KS-22719, 30KW OR 45KW and KS-22720, 75KW OR 115KW AUTOMATIC DIESEL ENGINE-ALTERNATORS (J86841)

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FIGURE(S)

1. ALARM LAMPS ON CABINET

2. J85520 MICROCOMPUTER CONTROLLER

TABLE(S)
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1. GENERAL

1.1 Scope

1.1.1 This section covers installation and test of 30,45,75 and 115 KW automatic diesel engine-alternators supplied by Power Systems, Div of Morrison-Knudsen.

1.1.2 Tests are based on the following circuit diagrams:

SD-81100-01	Alarm Circuit
SD-81223-01	Alarm Circuit
SD-81489-01	Transfer Breaker Circuit
SD-81693-01	Automatic Plant Schematic
SD-81738-03	Engine-Alternator Circuit
SD-81796-01	J87249 Battery Charger
SD-82324-01	202 Type Power Unit
SD-82326-01	203 Type Power Unit
SD-82531-01	Microcomputer Controller
SD-82572-01	Auxiliary Board

1.2 Inspection

1.2.1 As soon as possible after the unit is received remove shipping materials and make a complete inspection of the engine-alternator and associated equipment and parts. Examine carefully for visible defects and damage. Examine the interior of the control cabinet for concealed damage.

NOTICE
Not for use or disclosure outside the
Bell System except under written agreement.

1.2.2 Report any defects, damage or missing parts in accordance with established routines.

1.3 Description of Engine-Alternator

1.3.1 The basic set consists of an engine-alternator mounted on vibration isolators and a floor-mounted control cabinet. The radiator is on the set except for the 115KW set where a remote radiator is optional. Shutters are available for the set-mounted radiator and always furnished with a remote radiator. Four jack screws, inside the base, are furnished to raise the base to place the isolators.

1.3.2 The set may be open or enclosed. If the set is enclosed the covers may or may not include sound-absorbing material, according to the list number. Pans, coated with sound-absorbing material are mounted under the set to further reduce noise if the list number includes the sound absorption.

1.3.3 An extended lube oil supply is available. It uses a Ren lube oil regulator valve to keep a constant crankcase oil level. A shut-off valve is furnished in the input line of the Ren valve.

1.3.4 The control cabinet is placed about 1/2 inch away from the alternator end of the set. The upper part of the control cabinet has a hinged front cover on which is mounted meters, alarm lamps and control switches. The interior of the cabinet contains relays, fuses, small breakers, one or two main breakers and customer connections. The lower portion of the cabinet houses the J85520A Micro Computer Controller, the Auxiliary Board, the J87249 Rectifier and the voltage regulator.

1.3.5 The alternator is a Delco single-bearing unit close-coupled to the engine flywheel. The exciter is a brushless type using rotating diodes to provide dc for the alternator field. The voltage regulator is a static type.

1.3.6 Available cold weather starting devices consist of an ether capsule device or an immersion heater for the engine water jacket.

1.3.7 The set may be furnished with a PSG governor, capable of isochronous or Droop operation.

1.3.8 Room Exhaust Louvers will always be furnished. Discharge Shutters or Recirculating Shutters will also be furnished. The discharge duct may include a KS-20023 Load Bank which may be ordered with Discharge Shutters. Where the supplementary load bank is ordered with Recirculating Shutters the load resistors will be mounted in the radiator end of the KS-5704 Duct feeding into the shutters.

1.3.9 Alarm lamps on the cabinet are illustrated in Figure 1 at the end of this section.

1.4 Description of Operation

NOTE: The Operation Selector Switch has five positions, OFF, MANUAL, AUTO NO LOAD, FULL AUTO and AUTO MAN RESTORE. Operation is described below for each position of the switch.

1.4.1 Selector Switch at OFF

1.4.1.1 With the OSS switch if OFF the set is not available for operation. The SWITCH OFF NORM lamp is lit on the control panel.

1.4.2 Selector Switch at MANUAL

1.4.2.1 With the OSS in this position the set will not automatically start on a commercial power failure. The set is started by depressing the ENGINE CONTROL START push-button.

1.4.2.2 If the set has the On-Set Transfer, load will be transferred to the set by depressing the CIRCUIT BREAKER CLOSE push-button. This opens the Normal breaker and closes the alternator or Emergency breaker.

1.4.2.3 Closing the alternator breaker (by depressing the CIRCUIT BREAKER CLOSE pushbutton) has no effect on a Remote Transfer Breaker Circuit. Load can be transferred manually to the emergency bus or by operating the necessary switches in the remote circuit.

1.4.2.4 To shut the set down, it is necessary to depress the CIRCUIT BREAKER OPEN pushbutton and then the ENGINE STOP pushbutton. Depressing the CIRCUIT BREAKER OPEN pushbutton does not affect a Remote Transfer Circuit but will cause transfer of load back to commercial power, if available, where On-Set Transfer equipment is furnished.

1.4.3 Selector Switch at FULL AUTO

1.4.3.1 When commercial power fails the engine starts after a start delay period (SDT). When alternator voltage and speed are normal the warmup time (WUT) starts.

1.4.3.2 After a warm-up period, with a remote Transfer Breaker Circuit, the alternator breaker closes, provided no other set is already on the emergency bus, and a signal is given to the customer's remote transfer breaker circuit to transfer load to the set. With an On-Set Transfer Breaker, the Normal Breaker will be opened after the warmup time and then the alternator or Emergency breaker will close to transfer the load to the set.

1.4.3.3 The set will carry the connected load for a run time period of at least 56 minutes. A 10 minute holdover time will be started when commercial power returns. The set will transfer the load back to commercial power only after both timers have timed out.

1.4.3.4 After commercial power is restored, and after the holdover period, the control signals the remote transfer breaker circuit to transfer the load to commercial power, which in turn causes the alternator breaker to open. With the On-Set Transfer breaker the control opens the alternator breaker, which in turn closes the Normal breaker. After the load is transferred to commercial power the set will continue to run for a two minute cooldown period after which it will shutdown.

1.4.3.5 With the OSS switch in the FULL AUTO position the set may be started manually with the ENGINE CONTROL START pushbutton. When started this way the set and control will run through the sequence above.

1.4.3.6 With the OSS switch in this position a Remote Routine Start may be initiated by grounding the RS lead. The set will start immediately, warm-up and load will be transferred to the set. After the run time and holdover time periods the load will be transferred back to commercial power, if available, and the set will shut down after a two minute cooldown period.

1.4.4 Selector Switch at AUTO NO LOAD

NOTE: If commercial power fails with the OSS switch in this position the sequence of operation will be the same as for FULL AUTO position.

1.4.4.1 The set can be started with the OSS switch in this position with the ENGINE CONTROL START pushbutton. Once started the set will run at no-load for the run time of 56 minutes period and then shut down, provided commercial power does not fail during this time.

1.4.4.2 With the switch in this position the set can be started manually for tests and transfer of load to the set will not occur as long as commercial power is available.

1.4.5 Selector Switch at AUTO MAN RESTORE

1.4.5.1 The set will start automatically on a commercial power failure and the load will be transferred to the set as described for the FULL AUTO position of the OSS switch.

1.4.5.2 The load will not transfer back automatically to commercial power. To do this it will be necessary to operate the OSS switch to FULL AUTO position. With commercial ac available the load will transfer back to commercial power after the run time and holdover time and the set will shut down after a two minute cooldown period.

1.4.6 Trouble Shutdowns and Alarms

1.4.6.1 When the set is running the following major troubles will stop the set, transfer load back to commercial power, if it is available, light the associated alarm lamp and provide a major alarm signal to connected alarm circuits.

LOW OIL PRESSURE	Lube oil pressure 20-30 psi
UNDERSPEED	Engine underspeeds to less than 1710 rpm and remains there for more than 1.5 seconds after first attaining rated speed. The UNDER/OVER SPEED lamp will light steady.
OVERSPEED	Engine overspeeds to more than the trip point of 2160 rpm. The UNDER/OVER SPEED lamp will continuously blink.
UNDERVOLTAGE	The alternator output voltage drops to less than 85±2% of rated voltage. The UNDER/OVER VOLTAGE lamp will light steady.
OVERVOLTAGE	The alternator output voltage increases to more than 120±2% of rated voltage. The UNDER/OVER VOLTAGE lamp will continuously blink.
BREAKER TRIPPED	SET or EMER Breaker tripped. The BKR TRIP lamp will light steady.
REVERSE POWER	Alternator draws more that 20KW reverse power (for parallel operation only). The REVERSE POWER lamp will continuously blink.
HIGH WATER TEMP	Jacket water reaches 205-215°F.
CONTROL FUSE FAIL	Blown CF fuse or open CB1 or CB2 breakers.

1.4.6.2 During starting certain failures light the CRANK FAILURE lamp, and provide remote Engine Failure alarms. These are failures of the engine to reach 100 rpm speed in 3 seconds or if the engine fails to reach 650 rpm in 20 seconds. If the OSS switch is in any AUTO position and a commercial power failure initiated an unsuccessful start, then a restart will be attempted. After the first start failure, the CRANK FAILURE lamp will blink for one minute before attempting a restart. If the restart fails, the CRANK FAILURE lamp will light steady and no further restarts will be attempted.

1.4.6.3 The following minor alarms are also indicated by lighting the associated alarm lamp. There is no shutdown if the set is running. A minor alarm signal is provided to the customer's alarm circuit.

RECTIFIER FAILURE	Failure of battery charging rectifier

JACKET HEATER FAIL Jacket water temperature Falls below 45 to 55°F.

1.5 Associated Information

1.5.1 Sections 129 In this handbook covers levelling and vibration isolator adjustments.

1.5.2 Section 132 In this handbook covers piping information and Section 133 covers information on the cooling system.

1.5.3 Section 130 In this handbook covers paralleling information, where this is applicable.

2. PRECAUTIONS

2.1 Engine-Alternator

2.1.1 When working on the engine first turn OPERATION SELECTOR Switch to OFF. Disconnect the B- battery lead on the Starting Battery.

CAUTION: BEFORE DISCONNECTING THE LEAD IT WILL BE NECESSARY TO REMOVE AN INPUT FUSE ON THE J87249B RECTIFIER, OR DAMAGE WILL OCCUR TO THE RECTIFIER. THEN REMOVE THE OUTPUT FUSE FROM THE RECTIFIER.

2.1.2 When cold-weather starting equipment is furnished (Z Option) be sure that H1 and H2 fuses are removed until the radiator is filled.

2.1.3 When working inside the control cabinet (front portion) first turn OPERATION SELECTOR Switch to OFF. Then disconnect commercial ac from the cabinet whenever possible. This can be done on an OFF-Set Transfer unit by removing the three ac fuses feeding the control cabinet from the ac service cabinet.

2.1.4 Where the unit has the On-Set Transfer Breaker take extreme care when working in the area behind the breakers. Commercial ac is always present on both sides of the NORMAL Breaker. The only way to remove this commercial ac is to open the main power service to the stations.

2.1.5 The starting motor should not be operated more than 30 seconds at a time to avoid overheating the motor. Also, wait one minute between cranking attempts. If the engine fails to start DO NOT press the START button again until the engine stops rotating.

2.1.6 Immediately after starting observe lube oil pressure on the gauge. If no oil pressure is shown after 10-15 seconds Immediately stop the engine with the STOP button.

2.1.7 The AIR BOX DRAIN must be drained weekly.

2.2 J85520 Microcomputer Controller and Auxiliary Boards

2.2.1 When disconnecting and reconnecting the cord connected plugs from the jacks on the boards, always turn the OPERATION SELECTOR switch to OFF. Disconnecting power to the boards is necessary to prevent damage to the intergrated circuits.

2.2.2 Static electricity picked up by the body can easily ruin the integrated circuit chips on the microprocessor. Never touch these devices.

2.3 J87249 Rectifier

2.3.1 Install output fuse (F4) before installing the input fuse because resultant open-circuit voltage will damage the charger. When disconnecting the rectifier remove an ac input fuse before removing the output fuse.

2.3.2 For 208 volt input insert COM & 208V fuses. Fro 220-240 volt input insert COM & 240V fuses. In no case shall 208V and 240V fuses be inserted at the same time.

3. TOOLS, TEST SETS AND RECORDS

3.1 Tools and Test Sets

NOTE	QUAN.	CODE	DESCRIPTION
	1	R-2705	Tachometer, Hand
	1	R-3404	Phase Sequence Indicator
1	3	R-3413	Wire & Lug Assembly
	1	ITE-1000	AC Voltmeter
	1	ITE-4442	Volt-Ohmmeter
	1	ITE-4474	DC Power Voltmeter
2	1	ITE-4782	150 KW AC/DC Test Load
	1	ITE-4824	Hasler Tachometer
	1	ITE-4297	Auto-Transformer
	1	ITE-9114	Test Cord
	1	ITE-9115	Test Cord

NOTE: 1) For connecting ITE-4782 Test Load.

2) Due to the heat produced by this load it should be placed outside or in a doorway for the test.

3.2 Records

ID-946	Engine-Alternator Test Record
ID-1275	Lubrication Record
ID-1285	Storage Battery Report
SD-4-1313	Test Trouble Record
SD-4-1315	Summary of Tests

4. INSTALLATION

4.1 Preliminary

4.1.1 The floor or pedestal under the unit shall slope not more than 1/4" in 10 feet. Also, the mounting areas for the isolators shall not vary more than 1/32 inch in height from each other. Floor coverings such as linoleum or tile must be removed under the isolators so that the base of the isolator rests on the floor.

4.1.2 Lay out and drill for isolator hold-down bolts when it is required to bolt them down, as in Earthquake areas. The control cabinet should be bolted down in all cases. When bolting down the isolators the anti- walk ribbed material on the bottom should be removed.

4.1.3 When the set is received have the riggers move it into position and install the vibration isolators. Isolators can be installed later, however, using the jack screws provided with the set to raise it high enough to place the isolators.

4.1.4 Wire all external control circuits. Control leads terminate on terminal strips inside the upper rear of the control cabinet.

4.1.5 Remove the grill from the lower front of the control cabinet.

4.2 J85520 Microcomputer Controller and Auxiliary Boards

4.2.1 Check the controller and auxiliary boards for signs of damage. Check that each plug is secure in its socket.

4.2.2 In the upper right corner of the microcomputer controller, locate the small red and white microswitch assembly (See Figure 2). Operate the microswitches as follows:

SWITCH	FUNCTION	POSITION
SW1	30 or 40 KW SET	CLOSED
	75 OR 115 KW SET	OPEN
SW2	(See TABLE A)	OPEN
SW3	NOT USED	OPEN
SW4	ALM CLK	CLOSED
SW5	NOT CONNECTED	OPEN
SW6	NOT CONNECTED	OPEN
SW7	NOT CONNECTED	OPEN

4.3 J87249 Rectifier and Batteries

NOTE: 1) Always insert the output fuse before inserting the input fuses as the high open-circuit voltage will damage the rectifier.

2) If required to use the J87249 Rectifier before commercial ac is connected to a set arranged for On-Set Transfer, internal connections to R1 and R2 fuses may be disconnected and separate temporary lines run to these fuses. The temporary lines should be #10 gauge with each line protected at the ac service cabinet with 15 ampere fuses.

4.3.1 Remove all fuses from the rectifier. Remove the cover from the rectifier and ascertain that the following list number is marked on the card (according to the battery used):

List TB - 12 cell lead-acid battery (setting is 27.0 volts)

List TA - 20 cell nickel-cadmium battery (setting is 28.5 volts)

4.3.2 Install the J87249 Rectifier in the area providing (lower left hand corner). Install the starting battery and the control battery, where furnished.

4.3.3 With the ac input to the rectifier disconnected put the plug into the socket on the rectifier.

4.3.4 Install the output fuse (F4) on the J87249. When a separate control battery is furnished install the remote CBF fuse. Then install the ac input fuses (COM and 208V or 240V) on the rectifier.

CAUTION: INSERT 208V OR 240V FUSE ACCORDING TO THE COMMERCIAL LINE VOLTAGE.

4.3.5 Install the remote ac line fuses for the rectifier, where these are provided. For the Off-Set Transfer unit fuses for the rectifier are furnished in the Essential AC Load Service Cabinet (from LL1 and LL2 cabinet terminals). Install R1 and R2 fuses in the cabinet.

4.3.6 With the charger operating check charging voltage. Use the ITE-4474 DC Power Voltmeter for checking the voltage. Connect the voltmeter across the DC OUTPUT jacks on the rectifier unless these are inaccessible, in which case connect the voltmeter across the start battery.

4.3.7 Measure charging current with a voltmeter across the 4A/VOLT jacks on the J87249. The voltmeter used for this should be a good 3V dc meter, or the 3 volt dc scale of ITE-4442 may be used. Each volt

Indicated = 4 amperes, less 0.4 ampere for R15 bleeder resistor current.

4.3.8 Measure voltage and current and observe that after several hours the voltage reaches the required float voltage and that charging current reduces to a very low value.

4.4 Engine-Alternator and Control

4.4.1 Open the lube oil drain valve and drain out any oil or residue left in the system. Then close the drain valve. If a Ren Valve is furnished also close the shutoff valve in the inlet line to the valve.

4.4.2 Add oil to the crankcase as follows:

4.4.2.1 Remote Lube Oil Supply: First addition of lube oil is as follows:

30 KW:	13-1/2	quarts
45 KW:	19	quarts
75 KW:	25	quarts
115 KW:	37	quarts

Add lube oil in the oil filler opening until crankcase oil level passes the "L" mark on the dipstick. Check after lube oil has been allowed to settle for about 20 minutes. Then open the inlet line to the Ren Valve (from the remote supply) and observe that oil level in the sight- glass of the Ren Valve is close to the center-line.

CAUTION: IF THE REN VALVE IS NOT VENTED TO THE ATMOSPHERE, THE CRANK-CASE WILL OVER-FLOW. REMOVE THE PLUG IN THE TOP OF THE REN VALVE BEFORE OPENING THE INLET VALVE AND MAKE CERTAIN THAT THE PLUG HAS A SMALL HOLE IN IT BEFORE REPLACING IT.

4.4.2.2 No Remote Lube Oil Supply: The following quantities will be required:

30 KW:	15-1/2	quarts
45 KW:	21	quarts
75 KW:	27	quarts
115 KW:	40	quarts

Add lube oil to the oil filler opening until crankcase oil level reaches the "F<-->F" range on the dipstick. Check after the oil has been allowed to settle for about 20 minutes.

4.4.2.3 Recommended Lube Oils: MIL-L-2104B Lubricants are recommended for use in these engines. SAE-30 oil should be used until the initial oil drain and is recommended for continued use thereafter in all ambients.

NOTE: The following lube oils meet this specifications and are acceptable.

Gulf Oil Corp.	- Gulflube Motor Oil X.H.D.
Phillips 66	- HDS Motor Oil
Shell Oil Co.	- Shell Rotella T Oil Shell MIL-B Oil
Standard Oil of California	- RPM DELCO Multi-service Oil
Sun Oil Co.	- Sun Fleet MIL-B Sunoco Ocnus 4500 Series
Texaco, Ind	- Ursa Oil Extra Duty

4.4.3 Add engine lube oil to each Air Cleaner to the level indicated on the body of the cleaner. Reinstall the Air Cleaner(s).

4.4.4 Remove the rocker arm cover on the engine and pour about one pint of lube oil over the rocker arms. Replace the cover.

4.4.5 Add water and antifreeze or rust inhibitor to the cooling system. Rust inhibitor is used unless antifreeze is used. Section 133 in this handbook covers information on antifreeze and rust inhibitors.

CAUTION: BE SURE THAT THE VALVES AT EACH END OF THE IMMERSION HEATER ARE OPEN.

CAUTION: NEVER PLUG THE RADIATOR DRAIN OPENING IN THE BASE NOR INSTALL A VALVE AT THIS OPENING.

4.4.6 The following terminals on the customer terminal strips should be strapped:

BDS2 to BDS3	(unless Blast shutdown circuit is used)
RC+ to GRD	
EVS1-EVS2	(unless Exhaust Line Valve is used)
MB1-MB2	(except for parallel operation)
PHR1-PHR2	(unless Phase Reversal Relay is furnished in On-Set Transfer units only)

4.4.7 Install the following fuses in the Essential Load Cabinet for the following figures and options which may be furnished under SD-81693-01:

Fig. 12 Auxiliary Room Ventilating Circuit

NOTE: Install the 5 amp control fuses for

the circuit before installing the fuses in Ess. Load Cab.

Fig. 13 Supplementary Load Bank.

NOTE: Do not install fuses for SLB1, SLB2 and SLB3 leads at this time but do install fuses for LC1 and LC3 leads.

Fig. 14 Recirculating Louver Control and Discharge Louver Control.

Fig. 15 Auxiliary Automatic Fuel Pumping System.

4.4.8 Close any disconnect switches provided for the figures in Paragraph 4.4.7.

4.4.9 With commercial ac available on Fig. 13 and 14 observe that shutters are held closed.

4.5 Remote Radiator Cooling System

4.5.1 Install piping and wiring in accordance with job drawings.

4.5.2 Install isolators under the remote radiator at the marked locations and bolt the radiator down in accordance with job drawings.

4.5.3 Install the thermometers in the engine inlet and outlet connections.

5. CONTROLLER TESTS

5.1 Preliminary

5.1.1 In the following tests, the controller will self check and then the installer will sequentially test each lamp circuit and a number of relay circuits for proper operation. Once this is verified, then the controller is used to test all other circuits and will operate the lamps only as feedback indicator that these circuits are operating properly.

5.1.2 In each test, if the indicated circuit did not operate the proper lamp or relay, do not proceed with the tests until the circuit trouble is corrected. To correct troubles, operate the OPERATION SELECTOR switch to OFF. Remove the plug on the controller or auxiliary board that is associated with that circuit. Using the ITE-4442 Volt-Ohmmeter or equivalent, check for continuity from the plug through the circuit to the final destination. Correct the trouble and reconnect the plug to the controller or auxiliary board.

5.1.3 In any of the following tests, if the OPERATION SELECTOR switch is turned OFF, then tests resumes from the very beginning (paragraph 5.1.4.)

5.1.4 Operate the OPERATION SELECTOR switch to MANUAL position. If the POWER FAILURE lamp lights after 15 seconds, then there is no commercial power available at the power sense fuses CA, CB and CC. Correct before proceeding.

5.1.5 Operate circuit breakers CB1 & CB2 to ON.

5.1.6 Place engine controls in EMERGENCY STOP mode by pulling outward on the "T" handle (located on the left side of the engine along with the lube oil pressure gauge) marked EMERGENCY STOP. Observe that the SWITCH OFF NORMAL and EMERGENCY STOP lamps light. The ESDR relay operates and the ADS solinoid on the right side of the engine will pulse once to release the air damper shutdown mechanism.

NOTE: A) In any of the controller tests, ignore the operation of lamps that are not specifically mentioned.

B) From STEP 3 and on, paragraph 5.4, the lamps are used only as a feed-back indicator that the circuits under tests are operating properly. If any troubles are encountered, do not check the lamp circuits for they were previously checked in STEP 2. Begin checking the circuit, under the function name, in the auxiliary board schematic SD-82572-01, sheet B1.

5.2 STEP 1 - Controller Shelf Check

5.2.1 In the upper left corner of the controller board there is a small black and red pushbutton switch (S1). Momentarily depress this pushbutton. The controller will self check and 15 seconds later several major and minor lamps will blink. If one or more lamps blink then proceed to STEP 2 - paragraph 5.3 else continue below.

NOTE: Once switch S1 is depressed, the controller is automatically set to the circuit test mode. All switches and pushbuttons will not operate in their normal function and the engine cannot be started. To reset the switches and pushbuttons to operate in their normal function, first move the OPERATION SELECTOR switch to off then move the switch to the desired function.

NOTE: If paragraph 5.1.6 was not performed, depressing the S1 switch on the controller board will (after a short delay) cause the ADS solinoid on the right side of the engine to pulse once thereby releasing the air damper shutdown mechanism. This action in itself will illuminate the SWITCH OFF NORMAL and EMERGENCY STOP lamps. The ESDR relay will operate. Several MAJOR and MINOR lamps will blink. When this occurs, proceed to paragraph 5.3, otherwise continue below.

5.2.2 Use the DC Voltmeter to check for voltages (used to power the controller board) between test point TP10 and test points as listed below on the controller board.

VOLTAGES	TP TEST POINTS
-12 to -13.2	TP 51
+4.9 to +5.3	TP 52
+12 to +13.2	TP 50
+12 to +14	TP49

5.2.3 If all voltages are present and correct then the controller or auxiliary board is probably defective. If any voltage is missing or incorrect or if the polarity is incorrect this must be corrected before any additional testing can be done.

5.3 STEP 2 - Output Sequence Checks

NOTE: The SWITCH OFF NORMAL lamp is illuminated at this point.

5.3.1 When the TEST pushbutton is momentarily depressed a lamp will blink or a relay will operate and release. Sequentially depress the ALARM TEST pushbutton once for each condition listed below and check for the operation of each lamp or relay as given in the sequence below. Check the relay operation by sight and feel.

a. HIGH WATER TEMP lamp

b. CRANK FAILURE lamp

c. POWER FAILURE lamp

d. LOW OIL PRESSURE lamps

e. BKR TRIP/REVERSE POWER lamp

f. UNDER/OVER SPEED lamp

g. UNDER/OVER VOLTAGE lamp

h. K2 relay (auxiliary board - middle relay)

i. CBC relay (inside control cabinet). On Off Set transfer Engines with commercial AC present and CA, CB, CC fuses in place, relay PRR (inside control cabinet) will pulse.

j. FUEL relay. For this test, temporarily connect a small clip lead across terminals 10 and 11 of the ESDR relay in the control cabinet and hold the SON switch closed on the right side of the engine. The ERR relay will pulse in the control cabinet and the FRS relay on the right side of the engine will pulse. The FRS relay is a sealed device therefore, use a DC voltmeter to check for pulsating voltage across diode CR5 which is located directly below the FRS relay. The CIRCUIT BREAKER OPEN lamp will also blink.

k. K3 relay (auxiliary board - right relay)

l. K1 relay (auxiliary board - left relay)

5.3.2 If any of the lamps or relays did not operate refer to paragraph 5.1.2 otherwise, continue testing below.

5.4 STEP 3 - Input 1 checks

5.4.1 Momentarily depress the TEST pushbutton once (refer to NOTES A and B). K1 relay will stop clicking.

5.4.2 Depress and hold the START pushbutton. The engine will not start. If the START pushbutton circuit is correct then the HIGH WATER TEMP lamp will light. Release the START pushbutton, the lamp will extinguish.

5.4.3 Depress and hold the ALARM RESET pushbutton. If the ALARM RESET pushbutton circuit is correct then the CRANK FAILURE lamp will light. Release the ALARM RESET pushbutton, the lamp will extinguish.

5.4.4 Depress and hold the CIRCUIT BREAKER CLOSE pushbutton. If the CIRCUIT BREAKER CLOSE pushbutton circuit is correct then the POWER FAILURE lamp will light. Release the CIRCUIT BREAKER CLOSE pushbutton, the lamp will extinguish.

5.4.5 Depress and hold the CIRCUIT BREAKER OPEN pushbutton. If the CIRCUIT BREAKER OPEN pushbutton circuit is correct then the LOW OIL PRESSURE lamp will light. Release the CIRCUIT BREAKER OPEN pushbutton, the lamp will extinguish.

5.4.6 Depress and hold the STOP pushbutton. If the STOP pushbutton circuit is correct then the BKR TRIP lamp will light. Release the STOP pushbutton, the lamp will extinguish. Repeat the above use the EMERGENCY STOP pushbutton.

5.4.7 If any STEP 3 tests did not operate properly, refer to paragraph 5.1.2 otherwise, continue testing below.

5.5 STEP 4 - Input 2 Checks

5.5.1 Momentarily depress the TEST pushbutton once (refer to NOTES A and B). UNDER/OVER voltage lamp lights and remains ON.

5.5.2 Using a small test clip, strap together the terminal of the high water temperature sensor (HWT). The HIGH WATER TEMP lamp will light. Remove the clip lead and the lamp will extinguish.

5.5.3 Using a small clip lead, strap together the terminals of the low water temperature sensor (JHFS) in the immersion heater. The CRANK FAILURE lamp will light. Remove the clip lead and the lamp will extinguish.

5.5.4 Using a small clip lead, strap together the normally opened contacts on the reverse power relay (K4) on the auxiliary board (for parallel operation only). The POWER

FAILURE lamp will light. Remove the clip lead and the lamp will extinguish.

5.5.5 Use an AC voltmeter and check the alternator bus for an absence of AC potential. The LOW OIL PRESSURE lamp should be extinguished.

On OFF-Set Transfer Engines, manually operate the alternator circuit breaker to on and the LOW OIL PRESSURE lamp should light.

NOTE: Inertia may cause the alternator circuit breaker to move to the trip position. Do not consider this to be a malfunction.

NOTE: If this is an On-Set Transfer Engine, open the commercial circuit breaker manually before attempting to close the alternator circuit breaker. If commercial AC is present, opening the commercial circuit breaker will kill AC power. Therefore, provide an alternate independent light source.

Operate the alternator circuit breaker back to off and the lamp should extinguish. This circuit is associated with the circuit breaker contact BT-1 on terminal 21 and 43 of terminal strip TS-56. On On-Set Transfer Engines, close the commercial circuit breaker to restore power.

5.5.6 Test circuit breaker CB1 and CB2 inside the control cabinet at lower right. The BKR TRIP and CONTROL FUSE lamps shall not be lighted.

Operate CB1 to OFF	The lamp shall light.
Operate CB1 to ON	The lamp shall extinguish.
Operate CB2 to OFF	The lamp shall light.
Operate CB2 to ON	The lamp shall extinguish.

5.5.7 Remove the Start and Control battery rectifier AC INPUT fuses. The RECTIFIER FAIL and UNDER/OVER SPEED lamps shall light. Replace the fuses and the lamps will extinguish. For installations which uses a rectifier other than a J87249B, such as a Lamarche rectifier mounted externally from the engine, remove the AC fuse feeding it. This should cause an alarm relay within the rectifier to close a set of contacts which should be job wired into pins E and D (or equivalent leads) of the RC plug.

CAUTION: THESE PINS (LEADS) ARE AT BATTERY POTENTIAL AND SERIOUS DAMAGE COULD RESULT IF EITHER LEAD CAME IN CONTACT WITH GROUND.

The RECTIFIER FAIL and UNDER/OVER SPEED lamps should light when the rectifier AC INPUT fuses are removed. Replace the fuses and the lamp shall extinguish.

5.5.8 If any STEP 4 tests did not operate properly, refer to paragraph 5.1.2, otherwise continue testing below.

5.6 STEP 5 - Input 3 Checks

5.6.1 Momentarily depress the TEST pushbutton once (see NOTES A and B). The UNDER/OVER VOLTAGE lamp extinguishes. The CRANK FAIL and SWITCH OFF NORMAL lamp are lighted.

5.6.2 If the battery is charged to float voltage, then the HIGH WATER TEMP lamp should be extinguished. If the battery has an insufficient charge, then the lamp will turn on. If the battery is fully charged and the wiring from the battery to the boards are correct, then the controller or auxiliary board is defective when lamp is on.

5.6.3 Using a small clip lead, strap together the normally opened contacts on the low oil pressure sensor (LOPS). The CRANK FAILURE lamp will extinguish. Remove the clip lead and the lamp will light.

5.6.4 Using a small clip lead, ground the NPO point on terminal strip TS-69. The POWER FAILURE lamp will light. Remove the clip lead and the lamp will extinguish.

5.6.5 Using a small clip lead, ground the LF point on terminal strip TS-69. The LOW OIL PRESSURE lamp will light. Remove the clip lead and the lamp will extinguish.

5.6.6 Using a small clip lead, ground the RS point on terminal strip TS-69. The BKR TRIP lamp will light. Remove the clip lead and the lamp will extinguish.

5.6.7 If any STEP 5 tests did not operate properly, refer to paragraph 5.1.2, otherwise continue testing below.

5.7 STEP 6 - Input 4 checks

5.7.1 Momentarily depress the TEST pushbutton once (see NOTES A and B). BREAKER TRIP/REVERSE POWER lamp comes on. The HIGH WATER TEMP lamp may come on (see paragraph below).

5.7.2 In the upper right corner of the controller there is a small red and white mini switch assembly. If SW1 is open then the HIGH WATER TEMP lamp will be on. If the switch is closed then the lamp will be extinguished. Operate this switch to verify the above and then return the switch to its original position. Refer to paragraph 4.2.2.

5.7.3 Operate SW2 switch to CLOSED position. The CRANK FAILURE lamp will extinguish. Operate SW2 switch to OPEN position and the lamp will light. Leave SW2 in the OPEN position.

5.7.4 If commercial AC power is present, then the POWER FAILURE lamp will be extinguished. To simulate commercial AC power failure remove the 15 amp fuses CA, CB and CC

to check for the above condition. Replace the fuses.

5.7.5 The LOW OIL PRESSURE lamp should be extinguished, otherwise the alternator voltage circuits are faulty.

5.7.6 The BKR TRIP lamp should be on, otherwise the alternator voltage circuits are at fault.

5.7.7 If any STEP 6 tests did not operate properly, refer to paragraph 5.1.2, otherwise continue below.

5.8 STEP 7 - OSS Checks

5.8.1 Momentarily depress the TEST pushbutton once (see NOTES A and B).

5.8.2 With the OSS switch in MANUAL position the HIGH WATER TEMP lamp should be lit.

5.8.3 With the OSS switch in AUTO NO LOAD position the CRANK FAILURE lamp should be lit. HIGH WATER TEMP lamp is out. <

5.8.4 With the OSS switch in FULL AUTO position the POWER FAILURE lamp should be lit. CRANK FAILURE lamp is out. <

5.8.5 With the OSS switch in AUTO MAN RESTORE position the LOW OIL PRESSURE lamp should be lit. POWER FAILURE lamp is out. <

5.8.6 If any STEP 7 tests did not operate properly, refer to paragraph 5.1.2.

6. INITIAL START

NOTE: If Off-Set Transfer Breaker Circuit (SD-81489-01) is furnished, disconnect LB6, TR16, CB9 and TR15 leads at the customer connection strip in the control cabinet. Also, to prevent external alarms from coming in disconnect external alarm connections until Paragraph 9.

6.1 The start battery and separate control battery (where furnished) shall have had a satisfactory initial Charge.

6.2 Separately test associated systems such as Automatic Fuel Pumping System, Auxiliary Room Ventilating Circuit, Remote Radiator Circuit and Recirculating Louver Circuit insofar as possible.

6.3 Turn OPERATION SELECTOR Switch to OFF. Switch off NORMAL lamp is on. <

6.4 Where a remote radiator is furnished be sure that RFM Breaker is open.

NOTE: 1) H1 and H2 fuses for Immersion Heater and R1 and R2 fuses for the J87249B Rectifier may already be installed.

2) Fuses L1 and L3 will not be required unless the set is to be paralleled.

6.5 On the top of the governor turn the knurled brass knob or ring several turns CCW and then turn it several turns CW. Observe that it moves freely. If there should be paint in the threads preventing if from turning freely it will be necessary to remove the top of the governor, clean paint from the threads on the shaft and knurled ring and then reassemble.

6.6 Check the Air Shutdown Solenoid (ADS) on the blower (intake) housing. Pull down the armature of the solenoid to make certain that the flapper valve is open. This will also reset the spring-loaded switch (SON) on the other end of the flapper valve shaft.

6.7 Operate the cross current compensation switch (CCC) on the Voltage Regulator as follows:

OUT position for single-set operation.

IN position for parallel operation.

Position the governor arm on the PSG governor as follows:

ISO position for single-set operation.

DROOP position for parallel operation.

NOTE: 1) Switch CCC at OUT cuts out the Cross-Current-Compensating Resistor on the Voltage Regulator.

2) ISO position of the PSG governor arm eliminates speed droop from no-load to full-load. The arm can be moved after loosening the knurled knob. Tighten the knob securely after positioning the arm.

6.8 Open the front cabinet panel and manually open the SET Breaker. When a NORM Breaker is furnished manually open it.

NOTE: If a breaker is in the tripped position (operating knob at midpoint) it will be necessary to relatch the breaker before operating it to the desired position. Relatch the breaker by pulling the manual operating handle downward toward the OFF position as far as it will go and then release the handle.

6.9 Open the valve in the fuel suction line, and prime the fuel system. Turn the RUN/PRIME valve to PRIME position and then operate the Deming hand pump until considerable restriction is felt, indicating the fuel cup is filled and the system is primed. Stop pumping and turn RUN/PRIME valve to RUN position.

NOTE: If any leaks are observed in the fuel lines during the priming operation fix these leaks before attempting to start and then reprime.

6.10 Turn OPERATION SELECTOR Switch to MANUAL. SWITCH OFF NORMAL lamp extinguishes. Operate ENGINE SPEED control in RAISE direction for a few seconds and observe that the motor turns freely. Then operate ENGINE SPEED control in LOWER direction for about 10 seconds and observe that the brass knurled ring turns CCW. This will cause the set to start at reduced speed on the initial Start.

6.11 Turn ALTERNATOR VOLTS ADJUST control full CCW. Turn Voltmeter Selector Switch to ALTERNATOR 1-2 position.

6.12 Push the START button and hold operated until the engine fires.

NOTE: The set may also be started by using the ESE button on the engine.

6.13 As soon as the engine fires and starts have one man check speed with the R-2705 Tachometer while another man is raising engine speed by holding ENGINE SPEED Switch at RAISE position. Speed is checked by inserting the R-2705 Tachometer in the opening of the transducer (speed pickup) housing. Adjust speed to 1800 rpm. Observe that output voltage is indicated when speed is approximately 1400 rpm.

NOTE: 1) As soon as voltage builds up (about 1400 rpm) continue to increase speed to 1800 rpm. Do not continue to operate the set at this buildup speed or reduce speed below the buildup point. This may cause damage to the Voltage Regulator. It will be satisfactory to shut the engine down at this time, however, if operating conditions are unsatisfactory.

2) If voltage does not buildup it will be necessary to flash the field. To do this leave the set running at 1800 rpm. Apply 1-1/2 volts (flashlight cell) to terminals 186 (+) and 115 (-) at the terminal strip in the rear of the cabinet until build-up occurs. Remove flashing battery as soon as voltage starts to build-up.

6.14 When the alternator voltage is available observe that intake louvers open and that the shutters on a KS-20023 Supplementary Load also open.

6.15 Set no-load speed to desired value: 1800 rpm for PSG governor at ISO: 1890 rpm for PSG governor at DROOP. Then set alternator voltage to desired value. Check engine speed here and throughout the load run with either the ITE-4824 or R-2705 Tachometer.

6.16 Allow the engine to run for about 30 minutes at no-load. Observe that lube oil pressure remains above 30 psi. Also observe that engine water temperature steadily increases but remains approximately 185°F.

6.17 Where engine-mounted shutters are furnished observe that these shutters begin to open when water temperature reaches the range 130-160°. These shutters should be fully open when water temperature reaches 160-170°F.

6.18 With alternator voltage available check phase sequence of the output with the R-3404 Phase Sequence Indicator. 1-2-3 order is required. Where a remote radiator is furnished close the RFM Breaker. Observe that the remote fan starts and turns in the correct direction.

6.19 Check the set over carefully for oil and water leaks. After the no-load run shut the set down with the EMERGENCY STOP button. This button will light. SWITCH OFF NORMAL lamp also lights.

6.20 Depress ALARM RESET to cancel EMERGENCY STOP lamp. Reset the Air Damper and the toggle switch on the Blower Housing to cancel SWITCH OFF NORMAL lamp. Turn OPERATION SELECTOR Switch to OFF; SWITCH OFF NORMAL lamp lights.

6.21 Change alternator output leads for correct phase sequence, if sequence was not 1-2-3 order.

6.22 Turn OPERATION SELECTOR Switch to MANUAL. The SWITCH OFF NORM lamp should go out.

6.23 Press and hold the ALARM TEST pushbutton. Observe that all MAJOR ALARM and POWER FAILURE lamps are lighted except for the SWITCH OFF NORMAL and CONTROL FUSE FAIL lamps. Release the ALARM TEST pushbutton and all lamps extinguishes.

NOTE: Fuses CA, CB and CC are used to sense commercial power and were inserted in paragraph 5.7.4. If voltage on all three sense leads (CA,CB and CC) are present and within normal voltage limits, the POWER FAILURE lamp should be extinguished.

6.24 Turn OPERATION SELECTOR Switch to OFF. Observe that SWITCH OFF NORM lamp lights and the other lamps go out. Reset the AIR Shutdown Solenoid and SON Switch on the Blower Housing.

6.25 Where a remote lube oil system is not furnished check lube oil level in the crankcase and add oil as necessary to bring level on the dipstick near the F mark.

NOTE: About 2 quarts of oil will be required as this amount of oil is retained in the lube oil filters.

6.26 Connect the ITE-4782 Test load to the load side of the alternator or EMER Breaker.

NOTE: Where the ON-Set transfer Breaker is furnished it is assumed that commercial ac is not yet connected to the NORM Breaker.

6.27 Start the set and load it to full load. Start with OPERATION SELECTOR Switch at MANUAL using the START button. Close breaker and add load.

6.28 Allow the set to run about 30 minutes at full load. Observe lube oil pressure, water temperature, voltage, current and KW. If necessary to correct speed for 60 hertz do so with RAISE/LOWER speed switch.

NOTE: DC field current on the DC AMMETER will be about 2 amperes.

6.29 After a 30 minute run open the circuit breaker and stop the set. Reduce load to zero on ITE-4782.

6.30 Install CA, CB, and CC fuses for the voltage monitors and external fuses feeding these leads for an Off-Set Transfer Breaker Circuit. Observe that the POWER FAILURE lamp on the control cabinet (turn OPERATION SELECTOR Switch to MANUAL) is off. Then restore switch to OFF.

7. FULL LOAD TEST

TIME: A Preliminary Load Test of one hour and a Final Acceptance Test of 2-1/2 hours in length, two hours at full-load and the last half-hour at the usual office load value, or, at full-load.

LOAD: Supplementary load and artificial load equal to full capacity of the set.

7.1 Preliminary

7.1.1 Install the side covers on the engine, where these are furnished.

7.1.2 Install the fuses for the Supplementary Load Bank SLB1, SLB2, and SLB3 in the Essential Load Cabinet.

7.2 Preliminary Load Test

7.2.1 Turn OPERATION SELECTOR Switch to MANUAL. Start the set. Adjust speed and voltage.

7.2.2 Take a set of readings at no-load. This will include Time, Frequency, Volts, Water Temperature, Lube Oil Pressure, Ambient Temperature and Time Meter.

7.2.3 Operate the CIRCUIT BREAKER CLOSED pushbutton. Observe that supplementary load is connected to the set, if this is furnished.

7.2.4 Add artificial load until the set is loaded to full-load. Adjust speed and voltage as necessary.

7.2.5 Take a set of readings at full-load. This will include Time, Frequency, Volts, Amperes, KW, Power Factor, Oil Pressure, Water Temperature and Ambient Temperature.

7.2.6 Take readings every 30 minutes until the set has run one hour at full-load. The requirements in Paragraph 7.4 shall be met during the hour run.

7.2.7 Reduce artificial load to zero and operate the CIRCUIT BREAKER OPEN pushbutton. Allow the set to run about three minutes to cool down. Then shut the set down by depressing the STOP button.

7.2.8 Turn OPERATION SELECTOR Switch to OFF.

7.3 Final Acceptance Test

7.3.1 The Warm-up Timer and Power Fail Timer may be set in accordance with TABLE A. Discuss with the operating company representatives as to how long a delay they prefer and adjust the switches accordingly. The switch is a red and white mini switch assembly in the right hand corner of the controller board.

7.3.2 Turn OPERATION SELECTOR Switch to MANUAL. Start the set and adjust speed and voltage as necessary.

7.3.3 Allow the set to warm up for a few minutes. Then close the alternator breaker and add artificial load until the set is loaded to full-load.

7.3.4 Take a set of test readings at full-load. Then take readings every 30 minutes until the set has run two hours at full-load. The requirements in Paragraph 7.4 shall be met during this run.

7.3.5 After two hours at full-load reduce load to the value of load normally carried by the set, or, continue at full load. Take a set of readings if load is reduced from full-load.

7.3.6 After 30 minutes at the normal load value (or at full-load) take a set of readings. Then decrease artificial load to zero. Open the alternator circuit breaker.

7.3.7 Allow the set to run about 3 minutes. Then shut the set down by pushing the EMERGENCY STOP button. The button lights.

7.3.8 After the set has coasted to a stop turn OPERATION SELECTOR Switch to OFF. The EMERGENCY STOP lamp goes out.

7.3.9 Reset the Air Damper Solenoid (ADS) and the SON Switch on the blower housing.

7.4 Requirements

7.4.1 The unit shall be capable of carrying full KW load up to the following altitudes (above sea level):

30 KW Set: 9500 feet
45 KW Set: 6000 feet
75 KW Set: 5000 feet
115KW Set: 5000 feet

7.4.2 Lube oil pressure shall not be less than 30 psi.

7.4.3 Water temperature shall not exceed 195°F.

7.4.4 Speed at full-load, or at a derated full- load, shall not change more than ±1/4 hertz under steady load conditions. Also, speed changes shall not by cyclic (hunting).

7.4.5 With the engine hot, the speed droop from no-load to full-load (or to the derated full-load) shall not be greater than the following:

NOTE: The cold speed setting is taken after a minimum of 15 minutes operation of the set.

PSG GOVERNOR

ISO SETTING: : ± 1/4 hertz (±8 rpm)
DROOP SETTING: 90 rpm

SG GOVERNOR: 90 rpm

7.4.6 The voltage throughout the load run should not vary more than ± 1% from the original cold setting at no load.

8. REVERSE POWER TEST

NOTE: The RP will not require checking and adjustment unless the set will be paralleled. RP cannot be adjusted without operating the set in parallel with another set in accordance with Section 130 in this handbook. The REV PWR TST Switch, furnished on the J86634A, cannot be used at all.

8.1 As a matter of information the amount of reverse power that will trip the circuit breaker should be 19-21 KW. If the set draws this amount of reverse power in parallel with another set the circuit breaker trips and the set shuts down. The breaker TRIP lamp will blink. A major office alarm will be brought in.

8.2 Before the set can be restarted the Air Shutdown Solenoid and the SON Switch will have to be reset. Also, the alternator circuit breaker will have to be manually relatched.

8.3 The circuit breaker is relatched by pulling the manual operating handle downward toward the breaker OFF position as far as it will go and then releasing the handle. Observe that the breaker knob had been moved from the tripped (mid-position) to the OFF position.

9. OVERSPEED TRIP TEST

9.1 Remove T1 fuse from the cabinet to protect the Frequency Meter.

9.2 Turn OPERATION SELECTOR Switch to AUTO NO LOAD. Start the set with the START button.

9.3 Increase speed by operating ENGINE SPEED Switch in RAISE direction. It should be possible to increase speed to above 2160 rpm. If shutdown should occur the UNDER/ OVER/SPEED lamp should blink.

9.4 Restore engine speed to 60 hertz (or 63 hertz if set will be paralleled) with ENGINE SPEED LOWER Switch.

9.5 The following operations take two men. Have one man insert the R-2705 Tachemeter in the opening on the speed pickup housing. Have a second man overspeed the engine by pushing the fuel rod on the governor in, which overrides the load limit adjustment on the governor. For the 30 and 45 KW sets it will be necessary to protect the hand with a wrench handle or similar metal tool.

9.6 Shutdown should occur in the range 2050-2250 rpm.

9.7 Observe that at shutdown the OVER-SPEED lamp lights.

9.8 After shutdown turn OPERATION SELECTOR Switch to OFF. Reset the Air Shutdown Solenoid and SON Switch. Restore the T1 fuse.

10. AUTOMATIC CONTROL TESTS

NOTE: Where a Remote Breaker Circuit is furnished, do not connect leads CB-9, TR-15, LB-6 and TR-16 leads until the test shown in Paragraph 10.1.2 has been completed.

10.1 Preliminary

10.1.1 For both the On-Set and Off-Set Transfer units connect commercial ac to the engine- alternator. Observe that the NORMAL Breaker closes when the commercial ac is connected to an On-Set Breaker set. For the Off-Set Transfer set, commercial ac is applied on CA, CB and CC leads by installing the 15

ampere fuses in the AC Service Cabinet.

CAUTION: BE CERTAIN THAT THE 3-PHASE COMMERCIAL AC POWER LEADS ARE "PHASED-OUT" TO MATCH THE PHASE SEQUENCE OF THE ALTERNATOR OUTPUT LEADS.

10.1.2 For the Off-Set Transfer unit check voltages on CB-9, TR-15, LB-6 and TR-16 leads as follows:

10.1.2.1 Turn OPERATION SELECTOR Switch to FULL AUTO.

10.1.2.2 Simulate a commercial power failure by removing one of the 15 ampere fuses feeding CA, CB or CC leads. POWER FAILURE lamp lights.

10.1.2.3 Observe that the set starts after the power fail time. After the WUT time the alternator breaker closes. Check for alternator voltage on LB-6 and TR-16 terminals with the 300 volt scale of ITE-1000 or ITE-4442.

10.1.2.4 After the breaker closes reinstall the 15 ampere commercial power fuse. The POWER FAILURE lamp goes out.

10.1.2.5 Disconnect ITE-1000 or ITE-4442 from LB-6 and TR-16 terminals and connect to CB-9 and TR-15 terminals, using the 300 volt ac scale.

10.1.2.6 After the run time period (about 56 minutes) times out. Observe that commercial voltage appears momentarily on CB-9 and TR-15 terminals. The alternator breaker opens and the set shuts down after a 2 minute cooldown period. The voltage is removed from both sets of leads: LB-6 and TR-16; CB-9 and TR-15.

10.1.2.7 Turn OPERATION SELECTOR Switch to OFF. Remove the 15 ampere fuses in the AC Service Cabinet that fuse the CA, CB and CC leads.

10.1.2.8 Connect the LB-6, TR-16, CB-9 and TR-15 leads to the Remote Breaker Circuit. Then Reinstall the 15 ampere fuses for the CA, CB and CC leads.

10.1.3 Connect to the alarm circuit (SD-81100-01 or SD-81223-01)

CAUTION: GRD LEAD FROM GRD TERMINAL AND BAT LEAD FROM BAC TERMINAL ARE NOT RUN TO THE ALARM CIRCUIT UNLESS A SEPARATE CONTROL BATTERY IS FURNISHED. HG LEAD IS NEVER RUN.

10.2 Alarm

10.2.1 Check minor alarm by removing an ac input fuse from J87249 Rectifier. Verify that OC and EF relays operate and EF lamp lights on SD-81100-01 Circuit. Verify that RA relay operates and RA lamp lights on SD-81223-01 Circuit. Restore the fuse to remove alarm indication.

10.2.2 Check major alarm by depressing the ALARM TEST button on the engine with OPERATION SELECTOR Switch in any position but OFF. (This will also bring in the minor alarm which will be removed when the ALARM TEST button is released).

10.2.3 Verify that the relays shown in Paragraph 10.2.1 operate but in addition the OS relay operates on SD-81100-01 circuit and EF relay operates on SD-81223-01. Release TEST ALARM button and observe that minor alarm indications are removed. Press ALARM RESET button and observe that major alarm indications are removed.

NOTE: Alarms may also be cancelled by turning OPERATION SELECTOR Switch to OFF.

10.3 Automatic Operation

10.3.1 Turn OPERATION SELECTOR Switch to FULL AUTO.

10.3.2 Fail commercial power. This may be simulated by removing the voltage monitor fuses. For Off-Set Transfer remove the 15 ampere fuses feeding CA, CB, and CC leads, or, remove CA, CB, and CC fuses in the engine cabinet. For On-Set Transfer remove CA, CB and CC fuses in the engine cabinet.

10.3.2.1 SD-81100-01: PF alarm is given after a delay (see chart in paragraph 7.31). PF lamp lights and office alarm (minor) sounds. PF alarm is sent out on B1, C1, etc. systems.

10.3.2.2 SD-81223-01: PF lamp lights and office major alarm sounds immediately.

10.3.3 The engine starts after the power fail time and the load transfers from commercial power to the set after the WUT time. Proper operation (PO) alarm is given by circuits SD-81100-01 and SD-81223-01 and PO lamp lights on SD-81223-01. Both circuits transmit PO alarms.

NOTE: For the Off-Set Transfer the breaker sequence is to close the alternator breaker, open the NORM Breaker and then close the EMERG Breaker.

10.3.4 After PF and PO alarms come in replace the voltage monitor fuse that was removed, or, restore commercial power. Observe that PG alarm is removed.

10.3.5 The set will carry the load through the Run-Time period. Transfer the load back to commercial power and then shut down after a 2 minute cooldown period.

NOTE: The sequence of breakers with the Off-Set Transfer is to open the remote EMERG Breaker, close the remote NORM Breaker and then to open the alternator breaker.

10.4 Remote Start Test

10.4.1 With OPERATION SELECTOR Switch at FULL AUTO ground the RS lead to the cabinet or otherwise provide ground on RS lead from the alarm circuit.

10.4.2 The sequence of events will be the same as that shown in Paragraph 9.3 except that power fail time will be bypassed (set starts immediately) and no pF alarm will come in.

11. ACCESSORY TESTS AND ALARMS

NOTE: The following have been factory-set and tested. If adjustment is necessary, refer to the supplier's manual.

11.1

LOPS: This switch closes when lube oil pressure builds up. If pressure falls into the range 20-30 psi the switch opens, causing the engine to shut down, lights the LOW OIL PRESSURE lamp and brings in a major alarm. Simulate opening of the switch by removing the cover and pushing the actuating arm in LOPS to operate the microswitch.

11.2

HWTS: This switch shuts down the engine, lights HIGH WATER TEMPERATURE lamp and gives a major alarm when coolant temperature reaches 205-215°F. The switch will remain closed until temperature reduces about 6°F below the operate point. Simulate a failure by removing the cover and connecting a temporary jumper across the switch terminals.

11.3

HCS: This is a non-adjustable switch (part of List 3) for the immersion Heater. Switch contacts are closed in the range 75-100°F. Water temperature on the gauge may be 130-140°F.

11.4

JHF: This is an adjustable switch (part of List 3) to monitor the jacket water temperature. Contacts will close if coolant temperature is between 45-55°F to light the JACKET HEATER FAIL lamp. Switch is adjustable by a 9/16 inch hex nut under the switch cover.

12. MAINTENANCE DURING INSTALLATION

12.1 Before Staring (Engine Cold)

12.1.1 Check lube oil level in the crankcase. Pull dipstick and observe crankcase oil level. Oil level should be as follows:

Ren Valve: Between F marks
No Ren valve: Between F marks

12.1.2 Where no Ren Valve is furnished add oil when level reaches the L mark to bring level between the F marks.

12.1.3 Check that the voltage of the starting and control battery (if furnished) is within the following range:

Lead Acid: 26.0-26.3 volts
Nickel-Cadmium: 28.3-28.5 volts

Measure across battery terminals with ITE-4474 Voltmeter as the DC OUTPUT jacks are likely to be inaccessible.

12.1.4 Check coolant level weekly in the set-mounted radiator. Maintain coolant level near the top of the radiator upper tank. It should be within 2" of the top of the filler neck. Add water as necessary.

12.1.5 Check coolant level weekly in the remote radiator (115 KW set) when one is furnished. Coolant level should be near the top of the sightglass. Add water as necessary.

12.2 During Operation

12.2.1 Check for unusual vibration and/or noise.

12.2.2 Check for signs of unusual operating conditions.

12.2.3 Check for lube oil, fuel, water and exhaust leaks. Correct these as soon as possible after shutdown.

12.3 Other Items

12.3.1 Periodically check electrolyte level in the batteries and fill in accordance with instructions.

12.3.2 Periodically check battery charging rate (4 AMP/VOLT terminals on the J87249 Rectifier). Also periodically check battery voltage with ITE-4474 Voltmeter by measuring across the battery terminals.

12.3.3 Check for leaks in fuel system, cooling system and lube oil system and correct as necessary.

12.3.4 Drain residue from the AIR BOX DRAIN on a weekly basis.

13. GENERAL TROUBLES AND CAUSES

13.1 Engine will not crank.

Weak start battery.
Loose battery connections.
Failure of
OSS Switch at OFF.
Wrong battery polarity applied
to Air shutdown device not reset.

13.2 Engine cranks but does not start.

Defective fuel pump.
Restricted fuel filter or strainer.
Insufficient fuel.
Air in fuel system.
Failure of Throttle Solenoid.
Failure of Governor.
Failure of PS Circuit Pack.
Shorted or open speed pickup.
Fuel system not primed.

13.3 Hard starting

Engine overhaul required.
Air in fuel system.
Insufficient fuel pressure.
Clogged Air Cleaner.
Excessive exhaust system back pressure.
Weak start battery.
Improper fuel.
Low ambient temperature.
Incorrect SAE rating of lube oil.

13.4 Engine stops.

RUN/PRIME Valve left on PRIME.

Refer to alarm lamp indication below.

1. CRANK FAILURE lamp lights solid. Shorted or open speed pickup
2. CONTROL FUSE FAIL lamp lights solid. CF fuse blown. CB1 and CB2 opened.
3. UNDER/OVER SPEED lamp blinks. Speed set too high. Defective governor.
4. UNDER/OVER SPEED lamp lights solid. Speed set too low. Defective governor.
5. LOW OIL PRESSURE lamp lights solid. See Paragraph 11.1.
6. HIGH WATER TEMP lamp lights solid. See Paragraph 11.2
7. BKR TRIP lamp lights solid. Excessive KW load.
8. REVERSE POWER lamp blinks. Failure in parallel operation.
9. UNDER/OVER VOLTAGE lamp blinks. Output voltage too high.
10. UNDER/OVER VOLTAGE lamp lights solid. Output voltage too low.

13.5 Engine overheats.

Thermostats fail to open.
Restricted passages in lube oil cooler.
Defective water pump.
Loose or broken fan belts.
Excessive KW load.
Clogged radiator passages.
Low coolant level.
Insufficient air intake in room.

13.6 Low lube oil pressure

Insufficient lube oil in crankcase.
Defective lube oil pressure regulator.
Leaks in lube oil system.
Defective lube oil pump.
Engine requires overhaul.
Clogged lube oil filters.
Clogged oil cooler passages.

13.7 Exhaust smoke analysis.

Black or grey smoke.
Incompletely burned fuel.
Clogged air cleaner.
Improper fuel.
Insufficient combustion air.
Excessive exhaust back pressure.
Light load (less than 30%).

Blue smoke.
Incompletely burned fuel.
Improper fuel.
Internal fuel or lube oil leaks.

White smoke.
Improper fuel.
Faulty injectors.
Misfiring cylinders.

13.8 Engine knocks.

Lube oil diluted by fuel.
Air box drain is clogged.
Leaking injectors.

13.9 Engine runs unevenly.

Fuel supply erratic or insufficient.
Defective governor.
Operating temperature too low.
Engine requires overhaul.

Vertical line at side of paragraph indicates requirement.

13.10 Low lube oil level.

Insufficient lube oil in crankcase.
Ren Valve positions incorrectly.
Inlet valve to Ren Valve not full open.

13.11 High lube oil level.

Ren Valve positioned incorrectly.

Defective Ren Valve.
Ren Valve not vented.

13.12 Vibration on the set.

Unbalanced alternator armature.
Excessive grease in alternator bearing.
Loose electrical connections.
Fuel system problems.
Erratic governor.

13.13 No output voltage or low output

(Refer to Supplier's Manual)
Faulty diodes in alternator.
Loss of exciter residual magnetism
(Flash field - see Par. 6.13)
Speed below 1400 rpm.

13.14 Erratic voltage

(Refer to Supplier's Manual)
Faulty diodes in alternator.
Loss of residual magnetism.
Loose connections.

13.15 High output voltage and voltage is uncontrollable.

(Refer to Supplier's Manual)

Defective voltage regulator circuit.

13.16 Engine starts with OSS Switch at OFF position

Disconnect strap from ECB - to BAC.

13.17 Alarm lamps light when OSS Switch is turned from OFF position.

ALARM TEST button wiring not correct for the J8663A module wiring.

13.18 Breakers do not close satisfactorily.

Defective mechanical interlock.
Defective LR relay.

< Arrows indicate new or changed information.

Manager - Engineering

Reason for Reissue:
1) To correct information in paragraphs 6.23 and 6.24.
2) To provide additional information and make minor changes throughout section.

Figure 1. ALARM LAMPS ON CABINET

ALARMS

TEST	RESET

MINOR

RECTIFIER FAILURE	SPARE
POWER FAILURE	JACKET HEAT FAIL

MAJOR

LOW OIL PRESSURE	CRANK FAILURE	SPARE	SWITCH OFF NORMAL	UNDER/OVER VOLTAGE
HIGH WATER TEMP	UNDER/OVER SPEED	CONTROL FUSE FAIL	BKR TRIP / REVERSE POWER	SPARE

Figure 2. J85520 MICROCOMPUTER CONTROLLER

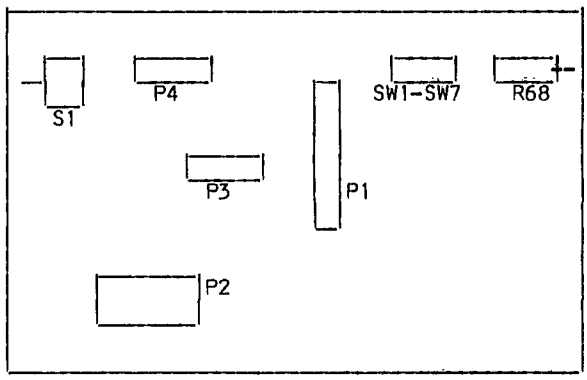

TABLE A. WARM-UP AND POWER FAIL TIMERS

	SW2			
	OPEN		CLOSED	
	1ST START	RESTART	1ST START	RESTART
WARM-UP	30 SEC	2 MIN	60 SEC	4 MIN
POWER FAIL	15 SEC		60 SEC	