LAKE SHORE ELECTRIC CORPORATION

INSTALLING, OPERATING AND MAINTAINING

INSULATED CASE
FIXED AND DRAW OUT

AUTOMATIC TRANSFER SWITCHES

WITH ELECTROMECHANICAL CONTROLS

LAKE SHORE ELECTRIC CORPORATION

205 WILLIS STREET, BEDFORD, OH 44146
Phone 800-225-0141 or 440-232-0200 Fax 440-232-5644

WARNING!

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS, THIS MAY RESULT IN INJURY OR DEATH. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, TURN OFF POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

NO ENTRANCE TO THE CABLE COMPARTMENT SHOULD EVER BE MADE UNLESS ALL SOURCES OF POWER TO THIS TRANSFER SWITCH HAVE BEEN DISCONNECTED AND LOCKED OUT.

WARRANTY

Lake Shore Electric Corporation Automatic Transfer Switches are guaranteed against defective materials and workmanship for a period of one year from date of shipment. If, within one year after shipment, it is proved to Lake Shore Electric Corporation's satisfaction that the equipment does not meet the above warranty, and if Lake Shore Electric Corporation is promptly notified of same, Lake Shore Electric Corporation will make necessary corrections, free of charge, F.O.B. works where manufactured.

Such necessary corrections constitute the full extent of Lake Shore Electric Corporation's warranty. There are no warranties, which extend beyond those described herein. This warranty is exclusive and is in lieu of all other warranties, whether written, oral, implied or statutory. No warranty of merchantability or of fitness for purpose shall apply.

Lake Shore Electric Corporation is not responsible for damage to its equipment through improper installation or use, unauthorized repair or modifications, or attempts to operate it above its rated capacities or in abnormal environments. In no event, whether as a failure to meet conditions of the warranty or otherwise, shall Lake Shore Electric Corporation be liable for any special, incidental, or consequential damages, including, but not limited to, loss of profit or revenues, loss of good will, damages to associated equipment, cost of capital, cost of substitute products, facilities, service or replacement power, costs of downtime or claims of third parties for such damages.

> **Notice:** The owner of this automatic transfer switch must perform certain required maintenance functions as described in **Section #9 – Required Maintenance** of this manual in order to maintain Lake Shore Electric Corporation's one year exclusive warranty. Failure to perform this maintenance shall void this warranty.

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NOTE

Engineering changes may have been made after publication date. Any departure from this manual should be checked with Lake Shore Electric Corporation.

Lake Shore Electric Corporation reserves the right to change specifications without prior notice.

1. CONSTRUCTION

Insulated Case Transfer Switches manufactured by Lake Shore Electric Corporation use two stored energy insulated case switches and/or circuit breakers to accomplish the transfer between two separate power sources to a single load.

These insulated case switches and/or circuit breakers are electrically interlocked through the Electromechanical Controls, auxiliary switches, and mechanical interlock. The mechanical interlock is located on the right side of the two switches. This mechanism is a factory-installed device, which positively prevents both of the insulated case switches or circuit breakers from being in the **ON** position simultaneously. This redundant interlocking system provides a "Fail-Safe" design. **Note:** This mechanical interlock is not provided on units equipped with the Closed Transition Transfer Option.

Manually operable push buttons are accessible from the front of the switch to enable personnel to manually operate the transfer switch should this become necessary. These pushbuttons are permanently mounted and readily accessible in an emergency. This transfer switch can be manually operated under load.

All interface relays are of the enclosed industrial type to ensure long life and minimum maintenance. All relays are rated for continuous duty to eliminate overheating of coils. The Positive Control Board, which is the heart of the electromechanical control system, is a rugged, durable industrial quality device that assures minimum maintenance. All timed control relays are of the solid state or pneumatic type.

Wiring harnesses are manufactured from 16-gauge insulated machine tool wire. All control relays and logic are unfused in accordance with UL 1008.

2. DESCRIPTION OF OPERATION

The following are general descriptions of operation applying to Insulated Case Transfer Switches. Certain accessory additions may modify the sequence of operations as required to suit specific applications.

The Insulated Case Automatic Transfer Switch utilizes the built-in electrical operator (charge, open and close coils) of each of the normal and emergency breakers for its operation. Normally, the transfer switch operates on the preferred power source with the normal breaker in the closed position and the emergency breaker in the open position.

All phases of the preferred power source are continuously monitored by a voltage sensitive relay, which is adjustable from 70% to 100% of the nominal voltage. In the event of a drop in any phase of the preferred voltage below the dropout set point, the voltage relay provides a “form C” contact which triggers the transfer to Emergency Power. An Outage Delay Timer (ODR) waits for confirmed loss of Preferred Source before enabling the Emergency Source Generator start circuit. The Frequency and Voltage sensing Relay (FVR) for the Emergency Source will indicate via a dry “form C” contact when acceptable frequency and voltage has been reached. A Time Delay to Emergency Timer (TDE) provides time for the generator to stabilize so that it is ready to accept the load. Upon expiration of the TDE, the normal

breaker will be opened thus placing the transfer switch in the neutral position and initiate a Time Delay to Transfer Timer (TDT). When timed out, the emergency breaker closes, thus connecting the alternate source to the load. With the Automatic Transfer Switch now operating on the emergency source, the voltage relay continues to monitor the normal source.

Upon restoration of normal power as sensed by the voltage relay, a Time Delay to Return (TDR) is initiated. Upon completion of the TDR, the switch will retransfer the load from emergency by opening the emergency breaker, initiating the TDT and when it times out, close the normal breaker. After retransfer to normal an Engine Maintain Timer (EMT) timer is initiated. Upon completion of the EMT, the engine start signal will be removed.

For those Transfer Switches built as Draw-Out switches, additional safety and reliability is provided. The transfer switch itself inherently functions to bypass either source by connecting the alternate source to the load. By offering the draw-out feature, either or both of the insulated case switches can be withdrawn, thereby isolating them from live parts. This allows maintenance, service or replacement of the switching element without loss of service to the load or danger to the maintenance personnel. Please refer to the Masterpact® NW manual, provided with each Insulated Case Automatic Transfer Switch, for detailed instruction on the operation of these insulated case products.

The Insulated Case Automatic Transfer Switch is effectively used for Service Entrance Rated Transfer Switches because the design allows the necessary condition of having both switches in the off position so that the load is isolated and disconnected from the two sources.

The Insulated Case Automatic Transfer Switch is also effectively used for Closed Transition Transfer Switches because the design allows the necessary condition of having both switches in the on position so that the load is momentarily connected to both sources when they are synchronized providing a “make before break” transfer.

3. INSTALLATION

3.1 MOUNTING AND CONNECTING

The standard Lake Shore Electric Corporation transfer switch is designed for operation in a clean, dry, dust-free location where a minimum of vibration is present.

When used in conjunction with an engine generator set, it is recommended that the transfer switch be located as close as possible to the generator set, as this will reduce the length of the DC control wiring (required for automatic operation) thus preventing voltage drops and improper operation. The maximum recommended distance the automatic transfer switch should be installed from the engine generator set batteries is 1400 feet, using #10 gauge wire.

Insulated Case Transfer Switches are manufactured in free standing enclosures. Open transfer switches are generally mounted in a customer-supplied enclosure; consequently, there are certain steps, which should be followed:

1. Mount to a rigid framework to prevent vibration.
2. Review all electrical clearances with the enclosure door or panels closed.
3. Insure there is no strain on the bus bars due to improper alignment.

BEFORE BRINGING THE POWER CABLES INTO THE ENCLOSURE, BE CERTAIN THAT THE LUGS WILL BE OF THE CORRECT SIZE. IF NOT, DIFFERENT SIZES MAY BE ORDERED FROM LAKE SHORE ELECTRIC CORPORATION.

The Normal source power cables are to be connected to the Normal Bus extensions marked NL1, NL2, and NL3. Please refer to the specific wiring diagram supplied with the switch. The Emergency source power cables are to be connected in a like manner to the Emergency bus extensions marked EL1, EL2 and EL3. (**Note:** Be careful to pass the cable through any current transformers or other devices, which may be part of a generator control.) The load cables are to be connected to the load bus extensions marked L1, L2 and L3. On three-phase, four-wire transfer switches, or single-phase, three-wire transfer switches, a neutral bus is provided. **Note:** Verify that the phase sequence of normal and emergency sources is identical. Failure to do this could result in damage to the transfer switch and/or other equipment and will void the warranty extended by Lake Shore Electric Corporation. When installing the power cables, be careful not to disturb or damage the control wires that go to the various terminals. Ground lugs are provided on all transfer switches. These lugs **must** be connected to earth ground.

CAUTION: Be sure to check that all power cable lugs are torqued to the applicable requirement for the switch see Section 9, Required Maintenance.

Connect Gen Set to the start contacts. There are numerous accessories available on Lake Shore Electric Corporation transfer switches which require external connections. Refer to the wiring diagram included with your transfer switch for specific instructions on connecting these accessories.

3.2 PLACING THE TRANSFER SWITCH IN OPERATION

Before energizing the switch electrically, be certain all external connections have been properly made according to the wiring diagram provided with the switch. Inspect all wires, cables, and bus bar for abraded insulation, foreign matter, and electrical clearance.

Manually set the transfer switch to the Normal source (Normal breaker **Closed** and Emergency Breaker **Open**) and energize the normal source. The red LED on the Voltage Sensing Relay should be lighted, indicating that the normal source is available and within the pick-up setting of the relay. If this does not light (i.e. pick up), place a voltmeter on the normal source to be sure that the voltage is adequate and within the range of the relay. The switch will not operate on a voltage other than that stamped on the nameplate of the transfer switch.

Do not attempt to energize the Emergency source until the switch is operating satisfactorily on normal.

[NOTE: If not using a Gen Set of equal, or greater, capacity to that of the Utility supplying the normal side of the ATS, see the Job Specific Sequence of Operation documentation included by LSEC.**]**

With the Normal source operating, the Emergency source may now be **manually** energized for testing. The Emergency source, including all safety interlocks, should be checked over before an attempt is made at a complete automatic system test. When the Emergency source has been tested satisfactorily and de-energized, a test of the automatic system can be tried.

All Electromechanical Control Transfer Switches have a "Load Test" operating mode which is selectable via a Selector Switch. A test of the automatic circuitry can be initiated by placing the Transfer Switch in the load test mode. This will cause the normal control circuits to de-energize and give a signal to start the engine. After the generator is up to voltage and frequency, the transfer switch should transfer to the emergency source.

The above tests are sufficient to place the transfer switch in operation. The following pages contain specific information on the various components and troubleshooting.

4. TIMING RELAYS

The following timing relays are used on Lake Shore Automatic Transfer Switches, however, only the TDR is standard on **all** styles of Lake Shore switches and the TDT is used on only the Style 3. All other timing relays discussed are optional.

Factory Setting

Unless specific settings are required by a customer or specifications, factory settings of the timing relays are as follows:

Timing Relay	Setting
TDR	5 Minutes
TDE	5 Seconds
EMT	5 Minutes
ODR	10 Seconds
TDT (Style 3 Only)	10 Seconds

TDR, TDE, EMT, & TDT Timing Relays

The same model timer is used for all these functions. As such, these timers can be used interchangeably. They are all **ON** delays and have identical operating characteristics. The setting accuracy is 10% of the range. Each timer has five dial selectable ranges as follows:

Ranges and minimum settings:

Ranges	Minimum Setting
0-0.03 sec.	0.02 sec.

0-3 sec.	0.07 sec.
0-30 sec.	0.6 sec.
0-3 min.	3.5 sec.
0-30 min.	35.0 sec.

Setting the Range

Position the knob near mid scale. Pull the spring loaded knob out and turn clockwise to increase the timing range; turn counter clockwise to decrease the timing range. A click will be heard as you make the progression through the ranges. All graphics and electrical connections are switched by rotating the knob.

The timing beings when 120 VAC is applied to terminals 2 and 7. At the end of the delay period N.O. contacts 1 - 3 and 7 - 8 and N.C. controls 1 - 4 and 5 - 8 transfer. The timer resets when power is interrupted to terminals 2 and 7.

ODR Relay

This timer may be pneumatic, or of solid state design. In both cases, it is a true **OFF** delay relay as no power is required for timing. When power is applied to the relay coil the N.O. and N.C. contacts transfer. When power is removed from the relay coil, the timing cycle starts. After the timer has timed out, the contacts will transfer to their original state.

5. VOLTAGE RELAYS

PHASE FAILURE RELAY

General

This relay continuously monitors the voltage of a three phase or a single phase power source. When the voltage in each phase attains a value equal to or greater than the "pick-up" setting, the output contacts change state and the LED energizes. When the voltage of any phase falls below the "drop-out" setting, the output contacts revert to their de-energized state and the "LED" turns off.

Pick-up and drop-out values are adjustable from 70 to 100% of nominal voltage via two potentiometers that are externally accessible.

Factory Setting

Unless specific settings are required by a customer or specifications, the Phase Failure Relay will be factory set to drop-out at 80% and pick-up at 90% of nominal voltage.

Three Phase Style

The three phase unit comes in two models, each with a different voltage range. Part number 9926220 has a range of 208-240 VAC and 380-480 VAC. These are selectable by changing the position of a small printed circuit board inside the chassis of the unit and may be done in the field. Part number 9926221 is used when 120 VAC is to be monitored. Its voltage is fixed and is not selectable like number 9926220.

CALIBRATION:

1. Select proper voltage range.

2. Set pickup potentiometer full clockwise.
3. Set dropout potentiometer full counter-clockwise
4. Using a small screwdriver, turn the calibrate potentiometer fully clockwise.
5. Apply nominal input voltage to unit.
6. Slowly turn the calibration potentiometer counter-clockwise until the units picks up as indicated by the "energized" light.
7. Set pickup and dropout potentiometers to desired settings.
8. Unit is ready for operation.

Note: Field adjustment can only be considered approximate if potentiometers are set using the scale on the front of the unit. For an accurate setting of the pickup and dropout points, a variable voltage power supply must be used.

Single Phase Style

The single phase unit is available in four models. Each model is adjustable to 70 to 100% of the voltage range selected. The voltage ranges and Model numbers are as follows:

Numbers	Voltage Ranges
1925024	208 VAC
1925025	240 VAC
1925026	480 VAC
1925027	120 VAC

CALIBRATION:
Indication of pickup or dropout of the PFR can only be seen by attaching a continuity meter to terminals #3 and #4 (Common and N.O.) When the meter shows continuity, the PFR is picked up.

1. Remove protective black plugs.
2. Using a small slotted screwdriver, turn the dropout potentiometer fully counter-clockwise.
3. Using a small slotted screwdriver, turn the pickup potentiometer fully clockwise.
4. Apply required level of pickup voltage to the unit.
5. Turn the pickup potentiometer slowly counter-clockwise until the meter shows continuity.
6. Reduce the voltage to the required voltage dropout level.
7. Turn the dropout potentiometer slowly clockwise until the meter shows no continuity.

FREQUENCY VOLTAGE RELAY

General
This device is used to prevent transferring to the Emergency power source until the emergency power generator has reached correct operating voltage and frequency.

Factory Setting:
The unit pickup set point is factory set at 48HZ (50HZ line) or 58HZ (60HZ line) and 108 VAC. This device is not field adjustable.

6. PROGRAM TIME CLOCK

General
This unit is used to provide the plat exerciser (Option 6) and uses a contact to initiate a test cycle at customer required days and times. There are two basic types of timers used in this option- an electro-mechanical and digital- both of which are covered here.

ELECTROMECHANICAL TIME CLOCK – TORK MODEL #8007

Description
The Plant Exerciser consists of a 120VAC timing motor (terminals L and 2) and an aux switch with terminals labeled Common (C), Normally Open (NO) and Normally Closed (NC). In a Lake Shore Electric Transfer Switch the Plant Exerciser (PE) contact is installed in the control circuitry using aux switch Common and Normally Closed. The 120VAC supply in connected to charge coil terminals L and 2. At installation, all of the spring clips located around the Time Dial are rotated outward away from the center of the dial. With the spring clips rotated outward, the Plant Exerciser aux switch is always activated and the Normally Closed contact is held open in the transfer switch control circuit. This prevents the Plant Exerciser function from initiating. When a spring clip is rotated inward toward the center of the dial, the aux switch is deactivated and the normally closed contact is allowed to close. This starts the Plant Exerciser function of the transfer switch.

TO SET THE TIME DIAL
Rotate the dial by hand counterclockwise only until the correct time of day is opposite the time arrow. To activate the exerciser, rotate a spring clip inward toward the center of the dial at the desired time of day. Each spring clip will operate the exerciser for 15 minutes. This is the smallest time increment that can be chosen. If more exercise time is required, more spring clips can be rotated inward.

TO SET THE DAY WHEEL
Rotate the Day Wheel until the present day of the week is opposite the day arrow. Earth tab of the Day Wheel is stamped with the first two letters for each day of the week. Screw a brass pin into the Day Wheel tab on the days which exercising is not desired. The tabs which do not have a pin in them are the day on which the exerciser switch will activate. The small arm on the Time Dial advances the Day Wheel one day at 2:00 A.M.

CAUTION: DO NOT ATTEMPT TO INSERT A BRASS SCREW IN A DAY WHEEL TAB WHILE THE DAY ARROW IS POINTING TO THAT TAB. THIS WILL LOCK THE TIME DIAL IN PLACE AND NOT ALLOW THE EXERCISER TO ADVANCE.

TORK TIME SWITCH

MODEL 8007

DUTY CYCLE TIMER WITH OMITTING DEVICE

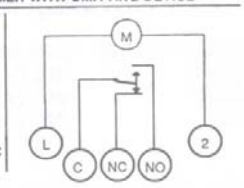
SWITCH: SPDT

SWITCH CAPACITY:

20 Amps, 240V AC

¾ H.P., 120V AC

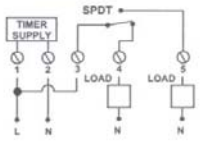
1 ½ H.P., 240V, AC



Type of Load	120VAC N.O.	120VAC N.C	240VAC N.O.	240VAC N.C	277VAC N.O.	277VAC N.C
Resistive	20A	10A	20A	10A	6A	3A
Inductive	20A	10A	20A	10A	6A	3A
Ballast	6A	3A	6A	3A	6A	3A
Tungsten	5A	3A	5A	3A	–	–
Pilot Duty	470 VA	275 VA	470 VA	275 VA	660 VA	–
Motor	1 HP	1/4 HP	2 HP	1/2 HP	–	–
N.O. 20A Resistive @ 28VDC N.C. 10A Resistive @ 28VDC						

- ☐ **ES120** 120VAC
- ☐ **ES120-2** 240VAC
- ☐ **ES120-3** 277VAC
- ☐ **ES120-24** 24VAC

OUTPUT: SPDT



TORK

MLI-139(B) 1 GROVE STREET, MT. VERNON, NY 10550 TEL: 914-664-3542
FAX: 914-664-5052

DIGITAL TIME CLOCK TORK ES120

INSTALLATION

UNIT IS TO BE INSTALLED BY A LICENSED ELECTRICIAN

To remove unit from enclosure: Push tab on right to swing unit to the left and remove.

Mount the enclosure at eye level using screws or other suitable fastening device. Bring supply and load wires in through bottom or side knockouts. DO NOT USE TOP.

Install 9 volt alkaline battery (not supplied) by sliding battery cover in direction of arrow and removing(located above key pad). Pull out the battery connector and connect the battery. Reinstall battery cover Note: Unit can be fully programmed using battery power only.

Reinstall unit by reversing step #1 above and connect wires to unit as per suggested wiring diagrams. See illustration on back page.

KEY FUNCTIONS

DAY: Press to select proper day of the week in the CLK (clock) mode and to select days to be skipped in the SKIP mode.

HOUR: Press to set the hours in the CLK mode and in the SCH (schedule) mode.

MIN: Press to set the minutes in the CLK mode and in the SCH mode.

OVERRIDE: Press to alter the current load status (operates in both AUTO and MAN modes).

MODE: Press to advance to next mode. Sequence is: CLK, SCH, AUTO, MAN, SKIP. In the CLK, SCH, and SKIP modes, UNIT AUTOMATICALLY REVERTS TO THE AUTO MODE IF NO ENTRIES ARE MADE FOR 5 MINUTES.

DELETE: Press to delete the displayed information when in the SCH mode.

SKIP: Press to set or delete skip days (those on which no schedule is executed).

ENTER: Press to store the displayed information into memory. **Information will not be stored until ENTER key is pressed.**

NOTE: During settings, each press of the key will advance one number. For rapid advance, hold key in.

TO SET CLOCK

Press MODE key until display shows CLK.

Press DAY key to select current day.

Press HOUR key to select current hour.

Check A (AM) or P (PM).

Press MIN key to select current minute.

Press ENTER key and the clock is set for current time and day.

TO SET SCHEDULE

If display does not show SCH, press mode key until display shows SCH.

Note: There are 7 ON and 7 OFF set points which alternate (set point #1 is ON; #2 is OFF; #3 is ON).

The display will indicate it is ready to receive SCH setpoint #1 which is an ON event.

Press HOUR and MIN keys for the first ON

setting (check for AM or PM).

Press ENTER key to store the information and display will indicate it is ready to receive SCH setpoint #2 which is an OFF event.

Press HOUR and MIN keys for the first OFF setting.
Press ENTER key to store the information and display will indicate it is ready to receive SCH setpoint #3 which is the next ON event.

Proceed for up to 7 ON and 7 OFF setpoints.

Press MODE key and unit will go to the AUTO (run) mode.

In the AUTO mode, the unit will display current time and day as well as load status (ON and OFF).

Note: When the unit is returned to the auto mode, check the load status of the current setting. If it is showing OFF but should be ON, press the override key. The unit will correct itself at the next scheduled event and no further alteration will be necessary.

TO SET SKIP DAYS
Press mode key until display shows SKIP.

Press DAY key and M (Monday) starts flashing.

Press SKIP key to set or delete a flashing day.

Press DAY key to advance the days.

When all desired skip days are selected (showing solid on LCD), press ENTER key.

Note: During skip days, only OFF events are executed. This will allow the load to turn off if it was overridden ON during these days.

REVIEW/MODIFY

CLOCK - ALTER TIME

Press mode key until display shows CLK.

Press DAY, HOUR, and MIN keys to change to the correct time.
Press ENTER.

SCHEDULE – REVIEW
Press mode key until display shows SCH.

Press ENTER key repeatedly to review all the scheduled entries.

During the review, any selected skip days will appear on the display with the word SKIP.

SCHEDULE – MODIFY

During the review (see previous section) any set point can be modified or deleted.

Use the HOUR, and MIN keys to modify.

Use the DELETE key to eliminate that event.

Press ENTER key after each modification.

SKIP DAYS - ADD/DELETE

Press mode key until display shows SKIP.

All previously selected skip days will appear.

To add or delete days, follow steps in section titled “TO SET SKIP DAYS”.

OVERRIDE – TEMPORARY

In order to temporarily change the current

ON or OFF status of a load, simply press the override key when the unit is in the AUTO mode.

The altered load status will flash. Override is in effect until the next scheduled event.

In order to cancel the override, press override key again.

OVERRIDE - LONG TERM

Press mode key until display shows MAN (manual).

Normal schedule will not be executed and the load status will remain unchanged as indicated.

Press the OVERRIDE key to obtain the correct status or to alter the load status

7. INSULATED CASE SWITCHES

The operating or switching mechanisms used in the Insulated Case Transfer switches are MASTERPACT® NW automatic and non-automatic circuit breakers. The MASTERPACT® devices may be non-automatic, automatic, fixed or draw-out as required by the transfer switch configuration. See the MASTERPACT® O & M manual provided with the Insulated Case Transfer Switch for necessary technical information on these products. If additional information is necessary, please contact the factory; call 800-225-0141.

Masterpact® NW Low-voltage Power/Insulated Case Circuit Breaker

8. TROUBLESHOOTING GUIDE

This guide is intended to assist an individual with a basic understanding of electrical circuitry to troubleshoot an automatic transfer switch as manufactured by Lake Shore Electric Corporation. Any questions relating to the use of this Operating Manual should be referred to the Service Department of Lake Shore Electric Corporation, 205 Willis Street, Bedford, Ohio 44146, Phone (440) 232-0200 or (800) 225-0141, Fax (440) 232-5644.

CAUTION: WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER FROM ELECTRICAL HAZARD EXITS. DO NOT ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT TAKING EVERY PRECAUTION TO PREVENT AN ACCIDENT.

WARNING!

IN INSTALLATION AND USE OF THIS PRODUCT, COMPLY WITH THE NATIONAL ELECTRICAL CODE, FEDERAL, STATE AND LOCAL CODES, AND ALL APPLICABLE SAFETY CODES. IN ADDITION, **TURN OFF** POWER AND TAKE OTHER NECESSARY PRECAUTIONS TO PREVENT PERSONAL INJURY AND EQUIPMENT DAMAGE.

WHEN WORKING ON EQUIPMENT OF THIS TYPE, EXTREME DANGER OF ELECTROCUTION EXISTS, THIS MAY RESULT IN INJURY OR DEATH. **DO NOT** ATTEMPT ANY REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT WITHOUT FIRST TAKING EVERY PRECAUTION TO PREVENT ACCIDENTAL INJURIES.

The following conditions **MUST** be met before attempting to troubleshoot an Insulated Case Transfer Switch:

1. A wiring diagram for the specific switch must be available.
2. Normal and Emergency voltage and frequency must be available and within the correct operating limits.
3. Control circuit voltage (if transformers are used) must be 110 to 125 volts.
4. Connections to the under-voltage relay must be correct and the relay must be adjusted to pick up on the voltage at which the switch is operating. See voltage relay instructions on a Page 23.
5. All timers must be turned down or considerations given to them while the tests are being conducted.
6. If trip units are included in the switch, they must be reset if previously tripped due to an overload.
7. All electrical connections must be tight and in accordance with the wiring diagram.
8. All components must be free of obvious defects with the exception of normal usage.
9. The switch must be connected to a good earth ground.

When you are satisfied that all the above conditions are met, and all accessories are either working correctly or eliminated, the problem will be confined to:

1. Positive Control Board

2. OFF Board Timers

3. The interconnections and cable connections

4. The Insulated Case Switches

The troubleshooting procedures outlined here are designed to test the control circuit and the operating mechanism of the transfer switch. It is, therefore, necessary that all factors external to the transfer switch are correct, and that all accessory devices which are not imperative to switch operation either operate satisfactorily or are bypassed and jumpered out of the circuit.

Many of the accessory devices described below may not exist in the transfer switch being examined. The proper wiring diagrams should be on hand before beginning work on the switch. We recommend that the entire manual be read before attempting to make any adjustment. Above all, **CAUTION** is recommended.

Many of the troubleshooting tests require a simulated failure of the normal source. This can be done with the Load Test Switch.

> **[NOTE:** If not using a Gen Set of equal, or greater, capacity to that of the Utility supplying the normal side of the ATS, see the Job Specific Sequence of Operation documentation included by LSEC.**]**

8.1 NORMAL POWER FAILS – ENGINE DOES NOT START

1. **Maintenance Disconnect Switch (MDS)**

   Verify that the maintenance disconnect switch is in the **"NORMAL"** position.

2. **Selector Switch (SS)**
   Verify that the Selector Switch is in the **"AUTOMATIC"** position.

3. **Outage Delay Relay (ODR) Defective**

   Disconnect the wires connected to Terminals 28 and 29 of the Printed Circuit Board. Then place an OHM-Meter or continuity checker on terminals 28 & 29. If the meter indicates a closed or short circuit, the ODR is okay; continue to Step 3. If the meter indicates an open circuit, the ODR is defective.

4. **Engine Batteries Bad**

   a. Check engine battery voltage. If voltage is proper, continue to Step b.

   b. Place generator control in the **manual** position to crank engine. If engine fails to crank, troubleshoot the engine starting system.

8.2 ENGINE STARTS – ATS WILL NOT TRANSFER TO EMERGENCY

1. Improper Generator Voltage

Using an appropriately set voltmeter, check the Generator output voltage on terminals EL1 to EL2, and EL2 to EL3, and EL3 to EL1. If each set of readings indicate the generator's proper line to line voltage, continue to Step 2. If the readings do not indicate proper line to line voltage, further checks are required on the generator, generator circuit breaker and/or voltage regulator.

2. Frequency Voltage Relay Not Energizing (FVR)

a. Using an appropriately set voltmeter, check the voltage on terminals 23 to 25 (23 to NE for transfer switches without control transformers). If the reading is 120 VAC nominal, continue to Step b. If the reading is not 120 VAC nominal, check the ECT transformer and/or return to Step 1.

b. Using an appropriately set voltmeter, check the voltage at the input of the FVR terminals (0 to 120). If the voltage is 120 VAC nominal, continue to Step c. If the reading is not 120 VAC nominal, the circuit between ECT and the FVR is broken.

c. Check the voltage at the terminals 16 to 25 (16 to NE for transfer switches without control transformers). If this voltage is 120 VAC nominal, continue to Step d. If it is not 120 VAC nominal, replace ODR 2 Relay.

d. Check the voltage at terminal 18 to 25 (18 to NE for transfer switches without control transformers). If this voltage is 120 VAC nominal continue to Step 3. If it not 120 VAC nominal, replace FVR Relay.

3. Time Delay to Emergency (TDE)

a. If neither the "timing" or "timed out" lights are energized, replace the TDE Timer Relay with the EMT or TDR Timer Relay. If the "timing light" energizes, replace the defective TDE timer relay. If the "timing light" still does not energize, return to Step 2.

b. If only the "timing light" is energized and will not time out, the timer is defective and must be replaced.

c. If only the "timed-out" light is energized, the timer relay is functioning; continue to Step 4.

4. Emergency Control Breaker (EB1) Protective Circuit Breaker Tripped

If the button on the top of EB1 is popped out, it must be pressed in to reset EB1. This indicates the clutch could have excessive slip and should be adjusted according to the routine adjustment section of the operating manual. It can also be an indication of a bad charge coil. If the button is not popped out, continue to Step 5.

5. **Emergency Aux Contact (ES(AUX)-#) Defective**

   a. Using an appropriately set voltmeter, check the voltage across the normally open aux contact terminals of the Emergency Breaker, (see circuit breaker manufacturer documentation for correct terminal numbering). If the voltage is 120 VAC nominal, continue to Step b; if voltage is not 120 VAC nominal, return to Step 4 and continue to check the components in the series circuit to the transfer charge coils.

8.3 AUTOMATIC TRANSFER SWITCH WILL NOT TRANSFER TO NORMAL

1. Improper Utility Voltage

Using an appropriately set voltmeter, check the utility voltage on terminals NL1 to NL2, and NL2 to NL3, and NL3 to NL1. If each set of readings indicate the proper utility line to line voltage, continue to Step 2. If the readings do not indicate proper line to line voltage, the incoming voltage circuitry should be looked at with possible help from the local utility company.

2. Improper Control Voltage

Using an appropriately set voltmeter, check the voltage on terminals NX1 to 25 (NX1 to NE for transfer switches without control transformers). If the reading is 120 VAC nominal, continue to Step 3. If the reading is not 120 VAC nominal, check the NCT transformer and/or return to Step 1.

3. Phase Failure Relay Not Functioning (PFR)

Using an appropriately set voltmeter, check the voltage on the phase failure relay terminal C to 25 and terminal NO to 25 (C to NE and NO to NE for transfer switches without control transformers). If the voltage of both readings is 120 VAC nominal, continue to Step 4. If only one set indicates 120 Volt nominal, check the applied voltage at the PFR. If this is normal, the PFR is defective.

4. Load Test, Selector Switch and Maintenance Disconnect Switch

a. Verify that the Load Test Switch is in the **"Normal"** position.

b. Verify that the Selector Switch (if used) is in the **"Automatic"** position.

c. Maintenance Disconnect Switch (if used) is in the **"Normal"** position.

5. Time Delay to Return (TDR)

a. If neither the "timing" or "timing out" lights are energized, replace the TDR Timer Relay with the EMT or TDE Timer Relay, if available. If the "timing light" energizes, replace the defective TDR timer. If the timing light" still does not energize, the aux switch NS(AUX1) should be checked and replaced if necessary.

b. If only the "timing light" is energized and will not time out, the timer is defective and must be replaced.

c. If only the "timed-out" light is energized, the relay is functioning; continue to Step 6.

6. Normal Control Breaker (NB1) Protective Circuit Breaker Tripped

If the button on the top of the NB1 is popped out, it must be pressed in to reset NB1. This indicates the clutch could have excessive slip and should be adjusted according to the routine adjustment section of the operating manual. This can also be an indication of a bad charge coil. If the button is not popped out, continue to Step 7.

7. Normal Aux Contact (ES(AUX)-#) Defective

a. Using an appropriately set voltmeter, check the normally open aux contact terminals of the Normal Breaker, (see circuit breaker manufacturer documentation for correct terminal numbering). If the voltage is 120 VAC nominal, continue to Step b; if voltage is not 120 VAC nominal, return to Step 6 and continue to check the components in the series circuit to the charge coils.

9. REQUIRED MAINTENANCE

LUG TORQUE REQUIREMENTS - USE COPPER WIRE ONLY
LINE-LOAD-NEUTRAL

The following cable lug torque values are required to be checked at installation and every six months in order to maintain the Lake Shore Electric Corporation exclusive one year warranty.

TIGHTENING TORQUE VALUES
FOR
SCREW CONNECTIONS

AWG. Or Circular Mill Size	Tighten Torque in Inch Pounds	
	Screw Driver	External Drive Wrench
14	35	75
12	35	75
10	35	75
8	40	75
6	45	110
4	45	110
2	50	150
1	50	150
1/0	50	180
2/0	50	180
3/0		250
4/0		250
250		325
350		325
500		375
600		375
700		375
750		375
800		500
1000		500

TIGHTENING TORQUE VALUES
FOR
SOCKETHEAD SCREW CONNECTORS

Internal Socket Size Across Flats Inches	Tightening Torque in Inch Pounds
1/8	45
5/32	100
3/16	120
7/32	150
1/4	200
5/16	275
3/8	375
1/2	500
9/16	600

Warning: Whenever bus and cable connections are being maintained, all power sources to the transfer switch must be disconnected and locked out.