

## “ON-MOTORCYCLE” TESTS

### Starter Relay Test

#### NOTE

Starter relay test also applies to ignition and key switch relays.

1. See Figure 5-5. Locate starter relay. The relay is attached to the relay block left of instrument console.
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 5-6. 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**.

### Starter Current Draw Test

#### NOTES

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

See Figure 5-7. 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**.

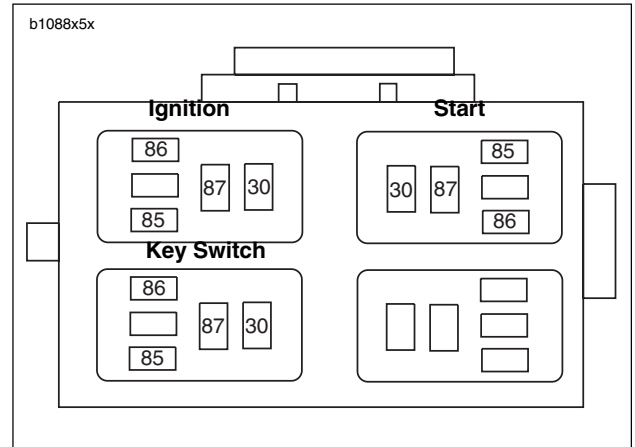


Figure 5-5. Relay Block (top view)

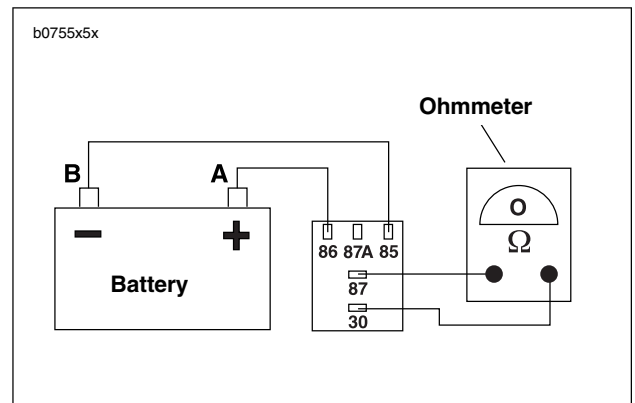


Figure 5-6. Starter Relay Test

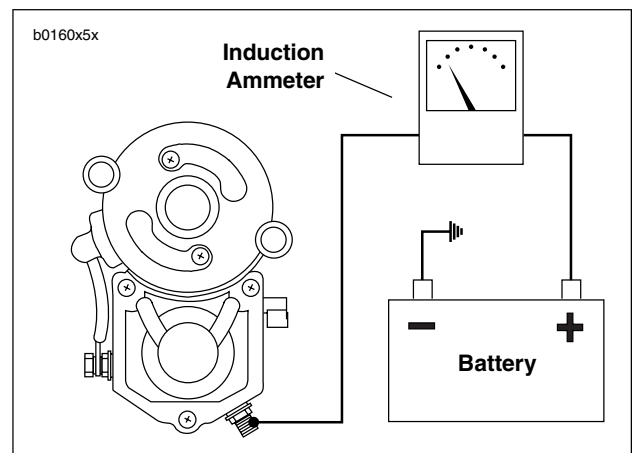


Figure 5-7. Starter Draw Test

## REMOVAL

1. Remove seat. See [2.38 SEAT](#).

**⚠ WARNING**

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

2. Disconnect battery. See [1.5 BATTERY MAINTENANCE](#).
3. Remove primary cover. See [REMOVAL](#) under [6.2 PRIMARY COVER](#).
4. Remove sprocket cover. See [2.30 SPROCKET COVER](#).

## NOTE

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

5. See [Figure 5-8](#). Remove two starter mounting bolts and washers (1).
6. See [Figure 5-9](#). Remove fastener with washer (1) (metric).
  - a. Remove protective boot.
  - b. Remove positive battery cable ring terminal (2).
  - c. Detach solenoid wire (3).
7. Remove starter and gasket from the gearcase cover side.

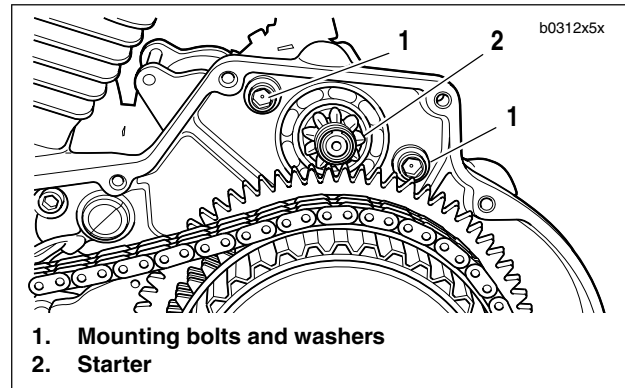


Figure 5-8. Starter Mounting

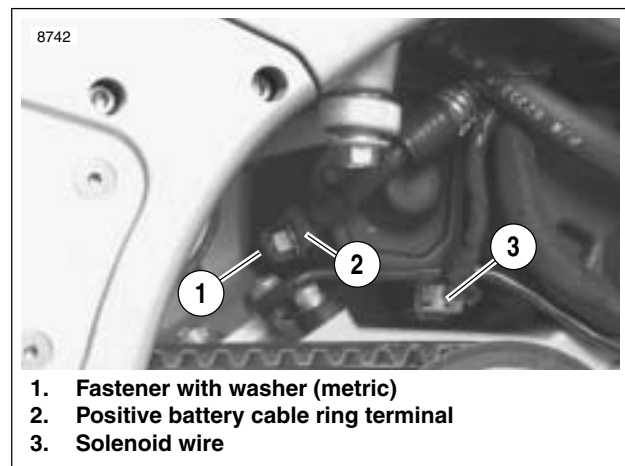


Figure 5-9. Starter Wires (Protective Boot Not Shown)

## TESTING ASSEMBLED STARTER

### Free Running Current Draw Test

- Place starter in vise, using a clean shop towel to prevent scratches or other damage.
- See [Figure 5-10](#). Attach one heavy jumper cable (6 gauge minimum).
  - To the starter mounting flange (1).
  - To the negative (-) terminal of a fully charged battery.
- Connect a second heavy jumper cable (6 gauge minimum).
  - To the positive (+) terminal of the battery (2).
  - To an inductive ammeter (3). Continue on to the battery terminal (4) on the starter solenoid.
- Connect a smaller jumper cable (14 gauge minimum).
  - To the positive (+) terminal of the battery (2).
  - To the solenoid relay terminal (5).
- Check ammeter reading.
  - Ammeter should show 90 amps maximum.
  - If reading is higher, disassemble starter for inspection. See [5.7 STARTER](#).
  - 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 5-11](#).

#### 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

- See [Figure 5-11](#). Using a 12 volt battery, connect three separate test leads as follows:
  - Solenoid housing to negative battery post.
  - Solenoid motor terminal to negative battery post.
  - Solenoid relay terminal to positive battery post.
- Observe starter pinion.
  - If starter pinion pulls in strongly, solenoid is working properly.
  - If starter pinion does not pull in, replace the solenoid.

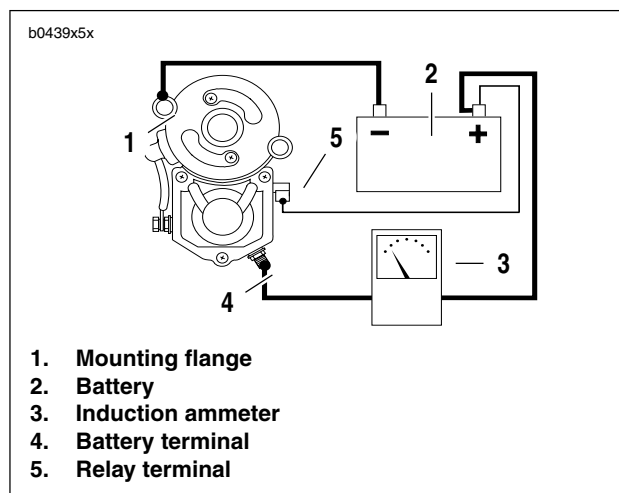


Figure 5-10. Free Running Current Draw Test

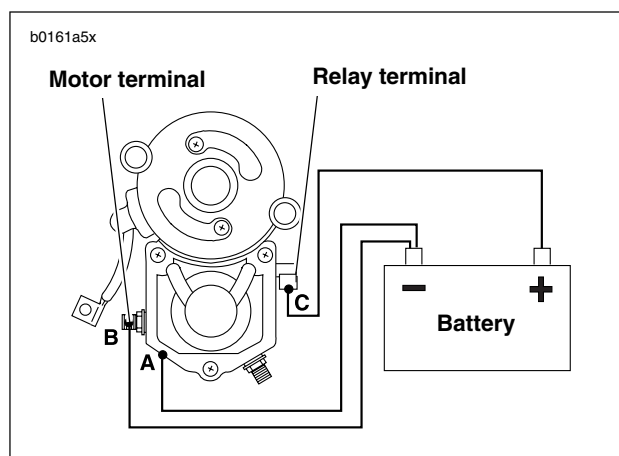


Figure 5-11. Pull-In Test

## Solenoid Hold-in Test

1. See [Figure 5-12](#). 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 5-13](#). 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.

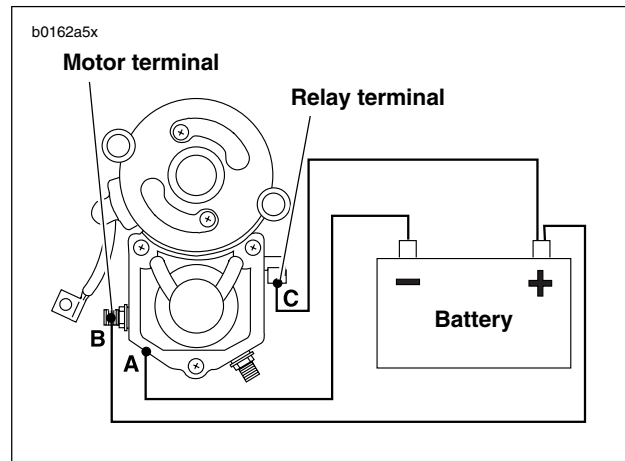


Figure 5-12. Hold-In Test

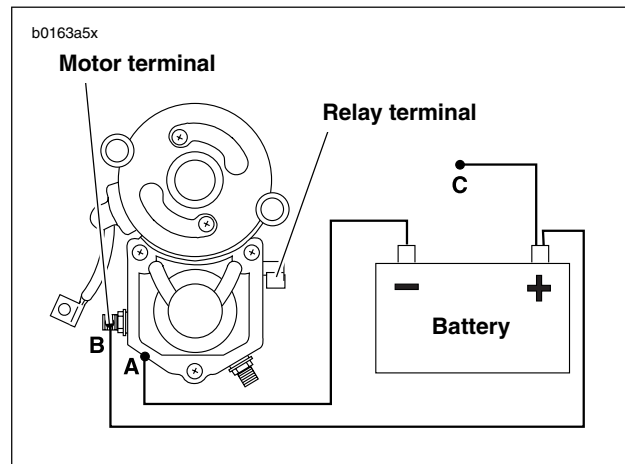


Figure 5-13. Return Test

## DISASSEMBLY, INSPECTION AND REPAIR

1. See [Figure 5-14](#). Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).
2. See [Figure 5-15](#). Remove both thru-bolts (1, 3).
3. Remove both end cover screws with O-rings (2) and end cover (4).
4. See [Figure 5-16](#). 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.**

### NOTE

See [Figure 5-17](#). 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.

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.

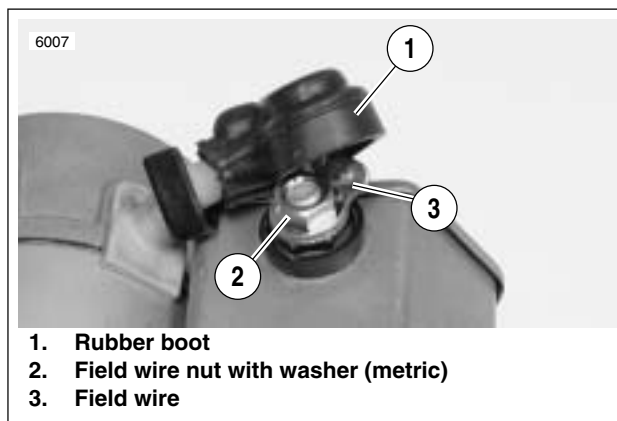


Figure 5-14. Field Wire

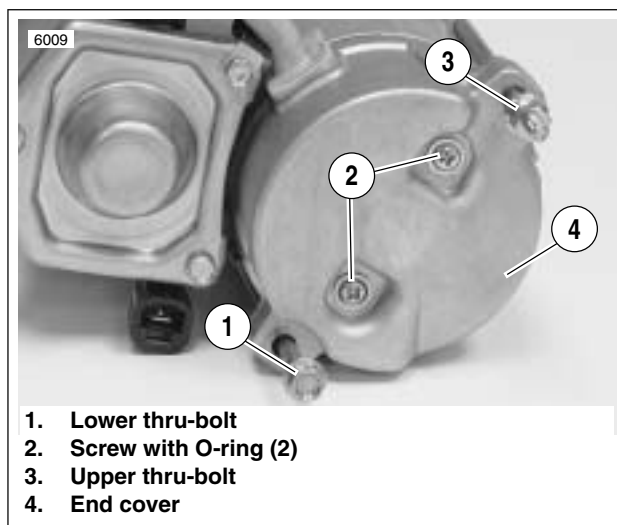


Figure 5-15. Removing the Thru-Bolts

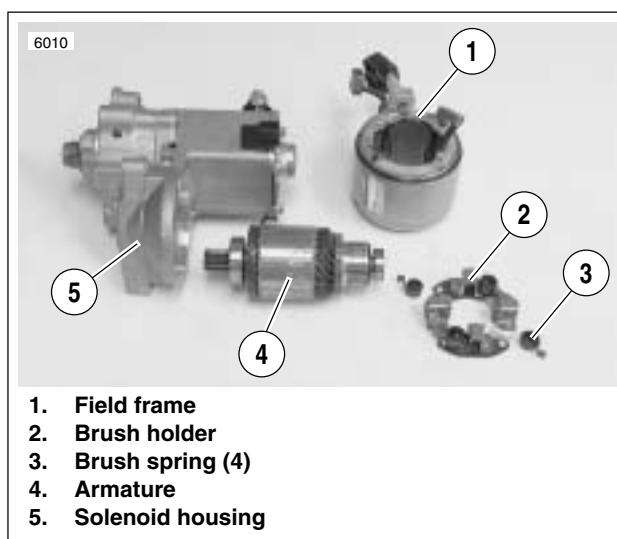
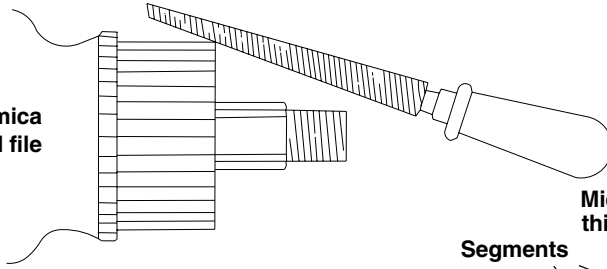


Figure 5-16. Starter Components

b0136x5x

Starting groove in mica  
with 3 cornered file



Undercutting mica with  
piece of hacksaw blade

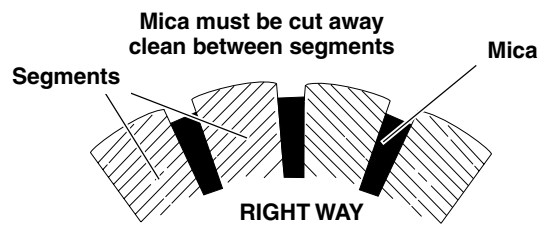
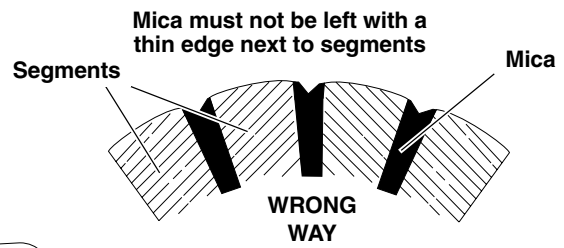
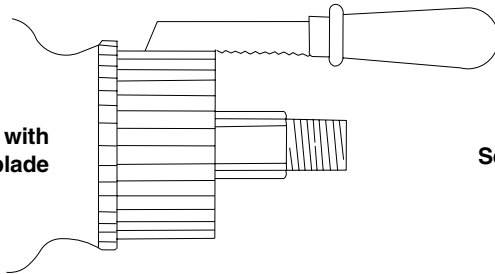
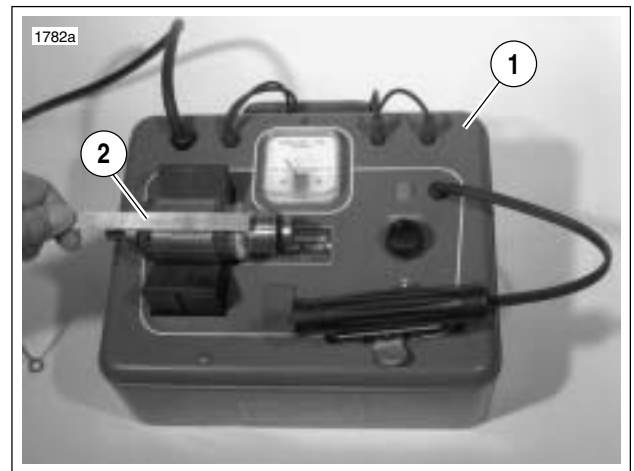
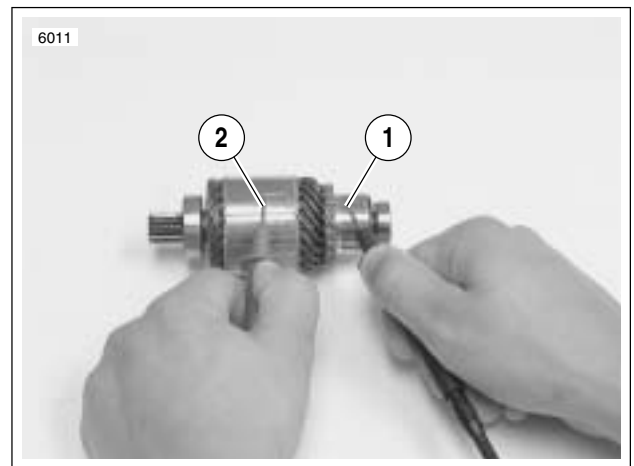


Figure 5-17. Undercutting Mica Separators

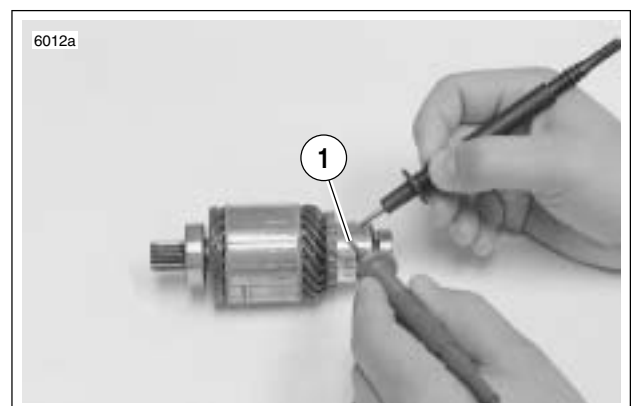
9. See [Figure 5-18](#). Check for SHORTED ARMATURE with a growler.
  - a. Place armature on growler (1).
  - b. Hold a thin steel strip (2) (hacksaw blade) against armature core and slowly turn armature.
  - c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace shorted armatures.
10. See [Figure 5-19](#). 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.
11. See [Figure 5-20](#). 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 5-18. Shorted Armature Test Using Growler**

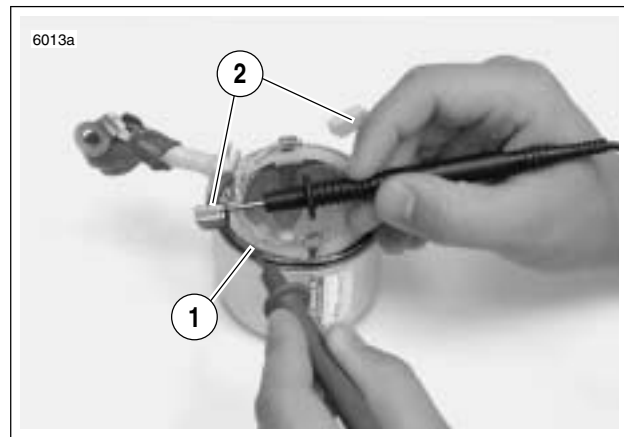


**Figure 5-19. Grounded Armature Test**

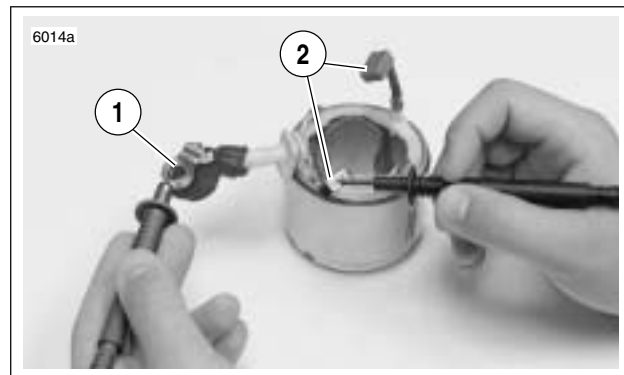


**Figure 5-20. Open Armature Test**

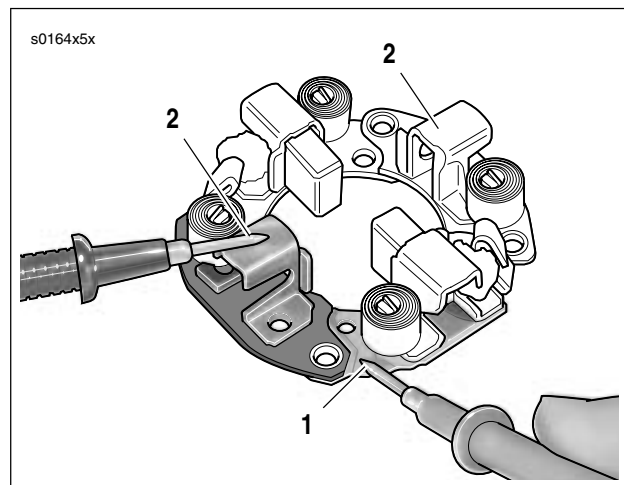
12. See [Figure 5-21](#). Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester.
  - a. Touch one probe to the frame (1).
  - b. Touch the other probe to each of the brushes (2) attached to the field coil.
  - c. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field coil(s) are grounded and the field frame must be replaced.
13. See [Figure 5-22](#). 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 5-23](#). 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.
15. See [Figure 5-24](#). 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).



**Figure 5-21. Grounded Field Test**



**Figure 5-22. Open Field Test**



**Figure 5-23. Brush Holder Insulation Test**



## ASSEMBLY

1. See [Figure 5-24](#). Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.
2. See [Figure 5-27](#). 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).
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.

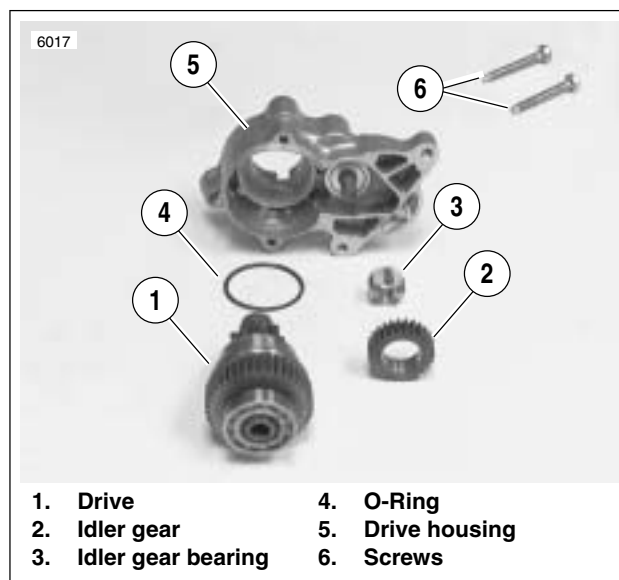


Figure 5-24. Starter Drive Assembly

## INSTALLATION

1. Install starter and starter gasket from the gearcase cover side.
2. See [Figure 5-25](#). Connect wiring to starter.
  - a. Connect solenoid wire (3).
  - b. Attach positive battery cable ring terminal (2) to stud with fastener and washer.
  - c. Install nut and washer (1) (metric). Tighten nut to 60-85 **in-lbs** (7-10 Nm).
  - d. Replace protective boot.
3. See [Figure 5-26](#). Install both starter mounting bolts and washers. Tighten to 13-20 ft-lbs (18-27 Nm).
4. Install sprocket cover. See [2.30 SPROCKET COVER](#).
5. Install primary cover. See [6.2 PRIMARY COVER](#).

### ⚠ WARNING

**Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)**

6. Install positive battery cable (red) to positive terminal of battery. Tighten to 72-96 **in-lbs** (8-11 Nm).
7. Connect negative battery cable. Tighten to 72-96 **in-lbs** (8-11 Nm).

### ⚠ WARNING

**After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)**

8. Install seat. See [2.38 SEAT](#).

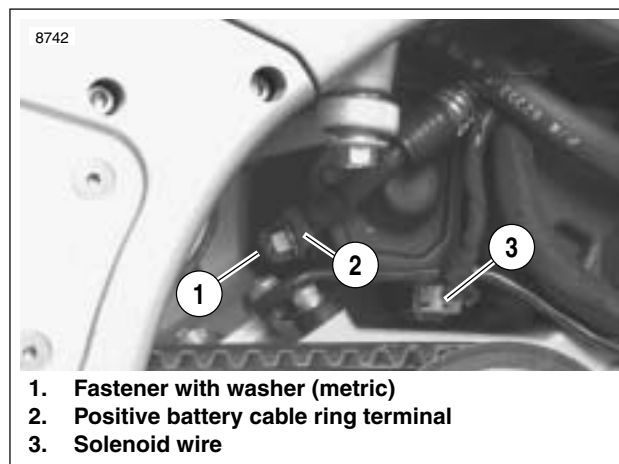


Figure 5-25. Starter Wires (Protective Boot Not Shown)

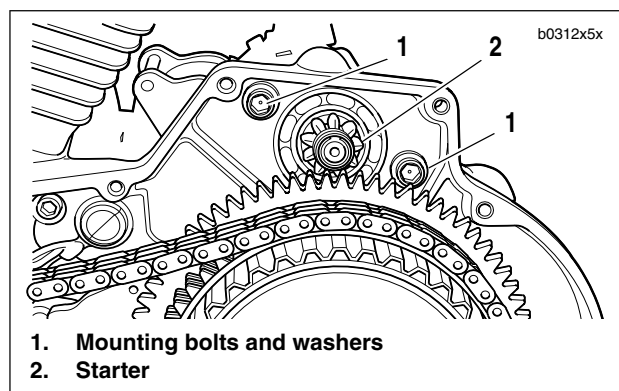
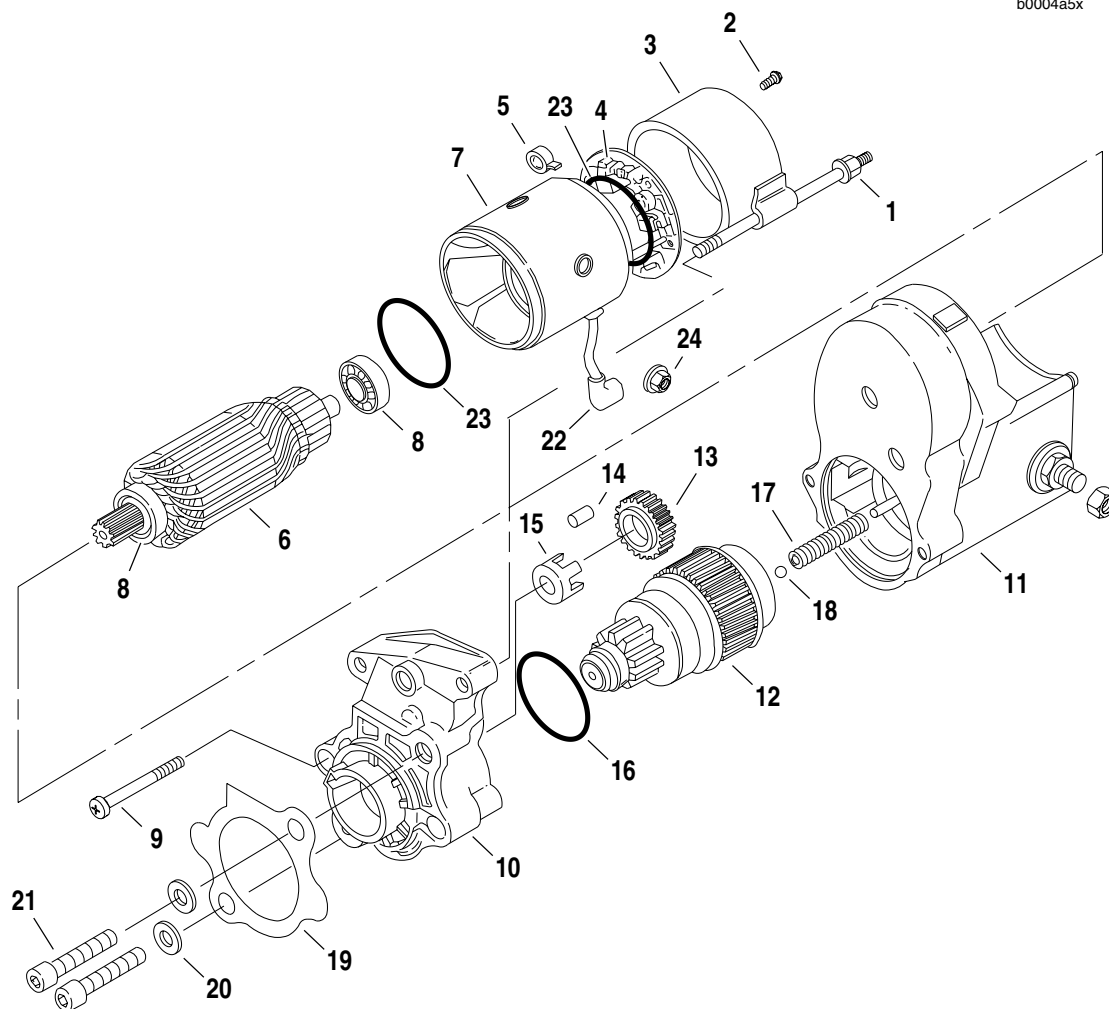


Figure 5-26. Starter Mounting



1. Thru-bolt (2)
2. End cover screw and o-ring (2)
3. End cover
4. Brush holder
5. Brush spring (4)
6. Armature
7. Field frame
8. Armature bearing (2)
9. Drive housing mounting bolt
10. Drive housing
11. Solenoid housing
12. Drive assembly/overrunning clutch
13. Idler gear
14. Idler gear roller (5)
15. Idler gear  
Bearing cage
16. O-ring
17. Return spring
18. Ball
19. Gasket
20. Washer (2)
21. Mounting bolt (2)
22. Field wire
23. O-ring (2)
24. Field wire nut with washer (metric)

Figure 5-27. Starter Assembly

## GENERAL

### CAUTION

See [Figure 5-28](#). Do not tighten nut (7) without removing items (1) through (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 5-28](#). 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 5-28](#). 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).

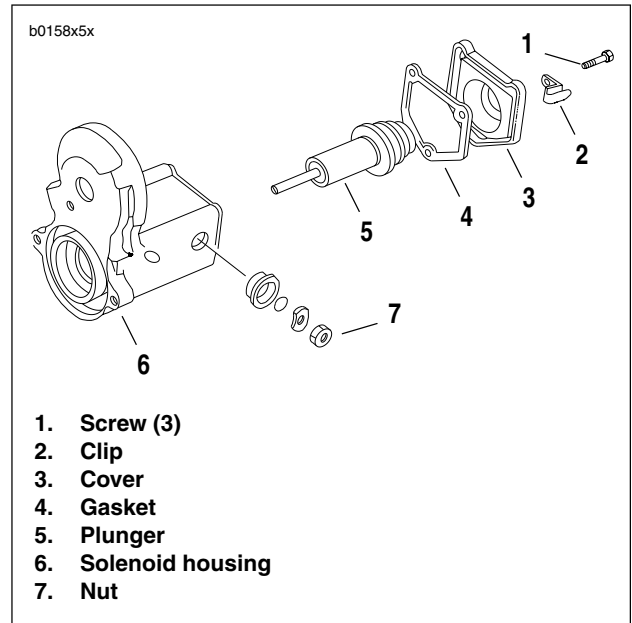


Figure 5-28. Starter Solenoid

# NOTES

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