Generator Troubleshooting Guide

GENERATOR TROUBLESHOOTING

A generator troubleshooting chart is provided to assist the serviceperson in diagnosing the cause of problems. Locate the trouble on the troubleshooting chart and investigate each of the possible causes indicated. Refer to the Generator Service Procedures section for required testing and service procedures.

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
NO AC OUTPUT VOLTAGE	1. Blow fuse or circuit breaker (if used).	1. Look for cause and repair. Then replace fuse or reset circuit breaker.
	2. Disconnected wire or lead on brushes.	2. Reconnect wire or wires.
	3. Brushes not making contact with slip rings	3. Check brush springs for free movement or brushes which may be excessively worn.
	4. Open, grounded or short circuit in field or armature winding.	4. Test for open, grounded, or shorted windings. Repair or replace as necessary.
LOW AC OUTPUT VOLTAGE	1. External short circuit on line.	1. Locate and eliminate short circuit problem.
	2. Generator overloaded.	2. Remove part of load.
	3. Shorted or grounded circuit in field or armature winding.	3. Test for open, grounded, or shorted windings. Repair or replace as necessary.
	4. Engine not running properly causing generator to slow down.	4. Refer to Engine Troubleshooting Guide.
NOISY GENERATOR	1. Defective bearing in end bell.	1. Replace bearing.
	2. Brush rig loose.	2. Retorque.
	3. Armature and field frame rubbing together.	3. Check for generator misalignment and for varnish lumps between armature and field. Repair as necessary.
	4. Raised commutator bar or high mica condition.	4. Turn commutator on lathe; undercut mica insulation.

TROUBLE	POSSIBLE CAUSE	CORRECTIVE ACTION
GENERATOR OVERHEATS	1. Generator overloaded.	1. Remove part of load.
	2. Windings and parts covered with oil or dirt.	2. Clean generator.
	3. Air intake restricted or incoming air too hot.	3. Take necessary steps to allow for proper cooling.
	4. Shorted, open or grounded circuit in armature or field windings.	4. Test for open, grounded or shorted windings. Repair or replace as necessary.

GENERATOR DISASSEMBLY

In most cases, the generator set will have to be removed from the coach (see Set Removal section) before the generator can be disassembled. However, depending on the available space, it might be possible to remove certain components such as the brush rigs without removing the set from the coach. When disassembly is necessary, proceed as specified. Figure 41 shows a typical generator parts breakdown.

1. Remove the generator fan cover and end bell wrapper.
2. Remove the generator fan, mounting nut, and lock washer.
3. Disconnect all the generator wires and load wires from the brush rigs.
4. Remove the brush rig mounting screws; and then carefully lift out the brush rigs to avoid damaging the brushes. Make note of the location of each brush rig since they must be replaced in the same location in the end bell.
5. Remove the four through bolts that hold the adapter, frame assembly, and end bell together.
6. Separate the end bell from the frame assembly by lightly tapping around the end bell with a plastic hammer. If the end bell will not separate, use two screwdrivers (placed at opposite corners and inserted between the end bell and frame) to carefully pry the end bell loose. Apply light pressure equally and evenly around the end bell to avoid distorting any components.

CAUTION ***Do not push the screwdriver into the frame assembly windings or the winding insulation may be damaged.***

7. Remove the generator load wires from the slot in the top of the frame assembly.
8. Separate the frame assembly from the generator-to-engine adapter using the same procedure covered in Step 6. Do not let the frame assembly windings drag on the armature or the insulation may be damaged.
9. To remove the armature, strike the armature on the laminations with a lead hammer. Rotate the armature after each blow. Slide the armature off the through stud when loose.

CAUTION ***The armature windings, commutator, slip rings, or bearing will be damaged if struck. Strike armature only on the laminations.***

10. Remove the armature through stud from the engine crankshaft.
11. Remove the adapter mounting screws and remove adapter from the engine.

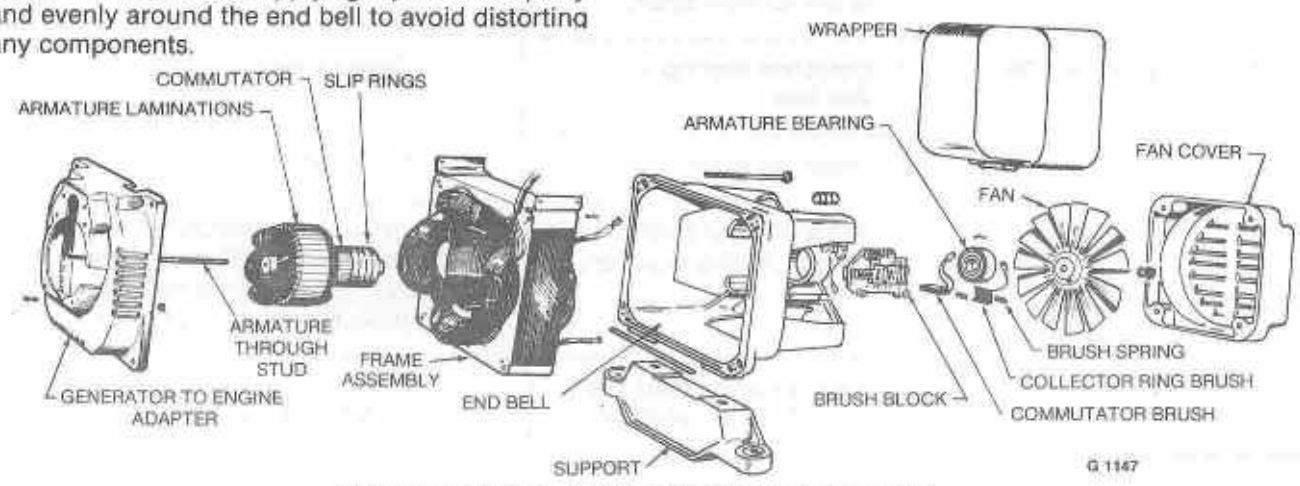


FIGURE 41. TYPICAL GENERATOR PARTS BREAKDOWN

GENERATOR SERVICE PROCEDURES

Use the following service or test procedures as specified in the troubleshooting chart.

Brush Replacement

Install new brushes when the old ones are worn to the dimensions shown. Replace brush springs if damaged or if proper tension is questionable.

1. Remove the generator end bell wrapper to expose the brushes.
2. Measure the brush wear (see Figure 42).
3. Remove the three screws holding each brush block in place.
4. Remove old brushes and clean holders so new brushes can move easily in their holders.
5. Install new brushes.

> **CAUTION** ***Always use correct Onan brush (correct number given in parts catalog). Never substitute a brush which appears to be the same, for it may have different electrical characteristics.***

6. Install brush blocks and generator end bell wrapper.

New brushes are shaped to fit and seldom need sanding to fit properly. If some brush sparking does occur, run the generator set with a light load until the brushes are properly seated.

Slip Rings and Commutator

If slip rings are grooved or pitted, remove the armature and refinish the slip rings in a lathe (see next section for procedure). If the commutator appears rough or scored, refinish it at the same time.

> **CAUTION** ***Shield the bearing during refinishing to prevent damage.***

The commutator gradually wears with use. If the proper brushes are used, and they are replaced at proper intervals, wear occurs slowly and evenly. Under dusty conditions or if the wrong brushes are used, wear occurs faster. Improper or excessive cleaning with sandpaper can cause the commutator to become grooved or out of round. If this condition exists, refinish it in a lathe (see next section for procedure).

BRUSH WEAR LIMITS

CONDITION	DC	AC
NEW	5/8" (15.8 mm)	11/16" (17.5 mm)
1/2 WEAR	13/16" (20.6 mm)	7/8" (22.2 mm)
REPLACE	1" (25.4 mm)	1-1/16" (26.9 mm)

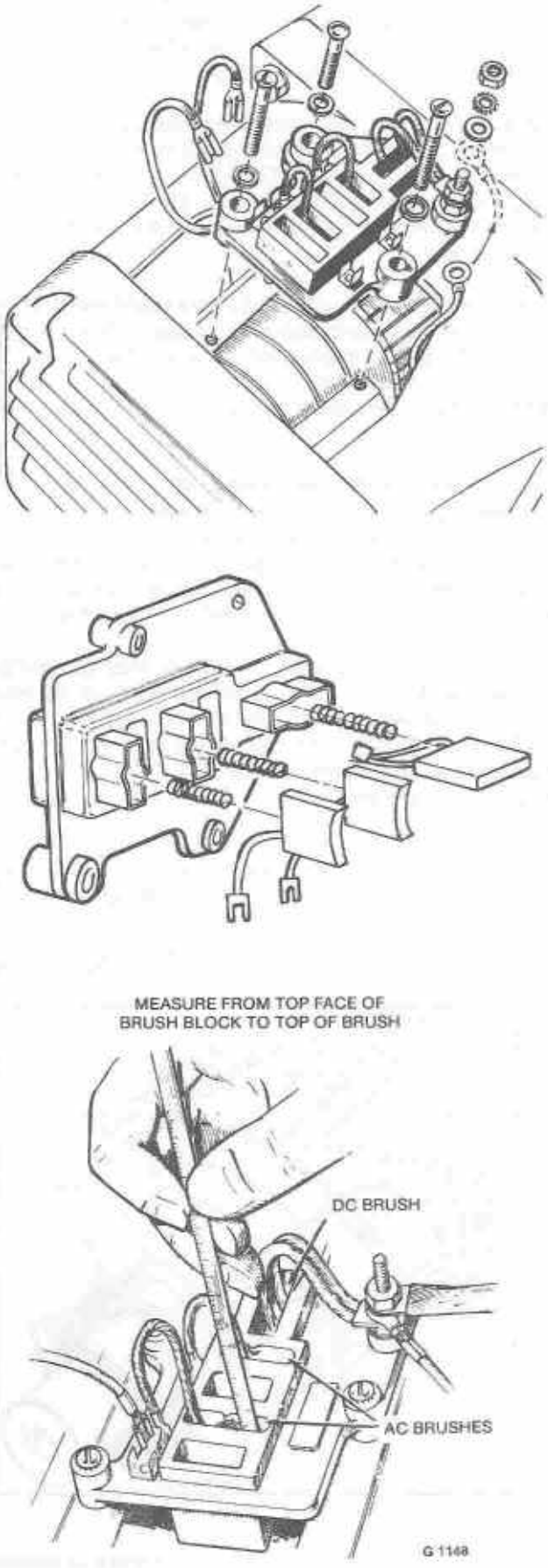


FIGURE 42. BRUSH BLOCKS

Turning Slip Rings or Commutator (Using a lathe)

When a slip ring or commutator becomes grooved or pitted, turn it true in a lathe. Any qualified lathe operator can perform this operation easily.

Remove armature and center accurately on a lathe. Turn the commutator or slip ring just enough to provide a true, concentric surface. Tool marks can be removed by using number 240 sandpaper. Do not use emery paper. The emery particles are conductive and will cause shorts.

After turning the slip rings, cut a very slight chamfer on them to remove burrs and sharp edges. This reduces the possibility of a "flash-over" between the rings. After turning the commutator, undercut the mica insulation between the commutator bars as described in the next section.

Undercutting the Mica Insulation: When the commutator wears down so that the mica insulation between any bars comes in contact with the brushes, it causes the brushes to jump, spark, operate noisily, and wear rapidly. Sparking brushes lower the efficiency of the generator and burn the commutator (Figure 43).

When a "high mica" condition exists or after commutator has been turned on a lathe, mica insulation requires undercutting. A typical tool for this is shown in Figure 43. To undercut the mica, center the cutting tool over the mica and with a firm, steady pull, draw the tool the length of the commutator.

CAUTION ***The undercutting tool can damage the slip rings if used carelessly. Be careful not to draw it across the slip rings.***

Repeat the cutting operation until the mica has been cut down to approximately 1/32 inch (0.8 mm) below the surface of the commutator. Proceed to the next section until all are equally undercut. If any burrs are present along the edges of the bars, carefully remove them. This is done by holding apiece of number 240 sandpaper against the commutator with a flat piece of wood while the commutator is turning rapidly. Before putting the armature back into service, be sure to blow or brush all mica dust, metallic particles, etc. from the commutator grooves and surface.

Testing Armature AC Windings For Continuity

Use a continuity tester (buzzer or light) or ohmmeter to test the AC armature windings for continuity. Place the test prods on the slip rings as shown in Figure 44. There should be continuity between slip rings M1-M2 and M3-M4. There should be no continuity between M2-M3.

No continuity between M1-M2 or M3-M4 indicates an open AC winding. Continuity between M2-M3 indicates a shorted AC winding. Replace the armature if either condition exists.

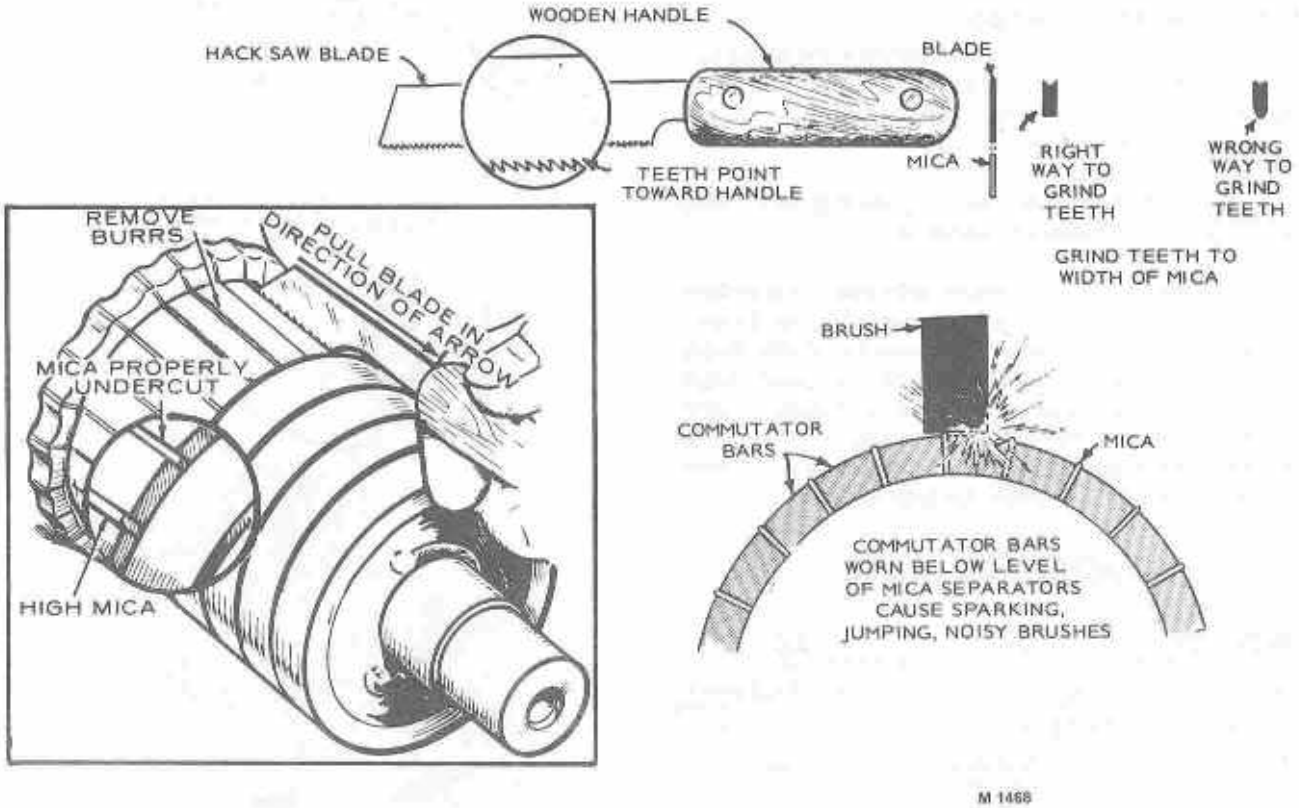


FIGURE 43. UNDERCUTTING MICA INSULATION

TABLE 5
SINGLE-PHASE ARMATURE RESISTANCES

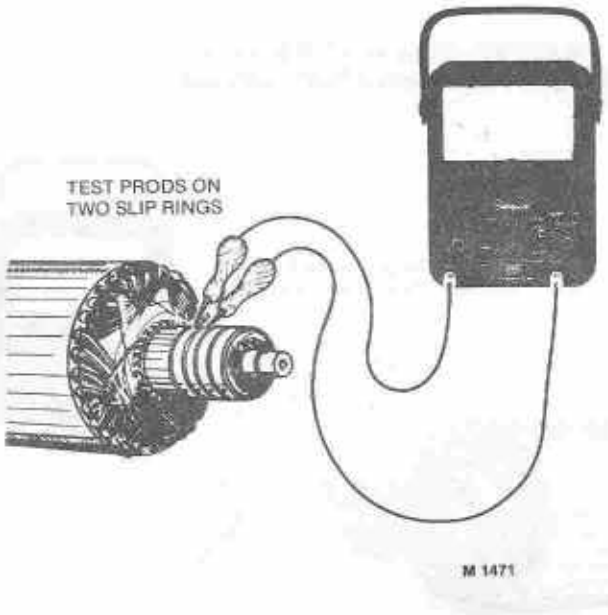
VOLTAGE	kW	*RESISTANCE
120/240	6.5	0.15 ohms
120/240	5.5	0.25 ohms
120/240	5.0	0.141 ohms
120	4.0	0.27 ohms
120/240	4.0	0.39 ohms

*Values shown are for reference only.

The resistance values for the armature AC windings are shown in Table 5. These values are too small to be measured accurately with an ohmmeter. They are only shown to indicate that the armature resistance is very small. An ohmmeter reading that shows high resistance in the AC windings indicates a defective armature.

Testing DC Armature Windings For Continuity

Use a continuity tester (buzzer or light) or ohmmeter to test the DC armature windings for continuity. Place a test prod on one of the commutator bars and hold it there. Touch the other test prod to each of the other bars, working completely around the commutator. There should be continuity between the commutator bar with the stationary test prod and all other commutator bars. If there is no continuity or high resistance when a commutator bar is tested, an open DC winding is indicated. Replace the armature.



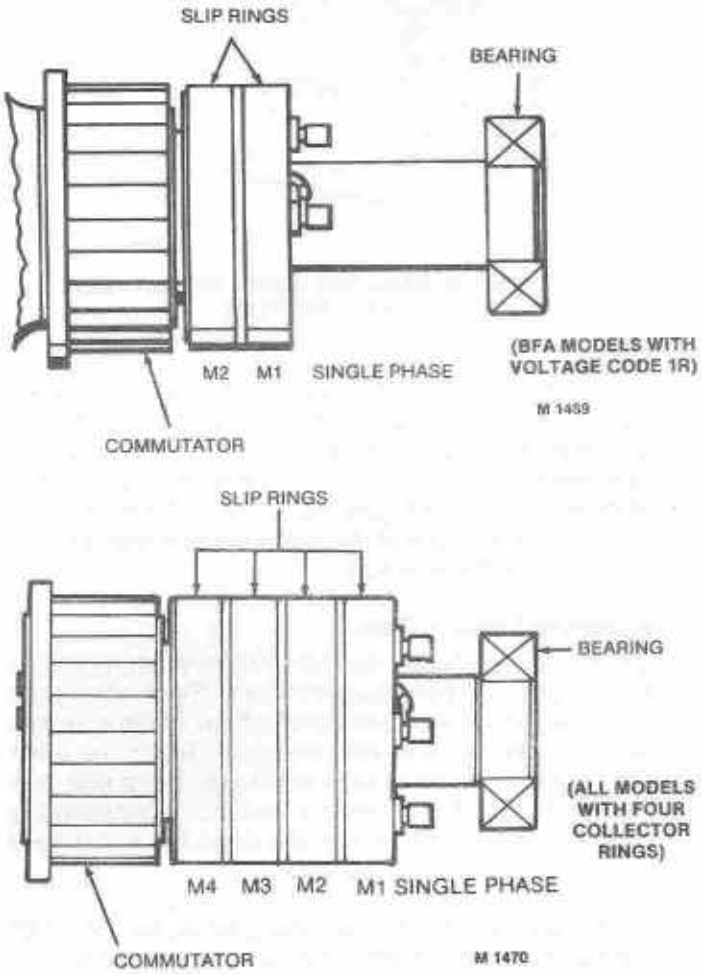


FIGURE 44. ARMATURE AC OPEN TEST

Armature Short Circuit Test

To test for a short circuit, place the armature in a growler (Figure 45). With the growler current on, hold a steel strip about 1/2 inch (13 mm) above the armature laminations. Pass the strip back and forth over the lamination. Cover as much of the lamination area as possible. If the strip vibrates when passed over the armature, a short is indicated.

After testing in one position, rotate the armature slightly in the growler and repeat the test. Continue until you complete a revolution of the armature in the growler. Replace a short circuited armature with a new one.

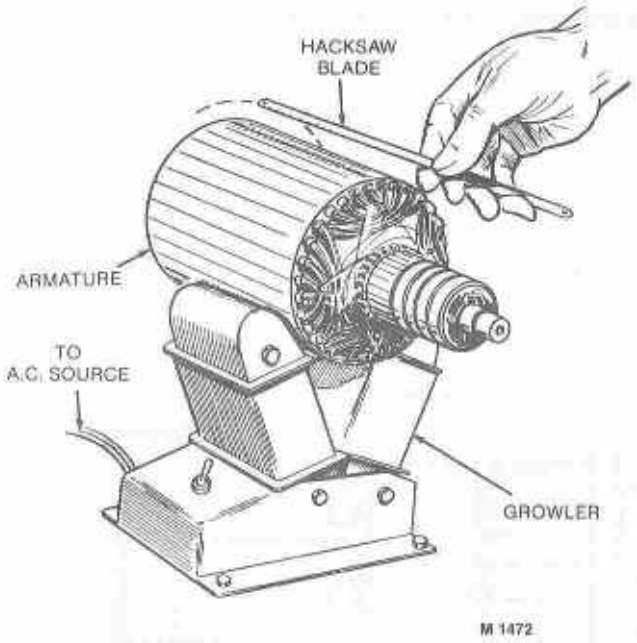


FIGURE 45. ARMATURE SHORT CIRCUIT TEST WITH GROWLER

Use a continuity tester (buzzer or light) or ohmmeter to test for a short between the AC and DC armature windings. Place a test prod on one of the commutator bars and hold it there. Touch the other test prod to each of the slip rings (see Figure 46). Continuity between the commutator and any of the slip rings indicates a short. If so, replace the armature.

Armature Ground Test

Use a continuity tester (buzzer or light) or ohmmeter to test for grounded armature windings. Place a test prod on the armature shaft and hold it there. Make sure that good contact is made with the shaft. Touch the other test prod to the commutator and to each slip ring (see Figures 47 and 48). If there is continuity between the shaft and the commutator or slip rings, the armature is grounded and must be replaced.

If available, perform this test using a megger. The high voltage potential created during megger testing will often detect an insulation breakdown that cannot be detected with a low voltage testing device.

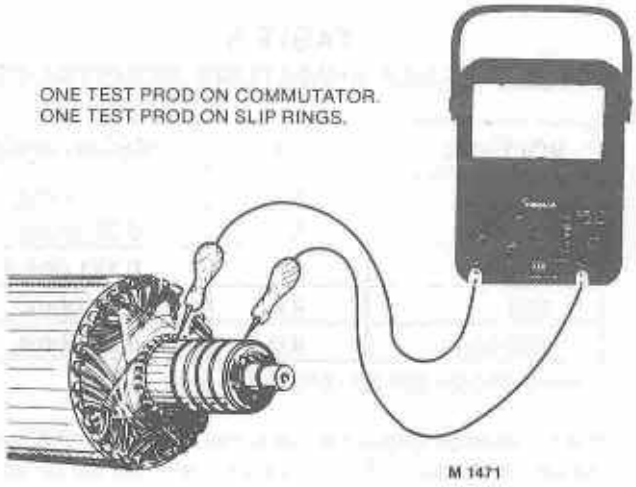


FIGURE 46. AC TO DC SHORT CIRCUIT TEST

Field Winding Voltage Test

Use a voltmeter to check the generator field voltage. Normal field voltage during no-load operation should be 27 to 33 volts DC. To connect the voltmeter, remove the wrapper from the end bell. With the generator set stopped, connect the negative (−) lead to the top commutator brush lead which goes to ground and connect the positive (+) lead to the commutator brush lead on the left. Start the generator set and note DC field voltage. Stop the generator set, remove the voltmeter lead from the brush on the left side and connect it to the other commutator brush lead on the right side. Restart generator set and again check DC voltage. Stop generator set when finished.

If the voltage is not within the normal range, perform a field ground test and a field open test.

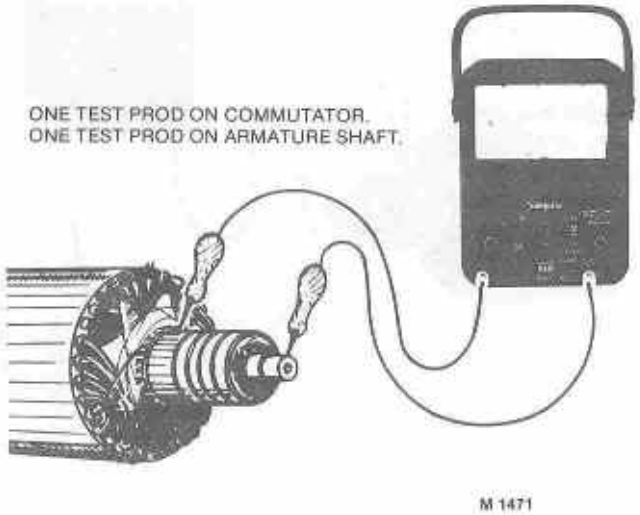


FIGURE 47. ARMATURE DC GROUND TEST

Field Ground Tests

The following test can be performed without disassembling the generator. Disconnect the field coil leads from their terminal points on brush blocks and disconnect S1 terminal from the start solenoid.

Use a continuity tester (buzzer or light) or ohmmeter to test for grounded field windings. Place a test prod on a clean, paint-free, part of the frame. Make sure that good contact is made with the frame. Touch the other test prod to stator leads S1, S2, F1, and F2 (see Figure 49). If there is continuity between the frame and any of the stator leads, the field winding is grounded. If the problem is an external lead between coils or a coil lead, repair as required. If the problem lies within a coil, the complete stator assembly must be replaced.

If available, perform this test using a megger. The high voltage potential created during megger testing will often detect an insulation breakdown that cannot be detected with a low voltage testing device.

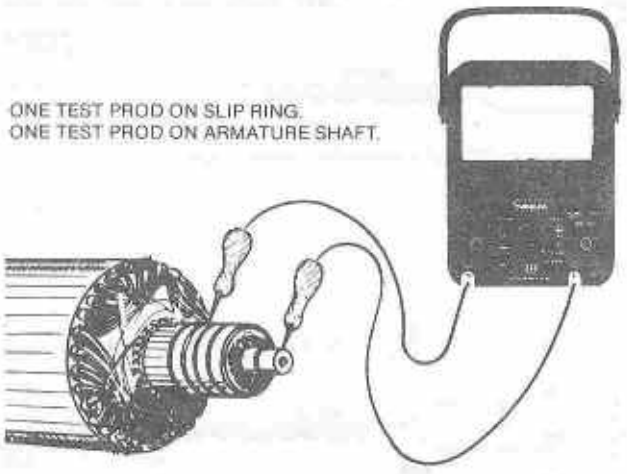


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FIGURE 48. ARMATURE AC GROUND TEST

Field Open Tests

The following test can be performed without disassembling the generator. Disconnect the field coil leads from their terminal points on brush blocks and disconnect S1 terminal from the start solenoid.

Use a continuity tester (buzzer or light) or ohmmeter to test the stator field windings for an open circuit. Test for continuity between stator leads S1-F2, S1-S2, and S1-S3. No continuity indicates an open field winding. If the problem is an external lead between coils or a coil lead, repair as required. If the problem lies within a coil, replace the complete stator assembly.

The resistance values for the stator windings are shown in Table 6. Most of these values are too small to be measured accurately with a standard ohmmeter. The stator windings can be checked with a Wheatstone bridge or a digital meter capable of making milliohm (one-thousandth of an ohm) resistance measurements. A high resistance reading of the stator windings would indicate that the stator is defective.

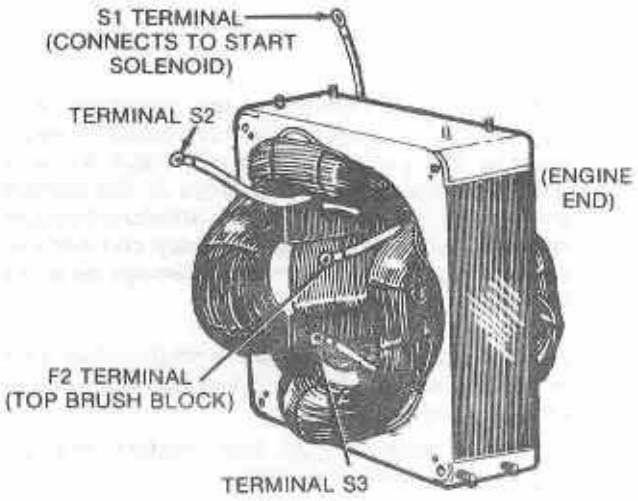

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FIGURE 49. STATOR ASSEMBLY

TABLE 6. STATOR WINDING RESISTANCES*

GENERATOR SET	SHUNT WINDING	SERIES WINDING
BF	1.82	0.019
BFA	1.62	0.019
BGA	1.48	0.014
NH	0.93	0.011

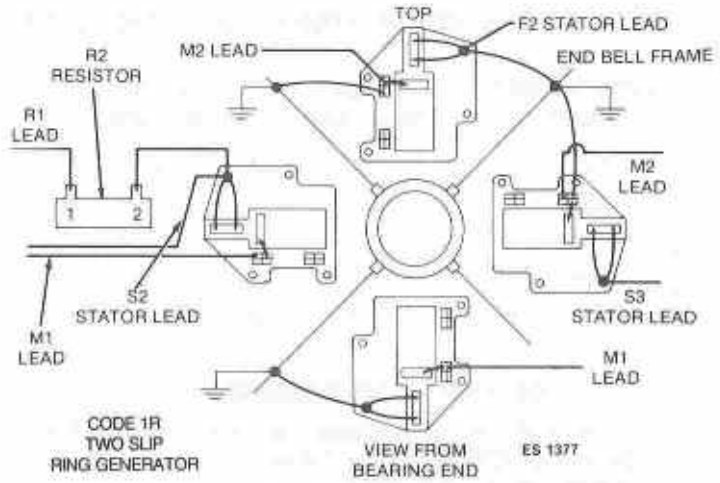
*Values in ohms are ±7% at 77°F (25°C).

GENERATOR ASSEMBLY

1. Inspect all mating surfaces before assembling the generator. Clean off any dirt and file flat any nicks that could cause misalignment.
2. Install the generator adapter to the engine and tighten securely.
3. Install the armature through-stud in the engine crankshaft.
4. Slide the armature over the through-stud and into position against the crankshaft.
5. Install the frame assembly, being careful not to drag the field windings on the armature. Make sure the stator leads are oriented as shown in Figure 49.
6. Coat the bearing bore in the end bell with a light layer of molykote grease. Position the load leads between the frame assembly and end bell; then install the end bell. Note that the tab on the bearing must be aligned with the slot in the bearing bore.
7. Install the four generator through-bolts, locking washers, and nuts; and tighten to specified torque. Note that no lock washer is used on the bolt for the upper left side of the end bell (viewed from bearing end).

CAUTION ***Tightening the armature thru-stud too soon can cause misalignment of the armature. This can result in noisy generator operation and damage to the bearing and brushes. Do NOT tighten the armature through-stud-nut before the frame assembly and end bell are mounted and the generator through-bolts are tightened.***

8. Install the brush rigs in the same position they were in prior to removal; then connect the lead wires as shown in Figure 50.
9. Install the generator fan, lock washer, and nut. Tighten to the specified torque.
10. Install the fan cover and end bell wrapper.



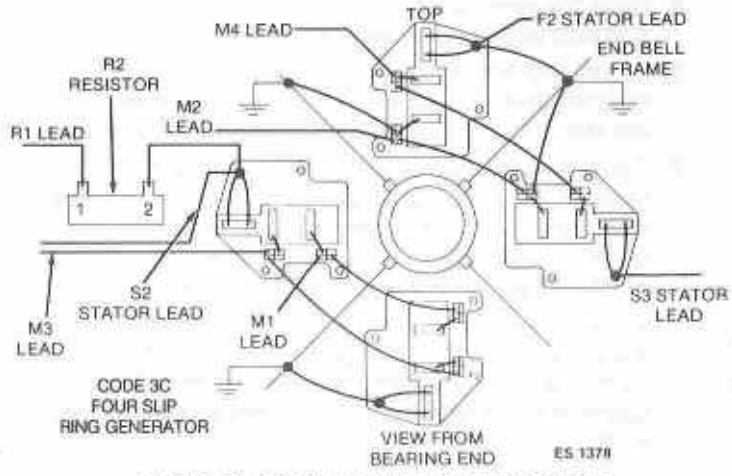


FIGURE 50. BRUSH RIG LEAD CONNECTIONS

LOAD WIRE CONNECTIONS

Single phase voltage code 3C generators may be connected for 120 volt or 120/240 volt service (see Figure 51). Use the connection for 120 volt, two wire service when one load exceeds one-half the rated capacity. Overloading can damage the generator windings. When two circuits are used, divide the load equally between them.

Single phase voltage code 1R generators should be connected as shown in Figure 52.

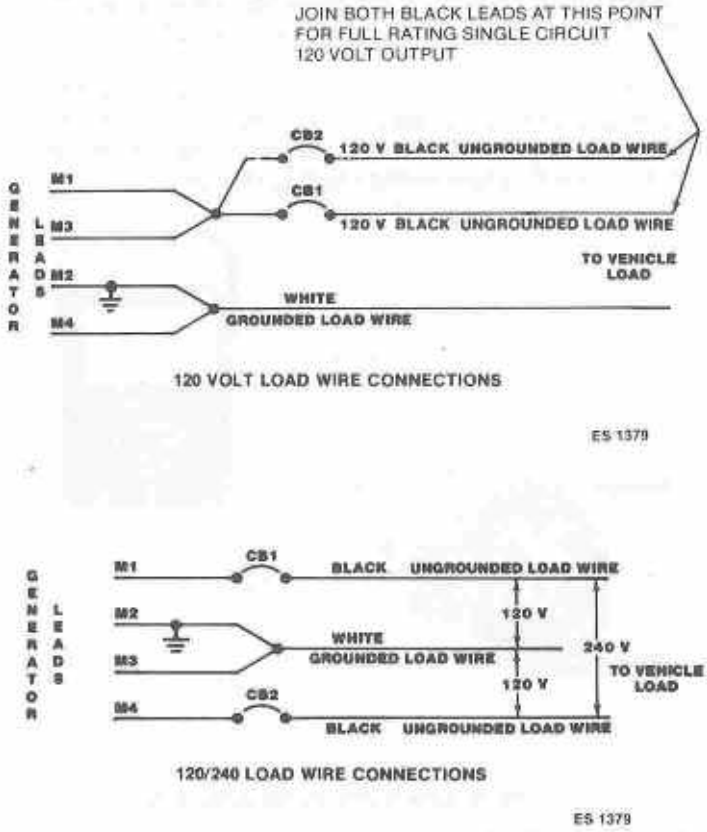


FIGURE 51. SINGLE-PHASE, "-3C" VOLTAGE CODE GENERATOR CONNECTIONS

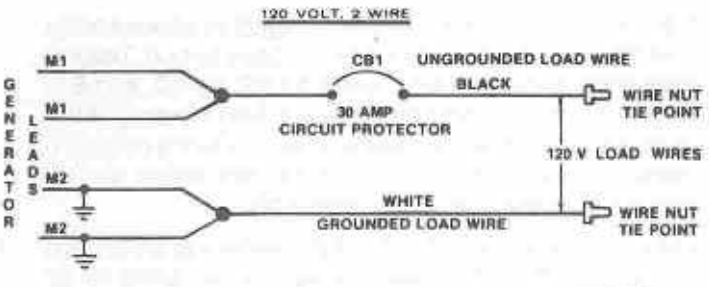


FIGURE 52. SINGLE-PHASE "1R" VOLTAGE CODE GENERATOR CONNECTIONS