

Installation Engineering Handbook 19
Western Electric Company, Incorporated
Kearny Works

Section **252**
9-24-71
Replaces Sect. 252
dated 8-8-69
Sect. T.I. 252
dated 6-12-70

KS-19587 DIESEL ENGINE-ALTERNATOR

115 KW (J86842)

CONTENTS

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. GENERAL <ol style="list-style-type: none"> 1.1 Scope 1.2 Inspection 1.3 Description of Unit 1.4 Description of Operation 1.5 Associated Information 2. PRECAUTIONS <ol style="list-style-type: none"> 2.1 Engine-Alternator 2.2 J86634 Control Module 2.3 J87249 Rectifier 3. TOOLS, TEST SETS AND RECORDS 4. INSTALLATION <ol style="list-style-type: none"> 4.1 Preliminary 4.2 J86634 Solid-State Control 4.3 J87249 Rectifier and Batteries 4.4 Engine-Alternator and Control 4.5 Remote Radiator and Cooling System | <ol style="list-style-type: none"> 5. INITIAL START AND RUN <ol style="list-style-type: none"> 5.1 Preliminary 5.2 Priming Fuel System 5.3 Starting 5.4 No-Load Run 5.5 Governor Adjustments 5.6 Final Operations 6. FULL LOAD TEST 7. REVERSE POWER TEST 8. OVERSPEED TRIP TEST 9. AUTOMATIC CONTROL TESTS 10. ACCESSORY TESTS AND ALARMS 11. MAINTENANCE DURING INSTALLATION 12. GENERAL TROUBLES and CAUSES |
|--|---|

1. GENERAL

1.1 Scope

1.11 This section covers installation and test of 115 KW diesel engine-alternators supplied by Allis Chalmers Mfg. Co., Harvey, Illinois.

1.12 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-81692-01	J86634 Solid State Control
SD-81693-01	Automatic Plant Schematic
SD-81739-01	Engine-Alternator Schematic
SD-81739-02	Engine-Alternator Schematic
SD-81796-01	J87249 Battery Charger

1.2 Inspection

1.21 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.

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

1.3 Description of Engine-Alternator

1.31 The basic set consists of an engine-alternator mounted on four vibration isolators and a floor-mounted control cabinet. Four jack screws, inside the base, are furnished to lift the set high enough to place isolators. The radiator may either be on the set or remote. Shutters are available for the front of the radiator, whether it is set-mounted or remote.

1.32 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.

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

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

1.35 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, breakers and customer's connections. The lower portion of the cabinet houses the J86634 Solid-State Control, one or two main breakers, the J87249 Rectifier and Roosa-tronic Load Compensator, when provided.

1.36 Two types of sets are available, dual breaker (called ON-SET TRANSFER) or single Breaker (called OFF-SET TRANSFER). Either unit may be ordered with or without the Roosa-tronic Load Compensator. With this compensator speed should remain constant from no-load to full-load; without this compensator speed will droop about 4% from no-load to full-load.

1.37 The ON-SET TRANSFER unit does not have provisions for paralleling. The OFF-SET TRANSFER unit has provisions for paralleling, including synchronizing lamps and RP Current Transformer. The Reverse Power Relay should be ordered on the set because it will not be possible to order this later.

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.

1.41 Selector Switch at OFF

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

1.42 Selector Switch at MANUAL

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

1.422 If the set has the On-Set Transfer (List 6 equipment) load will be transferred to the set by depressing the CIRCUIT BREAKER CLOSE button. This opens the Normal breaker and closes the alternator or Emergency breaker.

1.423 Closing the alternator breaker (by depressing the CIRCUIT BREAKER CLOSE button) 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.

1.424 To shut the set down it is necessary to depress the CIRCUIT BREAKER OPEN button and then the STOP button. Depressing the CIRCUIT BREAKER OPEN button 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.

1.43 Selector Switch at FULL AUTO

1.431 When commercial power fails the engine starts after about a 5-15 second delay (DT). When alternator voltage and speed are normal the Warm-Up Timer (WUT) starts.

1.432 After 3-5 minutes warm-up, 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 warm-up time and then the alternator or Emergency breaker will close to transfer the load to the set.

1.433 The set will carry the connected load for the period of the Run Timers (RT2 and RT3), which may cover a total time period of 46-64 Minutes, plus the Hold-Over Time of 9-11 Minutes. The Hold-Over-Timer will not be started until commercial power returns so that the set will continue to carry the load for about ten minutes after power is restored, if not restored during the Run-Time period.

1.434 After the power is restored, and after the Hold-Over Time 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. As soon as the load is transferred to commercial power the set will be shut down.

1.435 With the OSS switch in FULL AUTO position the set may be started manually with the START button. When started this way the set and control will run through the sequence of events above. Load will be transferred to the set after the Warm-Up Time and be carried by the set during the Run-Time and Hold-Over Time. Then the load will be transferred back to commercial power, provided it is still available, and the set will shut down.

1.436 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 Hold-Over-Time periods the load will be transferred back to commercial power, if available, and the set will shut down.

1.44 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.

1.441 The set can be started with the OSS switch in this position with the START pushbutton. Once started the set will run at no-load for the Run-Time and Hold-Over-Time periods and then shut down, provided commercial power does not fail during this time.

1.442 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.

1.45 Selector Switch at AUTO MAN RESTORE

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

1.452 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 Hold-Over time and the set will shut down.

1.46 Trouble Shutdowns and Alarms

1.461 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. The horn will sound if the HORN SW (inside the cabinet) is in the ON position.

LOW OIL PRESSURE	Lube oil pressure 15-19 psi
OVERSPEED	Engine speed exceeds 2100 rpm
BREAKER TRIPPED	SB or EB Breaker open
REVERSE POWER	Alternator draws more than 25 KW in parallel
HIGHWATER TEMP	Jacket water reaches 206-212°F
CONTROL FUSE FAIL	CKT BKR CONT open, CB-9 Breaker open (or F-10 Fuse blown)

1.462 During starting certain failures light the CRANKING FAILURE lamp, sound the horn 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 600 rpm in 30 seconds.

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

PREL WATERTEMP	Jacket water temperature reaches 193-197°F.
RECT FAILURE	Failure of battery charging rectifier
JACKET HEATERFAIL	Jacket water temperature falls below 50°F.

1.5 Associated Information

1.51 The test of the engine-alternator should be done in conjunction with Section 254 in this handbook which covers the J86634A Control Module.

1.52 Section 129 in this handbook covers levelling and vibration isolator adjustments.

1.53 Section 132 in this handbook covers piping information and Section 133 covers information on the cooling system.

1.54 Section 130 in this handbook covers paralleling information, where this is applicable.

1.55 Section 19 in Handbook 18 covers handling and charging of start and control batteries.

2. PRECAUTIONS

2.1 Engine-Alternator

2.11 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 J87249 B Rectifier or damage will occur to the rectifier. Then remove the OUTPUT fuse from the rectifier.

2.12 When cold-weather starting equipment is furnished (Z Option) be sure that the IMM HTR Switch is open or OFF until the radiator is filled. Also open Circuit Breakers CB-7 and CB-8 (remove Fuses F-7 and F-8).

2.13 When working inside the control cabinet 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.

2.14 Where the set has the On-Set Breaker take extreme care when working in the area behind the breakers because commercial ac is present on both sides of the NORMAL breaker. The only way to remove commercial power is to open the main power disconnect in the station.

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

2.2 J86634 Control Module

2.21 Components in the module will be damaged if incorrect control battery polarity is applied to the module. A diode is now furnished in the cabinet (in ECB-lead) to prevent this.

2.22 Except where indicated for test purposes do not pull out or insert circuit packs in the module without first turning OPERATION SELECTOR Switch to OFF to disconnect the battery from the module.

2.23 There are a number of duplicate circuit packs that have specific adjustments. These are timers and frequency monitors, for example. To prevent a mixup of these boards they should be marked with the Equipment Location.

2.3 J87249 Rectifier

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

2.32 For 208 volt input insert COM and 208V fuses; for 220-240 volt input insert COM and 240V fuses. In no case shall 208V and 240V fuses be installed on the same charger.

2.33 Components in the rectifier will be damaged if incorrect starting battery polarity is applied to the set.

The B+ starting battery lead should be connected to the Start Motor and B- to the Start Contactor.

3. TOOLS, TEST SETS AND RECORDS

3.1 Tools and Test Sets

<u>Note</u>	<u>Quan.</u>	<u>Code</u>	<u>Description</u>
	1	R-2705	Tachometer
	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
3	1	ITE-4297	Auto-Transformer
3	1	ITE-9114	Test Cord
3	1	ITE-9115	Test Cord

NOTE 1: For connecting ITE-4782 Test Load.

NOTE 2: Due to the heat produced by this load it should be placed outside whenever possible, or in a well-ventilated area.

NOTE 3: For testing Voltage Monitors.

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

4.11 The floor or pedestal under the unit shall slope not more than 1/4 inch 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 asphalt tile must be removed from under the isolators so that the base of isolators rest on the floor.

4.12 Lay out and drill for isolator hold-down bolts when it is required to bolt them down, as in Earthquake areas. The control cabinet is floor-mounted and is always bolted down. When the isolators are bolted down the anti-walk material on the bottom should be removed.

NOTE: Drawing ED-80730-11 does not cover plates for these isolators. Requests for information should be made through the Region until the information is on the drawing.

4.13 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 on the engine base to raise the engine base high enough to place the isolators.

4.14 Front-connected circuit breakers are furnished and the control cabinet can be placed about 1/2 inch from the engine set before connecting the heavy leads.

4.15 Remove all fuses or open all small breakers. Wire all external control circuits. Control leads terminate on terminal strips inside the front of the cabinet.

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

4.2 J86634 Solid-State Control

4.21 After unpacking the J86634A Control Module, turn it over and remove the bottom cover. Check all connections carefully for breakage and damage. Correct as necessary.

4.22 Check the unit carefully for other signs of damage. Check that each circuit pack is secure in its socket.

4.23 Compare the placement of the circuit packs with the diagram on the cover. Certain packs are duplicates and are adjusted for specific times or frequency. The Equipment Location should be marked on these packs.

4.24 Install the J86634 Solid-State Control on the slides furnished in the lower portion of the control cabinet.

CAUTION: Do not insert the plug into the socket on the back of the Control Module at this time.

4.3 J87249 Rectifier and Batteries

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

List TB - 12 cell lead-acid battery (setting is 26.0 volts)

4.32 Install the J87249 Rectifier in the area provided (lower right hand corner).

4.33 Install the starting battery and, when furnished, the control battery.

4.34 With the ac input to the rectifier disconnected put the plug into the socket on the rectifier. When the external capacitor is furnished connect the capacitor to the rectifier and the plug on the set to the capacitor.

4.35 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 fuse (COM and 208V or 240V on the rectifier.

4.36 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). For the On-Set Transfer unit Circuit Breakers CB-17 and CB-18 (FU-17 and FU-18 Fuses) in the cabinet feed the charger.

4.37 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 measure voltage across the start battery terminals.

4.38 Measure charging current with a voltmeter across 4A/VOLT jacks on the J87249. The voltmeter used for this should be a good 3V dc meter, or the 3 volt scale of ITE-4442 may be used. Each volt indicated - 4 amperes, less 0.4 amperes for R15 bleeder resistor current.

4.39 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

4.41 Open the lube oil drain valve and drain out any oil or residue left in the system. Then close the drain valve. Also close the shutoff valve (1/2 inch valve) in the inlet line to the Ren Valve (Lube Oil Level Regulator), when this is furnished.

4.42 Add oil to the crankcase as follows:

4.421 Remote Lube Oil Supply: Add lube oil in the oil filler opening until crankcase oil level passes the STATIC ADD mark on the dipstick (about 10 quarts). Check after the oil has been allowed to settle for about 20 minutes. Then open the inlet line to the Ren Valve from the remote lube oil supply and observe that oil level in the sightglass of the Ren Valve is close to the center line.

4.422 No Remote Lube Oil Supply: Add lube oil in the oil filler opening until crankcase oil level reaches the RUN FULL mark on the dipstick (about 17 quarts). Check after the oil has been allowed to settle for about 20 minutes.

4.423 Recommended Lube Oils: Always use Series 3 lubricants with the following SAE ratings:

Ambient Above 32°F	SAE 30
Ambient 0°F - 32°F	SAE 20
Ambient 0°F and below	SAE 10W

NOTE: Acceptable lube oils are listed in Section 1A of this handbook.

4.43 Add about one quart of engine oil to the VORTOX Oil Bath Air Cleaner. Loosen the wing nuts and remove the lower portion of the cleaner. Take out the prefilter and add oil to the cup until the level reaches the mark on the disc. Replace the prefilter and reinstall the lower portion of the air cleaner.

4.44 Add coolant to a set-mounted radiator as follows: Fill to within 1-1/2" of the filler neck (approximately 40 quarts). Rust inhibitor must always be used unless antifreeze will be used. Refer to Section 133 in this handbook for information on antifreeze and rust inhibitors.

CAUTION: If there is an Immersion Heater be sure that the valves at each end of the heater are open.

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

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)

4.46 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 the Essential Load Cabinet.

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.

4.47 Close any disconnect switches provided for the figures in Paragraph 4.46.

4.48 With commercial ac on the Fig. 13 and Fig. 14 shutters observe that shutters are held closed.

4.5 Remote Radiator and Cooling System

4.51 Install piping and wiring in accordance with job drawings.

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

4.53 Install the thermometers in engine inlet and outlet connections.

5. INITIAL START AND RUN

5.1 Preliminary

5.11 Disconnect external alarm leads until Paragraph 9. For an OFF-SET TRANSFER unit temporarily disconnect leads LB6, TR16, CB9 and TR15 at the customer connection strip in the control cabinet. These leads are checked and connected later in Paragraph 9.

5.12 Verify that OPERATION SELECTOR Switch is at OFF. Also, verify that the small circuit breakers in the cabinet are open, or that fuses in the cabinet have been removed.

NOTE: Breakers CB-7 and CB-8 for the Immersion Heater may already be closed (or Fuses F-7 and F-8 may be installed). Also, Breakers CB-17 and CB-18 for the J87249 Rectifier may already be closed (or Fuses F-17 and F-18 may be installed).

5.13 Connect the ITE-4782 Test Load to the load side of the alternator breaker.

5.14 Check polarity of control battery on GG and N terminals of the J86634A Control Module plug and then insert the plug. Proceed as follows:

5.141 Close CB-9 and CB-10 Breakers (or install F-9 and F-10 Fuses).

5.142 Turn OPERATION SELECTOR Switch to MANUAL.

5.143 Connect ITE-4442 (60 VDC Scale) to GG and N terminals of the module plug. The meter should read up-scale with the following polarity:

+ on Terminal GG
- on Terminal N

5.144 When control battery polarity is correct turn OPERATION SELECTOR Switch to OFF and insert the plug into the rear of the J86634A Control Module.

5.15 Operate DROOP SWITCH (if furnished) to ON and CROSS CURRENT Switch to OUT.

NOTE 1: A DROOP SWITCH is furnished when a Roosa-Tronic Load Compensator is furnished. For isochronous operation this DROOP SWITCH must be at ON position.

NOTE 2: The CROSS CURRENT Switch should be at OUT position for single set operation. This switch will be at IN for parallel operation.

5.16 Turn ALTERNATOR VOLTS ADJUST control full CCW. Turn VOLTMETER SELECTOR Switch to ALTERNATOR 1-2 position.

5.17 When a Roosa-Tronic Load Compensator is furnished, proceed as follows:

5.171 Put the plug into the bottom of the unit.

5.172 On the terminal strip directly under the control cabinet remove the jumper between MAC1-MAC2 Terminals. Later units do not have an MAC2 Terminal. In this case, disconnect the bottom lead from MAC1 terminal and temporarily insulate the end of the lead.

5.2 Priming Fuel System

NOTE: Fix any leaks observed in the fuel system during the priming operation before running the set.

5.21 Open the valve in the fuel suction line to the set.

5.22 Turn RUN/PRIME valve on the set to PRIME position. (PRIME position is parallel to the fuel line)

5.23 Loosen the vent plugs on the top of the two fuel filters (left side of engine). Place rags around the vent openings to absorb fuel.

5.24 Operate Deming pump handle with slow even strokes until the fuel coming out of the vents on the fuel filters is free of bubbles.

5.25 Stop pumping. Close vents on the fuel filters. Turn RUN/PRIME valve to RUN position.

5.3 Starting

NOTE: The engine may be started by rising either the START button on the cabinet or the one on the engine.

5.31 With OPERATION SELECTOR Switch at OFF close Breakers CB-4, CB-5, CB-6, CB-11, CB-12 and CB-13 (install Fuses F-4, F-5, F-6, F-11, F-12 and F-13). When a remote radiator is furnished close Breakers CB-20 and CB-21 (install fuses F-20 and F-21). For an OFF-SET TRANSFER unit close Breakers CB-22 and CB-23 (install Fuses F-22 and F-23).

NOTE: CB-11 and CB-12 Breakers (Fuses F-11 and F-12) are not furnished unless the set is for parallel operation.

5.32 Turn OPERATION SELECTOR Switch to MANUAL. Push the START button and hold operated until the engine fires.

CAUTION: Do not crank more than 30 seconds at one time if the engine fails to fire. Then wait about two minutes before attempting another start.

5.33 As soon as the engine comes up to speed check speed with an R-2705 or ITE-4824 Tachometer. Insert the tachometer in the end of the alternator. Adjust speed with the RAISE or LOWER Switch to about 1820 rpm when a Roosa-Tronic Load Compensator is furnished, or, to about 1875 rpm when the Load Compensator is not furnished.

NOTE: If unable to use a tachometer on the end of the alternator shaft use the frequency meter on the panel as reference. (1820 rpm is 60.6 hertz and 1875 rpm is 62.4 hertz).

5.34 Observe lube oil pressure as soon as the engine is running. If no pressure is indicated shut the engine down immediately with ENGINE STOP button. (The control module should shut the set down in this case.)

5.35 After setting no-load speed adjust voltage to the desired value, which should match commercial service voltage.

NOTE: If voltage does not buildup it will be necessary to flash the exciter field. Stop the set by turning OPERATION SELECTOR Switch to OFF. Remove cover plate from the lower left hand side of the alternator. Disconnect external leads from terminals 25 (F1+) and 26 (F2-) on the terminal strip in the alternator foot. Apply 12 volts dc (from start battery string) for about 5 seconds as follows: + to T25 (F1+) and - to T26 (F2-). Then reconnect the lead and restart the set.

5.36 Observe that a set-mounted shutter assembly opens as soon as the lube oil pressure comes up. Observe that Discharge and Intake Louvers open as soon as the engine comes up to speed.

5.4 No-Load Run

5.41 With alternator voltage available use the R-3404 Phase Sequence Indicator and check that alternator output voltage (on the load side of the SET Breaker) is 1-2-3 order. If it is not 1-2-3 order (this will have to be corrected before starting the set again).

5.42 Where a remote radiator is furnished close the RFM breaker on the control cabinet. Observe that the remote fan starts and turns in the right direction. If direction of rotation is incorrect shut the set down and interchange two of the three line leads between the control cabinet and the fan disconnect switch at some convenient point.

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

5.44 Where shutters are furnished on a remote radiator, observe that these shutters begin to open when water temperature reaches the range 130-160°F. and that they are fully open when water temperature reaches 170-185°F.

5.5 Governor Checks and Adjustments

5.51 Requirements

5.511 If a Roosa-Tronic Load Compensator is furnished, the governor should have a speed droop of 1% from no-load to full-load (16-20 rpm or 0.53 - 0.67 hertz). Then, when the Load Compensator is connected and adjusted, the speed from no-load to full-load should remain approximately the same (isochronous).

5.512 If a Roosa-Tronic Load Compensator is not furnished the governor should have a speed droop of 4-1/2 to 5% from no-load to full-load. (81-90 rpm or 2.7 - 3 hertz.)

5.52 Mechanical Droop Check

5.521 Start the set and close the circuit breaker.

5.522 Apply 115KW unity power factor load with the ITE-4782 Test Load.

5.523 Adjust speed to 1800 rpm (60 hertz) and voltage to desired value, if necessary.

5.524 Open the circuit breaker and then check speed or frequency.

5.525 The speed or frequency change from full-load to no-load should be within the range shown in Paragraph 5.511 or 5.512.

5.526 The knurled screw on the rear of the governor controls the speed droop. Turn the adjustment screw CW to increase the droop, or, CCW to decrease the droop.

5.527 Make any necessary readjustments of the speed droop screw and recheck the droop until it falls within the required range in Paragraph 5.511 or 5.512.

5.53 Roosa-Tronic Compensator Adjustments

NOTE: The Roosa-Tronic Load Compensator adjustment is dependent on alternator voltage. The factory adjustments are at 208 volts. The following adjustments will have to be repeated whenever the alternator voltage is changed.

5.531 Shut down the set and reconnect the jumper between MAC1-MAC2 Terminals, or, reconnect the lead to MAC1 Terminal.

5.532 Start the set.

5.533 Adjust no-load speed to 1800 rpm (60Hertz). Also make certain that alternator voltage is set for desired value.

5.534 Connect ITE-4442 (12V DC scale), in turn, across test points TP1-TP2, TP2-TP3 and TP3-TP4. These voltages should be zero. If not, adjust the associated control between the test points (R1, R2 or R3) for zero voltage on each pair of test points. Then disconnect ITE-4442.

5.535 Close the alternator breaker.
Apply 115KW load with the ITE-4782 Test Load.

5.536 The speed at full-load should remain at 1800 rpm (60 hertz). If it changed from the no-load setting adjust R6 control on the Roosa-Tronic Compensator until the frequency is 60 hertz at 115KW load.

NOTE: Field current on the DC AMMETER will be about 0.5 amperes at full-load.

5.6 Final Operations

5.61 With the set shut down correct all oil, fuel, water and exhaust system leaks.

5.62 Check crankcase lube oil level after about 20 minutes where a remote lube oil supply is not furnished. Add sufficient oil to bring the crankcase level up to the STATIC FULL mark on the dipstick.

6. 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 (if furnished) and artificial load equal to full capacity of the set.

6.1 Preliminary

6.11 Install all the side covers on the engine, when these are furnished.

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

6.2 Preliminary Load Test

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

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

6.23 Close the alternator circuit breaker. Observe that the supplementary load (about 45 KW) is connected to the set, if furnished.

6.24 Add artificial load until the set is loaded to 115 KW. Adjust speed and voltage as necessary.

6.25 Take a set of readings at full-load. This will include time, Frequency, Volts, Amperes, KW, Power Factor, oil pressures, water temperature and ambient temperature.

6.26 Take readings every 30 minutes until the set has run one hour at full-load. The requirements in Paragraph 6.4 shall be met during the hour run.

6.27 Reduce artificial load to zero and open the alternator circuit breaker. Allow the set to run about three minutes to cool down. Then shut the set down by depressing the STOP button.

6.28 Turn OPERATION SELECTOR Switch to OFF.

6.3 Final Acceptance Test

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

6.32 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.

6.33 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 6.4 shall be met during this run.

6.34 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.

6.35 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.

6.36 Allow the set to run about 3 minutes. Then shut the set down by pushing the EMERGENCY STOP button. The button lights. The horn sounds. Press ALARM SILENCE button to silence the horn.

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

6.4 Requirements

6.41 The set shall carry full 115KW load at the ambients shown below up to the altitude indicated.

Ambient - °F	Altitude - Feet
70°F	10,000
80°F	9,000
90°F	8,000
100°F	5,500
110°F	2,000

For ambients higher than 70°F and altitudes above those listed full-load is less than 115KW. The expected deratings are shown below.

Ambient - °F	KW at 10,000 Feet
80°	108
90°	101
100°	94
110°	87

NOTE: The deratings are linear and may be plotted on a graph to find intermediate deratings.

6.42 Lube oil pressure shall not be less than 19 psi.

6.43 Fuel oil pressure shall not be less than 10 psi.

6.44 Water temperature shall not exceed 195°F.

6.45 Speed at full-load, or at a derated full-load, shall not change more than $\pm 1/4$ hertz under steady load conditions. Also, speed changes shall not be cyclic (hunting).

NOTE: When a Roosa-Tronic Load Compensator is furnished there may be some small erratic speed and voltage swings.

6.46 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:

with Load Compensator:
7rpm (0.23 hertz)

without Load Compensator:
90 rpm (3.0 hertz)

6.47 The voltage shall not vary $\pm 1\%$ from the original cold full-load setting.

7. REVERSE POWER TEST

NOTE 1: The RP will not require checking and adjustment unless the set will be paralleled. In this case, it is suggested that RP (CP12, Equip. Loc. 25) be removed from the J86634A Module to prevent nuisance tripping of the breaker.

NOTE 2: 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.

7.1 As a matter of information the amount of reverse power that will trip the circuit breaker should be 24-26KW. If the set draws this amount of reverse power in parallel with another set the circuit breaker trips and the set shuts down. The REVERSE POWER and EMERGENCY STOP lamps light and the horn sounds. A major office alarm will be brought in.

7.2 The horn is silenced by depressing ALARM SILENCE button. The alarm is removed by depressing ALARM RESET button. REVERSE POWER and EMERGENCY STOP lamps go out.

7.3 After shutdown turn OPERATION SELECTOR switch to OFF.

7.4 Before the set can be restarted the alternator circuit breaker will have to be manually relatched.

7.41 The older sets used ITE breakers. These are relatched with the handle furnished with the set. Insert the handle on the front of the breaker and push the handle downward until OFF shows in the window on the breaker.

7.42 Newer sets have General Electric breakers. These are relatched by pushing the operating knob downward while holding the hinged motor mechanism up out of the way.

8. OVERSPEED TRIP TEST

NOTE: The shutdown point is determined by the setting of R4 potentiometer on OSD (CP22, Equip. Loc. 38) in the J86634A Control Module.

8.01 With the engine shutdown remove the cap or plug on the end of the alternator.

8.02 Loosen the jam nut on the high idle adjustment screw on the governor and turn this screw out 5 turns (CCW). (The high idle adjustment screw is the adjustment on the movable arm toward the rear of the engine).

8.03 Pull the plug out of the Roosa-Tronic Load Compensator, when this is furnished.

8.04 Turn OPERATION SELECTOR Switch to MANUAL. Start the set with the START button.

8.05 Increase speed by operating ENGINE SPEED Switch in RAISE direction to about 65 hertz. If the engine shuts down from overspeed at this time turn R4 potentiometer on CP22, Equip. Loc. 38 in the J86634A Module full CW. Then restart the set and perform operations in Paragraphs 8.06 through 8.135.

8.06 Reduce speed by operating ENGINE SPEED Switch in LOWER direction until speed is about 60 hertz.

8.07 Open CB-4 Breaker (or remove F4 Fuse) to protect the Frequency Meter.

8.08 The operation in Paragraph 8.09 take two men. Have one man insert the R-2705 Tachometer in the end of the alternator to read engine speed. Have a second man overspeed the engine.

8.09 Overspeed the engine by disconnecting the governor speed control lever from the throttle control yoke and increasing speed by manually pulling the speed control lever toward the rear of the unit.

8.10 The engine should shut down in the range 2100-2150 rpm. Adjust R4 potentiometer as necessary to obtain shutdown in this range. Turn R4 CW to raise the shutdown point, or, CCW to lower the shutdown point.

8.11 At shutdown observe that the OVERSPEED lamp lights and that the horn sounds. Press the ALARM SILENCE button and then the ALARM RESET button.

8.12 Turn OPERATION SELECTOR Switch to OFF.

8.13 Restore to normal as follows:

8.131 Reconnect the governor speed control lever to the throttle control yoke.

8.132 Close CB-4 Breaker (or insert F4 Fuse).

8.133 On the governor turn the high idle adjustment screw in (CW) five turns to its original position and tighten the jam nut.

8.134 Reconnect the plug on the Roosa-Tronic Load Compensator.

8.135 Replace the cap or plug on the end of the alternator.

9. 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 9.13 has been completed.

9.1 Preliminary

9.11 Test and adjust the Voltage Monitors in accordance with Paragraph 6 of Section 254. Then close CB-14, CB-15 and CB-16 (or install F14, F15 and F16 Fuses). Also close CKR BKR CONT Breaker.

9.12 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.

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

9.131 Open the J86634A Control Module cover and operate the OUT-IN Switch on CP19. Equip Loc. 34 to OUT. This cuts out the Run Timer.

9.132 Turn OPERATION SELECTOR Switch to FULL AUTO. In turning from OFF stop about 10 seconds on MANUAL position to charge up the timing circuits.

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

9.134 Observe that the set starts after the DT 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.

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

9.136 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.

9.137 After the HOT timer (about 15 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. The voltage is removed from both sets of leads: LB-6 and TR-16; CB-9 and TR-15.

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

9.139 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.

9.14 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.

9.2 Alarms

9.21 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.

9.22 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.)

9.23 Verify that the relays shown in Paragraph 9.21 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.

9.3 Automatic Operation

9.31 Turn OPERATION SELECTOR Switch to FULL AUTO. In turning from OFF stop about ten seconds on MANUAL position to charge up the timing circuits.

9.32 Fail commercial power. This can be simulated for the Off-Set. Transfer Set by removing a 15 ampere fuse feeding CA, CB or CC lead in the AC Service Cabinet. It cannot be simulated for the On-Set (dual breaker) Set and the commercial to the diesel cabinet must be interrupted.

9.321 SD-81100-01: After 1-1/2 to 3 minutes PF lamp lights and minor alarm sounds. PF alarm is sent out on C1, B1, etc systems.

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

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

9.34 After PF and PO alarms replace the voltage monitor fuse, or, restore commercial power. PF alarm is removed.

9.35 The set carries the load through Run-Time period (if OUT/IN Switch is IN) and HOT period, load transfers to commercial power and the set shuts down. PO alarm is removed.

9.4 Remote Start Test

9.41 With OPERATION SELECTOR Switch at FULL AUTO ground RS lead.

9.42 Operation is the same as Paragraph 9.3 except DT is bypassed (set starts immediately) and no PF alarm comes in.

10. ACCESSORY TESTS AND ALARMS

NOTE: The following switches were factory-set. For adjustment refer to the supplier's manual.

10.1 LOP: Closes when oil pressure builds up to 21-25 psi and opens when pressure drops to 15-19 psi. This shuts down the engine, lights LOW OIL PRESSURE lamp and brings in a major alarm. Simulate switch operation by disconnecting a lead from M1 or L1 terminals.

10.2 PCTS: Closes when coolant temperature is 193-197°F. This lights PREL WATER TEMP lamp and gives minor alarm. Simulate switch operation with a temporary jumper across M1-L1 terminals.

10.3 HCT: Shuts down the engine, lights HIGH WATER TEMP lamp and gives a major alarm when coolant temperature reaches 207-211°F. Contacts open when temperature reduces to 197-201°F. Simulate switch closure by a temporary jumper across M1-L1 terminals.

10.4 CHF: Controls the Immersion Heater and keeps engine block temperature about 60°F. The switch opens about 60°F, but closes if coolant drops below 50°F. This brings in a minor alarm and JACKET HEATERFAIL lamp lights.

11. MAINTENANCE DURING INSTALLATION

11.1 Before Starting (Engine Cold)

11.11 Pull dipstick and check oil level. Oil level should be:

With Ren Valve: Between STATIC ADD and FULL
No Ren Valve: Above RUN ADD

11.12 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

11.13 Check coolant level in the radiator. It should be approximately 1-1/2 inches below the bottom of the radiator filler neck. For a remote radiator the coolant level should be up to the high level point on the sightglass.

11.2 During Operation

11.21 Check for signs of unusual operating conditions.

11.22 Check for leaks in associated systems.

11.3 Other Items

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

11.32 Routine the engine weekly until turn-over. A run of at least 1-hour each week will be required, with a minimum load of 50 KW.

12. GENERAL TROUBLES AND CAUSES

12.01 Engine will not crank.

Weak start battery.
Loose battery connections.
Failure of SC Circuit Pack.
OSS Switch at OFF.

12.02 Engine cranks but does not start.

Defective fuel pump.
Restricted fuel filter or strainer.
Insufficient fuel or clogged intake.
Air in fuel system
Failure of FC Circuit Pack.
Failure of Throttle Solenoid.
Failure of Governor.
Failure of PS Circuit Pack.
Shorted or open Speed Pickup.
Fuel System not primed.

12.03 Hard starting.

Defective turbo-charger.
 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.

12.04 Engine stops

RUN/PRIME Valve left on PRIME.
 Refer to alarm lamp indication below:

- (1) **CRANK FAILURE.**
 Shorted or open speed pickup.
- (2) **CONTROL FUSE FAIL.**
 F9 fuse blown or CB-9 Breaker open.
- (3) **OVERSPEED.**
 Speed set too high.
 Defective governor.
 Defective or misadjusted OSD.
- (4) **LOW OIL PRESSURE**
 See Paragraph 12.06.
- (5) **HIGH WATER TEMPERATURE**
 See Paragraph 12.05.
- (6) **BREAKER TRIP**
 Excessive KW load.
- (7) **REVERSE POWER**
 Failure in parallel operation.
 Defective RP circuit pack.
 REV PWR TST button in up position.

12.05 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.

12.06 Low lube oil pressure.

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

12.07 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.

Operating temperature too low (open thermostat)
 Internal fuel or lube oil leaks.
 Injection nozzles not operating properly.
 Light load (less than 30%)

White smoke.

Improper fuel.
 Faulty injection nozzles.
 Engine requires overhaul.

12.08 Engine knocks.

Lube oil diluted by fuel.
 Injection timing incorrect.
 Defective fuel injection pump.

12.09 Engine runs unevenly.

Fuel supply erratic or insufficient.
 Defective governor.
 Operating temperature too low.
 Engine requires overhaul.
 Defective Roosa-Tronic Compensator.

12.10 Low Lube Oil level.

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

12.11 High Lube Oil level.

Ren Valve positioned incorrectly.
 Defective Ren Valve.

12.12 Vibration on the set.

Unbalanced alternator armature.
Excessive grease in alternator bearing.
Loose electrical connections.

12.13 No output voltage or low output voltage.

(Refer to Supplier's Manual)

Faulty diodes in alternator.
Loss of exciter residual magnetism.
(flash field - see Par. 5.35)

[Vertical line at side of paragraphs indicates requirements.

Arrows not shown due to extensive changes.

12.14 Erratic voltage

(Refer to Supplier's Manual)

Loose connections.
Faulty voltage regulator.
Faulty diode(s) in alternator.
Engine governor unstable.
Incorrect setting of R11 on voltage regulator circuit board.

12.15 High output voltage and voltage is uncontrollable.

(Refer to Supplier's Manual)

Open F1 fuse in voltage regulator.
Defect in regulator printed circuit board.

Manager, Product Engineering

Reason for Reissue:

- (1) To remove requirement on spacing between cabinet and set.
- (2) To show governor adjustments.
- (3) To show new circuit using control breakers instead of fuses.