STARTER

CONTENTS

page

GENERAL INFORMATION
INTRODUCTION 1
DESCRIPTION AND OPERATION
SUPPLY CIRCUIT AND CONTROL CIRCUIT 1
DIAGNOSIS AND TESTING
CONTROL CIRCUIT TEST 1
FEED CIRCUIT RESISTANCE TEST 3
FEED CIRCUIT TEST 4

page

REMOVAL AND INSTALLATION
STARTER—2.4L ENGINE 5
STARTER—3.0L ENGINE 6
STARTER—3.3/3.8L ENGINE 6
SPECIFICATIONS
STARTER 7
TORQUE 7

GENERAL INFORMATION

INTRODUCTION

The starting system has (Fig. 1):

- Ignition switch
- Starter relay
- Powertrain Control Module (PCM) double start override
- Neutral starting and back up switch with automatic transmissions only
- Wiring harness
- Battery
- Starter motor with an integral solenoid
- Positive Temperature Coefficient (PTC) is the circuit protection for the ignition feed to the starter relay coil. The PTC is located in the Junction Block.

These components form two separate circuits. A high amperage circuit that feeds the starter motor up to 300+ amps, and a control circuit that operates on less than 20 amps.

DESCRIPTION AND OPERATION

SUPPLY CIRCUIT AND CONTROL CIRCUIT

The starter system consists of two separate circuits:

- A high amperage supply to feed the starter motor.
- A low amperage circuit to control the starter solenoid.

DIAGNOSIS AND TESTING

CONTROL CIRCUIT TEST

The starter control circuit has:

- Starter solenoid
- Starter relay

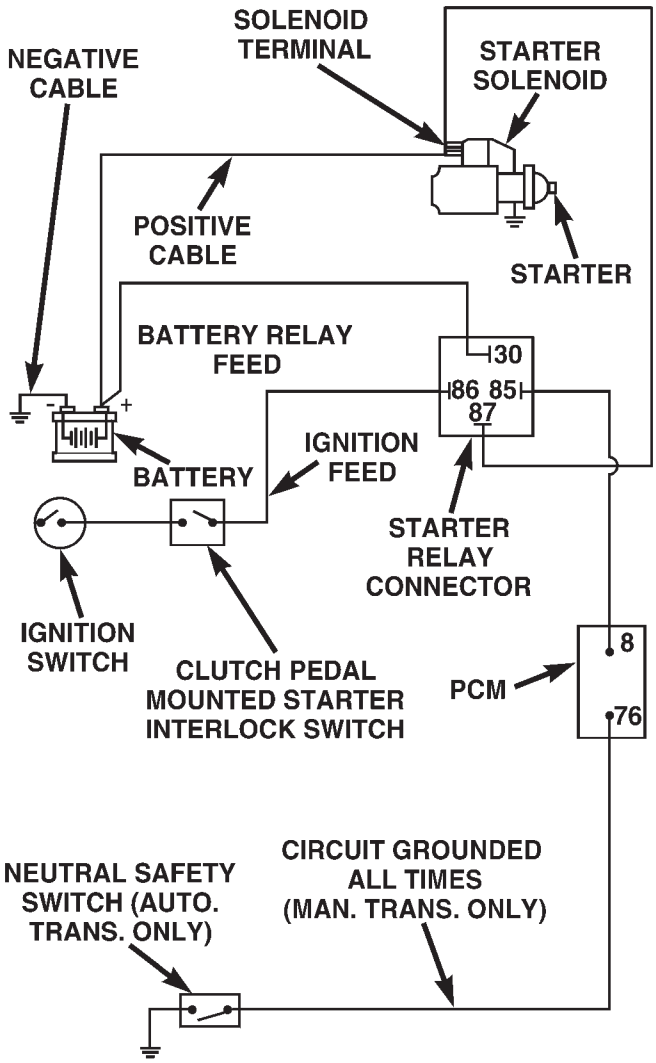


Fig. 1 Starting System Components

DIAGNOSIS AND TESTING (Continued)

- Transmission range sensor, or Park/Neutral Position switch with automatic transmissions
- Clutch Pedal Position Switch with manual transmissions
- Ignition switch
- Battery
- All related wiring and connections

CAUTION: Before performing any starter tests, the ignition and fuel systems must be disabled.

- To disable ignition and fuel systems, disconnect the Automatic Shutdown Relay (ASD). The ASD relay is located in the in the Power Distribution Center (PDC). Refer to the PDC cover for the proper relay location.

STARTER SOLENOID

WARNING: CHECK TO ENSURE THAT THE TRANSMISSION IS IN THE PARK POSITION WITH THE PARKING BRAKE APPLIED

(1) Verify battery condition. Battery must be in good condition with a full charge before performing any starter tests. Refer to Battery Tests.

(2) Perform Starter Solenoid test BEFORE performing the starter relay test.

(3) Raise the vehicle.

(4) Perform a visual inspection of the starter/starter solenoid for corrosion, loose connections or faulty wiring.

(5) Lower the vehicle.

(6) Locate and remove the starter relay from the Power Distribution Center (PDC). Refer to the PDC label for relay identification and location.

(7) Connect a remote starter switch or a jumper wire between the remote battery positive post and terminal 87 of the starter relay connector.

(a) If engine cranks, starter/starter solenoid is good. Go to the Starter Relay Test.

(b) If engine does not or solenoid chatters, check wiring and connectors from starter relay to starter solenoid for loose or corroded connections. Particularly at starter terminals.

(c) Repeat test. If engine still fails to crank properly, trouble is within starter or starter mounted solenoid, and replace starter.

STARTER RELAY

WARNING: CHECK TO ENSURE THAT THE TRANSMISSION IS IN THE PARK POSITION/NEUTRAL WITH THE PARKING BRAKE APPLIED

RELAY TEST

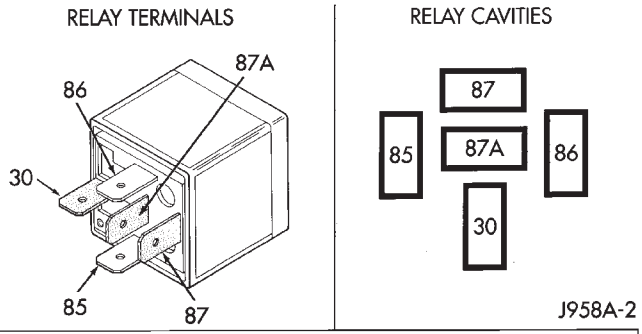
The starter relay is located in the Power Distribution Center (PDC) in the engine compartment. Refer to the PDC label for relay identification and location.

Remove the starter relay from the PDC as described in this group to perform the following tests:

(1) A relay in the de-energized position should have continuity between terminals 87A and 30, and no continuity between terminals 87 and 30. If OK, go to Step 2. If not OK, replace the faulty relay.

(2) Resistance between terminals 85 and 86 (electromagnet) should be 75 ±5 ohms. If OK, go to Step 3. If not OK, replace the faulty relay.

(3) Connect a battery B+ lead to terminals 86 and a ground lead to terminal 85 to energize the relay. The relay should click. Also test for continuity between terminals 30 and 87, and no continuity between terminals 87A and 30. If OK, refer to Relay Circuit Test procedure. If not OK, replace the faulty relay.



TERMINAL LEGEND	
NUMBER	IDENTIFICATION
30	COMMON FEED
85	COIL GROUND
86	COIL BATTERY
87	NORMALLY OPEN
87A	NORMALLY CLOSED

Starter Relay

RELAY CIRCUIT TEST

(1) The relay common feed terminal cavity (30) is connected to battery voltage and should be hot at all times. If OK, go to Step 2. If not OK, repair the open circuit to the PDC fuse as required.

(2) The relay normally closed terminal (87A) is connected to terminal 30 in the de-energized position, but is not used for this application. Go to Step 3.

(3) The relay normally open terminal (87) is connected to the common feed terminal (30) in the energized position. This terminal supplies battery voltage to the starter solenoid field coils. There should be continuity between the cavity for relay terminal 87 and the starter solenoid terminal at all times. If OK, go to Step 4. If not OK, repair the open circuit to the starter solenoid as required.

(4) The coil battery terminal (86) is connected to the electromagnet in the relay. It is energized when the ignition switch is held in the Start position. On

DIAGNOSIS AND TESTING (Continued)

vehicles with a manual transmission, the clutch pedal must be fully depressed for this test. Check for battery voltage at the cavity for relay terminal 86 with the ignition switch in the Start position, and no voltage when the ignition switch is released to the On position. If OK, go to Step 5. If not OK with an automatic transmission, check for an open or short circuit to the ignition switch and repair, if required. If the circuit to the ignition switch is OK, see the Ignition Switch Test procedure in this group. If not OK with a manual transmission, check the circuit between the relay and the clutch pedal position switch for an open or a short. If the circuit is OK, see the Clutch Pedal Position Switch Test procedure in this group.

(5) The coil ground terminal (85) is connected to the electromagnet in the relay. On vehicles with an automatic transmission, it is grounded through the park/neutral position switch only when the gearshift selector lever is in the Park or Neutral positions. On vehicles with a manual transmission, it is grounded at all times. Check for continuity to ground at the cavity for relay terminal 85. If not OK with an automatic transmission, check for an open or short circuit to the park/neutral position switch and repair, if required. If the circuit is OK, see the Park/Neutral Position Switch Test procedure in this group. If not OK with a manual transmission, repair the circuit to ground as required.

SAFETY SWITCHES

For diagnostics,

- Clutch Pedal Position Switch, refer to Group 6, Clutch.
- Park/Neutral Position Switch, refer to Group 21, Transaxle

IGNITION SWITCH

After testing starter solenoid and relay, test ignition switch and wiring. Refer to Group 8D, Ignition Systems or Group 8W, Wiring Diagrams. Check all wiring for opens or shorts, and all connectors for being loose or corroded.

BATTERY

Refer to Group 8A, Battery for proper procedures.

ALL RELATED WIRING AND CONNECTORS

Refer to Group 8W, Wiring Diagrams,

FEED CIRCUIT RESISTANCE TEST

Before proceeding with this operation, review Diagnostic Preparation and Starter Feed Circuit Tests. The following operation will require a voltmeter, accurate to 1/10 of a volt.

CAUTION: Before performing any starter tests, the ignition and fuel systems must be disabled.

(1) To disable the ignition and fuel systems, disconnect the Automatic Shutdown Relay (ASD). The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC cover for proper relay location.

(2) With all wiring harnesses and components properly connected, perform the following:

(a) Connect the negative lead of the voltmeter to the battery negative post, and positive lead to the battery negative cable clamp (Fig. 2). Rotate and hold the ignition switch in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between cable clamp and post.

(b) Connect positive lead of the voltmeter to the battery positive post, and negative lead to the battery positive cable clamp. Rotate and hold the ignition switch key in the START position. Observe the voltmeter. If voltage is detected, correct poor contact between the cable clamp and post.

(c) Connect negative lead of voltmeter to battery negative terminal, and positive lead to engine

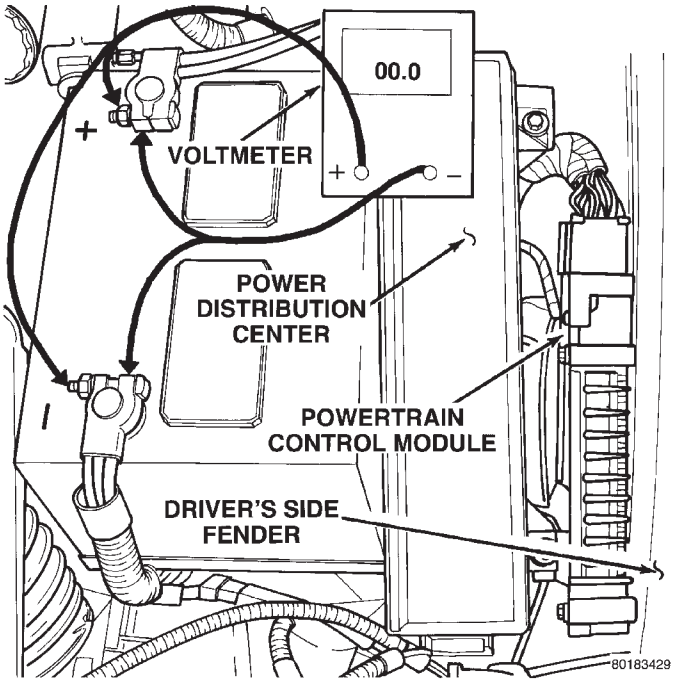


Fig. 2 Test Battery Connection Resistance

DIAGNOSIS AND TESTING (Continued)

block near the battery cable attaching point (Fig. 3). Rotate and hold the ignition switch in the START position. If voltage reads above 0.2 volt, correct poor contact at ground cable attaching point. If voltage reading is still above 0.2 volt after correcting poor contacts, replace ground cable.

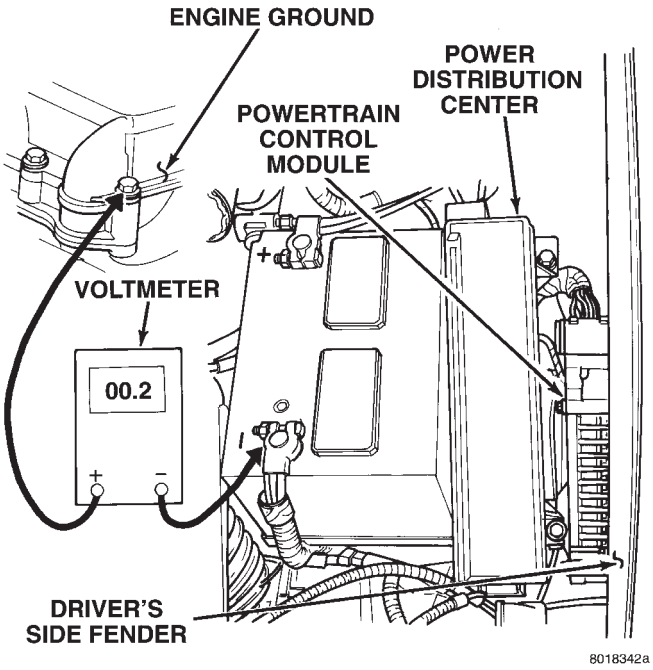


Fig. 3 Test Ground Circuit Resistance

(3) Connect positive voltmeter lead to the starter motor housing and the negative lead to the battery negative terminal (Fig. 4). Hold the ignition switch key in the START position. If voltage reads above 0.2 volt, correct poor starter to engine ground.

(a) Connect the positive voltmeter lead to the battery positive terminal, and negative lead to battery cable terminal on starter solenoid (Fig. 5). Rotate and hold the ignition switch in the START position. If voltage reads above 0.2 volt, correct poor contact at battery cable to solenoid connection. If reading is still above 0.2 volt after correcting poor contacts, replace battery positive cable.

(b) If resistance tests do not detect feed circuit failures, remove the starter motor and go to Starter Solenoid Test in this Group.

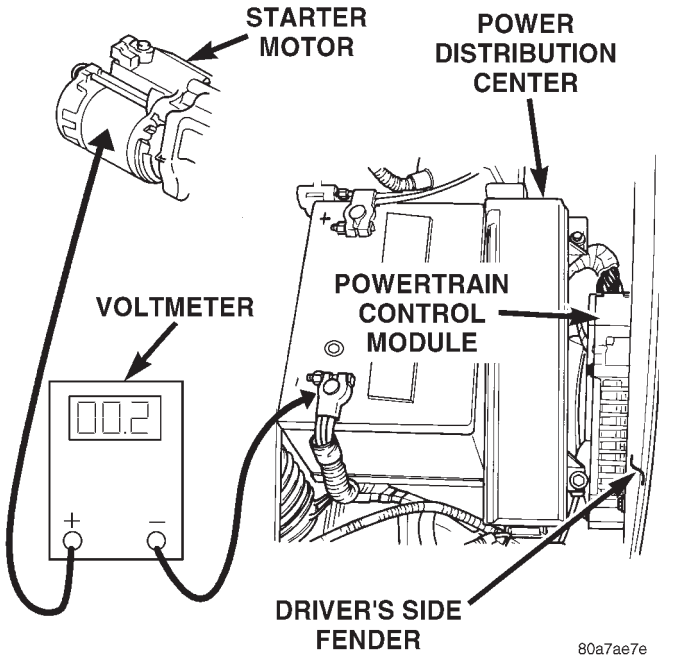


Fig. 4 Test Starter Motor Ground

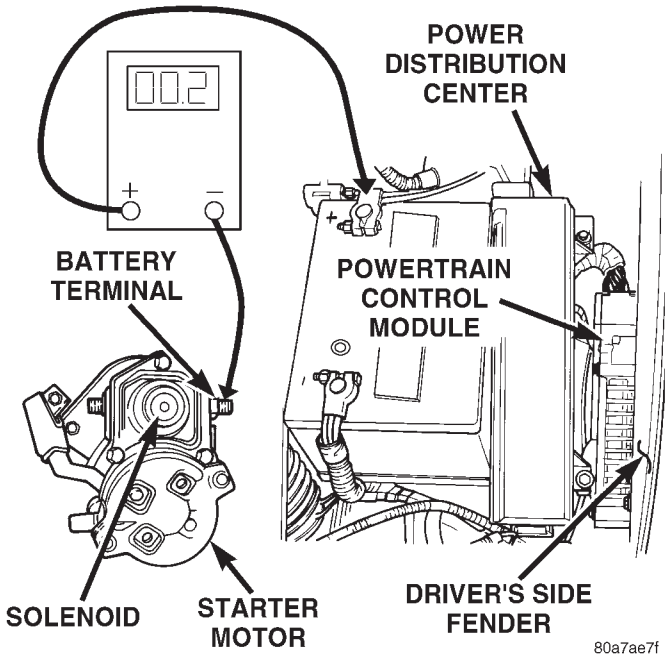


Fig. 5 Test Battery Positive Cable Resistance

FEED CIRCUIT TEST

The following procedure will require a suitable volt-ampere tester (Fig. 6).

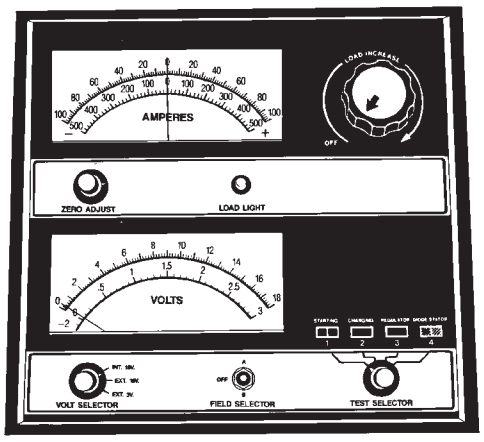


Fig. 6 Volt Ampere Tester

DIAGNOSIS AND TESTING (Continued)

CAUTION: Before performing any starter tests, the ignition and fuel systems must be disabled.

(1) Connect a volt-ampere tester to the battery terminals (Fig. 7). Refer to the operating instructions provided with the tester being used.

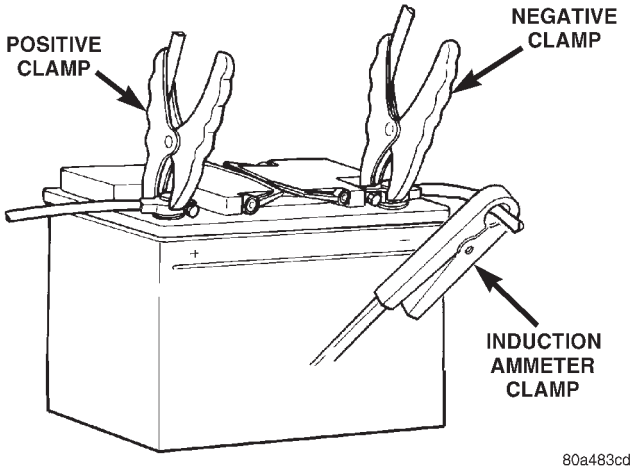


Fig. 7 Volt-Ampere Tester Connections

(2) To disable the ignition and fuel systems, disconnect the Automatic Shutdown Relay (ASD). The ASD relay is located in the Power Distribution Center (PDC). Refer to the PDC cover for proper relay location. The 2.5L Diesel Engine, to disable the engine from starting, disconnect wire connector from the Fuel Solenoid.

(3) Verify that all lights and accessories are OFF, and the transmission shift selector is in the PARK position or with the clutch pedal depressed and SET parking brake.

CAUTION: Do not overheat the starter motor or draw the battery voltage below 9.6 volts during cranking operations.

(4) Rotate and hold the ignition switch in the START position. Observe the volt-ampere tester (Fig. 6).

- If voltage reads above 9.6 volts, and amperage draw reads above 280 amps or the Diesel engine above 450 amps, check for engine seizing or faulty starter.
- If voltage reads 12.4 volts or greater and amperage reads 0 to 10 amps, check for corroded cables and/or bad connections.
- Voltage below 9.6 volts and amperage draw above 300 amps or Diesel engine above 500 amps, the problem is the starter. Replace the starter refer to starter removal.

(5) After the starting system problems have been corrected, verify the battery state-of-charge and charge battery if necessary. Disconnect all testing equipment and connect ASD relay or the Fuel Solenoid. Start the vehicle several times to assure the problem has been corrected.

REMOVAL AND INSTALLATION

STARTER—2.4L ENGINE

REMOVAL

(1) Release hood latch and open hood.

(2) Disconnect battery negative cable (Fig. 8).

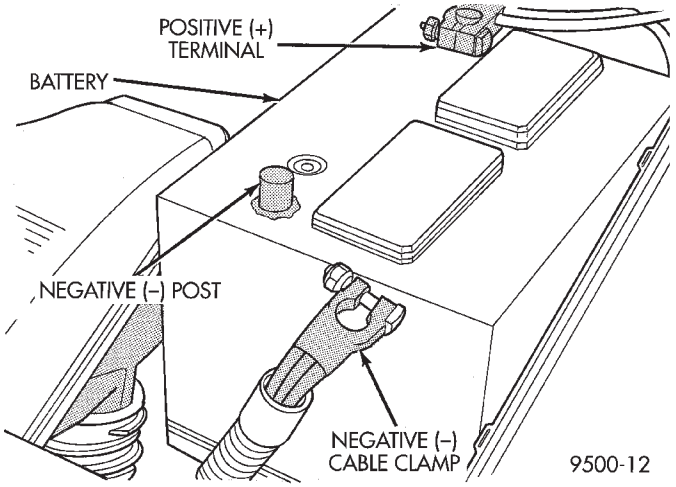


Fig. 8 Battery Negative Cable

(3) Hoist and support vehicle on safety stands.

(4) Disconnect solenoid wire connector from terminal.

(5) Remove nut holding B+ wire to terminal.

(6) Disconnect solenoid and B+ wires from starter terminals.

(7) Remove bolts holding starter to transaxle bellhousing (Fig. 9).

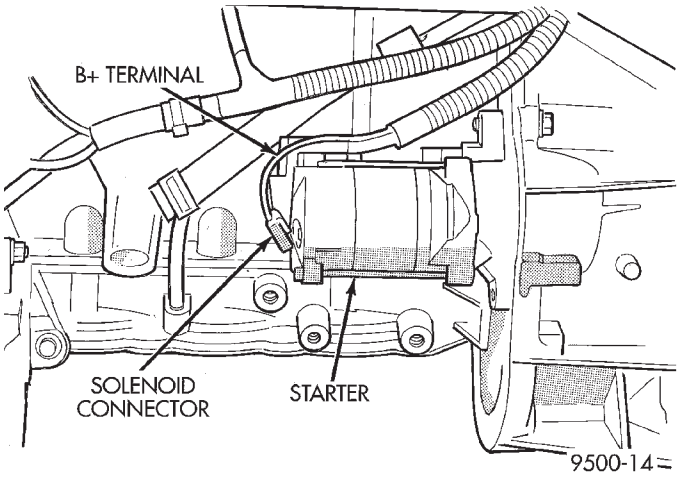


Fig. 9 Starter–2.4L Engine

(8) Remove starter.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Place starter in position on vehicle.
(2) Install bolts to hold starter to transaxle bellhousing.
(3) Place solenoid and B+ wires in position on starter terminals.
(4) Install nut to hold B+ wire to terminal.
(5) Connect solenoid wire connector onto terminal.
(6) Lower vehicle.
(7) Connect battery negative cable.
(8) Verify starter operation.

STARTER—3.0L ENGINE

REMOVAL

(1) Release hood latch and open hood.
(2) Disconnect battery negative cable (Fig. 8).
(3) Hoist and support vehicle on safety stands.
(4) Remove nut holding solenoid wire to terminal (Fig. 10).

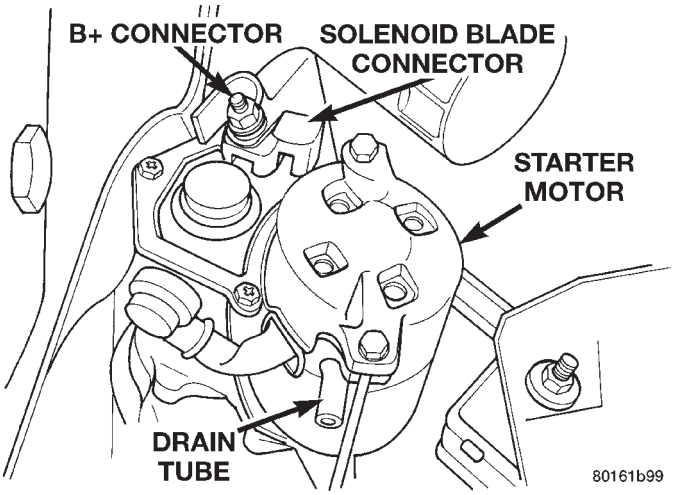


Fig. 10 Wire Connectors

(5) Remove nut holding B+ wire to terminal (Fig. 6)
(6) Disconnect solenoid and B+ wires from starter terminals.
(7) Remove bolts holding starter to transaxle bellhousing (Fig. 11).
(8) Remove starter.

INSTALLATION

(1) Place starter in position on vehicle.
(2) Install bolts to hold starter to transaxle bellhousing.
(3) Place solenoid and B+ wires in position on starter terminals.
(4) Install nut to hold B+ wire to terminal.
(5) Install nut to hold solenoid wire to terminal.
(6) Lower vehicle.
(7) Connect battery negative cable.
(8) Verify starter operation.

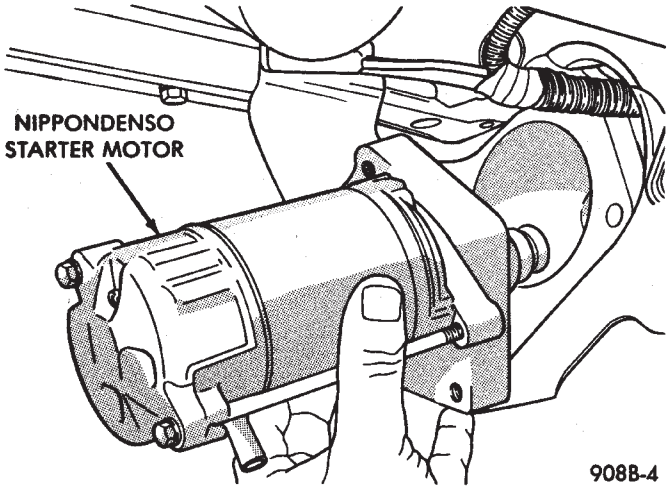


Fig. 11 Starter–3.0L Engine

STARTER—3.3/3.8L ENGINE

REMOVAL

(1) Release hood latch and open hood.
(2) Disconnect battery negative cable (Fig. 8).
(3) Hoist and support vehicle on safety stands.
(4) Remove nut holding B+ terminal to starter solenoid (Fig. 12).

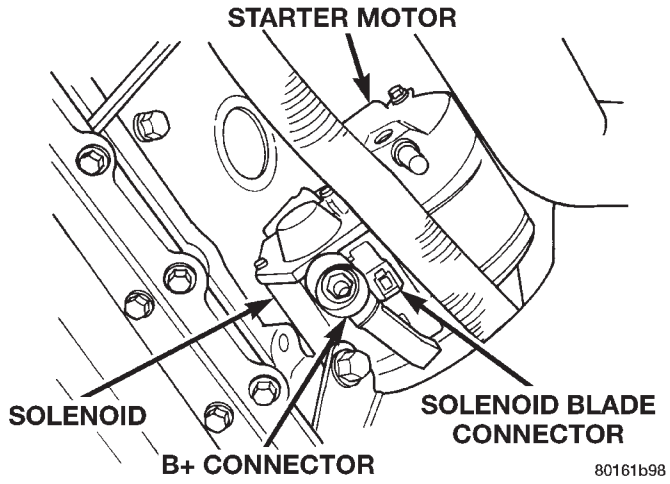


Fig. 12 Wire Connectors

(5) Disconnect solenoid connector from starter.
(6) Remove bolts holding starter to transaxle bellhousing (Fig. 13).
(7) Remove starter from bellhousing (Fig. 14).
(8) Separate starter spacer from transaxle bellhousing.

INSTALLATION

(1) Place starter spacer in position on transaxle bellhousing, flange toward flywheel.
(2) Place starter in position on bellhousing.
(3) Install bolts to hold starter to transaxle bellhousing.

REMOVAL AND INSTALLATION (Continued)

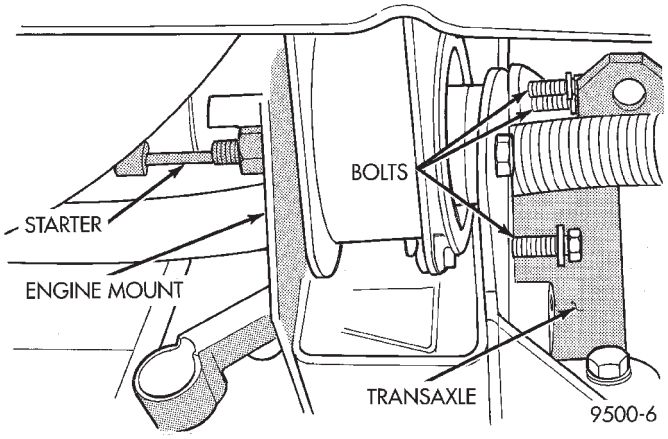


Fig. 13 Starter Bolts

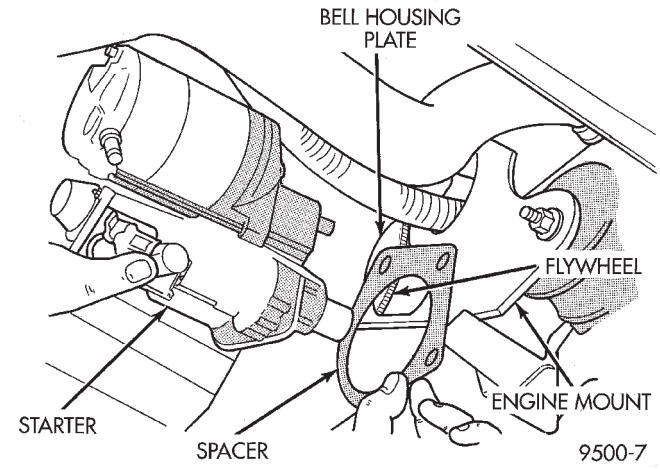


Fig. 14 Starter–3.3/3.8L Engine

(4) Connect solenoid connector into starter.
(5) Install nut to hold B+ terminal to starter solenoid.
(6) Lower vehicle.
(7) Connect battery negative cable.
(8) Verify starter operation.

SPECIFICATIONS

STARTER

MANUFACTURER	NIPPONDENSO
Engine Application	2.4L /3.0L /3.3/3.8L
Power rating	1.2 Kw
Voltage	12 VOLTS
No. of Fields	4
No. of Poles	4
Brushes	4
Drive	Conventional Gear Train
Free running Test	
Voltage	11
Amperage Draw	73 Amp
Minimum Speed	3401 RPM
SolenoidClosing Voltage	7.5 Volts
Cranking Amperage Draw test	150 - 200 Amps.

Engine should be up to operating temperature. Extremely heavy oil or tight engine will increase starter amperage draw.

TORQUE

DESCRIPTION	TORQUE
Starter Mounting Bolts	54 N·m (40 ft. lbs.)
Starter Solenoid Battery Nut	10 N·m (90 in. lbs.)