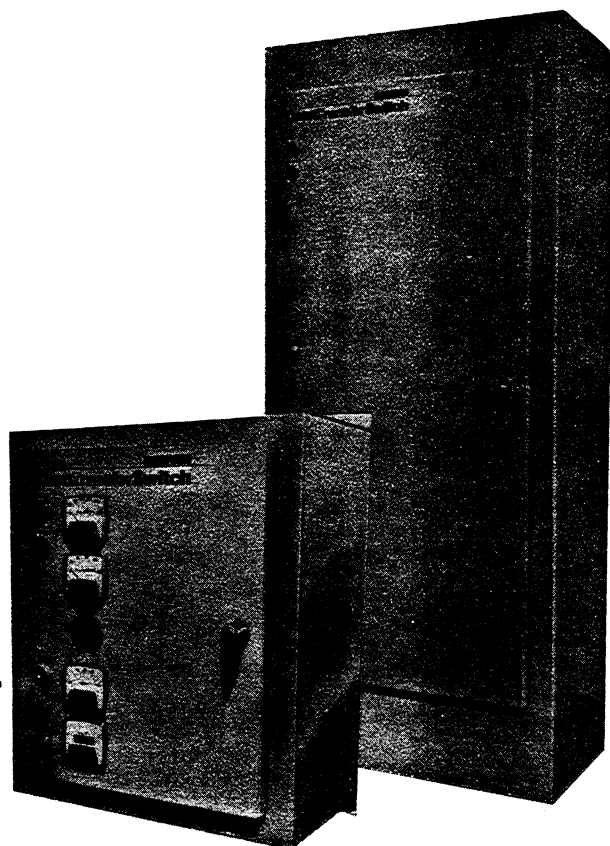




Operators Manual

OT II
Switch

**Utility-to-GenSet
Automatic Control**



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

This symbol is used throughout the text to warn of possible injury or death.

CAUTION

This symbol is used to warn of possible equipment damage.

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

Keep the transfer switch cabinet closed and locked. Make sure only authorized personnel have the cabinet and operational keys.

Due to high voltages of components within the cabinet which present a serious shock hazard, always have an electrician or authorized service representative perform any service or adjustments to the automatic transfer switch. If the cabinet must be opened for any reason: 1) always move the operation selector switch on the generator set or Stop/Auto/Hand Crank switch on the automatic transfer switch, whichever applies, to STOP; 2) disconnect the starting batteries of the generator set; and 3) remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

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.



Supplement 962-1013

Date: 6-85

Insert with -

Title: OT II Operator's Manual

Number: 962-0107

This supplement applies to the 40 through 1000 ampere, Spec E and later OT II transfer switch. The two to three wire converter is available for converting the two wire start transfer switch for use with a three wire start generator set. The converter includes a Start Disconnect relay, Overcrank relay, and may include a Preheat Time delay depending on the options selected.

INSTALLATION SECTION

2 to 3 Wire Converter

The converter mounts on the left inside cabinet wall directly below terminal block TB2 and use the same remote TB10 connections for three-wire starting as shown in the Operator's Manual. Reference Figure 9.

CHECKOUT PROCEDURES

Overcrank Relay and Voltage Sensor Adjustments (Three-wire starting only)

1. Locate the overcrank relay on the converter as shown in Figure 9. It has a range of 0 to at least 180 seconds. The maximum time delay occurs between the F and 0. At 0, there is no time delay. Turning the knob to A equals about 30 to 40 seconds. See listing below for times and settings.

If the converter also includes a preheat relay, double the time setting. For example, set the knob to 60 seconds to obtain a 30-second overcrank relay time.

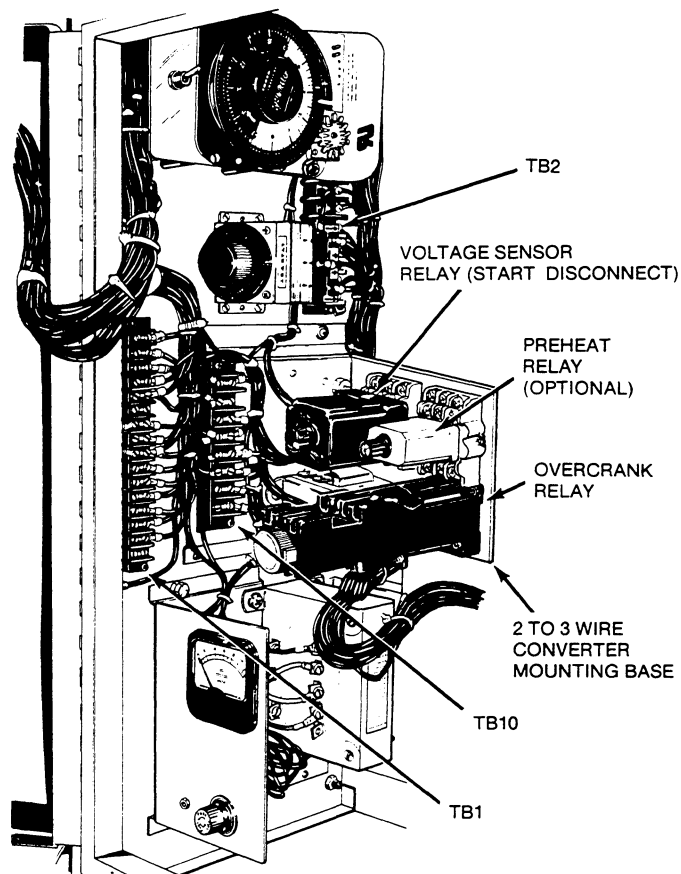
- A — 30 to 40 seconds
- B — 60 to 90 seconds
- C — 90 to 150 seconds
- D — 150 to 210 seconds
- E — 210 to 260 seconds
- F — 240 to 360 seconds

The small button next to the adjustment knob bypasses the delay function. The button should not be used for normal operation.

2. Locate the Voltage Sensor (Start Disconnect) on the converter as shown in Figure 9. It senses generator output and at a predetermined voltage value, energizes to open the start circuit (after the generator set is running). Refer to following table for correct setting of sensor.

CAUTION

Do not set voltage sensor above rating of transfer switch or sensor will not operate. Improper adjustment can result in abnormal operation of transfer switch.



ES-1543

FIGURE 9. LOCATION OF 2 to 3 WIRE CONVERTER, OVERCRANK RELAY AND OPTIONAL PREHEAT TIME DELAY

APPROXIMATE VOLTAGE SENSOR PICKUP SETTINGS

DIAL SETTING	120-VOLT MODEL	208-240 VOLT MODEL	480-VOLT MODEL	600-VOLT MODEL
1	93	183	390	488
2	97	193	407	509
3	101	203	424	530
4	105	213	441	551
5	111	226	466	583
6	116	236	487	609
7	121	248	508	635
8	126	257	529	661
9	131	265	550	688
10	133	268	559	698

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WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS MIGHT RESULT IN SEVERE PERSONAL INJURY AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

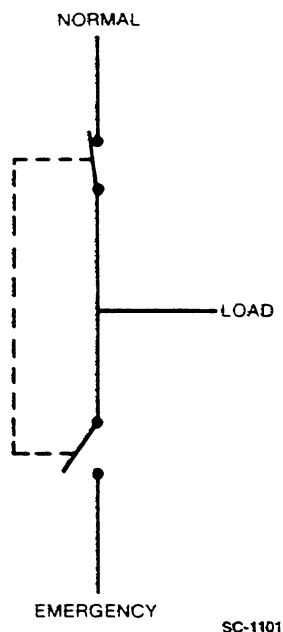
Introduction

OPERATORS MANUAL

This operators' manual provides information necessary for operation of the Onan OT transfer switch. The manual includes installation, description, and operation chapters. A troubleshooting guide is also included. Operators should become familiar with this manual, especially the operation procedures which apply to their automatic transfer switch.

TRANSFER SWITCH APPLICATION

Transfer switches are an essential part of a building's standby or emergency power system. The Normal power source, commonly the utility line, is backed up by an Emergency power source, often an electric generating set. A transfer switch supplies the electrical load with power from one of these two power sources. The load being served is connected to the common of the transfer switch as shown. Under normal conditions, the load is supplied with power from the Normal source (as illustrated). Should the Normal power source be interrupted, the load is transferred to the Emergency power source. When Normal power returns, the load is retransferred to the Normal power source. The transfer and retransfer of the load are the two most basic functions of a transfer switch.



**FIGURE 1. LOAD TRANSFER SWITCH
(TYPICAL FUNCTION)**

AUTOMATIC TRANSFER SWITCHES

Automatic transfer switches, capable of automatic operation without operator involvement, perform the following basic functions:

1. Sense the interruption of the Normal power source.
2. Send a start signal to the generator set (Emergency power source).
3. Transfer the load to the Emergency power source.
4. Sense the return of the Normal power source.
5. Retransfer the load to the Normal power source.
6. Send a stop signal to the generator set.

MODEL IDENTIFICATION

Identify your model by referring to the Model and Specification number as shown on the nameplate. Electrical characteristics are shown on the lower portion of the nameplate. It is located inside the cabinet door on the control box cover.

If it is necessary to contact a dealer or the factory regarding the transfer switch, always give the complete Model, Spec, and Serial number as listed on the nameplate. Also give the number(s) of any options that may be listed on a label below the nameplate. This information is necessary to properly identify your unit among the many types manufactured.

A typical model number with explanation is given below.

OT	B	C	A	260	-	4X	U	/	31	01	E
└─┘	└─┘	└─┘	└─┘	└─┘		└─┘	└─┘		└─┘	└─┘	└─┘
1	2	3	4	5		6	7		8	9	10

1. Basic model series.
OT indicates OT II transfer switch series
2. Number of switched conductor poles.
B-indicates 3-pole.
3. Basic control group.
C-indicates utility to standby generator.
4. Enclosure type.
A-indicates general purpose NEMA 1.
5. Ampere rating.
6. Voltage code and frequency.
4X or 54X (50 Hz) = 277/480, 3-phase, 4-wire.
7. Agency Certification.
U-Underwriters' Laboratories, Inc.
8. Control option group number.
9. Meter option group number.
10. Specification letter: advances with production modification.

Installation

LOCATION

Locating the 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 transfer switch. A typical installation is shown in Figure 2.

Choose a vibration-free mounting surface. Avoid hot, moist, or dusty locations.

TABLE 1. APPROXIMATE CABINET DIMENSIONS

Switch Amp Rating	Height (H)	Width (W)	Depth W/Door—	
			Closed (D)	Open D _o
40, 70, 100	30.5-in (775mm)	23.0-in (584mm)	13.5-in (343mm)	32.75-in (832mm)
150, 260	63.0-in (1600mm)	30.0-in (762mm)	21.6-in (549mm)	44.2-in (1122mm)
400	78.0-in (1981mm)	30.0-in (762mm)	22.6-in (574mm)	46.2-in (1173mm)
600, 800, 1,000	84.0-in (2134mm)	36.0-in (914mm)	22.6-in (574mm)	51.7-in (1313mm)

MOUNTING

Wall Mount, 40-100 Ampere

1. Install two mounting bolts in the wall for the bottom cabinet mounting keyholes.
2. With the shipping box standing so the cabinet is upright, carefully remove the top and sides of the box.
3. Raise cabinet and mount on the two mounting bolts in the wall.

WARNING

Have sufficient manpower for lifting and mounting cabinet to prevent serious personal injury.

4. Tighten two bottom mounting bolts.
5. Install two top mounting bolts and tighten.

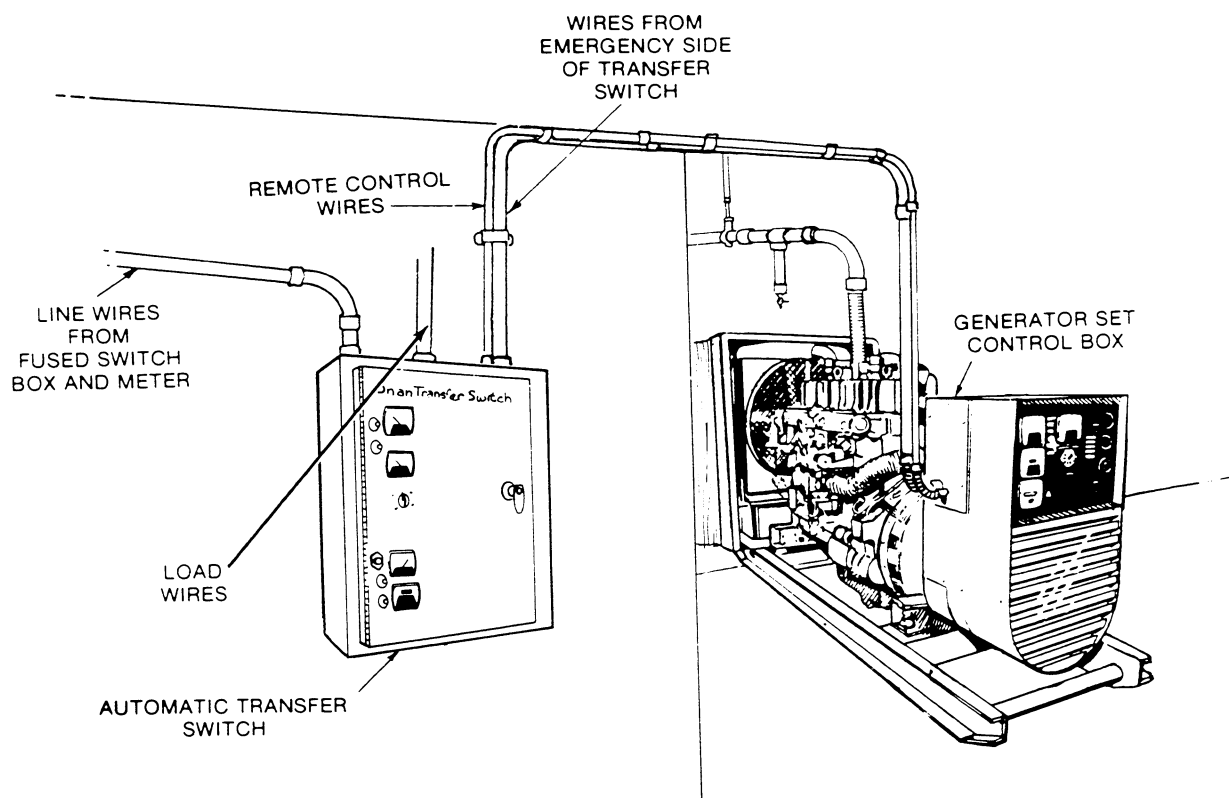


FIGURE 2. TYPICAL WALL MOUNT INSTALLATION

SC-1279

Floor Mount, 150-1000 Ampere

1. With the shipping box standing so the cabinet is upright, carefully remove the top and sides of the box.
2. Connect a hoist or similar lift to the two lifting eyebolts on the cabinet top.

WARNING *Do not attempt to lift manually because of the danger of serious personal injury.*

3. Carefully raise the cabinet and move it to its installation location. Mounting bolts are usually placed in concrete when floor is poured. Bolts should protrude about one inch (25 mm) from floor. Secure the cabinet to the floor.

WIRING

Wiring must be performed by qualified personnel only.

If using rigid conduit between the generator set and the OT transfer switch, install at least 2 feet (610 mm) of flexible conduit between the rigid conduit and generator set to absorb vibration. Run control circuit wiring in separate conduit from the AC wiring, otherwise induced currents could cause operational problems within the OT. When facing the front of the cabinet, knockouts can be made through the top, bottom, or right side of the cabinet.

CAUTION *Use extreme care to keep drill chips and fillings out of the relays, contacts, and other parts of the automatic transfer switch when mounting or connecting conduit. Also, screwdrivers should be used carefully to prevent damage to the resistors, coils, and contacts.*

Perform wiring in the following sequence:

1. Test operation of the generator set from its own controls.
2. Stop the generator set and remove the negative lead from the cranking battery to prevent starting.

WARNING *Failure to prevent the generator set from starting before wiring procedures are performed presents a shock hazard and might cause serious personal injury or death.*

3. 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 (A and B on single-phase switches). Table 2 gives the type and maximum wire size the transfer switch will accept. Figure 3 shows transfer switch connections.

TABLE 2. TERMINAL LUG CAPACITY

For Copper or Aluminum Conductors

Switch Amp Rating	Number of Conductors	Size Range of Conductors
40	1	#0 AWG to #14 AWG
70	1	#0 AWG to #14 AWG
100	1	#0 AWG to #14 AWG
150	1	#6 AWG to 350 MCM
260	1	#4 AWG to 500 MCM
400	1	350 MCM to 1000 MCM
600	2	#2 AWG to 600 MCM
800	4	#4 AWG to 600 MCM
1000	4	#4 AWG to 600 MCM

For transfer switches with an AC ammeter, the generator load wires must pass through a transformer three times for 40-ampere OT, twice (two primary turns) for a 70- and 100-ampere OT, once (one primary turn) for any 150- through 1000-ampere OT. See Figure 4.

4. Neutral bar with lugs is standard on switches supplied with cabinet. See Table 2 for wire sizes.

OT transfer switches of 150 to 1000 ampere size are factory assembled with the load terminal lugs at the top. The load terminal lugs may be moved for a bottom connection using this procedure:

- A. Remove switch covers, and load cover on front connect units. See Figure 5. On units in the 600 and 1000 ampere range, the end assemblies on each end of the actuator rod must be removed to facilitate removal of the switch cover.
- B. Remove nuts and lockwashers from jumper strap at center of switch (leave bolts in place). See Figure 5.
- C. Remove screw, lockwasher and flatwasher securing the standoff insulator to the mounting base.
- D. Reverse position of load strap and replace hardware removed in Step B. Be sure electrical joint compound is applied before assembly.
- E. Secure standoff insulator at bottom of switch with hardware removed in Step C.
- F. Torque screws and nuts to values shown in Figure 5.
- G. Replace load cover and switch covers.
- H. Replace end assemblies on actuator rod and torque screws to value shown (600 and 1000 ampere units only).

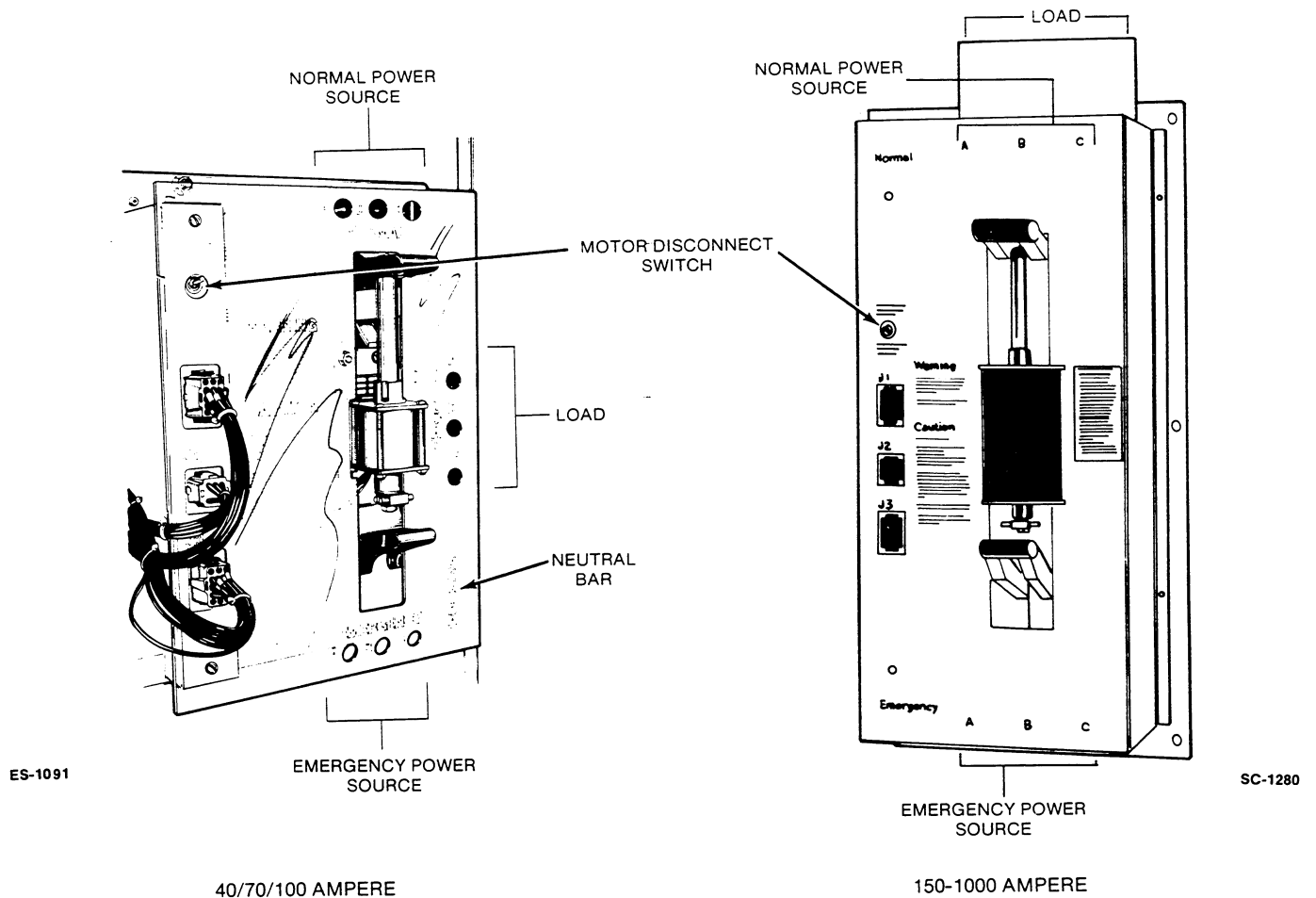


FIGURE 3. TRANSFER SWITCH WIRE CONNECTIONS

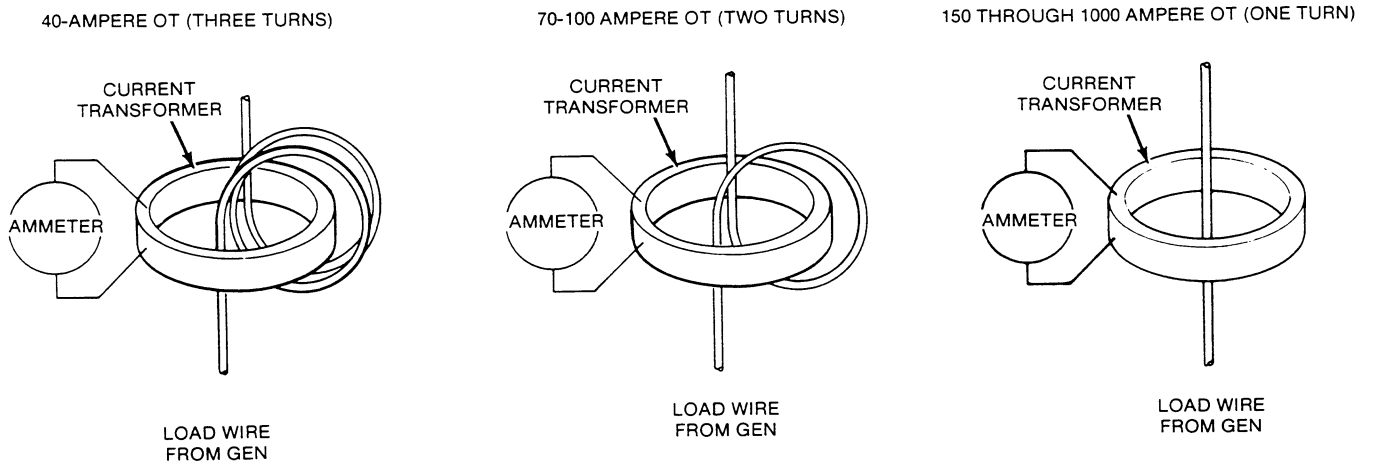
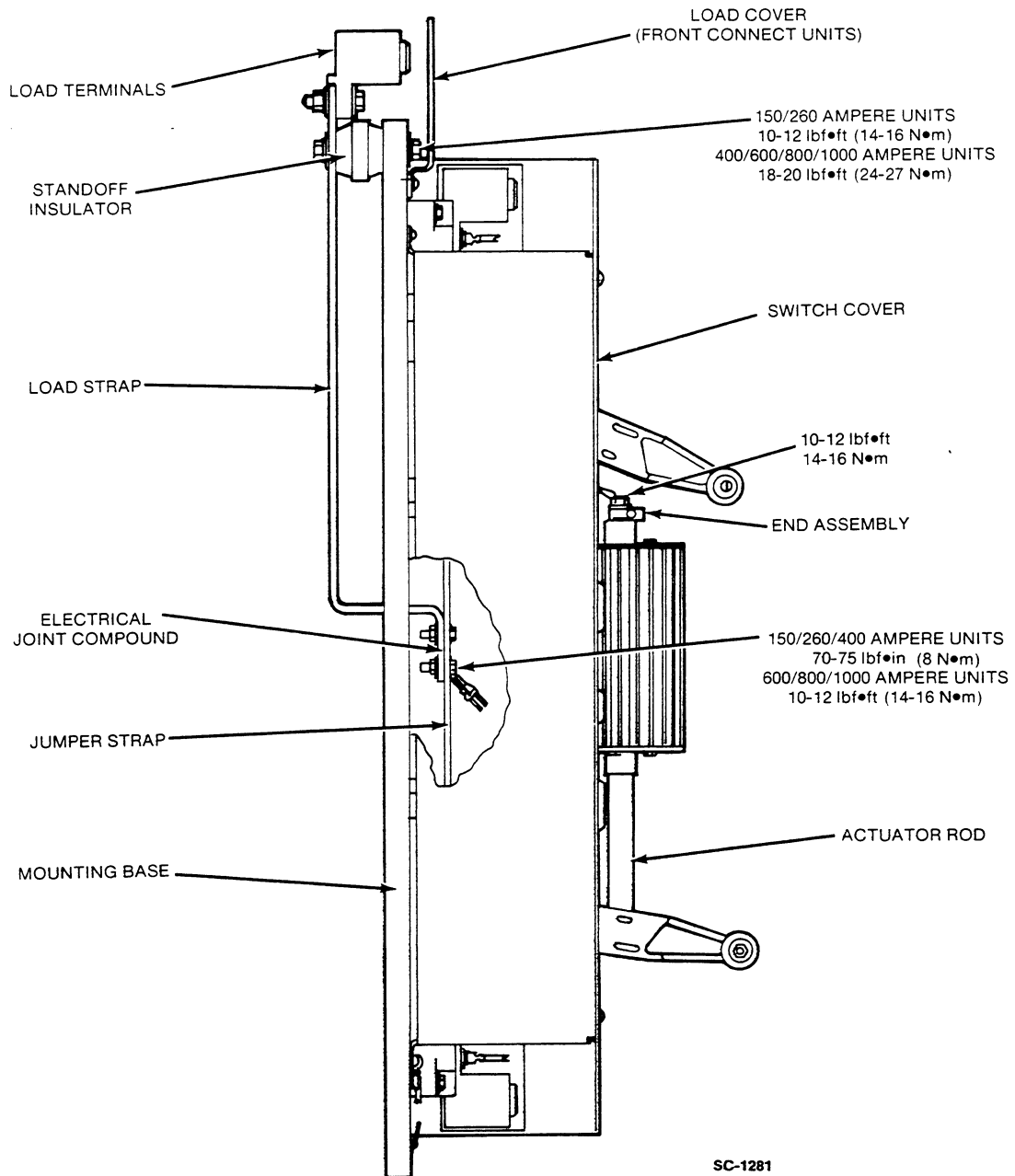


FIGURE 4. CURRENT TRANSFORMER WIRING

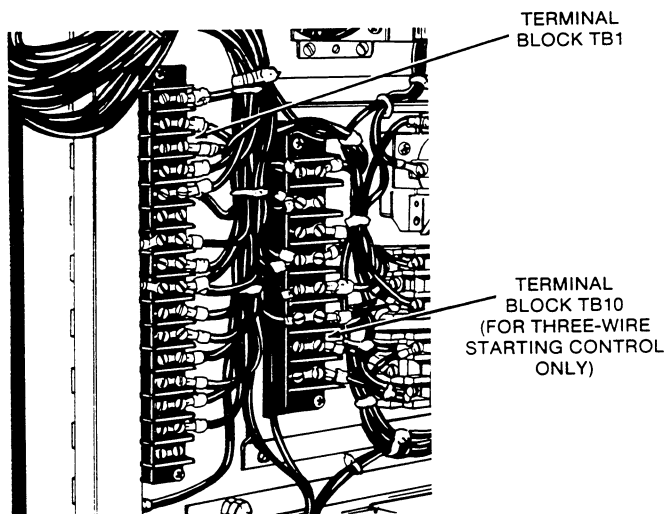


**FIGURE 5. TRANSFER SWITCH LOAD TERMINALS (SIDE VIEW)
150-1000 AMPERE**

Control Circuit Connections

1. Area Protection or Remote Test Switch (if used):

- A. To add area protection equipment or a remote test transfer switch, first remove the jumper between terminals 7 and 8 of TB1. Figure 6 shows the terminal block location.
- B. Connect the two leads from the normally closed circuit of the area protection equipment or single-pole, single-throw remote test switch to terminals TB1-7 and -8. Use number 16 wire for distances up to 800 feet or 244 metres (maximum resistance of 4 ohms per line).



ES-1092

FIGURE 6. CONTROL TERMINAL BLOCKS

2. **Auxiliary Contacts (if used):** Auxiliary contacts are located on the Normal and Emergency sides of the transfer switch for external alarm or control circuitry. Connections for auxiliary contacts can be made on terminal block TB1 terminals 10 through 15. The contacts have ratings of 10 amperes at 480 VAC. Listed below are open and closed positions of auxiliary contacts with transfer switch in neutral position. Moving the transfer switch to Normal or Emergency only affects the corresponding auxiliary contacts.

NORMAL AUXILIARY CONTACT	EMERGENCY AUXILIARY CONTACT
TB1-10 — N/O	TB1-13 — N/O
TB1-11 — N/C	TB1-14 — N/C
TB1-12 — COM	TB1-15 — COM

3. **Generator Failure Contact (Optional for Three-Wire Start Only):** Three-wire starting for Onan air-cooled generator sets has as an option a normally-open set of contacts for an external signal of a generator failure condition (overcrank).

Connect the remote signal device to terminals TB10-7 and -8 using number 16 wire for distances up to 800 feet or 244 metres (maximum of 4 ohms per line). The contacts have ratings of 10 amperes at 240 VAC.

4. **Remote Start-Stop Connections:** Use number 16 wire for up to 100 feet or 30 metres with a maximum of 0.5 ohm per line.

A. **Two-Wire Starting:** Two-wire starting for Onan water-cooled generator sets uses the three terminals B+, GND (ground) and REMOTE of terminal block TB1.

B. **Three-Wire Starting:** Three-wire starting for Onan air-cooled generator sets uses the four terminals, 1 (GND or ground), 2, 3, and 4 (B+) of terminal block TB10 which should connect to respective terminals of the generator set.

5. **Preheat Time Delay (Optional for Three-Wire Starting Only):** In addition to remote start-stop wiring, the preheat time delay allows for a diesel engine preheat period. To connect, first remove the jumper from between terminals TB10-5 and -6. Then connect a wire from TB10-5 (H) in the cabinet to terminal H in the generator set control.

When preheat circuit is used, remove jumper between terminal "3" and "H" in the engine control.

CLEANING OF CABINET

After mounting and wiring of cabinet are completed, clean the interior with a vacuum cleaner to remove any chips, filings, or dirt from the cabinet interior and components.

CHECKOUT PROCEDURES

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 solid-state or relay control.

Exerciser Clock Settings (if Equipped)

1. Check exerciser. It normally has a factory program for one-half hour exercise once per week (12:00 to 12:30 p.m. on Saturdays). If you want other times, proceed to Step 2. If these times are satisfactory, proceed to Step 3.
2. To change exerciser program:

- A. On the large dial, install a trip pin (left-hand thread) in the inside row of holes for the time of day you want the generator set to start. See Figure 7.
- B. On the large dial, install a trip pin (left-hand thread) in the outside row of holes for the time you want to stop the generator set exercise period.

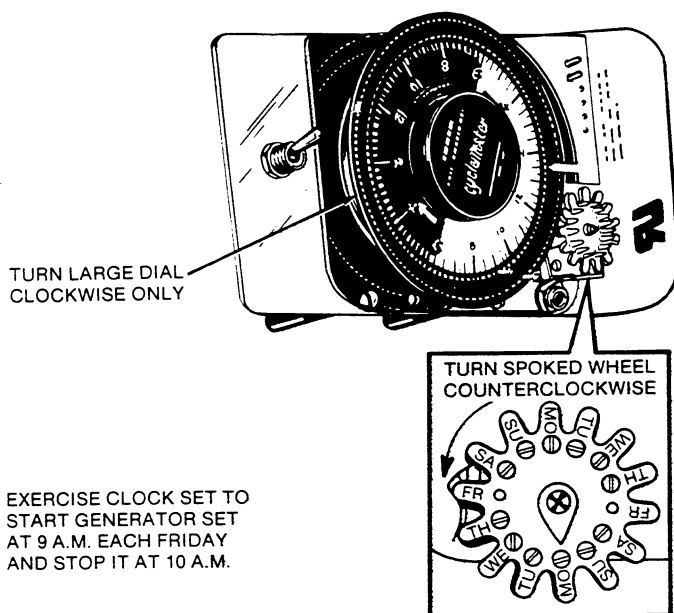
Onan recommends settings which will operate the generator set for at least 30 minutes each week. Exercising for one long period is better than several short periods.

3. Set exerciser for correct day and hour.

- A. Rotate the large dial clockwise until the correct time of day aligns with the pointer.
- B. Turn the small spoked wheel counterclockwise until the correct day aligns with the pointer.

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

- C. Install a trip pin (left-hand thread) into the small spoked wheel for each day no exercise is desired.



NOTE: Trip pins are left-hand thread.

FIGURE 7. TYPICAL SETTING OF EXERCISER

Programmed Transition (if equipped)

1. Locate the programmed transition time delay on the left inside wall of the cabinet (Figure 8). It normally has factory settings for a few seconds. If the setting is satisfactory, proceed to next check. Otherwise, proceed to Step 2.
2. The programmed transition has either a time range of 0.5 to 5 seconds, 1.5 to 15 seconds, or 5 to 50 seconds (three timers are available). Turn the knob clockwise to increase delay, counterclockwise to decrease time delay. Increments are marked on the knob.

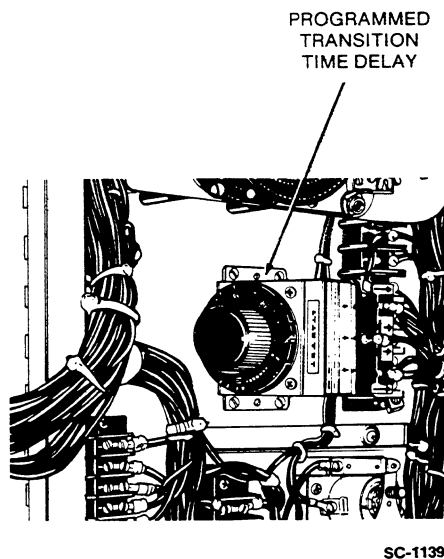


FIGURE 8. LOCATION OF PROGRAMMED TRANSITION TIME DELAY

Overcrank Relay and Optional Generator Failure Contact (Three-Wire Starting Only)

1. Locate the overcrank relay on the three-wire control, as shown in Figure 9. It has a range of 0.6 to 60 seconds unless the three-wire control has the optional relay with the generator failure contact. Then the time range is from 6 to 60 seconds.

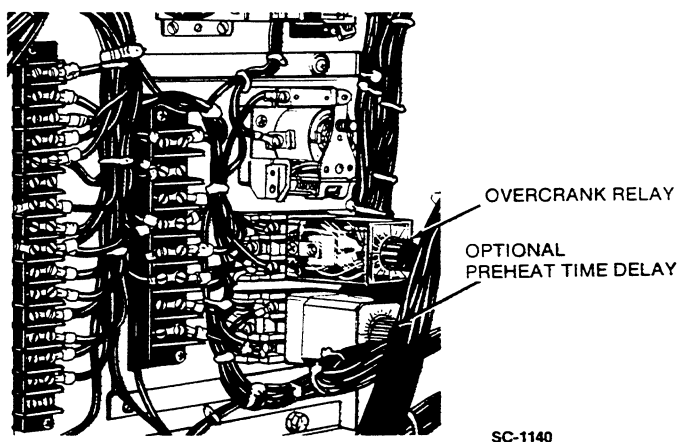


FIGURE 9. LOCATION OF OVERCRANK RELAY AND OPTIONAL PREHEAT TIME DELAY

2. The time delay has settings from 0 to 100 percent. A 100 percent setting gives a 60 second delay, 50 percent gives 30 seconds, etc. Turn the knob clockwise to increase the percentage of seconds, counterclockwise to decrease the percentage.

Preheat Time Delay (Option for Three-Wire Starting Only)

1. Locate the preheat time delay, as shown in Figure 9. It has a time range of 0.6 to 60 seconds.
2. The time delay has settings from 0 to 100 percent. A 100 percent setting gives a 60 second delay, 50 percent gives 30 seconds, etc. If you want a different time other than the factory setting, turn the knob clockwise to increase the percentage of seconds, counterclockwise to decrease the percentage.

Relay Control Start and Retransfer Time Delay Settings (if equipped)

1. On the rear of the cabinet door, remove the control cover to expose the control components. See Figure 10.
2. Note the setting on the retransfer time delay in the upper left corner of the control. It is adjustable from 3 to 30 minutes. Onan recommends a setting of 10 to 15 minutes. To change setting, simply turn knob to desired time.

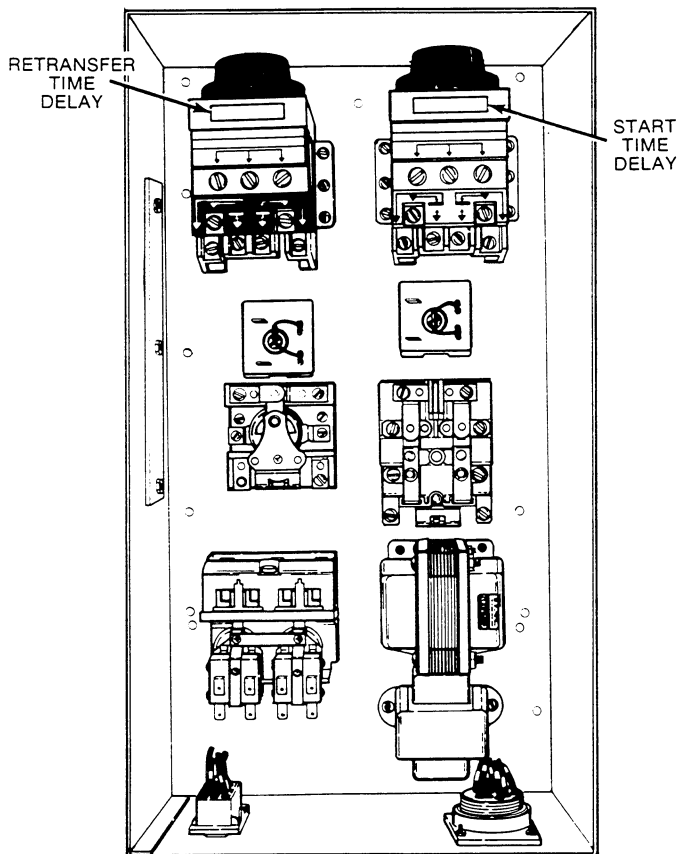


FIGURE 10. RELAY CONTROL TIME DELAYS

3. Note the setting of the start time delay in the upper right corner of the control. It is adjustable from 1.5 to 15 seconds. Onan recommends a setting of 1 to 3 seconds. To change setting, turn knob to desired time.
4. Replace the control cover with the four screws.

Check Switch Positions

1. *Exerciser (if equipped)*. Move the switch on the exerciser to With Load or Without Load, depending on whether you want the generator set to exercise with or without load (with load selection results in load transfer during exercise period).
2. *Transfer Switch Disconnect Switch*. Move the disconnect switch to the up position for automatic operation. Close cabinet door when finished.
3. *Operation Selector Switch*. For a water-cooled Onan generator set with two-wire starting, move the operation selector switch on the generator set control panel to Stop. For an air-cooled Onan generator set with three-wire starting, move the keyed Stop/Auto/Hand Crank switch on the OT cabinet to Stop.
4. *Test/Normal/Retransfer Switch*. Move the key-operated test switch on the OT cabinet to Normal.

Connect AC Line

If the transfer switch main contacts are not closed to the Normal power source side, manually close the transfer switch to the Normal side. Then connect AC line power to the automatic transfer switch. The lamp on the cabinet front should light.

Connect the Battery

WARNING High voltages within the cabinet and rear side of cabinet door present a shock hazard which might cause serious personal injury or death. Use care when opening cabinet door.

Connect the battery and, if equipped with a battery charger, note charging current by opening cabinet door and observing ammeter on battery charger.

Test Overcrank Function, Three-Wire Starting

- A. Disconnect positive start lead from the start solenoid or starter.
- B. Move the Stop/Auto/Hand Crank switch to Auto.
- C. Move Test/Normal/Retransfer switch to Test. Overcrank lamp on automatic transfer switch should light at end of crank period (usually factory set at 60 seconds).
- D. Move Test/Normal/Retransfer switch to Normal.
- E. Move the Stop/Auto/Hand Crank switch to Stop and push the Overcrank button (overcrank lamp should go out).
- F. Reconnect positive lead to starter or start solenoid.
- G. Move the Stop/Auto/Hand Crank switch to Auto.

Starting Test

1. *Two-wire starting.*
 - A. Move selector switch on engine control to Run. Generator set should start and run.
 - B. Move selector switch to Remote. Generator set should stop.
2. *Three-wire starting.*
 - A. Move the Stop/Auto/Hand Crank switch on automatic transfer switch to Hand Crank.
 - B. Push start button on generator set control. Generator set should start and run.
 - C. Move the Stop/Auto/Hand/Crank switch from Hand Crank to Stop. Generator set should stop.
 - D. Move the Stop/Auto/Hand Crank switch to Auto. Generator set should not start.

Test Transfer With Load

1. If the OT has the optional exerciser, move the With Load/Without Load selector switch to With Load.
2. Move the Test/Normal/Retransfer switch to Test. Generator set should start after time delay (the load will be transferred to the generator), and light the red Emergency lamp on the cabinet door.
3. Check operation of the AC meters (if equipped) on the cabinet door.
4. Move the Test/Normal/Retransfer switch to Normal. The transfer switch should retransfer load to the Normal power source and stop the generator set after any time delays. The Normal lamp should light.

ELECTRONIC CONTROL SETTINGS

Time Delay/Undervoltage/Overvoltage/ Frequency

The adjustments on the electronic modules are factory set and normally do not require field adjustment. If desired, the Pickup, Dropout and Time Delay settings may be adjusted to other than factory settings as outlined below. However, the calibration (Cal) adjustments should be changed only if the nominal voltage is significantly different than the nameplate rating, or when installing a replacement sensor module.

CAUTION *Haphazard setting of the module calibration (Cal) adjustments may result in abnormal operation of the transfer switch.*

Complete all installation procedures before any adjustments are made. All adjustments are made with a screwdriver through openings in the module panels by turning a potentiometer (see Figures 12 and 13).

A separate voltage sensor is used for each power source. They are located one on each side of the time delay module (Figure 11).

Place the Motor Disconnect Switch (Figure 3) in the down position when making adjustments. Return switch to up position after adjustments are completed.

WARNING *High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!*

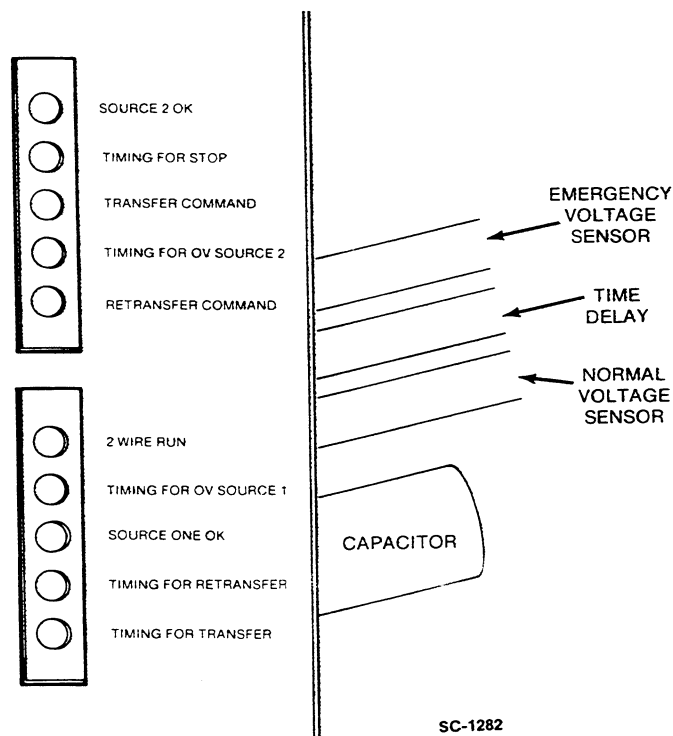


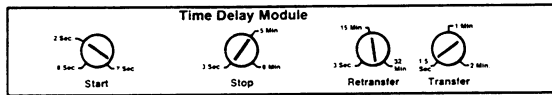
FIGURE 11. CONTROL PANEL LAMPS AND MODULES

Time Delay Module: The time delay module controls the following functions:

- Start time delay
- Stop time delay
- Transfer time delay
- Retransfer time delay

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 12. Range of adjustments and factory settings are as follows:

DELAY	ADJUSTMENT RANGE	FACTORY SETTING
Start	0-6 seconds	2 seconds
Transfer	0-120 seconds	2 seconds
Retransfer	0-32 minutes	15 minutes
Stop	0-8 minutes	5 minutes

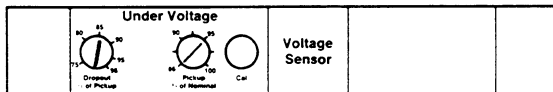


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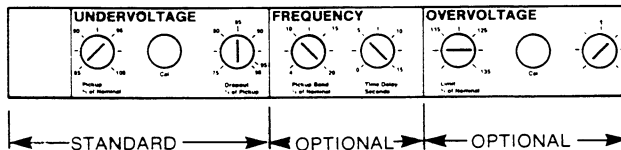
FIGURE 12. TIME DELAY MODULE

Undervoltage Sensor: The standard voltage sensor modules monitor the Normal and Emergency power source for an undervoltage condition. The undervoltage range of adjustment is shown below. If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Dropout	75% to 98%	85%
Pickup	85% to 100%	95%



EARLY VERSION



LATER VERSION

SC-1283

FIGURE 13. VOLTAGE/FREQUENCY SENSOR MODULE

If necessary, the undervoltage sensor for either the Normal or Emergency sources may be calibrated as follows (see Figure 11 for location):

1. Ensure that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Pickup Band potentiometer.
2. Turn the Undervoltage Pickup and Dropout potentiometers on the voltage sensor fully clockwise.
3. Turn the Undervoltage calibration (Cal) potentiometer fully clockwise. The Source OK lamp corresponding to source sensor being calibrated should be on (Source One OK-Normal source, Source 2 OK-Emergency source). If the Source OK lamp fails to come on, and the voltage sensor has an overvoltage sensing option, turn overvoltage Limit and Cal potentiometers fully clockwise.
4. Turn the Cal potentiometer counterclockwise until the Source OK lamp turns off.
5. Slowly turn the Cal potentiometer until the Source OK lamp just turns on again.
6. The Undervoltage sensor is now calibrated. If the Overvoltage sensor was adjusted in Step 3, then recalibrate it by using the Overvoltage Sensor calibration procedure.

After calibration, reset the Pickup and Dropout potentiometers to the factory settings or to desired setting.

Overvoltage Sensor: The optional overvoltage sensor detects when the source voltage has exceeded the overvoltage limit.

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 13. Range of adjustments and factory settings are shown below.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Limit	105 to 135%	110%
Time Delay	0 to 2 minutes	5 seconds

The overvoltage pickup point is fixed at 5 percent below the Limit setting. The adjustable dropout Time Delay overrides momentary overshoots in voltage.

If necessary, the Overvoltage sensor may be calibrated as follows:

If the Undervoltage sensor has not been calibrated, do so before proceeding.

1. Ensure that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Pickup Band potentiometer.
2. Turn the overvoltage Limit and Time Delay potentiometers fully counterclockwise.
3. Turn the Overvoltage Cal potentiometer fully clockwise. The Source OK lamp for the selected source should light (Figure 11).
4. Turn the Cal potentiometer counterclockwise until the Source OK lamp turns off.
5. Slowly turn the Cal potentiometer clockwise until the Source OK lamp just turns on again.

After calibration, reset the Overvoltage Limit and Time Delay potentiometers to the desired values.

Frequency Sensor: The optional frequency sensor detects when the source frequency is within an acceptable band. This band is centered about the nominal system frequency (50 or 60 hertz).

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 13. Range of adjustments and factory settings are shown below.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Pickup Band	± 4 to $\pm 20\%$	$\pm 10\%$
Time Delay	0 to 15 Seconds	5 Seconds

The dropout bandwidth is always 2.5% wider (on each end) than the pickup bandwidth.

The adjustable dropout Time Delay allows the control to ignore momentary dips or rises in frequency.

Description

Onan automatic transfer switches basically control transfer of the load to either Normal power source or to Emergency power source (generator set) without operator involvement. Throughout this manual, frequent references are made to two-wire and three-wire start-stop functions of generator sets. Onan water-cooled generator sets have two-wire start controls and the air-cooled sets have three-wire start controls.

Standard items and features of the transfer switch are covered in the first part of this section. Descriptions of options and accessories appear in the second part.

CABINET

The standard Onan OT cabinet meets requirements of the National Electrical Manufacturers Association (NEMA) for a "Type 1" cabinet. This type is designated as a general purpose, indoor cabinet. Exterior items on a typical OT cabinet are shown in Figure 14.

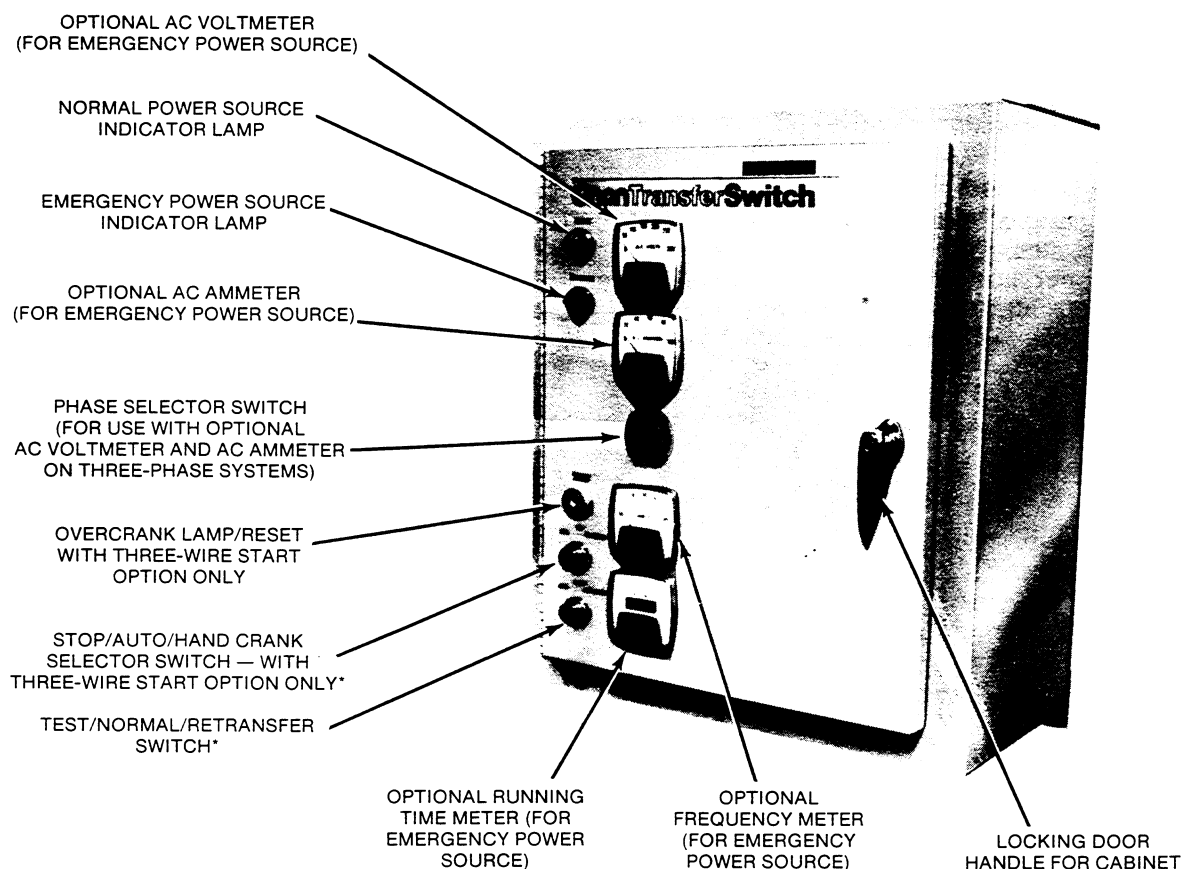
Indicator Lamps

Two lamps on the cabinet door indicate which power source is connected to the load. The Normal lamp when lit indicates the Normal power source is supplying load. The Emergency lamp will light when the Emergency power source is supplying the load.

Test Transfer Switch

This switch has three positions and can simulate a power outage for test purposes. In the Normal position, the transfer switch is set for automatic operation. Moving the switch to Test sends a start signal to the generator set. The generator set will start and assume load as long as the switch is in this position.

Moving the switch to Normal causes load transfer to the Normal power source after the retransfer time delay expires (see Control section for time delay description). To avoid the delay and have fast retransfer of load to the Normal power source, the switch can be moved to the Retransfer position.



*KEY-OPERATED

FIGURE 14. OT CABINET WITH OPTIONS

TRANSFER SWITCH

The transfer switch opens and closes the contacts that transfer the load between Normal and Emergency power. The transfer switch is mechanically interlocked to prevent simultaneous closing to both power sources. The main parts of the transfer switch discussed here are the contact assemblies, linear actuator, motor disconnect switch, and auxiliary contacts.

Contact Assemblies

Series OT transfer switches are two or three pole, with a neutral block. The contact assemblies make and break the current flow. When closed to either Normal or Emergency power source, the contacts are mechanically held. A mechanical interlock prevents them from closing to both power sources at the same time.

Linear Actuator

The linear actuator is a linear induction motor that actuates the contact assemblies. It moves the contact assemblies between the Normal power source and Emergency power source as required. The linear actuator operation is initiated automatically with automatic transfer switches. Manual operation of the transfer switch is possible. Refer to manual operation in the OPERATION section.

Motor Disconnect Switch

The motor disconnect toggle switch opens and closes the linear actuator circuit. It is located on the transfer switch panel as in Figure 3. It is placed in the down position for manual operation and the up position for automatic operation.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal and Emergency side of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The auxiliary contacts have current ratings of 10 amperes at 480 VAC.

ELECTRONIC CONTROL

This section describes the standard electronic control. A description of the basic circuits follows.

Starting Circuits

The starting circuit is a basic supervisory function of the OT control. Water-cooled Onan generator sets use a two-wire start control.

Although the logic is more involved, the two-wire starting circuit can be thought of as a single pole, single throw switch. A closed switch signals the generator set to start. An open switch signals the electric generator set to stop. The starting battery of the generator set provides the operating voltage.

An OT option is available for Onan air-cooled generator sets which require a three-wire starting control. See *OPTIONS* later in this section for a description.

Time Delays

Start Time Delay: is adjustable from zero to six seconds. This brief time delay (factory set at two seconds) prevents generator set starting from power interruptions of short duration. Timing starts the moment of Normal power interruption. If the duration of interruption exceeds the delay time, the OT signals the generator set to start.

Stop Time Delay: is adjustable from zero to eight minutes, is factory set for five minutes. It begins timing when the load is retransferred to the Normal power source. At the end of delay, the stop signal is sent to the generator set. This time delay allows the generator set to cool down at no load before stopping.

Transfer Time Delay: begins when generator voltage and frequency reach the settings of the control. After the delay, the transfer switch transfers the load to the Emergency power source. This brief time delay (factory set at two seconds) allows the generator set to stabilize before load is applied. It has an adjustable range of zero to two minutes.

Retransfer Time Delay: is factory set for 15 minutes and begins the moment Normal line voltage and frequency return. After the delay, the transfer switch can retransfer the load to the Normal source. The delay allows the Normal source to stabilize before retransfer. It has an adjustable range of 0 to 32 minutes.

Undervoltage Sensing

If the monitored source voltage falls to the dropout point, a signal from the time delay module transfers the load to the other power source (if present and within acceptable limits). The time delay module logic looks at the source OK signals from both sources and decides which one to transfer to after the appropriate time delay. The undervoltage sensor only decides if the source it is monitoring is OK.

The sensors are factory set to pick up at 95 percent of the nominal voltage and drop out at 85 percent. The pickup setting is adjustable from 85 to 100 percent of the nominal voltage, and the dropout setting from 75 to 98 percent of the pickup voltage.

To transfer load to the Normal power source, for example, the Normal source voltage would have to be 95 percent of the nominal voltage. Once connected, the voltage sensor would not signal for a drop of load unless Normal voltage fell below 85 percent of the pickup voltage.

The standard OT will have undervoltage sensing for all phases of the Normal and Emergency power source.

Options

Three Wire Starting Control: A three-wire starting control enables the transfer switch to start and stop a three-wire start generator set (Onan air-cooled). See Figure 15. Three-wire starting logic is similar to a single-pole, double-throw switch. A common is closed to one side to send a start signal, and to the opposite side to send a stop signal. In addition to start and stop functions, the control has an Overcrank Relay, Overcrank Lamp/Reset Switch, and Auto/Stop/Hand Crank Switch described below.

Overcrank Relay: (Figure 15) protects the engine starter motor by limiting cranking time. If the generator set does not start within the adjustable time limit (up to 60 seconds), the relay opens the starting circuit. The Overcrank lamp lights to indicate an overcrank condition.

Overcrank Lamp/Reset Switch: is located on the cabinet door, Figure 14, and is operated by the overcrank relay. It lights to indicate the engine starting circuit has opened. After the starting problem is corrected, the circuit is reset by pushing the lamp inward and releasing.

Auto/Stop/Hand Crank Switch: is located on the cabinet door, Figure 14. This switch is the operation selector switch for the three-wire start Onan generator set. The three positions Auto, Stop, and Hand Crank, function as follows:

- | | |
|--------------------|--|
| AUTO: | Allows the generator set to start and assume the load if a power outage occurs. This is the normal operating position. |
| STOP: | Shuts down the generator set and prevents it from starting. Use this position when servicing the generator set. |
| HAND CRANK: | Prevents the automatic transfer switch from starting the generator set but allows starting and stopping at the set. Use this position for generator set maintenance. |

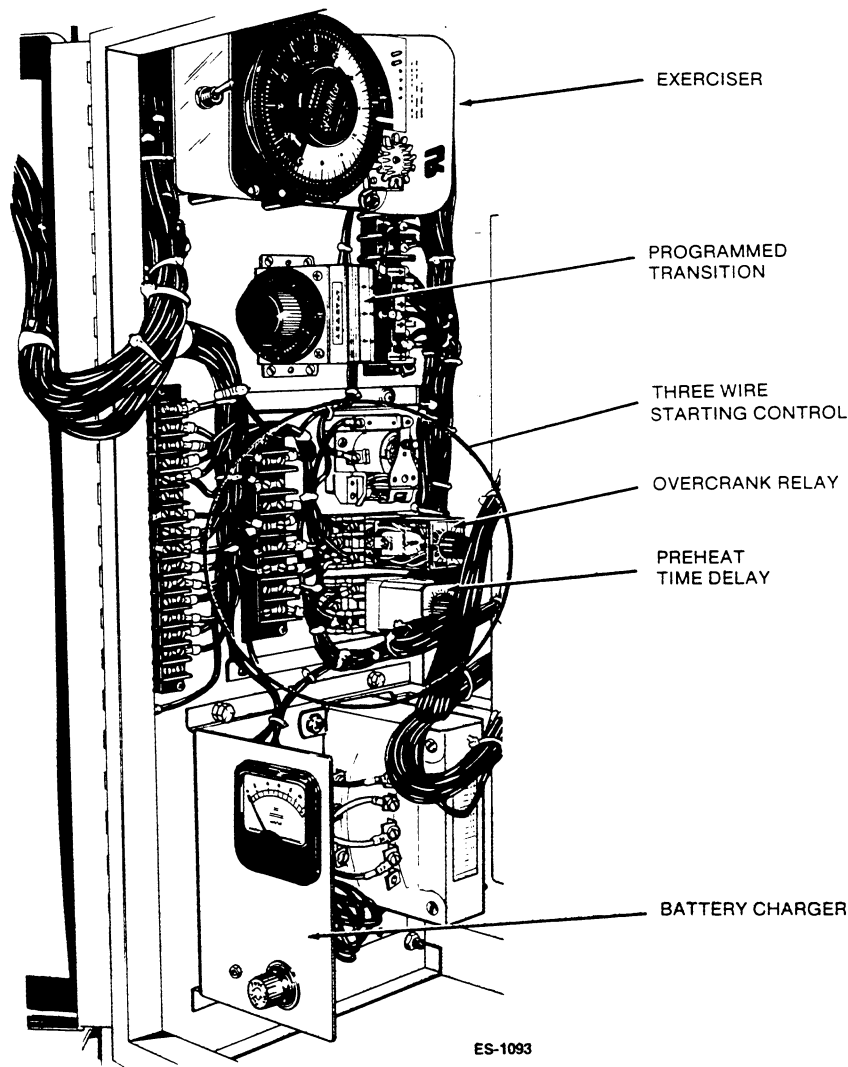


FIGURE 15. OT OPTIONS WITHIN CABINET

Generator Failure Contact

(Three-Wire Starting Only): This option has a two-place terminal connection for a remote signal device to indicate a generator failure such as an overcrank condition described previously. The relay with this contact is located within the three wire starting control.

Preheat Time Delay (Three-Wire Starting Only): If the application requires, a time delay relay can be installed which delays cranking of a three-wire start Onan diesel generator set for preheating (Figure 15). This relay prevents the engine starter motor from functioning until the adjustable preheat time delay, 0.6 to 60 seconds, is complete.

Exerciser: The exerciser initiates generator set starting and exercising for preheat intervals. See Figure 15. It is a fourteen-day, twenty-four hour clock. A large dial divides the twenty-four hour day into fifteen-minute intervals. A smaller spoked dial divides two weeks into one-day segments. Placement of trip pins in the dial faces determines exercise periods.

Preferably, the generator set should have load during the exercise periods. However, the With Load/Without Load selector switch on the exerciser gives the option of exercise load conditions. The With Load position means the generator set will assume any loads (during exercise periods) that normally are supplied through the transfer switch from the utility.

Battery Charger: An OT automatic transfer switch can be equipped with either a float battery charger or a trickle battery charger. Both can be used with lead-acid or nickel-cadmium batteries.

Float Battery Charger: A float-charge battery charger regulates its charge voltage to continuously charge 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. The battery charger has an ammeter for indication of charging current and has a fuse for protection of the battery charger circuit.

For 12-volts, the battery charger option is available either as a 2-ampere or a 10-ampere battery charger. For 24 volts, the battery charger option is available either as a 2-ampere or a 6-ampere battery charger.

Trickle Battery Charger: Available for 12-volt battery systems, the trickle charger has an adjustment knob for setting the trickle charge from 5 to 300 milliamperes. It has an ammeter on the front and also has a fuse for circuit protection.

Meters: Onan has meter options as operating indicators of the Emergency power source. These include an AC voltmeter, AC ammeter, frequency meter, and running time meter. Figure 14 shows the location of these optional meters.

AC Voltmeter: The voltmeter measures line-to-line voltage of the Emergency power source. For three-phase voltages, a selector switch is included.

AC Ammeter: The ammeter measures the line currents of the Emergency source output. For three-phase systems, a selector switch is included.

Frequency Meter: This meter measures the output frequency of the Emergency power source in hertz.

Running Time Meter: A running time meter records the time the generator set has run in hours and tenths of an hour.

Frequency Sensing: Optional frequency sensing for the Normal and Emergency power source detects when frequency is within an adjustable bandwidth (± 4 to $\pm 20\%$). If the frequency goes above or below the bandwidth, the automatic transfer switch will initiate transfer of load to the other source. An adjustable dropout time delay allows the control to ignore momentary dips or rises in frequency.

Overvoltage Sensing: Optional overvoltage sensing of all lines is available along with undervoltage and frequency sensing.

The overvoltage sensing limit is adjustable from 105 to 135 percent of the nominal voltage, and is factory set at 110 percent. The overvoltage pickup point is fixed at 5 percent below the limit setting. An adjustable time delay overrides momentary overshoots in voltage.

Programmed Transition: Programmed transition is an optional feature of Onan Series OT transfer switches. Programmed transition is the capability of the transfer switch to assume a mid-transition position, for an adjustable interval of time, when the load is neither connected to the Normal power source nor to the Emergency power source. This feature allows residual voltages in a motor load to decay to an acceptable level before transition is completed. The length of time that the transfer switch is in the mid-position can be adjusted from 0.5 to 5 seconds, 1.5 to 15 seconds, or 5 to 50 seconds depending on the timer option. The proper adjustment is a function of the motor and its connected load.

RELAY CONTROL

The basic part of the standard relay control circuit is the starting circuit. Water-cooled Onan generator sets use an OT with a two-wire start control circuit.

Although the logic is more involved, the operation of a two-wire starting circuit can be thought of as a simple single-pole, single-throw switch. A closed switch signals the generator set to start and run. An open switch signals the generator set to stop.

Voltage sensing is accomplished by relays in the control. Frequency sensing is not available for an OT with a relay control.

Options

Start Time Delay: This delay, adjustable from 1.5 to 15 seconds, provides a factory-set, 3-second delay before the generator set is allowed to start. It starts timing the moment of Normal power interruption. If the duration of power interruption exceeds the delay time, the OT signals the generator set to start. The purpose of the start time delay is to prevent the generator set from starting when power interruptions of very short duration occur.

Stop Time Delay: The stop time delay has a fixed setting for five minutes. It begins timing when the load is retransferred to the Normal power source. At the end of the stop time delay, the stop signal is sent to the generator set. The purpose of this time delay is to allow the generator set to cool while running at no load.

Transfer Time Delay: The transfer time delay begins the moment generator voltage and frequency reach the pick up settings of the control. At the end of the transfer delay, the transfer switch is allowed to operate, transferring the load to the Emergency power source. This factory fixed time delay of six seconds allows the generator set to stabilize before load is applied.

Retransfer Time Delay: This time delay, set for 10 minutes at the factory, begins the moment Normal line voltage returns. At the end of the delay, the transfer switch is allowed to retransfer the load to the Normal power source. The delay allows the Normal power source to stabilize before retransfer. It has a time range adjustable from 3 to 30 minutes.

Battery Charger: See description in the *Electronic Control* section.

Operation

AUTOMATIC OPERATION

The automatic transfer switch is set for automatic operation by placing control switches in the positions given below. The generator set must also be set for automatic operation.

Motor Disconnect switch (on transfer switch cover) - up position.

Test/Normal/Retransfer switch - Normal position.

Stop/Auto/Hand Crank switch (three-wire start for Onan air-cooled generator sets only) - Auto position.

Operation selector switch on engine control (two-wire start for Onan water-cooled generator sets only) - Remote position.

MANUAL OPERATION

The transfer switch has operator handles for manually transferring of the load. Use the following procedure:

WARNING *Some terminals within the transfer switch cabinet and door present a shock hazard which might cause serious personal injury or death if touched. For this reason, stay clear of exposed terminals while performing manual operation of the transfer switch.*

1. Open the cabinet door of the automatic transfer switch.
2. Move the motor disconnect switch to the down position.
3. **Transfer** - from the Normal to the Emergency power source
 - A. Pull the upper manual operator handle down.
 - B. Push the lower manual operator handle down.

Retransfer - from the Emergency to the Normal power source

- C. Pull the lower manual operator handle up.
 - D. Push the upper manual operator handle up.
4. Before moving the Motor Disconnect switch back to the on or up position, remember the transfer switch will transfer load to the active power source (if both power sources are available, transfer will occur to Normal source if voltage is satisfactory).

WARNING *Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of serious personal injury. Keep hands clear of handles when switching back to automatic operation.*

5. Move the Motor Disconnect switch to the up position.
6. Close the cabinet door.

GENERATOR SET EXERCISE

Onan recommends running the generator for at least 30 minutes once each week with at least 50 percent load (if possible). If you do not have an optional exerciser, Figure 7, use the Test/Normal/Retransfer switch, as described earlier, to exercise the generator set each week.

The optional exerciser has preselected exercise periods and exercises the generator set automatically with or without load, depending on its switch position, Without Load or With Load. If the Normal power source has an interruption while the generator set is exercised without load, the automatic transfer switch will transfer the load to the generator set.

STANDBY SYSTEM TEST

1. Move the Test/Normal/Retransfer switch to Test. The generator set should start after the start time delay and assume the load after the transfer time delay.

If the OT has the optional exerciser, the With Load/Without Load Selector switch must be in the With Load position in order to test with load.

2. At the end of the test period, move the Test/Normal/Retransfer switch to Normal if you want the automatic transfer to transfer load back to the Normal power source after the retransfer time delay. To bypass the retransfer time delay and cause immediate load transfer, move the Test/

Normal/Retransfer time delay to the spring-return position. Retransfer and release (switch will return to Normal). The generator set will stop after the stop time delay.

STARTING CIRCUIT RESET

An overcrank condition exists when the generator set fails to start within the time limit set on the overcrank relay. When this condition occurs, the Overcrank lamp on the cabinet door will light as an indicator (Figure 11). To restore the automatic starting circuit:

1. Correct the engine starting problem.
2. Push the Overcrank lamp inward and release to reset the overcrank relay.

Troubleshooting

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

1. Check for overcrank condition.
2. Two-wire starting only (for Onan water-cooled generator sets): The operation selector switch on the generator set control panel should be set at *Remote*.
3. Three-wire starting only (for Onan air-cooled generator sets): The Auto/Stop/Hand Crank switch on the OT cabinet should be set to *Auto*.
4. Check generator set. Start with start-stop controls on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

WARNING *Ignition of explosive battery gases might cause severe personal injury. Do not smoke while servicing batteries.*

WARNING *Ignition of fuel might cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, or other igniter near the fuel system.*

GENERATOR SET STARTS DURING NORMAL POWER SERVICE

1. Two-wire starting only (for Onan water-cooled generator sets): The operation selector switch on the generator set control panel should be set at *Remote*.
2. Three-wire starting only (for Onan air-cooled generator sets): The Auto/Stop/Hand Crank switch on the OT cabinet should be set to *Auto*.
3. Check Test/Normal/Retransfer switch to make sure it is set at *Normal* position.
4. Open OT cabinet door and check exerciser clock to see if it is scheduled for exercise period.

WARNING

High voltages within cabinet and rear side of cabinet door present a shock hazard which might cause serious personal injury or death. Use care when opening cabinet door.

5. Momentary voltage dips might cause voltage sensors to initiate generator set starting. If problem persists, contact authorized service personnel. Voltage sensing settings might have to be changed.

GENERATOR SET DOES NOT EXERCISE (IF EQUIPPED WITH EXERCISER)

1. Two-wire starting only (for Onan water-cooled generator sets): The operation selector switch on the generator set control panel should be set at *Remote*.
2. Three-wire starting only (for Onan air-cooled generator sets): The Auto/Stop/Hand Crank switch on the OT cabinet should be set at *Auto*.
3. Check exerciser to see if it is set correctly and is running.

WARNING

High voltages within cabinet and rear side of cabinet door present a shock hazard which might cause serious personal injury or death. Use care when opening cabinet door.

4. Check generator set. Start with start-stop controls on generator set. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply.

WARNING

Ignition of explosive battery gases might cause severe personal injury. Do not smoke while servicing batteries.

WARNING

Ignition of fuel might cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, or other igniter near the fuel system.

GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check output voltage of the emergency power source by observing voltmeter of generator set or optional voltmeter on the automatic transfer switch.
2. Open cabinet door and check to see if motor disconnect switch is in up position.

WARNING *High voltages within cabinet and rear side of cabinet door present a shock hazard which might cause serious personal injury or death. Use care when opening cabinet door.*

NO TRANSFER OF LOAD TO NORMAL POWER FROM GENERATOR SET

1. The retransfer time delay period might not have expired. Wait a few moments.
2. Open the cabinet door and check the motor disconnect switch position. For automatic operation, it should be in the up position.

WARNING *High voltages within cabinet door rear side of cabinet door present a shock hazard which might cause serious personal injury or death. Use care when opening cabinet door.*

3. Manually initiate retransfer by turning the Test/-Normal/Retransfer switch to *Retransfer*.

4. Stop the generator set with the start-stop switch. When the generator set stops, the transfer switch will transfer load to the normal power source if voltage is normal.

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

Stop time delay function could be a problem. Stop generator set with start-stop switch.

BATTERY CHARGER FAILS TO CHARGE (IF EQUIPPED)

Check battery charger fuse on the battery charger. Replace if necessary with correct fuse.

WARNING *Ignition of explosive battery gases might cause severe personal injury. Do not smoke while servicing batteries.*

BATTERY LOSES WATER

Battery charger float voltage could be too high (if equipped with battery charger). Call Onan service representative.

BATTERY LOSES CHARGE

Battery charger float voltage could be too low (if equipped with battery charger). Call Onan service representative.

Parts and Service Information

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. Also note if the cabinet contains a modification

label inside which lists any added options. If it does, give the information listed on the label to your dealer too. The wiring diagrams furnished with your Series OT transfer switch should be kept with your instruction manual.



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