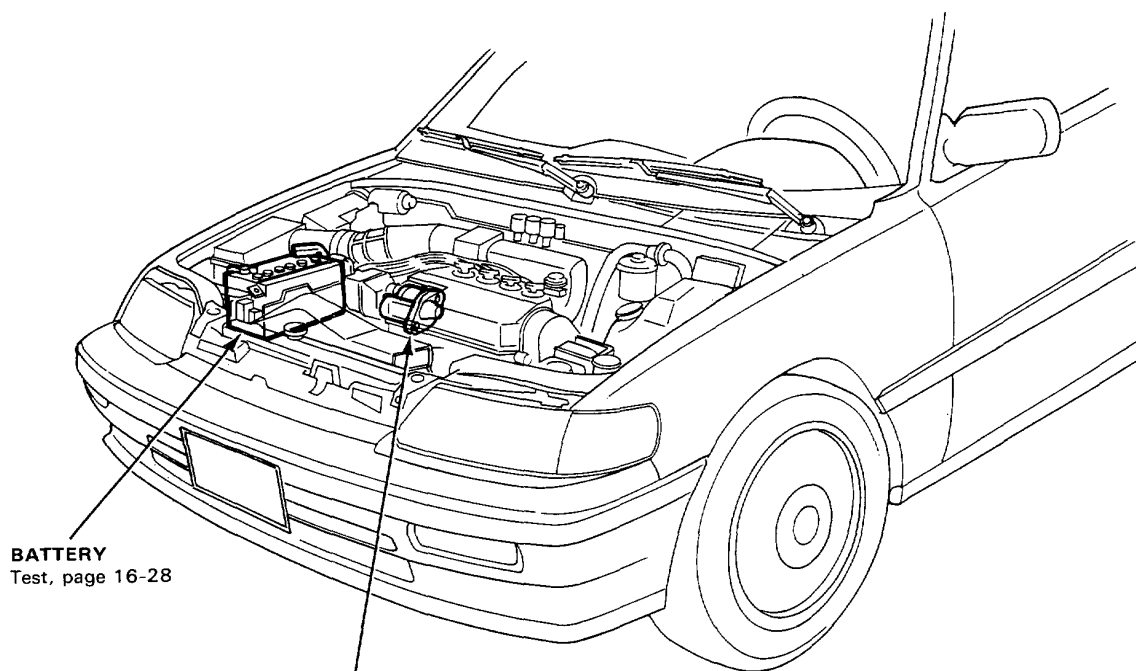


Starting System

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STARTER

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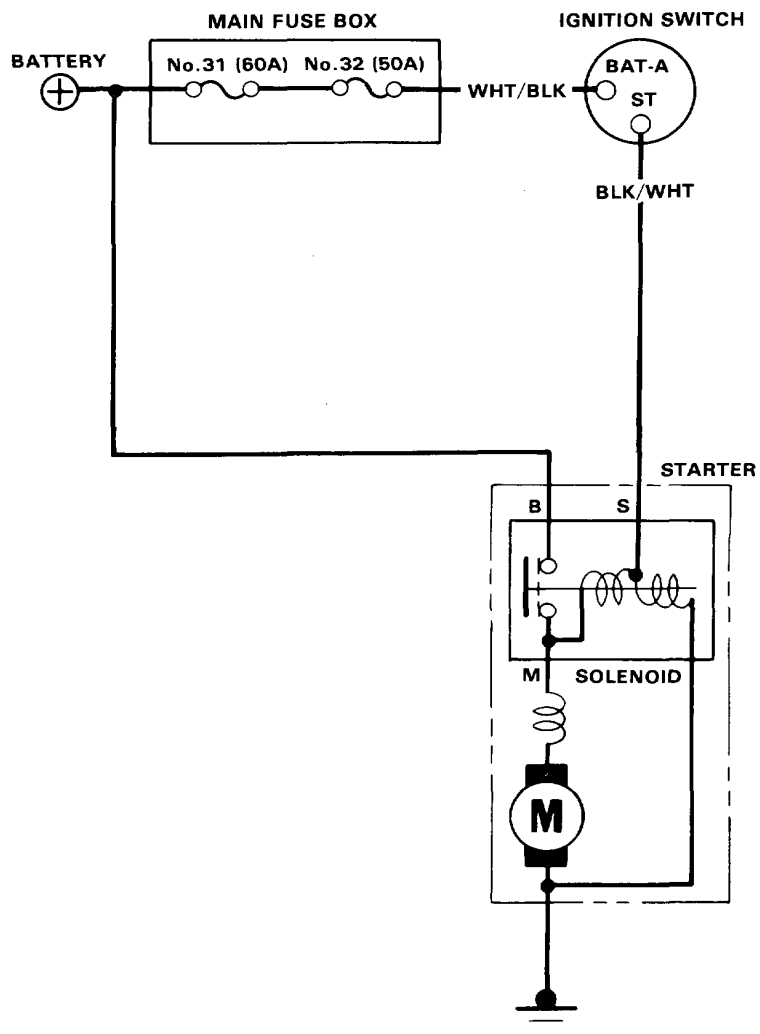
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Circuit Diagram



Starting System

Starter Test

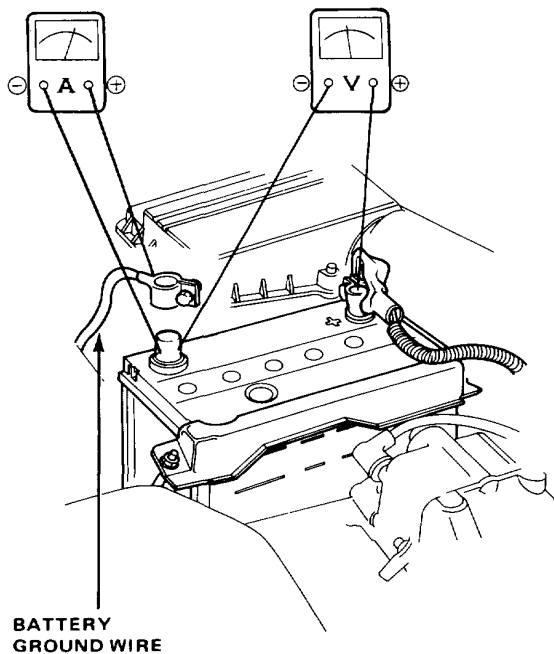
NOTE: The air temperature must be between 15 and 38°C (59 and 100°F) before testing.

Recommended Procedure:

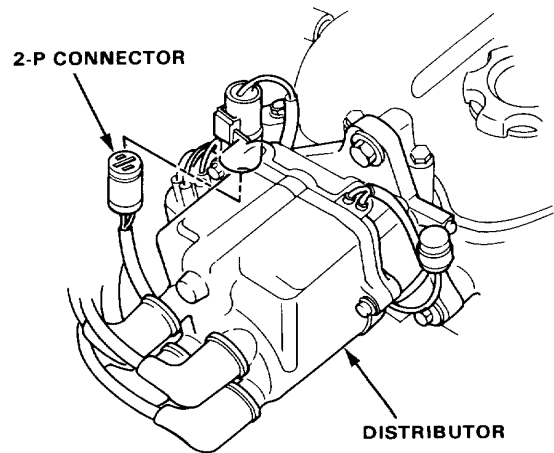
Use a starter system tester.
Connect and operate the equipment in accordance with manufacturer's instructions.
Test and troubleshoot as described.

Alternate Procedure:

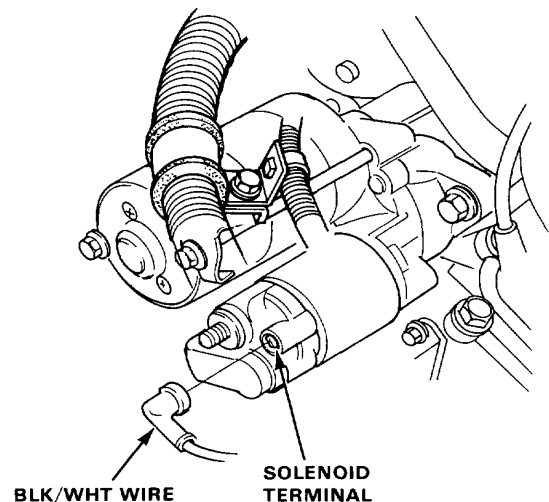
- Use the following equipment:
 - Ammeter, 0–400 A
 - Voltmeter, 0–20 V (accurate within 0.1 volt)
 - Tachometer, 0–1200 rpm
- Hook up voltmeter and ammeter as shown.



1. Disconnect the 2-P connector (Ignition coil primary lead) from the distributor.



2. Check the starter engagement:
Turn the ignition switch to "Start". The starter should crank the engine.
- If the starter does not crank the engine, check the battery, battery positive wire and ground, and the wire connections for looseness or corrosion.
 - Test again.
If the starter still does not crank the engine, bypass the ignition switch circuit as follows:
Unplug the connector (BLK/WHT wire) from the starter. Connect a jumper wire from the battery positive (+) terminal to the solenoid terminal. The starter should crank the engine.





- If the starter still does not crank the engine, remove the starter and diagnose its internal problems.

- If the starter cranks the engine, check for an open in the BLK/WHT wire circuit between the starter and ignition switch, and connectors. Check the ignition switch.

3. Check for wear or damage:

The starter should crank the engine smoothly and steadily.

If the starter engages, but cranks the engine erratically, remove the starter motor. Inspect the starter, drive gear, and flywheel ring gear for damage.

Check the drive gear overrunning clutch for binding or slipping when the armature is rotated with the drive gear held. Replace the gears if damaged.

4. Check cranking voltage and current draw,

Voltage should be no less than specified below:

1.2kw and 1.4kw: 8 volts

Current should be no greater than specified below:

1.2 kw: 280 amperes

1.4 kw: 350 amperes

If voltage is too low, or current draw too high, check for:

- Battery fully charged.
- Open circuit in starter armature commutator segments.
- Starter armature dragging.
- Shorted armature winding.
- Excessive drag in engine.

5. Check cranking min^{-1} (rpm):

Engine speed during cranking should be above 100 min^{-1} (rpm).

- Loose battery or starter terminals.
- Excessively worn starter brushes.
- Open circuit in commutator segments.
- Dirty or damaged helical spline or drive gear.
- Defective drive gear overrunning clutch.

6. Check the starter disengagement:

Turn the ignition switch to "Start" and release to "Run." The starter drive gear should disengage from the flywheel ring gear.

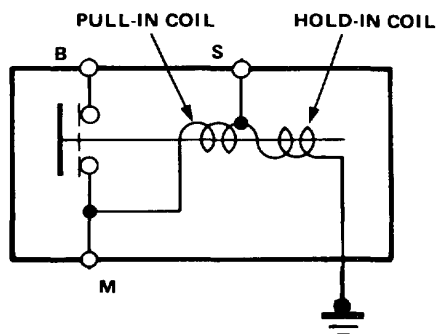
If the drive gear hangs up on the flywheel ring gear, check:

- Solenoid plunger and switch for malfunction.
- Drive gear assembly for dirty or damaged over-running clutch.

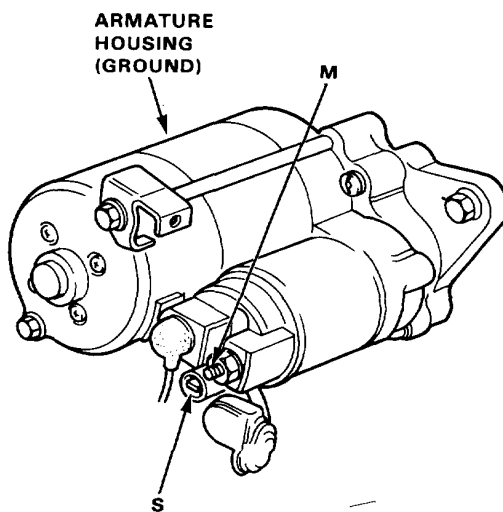
Starting System

Starter Solenoid Test

1. Check the hold-in coil for continuity between the S terminal and the armature housing (ground).
Coil is OK if there is continuity.
2. Check the pull-in coil for continuity between the S and M terminals.
Coil is OK if there is continuity.

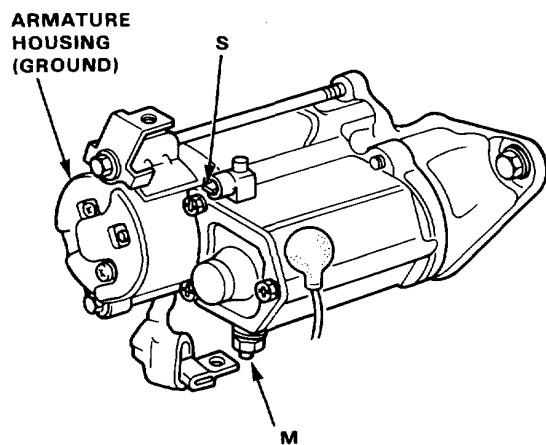


Mitsuba (1.4 kw) type:



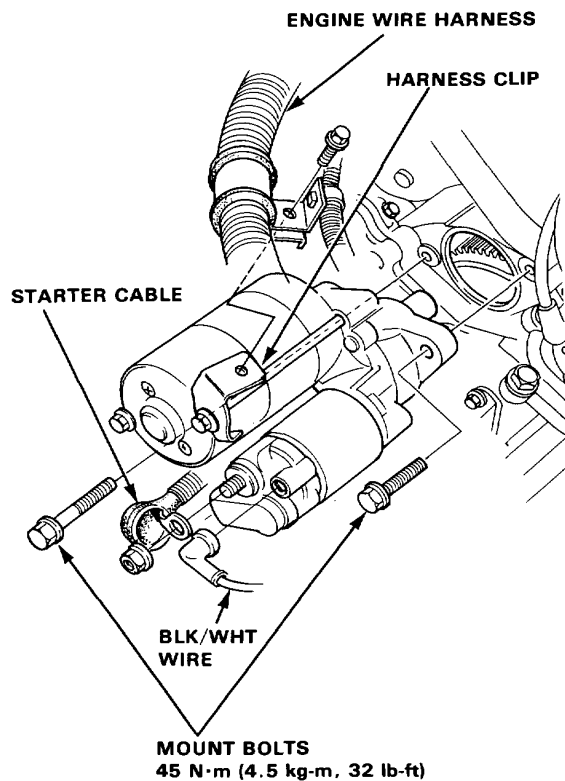


Nippon Denso (1.2 kw) type:



Starter Replacement

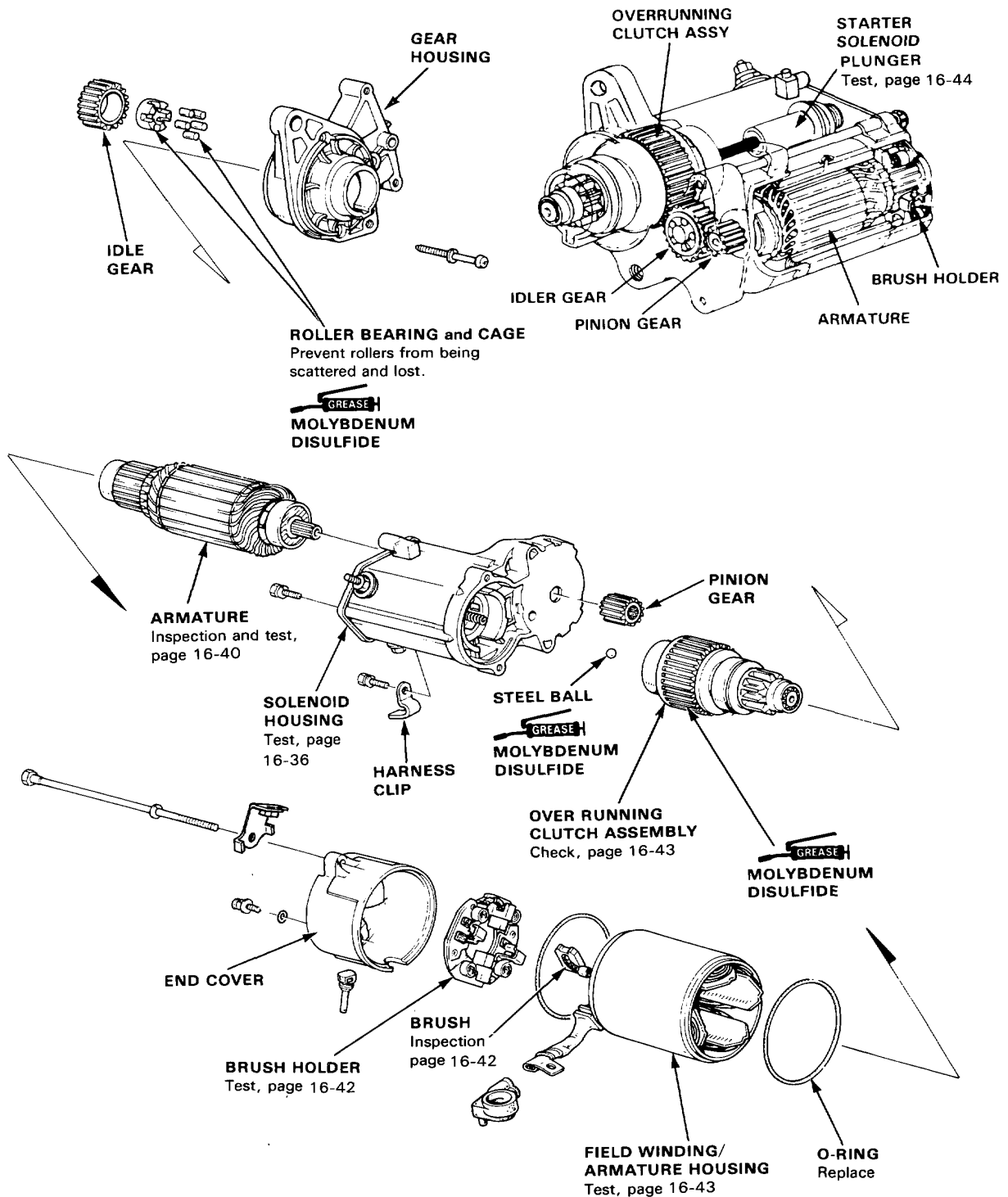
1. Disconnect the ground wire from the battery negative (-) post.
2. Remove the engine wire harness from the harness clip on the starter motor.
3. Disconnect the starter cable from the B terminal on the solenoid, and the BLK/WHT wire from the S terminal.
4. Remove the 2 bolts holding the starter, and remove the starter.



Starting System

Starter Overhaul (Gear Reduction ND type)

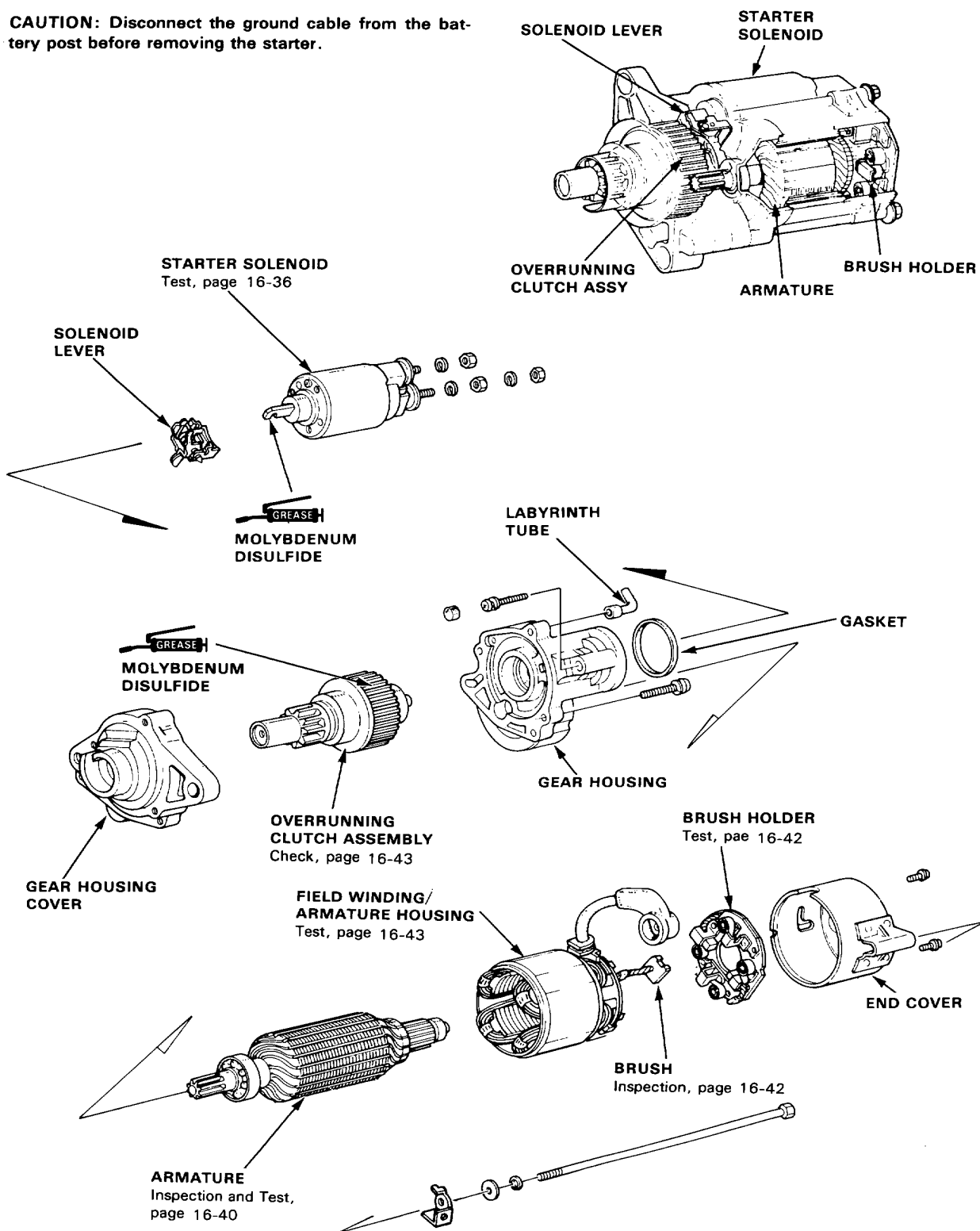
CAUTION: Disconnect ground wire from the battery post before removing the starter.





(Gear Reduction Mitsuba type)

CAUTION: Disconnect the ground cable from the battery post before removing the starter.

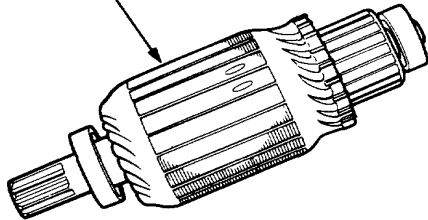


Starting System

Armature Inspection and Test

1. Inspect the armature for wear or damage due to contact with the field coil magnets.

Inspect for damage.

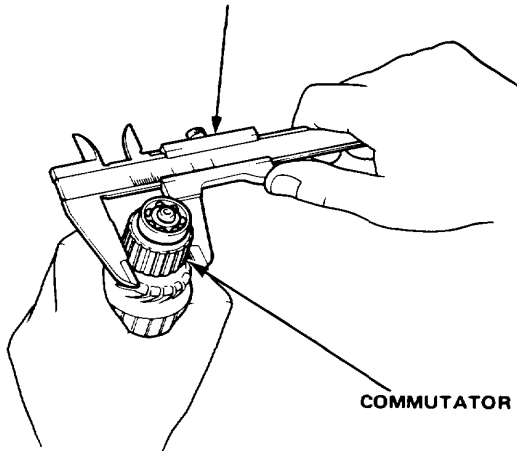


2. A dirty or burnt commutator surface may be resurfaced with emery cloth or a lathe within the following specifications.

Commutator Diameter

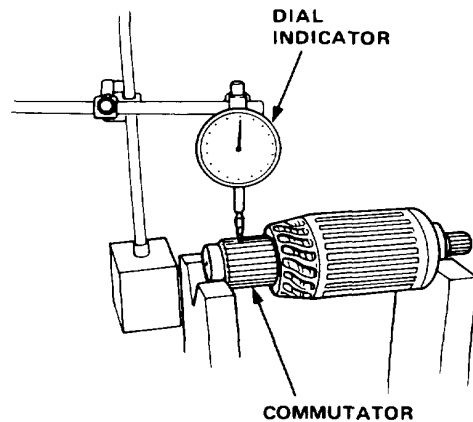
	Standard (New)	Service Limit
ND	28.0—30.0 mm (1.177—1.181 in)	29.0 mm (1.14 in)
Mitsuba	26.0—28.1 mm (1.102—1.106 in)	27.5 mm (1.08 in)

VERNIER CALIPER



Commutator Runout

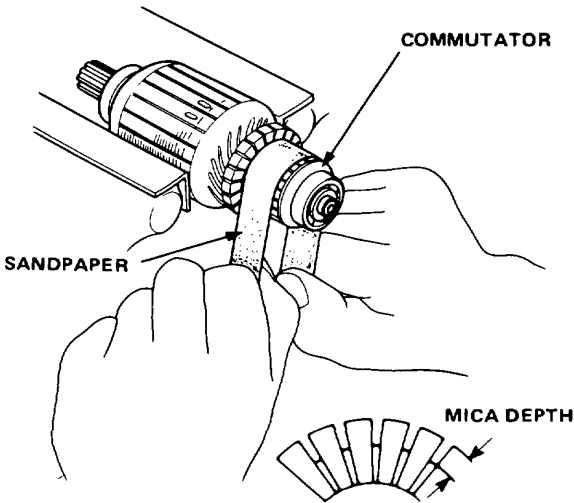
	Standard (New)	Service Limit
ND and Mitsuba	0—0.02 mm (0—0.001 in)	0.05 mm (0.002 in)



3. If the commutator runout and diameter are within limits, check the commutator for damage or for carbon dust or brass chips between the segments.



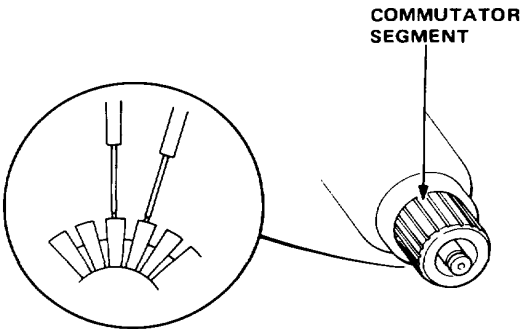
4. If surface is dirty, recondition it with a #500 or #600 sandpaper. Then, check mica depth. If necessary, undercut mica with a hacksaw blade to achieve proper depth.



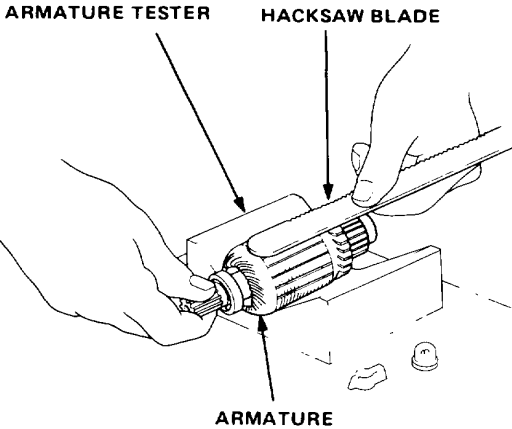
Commutator Mica Depth

	Standard (New)	Service Limit
ND	0.5—0.8 mm (0.020—0.031 in)	0.2mm (0.008 in)
Mitsuba	0.4—0.5mm (0.016—0.020 in)	0.15 mm (0.006 in)

5. Check for continuity between each segment of the commutator. If an open circuit exists between any segment, replace the armature.

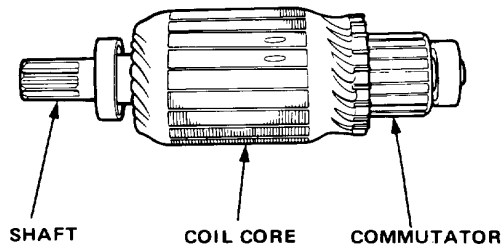


6. Place the armature on an armature tester. Hold a hacksaw blade on the armature core.



If the blade is attracted to the core or vibrates while core is turned, the armature is shorted. Replace the armature.

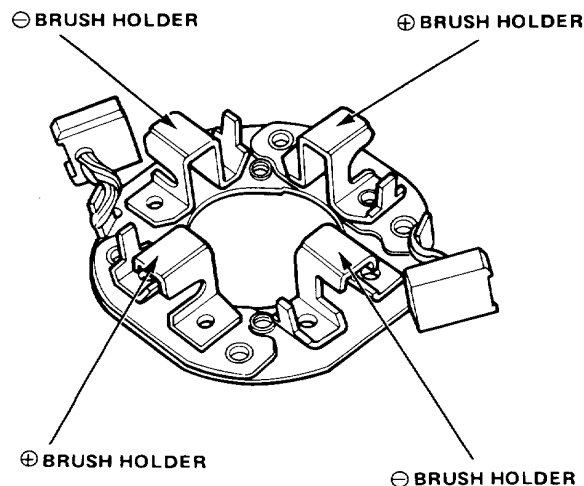
7. With an ohmmeter, check that no continuity exists between the commutator and armature coil core, and between the commutator and armature shaft. If continuity exists, replace the armature.



Starting System

Starter Brush Holder Test

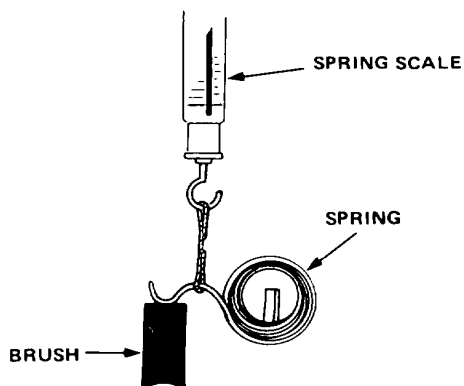
1. Check that there is no continuity between the \oplus and \ominus brush holders.
If continuity exists, replace the brush holder assembly.



2. Insert the brush into the brush holder, and bring the brush into contact with commutator, then attach a spring scale to the spring. Measure the spring tension at the moment the spring lifts off the brush.

Spring Tension:

ND: 18.5—24.4 N (1.85—2.44 kg, 4.1—5.41 lb)
Mitsuba: 20.5—27.0 N (2.05—2.70 kg, 4.5—6.016 lb)

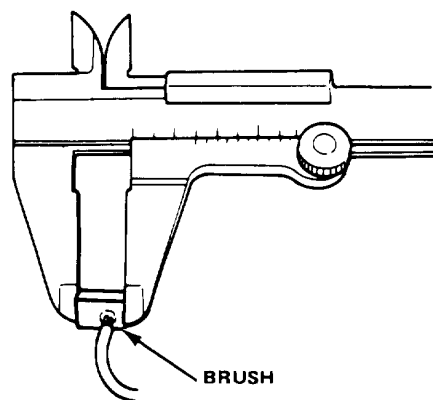


Starter Brush Inspection

Measure brush length. If not within service limit, replace the armature housing and brush holder assembly.

Brush Length

	Standard (New)	Service Limit
ND	12.5—13.5 mm (0.49—0.53 in)	8.5 mm (0.33 in)
Mitsuba	14.3—14.7 mm (0.56—0.58 in)	9.3mm (0.37in)

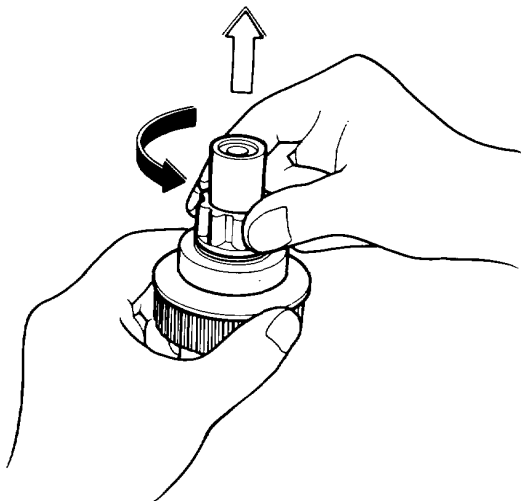


NOTE: To seat new brushes after installing them in their holders, slip a strip of #500 or #600 sandpaper, with the grit side up, over the commutator, and smoothly rotate the armature. The contact surface of the brushes will be sanded to same contour as the commutator.



Overrunning Clutch Check

1. Check if the overrunning clutch moves along the shaft freely. If not, replace the overrunning clutch assembly.
2. Check if the overrunning clutch locks in one direction and rotates smoothly in reverse. If it does not lock in either direction or it locks in both directions, replace the overrunning clutch assembly.

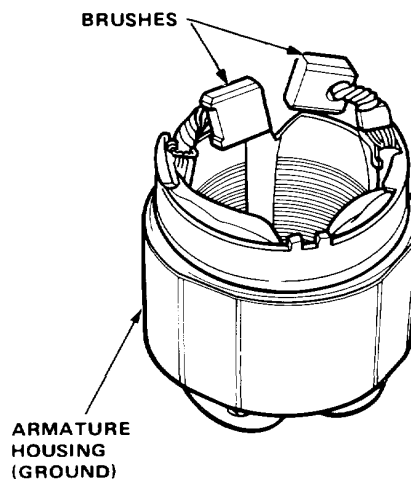


3. Check if the starter drive gear is worn or damaged. If the gear is worn or damaged, replace the overrunning clutch assembly; the gear is not available separately.

NOTE: Check condition of the flywheel if the starter drive gear teeth are damaged.

Starter Field Winding Test

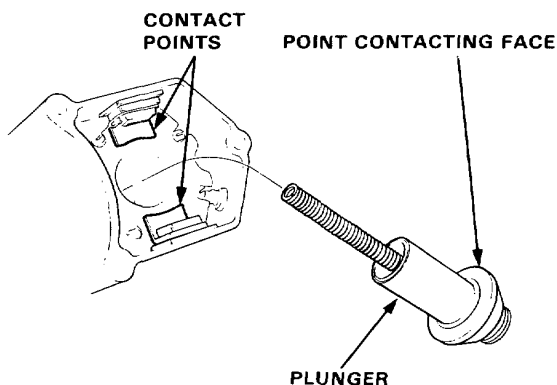
1. Check for continuity between the brushes. If no continuity, replace the armature housing.
2. Check for continuity between each brush and the armature housing (ground). If continuity exists, replace the armature housing.



Starting System

Solenoid Plunger Inspection (ND type)

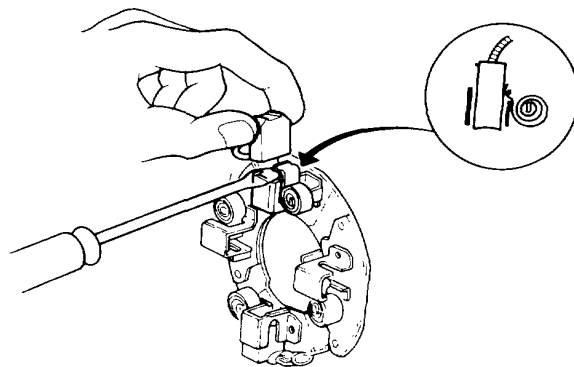
Check the contact points, and face of the starter solenoid plunger for burning, pitting or any other defects. If surfaces are rough, recondition with a strip of #500 or #600 sandpaper.



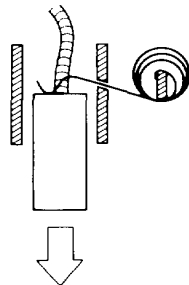
Starter Reassembly

Reassemble the starter in the reverse order of disassembly.

1. Pry back each brush spring with a screwdriver, then position the brush about halfway out of its holder, and release the spring to hold it there.



2. Install the armature in the housing. Next pry back each brush spring again and push the brush down until it seats against the commutator, then release the spring against the end of the brush.



3. Install the end cover on the brush holder.

