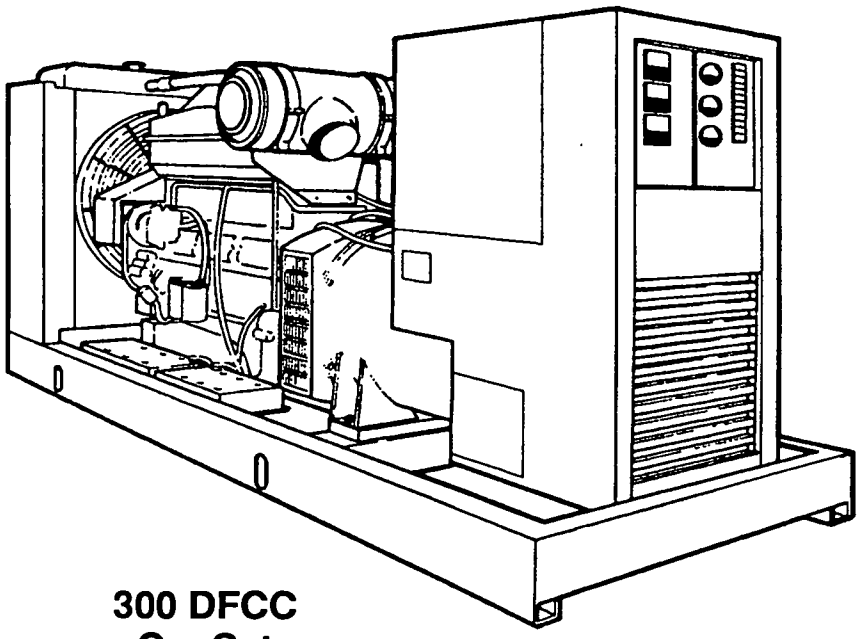
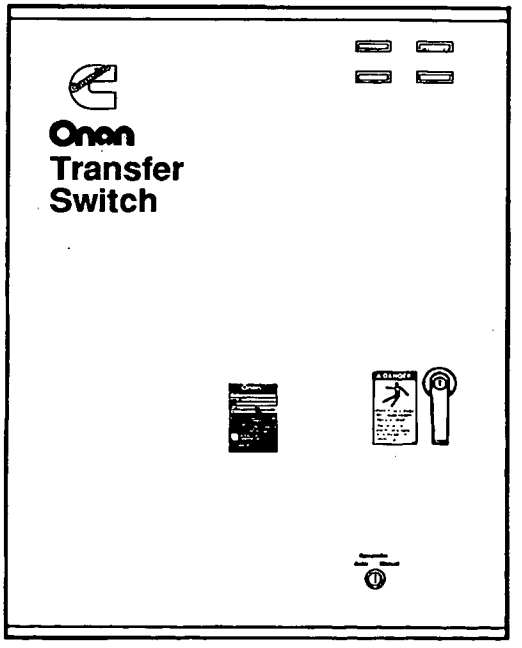
Instruction Manual



300 DFCC
GenSet

Standby GenSet and Transfer Switch System



OT/ON
(OT III)
Transfer
Switch

Printed U.S.A.

900-0277 4-94

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Table of Contents

Section 1. Introduction

GENERAL

This section of the manual describes the major components of the load transfer control system equipment (Generator Set and Transfer Switch). The system provides for automatic and manual transfer switch control of the power between the normal (utility) and emergency (generator set) sources to the load(s).

MAJOR COMPONENTS

The system consists of an automatic transfer switch cabinet and a diesel engine–generator set (GenSet).

Transfer Switch

The Onan® Model OT III™ Automatic Transfer Switch includes the following features:

- transfer switch position indicator lamps –

  Normal (Source 1)
  Emergency (Source2)

- key operated Auto/Manual switch

  Manual position provides immediate retransfer to normal source, bypassing time delay.

- key locking cabinet

For in-depth description of the OT III Transfer Switch, refer to the following manuals:

Installation Manual – 962–0600 – in tab section 6

Operation – 962–0113 – in tab section 6

Service – 962–0512 – in tab section 7

GenSet

The Onan Generator Set (GenSet) consists of the following components:

- Cummins® diesel engine
- Onan® generator and control panel

For in-depth description of the GenSet components, refer to the following manuals:

Installation Manual – 960–0606 – in tab section 6

Operation – 960–0138 – in tab section 6

Service – 960–0504 – in tab section 7

TRANSFER SWITCH CONTROL

The transfer switch contains external operational status indicator lamps as shown in Figure 1-1.

For in-depth description of transfer switch operation, refer to:

Operater's Manual – 962–0113 – in tab section 6

Service – 962–0512 – in tab section 7

The primary transfer switch control component is a *Power Sentry*™ control (internal control component) that initiates starting and stopping of the genset, and closing or opening the transfer switch, to enable the GenSet power to supply loads when the normal source fails.

The Power Sentry control contains multiple function timing adjustments. The program transition module contains the program transition timing adjustment.

All controls and indicators are described in *Operation*, Section 4 and adjustments are described in *Adjustments*, Section 6 of this manual.

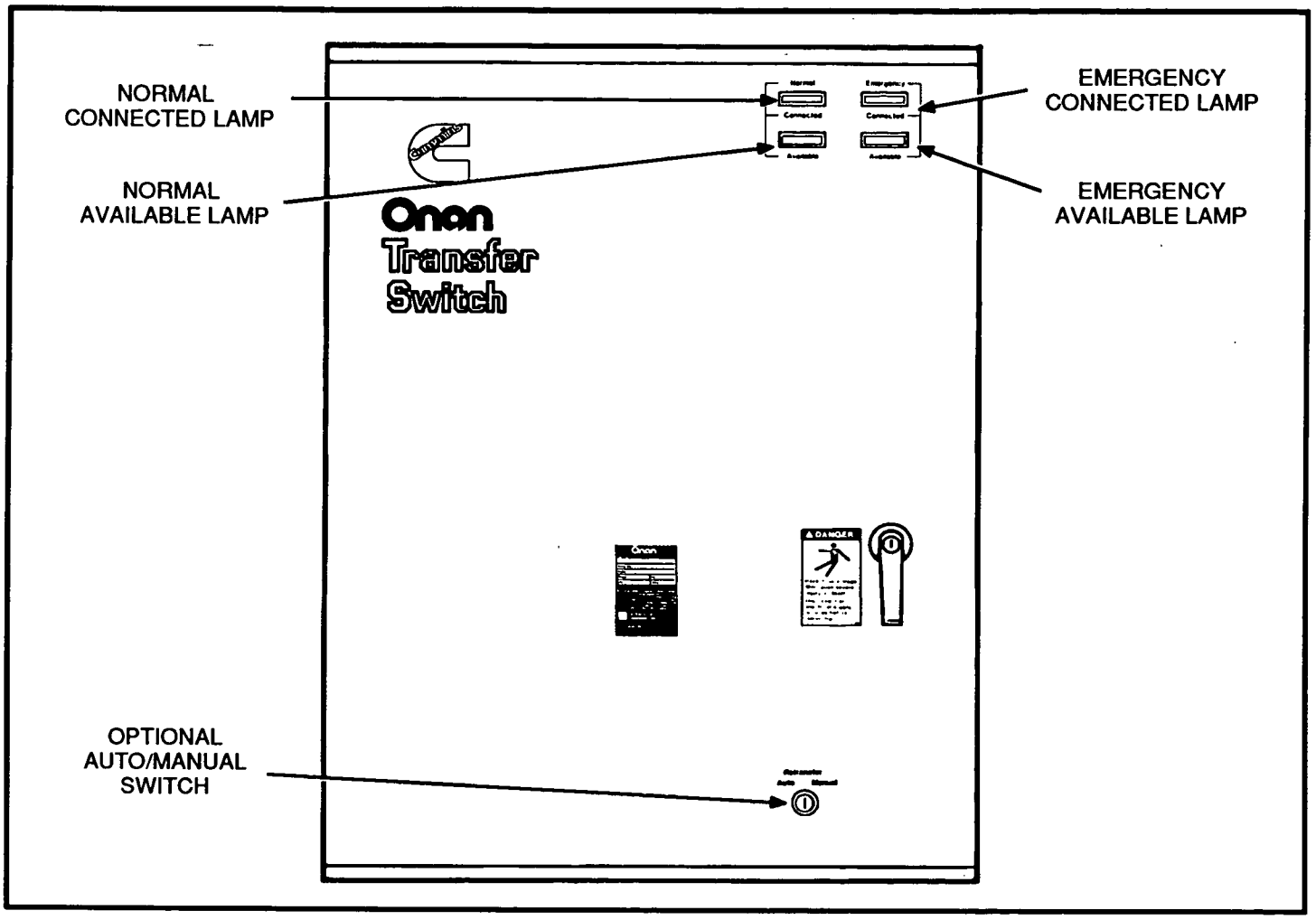

FIGURE 1-1. OT III TRANSFER SWITCH

GENSET CONTROLS

The control panels are separated into an AC panel for monitoring the generator and a DC panel for monitoring the engine. Review Figure 1-2 to identify the control configuration, and refer to Control Descriptions that follow for further information.

AC Panel

The following describes the function and operation of the optional AC panel for monitoring the generator. Review the following component descriptions and Figure 1-2.

AC Voltmeter: Dual range instrument indicating generator AC voltage. Measurement range in use shown on indicator lamps.

AC Ammeter: Dual range instrument indi–cates AC generator line current. Measurement range in use shown on indicator lamps.

Frequency/RPM Meter: Indicates generator output frequency in hertz and engine speed in revolutions–per–minute (RPM).

Voltage Adjust: Rheostat providing approximately plus or minus five percent adjustment of the rated output voltage.

Upper and Lower Scale Indicator Lamps: Indicates which scale to use on the AC voltmeter and AC ammeter.

Phase Selector Switch: Selects phases of generator output to be measured by AC voltmeter and AC ammeter.

Field Breaker: Provides generator exciter and regulator protection from overheating in the event of an overvoltage fault condition.

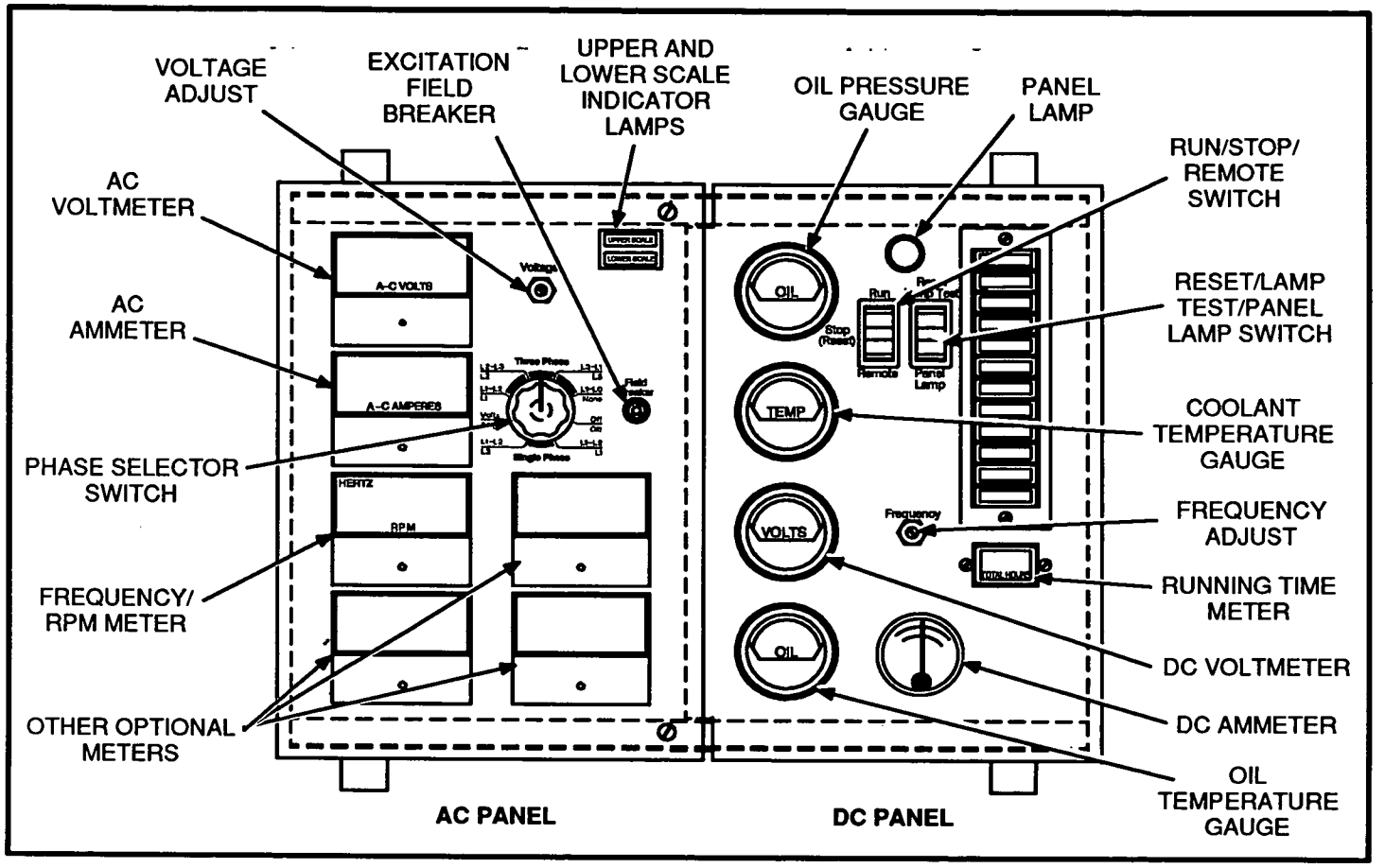

FIGURE 1-2. GENSET CONTROL PANELS

DC Panel

The following describes the function and operation of the DC panel components. The control includes pre–alarm monitoring to inform the operator that a shutdown might occur if attention is not given to an aspect of engine operation soon. Review the following component descriptions and Figure 1-2.

Panel Lamp: Illuminates control panel.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine (wired to a sensor unit located on the engine).

Water Temperature Gauge: Indicates temperature of circulating coolant in engine (wired to a sensor unit located on the engine).

DC Voltmeter: Indicates the battery condition. Proper reading should be approximately 26 to 28 volts when set is running.

Oil Temperature Gauge: Indicates temperature of lubricating oil in engine (wired to a sensor unit located on the engine).

Battery Charge Rate DC Ammeter: Indicates the battery charging current.

Run–Stop–Remote Switch: Starts and stops the unit locally, or from a remote location that is wired to the control engine monitor board.

Reset, Lamp Test, Panel Lamp Switch: Resets the fault circuit only when the Run–Stop–Remote switch is in the Stop (Reset) position. Tests fault lamps and turns on the control panel lamp.

Frequency Adjust: Potentiometer providing engine speed adjustment to achieve proper AC frequency.

Running Time Meter: Registers the total number of hours the unit has run. Use it to keep a record of periodic servicing. Time is cumulative; meter cannot be reset.

Indicator Lamps

The control panel has a 12 lamp monitoring system. The following describes each lamp function.

- **RUN** (green) lamp comes on when both starter circuits are opened after unit starts.
- **PRE LO OIL PRES** (yellow) indicates engine oil pressure is marginally low.
- **PRE HI ENG TEMP** (yellow) indicates engine temperature is marginally high.
- **LO OIL PRES** (red) indicates engine has shut down because of critically low oil pressure.
- **HI ENG TEMP** (red) indicates engine has shut down because of critically high temperature.
- **OVERSPEED** (red) indicates engine has shut down because of excessive speed.
- **OVERCRANK** (red) indicates the starter has been locked out because of excessive cranking time.
- **FAULT 1** (red) an undedicated fault. May be programmed as a timed or non–timed shutdown or fault light only (normally factory set for timed shutdown).
- **FAULT 2** (red) same features as Fault 1 (normally factory set for non–timed shutdown).
- **LOW ENG TEMP** (yellow) engine temperature is marginally low for starting. Indicates possible inoerative coolant heater. Lamp lights when engine water jacket temperature is 70° F (21° C) or lower. The lamp may stay on during initial generator set operation, but should go out after the engine warms up.
- **LO FUEL** (yellow) indicates fuel supply is marginally low.
- **SWITCH OFF** (flashing red) indicates generator set is not in automatic start operation mode.

SYSTEM POWER

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 is connected to the common of the transfer switch (Figure 1-3). Under normal conditions, the load is supplied with power from the Normal source (as illustrated). If the Normal power source is 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.

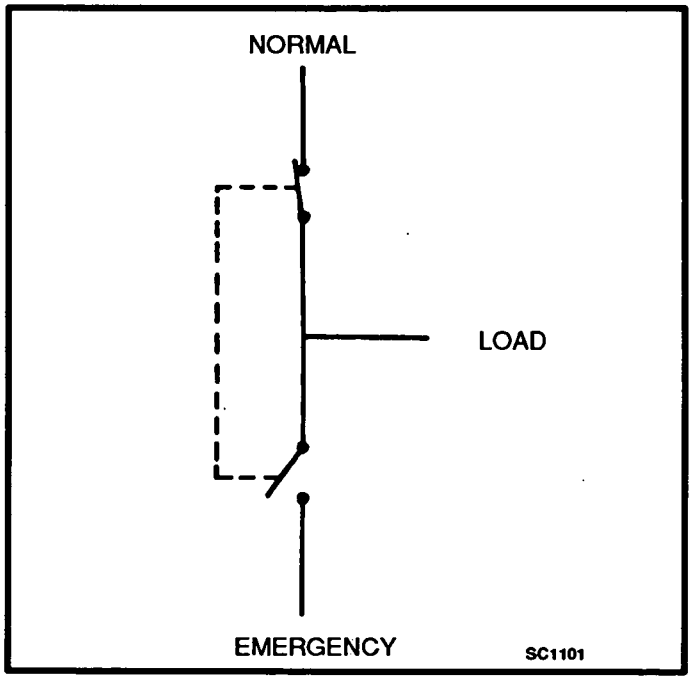

FIGURE 1-3. LOAD TRANSFER SWITCH (TYPICAL FUNCTION)

NORMAL OPERATION

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.

Section 2. Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

HIGH VOLTAGE GENERATOR SETS (1.9kV to 15kV)

- High voltage acts differently than low voltage. Special equipment and training is required to work on or around high voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of high voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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

High voltage in OT transfer switch components presents serious shock hazards that can result in severe personal injury or death. Read and follow these suggestions.

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

Due to the serious shock hazard from high voltages within the cabinet, all service and adjustments to the transfer switch must be performed only by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move the REMOTE/STOP/RUN selector switch on the generator set to STOP position.
2. Disconnect the starting batteries of the generator set (remove the ground [–] lead first).

⚠CAUTION ***To prevent arcing, always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).***

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (–) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (–) cable first, and reconnect it last.

3. Remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

Place rubber insulative mats on dry wood platforms over metal or concrete floors 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, or after consuming alcohol or any drug that makes the operation of equipment unsafe.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

Section 3. Installation

LOCATING THE GENSET AND TRANSFER SWITCH

Draw up plans for location and mounting on the basis of the applicable outline drawing of the set. See your distributor.

The location of the GenSet and Transfer Switch in the existing electrical circuit varies with the application and the type of entrance switch. The location and wiring must comply with the contract drawings.

To aid you in your planning, typical GenSet and Transfer Switch installations are shown in Figures 3-1 and 3-2.

Refer to GenSet and Transfer Switch Installation Manuals in Tab section 6 for further information (i.e., control wiring and power cabling).

Locate the set where there will be enough room to perform periodic maintenance and service. Because of noise, vibration and fumes, the generator room should be located as far from office rooms as possible. The requirements for ventilation, engine cooling and exhaust discharge must also be considered when locating the set.

⚠WARNING ***Do not install these generator sets in conjunction with gasoline fueled equipment. They are not "ignition protected" and can therefore ignite gasoline fumes.***

The set should be mounted as level as possible. The skid can usually be bolted securely to specific anchor bolts installed in the flooring (concrete base), or to integral vibration isolators provided between the base and the skid.

There must be a service disconnect in the commercial power line ahead of the transfer switch.

Choose a vibration-free mounting surface that will support the weight of the GenSet. Avoid locations that are near flammable liquids or gases, or are hot, moist, or dusty.

⚠WARNING ***Because an electrical arc will occur during transfer, the switch must not be located near batteries, fuel tanks, solvents, or other sources of flammable liquids or gases.***

WALL MOUNTING THE TRANSFER SWITCH

1. Check the location to be sure that no wires, or plumbing, gas, or exhaust lines run behind the wall.
2. Install two mounting bolts in the wall for the top cabinet mounting keyholes.
3. With the shipping box standing so the cabinet is upright, carefully remove the top and sides of the box.
4. Raise the cabinet and mount it on the two mounting bolts in the wall.

   ⚠WARNING ***Improper lifting can cause severe personal injury. Have sufficient manpower for lifting and mounting the cabinet.***
5. Install two bottom mounting bolts, but do not tighten. (Do not remove the cabinet support until all bolts are installed.)
6. Push the cabinet against the wall. If the cabinet will not align flush against the wall, shim the mounting bosses as required.
7. Tighten all mounting bolts.

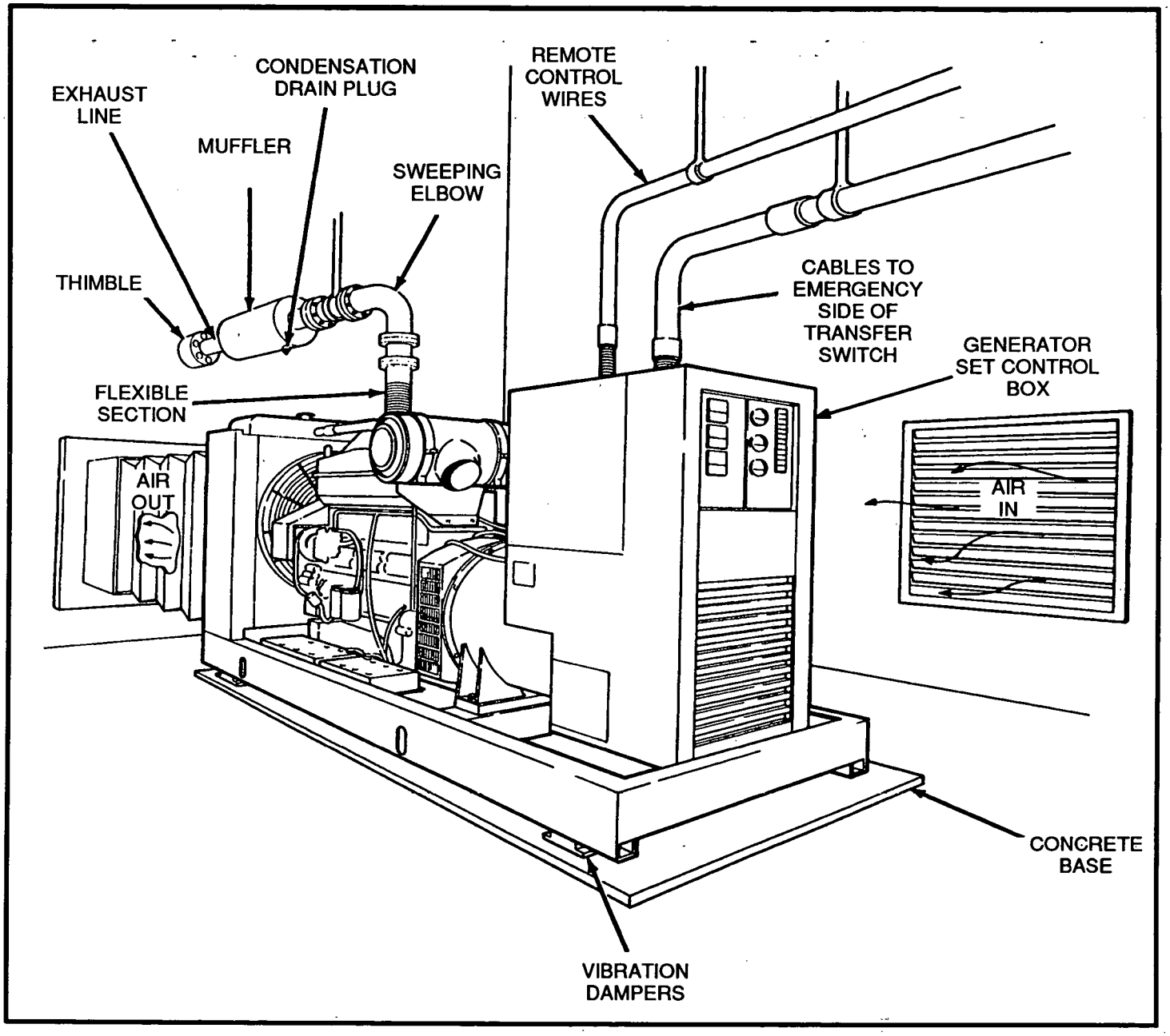

FIGURE 3-1. TYPICAL GENSET INSTALLATION

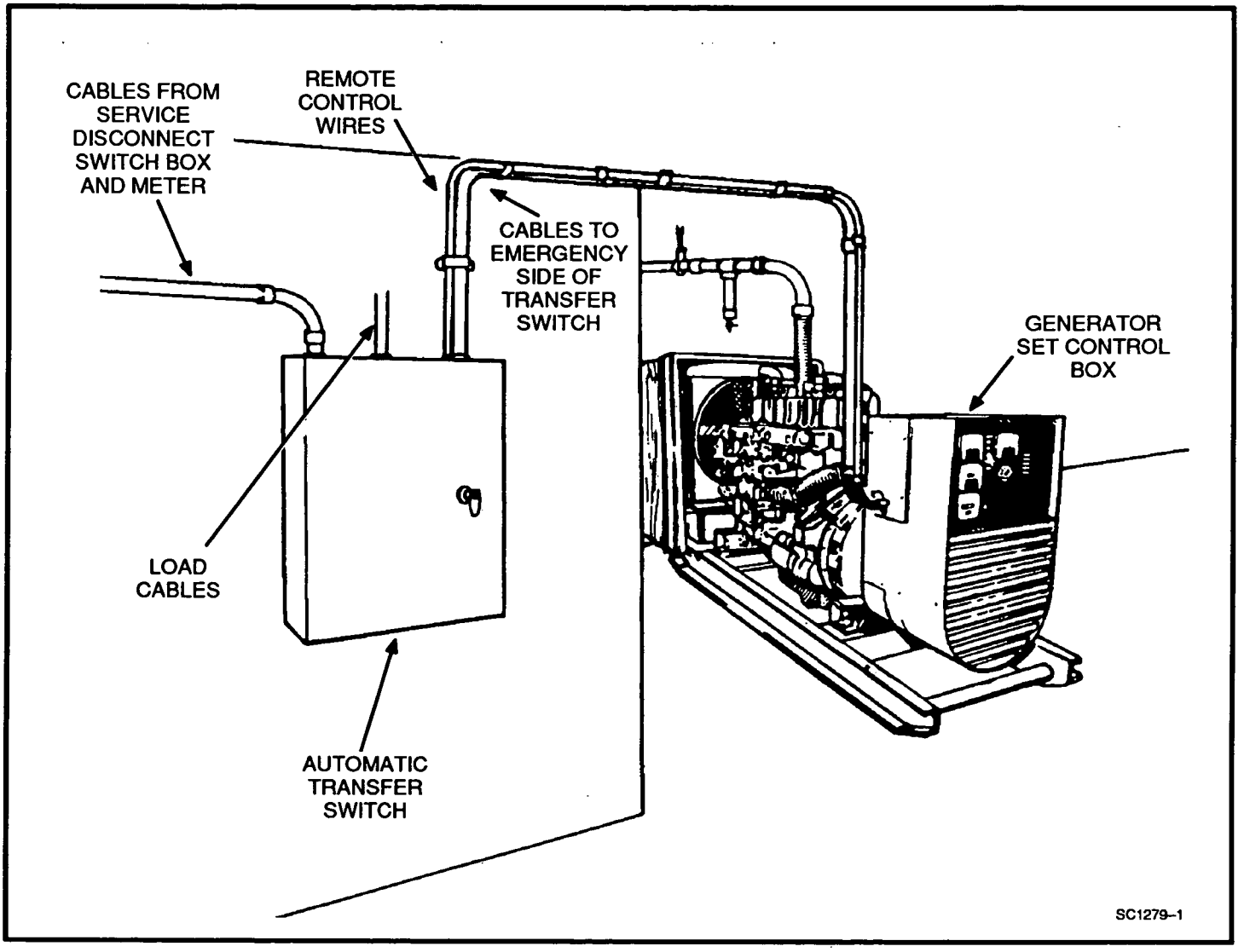

FIGURE 3-2. TYPICAL WALL-MOUNT TRANSFER SWITCH INSTALLATION

Section 4. Operation

INTRODUCTION

Automatic transfer switches control transfer of the load to the Normal power source or to the Emergency power source (generator set) without operator involvement. Thoroughly review the transfer switch Operator's Manual in Tab section 6.

CABINET

The standard cabinet (Figure 4-1) meets the requirements for a UL Type 1 cabinet. This type is designated as a general-purpose, indoor cabinet.

Indicator Lamps

There are four indicator lamps on the cabinet door. The Normal Available and Emergency Available lamps are lit whenever their corresponding power sources (utility or generator set) are producing power. These two lamps can be lit simultaneously.

The Normal Connected lamp is lit when the automatic transfer switch is in the normal position.

The Emergency Connected lamp is lit when the automatic transfer switch is in the emergency position.

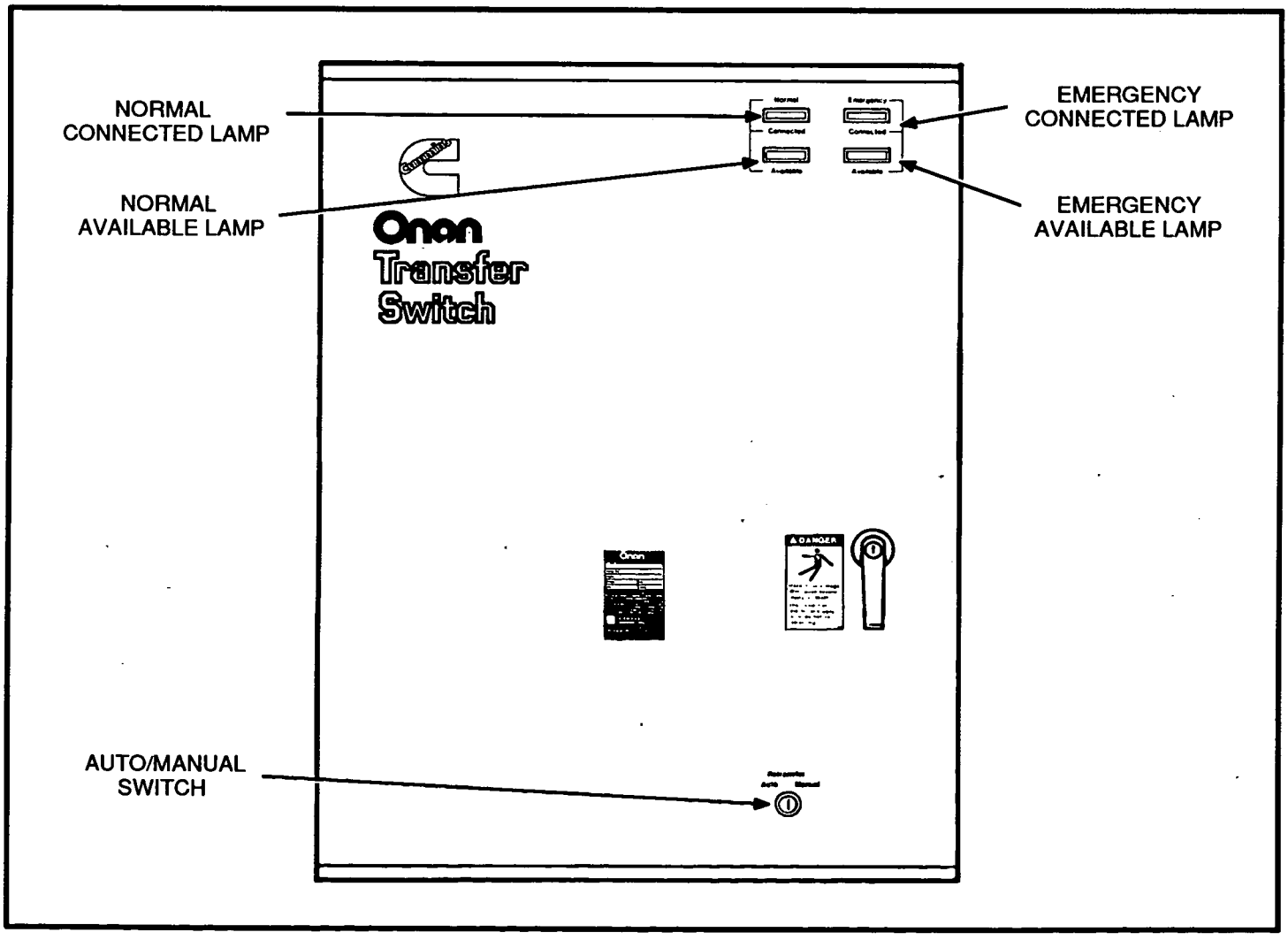

FIGURE 4-1. CABINET

Auto/Manual Switch

The Auto/Manual switch is used to enable or disable the automatic retransfer function. This switch has two positions. In the Auto position, normal automatic retransfer is enabled. In the Manual position, automatic retransfer (from a functioning generator set back to utility power) is disabled; only manual retransfer is possible. In the event of generator set failure, however, the Power Sentry control logic will ignore the Auto/Manual switch and initiate retransfer to utility power.

TRANSFER SWITCH

The transfer switch (Figure 4-2) 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

The automatic transfer switch has either three or four poles. Three pole transfer switches are provided with a neutral bar. The contact assemblies make and break the current flow. When closed to either the Normal or the 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 moves the contact assemblies between the Normal power source and the Emergency power source. Linear actuator operation is initiated automatically with automatic transfer switches. Manual operation of the transfer switch is also possible. Refer to Manual Operation in the *Operation* section of the Operator's Manual.

Motor Disconnect Switch

The Motor Disconnect toggle switch, on the accessory control panel, enables and disables the linear actuator. Place the switch in the Auto position to enable the linear actuator. Place the switch in the Off position to disable the linear actuator.

Auxiliary Contacts

Auxiliary contacts are provided on the Normal and Emergency sides of the transfer switch. They are actuated by operation of the transfer switch during transfer and retransfer. The Normal side auxiliary contact switch is actuated when the transfer switch is in the Normal position. The Emergency side auxiliary contact switch is actuated when the transfer switch is in the Emergency position. The auxiliary contacts have current ratings of 10 amperes at 250 VAC. The contacts are wired to terminal block TB1.

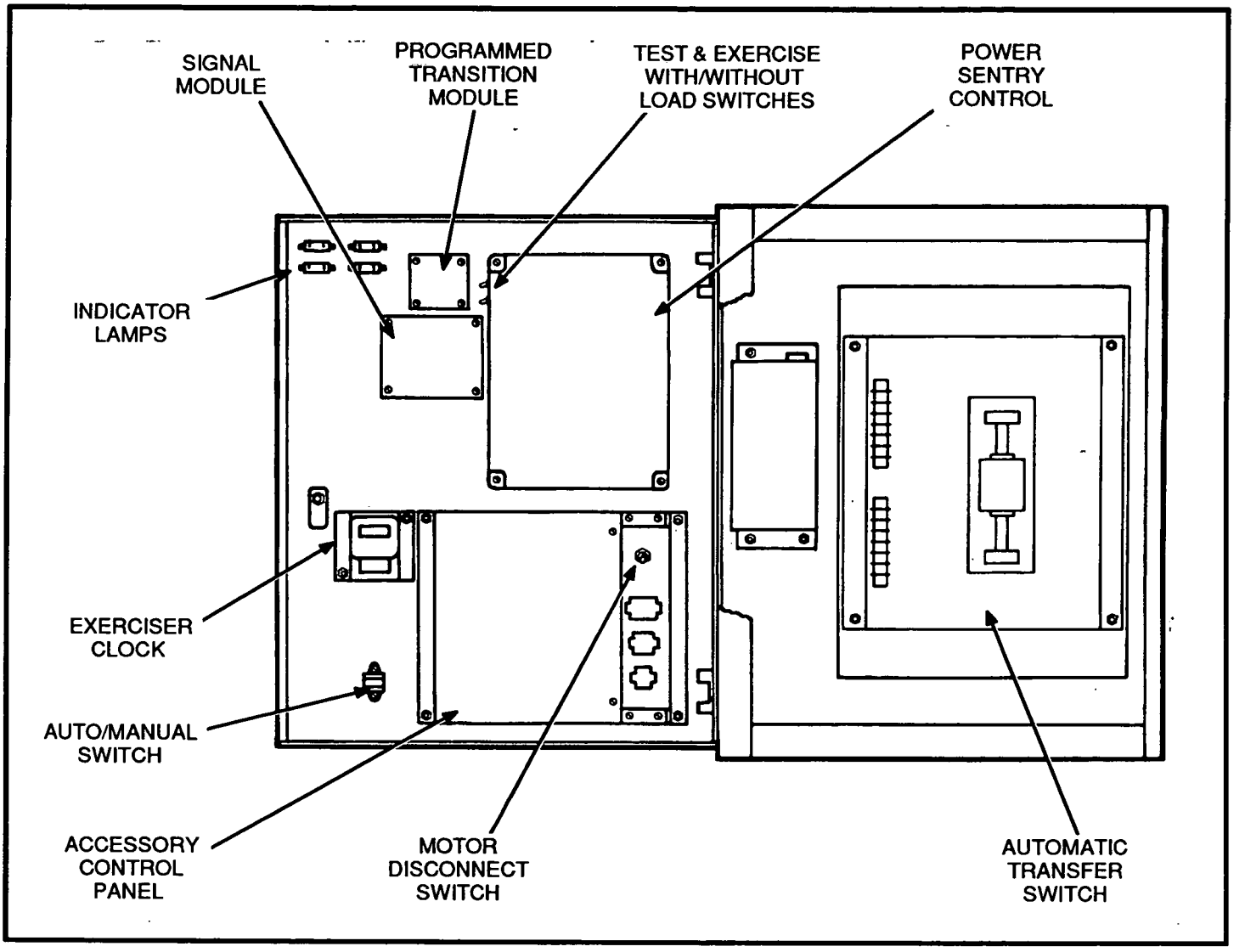

FIGURE 4-2. INTERIOR/COMPONENTS

ELECTRONIC CONTROL SYSTEM

This section describes the components of the electronic control system.

⚠WARNING ***Improper calibration or adjustment of electronic control modules can cause death, severe personal injury, and equipment or property damage. Calibration and adjustment of these components must be performed by technically qualified personnel only.***

All calibration and adjustment procedures are described in the Installation manual and in the Service manual.

The most important component of the electronic control system is the Power Sentry control (Figure 4-2). The Power Sentry includes voltage sensing circuits, time delay circuits and control relays. There are also several adjustment potentiometers and indicator lamps on the Power Sentry. The adjustments must be performed only by qualified service personnel.

⚠WARNING ***Accidental actuation of the linear motor could cause severe personal injury. Disable the motor, as described below, before making any adjustments.***

Place the Motor Disconnect Switch (Figure 4-2) in the Off position when making adjustments. Return the switch to the Auto position after adjustments are completed.

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open.***

Power Sentry Time Delays

Start Time Delay: This delay is adjustable from 0 to 15 or (optionally) from 0 to 90 seconds. This brief time delay prevents generator set starting during power interruptions of short duration. Timing starts the moment of Normal (utility) power interruption. If the duration of interruption exceeds the delay time, the control system signals the generator set to start.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Stop Time Delay: This delay is adjustable from 0 to 10 minutes. It begins timing when the load is retransferred to the Normal power source. At the end of the 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.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Transfer Time Delay: This 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 allows the generator set to stabilize before the load is applied. It has an adjustable range of 0 to 120 seconds.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Retransfer Time Delay: This delay 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 30 minutes.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Undervoltage Sensing

Two voltage sensors, one for the Normal side and one for the Emergency side, monitor source voltages for an undervoltage condition and generate signals, which are sent to the time delay module. If, for example, an under- voltage condition is sensed on the Normal source, the voltage sensor module sends a signal to the time delay module that initiates and controls the timing for generator set start and the transfer of load.

The standard transfer switch has undervoltage sensing for all phases of the Normal and Emergency power sources.

Overvoltage and Frequency Sensing Option

Overvoltage and frequency sensing are available as a single option.

Overvoltage Sensing: With optional overvoltage sensing, the Normal and Emergency sources are monitored for an overvoltage condition.

As with the standard undervoltage sensing, the voltage sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 120 seconds) overrides momentary overshoots in voltage.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Frequency Sensing: With optional frequency sensing, the Normal and Emergency sources are monitored for variations in frequency. The sensors determine whether the source is within an adjustable bandwidth.

As with the standard undervoltage sensing, the frequency sensors signal the time delay module, which controls the transfer or retransfer sequence.

An adjustable time delay (0 to 15 seconds) allows the control to ignore momentary dips or rises in frequency.

To set this time delay, align the slot on the potentiometer with the desired marking on the Power Sentry cover.

Programmed Transition

The optional Program Transition module (Figure 4-4) is used to introduce a pause during transition. Programmed transition allows the transfer switch to assume a mid-transition position for an adjustable interval of time. In this position, the load is **not** connected to either (Normal or Emergency) power source.

This feature allows residual voltage from inductive loads to decay to an acceptable level before transfer is completed. The length of time that the transfer switch is in the midposition can be adjusted from 0 to 7.5 seconds or 0 to 60 seconds, depending on the timer option. The proper adjustment is a function of the load.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 4-4).

If a time delay is desired, make sure that the Delay/ No Delay switch is in the Delay position.

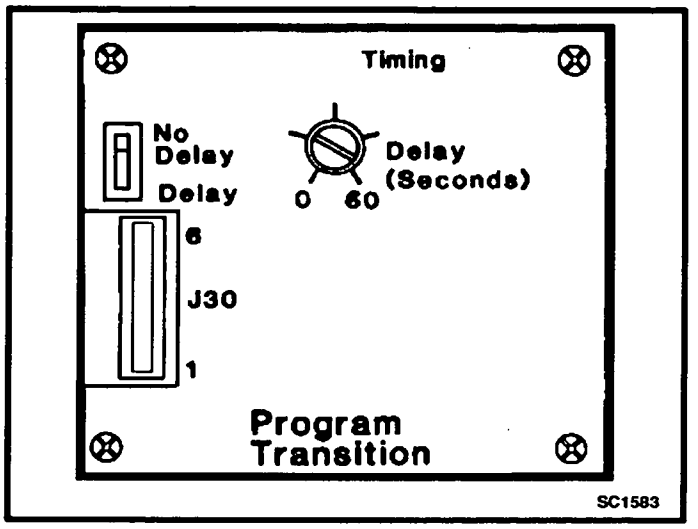

FIGURE 4-4. PROGRAM TRANSITION MODULE

Signal Module

The main function of the Signal Module is to delay transfer (or retransfer) for a preset time while operating a signal contact to give warning that a transfer (or retransfer) is about to occur. This option is typically used in elevator applications.

This module also provides four other sets of form C signal contacts.

The Signal Module has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period.

This time delay is adjustable over a range of 0 to 50 seconds.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 4-5).

If a time delay is desired, make sure that the Delay/ No Delay switch is in the Delay position.

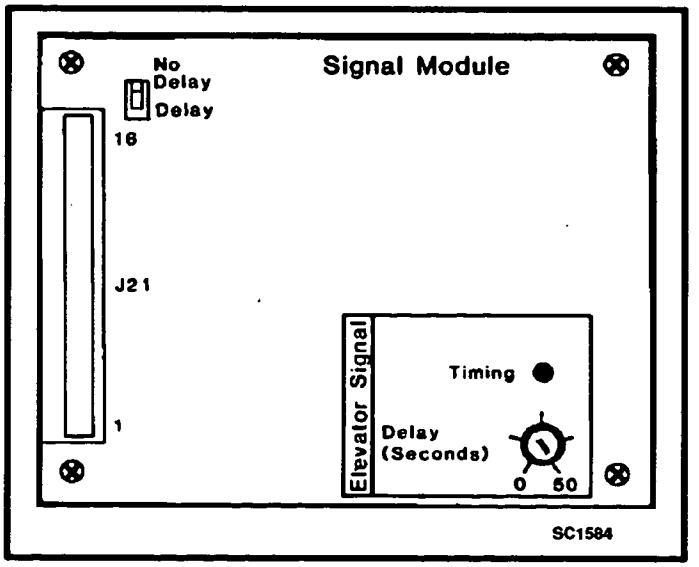

FIGURE 4-5. SIGNAL MODULE

AUTOMATIC OPERATION

Place control switches in the positions given below.

- **Auto/Manual switch:** Auto position.
- **Motor Disconnect switch:** Auto position.
- **Operation selector switch (engine control):** Remote position.

The generator set must also be set for automatic operation.

MANUAL OPERATION

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

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

1. Open the cabinet door of the automatic transfer switch.
2. Move the Motor Disconnect switch to the Off 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 Auto position, remember the transfer switch will transfer load to the active power source. (If both power sources are available, it will transfer the load to the Normal source.)

   ⚠WARNING ***Automatic transfer switch operation results in rapid movement of the manual operator handles and presents a hazard of severe personal injury. Keep hands clear of handles when switching back to automatic operation.***
5. Move the Motor Disconnect switch to the Auto position.
6. Close the cabinet door.

GENERATOR SET EXERCISE

Run the generator for at least 30 minutes once each week with at least 50 percent load (if possible).

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

Remote Test Transfer

The transfer switch may be wired with a remote test switch. Closure of a set of contacts across the remote test transfer inputs causes the transfer switch to sense a (simulated) utility power failure and send a start/run signal to the generator set. The load is transferred to the generator set when generator set power becomes available. (Refer to the Installation and Service manuals.)

Section 5. Periodic Maintenance

INTRODUCTION

Refer to the recommended maintenance schedule for this equipment in the Operator's Manuals. Onan recommends using two maintenance schedules. One based on operational hours (applies to GenSets™), and the second is based on a calendar (lapsed time). Operational hours are those recorded on equipment running–time–meters.

Except for performing Periodic Running Test of Power System Equipment, observe the following warning when performing maintenance.

⚠ DANGER ***This power system represents a hazard that can cause serious injury or death to operating personnel. Both utility and GenSet power must be disconnected from the equipment while maintenance is being performed. the GenSet must also be disabled while performing maintenance.***

Prior to beginning any procedures: Operate GenSet control panel REMOTE/STOP/RUN switch to STOP; battery charger switch OFF and disconnect GenSet battery cables. Silence the Alarm Horn by pressing ALARM SILENCE switch on the Remote Annunciator panel.

PERIODIC RUNNING TEST OF POWER SYSTEM EQUIPMENT

The power system equipment should be run periodically to maintain the operational integrity of the system. Failure to do so can increase maintenance and reduce the reliability of the equipment. Two methods of running tests; system test, and interrupting normal utility power will cause the system to start, run, and provide power to the power bus. The first method, performing the System Test capability should be used. The second method, operating the Utility Main Disconnect switch may also be used.

⚠ DANGER ***Personnel can be exposed to a hazardous situation that can result in serious injury or death. Stay clear and free of the equipment and make sure everyone is aware of this test.***

The method selected for running periodic test of the power system can momentarily disrupt power to the loads. Be sure to alert all areas requiring power prior to running tests to prevent causing an emergency situation.

Generator Set Exercise

Perform the following procedures to run the generator for at least 30 minutes once each week with at least 50 percent load (if possible).

This is the preferred method of disabling power to perform a running test of the power system.

1. At the GenSet, place the Remote/Stop/Run switch to the RUN position. The GenSet will start.

   ⚠WARNING ***Exhaust gas is deadly and can cause serious illness or injury. Shut down the GenSet immediately after detecting an exhaust leak or the necessary replacement of exhaust system components. Do not use the GenSet until repairs have been made.***

2. While system is running, check for visual and audible evidence of exhaust system leaks. Observe the security of exhaust system supports. If any leaks are detected, shut down the GenSet and repair.

   ⚠WARNING ***Fuel and oil leaks can create hazardous conditions that can cause serious injury.***

3. Check the GenSet visually for fuel, oil, or coolant leaks. Shut system down and have leaks repaired. Do not use the GenSet until repairs have been accomplished.
4. After the GenSet reaches operating temperature (approximately 10 minutes), observe and record (in maintenance log) oil pressure, oil temperature, coolant temperature, and the battery charging rate.

5. Operate the Phase Selector switch on GenSet panel to read generator outputs. Observe and record (in maintenance log) individual meters.
6. Proceed to the *Adjustments* section in this manual if GenSet speed (frequency) or voltage require adjustment.

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

If possible, remove all AC power to the transfer switch before manually operating the switch. If it is necessary to perform manual operation with AC power connected, follow the "Safety Related Work Practices" listed in NFPA 70E.

7. Open the cabinet door of the automatic transfer switch.
8. Move the Motor Disconnect switch to the Off position.
9. **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.
10. Before moving the Motor Disconnect switch back to the Auto position, remember the transfer switch will transfer load to the active power source. (If both power sources are available, it will transfer the load to the Normal source.)

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

11. Move the Motor Disconnect switch to the Auto position.
12. Close the cabinet door.
13. At the GenSet, place the Remote/Stop/Run switch to the STOP position. The GenSet will stop.

Main Disconnect Power Switch

Only use this procedure to check operation of the main disconnect power switch or when utility power can not be disconnected through the operation of a remote test switch.

⚠WARNING ***Operating this switch will momentarily disrupt power to the loads. Be sure to alert all areas requiring power prior to running tests to prevent causing an unnecessary emergency situation.***

1. Operate the Utility Main Disconnect Switch to remove utility power causing an actual power outage. The GenSet will start, after a time delay the transfer switch will transfer power supply to the emergency GenSet.

   ⚠WARNING ***Exhaust gas is deadly and can cause serious illness or injury. Shut down the GenSet immediately after detecting an exhaust leak or the necessary replacement of exhaust system components. Do not use the GenSet until repairs have been made.***

2. While the system is running, check for visual and audible evidence of exhaust system leaks. Observe the security of exhaust system supports. If any leaks are detected, shut down the GenSet and repair.

   ⚠WARNING ***Fuel and oil leaks can create hazardous conditions that can cause serious injury.***

3. Check the GenSet visually for fuel, oil, or coolant leaks. Shut system down and have leaks repaired. Do not use the GenSet until repairs have been made.
4. After GenSet reaches operating temperature (approximately 10 minutes), observe and record (in maintenance log) engine control panel oil pressure, oil temperature, coolant temperature, and the battery charging rate gauge readings.
5. Operate the Phase Selector switch on GenSet panel to read generator outputs. Observe and record (in maintenance log) individual meters.
6. Proceed to the *Adjustments* section in this manual if GenSet speed (frequency) or voltage require adjustment.

7. Operate the Utility Main Disconnect Switch to reconnect utility power. The transfer switch will automatically retransfer back to utility power after a short time delay. The GenSet will continue to run for a cool down period, then stop. The system will return to the normal mode of operation.

PREPARING GENSET FOR MAINTENANCE

Any time planned maintenance is scheduled for a GenSet, be sure to use this procedure to prevent accidental starting.

⚠WARNING ***Starting the GenSet while performing maintenance can result in serious injury. Prevent accidental starting of the GenSet by performing the following procedures of steps 1 and 2.***

1. On the GenSet, operate panel Remote/Stop/Run switch to the STOP position.
2. Disconnect starting battery cables (negative [–] lead first).
3. At the GenSet control panel depress the RESET switch to put out alarm lamps and reset the alarm circuits.
4. Perform GenSet maintenance following instructions in the appropriate GenSet manual.
5. After performing GenSet maintenance, reconnect the starting battery cables and battery charger.
6. Operate the GenSet panel Remote/Stop/Run switch to the REMOTE position. The GenSet is now ready for the emergency mode of operation.

PERIODIC MAINTENANCE

Weekly Preventative Maintenance

Weekly preventative maintenance must be performed to maintain the operational integrity of the system, GenSet batteries, and battery charger. The permanent equipment log must contain a record of the checks made to the system, the date the checks were made, and the corrective measures taken to maintain the system.

Service the batteries to maintain a proper charge. Maintain clean and tightened battery terminals and battery cables.

Verify that the battery charger is operating properly.

Yearly Preventative Maintenance

Yearly preventative maintenance must be performed to maintain the operational integrity of the system. The permanent equipment log must contain a record of the extent of work performed and the date, together with comments as to the condition of the system and system components. Perform the following procedure:

1. De–energize power system and disable operational capability of GenSet.
2. Clean
   a. Thoroughly dust and vacuum all controls, meters, circuit breakers and bus compartments.
   b. Wash cabinet surfaces and meter faces using a damp (mild detergent and water) sponge (do not allow excess water to enter meters or cabinets).
3. Inspect
   a. Visually inspect system buswork and supports for carbon tracking, cracks, corrosion, or any other types of deterioration.
   b. Check the system buswork hardware for loose connections.
   c. Visually inspect all control wiring and power cables for signs of wear (especially wiring between hinged doors) or deterioration.
   d. Check all control wiring and power cables for loose connections.
   e. Check system cabinets for loose or missing hardware.
4. Preventative Maintenance
   a. Tighten all system buswork hardware, all control wiring, power cables, and system cabinets hardware.
   b. Service or replace the GenSet batteries.
   c. Verify the proper operation of GenSet batteries battery charger.
5. Operational Check
   a. Run Periodic Running Test and operate all operational controls while observing meters and indicator lights.
   b. Check the operational capability of all protective circuits and devices while observing meters and indicator lights.

Section 6. Adjustments

INTRODUCTION

This section of the manual describes the adjustments of the generator output frequency and voltage. It also describes the adjustments of the Power Sentry™ transfer switch control components. Refer to Operator's or Service Manuals for any other equipment adjustments or contact your Onan® service representative.

GENERATOR FREQUENCY

Perform this adjustment procedure only after periodic testing and troubleshooting have determined that the generator frequency does not match its nameplate. GenSet™ must be off line (no power to loads).

1. At the GenSet control panel, operate the Run/Stop/Remote switch to RUN position. The GenSet will start and run, but the transfer switch will not transfer.

2. Observe the frequency of the GenSet frequency meter. Perform the following steps if the frequency is not as specified on the nameplate.

   a. Locate FREQ ADJUST adjustment on GenSet control panel, use a screwdriver to hold the adjustment and using a wrench carefully loosen the locking nut.

   b. Slowly turn the screwdriver clockwise to increase or counterclockwise to decrease frequency to that specified on the nameplate.

   c. Retighten the locking nut, being careful not to change adjustment.

3. At the GenSet control panel, operate the Phase Selector switch to read generator output current and voltage. Observe that the ammeter does not register any output current. If output current is observed on the ammeter, proceed to the Generator Voltage procedure, otherwise proceed to the next step.

4. At the GenSet control panel, operate the Phase Selector switch to the OFF position.

5. At the GenSet control panel, place the Run/Stop/Remote switch to STOP position. GenSet will stop running.

GENERATOR VOLTAGE

Perform this adjustment procedure only after periodic testing and troubleshooting have determined that the generator voltage does not match the nameplate voltage rating. GenSet must be off–line (not supplying power to loads).

1. At the GenSet control panel, operate the Run/Stop/Remote switch to RUN position. The GenSet will start and run, but the transfer switch will not transfer.

2. At the GenSet control panel, operate the Phase Selector switch to read generator output current and voltage. Observe that the generator set output voltage matches the nameplate voltage rating. If output voltage matches the nameplate, proceed to step 3, otherwise perform the following procedure:

   a. Locate VOLT ADJUST adjustment on GenSet control panel, use a screwdriver to hold the adjustment and using a wrench carefully loosen the locking nut.

   b. Slowly turn the screwdriver clockwise to increase voltage or counterclockwise to decrease voltage as specified on the nameplate.

   c. Retighten the locking nut, being careful not to change adjustment.

3. At the GenSet control panel, observe AMMETER for zero current. If there is any reading on the ammeter other than zero current, repeat step 2a and 2b, until the nameplate voltage rating is obtained with zero frequency. Repeat step 2c to retighten adjustment.

4. At the GenSet control panel, operate the Phase Selector switch to the OFF position.

5. At the GenSet, place the SELECTOR switch to STOP position. GenSet will stop running.

TRANSFER SWITCH CONTROL

The transfer switch control consists of the Power Sentry Control with 3 plug–in modules (line side, generator side and time delay), a program transition module, two transformers and three relays. The Power Sentry Control contains multiple function timing adjustments. The Program Transition module contains the program transition timing adjustment. Contact your Onan service representative for further assistance, if necessary.

POWER SENTRY CONTROL ADJUSTMENTS

Access to the adjustment potentiometers, as shown in Figure 6–1, are through openings in the cover of the Power Sentry Control. These potentiometers are screwdriver adjustable.

⚠WARNING High voltages can cause severe burns or shock resulting in serious injury or death. Observe the following safety precautions:

⚠CAUTION Haphazard setting of the (Cal) adjustments will result in abnormal operation.

A separate voltage sensor is used for each power source. The Source 1 sensor monitors the normal (utility) power source. The Source 2 sensor monitors the emergency (GenSet) power source.

Undervoltage Sensor Calibration

The undervoltage sensor monitors the source or emergency voltage for an undervoltage condition. To calibrate these sensors, the nominal voltage at the correct frequency (Frequency Bandwith) must be present at all three phases.

Adjust Pickup Of Nominal, Dropout Of Pickup and the Cal potentiometer fully clockwise. The Source Available lamp will light.

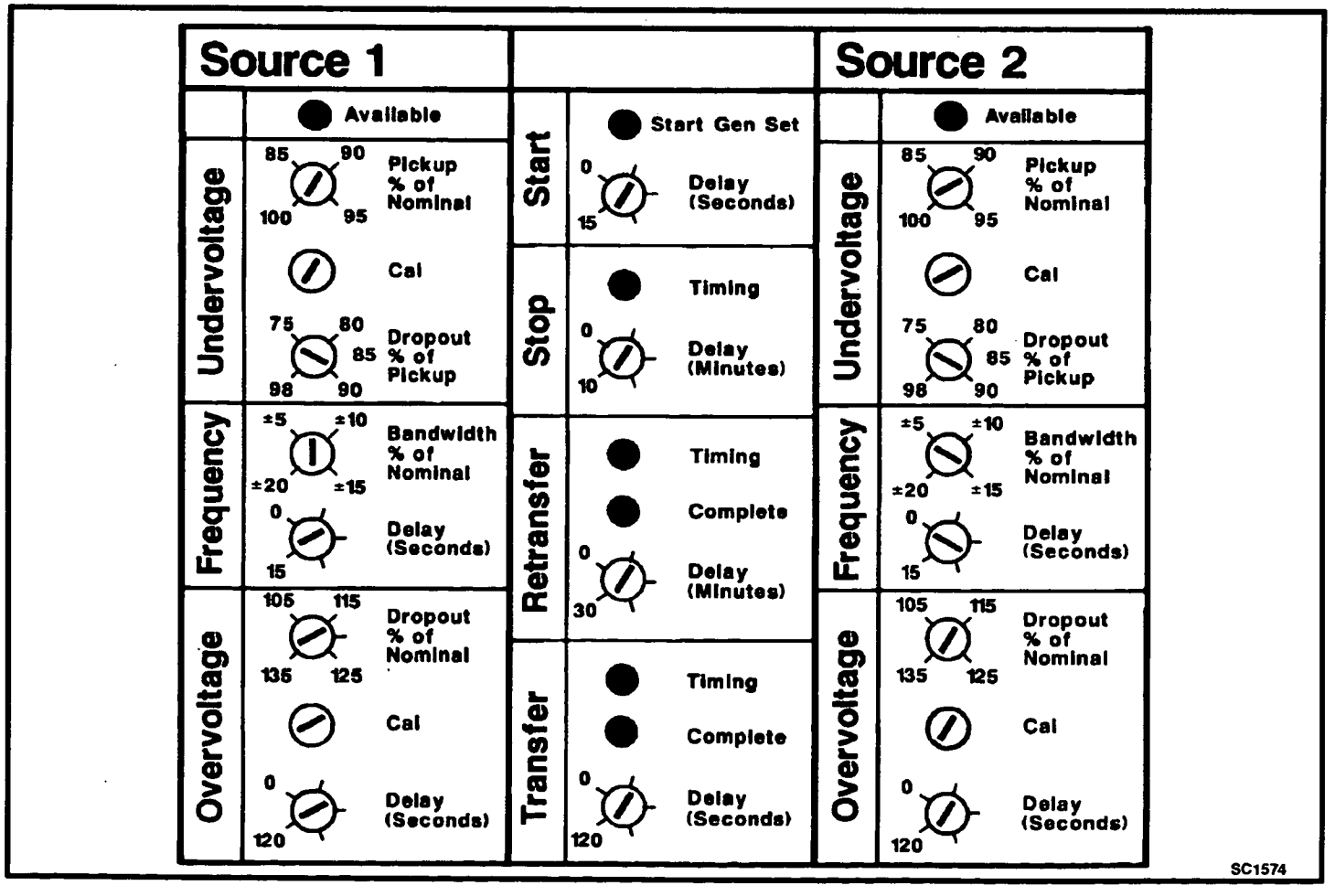

FIGURE 6-1. POWER SENTRY ADJUSTMENTS

If the Source Available lamp does not light, adjust the corresponding Overvoltage sensor Dropout and Cal potentiometers fully clockwise.

Adjust Undervoltage Cal potentiometer counterclockwise until the Source Available lamp goes out, then clockwise until the Source Available lamp just lights again.

If it was necessary to adjust the Overvoltage sensor Dropout and Cal potentiometers for this procedure, then readjust using the "Overvoltage Sensor Calibration" procedure.

Undervoltage Pickup And Dropout Adjustments

The undervoltage pickup sensor occurs when an acceptable voltage is sensed. The undervoltage dropout occurs when an overvoltage condition is sensed. Pickup is adjustable at 85%–100% of nominal voltage. Dropout is adjustable at 75%–98% of pickup voltage.

To set the pickup and dropout, use a screwdriver to turn the potentiometers to align with the graduated markings on the face plate.

Overvoltage Sensor Calibration

The overvoltage sensor monitors the source or emergency voltage for an overvoltage condition. To calibrate these sensors, the nominal voltage at the correct frequency (Frequency Bandwith) must be present at all three phases.

Adjust Dropout Of Nominal and Delay potentiometers fully counterclockwise and the Cal potentiometer fully clockwise. The Source Available lamp will light.

Adjust the Cal potentiometer counterclockwise until the Source Available lamp goes out, then clockwise until the Source Available lamp just lights again.

Overvoltage Dropout And Time Delay Adjustments

The overvoltage sensor has an adjustable dropout and time delay. Dropout occurs when an overvoltage condition is sensed. The dropout time delay allows ignoring momentary voltage overshoots. Pickup is fixed at 5% below the dropout setting. Overvoltage dropout is adjustable at 105%–135% of nominal voltage and time delay is adjustable to 0–120 seconds.

To set the dropout and time delay, use a screwdriver to turn the potentiometers to align with the graduated markings on the face plate.

Frequency Sensor Adjustments

The frequency sensor monitors the source frequency. When the source frequency is outside the acceptable band, dropout occurs. The band is centered about the nominal system frequency of 60 Hertz. The dropout bandwidth is 2.5% wider (on each end) than the pickup bandwidth. The pickup bandwidth is adjustable.

An adjustable dropout time delay allows ignoring momentary drops or rises in frequency.

Frequency sensor pickup bandwidth is adjustable (15%–120% of nominal) and time delay is adjustable (0–15 seconds).

To set the pickup bandwidth and time delay, use a screwdriver to turn the potentiometers to align with the graduated markings on the face plate.

Time Delay Module Adjustments

The time delay module controls the Start, Stop, Transfer and Retransfer time delays.

Standard time delay modules are adjustable over the following ranges for Start 0–15 seconds, Stop 0–10 minutes, Transfer 0–120 seconds and Retransfer 0–30 minutes.

To set the time delay, use a screwdriver to turn the potentiometer to align it with the graduated markings on the face plate.

PROGRAM TRANSITION MODULE

The program transition has a Delay and No Delay switch and a single time delay adjustment, as shown in Figure 6-2. The Delay and No Delay switch provides a choice of a delayed transition time or no delay in the transition. The time delay functions to hold a transfer switch in the neutral position before allowing it to complete a transfer to the other source.

The program transition has a 0–to–7.5 seconds adjustment range.

Set the Delay–No Delay switch to the Delay position before adjusting the retransfer time delay adjustment.

To set the time delay, use a screwdriver to turn the potentiometer to align it with the graduated markings on the face plate.

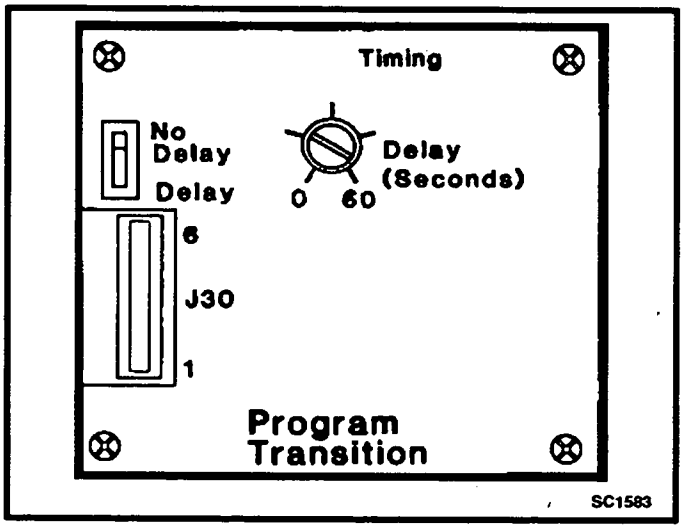

FIGURE 6-2. PROGRAM TRANSITION

EXERCISER CLOCK

The exerciser clock initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Programming the exerciser clock requires setting the time of day and entering the exercise start and stop times.

Refer to the Operator's Manual in Tab Section 6 for procedures of setting the exerciser clock.

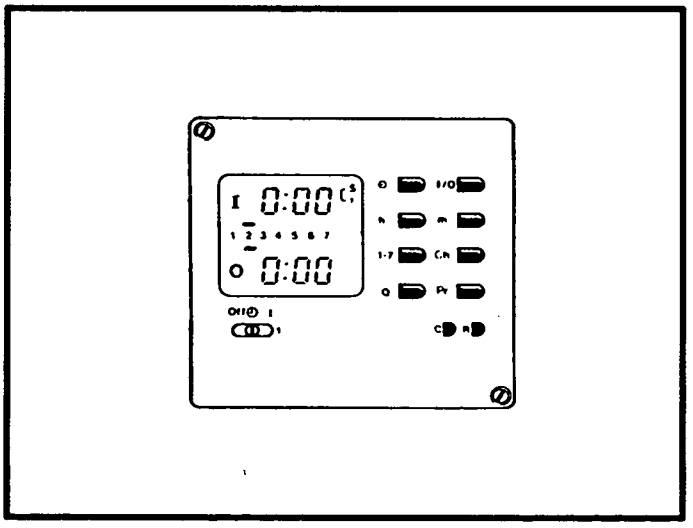

FIGURE 6-3. EXERCISER CLOCK

SIGNAL MODULE

The main function of the Signal Module is to delay transfer (or retransfer) for a preset time while operating a signal contact to give warning that a transfer (or retransfer) is about to occur. This option is typically used in elevator applications.

This module also provides four other sets of form C signal contacts.

The Signal Module has one adjustable timer. The Elevator Signal delay controls the timing of two events. It delays transfer/retransfer and energizes the Elevator Transfer Signal relay during the delay period.

This time delay is adjustable over a range of 0 to 50 seconds.

To set the time delay, align the slot on the potentiometer with the desired marking on the faceplate (Figure 6-4).

If a time delay is desired, make sure that the Delay/No Delay switch is in the Delay position.

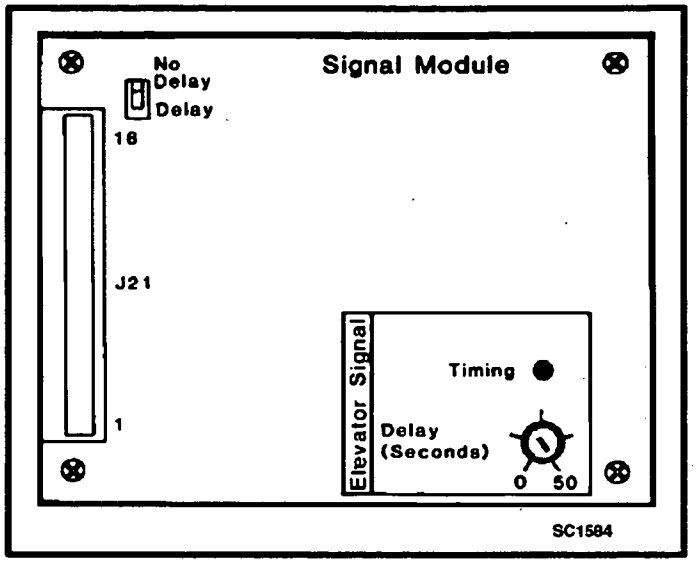

FIGURE 6-4. SIGNAL MODULE

Section 7. Troubleshooting

The following procedures describe preliminary troubleshooting checks. For further troubleshooting information, refer to appropriate Operator's Manual in Tab Section 6, or Service Manual in Tab Section 7. If the trouble persists, call your distributor.

GENERATOR SET STARTS DURING NORMAL POWER SERVICE

1. The operation selector switch on the generator set control panel should be set at Remote.

   ⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

2. Check the exerciser clock to see if it is in an exercise period. When the exerciser clock is in an exercise period, a "1" appears in the upper right-hand corner of the display window (Figure 7-1). You can view the display by looking through the transparent clock cover. Check that the red slide switch is in the center position.

   If the exercise period occurs at an unexpected time or for an excessive duration, refer to the exerciser clock programming procedure or call your dealer or distributor.

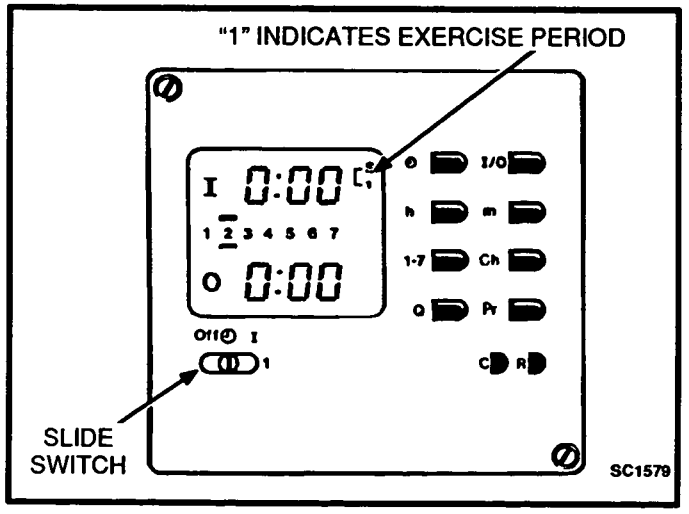

FIGURE 7-1. EXERCISER CLOCK

3. Momentary voltage dips might cause voltage sensors to initiate generator set starting. If the problem persists, call your distributor.

GENERATOR SET DOES NOT EXERCISE

1. The operation selector switch on the generator set control panel should be set at Remote.

   ⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

2. Check the exerciser to see if it is in an exercise period. When the exerciser clock is in an exercise period, a "1" appears in the upper right-hand corner of the display window (Figure 7-1). You can view the display by looking through the transparent clock cover. Check that the red slide switch is in the center position.

3. Start the generator set using its start-stop controls. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply. If the problem persists, call your dealer or distributor.

   ⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

   ⚠WARNING ***Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.***

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

1. Check the generator set. The operation selector switch on the generator set control panel should be set at Remote position. Check for fault indicators on the generator set control.
2. Start the generator set using its start-stop control. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply. If the problem persists, call your dealer or distributor.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

⚠WARNING ***Ignition of fuel can cause severe personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, arcing equipment, or other possible source of ignition near the fuel system.***

AFTER A POWER FAILURE, GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check the output voltage of the emergency power source by observing the voltmeter on the generator set.
2. Open the cabinet door and check to see if the Motor Disconnect switch is in the Auto position.

   ⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***
3. Check the Source 2 Available lamp on the Power Sentry.
4. Manually transfer the switch (see *Operation*). Call your dealer or distributor.

AFTER POWER RETURNS, TRANSFER SWITCH DOES NOT RETURN TO NORMAL POSITION

1. The retransfer time delay period may not have expired. Check the Retransfer Timing lamp on the Power Sentry.
2. Open the cabinet door and check the Motor Disconnect switch position. For automatic operation, it should in the Auto position.

   ⚠WARNING ***AC power within the cabinet and the rear side of the cabinet door presents a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts whenever the cabinet door is open.***

3. Manually initiate retransfer by turning the Auto/Manual switch to Manual position.
4. Stop the generator set by placing the Remote/Stop/Run switch to Stop position. When the generator set stops, the transfer switch will transfer load to the Normal power source if power is acceptable. Call your dealer or distributor.
5. If the switch still does not retransfer, refer to transfer switch service manual. Call your dealer or distributor.

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

The stop time delay function may not have expired. Check the Stop Timing lamp on the Power Sentry. Stop the generator set by placing the Remote/Stop/Run switch to Stop position, and call your dealer or distributor.

BATTERY CHARGER FAILS TO CHARGE

Check the battery charger fuses. Replace, if necessary, with fuses of the correct rating. Fuse ampere ratings are shown on the charger faceplate.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

If the fuse is OK, call your dealer or distributor.

BATTERY LOSES WATER

The battery charger float voltage could be too high. Call your dealer or distributor.

BATTERY LOSES CHARGE

Battery charger float voltage could be too low. Call your dealer or distributor.

Section 8. Wiring Diagrams

This section of the manual contains a few commonly used GenSet™ and Transfer Switch wiring diagrams.

Refer to *Wiring Diagrams/Schematics*, in Tab Section 4, and *Options*, in Tab Section 9 for diagrams specific to the unit ordered.

CUMMINS/ONAN®

ONAN DRAWING NUMBER	REVISION LEVEL	NUMBER OF PAGES	DESCRIPTION
612-6538	B	2	GenSet DC Diagram
612-6490	K	1	GenSet AC Diagram
626-1763	E	5	OT III Schematic/Wiring Diagram

Section 9. Glossary

Active Power

Active Power is the real power (kW) supplied by the GenSet™ to the electrical load. Active power creates a load on the set's engine and is limited by the horsepower of the engine. Active power does the work of heating, turning motor shafts, etc.

Air Circuit Breaker

An air circuit breaker automatically interrupts the current flowing through it when that current exceeds the trip rating of the breaker. Air is the medium of electrical insulation between electrically live parts and grounded (earthed) metal parts. Also see *Power Circuit Breaker*.

Annunciator

An annunciator is used to give remote indication of the status of an operating component in a system. Annunciators are typically used in applications where the equipment monitored is not located in a portion of the facility that is normally attended. The NFPA has specific requirements for annunciators used in some applications, such as hospitals.

ANSI

American National Standards Institute. See *Codes and Standards* for further information.

Authority Having Jurisdiction

The authority having jurisdiction is the governmental body or its designated private organization or individual with the legal responsibility of inspecting a facility and judging whether or not the equipment in the facility is properly installed and meets applicable codes and standards.

Automatic (Exciter) Paralleling

Automatic (exciter) paralleling describes a system where two or more GenSets can be started and paralleled while coming up to rated frequency and voltage. Because the generator excitation system is not turned on until the GenSet is started (thus the term "dead field"), the GenSets automatically synchronize as they come to rated speed and voltage. In Onan® automatic exciter paralleling systems, only manual paralleling to a live bus is possible.

Black Start

Black start refers to the starting of a power system with its own power sources, without assistance from external power supplies.

Breaker Overcurrent

Refers to the tripping of a circuit breaker by its trip unit, due to overload or fault conditions.

Bumpless Transfer

A smooth transition where the load on one source is ramped down while the load on the other source is ramped up.

Bus

Bus can refer to the devices that connect the generators and loads in a paralleling system, or to the parallel output of the generators in a system.

Bus Bars

Bus bars are rectangular copper or aluminum bars that connect the output of the GenSet circuit breakers to the transfer switches, circuit breakers, or fusible switches that transfer power to the loads. The bus bars are sized and assembled in multiples according to the current they must carry. There is one bar for each phase and for the neutral (if neutral is used). A typical sizing criteria for copper bus bars rated from 500–5000 amps is to maintain a current density of 1000 amps per square inch of cross sectional area. This results in a bus temperature rise at full load that is within acceptable limits.

Bus Capacity

Bus capacity is the maximum load that can be carried on a system without causing degradation of the generator frequency to less than a prescribed level (usually 59 Hz in a 60 Hz system).

Buswork

Buswork are copper bars, silver plated, that connect the output of the generator circuit breakers to the totalizer switchboard and, when required, to the distribution sections containing transfer switches, circuit breakers, and fusible switches.

CCT

CCT is an abbreviation for Cross Current Transformer. Current Transformers are used to step down the higher line current to the lower currents for which the control system is designed.

CPU

(Central Processing Unit) Onan random access paralleling systems typically include a microprocessor to handle complex control functions in the master/totalizing control panel. One module of the microprocessor control is the CPU, which manipulates data gathered from other modules and issues output commands via other modules.

Circulating Harmonic Currents

Circulating harmonic currents are currents that flow because of differences in voltage waveforms between paralleled power sources, or induced by operation of non–linear loads.

Cooldown Mode

The GenSets are running unloaded to cool down prior to stopping.

Cross Current Compensation

Cross current compensation is a method of controlling the reactive power supplied by generators in a paralleling system so that they equally share the total reactive load on the bus without significant voltage droop.

Cross Currents

Cross currents are currents that circulate between paralleled GenSets when the internal (excitation) voltage of one set is different from the other set(s). The set with the higher internal voltage supplies reactive power (kVAR) to the other set(s). The amount of cross current that flows is a measure of this reactive power. Cross currents are 90 degrees out of phase (lagging) compared to the current that the generator would supply at 1.0 (unity) power factor.

Dead Bus

Dead bus refers to the de–energized state of the power connections between outputs of paralleled GenSets. The term bus in this usage can either be rigid solid bus bars or insulated flexible cables.

Dead Field Paralleling

See *Automatic (Exciter) Paralleling.*

Demand Mode Standby

A status condition on random access paralleling control panels, which indicates that the GenSet has shut down automatically due to light load conditions on the system. If load increases or another GenSet fails, the GenSet will automatically restart, and reclose to the system bus.

Demand Sequence

Indicates to the operator the order in which GenSets will shut down if the load demand system is in operation.

Distribution Circuit Breaker

A distribution circuit breaker is a device used for overload and short current protection of loads connected to a main distribution device.

Distribution Switchgear

Distribution switchgear may include automatic transfer switches, drawout air frame circuit breakers, fusible switches, or molded case breakers.

DMSU

Demand Mode Standby Unit is a GenSet that can be shut down by the system when there is a low load level.

Draw Out Unit

A draw out unit is a structure that holds a circuit breaker in an enclosure. It has a movable carriage and contact structures that permit the breaker to be removed from the enclosure without manually disconnecting power cables and control wires.

Droop Load Sharing

Droop load sharing is a method of making two or more parallel GenSets share a system kW load. This is accomplished by having each governor control adjusted so that the sets have the same droop (reduction of speed). Typical droop is two cycles in frequency from no load to full load.

Earth Fault Protection

See *Ground Fault Protection.*

Earthing or Grounding

A grounding bar is a copper bar that electrically joins all the metal sections of the switchgear. This bar is connected to the earth or ground connection when the system is installed. The grounding or earthing protects personnel from stray currents that could leak to the metallic enclosures.

Electrical Operator

An electrical operator is the electric motor driven closing and tripping devices that permit remote control of a circuit breaker.

Emergency Bus

An emergency bus is the silver–plated copper bus bars or flexible cable used to connect the paralleling breakers to the emergency system feeder breakers, and ultimately to automatic transfer switches or other distribution devices.

Emergency System

An emergency system is independent power generation equipment that is legally required to feed equipment or systems whose failure may present a hazard to persons or property.

Exciter

An exciter is the generator component that generates the main field current.

Exciter Paralleling Control

An exciter paralleling control initiates the start of generator excitation in GenSets used in automatic paralleling systems.

Exerciser Clock

An electronic component in the master/totalizing control panel which causes the system to automatically be started at a pre–set time on a weekly basis, to test the system.

OSPS,SSPS and ISPS are trademarks for Onan Corporation.

Fault

This term may refer to either: (1.) the failure of an operating piece of equipment, and the specific reason for the failure, or (2.) an electrical distribution system failure, where there is a line–to–ground or line–to–line short circuit.

Feeder Circuit Breaker

See *Distribution Circuit Breaker.*

Field Breaker with Auxiliary Switch

This is the circuit breaker (usually mounted in the generator control panel) that monitors the alternating current input to the automatic voltage regulator. If a malfunction occurs in the excitation system, the circuit breaker trips on overcurrent—closing the auxiliary switch, shutting down the GenSet, and energizing the alarm circuit.

First Start Sensor

A first start sensor is an electronic device within Onan OSPS™, SSPS™ and ISPS™ paralleling equipment that senses GenSet and bus voltage and frequency, and determines whether or not a GenSet is the first unit ready to close to the bus following a call to start under "black start" conditions.

Frequency Adjust Potentiometer

A frequency adjust potentiometer is used to manually bring the frequency (speed) of the incoming set to that of the bus for synchronizing purposes. When the GenSet is paralleled, operation of this potentiometer will adjust the kW load assumed by the GenSet.

Fusible Switch

A fusible switch is an isolating switch and overcurrent protective device used for feeder or transfer switch isolation and protection. It is typically a manually operated, stored energy opening and closing, bolted compression blade switch, with provisions for installing current limited fuses.

Generator Bus

Refers to the buswork in the paralleling equipment, or to the sum total of the system capacity with the generators running.

Generator Main CB

The circuit breaker, normally mounted on the GenSet, which provides overcurrent and overload protection for the conductors between the GenSet and the paralleling equipment. This item may or may not be required in all systems, depending on system design, local code interpretation, and customer preference.

Governor

A governor is a device on the engine that maintains a constant engine speed under various load conditions. The governor must have provision for adjustment of speed (which controls generator frequency) and of the amount of speed droop from no load to full load.

Ground Fault Protection

This function trips (opens) a circuit breaker or sounds an alarm in the event that there is an electrical fault between one or more of the phase conductors and ground (earth). This ground fault protection function may be incorporated into a circuit breaker.

Harmonic Distortion (Total Harmonic Distortion)

Total harmonic distortion is an expression of the total harmonic content of a voltage waveform. The harmonic distortion (or harmonic content) of a waveform is usually expressed as the square root of the sum of the squares of each of the harmonic amplitudes (with amplitude as a percent of the fundamental voltage amplitude).

Harmonics

Harmonics are voltage components that operate at integral multiples of the fundamental frequency of a power system (50 or 60 Hz). The harmonics have the effect of distorting the shape of the waveform from a pure sinusoid.

Import/Export Control

An import/export control is an electronic device used in utility paralleling systems to actively control the amount of electrical power created by a GenSet operating in parallel with the utility service.

Incoming Set

This is the GenSet that is about to be connected to (paralleled with) the energized bus.

Insulated Case Circuit Breaker

An insulated case circuit breaker is a power circuit breaker that is provided in a preformed case, similar to a molded case breaker.

Internal Voltage

The internal voltage is the voltage a generator would develop at no load if it were not connected in a parallel operation. Excitation of the generator field controls internal voltage.

Interruptible

This refers to the practice of operating on–site power systems, at the request of a utility, to reduce electrical demand on the utility grid during periods of high consumption. Interruptible facilities may also be disconnected from all electrical service in the event of high demand on the utility grid, even if no on–site power system is available.

Interrupting Capacity

Interrupting capacity is the magnitude of electrical current that a device can safely interrupt (open against), without failure of the component.

Isochronous Load Sharing/ILS

ILS is a method of controlling the speed of parallel GenSets so that all sets share the load equally, without any droop in frequency. This is accomplished with electronic governors controlled from isochronous load sharing modules contained in the individual paralleling controls. ILS usually refers to the electronic component that provides this function.

ISPS™

Is an Onan model designation for random access paralleling system which has an optional master/totalizer section. It has breakers that may be power or molded case and stationary or drawout mounted.

kVA

This is the abbreviation for kilo–volt–amperes, a common term for rating electrical devices. A device's kVA rating is equal to its rated output in amps multiplied by its rated operating voltage. In the case of three–phase GenSets, kVA is the kW output rating divided by 0.8, the rated power factor. kVA is the vector sum of the active power (kW) and the reactive power (kVAR) flowing in a circuit.

kW

This is an abbreviation for kilowatt, an alternate form for rating electrical devices. GenSets in the United States are usually rated in kW. kW, sometimes called active power, loads the engine of the GenSet.

kW Load Alarm

This alarm monitors the kilowatt output at some point in a system and initiates an alarm when the output exceeds a preset amount.

kW Load Sensor

The kW load sensor is an electronic device provided to sense kW level at various points in a system, for use in control functions without the system, such as kW Load Alarms, or load demand.

Lead Unit

In a paralleling system that has a load demand feature, the lead unit is the last unit to be shut down in the event that load demand mode is in operation.

Leg

In electrical generating systems, leg refers to one of the three–phase windings of the generator.

Levels of Totalizer for ISPS

Level 0 – No Master/Totalizer

Level 1 – Main Bus metering

Level 2 – Metering and Load Control

Level 3 – Full Master/Totalizer Package With Load Demand

Load Demand

Load demand is a paralleling system operating mode in which the system monitors the total kW output of the GenSets, and controls the number of operating sets as a function of the total load on the system. The purpose of load demand controls is to reduce fuel consumption and limit problems caused by light load operation of reciprocating diesel GenSets.

Load Management

Load management is the overall control of load connected to match available generator capacity. Priority control and load shedding are two features required for load management.

Load Shedding

Load shedding is the process by which the total load on a paralleling system is reduced, on overload of the system bus, so that the most critical loads continue to be provided with reliable electrical service.

Low Voltage

In the context of this manual, low voltage refers to AC system operating voltages from 120 to 600 VAC.

Main Breaker

A main breaker is a circuit breaker at the input or output of the bus, through which all of the bus power must flow. The generator main breaker is the device, usually mounted on the GenSet, that interrupts the set's power output. Main breakers provide overcurrent protection and a single disconnect point for all power in a switchboard or device.

Main Line Circuit Breaker

See *Generator Main CB.*

Mains

Mains is a term used extensively outside of the United States to describe the normal power service (utility).

Manual Paralleling

The act of adjusting an operating GenSet to safely close to an operating system bus.

Master Control

A control section in a typical paralleling system that provides total system metering and the interface point between the paralleling system and the facility.

Master First Start Sensor

An electronic device in the master/totalizing control which provides signals to the first start sensor module in each paralleling control, to allow only one GenSet to close to the bus on system startup, without synchronization.

Master/Totalizing

The control panel which provides total system metering and alarm/status indications, and provides the interface between the GenSet and the balance of the facility.

Medium Voltage

In the context of this manual, medium voltage refers to AC system operating voltages from 1000 to 15000 VAC.

Molded Case Circuit Breaker

A molded case circuit breaker automatically interrupts the current flowing through it when the current exceeds the trip rating of the breaker. *Molded case* refers to the use of molded plastic as the medium of electrical insulation for enclosing the mechanisms, and for separating conducting surfaces from one another and from grounded (earthed) metal parts. Molded case circuit breakers usually contain thermal–magnetic trip units, although larger sizes can be equipped with solid state trip sensors.

NEC

National Electric Code. This document is the most common general electrical standard in the United States. See *Codes and Standards* for further information on NEC stipulations for paralleling equipment.

NEMA

National Electrical Manufacturers Association. See *Cases and Standards* for further information.

NEMA 1 Enclosure

This enclosure designation is for indoor use only — where dirt, dust, and water are not a consideration. Personnel protection is the primary source of this type of enclosure.

Neutral Current

Neutral current is the current that flows in the neutral leg of a paralleling system. Often, this term is used in reference to circulating neutral currents or cross currents.

NFPA

National Fire Protection Association. See *Codes and Standards* for further information.

Nonlinear Loads

A nonlinear load is any load for which the relationship between voltage and current is not a linear function. Some common non–linear loads are fluorescent lighting, SCR motor starters, and UPS systems. Non–linear loads cause abnormal conductor heating and voltage distortion.

Normal Standby Mode

In the normal standby mode, power to the load is supplied by the utility. The paralleling system is ready to provide power to the load in the event of utility failure.

ONCU, OTCU

An Onan transfer switch model number — ONCU is a 4 pole/switched neutral automatic transfer switch, OTCU is a 3 pole/solid neutral automatic transfer switch.

On–Set Paralleling

On–set paralleling is a manual paralleling system that is built onto the GenSet; no additional switchboards are required.

Operating Source

An operating source is a source of electrical power that is delivering power to a load. The operating source can be either a GenSet or a commercial (utility bus) power line.

OSPS™

OSPS is an Onan model designation for traditional paralleling switchgear that incorporates paralleling and master/totalizing controls, with drawout breakers below the controls and the bus structure isolated to the rear of the equipment.

Over Crank

Over crank is an alarm function provided with most GenSets that indicates that the GenSet has failed to start.

Overlapping Neutral

Overlapping neutral is a feature of some 4–pole (switched neutral) transfer switches in which all the neutral contacts of the switch remain closed during the time that the phase conductors are operating. Because of potential operating problems caused by interconnecting the normal and emergency system grounding points, Onan recommends that this operating system **not** be used.

Parallel Operation

Parallel operation is the operation of two or more sources of AC electrical power whose output leads are connected to a common load. Connection of the power sources is made so that the sources electrically function as single source of power. Parallel Operation requires that the two sources of electrical power must match in voltage, frequency, and number of phases.

Paralleling Breaker

The breaker in a paralleling system which is used to close the GenSet to the system bus in normal paralleling operations. This breaker is typically mounted in the paralleling equipment structure.

Paralleling Control

The control panel which monitors and controls an individual GenSet, and include generator output metering, and alarm/status indication lamps.

Paralleling Suppressers

Paralleling suppressers are semiconductor devices that protect the silicon diodes on a brushless excitation system from damaging overvoltages. Overvoltages, usually of short duration, occur when a generator is paralleled out of phase with the energized bus.

Peak Shaving

Peak shaving is the process which loads in a facility are reduced for a short time to limit maximum electrical demand in a facility and to avoid a portion of the demand charges from the local utility.

Permissive Paralleling

Permissive paralleling is a feature in Onan manual and automatic paralleling switchboards that prevents out–of–phase manual paralleling. A synchronizing check relay prevents the electrical closing of the electrically operated circuit breaker if the incoming set is outside of the frequency or phase angle limits required for proper paralleling to a bus.

Phase Rotation

Phase rotation (or phase sequence) describes the order (A–B–C, R–S–T, or U–V–W) of the phase voltages at the output terminals of a three–phase generator. The generator phase rotation must match the facility phase rotation. This must be checked prior to operation of the electrical loads in a facility with an on–site generator.

Pitch

Pitch is a mechanical design characteristic of a generator that indicates the ratio of the number of winding slots per generator pole to the number of slots enclosed by each coil. The generator designer may use the pitch of a machine to optimize the generator cost versus the quality of the voltage waveform generated.

Power Circuit Breaker

A power circuit breaker is a circuit breaker whose contacts are forced closed via a spring charged over–center mechanism, so that fast (5–cycle) closing and high withstand and interrupting ratings are achieved. A power circuit breaker can be an insulated case or power air circuit breaker.

Power Factor

Power factor is the cosine of the angle between the active power (kW) and apparent power (kVA) in a circuit.

Prime Power

Prime power describes an application where the GenSet(s) must supply power on a continuous basis and for long periods of time between shutdowns. No utility service is present in typical prime power applications.

Priority Control

Priority control is the process by which the total load on the bus is limited to the most critical loads in the system until adequate generation capacity is available to serve all loads.

Programmable Logic Controller (PLC)

The microprocessor, or CPU, to handle complex control functions in the Master/Totalizer Control Panel. It replaces relays and can be easily reprogrammed without making physical hardware changes.

Pulse Alarm

Pulse alarm is an alarm logic system that allows all alarms to be annunciated, even if a previous alarm has been silenced but is still present in the system.

Random Access Paralleling

Random access paralleling is a paralleling operation where any generator may be the first unit to close to the bus on startup of the system. Random access systems use active synchronizing to force the second and all subsequent GenSets to close to the bus as fast as possible.

Reactive Differential Compensation

Reactive differential compensation (also called cross current compensation) is a method of controlling the reactive power supplied by generators in a paralleling system so that they equally share the total reactive load on the bus, without inducing significant voltage droop in the system.

Reactive Droop Compensation

Reactive droop compensation is one method used in paralleled GenSets to enable them to share reactive power supplied to a load. This system causes a drop in the internal voltage of a set when reactive currents flow from that generator. Typically, at full load, 0.8 PF, the output voltage of a set is reduced by 4% from that at no load when reactive droop compensation is used.

Reactive Power

Reactive power is power that flows back and forth between the inductive windings of the generator and the inductive windings of motors, transformers, etc., which are part of the electrical load. This power does no useful work in the electrical load nor does it present load to the engine. It does apply load to the generator and limits the capacity of the generator.

Reactor

A reactor is an electrical device that applies only reactive load to a system.

Redundant/Parallel Configuration

A redundant/parallel configuration is a paralleling system that is designed with extra GenSets in the system, so that the failure of one (or more) of the GenSets will not require load shedding.

Reverse Power Relay

A reverse power relay is a relay with a wattmeter movement that senses the direction of power flow. In paralleled sets, a flow of reverse power (i.e., power flow into a set) will actuate the reverse power relay and disconnect the set from the system. If one set stops and reverse power protection is not provided, the set still running will drive the set that has stopped. (The generator on the set that has stopped will act as a motor.)

Risers

Risers are rectangular copper or aluminum bars that connect circuit breakers, fusible switches, and transfer switches with the main system bus. As with bus bars, they are sized and assembled in multiples according to the current that they must carry.

Sequential Paralleling

Sequential paralleling is a type of automatic paralleling system where the generators in a system close to the bus in a prescribed order, typically by use of a single synchronizer.

Service Entrance

The service entrance is the point where the utility service enters a facility. In low–voltage systems, the neutral is grounded at the service entrance.

Shunt Trip

Shunt trip is a feature added to a circuit breaker or fusible switch to permit the remote opening of the breaker or switch by an electrical signal (usually 24 volts DC on OSPS switchgear).

SPF

SPF is an Onan model designation for a compact, random access paralleling system.

SSPS™

SSPS is an Onan model designation for a compact, random access paralleling system.

Standby System

A Standby system is an independent power system that allows operation of a facility in the event of normal power failure.

Steady State Rating

Steady state rating is the maximum load that a GenSet or paralleling system can carry, on a continuous basis, for the duration of a utility power outage.

Surge Rating

Surge rating is the rating of a machine, usually in excess of its normal operating level, for which it can provide power for a very short time.

Sync Check Relay

A sync check relay is an electrical device that monitors the phase relationship between two voltage sources and provides a signal when the voltage sources are within specific preset parameters.

Synchronization

Synchronization is obtained when an incoming GenSet is matched with and in step to the same frequency, voltage, and phase sequence as an operating source of power.

Synchronizer

A synchronizer is an electronic device that monitors the phase relationship between two voltage sources and provides a correction signal to an engine governor, to force the GenSet to synchronize with a system bus.

Synchronizing Lights

Synchronizing (sync) lights are lamps connected across the line contactor of the incoming GenSet. The lights indicate when the voltage waveforms of the incoming and operating power sources coincide and paralleling can be completed.

Synchroscope

A synchroscope is a meter that indicates the relative phase angle between an incoming set voltage and the bus voltage. The synchroscope pointer indicates whether the set is faster of slower than the bus and allows the operator to adjust the frequency (speed) accordingly before manually paralleling to the bus.

Total Harmonic Distortion (THD)

See *Harmonic Distortion.*

Totalizer/Totalizing Control

See *Master Control.*

Transfer Switch

A transfer switch is an electrical device for switching loads between alternate power sources. An automatic transfer switch monitors the condition of the sources and connects the load to the alternate source if the preferred source fails.

UL

Underwriters Laboratories. See a *Codes and Standards* manual for further information.

Utility

The utility is a commercial power source that supplies electrical power to specific facilities from a large central power plant.

Voltage Control

The Voltage Control is a rheostat that sets the operating point of the voltage regulator and therefore controls the output of the GenSet, within its design limits.

Watthour Demand Meter

A watthour demand meter records the total power output at a specific point in a system. Typical recording increment is in kW hours.

Wattmeter

A wattmeter records power being delivered from a source to the load. Wattmeters for paralleling systems are calibrated in kilowatts.