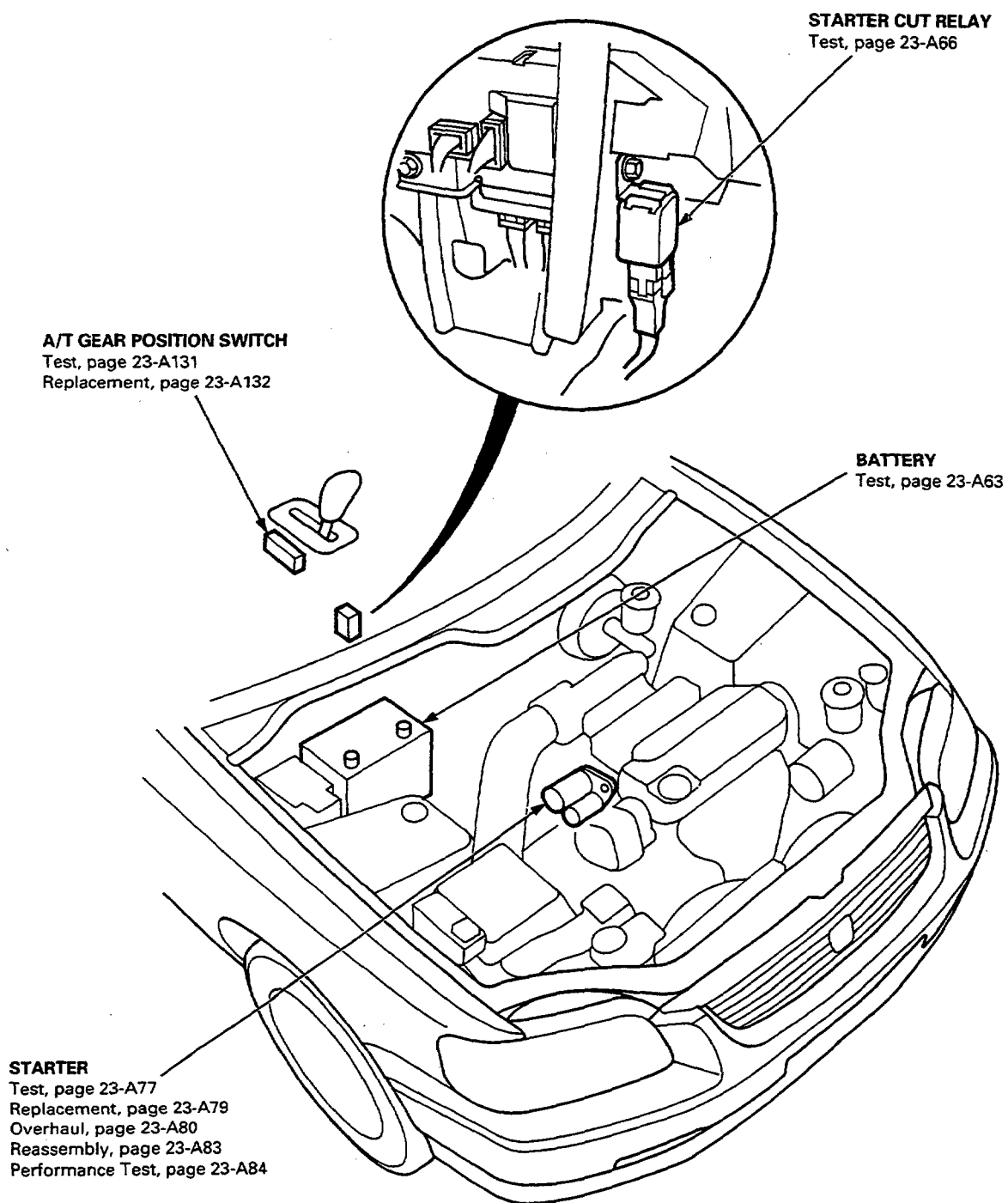


Starting System

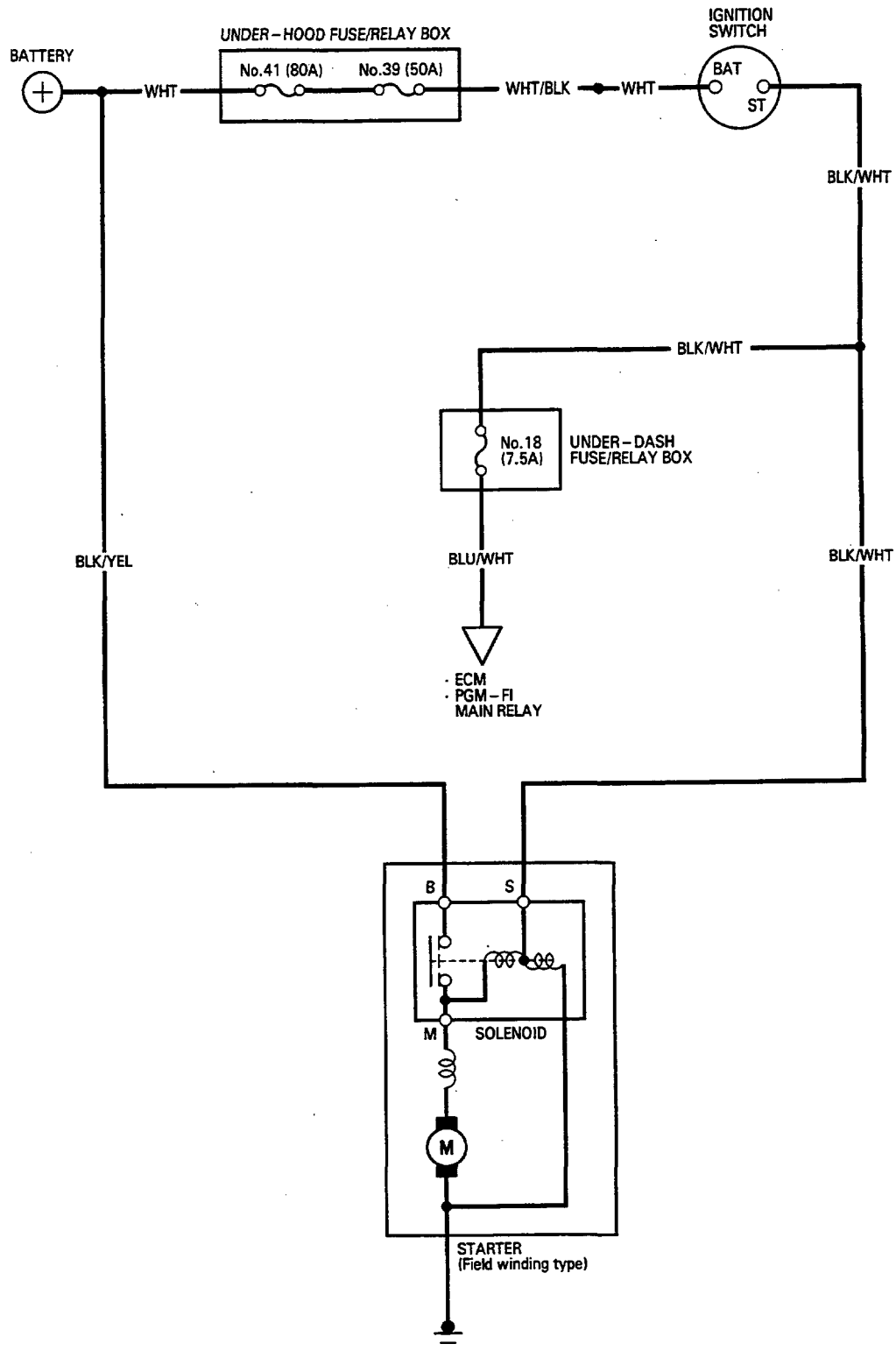
Component Location Index

NOTE: LHD type is shown, RHD type is similar.



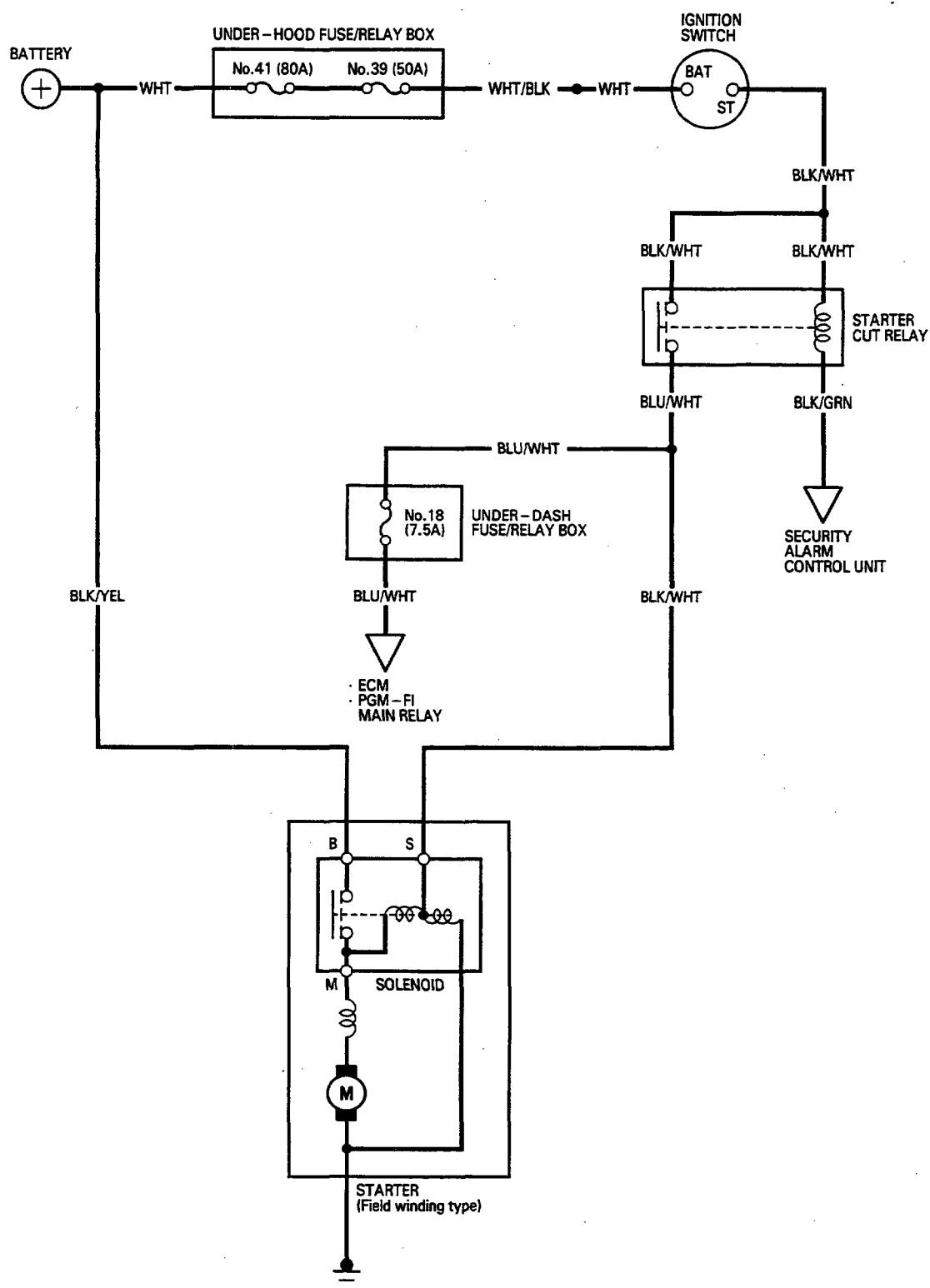


Circuit Diagram (KG: M/T without Security Alarm System)



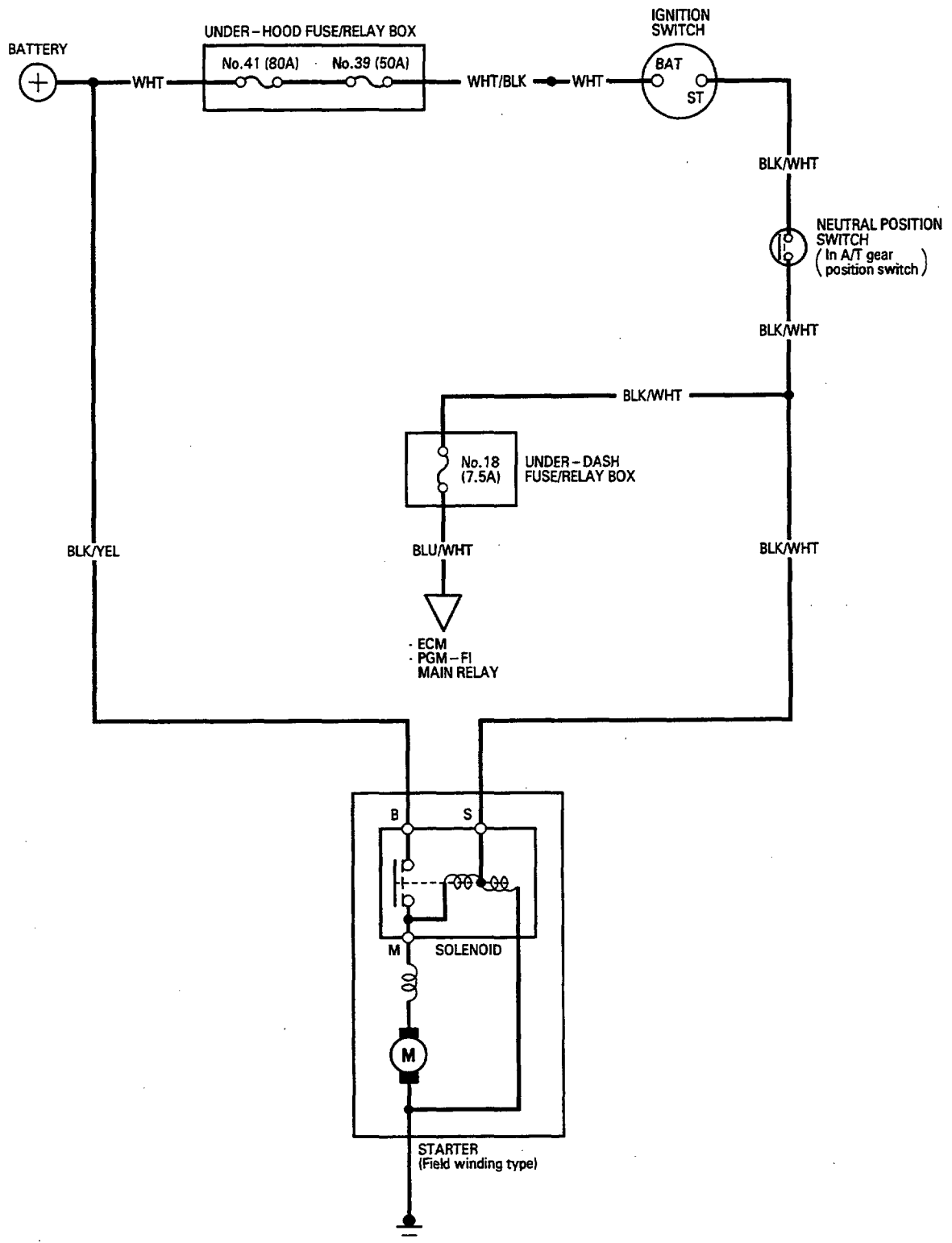
Starting System

Circuit Diagram (KG: M/T with Security Alarm System)



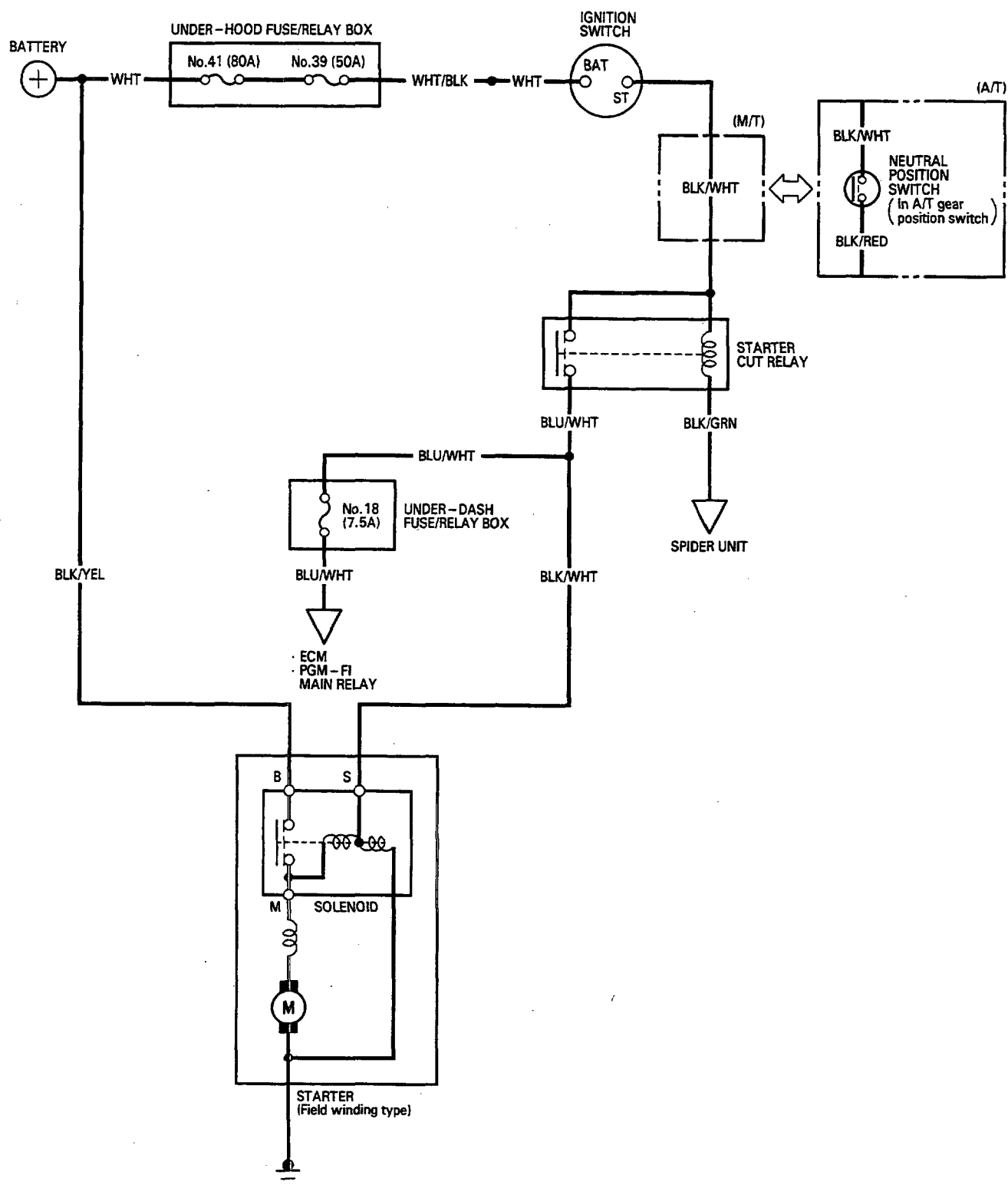


Circuit Diagram (KG: A/T)



Starting System

Circuit Diagram (KE)





Starter Test

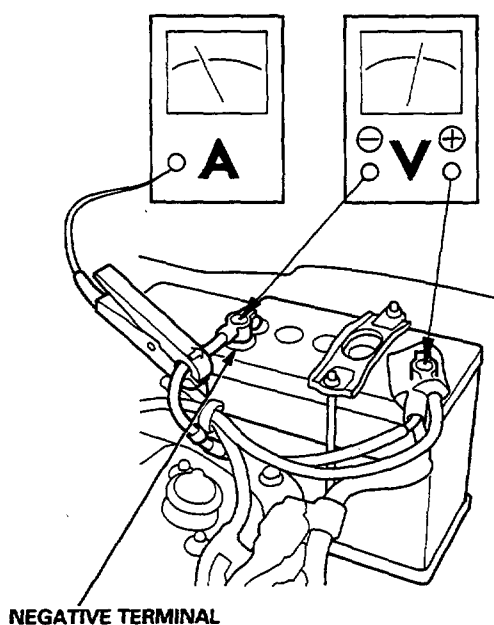
NOTE: The air temperature must be between 15 and 38°C (59 and 100°F) before testing.

Recommended Procedure:

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

Alternate Procedure:

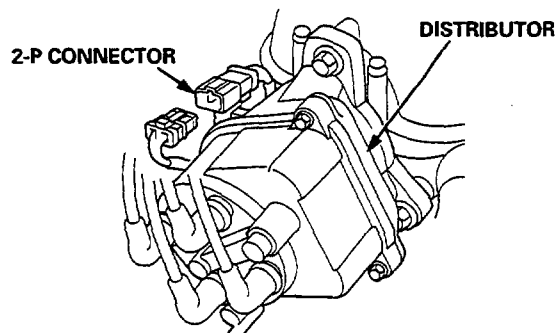
- Use the following equipment:
 - Ammeter, 0 – 400 A
 - Voltmeter, 0 – 20 V (accurate within 0.1 volt)
 - Tachometer, 0 – 1200 rpm (min⁻¹)
- Hook up voltmeter and ammeter as shown.



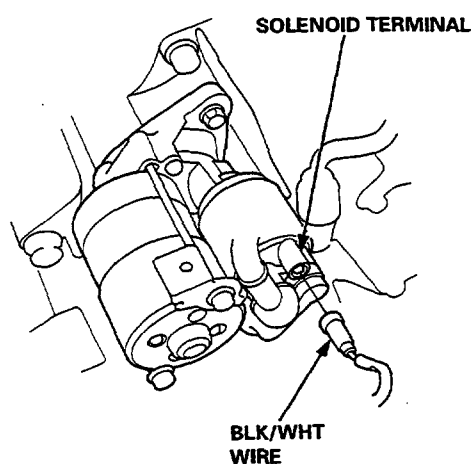
NOTE: After this test, or any subsequent repair, reset the ECM to clear any codes (see section 11).

Check Starter Engagement:

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



2. Turn the ignition switch to "III" (ST), the starter should crank the engine. If the starter does not crank the engine, go to step 3.
3. Check the battery, battery positive cable, ground, and the wire connections for looseness and corrosion. Test again. If the starter still does not crank the engine, go to step 4.
4. Bypass the ignition switch circuit as follows (make sure the transmission is in neutral):
Unplug the connector (BLK/WHT wire and solenoid terminal) from the starter. Then 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, replace it, and diagnose its internal problems.
 - If the starter cranks the engine, go to step 5.



(cont'd)

Starting System

Starter Test (cont'd)

5. Check for an open in the BLK/WHT wire circuit between the starter and ignition switch, and connectors.
6. Check the ignition switch (see page 23-A68).
7. On cars with automatic transmission, check the A/T gear position switch (neutral position switch), starter cut relay (KE) and connector. On cars with manual transmission, check the starter cut relay (with security alarm system), and connectors.

Check for Wear and Damage

The starter should crank the engine smoothly and steadily. If the starter engages, but cranks the engine erratically, remove it. 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.

Check Cranking Voltage and Current Draw

Cranking voltage should be no less than 8.0 volts.
Current draw should be no more than 230 amperes.

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

- Dead or low battery
- Open circuit in starter armature commutator segments
- Starter armature dragging
- Shorted armature winding
- Excessive drag in engine

Check Cranking rpm

Engine speed during cranking should be above 100 rpm.

If speed is too low, check for:

- 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

Check Starter Disengagement

Turn the ignition switch to "III" (ST), and release to "II" (ON). The starter drive gear should disengage from the flywheel ring gear when you release the key.

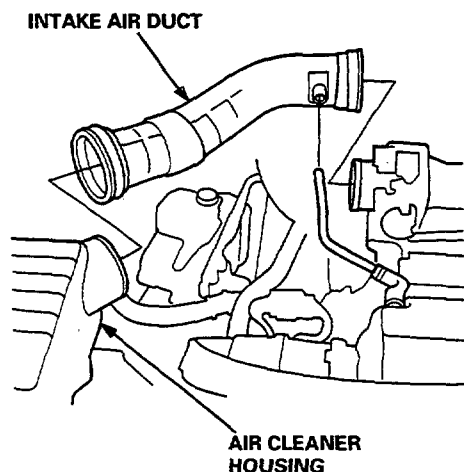
If the drive gear hangs up on the flywheel ring gear, check for:

- Solenoid plunger and switch malfunction
- Dirty drive gear assembly or damaged overrunning clutch

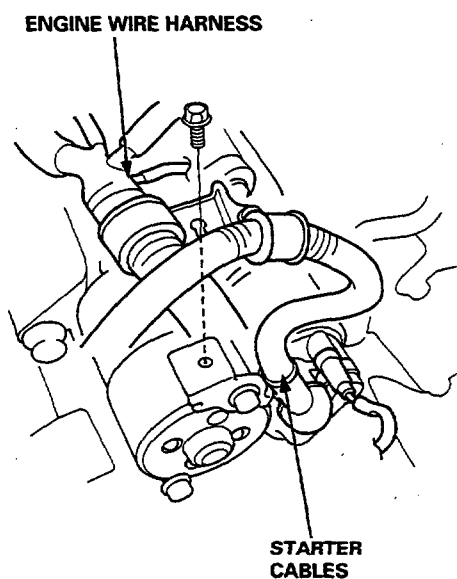


Starter Replacement

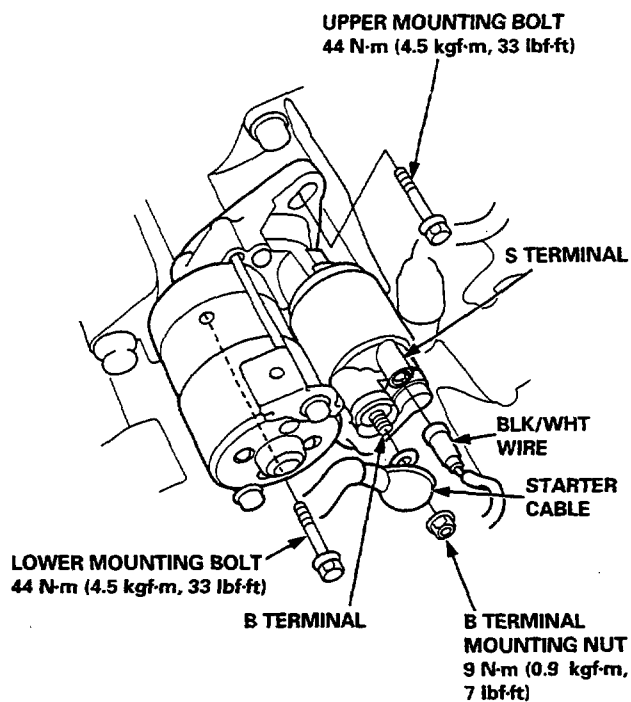
1. Disconnect the negative cable from the battery.
2. Remove the intake air duct.



3. Remove the engine wire harness and starter cables from their brackets.

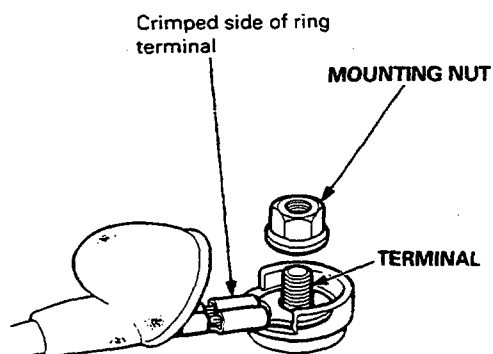


4. Disconnect the starter cable from the B terminal on the solenoid, then disconnect the BLK/WHT wire from the S terminal.
5. Remove the two bolts holding the starter, then remove the starter.



6. Install in the reverse order of removal.

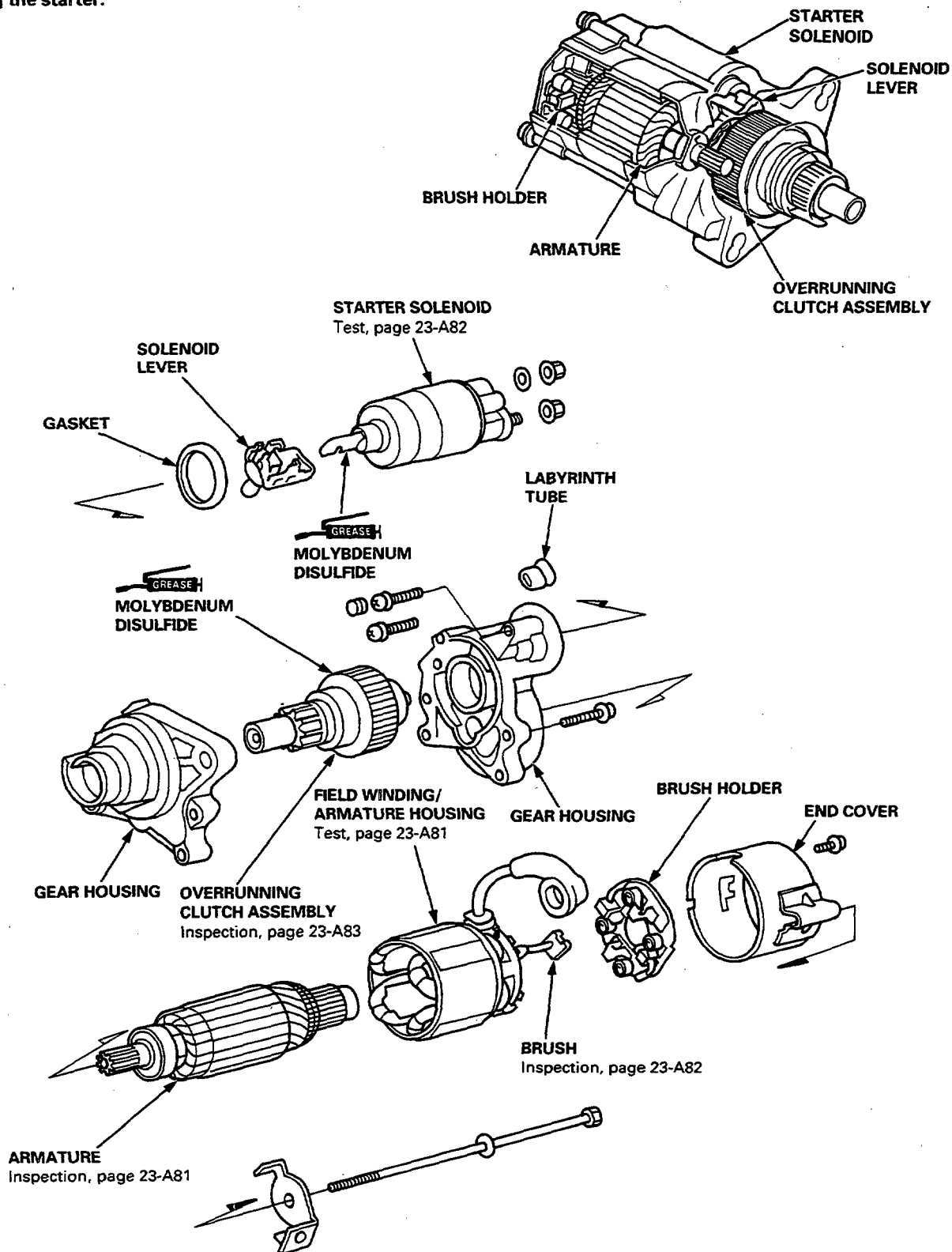
NOTE: When installing the starter cable, make sure that the crimped side of the ring terminal is facing out.



Starting System

Starter Overhaul (Valeo)

CAUTION: Disconnect the battery negative cable before removing the starter.

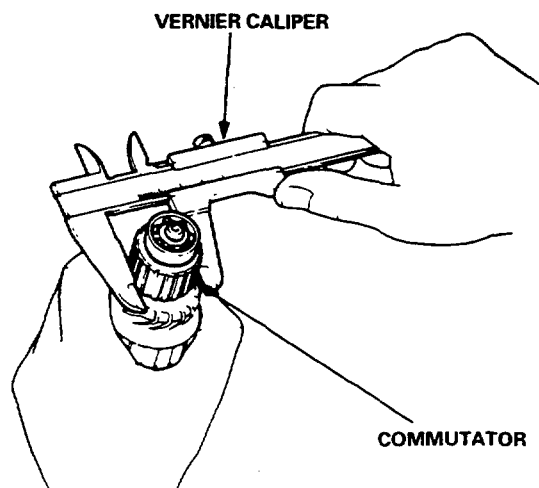




Armature Inspection

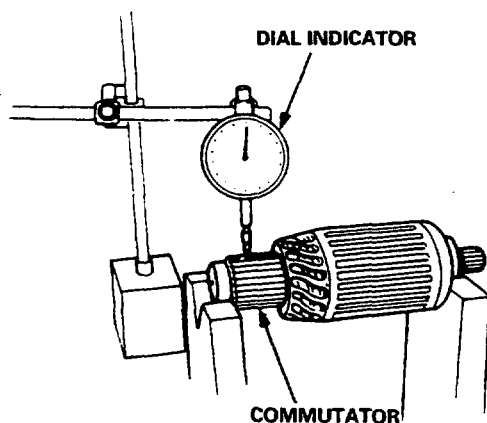
Commutator Diameter:

Manufacturer	Standard (NEW)	Service Limit
Valeo	28.0 – 28.1 mm (1.102 – 1.106 in)	27.5 mm (1.083 in)



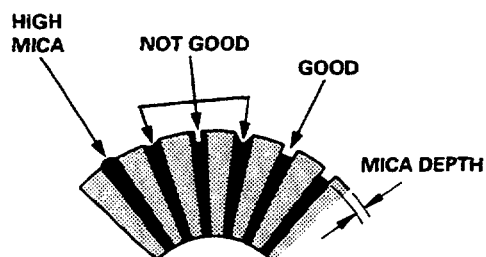
Commutator Runout:

Manufacturer	Standard (NEW)	Service Limit
Valeo	0 – 0.02 mm (0.0008 in)	0.05 mm (0.002 in)



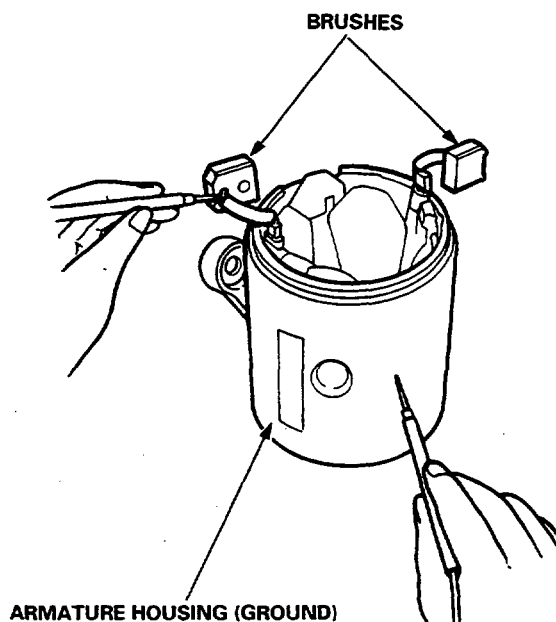
Commutator Mica Depth:

Manufacturer	Standard (NEW)	Service Limit
Valeo	0.4 – 0.5 mm (0.016 – 0.02 in)	0.15 mm (0.006 in)



Starter Field Winding Test








1. Check for continuity between the brushes. If there's 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.

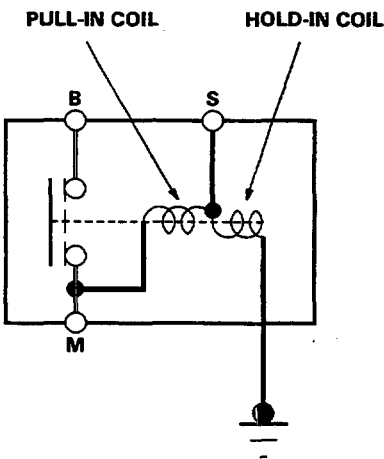
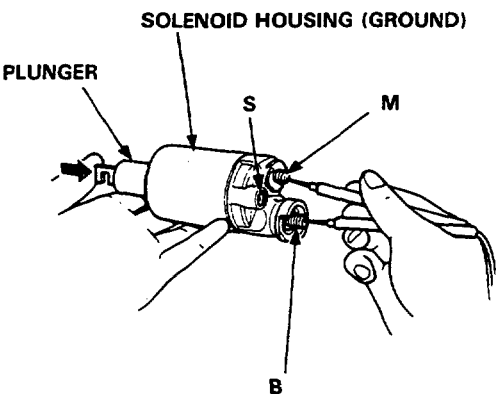


Starting System

Starter Solenoid Test

- 1. Remove the starter solenoid.
- 2. Check for continuity between the terminals in each solenoid plunger position according to the table.

Terminal Position	B	M	S	Housing
RELEASED				
PUSHED				

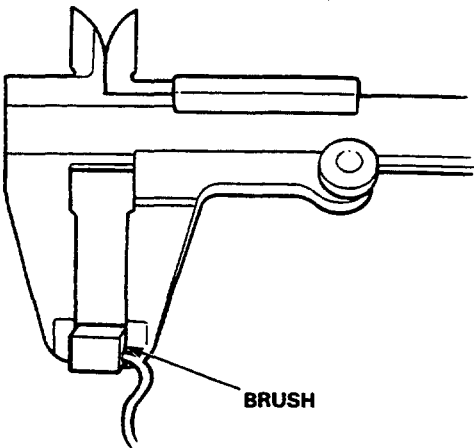


Starter Brush Inspection

Measure the brush length. If it is less than the service limit, replace the armature housing and brush holder assembly.

Brush Length

Manufacturer	Standard (NEW)	Service Limit
Valeo	14.3 – 14.7 mm (0.56 – 0.58 in)	9.5 mm (0.37 in)

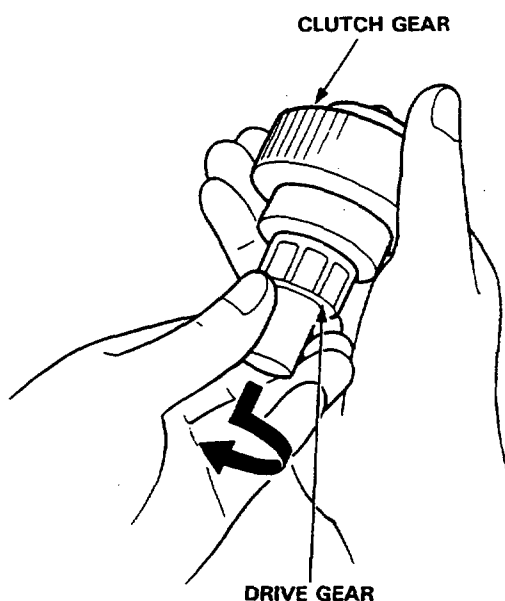


NOTE: To seat new brushes after installing them in their holders, slip a strip of #500 or #600 sandpaper, with the grit side up, over the commutator, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.



Overrunning Clutch Inspection

1. Slide the overrunning clutch along the shaft. Does it move freely? If not, replace it.
2. Rotate the overrunning clutch both ways. Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction or it locks in both directions, replace it.

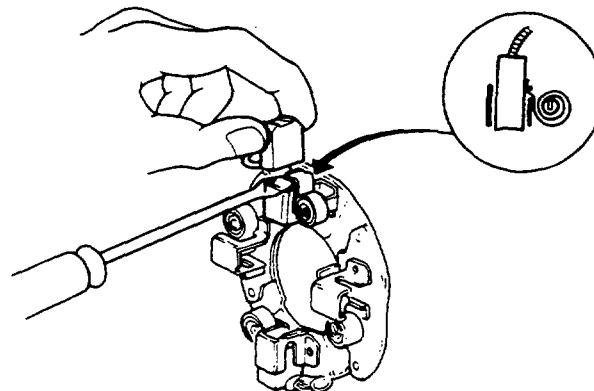


3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly; the gear is not available separately.
4. Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

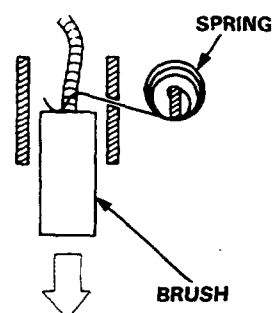
Starter Reassembly

Reassemble the starter in the reverse order of disassembly.

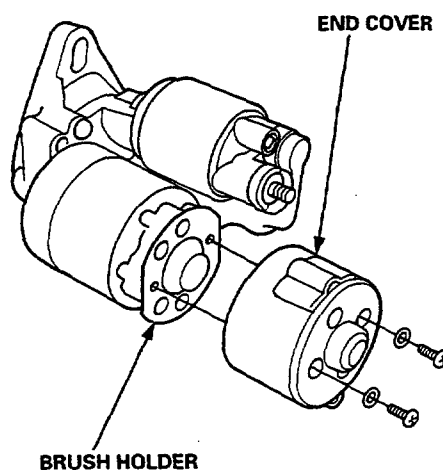
1. Pry back each brush spring with a screwdriver, then position the brush about halfway out of its holder, and release the spring to hold it there.



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.



Starting System

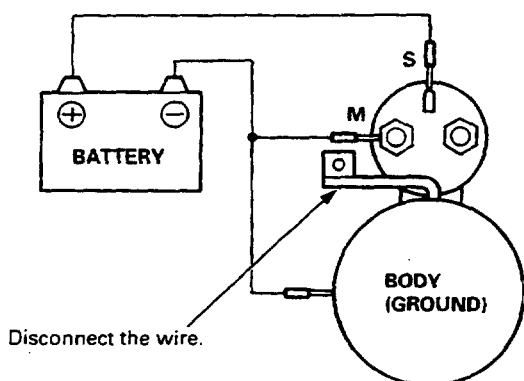
Performance Test

NOTE: Before starting the following checks, disconnect the wire from terminal M, and make a connection as described below using as heavy a wire as possible (preferably equivalent to the wire used for the car).

Pull-in Coil Test:

Connect the battery as shown. If the starter pinion pops out, it is working properly.

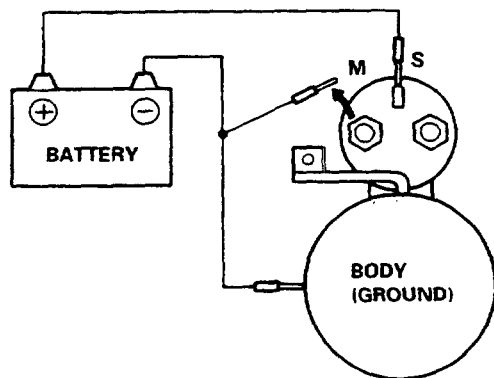
CAUTION: Do not leave the battery connected for more than 10 seconds.



Hold-in Coil Test:

Disconnect the battery from the M terminal. If the pinion does not retract, the hold-in coil is working properly.

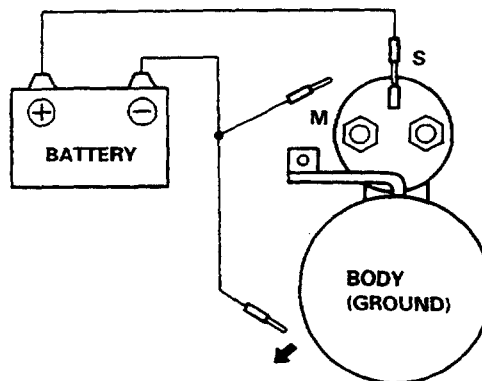
CAUTION: Do not leave the battery connected for more than 10 seconds.



Retracting Test:

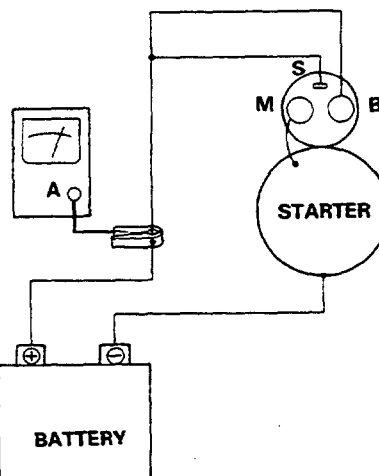
Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly.

CAUTION: Do not leave the battery connected for more than 10 seconds.



Starter No-load Test:

1. Clamp the starter firmly in a vise.
2. Connect the starter to the battery as described in the diagram below, and confirm that the motor starts and keeps rotating.



3. If the electric current and motor speed meet the specifications when the battery voltage is at 11 V, the starter is working properly.

Specifications:

Valeo (1.0 kW)	100 A or less (Electric current), 3000 rpm (min ⁻¹) or more (Motor speed)
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