

“ON-MOTORCYCLE” TESTS

Starter Relay Test

1. See [Figure 5-6](#). Locate starter relay. The relay is attached to the relay block underneath the seat.
2. To test relay, proceed to Step 3. If installing a **new** starter relay, remove old relay. Install **new** relay into relay block.
3. See [Figure 5-7](#). Obtain a 12 volt battery and a continuity tester or ohmmeter.
 - a. Pull relay from relay block.
 - b. Connect positive battery lead to the 86 terminal.
 - c. Connect negative battery lead to the 85 terminal to energize relay.
 - d. Check for continuity between the 30 and 87 terminals. A good relay shows continuity (continuity tester lamp “on” or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.
4. If starter relay is functioning properly, proceed to [STARTER CURRENT DRAW TEST](#).

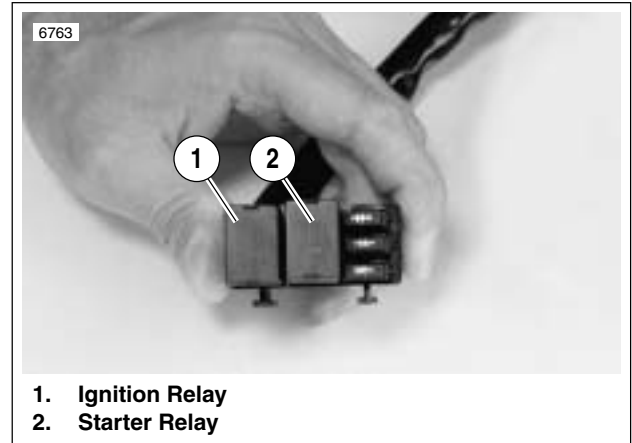


Figure 5-6. Starter Relay Block

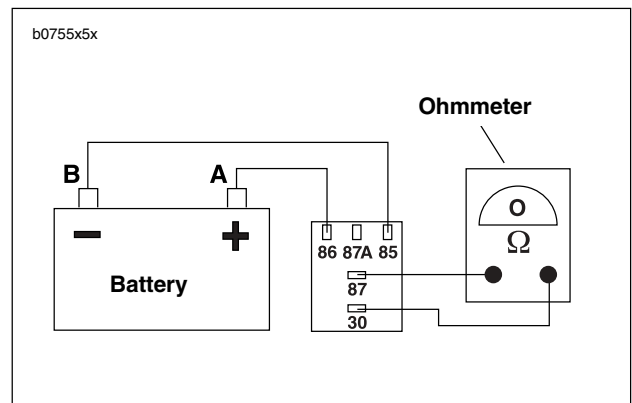


Figure 5-7. Starter Relay Test

Starter Current Draw Test

NOTE

- Engine temperature should be stable and at room temperature.
- Battery should be fully charged.

See [Figure 5-8](#). Check starter current draw with an induction ammeter before disconnecting battery. Proceed as follows:

1. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.
2. Clamp induction ammeter over positive battery cable next to starter.
3. With ignition key switch ON, turn engine over by pressing starter switch while taking a reading on the ammeter.

Disregard initial high current reading which is normal when engine is first turned over.

- a. Typical starter current draw will range between 140-180 amperes.
- b. If starter current draw exceeds 180 amperes, then the problem may be in the starter or starter drive. Remove starter for further tests. See [5.7 STARTER](#).

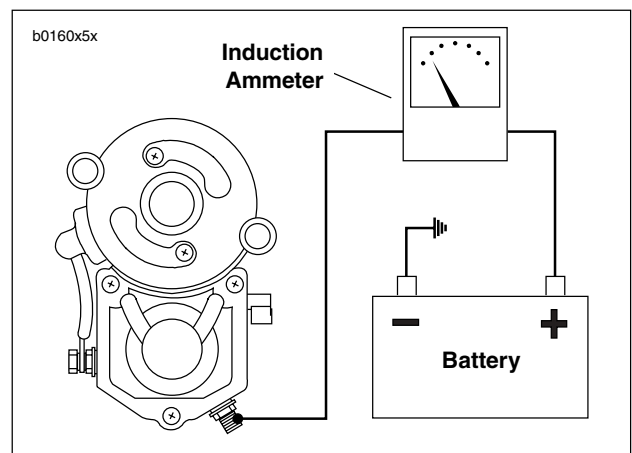


Figure 5-8. Starter Draw Test

REMOVAL

WARNING

To protect against accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

WARNING

Always disconnect the negative battery cable first. If the positive battery cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion which could result in death or serious injury.

1. Remove primary cover. See [PRIMARY COVER](#) under [6.2 PRIMARY CHAIN](#).
2. See [Figure 5-9](#). Remove both starter mounting bolts and washers (1).

NOTE

A ball hex driver may be required to gain access to the starter mounting bolts.

3. See [Figure 5-10](#). Remove nut with washer (1) (metric).
 - a. Remove protective boot if present.
 - b. Remove positive battery cable ring terminal (2).
 - c. Remove circuit breaker wire ring terminal (3).
 - d. Detach solenoid wire (4).
4. Remove starter and gasket from the gearcase cover side.

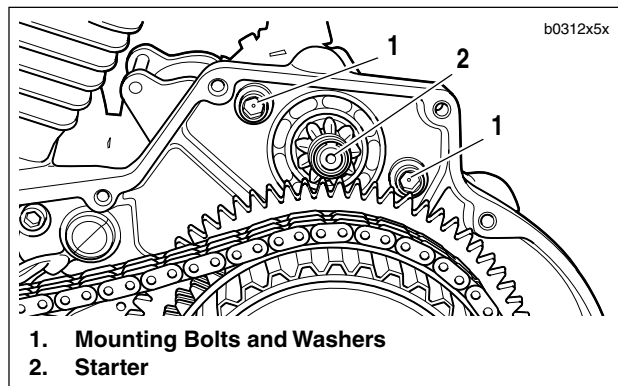


Figure 5-9. Starter Mounting

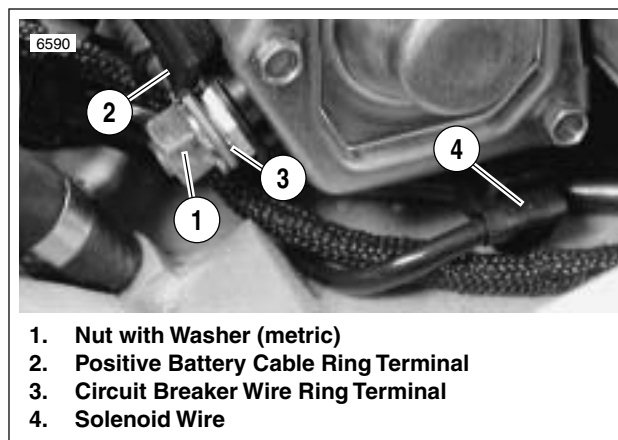


Figure 5-10. Starter Wires (Protective Boot Not Shown)

TESTING ASSEMBLED STARTER

Free Running Current Draw Test

1. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. See [Figure 5-11](#). Attach one heavy jumper cable (6 gauge minimum).
 - a. To the starter mounting flange (1).
 - b. To the negative (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
 - a. To the positive (+) terminal of the battery (2).
 - b. To an inductive ammeter (3). Continue on to the battery terminal (4) on the starter solenoid.
4. Connect a smaller jumper cable (14 gauge minimum).
 - a. To the positive (+) terminal of the battery (2).
 - b. To the solenoid relay terminal (5).
5. Check ammeter reading.
 - a. Ammeter should show 90 amps maximum.
 - b. If reading is higher, disassemble starter for inspection. See [5.7 STARTER](#).

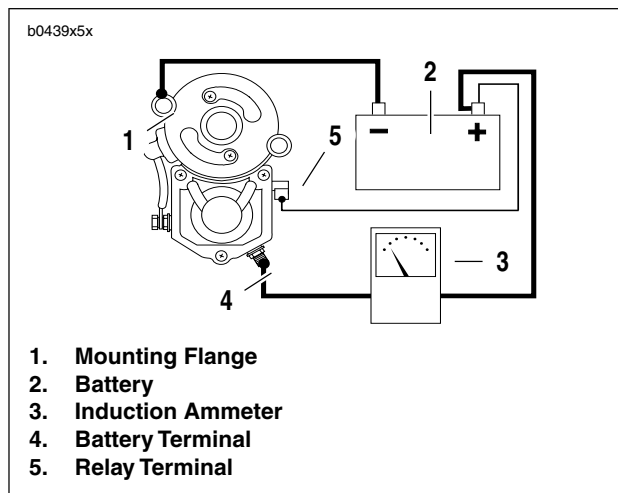


Figure 5-11. Free Running Current Draw Test

- c. If starter current draw on vehicle was over 200 amps and this test was within specification, there may be a problem with engine or primary drive.

Starter Solenoid

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in [Figure 5-12](#).

CAUTION

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

NOTE

The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. Conduct all three tests one after the other in the sequence given without interruption.

Solenoid Pull-in Test

1. See [Figure 5-12](#). Using a 12 volt battery, connect three separate test leads as follows:
 - a. Solenoid housing to negative battery post.
 - b. Solenoid motor terminal to negative battery post.
 - c. Solenoid relay terminal to positive battery post.
2. Observe starter pinion.
 - a. If starter pinion pulls in strongly, solenoid is working properly.
 - b. If starter pinion does not pull in, replace the solenoid.

Solenoid Hold-in Test

1. See [Figure 5-13](#). With test leads still connected in the manner specified in the previous [SOLENOID PULL-IN TEST](#), disconnect solenoid motor terminal/battery negative test lead (B) at negative battery post only; reconnect loose end of this test lead to positive battery post instead.
2. Observe starter pinion.
 - a. If starter pinion remains in pull-in position, solenoid is working properly.
 - b. If starter pinion does not remain in pull-in position, replace the solenoid.

Solenoid Return Test

1. See [Figure 5-14](#). With test leads still connected in the manner specified at the end of the previous [SOLENOID HOLD-IN TEST](#), disconnect solenoid relay terminal/positive battery post test lead (C) at either end.
2. Observe starter pinion.
 - a. If starter pinion returns to its original position, solenoid is working properly.
 - b. If starter pinion does not return to its original position, replace the solenoid.

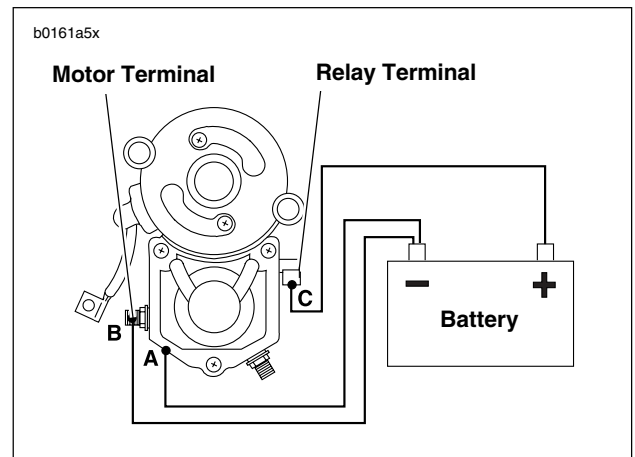


Figure 5-12. Pull-In Test

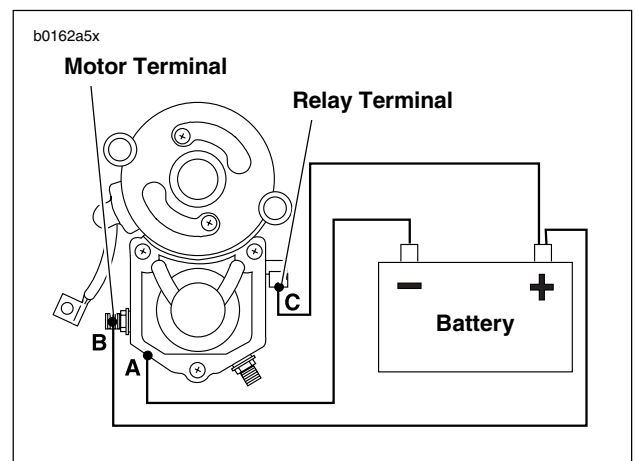


Figure 5-13. Hold-In Test

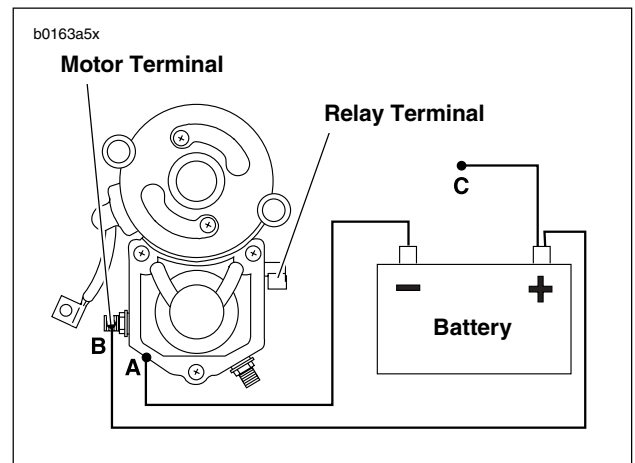


Figure 5-14. Return Test

DISASSEMBLY, INSPECTION AND REPAIR

1. See [Figure 5-15](#). Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).
2. See [Figure 5-16](#). Remove both thru-bolts (1, 3).
3. Remove both end cover screws with O-rings (2) and end cover (4).
4. See [Figure 5-17](#). Use a wire hook to pull upward on brush springs (3), and lift brushes out of holder (2). Remove brush holder.
5. Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm).

NOTE

Brushes not available separately. Purchase a **new** field frame (1) and brush holder (2) to replace brushes.

6. Remove armature (4) and field frame (1).
7. Place armature in lathe or truing stand and check commutator runout and diameter.
 - a. Commutators with more than 0.016 in. (0.406 mm) of runout should be replaced or machined on a lathe.
 - b. Replace commutators when diameter is less than 1.141 in. (28.981 mm)
 - c. Check armature bearings. Replace if necessary.

CAUTION

Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.

8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.203 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.794 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.

NOTE

See [Figure 5-18](#). If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.

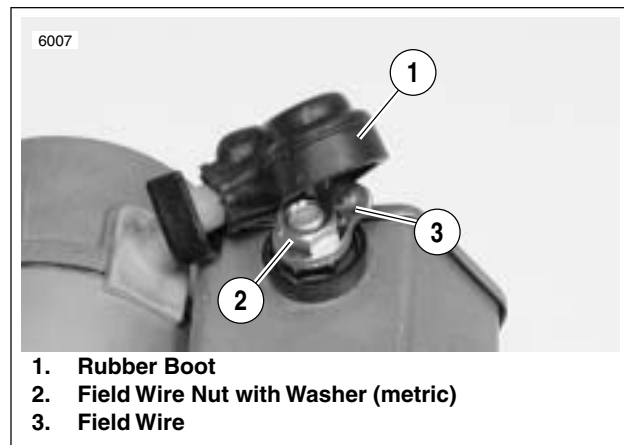


Figure 5-15. Field Wire

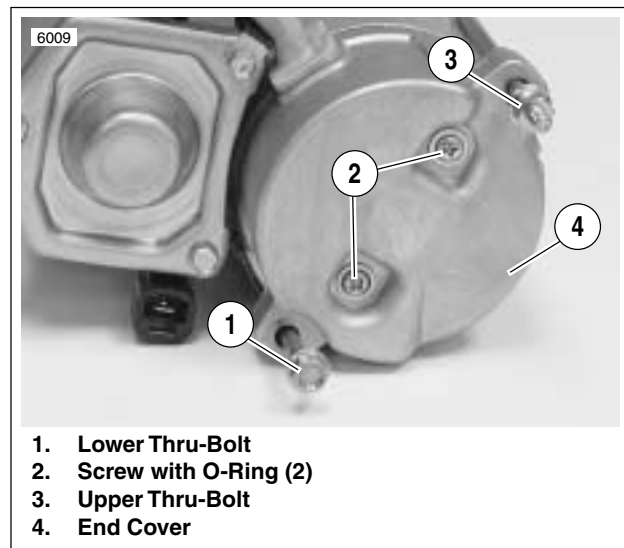


Figure 5-16. Removing the Thru-Bolts

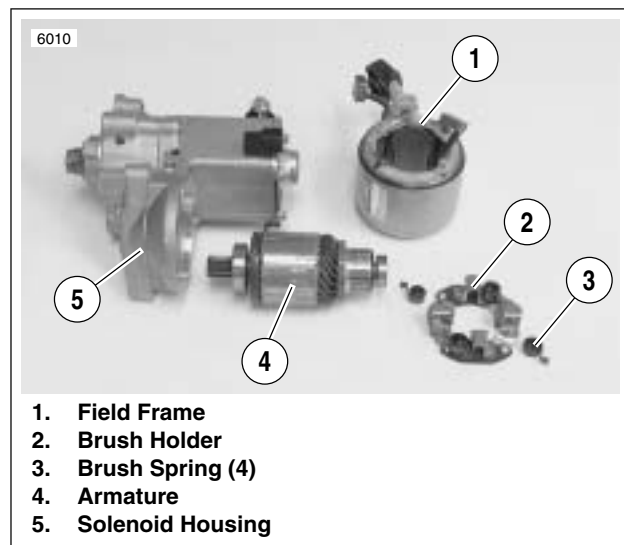


Figure 5-17. Starter Components

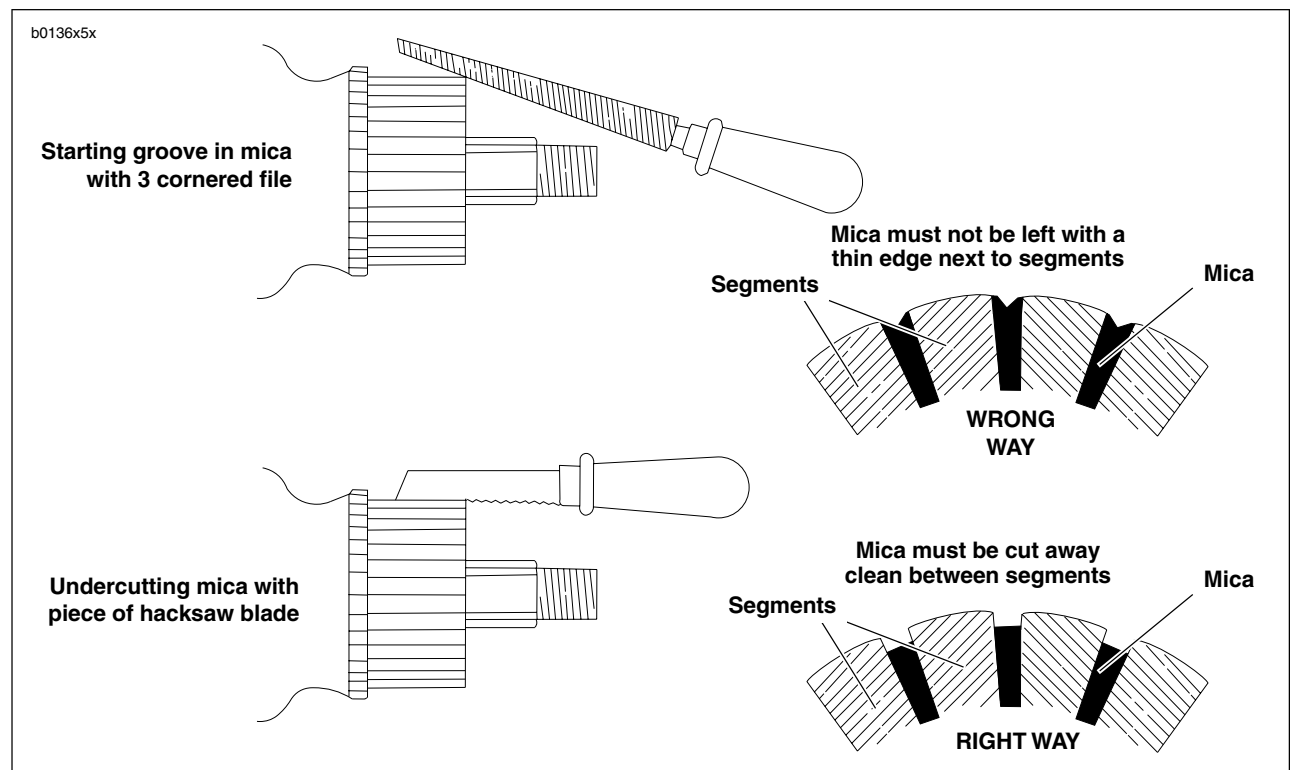


Figure 5-18. Undercutting Mica Separators

9. See [Figure 5-19](#). Check for SHORTED ARMATURE with a growler.
 - a. Place armature on growler (1).
 - b. Hold a thin steel strip (2) (hacksaw blade) against armature core and slowly turn armature.
 - c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace shorted armatures.
10. See [Figure 5-20](#). Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
 - a. Touch one probe to any commutator segment (1).
 - b. Touch the other probe to the armature core (2).
 - c. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace grounded armatures.

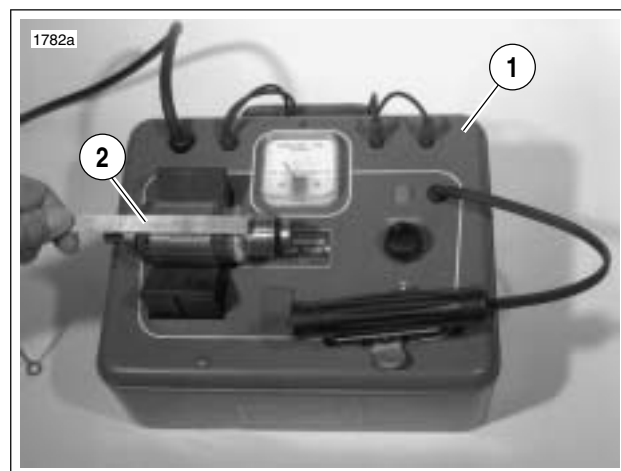


Figure 5-19. Shorted Armature Test Using Growler

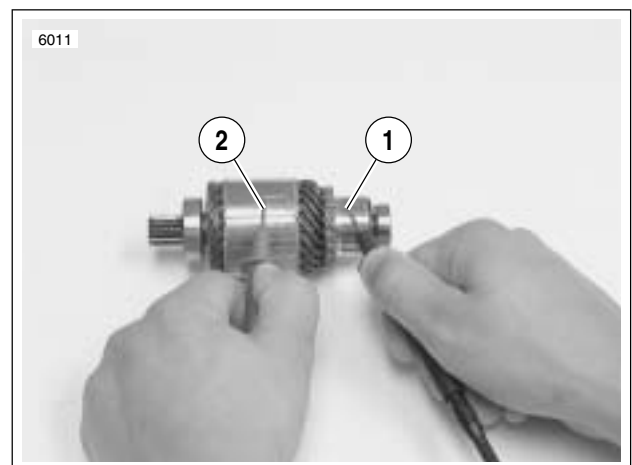


Figure 5-20. Grounded Armature Test

11. See [Figure 5-21](#). Check for OPEN ARMATURE with an ohmmeter or continuity tester.

- a. Check for continuity between all commutator segments (1).
- b. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.

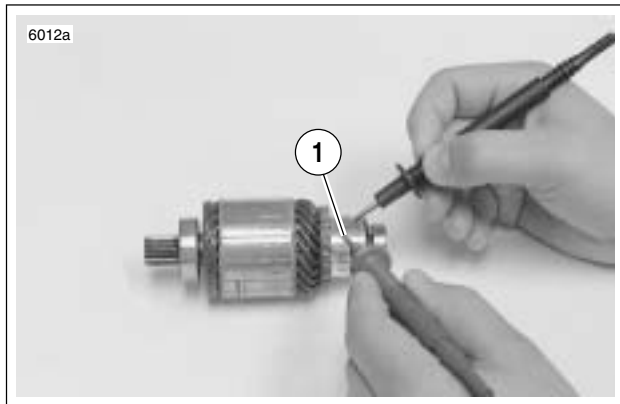


Figure 5-21. Open Armature Test

12. See [Figure 5-22](#). Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester.

- a. Touch one probe to the frame (1).
- b. Touch the other probe to each of the brushes (2) attached to the field coil.
- c. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field coil(s) are grounded and the field frame must be replaced.

13. See [Figure 5-23](#). Check for OPEN FIELD COILS with an ohmmeter or continuity tester.

- a. Touch one probe to the field wire (1).
- b. Touch the other probe to each of the brushes attached to the field coil(s) (2).
- c. There should be continuity (0 ohms). If there is no continuity at either brush, then the field coil(s) are open and the field frame must be replaced.

14. See [Figure 5-24](#). Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.

- a. Touch one probe to holder plate (1).
- b. Touch the other probe to each of the positive (insulated) brush holders (2).
- c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.

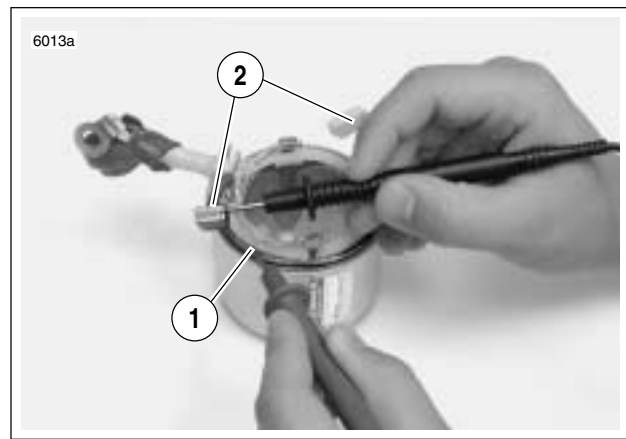


Figure 5-22. Grounded Field Test

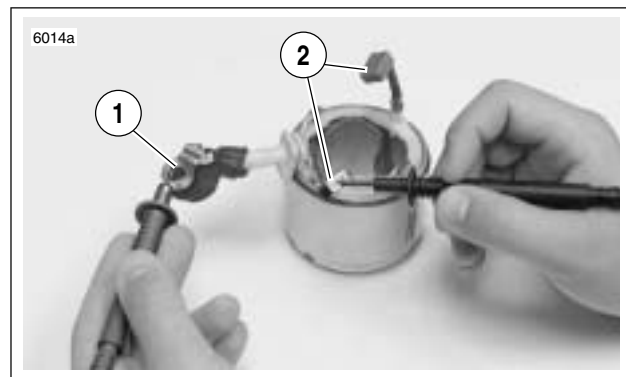


Figure 5-23. Open Field Test

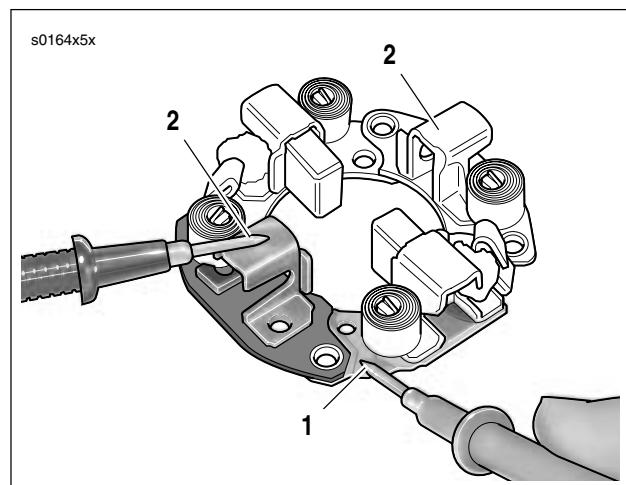


Figure 5-24. Brush Holder Insulation Test

15. See [Figure 5-25](#). Remove two drive housing mounting screws (6). Remove drive housing (5) from solenoid housing.
16. Remove drive (1), idler gear (2), idler gear bearing (3), and O-ring (4) from drive housing (O-ring is located in drive housing groove).

ASSEMBLY

1. See [Figure 5-25](#). Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.
2. See [Figure 5-26](#). When installing drive assembly components, open end of idler bearing cage (15) faces toward solenoid.
3. When installing drive housing (10) to solenoid housing (11), use **new** O-ring (16). Be sure to install return spring (17) and ball (18).

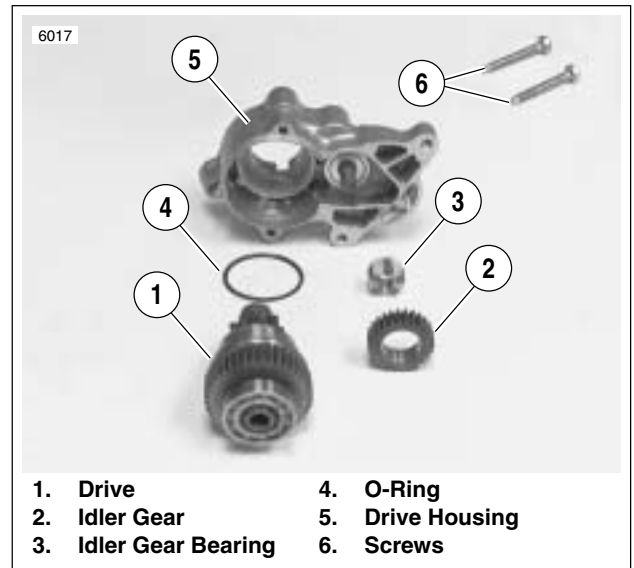


Figure 5-25. Starter Drive Assembly

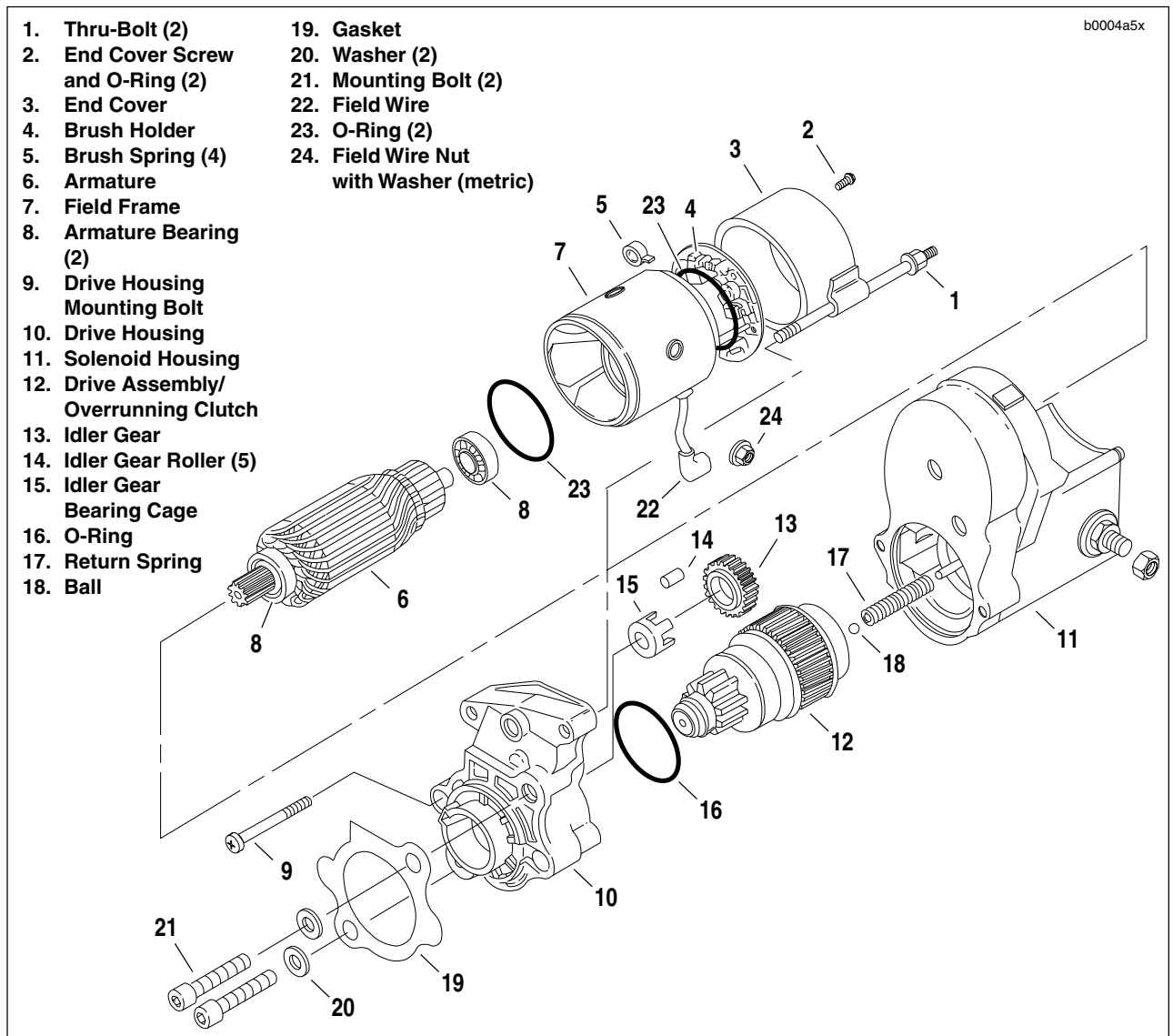


Figure 5-26. Starter Assembly

4. Lubricate armature bearings (8) with high temperature grease, such as LUBRIPLATE 110. Install armature (6) and field frame (7) to solenoid housing (11).
5. Install brushes and brush holder (4).
6. Install O-rings (23). Attach end cover (3) with end cover screws and O-rings (2).
7. Install thru-bolts (1).
8. Attach field wire (22) to solenoid housing (11) with field wire nut and washer (24) (metric). Replace rubber boot.

INSTALLATION

1. Install starter and starter gasket from the gearcase cover side.
2. See [Figure 5-10](#). Connect wiring to starter.
 - a. Connect solenoid wire (4).
 - b. Attach circuit breaker wire ring terminal (3).
 - c. Attach positive battery cable ring terminal (2).
 - d. Install nut with washer (1) (metric). Tighten to 60-85 **in-lbs** (7-10 Nm).
 - e. Replace protective boot if present.
3. See [Figure 5-9](#). Install both starter mounting bolts and washers. Tighten to 13-20 ft-lbs (18-27 Nm).
4. Install primary cover. See [PRIMARY COVER](#) under [6.2 PRIMARY CHAIN](#).
5. Fill transmission to proper level with fresh lubricant. See [1.10 CLUTCH](#).
6. Connect battery cables, positive cable first. Tighten terminal hardware to 60-96 **in-lbs** (7-11 Nm).

WARNING

Always connect positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks could cause a battery explosion which could result in death or serious injury.

GENERAL

CAUTION

See [Figure 5-27](#). Do not tighten nut (7) without removing items 1-5. Movement will cause damage to the contact.

The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See [Figure 5-27](#). Remove screws (1) and clip (2).
2. Remove cover (3) and gasket (4). Discard gasket.
3. Remove plunger (5) from solenoid housing (6).

ASSEMBLY

1. See [Figure 5-27](#). Replace wire connection hardware as necessary.
2. Install plunger (5) in solenoid housing (6).
3. Install **new** gasket (4) onto cover (3).
4. Position cover with gasket onto solenoid housing. Install clip (2) and screws (1).

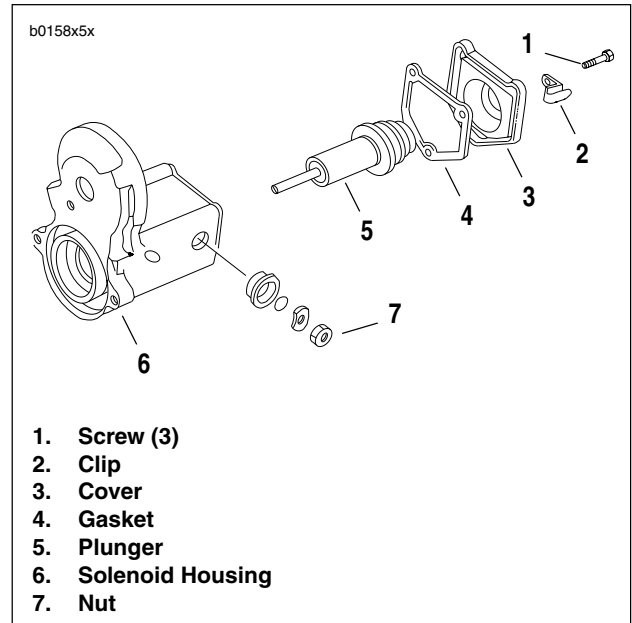


Figure 5-27. Starter Solenoid

NOTES
