TM 9-4910-472-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S MANUAL

TEST SET, GENERATOR AND VOLTAGE REGULATOR, AUTOMOTIVE: 6, 12, AND 24 VOLT SYSTEMS (SUN ELECTRIC CORP., MODEL NO. VAT-25) (4910-270.3780)

This copy is a reprint which includes current pages from Change 1.

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WASHINGTON, D. C., 12 *August* 1966

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NG: State AG (3) : Units—Same as Active Army except allowance is one copy to each unit.

USAR: None

For explanation of abbreviations used, see AR 320-50.

Change No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *10 October 1972*

Operator's Manual
TEST SET, GENERATOR AND VOLTAGE REGULATOR, AUTOMOTIVE: 6,12, AND 24 VOLT SYSTEMS (SUN ELECTRIC CORP., MODEL NO. VAT-25) (4910-270-3780)

This Change is current as of 26 September 1972.

TM 9-4910-472-10, 12 August 1966, is changed as follows:

Page 3. Paragraphs 1-6 and 1-7 are added after 1-5.

1-6. REPORTING OF ERRORS. You can improve this manual by calling attention to errors and by recommending improvements, using DA Form 2028 (Recommended Changes to Publications), or by a letter, and mail directly to: Commanding General, Headquarters, U. S. Army Weapons Command, ATTN: AMSWE-MAS, Rock Island, IL 61201. A reply will be furnished directly to you.

1-7. PARTS INCLUDED WITH END ITEM. Parts included with end item and considered a component or part of item configuration are listed in the following table. The part numbers listed are Sun Electric Corporation (code 82386) numbers.

PART	PART NUMBER
LEAD, TEST, BATTERY:	6002-043
LEAD, TEST, GROUND:	6002-044
LEAD, TEST, REGULATOR:	6002-042
LEAD, TEST, VOLTMETER: black	6002-045
LEAD, TEST, VOLTMETER: red	6002-046
LEADS, TEST, FIELD:	6002-026

Pages 19 and 20, APPENDIX A is rescinded.

By the Order of the secretary of the Army:

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OCC-E (1)	29-42 (2)
CONARC (3)	29-45 (2)
AMC (10)	29-46 (3)
ARADCOM (2)	29-55 (2)
ARADCOM Rgn (2)	29-56 (5)
TACOM (5)	29-57 (5)
AVSCOM (10)	29-85 (5)
WECOM (10)	29-86 (5)
OS Maj Comd (5)	29-87 (5)
LOGCOMD (3)	57 (2)
Armies (3) except	67 (2)
2nd USA (2)	
7th USA (5)	
8th USA (5)	

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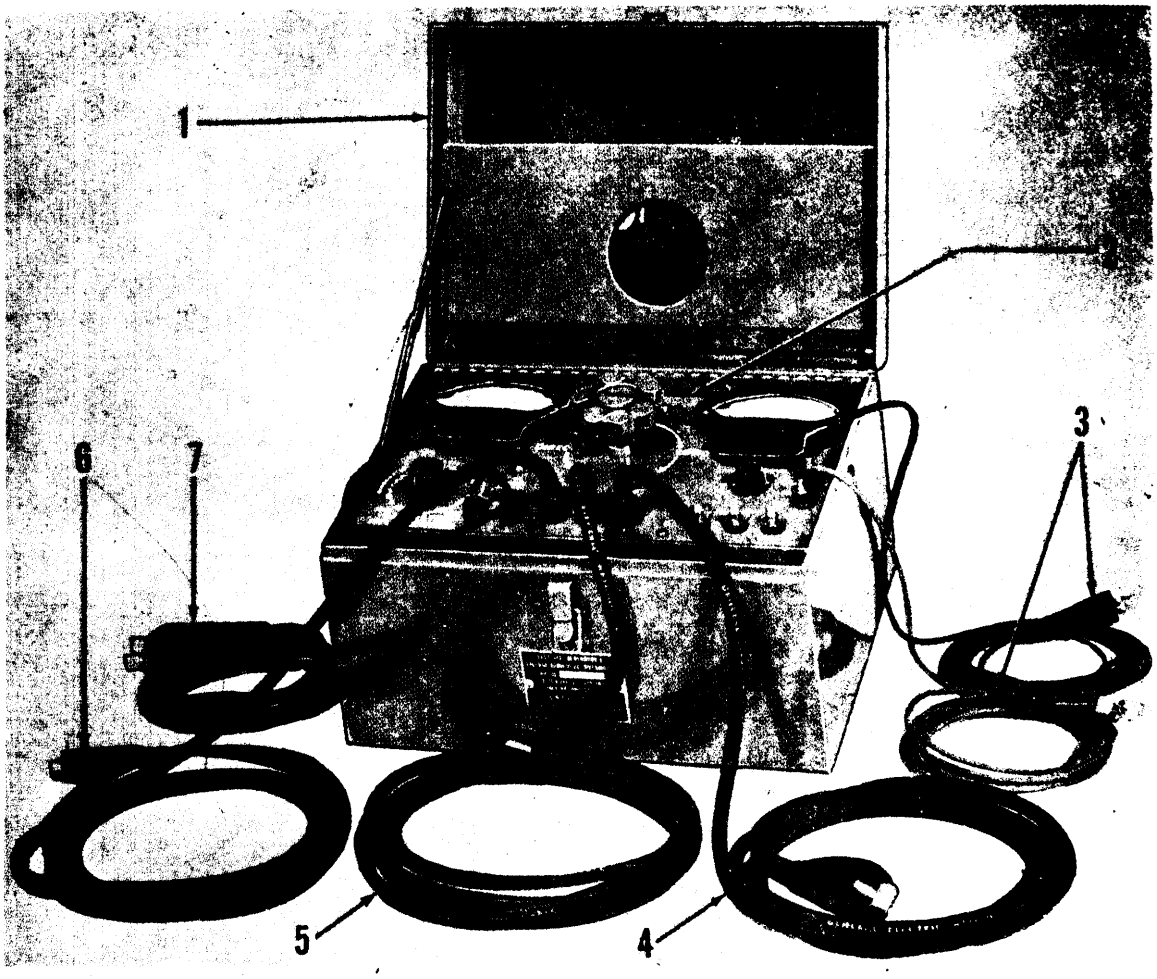


1. Test set case:7006-006
2. Control panel:7001-05
3. Voltmeter test leads: 6002-45 and 6002-46
4. Ground test lead:6002-044
5. Regulator test lead:6002-&2°
6. Battery test lead:6002-043
7. Field test leads:6002-026

Figure 1. Automotive Generator and Voltage Regulator Test Sets Model VAT-25

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION. This handbook provides operating instructions for the Automotive Generator and Voltage Regulator Test Set, Model VAT-25,

With this unit, an operator can quickly and accurately test the battery charging system of any passenger vehicle and truck equipped with a standard 24, 12, or 6 volt system.

By following the simplified test procedures contained in this manual, the entire battery charging system consisting of the generator, voltage regulator, and associated circuitry can be tested with a minimum of changes in the test lead connections and operating controls.

1-2. DESCRIPTION OF INSTRUMENTS AND OPERATING CONTROLS

The following Table identifies the instruments and operating controls, listing their functions:

Figure and Index No.	Instrument or Control and Marketing	Function
2-16	D.C. AMMETER, AMPERS D.C.	Indicates the battery charging current on the 0 120 amp scale. Indicates the discharge current on the 0 to −12 amp scale. The GROUND POLARITY Switch must be in correct position.
2-2	D.C. VOLTMETER, VOLTS D.C.	Indicates voltage between the points at which the VOLTS Test Leads are connected.
2-13	TOGGLE SWITCH, GROUND POLARITY	Reverses the polarity of the DC Ammeter. Set to (+) for a positive or to (−) for a negative ground system.
2-1	VARIABLE RESISTOR, DIRECT-¼Ω - LOAD	Changes the internal circuitry to insert or remove the ¼ ohm resistor or the carbon pile variable resistor.
	DIRECT Position (Between stop and ⅛ turn clockwise)	BAT. is connected directly to REG. No connection between REG. and GRD.
	¼Ω Position (Between ⅛ and ⅓ turn clockwise)	¼ ohm resistor is inserted between BAT and REG. No connection between REG. and GRD.
	LOAD Position	Carbon pile variable resistance is effective between REG, and GRD. Clockwise rotation reduces resistance.
2-9	SELECTOR SWITCH, 40-16-8	Selects voltmeter scale corresponding to the switch position.

Figure and Index No.	Instrument or Control and Marking	Function
2-15	VARIABLE RESISTOR-GENERATOR FIELD CONTROL	Changes the resistance of a variable resistor which is connected across the FIELD LEADS terminals. Resistance can be continuously varied from 0 to 50 ohms.
	OPEN Position	Open circuit between FIELD LEADS terminals.
	DIRECT Position	Direct connection (short circuit) between FIELD LEADS terminals.
2-6 2-7 2-8	TERMINAL-7 Ohms TERMINAL-1½ Ohms TERMINAL-¾ Ohm	Terminals provide fixed resistors for tests where fixed resistances are specified.

METERS—Meters used on the Test Set (2, 16, Figure 2) have an accuracy of 2 percent of full scale deflection. Meters are constructed with jeweled pivot bearings and are capable of withstanding a 400‰ momentary overload without damage. Zero Corrector Buttons (3) are provided to permit zeroing of pointers before using the Test Set.

D.C. VOLTMETER —Following is the voltage reading represented by each scale division of the D.C. Voltmeter:

METER SCALE	EACH DIVISION
0 to 40	0.5 volt
0 to 16	0.2 volt
0 to 8	0.1 volt

NOTE

Always use a voltmeter scale higher than the battery voltage of the system under test except when a lower scale is specified for a particular reading.

D.C. AMMETER -The 0 to 120 scale of the D.C. Ammeter provides a sufficient range to measure the charging rate of the latest, high output type battery charging systems. The O to —10 (actually — 12) portion of the scale measures the discharge (reverse) current. Each division of the D.C. Ammeter scale represents a current flow of 2 amperes, both to the right and left of Zero indication.

OPERATING CONTROLS —Figure 2 illustrates the Model VAT-25 Control Panel with the test leads removed. The Test Set has four operating controls:

(1) Generator Field Control
(2) Ground Polarity Switch
(3) Direct-¼Ω -Load Control
(4) Volts Selector Switch-40-16-8

The Generator Field Control is used to change the generator field current which controls the generator output during the cutout relay generator output and voltage regulator tests. It eliminated the need for changing engine speeds during tests and is also used to “cycle” the regulator.

The Ground Polarity Switch selects the correct polarity for the D.C. Ammeter so that the meter pointer reads upscale for battery charging current, or to left of Zero for discharge indications.

The DIRECT-¼ Ω-LOAD control is continuously adjustable over its range; however there are two basic positions (not marked) at which the circuitry is changed for each test. These positions are at approximately 1/6 and 1/3 turn clockwise rotation of the control knob from the stop. The open position of the carbon pile (open circuit) and contacts actuated by the control knob change the circuitry for the tests indicated on the control. By automatically inserting or removing the ¼ ohm resistor or carbon pile, accurate test results are assured. The black arrow on the control knob points to the control positions.

The DIRECT range of the control is used for generator output, cutout relay and circuit resistance tests.

The ¼ Ω range is used for voltage regulating relay test.

The LOAD range is used for current regulating relay tests

The 40-16-8 Volts Selector Switch is set to the voltage scale range of the D.C. Voltmeter required for the charging system under test.

1-3. TEST LEADS.

The Test Set is furnished with seven Test Leads, fitted with clips or lugs to allow quick test connections to the generator and voltage regulator of the vehicle. Three of the leads are separate, heavy current cables, marked BAT., REG., and GRD, which connect to the battery wire, voltage regulator battery terminal and ground respectively. These test lead connections are the same for all vehicles, regardless of battery ground polarity.

Two separate voltmeter leads are color coded-red for positive (+) and black for negative (–). The positive lead also has a rubber collar above the clip to further identify it.

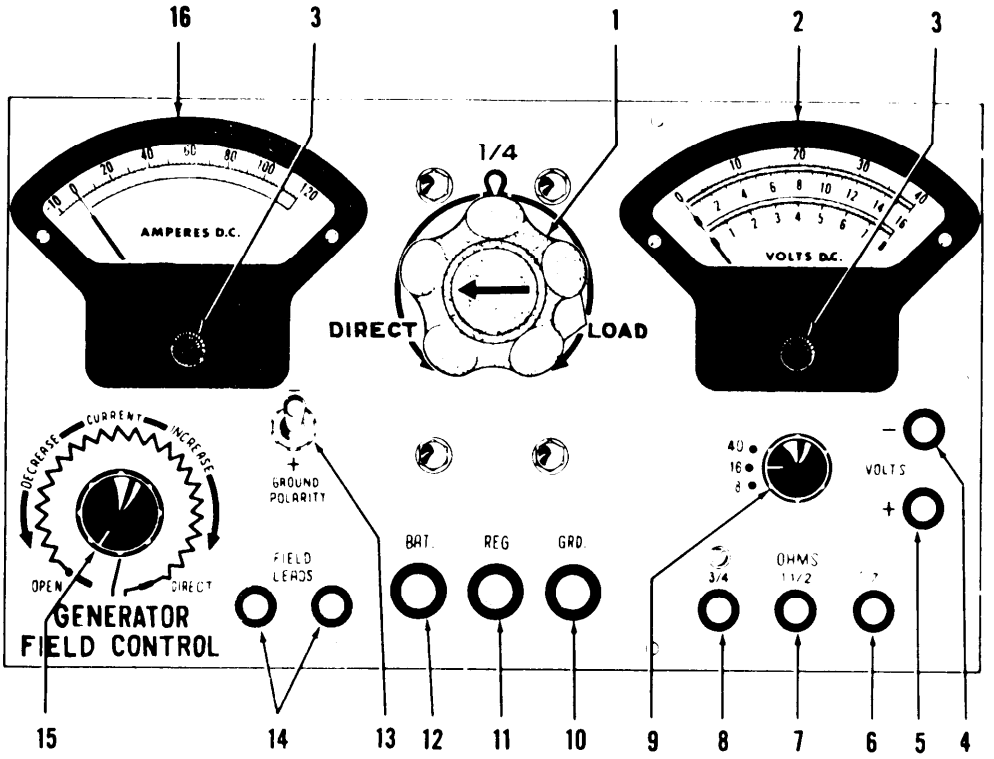
The remaining two leads which are connected into the field circuit of the generator are contained in a single cable.

1-4. FIXED LOADS.

Three fixed load resistors of 3/4, 1 1/2, and 7 ohms each, have special terminals on the test set panel for receiving the BAT. lead clip. When the BAT. lead is connected to one of these terminals, the corresponding resistor is connected between the BAT. lead clip and GRD.

1-5. CONNECTING TEST LEADS.

Remove the test leads from the storage compartment inside the test set case and install them on the proper terminals of the control panel (See Figure 1). Make certain that the red(+) and black(–) Volts test leads are connected to the correct terminals (See Figure 2).



1. Direct - 1 4 Ω - load control
2. D.C. voltmeter
3. Zero corrector button
4. Terminal for volts – test lead
5. Terminal for volts + test lead
6. Terminal for 7 ohms fixed resistor
7. Terminal for 1-1 2 ohms fixed resistor
8. Terminal for 3 4 ohm fixed resistor
9. Voltmeter range switch
10. Terminal for ground test lead
11. Terminal for regulator test lead
12. Terminal for battery test lead
13. Ground polarity switch
14. Terminals for field leads
15. Generator field control
16. D.C. ammeter

Figure 2. Sun Model VAT -25 Control Panel,
Test Leads Removed

SECTION II

BATTERY CHARGING SYSTEM TESTS

2-1. NEED FOR TESTS.

Whenever symptions indicate that battery charging irregularities are present, a thorough test of the battery charging system should be conducted to locate the source of trouble. Proper operation of the system is only possible when it has been completely tested and found to be in good working order. To completely test the charging system, the following tests should always be performed.

2-2. GENERATOR OUTPUT TEST.

This test is performed first to determine if the generator has sufficient output to meet the demands of the vehicle electrical system. A good generator is able to produce current equal to its rating or more, and is capable of meeting the system demands, plus keeping the battery fully charged. A generator which does not meet specifications should be removed and subjected to further tests and repair or replacement.

CAUTION

Operating the generator above the manufacturer's rating for extended periods of time can be harmful to the equipment.

2-3. CUTOUT RELAY TEST.

This test is made to determine whether or not the cutout relay closes and opens properly with respect to the generator voltage and battery current. Unless the relay is operating within the manufacturer's specifications, a discharged battery or damage to the charging system can result. A relay which is not operating within specifications is cause for removal of the voltage regulator for further tests and adjustments.

2-4. INSULATED AND GROUND CIRCUIT RESISTANCE TESTS.

These tests are made to determine the amount of voltage loss occuring between the armature terminal of the generator and the insulated (not grounded) battery post, and the generator housing and the grounded battery terminal respectively. Any voltage loss caused by high resistance in these circuits, will reduce the overall charge rate and can lead to eventual battery discharge. High resistance may be present in the form of poor connections or defective or inadequate wiring. If excessive resistance is indicated by this test, the cause should be located and corrected.

2-5. REGULATOR GROUND CIRCUIT RESISTANCE TEST.

This test determines the amount of voltage loss occuring between the generator housing and the voltage regulator base. Excessive voltage loss due to high resistance will cause the cutout relay and the voltage regulating relay to operate at a higher than actual setting. If voltage loss becomes extremely high, reversed generator polarity and consequent damage to the charging system may result.

2-6. VOLTAGE REGULATING RELAY TEST.

Purpose of this test is to determine if the voltage regulating relay is operating properly and within the manufacturer's specifications. A regulating relay setting which is higher than specified can cause battery overcharge and damage to lights and accessories. A lower than specified setting can result in a discharged battery. If the voltage regulating relay setting is not within the specified limits or is unstable or erratic in operation, remove the voltage regulator for further tests, service and adjustments.

2-7. CURRENT REGULATING RELAY TEST.

This test is made to determine if the current regulating relay is operating properly and within the manufacturer's specifications. A current regulating relay setting which is higher than specified can allow the generator to exceed its rated output with consequent damage from overheating resulting. A setting lower than specified will not allow the generator to deliver the current demanded by the electrical system when loads are heavy with the result that the battery will be drained. If the current regulator relay setting is not within the specified limits, or is unstable or erratic in its operation, the voltage regulator should be removed for further tests, service and adjustments,

2-8. AUXILIARY TESTS.

Variable Resistance—A variable resistance of 50 ohms is available (see paragraph 5-14).

Ammeter Usage —The ammeter may be used to determine the direct current draw of auxiliary equipment (see paragraph 5-17).

Voltmeter Usage —Voltages up to 40 volts DC may be measured (see paragraph 5-16).

SECTION III

BATTERY CHARGING SYSTEM TYPES

3-1. GENERAL.

While either the negative or positive battery post maybe grounded in a charging system, basically there are only two types of battery charging systems in common use today employing direct current generators. These differ in the way in which the field circuit of the generator is connected and grounded, and not with respect to battery polarity. The two types are described in the following paragraphs.

NOTE

All the diagrams in this manual show a negative grounded battery system. When the system is positive grounded, reverse the VOLTS test leads and the GROUND POLARITY switch.

CAUTION

Make certain of the vehicle's battery ground system before connecting any test leads.

3-2. EXTERNALLY GROUNDED GENERATOR FIELD (A CIRCUIT).

The externally grounded field type has one wire of the field circuit connected to the hot armature terminal inside the generator with the other wire grounded outside the generator through the voltage regulator contacts, thereby completing the field coil circuit. Externally grounded field types manufactured by Auto-Lite and Delco-Remy are commonly found on passenger cars and the majority of trucks (Auto-Lite Standard Duty). See Figure 3 for test connections for an externally grounded generator (A Circuit).

3-3. INTERNALLY GROUNDED GENERATOR FIELD (B CIRCUIT).

The internally grounded field type has one wire of the field circuit grounded to the housing inside the generator. One of the armature terminals of the generator is always internally grounded to the housing. The internally grounded field types manufactured by Auto-Lite and Delco-Remy are generally used on the larger trucks. (Auto-Lite Heavy Duty, Delco-Remy, Lucas and all standard and heavy duty systems used on Ford products. Lucas systems are found on most British cars). See Figure 4 for test connections for an internally grounded generator (B Circuit).

3-4. ALTERNATOR CHARGING SYSTEMS

Alternator charging systems are treated about the same as direct current generator charging systems with the exception that battery current is necessary to energize the field winding to start the alternator charging. Since alternators have little residual magnetism, the field coil must be energized before the stator windings can develop enough voltage to start charging the battery.

3-5. TESTING ALTERNATOR CHARGING SYSTEMS WITH VAT-25.

The VAT-25 may be used for testing the operation of an alternator charging system. In general, the BAT., REG., and GRD., test leads are connected into the direct current output circuit of the alternator and rectifier, while the FIELD LEADS are connected into the field circuit of the alternator. Measurements of the alternator and rectifier direct current output, diode leakage, voltage regulation, field current, insulated circuit resistance, and ground circuit resistance are made the same as with a direct current generator. Consult manufacturer's manuals for specific vehicle circuits and test instructions.

SECTION IV

PREPARATION FOR TESTS

4-1. PRELIMINARY CONTROL SETTINGS (Refer to Figure 2).

a. Set GROUND POLARITY Switch to correspond to the ground polarity of the system to be tested.
b. Set DIRECT-1/4 Ω -LOAD Control Knob to DIRECT Position.
c. Set GENERATOR FIELD CONTROL to OPEN position.
d. Set VOLTS 40-16-8 Switch to:

40 for 24 volt system
16 for 12 volt system
8 for 6 volt system

NOTE

Most vehicle manufacturers specify that the engine be operated at a medium speed for at least 15 minutes to bring the battery charging system components up to operating temperature before performing tests.

4-2. PRELIMINARY TEST—Engine Not operating.

a. Use voltmeter leads to determine which is battery terminal of the voltage regulator (if not marked).
b. Clip VOLTS test lead to a good ground on the engine or frame. See NOTE, Paragraph 3-1.
c. Touch the other VOLTS test lead to the three terminals on the voltage regulator.
d. If voltage regulator is operating normally, voltmeter readings at respective terminals should be as follows:
Battery voltage at Battery Terminal (marked B or BAT)
Zero voltage at Armature Terminal (marked A or GEN)
Zero voltage at Field Terminal (marked For FIELD)

NOTE

If voltage is indicated on ALL THREE terminals, check voltage regulator for closed cutout relay points.

4-3. PRELIMINARY CONNECTIONS FOR VOLTS TEST LEADS,

a. Clip proper lead to an engine ground.
b. Clip the other lead to the armature terminal (marked A or GEN) of the voltage regulator.

4-4. PRELIMINARY CONNECTIONS FOR FIELD LEADS.

a. Disconnect field wire from the field terminal (marked F or FIELD) of the voltage regulator and clip one of the FIELD leads to it.
b. Clip the other FIELD lead to the armature terminal (marked A or GEN) of the voltage regulator.

4-5. PRELIMINARY CONNECTIONS FOR BAT., REG., and GRD. TEST LEADS.

a. Disconnect the battery wire from the battery terminal (marked B or BAT) on the voltage regulator and attach the BAT. test lead from the test set to the removed battery wire.
b. Attach the REG. test lead to the battery terminal of the voltage regulator.
c. Attach the GRD. test lead to a good ground on the engine or frame.

4-6. CONNECTIONS AND CONTROL POSITIONS DURING TEST PROCEDURES.

In the test procedures described in Section V, a test lead connection or control position not specifically mentioned remains the same as for the preceding test.

SECTION V

TEST PROCEDURES

5-1. GENERATOR OUTPUT TEST.

a. Start engine and with tachometer, adjust engine speed to 1500 rpm or to speed recommended by the manufacturer of the generator equipment.
b. Set the GENERATOR FIELD CONTROL to the DIRECT position.
c. If the D.C. Ammeter indicates, the generator is an internally grounded type (B Circuit), and the diagram of Figure 4 applies.
d. If the D.C. Ammeter does not indicate, remove the FIELD test lead from the armature terminal of the voltage regulator and clip to the base of the regulator. The other FIELD test lead remains on the field wire.
e. If the D.C. Ammeter indicates after step d. above, then the generator is an externally grounded type and the diagram of Figure 3 applies.
f. With either FIELD LEADS connections (A Circuit or B Circuit) proceed with the following steps.
g. Rotate the DIRECT-¼ Ω-LOAD control knob clockwise to move the voltmeter pointer upscale until it indicates the rated voltage for the system—24, 12, or 6 volts.
h. Observe the D.C. Ammeter reading at the rated voltage of the system. This is maximum output of the generator and reading should equal or be greater than the rated output of the generator.

CAUTION

Prolonged operation of generator at maximum output can damage the generator. Take reading quickly and then reduce generator output immediately by returning DIRECT- 1/4 Ω-LOAD control to DIRECT position and rotating GENERATOR FIELD CONTROL to OPEN position

NOTE

The diagrams which follow show connections for an A Circuit generator. The connections for a B Circuit generator, when different, are indicated by Notes.

5-2. CUTOUT RELAY TEST—See Figure 3.

a. Slowly rotate the GENERATOR FIELD CONTROL clockwise while observing both the D.C. Voltmeter and the D.C. Ammeter.
b. Note the highest VOLTS D.C. reading just before the D.C. Ammeter pointer begins to move upscale from Zero. This must be done carefully. The D.C. Volts reading represents the “closing voltage” of the cutout relay and should be within manufacturers specifications.
c. Continue to rotate the GENERATOR FIELD CONTROL clockwise until the D.C. Ammeter reads approximately 5 to 10 amperes charge. Check this reading on vehicle ammeter.
d. Slowly rotate the GENERATOR FIELD CONTROL counter-clockwise while observing the D.C. Ammeter for the greatest reading to the left of Zero (Reverse or discharge current) just before the pointer returns to Zero. This reading represents the “opening amperage” of the cutout relay and should be within the manufacturers specifications.
e. Return the GENERATOR FIELD CONTROL to OPEN position.

5-3. INSULATED CIRCUIT RESISTANCE TEST—See Figure 5.

a. Remove VOLTS test lead from the armature terminal of the voltage regulator and attach to the armature terminal of the generator,
b. Remove other VOLTS test lead from ground and attach to the insulated (not grounded) post of the battery.
c. Set VOLTS Switch to the 8 Volt position.
d. Start engine and rotate GENERATOR FIELD CONTROL clockwise until the D.C. Ammeter indicates exactly 20 amperes charging current. Compare with vehicle ammeter reading.

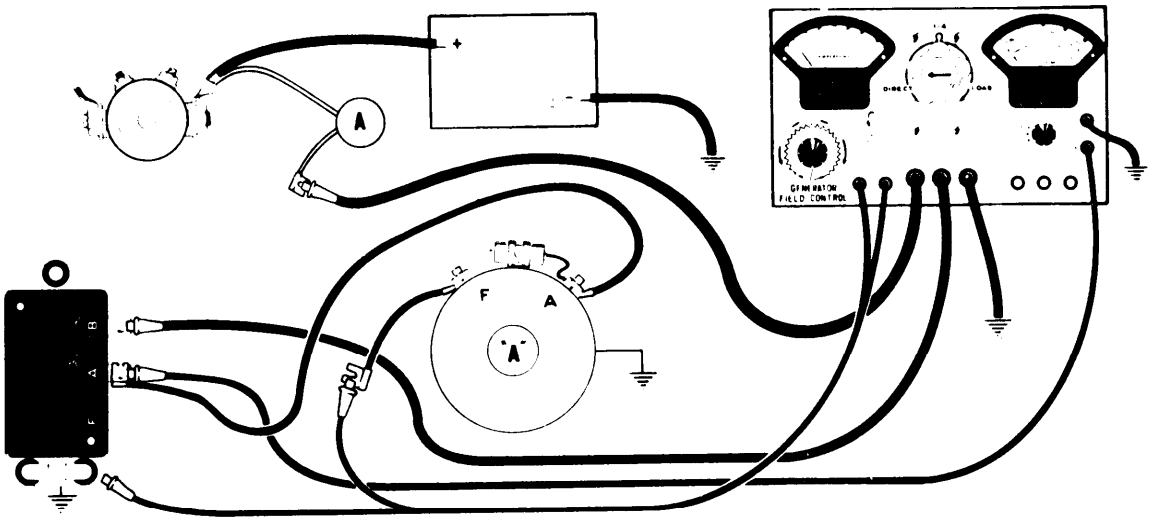


Figure 3. Externally Grounded Generator (A Circuit), Test Connections

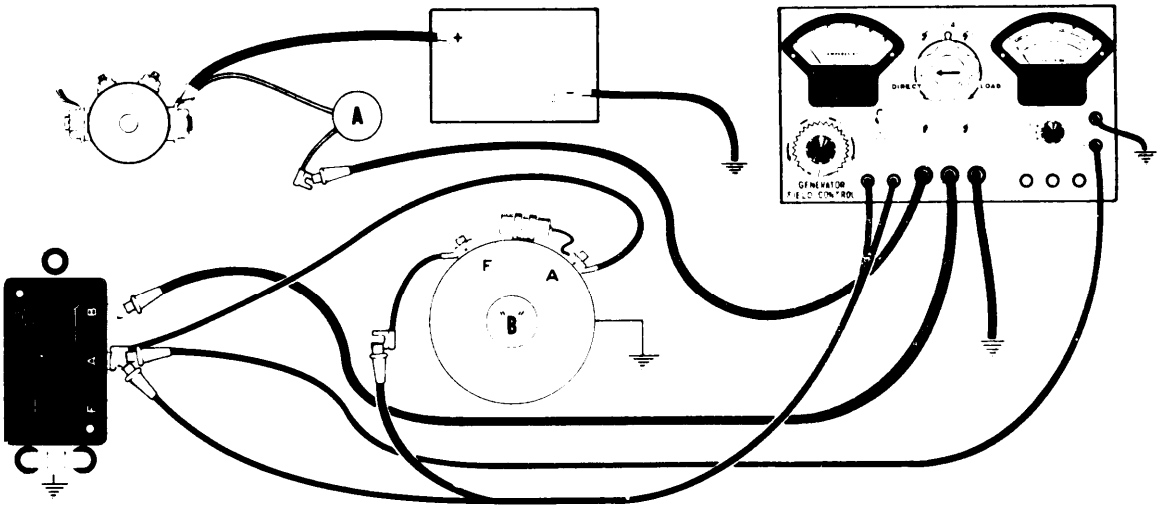


Figure 4. Internally Grounded Generator (B Circuit), Test Connections

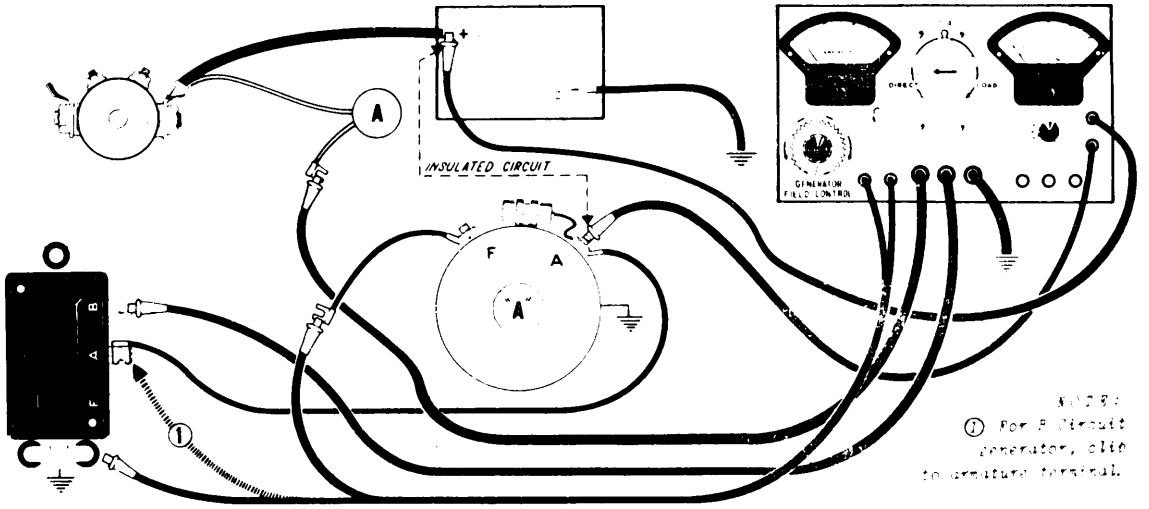


Figure 5. Insulated Circuit Resistance, Test Connections

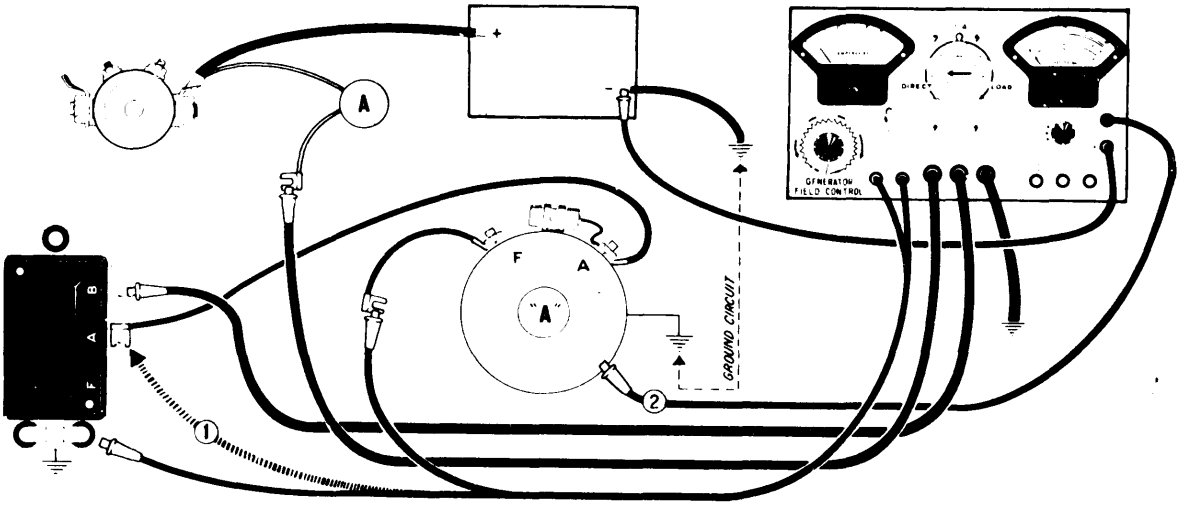
e. Note the D.C. Voltmeter reading. This reading is the voltage loss (which shows the amount of resistance) in the insulated wiring of the charging system and should be within specifications. Unless otherwise specified, the voltage loss should not exceed 1.0 volt. A higher reading indicates excessive resistance.
f. Find and correct a high resistance condition before proceeding to the other tests.

5-4. GROUND CIRCUIT RESISTANCE TEST - See Figure 6.

a. Maintain 20 amperes charging current.
b. Remove VOLTS test lead from the armature terminal of generator and connect to the grounded battery terminal.
c. Remove other VOLTS test lead from the insulated battery terminal and clip to a good ground on the generator housing,
d. For a B Circuit generator, remove the FIELD test lead from the base of the voltage regulator and clip to the armature terminal of the voltage regulator (See Note in Figure 6).
e. Note the D.C. Voltmeter reading, The reading is the voltage loss (which shows the amount of resistance) in the ground connections of the charging system and should be within specifications.
f. Unless otherwise specified, the voltage loss should not exceed 0.1 volt. If the D.C. Voltmeter reading is higher, find and correct the high resistance condition before proceeding to the other tests.

5-5. VOLTAGE REGULATOR GROUND CIRCUIT RESISTANCE TEST - See Figure 7.

a. Engine is still running.
b. Set the GENERATOR FIELD CONTROL to the OPEN position.
c. Disconnect the FIELD test lead from the base and connect to field terminal of voltage regulator.
d. Disconnect the VOLTS test lead from the grounded post of the battery, and connect it to the base of the voltage regulator.
e. Turn on the vehicle headlights and all the accessories. Check the grounds on accessories.
f. Rotate the GENERATOR FIELD CONTROL slowly clockwise to the DIRECT position and observe the D.C. Voltmeter for the highest reading. This reading is the voltage loss in the voltage regulator ground circuit and should be within specifications.
g. Unless otherwise specified, the D.C. Voltmeter reading should not exceed 0.1 volt and preferrably should remain at Zero.
h. If the D.C. Volts reading is high, find and correct the high resistance condition before proceeding to the other tests.
i. Turn off vehicle lights and other accessories after test.
j. Rotate GENERATOR FIELD CONTROL to OPEN position to remove load.

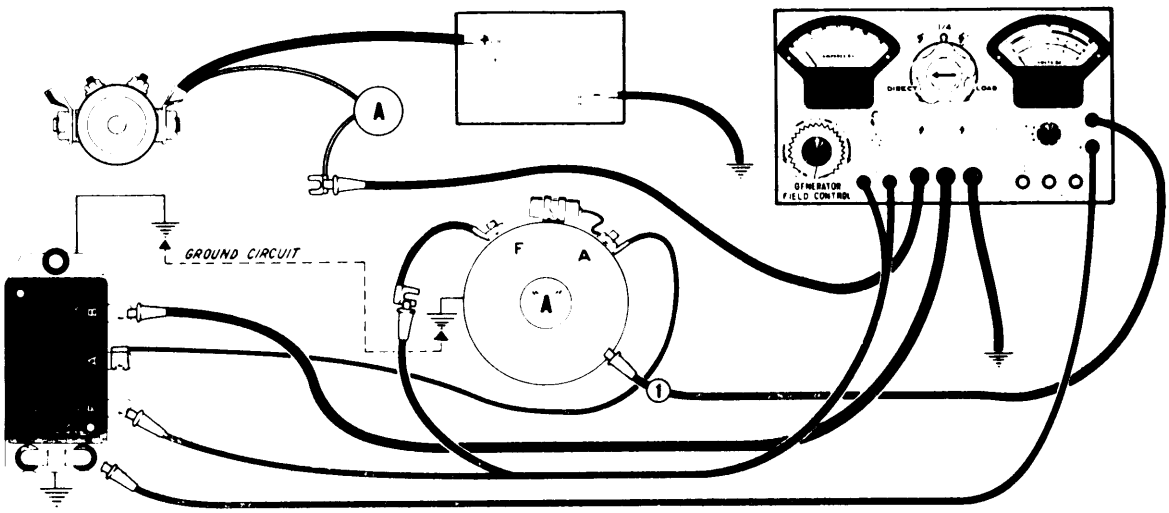


NOTE: ① For B Circuit generator, clip to armature terminal.
② Clip to generator frame.

Figure 6. Ground Circuit Resistance, Test Connections

5-6. VOLTAGE REGULATING RELAY TESTS.

There are three methods of testing the voltage regulating relay in the voltage regulator. These are: 1/4 Ω - Test, Open Circuit Test and Fixed Resistance Test. The test lead conditions for these tests are described in Paragraphs 5-8, 5-9, and 5-10. The method specified by the voltage regulator manufacturer should be used.



NOTE: ① Clip to generator frame.

Figure 7. Voltage Regulator Ground Circuit Resistance, Test Connections

5-7. SINGLE AND DOUBLE CONTACT VOLTAGE REGULATING RELAYS.

The single contact type of voltage regulating relay is installed on most automobiles. The double contact type is installed on vehicles with more accessories (air conditioning, for example) where a high current demand is required.

If the type of voltage regulating relay in the voltage regulator is not known, remove the voltage regulator cover and inspect the voltage regulating relay to determine whether it has single or double contacts.

The procedure for finding the voltage setting of the single contact type is the same for the three methods of testing. It is given in Paragraph 5-11.

The procedure for finding the voltage setting of the double contact type is the same for the three methods of testing. It is given in Paragraph 5-12.

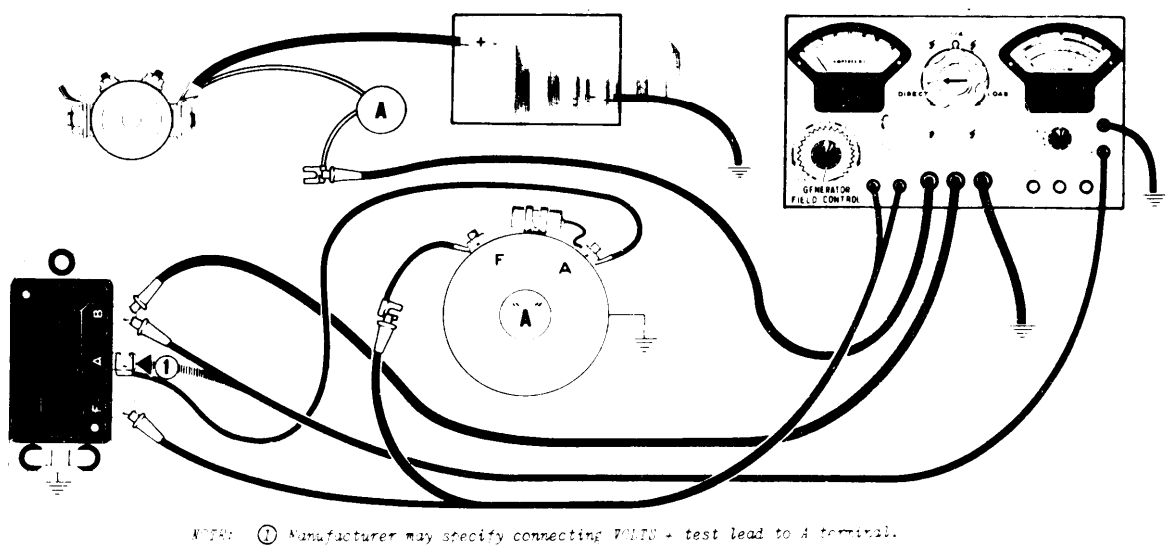


Figure 8. Test Lead Connections for ¼ Ω Test

5-8. TEST LEAD CONNECTIONS FOR ¼ Ω TEST—See Figure 8.

a. Disconnect VOLTS test lead from the base of the voltage regulator and clip to the battery terminal of the voltage regulator. If manufacturer advises connecting positive VOLTS test lead to the A terminal of voltage regulator, the reading will be approximately 0.1 volt higher.
b. Clip other VOLTS test lead to a good engine ground.
c. Set DIRECT-¼ Ω-LOAD control knob to the 1/4 Ω position,

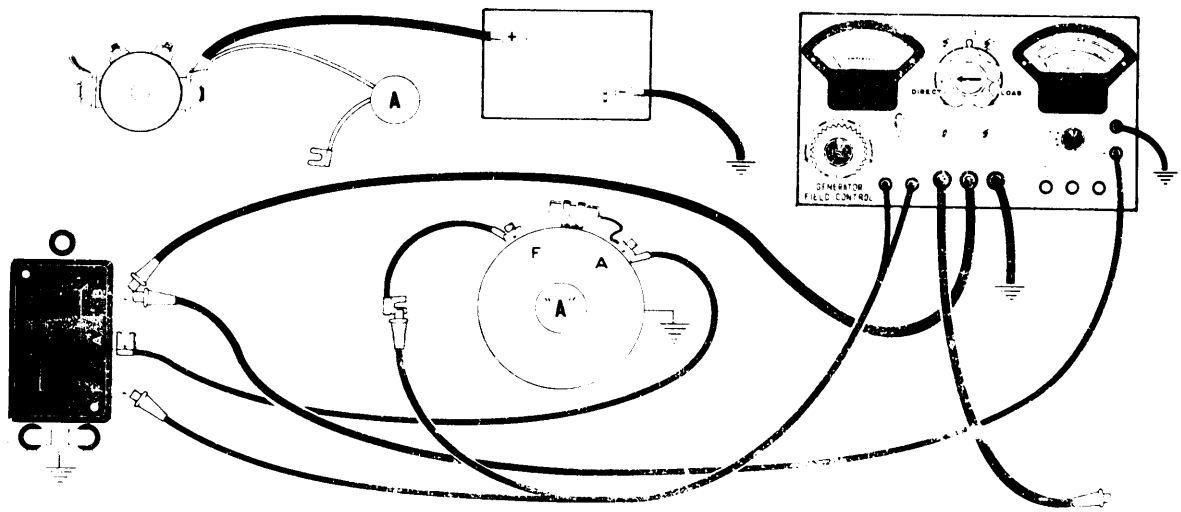


Figure 9. Test Lead Connections for Open Circuit Test

5-9. TEST LEAD CONNECTIONS FOR OPEN CIRCUIT TEST—See Figure 9.

Disconnect the BAT. test lead from the battery wire (to open the circuit) and tape or otherwise insulate the end of the battery wire. For a B Circuit generator, there is no change in the FIELD leads connections.

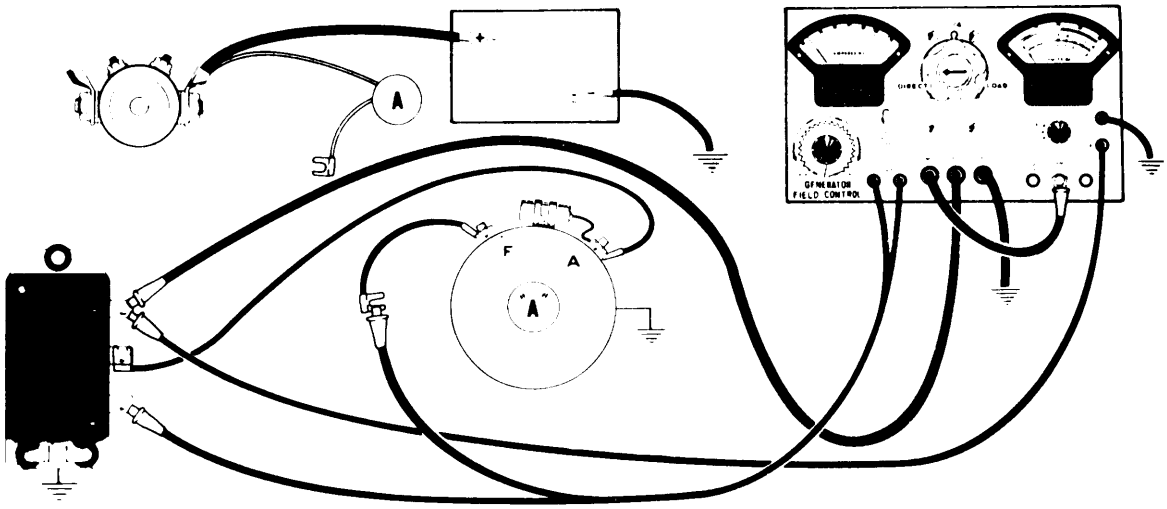


Figure 10. Test Lead Connections for Fixed Resistance Test

5-10. TEST LEAD CONNECTIONS FOR FIXED RESISTANCE TEST - See Figure 10.

a. Rotate the DIRECT-1/4 Ω LOAD control knob to DIRECT position.
b. When the equipment manufacturer recommends connecting a fixed resistance to ground in place of the vehicle battery (fully charged battery condition), attach the BAT. test lead clip to the terminal of the OHMS resistor corresponding to the resistance value specified.

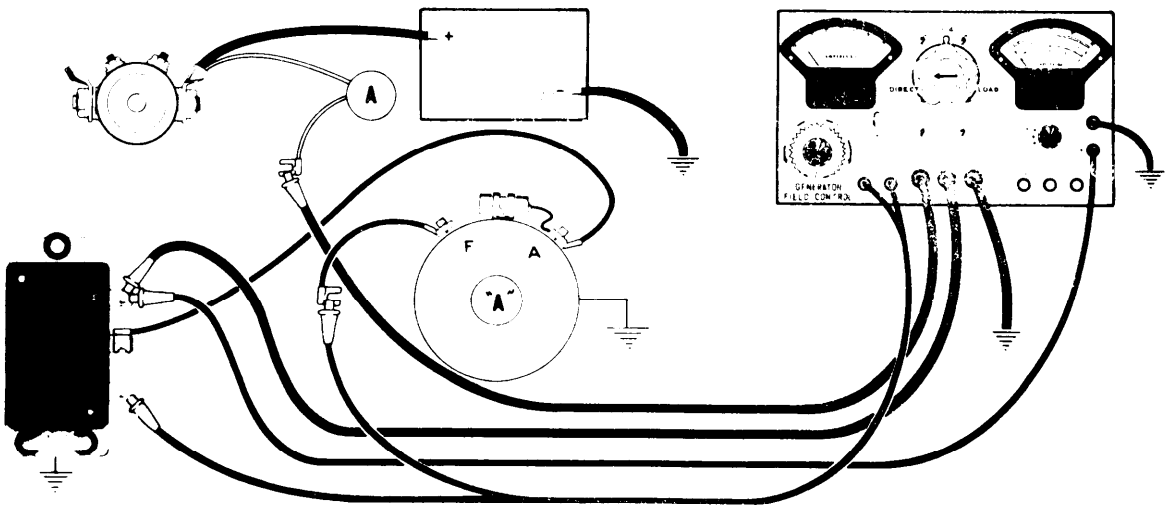


Figure 11. Test Lead Connections for Current Regulating Relay Test

5-11. TEST PROCEDURES FOR SINGLE CONTACT TYPE VOLTAGE REGULATING RELAY - See Paragraph 5-7.

a. Engine must be operating at 1500 rpm.
b. Rotate GENERATOR FIELD CONTROL clockwise to DIRECT position, then counter-clockwise to OPEN position and again clockwise to DIRECT position to "cycle" the voltage regulator.
c. Note D.C. Voltmeter reading. Reading is the voltage regulating relay setting and should be within specifications.
d. Return GENERATOR FIELD CONTROL to OPEN position to remove generator load.

5-12. TEST PROCEDURE FOR DOUBLE CONTACT TYPE VOLTAGE REGULATING RELAY-See Paragraph 5-7.

a. Operate engine at 2200 rpm.
b. Rotate GENERATOR FIELD CONTROL clockwise to DIRECT position, then counter-clockwise to OPEN position and again clockwise to DIRECT position to "cycle" the voltage regulator.
c. Note D.C. Voltmeter reading. Reading is the voltage regulating relay setting of the "shorting contacts" and should be within specifications.
d. Maintaining same engine speed, slowly rotate GENERATOR FIELD CONTROL counter-clockwise (towards OPEN position) while observing the D.C. Voltmeter. Reading should drop off slightly and then remain steady. This reading is the setting of the "series" contacts.
e. Subtract reading obtained in step d. from reading obtained in step c. The difference should be within specifications.
f. Return GENERATOR FIELD CONTROL to OPEN position to remove generator load.

5-13. CURRENT REGULATING RELAY TEST—See Figure 11.

a. Operate engine at 1500 rpm.
b. Connect BAT. test lead to the battery wire (if previously removed for performance of Open Circuit and Fixed Resistance tests).
c. Connect one VOLTS test lead to the battery terminal of the voltage regulator.
d. Connect other VOLTS test lead to engine ground.

NOTE

Be certain the VOLTS test lead connected to engine ground corresponds to the battery ground polarity.

e. For a B Circuit generator, there is no change in the FIELD leads connections.
f. Rotate the GENERATOR FIELD CONTROL clockwise to the DIRECT position.
g. Rotate the DIRECT-¼ Ω -LOAD control to the LOAD position and adjust control to obtain the highest possible D.C. Ammeter reading. This reading is the setting of the current regulating relay and should be within specifications.
h. Rotate DIRECT-¼ Ω -LOAD control counter-clockwise to DIRECT position.
i. Rotate GENERATOR FIELD CONTROL counter-clockwise to OPEN position to remove generator load.
j. Reduce engine speed to idle; stop engine and disconnect test leads.
k. Make certain all connections replaced are secure.

5-14. VARIABLE RESISTANCE.

A variable resistance of 0 to 50 ohms is available by using the FIELD leads and rotating the GENERATOR FIELD CONTROL clockwise to decrease the resistance between the test leads. The maximum current is 3 amperes.

5-15. CIRCUIT LOADING.

To load a Direct Current circuit to a maximum of 120 amperes with the carbon pile, connect the REG. and GRD. test leads to the circuit. Rotate the DIRECT-¼ Ω--LOAD control clockwise to increase the load on the circuit. Set the GROUND POLARITY Switch to the same polarity as the GRD. test lead.

5-16. VOLTAGE MEASUREMENTS.

The voltage of any Direct Current circuit not exceeding 40 volts maybe measured with the VOLTS test leads.

5-17. CURRENT MEASUREMENTS.

The current (amperes) in any Direct Current circuit up to but not exceeding 120 amperes may be measured by rotating the DIRECT-1/4 ↓Ω -LOAD control full clockwise and connecting the GRD. and REG. test leads in series in the circuit. Set the GROUND POLARITY Switch to the same polarity as the GRD. test lead

If the carbon pile is not desired in the circuit, use the BAT. and REG. test leads and turn the DIRECT -1/4 Ω - LOAD control to the DIRECT position.

SECTION VI

TEST INDICATIONS

6-1. TEST INDICATIONS.

The following Table provides information to assist an operator in evaluating the indications resulting from the tests made with the VAT-25. The Table lists the probable cause of tests which show the electrical system components are not functioning properly or are operating outside of the manufacturer's recommended specifications.

Before any test is concluded unsatisfactory, it should be repeated one or more times with the operator carefully checking the test lead connections in accordance with the related diagrams.

TEST AND INDICATIONS	PROBABLE CAUSE
GENERATOR OUTPUT TEST	
Output increases steadly as Generator Field Control is rotated to DIRECT position but levels off before DIRECT position is reached.	Generator drive belt is loose or worn.
Output is less than manufacturer's rating when Generator Field Control is in DIRECT position.	Defective armature, shorted or grounded field coils; dirty commutator, poor brush contact; loose or defective field or armature wire; burned or pitted cutout relay contacts
No output when Generator Field Control is in DIRECT position.	Defective armature, open field coil, open field or armature wire; cutout relay contacts fail to close (See Cutout Relay Test below).
CUTOUT RELAY TEST	
Cutout relay fails to close as indicated by high voltage and no current.	Voltage winding on relay open; contacts badly pitted or burned; excessive spring tension or air gap.
Closing voltage too high.	Excessive spring tension, air gap or point gap.
Closing voltage too low.	Insufficient spring tension, air gap or point gap.
Opening amperage too low.	Excessive spring tension or air gap; insufficient point gap.
INSULATED CIRCUIRER RESISTANCE TEST	
Voltage loss exceeds specified amount.	Loose or corroded connections at armature terminal of generator, armature terminal of regulator, ammeter posts, battery terminal of starter solenoid. Faulty wiring from: generator to regulator armature terminal; battery terminal of regulator to ammeter; or ammeter to starter solenoid. Burned or oxidized cutout relay contracts. Loose or corroded battery cable connections.

TEST AND INDICATIONS	PROBABLE CAUSE
GROUND CIRCUIT RESISTANCE TEST	
Voltage loss exceeds specified amount.	**Loose or corroded battery cable connections; poor electrical connection between generator and engine.**
REGUIATOR GROUND CIRCUIT RESISTANCE	
Voltage loss exceeds specified amount.	**Regulator ground tire defective or loose; poor electrical connection between regulator base and body or between body and engine.**
VOLTAGE AND CURRENT REGULATOR TESTS	
Regulator setting too high.	**Excessive spring tension or armature air gap.**
Regulator setting too low.	**Insufficient spring tension or armature air gap.**
Regulator setting erratic or unstable.	**Burned or oxidized regulator contacts; improper armature air gap; defective regulator resistor.**

APPENDIX A

BASIC ISSUE ITEM LIST

Section I. INTRODUCTION

1. General

This appendix is a list of basic issue items. It is composed of those items which make up the major end item of equipment and the operator's tools and equipment that are issued with the equipment, and are required for stockage.

2. Requisition Notes

When requisitioning a C source (local procurement) item identified only by a manufacturer's part number, it is mandatory that the following information be furnished the supply officer.

a. Manufacturer's code number (the five digit number preceding the colon in the description column).

b. Manufacturer's part number (the number and sometimes letters, following the colon (a) above). Dashes commas, or other marks must be included exactly as listed.

c. Nomenclature exactly as listed herein, including dimensions if necessary.

d. Name of manufacturer of end item (from cover of TM).

e. Federal Stock Number of end item (from cover of TM).

f. Manufacturer's model number (from TM or name/data plate) preferably name/data plate.

g. Manufacturer's serial number (from name/data plate).

h. Any other information such as type, frame number, and electrical characteristics, if applicable.

i. If DD Form 1348 (DOD Single Line Item Requisition System Document (Manual)) is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-5. Complete form as follows:

(1) In Mocks 4, 5, and 6, list manufacturer's code and manufacture's part number (as listed in the description column).

(2) In Remarks field, list noun name (repair part), end item application (FSN of end item), manufacturer, model number (end item), serial number (end item), and other pertinent information such as frame number, type, etc.

3. Explanation of Columns

a. Source, Maintenance, *and Recoverability code (Col.* 1).

(1) *Materiel code (col. 1a).* This column not required.

(2) *Source (col. 1b).* This column indicates the selection status and source for the listed item. Source code used in this list is:

Code	*Explanation*
C------	Obtain through local procurement. If not obtainable from local procurement, requisition through normal supply channels with a supporting statement of non-availability from local procurement.

(3) *Maintenance Level (col. 1c).* This column indicates the category of maintenance authorized to install the listed item. Maintenance level code used in this list is:

Code	*Explanation*
O/C----	*Operator or crew maintenance*

(4) *Recoverability (co1. 1d).* This column indicates whether unserviceable items should be returned for recovery or salvage. When no code is indi-

cated, the item will be considered expendable. Recoverability code used in this list is:

Code	*Explanation*
R------	Items which are economically repairable at direct and general support maintenance activities and are normally furnished by supply on an exchange basis.

b. Federal Stock Number (Col. 2). Self explanatory.

c. *Description (Col. 2). The* following manufacturer's code is included in this column.

Code	*Explanation*
82386---	Sun Electric Corporation, 6323 Avondale Avenue, Chicago, Illinois 60631

4. Abbreviations

Abbreviation	*Explanation*
amp	ampere(s)
h	high, height
v	volt(s)
w	wide, width
w/	with

5. Errors, Comments, and/or Suggestions

Reports by the individual user, of errors, comments and suggestions are encouraged. This should be reported on DA Form 2028 (Recommended Changes to DA Publications) and forwarded directly to the Commanding General, Headquarters, U.S. Army Weapons Command, ATTN: AMSWE-SMM-P, Rock Island Arsenal, Rock Island, Ill. 61201.

Section II. BASIC ISSUE ITEMS

(1) Source maintenance and recoverability code				(2)	(3)	(4)	(5)	(6)	
(a) Materiel code	(b) Source	(c) Maintenance level	(d) Recoverability	Federal stock No.	Description	Unit of issue	Quantity incorporated in unit	Illustration (a) Figure No.	Illustration (b) Item No.
					MAJOR COMBINATION				
					The following item is to be requisitioned for initial issue only.				
	----	----	R	4910-270-3780	TEST SET, GENERATOR AND VOLTAGE REGULATOR, AUTOMOTIVE: 6, 12, and 24 v systems, ammeter range 0 to 120 amp dc, voltmeter range 0 to 100 v dc, w/metal carrying case, 13 in. lg, 9-1/2 in. w, 7-1/4 in. h (82386:VAT-25).	EA	----	1	----
					COMPONENTS OF MAJOR COMBINATION				
					None authorized.				
					REPAIR PARTS				
					None authorized.				
					TOOLS AND EQUIPMENT FOR: TEST SET, GENERATOR AND VOLTAGE REGULATOR, AUTOMOTIVE: (82386:VAT-25).				
C	O/C	----	----	------	LEAD, TEST, BATTERY: (82386:6002-043).	EA	1	1	6
C	O/C	----	----	------	LEADS, TEST, GROUND: (82386:6002-044).	EA	1	1	4
C	O/C	----	----	------	LEAD, TEST, REGULATOR: (82386:6002-042).	EA	1	1	5
C	O/C	----	----	------	LEAD, TEST, VOLTMETER: black (82386:6002-045).	EA	1	1	3
C	O/C	----	----	------	LEAD, TEST, VOLTMETER: red (82386:6002-046).	EA	1	1	3
C	O/C	----	----	------	LEADS, TEST, FIELD: (82386:6002-026).	PR	1	1	7

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