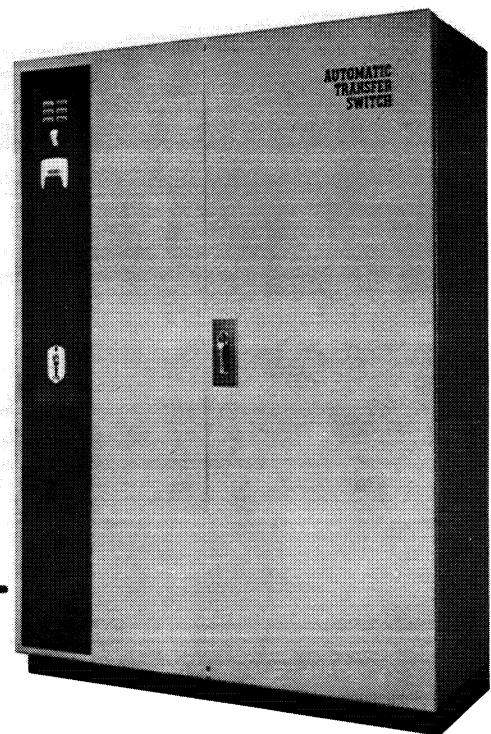




Operators Manual

AT Switches

800 through 1750 Amperes



962-0101

4-75
(Reprint 11-81)
Spec B
Printed in U.S.A.

SAFETY PRECAUTIONS

This manual includes the following symbols to indicate potentially dangerous conditions to the operator or equipment. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

WARNING Onan uses this symbol throughout this manual to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment damage.

The automatic transfer switch has components with high voltages which present serious shock hazards. For this reason, read the following suggestions:

Keep the automatic transfer switch cabinet(s) closed and locked. Make sure authorized personnel only have the cabinet keys.

Always move the operation selector switch on the generator set or automatic transfer switch to "STOP," disconnect the starting batteries of the generator set,

and remove AC line power to the automatic transfer switch before performing maintenance or adjustments (unless specified otherwise in the instructions—then only using extreme caution due to danger of shock hazard).

Before using the disconnect plug, if equipped, for deenergizing the control panel, be sure to place the operation selector switch on the generator set or automatic transfer to the "STOP" position. Neglect of this procedure results in set starting and energization of the transfer switch generator side.

Use rubber insulative mats placed on dry wood platforms over floors which are metal or concrete when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling any electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on the electrical equipment.

Do not work on this equipment when mentally or physically fatigued.

WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

962-1004 SUPPLEMENTARY INSTRUCTIONS

These supplementary instructions apply to 962-0101 Operator's Manual for "AT" series automatic transfer switches. Use the following instructions in place of or in addition to those in the manual. This supplement advances the manual to Spec C. Disregard all manual references made to groups 01 through 05 and 11 through 15. The appropriate group designations are group 51 through 55 and 10 through 15 respectively.

Instructions in the manual referring to the control accessory panel are for panel groups 51 through 55 and 10 through 15.

INSTALLATION SECTION

WIRING CONNECTIONS

Ammeter Readings:

To obtain accurate ammeter readings it is necessary that the GEN LOAD wire pass through the current transformer (one turn), as illustrated in Figure A.

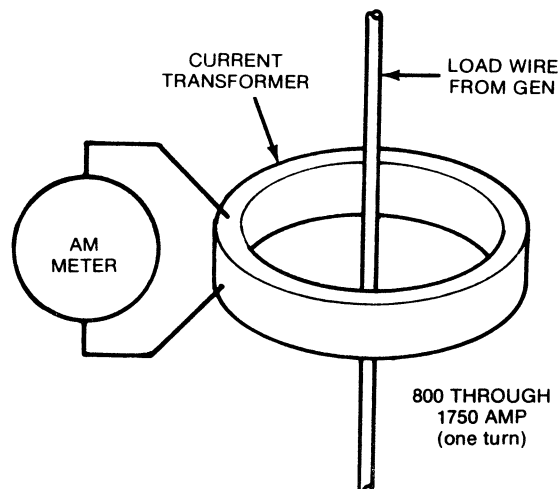


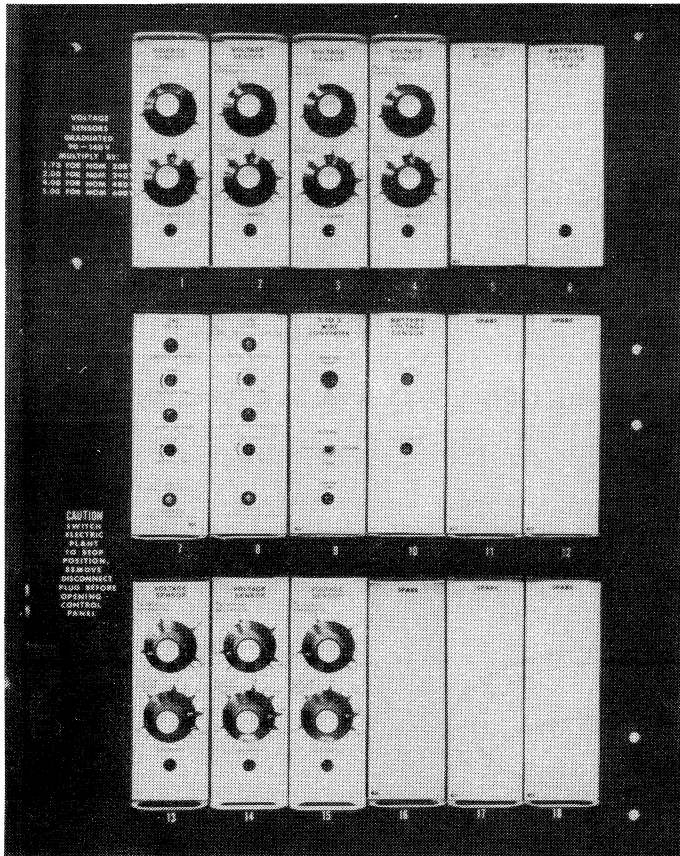
FIGURE A. CURRENT TRANSFORMER WIRING

OPERATION SECTION

CONTROL ACCESSORY PANEL

Control Accessory Groups 10 through 15:

The control accessory panel has three printed circuit board racks with positions "1" through "18" for plug-in modules, Figure B. All the following modules used in automatic transfer switches are listed after the number position they occupy in the control accessory panel.



Position	Module
1	Line undervoltage sensor (1 phase or 3 phase)
2	Line undervoltage sensor (3 phase), bypass or blank
3	Line undervoltage sensor (3 phase), bypass or blank
4	Generator undervoltage sensor (1 phase)
5	12 volt module, or 24 to 12 volt converter
6	12 or 24 volt battery charger (2 ampere)
7	12 volt start-stop time delay
8	Transfer-retransfer time delay or bypass
9	Blank
10	12 or 24 volt battery voltage sensor or blank
11	Blank
12	Blank
13	Line overvoltage sensor (1 phase or 3 phase) or blank
14	Line overvoltage sensor (3 phase) or blank
15	Line overvoltage sensor (3 phase) or blank
16	Blank
17	Blank
18	Blank

FIGURE B. MODULE NUMBERING

Transfer-Retransfer Time Delay (Continued)

1. Open cabinet door to automatic transfer switch.
2. Move the selector switch to "WITH LOAD".
3. Move test transfer switch to "TEST". The generator set will start and run.
4. With a stopwatch or watch with a second hand, measure the time that the red transfer LED remains lit (module 8). Once the time delay is completed, red transfer LED will turn off. If the time delay is correct or time you desire, proceed to Step 6, otherwise proceed to Step 5.
5. Insert a small screwdriver through the "TRANSFER" opening (upper opening) in the front panel of the transfer-retransfer delay module (Figure E). Turn clockwise in small increments to increase the time delay, counterclockwise to decrease time delay.
6. Move the test transfer switch "NORMAL".
7. With a stopwatch or watch with a second hand, count the number of flashes that the green LED (bottom LED) makes in 60 seconds (Onan suggests counting for 60 seconds - shorter intervals would give less accuracy for determining time delays). Once retransfer timing is complete red LED (timing for Retransfer) will turn off and green LED will cease flashing. Green LED will stay lit for duration of GEN SET "STOP DELAY". See following list for correlating pulses to time delays.

<u>Pulses/60 sec</u>	<u>Time Delay (min)</u>
50	5
25	10
17	15
13	20
10	25
8	30

If time delay is correct or time you desire, proceed to Step 10, otherwise proceed to Step 8.

8. Insert a small screwdriver through the "RETRANSFER" opening in the front panel of the transfer-retransfer time delay module. Turn clockwise in small increments to increase time delay, counterclockwise to decrease time delay.
9. Repeat Steps 3 through 8 until the desired time delays are obtained.
10. Move the selector switch to "WITH LOAD" if you want the generator set to assume load during exercise or tests.
11. Close cabinet door.

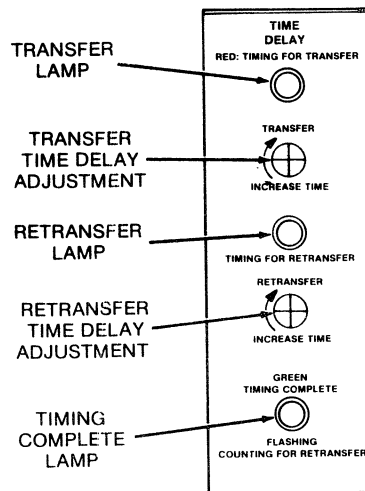


FIGURE E. TRANSFER-RETRANSFER TIME DELAY

ADJUSTMENTS SECTION

EXERCISER CLOCK

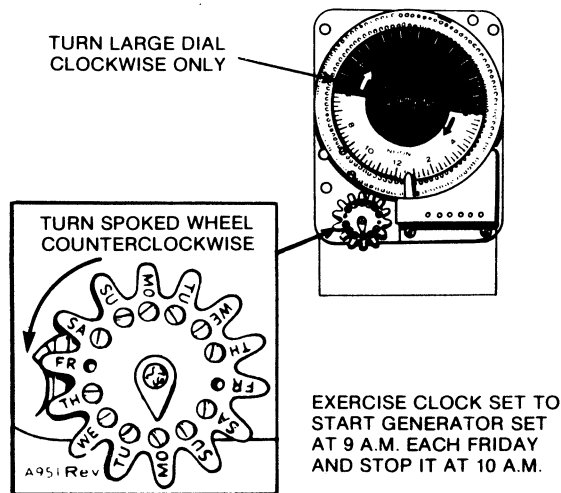
1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch (on engine control for two-wire starting, in cabinet for three-wire starting) to "STOP."
3. Install a trip pin (**left-hand thread**) in the inside row of holes on the large dial for the time of day you want the generator set to start. See Figure C.
4. Place a trip pin (**left-hand thread**) in the outside row of holes on the large dial to stop the generator set.

Onan recommends settings which operate the generator set for at least 30 minutes each week. Exercising for one long period is better than several short periods.

5. Install a trip pin (**left-hand thread**) in the small spoked wheel for every day *no exercise* is desired.
6. Rotate the large dial (**clockwise**) until the correct time is correctly aligned with the time pointer.
7. Turn the small spoked wheel counterclockwise until the correct day aligns with the pointer.

Sixteen trip pins are supplied with the clock. Store unused pins on the time pointer bracket.

8. Move the operation selector switch to "RMT".
9. Close the cabinet door.



NOTE: Trip pins are left-hand thread.

FIGURE C. EXERCISER CLOCK

TIME DELAYS

Control Accessory Groups 10 through 15 Optional Start Stop Time Delay

A programmable start-stop modular time delay (300-1059) is available for increasing the time span of the start-stop time delay. Table A lists switch settings and delay times.

TABLE A. PROGRAMMABLE TIME DELAY

PROGRAMMABLE START — STOP TIMER				
c = SWITCH CLOSED				
o = SWITCH OPEN				
SWITCH POSITIONS				
1	2	3	4	TO START
5	6	7	8	TO STOP
TIME				
o	o	c	o	0.5 sec
o	o	o	c	1.0 sec
c	o	c	o	1.4 sec
c	c	c	o	2.4 sec
c	o	o	c	5.5 sec
o	o	o	o	7.9 sec
c	c	o	c	9.6 sec
c	o	o	o	43 sec
o	o	c	c	62 sec
c	c	o	o	76 sec
c	o	c	c	345 sec
c	c	c	c	615 sec
TIME TOL ± 20%				

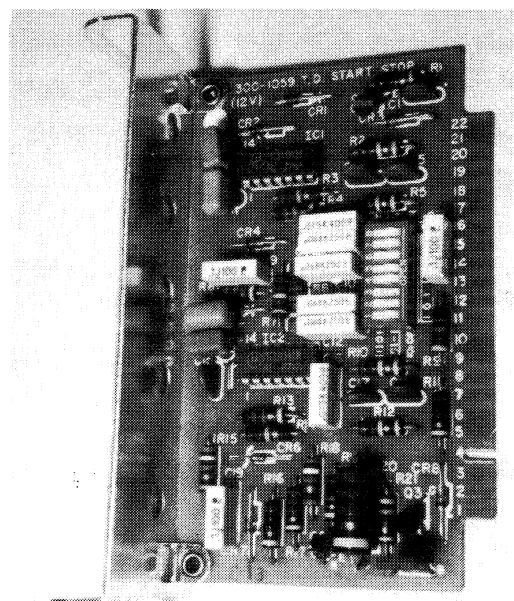


FIGURE D. START-STOP TIME DELAY

This module is for use on Control Accessory Groups 10 through 15 and 20 through 25. Figure D illustrates start-stop delay module.

Transfer-Retransfer Time Delay Module (SPEC C):

The transfer-retransfer time delay is factory set for 2-3 sec on transfer (transfer of load to generator set) and 10 minutes on retransfer (transfer of load to normal power). For adjustment or change of the time delay, follow this procedure.

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GENERAL INFORMATION

AUTOMATIC TRANSFER SWITCHES

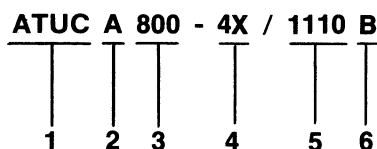
Onan automatic transfer switches are designed to operate with Onan generator sets and other Onan related equipment for standby service. The automatic transfer switch assures continuous power supply to a load either from the normal commercial power supply or from the emergency power source (generator set).

Onan standard cabinets meet requirements of the National Electrical Manufacturers Association (NEMA) for a "Type 1" cabinet: general purpose, indoor cabinet. Other type cabinets for outdoor use, etc. are available.

When contacting a dealer or the factory for information on operation or service of your automatic transfer switch, always furnish the complete model number, specification letter, and serial number as given on the nameplate. This information is needed to identify your automatic transfer switch among the basic and special types manufactured by Onan.

MODEL NUMBER

Following is a typical model number with explanations of the different parts:



1. Series Identification:

ATUC—2 wire start, 24 volts
ATUD—2 wire start, 12 volts

"U" indicates Underwriter's Laboratories (UL) listing.

2. Transfer Switch Code.
3. Current Rating (amperes).
4. Voltage Code:
 - 1 —120 volts, single phase.
 - 2 —240 volts, single phase.
 - 3 —120/240 volts, single phase, three wire.
 - 4 —120/208 volts, three phase, four wire.
 - 4X—277/480 volts, three phase, four wire.
 - 5D—120/240 volts, three phase, four wire, delta.
 - 9X—347/600 volts, three phase, four wire.
5. Control Accessory Code, Meter-Lamp Code.
6. Specification Letter: Advances with a production modification.

YOUR INSTRUCTION MANUAL

Since the manual contains the correct information for your automatic transfer switch, keep it handy and refer to it for installation, operation, adjustments and troubleshooting of your automatic transfer switch. On the inside of the automatic transfer switch is a special "pocket" for the manual, wiring diagram(s), and other pertinent material.

Throughout the text, front of the automatic transfer switch is the door side. Left and right are determined when facing the cabinet doors. Whenever reference is made to the operation selector switch, note its location on the generator set engine control.

Where applicable, metric unit follows U.S. customary unit in parentheses.

INSTALLATION

LOCATION

Locating the automatic transfer switch in the existing electrical circuit varies with application and type of entrance switch. There must be a switch and fuses in the commercial power line before the automatic transfer switch. See the typical installation in Figure 1. Onan also recommends protecting the generator set output and load. For generator set protection, use a fused switch or circuit breaker with the same capacity and electrical characteristics as the generator set, connected between the generator set and automatic transfer switch.

MOUNTING

Choose a mounting surface which is vibration-free, convenient for mounting and wiring the automatic transfer switch. Avoid hot, moist or dusty locations.

If the AT automatic transfer switch cabinet is an enclosed cabinet (as shown in Figure 1), use the following mounting instructions given under "*Enclosed Cabinet AT.*" If the automatic transfer switch is an open-construction type (transfer switch mounted on panel with control), use the instructions given under "*Open-Construction AT.*"

Enclosed Cabinet AT

1. Carefully remove the crating top and sides around the automatic transfer switch cabinet. Figure 2 gives dimensions of the cabinets.
2. Connect a hoist or other similar lift to the two lifting eyes of the cabinet.
3. Carefully raise the cabinet, remove the crating around the bottom of the cabinet, and move the cabinet to its installation location.

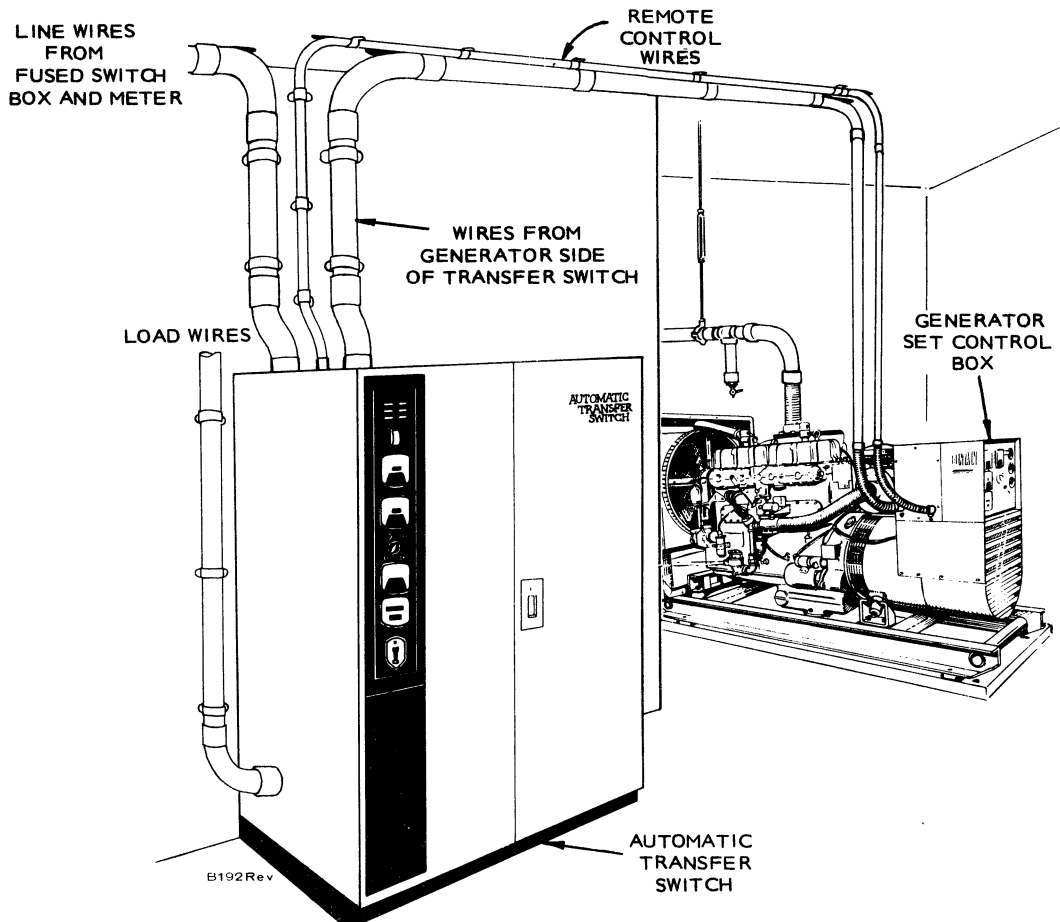
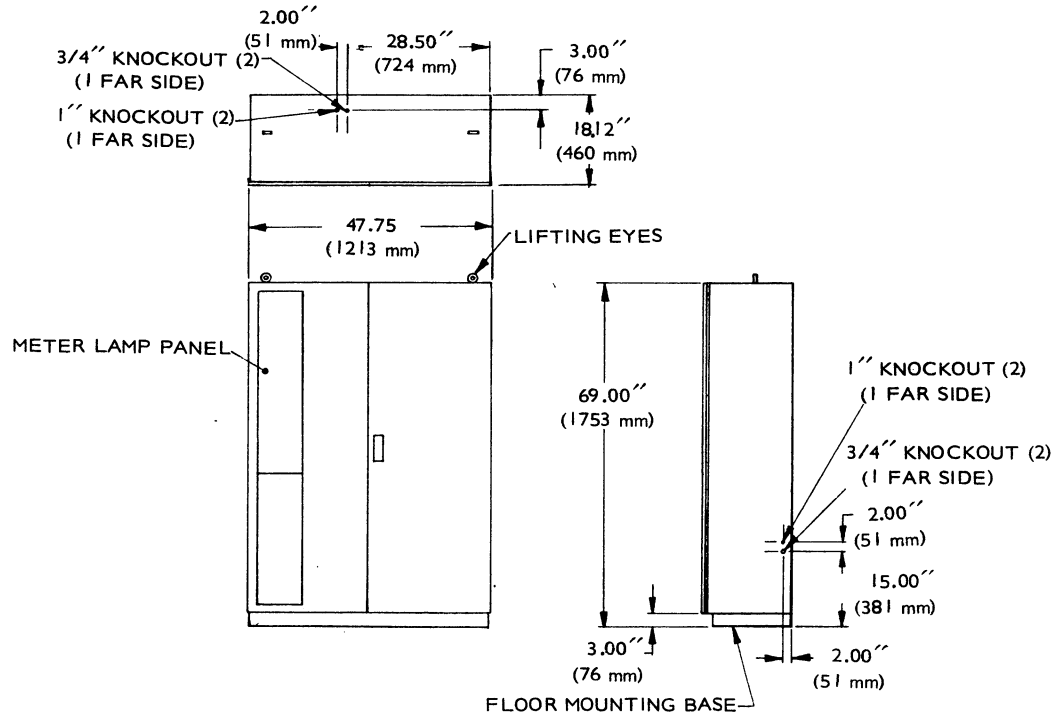


FIGURE 1. TYPICAL AUTOMATIC TRANSFER SWITCH INSTALLATION

800 AND 1200 AMPERE "AT" CABINET



1750 AMPERE "AT" CABINET

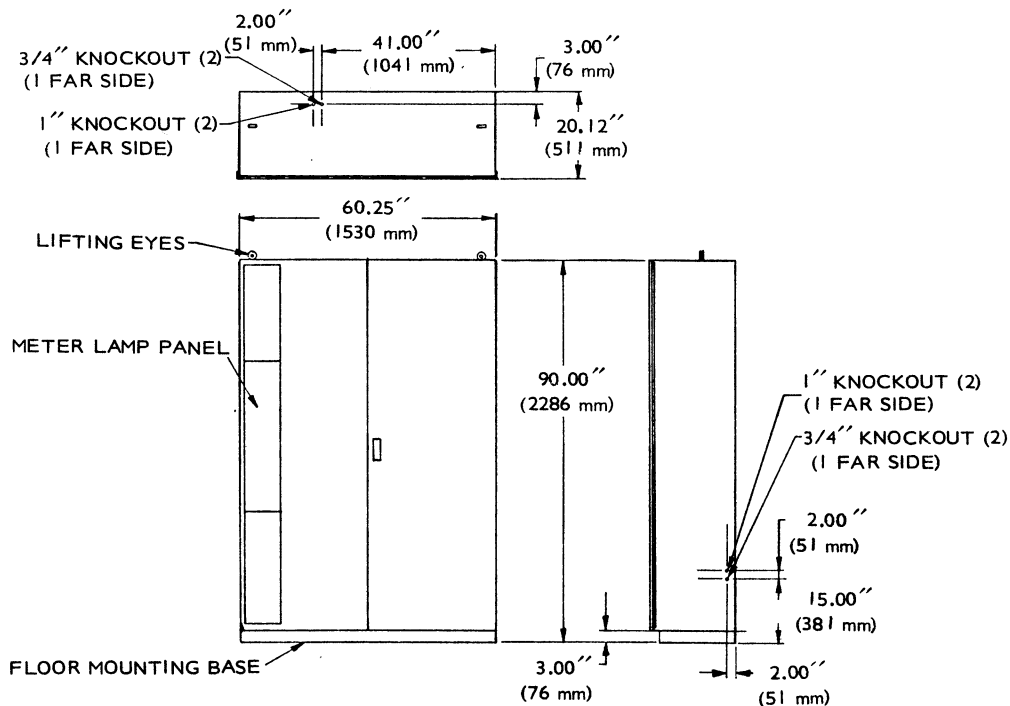


FIGURE 2. "AT" CABINET DIMENSIONS

Open Construction AT

Whether the open-construction AT is wall-mounted, mounted in a customer-furnished cubicle or an Onan NEMA type 4 cabinet (watertight for outdoor use . . . not submersible), choose the correct mounting procedure following.

Wall Mounted (no cubicle used):

1. Carefully remove the crating from around the AT panel.

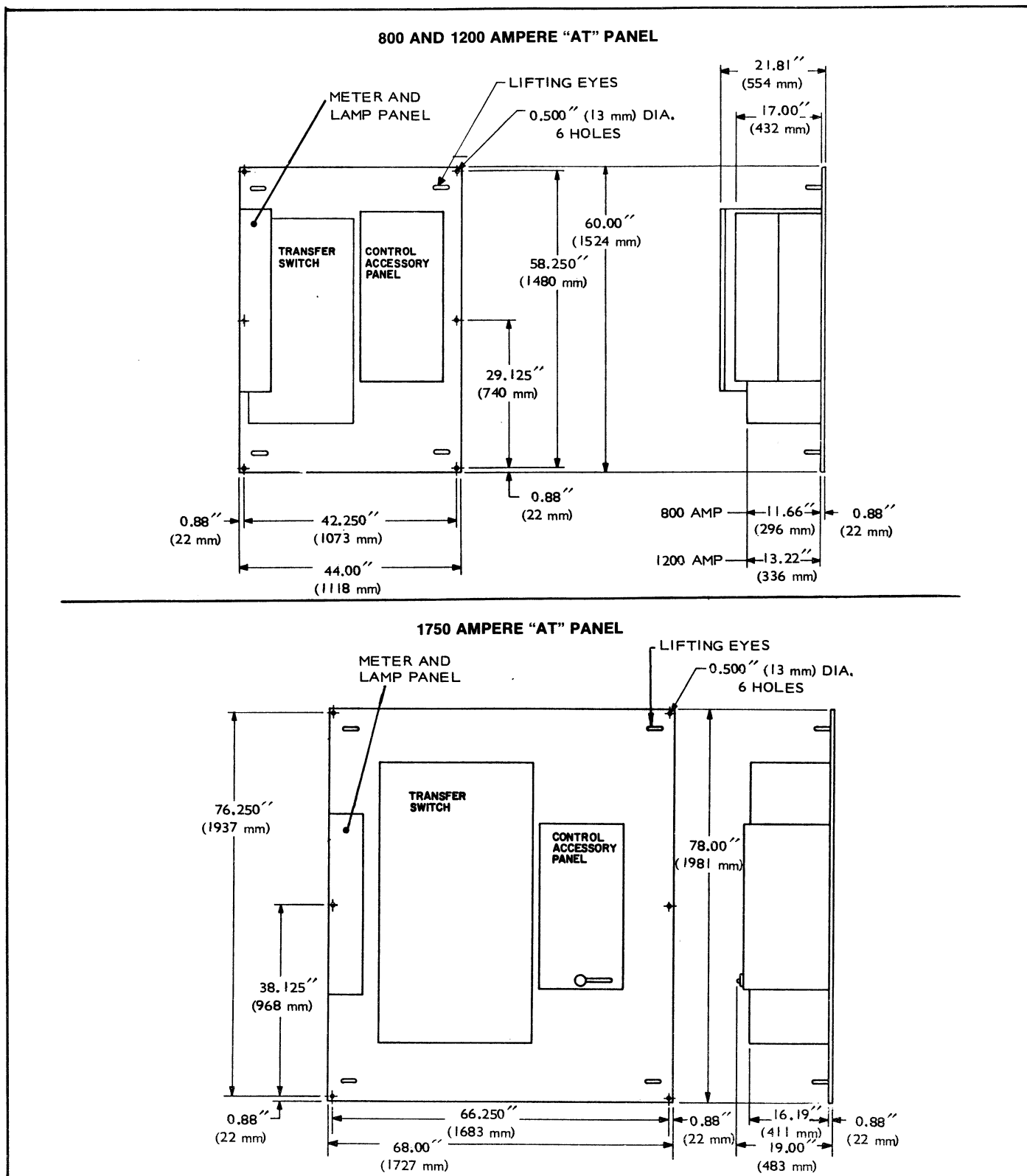


FIGURE 3. DIMENSIONS OF OPEN-CONSTRUCTION "AT"

2. Six 0.50-inch (13 mm) diameter mounting holes are furnished in the metal panel of the open-construction AT. To determine mounting location, refer to Figure 3 which gives the dimensions of the panel and mounting hole locations.

3. Raise the panel (has lifting eye) with a hoist or similar lift, and mount using six 3/8-inch mounting bolts, lockwashers and nuts.

Mounted in Cubicle:

1. Carefully remove the crating from around the AT panel.
2. Six 0.50-inch (13 mm) diameter mounting holes are furnished in the metal panel of the open-construction AT. Figure 3 gives the dimensions of the panel and location of mounting holes.
3. If the cubicle is an Onan NEMA type 4 cabinet, raise the AT panel (has lifting eyes) with a hoist or

similar lift and mount in cubicle. Secure the AT panel using 3/8-inch studs in the cabinet, and lockwashers and nuts. Figure 4 gives dimensions of Onan NEMA type 4 cabinets.

If the cubicle is not an Onan cabinet, locate and drill 0.50-inch (13 mm) diameter holes in the rear of the cabinet to match holes of AT panel (see Figure 3). Furnished cubicle must be at least 21 inches (533 mm) deep for 800 and 1200 ampere

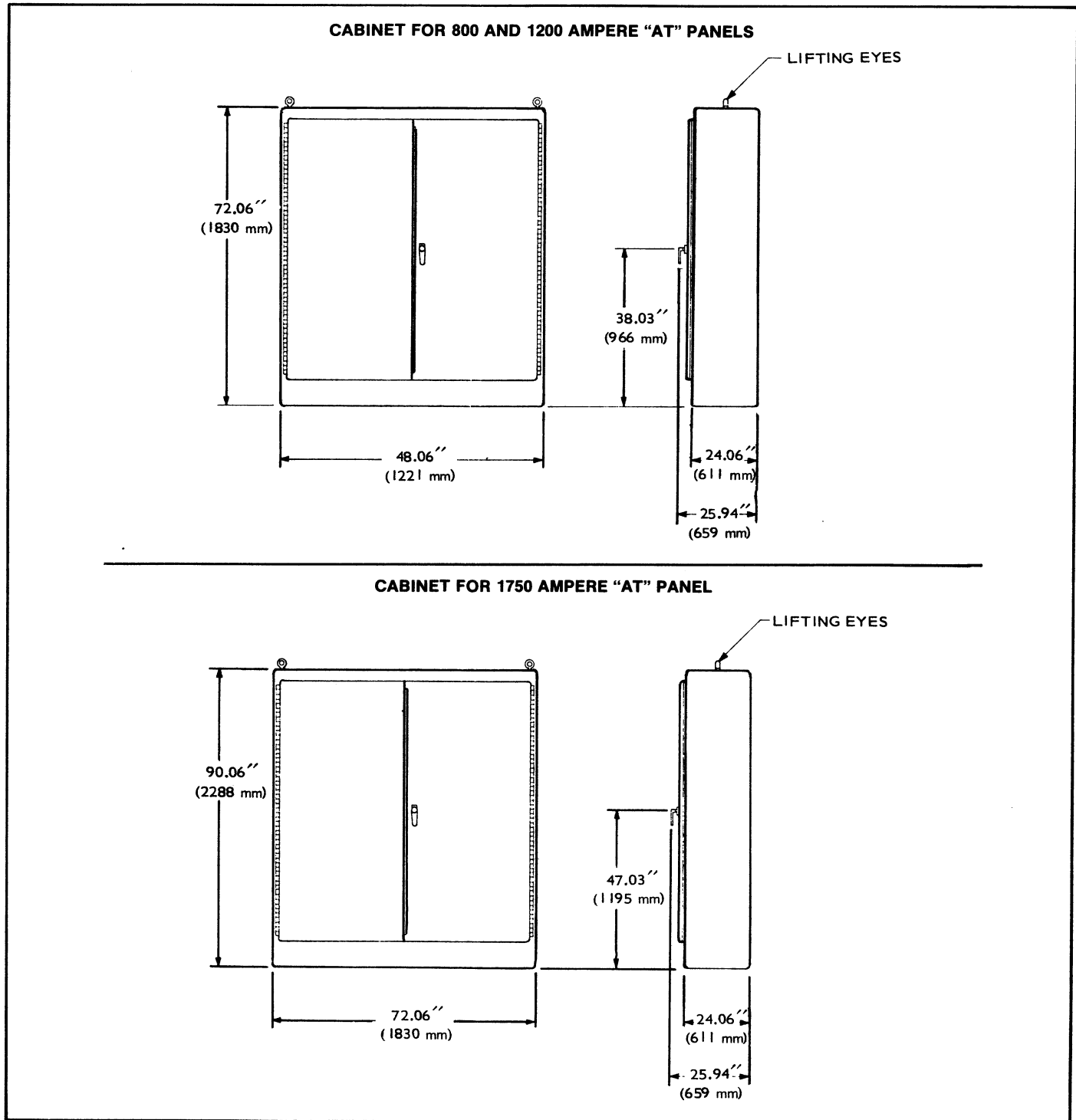


FIGURE 4. DIMENSIONS OF ONAN NEMA TYPE 4 CABINETS

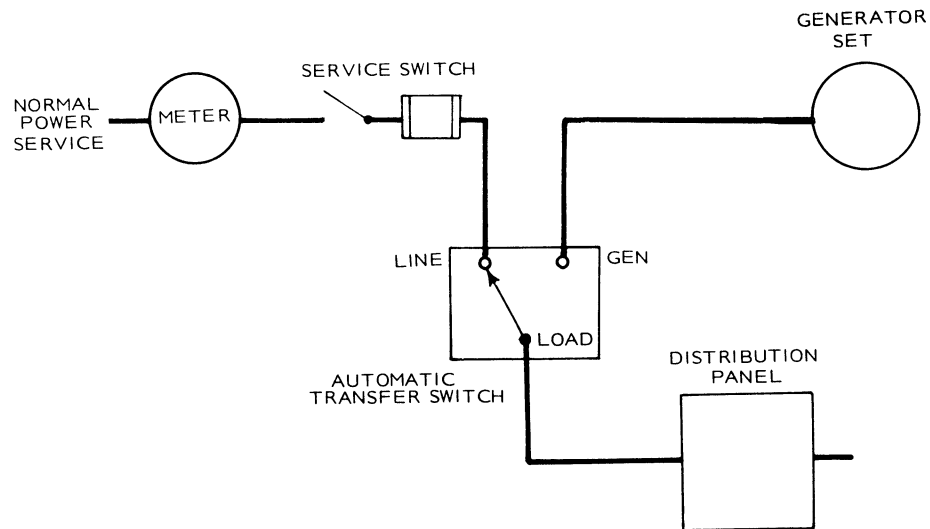


FIGURE 5. PROTECTION FOR COMPLETE ELECTRICAL SERVICE

switches, 18 inches (457 mm) deep for 1750 ampere switches to accommodate the AT panel and transfer switch. Raise the AT panel (has lifting eyes) with a hoist or similar lift and mount in cubicle. Secure with 3/8-inch screws, lockwashers and nuts.

4. Use a hoist or similar lift to move cubicle to its installation location (Onan NEMA type 4 cabinet has lifting eyes).

WIRING

Standby Systems

Before wiring is started, choose one of the following automatic transfer systems for your application.

1. Generator set protects complete electrical service (Figure 5).
2. Generator set protects part of electrical service (limited protection). See Figure 6.

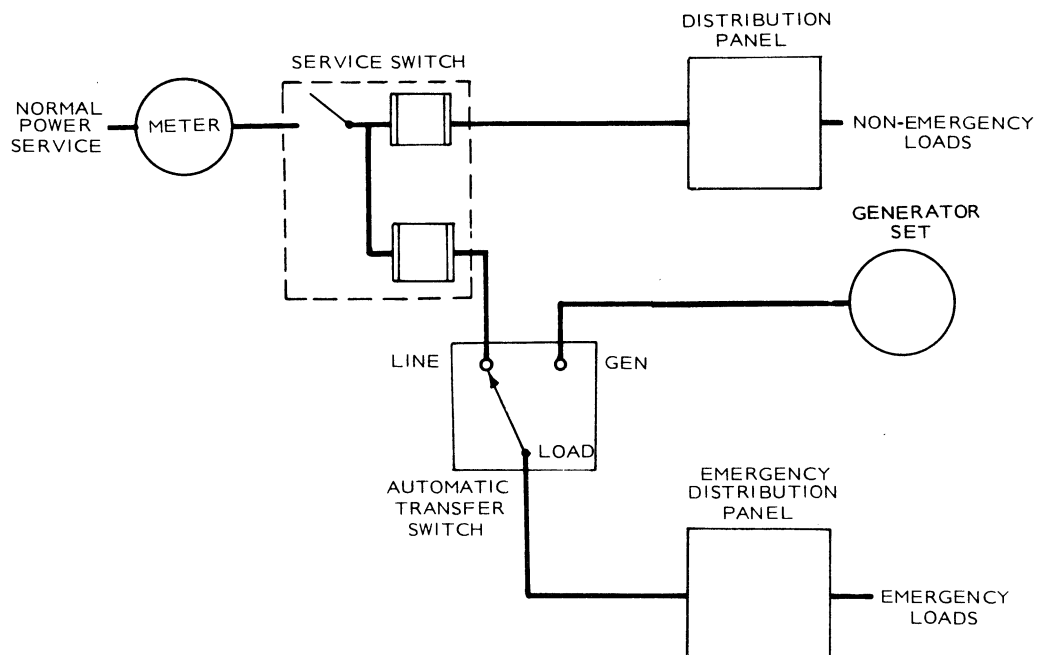


FIGURE 6. LIMITED PROTECTION WITH AN EMERGENCY DISTRIBUTION PANEL

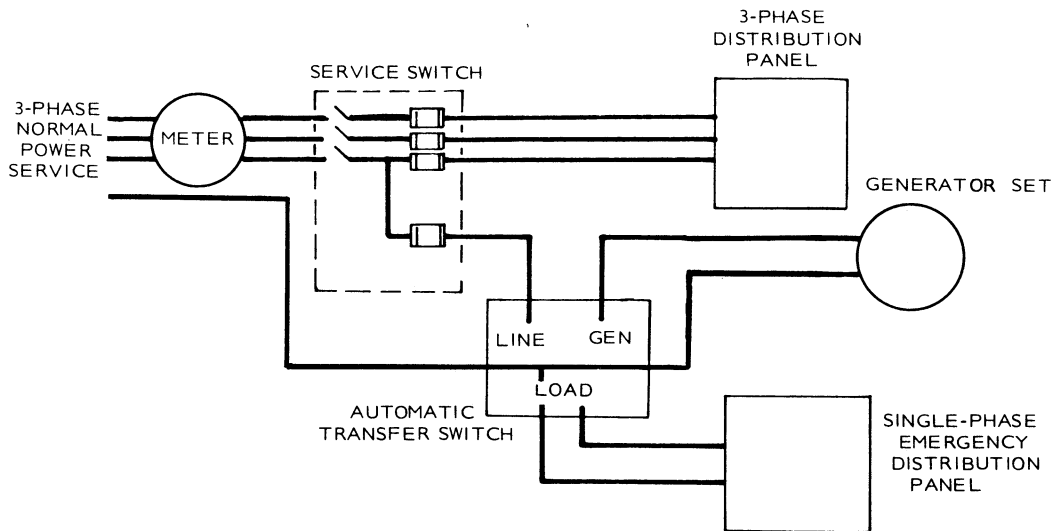


FIGURE 7. THREE-PHASE SERVICE AND SINGLE-PHASE STANDBY SERVICE

3. Generator set protects one phase of a three-phase system (Figure 7).
4. Multiple automatic transfer switches are used for more than one power service with one generator set for emergency standby power. The generator set can supply the single phase, the three-phase, or both simultaneously. Figure 8 shows a typical

installation. Use number 16 wire for the DC engine control leads up to 100 feet or 31 metres (maximum of 0.5 ohm per line).

The generator set must have the capacity to carry the total system.

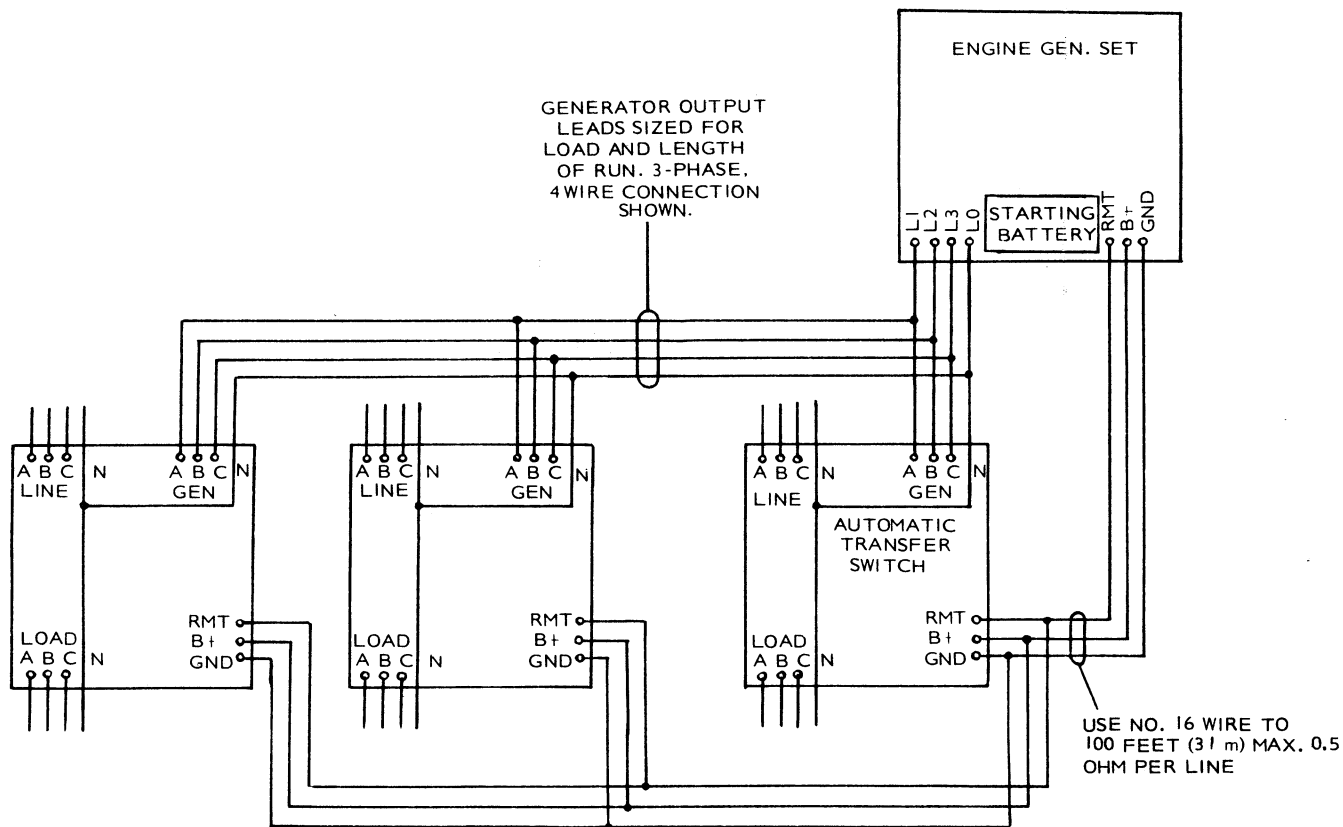


FIGURE 8. STANDBY INSTALLATION FOR MULTIPLE POWER SERVICES

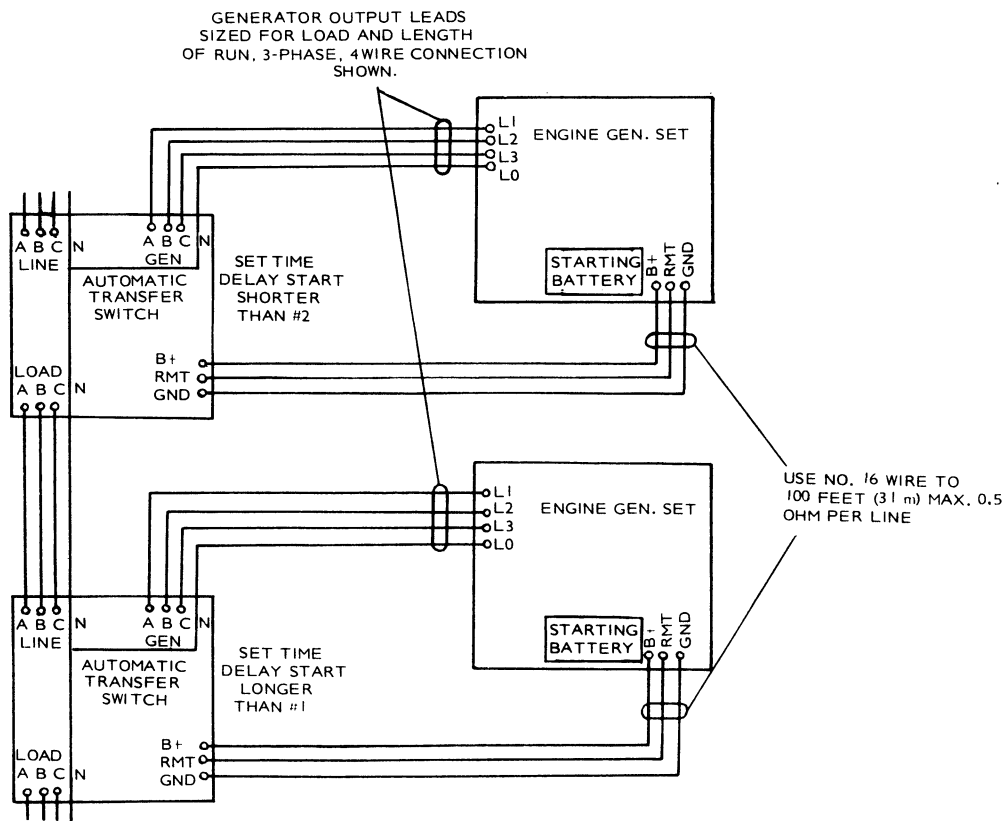


FIGURE 9. STANDBY TO STANDBY INSTALLATION

5. Two generator sets act as standby, one to the other, when an application requires absolute reliability of emergency power (Figure 9). Use number 16 wire for the DC engine control leads up to 100 feet or 31 metres (maximum of 0.5 ohm per line).

Set the start time delay longer on automatic transfer switch 2 as noted in Figure 9. See the *ADJUSTMENTS* section for changing the time delay setting.

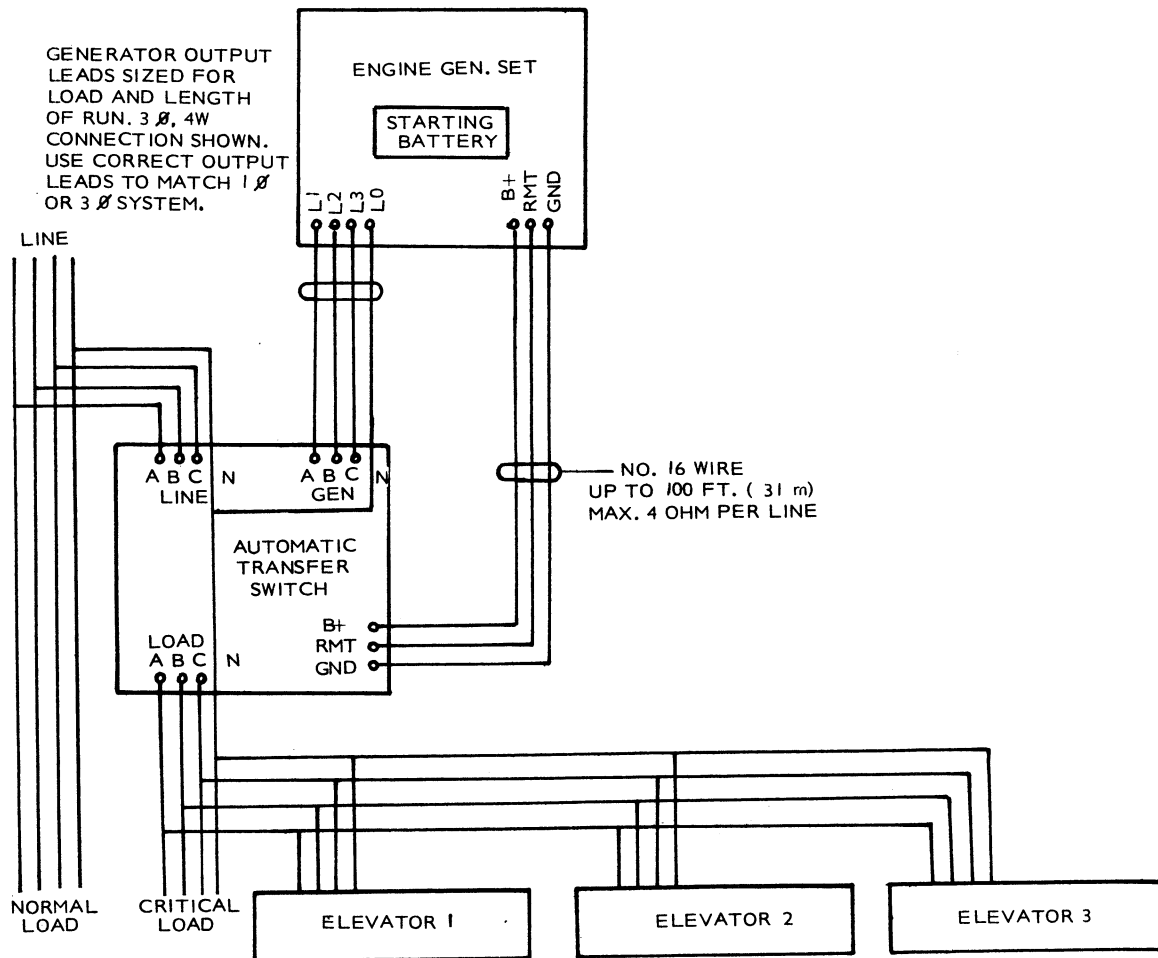


FIGURE 10. STANDBY PROTECTION OF ELEVATORS AND CRITICAL LOAD WITH ONE GENERATOR SET AND ONE "AT"

6. One generator set and one automatic transfer switch protect all elevators and critical load simultaneously. See Figure 10. Both the generator set and automatic transfer switch must be rated to carry the critical load and all elevators.

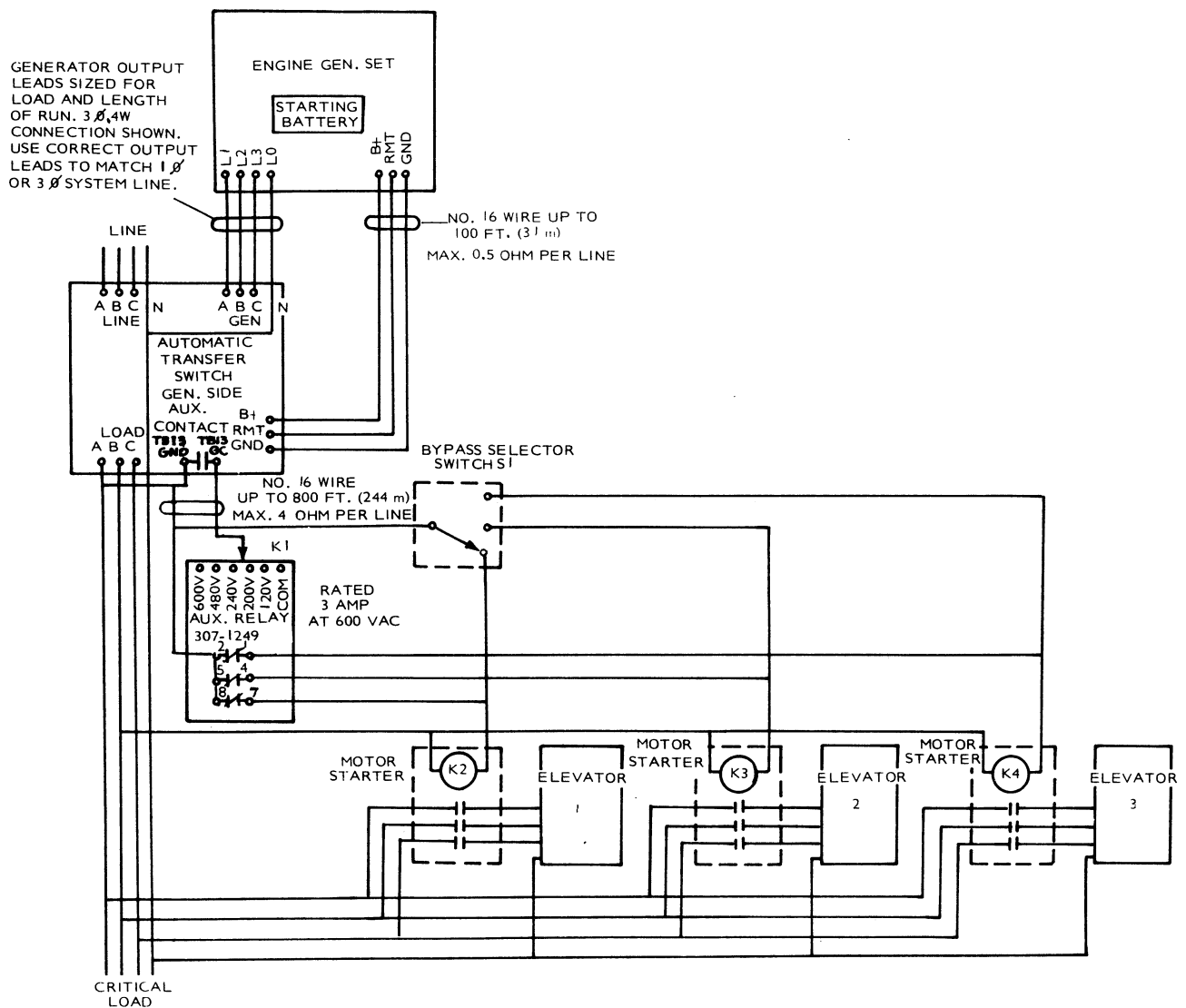


FIGURE 11. STANDBY PROTECTION OF ONE ELEVATOR AND CRITICAL LOAD WITH ONE GENERATOR SET AND ONE "AT"

7. One generator set and one automatic transfer switch protect only one elevator and the critical load (Figure 11). A selector switch is used to select which elevator will operate with standby power. While the generator set must have the rating to operate the critical load and one elevator, the automatic transfer switch must be rated to carry the critical load plus all the elevators.

Under normal conditions, the line supplies power to the load and all elevators. Relay K1 normally closed contacts bypass selector switch S1 to energize elevator starters K2, K3 and K4.

If a power outage occurs, the automatic transfer switch connects the load to the generator set. The auxiliary contact (on generator side) closes to energize relay K1. Relay contacts open to remove the bypass circuit around selector switch S1. Selector switch S1 selects the individual elevator to operate while the generator set supplies power to the loads.

Wiring Connections

1. *Transfer Switch Connections:* Connect wires of sufficient size to carry rated current from the line, load and generator set directly to the transfer switch terminals which are marked A, B, and C (use A and B for single phase). See Figures 12 and 13 for transfer switch connections. Table 1 gives the type and maximum wire size the transfer switch will accept.

TABLE 1. TRANSFER SWITCH WIRE CAPACITIES

TRANSFER SWITCH (AMPERES)		800, 1200	1750
TERMINAL LUGS Number of Conductors and Size per Pole	Switch Pole*	Four 2 to 600 MCM	Six 2 to 600 MCM
	Neutral Bar*	Four 2 to 600 MCM	Six 2 to 600 MCM

* Connectors will accept copper or aluminum conductors.

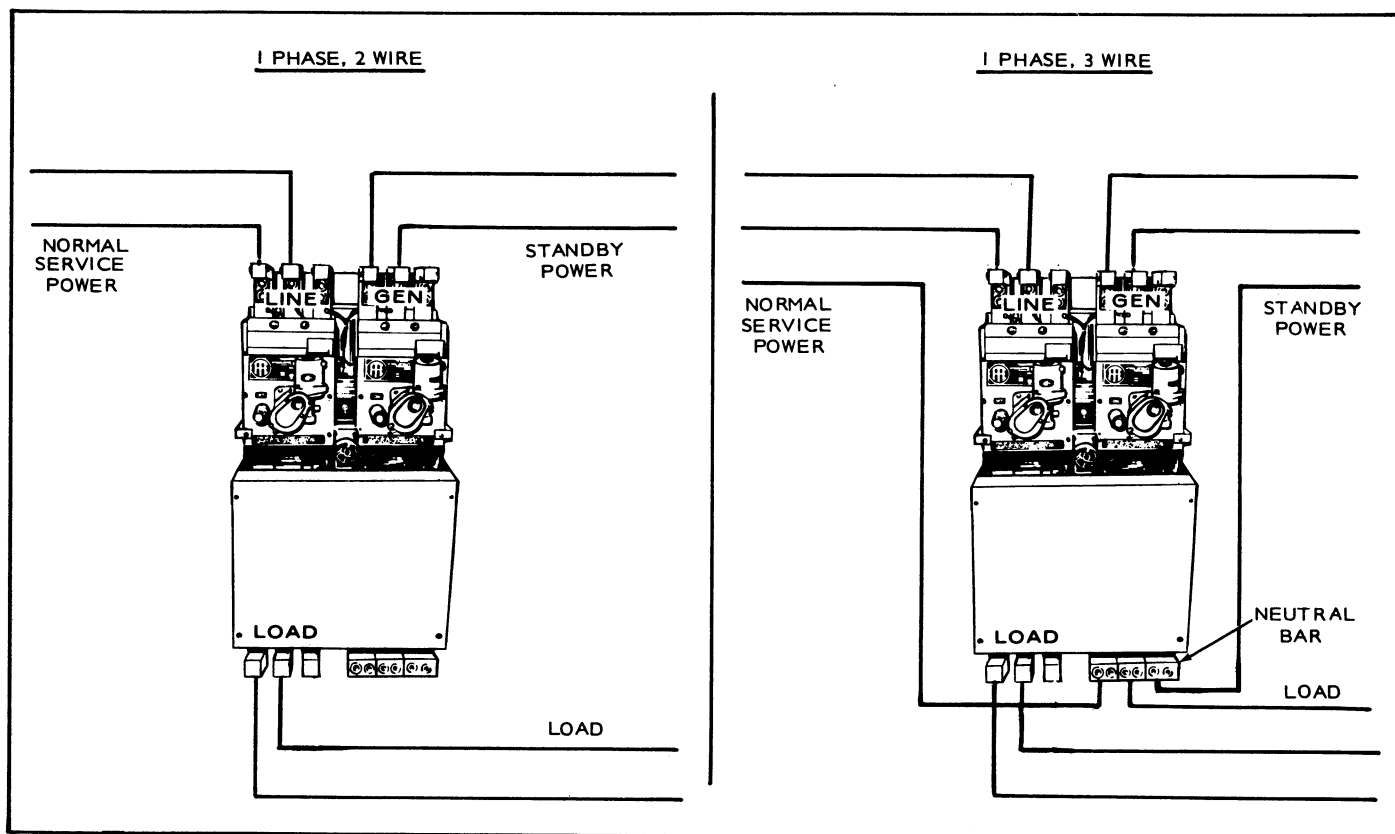


FIGURE 12. SINGLE-PHASE TRANSFER SWITCH CONNECTIONS

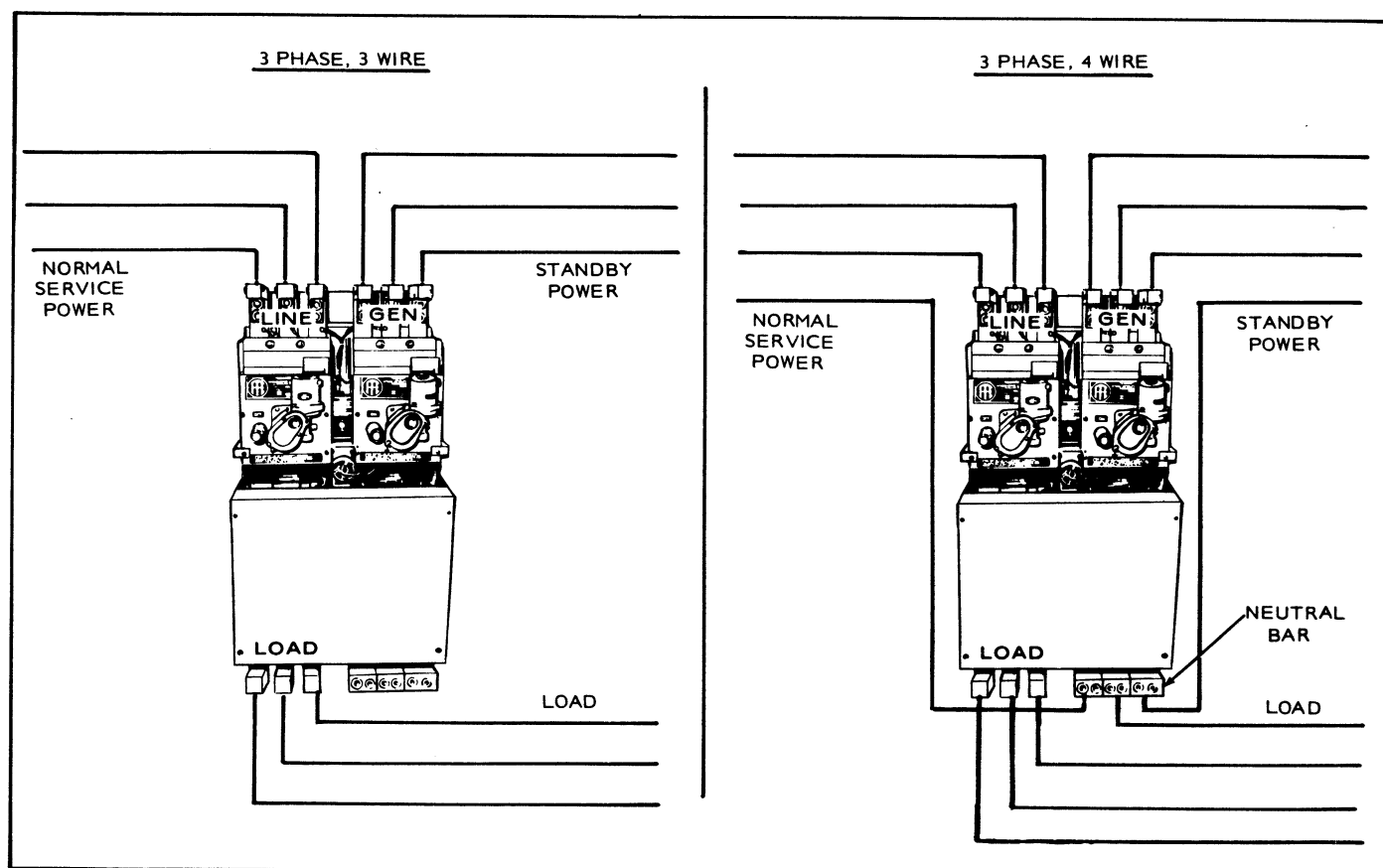


FIGURE 13. THREE-PHASE TRANSFER SWITCH CONNECTIONS

2. **DC Control Wires:** Connect the low voltage DC control wires from the automatic transfer switch terminal block TB1 to the generator set (Figure 14). Use number 16 wire up to 100 feet or 31 metres (maximum of 0.5 ohm per line).

When using conduit, run all low voltage DC control wires in separate conduit from AC wires, otherwise electrical induction can occur between the wires. Use flexible conduit at the generator set to prevent transmission of vibration (see Figure 1). If conduit is not used, a ground wire must interconnect the generator set, automatic transfer switch, switch and fuse boxes to the main entrance ground.

3. **Area Protection or Remote Test Switch (if used):**
 - a. Remove terminal jumper located between terminals 4 and 5 of terminal block TB1 (Figure 14).
 - b. Connect the two leads from the normally closed circuit of the area protection equipment or a single-pole, single-throw remote test switch to terminals TB1-4 and TB1-5. Use number 16 wire up to 800 feet or 244 metres (maximum of 4 ohms per line).
4. **Battery Voltage Alarm Circuit (if equipped):** For automatic transfer switches with a high battery voltage ("HI BAT VOLT") and low battery voltage ("LO BAT VOLT") lamp on the meter-lamp panel, there is a six-place terminal block TB2 for external circuit connections. The terminal block is located just above the TB1 terminal block used for remote connections. Connect the wire leads from

an external signal or alarm to terminal block TB2 as follows:

- a. High battery voltage alarm—normally open contacts connect to terminals 1 and 2, normally closed contacts connect to terminals 2 and 3.
 - b. Low battery voltage alarm—normally open contacts connect to terminals 4 and 5. Normally closed contacts connect to terminals 5 and 6.
5. **Auxiliary Contacts:** There is a 12-place terminal block TB13 (terminal points are marked) for connections to external alarms or control circuitry. Remove the six screws and cover from the transfer switch control (Figure 15). TB13 is located directly below the transfer switch motor mechanism. Rating of the auxiliary contacts is 15 amperes at 480 volts AC.
 - a. Line side—normally open contacts connect to terminals MC and MNO, normally closed contacts to terminals MC and MNC.
 - b. Generator side—normally open contacts connect to terminals GC and GNO, normally closed contacts connect to terminals GC and GNC.
 - c. Reinstall cover with six screws removed earlier.

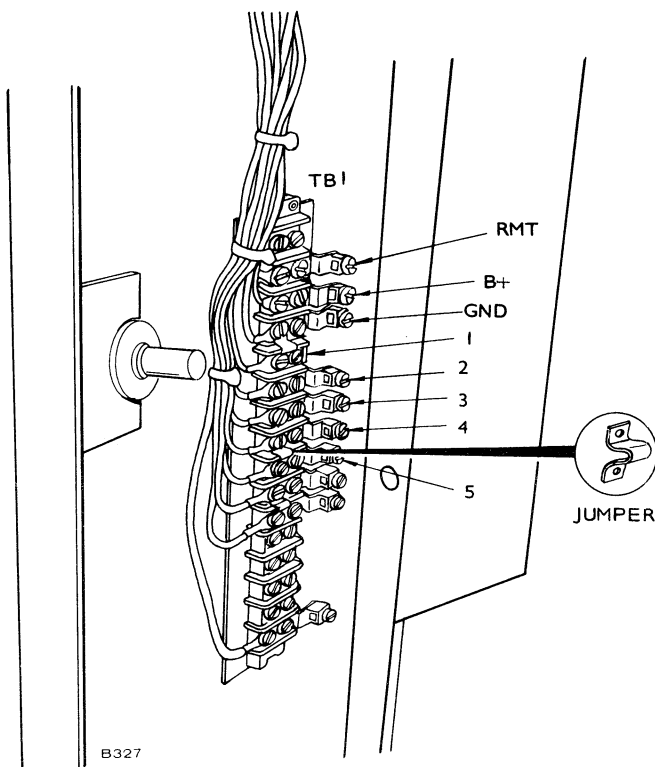


FIGURE 14. LOCATION OF TERMINAL BLOCK TB1

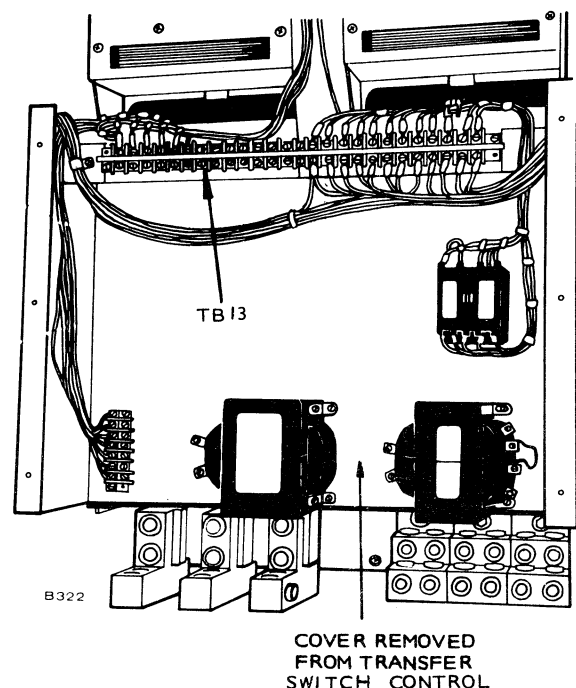


FIGURE 15. LOCATION OF TB13 FOR AUXILIARY CONTACTS CONNECTIONS

6. **Three-Phase Only:** Phase rotation must be checked and corrected before any load can be added to the generator set. Use the following procedures:
 - a. Connect an Onan load-test panel, phase rotation meter or three-phase motor to the transfer switch load terminals. Connect power to the line side (normal) of the transfer switch and observe rotation. If rotation is wrong, reverse any two main phase leads on the line side of the transfer switch.
 - b. Connect the battery and start the generator set. Check the phase rotation of the generator lead connections on the transfer switch. If this phase rotation is different from that of the power line, reverse two of the generator leads on the transfer switch.

CHECKOUT PROCEDURES AFTER INSTALLATION

After the generator set and automatic transfer switch are properly installed, check the various automatic transfer switch functions. Follow the appropriate checkout procedure for the automatic transfer switch, depending on whether it has a control accessory panel in groups 51 through 55 (relay groups) or in groups 11 through 15 (has solid-state, plug-in modules).

AT's With Control Accessory Groups 51 Through 55

Check Switch Positions:

1. Move the operation selector switch on the generator set to "STOP."
2. Move selector switch S2 on control accessory panel to "NORMAL."
3. Move test transfer switch S1 to "NORMAL."

Connect AC Line: Connect the AC normal line to the automatic transfer switch. The transfer switch should transfer the load to the line and light the green "NORMAL" lamp (if equipped with lamps).

Connect the Battery: Connect the starting batteries to the generator set observing correct polarity.

Test Overcrank Function:

1. Disconnect the positive lead from the starter (insulate lead so it can not touch metal frame).
2. Move the operation selector switch on the engine control to "RMT."
3. Move the test transfer switch to "TEST." "Fault" or "overcrank" lamp on engine control should light at the end of crank period (usually factory set at 75, \pm 15 seconds).
4. Move test transfer switch to "NORMAL."
5. Move the generator set operation selector switch to "STOP."

6. Reconnect positive lead to starter.
7. Move generator set operation selector switch to "RMT."

Starting Test:

1. Move selector switch on engine control to "RUN." Generator set should start and run.
2. Move selector switch to "RMT." Generator set should stop.

Test Transfer Without Load:

1. Move selector switch S2 to "TEST." Generator set should start and run.
2. Move selector switch back to "NORMAL." Generator set should stop.

Exercise Without Load (if equipped with exerciser):

1. Align day for exercise on spoked wheel with day pointer.
2. Turn the 24-hour dial clockwise until the pointer is between the two pins. The generator set should start and run, but not assume the load.
3. Turn the dial clockwise until the outside pin passes the pointer. The generator set should stop.
4. Reset the exerciser for the correct time and day (see *ADJUSTMENTS* section).

Test Transfer With Load:

1. Move test transfer switch S1 to "TEST." The generator set should start (after start time delay if used), run, take over the load, and light the red "EMERGENCY" lamp (if equipped with lamps).
2. Check operation of the AC meter(s) on the meter-lamp panel.
3. Move the test transfer switch to "NORMAL." The transfer switch should retransfer the load to the line and stop the engine (after duration of time delays if used).

AT's With Control Accessory Groups 11 Through 15

Check Switch Positions:

1. Move the operation selector switch on the generator set to "STOP."
2. Move selector switch to "WITHOUT LOAD."
3. Move test transfer switch to "NORMAL."

Connect AC Line: Connect the AC normal line service to the automatic transfer switch. The transfer switch should transfer the load to the line and should light the green "NORMAL" lamp (if equipped with lamps).

Connect the Battery: Charge ammeter should now indicate a charging current.

Test Overcrank Function:

1. Disconnect the positive lead from the starter (insulate lead so it can not touch metal frame).
2. Move the operation selector switch on the engine control to "RMT."
3. Move the test transfer switch to "TEST." "Fault" or "overcrank" lamp on engine control should light at the end of crank period (usually factory set at 75, \pm 15 seconds).
4. Move test transfer switch to "NORMAL."
5. Move the generator set operation selector switch to "STOP."
6. Reconnect positive lead to starter.
7. Move generator set operation selector switch to "RMT."

Starting Test:

1. Move selector switch on engine control to "RUN." Generator set should start and run.
2. Move selector switch to "RMT." Generator set should stop.

Test Transfer Without Load:

1. Make sure selector switch is positioned at "WITHOUT LOAD."
2. Move test transfer switch to "TEST." Generator set should start and run.
3. Move test transfer switch to "NORMAL." Generator set should stop.

Exercise Without Load (if equipped with exerciser):

- 1 Make sure selector switch is positioned at "WITHOUT LOAD."

2. Align day for exercise on spoked wheel with day pointer.
3. Turn the 24-hour dial clockwise until the pointer is between the two pins. The generator set should start and run, but not assume the load.
4. Turn the dial clockwise until the outside pin passes the pointer. The generator set should stop.
5. Reset the exerciser for the correct time and day (see *ADJUSTMENTS* section).

Test Transfer With Load:

1. Move selector switch to "WITH LOAD."
2. Move test transfer switch to "TEST." Generator set should start after start time delay, take over the load, and light the red "EMERGENCY" lamp (if equipped with lamps).
3. Check operation of the AC meter(s) on the meter-lamp panel.
4. Move the test transfer switch to "NORMAL." Transfer switch should retransfer the load to line and stop engine after duration of time delays.

Battery Voltage Lamps (if equipped):

1. Remove the battery charger module 6. Low battery lamp ("LO BAT VOLT") should light within 60 seconds.

The transfer switch line terminals must be energized and the battery must be connected to the automatic transfer switch.

2. Replace battery charger module 6. Low battery voltage lamp should go out within 60 seconds.

OPERATION

An Onan automatic transfer switch together with the standby generator set ensures a continuous supply of electrical power to the emergency lighting and power circuits. The automatic transfer switch performs these basic functions.

1. Senses the normal line power outage.
2. Starts the generator set.
3. Transfers the load to the generator set.
4. Senses return of normal power.
5. Retransfers the load to normal line power.
6. Stops the generator set.

WARNING

Always move the operation selector switch on the generator set to "STOP," disconnect the starting batteries of the generator set, and remove AC line power to the automatic transfer switch before performing maintenance or adjustments. Otherwise, the automatic transfer switch presents a serious shock hazard.

CABINET

Standard Onan automatic transfer switches have a floor standing, NEMA type 1 cabinet with two hinged front door(s). See Figure 16.

The black panel on the left side of the cabinet is the meter-lamp panel. The cabinet door opens to expose the transfer switch and black control accessory panel.

TRANSFER SWITCH

The transfer switch is mounted on the left side of the cabinet and does the actual transferring of the load to normal line power or standby generator set. The AC motor-operated switches, one on line side and one on generator side, are electrically operated to open or close. Each one is controlled by contact-making devices outside the switch and motor mechanism.

Designed for intermittent operation, the high torque operating motor reverses direction of rotation for closing and opening, and should not be put through more than ten complete closing and opening operations immediately following one another. The number of operations is not limited if the rate of operation is not greater than four per minute.

After the control contacts close, the switch motor is started and rotates the crank 180 degrees. A motor cut-off switch then opens the circuit to stop the motor and close a contact to rotate the crank another 180 degrees. This opens the switch when the opening control contact is made.

Manual Operation

1. Turn motor disconnect switch in the cabinet to off. See Figure 17.
2. Remove manual operator handle from storage position and push on shaft on side of transfer switch which is "ON."
3. Turn handle clockwise to "OFF" to open the transfer switch.

CAUTION

The transfer switch is mechanically interlocked. Be sure both sides of the transfer switch are open ("OFF") before a closure is attempted.

4. Push handle on shaft of transfer switch side to be closed.
5. Move handle counterclockwise to "ON" to close the transfer switch.
6. Return the transfer switch to original positions before moving motor disconnect switch back to "ON."

Auxiliary Transfer and Retransfer Time Delays

These time delays are mounted in the transfer switch control box. Adjustable from 1 to 300 seconds, the time delay assembly delays transfer of the load to the generator and retransfer of the load back to normal line (in addition to transfer and retransfer time delays, if used). Used with motor loads, it breaks power to the motor loads long enough, usually a few seconds, during transfer switch operation to permit motor residual voltages to decay before load connection to either normal line or the generator set. This avoids nuisance trips of overcurrent protection equipment, prevents damaged motors, couplings, or driven loads.

For description of other time delays, see "Control Accessory Panel."

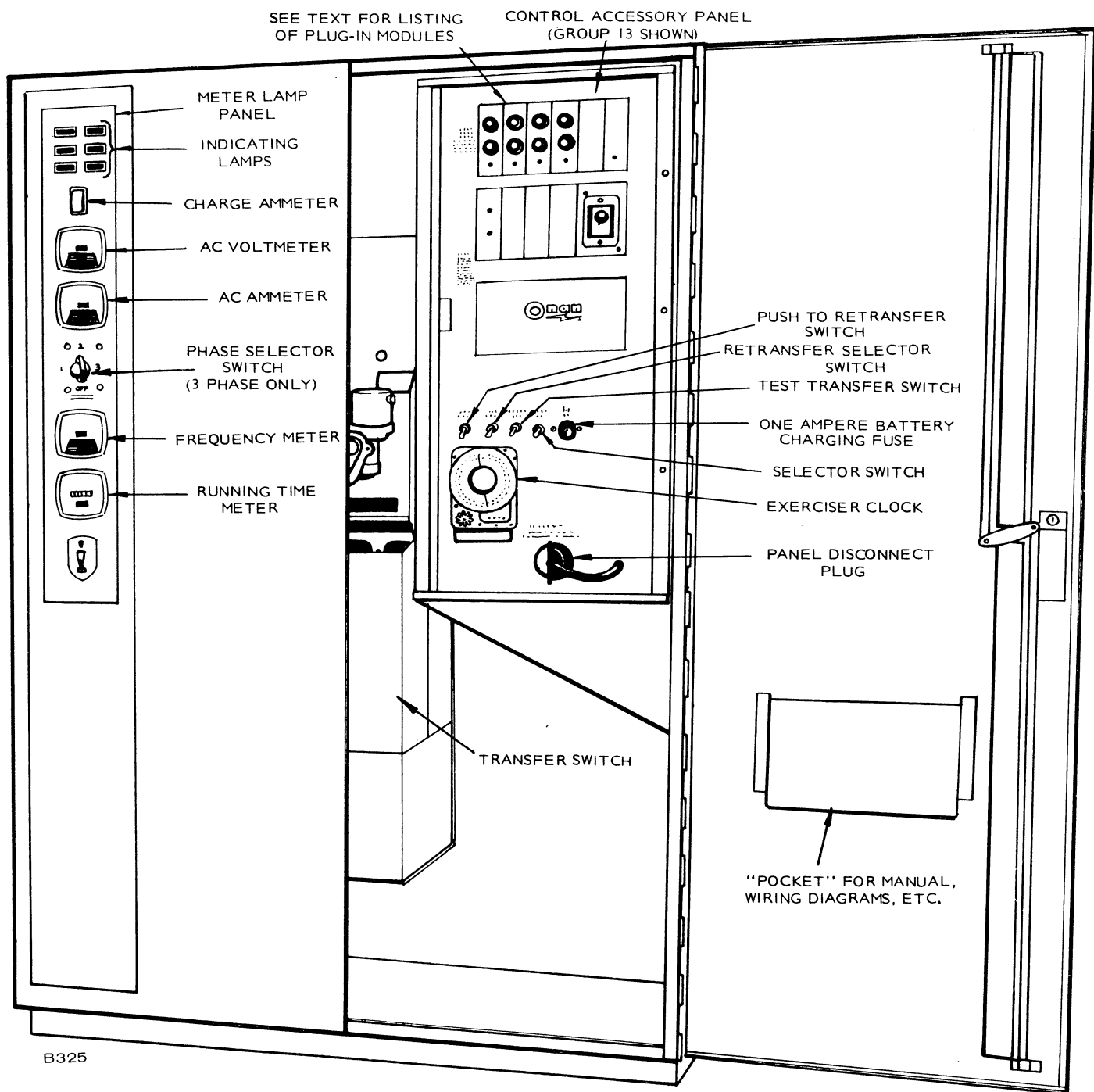


FIGURE 16. TYPICAL MODEL AUTOMATIC TRANSFER SWITCH

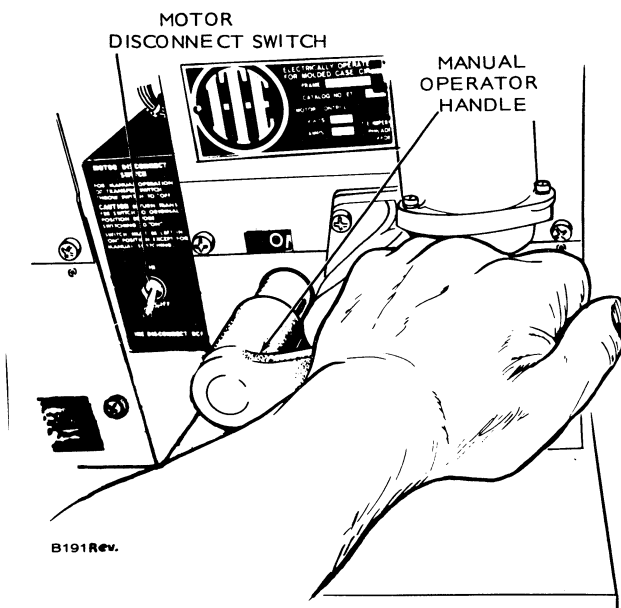


FIGURE 17. MANUAL OPERATION OF TRANSFER SWITCH

Auxiliary Contacts

These contacts, on line and generator side, can be connected to operate a pilot, signal or other special application circuit. They do not operate while the generator set is exercising unless it takes over the load (transfer switch operates). Rating of the contacts is 15 amperes at 480 volts AC.

METER-LAMP PANEL

The black meter-lamp panel on the left of the automatic transfer switch holds the combination of meters, selector switches, indicating lamps and step-down transformers that was specified for your automatic transfer switch (Figure 16). The meter-lamp combination of your automatic transfer switch determines which of these items is on the meter lamp panel. The following descriptions cover all the possible accessory items.

DC Charge Ammeter

The ammeter indicates the battery charge current rate (amperes) of the automatic transfer switch's float charger, if equipped. Battery float charging occurs only when the load is connected to commercial power.

AC Voltmeter, AC Ammeter, Frequency Meter, Running Time Meter

The voltmeter, ammeter and frequency meter indicate the voltage, amperage and frequency of the generator output. The running time meter indicates the total number of hours the generator set has operated. For three-phase operation, see "Voltmeter-Ammeter Selector Switch" for generator output voltage and ampere readings of each phase.

Voltmeter-Ammeter Selector Switch

This switch on the meter panel is normally at "OFF." It can be turned to "1", "2", or "3" for individual readings of line currents and line-to-line voltages of generator set output.

Indicating Lamps

Two battery voltage lamps used on some models indicate too high or too low battery float voltage. Lighting of the high battery voltage ("HI BAT VOLT") lamp during normal operation indicates the charging voltage has to be reduced. The low battery voltage ("LO BAT VOLT") lamp lights for a low voltage condition. Both lamps are energized by battery voltage sensor module 10.

The green "NORMAL" lamp lights and remains lit whenever the normal power source is supplying power to the load. During a power outage, the green normal lamp goes out. After the generator set assumes the load, the red "EMERGENCY" lamp lights. It remains lit as long as the generator set carries the load.

"Overcrank" lamp is on all automatic transfer switches, but nonfunctional for two-wire start generator sets.

CONTROL ACCESSORY PANEL

Series "AT" automatic transfer switches are equipped with either a modular type control accessory panel (groups 11 through 15, Figure 16) or a relay type control accessory panel (groups 51 through 55, Figure 18). See the appropriate description following.

Control Accessory Groups 51 Through 55

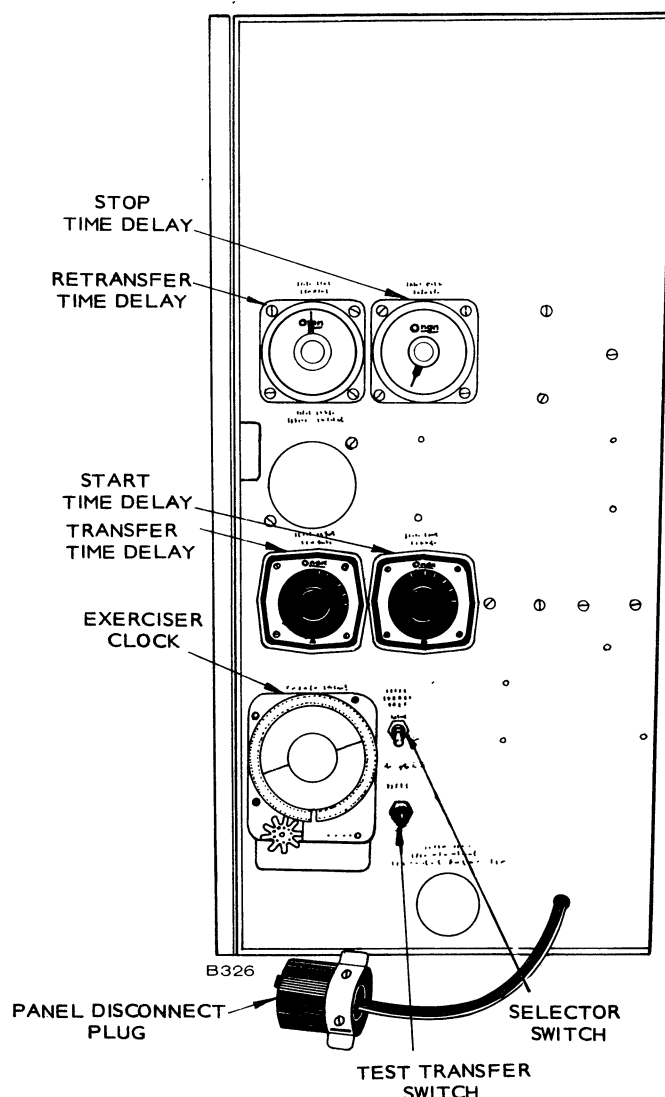
Before the control accessory panel is opened, move the operation selector switch to "STOP," and remove the control panel disconnect plug. It removes AC line voltage from the panel for safer service or maintenance when opened.

WARNING

If the operation selector switch is not moved to "STOP" before the disconnect plug is removed, the generator set will start and energize the transfer switch's generator side. Because the disconnect plug does not de-energize the transfer switch, the transfer switch presents a serious shock hazard unless AC power is removed from the automatic transfer switch.

Time Delays: A time delay is often required for one or more functions such as engine starting, transfer (load pickup), retransfer (load transfer to normal power source), and engine stopping. Table 2 gives the time ranges of the adjustable time delay relays, and the settings if factory set.

Time Delay on Starting: Delays generator set starting after a power outage. It prevents generator set operation during very short power outages.



**FIGURE 18. RELAY GROUP (55 SHOWN)
CONTROL ACCESSORY PANEL**

Time Delay on Transfer (load pickup): Delays the transfer of the load to the generator set to allow for engine warm-up.

Time Delay on Retransfer: Allows the generator set to run a few minutes under load before shutdown. This stabilizes engine temperature, reducing distortion and wear.

**TABLE 2. ADJUSTABLE, MOTOR-DRIVEN
TIME DELAYS**

TIME DELAY	TIME RANGE	SUGGESTED SETTING
Starting	1 to 300 sec.	1 to 3 sec.
Transfer	1 to 300 sec.	5 to 10 sec.
Retransfer	2 to 60 min.	15 to 30 min.
Stopping	2 to 60 min.	5 min.

Time Delay on Stopping (after retransfer): Allows the generator set to run for a few minutes under no load to cool down before shutdown.

Exerciser Clock: The exerciser clock automatically initiates starting of the generator set at regular intervals to run for preset time periods without load. If a power outage occurs while the generator set is exercising at no load, the automatic transfer switch will transfer the load to the generator set. After a power outage, reset the exerciser for correct time (exerciser operates only on normal power).

If the clock has not been previously set, see **ADJUSTMENTS** section. It will operate the generator set for any multiple of 15 minutes per day for as many days as desired. The clock has a 24-hour dial with the light half for day and the shaded half for night.

Onan recommends exercising the generator set for at least 30 minutes once each week. Running it for long periods each week is better than several short periods.

Selector Switch: Set at "NORMAL," the standby system is set for automatic operation (generator set starts if a power outage occurs). To check generator set operation without load, move the selector switch to "TEST." If you do not want the generator set to start if a power outage occurs, move the selector switch to "STOP."

WARNING Before performing maintenance or adjustments of the generator set, place the selector switches in the automatic transfer switch and on the engine control to "STOP," and disconnect the starting battery. Otherwise the standby system presents a serious injury hazard.

Test Transfer Switch: Set at "NORMAL," the standby system is set for automatic operation (generator set starts if a power outage occurs). To simulate a power outage, move the switch to "TEST." The generator set should start, run, and assume the emergency load.

Control Accessory Groups 11 Through 15

The control accessory panel holds the battery charger, switches, battery charger fuse, voltage sensors, time delays, etc. See Figure 16.

Before the control accessory panel is opened: (1) The operation selector switch must be moved to "STOP", and (2) the control accessory panel disconnect plug must be removed. It removes AC line voltage from the control panel for safer service or maintenance when opened.

WARNING If the operation selector switch is not moved to "STOP" before the disconnect plug is removed, the generator set will start and energize the transfer switch's generator side. Because the disconnect plug does not de-energize the transfer switch, the transfer switch presents a serious shock hazard unless AC power is removed from the automatic transfer switch.

The control accessory panel has three printed circuit board racks with positions "1" through "18" for plug-in modules. All the following modules used in

automatic transfer switches are listed after the number position they occupy in the control panel. Note that some positions list more than one module. If the automatic transfer switch is single-phase, for example, only one line undervoltage sensor is used and it is located in position "1." Positions "2" and "3" will have blank modules.

Position	Module
1	Line undervoltage sensor (1 Ø or 3 Ø)
2	Line undervoltage sensor (3 Ø), bypass or blank
3	Line undervoltage sensor (3 Ø), bypass or blank
4	Generator undervoltage sensor
5	12 volt module, or 24 to 12 volt converter
6	12 or 24 volt battery charger (2 ampere)
7	12 or 24 volt start-stop time delay
8	Transfer time delay or bypass
9	Blank
10	12 or 24 volt battery voltage sensor or blank
11 & 12	Retransfer time delay or two blanks
13	Line overvoltage sensor (1 Ø or 3 Ø) or blank
14	Line overvoltage sensor (3 Ø) or blank
15	Line overvoltage sensor (3 Ø) or blank
16	Blank
17	Blank
18	Blank

AC Voltage Sensors: Voltage sensors can be used for undervoltage or overvoltage sensing for line or generator power. Both the pickup and dropout voltages are adjustable. In undervoltage application, sensing is across the line. When line voltage falls to a dropout point, a relay de-energizes to start the generator set and transfer the load to the emergency power source. When line voltage returns to the preset pickup voltage, the relay initiates load return to the normal power source.

Overvoltage is much the same, only when the normal service voltage becomes excessively high, a relay is energized to initiate load transfer to the standby generator set. When the normal power source's voltage returns to normal, the relay is de-energized and initiates load retransfer to the normal source.

The voltage sensor for the generator connects across two generator output lines. It monitors generator voltage and signals the automatic transfer switch to transfer the load to the generator set.

TABLE 3. ADJUSTABLE VOLTAGE SENSORS

	UNIT STARTS (line dropout voltage)	UNIT STOPS (line pickup voltage)
Undervoltage Sensor	5% to 20% below pickup voltage setting	75% to 100% of normal voltage
Overvoltage Sensor	101% to 116% of normal voltage	5% to 20% below pickup voltage setting

Table 3 gives the ranges in percentages for the adjustable voltage sensors. Adjustments should be performed by qualified personnel only.

Time Delays: A time delay is often required for one or more functions such as engine starting, transfer (load pickup), retransfer (load transfer to the normal power source), and engine stopping. Table 4 gives the time ranges of the adjustable time delays and the settings, if factory set.

Time Delay on Starting: Delays generator set starting after a power outage. It prevents generator set operation during very short power outages.

Time Delay on Transfer (load pickup): Delays the transfer of the load to the generator set to allow for engine warm-up.

Time Delay on Retransfer: Allows the generator set to run for a few minutes under load before shutdown. This stabilizes engine temperature, reducing distortion and wear. The time delay is an adjustable motor timer and can be set from 0 to 30 minutes (to 36 minutes for 50 hertz). The motor timer has one light: "POWER ON" which indicates the normal power source. It has a red dial pointer to indicate time remaining before transfer.

If automatic transfer switch will not retransfer load to normal line, check one-ampere battery charging fuse and replace if necessary.

Time Delay on Stopping (after retransfer): Allows the generator set to run for a few minutes under no load to cool down before shutdown.

TABLE 4. ADJUSTABLE TIME DELAYS

TIME DELAY	TIME RANGE	FACTORY SETTING (if any)
Starting	0.5 to 10 sec.	2 sec.
Transfer	0.5 to 10 sec.	2.5 sec.
Retransfer	0 to 30 min.	—
Stopping	0.5 to 5 min.	5.0 min.

Battery Voltage Sensor: The battery voltage sensor, available in either a 12-volt or 24-volt version, is a plug-in module with two relays mounted on the printed circuit board. The battery voltage sensor module 10 monitors the battery charging system. If the battery charger is exceeding a safe float voltage, it lights the high battery voltage ("HI BAT VOLT") lamp. If the battery float charger fails to charge, the sensor lights the low battery voltage ("LO BAT VOLT") lamp.

Battery Charger: The solid state battery charger has a maximum two-ampere output and is voltage regulated to "float charge" the battery continuously without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery (keeping starting batteries fully charged). The battery charger can be used for either lead acid or nickel cadmium batteries.

The battery charger circuit is protected by a one-ampere fuse. If the battery charger fails to charge, be sure to check the fuse.

Exerciser Clock: The exerciser clock automatically initiates starting of the generator set at regular intervals and allows it to run for preset time periods. Whether the generator set exercises with or without load depends on the position of the selector switch (at "WITH LOAD" or "WITHOUT LOAD"). If a power outage occurs while the generator set is exercising at no load, the automatic transfer switch will transfer the load to the generator set. After a power outage, reset the exerciser for correct time (exerciser operates only on normal power).

If the clock has not been previously set, see *ADJUSTMENTS* section. It will operate the generator set for any multiple of 15 minutes per day for as many days as desired. The clock has a 24-hour dial with the light half for day and the shaded half for night.

Onan recommends exercising the generator set for at least 30 minutes once each week. Running it for long periods each week is better than several short periods.

If exerciser clock does not operate, check the one-ampere battery charging fuse and replace if necessary.

Selector Switch: This switch is set at "WITH LOAD" if the generator set is to carry the load during test or exercise periods. Set at "WITHOUT LOAD," the generator set starts but does not assume the load.

Test Transfer Switch: Set at "NORMAL," the standby system is set for automatic operation (generator set starts if a power outage occurs). To simulate a power outage, move the switch to "TEST." The generator set should start and run.

Retransfer Selector Switch: Positioned at "AUTO," the load will automatically be retransferred back to commercial power from the generator set. If it is set at "MANUAL," the load will not be transferred back to the normal line source until the push to retransfer switch is pressed.

Push to Retransfer Switch: This switch is used for installations which require the generator set to supply power until retransfer is manually initiated after normal power returns.

ADJUSTMENTS

LATCH AND LATCH PIN ADJUSTMENT

If the control accessory panel will not close because the latch is above or below the latch pin, perform the following.

1. Open right cabinet door of automatic transfer switch.
2. Move operation selector switch on engine control to "STOP" and disconnect starting battery.
3. Remove AC line voltage from the automatic transfer switch.

WARNING

Be sure to remove AC line voltage from the automatic transfer switch. Otherwise, the transfer switch has high voltages and presents a serious shock hazard.

4. Remove the twist-lock disconnect plug.
5. Completely open the control accessory panel.
6. Loosen the latch pin on the left side of the control cabinet, and move the latch pin up or down in the

slot as necessary (Figure 19). Then tighten.

7. Close the control accessory panel. If more adjustment is necessary, repeat Steps 5 and 6.
8. Reconnect the twist-lock disconnect plug.
9. Restore AC line voltage to the automatic transfer switch.
10. Move operation selector switch on engine control to "RMT."
11. Reconnect starting battery.
12. Close cabinet door.

EXERCISER CLOCK

1. Open the right cabinet door of the automatic transfer switch.
2. Move the operation selector switch on engine control to "STOP."
3. Install a trip pin (left-hand thread) in the inside row of holes on the large dial for the time of day you want the generator set to start. See Figure 20.

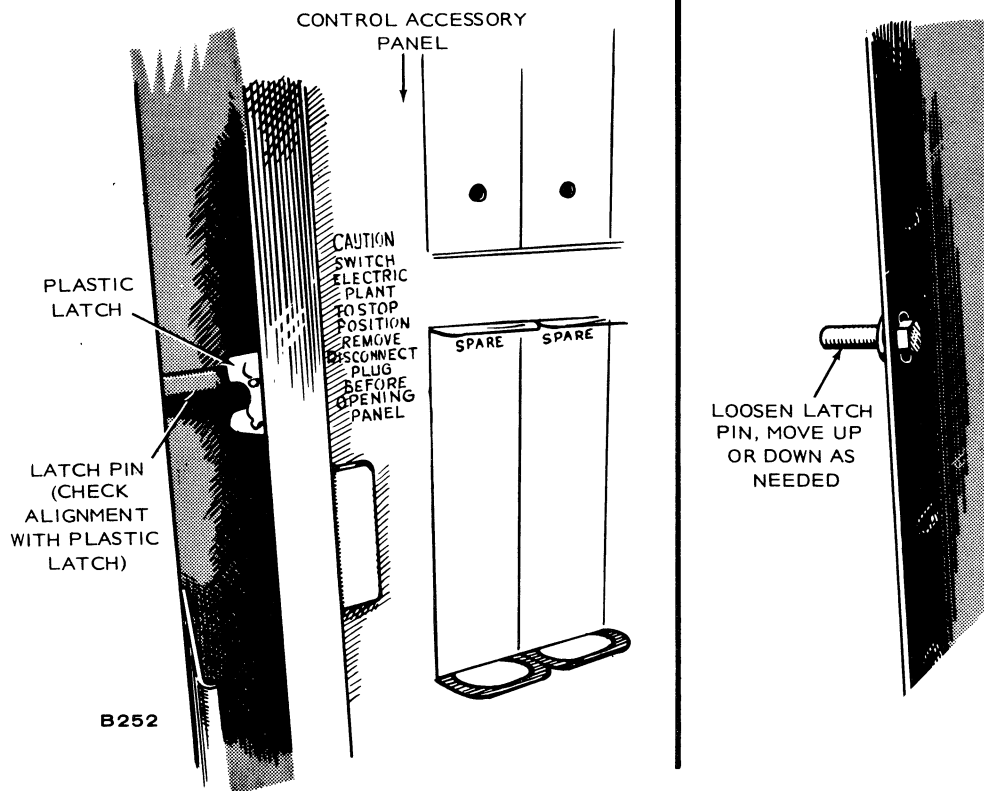


FIGURE 19. ADJUSTMENT OF LATCH PIN

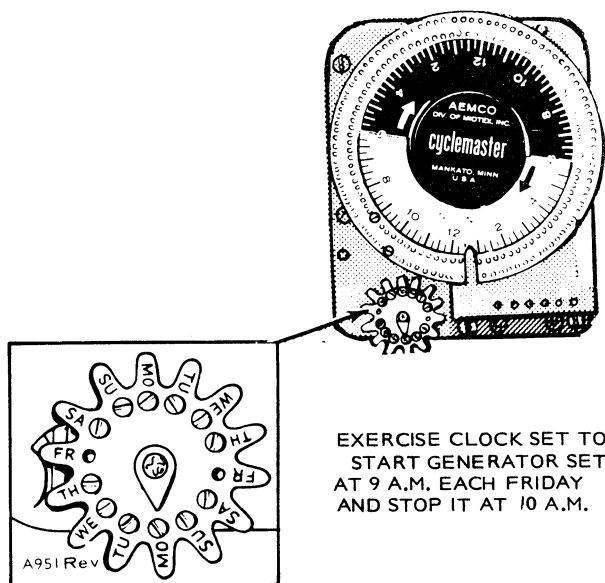


FIGURE 20. EXERCISER CLOCK

4. Place a trip pin in the outside row of holes on the large dial to stop the generator set.

Onan recommends settings which operate the generator set for at least 30 minutes each week. Exercising for one long period is better than several short periods.

5. Install a trip pin in the small spoked wheel for every day *no exercise* is desired.
6. Rotate the large dial clockwise until the correct time is correctly aligned with the time pointer.
7. Align the small spoked wheel with the correct day at its pointer.

Sixteen trip pins are supplied with the clock. Store unused pins on the time pointer bracket.

8. Move the operation selector switch on engine control to "RMT."
9. Close the cabinet door.

TIME DELAYS

For adjustments of the auxiliary transfer and retransfer time delay assembly, see the following instructions. For the other time delays, follow instructions under Control Accessory Groups 51 Through 55 for the relay-type panels, Control Accessory Groups 11 Through 15 for the modular-type panel.

Auxiliary Transfer and Retransfer Time Delay Assembly

Both auxiliary transfer and retransfer time delays can provide 1 to 300 seconds of no power to loads during transfer or retransfer of transfer switch operation. For adjustment of either time delay, use the following procedure.

1. Move the operation selector switch on engine

control to "STOP" and disconnect starting battery.

2. Remove AC line power to the automatic transfer switch.

WARNING

Be sure to move the operation selector switch to "STOP," disconnect starting battery, and remove AC line power before attempting adjustments. Otherwise, the automatic transfer switch presents a serious shock hazard.

3. Open both cabinet doors of automatic transfer switch.
4. Remove the six screws, control cover and terminal guard from the transfer switch control box (located just below transfer switch motors).
5. Locate the time delay assembly below the transfer switch on rear panel of cabinet. Transfer time delay K11 (for line side) is located on the left, time delay K12 (for generator side) is on the right.
6. Adjust the time delay.
7. Reinstall the transfer switch control box cover and terminal guard with the six screws removed in Step 4.
8. Close cabinet doors.
9. Restore AC line voltage to automatic transfer switch.
10. Reconnect starting battery.
11. Move the operation selector switch on engine control to "RMT."

Control Accessory Groups 51 Through 55

Start and Transfer Time Delays: Both of these motor-driven time delays require the same adjustment procedures. Settings can range from 1 to 300 seconds (*OPERATION* section lists suggested settings). To make settings, perform the following.

1. Open the right cabinet door of the automatic transfer switch.
2. Turn the knob on the time delay clockwise to increase delay time, counterclockwise to decrease the delay time. See Figure 21.
3. Close the cabinet door.

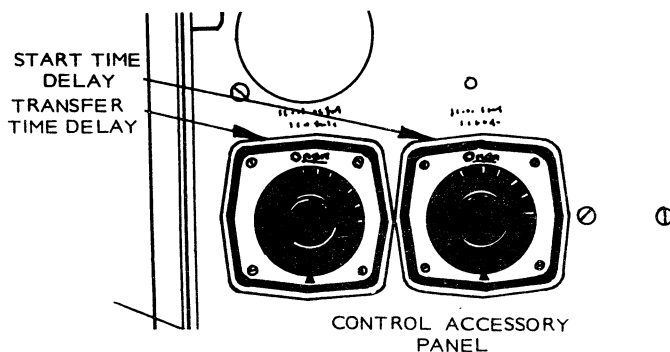


FIGURE 21. START AND TRANSFER TIME DELAY RELAYS

Stop and Retransfer Time Delays: Both of these synchronous motor-driven time delays require the same adjustment procedure. Settings can range from 2 to 60 minutes (*OPERATION* section lists suggested settings). To make settings, perform the following.

1. Open the cabinet door of the automatic transfer switch.
2. Set the time delay by turning the adjustment knob in the center of the delay. See Figure 22.

The black pointer on the face of the time delay indicates the preset delay. The red pointer indicates the delay time left in operation.

3. Close the cabinet door.

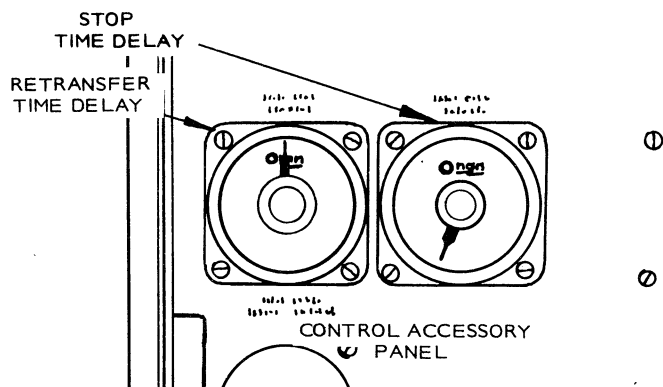


FIGURE 22. STOP AND RETRANSFER TIME DELAY RELAYS

Control Accessory Groups 11 Through 15

Start-Stop Time Delay: Time delay for start is factory adjusted for 2 to 3 seconds. Time delay on stop is factory adjusted for 4.5 to 5 minutes. If other times are desired, use the following procedure.

1. Open the right cabinet door of automatic transfer switch.
2. Move selector switch to "WITH LOAD."
3. Move test transfer switch to "TEST."
4. With a stop watch or watch with a second hand, measure the time until the generator set starts cranking.
5. Insert a small screwdriver through "START" hole in front panel of start-stop time delay module 7. Turn "START" potentiometer clockwise to increase start time delay or counterclockwise to decrease start time delay. Make adjustments in small increments.
6. Move test transfer switch to "NORMAL."
7. Measure time until generator set begins to shut down.
8. Turn "STOP" potentiometer with the small screwdriver clockwise to increase the stop time delay or counterclockwise to decrease the stop time

delay. Make adjustments in small increments.

9. Repeat Steps 2 through 8 until desired delay times are obtained.
10. Move selector switch to desired position, "WITHOUT LOAD" or "WITH LOAD."
11. Close cabinet door.

Transfer Time Delay: For adjustment or change of the time delay for transfer (transfer of the load to the generator set) from the standard setting, two to three seconds, use the following procedure.

1. Open right cabinet door of automatic transfer switch.
2. Move operation selector switch on engine control to "STOP."
3. Move selector switch to "WITH LOAD."
4. Remove the twist-lock disconnect plug.
5. Open the control accessory panel.
6. Locate generator interposing relay K4 (Figure 23).
7. Reconnect the twist-lock disconnect plug with the control accessory panel open.

WARNING

Rear of the control accessory panel and transfer switch are energized. Do not touch due to shock hazard!

8. Move operation selector switch to "RMT."
9. Move test transfer switch to "TEST." Generator set will start and run.
10. With a stopwatch or watch with a second hand, measure time from instant generator set reaches full speed until relay K4 contacts close. If time delay is correct or time you desire, proceed to Step 14. If not, proceed to Step 11.
11. Insert a small screwdriver through hole in front panel of transfer time delay module 8. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease the time delay.
12. Move the test transfer switch to "NORMAL" to stop the generator set.
13. Repeat Steps 9 through 12 until the desired time delay is obtained.
14. Move the test transfer switch to "NORMAL."
15. Move operation selector switch to "STOP."
16. Remove the disconnect plug and close the control accessory panel.
17. Reconnect the disconnect plug.
18. Move the operation selector switch to "RMT."
19. Return selector switch to desired position, "WITHOUT LOAD" or "WITH LOAD."
20. Close cabinet door.

Retransfer Time Delay: The retransfer time delay can be used to provide 0 to 30 minutes (36 minutes for 50 hertz) time delay on retransfer (retransfer of load to commercial power line). See the *OPERATION* section for operation description.

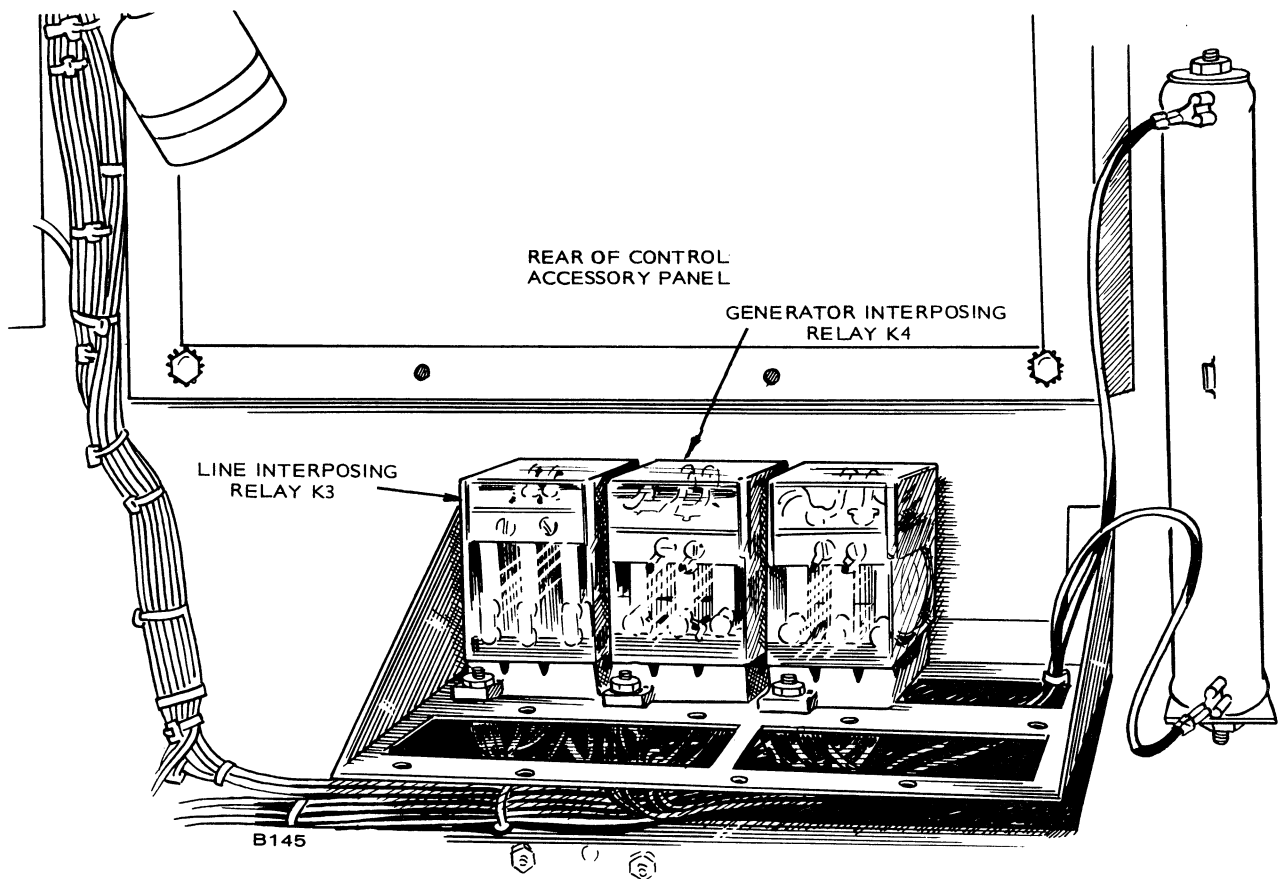


FIGURE 23. LOCATION OF INTERPOSING RELAYS

Shown in Figure 24 is the retransfer time delay with one lamp ("POWER ON") and a time adjustment knob. The adjustment knob has a black pointer and a red time-remaining indicator pointer. Turn the adjustment knob clockwise until the black pointer aligns with the desired time delay.

BATTERY FLOAT CHARGE

For the following adjustments, a fully-charged battery, a hydrometer and an accurate voltmeter (1/2 percent accuracy) are needed. Onan recommends float voltages of: 13.3 volts for nominal 12-volt or 26.6 volts for nominal 24-volt lead-acid batteries; 13.8 to 14.5 volts for 10-cell nickel-cadmium batteries, or 27.6 to 29.0 volts for 20-cell nickel-cadmium batteries.

During the first few weeks of operation, the batteries should be checked periodically with a hydrometer. A high specific gravity, bubbling of electrolyte and loss of water indicate excessive float voltage. A drop in specific gravity indicates insufficient float voltage.

1. Connect the fully-charged battery (verify charge condition with the hydrometer).
2. Connect the voltmeter directly to the battery terminals.

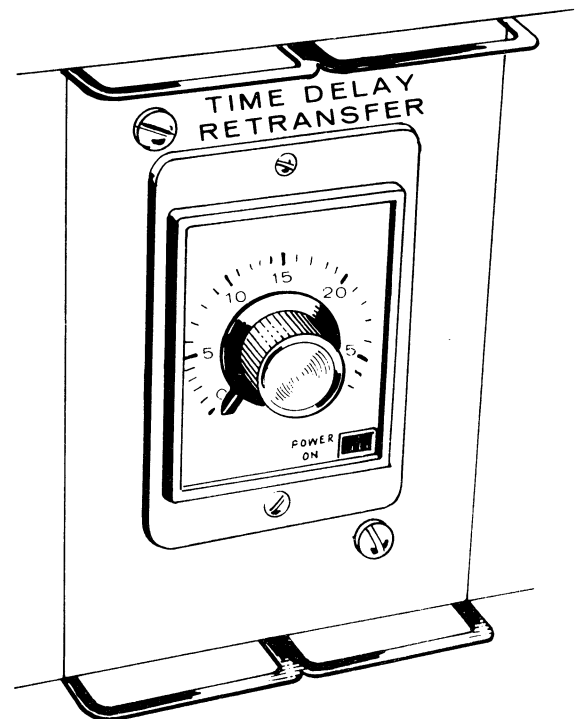


FIGURE 24. RETRANSFER TIME DELAY

3. Measure the battery voltage. If voltage is above the recommended float voltage, proceed to Step 4.
4. If the voltage is below the recommended float voltage, proceed to Step 7.
4. Open right cabinet door of automatic transfer switch.
5. Insert a small screwdriver through the hole in the front panel of battery charger module 6. Turn counterclockwise in small increments to decrease the float voltage.
6. After five minutes, measure the battery terminal voltage again. If voltage is still high, repeat Steps 5 and 6 until voltage stabilizes at the recommended float voltage. Proceed to Step 11.
7. Open right cabinet door of automatic transfer switch.
8. Note charge current rate on charge ammeter on meter-lamp panel.
9. Insert a small screwdriver through hole in front panel of battery charger module 6. Turn clockwise in small increments to increase float voltage. Note increase in the charging current on the charge ammeter on the meter-lamp panel.
10. In approximately one hour or when charge current has decreased to initial value noted in Step 8, recheck battery terminal voltage. Repeat Steps 8 through 10 until the battery terminal voltage stabilizes at the recommended float voltage.
11. Check the battery with a hydrometer and check the battery terminal voltage periodically during the first few weeks of operation. Readjust the float charge rate if necessary.
12. Close the cabinet door.

AC VOLTAGE SENSORS

Voltage sensors perform either undervoltage or overvoltage sensing for line or generator power. Range of the settings is from 90 to 140 volts for a nominal 120-volt system. For higher voltage systems, the knob ("PICK-UP VOLTAGE") readings are multiplied by the following multiplying factors.

VOLTAGE	MULTIPLYING FACTOR
120	1.0
208	1.73
240	2.0
480	4.0
600	5.0

If you wish to check the calibration of the sensors before making the settings, see "*Undervoltage Sensor Calibration*" or "*Overvoltage Sensor Calibration*," whichever applies. Otherwise, see "*Undervoltage Sensor Settings*" or "*Overvoltage Sensor Settings*." Refer to Figure 25.

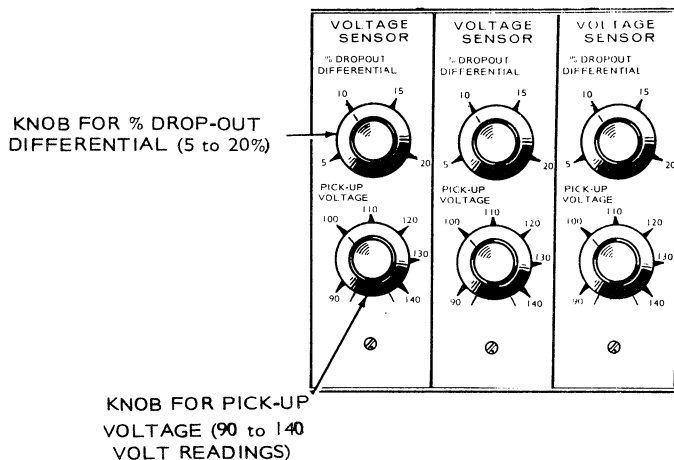


FIGURE 25. VOLTAGE SENSORS

Undervoltage Sensor Calibration

1. Open the right cabinet door of the automatic transfer switch.
2. Move the operation selector switch on engine control to "STOP."
3. Turn all the undervoltage sensor knobs to minimum voltage setting.
4. Turn the "PICK-UP VOLTAGE" knob of the sensor to be calibrated to its clockwise limit.
5. Turn the "PICK-UP VOLTAGE" knob very slowly counterclockwise until you hear relay K3 pick up. This reading times the multiplying factor (for your system voltage) should equal the line voltage. Check line voltage with a voltmeter, divide by the factor to see if the reading is correct. If it is, proceed to Step 7. If not, proceed to Step 6.
6. *Setting Too Low:* (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit, then counterclockwise to desired setting. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn counterclockwise very slowly until you hear relay K3 pick up.
Setting Too High: (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn to its clockwise limit. (c) Turn the "PICK-UP VOLTAGE" knob to desired setting. (d) Turn the "CALIBRATE" adjustment counterclockwise very slowly until you hear relay K3 pick up.
7. Repeat Steps 3 through 6 for each undervoltage sensor. If these calibrations are satisfactory for your application, make the sensor settings. See "*Undervoltage Sensor Settings*" (near end of section).
8. For a more accurate calibration and calibration of the "% DROP-OUT DIFFERENTIAL" knob, use the Onan Multi-Tester or a variac and use the following procedure.

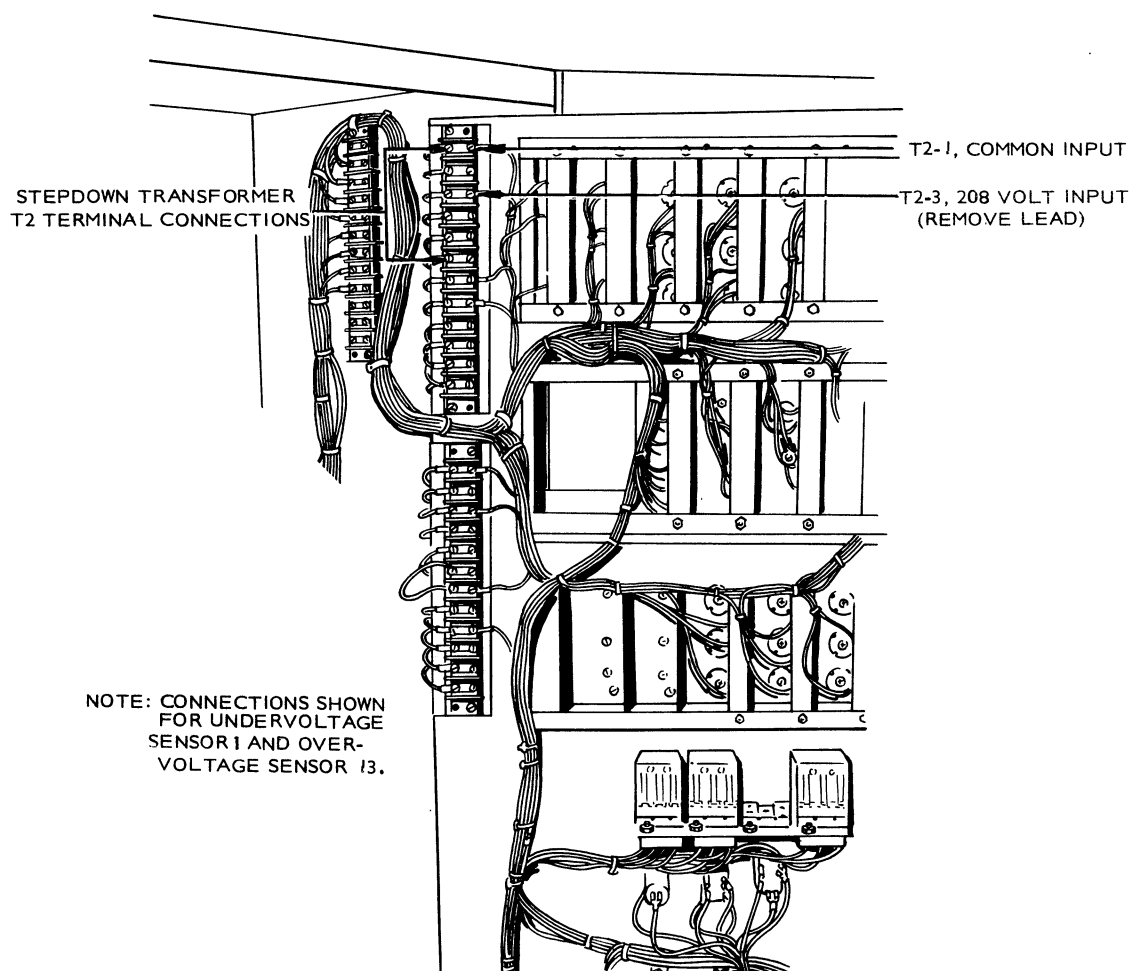


FIGURE 26. VOLTAGE SENSOR TRANSFORMER CONNECTIONS

9. Remove the twist-lock disconnect plug.
10. Open the control accessory panel.
11. Remove the plastic cover over the stepdown transformer terminals and remove the hot wire lead from the stepdown transformer's right side terminal of the terminal strip for the respective sensor. For example, if the nominal voltage is 208 volts, remove the wire lead from T2-3 for sensor 1. Do *not* remove the common (com) lead. See Figure 26.
12. If available, connect an Onan Multi-Tester to the transformer terminal strip and to the wire lead removed in Step 11 (using the instructions with the Multi-Tester). If using a variac, connect its common output lead to transformer T2-1 (com) and its other output lead to transformer terminal 2 (120-volt connection). See Figure 27.
13. Connect a voltmeter to the output leads of the variac.

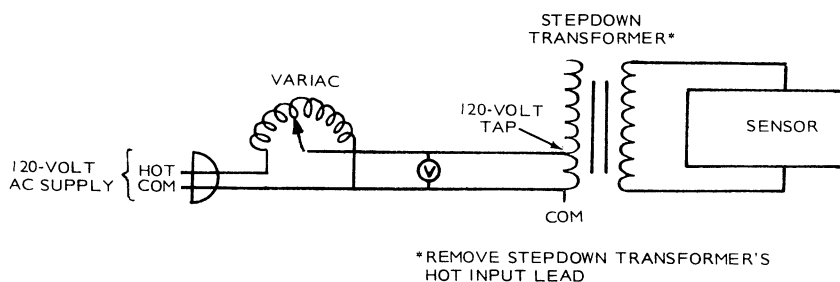


FIGURE 27. CONNECTION OF VARIAC TO STEPDOWN TRANSFORMER

14. Connect the variac input to a 120-volt AC source. Be absolutely sure the common from the transformer through the variac will be connected to the common of the line.



Common must connect to common of AC line. Otherwise, equipment damage can result.

15. Reconnect the disconnect plug.



Rear of control accessory panel is now energized and presents a serious shock hazard!

16. Turn all the undervoltage sensor knobs to minimum.
17. Adjust the Multi-Tester or variac to give a 120-volt output for the undervoltage sensor module.
18. Turn the "PICK-UP VOLTAGE" knob on the sensor to be calibrated to its clockwise limit.
19. Turn the knob very slowly counterclockwise until you hear relay K3 pick up. The knob should indicate 120 volts. If not, proceed to Step 20. If it does read 120 volts, proceed to Step 21.
20. *Setting Too Low:* (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit, then counterclockwise to desired setting. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn counterclockwise very slowly until you hear relay K3 pick up.
- Setting Too High:* (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn to its clockwise limit. (c) Turn the "PICK-UP VOLTAGE" knob to desired setting. (d) Turn the "CALIBRATE" adjustment counterclockwise very slowly until you hear relay K3 pick up.
21. With sensor module "PICK-UP VOLTAGE" knob at 120 volts and "% DROP-OUT DIFFERENTIAL" knob at maximum, lower the AC output voltage from the Multi-Tester or variac until the voltmeter reads 108 volts.
22. Turn "% DROP-OUT DIFFERENTIAL" knob counterclockwise until you hear relay K3 drop out. The knob should read approximately 10 (90 percent of 120 volts = 108 volts). If not, use a small screwdriver to loosen the knob and reposition so it indicates 10 percent.
23. Set the "PICK-UP VOLTAGE" and "% DROP-OUT DIFFERENTIAL" knobs at desired settings.
24. Decrease the voltage with the Multi-Tester or variac until you hear relay K3 drop out.
25. Increase the voltage with the Multi-Tester or variac until you hear relay K3 pick up.
26. Readjust the "PICK-UP VOLTAGE" and "% DROP-OUT DIFFERENTIAL" knobs to give the desired pickup and dropout voltages.
27. Rather than reconnecting the voltmeter, variac or Multi-Tester for the other undervoltage sensors, pull out the already calibrated module and

replace it with one of the other undervoltage sensors. Then perform the calibration procedures in this position.

28. After calibration is complete, remove the disconnect plug.
29. Disconnect the Multi-Tester or variac and voltmeter.
30. Reconnect the wire lead removed in Step 11 and install the plastic cover over the terminals.
31. Close the control accessory panel and reconnect the disconnect plug.
32. Make the sensor settings. See "*Undervoltage Sensor Settings*" (near end of section).

Overvoltage Sensor Calibration

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch on engine control to "STOP."
3. Turn the "% DROP-OUT DIFFERENTIAL" knobs to minimum and the "PICK-UP VOLTAGE" knobs to the clockwise limit (maximum).
4. On the sensor to be calibrated, turn "PICK-UP VOLTAGE" knob very slowly counterclockwise until you hear relay K6 close. This reading times the multiplying factor should equal the line voltage. Check line voltage with a voltmeter, divide by the factor to see if the reading is correct. If it is, proceed to Step 6. Otherwise, proceed to Step 5.
5. *Setting Too Low:* (a) Turn the "% DROP-OUT DIFFERENTIAL" knob counterclockwise to minimum. (b) Turn the "PICK-UP VOLTAGE" knob to the desired setting. (c) Insert a small screwdriver through the "CALIBRATE" hole and turn counterclockwise very slowly until you hear relay K6 pick up.
- Setting Too High:* (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn to its clockwise limit. (c) Turn the "PICK-UP VOLTAGE" knob to the desired setting. (d) Turn the "CALIBRATE" adjustment counterclockwise very slowly until you hear relay K6 pick up.
6. Repeat Steps 3 through 5 for each overvoltage sensor. If these calibrations are satisfactory for your application, make the sensor settings. See "*Overvoltage Sensor Settings*" (near end of section).
7. For a more accurate calibration and calibration of the "% DROP-OUT DIFFERENTIAL" knob, use the Onan Multi-Tester or a variac and use the following procedure.
8. Remove the twist-lock disconnect plug.
9. Open the control accessory panel.
10. Remove the plastic cover over the stepdown transformer terminals and remove the hot wire

lead from the stepdown transformer's right side terminal of the terminal strip for the respective sensor. For example, if the nominal voltage is 208 volts, remove the wire lead from T2-3 for sensor 13. Do *not* remove the common (com) lead. See Figure 26.

11. If available, connect an Onan Multi-Tester to the transformer terminals of the terminal strip and the wire lead removed using the instructions in the Multi-Tester. If using a variac, connect its common output lead to transformer T2-1 (com) and its other output lead to terminal 2 (120-volt connection). See Figure 27.
12. Connect a voltmeter to the output leads of the variac.
13. Connect the variac input to a 120-volt AC source. Be sure the common from the transformer will be connected to the common of the line.

CAUTION Common must connect to common of AC line. Otherwise, equipment damage can result.

14. Reconnect the disconnect plug.

WARNING Rear of control accessory panel is now energized and presents a serious shock hazard!

15. Turn the "% DROP-OUT DIFFERENTIAL" knob(s) to minimum and the "PICK-UP VOLTAGE" knob(s) to the clockwise limit (maximum).
16. Adjust the Multi-Tester or variac to give a 120-volt output for the overvoltage sensor module.
17. Turn the "PICK-UP VOLTAGE" knob on the sensor to be calibrated counterclockwise very slowly until you hear relay K6 close. The knob should indicate 120 volts. If not, proceed to Step 18. If it does, proceed to Step 19.
18. *Setting Too Low:* (a) Turn the "% DROP-OUT DIFFERENTIAL" knob counterclockwise to minimum. (b) Turn the "PICK-UP VOLTAGE" knob to the desired setting. (c) Insert a small screwdriver through the "CALIBRATE" hole and turn counterclockwise very slowly until you hear relay K6 pick up.

Setting Too High: (a) Turn the "PICK-UP VOLTAGE" knob to its clockwise limit. (b) Insert a small screwdriver through the "CALIBRATE" hole and turn to its clockwise limit. (c) Turn the "PICK-UP VOLTAGE" knob to the desired setting. (d) Turn the "CALIBRATE" adjustment counterclockwise very slowly until you hear relay K6 pick up.

19. Turn the sensor module "PICK-UP VOLTAGE" knob to 132 volts, relay K6 should drop out. Increase the AC output voltage from the Multi-Tester or variac until relay K6 picks up at approximately 132 volts.
20. Decrease the Multi-Tester or variac output voltage to check "% DROP-OUT DIFFERENTIAL."

With the knob set at 5 percent, relay K6 should drop out at approximately 95 percent of 132 volts = 125 to 126 volts. If not, use a small screwdriver to loosen the knob and reposition so it indicates 5 percent with drop-out voltage of 125 to 126 volts.

21. Set the "PICK-UP VOLTAGE" and "% DROP-OUT DIFFERENTIAL" knobs at desired settings.
22. Increase the voltage with the Multi-Tester or variac until you hear relay K6 pick up.
23. Decrease the voltage with the Multi-Tester or variac until you hear relay K6 drop out.
24. Readjust the "PICK-UP VOLTAGE" and "% DROP-OUT DIFFERENTIAL" knobs to give the desired pick-up and drop-out voltages.
25. Rather than reconnecting the voltmeter, variac or Multi-Tester for the other overvoltage sensors (if more than one), pull out the already calibrated module and replace it with one of the other overvoltage sensors. Then perform the calibration procedures in this position.
26. After calibration is complete, remove the disconnect plug.
27. Disconnect the Multi-Tester or variac and voltmeter.
28. Reconnect the wire lead removed in Step 10 and install the plastic cover over the terminals.
29. Close the control accessory panel and reconnect the disconnect plug.
30. Make the sensor settings. See "Overvoltage Sensor Settings" following.

Undervoltage Sensor Settings

1. Turn the "PICK-UP VOLTAGE" knob to the desired pick-up voltage (voltage at which load is transferred from generator set to commercial power). Unless you have special equipment which can be damaged by slight voltage changes, a setting which gives pickup at 90 percent of the nominal voltage is usually satisfactory. For example, 90 percent of 120 volts (for a 120-volt system) gives 108 volts for the knob setting.

The drop-out differential is determined by the pick-up setting.

2. Turn the "% DROP-OUT DIFFERENTIAL" knob to the desired percent deviation below the pick-up voltage. This setting is the voltage at which the load is transferred from commercial power to the generator set. A setting of 15 percent is often satisfactory. For example, 15 percent of 108 volts (pick-up voltage from Step 1) is 16 volts. The drop-out voltage is then pick-up voltage minus the differential voltage, $108 - 16 = 92$ volts.
3. After settings are finished, move the operation selector switch on engine control to "RMT."
4. Close cabinet door.

Overvoltage Sensor Settings

1. Turn the "PICK-UP VOLTAGE" knob to the desired pick-up voltage (voltage at which load is transferred from commercial power to the generator set). Unless you have special equipment which can be damaged by slight voltage changes, a setting (13 percent) which gives pick-up at 113 percent of the nominal voltage is usually satisfactory. For example, 113 percent of 120 volts (for a 120-volt system) gives 135 volts for the knob setting.

The drop-out differential is determined by the pick-up setting.

2. Turn the "% DROP-OUT DIFFERENTIAL" knob to the desired deviation below the pick-up voltage. This setting is the voltage at which the load is transferred from the generator set to commercial power. A setting of 5 percent is often satisfactory. For example, 5 percent of 135 volts (pick-up voltage from Step 1) is approximately 7 volts. The drop-out voltage is then pick-up voltage minus the differential voltage, $135 - 7 = 128$ volts.
3. After settings are finished, move the operation selector switch on engine control to "RMT."
4. Close cabinet door.

TROUBLESHOOTING

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

1. Check for overcrank condition.
2. Check position of operation selector switch. Should be at "RMT."
3. Check generator set. Start with start-stop switch on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

GENERATOR SET STARTS DURING NORMAL SERVICE

1. Check position of operation selector switch on engine control. Should be at "RMT."
2. Check position of selector switch in cabinet. Should be at "NORMAL."
3. Check if exerciser clock is turned to exercise period.
4. Check to see if control panel disconnect plug is inserted into receptacle.
5. Check voltage sensor settings (if equipped).
6. If settings are okay, starting may be due to momentary voltage dips. Pick-up voltage settings may have to be reduced.

GENERATOR SET DOES NOT EXERCISE

1. Check position of operation selector switch. Should be at "RMT."
2. Check exerciser clock to see if it is set correctly and running.
3. Check generator set. Start with start-stop switch on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check position of motor disconnect switch on the transfer switch. Should be at "ON."
2. Check output voltage of the generator set.
3. Check generator-side undervoltage sensor (if equipped) pick-up voltage setting. Setting in most cases should be at 100 volts.

NO TRANSFER OF LOAD TO COMMERCIAL POWER FROM GENERATOR SET

1. Check position of motor disconnect switch on the transfer switch. Should be at "ON."
2. Check disconnect plug in control accessory panel. Must be connected into receptacle.
3. Check retransfer time delay (if used) to see if time delay is still operating. See *OPERATION* section.
4. If automatic transfer switch has battery charging feature, check battery charging fuse. Replace if necessary with Buss KTQ1 fuse or equivalent.
5. Manually initiate retransfer by operating retransfer selector switch and push to retransfer switch (if equipped).
6. Stop generator set with start-stop switch. When generator set stops, the transfer switch will transfer the load to the normal power line if voltage is normal.

GENERATOR SET CONTINUES TO RUN AFTER RETRANSFER OF LOAD TO COMMERCIAL POWER

Start-Stop time delay may be defective. Stop generator set with start-stop switch.

BATTERY CHARGER FAILS TO CHARGE

Check battery charger fuse F1 in control accessory panel (if equipped with charger). Replace if necessary with Buss KTQ1 fuse or equivalent.

BATTERY LOSES EXCESS WATER

Battery charger float voltage may be too high (if equipped with charger). See *ADJUSTMENTS* section.

BATTERY LOSES CHARGE

Charge float voltage may be set too low (if equipped with charger). See *ADJUSTMENTS* section.

PARTS AND SERVICE INFORMATION

This automatic transfer switch is custom engineered and specially constructed. Optional equipment and special requirements demand particular circuits and components to perform the automatic functions. Because of the individuality of each automatic transfer switch, contact the dealer from whom you purchased this equipment for service and parts. Remember to give the complete model and serial number when requesting service or parts information. The wiring diagrams furnished with your automatic transfer switch should be kept with your instruction manual in the "pocket" on the rear of the cabinet door.

Any shipments made are complete unless the packing list indicates items are backordered. Shipments are properly packed and in good order when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.

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