

KS-20542 TURBINE-ALTERNATORS

200KW (J86637)

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1. GENERAL1.1 Scope

1.11 This section covers installation and test of the 200KW turbine-alternators supplied by Solar Division of International Harvester Company, San Diego, California.

1.12 Tests are based on the following schematic drawings:

SD-82319-01	Set
SD-82320-01	Remote Control Panel
SD-81796-01	J87249 Battery Charger
SD-81905-01	Standard Set Plant Schematic
SD-81498-01	Transfer Breaker Circuit
SD-81100-01	Alarm Circuit
SD-81223-01	Alarm Circuit

KS-19896 DRAWINGS

SD-81871-01	J86638 Solid-State Module
SD-81890-01	208-240 Volt Set

KS-19896 DRAWINGS (Cont'd)

SD-81891-01	416-480 Volt Set
SD-81892-01	Remotely-Controlled Set
SD-81929-01	Remote Control Cabinet

KS-20542 DRAWINGS

SD-81985-01	Set Without Remote Control
SD-81986-01	Set With Remote Control
SD-81987-01	Remote Control Cabinet

DRAWINGS COMMON TO BOTH SETS

SD-81796-01	J87249 Battery Charge
SD-81905-01	Standard Set Plant Schematic
SD-81907-01	Hardened Set Plant Schematic
SD-81498-01	Transfer Breaker Circuit
SD-81100-01	Alarm Circuit
SD-81223-01	Alarm Circuit

1.13 CAUTION:

NEVER REMOVE OR INSERT CIRCUIT PACKS WITH POWER ON THE BOARD. OPEN CIRCUIT BREAKERS CBI TO CBI7.

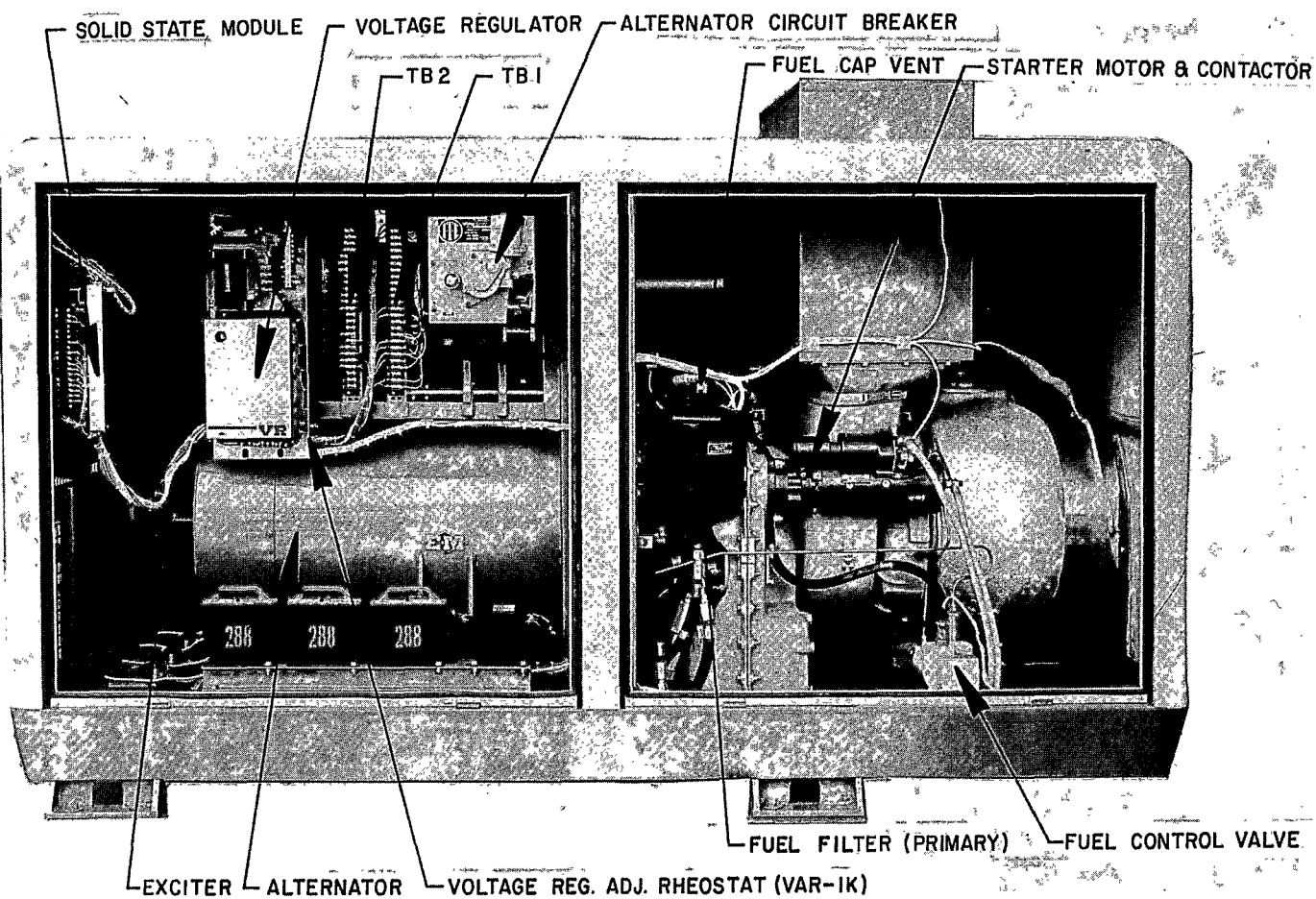


FIG. 1 RIGHT SIDE KS-20542 TURBINE ALTERNATOR WITH SOLID STATE MODULE

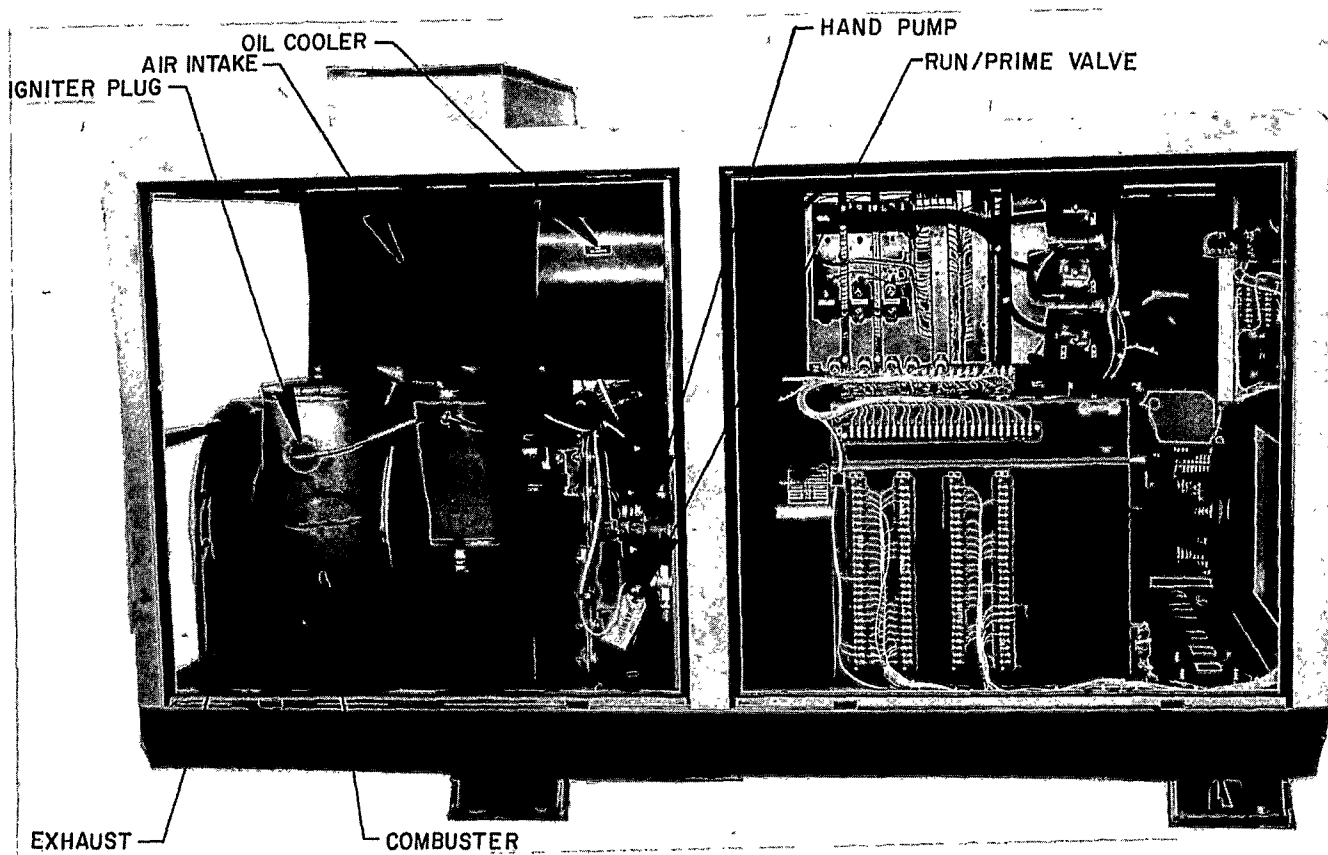
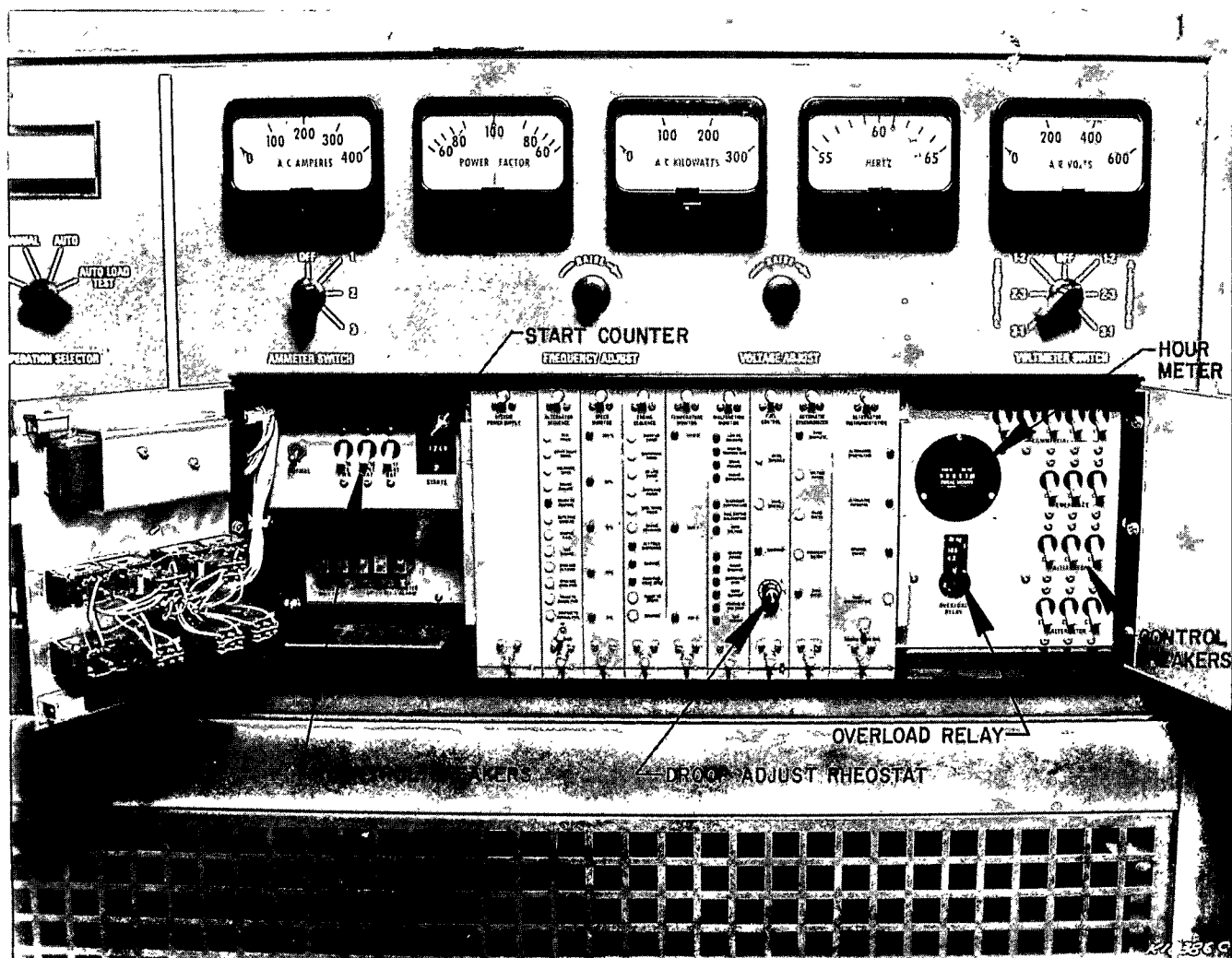


FIG. 2 LEFT SIDE OF KS-20542 TURBINE-ALTERNATOR WITH SOLID STATE CONTROL



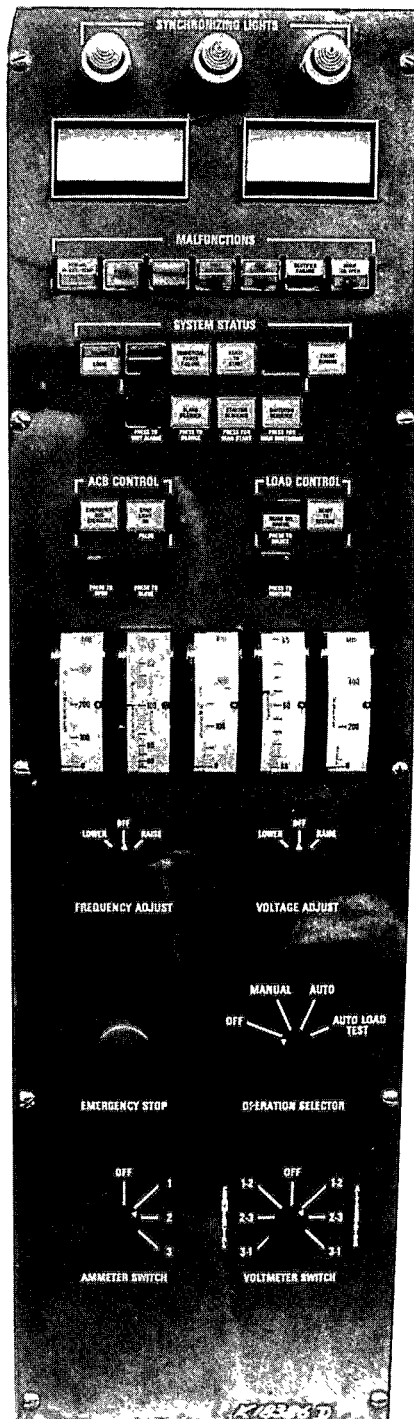


FIG. 4 REMOTE CONTROL PANEL OF KS-20542

1.2 Description of Turbine-Alternator

1.21 The KS-20542 turbine-alternator is shown in figures 1, 2, 3 and 4.

1.22 The turbine-alternator is contained in a sheet steel enclosure having removable sound-deadening panels. Locks are provided on the panels. The enclosure is divided into two sections by a transverse bulkhead. Designating the control end as the rear of the unit, the turbine and step-down gearbox are in the forward compartment; the alternator, voltage regulator and main circuit breaker is in the rear compartment.

1.23 The starting and control batteries are mounted outside the turbine on a battery rack. The J87249 rectifier is mounted on the left side in the rear enclosure.

1.24 The turbine has a nominal speed of 37,000 rpm. A reduction gearbox drives the 200 KW alternator at 3600 rpm. The starter motor drives the turbine through the gearbox. The gearbox, through gear trains, drives a boost fuel pump, a tandem lube oil pump and high pressure fuel pump. The gearbox has a 6 gallon capacity oil reservoir. The dipstick (connected to the fill cap) is marked 6 GALLONS FULL, ADD 1 QUART, ADD 4 QUARTS. A speed-sensitive pickup or transducer is mounted in the top of the gearbox.

1.25 An oil cooler is provided to keep lube oil temperature below 180°F. The oil cooler radiator is mounted on the alternator side of the bulkhead. A single-phase motor mounted on the turbine side of the bulkhead drives a suction fan to draw cool air through this radiator and the hot air is exhausted into the turbine compartment. The oil cooler fan starts as soon as alternator voltage is available.

1.26 The alternator is a two-bearing machine with a brushless exciter. A static voltage regulator is furnished with the alternator. A flexible coupling, factory-connected and aligned, is used between the gearbox and alternator.

1.27 Meters on the control panel of a standard turbine and the remote control cabinet include: An ac voltmeter, ac ammeter, wattmeter, power factor meter, frequency meter, engine speed meter (in percent). and an exhaust temperature meter.

- 1.28 Controls on the control cabinet include: OPERATION SELECTOR Switch, FREQUENCY ADJUST and VOLTAGE ADJUST Control. Also, the following pushbutton controls are: ALARM CONDITION, ALARM SILENCED, STARTING SEQUENCE, SHUTDOWN SEQUENCE, SYNC LIGHT ON, TRANS SEL AUTO/TRANS SEL MAN, TRANSFER SWITCH NORMAL, ALT CB is OPEN, ALT CB is CLOSED and REMOTE/LOCAL (on remote control panel only).
- 1.29 Each set may be furnished in a 208-240 volt or 480 volt versions. Also, each is furnished with one circuit breaker. The unit is satisfactory for 10psi or earthquake area applications by using one KWIK-BOLT in each mounting foot. In soft sites, no fastening is required.
- 1.3 Inspection
- 1.31 As soon as possible after receiving the unit on the job remove the shipping materials and make a complete physical inspection of the unit. Inspect for damage, defects of finish, missing part, etc. Report defects, damage and missing parts in accordance with established routines.
- 1.4 Supplier's Representative
- 1.41 As part of the contract with Solar a supplier's representative will be made available during the initial start and test of the unit if the customer desires this service and will pay for this service.
- 1.42 The installer shall notify the Field Service at least 30 days in advance of the date that Solar's trained representative will be required for the initial start and acceptance tests if this service is so desired by the customer.
- 1.5 Description of Operation
- NOTE: The OPERATION SELECTOR (OSS) Switch has four positions, OFF, MANUAL, AUTO and AUTO LOAD TEST. The TRANSEL SELECT (TSS) Switch under load control has a MANUAL and AUTO position. The following is a description of the OSS and TSS switches positions.
- 1.51 OSS Switch to "OFF"
- 1.511 With the OSS switch in the "OFF" position, the set is not available for operation. The red Switch OFF-Normal (SON) lamp is lighted when the OSS switch is in the "OFF" position informing the operator that set is not available for starting.
- 1.52 OSS & TSS Switches to "MANUAL"
- 1.521 When the OSS and TSS Switches are in the MANUAL position to transfer the load to the alternator, the operator must depress the MANUAL START pushbutton, depress the ALT-CB Is Closed pushbutton to close the alternator circuit breaker (provided no other set is on the line at the time); and manually operate the customer-furnished transfer device for transferring the load to the alternator.
- 1.522 To transfer the load back to commercial power and stop the engine, the operator must either manually operate the customer furnished transfer device to commercial power or depress the Transfer Switch Normal pushbutton to provide signals to retransfer the load. Next the operator must either depress the ALT-CB Is Open pushbutton or if the operator holds the Transfer Switch Normal pushbutton depressed until the load is transferred back to commercial power and then the alternator circuit breaker will open automatically. Then either depress the SHUTDOWN SEQUENCE pushbutton which will allow the set to operate for a three minute cool down period and then stop the engine or operate the OSS switch to the "OFF" position until the engine stops rotating.
- 1.53 OSS Switch to "AUTO"
- 1.531 When there is a commercial power failure and the OSS is in the "AUTO" position, the set will power up the circuit; automatically start; close its breakers (provided no other set is on the line at the time) and provide signals to operate (through a supplementary customer-furnished relay) the customer-furnished transfer device to transfer the station load to turbine power. When commercial power returns, the set will, provided it has operated for at least 25 minutes, run for a Hold Over (HOT) timer period of 15 minutes. After this period, the subsequent events of operation depend upon the position of the TSS switch.
- 1.54 TSS switch to "AUTO"
- 1.541 Upon completion of the HOT period, the set will automatically provide signals to operate (through a supplementary customer-furnished transfer device) to transfer the station load to commercial power. The set will also open the alternator circuit breaker; operate for a two minute cool down period; automatically stop the turbine; and power down the circuit.

1.55 TSS Switch to "MANUAL"

1.551 Transferring load back to commercial power the operator must manually depress the Transfer Switch Normal pushbutton to provide signals to operate (through a supplementary customer-furnished relay) the Customer-furnished transfer device to transfer the station to commercial power.

1.552 If the operator holds the Transfer Switch Normal pushbutton depressed until the load is transferred back to commercial power, the turbine's circuit breaker will open automatically.

1.553 If the Transfer Switch Normal pushbutton is not held, the operator must (after load is transferred) depress the ALT-CB is Open pushbutton to open the alternator circuit breaker then either allow the engine to shut down automatically after the end of the cool down period or, operate the OSS switch to the "OFF" position until the engine stops rotating.

1.56 OSS Switch to "AUTO LOAD TEST"

1.561 Operation of the OSS Switch to the "AUTO LOAD TEST" position simulates a power failure. The turbine, will automatically start; close its breaker; and provide signals to operate (through a supplementary Customer-furnished relay) the customer-furnished transfer device to transfer the station load to turbine power.

1.562 When it is desired to retransfer the load back to commercial power (provided the set has operated for a 30-minutes period), the operator must operate the OSS Switch from the "AUTO LOAD TEST" position to the "AUTO position. The turbine will then continue to operate for an additional 15 minutes HOT period. After the completion of this HOT period, the subsequent events of operation will depend upon the position of the TSS Switch.

1.57 Remote Starting

1.571 When starting the turbine from the Remote cabinet, it is necessary to depress the REMOTE/LOCAL pushbutton to REMOTE.

1.58 Trouble Shutdowns

1.581 The major troubles listed below will stop the turbine, transfer the load back to commercial power if it is available,

light the associated alarm lamps and signal any connected alarm circuits. The horn also sounds unless silenced by the "alarm silence" pushbutton.

LOW OIL PRESSURE: The lubrication oil pressure drops to 14 $\pm$.5 psig.

REVERSE POWER: The alternator receives approximately 75 KW $\pm$ 10 KW for 1.5 sec. of reverse power when it is operating in parallel.

HIGH OIL TEMP: The lube oil temperature exceeds 250°F $\pm$ 5°F.

HET: The exhaust gas temperature exceeds 1112°F $\pm$ 12°F.

OVERSPEED: The turbine speed exceeds 108 percent $\pm$ 1%.

CSCBO-MAJOR: Any or all of the Major Control System Circuit Breakers are open (CSCBO-MAJOR). There is no indication when the CB 15 Circuit Breaker is operated as this feeds "SYS PWR".

OVER VOLTAGE: The alternator output voltage, monitored between phase 1 and neutral equals 120 percent $\pm$ 2%.

OVER CURRENT: Short circuit or overload on alternator.

CRANK FAILURE: The engine is protected from three conditions during the cranking period. Overload or failure to rotate-(the engine fails to attain 5 percent $\pm$ 1% speed in 2.5 $\pm$.3 sec.); overcrank or failure to accelerate at proper rate-(the engine fails to attain 70 percent $\pm$ 1% speed in 45 $\pm$ 5 sec.); failure to light (no combustion ignition) - (the engine fails to reach a temperature of 400°F $\pm$ 12°F in 21 $\pm$ 3 sec.).

FUEL SYSTEM MAL FUNCTION: The fuel valve is not responding correctly.

- 1.59 The following minor alarms light the associated alarm lamp but no shutdown occurs. A minor alarm will be provided to connected alarms circuits.

PHET: The exhaust gas temperature exceeds 1000°F ± 12°F.

RECT. FAILURE: Battery charge failure.

CSCBO MINOR: Any or all of the Minor Control System Circuit Breaker are open (CSCBO MINOR).

2. PRECAUTIONS

2.1 Turbine-Alternator

- 2.11 Before working on the turbine control cabinet, turn the Local and Remote cabinets' OPERATION SELECTOR Switch to OFF. Then open all control circuit breakers. Disconnect commercial ac from the cabinet and protect incoming live power terminals.

- 2.12 CAUTION: Disconnect J87249 Rectifier by removing an ac input fuse from the rectifier before disconnecting the starting battery lead.

- 2.13 Check for and remove shorting straps on the turbine control cabinet meters before starting the set.

- 2.14 After five successive starts wait about one hour before making another start. The starting motor will cool during this period and some charge will be given to the batteries.

- 2.15 During the assembly of air intake and exhaust make certain that no loose items or debris are left in the system.

- 2.16 Before starting the turbine make certain that all tools and loose items are removed from the set.

- 2.17 Ear Protector must be worn during operation of turbine set.

2.2 J87249 Rectifier

- 2.21 Connect the battery to the rectifier before connecting the ac input. Open-circuit voltage from the rectifier is about 10 volts higher than with the battery connected and damage to the components will result.

- 2.22 If the battery is to be disconnected for any reason, be sure to first remove the input fuse before disconnecting the battery.

- 2.23 If the rectifier must be off for any period of time, such as might occur if it became defective, then the rectifier must be disconnected from the batteries after first removing the A.C Input. The rectifier has a resistor across the output and will discharge the battery when the rectifier is not functioning to charge the battery.

- 2.24 Install only one pair of ac input fuses on the rectifier. This will be either 208V and COM, or 240V and COM.

- 2.25 The J87249 Rectifier is mounted in a vulnerable place. Do not sit on the rectifier during installing operations.

- 2.26 If the J87249 Rectifier is furnished with Y option prior to Issue 6 of SD-81796-01, the voltage measured at DC OUTPUT jacks will not be battery voltage but something less, due to insertion of diodes after the jacks. In this case, measure battery voltage on start battery terminals and not at the DC OUTPUT jacks.

3. TOOLS, TEST SETS AND RECORDS

3.1 Tools & Test Sets

QUAN.	NOTE	CODE	DESCRIPTION
1		R-3404	Phase Sequence Indicator
1	2	ITE-5517	Power Module
1	2	ITE-5518	Oscillator
1	2	ITE-5519	100MHZ Counter
1	2	ITE-5520	Digital Multimeter
1	2	ITE-5521	Temperature Simulator
2		R-3076	Manometer (Water)
1	1	ITE-4785	250KW 3 Phase AC Test Load
		or	
2	1	ITE-4782	150KW AC/DC Test Load
		R-3413	Wire & Lug Assembly
3		R-4296	Ear Protector

NOTE 1: Due to the heat produced by the loads they should be placed outside whenever possible or in a well-ventilated area. This distance will determine the number of R-3413 leads required for connecting them.

NOTE 2: Part of the ITE-5516 TURBINE-SET PACKAGE.

3.2 Records

SD-97,946 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. INSTALLATION4.1 Preliminary

- 4.11 The floor or pedestal under the unit shall slope not more than 1/4 inch in 10 feet. Also, the mounting area for each foot shall be flat within 1/64 inch, and these mounting areas shall not vary more than 1/32 inch in height from each other.
- 4.12 The unit may sit on lineoleum or tile for standard applications for 10 psi applications or for earthquake applications. The Lord mounts furnished with the turbine are used under the feet for all applications.
- 4.13 Solar furnishes hold-down material with the turbines. This consists of four Kwik-Bolts, one for each foot. These will be used for earthquake and 10 psi applications. A set used in soft site locations will not be bolted down unless the customer specifically requests this.
- 4.14 Install the turbine in accordance with Drawing ED-82280-30.
- 4.15 Arrange for or install the turbine-alternator and associated systems, such as air intake, exhaust, fuel, ventilation, etc., in accordance with the appropriate ED-drawings. Install line connections and conduits, where applicable in accordance with ED-drawings.
- 4.16 Wire all external control circuits. Control leads terminate on terminal strips inside the control cabinet.

4.2 J87249 Rectifier

- 4.21 Before installing the rectifier remove the cover and check the List Number marked on the plug-in card. The card should be marked with the appropriate list number (shown below) to match the batteries furnished with the turbine:

List TA: For 20-cell KS-15578 nickel-cadmium.
 List TB: For 12-cell KS-15577 lead-acid.

- 4.22 Install the J87249 Rectifier in the area provided.

CAUTION: Do not connect the plug to the rectifier at this time.

- 4.23 Do not change the factory settings of the R11 and R14 controls in the rectifier.

4.3 Starting and Control Batteries

- 4.31 Install and connect the batteries in accordance with job drawing or job information, when this is furnished.
- 4.32 Refer to Section 19 in Handbook 18 for information on connecting, handling and charging the batteries.
- 4.33 After the batteries are connected, hook up the J87249 Rectifier. To do this, remove all fuses from the rectifier, install the plug in the back of the rectifier and install the output fuse. Then install the input fuses (only two) marked 208 and COM, or, 240V and COM, depending on the line voltage. Then install the fuses for the rectifier in the AC Service Cabinet.
- 4.34 Make an initial charge of the batteries in accordance with Section 19 in Handbook 18. Observe that the battery voltage stabilizes at one of the following float voltages after 3 or 4 days of charge.
- List TA: 28.5 volts
 List TB: 26.0 volts
- 4.35 After completing the initial charge, keep the charger connected and charging continuously.

4.4 Turbine-Alternator

- 4.41 Check for and remove the jumpers across the terminals of all meters. The jumpers provide damping for the instruments during transit.
- 4.42 Open the OIL DRAIN and drain out any oil or residue left in the system. Then close the drain valve. Remove the filter cap on the lube oil reservoir and add 6 gallons of KS-21273 L1 Lubricating Oil. This KS-21273 L1 Lubricating Oil, furnished by the operating company, can be purchased from Mobile Oil, Scarsdale, New York.

- 4.43 The KS-21273 L1 lubricating oil is the preferred oil for use in the KS-20542 gas

turbine engine alternator. Lube oils listed in Table A may be used.

TABLE A

<u>BRAND NAME</u>	<u>POUR POINT °F</u>	<u>APPLICATION (SEE NOTE)</u>	<u>OIL COMPANY</u>
SHC - 824			MOBILE
BRAYCO - 778			BRAY
SYNTHETIC - 35	-65°	ALL CLIMATES	SUN
DTE - LIGHT	+20°		MOBILE
TERESTIC - 43	+15°	AVERAGE AMBIENT TEMPERATURE	EXXON
TERESTIC - 47	+15°	HIGHER AMBIENT TEMPERATURE	EXXON

NOTE: OIL TANK TEMPERATURE SHALL BE 10°F ABOVE THE POUR POINT OR HIGHER AT ENGINE START UP.

- 4.44 It will be necessary for the installer to include the following information on the bottom of the SD-4-1275 Lubrication Record form:

- 4.441 Type and Batch Number of Lube Oil.
4.442 Initial Quantity placed in Lube Oil tank.
4.443 Quantity of Makeup of Lube Oil.
4.444 Accrued Number of Starts.
4.445 Hours of Operation.
4.45 Observe that the OLR (Overload Relay) is set at 3.5.
4.46 Operate the Alarm Silence Switch to prevent the horn from blowing during test. The switch should remain in this position until instructed otherwise.

- 4.5 Remote Control Cabinet When Provided
4.51 Install the Remote Cabinet in accordance with information provided on ED-Drawings.
4.52 Wire the Remote Cabinet in accordance with the information provided on SD- and T-Drawings.

5. STATIC TESTING

NOTE: The various tests that follow are sectionalized and are written in such a manner to be pretty much complete. However, when reference is made to turning the OPERATION SELECTOR switch to OFF and in the beginning of the next section, turning it back to MAN, this may be anticipated and omitted by reading ahead. The same would apply to the circuit breakers CB-1 to CB-17 except where temporary connections or disconnects are to be made and its required to disconnect power.

5.1 Crank Failure

NOTE: Crank Failure occurs when the engine fails to attain 5% speed in 2.5 sec.

- 5.11 Operate the OPERATION SELECTOR Switch to OFF and open the control breakers (CB1-CB17).
5.12 Remove and tape the leads on TB3 terminals 13 and 14 on the left side from the magnetic pickup.

- 5.13 Connect the ITE-5518 Sine Wave Generator between TB3 terminals 13 and 14 using clip lead adapter.
- 5.14 Vary the ITE-5518 to 125Hz and with an ITE-5520 measure for 3 volts rms.
- NOTE:** For greater accuracy of frequency reading use an ITE-5519 Counter. Place counter and multimeter in Internal Mode as patch cords between them and the Sine Wave Generator or oscillator are not required.
- 5.15 Close all the control breakers (CB1-CB17) and operate the OPERATION SELECTOR Switch to MANUAL at Local Control. Operate Start Sequence push button.
- 5.16 The set shuts down and the CRANK FAILURE and ALARM CONDITION lamps light and the ENGINE FAILURE lamp lights at the REMOTE cabinet.
- 5.17 Operate the OPERATION SELECTOR Switch to OFF.
- 5.18 Leave the ITE-5518 on terminals 13 and 14 for the OVERSPEED test in paragraph 5.2.
- 5.2 Overspeed
- 5.21 With the ITE-5518 between TB3 terminals 13 and 14, vary the ITE-5518 to 1000Hz starting point and measure with the ITE-5520 for 3 volts rms.
- 5.22 Operate the OPERATION SELECTOR Switch to MANUAL.
- 5.23 Vary the ITE-5518 to 2820Hz which is a 100% indication on Speed Meter. (3030Hz = 108% speed.
- 5.24 Vary the ITE-5518 slowly between the range of 3017.4 to 3073Hz.
- 5.25 In this range the following indication should be noted:
- 5.251 The OVERSPEED lamps lights on the Mal-function Monitor.
- 5.252 The 108% lamp lights on the Speed Monitor.
- 5.253 The ALARM CONDITION lamp is lit because of low oil pressure.
- 5.254 The ENGINE FAILURE lamp lights on the remote panel.
- 5.26 Operate the OPERATION SELECTOR Switch to OFF.
- 5.27 Vary the ITE-5518 to 2820Hz and proceed to paragraph 5.3.
- 5.3 Overspeed (Open Probe)
- 5.31 Operate the OPERATION SELECTOR Switch to MANUAL.
- 5.32 Remove the amphenol connector on the ITE-5518 to simulate an open probe condition.
- 5.33 In this range the following indication should be noted:
- 5.331 The OVERSPEED lamp lights on the Mal-function Monitor.
- 5.332 The ALARM CONDITION lamp lights or is lit.
- 5.333 The ENGINE FAILURE lamp lights on the remote panel.
- 5.34 Operate the OPERATION SELECTOR Switch to OFF.
- 5.35 Vary the ITE-5518 to zero, remove the ITE-5518 from TB3 terminals 13 and 14 and replace the leads removed from TB3 terminals 13 and 14.
- 5.4 Exhaust Over Temperature
- 5.401 Operate the OPERATION SELECTOR Switch to OFF and open all control breakers (CB1-CB17).
- 5.402 Disconnect the lead to thermo-couple. TB3 PCHGS 10 and 11.
- 5.403 Connect the ITE-5521 Temperature Simulator on TB3 with the AL (-) on punching #10 and the CHR (+) on punching #11. Set the ITE-5521 at 400°F and connect to 115V AC.
- 5.404 Operate the OPERATION SELECTOR to MANUAL and close all control breakers (CB1-CB17).
- 5.405 Note the 400°F lamp lights on the module.
- 5.406 Vary the ITE-5521 to 1000°F $\pm$ 12°F.
- 5.407 Note the following conditions:
- 5.4071 1000°F lamp lights.
- 5.4072 PENDING HI EXH TEMP lamp lights.
- 5.4073 Horn sounds.
- 5.4074 ALARM CONDITION lamp lights.
- 5.4075 ENGINE FAILURE lamp lights (at remote control only).
- 5.408 Vary the ITE-5521 to 1112°F $\pm$ 12°F.
- 5.409 Note the following conditions.

- 5.4091 1112°F lamp lights.
- 5.4092 HI EXH TEMP lamp lights.
- 5.4093 Horn sounds.
- 5.4094 ENGINE FAILURE lamp lights at the remote cabinet.
- 5.4095 ALARM CONDITION lamp lights.
- 5.410 Operate the OPERATION SELECTOR Switch to OFF and open all control breakers (CB1-CB17).
- 5.411 Remove the ITE-5521 from TB3 punching #10 and #11.
- 5.412 Reconnect the Thermo couples.
- 5.5 Lube Oil Over Temperature
- 5.51 Short terminal punching #6 to #7 on TB3.
- 5.52 Close all control breakers (CB1-CB17) and operate the OPERATION SELECTOR Switch to MANUAL.
- 5.53 Note the following alarm condition exists:
- 5.531 HIGH OIL TEMP lamp lights.
- 5.532 ENGINE FAILURE lamp lights (Remote control only).
- 5.533 ALARM CONDITION lamp lights.
- 5.534 Horn sounds.
- 5.54 Operate the OPERATION SELECTOR Switch to OFF and open all control breakers (CB1-CB17).
- 5.55 Remove the short on terminal punching #6 to #7 on TB3.

6. INITIAL START

6.1 Preliminary

- 6.11 Test associated systems for operation. These are such systems as Automatic Fuel Pumping System and Auxiliary Room Ventilating Circuit.
- 6.12 Connect ITE-4782 or ITE-4785 Test Loads. Refer to TMO-4782 or TMO-4785 in Handbook 100 for connecting and operating information. The loads may be connected to the output side of the alternator breaker or to the Emergency Bus. Loads should be set at zero load.

NOTE: Since the cubicle will have to be closed during the load tests, the leads should be run in such a way that the covers can be put on the cubicle.
- 6.13 Turn the OPERATION SELECTOR Switch to the OFF position (on the turbine). Turn the TRANSFER SELECTOR Switch on the turbine to the MANUAL position. Turn VOLTAGE SELECTOR Switch (turbine or Remote Cabinet) to ALTERNATOR 1-2 position.
- 6.14 Disconnect the following leads at the turbine LB6, TR16, CB9 and TR15.
- 6.15 Observe that all the control circuit breakers are open.
- 6.16 Close any condensate drains in the exhaust system.
- 6.2 Priming Fuel System
- 6.21 Make sure fuel is available and that fuel lines are tight to the unit. Open the valve in the fuel suction line to the unit.
- 6.22 Turn the RUN/PRIME selector valve (just below the hand pump) to the PRIME position.
- 6.23 Open the vent on the top of the FUEL CUP. Circle the vent cap (don't cover it) with a rag. Station a man at the FUEL CUP. Have one man use the hand pump to fill the FUEL CUP. As soon as fuel comes out of the FUEL CUP have the man close the vent.
- 6.24 Operate the RUN/PRIME valve to the RUN position.
- 6.25 Check for leaks in the low pressure and high pressure fuel lines and tighten as necessary. Wipe up any spilled fuel.

6.26 Before proceeding further check oil level in the sump and add oil to bring level to the FULL mark.

6.27 Initiate the start under Paragraph 6.3.

6.3 No-Load Operation

6.301 Zero-adjust volt meter, ammeter, wattmeter and Per Cent Speed Meter, using the zero-adjusters on the instruments.

6.302 With both OPERATION SELECTOR Switch at OFF close all control breakers (CB1-CB17). Switch OFF NORM lamp lights on the turbine.

PRECAUTION: R-4296 Ear Protector must be worn during operation of the set.

6.303 Turn the OPERATION SELECTOR Switch at the Local Control Cabinet to MANUAL. Switch OFF NORM lamp goes out. Operate the Local/Remote Switch to LOCAL.

6.304 Turn VOLTS ADJUST control on the turbine full CCW and operate switch behind synchronizing lights from Reduced Speed to Normal.

6.305 Press the STARTING SEQUENCE Button and release. The turbine should begin to crank. If the turbine does not light off and a crank failure indication is experienced, operate the OPERATION SELECTOR Switch at the Local Control Cabinet to OFF, then back into MANUAL (to reset the alarms). Repeat the starting attempt.

6.306 If the turbine lights off and accelerates, observe that speed increases smoothly toward 100%. At about 90% speed the alternator field is flashed, later the WUT (Warm-Up Timer) times out and the Ready To Load lamp lights.

NOTE: Exhaust Temperature Meter will show a steady increase in temperature during starting. Temperature may reach about 700°F and then is likely to reduce to about 600°F, which is the normal temperature at no-load.

6.307 Adjust alternator voltage to normal value.

6.308 Set the correct no-load speed. If the governor is set at ISO, 60 Hertz is the correct speed. If the governor is set at DROOP, 62.4 hertz is the correct speed (about 104%).

6.309 Check phase sequence of alternator output with R3404 Phase Sequence Indicator. Use identified terminals T1, T2 and T3 on the alternator breaker as reference. Refer to Section 135 in this handbook for information on how to use R3404.

6.310 Allow the set to run about ten minutes. Then shut it down by depressing the SHUT-DOWN SEQUENCE pushbutton. The set runs for a few minutes and shuts down.

7. LOW OIL PRESSURE

7.1 Operate the OPERATION SELECTOR Switch to MANUAL.

7.11 Place a jumper between TB3 terminal 8 and terminal 9 (low oil pressure switch contacts).

7.12 Depress the STARTING SEQUENCE pushbutton.

7.13 At 50% speed the turbine shuts down.

7.14 The following alarm condition exists:

7.141 LOW OIL PRESSURE lamp lights.

7.142 ALARM CONDITION lamp lights.

7.143 MAJOR ALARM lamp lights in alarm cabinet.

7.144 ENGINE ALARM lamp lights.

7.145 The horn sounds.

7.15 To cancel alarm operate the OPERATION SELECTOR Switch to OFF.

7.16 Remove the jumper between TB3 terminal 8 and terminal 9.

7.17 Open all control breakers (CB1-CB17).

8. OVERCURRENT

8.1 Close the control breakers (CB1-CB17).

8.2 Operate the OPERATION SELECTOR Switch to MANUAL.

8.3 Depress the STARTING SEQUENCE pushbutton.

8.4 When the READY TO LOAD lamp lights depress the ALTERNATOR CIRCUIT BREAKER CLOSE pushbutton.

8.5 Depress the OVERLOAD RELAY.

8.6 The following alarm condition exists:

8.61 The ACB Breaker will shunt trip and the ALT CB TRIPPED lamp lights.

- 8.62 OVERCURRENT lamp lights.
- 8.63 ALARM CONDITION lamp lights.
- 8.64 ENGINE FAILURE lamp lights on the remote panel.
- 8.7 Operate the OPERATION SELECTOR Switch to OFF.
- 8.8 Open the control breakers (CB1-CB17).
- 8.9 Reset the ACB Breaker.
- 9. REVERSE POWER TEST

NOTE: This set is provided with a Reverse Power Test Switch located on the front of the Alternator Instrumentation Module.

- 9.1 Operate the OPERATION SELECTOR Switch to MANUAL and close the Control Breakers (CB1-CB17).
- 9.2 Depress the START SEQUENCE pushbutton. Observe that the turbine starts, accelerates and comes up to speed.
- 9.3 With the READY TO LOAD lamp lighted close the circuit breaker and apply 55-60 KW of artificial load.
- 9.4 Operate and hold the REVERSE POWER TEST Switch. The set continues to operate with no shutdown or malfunction indication.
- 9.5 Increase the artificial load between the range of 85 to 95KW.
- 9.6 The engine shuts down and the following indications should be noted:
- 9.61 REVERSE POWER lamp lights.
- 9.62 ENGINE FAILURE lamp lights on the remote panel.
- 9.63 ALARM CONDITION lamp lights.
- 9.64 ACB Circuit Breaker trips.
- 9.65 Release REVERSE POWER TEST switch
- 9.7 Reset the ACB Circuit Breaker.
- 9.8 Operate the OPERATION SELECTOR Switch to OFF.
- 9.9 Open the control breakers (CB1-CB17).

10. OVERVOLTAGE

NOTE 1: If the alternator output voltage, monitored between phase 1 and neutral exceeds 120 percent of normal, the Alternator Instrumentation and Malfunction Monitor Module shuts down the turbine and gives the required alarms.

- 10.01 Operate the OPERATION SELECTOR Switch to OFF.
- 10.02 Open all the control breakers (CB1-CB17).
- 10.03 Place an ITE-5520 Digital Multimeter (500V range) between TB1-1 and TB1-2.
- 10.04 Mark the setting on the VAR-1K potentiometer (Voltage Reg Adjust Pot.) and loosen the locking device on the VAR-1K potentiometer.
- NOTE: If VAR-1K potentiometer is located to the right of the voltage regulator. Operate the Local/Remote switch to Local when provided.
- 10.05 At the local control operate the OPERATION SELECTOR Switch to MANUAL.
- 10.06 Close the control breakers (CB1-CB17).
- 10.07 Depress the STARTING SEQUENCE pushbutton. Observe that the turbine starts, accelerates and comes up to speed.
- 10.08 When the READY TO LOAD lamp lights, vary the VAR-1K potentiometer very slowly clockwise and take note of the voltage on the ITE-5520 when the set shutsdown.
- 10.09 When the set shutsdown the OVERVOLTAGE lamps light on the Alternator Instrumentation module and Malfunction Monitor module. Also the ENGINE FAILURE lamp lights on the remote panel and the ALARM CONDITION lamp lights.
- NOTE: For the 416-480V sets the voltage readings at TB1-1 and TB1-2 will be in the range of 173-200 volts.
- 10.10 Operate the OPERATION SELECTOR Switch to OFF.
- 10.11 Open the control circuit breakers (CB1-CB17).
- 10.12 Remove the ITE-5520 from terminals TB1-1 and TB1-2.

- 10.13 Vary the VAR-1K potentiometer to original position and tighten the locking device on the VAR-1K potentiometer.

11. FULL LOAD TEST

TIME: Make a three-hour Preliminary Load Test at half, three-quarter and a full load before a Final Acceptance Test. The Final Acceptance Test will be 2-1/2 hours in length and witnessed by a customer's representative; two hours will be at full-load and the last half-hour at the usual office load value, or, at full-load.

LOAD: Artificial load equal to full KW capacity of the set.

PARALLEL: If the set is to be paralleled additional Preliminary and Final Acceptance Tests in parallel will be required, in accordance with Section 130 in this Handbook.

11.1 Preliminary Operations

- 11.11 Remove the 1/8 inch pipe plug in the exhaust pipe and inlet duct and connect a water manometer at each point. Adjust the manometer for zero.

CAUTION: DO NOT DRILL INTO THE INLET DUCT AFTER IS HAS BEEN INSTALLED IN THE TURBINE ALTERNATOR. IT IS VERY IMPORTANT THAT NO PARTICLES GET INTO INLET OR DAMAGE TO THE TURBINE-ALTERNATOR WILL OCCUR.

- 11.12 Connect on ITE-5520 (500VAC) across TB1-1 and TB1-2.

NOTE: For the 416-480V sets the voltage reading at TB1-1 and TB1-2 will be in the range of 173-200 volts due to the potential transformers in line, which are rated at 2.4:1.

- 11.13 Be sure OPERATION SELECTOR Switch on the turbine is at OFF position. Close all the control breakers (CB1-CB17) on the turbine control. The SWITCH OFF NORM lamp lights on the turbine.

- 11.14 Install all the side covers on the enclosure.

- 11.15 Start any Auxiliary Fuel Pump or Auxiliary Room Ventilating Fan. Open doors to provide ventilation if this will be the normal method of ventilating the room.

- 11.16 Open the valve in the fuel suction line.

- 11.17 Close any condensate drain valves in the exhaust line.

11.2 Preliminary Load Test

- 11.201 Turn the OPERATION SELECTOR Switch to MANUAL.

- 11.202 Press the STARTING SEQUENCE pushbutton on the turbine control and release. Observe that the turbine starts, accelerates and comes up to speed and that the alternator voltage is normal. Adjust speed and voltage as required. Frequency will be 60 Hertz if the turbine is not to be paralleled or 62.4 to 62.75 hertz if it will be paralleled in droop or 60 hertz if it will be paralleled in ischronous.

- 11.203 Take a set of readings at no-load. This will include time, frequency, volts, exhaust temperature, room ambient for time meter and voltage verification.

- 11.204 With the READY TO LOAD lamp lighted close the alternator circuit breaker. Add load to the turbine until it is carrying half load.

- 11.205 Take a set of readings at half load. This will include time, Frequency, Volts, Amperes, KW, Power Factor and Exhaust Temperature.

- 11.206 With the alternator breaker closed use the R-3404 Phase Sequence Indicator and check for correct phase sequence on the output side of the alternator breaker.

- 11.207 Check the phase sequence of leads for 1-2-3 order on the alternator side of the remote EMERG Breaker. The sequence must match that of the commercial ac on the common or Emergency bus, if the commercial ac is already connected. If the commercial is not yet connected, the phase sequence of the leads from the turbine-alternator will be the reference and the commercial ac must match when it is connected.

- 11.208 Take readings every 30 minutes at half load until the unit has run one hour at half load.

- 11.209 Add load to the turbine until it is carrying 3/4 load.

- 11.210 Take a set of readings at 3/4 load. This will include time, Frequency, Volts, Amperes, KW, Power Factor and Exhaust Temperature.

- 11.211 Take readings every 30 minutes at 3/4 load until the unit has run one hour at 3/4 load.
- 11.212 Add load to the turbine until it is carrying full load.
- 11.213 Observe speed and voltage. Adjust voltage to match normal commercial ac line voltage and adjust speed for 60 hertz.
- NOTE: If speed is readjusted at this time it will be necessary to take no load speed reading later (as in Paragraph 11.217).
- 11.214 Take a set of readings at full load. This will include time, Frequency, Volts, Amperes, KW, Power Factor, Exhaust Temperature, and manometer readings for back pressure and inlet restriction.
- 11.215 Take readings every 30 minutes at full load until the unit has run one hour at full load.
- 11.216 During the Preliminary Load Test the unit shall meet the requirements in Paragraphs 11.4. If the customer's representative will allow the full load test to continue without interruption, proceed to Paragraph 11.3.
- 11.217 If the test will not be continued reduce the load to zero. Take a set of reading at no load.
- 11.218 With the set at no load, open the alternator circuit breaker. Then shut down the turbine by pressing the SHUTDOWN SEQUENCE pushbutton.
- 11.219 Turn off the ITE-5520 by depressing the POWER OFF button and disconnect the ITE-5520.
- 11.3 Final Acceptance Test
- 11.31 Allow the unit to carry full load for a total of 2 hours, uninterrupted. Take reading every 30 minutes.
- 11.32 During the run the unit shall meet the requirements in paragraph 11.4.
- 11.33 After two hours at full load open the alternator circuit breaker. Record no-load frequency, Per Cent Speed and voltage. This will determine speed droop, where applicable.
- 11.34 Close the alternator circuit breaker to fully load the set. Then reduce the load to what will be the normal office load. Take a set of readings.
- 11.35 After 30 minutes at the normal office load value take a set of readings. Then decrease load to zero or open the alternator breaker and take another set of reading.
- 11.36 Allow the set to run about 3 minutes at no load. Then shut the set down by pushing the EMERGENCY STOP button.
- 11.37 After the set has coasted to a stop turn OPERATION SELECTOR Switch to OFF. The EMERGENCY STOP lamp goes out.
- 11.38 Manually reset the alternator circuit breaker.
- 11.4 Requirements
- 11.41 The capacity of the set will vary with altitude and with combustion air inlet temperature. Table B gives the maximum alternator output power in KW for various combinations of altitude and combustion air inlet temperature.

TABLE B					
MAXIMUM ALTERNATOR POWER OUTPUT AT SPECIFIC ALTITUDES AND TEMPERATURES					
ALTITUDE (ABOVE SEA LEVEL)	COMBUSTION AIR INLET TEMPERATURE IN DEGREE F				
	70	80	90	100	110
FT	KW				
0 to 1500	200	200	200	185	170
2000	200	200	198	183	168
3000	200	200	192	177	163
4000	200	194	185	171	157
5000	200	187	178	165	151
6000	192	179	171	158	145
7000	184	172	164	152	139
8000	176	164	156	144	132
NOTE 1: These values include an allowance for 3 inches of water inlet and 6 inches of water exhaust system losses. NOTE 2: ALTITUDE ADJUSTMENT is located behind the FUEL CONTROL card on the module. To adjust vary the altitude potentiometer fully CCW. Then for each 500 feet, make 1 (one) full turn CW.					

11.42 Speed at full load, or at the derated full load condition, shall not change more than 1/4 hertz. Also, the speed shall not be cyclic (hunting).

11.43 The voltage shall not vary through out the full load run more than $\pm 1\%$ from the original full load setting.

11.44 When the turbine is operated with the governor set at DROOP, the speed from no-load to full-load shall not exceed 4-1/2% of rated or 100% speed.

11.45 When the turbine is operated with the governor set at 150 the speed variation

from no-load to partial load and to full load without adjustment of speed shall not exceed $\pm 1/4$ hertz.

11.46 The Voltage indicated on the AC voltmeter on the Control Cabinet should not vary from the ITE-5520 Digital Multimeter indication more than the following value:

208-240V set: 6 volts
416-480V set: 12 volts

11.47 The allowable back pressure varies with the inlet restriction. These values are shown in Table C.

TABLE C	
ALLOWABLE BACK PRESSURE VERSUS INLET RESTRICTION	
INLET RESTRICTION (IN. OF WATER)	MAXIMUM ALLOWABLE BACK PRESSURE (IN. OF WATER)
1.0	10
1.5	9
2.0	8
2.5	7
3.0	6

12. ALARM TESTS**12.1 Alarm Test Button**

12.11 The lamps can be checked with the TEST ALARM button provided the turbine is not running and the OPERATION SELECTOR Switch is in any position but OFF.

12.12 With the turbine not running and all control circuit breakers (CB1-CB17) closed, operate the OPERATION SELECTOR Switch to MANUAL or AUTO, depending on how the turbine will be used. The LOCAL/REMOTE Switch should be depressed to the LOCAL position. The ALARM SILENCED Switch should be depressed if lamp is lighted.

12.13 Depress TEST ALARM Button.

12.14 Observe that the following lamps light on the turbine malfunction module and the horn sounds.

MAJOR LAMPS	MINOR LAMPS
LOW OIL PRESSURE	PENDING HI EXH TEMP
HIGH OIL TEMP	ALT CB TRIPPED
CRANK FAILURE	
ENGINE OVERSPEED	POWER FAILURE
HI EXH TEMP	
FUEL SYS. MALF.	
OVER VOLTAGE	
OVERCURRENT	
EMERG. STOP	
REVERSE POWER	
MAJOR BREAKER	

12.15 Release the TEST ALARM Button. All alarms lamps go out.

12.16 Depress the LOCAL/REMOTE Switch to REMOTE and depress the TEST ALARM Button at the REMOTE cabinet.

12.17 Observe that the following lamps light and the horn sounds on a Remote Control Cabinet:

MAJOR LAMPS	MINOR LAMPS
HI EXH TEMP	PENDING HI EXH TEMP
REVERSE POWER	MINOR BREAKER
ENGINE FAILURE	MINOR CB OPEN
OVER VOLTAGE	POWER FAILURE
OVER CURRENT	
EMERGENCY STOP	
FUEL SYS MALF.	
ACB TRIPPED	
MAJOR BREAKER	

12.18 In addition to the lamps on the turbine and Remote Control Cabinet both MAJOR and MINOR VISUAL alarms light in the office and MAJOR and MINOR AUDIBLE alarms sound.

12.19 Release TEST ALARM Button. All alarm lamps go out. Operate the OPERATION SELECTOR Switch to OFF.

12.2 Major Alarm

12.21 With the turbine not running check the major alarm by operating the OPERATION SELECTOR Switch to MANUAL and opening the CB10 Breaker. Major AUDIBLE and VISUAL ALARMS come in on the office alarm.

NOTE: The LOCAL/REMOTE Switch must be depressed to LOCAL control to perform Test at Turbine.

12.22 Depress ACO Key on SD-81100-01 circuit if Option B has been furnished with Fig. 10. The MAJOR ALARM GUARD lamp lights.

12.23 Cancel the major alarms by turning the OPERATION SELECTOR Switch to OFF.

12.24 Operate CB10 Breaker to ON.

12.3 Minor Alarms

- 12.31 With the turbine not running check the minor alarm. Do this by opening the CB17 circuit breaker. The RECT FAIL lamp lights, the horn sounds and MINOR AUDIBLE and VISUAL Alarms come in on the office alarm.
- 12.32 If SD-81100-01 Alarm Circuit is furnished and Option B has been used in Figure 10 of the circuit minor audible and visual alarms can be cancelled by depressing ACO Key. The MINOR ALARM GUARD lamp lights.
- 12.33 Cancel the minor alarm by closing the CB17 circuit breaker.

13. AUTOMATIC CONTROL TESTS13.1 Preliminary

- 13.11 Interchange alternator leads as necessary where phase sequence was incorrect.
- 13.12 If commercial ac is not yet connected to the Remote Transfer Breaker Circuit, connect the commercial ac at this time. Be sure that the commercial is correctly "phased out" to match that of the alternator before starting the set.
- 13.13 When connecting the Remote Transfer Breaker Circuit, connect leads LB6, TR16, CB9 and TR15.
- 13.14 Connect all alarm leads not previously connected.
- 13.15 Turn OPERATION SELECTOR Switch to OFF on a remote control cabinet but turn the OPERATION SELECTOR Switch to AUTO on the turbine. Operate the LOCAL/REMOTE Switch to REMOTE.
- 13.16 When there is no remote control cabinet leave the OPERATION SELECTOR Switch at OFF on the turbine.
- 13.17 Operate the RUN TIMER Switch (located at the alternator sequence module) to ON position.

13.2 Automatic Control Tests

- 13.21 Place TRANSFER SELECTOR Switch to AUTO. Operate the OPERATION SELECTOR Switch to AUTO LOAD TEST on the Remote Control Cabinet to simulate a power failure. Set starts up, runs and shuts down. Power Failure lamp lights. The PF lamp lights and MINOR AUDIBLE and VISUAL office alarms come in about 1-1/2 to 3-1/2 minutes later. Operate the ACO key to remove these alarms and light the MINOR GUARD.

- 13.22 Observe that the turbine starts after the Start/Delay period, accelerates to rated speed goes through the Warm-Up time and then breakers operate as follows: Off-Set Transfer the alternator breaker closes which opens the NCB breaker and then closes ECB breaker: When the NORM or CB-C breaker closes a PROPER Operation Alarm will be given to the radio room, the station alarm sending circuit, the alarm trunk circuit or the ESS remote master scanner, the latter signal being ENGINE OPERATE.

- 13.23 After the alternator breaker closes, turn the OPERATION SELECTOR Switch to AUTO on the turbine or on the REMOTE CONTROL Cabinet. This simulates return of commercial power. The MINOR ALARM GUARD lamp is retired and remote power failure indications are discontinued. POWER FAILURE lamp goes out.

- 13.24 The turbine carries the load through or runs through the HOT (Hold-Over Time), about 15 minutes. At the end of this time the breakers operate as follows: for Off-Set Transfer circuit the ECB breaker opens, NCB breaker closes and then the alternator breaker opens.

- 13.25 The turbine then runs through a CDT (Cool Down Time) period about 3 minutes and shuts down.

- 13.26 With office load connected a true or simulated power failure test should be run. The loss of ac can be simulated by pulling one of the fuses in the AC Service Cabinet that feed the Power Failure Monitor in the turbine.

- 13.27 With OPERATION SELECTOR Switch at AUTO and TRANSFER SELECTOR Switch at AUTO, remove ac indicated in paragraph 13.26. Observe that start, transfer of load, etc., occurs as described in Paragraph 1.53. After load was transferred and the RT (RUN TIMER) is timing out, restore commercial ac or restore the fuse feeding PF monitors in the AC Service Cabinet. Observe that transfer back to commercial power occurs after RT and HOT and that the set shuts down as described in paragraphs 1.53 and 1.54.

NOTE: The set carries the load for the time setting of the Run Timer, provided the RUN TIMER Switch is ON.

13.3 Room Ventilation Circuit

- 13.31 When this circuit is furnished (Fig. 10 of SD-81905-01) Air Intake and Exhaust shutters begin to open and the ventilating fan starts when room temperature reaches about 100°F.

- 13.32 The fan continues to operate and shutters stay open until room temperature reduces to about 75°F.

14. MAINTENANCE DURING INSTALLATION

14.1 Before Starting

- 14.11 Check for lube oil or fuel oil leaks and tighten, as necessary.

- 14.12 Check oil level in lube oil pump. With the turbine cold the level on the dipstick should be slightly above ADD 1 QUART line. Add sufficient oil to keep it near this line.

- 14.13 Check that the voltage of the batteries is within the required limits.

14.2 During Operation

- 14.21 Check for vibration or noise.

- 14.22 Check for increase in turbine exhaust temperature at a given load and ambient.

- 14.23 Check for signs of unusual operating conditions.

- 14.24 Periodically observe the Differential Pressure (AP) Gauge connected across the FUEL CUP, which is the Primary (or low pressure) Fuel Filter. The gauge indicates the restriction offered by the filter. A satisfactory filter runs from 0-7 psi; the filter should be changed when the gauge indicates 7-10 psi. When this filter is changed the element in the high pressure fuel filter should be removed and cleaned.

14.3 Other Items

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

- 14.32 Periodically check the battery charging rate (4 AMP/ VOLT terminals on the J87249 Rectifier).

- 14.33 Visually check security of all self-locking nuts, capscrews and other fastenings. If lockwires are broken, tighten the nuts or bolts and replace the lockwire. Use stainless steel lockwires, and not a zinc-coated lockwire. Lockwires are generally .032 inch diameter except for #8 or smaller screws and on electrical harness coupling nuts, where .020 inch diameter wire is used.

14.4 Routine Runs

- 14.41 The turbine must be run at least 30 minutes a month. The minimum routine running is 30 minutes at No-Load each month and one hour every 3 months carrying the office load. Running at no load or short runs, such as demonstration runs have no adverse effect on the turbine.

- 14.42 It is recommended that a run of at least 30 minutes duration, at no-load, be made weekly and that one-hour load test be made each month. During the one hour load run automatic Transfer Breaker Circuit should be exercised, when provided, to transfer office to the set.

- 14.43 No load starting and running is done by turning the OPERATION SELECTOR Switch to MANUAL and starting the turbine with the MANUAL START button.

- 14.44 The load test can be done on an automatic basis by turning the OPERATION SELECTOR Switch to AUTO LOAD TEST and the TRANSFER SELECTOR Switch to AUTO. After load has transferred to the turbine turn the OPERATION SELECTOR Switch to AUTO. The turbine will then run through the Run Timer and Hold-Over Timer and transfer load back to commercial power after the Hold-Over Timer times out.

15. GENERAL TROUBLES

NOTE: In the information below reference is made to MISFIRE and SURGE, which are the two main classes of abnormal turbine operation.

MISFIRE: Caused by fuel igniter system failing to ignite the fuel. Engine does not accelerate beyond about 20% speed and exhaust temperature does not rise. In this case the No-Light Timer should shut down the engine.

SURGE: Caused by momentary malfunction of fuel or air supply system. At low speed the engine may fail to accelerate but exhaust temperature may rise accompanied by a sudden, high pitched pulsating sound. At higher speeds a surge may cause the engine fail to reach rated speed accompanied by a loud roar and/or popping noises.

15.01 Starter Does Not Operate

Discharge start battery
 Loose battery connection
 CB 17 Breaker open
 Defective start motor
 Seized engine

15.02 Engine Cranks But Combustion Does Not Occur

15.021 MISFIRE: Stop cranking by turning OPERATION SELECTOR Switch to OFF. Allow about 30 seconds for excess fuel to drain off and make another start. If combustion does not occur after three attempts proceed as below.

15.022 Fuel System

Fuel system empty
 Loose fuel connections
 Air in fuel system
 Water in fuel
 Contaminated fuel supply.

15.023 No Ignition

Ignition System Malfunction. Remove ignitor plug with cable attached. Ground plug by taping to engine frame. Crank engine. A spark should appear at the plug tip during cranking. If spark does not appear and the ignition exciter is producing an audible hum, check cable or plug for internal ground.

15.3 Engine Lights Off But Does Not Accelerate

Clogged low pressure fuel filter
 Dirty high pressure fuel filter
 Batteries discharged

15.4 Engine Does Not Hold Load

Clogged low pressure fuel filter
 Dirty high pressure fuel filter

15.5 Engine Shuts Down Under Load

Trouble Shutdowns

15.6 No Voltage Build-Up

Open in field-circuit
 Defective Voltage Regulator
 Field Needs Flashing

15.7 Voltage Too High

Defective Voltage Regulator

15.8 Voltage Too Low

Alternator Overloaded
 Defective Voltage Regulator
 Open VAR rheostat

Manager, Product Engineering

Reason for Reissue:

Provide test methods for the KS-20452 L101, L102, L111, L112. (Continental Solid State Control Modules).