amp Transfer Switches



1. Contacts 71-72 and 9-8, for transfers to emergency
2. Contacts 70-69 and 6-7, for transfers to normal

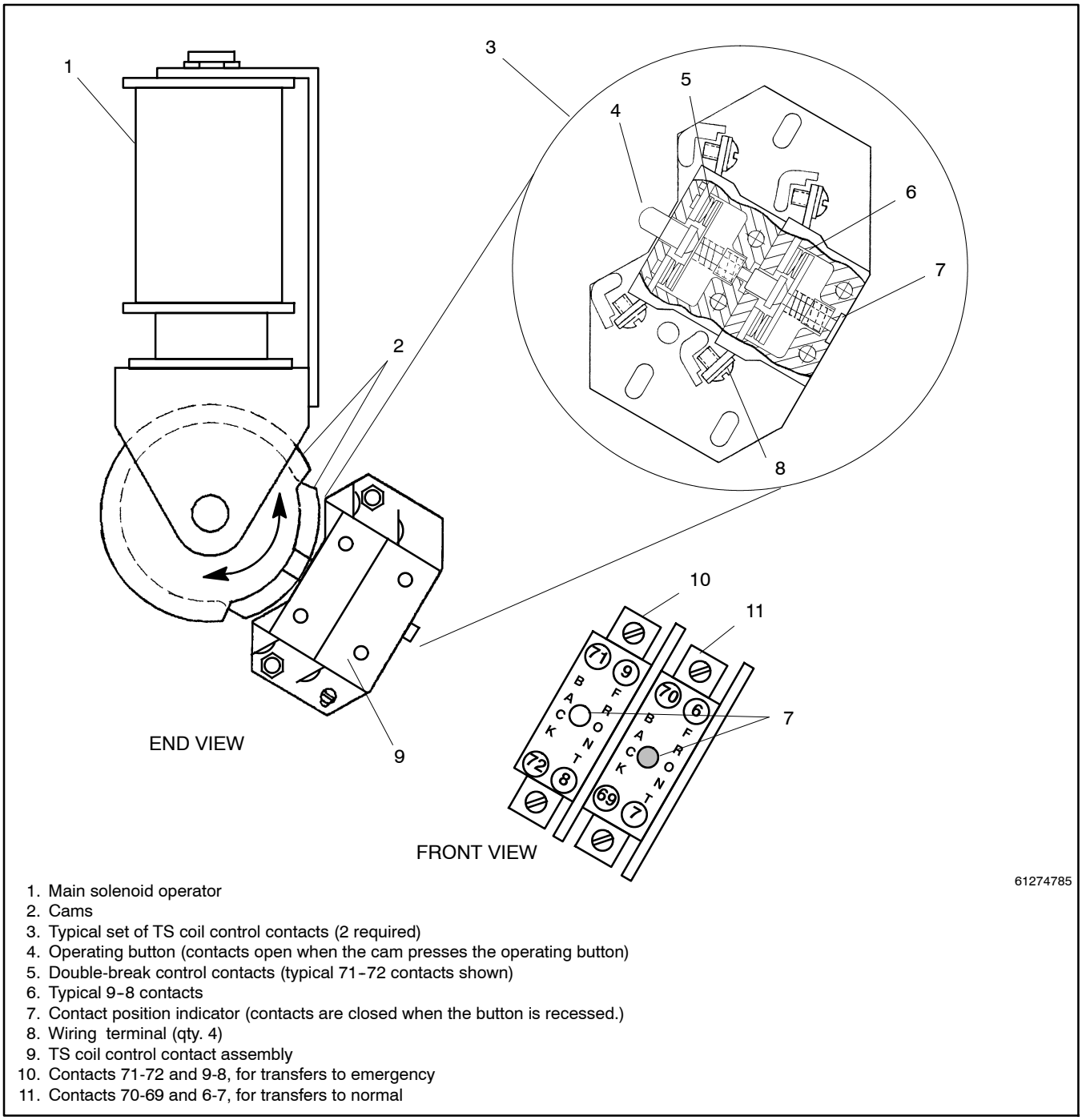
Figure 5-4 TS Coil Control Contact Positions when the Transfer Switch is in the Normal Position

b. With all power disconnected, use an ohmmeter (or a lamp type continuity tester) across each contact while slowly turning the manual operating handle to determine when the control contacts open. (Refer to Section 5.2 for manual operating instructions.) The pairs of coil clearing contacts do not have to operate simultaneously, but both must break the circuit *before* the main solenoid operator core reaches top dead center. See Figure 5-5 for control contact positions.

c. If the coil control contacts do not open before TDC, use the procedure in Section 5.5.2 to replace them These contacts are not field-adjustable.

Condition	**Control Contacts 71-72 & 9-8**	**Control Contacts 70-69 & 6-7**
Main contacts in NORMAL position	Closed	Open
Main contacts in EMERGENCY position	Open	Closed
During transfer from N to E	Open before TDC	Close after TDC
During transfer from E to N	Close after TDC	Open before TDC
N=Normal Position **E**=Emergency Position **TDC**=Top Dead Center of Solenoid core or main contact shaft.		

Figure 5-5 Control Contact Positions



1. Main solenoid operator
2. Cams
3. Typical set of TS coil control contacts (2 required)
4. Operating button (contacts open when the cam presses the operating button)
5. Double-break control contacts (typical 71–72 contacts shown)
6. Typical 9–8 contacts
7. Contact position indicator (contacts are closed when the button is recessed.)
8. Wiring terminal (qty. 4)
9. TS coil control contact assembly
10. Contacts 71-72 and 9-8, for transfers to emergency
11. Contacts 70-69 and 6-7, for transfers to normal

Figure 5-6 TS Coil Control Contact Locations with Main Solenoid Operator

5.5.2 Coil Control Contact Replacement

Under normal conditions the TS Control Contacts do not require replacement over the life of the transfer switch. If replacement becomes necessary, use the following procedure.

Note: Always check wiring and connections before replacing components.

Coil Control Contact Replacement Procedure

1. Disconnect all power to the transfer switch as instructed in the Test Procedure in Section 5.5.
2. Check to verify that the wires connected to the control contact assembly are marked so they can be identified after being disconnected. Add labels if necessary.
3. Disconnect the labeled wires from the control contact assembly.

4. Refer to Figure 5-7. Remove two 5/16 in. hex nuts with lock and flat washers from the left side of the control contact assembly. Remove the left control contact assembly. Then remove the two spacers and one #6-32 round head screw with lock and flat washers. Remove the right control contact assembly.

5. Install the new right-side control contact assembly (contacts 70-69 and 6-7). Depress the operating button (see Figure 5-6) to slide the assembly over the cam. Secure the assembly with one #6-32 round head screw with lock and flat washers. Align the assembly so that the screw is approximately centered in the slot.

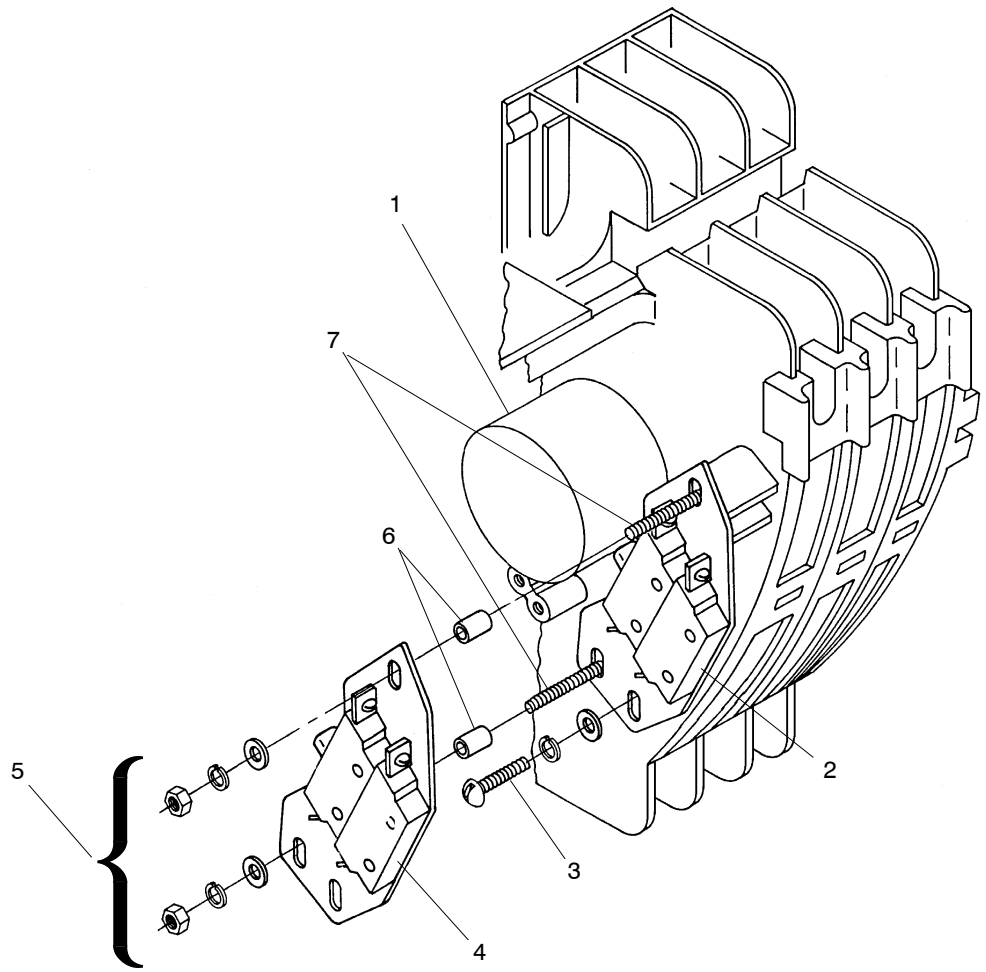
6. Reconnect the labeled wires to the four similarly marked screw terminals.

7. Install two spacers, then install the new left-side control contact assembly (contacts 71–72 and 9–8). Align with the right-side assembly. Secure the control contact assembly with two hex nuts, lock washers, and flat washers. Check that the threaded studs are approximately centered in the slot.

8. Reconnect the four remaining labeled wires to the similarly marked screw terminals on the new left-side control contact assembly.

9. Manually operate the switch by turning the manual operator handle. The action should be smooth without binding.

10. Check the control contact continuity. See the test procedure in Section 5.5.



1. Cam weight
2. Right (inside) TS coil control contact assembly, 70-69, 6-7
3. #6-32 round head screw with lock washer and flat washer
4. Left (outside) TS coil control contact assembly, 71-72, 9-8
5. Two 5/16 hex nuts with lock washers and flat washers
6. Spacers
7. #6-32 studs, molded into base

Figure 5-7 Replacing TS Control Contact Assemblies

Notes

Section 6 225–400 Amp Standard-Transition Transfer Switches

This section contains test and service procedures for the following transfer switches.

- 225–400 amp Model KCS connection S

Note: For 260–600 amp model KCS connection B switches, see Section 7. To identify connection B switches, check the model designation shown on the transfer switch nameplate. Connection B switches have a letter B at the end of the model designation. Example: KCS-DNTA-0400**B**.

Use the troubleshooting and test procedures in Sections 2 through 3 to diagnose problems before replacing parts. Use the instructions in this section if inspection, troubleshooting, or other test procedures reveal damaged or defective components that require replacement.

6.1 Manual Operation

The service procedures in this section call for manual operation of the transfer switch. Refer to the instructions in this section to manually operate the switch. Verify that the power to the transfer switch is disconnected before operating it manually.

Note: A manual operation handle is provided on the transfer switch *for maintenance purposes only*. Do not use the manual operation handle to transfer the load with the power connected.

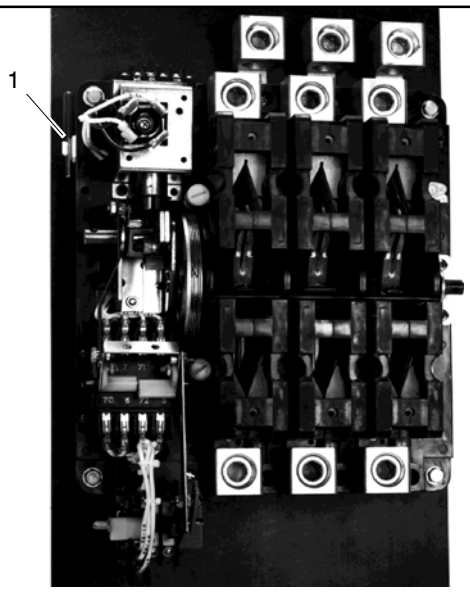
The 225–400 amp transfer switches have a detachable handle for manual operation. See Figure 6-1 for the typical handle storage location.

Manual Operation Procedure

1. Verify that the power sources to the transfer switch are OFF.
2. Remove the maintenance handle from the clips on the left side of the transfer switch frame. See Figure 6-1.
3. Insert the maintenance handle into the hole in the shaft on the left side of the operator. See Figure 6-2.
4. Move the maintenance handle up or down as shown to manually operate the transfer switch.
5. Return the transfer switch to the Normal (or Source N) position.
6. Remove the maintenance handle and store it on the frame in the clips provided.

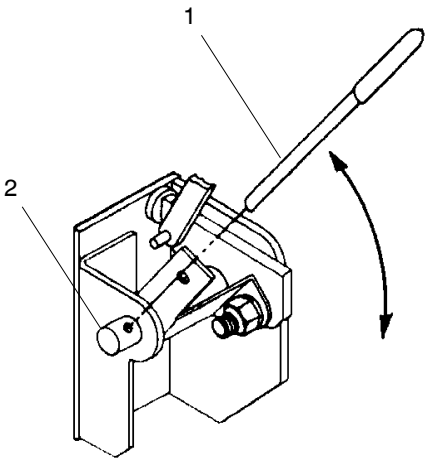
NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.



1. Maintenance handle

Figure 6-1 Typical Manual Handle Storage



1. Maintenance handle
2. Shaft

Figure 6-2 Manual Operation, 225–400 Amp Switches

6.2 Main Contact Replacement

Replace the transfer switch main contacts if inspection, troubleshooting, or testing indicates that the main contacts are damaged or excessively worn. See Section 1.3 for inspection information.

The following tools are needed for this procedure:

- Phillips screwdriver
- Blade screwdriver
- 5/32 in. hex key wrench
- 5/16 in. nutdriver
- 9/16 in. socket wrench
- Torque wrench capable of 175 in.
- Voltmeter
- Pliers
- Cotton swab or small brush
- Pencil or wood dowel

Use the detachable manual operating handle *for maintenance purposes only*. Disconnect the power and follow the manual operation instructions in the operation and installation manual to move the manual operating handle up or down as needed during these procedures. Do not operate the transfer switch manually when the power is connected.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

Main Contact Replacement Procedure

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position, disconnecting power to the generator engine starting battery charger, if installed, and disconnecting all generator engine start batteries, negative (–) leads first.

2. Disconnect all power sources to the transfer switch by opening switches or circuit breakers. Use a voltmeter to verify that no voltage is present at the transfer switch terminal lugs.

3. Remove the barrier/pole cover and arc chutes to gain access to the main contacts.

   a. Remove four screws in the corners of the barrier/pole cover and remove the cover.

   b. Remove the nylon retainer nuts on both sides of each arc chute. Then tip the chute toward the shaft while pulling it away from the panel.

   c. Place the arc chutes in a safe place for reinstallation later.

Movable Contact Disassembly

The movable contacts are mounted in the shaft. They are secured to the shunts by screws and held in place by the contact spring retainer. See Figure 6-4.

1. Remove the contact spring retainer: Use a 5/16 in. nutdriver to remove four #10-32 hex head screws with shake washers from the shaft. Then remove the retainer.

   Note: The retainer is under spring pressure. Hold the retainer with one hand and loosen all four screws equally to release the pressure.

2. Remove all contact springs: Pull off the contact springs from the heads of the screws.

3. Remove all movable contacts: Remove the 1/4-20 screws with lock washers from the contacts by using a hex key wrench. Then remove the contacts and contact stiffeners.

Stationary Contact Disassembly

The stationary contacts are mounted in the molded base. They are secured from the back and screwed to the terminal lugs. See Figure 6-5.

1. Remove all stationary contacts (with terminal lugs): Remove the two hex nuts (from the back) from the threaded studs by using a 7/16 in. socket wrench, then remove the stationary contact (with terminal lug) from the molded base.

2. Remove the terminal lugs: Secure each contact plate in a vise. See Figure 6-3. Remove terminal screws (from the back) by using a 9/16 in. socket wrench. Save terminal lugs and screws for reuse.

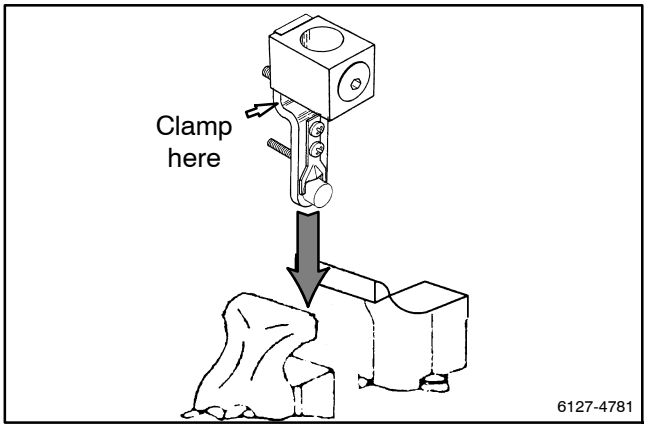
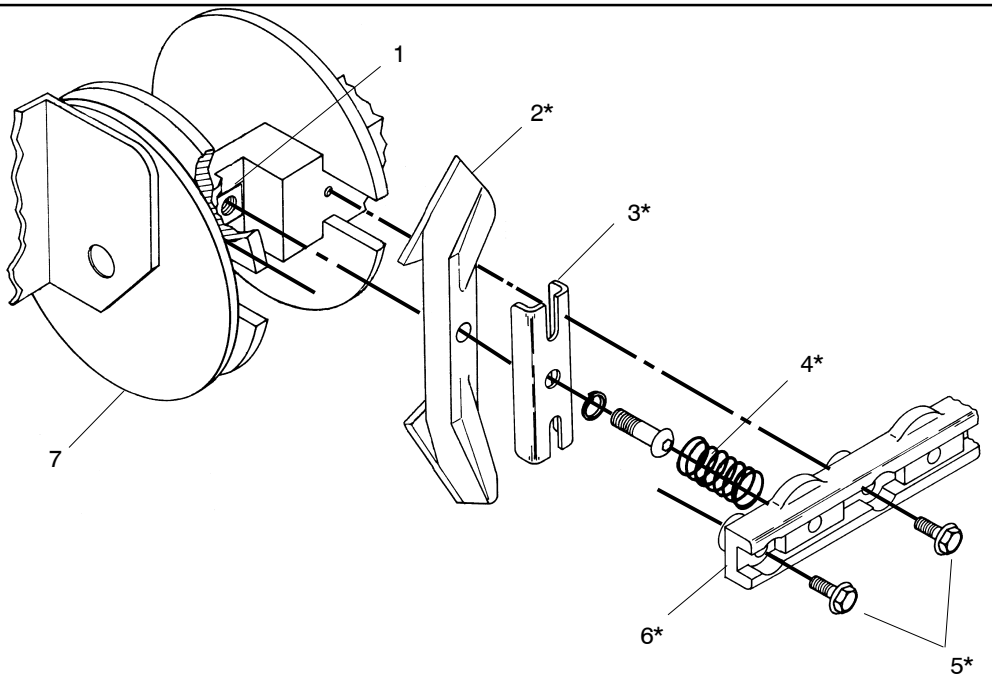


Figure 6-3 Stationary Contact Secured in a Vise to Remove and Install the Terminal Lug and Arc Runner

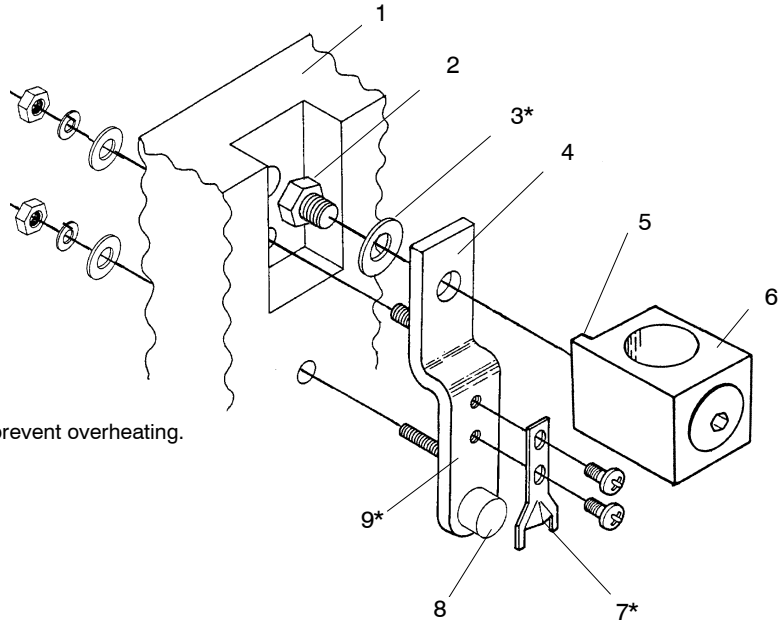
3. Remove the arc runners: Use a phillips screwdriver to remove two screws from each arc runner. Remove the arc runner by pulling it away from the contact button. Save the screws for reuse.



1. Shunt lug. Apply conductive lubricant
2. Movable contact*
3. Contact stiffener*
4. Contact spring*
5. #10-32 hex head screws*
6. Spring retainer*
7. Shaft

* Parts included in the kit.

Figure 6-4 Movable Contact



1. Molded base
2. Terminal screws. Tighten to 175 in. lb to prevent overheating.
3. Bevel washer*
4. Clean surface
5. Stepped edge
6. Lug
7. Arc runner*
8. Button
9. Stationary contact*

* Parts included in the kit.

Figure 6-5 Stationary Contact

Stationary Contact Reassembly

Reassemble as shown in Figure 6-5.

1. Reconnect the terminal lugs:

   a. Make sure that the new contact plate is *clean* before reattaching the terminal lug.

   b. Carefully secure each new stationary contact plate in a vise. See Figure 6-3.

   c. From the back, insert the terminal screw with a *new* bevel washer through the stationary contact plate into the terminal lug (with the stepped edge on the side as shown in Figure 6-5).

   d. Tighten the terminal screws to 19.8 Nm (175 in.).

   Note: To prevent overheating, torque the terminal screws to 19.8 Nm (175 in.).

2. Install *new* arc runners.

   a. Carefully secure each new stationary contact plate in a vise.

   b. Use two Phillips-head screws to install the new arc runner flat against the plate. Be sure that the formed side faces out, the jaws are on both sides of the contact button, and the arc runner is positioned as close as possible to the contact button.

3. Install new stationary contact assemblies: Insert each new stationary contact (with terminal lug & arc runner) into the molded base and secure it by installing two hex nuts with flat and lock washers behind the base. Use a 7/16 in. socket wrench to tighten nuts.

Movable Contact Reassembly

Reassemble as shown in Figure 6-4.

1. Apply conductive lubricant to shunt lugs: Use a cotton swab or small brush to apply conductive lubricant (available from the manufacturer) to the exposed surface of each shunt lug in the shaft.

   Note: Failure to use conductive lubricant between the shunt lug and contact may cause overheating.

2. Install new movable contacts: Place a new contact on the shaft and secure it to the shunt lug with the 1/4-20 screw and lock washer. Each screw passes through the movable contact and contact stiffener into the shunt lug. Use a 5/32 in. hex key wrench to tighten the screw to 100 in. lb.

   Note: To prevent overheating, torque the movable contact screw to 100 in. lb. To prevent binding, check the contact for free movement in the shaft.

3. Install new contact springs: Press a new spring onto the head of each screw that secures a movable contact.

4. Install the contact spring retainer:

   a. Place the spring retainer onto the springs so that they seat into the cavities of the retainer.

   b. Compress the springs with the retainer and hold it in position.

   c. Use a 5/16 in. nutdriver to install the four #10-32 hex head screws with shake washers to secure the spring retainer to the shaft. Tighten the screws.

5. Check contact deflection: Lift the tip of each movable contact to verify freedom of movement in the shaft. If there is binding, loosen the contact screw enough to reposition the shunt lug slightly, then retighten the screw to the proper torque. Recheck the deflection.

6. Install all arc chutes:

   a. Tip the arc chute while placing it over the stationary contact.

   b. Slide the arc chute toward the shaft (up or down) until it stops. Then position it so that it is centered over the stationary contact, and so the movable contact does not strike the arc chute plates.

   c. Secure the arc chute to the panel by using a screwdriver to install (cw) nylon retainer nuts on both sides of the arc chute. Torque the nuts to 12–14 in. lb.

7. Use the manual operation handle to slowly operate the switch, checking the contact clearance with the arc chutes.

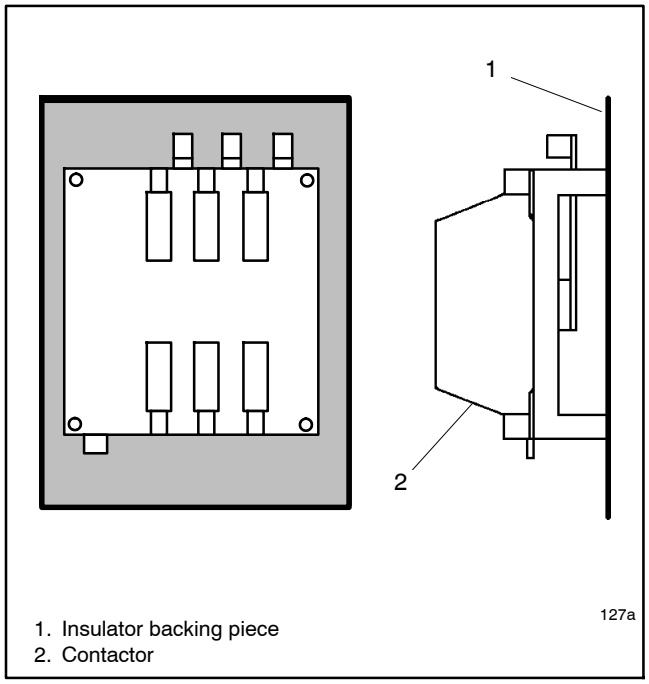
8. Install the barrier/pole cover: Place the cover against the arc chutes and use a Phillips screwdriver to install four screws in the cover.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Note: To prevent the possibility of personal injury or property damage, be sure to install the insulator backing piece behind the transfer switch when reinstalling it. See Figure 6-6.



1. Insulator backing piece
2. Contactor

Figure 6-6 Insulator for 225–400 Amp Switches

6.3 Operator Coil Replacement

Replace the coil if inspection or test procedures show that the coil is burned out or shorted.

Coil Assembly Removal

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

The coil assembly is mounted to the top left corner of the base with two screws. Remove it and place it on a work bench for disassembly.

1. Close the top main contacts: Use the manual operator handle to put the switch in the Emergency position.

2. Disconnect the rectifier: Pull off the four terminal lugs from the square rectifier mounted on the coil frame, then bend the wire leads away from the coil assembly.

3. Remove the clip assembly: Use a 5/32 in. hex key wrench to remove (cw) two screws with lock washers from the frame, then remove the coil assembly.

   Note: Hold the coil assembly securely when removing the screws. The spring exerts substantial force on the coil assembly.

4. Remove the core spring: Leave the core and link hooked onto the weight pin, but remove the core spring from the core.

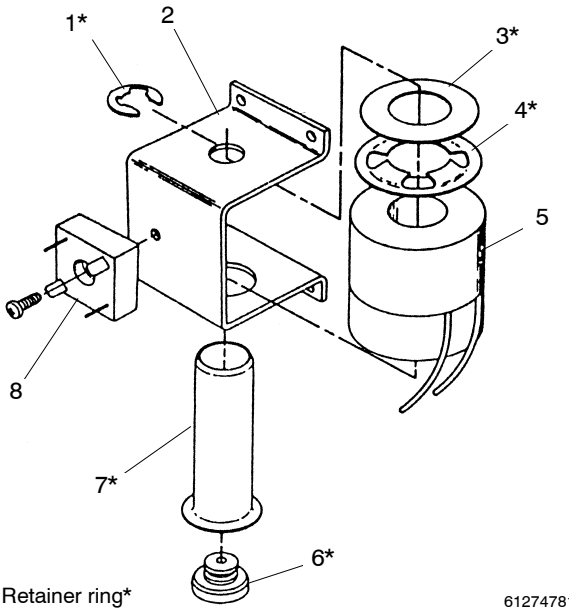
Coil Disassembly

The solenoid coil is held in the frame by the core tube. The retaining ring secures the core tube and stub core. Refer to Figure 6-7 during this procedure.

1. Remove the retaining ring: Use a screwdriver to pry the retaining ring out of the groove in the stub core, which extends through the frame.

2. Remove the core tube and stub core: Pull the core tube out through the other end of the frame. The stub core will come out with the core tube.

3. Remove the coil and washers: Pull the coil and washers out the side of the frame.



1. Retainer ring*
2. Frame
3. Spacer washer*
4. Spring washer*
5. Coil
6. Stub core*
7. Core tube*
8. Rectifier

* Parts included in the kit.

Figure 6-7 Coil Replacement

Coil Reassembly

Position the coil frame on its left side (rectifier on the left) on the workbench. The end of the frame with the large hole should be facing you. See Figure 6-7.

1. Install the new coil: Place a new coil (leads up and facing you), with washers at the far end, into the frame. Be sure the coil leads face the end of the frame with the large hole and that they face up.

2. Install the new core tube:

   a. Drop the stub core into the core tube so that it extends through the end of the tube.

   b. Align the holes in the coil, insulating washer, spring washer, and frame to accept the core tube.

   c. Insert the core tube with stub core through the frame, coil, spacer washer, and spring washer so that the stub core extends through the frame. Use a pencil or wood dowel in the core tube, if necessary, to push the stub core through the frame.

   Note: Do not insert any metal tool inside the core tube.

3. Install the retaining ring: Use pliers to slide the retaining ring into the groove in the stub core to secure the core tube in the frame.

4. Lubricate the core tube and spring: Apply lubricant (a mixture of Dow Corning #44 silicone grease and molybdenum disulfide powder, available from the manufacturer) to the inside of the core tube and to the new core spring. Then insert the spring into the core tube.

Coil Assembly Installation

1. Install the coil assembly:

   a. Place the coil assembly with core spring onto the solenoid core (still connected to the weight pin).

   b. Compress the spring with downward pressure while installing the two screws with a 5/32 in. hex key wrench.

   c. Tighten the screws to secure the coil assembly to the switch base. Note that only the lower left and upper right holes in the coil frame are used.

2. Replace the rectifier, if necessary:

   a. Remove the center screw to remove the rectifier.

   b. Install the new rectifier turned so its terminal with the *red dot* is on the upper left.

3. Reconnect the coil leads: Connect the coil leads, which have pink connectors, to the rectifier's push-on terminals marked with a *red dot* and *no dot* (DC + and – output).

4. Reconnect the rectifier: Connect the AC control leads, which have white connectors and come from the base, to the rectifier's push-on terminals marked with *yellow dots.*

5. Manually operate the switch:

   a. Use the manual handle to operate the switch to check the solenoid assembly. *The action should be smooth, without any binding.* If not, recheck the alignment of parts and the solenoid operator lubrication.

   b. Return the switch to the *Normal* position (top main contacts open). Then remove the manual handle and store it in the clips on the top left side of the switch.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Note: To prevent the possibility of personal injury or property damage, be sure to install the insulator backing piece behind the transfer switch when reinstalling it. See Figure 6-6.

6.4 Coil Control Contact Test and Adjustment

This section explains how to test and adjust the TS coil control contacts in 225–400 amp transfer switches. Only experienced electricians should test and adjust the switch. Observe all standard safety practices.

The TS coil control contacts control the duration of time that power is applied to the main solenoid operator (TS Coil). For proper operation, it is important that the contacts open at the proper time during the stroke of the solenoid. Improper adjustment will cause failure to operate at reduced voltages, failure of the main contacts to seat properly, and solenoid failure.

The manufacturer sets the TS coil control contacts so that the switch can operate satisfactorily over a voltage range of 80 to 110% of the nominal system voltage. The coil control contact settings may vary from switch to switch to accommodate minor variances in friction and tolerances.

6.4.1 Coil Control Contact Test

The adjustments are factory-sealed and usually do not require any change over the life of the switch. If it becomes necessary to check the settings in the field, follow the instructions in the Coil Control Contact Test Procedure. The settings can vary to the extremes and still provide acceptable operation. However, it is necessary that the coil control contacts always open *before* the solenoid core reaches top dead center (TDC).

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

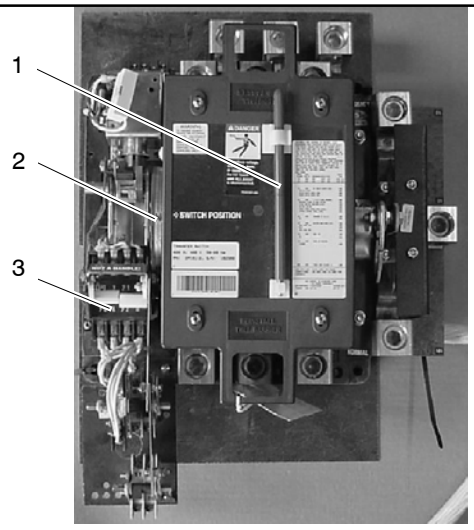
Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Coil Control Contact Test Procedure

Note: When the normal source breaker opens, the engine start circuit closes, signalling the generator set engine to start and run.

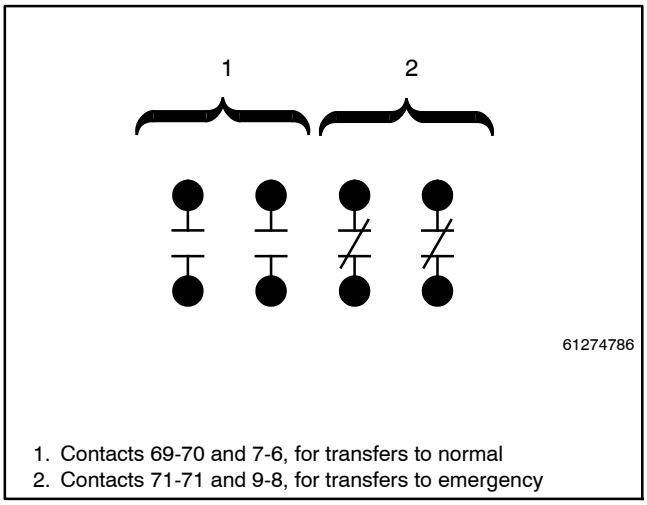
1. Prevent the generator set from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine starting battery charger, if installed; and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch. Then use a voltmeter to verify that no voltage is present at the switch terminal lugs on both power sources.
3. Locate the TS coil control contact assembly. See Figure 6-8.



1. Manual operator handle storage location
2. Main position indicator: N=closed on normal, E=closed on emergency
3. TS coil contact control assembly

Figure 6-8 Transfer Switch, 225–400 Amp Models

4. Check the settings of the TS control contacts:
   a. Refer to Figure 6-11. Two sets of contacts interrupt the control current to the solenoid operator coil (TS) in each direction (transfer to emergency and retransfer to normal). In Figure 6-11, the transfer switch is in the normal position and the coil control contacts for the emergency side are closed, ready to allow current to flow to the TS coil to transfer to the emergency source if the controller signals for transfer.
   b. With power disconnected, use an ohmmeter (or a lamp-type continuity tester) across each contact while slowly turning the manual operator handle to determine when the control contacts open. (Refer to Section 6.1 for operating handle instructions.) Compare contact operation to the positions given in Figure 6-10 and verify that both contacts open *before* the main solenoid operator core reaches top dead center. The pairs of coil clearing contacts do not have to operate simultaneously.
5. If any of the contacts require adjustment, use the following Contact Adjustment Procedures.



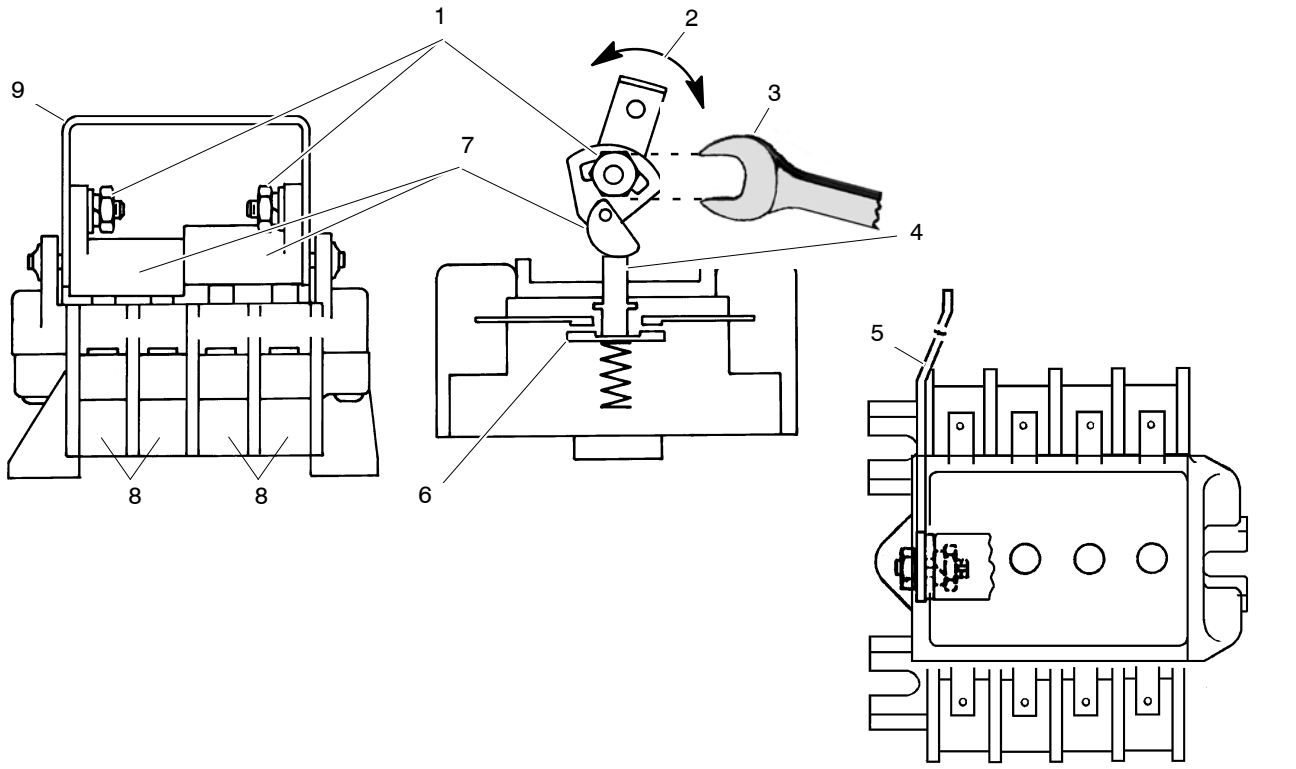
1. Contacts 69-70 and 7-6, for transfers to normal
2. Contacts 71-71 and 9-8, for transfers to emergency

Figure 6-9 TS Coil Control Contact Positions When Transfer Switch is in Normal Position

Condition	Control Contacts 71-72 and 9-8	Control Contacts 69-70 and 7-6
Main contacts in NORMAL position	Closed	Open
Main contacts in EMERGENCY position	Open	Closed
During transfer from N to E	Open before TDC	Close after TDC
During transfer from E to N	Close after TDC	Open before TDC

N=Normal Position
E= Emergency
TDC=Top Dead Center of solenoid core or main contact shaft rotation.

Figure 6-10 Coil Control Contact Positions



1. Adjustment nut
2. Adjustment range
3. 11/32 in. open-end wrench
4. Operating button
5. Upper drive link
6. Typical contacts. The contacts open when the cam presses the operating button.
7. Cams
8. Control contact sets
9. Drive bracket

Figure 6-11 TS Control Contact Arrangement (transfer switch is in the normal position)

6.4.2 Contact Adjustment

Contacts 71-72 and 9-8. Refer to Figure 6-12.

1. Use the manual operator handle, if necessary, to move the power switching device to the emergency position.
2. Loosen the #8-32 hex nut that unlocks the drive bracket from the cam adjustment slot on the right side of the assembly.
3. Rotate the cam until its top edge is within 9/32 in. from the side of the drive bracket.
4. Retighten the locking nut and verify the adjustment as described in the test procedure.

   Note: The setting shown in Figure 6-12 is satisfactory in most cases. However, to accommodate variances in tolerances, friction, and 80% minimum operating voltage, you can vary the setting over the range of adjustability provided that the control contacts maintain the positions shown in Figure 6-10.
5. Reconnect the engine start circuit.

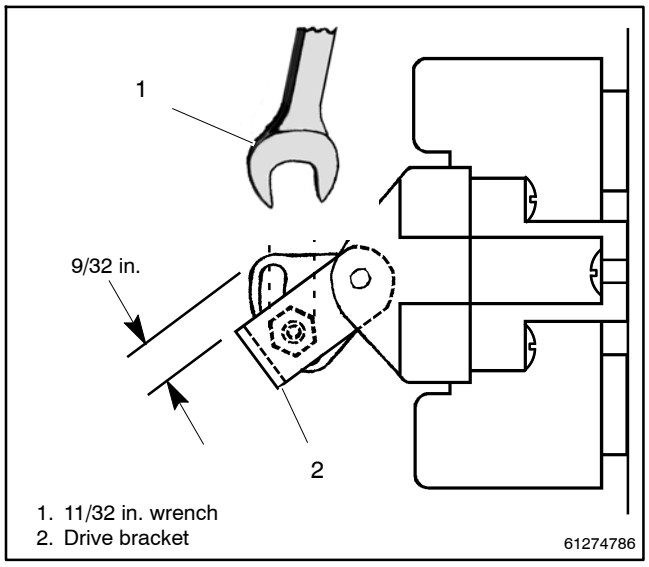


Figure 6-12 Adjusting TS Control Contacts 71-72 and 9-8 (view from the right side. main transfer switch contacts must be closed on emergency side)

Contacts 69-70 and 7-6. Refer to Figure 6-13.

1. Use the manual operator handle, if necessary, to move the power switching device to the NORMAL position.
2. Loosen the #8-32 hex nut that unlocks the drive bracket from the cam adjustment slot on the left side of the assembly.
3. Rotate the cam until its bottom edge is within 9/32 in. from the side of the drive bracket.
4. Retighten the locking nut and verify the adjustment as described in the test procedure.

   Note: The setting shown in Figure 6-13 is satisfactory in most cases. However, to accommodate variances in tolerances, friction, and 80% minimum operating voltage, you can vary the setting over the range of adjustability provided that the control contacts maintain the positions shown in Figure 6-10.
5. Reconnect the engine start circuit.

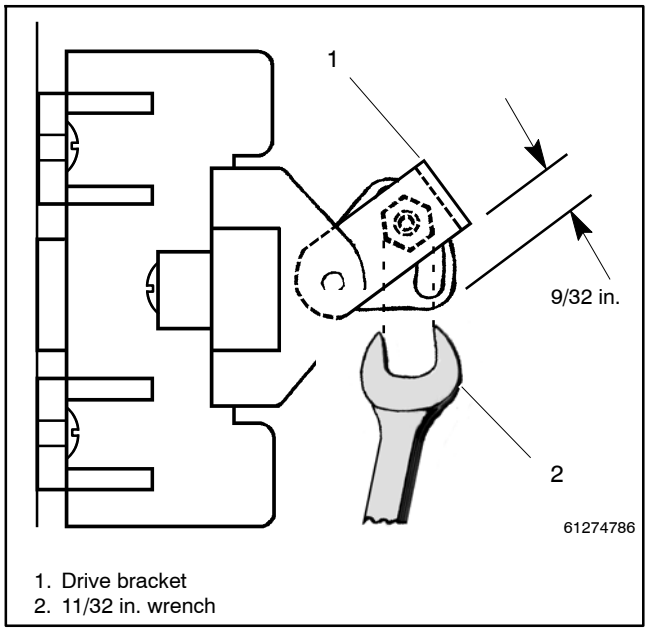


Figure 6-13 Figure 5. Adjusting TS Control Contacts 69-70 and 7-6 (view from the left side; main transfer switch contacts must be closed on normal side)

6.4.3 Coil Control Contact Replacement

Under normal conditions the TS control contacts do not require replacement over the life of the transfer switch. If replacement becomes necessary, use the following procedure.

Note: Always check wiring and connections before replacing components.

TS Control Contact Replacement Procedure

1. Disconnect all power to the transfer switch as instructed in the *Test and Adjustment Procedure.*

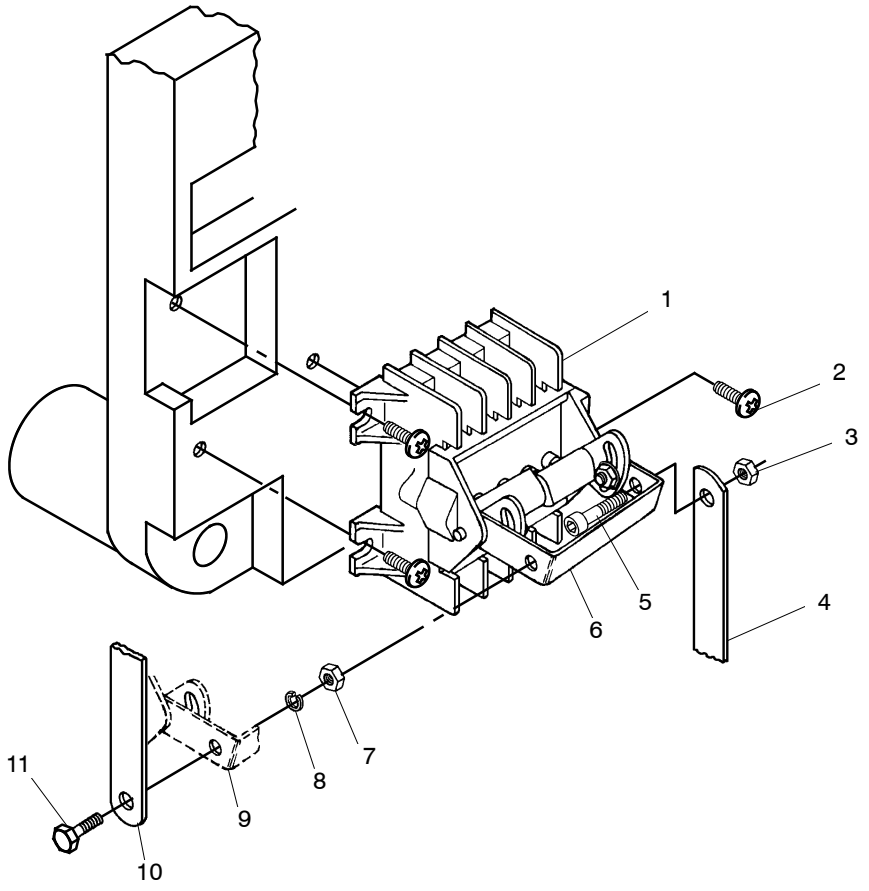
2. Refer to Figure 6-14. Disconnect the upper drive link by removing the #10-32 shoulder screw, lock washer, and hex nut from the left side of the drive bracket on the control contact assembly. Then reinstall the hardware onto the loose linkage for safekeeping.

3. Disconnect the lower drive link by removing the #10–32 allen head screw and locknut from the right side of the drive bracket. Then reinstall the hardware into the loose link for safekeeping.

4. Verify that the wires connected to the control contact assembly are marked so they can be identified after being disconnected. Add labels if necessary.

5. Disconnect the labeled wires from the control contact assembly.

   Note: Do not pull on the wires. Use a screwdriver to pry off the connectors. Pulling may damage the crimped wire connection.



1. TS control contact assembly
2. Phillips head self-tapping mounting screws
3. Locknut, 10-32
4. Lower drive link
5. Allen head screw, 10-32
6. Drive bracket
7. Hex nut
8. Lock washer
9. Drive bracket
10. Upper drive link
11. Shoulder screw, 10-32

Figure 6-14 TS Control Contact Assembly Replacement

6. Remove three #8 Phillips head self-tapping screws from the mounting feet and remove the control contact assembly.

7. Install the new control contact assembly onto the switch base. Apply one drop of Loctite® to each mounting screw thread to reform the self-tapping holes and secure the assembly.

8. Reconnect the lower drive link to the drive bracket (right side) with the #10-32 allen head screw and locknut. Check for free play between the locknut and drive link.

9. Reconnect the upper drive link to the left side of the drive bracket on the control contact assembly with the #10-32 shoulder screw, split lock washer, and hex nut. Check for free play between screw head and drive bracket.

10. Manually operate the drive linkage. The action should be smooth without any binding. Verify that the cams properly operate the pushbuttons on the control and auxiliary contact assemblies.

11. Reconnect the eight labeled wires to the proper terminals.

12. Check the control contact adjustment. See the test and adjustment procedures in Sections 6.4.1 and 6.4.2.

* Loctite is a registered trademark of the Loctite Corporation.

This section explains how to replace the solenoid coil and coil control contacts in 150–600 amp connection B transfer switches. Connection B switches have a letter B at the end of the model designation. Example: KCS-DNTA-0400**B**.

This section applies to the following Connection B models:

- 260–400 Amp KCS
- 150–600 Amp KCP
- 150–600 Amp KCC
- 150–600 Amp KBC

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Tools Needed

- Safety glasses (for eye protection)
- Straight blade 6 in. screwdriver, 1/4–3/8 in.
- Short handle blade screwdriver
- Ratchet drive, 3/8 in., 6 in. and 12 in. extensions
- Sockets, 3/8 in.
- Open-end or box wrenches, 3/8 in.
- Nutdriver, 3/8 in.
- Torque wrench, 0 to 27 Nm (0 to 20 ft. lb.)
- Needlenose and regular pliers
- Wire labels

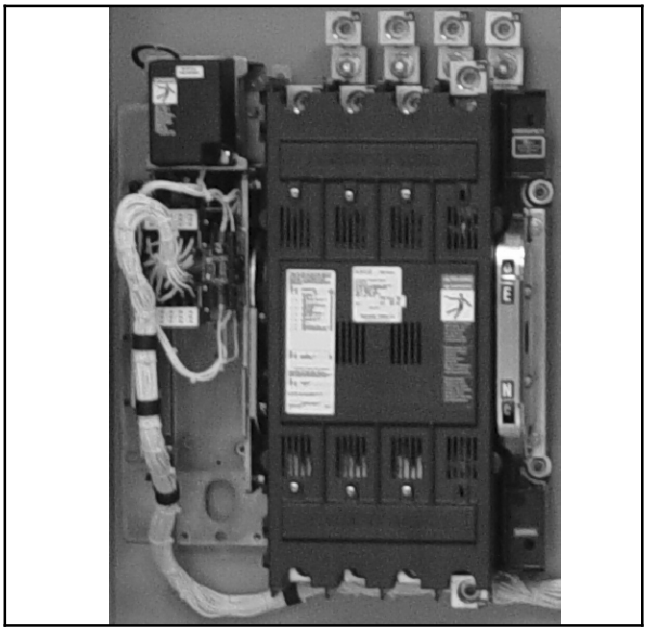


Figure 7-1

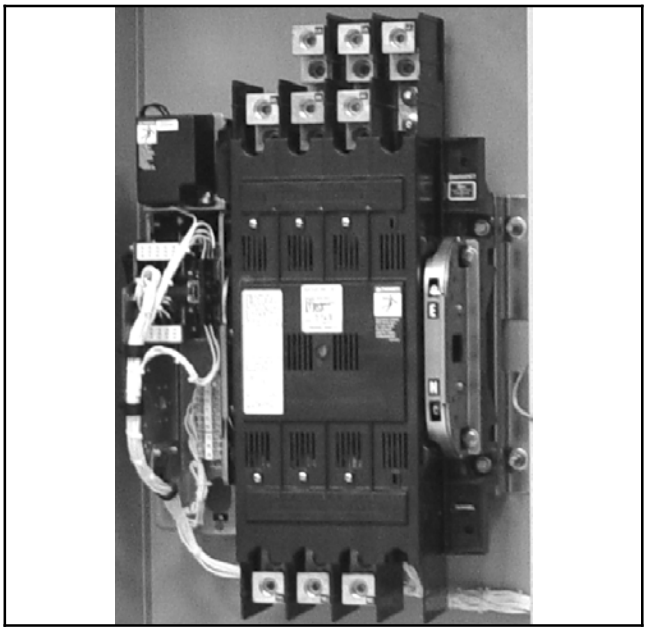


Figure 7-2

7.1 Maintenance Handle

A detachable maintenance handle is provided on the frame of the transfer switch for maintenance purposes only. After the transfer switch is completely deenergized, this handle can be used to change the position of the contacts and operator mechanism. The windows in the right side of the transfer switch frame indicate which contacts are open and closed.

When servicing closed-transition switches, check that both contacts are not left in the closed position before energizing the switch.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

Manual Operation Procedure

1. Deenergize the transfer switch. After deenergizing both power sources, open the enclosure door. Use a voltmeter to verify that no electrical power is present at the transfer switch terminals.

2. Install the maintenance handle. Locate and remove the maintenance handle from clips on the left side of the transfer switch frame. Insert the handle into the molded hub on the left side of the operator. See Figure 7-3, Figure 7-4, and Figure 7-5.

3. Move the maintenance handle up or down to manually operate the transfer switch to the opposite position.

   Note: If Normal and Emergency connections are reversed, this operation is also reversed.

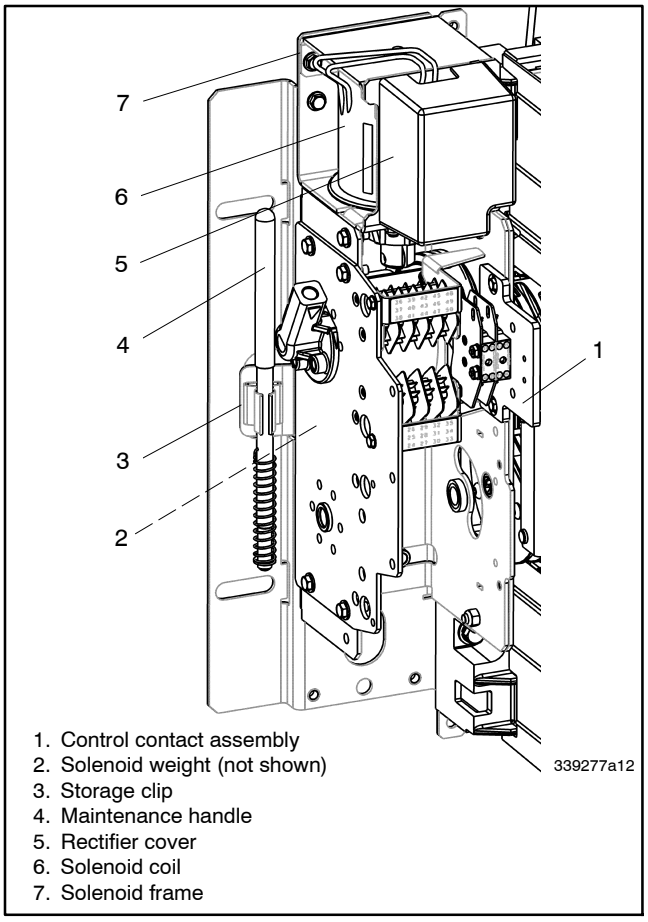
4. Return the transfer switch to the Normal position. Observe that the window indicators (right side) show the top shaft O (open) and the bottom shaft C (closed).

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause severe injury, death, or property damage.

Before energizing the transfer switch, verify that both the normal and emergency contacts are not left in the closed position.

5. Remove the maintenance handle and store it on the frame (left side) in the clips provided.



1. Control contact assembly
2. Solenoid weight (not shown)
3. Storage clip
4. Maintenance handle
5. Rectifier cover
6. Solenoid coil
7. Solenoid frame

Figure 7-3 Solenoid Operator Assembly (left side of transfer switch)

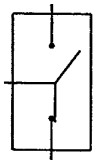
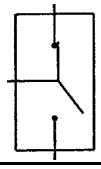
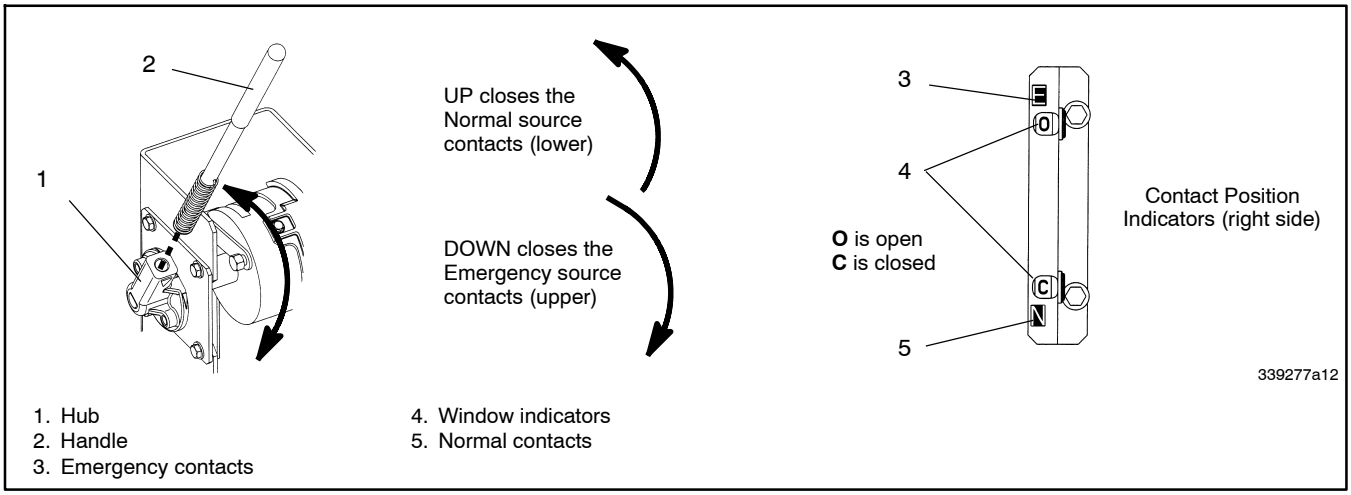
ATS Position		Handle	Indicators
Normal		 up	E = O upper contacts open N = C lower contacts closed
Emergency		 down	E = C upper contacts closed N = O lower contacts open

Figure 7-4 Maintenance Handle Positions



1. Hub
2. Handle
3. Emergency contacts
4. Window indicators
5. Normal contacts

Figure 7-5 Maintenance Handle Operation and Contact Position Indicators

7.2 Solenoid Coil Replacement

Solenoid coil kits include only the coil. See Figure 7-6. See the parts catalog for coil kit numbers.

Programmed- and closed-transition models use two coils as shown in Figure 7-7. Replacement procedures apply to both coils.

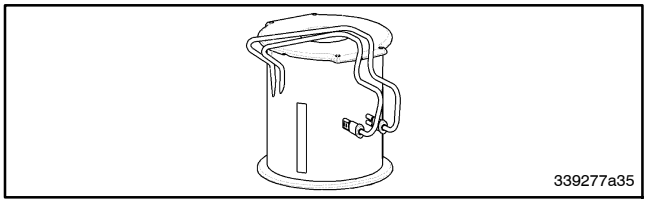
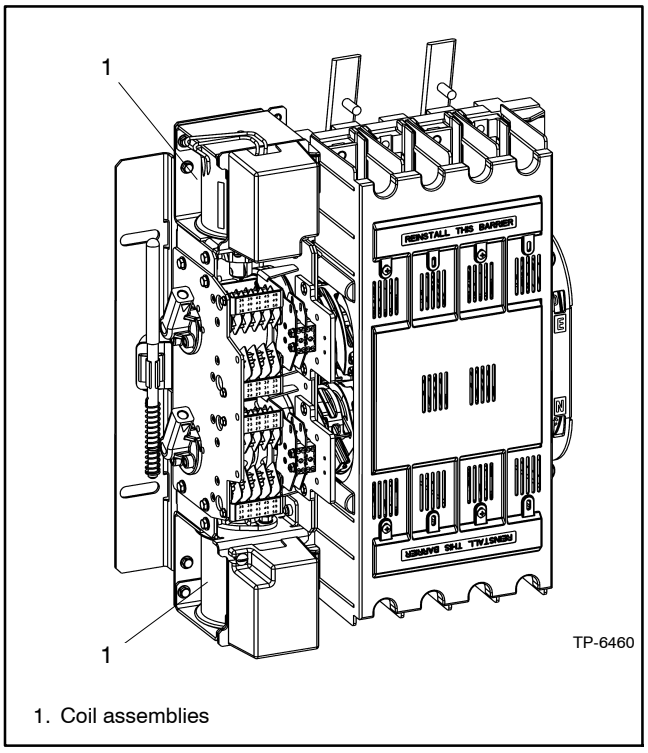


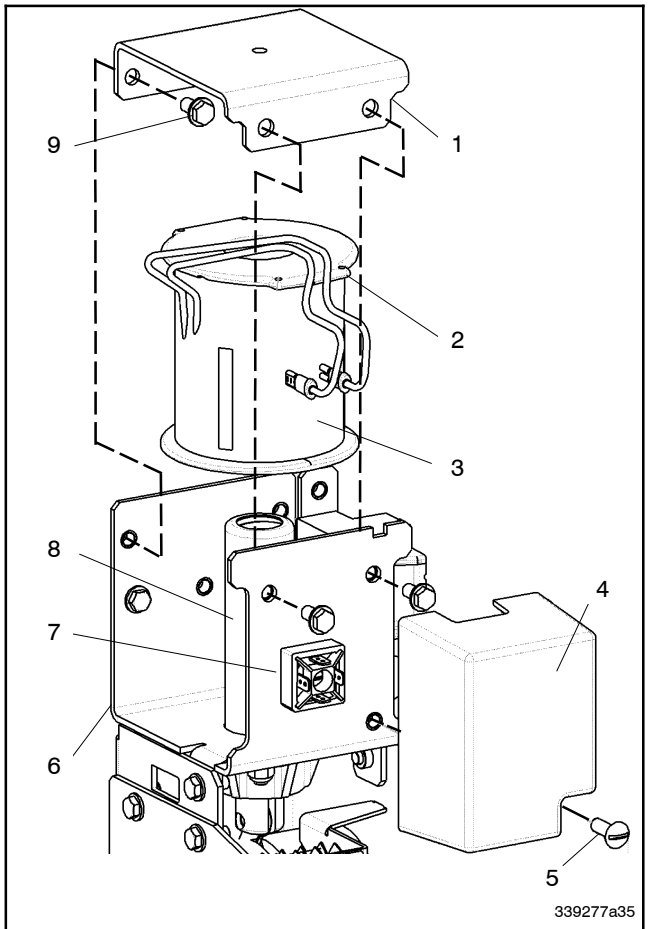
Figure 7-6 Solenoid Coil Kit



1. Coil assemblies

Figure 7-7 Two Coils used for Programmed-Transition and Closed-Transition Models

1. Remove the rectifier cover and disconnect the coil leads. Using a blade screwdriver and turning in a counterclockwise direction, loosen one screw (do not remove it) and remove the rectifier cover. Disconnect the two coil leads from the rectifier. See Figure 7-3 and Figure 7-8.



1. Retaining bracket
2. Flange on coil
3. Solenoid coil (included in kit)
4. Rectifier cover
5. Rectifier screw
6. Solenoid frame
7. Rectifier
8. Core tube
9. SEMS screws, qty. 4

Figure 7-8 Solenoid Coil

2. Remove the solenoid retaining bracket and the coil. Use a 3/8 in. socket, open-end, or box wrench to remove four SEMS screws from the solenoid retaining bracket. Remove the bracket from the top of the solenoid. Remove the solenoid coil by pulling it upward (off the core tube) and out of the frame. See Figure 7-8.

3. Install the new solenoid coil. Position the new replacement coil so that the flange end is on top and the coil leads are on the left side. Install the coil (in this position) into the frame by pushing it downward (onto the core tube) and into the frame. Secure the coil by reinstalling the solenoid retaining bracket. Use a 3/8 in. socket, open-end, or box wrench to install four SEMS screws. Tighten the screws to 7.5 Nm (5.5 ft. lb.) torque. See Figure 7-3.

4. Connect the new coil and reinstall the rectifier cover. Install the quick-connect coil leads onto the rectifier terminals (DC). Install the rectifier cover onto the top of the solenoid frame. Use a blade screwdriver to tighten the screw. See Figure 7-3 and Figure 7-8.

7.3 Solenoid Assembly Replacement

Solenoid assemblies include the entire solenoid with frame, coil, core tube, core spring, and core and link. See Figure 7-9. See the parts catalog for solenoid assembly kit part numbers.

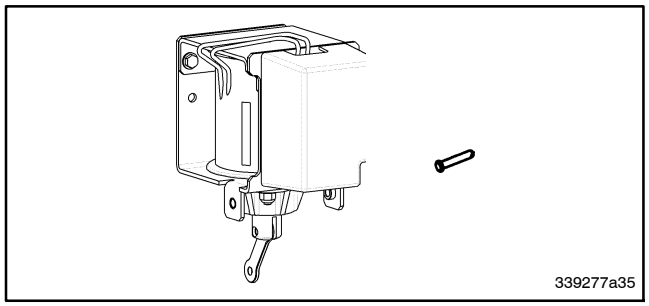


Figure 7-9 Replacement Solenoid Assembly with Core and Link (includes rectifier and cover, locking pin)

1. Put the transfer switch in the Emergency position. The upper contacts must be closed to replace the solenoid assembly. If necessary, use the maintenance handle to operate the transfer switch to the *Emergency* position. See Figure 7-5.

2. Remove the rectifier cover and disconnect the two wires. Use a blade screwdriver to loosen one screw and remove the rectifier cover. Disconnect the two wires coming into the solenoid assembly from the harness. See Figure 7-8.

3. Insert the weight locking pin. To prevent the operator from moving during disassembly, insert the locking pin through the hub and into the bearing plate. See Figure 7-10.

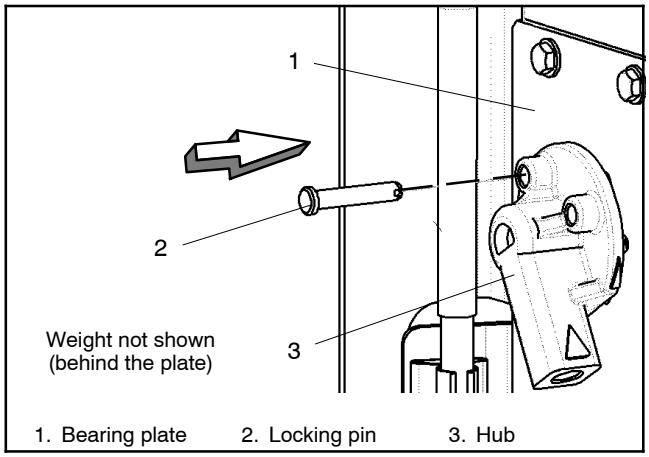


Figure 7-10 Weight Locking Pin

4. Remove the auxiliary contact assembly from the weight. Use a 3/8 in. open-end or box wrench to remove two SEMS screws and remove the auxiliary contact assembly to gain access to the weight. See Figure 7-11.

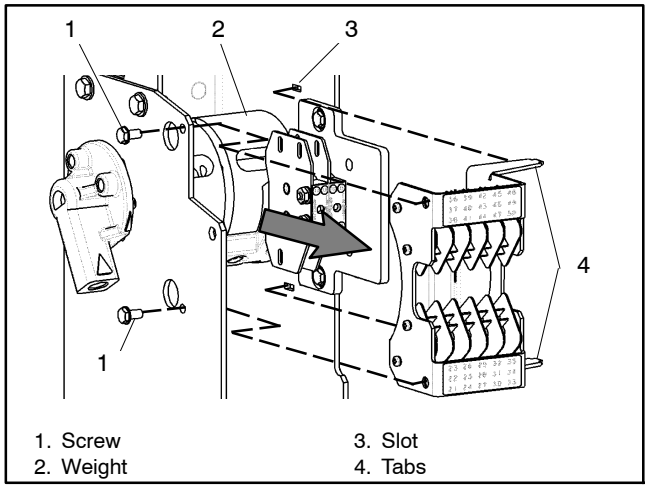
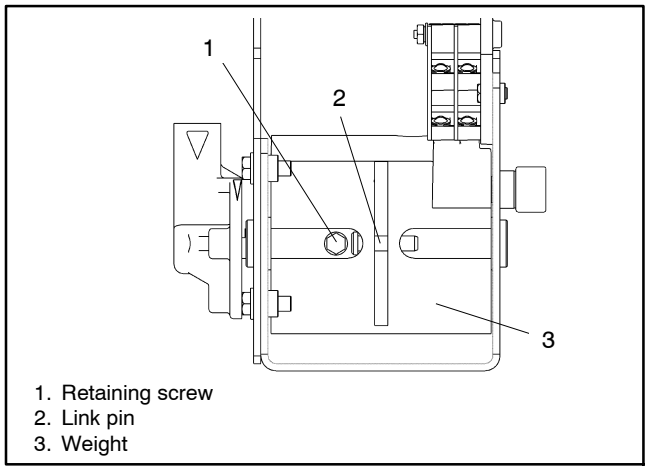


Figure 7-11 Auxiliary Contact Assembly Removal

5. Remove the link pin from the weight to release the core link. Use a 5/16 in. nutdriver to remove the link pin retaining screw from the weight left cavity. Insert a screwdriver into the weight right cavity and push the clevis pin to the left into the left cavity. This operation releases the core link from the weight. Remove the clevis pin from the weight. See Figure 7-12 and Figure 7-13.

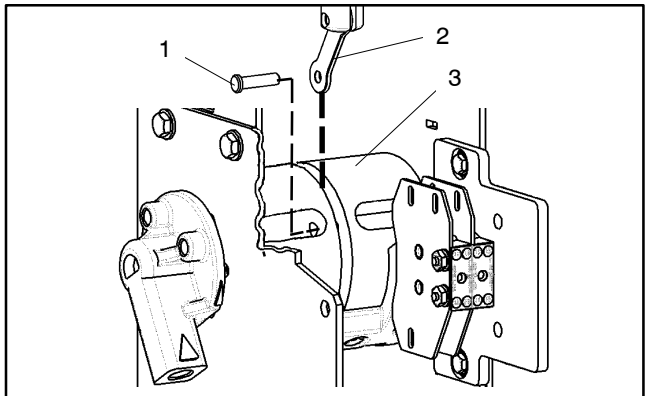
Note: To prevent personal injury, do not attempt to remove the clevis pin until the weight is locked in the emergency position (step 3, Figure 7-10).

Note: To prevent shortened equipment life or malfunction, do not damage the clevis pin when removing it.



1. Retaining screw
2. Link pin
3. Weight

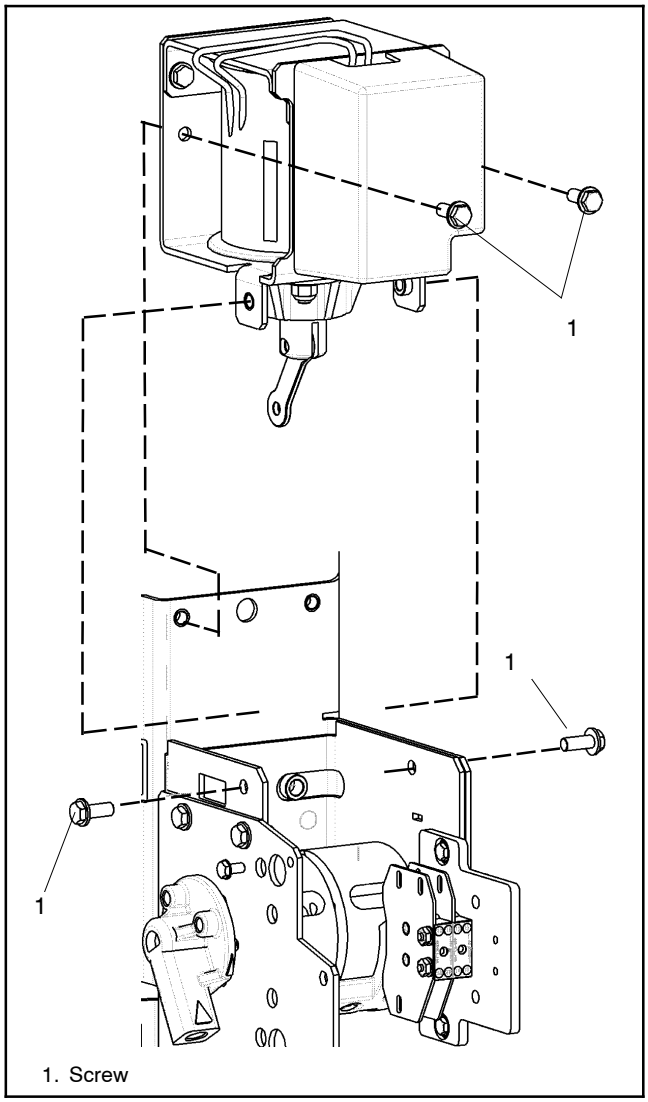
Figure 7-12 Link Pin Retaining Screw



1. Clevis pin
2. Core link
3. Weight

Figure 7-13 Link Connection

6. Remove the solenoid assembly. Use a 3/8 in. open-end or box wrench to remove four SEMS screws (two at the top, one on either side). See Figure 7-14.



1. Screw

Figure 7-14 Solenoid Assembly

7. Transfer the labels from the old solenoid to the new one. Carefully remove the nameplate, WCR label, and DANGER label from the old solenoid. Apply them onto the new solenoid.

8. Install the new solenoid assembly. Position the new solenoid assembly onto the mounting rail so that the two protrusions align with the holes in the solenoid assembly. The core link should be in the slot in the weight. Use a 3/8 in. open-end or box wrench to install four new 1/4-20 x 3/4 in. long SEMS screws (two at the top, one on either side). See Figure 7-14.

9. Install the new rectifier cover and connect the two wires. Connect the two wires from the harness (previously disconnected) to the rectifier terminals (AC). Then install the new rectifier cover onto the solenoid assembly. See Figure 7-8.

10. Reinstall the link pin into the weight**.** Install the link pin into the left side of the weight (through the core link from the solenoid assembly). Apply Loctite 242 sealant onto the threads of the 1/4-20 link retaining screw and install it through the control contact link and link pin into the left side of the weight. Use a 7/16 in. open-end or box wrench to tighten the retaining screw. There should be some play to allow movement of the control contact link. See Figure 7-12.

11. Remove the weight locking pin. To unlock the weight from the bearing plate, remove the clevis pin from the hub. This is very important! Severe damage will occur when the transfer switch is reenergized if the clevis pin is not removed. See Figure 7-13.

    Note: To prevent severe damage to the solenoid assembly, remove the clevis pin from the hub on the left side. This action will unlock the weight and allow free movement of the operator when it is reenergized.

12. Manually operate the transfer switch. Use the maintenance handle to operate the transfer switch several times. See Section 7.1. It should operate smoothly; if not, recheck the solenoid assembly installation.

7.4 Control Contact

The coil control contact assembly (two pushbutton switches) is located below the solenoid operator on the left side of the transfer switch. See Figure 7-3 and Figure 7-15.

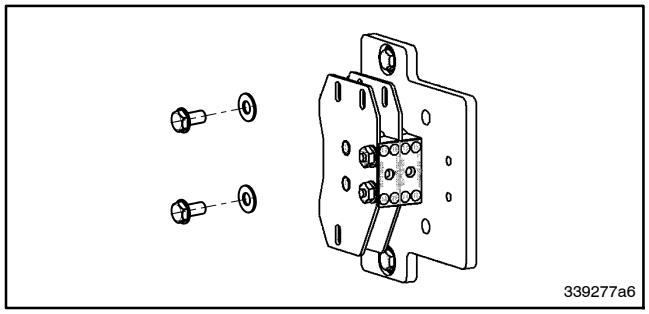


Figure 7-15 Coil Control Contact Kit

Control Contacts Replacement

1. Label the eight wires connected to the control contacts. Carefully label all wires that are connected to the control contacts. Then use a narrow blade screwdriver to disconnect the eight wires.

2. Remove the control contact assembly. Remove two SEMS screws and remove the control contact assembly. See Figure 7-16.

3. Install the new control contact assembly**.** Position the new control contact assembly with its pushbuttons against the cams on the weight. Install two #10-32 SEMS screws with washers and tighten. See Figure 7-16.

   Note: Properly position pushbuttons on cam surfaces prior to tightening screws.

4. Connect the eight labeled wires to the control contacts**.** Carefully reconnect the wires (disconnected in step 1) to the new control contact assembly.

5. Manually operate the transfer switch**.** Use the maintenance handle (see Section 7.1) to operate the transfer switch several times. You should see the two indicators change alternately from open to closed. If not, recheck the installation. See Figure 7-16.

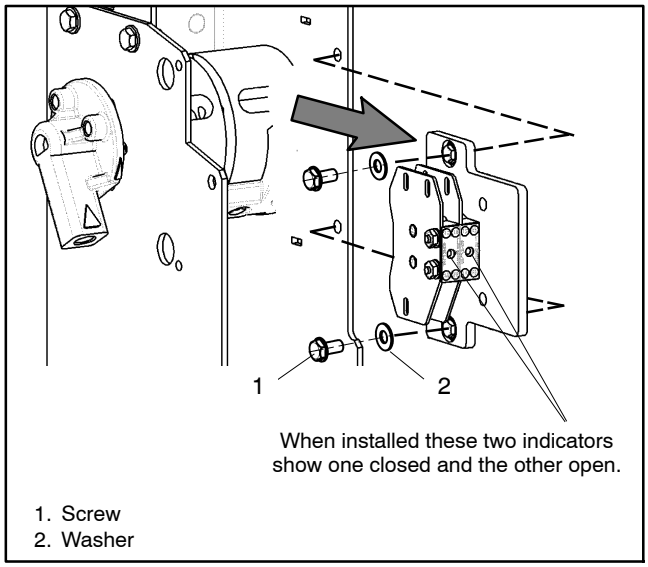


Figure 7-16 Control Contact Assembly

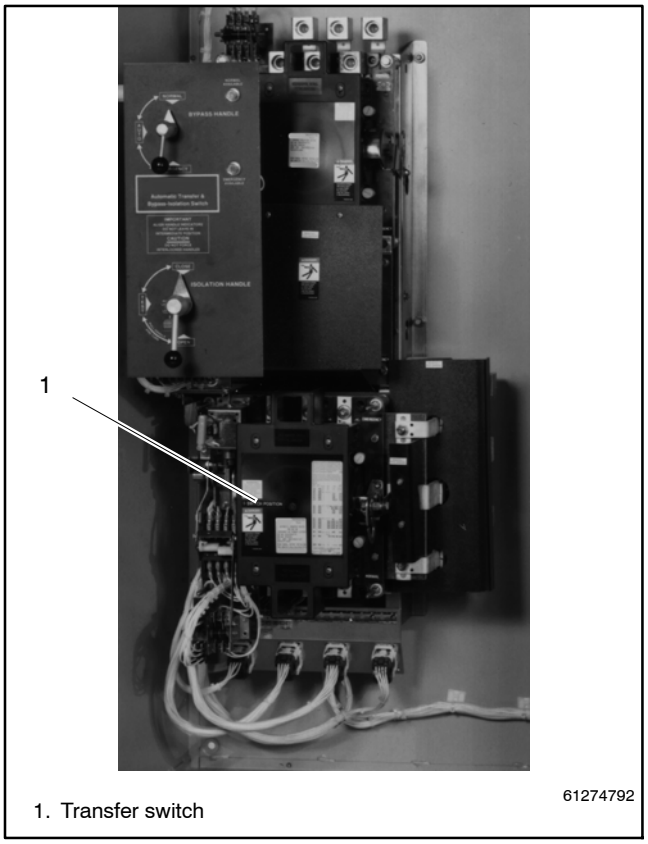
Section 8 150–400 Amp Programmed-Transition Transfer Switches and Bypass/Isolation Switches

This section explains how to replace the transfer switch main contacts and operator coil in 150–400 amp bypass/isolation switches and programmed-transition transfer switches (standard or bypass models). This section also contains instructions for adjusting and replacing the control contacts in 150–400 amp bypass/isolation switches.

- 150–400 amp KCP
- 150–400 amp KBS
- 150–400 amp KBP

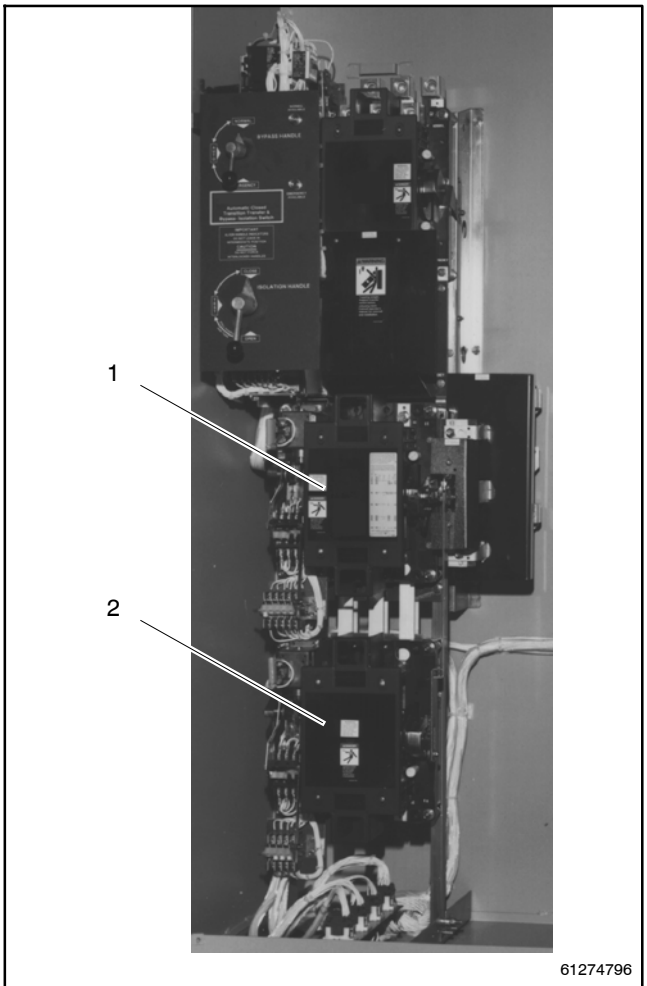
Note: For 150–600 amp model KCP connection B switches, see Section 7. To identify connection B switches, check the model designation shown on the transfer switch nameplate. Connection B switches have a letter B at the end of the model designation. Example: KCP-DNTA-0400**B**.

Figure 8-1 and Figure 8-2 show typical bypass/isolation switches.



1. Transfer switch

Figure 8-1 Typical Bypass/Isolation Switch



1. Upper transfer switch
2. Lower transfer switch

Figure 8-2 Typical Programmed-Transition Bypass/Isolation Switch

8.1 Manual Operation

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

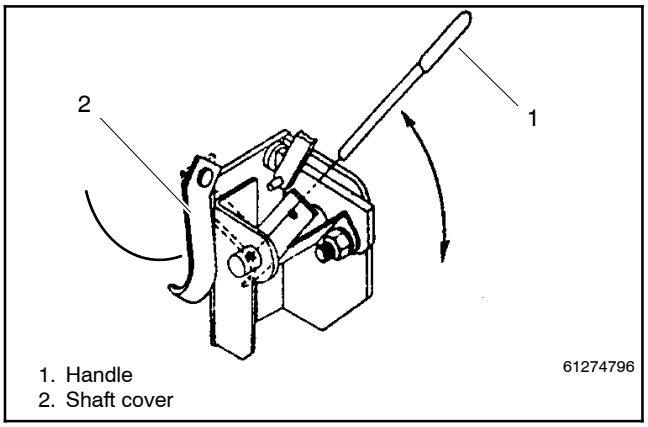
Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

A detachable manual operator handle is provided *for maintenance purposes only.* The handle is stored on the upper left side of the switch.

Note: Bypass and isolate the transfer switch before manually operating it. See the bypass/isolation switch operation and installation manual for instructions.

Swing the shaft cover to the left out of the way. Insert the manual handle into the hole in the shaft, left side of the operator. See Figure 8-3. Move the handle down and up to manually operate the switch, as needed, in the following maintenance procedures.



1. Handle
2. Shaft cover

Figure 8-3 Manual Operator Handle

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

Swing the shaft cover over the shaft after removing the manual operator handle.

8.2 Main Contact Replacement

Refer to the transfer switch parts catalog for instructions to obtain replacement parts.

Tools Needed

- Phillips screwdriver
- Blade screwdriver
- Hex key wrench, 5/32 in.
- Nutdriver, 5/16 in.
- Nutdriver or socket wrench, 9/16 in.
- Open-end wrench, 11/32 in.
- Torque wrench (100 in. lb.)
- Torque wrench (240 in. lb., 20 ft. lb.)
- Voltmeter
- Ohmmeter (or continuity tester)
- Pliers
- Cotton swab or small brush
- Pencil or wood dowel
- Ruler

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

Follow these instructions to remove the barrier/pole cover and arc chutes and gain access to the main contacts.

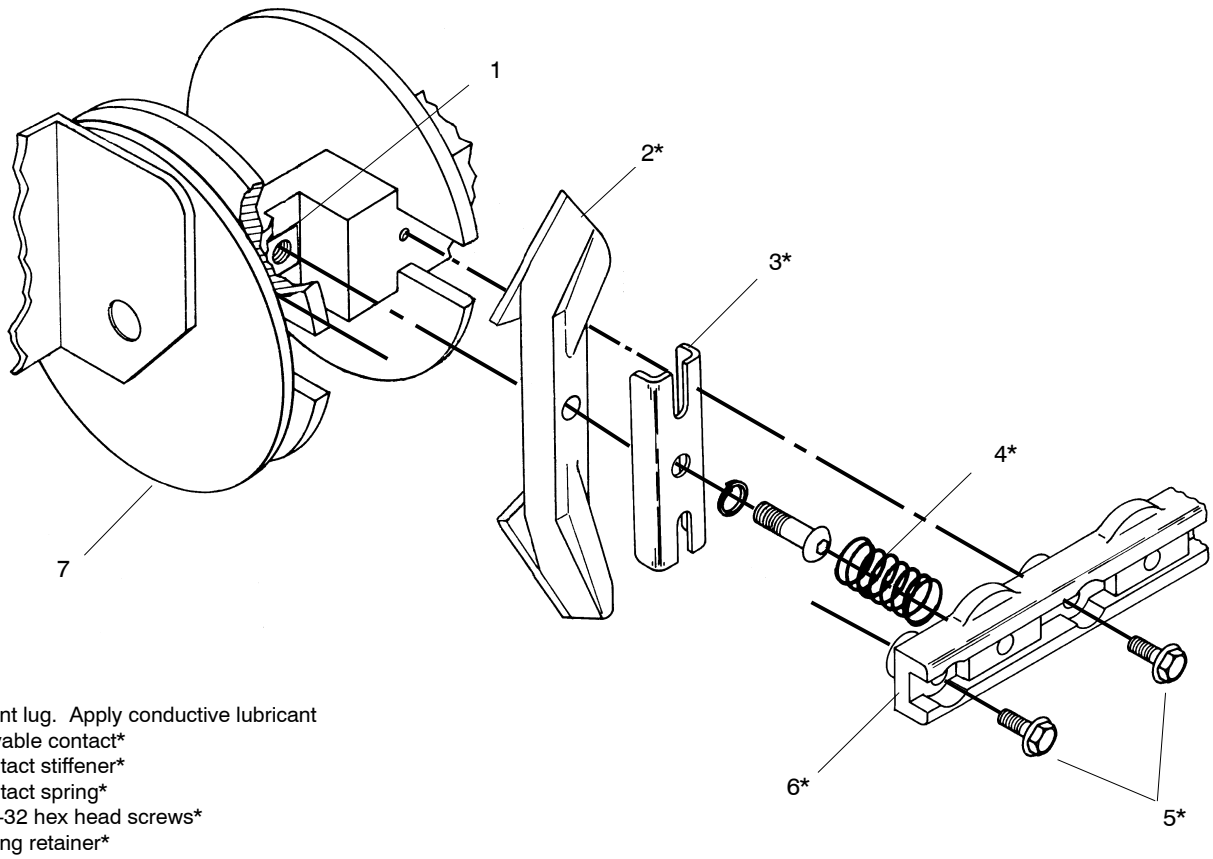
1. Remove the barrier/pole cover: Use a Phillips screwdriver to remove the four cover screws. Then remove the cover.

2. Remove all arc chutes: Use a blade screwdriver to remove the nylon retainer nuts on both sides of each chute. Then tip the chute toward the shaft while pulling it away from the panel. Place the arc chutes in a safe place.

8.2.1 Movable Contacts

Disassembly

The movable contacts are mounted in the shaft. They are secured to the shunts by screws and held in place by the contact spring retainer. See Figure 8-4.



1. Shunt lug. Apply conductive lubricant
2. Movable contact*
3. Contact stiffener*
4. Contact spring*
5. #10-32 hex head screws*
6. Spring retainer*
7. Shaft

* Parts included in the kit.

61274796

Figure 8-4 Figure 2. Movable contact.

1. Remove the contact spring retainer. Use a 5/16 in. nutdriver to remove four # 10-32 hex head (Sems) screws with shake washers from the shaft, then remove the retainer.

   Note: The retainer is under spring pressure. Hold the retainer with one hand and loosen all four screws equally to release the retainer pressure.

2. Remove all contact springs. Pull off contact springs from heads of screws.

3. Remove all movable contacts. Remove the 1/4-20 screws with lockwashers from the contacts by using a 5/32 in. hex key wrench. Then remove the contacts and contact stiffeners.

Reassembly

Reassemble as shown in Figure 8-4.

1. Apply conductive lubricant to shunt lugs. Use a cotton swab or small brush to apply conductive lubricant to the exposed surface of each shunt lug in the shaft.

   Note: Failure to use conductive lubricant between the shunt lug and contact may cause overheating.

2. Install new movable contacts. Place a new contact on the shaft and secure it to the shunt lug with the 1/4-20 screw and lockwasher. Each screw passes through the movable contact and contact stiffener, into the shunt lug. Tighten the screw by using a 5/32 in. hex key wrench to 100 in. lb..

   Note: To prevent overheating, torque the movable contact screw to 100 in. lb. To prevent binding, check the contact for free movement in shaft.

3. Install new contact springs. Press a new spring onto the head of each screw that secures a movable contact.

4. Install the contact spring retainer. Place the spring retainer onto the springs so that they seat into the cavities of the retainer. Compress the springs with the retainer and hold it in position. Use a 5/16 in. nutdriver to install the four # 10-32 hex head (Sems) screws with shake washers to secure the spring retainer to the shaft. Tighten the screws.

5. Check contact deflection. Lift the tip of each movable contact to verify freedom of movement in the shaft. If there is binding, loosen the contact screw enough to reposition the shunt lug slightly, then retighten the screw to proper torque. Recheck deflection.

6. Install all arc chutes. Tip the arc chute while placing it over the stationary contact. Slide the arc chute toward the shaft (up or down) until it stops. Then position it so that it is centered over the stationary contact, and so the movable contact does not strike the arc chute plates. Secure the arc chute to the panel by using a blade screwdriver to install nylon retainer nuts on both sides of arch chute. Torque the nuts to 12–14 in. lb.

7. Slowly operate the switch with the manual handle (see Figure 1). Check contact clearance with the arc chutes.

8. Install barrier/pole cover. Place the cover against the arc chutes. Use a Phillips screwdriver to install the four cover screws.

9. Reinstall the transfer switch. Refer to Section 3 of the operation manual (*Reinstallation* and *Return to Service*).

8.2.2 Stationary Contacts

Disassembly

The stationary contacts are mounted in the molded base. They are secured from the back and bolted to the isolation stabs. See Figure 8-5.

1. Remove all arc runner screws. Use a Phillips screwdriver to remove the screw from each arc runner. Remove the arc runner by pulling it away from the contact button.

2. Remove all stationary contacts. Remove the nut and bolt by using a 9/16 in. open-end wrench and a 9/16 in. socket wrench. Also remove the two hex nuts from the threaded studs by using a 7/16 in. socket wrench, then remove the stationary contact from the molded base.

Reassemble

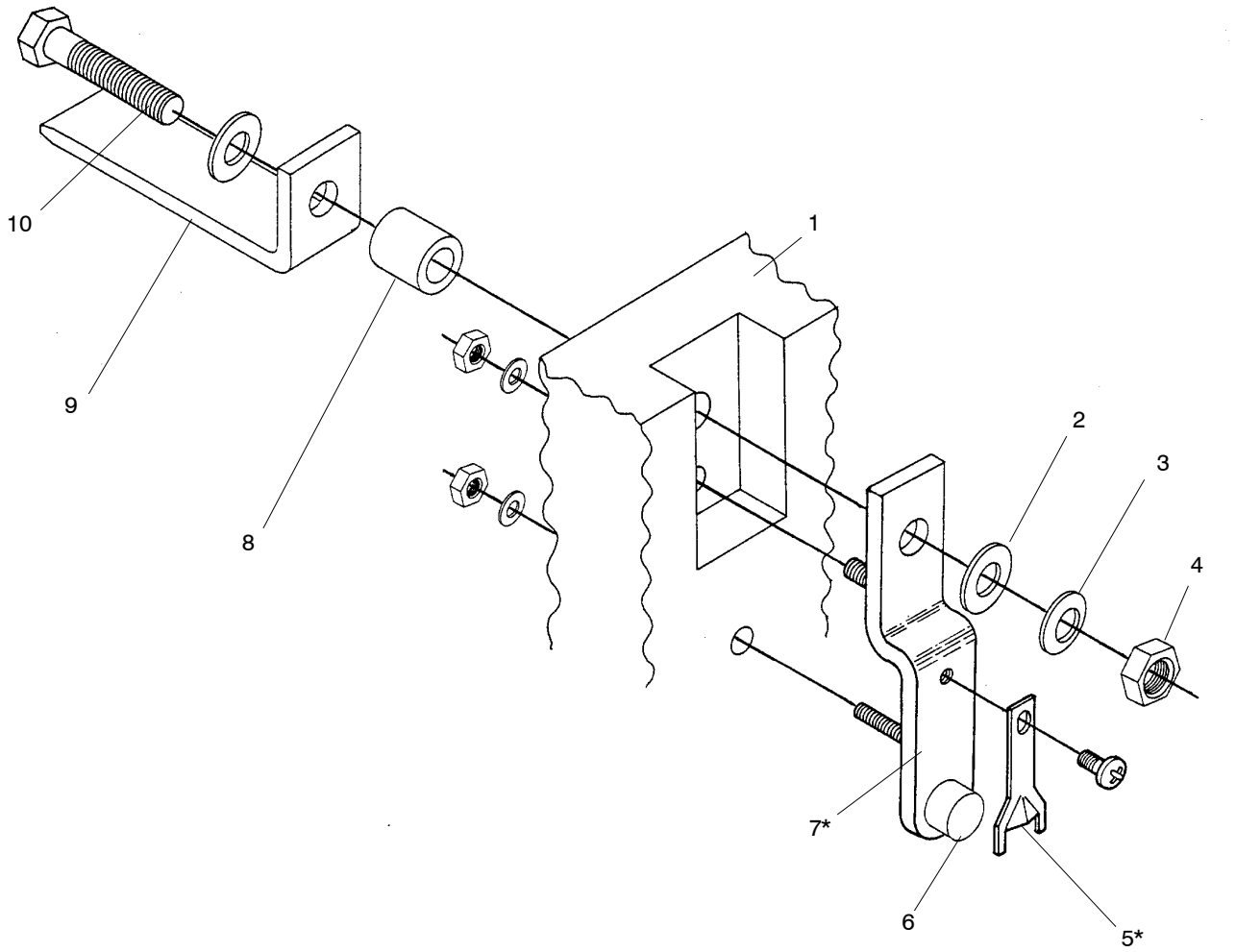
Reassemble as shown in Figure 8-5.

1. Install new stationary contacts. Insert each new stationary contact into the molded base and secure it by installing two hex nuts with flat washers behind the base. Use a 7/16 in. socket wrench to tighten the nuts.

2. Reconnect the isolation stabs. From the back of the molded base, insert the bolt with flat washers through the isolation stab, bushing, and stationary contact. Secure the connection with the hardware shown in Figure 3. Then use a 9/16 in. socket wrench and torque wrench to tighten to 27 Nm (20 ft. lb.)

   Note: To prevent overheating, tighten the stationary contact to the isolation stab connection to 27 Nm (20 ft. lb.) torque.

3. Install new arc runners. Install each arc runner flat against the plate by using a Phillips screwdriver to install two screws. Be sure that the formed side is out, and that the jaws are on both sides of the contact button.



1. Molded base
2. Flat washer
3. Bevel washer
4. Nut
5. Arc runner*
6. Button
7. Stationary contact*
8. Bushing
9. Isolation stab
10. Tighten isolation stab to stationary contact connection to 27 Nm (20 ft. lb. or 240 in. lb.) to prevent overheating.

* Parts included in the kit.

Figure 8-5 Stationary Contact. [Tighten connection to 27 Nm (20 ft. lb.) to prevent overeaten.]

8.3 Operator Coil Replacement

Refer to th transfer switch parts catalog for instructions to obtain replacement parts.

8.3.1 Removing Coil Assembly

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

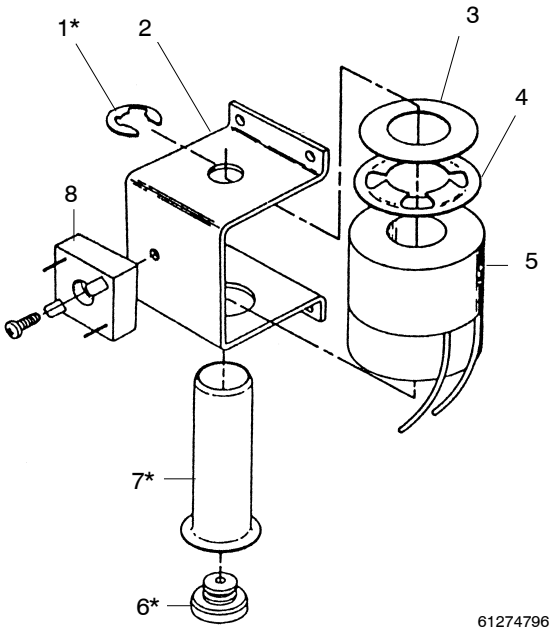
The coil assembly is mounted to the top left corner of the base with two screws. Follow these steps to remove the coil assembly and place it on a work bench for disassembly.

1. Close the top main contacts. Use the manual operator handle to put the switch in the *Emergency* position.
2. Disconnect the rectifier. Pull off the four terminal lugs from the square rectifier mounted on the coil frame, then bend the wire leads away from the coil assembly.
3. Remove the clip assembly. Use a 5/32 in. hex key wrench to remove two screws with lockwashers from the frame, then remove the coil assembly.

   Note: To prevent the possibility of personal injury or property damage, hold the coil assembly securely when removing screws. The spring exerts substantial force on the coil assembly.
4. Remove the core spring. Leave the core and link hooked onto the weight pin, but remove the core spring from the core.

8.3.2 Disassembly

The solenoid coil is held in the frame by the core tube. The retaining ring secures the core tube and stub core. See Figure 8-6.



1. Retainer ring*
2. Frame
3. Spacer washer*
4. Spring washer*
5. Coil
6. Stub core*
7. Core tube*
8. Rectifier

* Parts included in the kit.

Figure 8-6 Coil Replacement

1. Remove the retaining ring. Use a blade screwdriver to pry the retaining ring out of the groove in the stub core that extends through the frame.

2. Remove the core tube and stub core. Pull the core tube out through the other end of the frame. The stub core will come out with the core tube.

3. Remove the coil and washers. Pull the coil and washers out the side of the frame.

8.3.3 Reassembly

Position the coil frame on its left side (rectifier on the left) on the workbench. The end of the frame with the large hole should be facing you. See Figure 8-6.

1. Install the new coil: Place a new coil (leads up and facing you), with washers at the far end, into the frame. Be sure the coil leads face the end of the frame with the large hole and that they face up.

2. Install the new core tube: Drop the stub core into the core tube so that it extends through the end of the tube. Align the holes in the coil, insulating washer, spring washer, and frame to accept the core tube. Insert the core tube with stub core through the frame, coil, spacer washer, and spring washer so that the stub core extends through the frame. Use a pencil or wood dowel in the core tube, if necessary, to push the stub core through the frame.

   Note: *Do not insert any metal tool inside the core tube.*

3. Install the retaining ring: Use pliers to slide the retaining ring into the groove in the stub core to secure the core tube in the frame.

4. Lubricate the core tube and spring: Apply lubricant from *lubrication kit* 331800 to the inside of the core tube and to the new core spring. Then insert the spring into the core tube.

8.3.4 Installing Coil Assembly

1. Install the coil assembly: Place the coil assembly with core spring onto the solenoid core (still connected to the weight pin). Compress the spring with downward pressure while installing the two screws with a 5/32 in. hex key wrench. Tighten the screws to secure the coil assembly to the switch base. Note that only the lower left and upper right holes in the coil frame are used.

2. Replace the rectifier, if necessary. Remove the center screw to remove the rectifier and install the new rectifier turned so its terminal with the *red dot* is on the upper left.

3. Reconnect the coil leads. Connect the coil leads with pink lugs to the rectifier's push-on terminals marked with a *red dot* and *no dot* (DC + and – output).

4. Reconnect the rectifier. Connect the AC control leads with white lugs (from the base) to the rectifier's push-on terminals marked with *yellow dots.*

5. Use the manual handle to operate the switch to check the solenoid assembly (see Figure 1). *The action should be smooth, without any binding.* If not, recheck alignment of parts and lubrication in the solenoid operator. Return the switch to the *Normal* position (top main contacts open). Then remove the manual handle and store it in the clips on the top left side of the switch.

6. Reinstall the transfer switch. Refer to the bypass/isolation switch operation and installation manual.

8.4 Control Contact Test & Adjustment

This section explains how to test and adjust the TS Coil Control Contacts. The TS Control Contacts control the duration of time that power is applied to the main solenoid operator (TS Coil). To assure proper operation, it is important that the contacts open at the proper time during the stroke of the solenoid. Improper adjustment will cause failure to operate at reduced voltages, failure of the main contacts to properly seat, and solenoid failure.

The TS Control Contacts are factory set with an adjustable power supply so that the switch can operate satisfactorily over a voltage range of 80 to 110% of the nominal system voltage. To accommodate minor variances in friction and tolerances, it is not unusual for the control contact settings to vary from switch to switch.

The adjustments are factory sealed and usually do not require any change over the life of the switch. If it should become necessary to check adjustments in the field, an approximation can be made by using the following procedure. The adjustments can vary to the extremes and still provide acceptable operation. However, it is important that the TS Control Contacts always open ***BEFORE*** top-dead-center is reached by the solenoid core.

8.4.1 Test and Adjustment Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

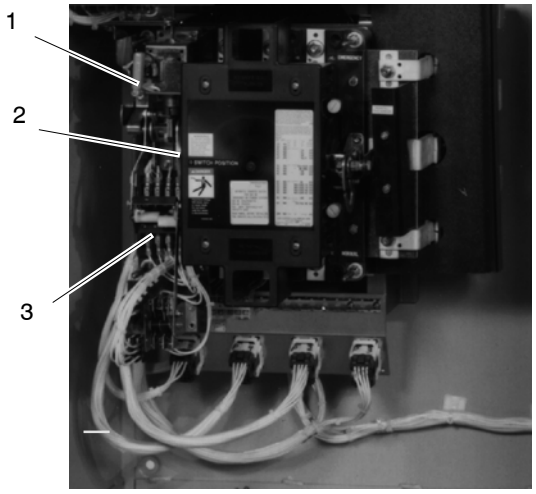
Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

1. Bypass, isolate, and remove the transfer switch. See the operation and installation manual.

2. Locate the TS control contact assembly. See Figure 8-7.



1. Manual operator handle storage
2. Main position indicator:
   N=closed on normal
   E=closed on emergency
3. TS control contact assembly

61274792

Figure 8-7 Control Contact Assembly Location

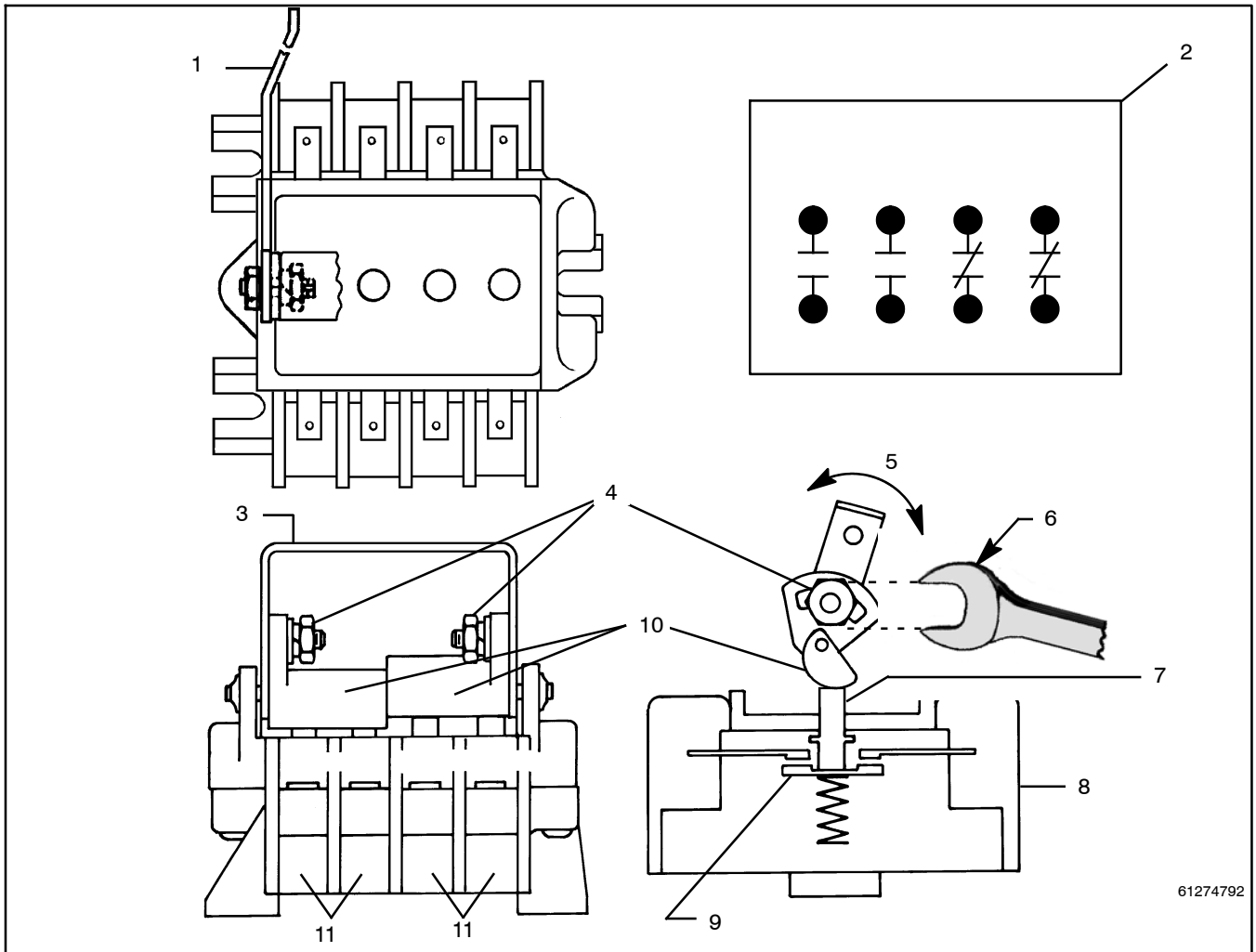
3. To verify settings and field adjust the TS control contacts, proceed as follows:

   a. Refer to Figure 8-9. Two sets of contacts interrupt the control current to the solenoid operator coil (TS) in each direction (transfer to emergency and retransfer to normal). The pairs of coil clearing contacts do not have to operate simultaneously, but both must break the circuit ***BEFORE*** the main solenoid operator core reaches top-dead-center. See Figure 8-8 for control contact positions.

N=Normal position **E**=Emergency position
TDC=Top dead center of solenoid core or main contact shaft.

Figure 8-8 Control Contact Positions

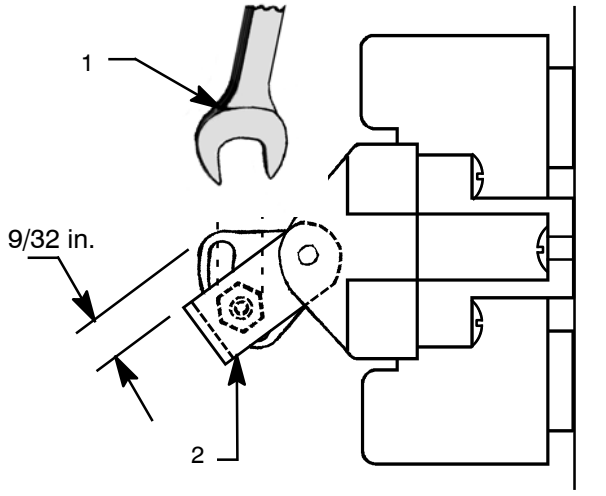
   b. With power disconnected, use an ohmmeter (or a lamp type continuity tester) across each contact to determine when the control contacts open while slowly turning the manual operator handle. Refer to Section 8.1, Manual Operation, for operating handle instructions.



1. Upper drive link
2. Electrical diagram. Control contact positions shown when TS contacts are closed on the normal source.
3. Drive bracket
4. #8-32 hex locking nuts
5. Range of adjustment
6. Open end wrench, 11/32 in.
7. Operating button
8. Cutaway side view
9. Typical control contacts 69, 70; contacts open when operating button is depressed by cam
10. Cams
11. Control contact sets

Figure 8-9 TS Control Contact Arrangement.

c. If adjustment of contacts 71–72 and 9–8 is necessary, refer to Figure 8-10. Make sure the main contacts of the transfer switch are closed on emergency (see position indicator in Figure 8-7). Use the manual operator handle, if necessary, to move the switch to the emergency position. Loosen the #8-32 hex nut that unlocks the drive bracket from the cam adjustment slot on the right side of the assembly. Rotate the cam until its top edge is within 7.1 mm (9/32 in.) from the side of the drive bracket. Retighten the locking nut and verify adjustment as described in step 4, sections a and b.



1. Wrench, 11/32 in.
2. Drive bracket

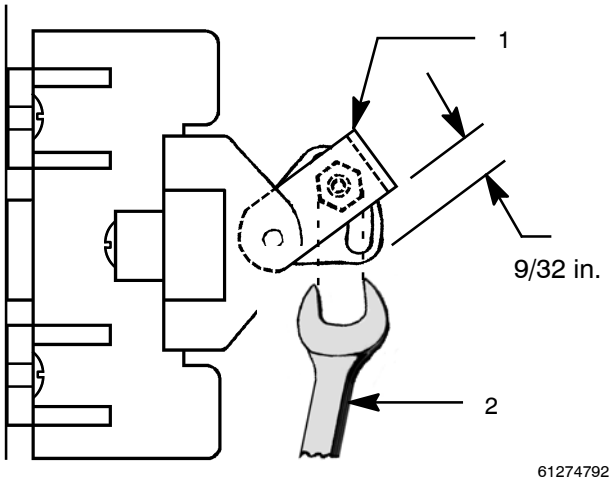
View from right side of TS control contact assembly. Main transfer switch contacts must be closed on emergency side.

Figure 8-10 Adjusting TS Control Contacts 71–72 and 9–8

d. If adjustment of contacts 69–70 and 7–6 is necessary, refer to Figure 8-11. Make sure the main contacts of transfer switch are closed on the normal side (see position indicator in Figure 8-7). Use the manual operator handle, if necessary to move the switch to the normal position. Loosen the 8-32 hex nut that unlocks the drive bracket from the cam adjustment slot on the left side of the assembly. Rotate the cam until its bottom edge is within 7 mm (9/32 in.) from the side of the drive bracket. Retighten the locking nut and verify adjustment as described in step 4, sections a and b.

e. The settings shown in Figure 8-10 and Figure 8-11 are satisfactory in most cases. However, settings can vary over the range of adjustability to accommodate variances in tolerances, friction, and 80% minimum operating voltage provided that the control contact positions as shown in Figure 8-8 are maintained.

f. Reinstall the transfer switch. Refer to the operation manual.



1. Drive bracket
2. Wrench, 11/32 in.

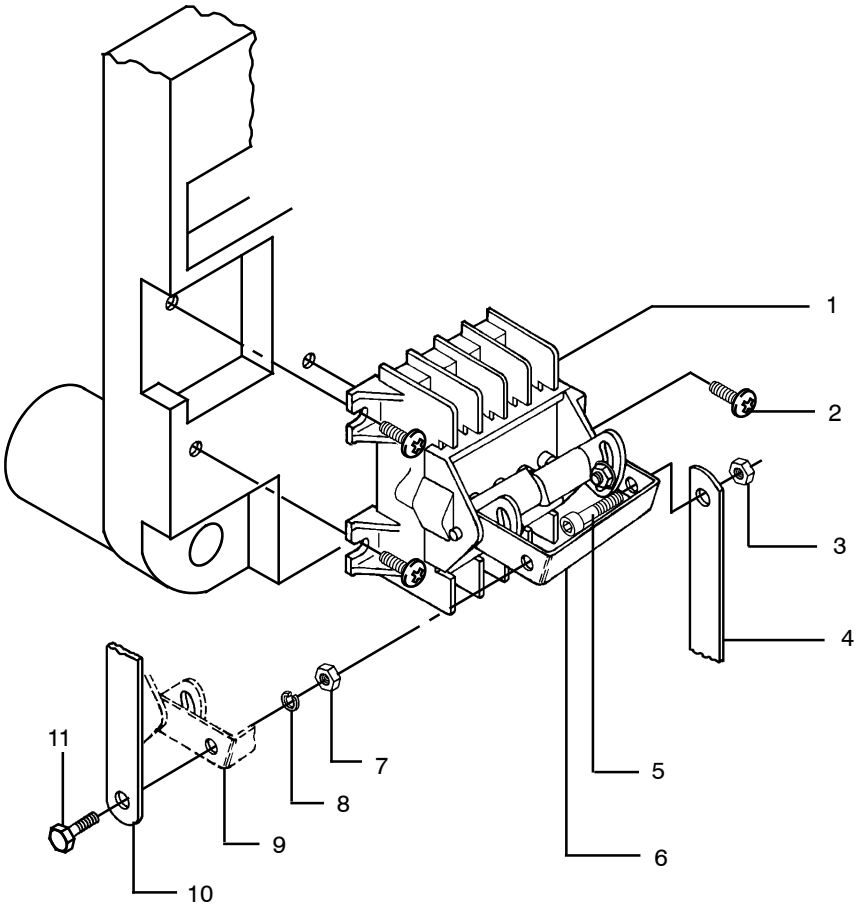
View from left side of TS control contact assembly. Main transfer switch contacts must be closed on normal side.

Figure 8-11 Adjusting TS Control Contacts 69–70 and 7–6

8.4.2 Test Control Contact Replacement

Under normal conditions the TS control contacts do not require replacement over the life of the transfer switch. If replacement becomes necessary, proceed as follows:

1. Bypass, isolate, and remove the transfer switch. See the operation and installation manual.
2. Refer to Figure 8-12. Disconnect the upper drive link by removing the #10-32 shoulder screw, lockwasher, and hex nut from the left side of the drive bracket on the control contact assembly. Then reinstall the hardware into the loose linkage for safekeeping.



1. TS control contact assembly
2. Phillips head self-tapping mounting screws (3 ea.)
3. #10-32 locknut
4. lower drive link
5. #10-32 allen head screw
6. Drive bracket
7. Hex nut
8. Lockwasher
9. Drive bracket
10. Upper drive link
11. #10-32 shoulder screw

Figure 8-12 TS Control Contact Assembly Replacement

3. Disconnect the lower drive link by removing the #10-32 allen head screw and locknut from the right side of the drive bracket. Then reinstall the hardware into the loose link for safekeeping.

4. Check to assure that the leads connected to the control contact assembly are marked so they can be identified after being disconnected. Add labels if necessary.

5. Disconnect the labeled leads from the control contact assembly.

   Note: Do not pull on the leads. Pry off connectors with a screw driver. Pulling may damage the crimped wire connection.

6. Remove three #8 Phillips head self-tapping screws from the mounting feet and remove the control contact assembly.

7. Install new control contact assembly onto switch base. Apply one drop of Loctite® to each mounting screw thread to reform self tapping holes and secure assembly.

8. Reconnect the lower drive link to the drive bracket (right side) with the #10-32 allen head screw and locknut. Check for free play between the locknut and drive link.

9. Reconnect the upper drive link to the left side of the drive bracket on the control contact assembly with the #10-32 shoulder screw, split lockwasher, and hex nut. Check for free play between screw head and drive bracket.

10. Manually operate the drive linkage. The action should be smooth without any binding. Be sure the cams properly operate the pushbuttons on the control and auxiliary contact assemblies.

11. Reconnect the eight labeled leads to the proper terminals.

12. Check the control contact adjustment. See Section 8.4.1, Test and Adjustment Procedure.

* Loctite is a registered trademark of the Loctite Corporation.

This section explains how to replace the arcing and main contacts and the solenoid coil and assembly in the following transfer switches.

- 600–1200 amp Model KCS

Note: For 600 amp model KCS connection B switches, see Section 7. To identify connection B switches, check the model designation shown on the transfer switch nameplate. Connection B switches have a letter B at the end of the model designation. Example: KCS-DNTA-0600**B**.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Tools Needed

- Safety glasses (for eye protection)
- Straight blade 6 in. screwdriver, 1/4–3/8 in.
- Short handle blade screwdriver
- Ratchet drive, 3/8 in., 6 in. and 12 in. extensions
- Sockets, 3/8 in., 1/2 in., 9/16 in.
- Open-end or box wrenches, 3/8, 7/16, 9/16, and 1/2 in.
- Nutdriver, 5/8 in.
- Torque wrench, 0 to 27.1 Nm (0 to 20 ft. lb.)
- Needlenose and regular pliers
- Wire labels

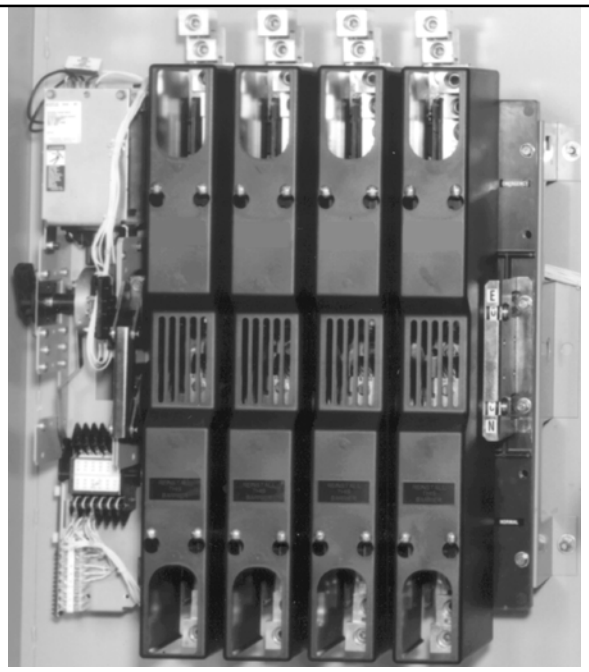


Figure 9-1 600 Amp Transfer Switch (3-pole with switched neutral shown; 600 amp has two-barrel terminal lugs)

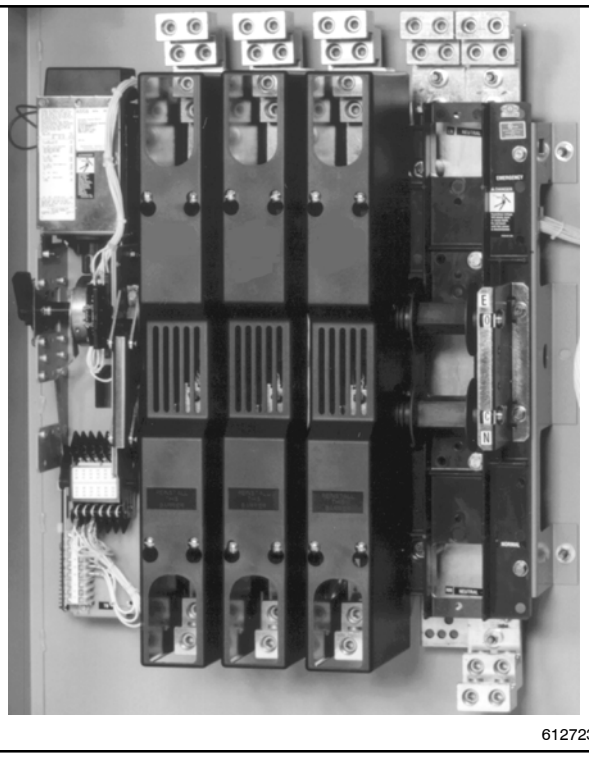


Figure 9-2 800–1200 Amp Transfer Switch (3-pole with solid neutral shown)

9.1 Maintenance Handle

A detachable maintenance handle is provided on the frame of the transfer switch *for maintenance purposes only*. After the transfer switch is completely deenergized, this handle can be used to change the position of the contacts and operator mechanism. The windows in the right side of the transfer switch frame indicate which contacts are open and closed.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

Manual Operation Procedure

1. Deenergize the transfer switch. After deenergizing both power sources, open the enclosure door. Use a voltmeter to verify that no electrical power is present at the transfer switch terminals.

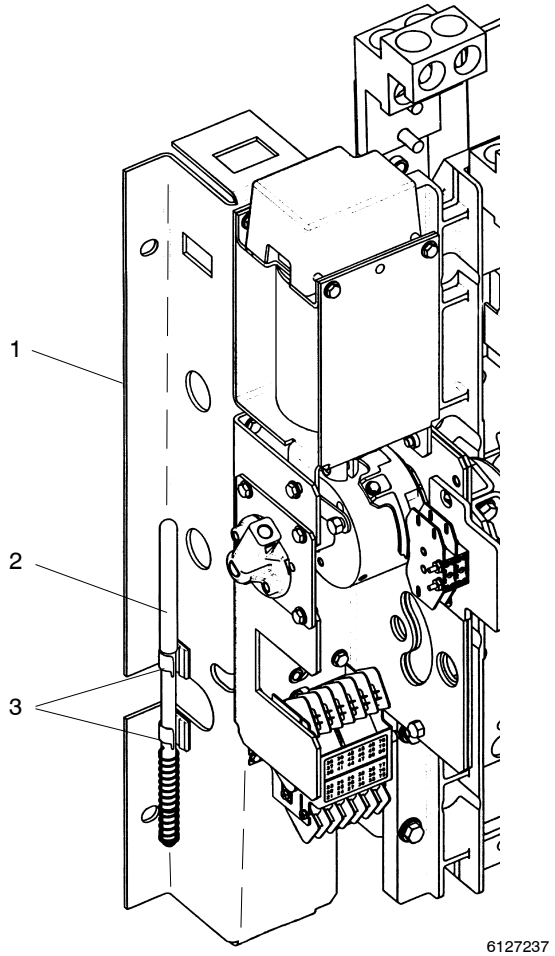
2. Install the maintenance handle. Locate and remove the maintenance handle from clips on the left side of the transfer switch frame. Insert the handle into the molded hub on the left side of the operator. See Figure 9-3, Figure 9-4, and Figure 9-5.

3. Move the maintenance handle up or down as shown to manually operate the transfer switch to the opposite position.

   Note: If Normal and Emergency connections are reversed, this operation is also reversed.

4. Return the transfer switch to the Normal position. Observe that the window indicators (right side) show the top shaft O (open) and the bottom shaft C (closed).

5. Remove the maintenance handle and store it on the frame (left side) in the clips provided.



1. Transfer switch, left side
2. Maintenance handle
3. Storage clips

Figure 9-3 Maintenance Handle and Storage Clips

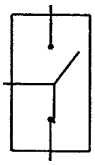
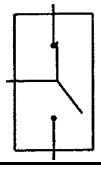
ATS Position		Handle	Indicators
Normal		up 	E = O upper contacts open N = C lower contacts closed
Emergency		 down	E = C upper contacts closed N = O lower contacts open

Figure 9-4 Maintenance Handle Positions

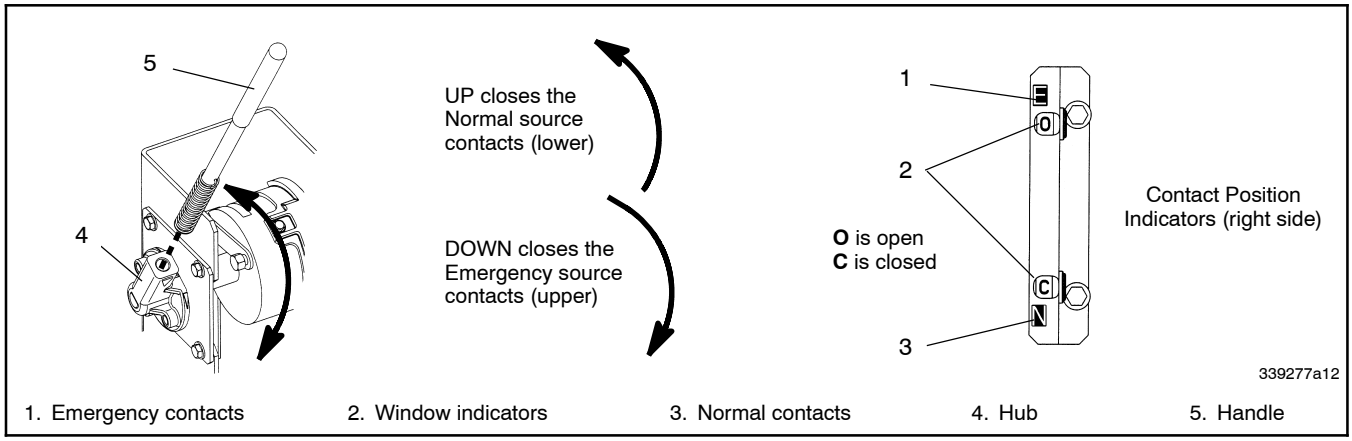


Figure 9-5 Maintenance Handle Operation and Contact Position Indicators

9.2 Main and Arcing Contact Replacement

9.2.1 Arc Chute and Barrier Removal

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

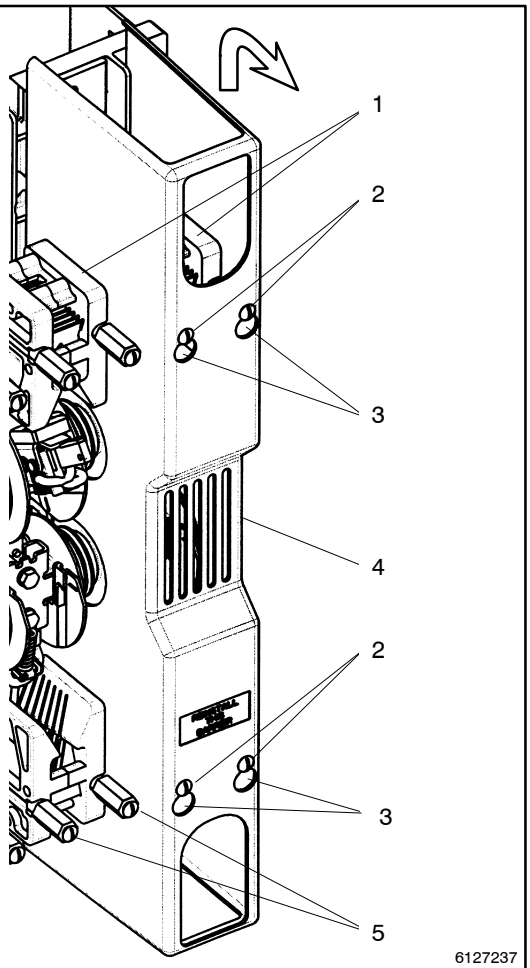
The contact assemblies (two for each pole) are located to the right of the operator mechanism.

1. Deenergize the transfer switch. After deenergizing both power sources, open the enclosure door. Use a voltmeter to verify that no electrical power is present at the transfer switch terminals.

2. Use the maintenance handle (if necessary). Open the contacts that will be replaced (if not already open). See Section 9.1.

3. Remove the interphase barriers (one per pole). Use a blade screwdriver to loosen four round head screws holding each barrier to the arc chutes. Slide the barrier up until the keyholes clear the round head screws, then remove the barrier. See Figure 9-6.

4. Remove the arc chutes. Use a 5/8 in. nutdriver to remove the two long insulator nuts. Then pull the arc chute outward (off the long threaded rods). See Figure 9-6.



1. Arc chutes
2. Loosen round head screws (do not remove)
3. Keyslots
4. Barrier
5. Insulator nuts

Figure 9-6 Interphase Barrier Removal

5. Remove the movable contact cover. Use your thumb and fingers to squeeze the sides inward until the contact cover is released from the shaft clamp (both sides). Then remove the movable contact cover. See Figure 9-7 and Figure 9-8.

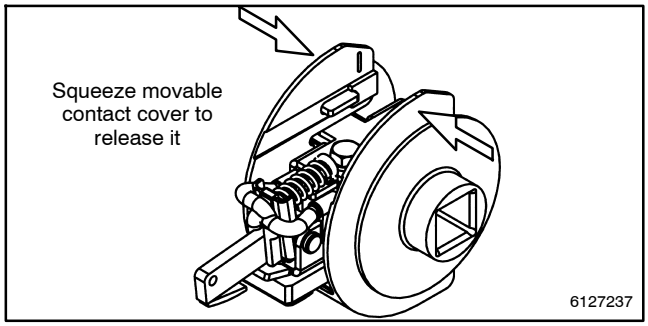
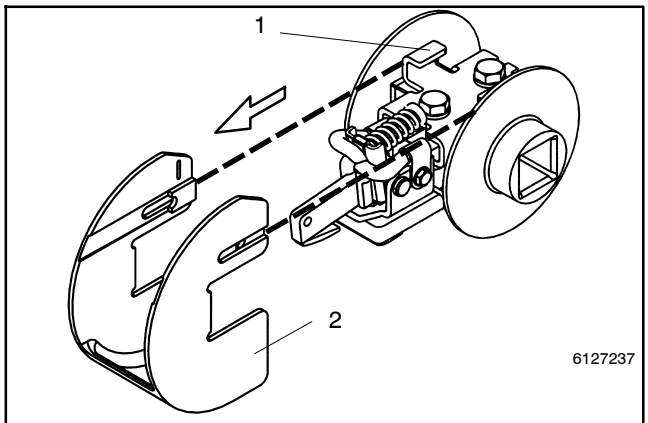


Figure 9-7 Movable Contact Cover Release



1. Shaft clamp
2. Movable contact cover

Figure 9-8 Movable Contact Cover Removal

9.2.2 Contact Inspection

The main contacts are protected by arcing contacts. The arcing contacts make first and break last to avoid arcing at the main contacts. Contact condition should be checked annually. Replace contacts when contact material becomes severely worn. Discoloration is normal. Do not file contacts because it wastes material. Instead use light emery paper to clean the contact surfaces. If the main contacts require replacement, follow the procedure for *Main and Arcing Contact Assembly Replacement*. If only the arcing contacts require replacement, follow the procedure for *Arcing Contact Replacement*.

Open the contacts that will be replaced (if not already open) by using the maintenance handle. See Section 9.1.

9.2.3 Movable Arcing Contacts

Arcing Contacts *make* first and *break* last during load transfer. They protect the main contacts.

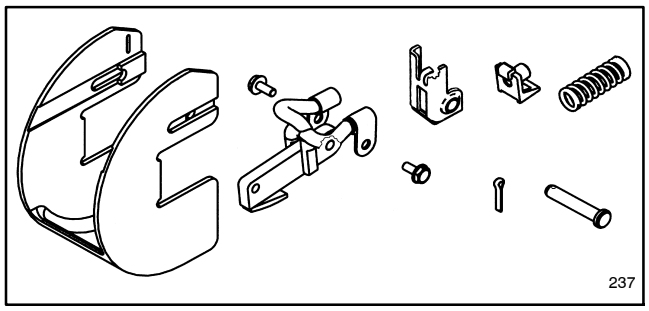


Figure 9-9 Replacement Movable Arcing Contact Kit (kit includes one movable arcing contact with cover, arcing contact spring, spring bracket, spring retainer, and hardware; a 3-pole switch requires six kits)

Movable Arcing Contact Replacement Procedure

⚠ WARNING

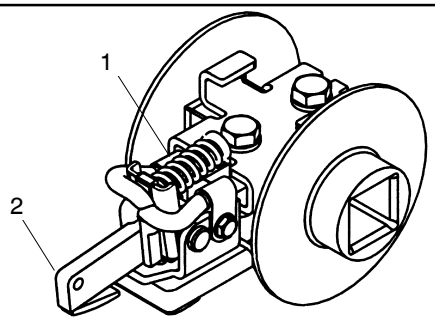
Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Note: To prevent the possibility of eye injury, wear safety glasses when removing the arcing contact spring. The spring may fly off if not held securely.

1. Remove the movable contact cover. See Section 9.2.1.

2. Remove the movable arcing contact spring. Use a screwdriver (or spring compressor) to carefully release the movable arcing contact spring from the tab on the shaft clamp. *See the note above!* Then remove the spring and spring retainer. See Figure 9-10.

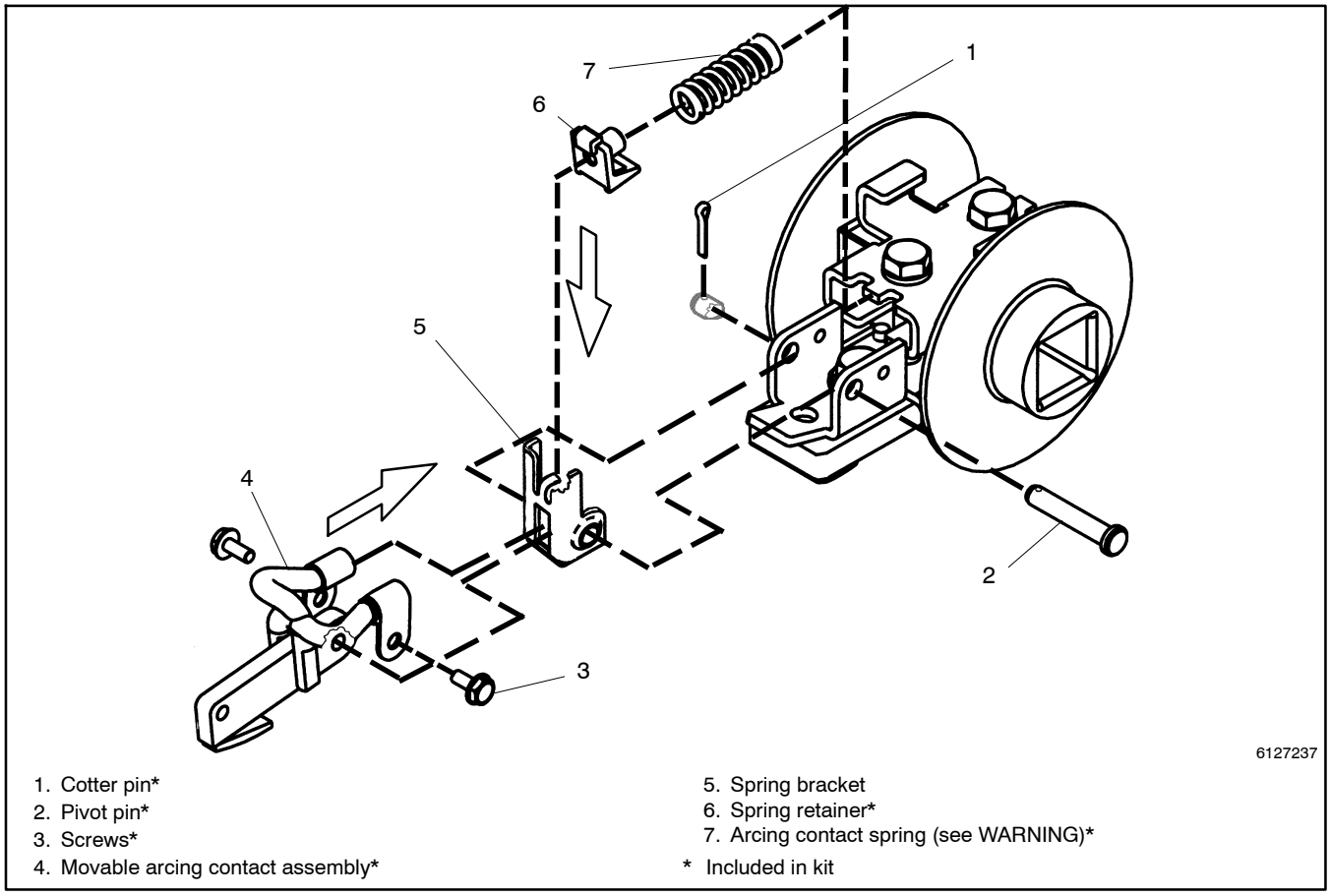


1. Arcing contact spring (see WARNING)
2. Movable arcing contact

Figure 9-10 Movable Contact Assembly

3. Disconnect the movable arcing contact shunts. Use a 5/16 in. open-end or box wrench to remove two SEMS screws that secure the movable arcing contact shunts to the pivot bracket. See Figure 9-11.

4. Remove the pivot pin from the pivot bracket. Use needlenose pliers to straighten and remove the cotter pin that secures the pivot pin. Then remove the pivot pin, spring bracket, and movable arcing contact. See Figure 9-11.



1. Cotter pin*
2. Pivot pin*
3. Screws*
4. Movable arcing contact assembly*
5. Spring bracket
6. Spring retainer*
7. Arcing contact spring (see WARNING)*

* Included in kit

Figure 9-11 Movable Arcing Contact Assembly

5. Install the new movable arcing contact. Install the new spring bracket into the pivot bracket. Then insert the new movable arcing contact into the slot of the spring bracket. Next insert the new pivot pin through the pivot bracket, spring bracket, and movable arcing contact. Install the new cotter pin into the end of the pivot pin (spread or bend the cotter pin to secure the assembly). See Figure 9-11.

6. Connect the new movable arcing contact shunts. Install two SEMS screws (#10-32 3/8 in.) to connect the two shunts of the new movable arcing contact to the pivot bracket. Tighten the screws with a 5/16 in. open-end or box wrench. See Figure 9-11.

Note: To prevent the possibility of eye injury, wear safety glasses when installing the new arcing contact spring. The spring may fly off if not held securely.

7. Install the new movable arcing contact spring. Install the new spring retainer onto the tab on the spring bracket. Then use a screwdriver (or spring compressor) to carefully install the new movable arcing contact spring between the spring retainer and the tab on the shaft clamp. See Figure 9-11.

8. Install the new movable contact cover onto the movable contact assembly. Use your thumb and fingers to squeeze the sides inward until the contact cover is latched onto the metal bracket (both sides). See Figure 9-7 and Figure 9-8.

9.2.4 Movable Main Contacts

Main contacts *make* last and *break* first during load transfer. They carry the electrical load.

Replacement movable main contacts are available as part of the movable contact assembly, which includes the main contact and the arcing contact.

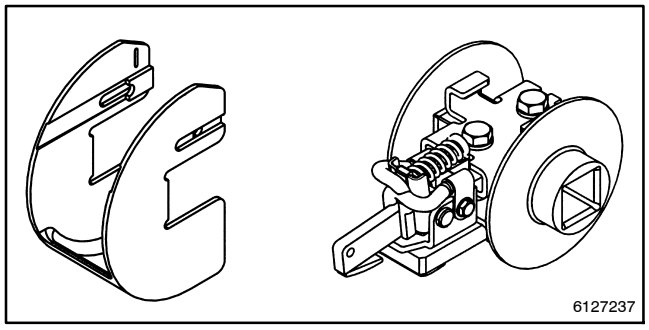


Figure 9-12 Replacement Movable Contact Kit (kit includes one movable contact with cover and main shunt hardware; a 3-pole switch requires six kits)

Movable Arcing/Main Contact Replacement Procedure

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

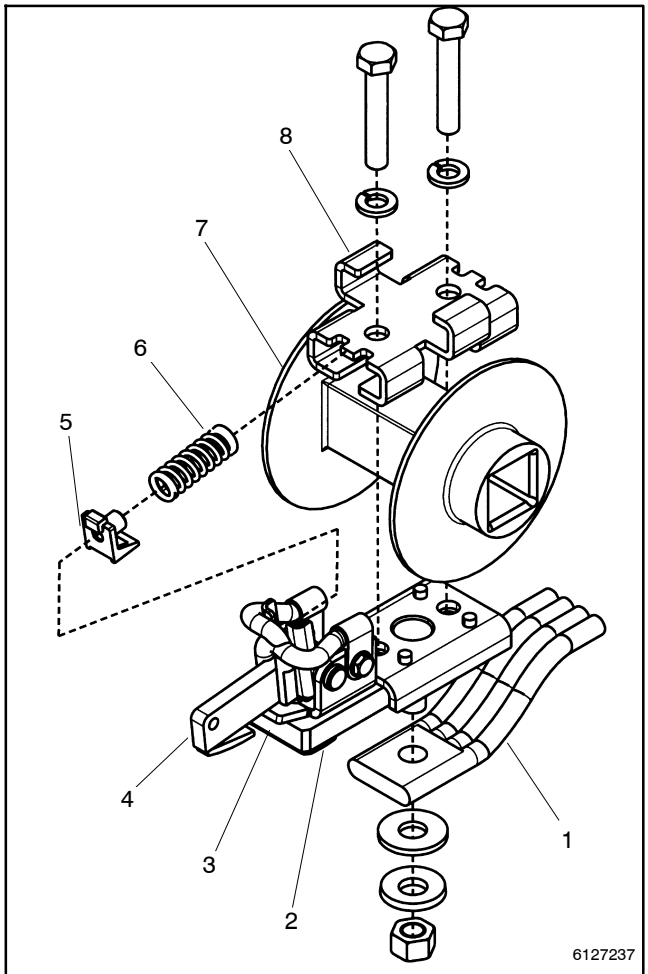
Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

1. Remove the movable contact cover. See Section 9.2.1.

2. Disconnect the main shunt. Use a 3/8 in. open-end or box wrench to remove the hex nut (with disc and flat washers) that secures the main shunt to the bottom of the main movable contact assembly. See Figure 9-13.

   Note: To prevent the possibility of eye injury, wear safety glasses when removing the arcing contact spring. The spring may fly off if not held securely.

3. Remove the movable arcing contact spring. Use a screwdriver (or spring compressor) to carefully release the movable arcing contact spring from the tab on the metal bracket. See the WARNING first! Then remove the spring and spring retainer. See Figure 9-13.



1. Main shunt
2. Main movable contact
3. Movable arcing and main contact assembly*
4. Movable arcing contact
5. Spring retainer*
6. Arcing contact spring (see WARNING)*
7. Shaft insulator; replace only if badly damaged
8. Shaft clamp*

* Included in kit

Figure 9-13 Movable Main Contact Assembly

4. Disconnect the main shunt. Use a 3/8 in. open-end or box wrench to remove the hex nut (with disc and flat washers) that secures the main shunt to the bottom of the main movable contact assembly. See Figure 9-13.

5. Remove the shaft clamp and movable contact assembly. Use a 5/16 in. socket wrench to remove the two hex head bolts (with lock washers) that secure the movable contact assembly and shaft clamp to the shaft. See Figure 9-13.

   Note: Replacing the shaft insulator is usually unnecessary. If it is badly damaged, contact Kohler Co. for assistance. Disassembly and readjustment of the main contact shaft will be required.

6. Install the new movable contact assembly. Position the new movable contact assembly under the shaft (align protrusions on both side). Secure it by installing the new shaft clamp and the new 5/16-18 x 1 3/4 in. long hex head bolts with split lock washers. Tighten both bolts to 6.8 Nm (5 ft. lb.), then continue tightening them to 14.9 Nm (11 ft. lb.). See Figure 9-13.

7. Reconnect the main shunt. Make sure the main shunt and new movable contact assembly surfaces are clean (do not use any abrasive). Position the main shunt under the movable contact assembly (onto the stud) and secure it with a new 3/8 in. flat washer, new 3/8 in. disc washer (curved surface toward nut), and new a 3/8 in. hex nut. Use a 3/8 in. open-end or box wrench to tighten nut. See Figure 9-13.

   Note: To prevent the possibility of eye injury, wear safety glasses when installing the new arcing contact spring. The spring may fly off if not held securely.

8. Install the new movable arcing contact spring. Install the new spring retainer onto the tab on the spring bracket. Then use a screwdriver (or spring compressor) to carefully install the new movable arcing contact spring between spring retainer and the tab on the shaft clamp. See Figure 9-13.

9. Install the new movable contact cover. Install the new movable contact cover onto the movable contact assembly. Use your thumb and fingers to squeeze the sides inward until the contact cover is latched onto the metal bracket (both sides). See Figure 9-7 and Figure 9-8.

9.2.5 Stationary Arcing Contacts

Figure 9-14 shows the replacement stationary arcing contact kit. Refer to the ATS parts catalog for instructions to obtain replacement parts.

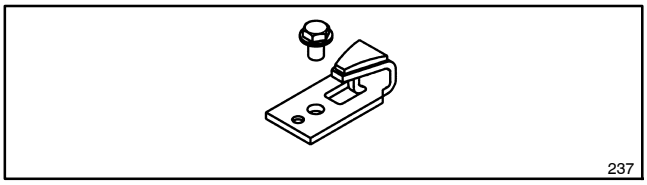


Figure 9-14 Replacement Stationary Arcing Contact Kit (Includes one stationary arcing contact and mounting screw; 3-pole switch requires six kits)

Stationary Arcing Contact Replacement Procedure

1. Remove the stationary contact assembly. Use a 3/8 in. socket wrench with 12 in. extension to remove the hex nut from the base of the stationary contact assembly. Then remove the washers, quick connect terminal plate, and stationary contact assembly from the stud in the bus plate. See Figure 9-15.

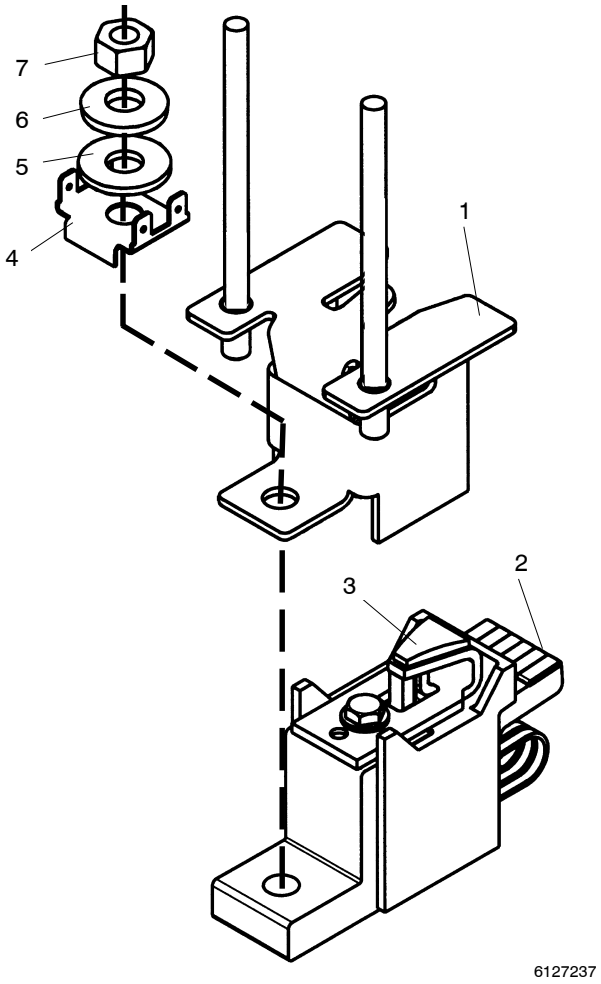
2. Remove the stationary arcing contact. Use a 3/8 in. socket wrench to remove the hex head (SEMS) screw, then remove the stationary arcing contact. See Figure 9-16.

3. Install the new stationary arcing contact. Make sure the arcing contact and contact block surfaces are clean (do not use any abrasive). Use a 3/8 in. socket wrench to install a new hex head screw (SEMS 1/4-20 x 3/8 in. long) and a new stationary arcing contact onto the contact block. The rectangular protrusion should align with the rectangular hole in the arcing contact. Tighten the screw to 7.5 Nm (5.5 ft. lb.). See Figure 9-16.

   Note: Torque the stationary arcing contact mounting screw to 7.5 Nm (5.5 ft. lb.) to prevent overheating at the contact block.

4. Reinstall the stationary contact assembly. Make sure the bus plate and contact assembly surfaces are clean (do not use any abrasive). Position the stationary contact assembly onto the stud in the bus plate. Use a 3/8 in. socket wrench with 12 in. extension to install the quick connect terminal plate, heavy flat washer, new heavy disc washer (curved surface out), and 3/8 in. hex nut to secure the assembly. Tighten to 27.1 Nm (20 ft. lb.) torque. See Figure 9-13.

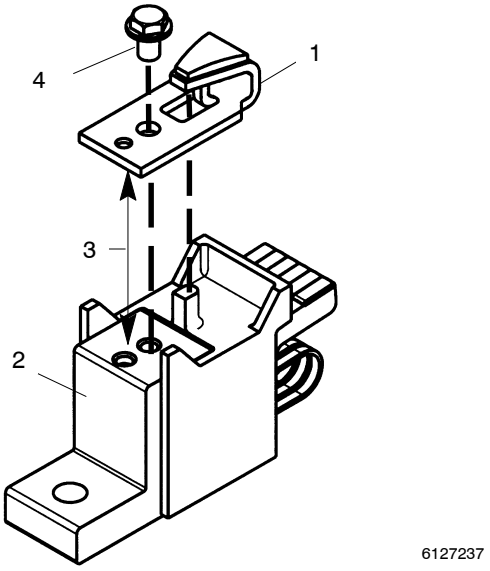
   Note: Torque the stationary contact assembly nut to 27.1 Nm (20 ft. lb.) to prevent overheating at the bus plate.



1. Arc chute mounting bracket
2. Main contacts
3. Arcing contact
4. Terminal plate
5. Flat washer
6. Disc washer
7. Hex nut

Note: Tighten hex nut to 27.1 Nm (20 ft. lb.)

Figure 9-15 Stationary Contact Assembly



1. Arcing contact*
2. Contact block
3. These surfaces must be clean
4. SEMS screw (1/4-20 x 3/8 in. long)* Tighten to 7.5 Nm (5.5 ft. lb.)

* Included in kit

Figure 9-16 Stationary Arcing Contact

9.2.6 Stationary Contact Assembly Replacement

Replacement stationary contacts (arcing and main) are available as an assembly. See Figure 9-17.

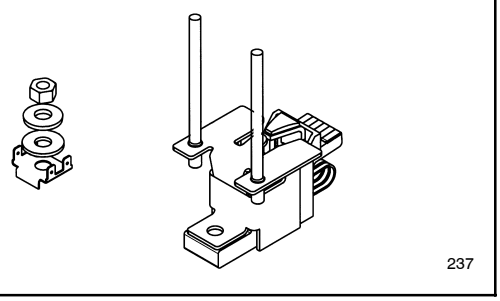


Figure 9-17 Replacement Stationary Contact Kit (includes one stationary main and arcing contact assembly with arc chute bracket and mounting hardware; a 3-pole switch requires six kits)

Stationary Contact Assembly Replacement Procedure

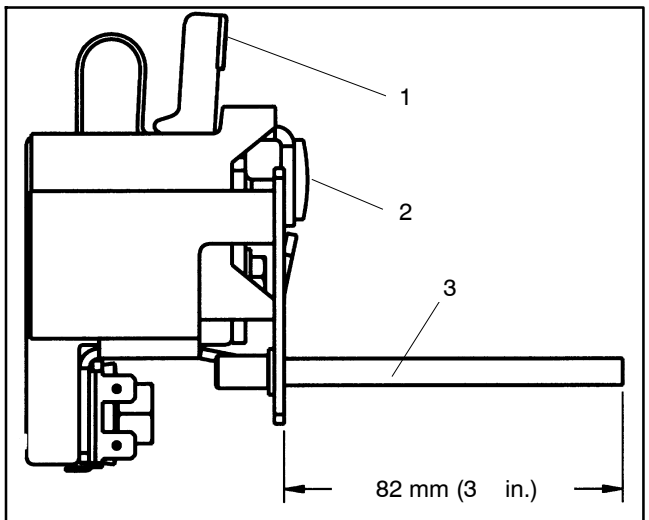
1. Remove the stationary contact assembly. Use a 3/8 in. socket wrench with 12 in. extension to remove the hex nut from the base of the stationary contact assembly. Then remove the washers, quick connect terminal plate, and stationary contact assembly from the stud in the bus plate. See Figure 9-15.

2. Install the new stationary contact assembly. Make sure the bus plate and contact assembly surfaces are clean (do not use any abrasive). Position the new stationary contact assembly onto the stud in the bus plate. Use a 3/8 in. socket wrench with 12 in. extension to install the new quick connect terminal plate, new heavy flat washer, new heavy disc washer (curved surface out), and new 3/8 in. hex nut to secure the assembly. Tighten to 27.1 Nm (20 ft. lb.) torque. See Figure 9-15.

9.2.7 Arc Chute and Barrier Reinstallation

After the arcing or main contacts are replaced, reinstall the arc chutes and interphase barriers as described in the following procedure.

1. Check the arc chute mounting rods. Make sure the two threaded rods are installed in the arc chute support plate. They should extend out from the plate no more than 82 mm (3.25 in.). The two treaded rods should have thread sealant to hold the proper length. See Figure 9-18.



1. Main contacts
2. Arcing contact
3. Threaded rods

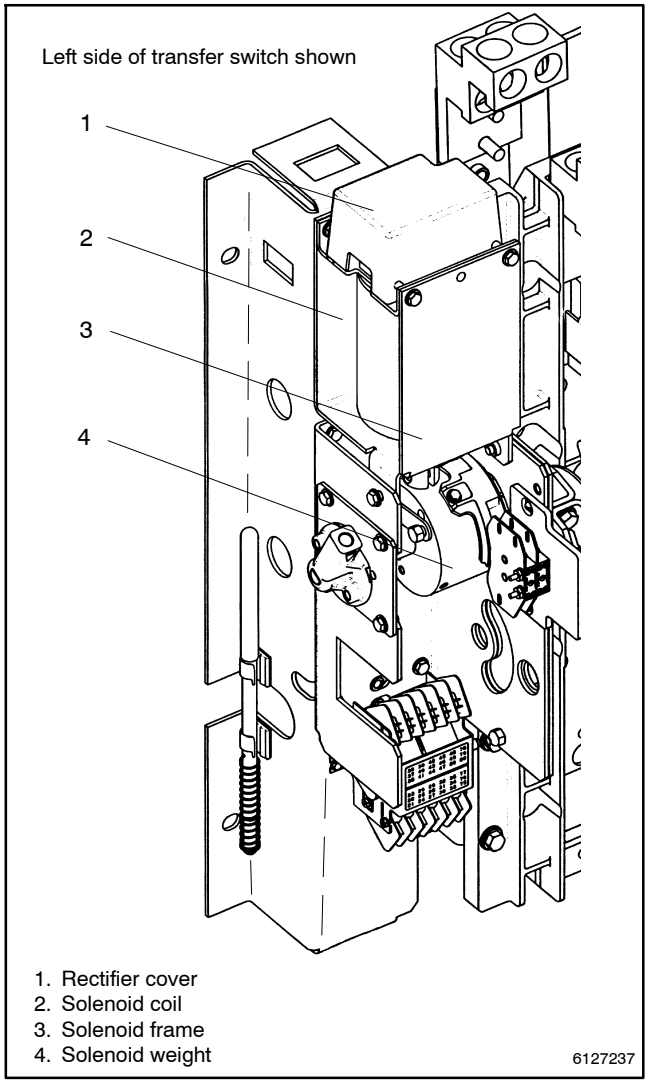
Figure 9-18 Threaded Rods For Arc Chutes

2. Reinstall the arc chute. Slide the arc chute (arc splitters toward the contacts and recess for nuts outward) between the two long threaded rods. Reinstall the two long insulator nuts (round shoulder in) and use a 5/8 in. nutdriver to GENTLY tighten until snug. Do not overtighten these nuts. See Section 9.2.1.

3. Reinstall the interphase barrier. Install the barrier over the arc chutes and slide it up until the four round head screws align in the four keyholes in the barrier. Then slide the barrier down. Use a blade screwdriver to tighten the four round head screws to secure the barrier to the arc chute insulator nuts. See Section 9.2.1.

9.3 Solenoid Coil and Solenoid Assembly Replacement

See Figure 9-19 for the solenoid assembly location.



1. Rectifier cover
2. Solenoid coil
3. Solenoid frame
4. Solenoid weight

Figure 9-19 Solenoid Operator Assembly

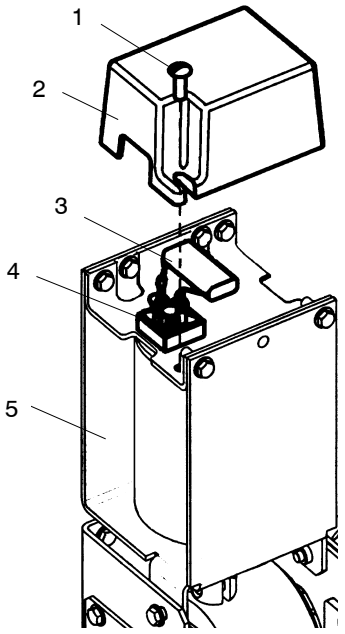
9.3.1 Solenoid Coil Replacement

Solenoid coil kits include only the coil. Refer to the ATS parts catalog for the coil kit part number for your transfer switch.

Solenoid Coil Replacement Procedure

1. Remove the rectifier cover and disconnect the coil leads. Use a blade screwdriver to loosen one screw (do not remove it) and remove the rectifier cover. Disconnect the two coil leads from the rectifier. See Figure 9-20.

2. Remove solenoid retaining bracket and coil. Use a 3/8 in. socket, open-end, or box wrench to remove the four SEMS screws from the solenoid retaining bracket. Then remove the bracket from the top of the solenoid. Remove the solenoid coil by pulling it upward (off the core tube) and out of the frame. See Figure 9-21.

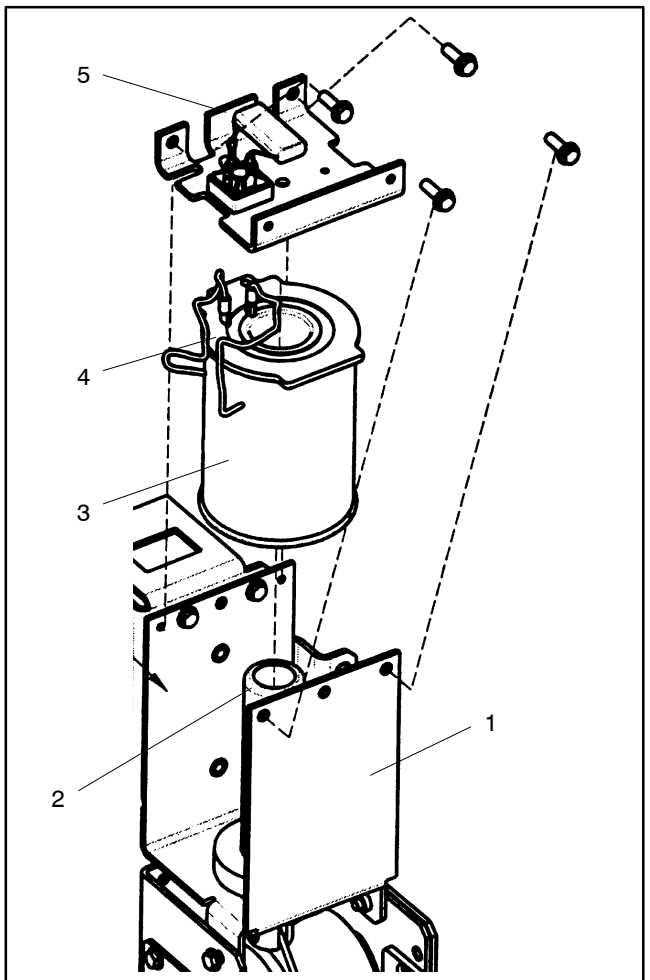


1. Screw
2. Rectifier cover
3. Snubber
4. Rectifier
5. Solenoid assembly

Figure 9-20 Rectifier Cover

3. Install the new solenoid coil. Position the new replacement coil so that the flange end is on top and the coil leads are on the left side. Install the coil (in this position) into the frame by pushing it downward (onto the core tube) and into the frame. Secure the coil by reinstalling the solenoid retaining bracket. Use a 3/8 in. socket, open-end, or box wrench to install four SEMS screws. Tighten the screws to 7.5 Nm (5.5 ft. lb.) torque. See Figure 9-21.

4. Connect the new coil and reinstall the rectifier cover. Install the quick-connect coil leads onto the rectifier terminals (DC). Then install the rectifier cover onto the top of the solenoid frame. Use a blade screwdriver to tighten the screw. See Figure 9-20.



1. Solenoid frame
2. Solenoid core tube
3. Solenoid coil*
4. Flange on coil
5. Solenoid retaining bracket

* Included in kit

Figure 9-21 Solenoid Coil

9.3.2 Solenoid Assembly Replacement

Solenoid assemblies include entire solenoid with frame, coil, core tube, core spring, and core and link.

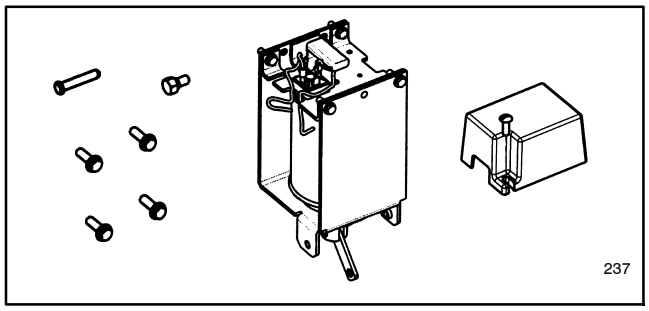


Figure 9-22 Replacement Solenoid Assembly with Core and Link (includes rectifier and cover, clevis pin, drive link screw, four mounting screws, and thread sealant)

Solenoid Assembly Replacement Procedure

1. Put the transfer switch in the EMERGENCY position. The upper contacts must be closed to replace the solenoid assembly. If necessary, use the maintenance handle to operate the transfer switch to the EMERGENCY position. See Section 9.1.

2. Insert the weight locking pin. To prevent the operator from moving during disassembly, insert the clevis pin through the hub and into the bearing plate. See Figure 9-23.

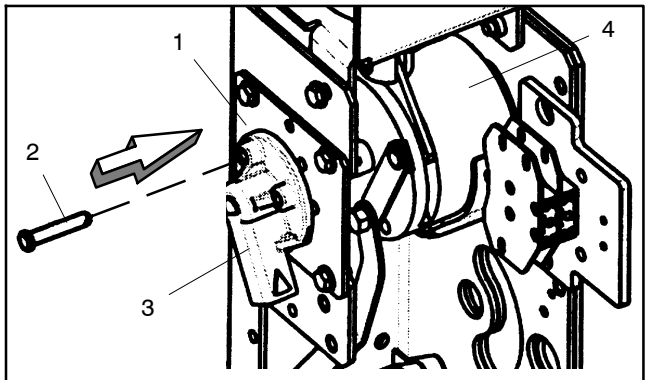


Figure 9-23 Weight Locking Pin

3. Remove the retaining screw and link pin from the weight. Use a 7/16 in. open-end or box wrench to remove the retaining screw from the left side of the weight. Then remove the link pin from the left side of the weight. See Figure 9-24.

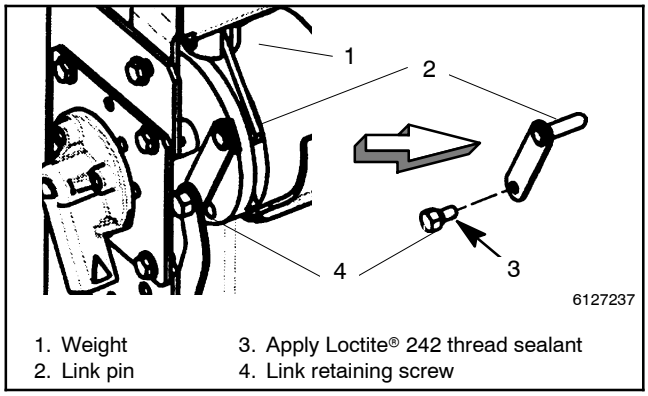


Figure 9-24 Retaining Screw and Link Pin

4. Remove the rectifier cover and disconnect the two wires. Use a blade screwdriver to remove one screw, then remove the rectifier cover. Then disconnect the two wires coming into the solenoid assembly from the harness. See Figure 9-20.

5. Remove the solenoid assembly. Use a 3/8 in. open-end or box wrench to remove four SEMS screws (two at the top, one on either side). See Figure 9-25.

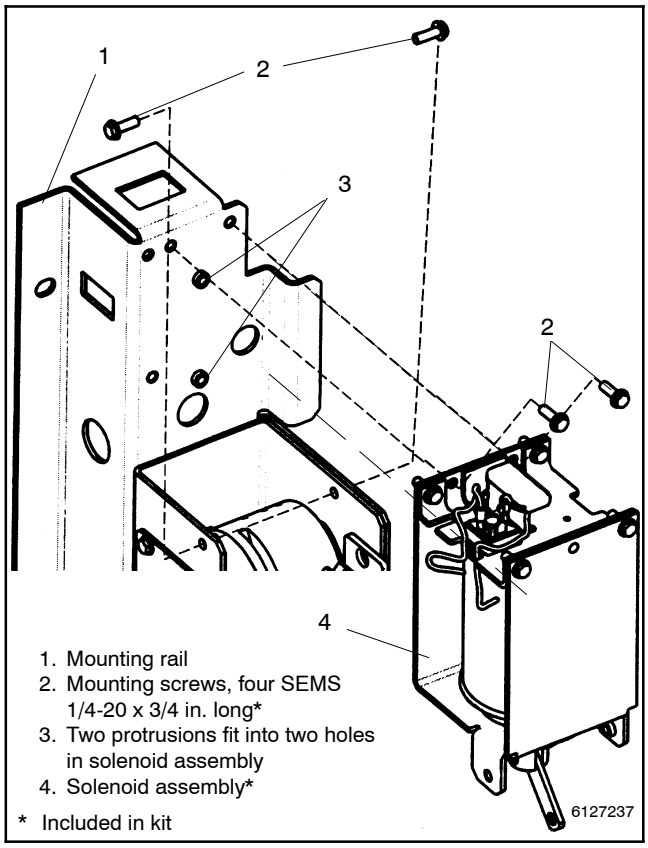


Figure 9-25 Solenoid Assembly

6. Transfer the labels from the old solenoid to the new one. Carefully remove the nameplate, WCR label, and DANGER label from the old solenoid. Then apply them to the new solenoid.

7. Install the new solenoid assembly. Position the new solenoid assembly onto the mounting rail so that the two protrusions align with the holes in the solenoid assembly. The core link should be in the slot in the weight. Use a 3/8 in. open-end or box wrench to install four new 1/4-20 x 3/4 in. long SEMS screws (two at the top, one on either side). See Figure 9-25.

8. Install the new rectifier cover and connect the two wires. Connect the two wires from the harness (previously disconnected) to the rectifier terminals (AC). Then install the new rectifier cover onto the solenoid assembly. See Figure 9-20.

9. Reinstall the link pin and screw it into the weight. Install the link pin into the left side of the weight (through the core link from the solenoid assembly). Apply Loctite® 242 sealant onto the threads of the 1/4-20 link retaining screw. Then install the screw through the control contact link and link pin into the left side of the weight. Use a 7/16 in. open-end or box wrench to tighten the retaining screw. There should be some play to allow movement of the control contact link. See Figure 9-24.

10. Remove the weight locking pin. To unlock the weight from the bearing plate, remove the clevis pin from the hub. This is very important! Otherwise severe damage will occur when transfer switch is reenergized! See Figure 9-23.

    Note: To prevent severe damage to the solenoid assembly, remove the clevis pin from the hub on the left side. Removing the clevis pin unlocks the weight, allowing free movement of the operator when it is reenergized.

11. Manually operate the transfer switch. Use the maintenance handle to operate the transfer switch several times. It should operate smoothly; if not, recheck the solenoid assembly installation.

9.4 Coil Control Contact Replacement

The coil control contact assembly (two pushbutton switches) is located below the solenoid operator on the left side of the transfer switch. See Figure 9-26 and Figure 9-27.

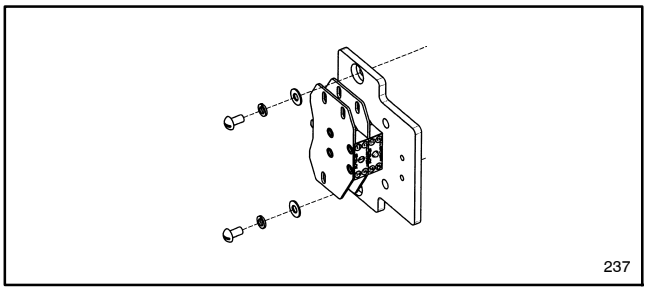


Figure 9-26 Coil Control Contact Kit (with mounting hardware)

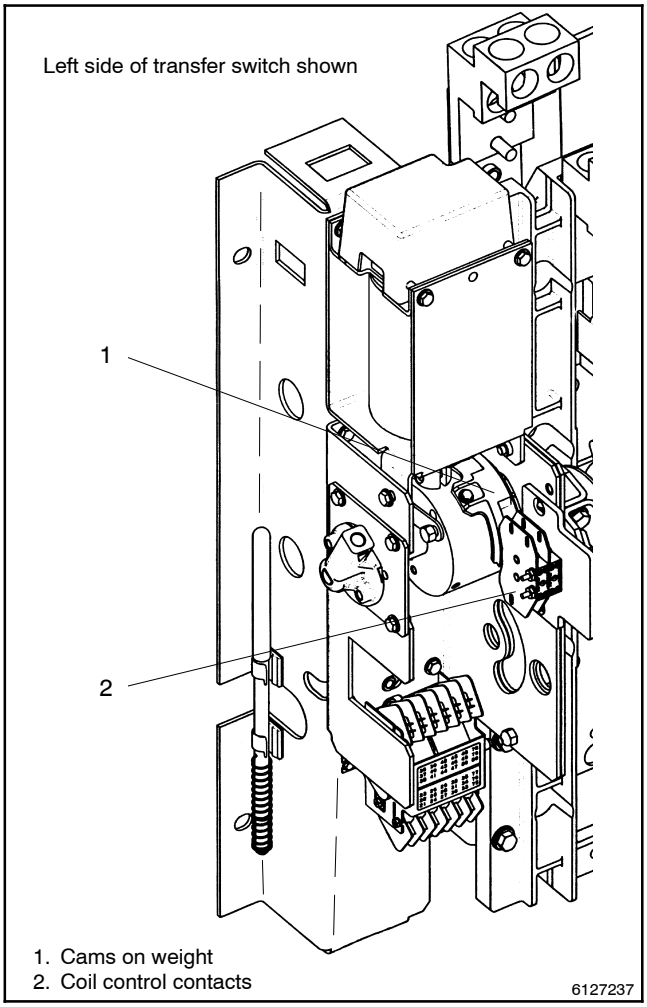


Figure 9-27 Solenoid Operator Assembly

* Loctite is a registered trademark of the Loctite Corporation.

Coil Control Contacts Replacement Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

1. Deenergize the transfer switch. After deenergizing both power sources, open the enclosure door. Use a voltmeter to verify that no electrical power is present at the transfer switch terminals.

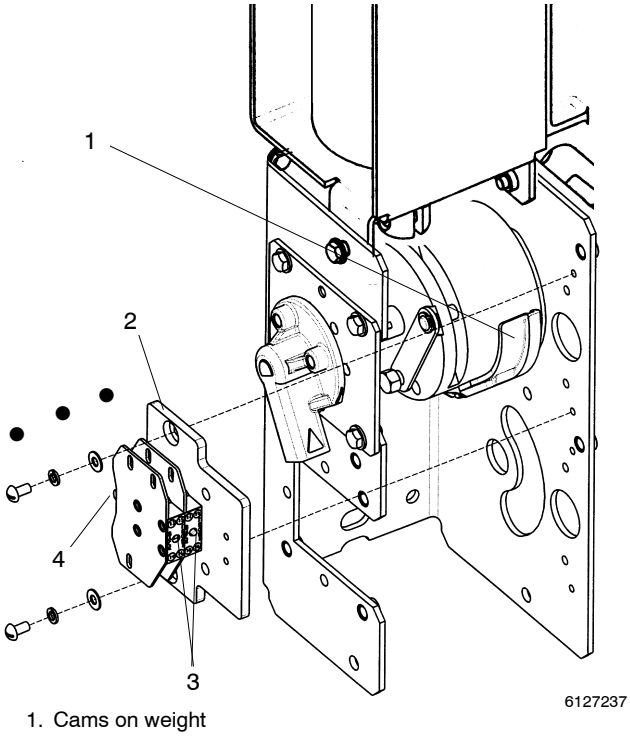
2. Label the eight wires connected to the control contacts. Carefully label all wires that are connected to the control contacts. Then use a narrow blade screwdriver to disconnect the eight wires.

3. Remove the control contact assembly. Use a short handle blade screwdriver to remove two screws with lock and flat washers. Then remove the control contact assembly. See Figure 9-28.

4. Install the new control contact assembly. Position the new control contact assembly with its pushbuttons against the cams on the weight. Use a short handle blade screwdriver to install two screws with lock and flat washers. See Figure 9-28.

5. Connect the eight labeled wires to the control contacts. Carefully reconnect the wires (disconnected in step 2) to the new control contact assembly.

6. Manually operate the transfer switch. Use the maintenance handle (see Section 9.1) to operate the transfer switch several times. You should see the two indicators change alternately from open to closed. If not, recheck the installation. See Figure 9-28.



1. Cams on weight
2. Coil control contact assembly*
3. When installed, these two indicators show one closed and the other open
4. Pushbuttons

* Included in kit

Figure 9-28 Coil Control Contact Assembly

Section 10 600–800 Amp Programmed-Transition and Closed-Transition Bypass/Isolation Switches

This section explains how to replace the transfer switch main contacts and operator coil in 600- and 800-amp programmed-transition and closed-transition bypass/isolation switches. This section applies to the following models:

- 600–800 Amp KBP
- 600–800 Amp KBC

Bypass, isolate, and remove the transfer switch from the enclosure before working on it.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

10.1 Manual Operation

A detachable manual operator handle is provided *for maintenance purposes only.* The handle is stored on the coil frame on the left side of the switch. See Figure 10-1.

Note: To prevent the possibility of personal injury or property damage, do not manually operate the transfer switch until it is bypassed and isolated.

Install the manual handle onto the upper or lower shaft on the left side of the transfer switch. See Figure 10-2. Move the handle down and up to manually operate the transfer switch, as needed, in the following maintenance procedures.

When servicing closed-transition switches, check that both contacts are not left in the closed position before energizing the switch.

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause severe injury, death, or property damage.

Before energizing the transfer switch, verify that both the normal and emergency contacts are not left in the closed position.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

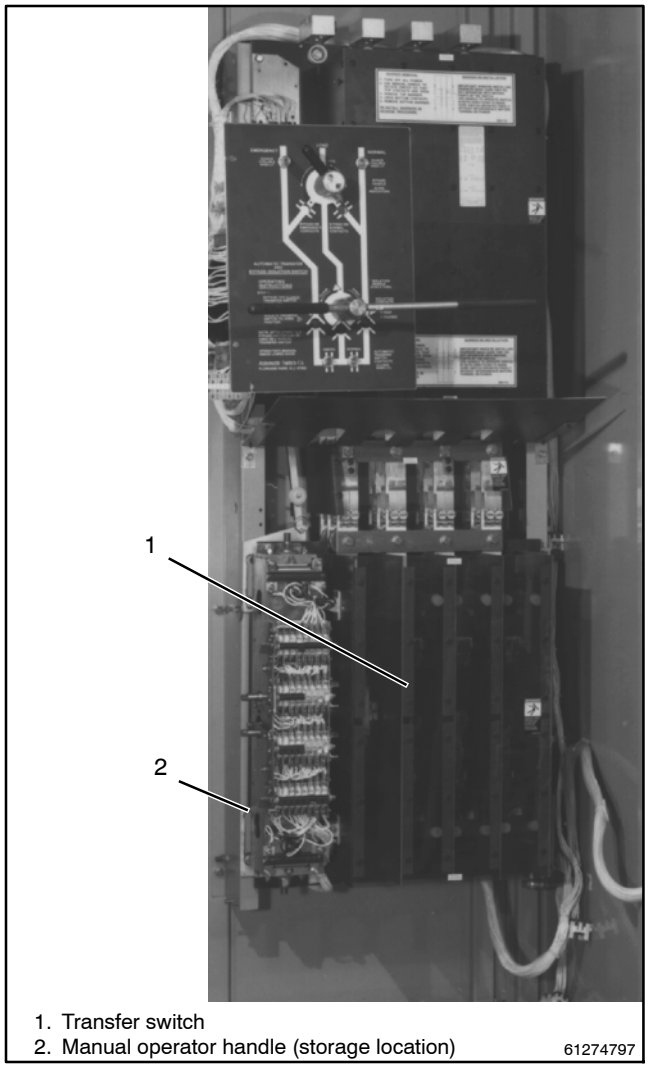


Figure 10-1 Bypass Switch, typical

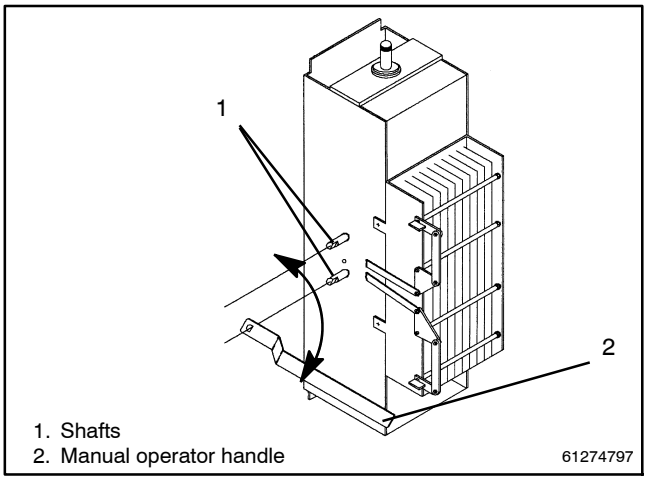


Figure 10-2 Manual Operator Handle

10.2 Main Contact Replacement

See the ATS parts catalog to identify the contact kits for your transfer switch.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

10.2.1 Tools Needed

- Medium blade screwdriver
- Phillips screwdriver
- Offset screwdriver
- Needle-nose pliers
- Rod or drill, 1/4 in. diameter
- Nutdriver, 1/4 in.
- Nutdriver, 5/16 in.
- Nutdriver, 7/16 in.
- Nutdriver, 1/2 in.
- Nutdriver, 3/4 in.
- Hex key wrench, 1/8 in.
- Hex key wrench, 3/16 in.
- Open-end wrench, 5/16 in.
- Socket wrench, 7/16 in.
- Socket wrench, 1/2 in.
- Bench vise
- Voltmeter
- Ruler
- Loctite® 222
- Thread sealant
- Cotton swab or small brush

* Loctite is a registered trademark of the Loctite Corporation.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

10.2.2 Remove Barriers and Arc Chutes

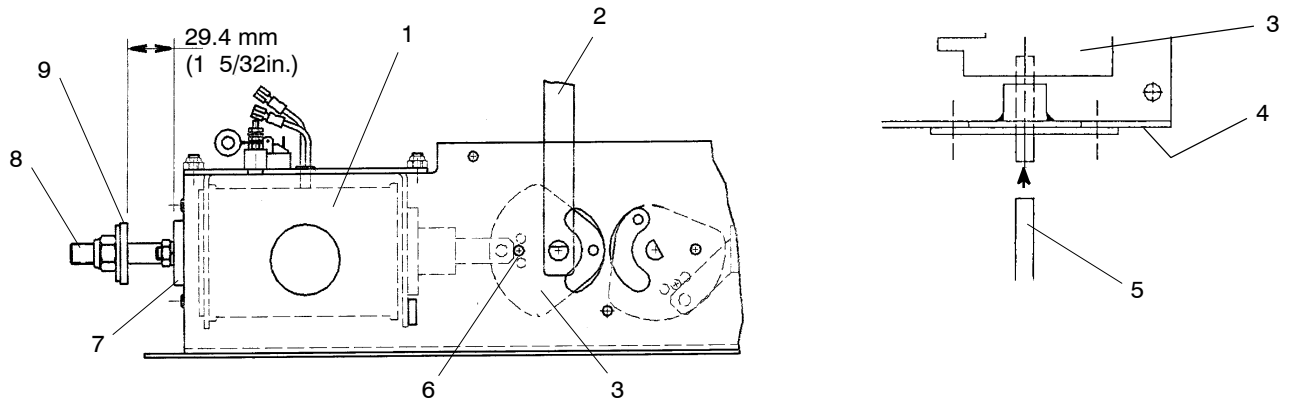
The barriers and arc chutes must be removed to gain access to the main contacts.

Procedure to Remove Barriers and Arc Chutes

1. Remove the barrier cover. Use a Phillips screwdriver to loosen only four screws (two on each side). Then pull the barrier cover straight out.

2. Remove all arc chutes. Use a screwdriver to remove two nylon retainer nuts and fiber clamp piece on each chute. Then carefully pull the arc chute away from the panel.

3. Put the switch in the center position (TDC). Use the manual handle to open the contacts until a 1/4 in. diameter rod (drill) can be inserted into the center hole in the side of the weight. It will hold the operator in the top-dead-center position and the contact shaft in a mid position. See Figure 10-3.



1. Coil
2. Manual operator handle
3. Weight
4. Sidewall of operator frame
5. Rod, 1/4 in. diameter. Insert rod through sidewall and into the center hole to lock weight in TDC (center) position.
6. Center hole
7. Retainer
8. Core stem
9. Leather washer

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Figure 10-3 Rod Inside of Solenoid Operator Weight (shown on its side)

10.2.3 Disassembly of Movable Contacts

The movable arcing and main contacts are mounted on the shaft assembly. The main contacts are screwed to the back side of the two finger blocks and to the shunts. The arcing contact assemblies, which extend from the ends of the main contacts, are the normal replacement parts. They *make* first and *break* last to protect the main contacts. See Figure 10-4.

Disassembly of Movable Arcing Contacts

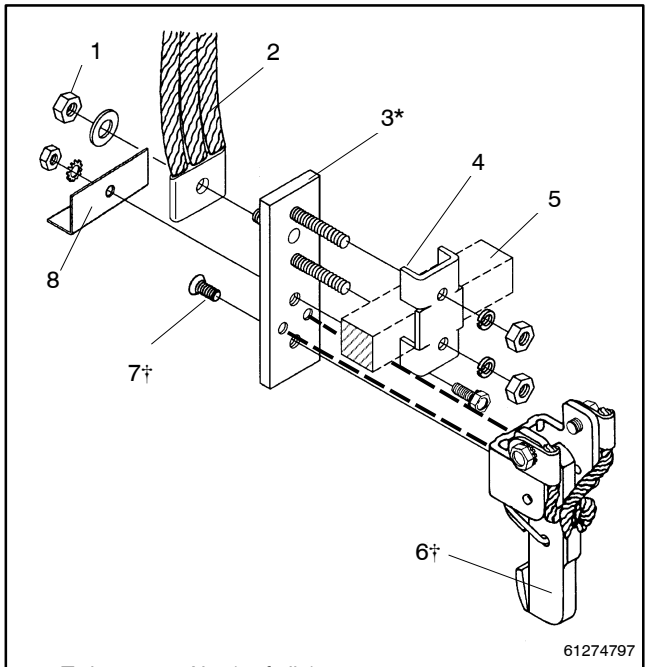
Remove the arcing contact assembly. Use a 1/8 in. hex key wrench to remove the retaining screw from the base of the arcing contact assembly.

Disassembly of Movable Main Contacts

1. Close the bottom main contacts. Remove the 1/4 in. rod (Figure 10-3) while using the manual operator handle to put the switch in the NORMAL position (bottom contacts closed).

2. Disconnect the main shunts. Use a 1/2 in. socket wrench to remove the large hex nut and flat washer to disconnect the shunt from the movable main contact.

3. Remove the movable main contacts. Use a 7/16 in. nutdriver to remove the two hex nuts and lock washers securing the movable main contact to the shaft. Use a 7/16 in. socket wrench to hold the nut securing the L insulator behind the main contact while removing the screw. Then remove the movable main contact.



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1. Tighten to 15 Nm (11 ft. lb.)
2. Shunt
3. Movable main contact*
4. Retaining plate
5. Shaft
6. Movable arcing contact assembly†
7. Retaining screw†
   Apply Loctite® 222; 1/8 in. hex key wrench; tighten to 3.6 Nm (32 in. lb.)
8. L insulator with hex nut and shake washer

* Indicates parts included in main contact kit.
† Indicates parts included in arcing contact kit.

Figure 10-4 Movable Contacts

10.2.4 Reassembly of Movable Contacts

Reassembly of Movable Main Contacts

1. Install the new movable main contacts. See Figure 10-4. Place the new movable main contact behind the shaft and install the retaining plate. Secure the parts with two hex nuts with lock washers. Install the L insulator behind the main contact and secure it with bolt and flat washer (front) and lock washer and hex nut (back). Use a 7/16 in. nutdriver and socket wrench to tighten the hardware.

Note: Be sure to install the L insulator behind the main contact.

2. Close the bottom main contacts. Use the manual operator handle to remove the spacer and to put the switch in the NORMAL position (bottom contacts closed).

3. Reconnect the main shunts. Attach the main shunt to the back of the movable main contact on the threaded stud and secure it with the large hex nut with flat washer. Use a 1/2 in. socket wrench to tighten to 15 Nm (11 ft. lb.).

Reassembly of Movable Arcing Contacts

1. Install the new arcing contact assembly on the main contact. Apply Loctite ® 222 thread sealant to threads of retaining screw. Install the retaining screw through the main contact into the base of the arcing contact and use a 1/8 in. hex wrench to tighten to 3.6 Nm (32 in. lb.)

2. Check the main contact gap. When installing a new arcing contact assembly, a gap of 4 mm (5/32 in.) between the main contacts is automatically obtained when the arcing contacts just touch. However, if a minor adjustment is necessary to obtain this gap, bend the adjustment tab on the arcing contact assembly. Refer to Figure 10-5 for instructions on tab adjustment.

   Note: Recheck any adjustment by manually operating the switch a few times and rechecking the gap between the main contacts.

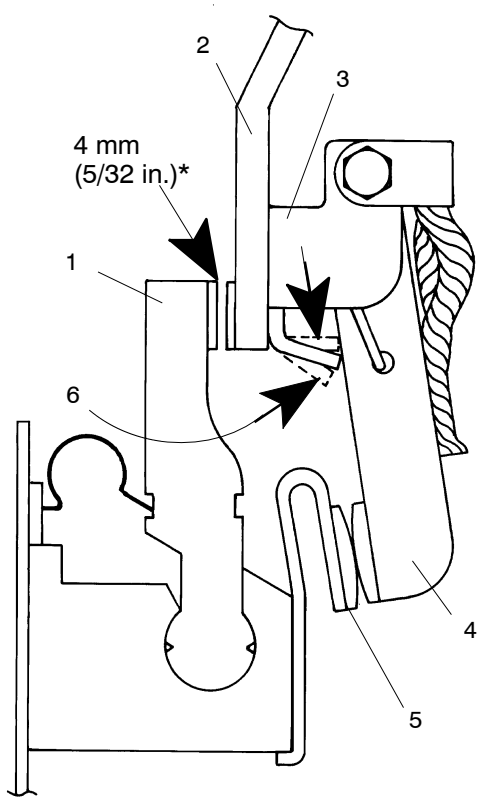
3. Install all arc chutes. Slide the arc chute (arc splitters toward the panel) between the long threaded rods. Place the arc chute retainer onto the arc chute. Use a blade screwdriver to gently tighten the two nylon retainer nuts on both sides of arc chute. Do not overtighten these nuts.

* Loctite is a registered trademark of the Loctite Corporation.

4. Check the clearance between the contacts and the arc chutes. Use the manual operator handle to slowly open and close the contacts while checking that they do not hit the arc chutes.

5. Install the barrier cover. Use the manual operator handle to put the switch in the NORMAL position (bottom contacts closed, top contacts open). Then reinstall the barrier cover and tighten the four Phillips head screws (two on each side).

Note: Operate the switch manually to be sure there is no misalignment or binding before operating it electrically.



1. Stationary main contact
2. Movable main contact
3. Bracket
4. Movable arcing contact*
5. Stationary arcing contact*
6. Adjustment tab:
   To increase gap, bend tab away from bracket. To decrease gap, bend tab toward bracket.

* With 4 mm (5/32 in.) gap at the main contacts, the arcing contacts should just touch.

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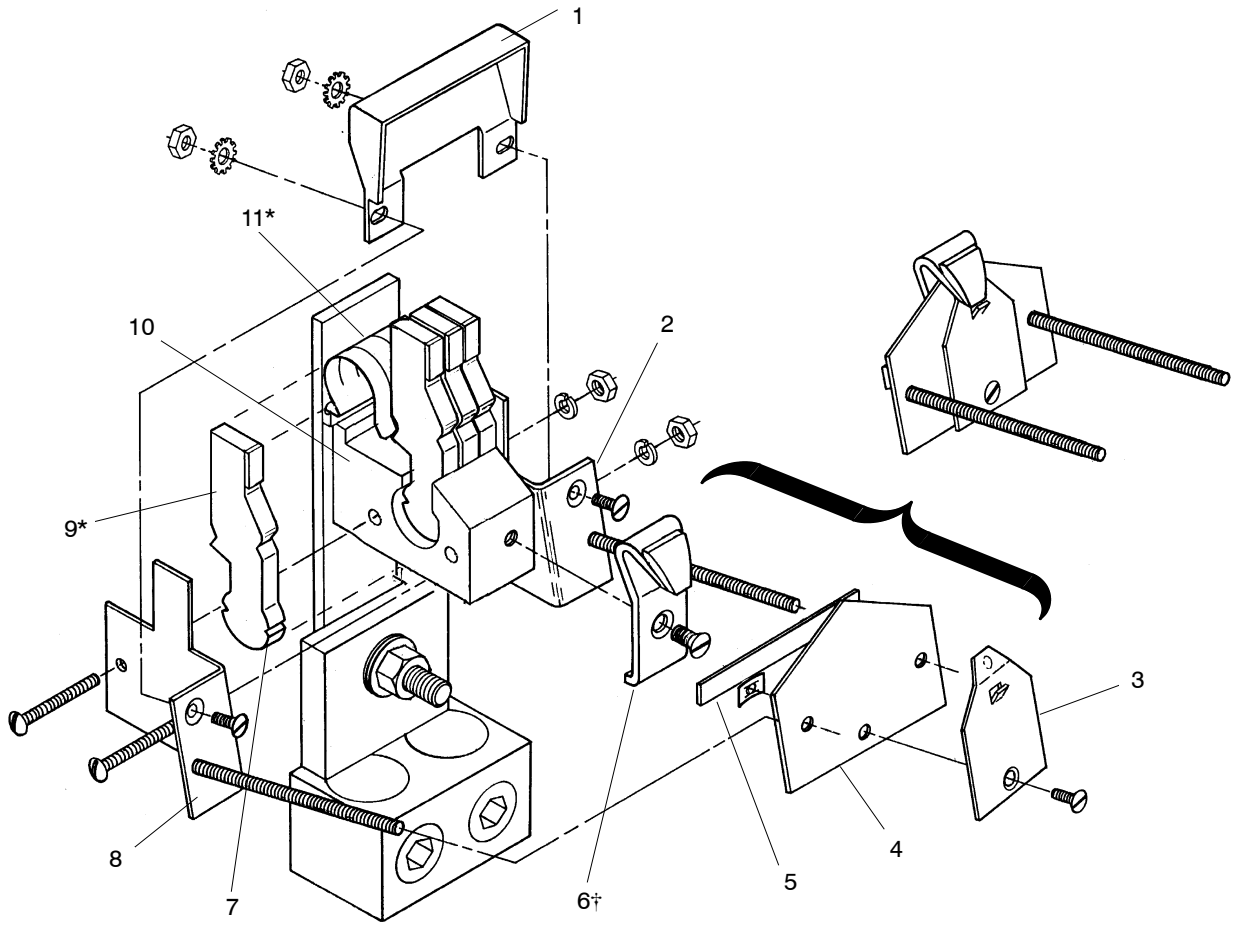
Figure 10-5 Arcing Contact Adjustment (side view)

10.2.5 Disassembly of Stationary Contacts

The stationary arcing and main contacts are mounted on the contact pivot blocks. The main contacts are held in the contact pivot blocks by the arc chute mounting brackets. The arcing contacts, which are screwed to the front of the contact pivot blocks, are the normal replacement parts. They make first and break last to protect the main contacts. See Figure 10-6.

Disassembly of Stationary Arcing Contacts

1. Remove the arc runner plate. Use a medium blade screwdriver to remove the flathead screw. Place your finger behind the plate to catch the spring nut. Then slide the arc runner plate out from under the arcing contact to remove it.
2. Remove the two insulator pieces. Carefully work the large insulator piece out from under the arcing contact while pulling it off the two long threaded rods. *Do not bend the insulator severely because it must be reused.* Also remove the thin insulator shim.
3. Remove all stationary arcing contacts. Use a medium blade screwdriver to remove the flathead screw, then remove the arcing contact.



1. Insulator tray
2. Right arc chute mounting bracket
3. Arc runner
4. Large insulator piece
5. Small insulator piece
6. Stationary arcing contact†
7. Apply conductive lubricant to main contact hinge joints
8. Left arc chute mounting bracket
9. Stationary main contact segment*
10. Contact pivot block
11. Stationary main contact leaf spring*

* Indicates parts included in main contact kit.
† Indicates parts included in arcing contact kit.

Figure 10-6 Stationary Contacts

Disassembly of Stationary Main Contacts

1. Remove the insulator trays. Use a medium blade screwdriver to remove the two flathead screws from the arc chute mounting brackets, then remove the insulator tray.

2. Remove the arc chute mounting brackets. Use a 5/16 in. open end or box wrench and an offset screwdriver to remove the two nuts from the screws through the contact pivot block. Then remove both arc chute mounting brackets.

3. Remove stationary main contacts and springs. Use a pair of needle-nose pliers to release the spring leaves from the individual contact segments and work the main contacts out of the pivot block. *Do not damage the inside of the contact pivot block.* Then remove the contact spring.

10.2.6 Reassembly of Stationary Contacts

Reassembly of Stationary Arcing Contacts

1. Install the new stationary arcing contacts. Apply a few drops of Loctite® 222 thread sealant to the threads of the large flat head screw. Then attach each new contact to the pivot block by using a medium blade screwdriver to install the large flat head screw. Tighten the screw.

2. Install two insulator pieces. Slide the large insulator piece onto the two long threaded rods. Carefully work the pointed side of the insulator under the arcing contact while pushing the insulator in. Insert the thin insulator shim behind the large insulator before pressing it all the way in. Position the thin insulator shim close to the threaded rods.

3. Install the arc runner plate. Hold the thin insulator shim in place close to the threaded rods while sliding the arc runner plate under the arcing contact. The arc runner plate should fit snugly and its tab must touch the tip of the arcing contact. Secure the arc runner plate to the large insulator piece with the small flat head screw and spring nut.

Reassembly of Stationary Main Contacts

1. Apply conductive lubricant to hinge joints. Use a cotton swab or small brush to apply conductive lubricant (Dynaloy 495) to the inside of the contact pivot blocks. Also apply a thin film of conductive lubricant to the curved surface of each new main contact segment.

Note: Failure to apply conductive lubricant to the main contact hinge joints will cause overheating.

2. Install new contact segments and springs. Place a new contact spring into the spring base insulator and hold it in place with one hand. With your other hand carefully install a new contact segment into the contact pivot block. Depress the contact spring leaves to work the contact into the center. In a similar manner install the remaining contact segments from either side of the pivot block. Carefully use a pair of needle-nose pliers to position the spring leaves close to the pivot block in the notch in each contact.

3. Install the arc chute mounting brackets. Place left and right arc chute mounting brackets on either side of the contact pivot block. Then insert two long #8-32 screws through the brackets and pivot block. Secure the brackets with lockwashers and nuts, and use a 5/16 in. open end or box wrench and an offset screwdriver to tighten the two nuts.

4. Check the contact deflection. Press in on each stationary main contact to verify freedom of movement and spring pressure. If there is binding check the position of the spring leaves and conductive lubrication.

5. Install the insulator trays. Place the insulator tray mounting tabs behind the arc chute mounting brackets. Fasten the insulator tray with two #6-32 flathead screws with lockwashers and nuts. Use a screwdriver to tighten the screws.

* Loctite is a registered trademark of the Loctite Corporation.

10.3 Operator Coil Replacement

Refer to the ATS parts catalog for instructions to obtain replacement parts for your switch.

10.3.1 Removal of Coil Assembly

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the operation and installation manual.

Two solenoid operators are used: One drives the normal source contact shaft, the other drives the emergency contact shaft. The solenoid operators face in opposite directions. These instructions (and Figure 10-7 through Figure 10-13) are for the upper solenoid operator.

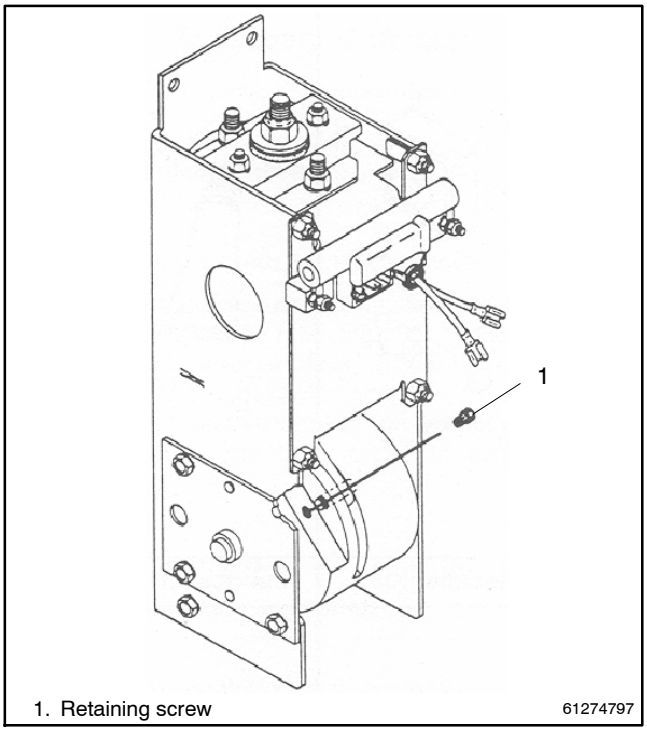


Figure 10-7 Retaining Screw

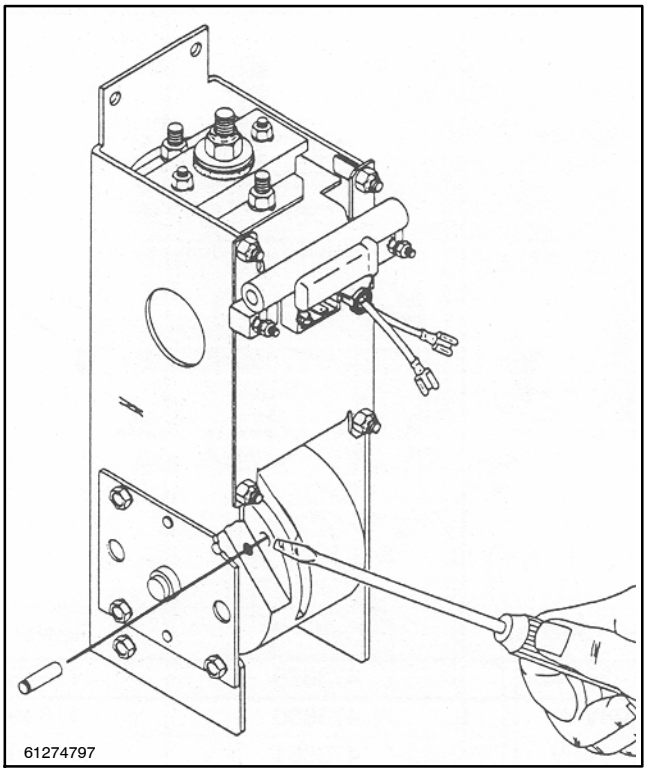


Figure 10-8 Link Pin

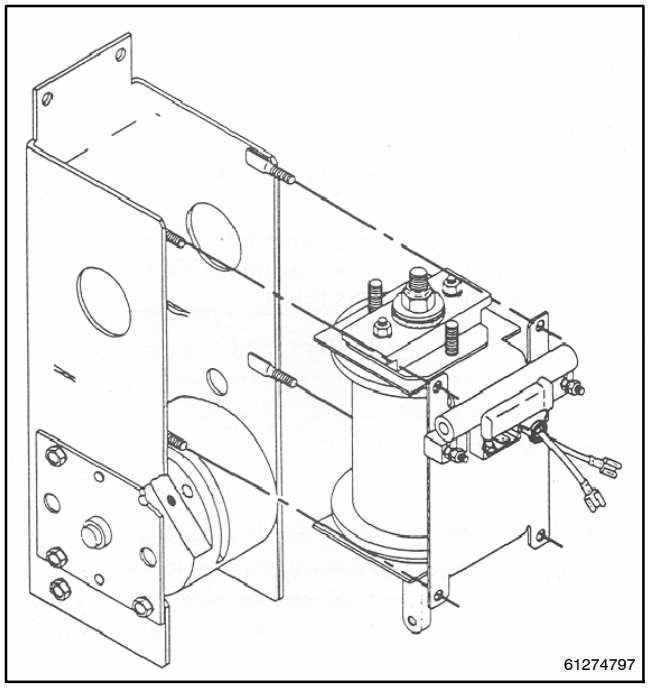


Figure 10-9 Removal of Coil Assembly from Operator Frame

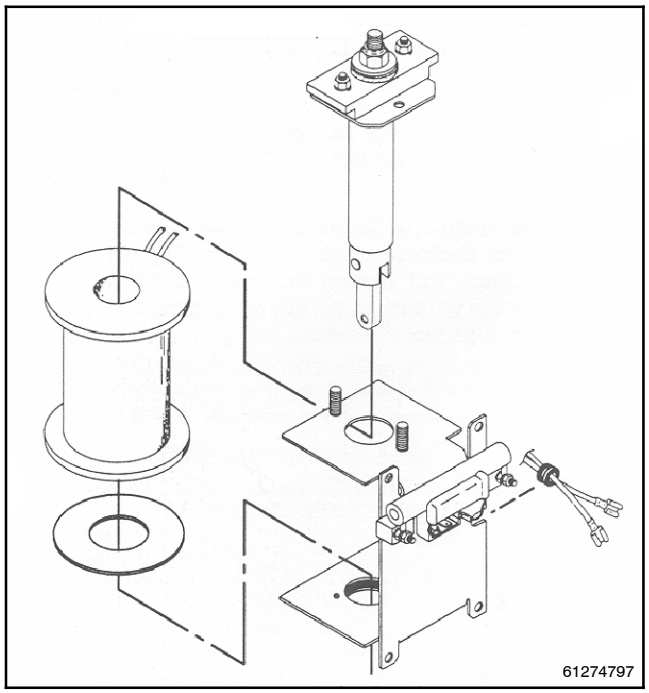


Figure 10-10 Removal of Coil and Core Tube Assembly

The coil assembly is mounted in the operator assembly on the left side of the panel. It must be removed to a work bench for disassembly. See Figure 10-7, Figure 10-8, and Figure 10-9.

1. Put the transfer switch in the Emergency position. Use the manual operator handle (Figure 10-2) if necessary to close the top contacts.
2. Disconnect the rectifier and resistor (Figure 10-7). Carefully pull off the two white power wires and the two black coil leads from the square rectifier mounted on the coil assembly. Do not remove the blue varistor. Then remove the two hex nuts to disconnect the two white wires from the resistor (one on each end).
3. Remove the retaining screw (Figure 10-7) and link pin (Figure 10-8). Use a 3/16 in. hex key wrench to remove the hex socket head screw from the weight. Then use a screwdriver to pry out the link pin in the left side of the weight.
4. Remove the coil assembly (Figure 10-9). Use a 7/16 in. nutdriver or wrench to remove four hex nuts from the operator frame. Then remove the coil assembly to a work bench.

10.3.2 Coil Removal

The solenoid coil is held in the coil frame by the core tube assembly. See Figure 10-10.

1. Remove the core tube assembly. Use a 1/2 in. nutdriver or wrench to remove the upper and lower hex nuts and lock washers from the end of the coil frame. Then pull out the core tube assembly.
2. Remove the coil from the coil frame. Slide the grommet with coil leads out of the slot. Use a 5/16 in. nutdriver or wrench to loosen (only) three coil-clamping SEMS head screws (lower end of coil frame), then pull out the coil and end washer.

Note: To avoid damage, do not tighten the vise on the core or core tube!

10.3.3 Core Tube and Core Disassembly

Disassembly of the core tube assembly is normally not required. If, however, the coil has overheated and has damaged the core tube assembly, rebuilding it is necessary. You will need an assistant to help you reassemble it, and you need to reset the stroke. See Figure 10-11 and Figure 10-12.

Note: To prevent the possibility of personal injury, hold the core tube assembly securely away from yourself when removing the center hex nut; the spring exerts substantial outward force on the core and link.

Note: To avoid damage, do not tighten the vise on the core or core tube!

1. Remove the core and compression spring (Figure 10-11). Hold the link in a vise to secure the assembly. Use a 3/4 in. nutdriver or wrench to remove the center large hex nut from the threaded stem end of the core.

Note: When the center hex nut is removed, the assembly will suddenly release the core and spring from the lower end of core tube assembly.

2. Take apart the core tube assembly (Figure 10-12). Use a 1/2 in. nutdriver or wrench to remove the left and right hex nuts and lockwashers and pull the spring retainer off core tube retaining plate. Then push core tube through retaining plate to remove it.

10.3.4 Core Tube and Core Reassembly

Replace damaged parts (core tube and core spring) and lubricate the core and core spring before reassembly. Use the lubrication kit shown in the ATS parts catalog listed in the Introduction to this manual.

You will need an assistant to help compress the spring while you install the hardware. See Figure 10-11 and Figure 10-12.

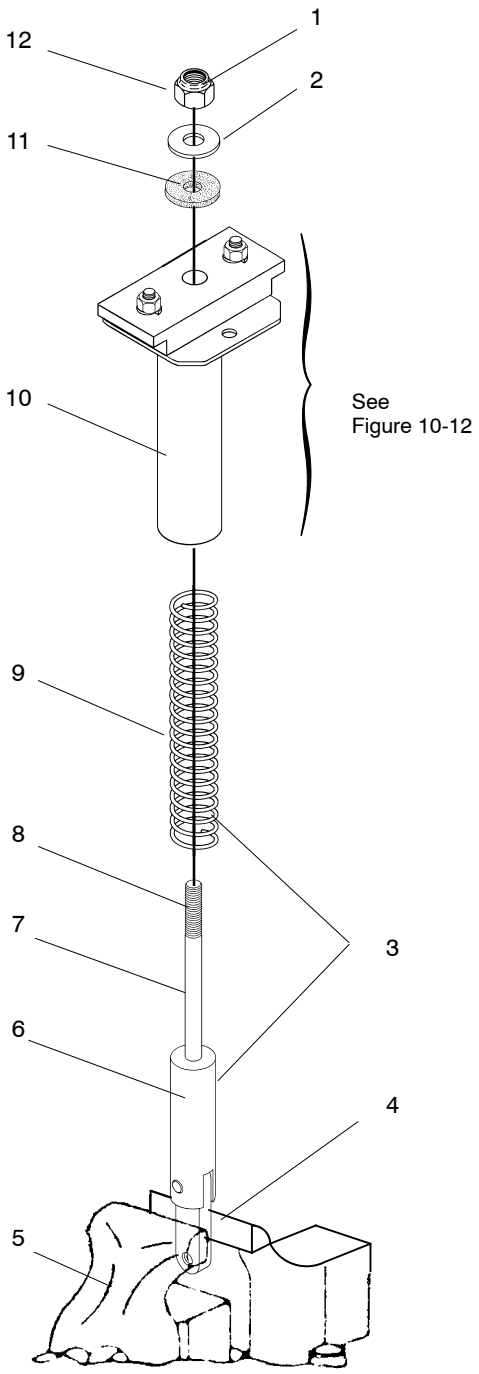
1. Put together the core tube assembly (Figure 10-12). Insert the core tube through the retaining plate (flared end seats on top). Then install the spring retainer (recessed hole inward) onto the retaining plate and use a 1/2 in. nutdriver or wrench to tighten the two 5/16-18 hex nuts on 5/16 in. lock washers.

2. Lubricate core and core spring. Use the contents of the Lubrication Kit to apply a thin coating onto the core surface and onto the core spring.

Note: To prevent the possibility of personal injury, hold the core tube assembly securely away from yourself when installing the center hex nut; the spring exerts substantial outward force on the core and link.

3. Assemble the core, spring, and core tube assembly (Figure 10-11). With the link held securely in a vise, set the lubricated core spring onto the core stem. Check to see if the nylon guide washer is still inside the spring retainer; if it is not, place it inside the spring retainer.

   Have an assistant push core tube assembly onto the spring and hold it down (guide threaded core stem through center hole) while you add threaded leather washer, flat washer, and 1/2-13 hex nut onto the core stem. Use a 3/4 in. nutdriver or wrench to tighten the nut. The nut must be adjusted later for proper stroke of 28.6 mm (1 1/8 in.).



1. Stroke adjustment stop nut
2. Flat washer*
3. Lubricate surface
4. Link
5. Vise
6. Core
7. Core and link assembly
8. Stem
9. Compression spring*
10. Core tube assembly
11. Leather washer*
12. Hex nut with nylon insert*

* Indicates parts included in coil kit.

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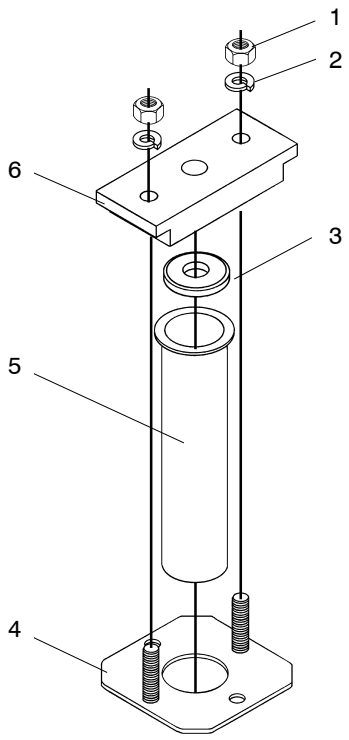
Figure 10-11 Core Tube and Core Disassembly



1. Split lock washer
2. Nylon guide washer*
3. Core tube retaining plate*
4. Core tube*
5. Spring retainer
6. Hex nut

* Indicates parts included in coil kit.

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Figure 10-12 Core Tube Assembly

10.3.5 Coil Installation

Replace the damaged coil before reassembly. See Figure 10-10.

1. Install the replacement coil. With the coil leads up and to the right, insert the new coil with a coil washer on the bottom into coil frame Then run the coil leads through the grommet and slide it into the slot (right side of coil frame).

2. Install the core tube assembly. Insert the core tube assembly down through the hole in the coil frame and use a 1/2 in. nutdriver or wrench to tighten the upper and lower hex nuts with lock washers on the coil frame.

3. Tighten the coil-clamping screws. Use a 5/16 in. nutdriver or wrench to tighten the three SEMS head screws on the bottom of the coil frame.

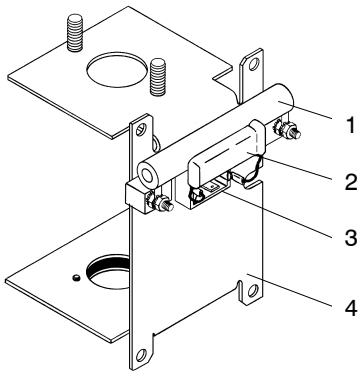
10.3.6 Installation of Coil Assembly

The coil assembly can now be reinstalled onto the operator assembly on the left side of the switch panel. See Figure 10-7, Figure 10-8, and Figure 10-9.

1. Install the coil assembly onto the operator frame (Figure 10-9). Place the coil assembly onto the four studs on the operator frame and align the link into the slotted weight. Use a 7/16 in. nutdriver or wrench to tighten the four hex nuts.

2. Install the link pin and retaining screw (Figure 10-8). Insert the link pin (groove side out) into the left side of the weight and through the link. Then install the hex socket head retaining screw into the weight and use a 3/16 in. hex key wrench to tighten it.

3. Reconnect the resistor/rectifier on the coil frame (Figure 10-7). Replace the resistor (if necessary) and reconnect the two white wires with ring lugs to each end and install and tighten the hex nuts. Replace the rectifier (if necessary) and carefully reconnect the four wires with push-on lugs to the rectifier terminals as follows: connect the two white power wires to the AC terminals (~), and connect the two black coil leads to the DC terminals (red dot and no dot, polarity does not matter). Be sure the blue snubber is still installed between the DC terminals. See Figure 10-13.



1. Resistor
2. Snubber
3. Rectifier
4. Coil frame

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Figure 10-13 Rectifier and Resistor

4. Manually operate the transfer switch. Use the manual operator handle (Figure 10-2) to manually operate the transfer switch. It should operate smoothly without any binding. If not, recheck the alignment of parts and the lubrication of the solenoid operator. Close the bottom contacts and remove the manual handle.

5. Reinstall the transfer switch. Refer to the bypass/isolation switch operation and installation manual for instructions.

Section 11 600–800 Amp Standard Bypass/Isolation Switches

This section explains how to replace the transfer switch main contacts, operator coil, and control contacts in 600- and 800-amp bypass/isolation switches. This section applies to the following models:

- 600–800 Amp KBS

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Tools Needed

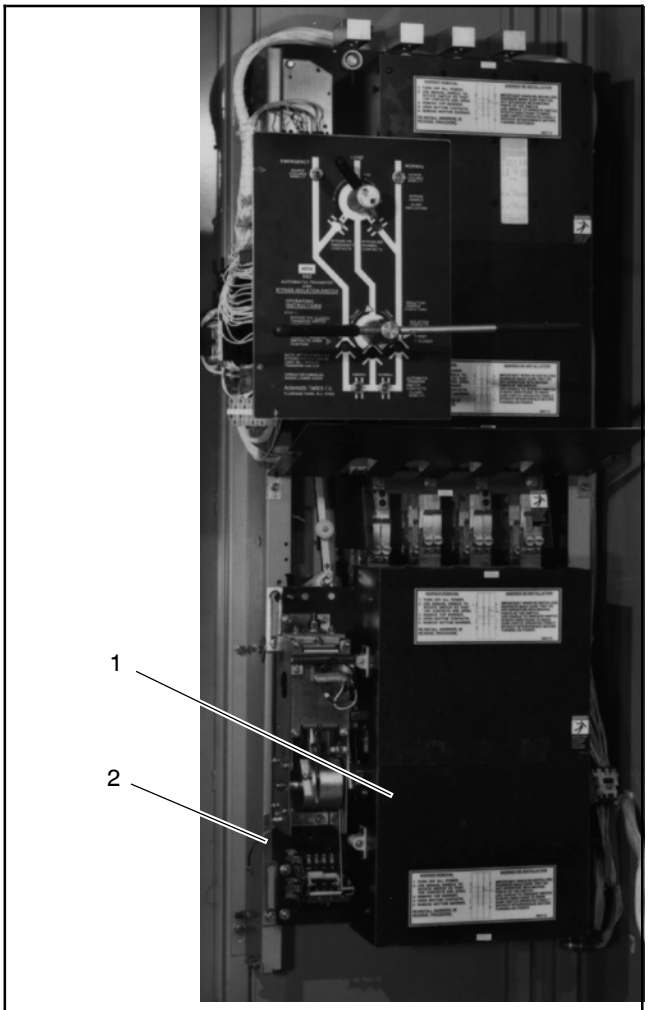
- Medium blade screwdriver
- Voltmeter, ohmmeter
- Phillips screwdriver
- Needle-nose pliers
- Offset screwdriver
- Cotton swab or small brush
- Nutdriver, 1/4 in.
- Nutdriver, 5/16 in.
- Nutdriver, 7/16 in.
- Nutdriver, 1/2 in.
- Nutdriver, 3/4 in.
- Rod or drill, 1/4 in. dia.
- Hex key wrench, 1/8 in.
- Hex key wrench, 3/16 in.
- Open-end wrench, 5/16 in.
- Socket wrench, 7/16 in.
- Socket wrench, 1/2 in.
- Open-end wrench, 11/32 in.
- Loctite® 222
- Thread sealant
- Torque wrench, 32 in. lb.
- Bench vise
- Ruler

* Loctite is a registered trademark of the Loctite Corporation.

11.1 Manual Operation

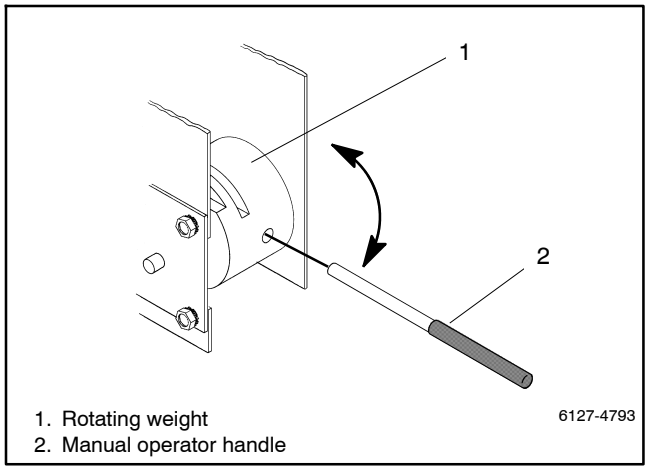
A detachable manual operator handle is provided *for maintenance purposes only.* The handle is stored on the coil frame, left side of the switch. See Figure 11-1.

Note: To prevent the possibility of personal injury or property damage, do not manually operate the transfer switch until it is bypassed and isolated.



1. Transfer switch
2. Manual operator handle storage location

Figure 11-1 Transfer Switch



1. Rotating weight
2. Manual operator handle

Figure 11-2 Manual Operator Handle

Insert the manual handle into the hole in the rotating weight on the left side of the switch. See Figure 11-2. Move the handle down and up to manually operate the switch, as needed, in the following maintenance procedures.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

11.1.1 Main Contact Replacement

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

The barriers and arc chutes must be removed to gain access to the main contacts. Use the manual operator handle to put the switch in the NORMAL position to remove the top barrier. Then put the switch in the EMERGENCY position to remove the bottom barrier.

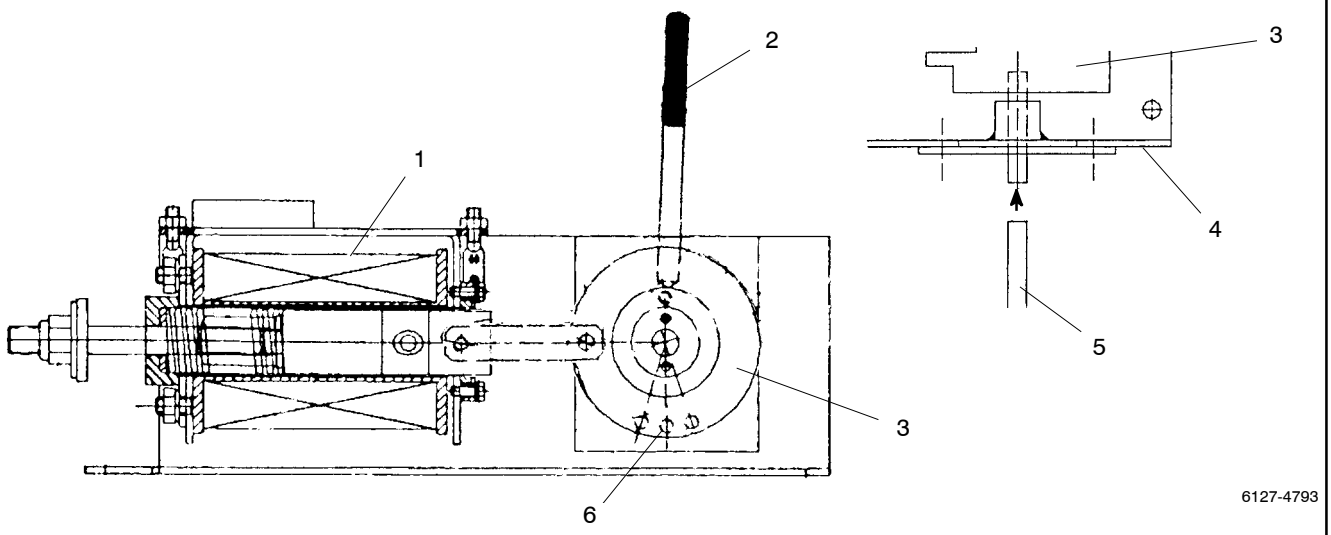
1. Remove the two barriers (see Section 11.2).

2. Remove all arc chutes. Use a blade screwdriver to remove two nylon retainer nuts and fiber clamp piece on each chute. Then carefully pull the arc chute away from the panel.

3. Put the switch in the center position (TDC). Use the manual handle to open the contacts until a 1/4 in. diameter rod (drill bit) can be inserted into the *center* hole in the side of the weight. It will hold the operator in the top-dead-center position and the contact shaft in a mid position. See Figure 11-3.

Movable Contacts Disassembly

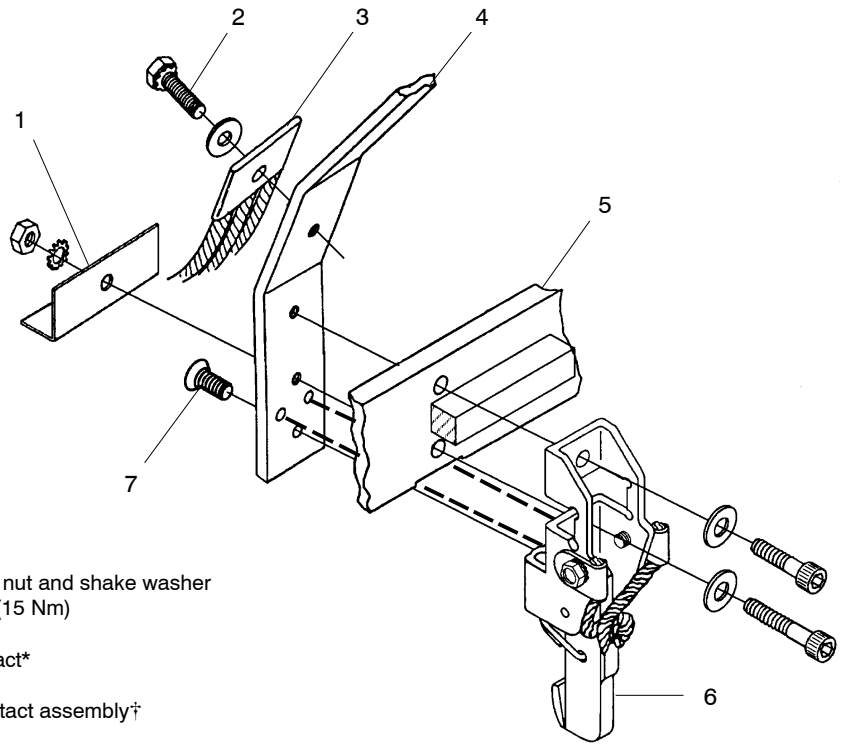
The movable arcing and main contacts are mounted on the shaft assembly. The main contacts are screwed to the back side of the two finger blocks and to the shunts. The arcing contact assemblies, which extend from the ends of the main contacts, are the normal replacement parts. They *make* first and *break* last to protect the main contacts. See Figure 11-4.



1. Coil
2. Manual operator handle
3. Weight
4. Operator frame side wall
5. 1/4 in. diameter rod
6. Center hole

Note: Insert rod through sidewall and into the center hole weight to lock weight in TDC (center) position.

Figure 11-3 Rod Inside of Solenoid Operator Weight



1. L insulator with hex nut and shake washer
2. Tighten to 11 ft. lb. (15 Nm)
3. Shunt
4. Movable main contact*
5. Finger block
6. Movable arcing contact assembly†
7. Retaining screw†

* Indicates parts included in main contact kit.
† Indicates parts included in arcing contact kit.
‡ Apply Loctite® 222, 1/8 in. hex key wrench, tighten to 32 in. lb. (3.6 Nm).

Figure 11-4 Movable Contacts

Movable Arcing Contacts and Main Contacts

1. Close the bottom main contacts. Remove the 1/4 in. rod while using the manual operator handle to put the switch in the *normal* position (bottom contacts closed). See Figure 11-3.

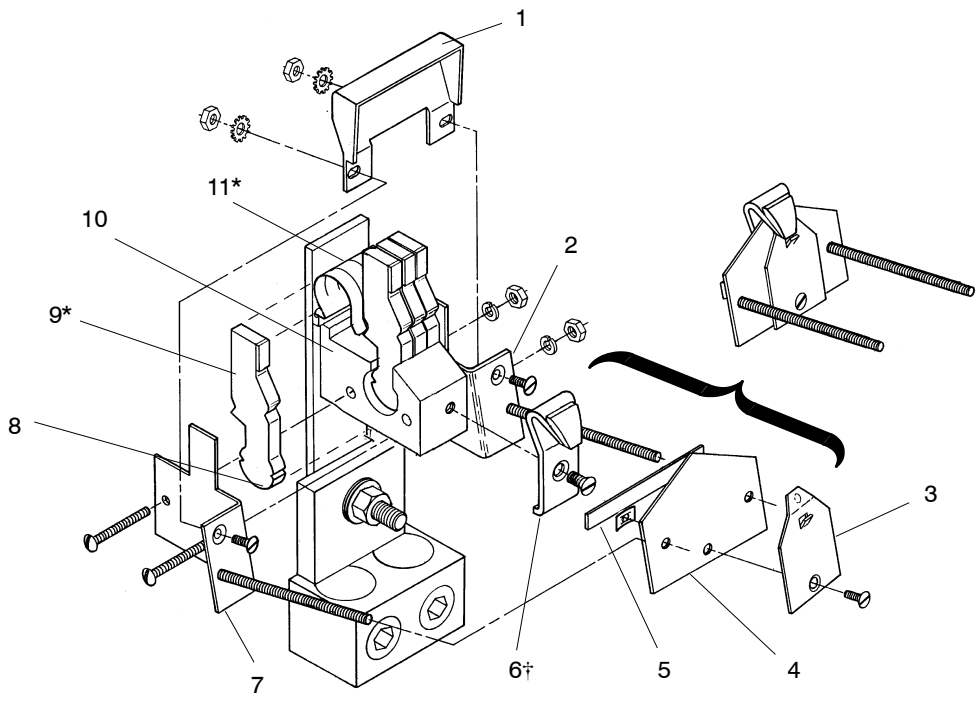
2. Disconnect the main shunts. Use a 1/2 in. socket wrench to remove the large hex head (SEMS) screw and flat washer to disconnect the shunt from the movable main contact.

3. Remove the arcing contact assembly. Use a 1/8 in. hex key wrench to remove the retaining screw from the base of the arcing contact assembly.

4. Remove the movable main contacts. Use the manual handle again to insert the spacer between the finger block and panel. Use a 3/16 in. hex key wrench to remove four socket head screws securing the movable arcing contact and movable main contact to the finger blocks. Use a 7/16 in. socket wrench to hold the nut securing the L insulator behind the main contact while removing the screw. Then remove the movable main contact.

11.1.2 Stationary Contacts Disassembly

The stationary arcing and main contacts are mounted on the contact pivot blocks. The main contacts are held in the contact pivot blocks by the arc chute mounting brackets. The arcing contacts, which are screwed to the front of the contact pivot blocks, are the normal replacement parts. They *make* first and *break* last to protect the main contacts. See Figure 11-5.



1. Insulator tray
2. Right arc chute mounting bracket
3. Arc runner
4. Large insulator piece
5. Small insulator piece
6. Stationary arcing contact†
7. Left arc chute mounting bracket
8. Apply conductive lubricant to main contact hinge joints.
9. Stationary main contact segment*
10. Contact pivot block
11. Stationary main contact leaf spring*

* Indicates parts included in main contact kit.
† Indicates parts included in arcing contact kit.

Figure 11-5 Stationary Contacts

Stationary Arcing Contacts

1. Remove the arc runner plate. Use a medium blade screwdriver to remove the flathead screw. Place your finger behind the plate to catch the spring nut. Then slide the arc runner plate out from under the arcing contact to remove it.

2. Remove the two insulator pieces. Carefully work the large insulator piece out from under the arcing contact while pulling it off the two long threaded rods. *Do not bend the insulator severely because it must be reused.* Also remove the thin insulator shim.

3. Remove all stationary arcing contacts. Use a medium blade screwdriver to remove the flathead screw then remove arcing contact.

Stationary Main Contacts

1. Remove the insulator trays. Use a medium blade screwdriver to remove two flathead screws from the arc chute mounting brackets, then remove the insulator tray.

2. Remove the arc chute mounting brackets. Use a 5/16 in. open end or box wrench and an offset screwdriver to remove two nuts from the screws through the contact pivot block. Then remove both arc chute mounting brackets.

3. Remove the stationary main contacts and springs. Use a pair of needle-nose pliers to release the spring leaves from the individual contact segments and work the main contacts out of the pivot block. *Do not damage the inside of the contact pivot block.* Then remove the contact spring.

11.1.3 Stationary Contacts Reassembly

Refer to Figure 11-5.

1. Apply conductive lubricant to hinge joints. Use a cotton swab or small brush to apply conductive lubricant (Dynaloy 495) to the inside of the contact pivot blocks. Also apply a thin film of conductive lubricant to the curved surface of each new main contact segment.

   Note: Failure to apply conductive lubricant to the main contact hinge joints will cause overheating.

2. Install new contact segments and springs. Place a new contact spring into the spring base insulator and hold it in place with one hand. With your other hand carefully install a new contact segment into the contact pivot block. Depress the contact spring leaves to work the contact into the center. In a similar manner install the remaining contact segments from either side of the pivot block. Carefully use a pair of needle-nose pliers to position the spring leaves close to the pivot block in the notch in each contact.

3. Install arc chute mounting brackets. Place left and right arc chute mounting brackets on either side of the contact pivot block. Then insert two long #8-32 screws through the brackets and pivot block. Secure the brackets with lockwashers and nuts, and use a 5/16 in. open end or box wrench and an offset screwdriver to tighten the two nuts.

4. Check contact deflection. Press in on each stationary main contact to verify freedom of movement and spring pressure. If there is binding, check the position of the spring leaves and conductive lubrication.

5. Install the insulator trays. Place the insulator tray mounting tabs behind the arc chute mounting brackets. Fasten the insulator tray with two #6-32 flathead screws with lockwashers and nuts. Use a blade screwdriver to tighten the screws.

Stationary Arcing Contacts

1. Install new stationary arcing contacts. Apply a few drops of Loctite® 222 thread sealant to the threads of the large flat head screw. Then attach each new contact to the pivot block by using a medium blade screwdriver to install the large flat head screw. Tighten the screw.

2. Install two insulator pieces. Slide the large insulator piece onto the two long threaded rods. Carefully work the pointed side of the insulator under the arcing contact while pushing the insulator in. Insert the thin insulator shim behind the large insulator before pressing it all the way in. Position the thin insulator shim close to the threaded rods.

3. Install the arc runner plate. Hold the thin insulator shim in place close to the threaded rods while sliding the arc runner plate under the arcing contact. The arc runner plate should fit snugly and its tab must touch the tip of the arcing contact. Secure the arc runner plate to the large insulator piece with the small flat head screw and spring nut.

11.1.4 Movable Contacts Reassembly

Reassemble as shown in Figure 11-4.

Movable Main Contacts and Arcing Contacts

1. Install the new movable main contacts. Place the new movable main contact behind the two finger blocks. Use the manual operator handle to insert the spacer or to open the top contacts enough to slide the new movable main contact in place.

2. Install new arcing contact assembly on the main contact. Secure it with two socket head screws through the finger block. Use the longer screw to install the L insulator behind the main contact and secure it with a nut with lock washer. Use a 3/16 in. hex key wrench to tighten the screws.

   Note: Be sure to install the L insulator behind the main contact.

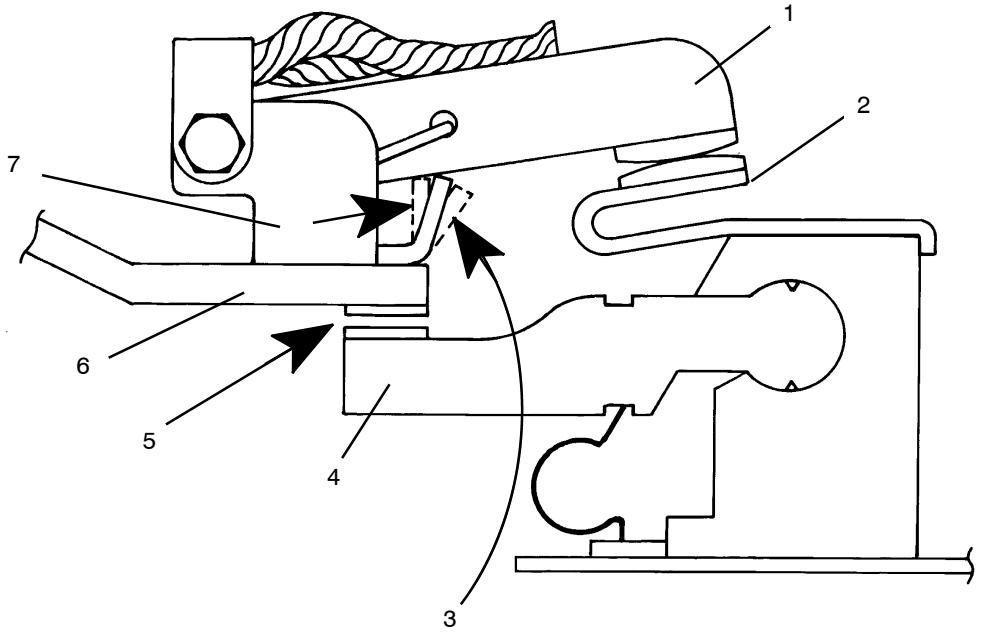
   Apply Loctite ® 222 thread sealant to threads of the retaining screw. Install retaining screw through the main contact into the base of the arcing contact. Then, using a 1/8 in. hex wrench, tighten the screw to 3.6 Nm (32 in. lb.).

3. Check the main contact gap. When installing a new arcing contact assembly, a gap of 5/32 in. between the main contacts is automatically obtained when the arcing contacts just touch. However, if a minor adjustment is necessary to obtain this gap, bend the adjustment tab on the arcing contact assembly. Refer to Figure 11-6 for instructions on tab adjustment.

   Note: Recheck any adjustment by manually operating the switch a few times and recheck the gap between the main contacts.

4. Close the bottom main contacts. Use the manual operator handle to remove the spacer and to put the switch in the *Normal* position (bottom contacts closed).

5. Reconnect the main shunts. Attach the main shunt to the back of the movable main contact with the large hex head (SEMS) screw with flat washer. Use a 1/2 in. socket wrench to tighten to 15 Nm (11 ft. lb.).



1. Movable arcing contact
2. Stationary arcing contact
3. Adjustment tab*
4. Stationary main contact
5. With 5/32 in. gap at main contacts, arcing contacts should just touch.
6. Movable main contact
7. Bracket

* To increase gap, bend tab away from bracket. To decrease gap, bend tab toward bracket.

Figure 11-6 ArcIng Contact Adjustment (side view)

11.2 Transfer Switch Barrier Removal and Installation

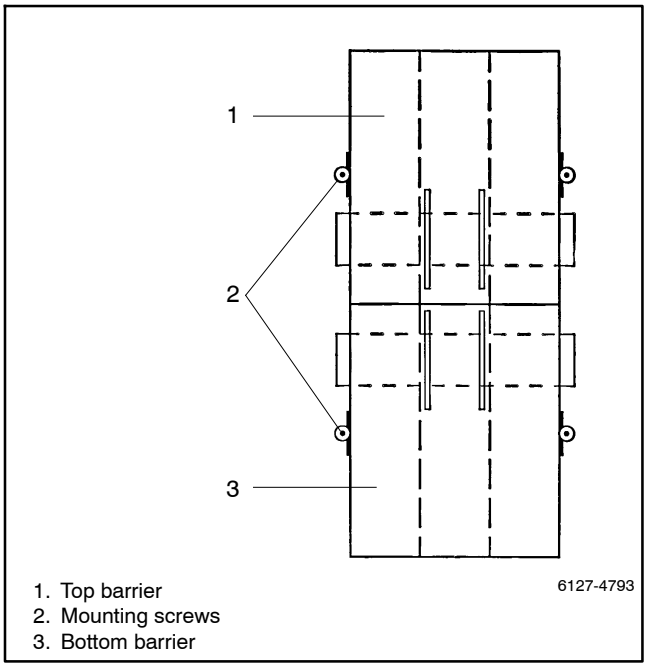


Figure 11-7 Transfer Switch Barriers

Note: IMPORTANT! When reinstalling barriers, make sure they do not interfere with moving parts of the switch. Use handle to operate switch in both directions to make sure switch operates freely without interference before turning on power.

11.2.1 Barrier Removal

1. Bypass and isolate the transfer switch. Refer to the bypass/isolation switch operation and installation manual for instructions.

2. Use the manual operator handle to put the switch in the NORMAL position (top contacts open). See Figure 11-2.

3. Use a Phillips screwdriver to loosen only two screws and remove the top barrier. Slide the barrier up and tilt outward.

4. Use manual operator handle to put the switch in the EMERGENCY position (bottom contacts open).

5. Use a Phillips screwdriver to loosen only two screws and remove the bottom barrier. Slide the barrier down and tilt it outward.

11.2.2 Barrier Installation

1. Install all arc chutes. Slide the arc chute (arc splitters toward the panel) between the long threaded rods. Place the arc chute retainer onto the arc chute. Use a screwdriver to gently tighten the two nylon retainer nuts on both sides of the arc chute. Do not overtighten these nuts.

2. Check the clearance between the contacts and the arc chutes. Use the manual operator handle to slowly open and close the contacts while checking that they do not hit the arc chutes.

3. Install the bottom barrier. Use the manual operator handle to put the switch in the *Emergency* position (top contacts closed). Then reinstall the bottom barrier; make sure that the center barriers are *outside* the movable barriers on the switch. Tighten the two Phillips head screws.

4. Install the top barrier. Use the manual operator handle to put the switch in the NORMAL position (bottom contacts closed). Then reinstall the top barrier; make sure that the center barriers are *outside* the movable barriers on the switch. Tighten the two Phillips head screws.

   Note: Manually operate switch to be sure there is no misaligment or binding before operating it electrically.

5. Return the transfer switch to service. Refer to the bypass/isolation switch operation and installation manual for instructions.

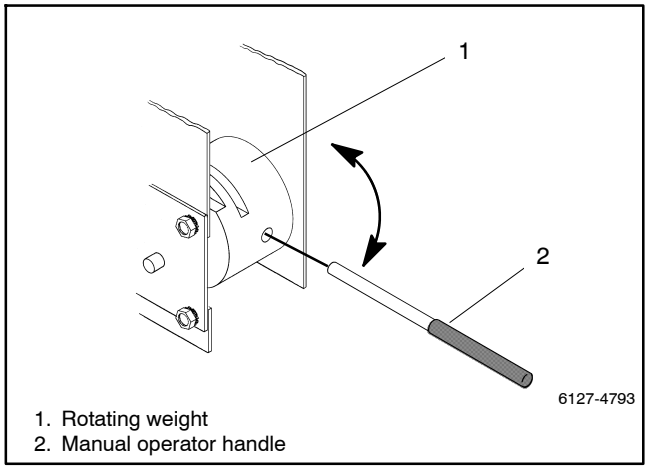


Figure 11-8 Manual Operator Handle

11.3 Operator Coil Replacement

11.3.1 Coil Assembly Removal

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

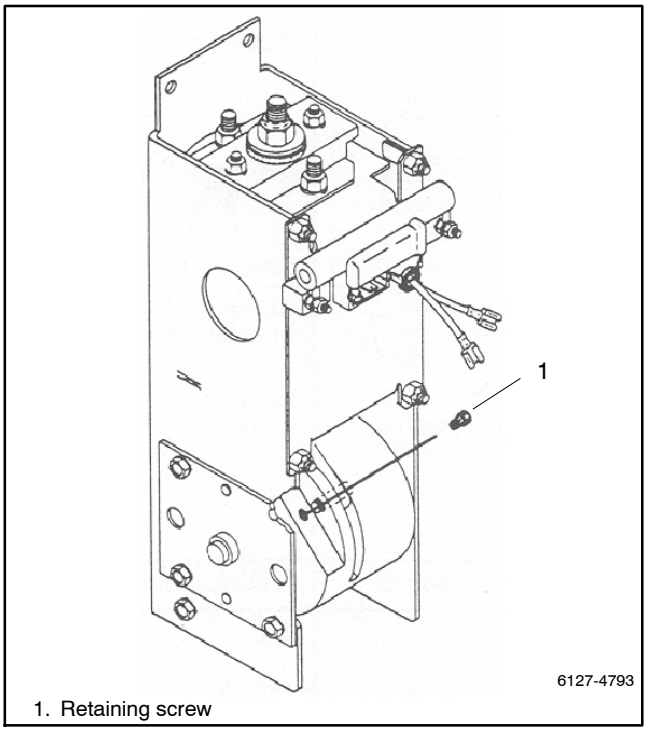
Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Disassembling the solenoid. Spring-loaded parts can cause severe personal injury or property damage. The spring in the solenoid assembly exerts substantial force on the coil. Hold the coil assembly securely when removing the screws.

Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

The coil assembly is mounted in the operator assembly on the left side of the panel. It must be removed to a work bench for disassembly. See Figure 11-9, Figure 11-10, and Figure 11-11.

1. Put the transfer switch in the EMERGENCY position. Use the manual operator handle if necessary to close top contacts. See Figure 11-2.



1. Retaining screw

Figure 11-9 Retaining Screw

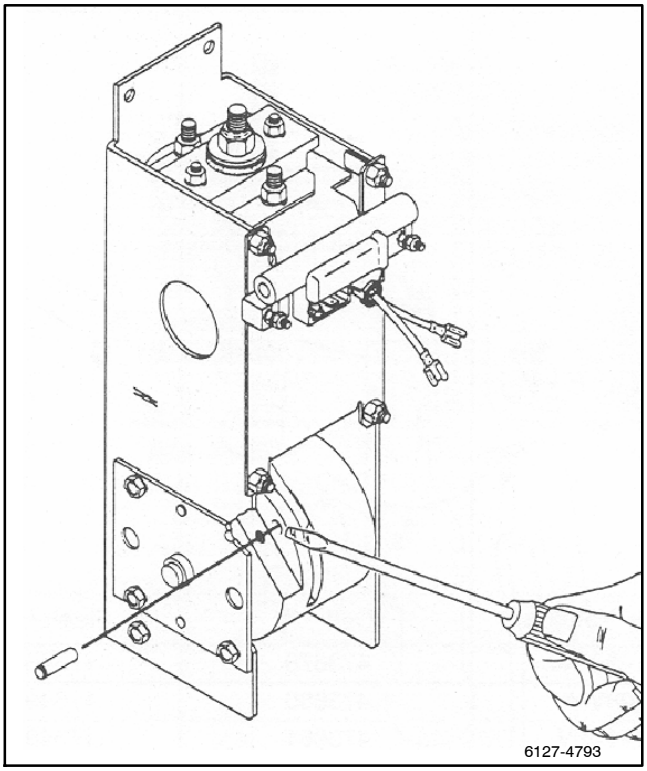


Figure 11-10 Link Pin

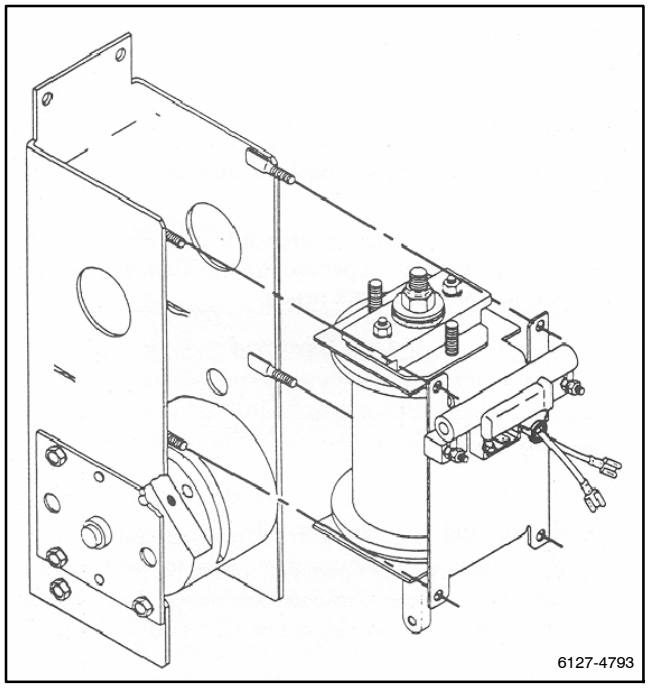


Figure 11-11 Removal of Coil Assembly from Operator Frame

2. Disconnect the rectifier and resistor. See Figure 11-9. Carefully pull off the two white power wires and the two black coil leads from the square rectifier mounted on the coil assembly. Do not remove the blue varistor. Then remove the two hex nuts to disconnect the two white wires from the resistor (one on each end).

3. Remove the retaining screw and link pin. See Figure 11-10. Use a 3/16 in. hex key wrench to remove the hex socket head screw from the weight. Then use a screwdriver to pry out the link pin in left side of the weight.

4. Remove the coil assembly. See Figure 11-11. Use a 7/16 in. nutdriver or wrench to remove four hex nuts from the operator frame. Then remove the coil assembly to a work bench.

11.3.2 Coil Removal

The solenoid coil is held in the coil frame by the core tube assembly. See Figure 11-12.

1. Remove the core tube assembly. Use a 1/2 in. nutdriver or wrench to remove the upper and lower hex nuts and lock washers from top end of the coil frame. Then pull out the core tube assembly.

2. Remove the coil from the coil frame. Slide the grommet with coil leads out of the slot. Use a 5/16 in. nutdriver or wrench to loosen (only) three coil-clamping SEMS head screws (lower end of coil frame), then pull out the coil and end washer.

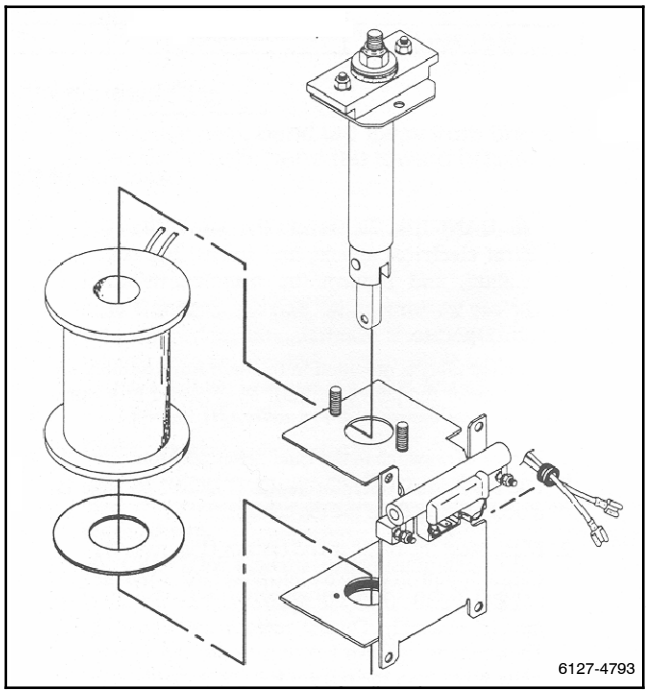


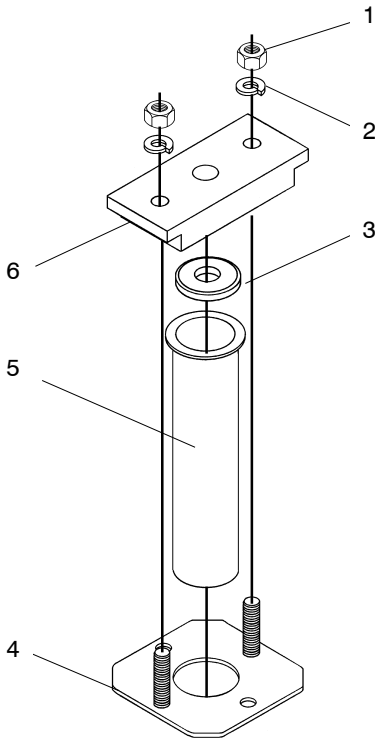
Figure 11-12 Removal of Coil and Core Tube Assembly

11.3.3 Core Tube and Core Disassembly

Disassembly of the core tube assembly is normally not required. If, however, the coil has overheated and has damaged the core tube assembly, rebuilding it is necessary. You will need an assistant to help you reassemble it, and you need to reset the stroke (explained in Sections 11.4 and 11.5). See Figure 11-13 and Figure 11-14.

Note: To avoid damage, do not tighten the vise on the core or core tube!

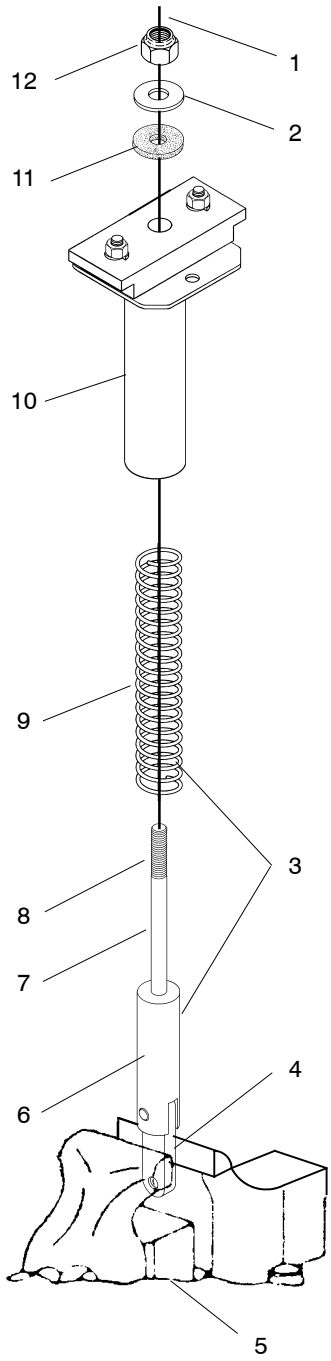
Note: To prevent the possibility of personal injury, hold the core tube assembly securely away from yourself when removing the center hex nut; the spring exerts substantial outward force on the core and link.



1. 5/16-18 hex nut
2. 5/16 in. split lock washer
3. Nylon guide washer*
4. Core tube retaining plate*
5. Core tube*
6. Spring retainer

* Indicates parts included in coil kit.

Figure 11-13 Core Tube Assembly



1. Stroke adjustment stop nut
2. Flat washer*
3. Lubricate surface using lubrication kit
4. Link
5. Vise
6. Core
7. Core and link assembly
8. Stem
9. Compression spring*
10. Core tube assembly
11. Leather washer*
12. Hex nut, 1/2-13 with nylon insert*

* Indicates parts included in coil kit.

Figure 11-14 Core Tube And Core Disassembly

1. Remove the core and compression spring. See Figure 11-14. Hold the link in a vise to secure the assembly. Use a 3/4 in. nutdriver or wrench to remove the center large hex nut from the threaded stem end of the core.

   Note: When the center hex nut is removed, the assembly will suddenly release the core and spring from the lower end of the core tube assembly.

2. Take apart the core tube assembly. See Figure 11-13. Use a 1/2 in. nutdriver or wrench to remove the left and right hex nuts and lockwashers and pull the spring retainer off the core tube retaining plate. Then push the core tube through the retaining plate to remove it.

11.3.4 Core Tube and Core Reassembly

Replace damaged parts (core tube and core spring) and lubricate the core and core spring with Lubrication Kit GM24237 before reassembly. You will need an assistant to help compress the spring while you install the hardware. See Figure 11-13 and Figure 11-14.

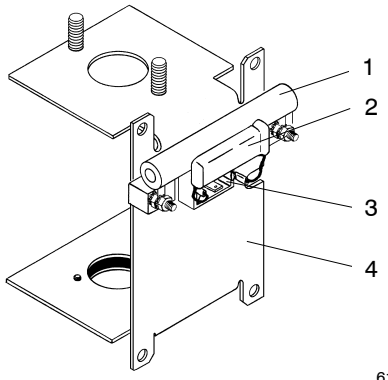
1. Put together the core tube assembly Figure 11-13. Insert the core tube through the retaining plate (flared end seats on top). Then install the spring retainer (recessed hole inward) onto the retaining plate and use a 1/2 in. nutdriver or wrench to tighten the two 5/16-18 hex nuts on 5/16 in. lock washers.

2. Lubricate the core and core spring. Use the Lubrication Kit to apply a thin coating onto the core surface and onto the core spring.

   Note: To prevent the possibility of personal injury, hold the core tube assembly securely away from yourself when installing center hex nut; the spring exerts substantial outward force on the core and link.

3. Assemble the core, spring, and core tube assembly. See Figure 11-14. With the link held securely in a vise, set the lubricated core spring onto the core stem. Check to see if the nylon guide washer is still inside the spring retainer; if it is not, place it inside the spring retainer.

   Have an assistant push the core tube assembly onto the spring and hold it down (guide the threaded core stem through the center hole) while you add the leather washer (threaded), flat washer, and 1/2–13 hex nut onto the core stem. Use a 3/4 in. nutdriver or wrench to tighten the nut (it must be adjusted later for proper stroke of 1 1/8 in.); refer to Sections 11.4 and 11.5 .



1. Resistor
2. Snubber
3. Rectifier
4. Coil frame

Figure 11-15 Rectifier and Resistor

11.3.5 Coil Installation

Replace the coil before assembly if it is damaged. See Figure 11-12.

1. Install the replacement coil. With coil leads up and to the right, insert the new coil with a coil washer on the bottom into coil frame. Then run the coil leads through the grommet and slide the grommet into the slot (on the right side of the coil frame).

2. Install the core tube assembly. Insert the core tube assembly down through hole in coil frame and use a 1/2 in. nutdriver or wrench to tighten upper and lower hex nuts with lock washers on the coil frame.

3. Tighten the coil-clamping screws. Use a 5/16 in. nutdriver or wrench to tighten the three SEMS head screws on the bottom of the coil frame.

11.3.6 Coil Assembly Installation

The coil assembly can now be reinstalled onto the operator assembly on the left side of the switch panel. See Figure 11-9, Figure 11-10, and Figure 11-11.

1. Install the coil assembly onto the operator frame. See Figure 11-11. Place the coil assembly onto the four studs on the operator frame and align the link into the slotted weight. Use a 7/16 in. nutdriver or wrench to tighten the four hex nuts.

2. Install link pin and retaining screw. See Figure 11-10. Insert the link pin (groove side out) into the left side of the weight and through the link. Then install the hex socket head retaining screw into the weight and use a 3/16 in. hex key wrench to tighten it.

3. Reconnect the resistor/rectifier on the coil frame. See Figure 11-9. Replace the resistor (if necessary), reconnect the two white wires with ring lugs to each end, and install and tighten the hex nuts. Replace the rectifier (if necessary) and carefully reconnect the four wires with push-on lugs to the rectifier terminals as follows: connect the two white power wires to the AC terminals (~), and connect the two black coil leads to the DC terminals (red dot and no dot, polarity does not matter). Be sure the blue snubber is still installed between the DC terminals. See Figure 11-15.

4. Use the manual operator handle to manually operate the transfer switch. It should operate smoothly without any binding. If not, recheck the alignment of parts and the lubrication in the solenoid operator. Close the bottom contacts and remove the manual handle.

5. Reinstall the transfer switch. Refer to the bypass/isolation switch operation and installation manual for instructions.

11.4 Control Contact Test and Adjustment

This section explains how to test and adjust the TS coil control contacts. The TS control contacts control the duration of time that power is applied to the main solenoid operator (TS coil). To assure proper operation, it is important that the contacts open at the proper time during the stroke of the solenoid. Improper adjustment will cause failure to operate at reduced voltages, failure of the main contacts to properly seat, and solenoid failure.

Tools Needed

- Voltmeter
- Ohmmeter
- Continuity lamp
- Open end wrench, 11/32 in.
- Rod or drill bit, 1/4 in.

Test and Adjustment Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

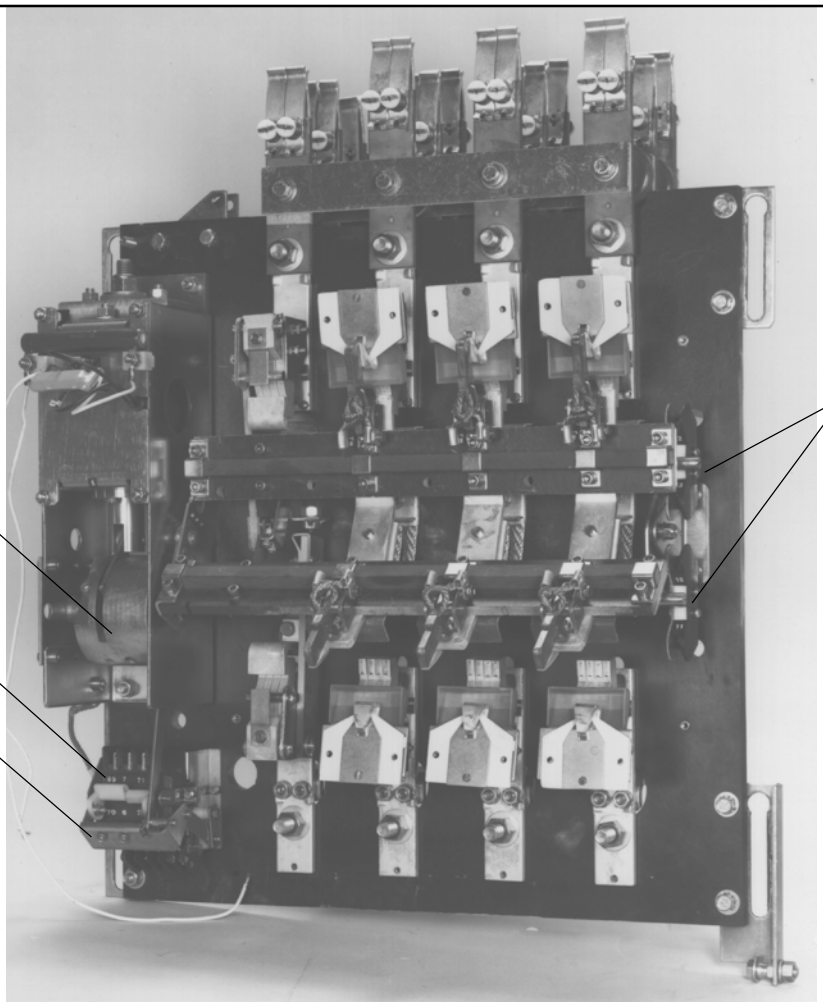
Note: To prevent the possibility of fatal electrical shocks and burns, bypass, isolate, and remove the transfer switch before working on it. Refer to the bypass/isolation switch operation and installation manual for instructions.

1. Bypass, isolate, and remove the transfer switch.

2. Locate the TS control contact assembly; see Figure 11-16. The control contacts are mounted on a metal bracket below the solenoid frame, and are connected with a drive link to the operator weight. There are other auxiliary microswitches inside, underneath the bracket, which are not part of this control circuitry.

3. The TS control contacts are factory set with an adjustable power supply so that the switch can operate satisfactorily over a voltage range of 80 to 110% of the nominal system voltage. To accommodate minor variances in friction and tolerances, it is not unusual for the control contact settings to vary from switch to switch.

   The adjustments are factory-sealed and usually do not require any change over the life of the switch. If it should become necessary to check adjustments in the field, an approximation can be made by following the instructions in steps 4–6. The adjustments can vary to the extremes and still provide acceptable operation. However, it is important that the TS control contacts always open *before* top-dead-center is reached by the solenoid core.



1. Main position indicator: N=closed on normal, E=closed on emergency
2. Control contact assembly
3. Miniature switch
4. Auxiliary contacts

Figure 11-16 Transfer Switch with Barriers Removed

4. To verify settings and field-adjust the TS Control Contacts, proceed as follows (refer to Figure 11-18):

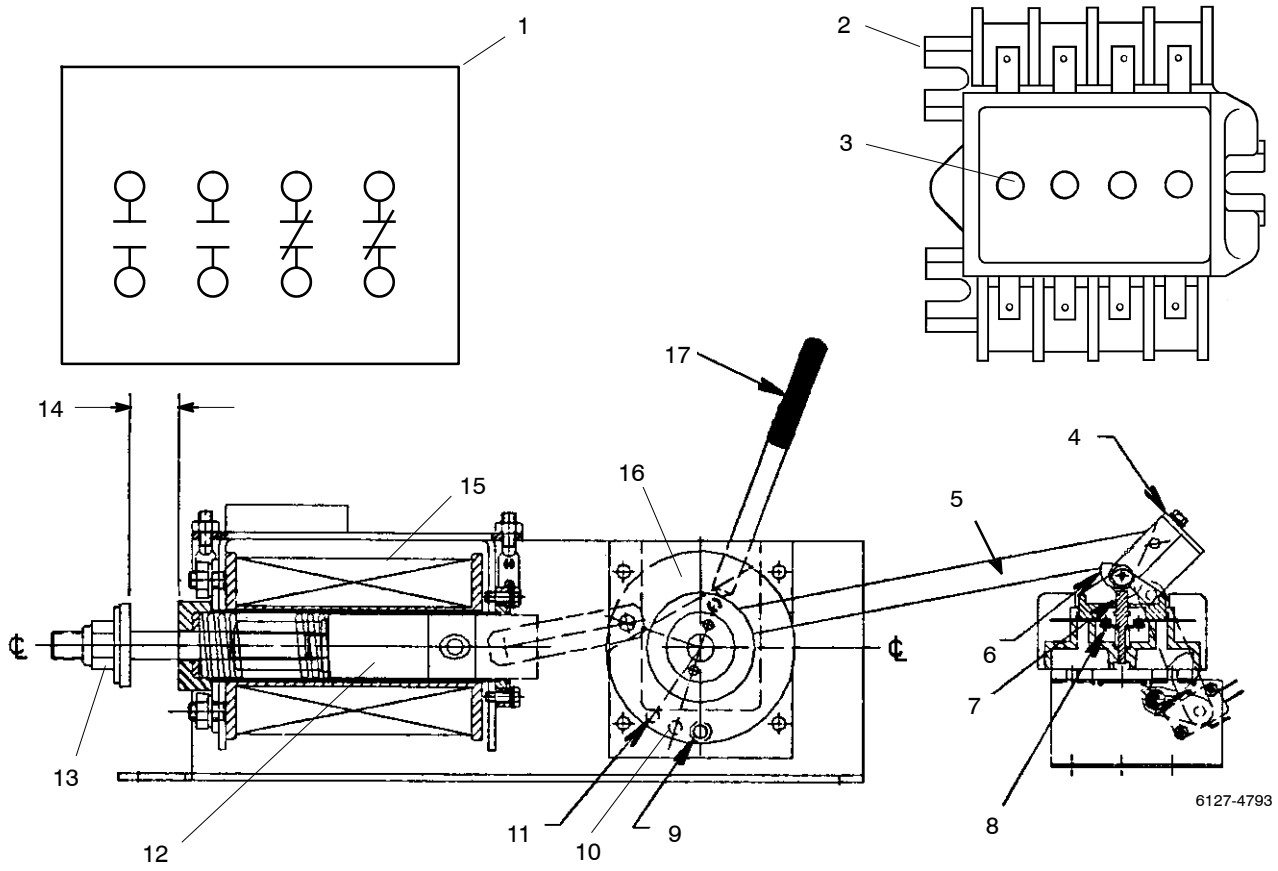
   a. Two sets of contacts interrupt the control current to the solenoid operator coil (TS) in each direction (transfer to emergency and retransfer to normal). The pairs of coil clearing contacts do not have to operate simultaneously, but both must break the circuit *before* the main solenoid operator's core reaches its maximum top-dead-center position. See the table in Figure 11-17 for the control contact position sequence.

Condition	Control Contacts 71-72 & 9-8	Control Contacts 69-70 & 7-6
Main contacts closed—on N	Closed	Open
Main contacts closed—on E	Open	Closed
During transfer from N to E	Open before TDC	Close after TDC
During transfer from E to N	Close after TDC	Open before TDC

N=Normal position
E=Emergency position
TDC=Top dead center of solenoid core or main contact shaft

Note: All contacts are open at TDC. See step 7.

Figure 11-17 Coil Control Contact Positions



1. Electrical diagram (control contact positions when main TS contacts are closed on the Normal source.)
2. Control contact assembly
3. Button
4. Drive bracket
5. Drive link
6. Cams
7. Operating button
8. Control contacts 69-70 (typical). Contacts open when operating button is depressed by cam.
9. Emergency adjustment hole in weight (Step 6)
10. TDC (Step 7)
11. Normal adjustment hole in weight (Step 5)
12. Core
13. Stroke adjustment nut
14. Reference solenoid core stroke dimension 1.040 in.; 1 1/8 in. maximum stroke in TDC position (Step 7)
15. Coil
16. Weight
17. Operator manual handle

Figure 11-18 TS Control Contact Arrangement Below Solenoid Operator

b. With power disconnected, use an ohmmeter (or a lamp-type continuity tester) across each contact to determine when the control contacts open while slowly turning the manual operator handle. Refer to Section 11.1, Manual Operation, for operating handle instructions.

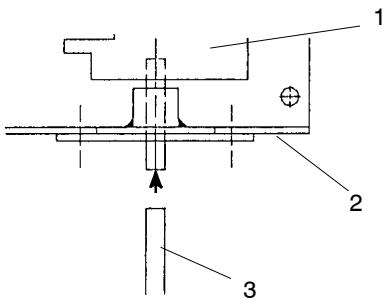
Note: There are three positioning holes in the side of the weight used for adjustment purposes. The center hole is used for TDC (top-dead-center) positioning. The other two are used for setting the control contacts. Make sure that positioning is correct for the task at hand.

5. If adjustment of contacts 71–72 and 9–8 is necessary, proceed as follows (refer to Figure 11-18 and Figure 11-20):

   a. Close the main contacts of the transfer switch on Normal. Starting from the closed-on-normal position, use the manual operator handle to rotate the weight until a rod can be inserted into first hole (normal adjustment hole) in the side of the weight.

   b. Insert a 1/4 in. diameter rod through the hole in the sidewall and into the first hole in the side of the weight. See Figure 11-19.

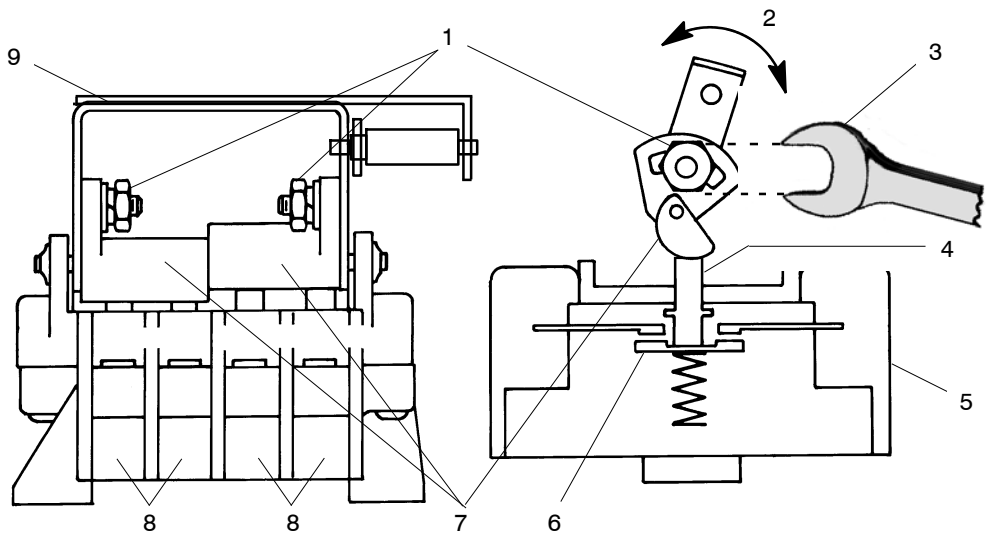
   c. Adjust the right control contact cam so that the contacts just break. Use a continuity lamp or ohmmeter across either contact for this adjustment.



1. Weight
2. Side wall of operator frame
3. 1/4 in. diameter rod

Note: Insert rod through sidewall and into weight to lock weight at appropriate adjustment position.

Figure 11-19 Rod in Weight



1. Adjustment, #8-32 hex locking nut
2. Range of adjustment
3. 11/32 in. open end wrench
4. Operating button
5. Cutaway side view
6. Control contacts typical 69, 70 contacts open when operating button is depressed by cam
7. Cams
8. Control contact sets
9. Drive bracket

Figure 11-20 TS Control Contact Adjustment

6. If adjustment of contacts 69-70 and 7-6 is necessary, proceed as follows. (This procedure is identical to the adjustment of contacts 71-72 and 9-8, except that the weight is positioned on the other side of the top-dead-center position.)

   a. Starting from closed-on-emergency position, use the manual operator handle to rotate the weight until a rod can be inserted into third hole (emergency adjustment hole) in side of weight.

   b. Insert a 1/4 in. diameter rod through the hole in the sidewall and into the third hole in the side of the weight. See Figure 11-19.

   c. Adjust the left control contact cam so that the contacts just break. Use a continuity lamp or meter across either contact for this adjustment.

      Note: IMPORTANT After final adjustment, verify that all control contacts are open when the switch is positioned at TDC.

7. Insert 1/4 in. diameter rod into the center hole in the side of weight. Use a continuity lamp to verify that all contacts are open in this position. Measure 1 1/8 in. max stroke between the leather washer and coil frame (Figure 11-18). If necessary, turn the hex nut to obtain proper stroke (Figure 11-20).

8. After contacts have been set, remove the rod and make sure the transfer switch is fully closed on normal (bottom).

   Note: Be sure to remove the rod from the weight to prevent coil burn out.

9. Reinstall the transfer switch. Refer to the bypass/isolation switch operation and installation manual for instructions.

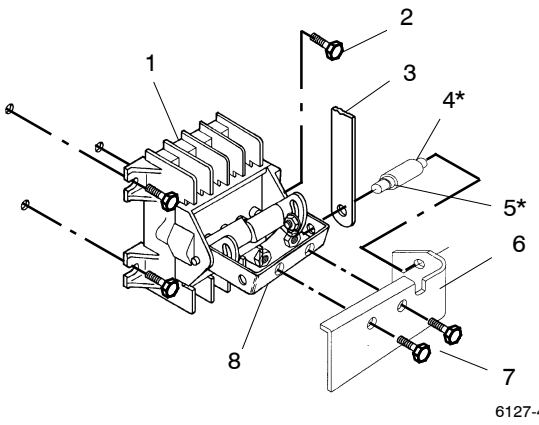
11.5 TS Control Contact Replacement

Under normal conditions the TS control contacts do not require replacement over the life of the transfer switch. If replacement becomes necessary, proceed as follows:

1. Disconnect all power to the transfer switch as instructed in the Test and Adjustment Procedure.

2. Disconnect the drive link; refer to Figure 11-21 below. Remove the lever by removing the two #8-32 hex head screws and nuts. Store the loose pivot pin and loose hardware for safekeeping.

   Note: Do not pull on the wires. Pry off connectors with a screw driver. Pulling may damage crimped wire connections.



1. TS contact assembly
2. Three hex head mounting screws
3. Link
4. Pivot pin
5. Shoulder
6. Lever
7. #8-32 hex head screws
8. Drive bracket

* Insert stepped end of pivot pin into link so that the link rides on the shoulder.

Figure 11-21 TS Control Contact Assembly

3. Check to verify that the wires connected to the control contact assembly are marked so that they can be identified after being disconnected. Add labels if necessary. Disconnect the labeled wires from the control contact assembly.

4. Remove three 8-32 hex head screws from the mounting feet and remove the control contact assembly.

5. Install the new control contact assembly and tighten screws securely.

   Note: Do not overtighten retaining screws; excessive pressure may cause binding.

6. Reconnect the drive link. Install the pivot pin between the link and lever (link must ride on shoulder of pivot pin). Then attach the lever to the drive bracket by installing the two 8-32 hex head screws and nuts.

7. Manually operate the drive linkage with the manual operator handle. The action should be smooth without any binding. Be sure the cams properly operate the pushbuttons on the control and auxiliary contact assemblies.

8. Reconnect the eight labeled wires to their proper terminals.

9. Check the control contact adjustment. Refer to the Test and Adjustment Procedure in Section 11.4.

Section 12 1600–3000 Amp Transfer Switches and 1000–3000 Amp Bypass/Isolation Switches

This section explains how to replace the arcing and main contacts and the solenoid assemby in 1600–3000 amp automatic transfer switches and 1000–3000 amp bypass/isolation switches (lower assembly). This section applies to the following models:

- 1600–3000 Amp KCS/KCP/KCC
- 1000–3000 Amp KBS/KBP/KBC

Note: Some procedures require bypassing and isolating the transfer switch. See the operation and installation manual for instructions to bypass and isolate the transfer switch.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

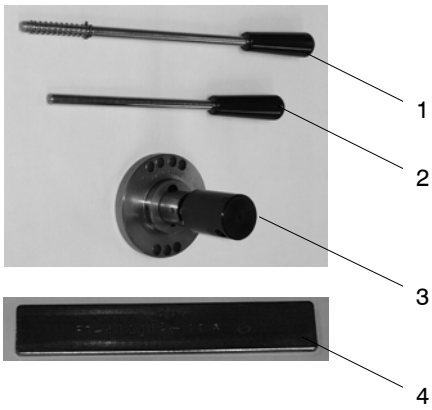
Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

Special Tools Needed

Contact your supplier of Kohler® parts to order the tools shown in Figure 12-1.

Other Tools Needed

- Small and large blade screwdrivers
- Ratchet drive, 3/8 in., and extensions, 6 in. and 12 in.
- Sockets, 3/8 in. and 1/2 in.
- Open-end/box wrenches, 5/16 in. and 1/2 in.
- Torque wrench (0–50 in. lb. minimum)
- Hex key (Allen) wrench, 5/32 in.
- Ohmmeter (or continuity tester)
- Needle nose and regular pliers



1. Maintenance handle GM25404
2. Adjusting pin GM25405
3. Adjusting hub GM25406
4. Main contact shim gauge GM25407

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Figure 12-1 Special Tools

12.1 Maintenance Handle

A detachable manual operator handle is provided on the frame of the transfer switch *for maintenance purposes only*. After the transfer switch is isolated and pulled out (drawn out and totally deenergized), this handle can be used to change the position of the contacts and operator mechanism. The windows in the left side of the transfer switch frame indicate which contacts are open and closed.

When servicing closed-transition switches, check that both contacts are not left in the closed position before energizing the switch.

Manual Operation

1. Bypass, isolate, and pull out the transfer switch. Follow the procedure explained in the operation and installation manual. Verify that no electrical power is present at the pulled-out transfer switch.

2. Install the hub and maintenance handle. Locate and remove the maintenance handle and hub stored on the lower part of the transfer switch frame. Then install the hub onto the center

operator shaft and insert the handle into the hole in the side of the hub. See Figure 12-2.

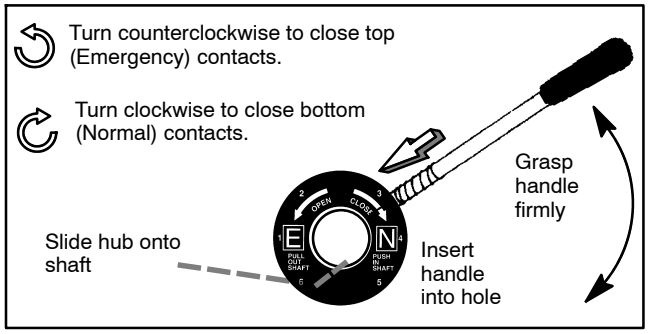


Figure 12-2 Maintenance Handle On Operator Shaft

3. To manually operate the deenergized transfer switch to the opposite position, grasp the maintenance handle firmly and turn either clockwise or counterclockwise. See Figure 12-2. Then remove the handle and hub.

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause severe injury, death, or property damage.

Before energizing the transfer switch, verify that both the normal and emergency contacts are not left in the closed position.

12.2 Main Contact Inspection and Replacement

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

The movable contact assemblies (two for each pole) are located above and below the operator mechanism.

1. Bypass, isolate, and pull out the transfer switch**.** Follow the procedure explained in the bypass/isolation switch operation and installation manual. See Figure 12-3. Verify that no electrical power is present at the pulled-out transfer switch.

2. Open the contacts that will be replaced (if not already open) by using the detachable maintenance handle. See Figure 12-2.

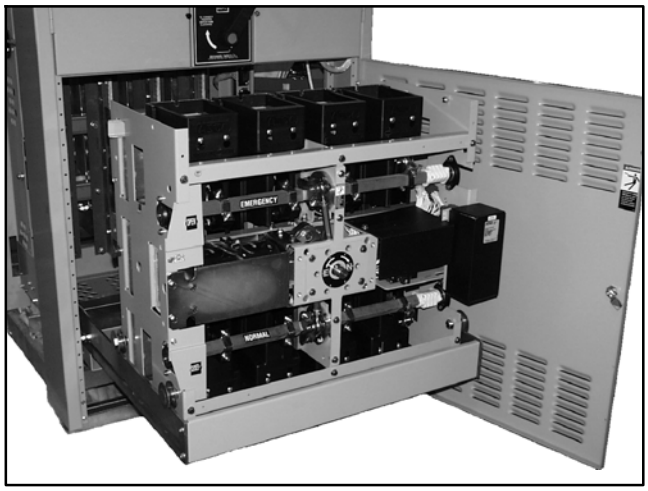


Figure 12-3 Isolated and Pulled-Out Transfer Switch

3. Remove the interphase barriers (one per pole). Use a blade screwdriver to loosen two round-head screws holding each barrier to the arc chutes. Slide the barrier away from the operator mechanism until the keyholes in barrier clear the two round-head screws, then remove the barrier. See Figure 12-4.

4. Carefully remove the arc chutes**.** Use a 5/8 in. nutdriver to remove two long insulator nuts. Then carefully pull the arc chute outward (off the long threaded rods). See Figure 12-5. Place the arc chutes in a safe place.

   Note: The arc chutes are fragile. To prevent breakage, avoid jarring them and do not use any tool to pry them loose. If they become cracked, replace them. See Figure 12-6.

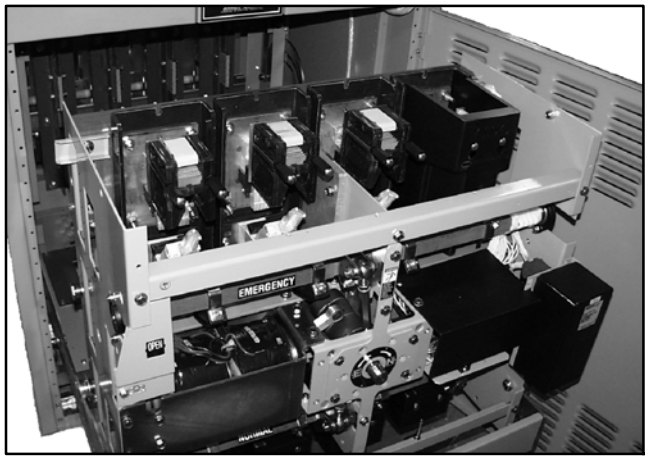


Figure 12-4 Interphase Barriers Removed

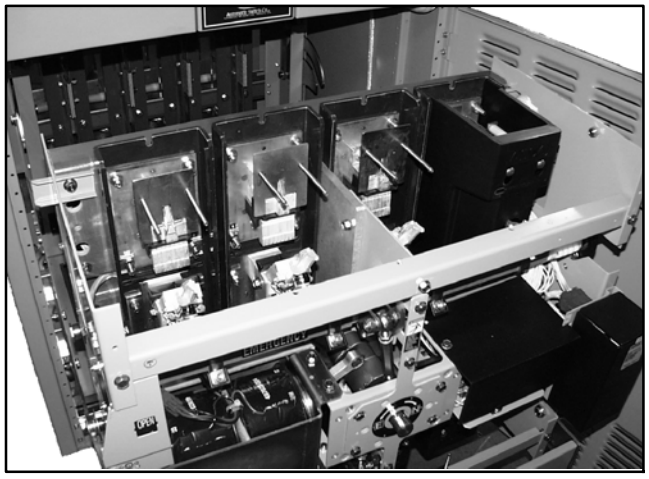
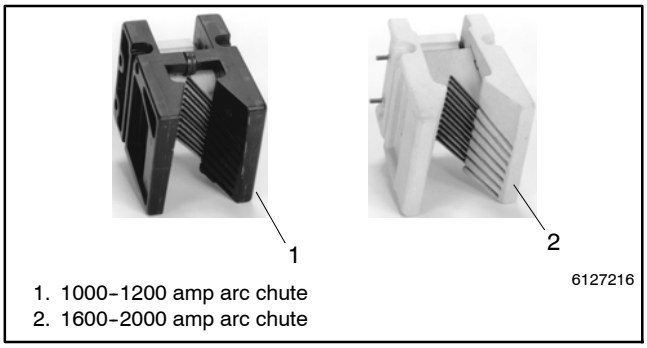


Figure 12-5 Arc Chutes Removed

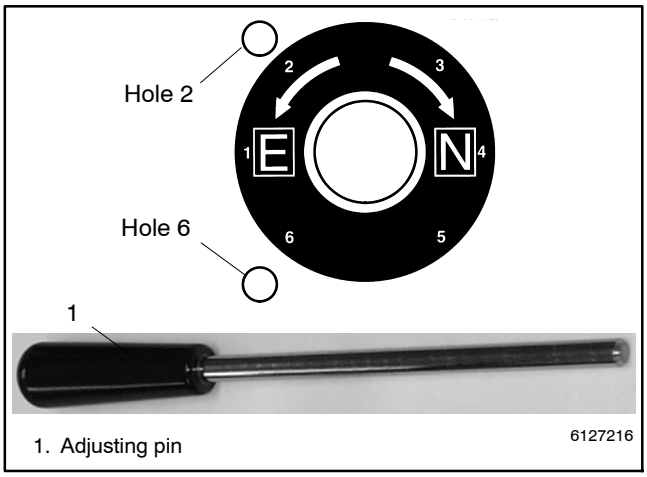


1. 1000–1200 amp arc chute
2. 1600–2000 amp arc chute

Figure 12-6 Replacement Arc Chutes

5. See Figure 12-7. Pin the weight to prevent mechanism from moving**.** Fully insert the adjusting pin through the frame and into the weight. Only one of the holes lines up with the hole in the weight. If you are replacing the upper contacts, use the hole labeled 2; if you are replacing the lower contacts, use the hole labeled 6.

   Note: To prevent the possibility of personal injury, be sure to pin the weight to the frame so that the mechanism cannot move.



1. Adjusting pin

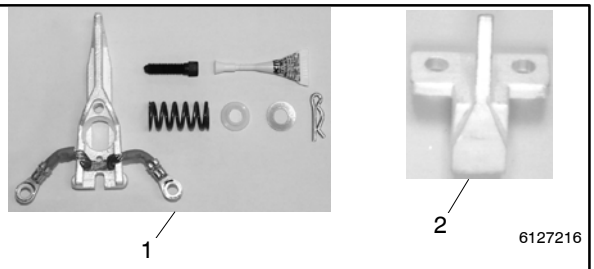
Figure 12-7 Pin Weight to Frame s(ee Step 5)

12.2.1 Contact Inspection

The main contacts are protected by arcing contacts. The arcing contacts make first and break last to avoid arcing at the main contacts. Check the contact adjustments annually (see Section 12.3). Replace contacts when the contact material becomes severely worn. Discoloration is normal. Do not file contacts because it wastes material. Instead use light emery paper to clean up the contact surfaces.

12.2.2 Contact Replacement

Arcing contacts *only* include just the arcing contacts that *make* first and *break* last during load transfer. See Figure 12-8.



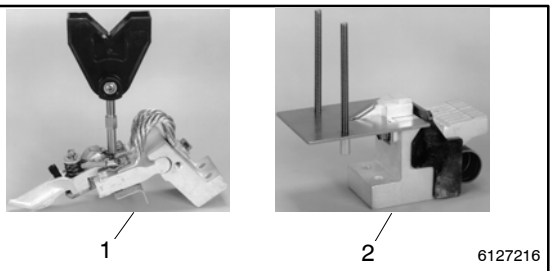
1. Movable arcing contact (with adjustment screw, thread locker Loctite® 222, contact spring, spring retainer, washer, spring pin)
2. Stationary arcing contact

Figure 12-8 Replacement Arcing Contact Kit (one kit includes one movable and one stationary; a 3-pole switch requires six kits)

* Loctite is a registered trademark of the Loctite Corporation.

Main *and* arcing contact assemblies include the entire movable or stationary contact structure, including contacts, springs, shunts, conductive lubricant, and hardware. See Figure 12-9.

If *only* the arcing contacts require replacement, follow the procedure for Arcing Contact Replacement. If the main contacts require replacement, follow the procedure for Main and Arcing Contact Assembly Replacement.



1. Movable main and arcing contact assembly (with thread locker Loctite® 222)
2. Stationary main and arcing contact assembly

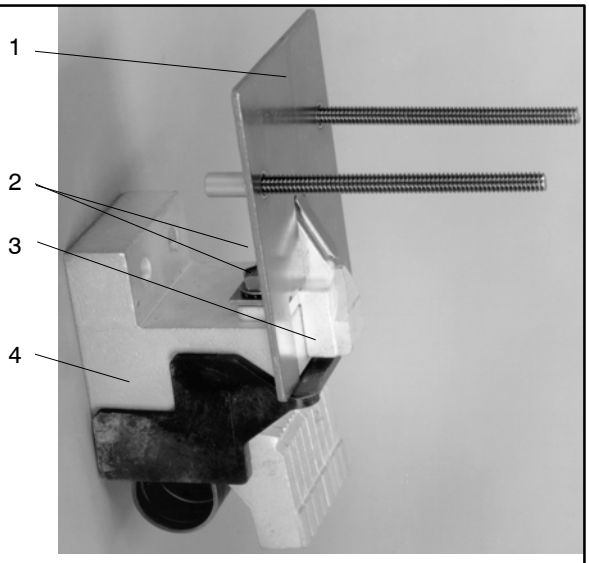
Figure 12-9 Main and Arcing Contact Assemblies Kit (one kit includes one movable and one stationary; a 3-pole switch requires six kits)

Arcing Contact Replacement

1. Remove the movable arcing contact**.** Use needlenose pliers and a screwdriver to remove the spring pin from the spring stud. Then remove the flat washer, spring guide, and contact spring. Next use a 3/8 in. socket wrench to remove two SEMS screws from the pigtails attached to the main movable contact. Now remove the arcing contact retainer and the movable arcing contact.

2. Remove the stationary arcing contact**.** Use a 3/8 in. socket wrench to remove two SEMS screws holding the arcing contact (and arc chute support plate) to the main contact pivot block. Then remove the stationary arcing contact.

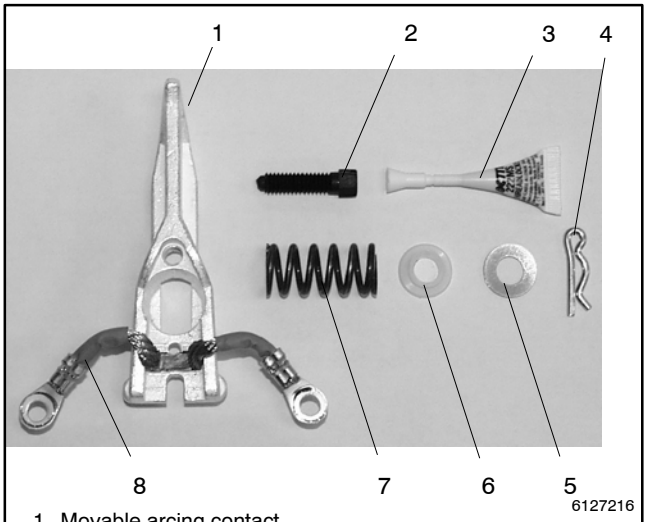
3. Install a new stationary arcing contact**.** Install a new stationary arcing contact and the arc chute support plate onto the main contact pivot block. Use a 3/8 in. socket wrench to secure it with two SEMS screws. Tighten both screws to 7.5 Nm (5.5 ft. lb.) torque. See Figure 12-10.



1. Arc chute support plate
2. SEMS screws, two
3. Stationary arcing contact
4. Main contact pivot block

Figure 12-10 Stationary Arcing Contact

4. Install new movable arcing contact**.** Put two drops of Loctite® 222 (this service-removable threadlocker is provided in the kit) to the lead threads of the adjustment screw. Then install the adjustment screw through the new movable arcing contact until it protrudes 3.2 mm (1/8 in.). Now install the movable arcing contact onto the movable main contact so that the spring stud goes through the arcing contact and its pivot points fit into the two depressions (in the main contact). Finally, install the arcing contact spring, spring guide, flat washer, and spring pin. See Figure 12-11.



1. Movable arcing contact
2. Adjustment screw
3. Loctite® 222 service removable thread locker
4. Spring pin
5. Washer
6. Spring guide
7. Spring
8. Pigtails

Figure 12-11 Movable Arcing Contact and Hardware

5. Reconnect the pigtails and shunts to the contact**.** Place the arcing contact retainer over the movable arcing contact and between the shunts and pigtails. Install two SEMS screws through the arcing pigtail lugs, arcing contact retainer, and main contact shunt lugs into the main movable contact. Use a 3/8 in. socket wrench to tighten the two screws to 7.5 Nm (5.5 ft. lb.) torque.

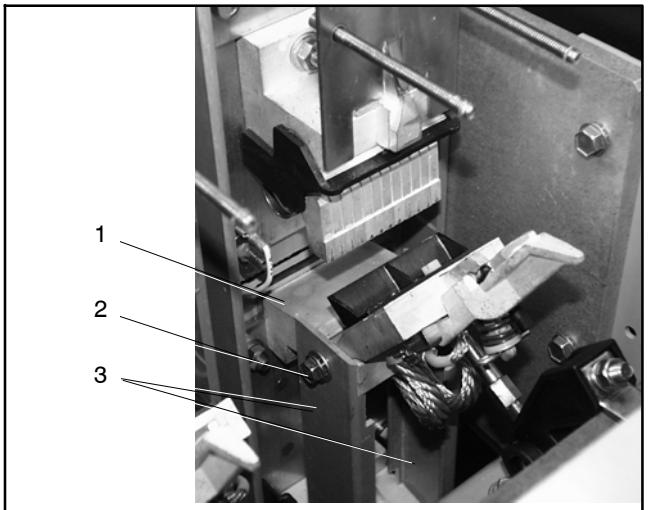
6. Adjust the arcing contacts**.** After all arcing contacts (both stationary and movable) have been installed, they must be adjusted. Proceed to Section 12.3.

   Note: Contact adjustment is required to prevent contact damage. Follow the adjustment procedures in Section 12.3.

* Loctite is a registered trademark of the Loctite Corporation.

Main and Arcing Contact Assembly Replacement

1. Remove the contact supports from both sides**.** Use a 1/2 in. box or open-end wrench to remove four SEMS screws (left and right, upper and lower). Then remove the two contact supports that run vertically between the Normal and Emergency movable contact assemblies (two for each pole). A 3-pole switch has 6 contact supports. See Figure 12-12.



1. Movable arcing assembly
2. SEMS screw
3. Contact supports

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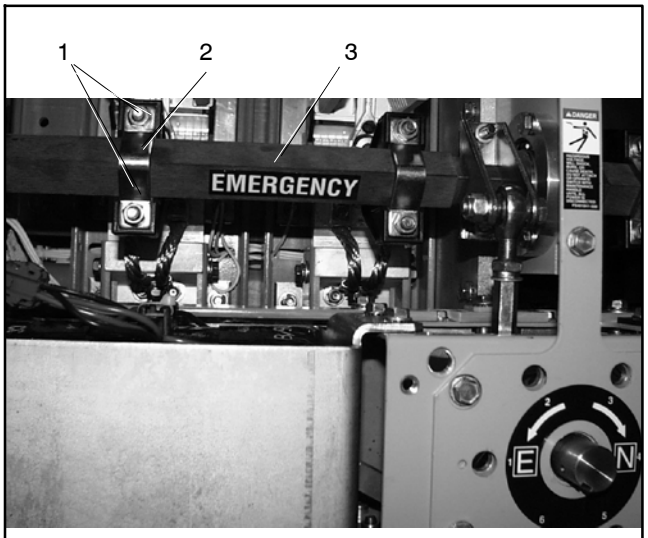
Figure 12-12 Contact Supports (Both Sides)

2. Disconnect the crank arm from the shaft**.** Use a 1/2 in. socket wrench to remove the two nuts with lock washers from each shaft clamp. Then remove the loose clamp from the shaft. Save all hardware. See Figure 12-13.



1. Nuts
2. Shaft clamp
3. Contact shaft

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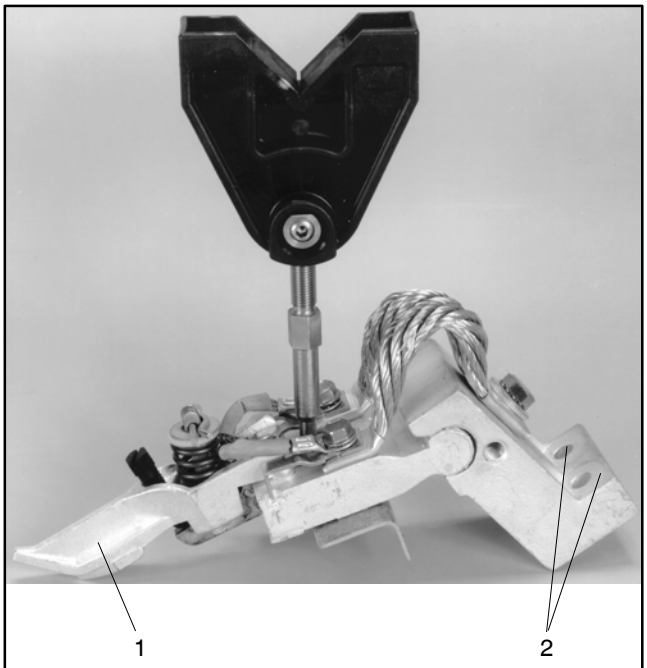
Figure 12-13 Movable Contact Shaft Clamps

3. Remove the movable contact assembly**.** Use a 1/2 in. socket wrench with 12 in. extension to remove two nuts with lock washers from the base of each movable contact assembly. See Figure 12-14.



1. Mounting holes, two
2. Movable arcing contact

Note: Crank arm attaches to the shaft

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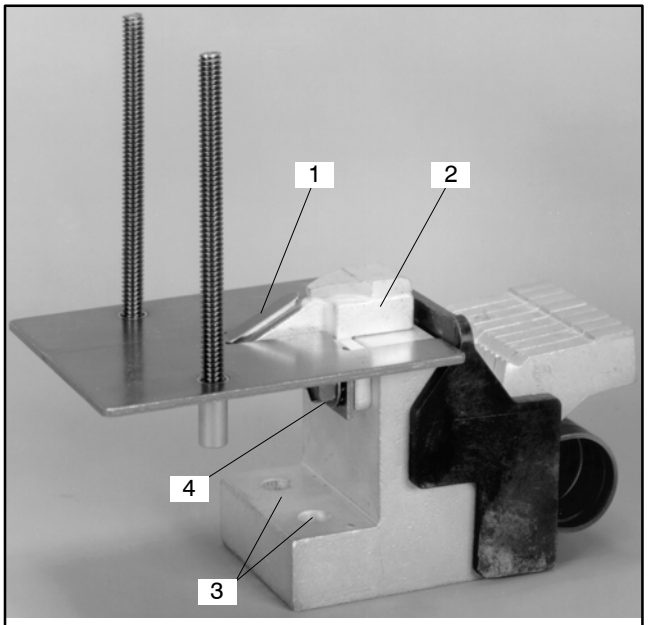
Figure 12-14 Movable Contact Assembly

4. Remove the stationary contact assembly**.** Use a 3/8 in. socket wrench to remove the two SEMS screws from the top (or bottom) of each stationary contact assembly. Then use a 1/2 in. socket wrench with 12 in. extension to remove two nuts with lock washers from the base of each main stationary contact assembly. See Figure 12-15.



1. Arc chute support plate
2. Stationary arcing contact
3. Mounting holes, two
4. SEMS screws, two

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Figure 12-15 Stationary Contact Assembly

5. Install the new stationary contact assembly**.** Position the *new* main stationary contact assembly onto the two 5/16 in. studs. Use a 1/2 in. socket wrench with 12 in. extension to install two nuts with lock washers to secure the assembly. Tighten to 132 in. lb. (11 ft. lb.) torque.

6. Install the arc chute support plate and arcing contact**.** Use a 3/8 in. socket wrench to install two SEMS screws through the *new* arc chute plate and *new* stationary arcing contact to the top (or bottom) of each new stationary contact assembly. Tighten to 66 in. lb. (5.5 ft. lb.) torque.

7. Install insulators onto the new stationary contact assembly. See Figure 12-16.

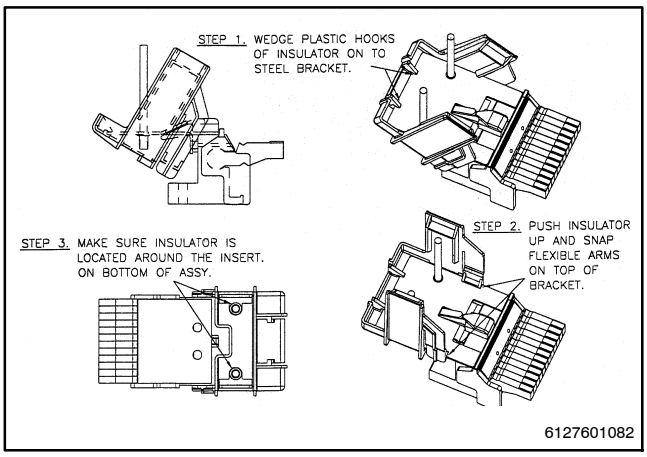


Figure 12-16 Insulators, 2600–3000 Amp Models

8. Install the new movable contact assembly**.** Position the *new* movable contact assembly onto the two 5/16 in. studs. Use a 1/2 in. socket wrench with 12 in. extension to install two nuts with lock washers to secure the assembly. Tighten to 132 in. lb. (11 ft. lb.) torque.

9. Connect new movable contact assembly to shaft**.** Position the *new* movable contact assembly (black drive arm) under the shaft. Then position the metal half clamp over the front and install two bolts (from the opposite side). Use a 1/2 in. wrench to install two nuts with lock washers to secure each clamp. Tighten the clamp nuts to 132 in. lb. (11 ft. lb.) torque.

10. Adjust the arcing and main contacts**.** After all movable and stationary contact assemblies have been installed, they must be adjusted. Proceed to Section 12.3.

    Note: Contact adjustment is required to prevent contact damage. Follow the adjustment procedures in Section 12.3.

12.3 Main and Arcing Contact Adjustment

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.

⚠ WARNING

Spring-loaded parts.
Can cause severe personal injury or property damage.

Wear protective goggles when servicing spring-loaded parts. Hold parts securely during disassembly.

Check the contact adjustment once a year. After contacts are replaced contact adjustment is required before the transfer switch can be reenergized. Adjustment includes: A–Stationary Arcing Contact Alignment and B–Arcing Contact Lead Adjustment.

Contact Adjustment Procedure

1. Bypass, isolate, and pull out the transfer switch**.** Follow the procedure explained in the operation and installation manual. Verify that no electrical power is present at the pulled-out transfer switch. See Figure 12-3.

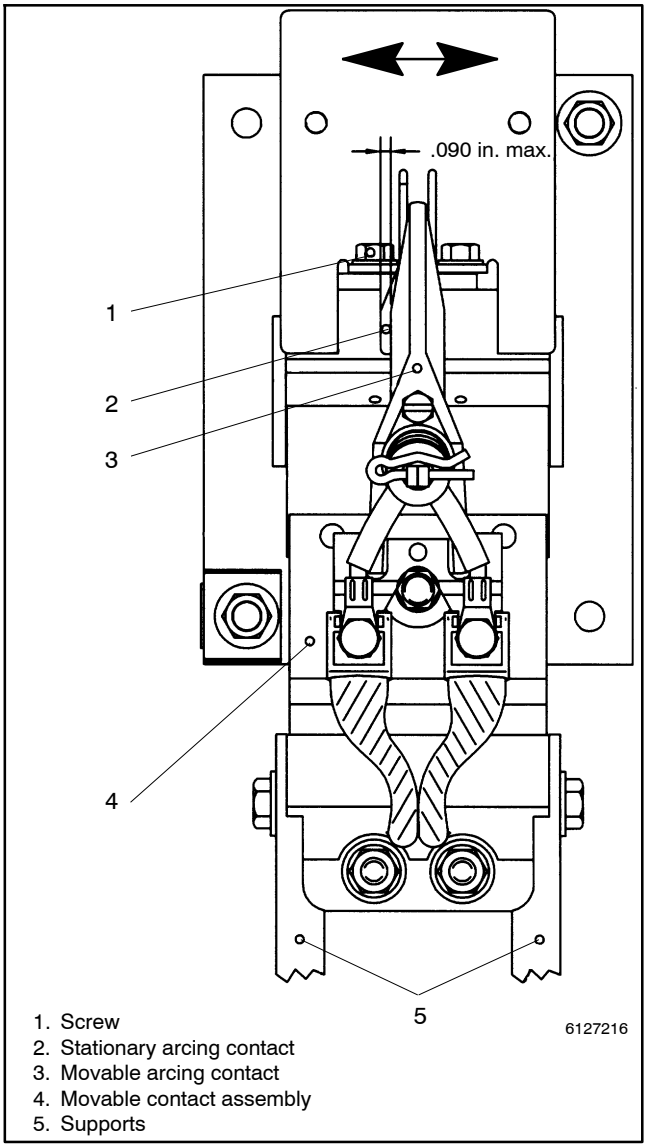
2. Use the maintenance handle (if necessary). Open the contacts that will be adjusted (if not already open) by using the detachable maintenance handle. See Figure 12-2.

3. Remove the barriers**.** Use a blade screwdriver to loosen only two round-head screws holding each barrier to the arc chutes. Slide the barrier away from the operator mechanism until the keyholes in the barrier clear the two round-head screws, then remove the barrier. See Figure 12-4.

4. Carefully remove the arc chutes**.** Use a 5/8 in. nutdriver to remove two long insulator nuts. Then carefully pull the arc chute outward (off the long threaded rods). Place the arc chutes in a safe place to prevent breakage. See Figure 12-5.

A–Stationary Arcing Contact Alignment

A maximum horizontal offset of 2.29 mm (0.090 in.) is allowed between the movable and stationary arcing contacts. See Figure 12-17. If adjustment is needed follow these steps:



1. Screw
2. Stationary arcing contact
3. Movable arcing contact
4. Movable contact assembly
5. Supports

Figure 12-17 Stationary Arcing Contact Alignment

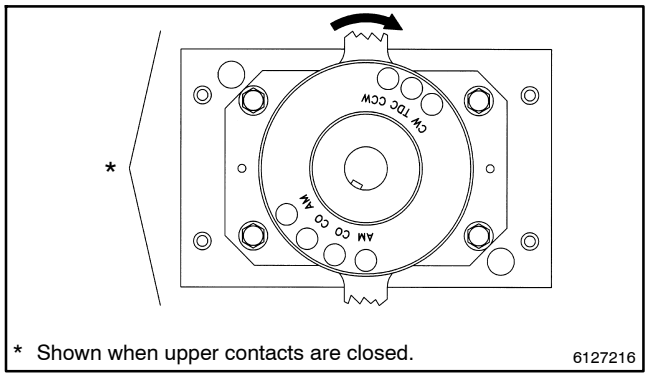
1. Loosen the screws and move the stationary arcing contact**.** Use a 3/8 in. socket wrench to loosen the two SEMS screws, then move the stationary contact left or right to approximately center it under the movable arcing contact.

2. Retighten the stationary arcing contact screws**.** Use the maintenance handle to open and close the contacts to recheck contact alignment. Use a 3/8 in. socket wrench to retighten the two nuts to 66 in. lb. (5.5 ft. lb.) torque.

Note: To prevent arc chute breakage, be sure that the stationary arcing contact alignment is set correctly.

B-Arcing Contact Lead Adjustment

The arcing contacts must lead the main contacts on closing by 2 to 3 mm (0.08 to 0.12 in.). To set this contact gap (at the main contacts) use the adjusting hub, adjusting pin, and maintenance handle from the contact adjustment handle kit. To check and/or change the adjustment, follow these steps (see Figure 12-18 through Figure 12-22).



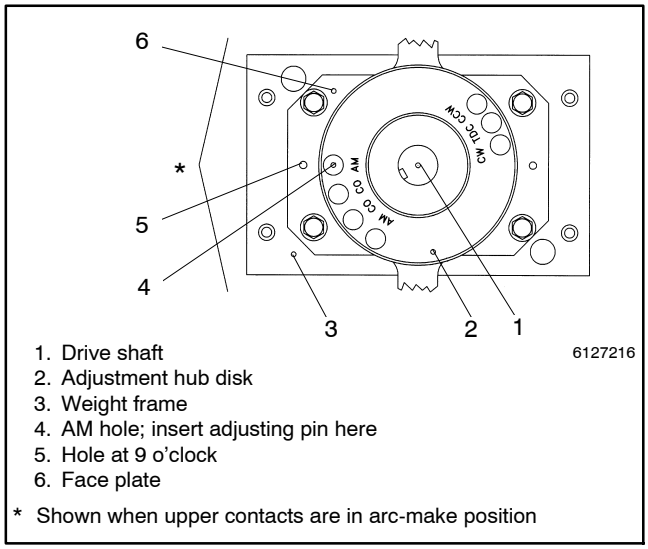
* Shown when upper contacts are closed. 6127216

Figure 12-18 Pinning Weight For **Upper** Contacts (before)

1. Install the adjusting hub and maintenance handle**.** Insert the maintenance handle completely into the hub (compress the handle spring) and grasp it firmly. Use the maintenance handle to close the contacts that you are checking or adjusting (if they are not already closed). See Figure 12-3.

   Note: To prevent the possibility of personal injury, be sure to fully pin the weight to the weight frame so that the mechanism cannot move while you are adjusting the contacts.

2. For closed **upper** contacts, pin the weight as shown in Figure 12-19**.** Turn the maintenance handle clockwise 30° until the hole is in the 9 o'clock position. Fully insert the adjusting pin into hole to lock the upper contact shaft in the ARC MAKE position. See Figure 12-18 (before) and Figure 12-19 (after).

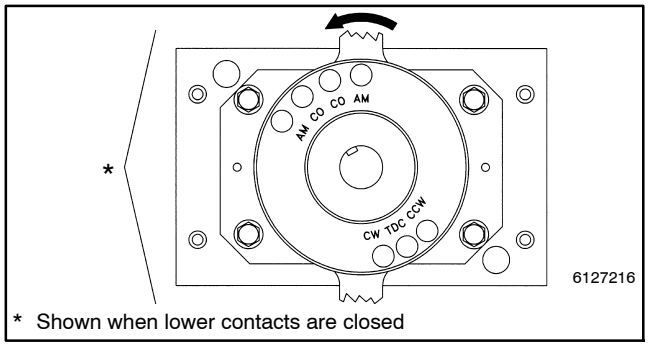


1. Drive shaft
2. Adjustment hub disk
3. Weight frame
4. AM hole; insert adjusting pin here
5. Hole at 9 o'clock
6. Face plate

* Shown when upper contacts are in arc-make position 6127216

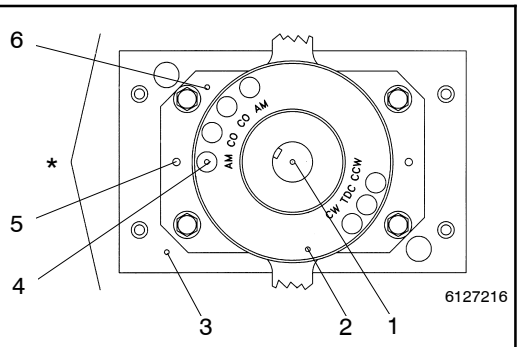
Figure 12-19 Pinned Weight For **Upper** Contacts (after)

3. For closed **lower** contacts, pin the weight as shown in Figure 12-21**.** Turn the maintenance handle counterclockwise 30° until the hole is in the 9 o'clock position. Fully insert the adjusting pin into hole to lock the lower contact shaft in the ARC MAKE position. See Figure 12-20 (before) and Figure 12-21 (after).



* Shown when lower contacts are closed 6127216

Figure 12-20 Pinning Weight For **Lower** Contacts (Before)

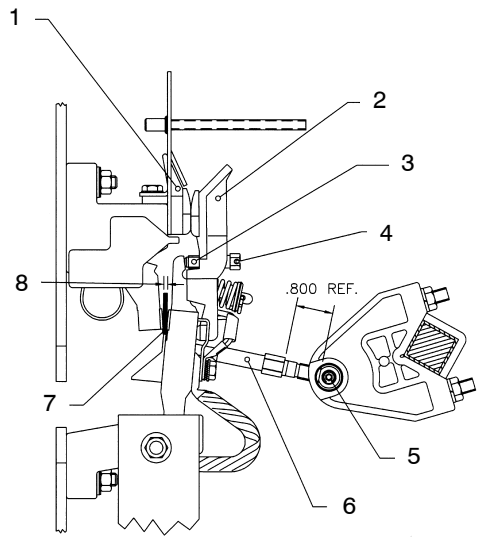


1. Drive shaft
2. Adjustment hub disk
3. Weight frame
4. AM hole; insert adjusting pin here
5. Hole at 9 o'clock
6. Face plate

* Shown when lower contacts are in arc-make position

Figure 12-21 Pinned Weight For **Lower** Contacts (After)

4. Measure and adjust the movable arcing contact screws**.** Check that *all* nylon adjustment screws protrude 3 mm (1/8 in.) through the far side of *all* movable arcing contacts. If adjustment is necessary, use a blade screwdriver or 11/32 in. nutdriver to turn the adjustment screw. See Figure 12-22.



1. Stationary arcing contact
2. Movable arcing contact
3. Nylon stop screw protrusion
4. Nylon stop screw
5. Set screw
6. Drive rod
7. Shim gage (0.001 in.)
8. Arc lead gap

Figure 12-22 Arcing Contact Lead Alignment

5. Check that the main contacts are open approx. 3 mm (1/8 in.). With the main contacts locked in the position (Figure 12-19 or Figure 12-21), verify that *all* main contacts are open approximately 3 mm (1/8 in.) on the shaft being adjusted. If any main contact is *not* open at least 3 mm (1/8 in.), use a 5/32 in. hex key (Allen) wrench to loosen the set screw in the side of the crank arm. Then use a 7/16 in. open-end wrench to turn the movable contact drive rod counterclockwise until that main contact is open 3 mm (1/8 in.). See Figure 12-22.

6. Insert the main contact shim gauge (GM25407) and adjust the drive rod**.** With the main contacts locked in the position (Figure 12-19 or Figure 12-21), insert the shim gauge between the movable and stationary main contacts. The shim should fit finger tight (this shim gauge is the arcing contact lead dimension). To decrease the gap, turn the drive rod clockwise; to increase the gap, turn the drive rod counterclockwise. *Recheck all gaps*. See Figure 12-22.

7. Adjust the movable arcing contact adjustment screws**.** After *all* main contacts on the shaft are set for the lead gap, adjust the arcing contacts. Turn each nylon adjustment screw until the arcing contacts *just touch* (no gap, no deflection). All arcing contacts on the same shaft should touch at approximately the same time. *Recheck all gaps.* See Figure 12-22.

8. Carefully unpin the weight as follows**:** After *all* contacts are checked and adjusted, insert the maintenance handle *completely* into the hub (handle spring compressed). Firmly grasp and hold the maintenance handle while you remove the adjusting pin. When the adjusting pin is pulled out, the weight releases suddenly and forcibly turns the handle to the closed contact position.

   Note: To prevent the possibility of personal injury, fully insert the maintenance handle into the hub and grasp and hold it firmly when you remove adjusting pin. Gently allow the contacts to close.

   Note: To prevent coil burnout in the solenoid assembly, be sure to remove the adjusting pin so that the mechanism is free to operate.

9. Manually operate the switch and recheck adjustments**.** Use the maintenance handle (see Figure 12-3) to manually operate the transfer switch several times. Then repeat steps 3 through 8. When you are finished with all contact adjustments, remove the hub and maintenance handle and store them on the lower frame in the place provided.

10. Carefully reinstall the arc chutes**.** Carefully slide the arc chute (with the arc splitters toward the contacts and the recess for nuts outward) between the two long threaded rods. Reinstall the two long insulator nuts (round shoulder in) and use a 5/8 in. nutdriver to GENTLY tighten until snug. Do not overtighten these nuts. See Figure 12-4 and Figure 12-5.

    Note: Handle the arc chutes gently to prevent breakage. Do not clamp the arc chutes too tightly (hand tighten the insulator nuts only).

11. Reinstall the barriers**.** Install the barrier over the arc chute and slide it toward the operator mechanism until the two round-head screws align in the keyholes in the barrier. Then use a blade screwdriver to tighten the two round-head screws to secure the barrier to the arc chute insulator nuts. See Figure 12-4.

12.4 Solenoid Assembly Replacement

Solenoid assemblies include the entire solenoid with frame, coils, core tube, core spring, core and link. Solenoid assemblies must be matched to the transfer switch voltage rating. Refer to the transfer switch parts catalog for the part number for the appropriate solenoid assembly for your transfer switch.

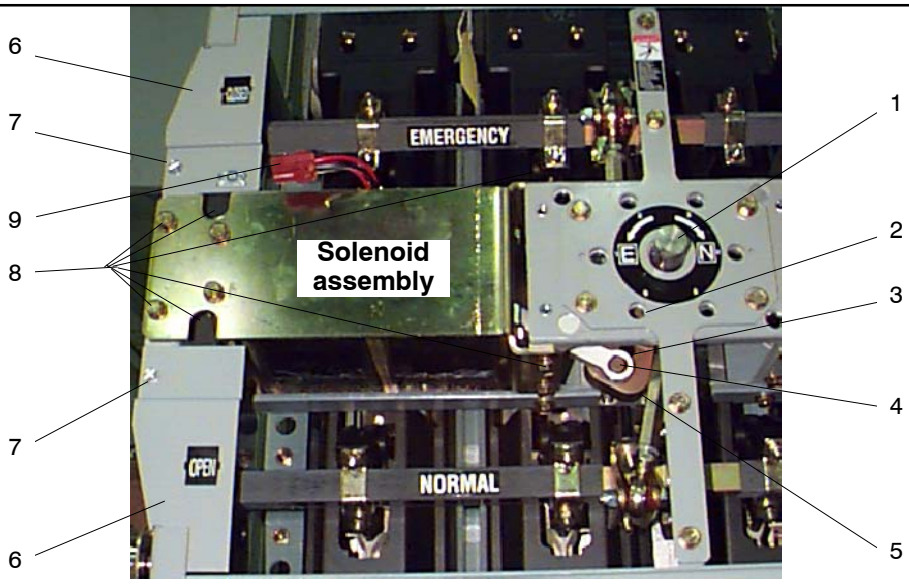
The solenoid assembly is located in the left front of the transfer switch. See Figure 12-23.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Removing the transfer switch from bypass/isolation models. Hazardous voltage can cause severe injury or death. Bypass and isolate the transfer switch before removing it from the enclosure. The bypass/isolation switch is energized. Do not touch the isolation contact fingers or the control circuit terminals.



1. Operator shaft
2. Hole 6 for pinning weight to weight frame
3. Core link
4. Post on weight
5. Weight
6. Shaft indicator plate
7. Mounting screw
8. Mounting bolts, 8 ea.
   Note: Two longer bolts are used in the rear.
9. Coil harness plug

6127216

Figure 12-23
Location of the Solenoid Assembly and Related Parts in the Drawn-Out (Removed) Transfer Switch

Solenoid Assembly Replacement Procedure

1. Bypass, isolate, and pull out the transfer switch**.** Follow the procedure explained in the operation and installation manual. Verify that no electrical power is present at the removed transfer switch.

2. Manually operate the switch to the EMERGENCY position. After the transfer switch is pulled out completely, use the maintenance handle (Figure 12-3) to turn the weight so that the core link is down, as shown in Figure 12-23 (Normal contacts are in the *OPEN* position). Refer to the operation and installation manual.

3. Disconnect the solenoid assembly. Squeeze the plug latches and separate the inline wire harness plug to the coils to disconnect them.

4. Remove both shaft indicator plates (left side). Use a 3/8 in. socket wrench to remove two screws.

5. Pin the weight to prevent the mechanism from moving. Insert the adjusting pin (see Figure 12-1) through the weight frame and into the weight. Use the hole labeled **6** on the round label; it is the bottom left hole adjacent to the center operator shaft (in the 7 o'clock position). See Figure 12-24.

   Note: To prevent the possibility of personal injury, be sure to pin the weight to the frame so that the mechanism cannot move while removing the solenoid assembly.

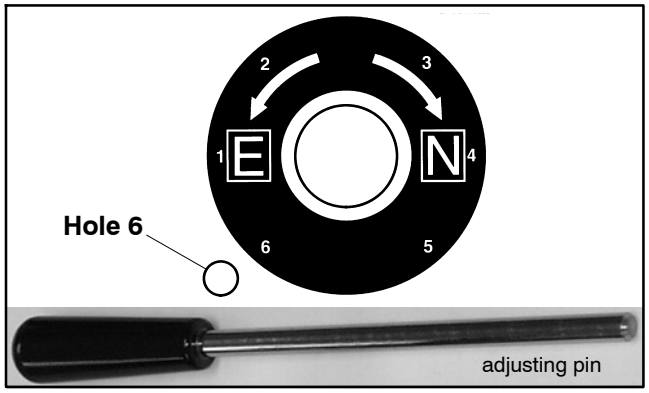


Figure 12-24 Pin Weight To Frame (see step 5)

6. Remove the solenoid assembly.

   Note: The solenoid assembly weighs about 16 kg (35 lb.).

   First use a 1/2 in. socket wrench with 6 in. extension (minimum) to remove the *two* left rear hex-head bolts. Then use a 1/2 in. socket and/or open-end wrench to remove the *six* other bolts (2 on the left, 4 on the right). Then carefully pull out the solenoid assembly (unhook the core link from the post on the weight) and swing out the left side first. See Figure 12-25.

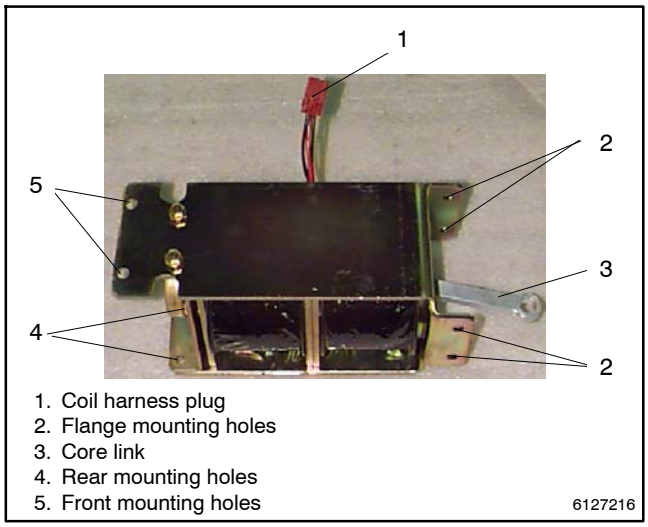


Figure 12-25 Solenoid Assembly

7. Install the replacement solenoid assembly. Position the solenoid assembly with the core link facing right and the coil wire harness plug on top. Install the new solenoid assembly (put in the right side first) and hook the link onto the post on the weight. Use a 1/2 in. socket wrench with 6 in. extension (min.) to reinstall *two* longer screws in the left rear. Then use a 1/2 in. socket and/or open-end wrench to reinstall *six* hex-head bolts (four on the right above and below the flanges, 2 on the far left side front). Tighten all eight bolts to 15 Nm (11 ft. lb.) torque.

8. Reinstall the two shaft indicator plates (on the left). Use a 3/8 in. socket wrench to reinstall two screws.

9. Connect the new solenoid assembly. The inline wire harness plug and plug from the coils are keyed to go together only one way. Carefully connect the plugs and be sure that both latches *click*.

10. Unpin the weight to free the mechanism. Insert the maintenance handle *completely* into the hub (compress the handle spring). Firmly grasp and hold the maintenance handle while you remove the adjusting pin from hole 6. When the adjusting pin is pulled out, the weight releases suddenly and forceably turns the handle to the closed contact position.

Note: To prevent the possibility of personal injury, fully insert the maintenance handle into the hub and grasp and hold it firmly when you remove the adjusting pin. Gently allow the contacts to close.

Note: To prevent coil burnout in the new solenoid assembly, be sure to remove the adjusting pin so that the mechanism is free to operate again.

11. Manually operate the transfer switch. Use the maintenance handle (see Figure 12-3) to operate the transfer switch several times. It should operate smoothly without any binding. If it does not, check to be sure that the solenoid is installed correctly. When you are finished with all contact adjustments, remove the hub and maintenance handle and store them on the lower frame in the place provided.

12. Check the main contact adjustments. Before returning the transfer switch to service, the main contact adjustments must be checked. Refer to Section 12.3. When you are finished with all contact adjustments, remove the hub and maintenance handle and store them on the lower frame in the place provided.

    Note: To prevent possible damage to the transfer switch and interruption to the load, check the main contact adjustments after replacing the solenoid assembly.

13. Return the transfer switch to service**.** After you verify that the control and main contact adjustments are correct, you can return the transfer switch to service. Follow the procedure explained in the operation and installation manual.

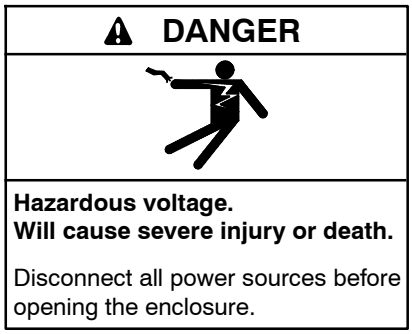
Notes

13.1 Purpose

This section explains how to test and adjust the TS coil control contacts in 4000-amp transfer switches.

The TS control contacts control the duration of time that power is applied to the main solenoid operator (TS coil). To assure proper operation, it is important that the contacts open at the proper time during the stroke of the solenoid. Improper adjustment will cause failure to operate at reduced voltages, failure of the main contacts to seat properly, and solenoid failure.

Only experienced electricians should test and adjust the switch. All standard safety practices must be observed.



Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

13.2 Manual Operation

A detachable manual operator handle is provided for maintenance purposes only. The handle is stored on the transfer switch. See Figure 13-1.

Note: Do not manually operate the switch until all power and control circuits are disconnected.

Note: The engine start circuit closes when the transfer switch is operated to the emergency side. This will cause the emergency generator set to start and run if not disconnected beforehand.

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position, disconnecting power to the generator engine starting battery charger, if installed, and disconnecting all generator engine start batteries, negative (-) leads first.
2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch.
3. Insert the manual handle into the hole in the rotating weight (Figure 13-4). Move the handle down and up to manually operate the switch, as needed, in the service procedures.

NOTICE

Improper operator handle usage. Use the manual operator handle on the transfer switch for maintenance purposes only. Return the transfer switch to the normal position. Remove the manual operator handle, if used, and store it in the place provided on the transfer switch when service is completed.

13.3 Coil Control Contact Test and Adjustment

The TS control contacts are factory-set using an adjustable power supply so that the switch can operate satisfactorily over a wide voltage range of 80 to 110% of the nominal system voltage. To accommodate minor variances in friction and tolerances, it is not unusual for the control contact settings to vary from switch to switch.

The adjustments are factory-sealed and usually do not require any change over the life of the switch. If it should become necessary to check adjustments in the field, an approximation can be made by following the instructions in the following procedure. The adjustments can vary to the extremes and still provide acceptable operation. However, it is important that the TS control contacts always open ***BEFORE*** top-dead-center is reached by the solenoid core.

Coil Control Contact Test and Adjustment Procedure

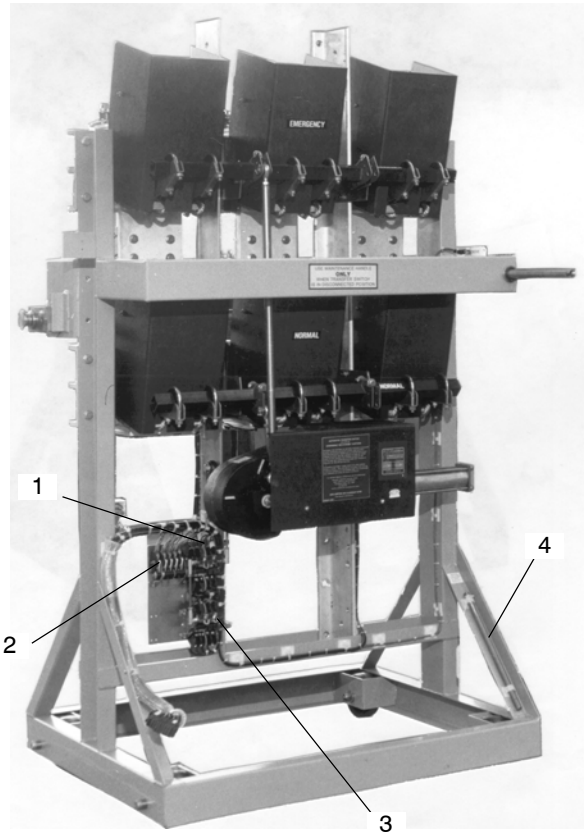
⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (–) leads first. Reconnect negative (–) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine starting battery charger, if installed; and disconnecting all generator engine start batteries, negative (–) leads first.
2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch.
3. Use a voltmeter to verify that no voltage is present at the switch terminal lugs on both power sources.
4. Locate the TS control contact assembly; see Figure 13-1.
5. To check the settings of the TS control contacts, proceed as follows (refer to Figure 13-2):
   a. Two sets of contacts interrupt the control current to the solenoid operator coil (TS) in each direction (transfer to emergency and retransfer to normal). The pairs of coil clearing contacts do not have to operate simultaneously, but both must break the circuit ***BEFORE*** the main solenoid operator core reaches top-dead-center (TDC) position. See the table in Figure 13-3 for control contact positions.
   b. With the power disconnected, use a multimeter (or a lamp-type continuity tester) across each contact to determine when the control contacts open while slowly turning the manual operator handle (see Figure 13-4 and section on **Manual Operation** for instructions).



1. TS control contact assembly
2. Miniature switches
3. Auxiliary contacts
4. Manual operator handle (storage location)

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Figure 13-1 4000 Amp Transfer Switch

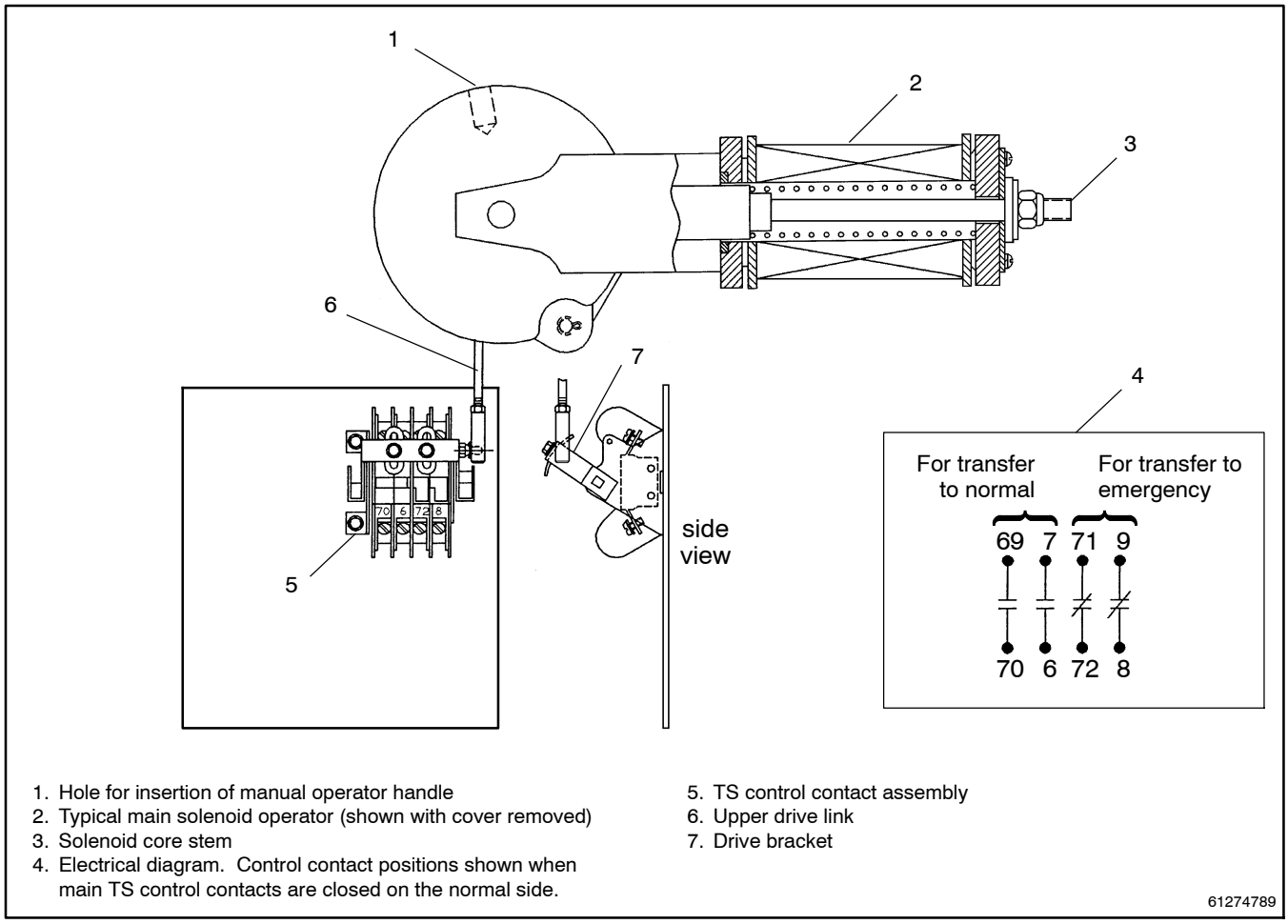


Figure 13-2 Typical TS Control Contact Arrangement

Condition	Control Contacts 71-72 & 9-8	Control Contacts 69-70 & 7-6
Main contacts closed-on N	Closed	Open
Main contacts closed-on E	Open	Closed
During transfer from N to E	Open before TDC	Close after TDC
During transfer from E to N	Close after TDC	Open before TDC
N- Normal Position	**E**-Emergency Position	
TDC- Top Dead Center of solenoid core.		

Figure 13-3 Control Contact Positions

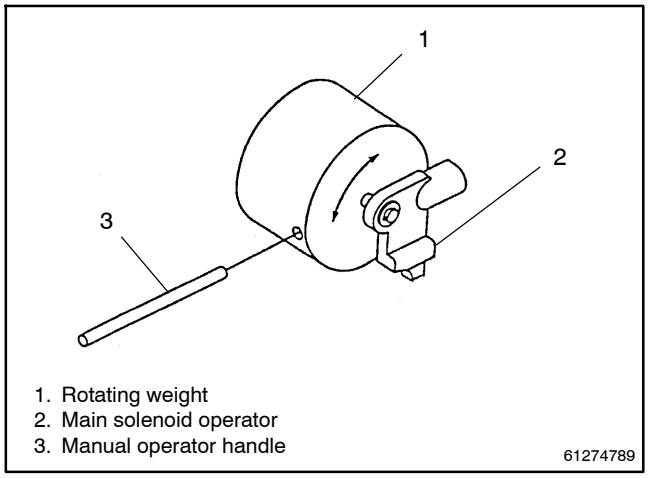


Figure 13-4 Manual Operator Handle

6. If adjustment of contacts 71–72 and 9–8 is necessary, proceed as follows. Refer to Figure 13-6 and Figure 13-5.

   a. Make sure the main contacts of the transfer switch are closed on normal. Use the manual operator handle to change the contact position, if necessary.

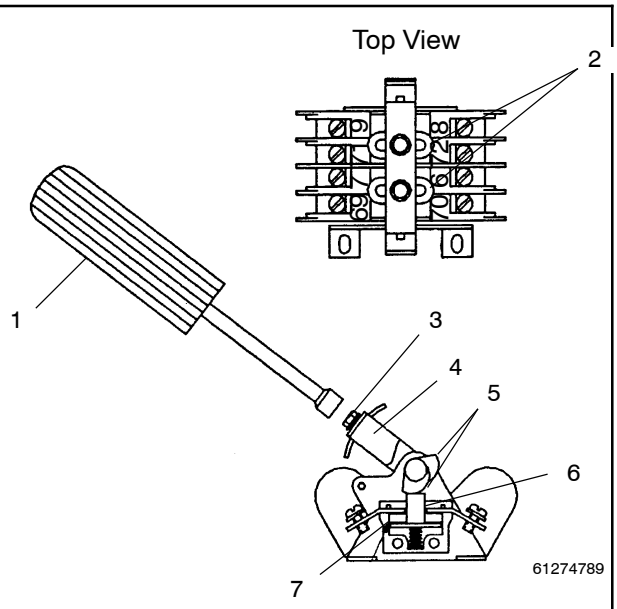
   b. Starting from the closed-on-normal position, use the manual operator handle to rotate the weight until the core has moved up to the indicated dimensions. See Figure 13-6.

   c. At this point adjust the right side control contact cam adjusting arm so that the contacts just break: Use a 1/4 in. nutdriver to loosen the hex-head locking screw. Move the cam adjusting arm so that the contacts just break. Then tighten the locking screw. See Figure 13-5.

7. Rotate the manual handle so that the weight is over center on the opposite side *(EMERGENCY)*. Then rotate the weight to the same core position in Figure 13-6 except coming from emergency side. Perform the adjustment described in step 6 on the two opposite control contacts, 69–70 and 7–6.

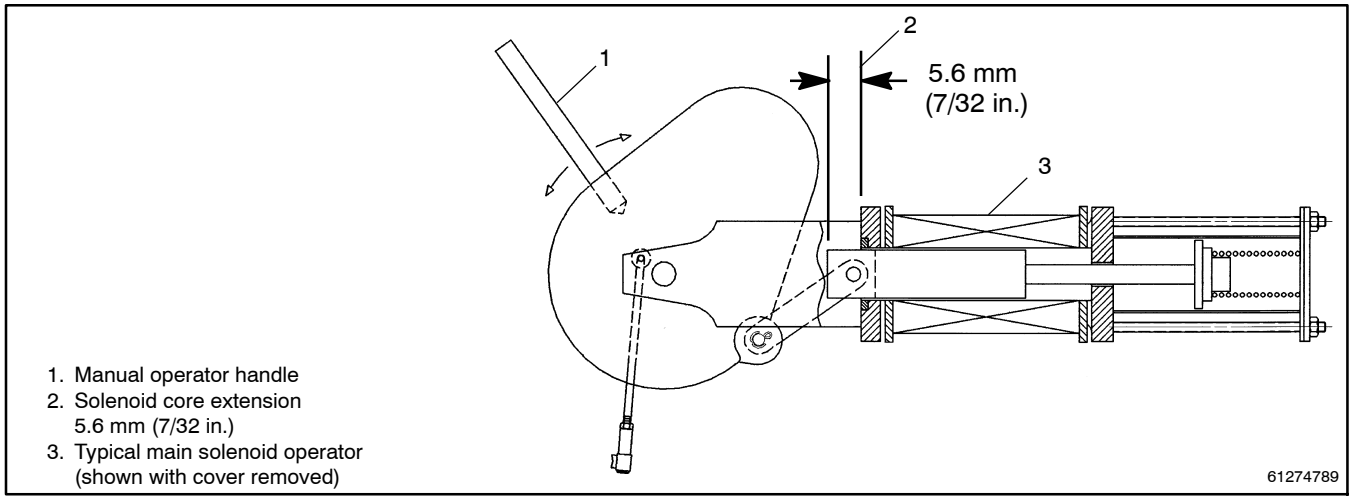
8. Reconnect power supplies to the transfer switch.

9. Reconnect the generator engine starting battery cables, negative (–) leads last; reconnect power to the generator engine starting battery charger, if installed; and move the generator set master switch to the AUTO (automatic) position. The generator set may start and run until the ATS time delay engine cooldown (TDEC) expires.



1. 1/4 in. nutdriver
2. Control contact cam adjusting arms (shown in midpoint position)
3. #8-32 hex head locking screw
4. Drive bracket
5. Cams
6. Operating button
7. Control contacts 71–72 (typical). Contacts open when the operating button is depressed by the cam.

Figure 13-5 TS Control Contact Adjustment



1. Manual operator handle
2. Solenoid core extension 5.6 mm (7/32 in.)
3. Typical main solenoid operator (shown with cover removed)

Figure 13-6 Establishing Solenoid Stroke Position for Control Contact Actuation

13.4 TS Control Contact Replacement

Under normal conditions the TS control contacts do not require replacement over the life of the transfer switch. If replacement becomes necessary, use the following procedure.

Control Contact Replacement Procedure

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Turn off the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

1. Prevent the generator set from starting by moving the generator set master switch to the OFF position; disconnecting power to the generator engine starting battery charger, if installed; and disconnecting all generator engine start batteries, negative (-) leads first.
2. Disconnect all power sources before opening the transfer switch enclosure by opening upstream circuit breakers or switches to the transfer switch.
3. Use a voltmeter to verify that no voltage is present at the switch terminal lugs on both power sources.
4. Refer to Figure 13-7. Disconnect the upper drive link between the weight and the control contact assembly by prying the link off the ball joint with a screwdriver.
5. Label the wires connected to the control contact assembly so they can be identified after being disconnected.
6. Disconnect the labeled wires from the control contact assembly.
7. Disconnect the lower drive link connected to the auxiliary contact assembly by removing the #10–32 shoulder screw, lockwasher, and hex nut from the left side of the drive bracket. Then reinstall the hardware into the loose link for safekeeping.
8. Remove three #8–32 screws from the mounting feet and remove the control contact assembly.
9. Install the new control contact assembly onto mounting plate and secure it with three #8–32 screws.

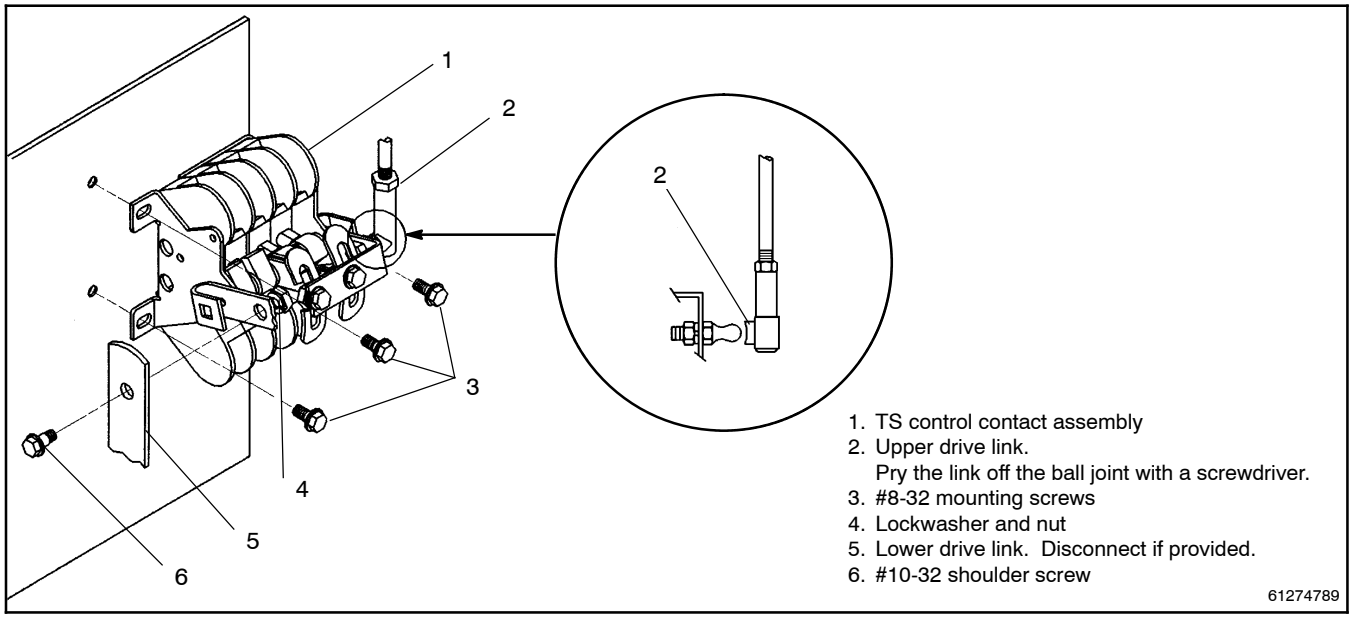


Figure 13-7 Replacing TS Control Contacts

10. Reconnect the lower drive link to the drive bracket. When assembled properly there will be free play between the drive bracket and the head of the shoulder screw.

11. Manually operate the drive linkage. The action should be smooth without any binding. Be sure the cams properly operate the pushbuttons on the control and auxiliary contact assemblies.

12. Reconnect the eight labeled wires to the proper terminals.

13. Connect the upper drive link to the left side of the drive bracket on the control contact assembly. Recheck for binding and interference.

14. Check the control contact adjustment. See Section 13.3.

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	advanced digital control; analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
Ah	amp-hour
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
APDC	Air Pollution Control District
API	American Petroleum Institute
approx.	approximate, approximately
AQMD	Air Quality Management District
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CAN	controller area network
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cUL	Canadian Underwriter's Laboratories
CUL	Canadian Underwriter's Laboratories
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dB(A)	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
DFMEA	Design Failure Mode and Effects Analysis
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
ECM	electronic control module, engine control module
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
ftp	file transfer protocol
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temp., high engine temp.
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard

k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
KBus	Kohler communication protocol
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
kWth	kilowatt-thermal
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/hr.	cubic meters per hour
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCCB	molded-case circuit breaker
MCM	one thousand circular mils
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
ms	millisecond
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MTU	Motoren-und Turbinen-Union
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips® head Crimptite® (screw)
PHH	Phillips® hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
psig	pounds per square inch gauge
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTU	remote terminal unit
RTV	room temperature vulcanization
RW	read/write
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SNMP	simple network management protocol
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec	specification
specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
THD	total harmonic distortion
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

System Alert Message Summary

Fault	Type	Description
Failure to Acquire Standby Source	Warning	The source voltage did not reach the acceptable range within a set time (see Time Delays). For example, the standby source generator set did not start.
Failure to Acquire Preferred Source	Warning	
Failure to Transfer	Warning	The signal to transfer is sent to the contactor and the main shaft auxiliary switch fails to indicate a complete ATS position change. The controller will attempt to transfer the unit three times before the fault is indicated.
IPM Synching (In-Phase Monitor Synching)	Warning	The two sources did not come into phase within the Fail to Synchronize time delay. **Note:** If the sources do become in phase, the warning is automatically cleared and normal ATS operation continues.
Battery Backup Low	Warning	The ATS backup battery voltage is low. Replace the battery on the main logic board. See Section 4.3.3.
Auxiliary Switch Fault	Manual Reset Fault	The main shaft auxiliary switches indicate that the ATS is in more than one position, or the position changed when no signal was sent to initiate the change.
Auxiliary Switch Open	Manual Reset Fault	The main shaft auxiliary switches indicate that the ATS is in neither position (all inputs are open).
Src N (or Src E) Rotation Err	Self-Resetting Fault	The detected phase rotation of one or both sources does not match the preselected setting.
I/O Module Lost Comm	Self-Resetting Fault	An I/O device has stopped communicating or does not have a correct address specified.
External Fault	Self-Resetting Fault	The external contact assigned to this input is closed.

Event History Message Summary

System History Message Summary	
Display Message	**The Controller Has Detected the Following Condition**
End Time Delay Btn	End delay button pressed.
Test Btn	Test button pressed.
Exercise Btn	End exercise button pressed during exercise run.
Lamp Test	Lamp test button pressed.
Service Req'd Reset	Reset button pressed to clear a fault that triggered the system alert LED.
Maint DIP Switch	Maintenance DIP switches closed (transfer inhibited for service).
Pwd DIP Switch	Password disable DIP switch closed.
Manual Option Switch	Supervised transfer switch changed position.
New Module	New I/O, alarm, or battery supply module detected.
Contactor in Off	Transfer switch moved to the OFF position (programmed-transition models only).
Contactor in Src N	Transfer switch moved to the Source N position.
Contactor in Src E	Transfer switch moved to the Source E position.
Low Battery	Output to indicate low voltage on the external battery (connected to the EBSM).
Exerciser Active	Scheduled exercise sequence running.
Fail to Acquire Pref	Preferred source not within acceptable voltage or frequency range.
Fail to Acquire Stby	Standby source not within acceptable voltage or frequency range.
Fail to Transfer	Transfer switch failed to transfer when signaled, according to position switches.

System History Message Summary	
Display Message	**The Controller Has Detected the Following Condition**
I/O Module Lost Comm	Communication with an installed I/O module has been lost.
Aux Switch Fault	The main shaft auxiliary switches indicate that the ATS is in more than one position, or the position changed when no signal was sent to initiate the change.
Aux Switch Open	The main shaft auxiliary switches indicate that the ATS is in neither position (all inputs are open).
Battery Backup Low	Transfer switch controller battery voltage is low. Battery needs to be replaced.
Rem End Time Delay	Remote input assigned to remote end time delay is active (contact closed). The time delay running at the time of the signal ends.
Forced Trans to Off	Remote input assigned to forced transfer to OFF for load shed function (programmed-transition models only) is active (contact closed).
Peak Shave Mode	Peak shave mode is active (initiated by the forced transfer to OFF input).
Inhibit Transfer	Remote input assigned to inhibit transfer function is active (contact closed). Prevents transfer for maintenance or service.
Remote Test	External signal (contact closure) connected to a programmable input assigned to remote test. Signals the transfer switch to start a test sequence.
Low Battery Voltage	External battery (connected to the EBSM) voltage is low.
Remote Common Alarm	One or more conditions assigned to the common alarm is active.
Bypass Contactor Dis	Bypass/Isolation switches only.
3 Src System Disable	A 3 Source System Disable input signal is active. See Section 4.1.3.
Over Frequency	Source frequency is above the overfrequency dropout setting.
Under Frequency	Source frequency is below the underfrequency dropout setting.
Phase Loss	One or more phases not detected.
Phase Rotation Error	Source ABC or BAC rotation does not match system setting.
Over Voltage L1-L2	Source voltage across L1 and L2 is above the overvoltage dropout setting.
Over Voltage L2-L3	Source voltage across L2 and L3 is above the overvoltage dropout setting.
Over Voltage L3-L1	Source voltage across L3 and L1 is above the overvoltage dropout setting.
Under Voltage L1-L2	Source voltage across L1 and L2 is below the undervoltage dropout setting.
Under Voltage L2-L3	Source voltage across L2 and L3 is below the undervoltage dropout setting.
Under Voltage L3-L1	Source voltage across L3 and L1 is below the undervoltage dropout setting.
Voltage Imbalance	Source voltage imbalance detected.
Save History To File	Event history saved to a file.
Auto Loaded Test End	The auto load test sequence timer has expired, ending the test sequence.
Test Loaded Changed	The remote test loaded/unloaded setting was changed.
Pref Source Changed	The preferred source selection has been changed (optional accessory).
Reload Dflt Params	The system has been reset to the factory default settings (see Reset Data screen)
MODBUS Peak Shave	A peak shave command has been received through Monitor III or other Modbus application.
MODBUS Forced to OFF	A Transfer to OFF command has been received through Monitor III or other Modbus application.
MODBUS System Test	A Test command has been received through Monitor III or other Modbus application.
Battery Control Out	Battery control command turns off the battery 20 seconds after power is lost to preserve the controller's battery.

System History Message Summary	
Display Message	**The Controller Has Detected the Following Condition**
USB Connected	A device has been connected to the controller's USB port.
USB Disconnected	A device has been disconnected from the controller's USB port.

Appendix C Noise and Wiring Practices

Electrical noise is an unwanted electrical signal that can cause errors in measurement, loss of control, malfunctions in microprocessor-based control systems, errors in data transfer between systems over communication links, or reductions in system performance.

Good system design and wiring practices can minimize noise levels and the effects of noise.

Noise, because of its random nature, is typically characterized by frequency distribution. Many noise sources are broad-spectrum, that is, they produce many frequencies distributed over a wide range. Broad-spectrum noise is particularly troublesome because it cannot be removed easily by filtering, and because it can affect a variety of systems in unpredictable ways. One common source of broad-spectrum noise is a switch, which can produce voltage and current changes when an electrical circuit is connected and disconnected.

Coupling is the transfer of signals between separate circuits. Signals from one circuit become noise in another. The amount of coupling is cumulative and is a function of the proximity of the circuits, their orientation, exposed area, and length of run. Minimize coupling by the following:

- Isolating circuits from each other by using separate raceways or conduit
- Separating circuits from each other by locating them as far apart as possible
- Enclosing circuits with a grounded metallic shield such as an enclosure, metallic conduit, or cable shield
- Running conductors perpendicular, rather than parallel, to each other
- Running wires loosely and randomly rather than bundling them tightly together
- Twisting a circuit's wires together in pairs

In an industrial environment, there are typically five types of circuits with different noise emission and rejection capabilities. The five types of circuits are as follows:

- **High-Power Distribution.** Circuits to high-power loads such as large electric motors and heaters can emit transient high levels of broad-spectrum noise. Loads on high-power distribution circuits are nearly immune to noise.
- **General Purpose Power Distribution.** Circuits to medium-power loads such as lighting, offices, light-duty equipment, and small motors such as fans and pumps can emit transient, medium levels of broad-spectrum noise. Some electronic equipment, such as computers, emits constant levels of broad-spectrum noise in addition to transient broad-spectrum noise. Loads on general-purpose circuits, except for sensitive electronic equipment, are nearly immune to noise.
- **Control.** Control circuits include DC circuits and 120 VAC maximum AC circuits that operate at a low power level (less than 1 W). Typical circuits include circuits to switches, actuators, and dry-contact relays, including the generator engine-start circuit. Control circuits emit transient low levels of broad-spectrum noise and are fairly immune to noise.
- **Analog.** Analog circuits are low-voltage DC circuits that convey measurement information as relatively small changes in current or voltage. Typical circuits include those connected to the controller's analog inputs. Analog circuits create the lowest noise levels and are the most sensitive to noise.
- **Communication and Signaling.** Communication and signaling circuits are low-voltage circuits that convey information. Typical circuits include RS-232 and RS-485 serial communication lines, telephone lines, and computer network lines. These circuits create noise with frequencies related to the communication signaling rate. These circuits have some level of built-in noise immunity. Typical systems will detect or correct errors caused by noise below certain levels, but with a corresponding reduction in the data transfer rate.

When planning an installation, separate all of these types of circuits as much as possible to minimize the hazards of insulation failure, accidental miswiring, and noise coupling. For best results, install control circuits, analog circuits, and communication and signaling circuits separately. Combining circuit types is unavoidable in the controller's enclosure and some other areas.

Note: It is very important to isolate high- and medium-power circuits in raceways or conduit separate from the other types of circuits.

Appendix D Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spiralock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See Appendix E, General Torque Specifications, and other torque specifications in the service literature.

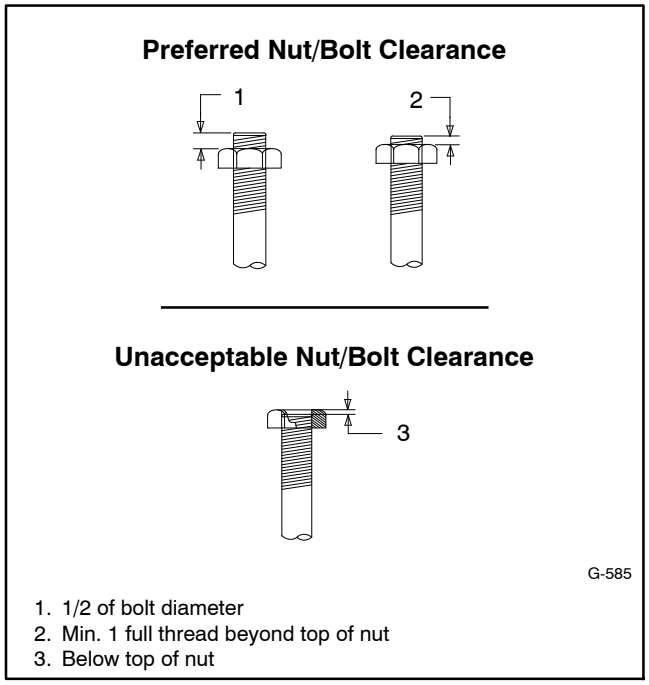


Figure 1 Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

   For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spiralock nut. See Figure 2.
3. Follow these SAE washer rules after determining exit hole type:
   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see 2 above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to Figure 2, which depicts the preceding hardware configuration possibilities.

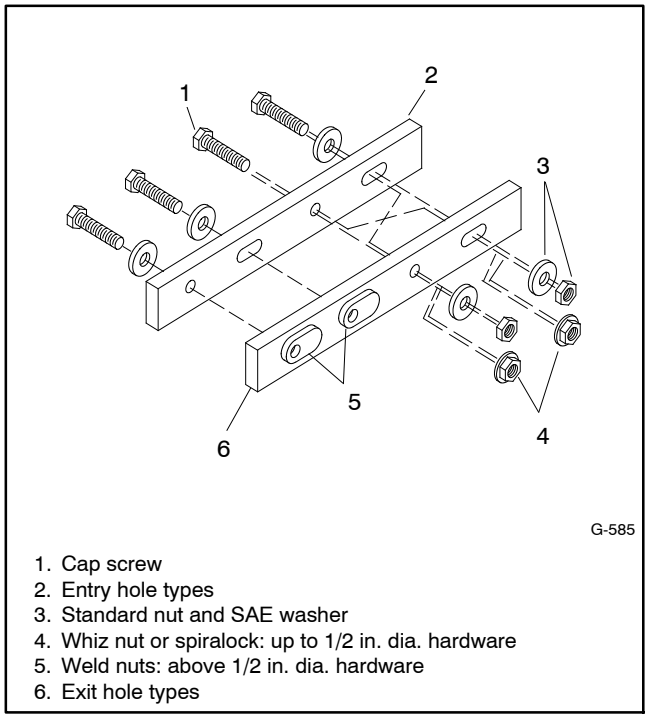


Figure 2 Acceptable Hardware Combinations

Appendix E General Torque Specifications

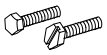
American Standard Fasteners Torque Specifications								
Size	Torque Measurement	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 2 or 5
		Grade 2		Grade 5		Grade 8		
8-32	Nm (in. lb.)	1.8	(16)	2.3	(20)	—		See Note 3
10-24	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
10-32	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
1/4-20	Nm (in. lb.)	6.8	(60)	10.8	(96)	14.9	(132)	
1/4-28	Nm (in. lb.)	8.1	(72)	12.2	(108)	16.3	(144)	
5/16-18	Nm (in. lb.)	13.6	(120)	21.7	(192)	29.8	(264)	
5/16-24	Nm (in. lb.)	14.9	(132)	23.1	(204)	32.5	(288)	
3/8-16	Nm (ft. lb.)	24.0	(18)	38.0	(28)	53.0	(39)	
3/8-24	Nm (ft. lb.)	27.0	(20)	42.0	(31)	60.0	(44)	
7/16-14	Nm (ft. lb.)	39.0	(29)	60.0	(44)	85.0	(63)	
7/16-20	Nm (ft. lb.)	43.0	(32)	68.0	(50)	95.0	(70)	
1/2-13	Nm (ft. lb.)	60.0	(44)	92.0	(68)	130.0	(96)	
1/2-20	Nm (ft. lb.)	66.0	(49)	103.0	(76)	146.0	(108)	
9/16-12	Nm (ft. lb.)	81.0	(60)	133.0	(98)	187.0	(138)	
9/16-18	Nm (ft. lb.)	91.0	(67)	148.0	(109)	209.0	(154)	
5/8-11	Nm (ft. lb.)	113.0	(83)	183.0	(135)	259.0	(191)	
5/8-18	Nm (ft. lb.)	128.0	(94)	208.0	(153)	293.0	(216)	
3/4-10	Nm (ft. lb.)	199.0	(147)	325.0	(240)	458.0	(338)	
3/4-16	Nm (ft. lb.)	222.0	(164)	363.0	(268)	513.0	(378)	
1-8	Nm (ft. lb.)	259.0	(191)	721.0	(532)	1109.0	(818)	
1-12	Nm (ft. lb.)	283.0	(209)	789.0	(582)	1214.0	(895)	

Metric Fasteners Torque Specifications, Measured in Nm (ft. lb.)								
Size (mm)	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 5.8 or 8.8
	Grade 5.8		Grade 8.8		Grade 10.9		
M6 x 1.00	6.2	(4.6)	9.5	(7)	13.6	(10)	See Note 3
M8 x 1.25	15.0	(11)	23.0	(17)	33.0	(24)	
M8 x 1.00	16.0	(11)	24.0	(18)	34.0	(25)	
M10 x 1.50	30.0	(22)	45.0	(34)	65.0	(48)	
M10 x 1.25	31.0	(23)	47.0	(35)	68.0	(50)	
M12 x 1.75	53.0	(39)	80.0	(59)	115.0	(85)	
M12 x 1.50	56.0	(41)	85.0	(63)	122.0	(90)	
M14 x 2.00	83.0	(61)	126.0	(93)	180.0	(133)	
M14 x 1.50	87.0	(64)	133.0	(98)	190.0	(140)	
M16 x 2.00	127.0	(94)	194.0	(143)	278.0	(205)	
M16 x 1.50	132.0	(97)	201.0	(148)	287.0	(212)	
M18 x 2.50	179.0	(132)	273.0	(201)	390.0	(288)	
M18 x 1.50	189.0	(140)	289.0	(213)	413.0	(305)	

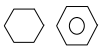
Notes:

1. The torque values above are general guidelines. Always use the torque values specified in the service manuals and/or assembly drawings when they differ from the above torque values.
2. The torque values above are based on new plated threads. Increase torque values by 15% if non-plated threads are used.
3. Hardware threaded into aluminum must have either two diameters of thread engagement or a 30% or more reduction in the torque to prevent stripped threads.
4. Torque values are calculated as equivalent stress loading on American hardware with an approximate preload of 90% of the yield strength and a friction coefficient of 0.125.

Appendix F Common Hardware Identification

Screw/Bolts/Studs	
Head Styles	
Hex Head or Machine Head	
Hex Head or Machine Head with Washer	
Flat Head (FHM)	
Round Head (RHM)	
Pan Head	
Hex Socket Head Cap or Allen™ Head Cap	
Hex Socket Head or Allen™ Head Shoulder Bolt	
Sheet Metal Screw	
Stud	
Drive Styles	
Hex	
Hex and Slotted	
Phillips®	
Slotted	
Hex Socket	

Nuts	
Nut Styles	
Hex Head	
Lock or Elastic	
Square	
Cap or Acorn	
Wing	
Washers	
Washer Styles	
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

Hardness Grades	
American Standard	
Grade 2	
Grade 5	
Grade 8	
Grade 8/9 (Hex Socket Head)	
Metric	
Number stamped on hardware; 5.8 shown	

Allen™ head screw is a trademark of Holo-Krome Co.

Phillips® screw is a registered trademark of Phillips Screw Company.

Sample Dimensions

American Standard (Screws, Bolts, Studs, and Nuts)

1/4-20 x 1

- 1 — Length In Inches (Screws and Bolts)
- 20 — Threads Per Inch
- 1/4 — Major Thread Diameter In Fractional Inches Or Screw Number Size

Metric (Screws, Bolts, Studs, and Nuts)

M8-1.25 x 20

- 20 — Length In Millimeters (Screws and Bolts)
- 1.25 — Distance Between Threads In Millimeters
- M8 — Major Thread Diameter In Millimeters

Plain Washers

9/32 x 5/8 x 1/16

- 1/16 — Thickness
- 5/8 — External Dimension
- 9/32 — Internal Dimension

Lock Washers

5/8

- 5/8 — Internal Dimension

Appendix G Common Hardware List

The Common Hardware List lists part numbers and dimensions for common hardware items.

American Standard

Part No.	Dimensions
Hex Head Bolts (Grade 5)	
X-465-17	1/4-20 x .38
X-465-6	1/4-20 x .50
X-465-2	1/4-20 x .62
X-465-16	1/4-20 x .75
X-465-18	1/4-20 x .88
X-465-7	1/4-20 x 1.00
X-465-8	1/4-20 x 1.25
X-465-9	1/4-20 x 1.50
X-465-10	1/4-20 x 1.75
X-465-11	1/4-20 x 2.00
X-465-12	1/4-20 x 2.25
X-465-14	1/4-20 x 2.75
X-465-21	1/4-20 x 5.00
X-465-25	1/4-28 x .38
X-465-20	1/4-28 x 1.00
X-125-33	5/16-18 x .50
X-125-23	5/16-18 x .62
X-125-3	5/16-18 x .75
X-125-31	5/16-18 x .88
X-125-5	5/16-18 x 1.00
X-125-24	5/16-18 x 1.25
X-125-34	5/16-18 x 1.50
X-125-25	5/16-18 x 1.75
X-125-26	5/16-18 x 2.00
230578	5/16-18 x 2.25
X-125-29	5/16-18 x 2.50
X-125-27	5/16-18 x 2.75
X-125-28	5/16-18 x 3.00
X-125-22	5/16-18 x 4.50
X-125-32	5/16-18 x 5.00
X-125-35	5/16-18 x 5.50
X-125-36	5/16-18 x 6.00
X-125-40	5/16-18 x 6.50
X-125-43	5/16-24 x 1.75
X-125-44	5/16-24 x 2.50
X-125-30	5/16-24 x .75
X-125-39	5/16-24 x 2.00
X-125-38	5/16-24 x 2.75
X-6238-2	3/8-16 x .62
X-6238-10	3/8-16 x .75
X-6238-3	3/8-16 x .88
X-6238-11	3/8-16 x 1.00
X-6238-4	3/8-16 x 1.25
X-6238-5	3/8-16 x 1.50
X-6238-1	3/8-16 x 1.75
X-6238-6	3/8-16 x 2.00
X-6238-17	3/8-16 x 2.25
X-6238-7	3/8-16 x 2.50
X-6238-8	3/8-16 x 2.75
X-6238-9	3/8-16 x 3.00
X-6238-19	3/8-16 x 3.25
X-6238-12	3/8-16 x 3.50
X-6238-20	3/8-16 x 3.75
X-6238-13	3/8-16 x 4.50
X-6238-18	3/8-16 x 5.50
X-6238-25	3/8-16 x 6.50

Part No.	Dimensions
Hex Head Bolts, cont.	
X-6238-14	3/8-24 x .75
X-6238-16	3/8-24 x 1.25
X-6238-21	3/8-24 x 4.00
X-6238-22	3/8-24 x 4.50
X-6024-5	7/16-14 x .75
X-6024-2	7/16-14 x 1.00
X-6024-8	7/16-14 x 1.25
X-6024-3	7/16-14 x 1.50
X-6024-4	7/16-14 x 2.00
X-6024-11	7/16-14 x 2.75
X-6024-12	7/16-14 x 6.50
X-129-15	1/2-13 x .75
X-129-17	1/2-13 x 1.00
X-129-18	1/2-13 x 1.25
X-129-19	1/2-13 x 1.50
X-129-20	1/2-13 x 1.75
X-129-21	1/2-13 x 2.00
X-129-22	1/2-13 x 2.25
X-129-23	1/2-13 x 2.50
X-129-24	1/2-13 x 2.75
X-129-25	1/2-13 x 3.00
X-129-27	1/2-13 x 3.50
X-129-29	1/2-13 x 4.00
X-129-30	1/2-13 x 4.50
X-463-9	1/2-13 x 5.50
X-129-44	1/2-13 x 6.00
X-129-51	1/2-20 x .75
X-129-45	1/2-20 x 1.25
X-129-52	1/2-20 x 1.50
X-6021-3	5/8-11 x 1.00
X-6021-4	5/8-11 x 1.25
X-6021-2	5/8-11 x 1.50
X-6021-1	5/8-11 x 1.75
273049	5/8-11 x 2.00
X-6021-5	5/8-11 x 2.25
X-6021-6	5/8-11 x 2.50
X-6021-7	5/8-11 x 2.75
X-6021-12	5/8-11 x 3.75
X-6021-11	5/8-11 x 4.50
X-6021-10	5/8-11 x 6.00
X-6021-9	5/8-18 x 2.50
X-6239-1	3/4-10 x 1.00
X-6239-8	3/4-10 x 1.25
X-6239-2	3/4-10 x 1.50
X-6239-3	3/4-10 x 2.00
X-6239-4	3/4-10 x 2.50
X-6239-5	3/4-10 x 3.00
X-6239-6	3/4-10 x 3.50
X-792-1	1-8 x 2.25
X-792-5	1-8 x 3.00
X-792-8	1-8 x 5.00

Part No.	Dimensions	Type
Hex Nuts		
X-6009-1	1-8	Standard
X-6210-3	6-32	Whiz
X-6210-4	8-32	Whiz
X-6210-5	10-24	Whiz
X-6210-1	10-32	Whiz
X-6210-2	1/4-20	Spiralock
X-6210-6	1/4-28	Spiralock
X-6210-7	5/16-18	Spiralock
X-6210-8	5/16-24	Spiralock
X-6210-9	3/8-16	Spiralock
X-6210-10	3/8-24	Spiralock
X-6210-11	7/16-14	Spiralock
X-6210-12	1/2-13	Spiralock
X-6210-15	7/16-20	Spiralock
X-6210-14	1/2-20	Spiralock
X-85-3	5/8-11	Standard
X-88-12	3/4-10	Standard
X-89-2	1/2-20	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
X-25-46	.125	.250	.022	#4
X-25-9	.156	.375	.049	#6
X-25-48	.188	.438	.049	#8
X-25-36	.219	.500	.049	#10
X-25-40	.281	.625	.065	1/4
X-25-85	.344	.687	.065	5/16
X-25-37	.406	.812	.065	3/8
X-25-34	.469	.922	.065	7/16
X-25-26	.531	1.062	.095	1/2
X-25-15	.656	1.312	.095	5/8
X-25-29	.812	1.469	.134	3/4
X-25-127	1.062	2.000	.134	1

Metric

Hex head bolts are hardness grade 8.8 unless noted.

Hex Head Bolts (Partial Thread)

Part No.	Dimensions
M931-05055-60	M5-0.80 x 55
M931-06040-60	M6-1.00 x 40
M931-06055-60	M6-1.00 x 55
M931-06060-60	M6-1.00 x 60
M931-06060-SS	M6-1.00 x 60
M931-06070-60	M6-1.00 x 70
M931-06070-SS	M6-1.00 x 70
M931-06075-60	M6-1.00 x 75
M931-06090-60	M6-1.00 x 90
M931-06145-60	M6-1.00 x 145
M931-06150-60	M6-1.00 x 150
M931-08035-60	M8-1.25 x 35
M931-08040-60	M8-1.25 x 40
M931-08045-60	M8-1.25 x 45
M931-08050-60	M8-1.25 x 50
M931-08055-60	M8-1.25 x 55
M931-08055-82	M8-1.25 x 55*
M931-08060-60	M8-1.25 x 60
M931-08070-60	M8-1.25 x 70
M931-08070-82	M8-1.25 x 70*
M931-08075-60	M8-1.25 x 75
M931-08080-60	M8-1.25 x 80
M931-08090-60	M8-1.25 x 90
M931-08095-60	M8-1.25 x 95
M931-08100-60	M8-1.25 x 100
M931-08110-60	M8-1.25 x 110
M931-08120-60	M8-1.25 x 120
M931-08130-60	M8-1.25 x 130
M931-08140-60	M8-1.25 x 140
M931-08150-60	M8-1.25 x 150
M931-08200-60	M8-1.25 x 200
M931-10040-82	M10-1.25 x 40*
M931-10040-60	M10-1.50 x 40
M931-10045-60	M10-1.50 x 45
M931-10050-60	M10-1.50 x 50
M931-10050-82	M10-1.25 x 50*
M931-10055-60	M10-1.50 x 55
M931-10060-60	M10-1.50 x 60
M931-10065-60	M10-1.50 x 65
M931-10070-60	M10-1.50 x 70
M931-10080-60	M10-1.50 x 80
M931-10080-82	M10-1.25 x 80*
M931-10090-60	M10-1.50 x 90
M931-10090-82	M10-1.50 x 90*
M931-10100-60	M10-1.50 x 100
M931-10110-60	M10-1.50 x 110
M931-10120-60	M10-1.50 x 120
M931-10130-60	M10-1.50 x 130
M931-10140-60	M10-1.50 x 140
M931-10180-60	M10-1.50 x 180
M931-10235-60	M10-1.50 x 235
M931-10260-60	M10-1.50 x 260
M960-10330-60	M10-1.25 x 330
M931-12045-60	M12-1.75 x 45
M960-12050-60	M12-1.25 x 50
M960-12050-82	M12-1.25 x 50*
M931-12050-60	M12-1.75 x 50
M931-12050-82	M12-1.75 x 50*
M931-12055-60	M12-1.75 x 55
M931-12060-60	M12-1.75 x 60
M931-12060-82	M12-1.75 x 60*
M931-12065-60	M12-1.75 x 65
M931-12075-60	M12-1.75 x 75
M931-12080-60	M12-1.75 x 80
M931-12090-60	M12-1.75 x 90
M931-12100-60	M12-1.75 x 100
M931-12110-60	M12-1.75 x 110

Hex Head Bolts (Partial Thread), continued

Part No.	Dimensions
M960-16090-60	M16-1.50 x 90
M931-16090-60	M16-2.00 x 90
M931-16100-60	M16-2.00 x 100
M931-16100-82	M16-2.00 x 100*
M931-16120-60	M16-2.00 x 120
M931-16150-60	M16-2.00 x 150
M931-20065-60	M20-2.50 x 65
M931-20090-60	M20-2.50 x 90
M931-20100-60	M20-2.50 x 100
M931-20120-60	M20-2.50 x 120
M931-20140-60	M20-2.50 x 140
M931-20160-60	M20-2.50 x 160
M931-22090-60	M22-2.50 x 90
M931-22120-60	M22-2.50 x 120
M931-22160-60	M22-2.50 x 160
M931-24090-60	M24-3.00 x 90
M931-24120-60	M24-3.00 x 120
M931-24160-60	M24-3.00 x 160
M931-24200-60	M24-3.00 x 200

Hex Head Bolts (Full Thread)

Part No.	Dimensions
M933-04006-60	M4-0.70 x 6
M933-05030-60	M5-0.80 x 30
M933-05035-60	M5-0.80 x 35
M933-05050-60	M5-0.80 x 50
M933-06010-60	M6-1.00 x 10
M933-06012-60	M6-1.00 x 12
M933-06014-60	M6-1.00 x 14
M933-06016-60	M6-1.00 x 16
M933-06020-60	M6-1.00 x 20
M933-06025-60	M6-1.00 x 25
M933-06030-60	M6-1.00 x 30
M933-06040-60	M6-1.00 x 40
M933-06050-60	M6-1.00 x 50
M933-07025-60	M7-1.00 x 25
M933-08010-60	M8-1.25 x 10
M933-08012-60	M8-1.25 x 12
M933-08016-60	M8-1.25 x 16
M933-08020-60	M8-1.25 x 20
M933-08025-60	M8-1.25 x 25
M933-08030-60	M8-1.25 x 30
M933-08030-82	M8-1.25 x 30*
M933-10012-60	M10-1.50 x 12
M961-10020-60	M10-1.25 x 20
M933-10020-60	M10-1.50 x 20
M933-10025-60	M10-1.50 x 25
M961-10025-60	M10-1.25 x 25
M933-10025-82	M10-1.50 x 25*
M961-10030-60	M10-1.25 x 30
M933-10030-60	M10-1.50 x 30
M933-10030-82	M10-1.50 x 30*
M961-10035-60	M10-1.25 x 35
M933-10035-60	M10-1.50 x 35
M933-10035-82	M10-1.50 x 35*
M961-10040-60	M10-1.25 x 40

Hex Head Bolts (Full Thread), continued

Part No.	Dimensions
M933-12016-60	M12-1.75 x 16
M933-12020-60	M12-1.75 x 20
M961-12020-60F	M12-1.50 x 20
M933-12025-60	M12-1.75 x 25
M933-12025-82	M12-1.75 x 25*
M961-12030-60	M12-1.25 x 30
M933-12030-82	M12-1.75 x 30*
M961-12030-82F	M12-1.50 x 30*
M933-12030-60	M12-1.75 x 30
M933-12035-60	M12-1.75 x 35
M961-12040-82	M12-1.25 x 40*
M933-12040-60	M12-1.75 x 40
M933-12040-82	M12-1.75 x 40*
M961-14025-60	M14-1.50 x 25
M933-14025-60	M14-2.00 x 25
M961-14050-82	M14-1.50 x 50*
M961-16025-60	M16-1.50 x 25
M933-16025-60	M16-2.00 x 25
M961-16030-82	M16-1.50 x 30*
M933-16030-82	M16-2.00 x 30*
M933-16035-60	M16-2.00 x 35
M961-16040-60	M16-1.50 x 40
M933-16040-60	M16-2.00 x 40
M961-16045-82	M16-1.50 x 45*
M933-16045-82	M16-2.00 x 45*
M933-16050-60	M16-2.00 x 50
M933-16050-82	M16-2.00 x 50*
M933-16060-60	M16-2.00 x 60
M933-16070-60	M16-2.00 x 70
M933-18035-60	M18-2.50 x 35
M933-18050-60	M18-2.50 x 50
M933-18060-60	M18-2.50 x 60
M933-20050-60	M20-2.50 x 50
M933-20055-60	M20-2.50 x 55
M933-24060-60	M24-3.00 x 60
M933-24065-60	M24-3.00 x 65
M933-24070-60	M24-3.00 x 70

Pan Head Machine Screws

M7985A-03010-20	M3-0.50 x 10
M7985A-03012-20	M3-0.50 x 12
M7985A-04010-20	M4-0.70 x 10
M7985A-04016-20	M4-0.70 x 16
M7985A-04020-20	M4-0.70 x 20
M7985A-04050-20	M4-0.70 x 50
M7985A-04100-20	M4-0.70 x 100
M7985A-05010-20	M5-0.80 x 10
M7985A-05012-20	M5-0.80 x 12
M7985A-05016-20	M5-0.80 x 16
M7985A-05020-20	M5-0.80 x 20
M7985A-05025-20	M5-0.80 x 25
M7985A-05030-20	M5-0.80 x 30
M7985A-05080-20	M5-0.80 x 80
M7985A-05100-20	M5-0.80 x 100
M7985A-06100-20	M6-1.00 x 100

Flat Head Machine Screws

M965A-04012-SS	M4-0.70 x 12
M965A-05012-SS	M5-0.80 x 12
M965A-05016-20	M5-0.80 x 16
M965A-06012-20	M6-1.00 x 12

* This metric hex bolt's hardness is grade 10.9.

Metric, continued

Hex Nuts

Part No.	Dimensions	Type
M934-03-50	M3-0.50	Standard
M934-04-50	M4-0.70	Standard
M934-04-B	M4-0.70	Brass
M934-05-50	M5-0.80	Standard
M934-06-60	M6-1.00	Standard
M934-06-64	M6-1.00	Std. (green)
M6923-06-80	M6-1.00	Spiralock
M982-06-80	M6-1.00	Elastic Stop
M934-08-60	M8-1.25	Standard
M6923-08-80	M8-1.25	Spiralock
M982-08-80	M8-1.25	Elastic Stop
M934-10-60	M10-1.50	Standard
M934-10-60F	M10-1.25	Standard
M6923-10-80	M10-1.50	Spiralock
M6923-10-62	M10-1.50	Spiralock†
M982-10-80	M10-1.50	Elastic Stop
M934-12-60	M12-1.75	Standard
M934-12-60F	M12-1.25	Standard
M6923-12-80	M12-1.75	Spiralock
M982-12-80	M12-1.75	Elastic Stop
M982-14-60	M14-2.00	Elastic Stop
M6923-16-80	M16-2.00	Spiralock
M982-16-80	M16-2.00	Elastic Stop
M934-18-80	M18-2.5	Standard
M982-18-60	M18-2.50	Elastic Stop
M934-20-80	M20-2.50	Standard
M982-20-80	M20-2.50	Elastic Stop
M934-22-60	M22-2.50	Standard
M934-24-80	M24-3.00	Standard
M982-24-60	M24-3.00	Elastic Stop
M934-30-80	M30-3.50	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
M125A-03-80	3.2	7.0	0.5	M3
M125A-04-80	4.3	9.0	0.8	M4
M125A-05-80	5.3	10.0	1.0	M5
M125A-06-80	6.4	12.0	1.6	M6
M125A-08-80	8.4	16.0	1.6	M8
M125A-10-80	10.5	20.0	2.0	M10
M125A-12-80	13.0	24.0	2.5	M12
M125A-14-80	15.0	28.0	2.5	M14
M125A-16-80	17.0	30.0	3.0	M16
M125A-18-80	19.0	34.0	3.0	M18
M125A-20-80	21.0	37.0	3.0	M20
M125A-24-80	25.0	44.0	4.0	M24

† This metric hex nut's hardness is grade 8.

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