

595SLE/595LSP LOADER BACKHOE SERVICE MANUAL

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Section

1001

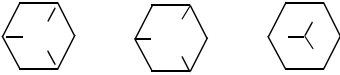
STANDARD TORQUE SPECIFICATIONS AND LOCTITE PRODUCT CHART

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TORQUES SPECIFICATIONS (DECIMAL HARDWARE)

Use the torques in this chart when special torques are not given. These torques apply to fasteners with both UNC and UNF threads as received from suppliers dry, or when lubricated with engine oil. Not applicable if special graphities, Molydisulfide greases, or other extreme pressure lubricants are used.

Grade 5 Bolts, Nuts and Studs		
		
Size	Pound-inches	Newton metres
1/4 inch	8 to 11	12 to 15
5/16 inch	17 to 21	23 to 28
3/8 inch	35 to 42	48 to 57
7/16 inch	54 to 64	73 to 87
1/2 inch	80 to 96	109 to 130
9/16 inch	110 to 132	149 to 179
5/8 inch	150 to 180	203 to 244
3/4 inch	270 to 324	366 to 439
7/8 inch	400 to 480	542 to 651
1.0 inch	580 to 696	787 to 944
1-1/8 inchs	800 to 880	1085 to 1193
1-1/4 inchs	1120 to 1240	1519 to 1681
1-3/8 inchs	1460 to 1680	190 to 2278
1-1/2 inchs	1940 to 2200	2631 to 2983

Grade 8 Bolts, Nuts and Studs		
		
Size	Pound-inches	Newton metres
1/4 inch	12 to 15	16 to 20
5/16 inch	24 to 29	33 to 39
3/8 inch	45 to 54	61 to 73
7/16 inch	70 to 84	95 to 114
1/2 inch	110 to 132	149 to 179
9/16 inch	160 to 192	217 to 260
5/8 inch	220 to 264	298 to 358
3/4 inch	380 to 456	515 to 618
7/8 inch	600 to 720	814 to 976
1.0 inch	900 to 1080	1220 to 1465
1-1/8 inchs	1280 to 1440	1736 to 1953
1-1/4 inchs	1820 to 2000	2468 to 2712
1-3/8 inchs	2380 to 2720	3227 to 3688
1-1/2 inchs	3160 to 3560	4285 to 4827

NOTE : Use thick nuts with Grade 8 bolts.

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TORQUE SPECIFICATIONS (METRIC HARDWARE)

Use the following torques when specifications are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil. These values do not apply if graphite or Molydisulfide grease or oil is used.

Grade 8.8 Bolts, Nuts and Studs		
		
Size	Pound-inches	Newton metres
M4	2 to 3	3 to 4
M5	5 to 6	7 to 8
M6	8 to 9	11 to 12
M8	19 to 23	26 to 31
M10	38 to 45	52 to 61
M12	66 to 79	90 to 107
M14	106 to 127	144 to 172
M16	160 to 200	217 to 271
M20	320 to 380	434 to 515
M24	500 to 600	675 to 815
M30	920 to 1100	1250 to 1500
M36	1600 to 1950	2175 to 2600

Grade 10.9 Bolts, Nuts and Studs		
		
Size	Pound-inches	Newton metres
M4	3 to 4	4 to 5
M5	7 to 8	9 to 11
M6	11 to 13	15 to 18
M8	27 to 32	37 to 43
M10	54 to 64	73 to 87
M12	93 to 112	125 to 150
M14	149 to 179	200 to 245
M16	230 to 280	310 to 380
M20	450 to 540	610 to 730
M24	780 to 940	1050 to 1275
M30	1470 to 1770	2000 to 2400
M36	2580 to 3090	3500 to 4200

Grade 12.9 Bolts, Nuts and Studs



Usually the torque values specified for grade 10.9 fasteners can be used satisfactorily on grade 12.9 fasteners.

TORQUE SPECIFICATIONS (STEEL HYDRAULIC FITTINGS)

Tube OD Hose ID	Thread size	Pound- inches	Newton metres
37 Degree flare fitting			
1/4 inch/ 6.4 mm	7/16-20	6 to 12	8 to 16
5/16 inch/ 7.9 mm	1/2-20	8 to 16	11 to 22
3/8 inch/ 9.5 mm	9/16-18	10 to 25	14 to 34
1/2 inch/ 12.7 mm	3/4-16	15 to 42	20 to 57
5/8 inch/ 15.9	7/8-14	25 to 58	34 to 79
3/4 inch/ 19.0 mm	1-1/16-12	40 to 80	54 to 108
7/8 inch/ 22.2 mm	1-3/16-12	60 to 100	81 to 135
1.0 inch/ 25.4 mm	1-5/16-12	75 to 117	102 to 158
1-1/4 inch/ 31.8 mm	1-5/8-12	125 to 165	169 to 223
1-1/2 inch/ 38.1 mm	1-7/8-12	210 to 250	285 to 338

Tube OD Hose ID	Thread size	Pound- inches	Newton metres
Straight threads with O-ring			
1/4 inch/ 6.4 mm	7/16-20	12 to 19	16 to 26
5/16 inch/ 7.9 mm	1/2-20	16 to 24	22 to 34
3/8 inch/ 9.5 mm	9/16-18	24 to 40	34 to 54
1/2 inch/ 12.7 mm	3/4-16	42 to 67	57 to 91
5/8 inch/ 15.9	7/8-14	58 to 92	79 to 124
3/4 inch/ 19.0 mm	1-1/16-12	80 to 128	108 to 174
7/8 inch/ 22.2 mm	1-3/16-12	100 to 160	136 to 216
1.0 inch/ 25.4 mm	1-5/16-12	117 to 187	159 to 253
1-1/4 inch/ 31.8 mm	1-5/8-12	165 to 264	224 to 357
1-1/2 inch/ 38.1 mm	1-7/8-12	250 to 400	339 to 542

Split flange mounting screws		
Size	Pound- inches	Newton metres
5/16-18	15 to 20	20 to 27
3/8-16	27 to 40	36 to 53
7/16-14	35 to 45	47 to 61
1/2-13	55 to 65	74 to 88
5/8-11	140 to 150	190 to 203

Section

2000

ENGINE AND RADIATOR REMOVAL AND INSTALLATION

RADIATOR REMOVAL

Put identification tags on all disconnected hoses and wires. Close disconnected hoses and fittings with caps and plugs.

STEP 1

Park the machine on a level surface. Raise the loader and install the support strut to hold the loader.

STEP 2

Open the hood.

STEP 3

Remove the bolts, washers, and nuts from the pivot point on the hood.

STEP 4

Have another person help with the following procedure :

- A. Remove the retainers from the hood struts and disconnect the hood struts from the stud.
- B. Remove the hood from the machine.

STEP 5

Slowly remove the radiator cap.



WARNING : Do not remove the cap when the engine is hot. The circuit is still under pressure and you could be scalded.

NOTE : During installation, fill the radiator and coolant reservoir completely. See Section 1002 for coolant specifications. Start and run the engine until the coolant is at operating temperature. Stop the engine and check for leakage. When the coolant is cold, check the coolant reservoir level. Add coolant as required. Never remove the radiator cap to check the coolant level in the radiator.

STEP 6

Depressurize the hydraulic system as follows see section 8002.

STEP 7

Disconnect the hoses from the hydraulic filter.

STEP 8

Remove and fit blanks to the expansion reservoir hoses.

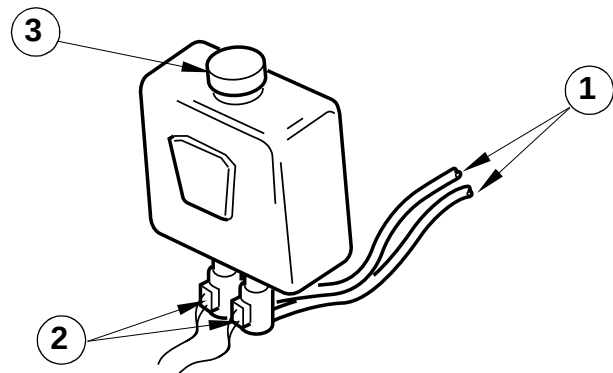
STEP 9

Tag and disconnect the wires on the audible warning device.

STEP 10

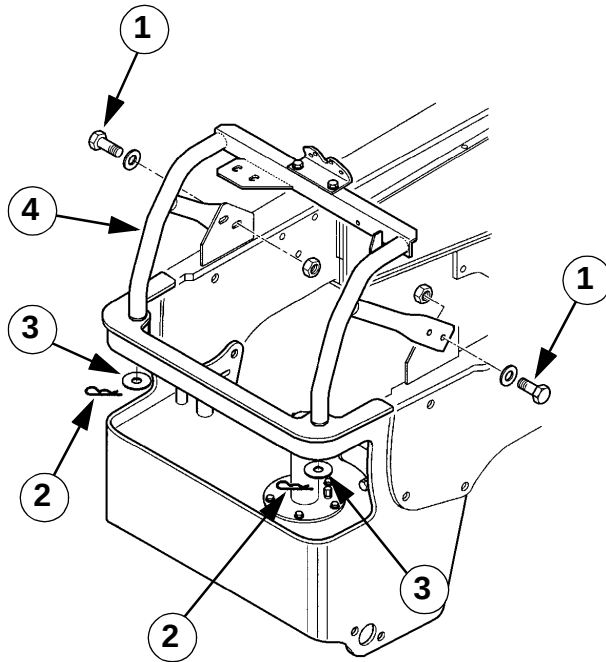
Tag and disconnect the wires on the hydraulic filter obstruction indicator.

STEP 11



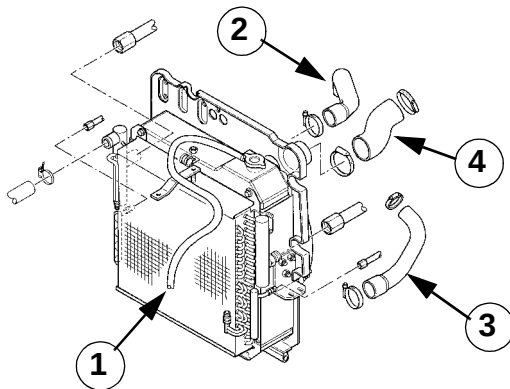
789M250A

Release the fluid pipes (1) and electrical connections (2) to the screen wash bottle (3) and tie back to the chassis.

STEP 12

CI98G516

Remove the hardware (1), the retaining pins (2), the washers (3) and support (4).

STEP 13

CI98G517

Disconnect the overflow hose (1) from the radiator neck.

STEP 14

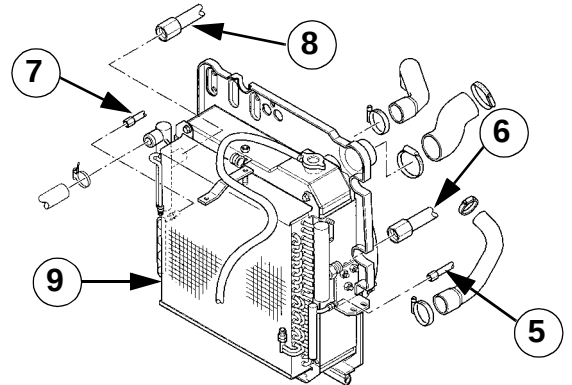
Loosen the clamp and disconnect the upper radiator hose (2).

STEP 15

Loosen the clamp and disconnect the lower radiator hose (3).

STEP 16

Loosen the clamp and disconnect the air cleaner hose (4).

STEP 17

CI98G517

Position a suitable drainage container beneath the hydraulic hose (5) and disconnect the hose from the oil cooler (9).

NOTE : Fit blanks to the hose and the oil cooler connection.

STEP 18

Repeat step (5) for the remaining hydraulic hoses (6), (7) and (8).

STEP 19

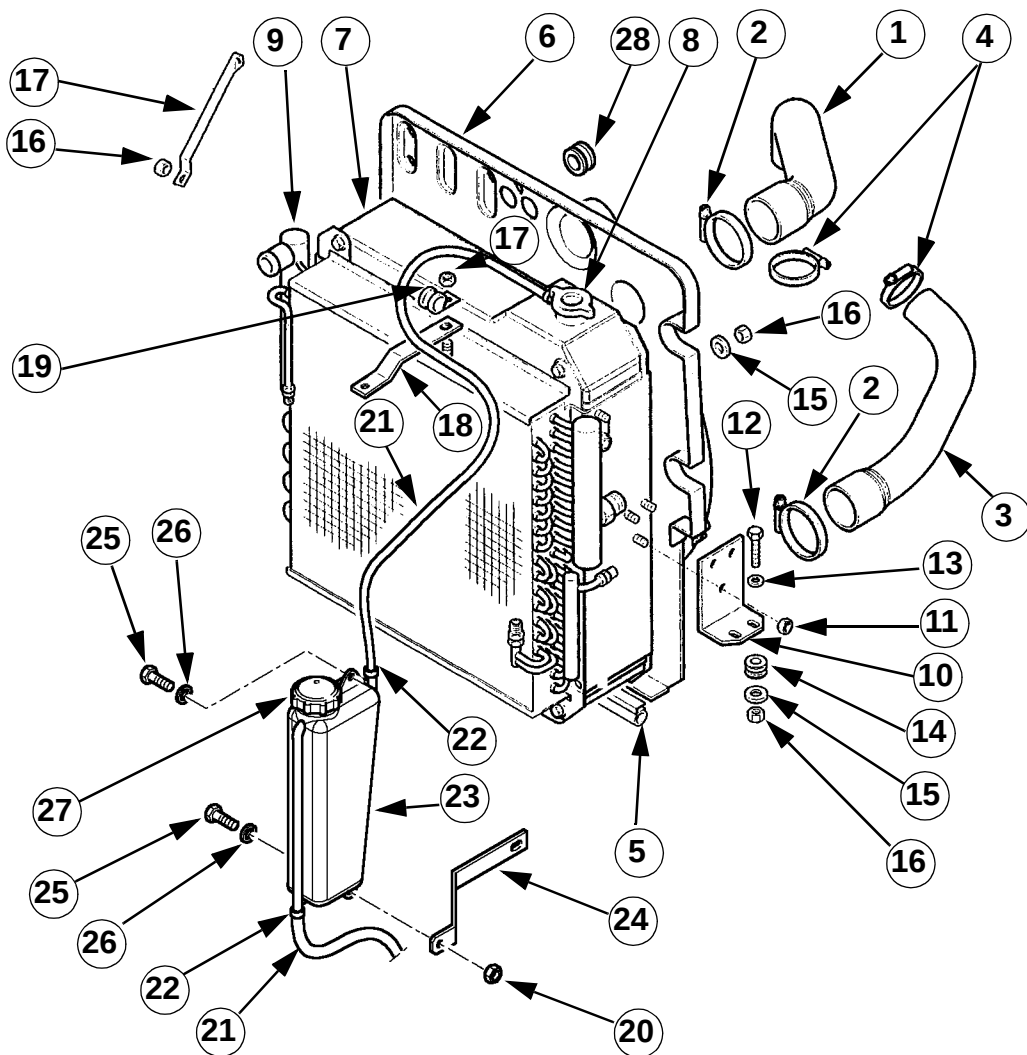
Remove the for radiator retaining screw.

STEP 20

Install a suitable sling around the radiator and remove the radiator.

NOTE : Installation of the radiator is the reverse of removal.

PERSPECTIVE VIEW



- | | |
|----------------|---------------------|
| 1. Hose | 15. Washer |
| 2. Collar | 16. Nut |
| 3. Hose | 17. Bracket |
| 4. Collar | 18. Bracket |
| 5. Seal | 19. Collar |
| 6. Shroud | 20. Nut |
| 7. Radiator | 21. Hose |
| 8. Cap, filler | 22. Clamp |
| 9. Cooler, oil | 23. Tank, expansion |
| 10. Bracket | 24. Bracket |
| 11. Nut | 25. Screw |
| 12. Screw | 26. Washer |
| 13. Washer | 27. Plug |
| 14. Stanchion | 28. Grommet |

CI98G505

ENGINE REMOVAL

Put identification tags on all disconnected hoses and wires. Close disconnected hoses and fittings with caps and plugs.

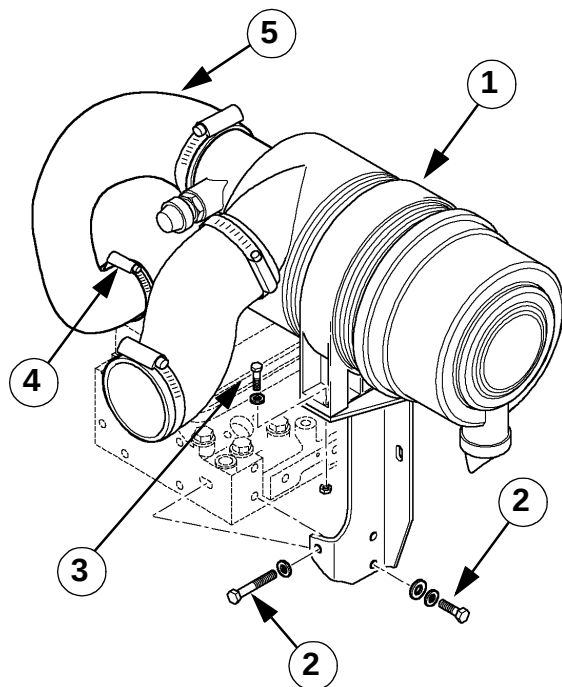
STEP 1

Remove the radiator see page 4.

STEP 2

Disconnect the battery.

STEP 3



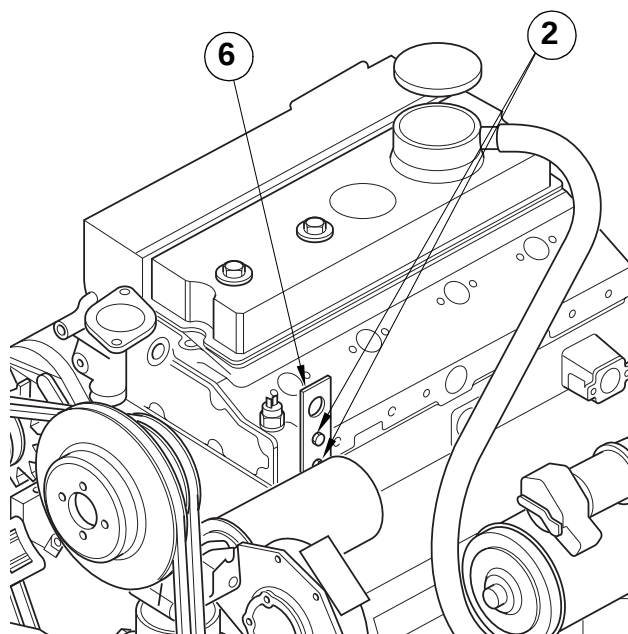
CI98G518

Remove the hose clip (4) from the air filter hose (5) at the turbocharger inlet.

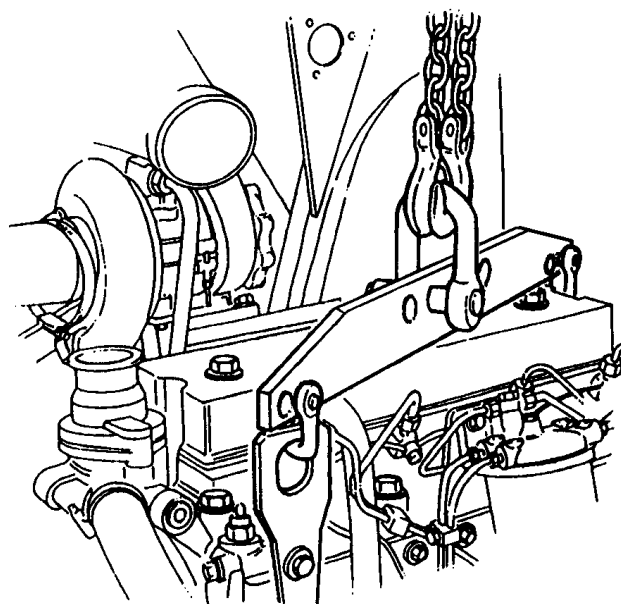
STEP 4

Support the air filter assembly (1) and remove the three bolts (2) from the cylinder head and two bolts (3) from the exhaust bracket. Remove the air filter assembly.

STEP 5

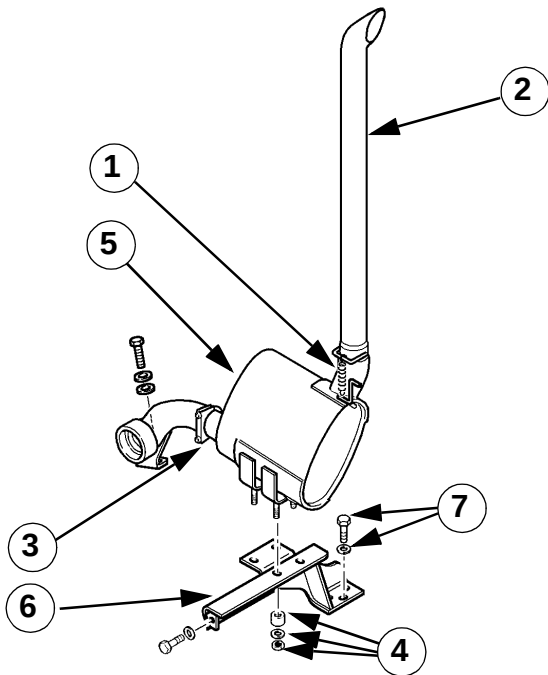


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Install the engine lifting bracket (6) using two of the bolts (2) from the air filter bracket. The bracket is part of the machine tool kit.

STEP 6

CI98G519

Release the spring (1) and remove the exhaust pipe (2).

STEP 7

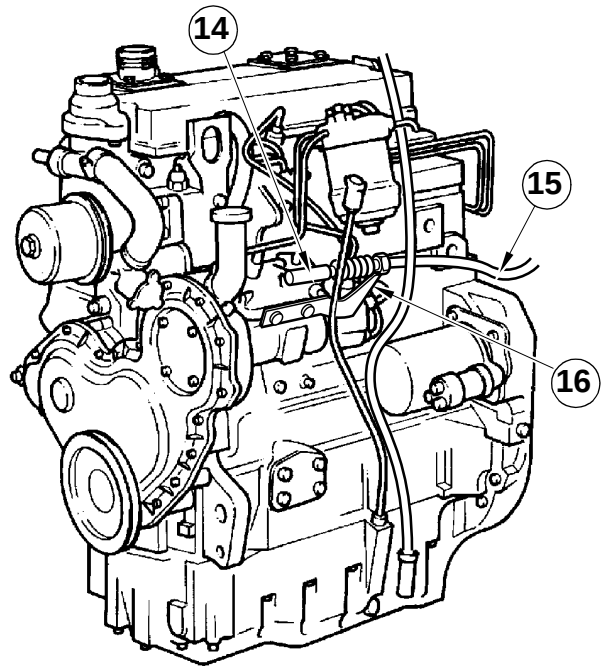
Release the clip (3) on the silencer to turbocharger connection and remove the nuts, washers and spacers (4). Remove the silencer (5) from the bracket (6).

STEP 8

Remove the three bolts and washers (7) from the exhaust bracket and remove the bracket.

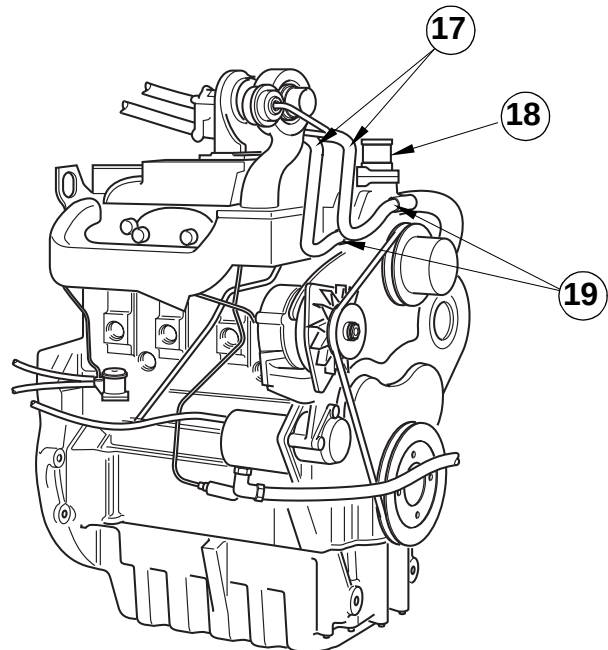
STEP 9

Remove the hydraulic oil pump drive shaft (see section 8004).

STEP 10

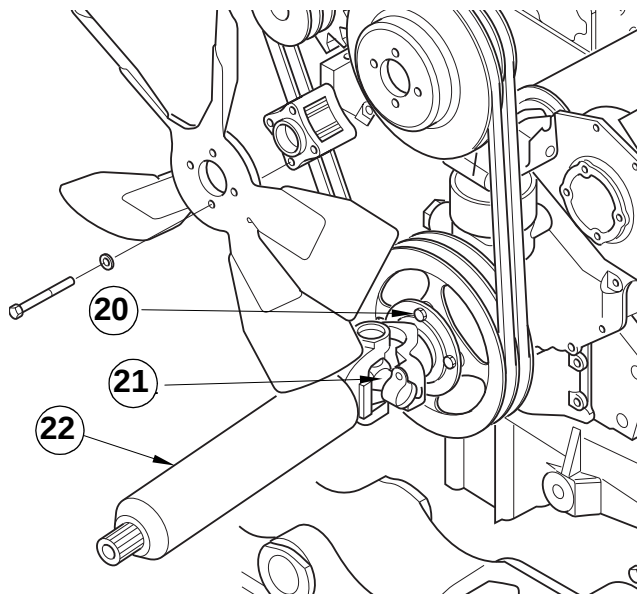
789M259A

Disconnect the throttle cable (15) from the fuel injection pump lever (14) and the bracket (16).

STEP 11

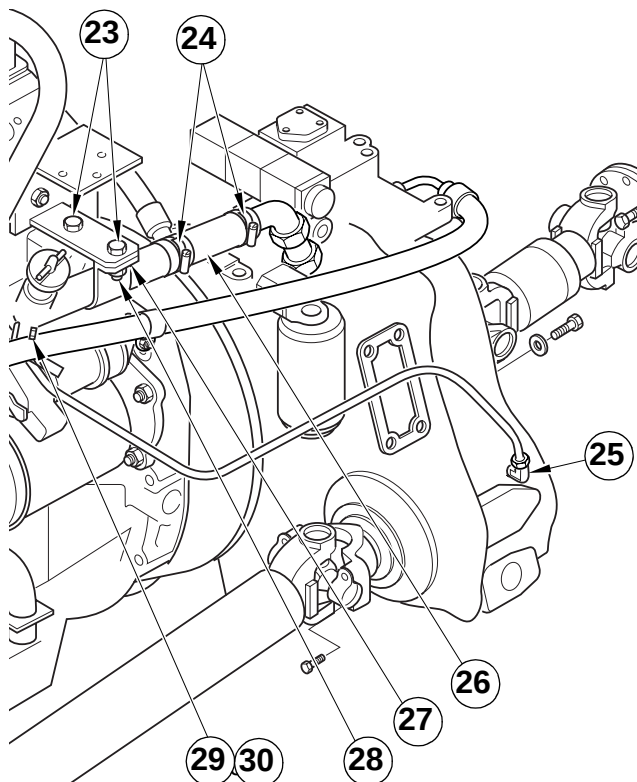
789M287A

Release the hose clips (19) on the heater hoses (17) at the thermostat housing (18). Remove the hoses and tie back under the scuttle.

STEP 12

789M261A

Remove the four bolts (20) in the hydraulic pump drive coupling (21) and remove the drive shaft (22).

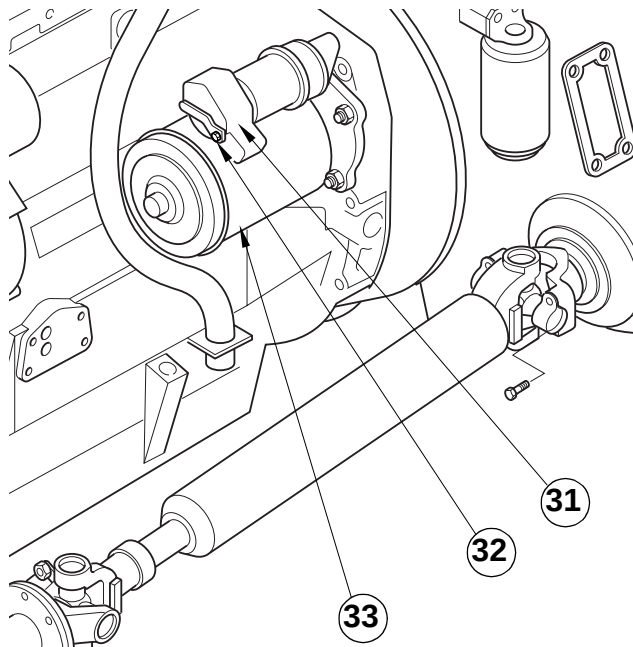
STEP 13

789M262A

Release the hose clips (24) on the transmission filler flexible pipe (26), remove the two bolts and nuts (23) and (28) in the support bracket (27) and the nut and bolt (29) and (30) in the dipstick pipe support.

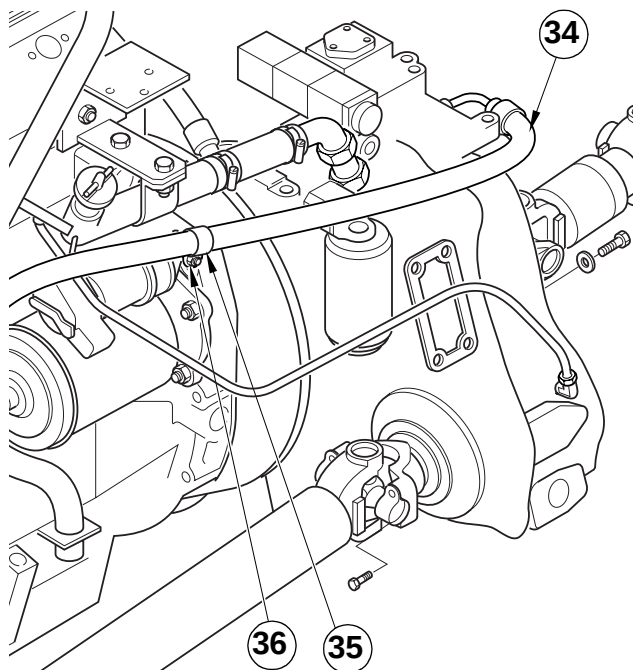
STEP 14

Release the dipstick pipe coupling (25) on the transmission and remove the dipstick assembly.

STEP 15

789M263A

Remove the nut (32) from the wiring cover (31) on the starter motor (33) and remove the cover.

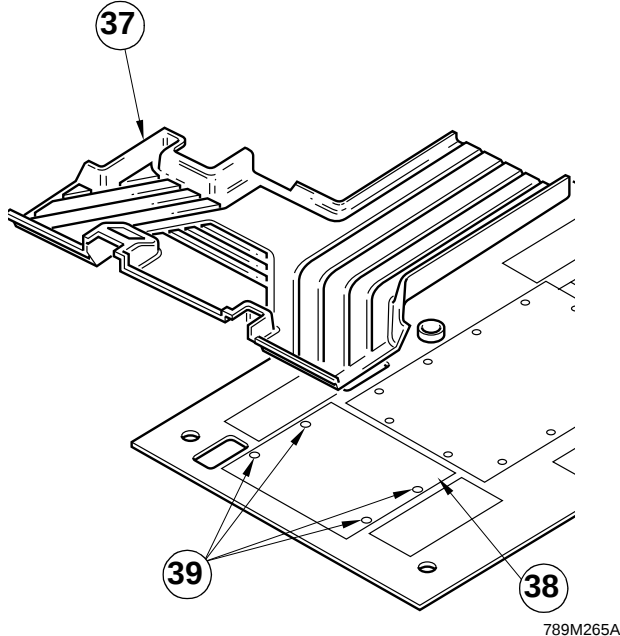
STEP 16

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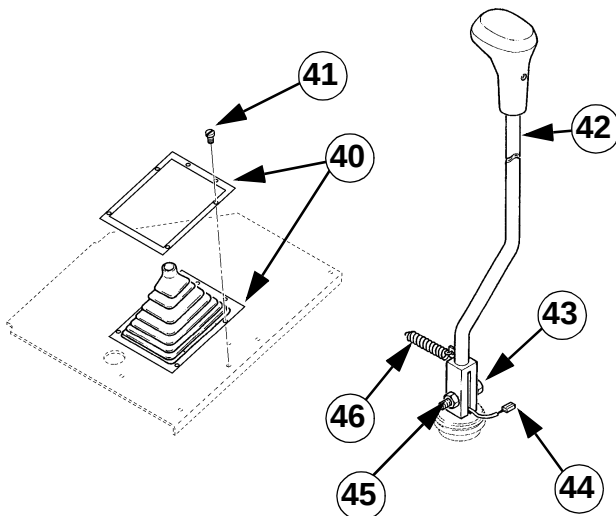
Remove the bolt and nut (36) in the clip (35) for the transmission oil cooler pipe (34), and release the pipe.

STEP 17

Disconnect and tag all wiring connections from the engine. These include the starter motor, the alternator, the water temperature switch, the oil pressure switch, the thermostat unit, the air filter restriction switch and the fuel injection pump stop solenoid.

STEP 18

Remove the front floor mat (37) in the cab. Remove the four screws (39) from the centre front floor plate (38) and remove the plate.

STEP 19

Remove the six screws (41) from the gear lever tower (40) and slide the tower up the lever (42).

STEP 20

Remove the six screws (41) from the gear lever tower (40) and slide the tower up the lever (42).

STEP 21

Disconnect the clutch switch wiring connection (44) and remove the spring (46) from the shift lever.

STEP 22

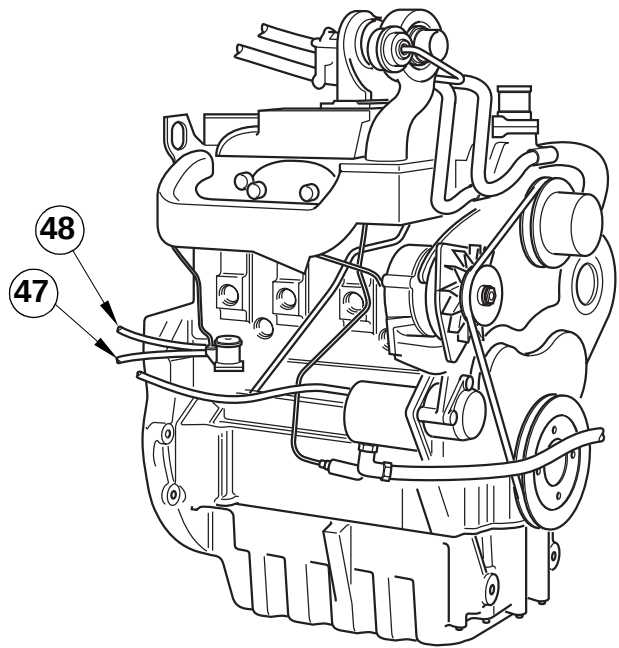
Remove the bolt and nut (43) and (45) from the shift lever and remove the lever from the transmission.

STEP 23

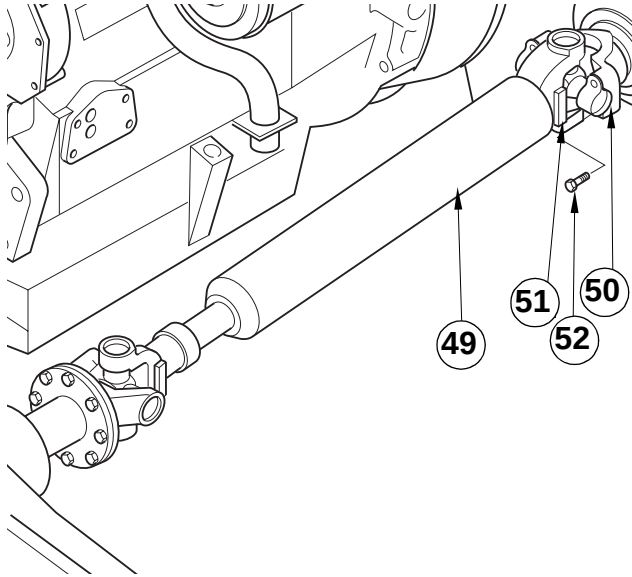
Put the wiring ties which attach the electrical harness to the support rail at the rear of the engine.

STEP 24

Release the oil cooler hose clamp on the right hand side of the chassis.

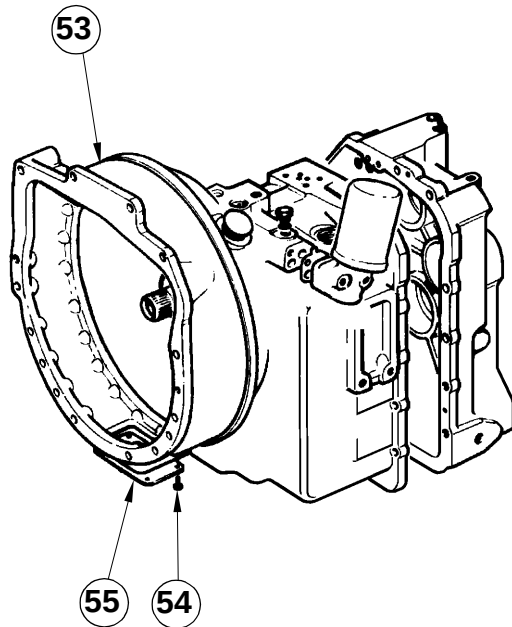
STEP 25

Disconnect the fuel inlet and discharge pipe (47) and (48) from the fuel lift pump.

STEP 26

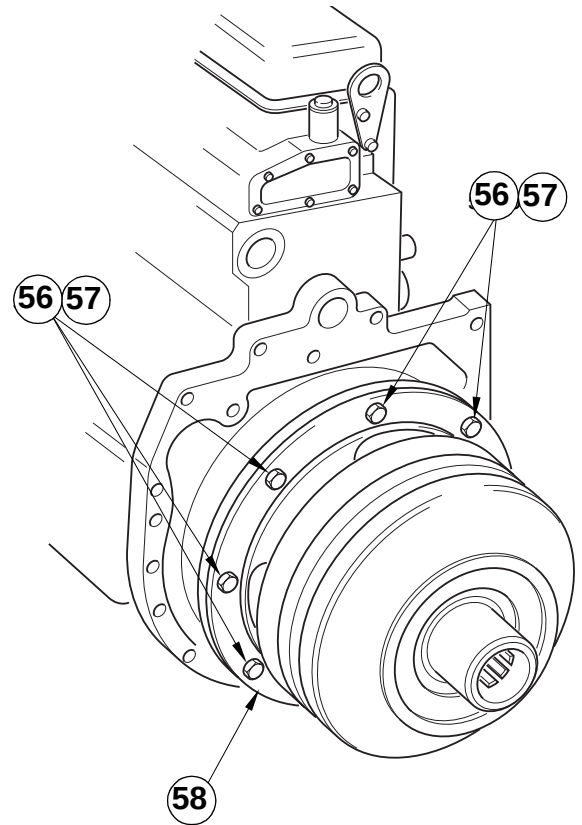
789M270A

Remove the four bolts (52) and the two bearing caps (51) from the rear coupling. Lower the propshaft (49). Make sure that the needle roller bearing cups (50) on the rear coupling are taped to the joint.

STEP 27

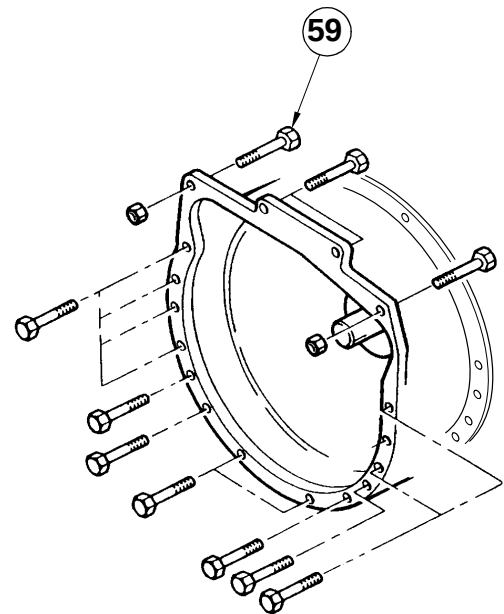
789M271A

Remove the four bolts (54) and the inspection plate (55) from the bottom of the bell housing (53).

STEP 28

789M272A

Remove the eight flywheel to torque converter bolts (56) and the washers (57) from the flex plate assembly (58).

STEP 29

789M273A

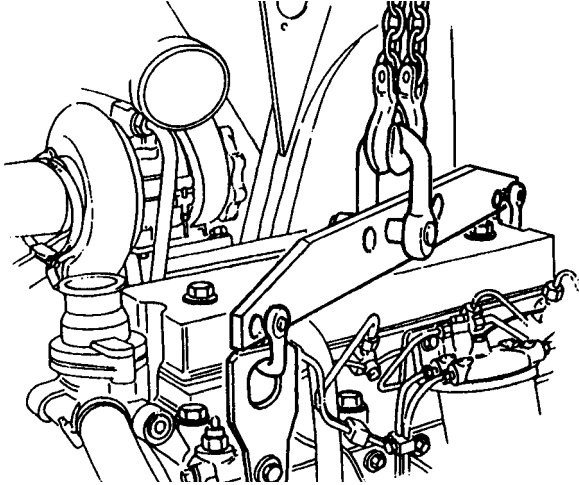
Remove all except two of the spacer housing bolts (59).

STEP 30

Position a trolley jack under the transmission, next to the front axle drive coupling flange. Raise the jack into contact with the transmission but DO NOT lift the transmission.

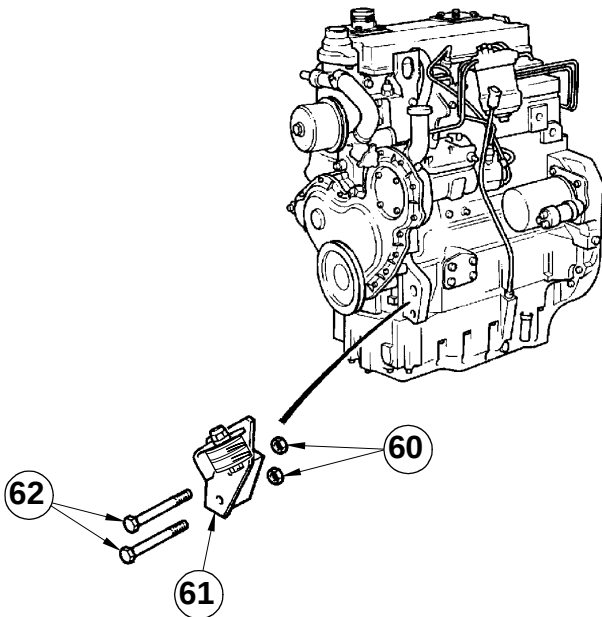
STEP 31

Attach the special lifting bracket to the engine.

STEP 32

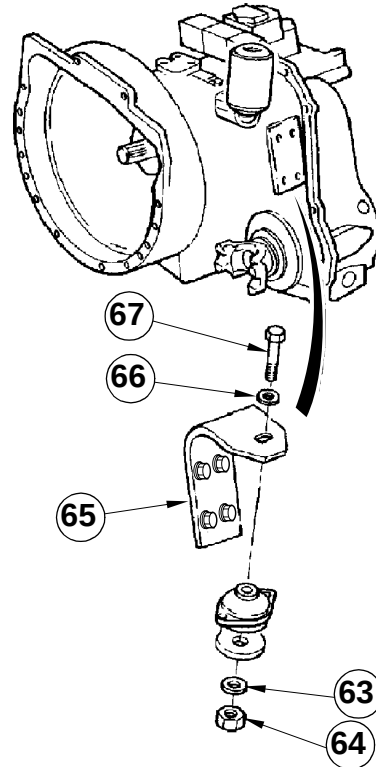
789M256A

Using a suitable hoist attached to the lifting bracket, apply tension to the lift chains. DO NOT raise the engine.

STEP 33

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Loosen the two bolts (62) and the nuts (60) from each engine bracket (61).

STEP 34

789M276A

Remove the centre bolt (67), the nuts (64) and the washers (63) and (66) from each transmission mounting plate (65).

STEP 35

Remove the rear propshaft.

STEP 36

Using the hoist and trolley jack, raise the engine/transmission unit sufficient to remove the engine mountings. (approximately 40 mm (1.5 in)).

STEP 37

Lower the engine/transmission unit and move it towards the rear of the machine until the rear propshaft slicing joint is completely closed.

STEP 38

Remove the two bolts in the spacer housing.

STEP 39

Hold the transmission to the rear, and move the engine forward on the hoist to disengage the torque converter spigot. Make sure that the torque converter does not disengage from the transmission input shaft when the engine moves forward.

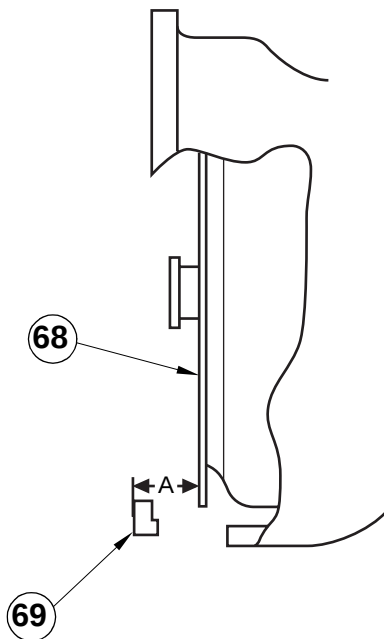
STEP 40

Remove the engine from the machine.

Installation

NOTE : *Install the engine in the reverse order of the removal but note the following :*

1.



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Before installation of the engine, make sure that the torque converter is correctly installed in the transmission. The flex plate face (68) must be at least 50 mm (2.0 in) from the transmission flywheel cover face (69) (measurement A). If the measurement A is 40 mm (1.5 in) or less, the torque converter is not correctly installed and must be removed and installed correctly.

2. During assembly of the engine to the transmission, make sure that the torque converter spigot enters the fly wheel bush correctly. To check, rotate the torque converter as the engine and transmission come together.

3. Torque tighten attaching parts as follows :

Flywheel to torque converter flexible plate bolts.....28 Nm (21 lbf ft)
Rear coupling bearing cap bolts 37 Nm (27 lbf ft)
Coupling flange bolts.....48 Nm (35 lbf ft)
Starter motor friction nuts.....36 Nm (26 lbf ft)

4. Before starting the engine, do steps 3 through 8.
5. Bleed air from fuel system (see section 3410).
6. Check the transmission oil level (see section 6002).
7. Check the engine oil level.
8. Replenish the radiator and header tank with coolant.
9. Check the hydraulic oil level.
10. Carry out a complete functional test of the machine. Check all connections and joints for leakage. Check all fluid levels with the engine stopped and cold.

Special tools

0 - 20 V DC voltmeter

0 - 150 A ammeter

Mechanical tachometer 0 - 10,000 rev/min.

Tightening Torques

	Nm	lbf ft
Solenoid main 'BAT' terminal M8 stud	6.0	4.5
Cable fixing nut M10 stud	12.0	9.0
Solenoid terminal M8 nut	6.0	4.5
Solenoid terminal M10 nut	12.0	9.0
Starter terminal 1/4 BSF nut	4.0	3.0
Solenoid end-cover screws	2.0	1.5
Solenoid unit screws	6.0	4.5
Brush-plate screws	7.0	5.0
Starter earth nuts	8.0	6.0
Pole shoes fixing screws	41.0	30
Through bolts	11.0	8.0
Eccentric pivot pin lock-nut	20.0	15.0

Specifications

Pilot diameter	12.71 mm (0.5 in)
Light running speed	5500 - 8000 rev/min.
Light running current/voltage	115A at 11V
Pinion end clearance when engaged	0.13 - 1.14 mm (0.005-0.045 in)
New brush length	28.51 mm (1.226 in)
Renew brushes at	8 mm (0.3 in)
Spring pressure in workint position with new brushes	11.6 N (42 oz.)

Removing and installing the starter motor

Removing the starter motor

Remove the starter motor as follows:

1. Disconnect the battery see section 4003.

NOTE : *Make sure the key is removed from the start switch on the side console.*

2. Open the hood.
3. Remove the protective cover (13), the nut (12) and the cover (14) from the solenoid (4).
4. Note the installed positions of the electrical cables (9) and (17).

5. Remove the nut (11), the washer (10) and disconnect the four electrical cables (9) from the starter motor (8).
6. Remove the two nuts (15), the two washers (16) and disconnect the three electrical cables (17) from the solenoid (4).
7. Attach the electrical cables (9) and (17) to the structure of the engine with temporary ties.
8. Support the starter motor (8) and solenoid (4). Remove the three nuts (7) and the "P-clip" mounting bracket (6) from the studs (5).
9. Slide the starter motor (8) together with the solenoid (4) from the studs (5) and remove from the engine.
10. Put a warning sign in the cab to tell persons not to start the engine.

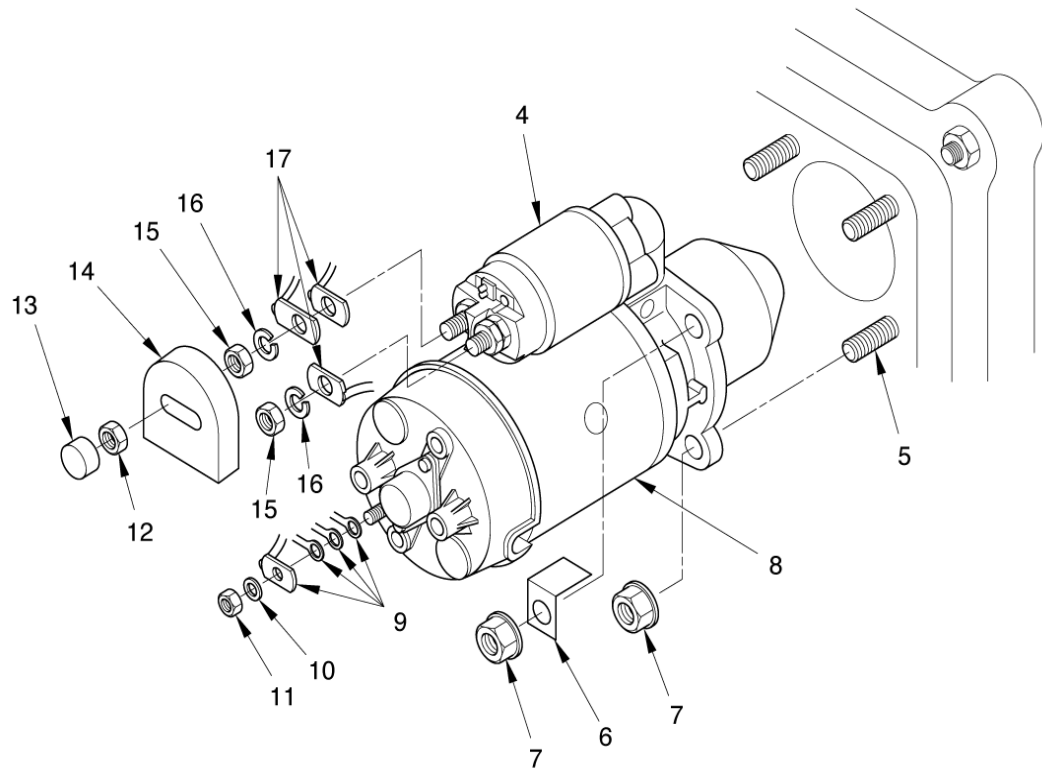
Installing the starter motor

NOTE : *The installation of the starter motor is the reverse of the removal.*

Install the starter motor in the reverse order of the removal but note the following:

1. Torque tighten the nuts (12): 12 Nm.
2. Torque tighten the nut (11): 6 Nm.
3. After installation do the following tests:
 - The battery voltage under load test, refer to page 7.
 - The starter motor terminal voltage under load test, refer to page 8.
 - The voltage drop on the insulated line test, refer to page 8.
 - The voltage drop across solenoid contact refer to page 9.

The voltage drop in earth line test, refer to page 10.



789M048A

Disassembling the starter motor

Disassemble the starter motor as follows:

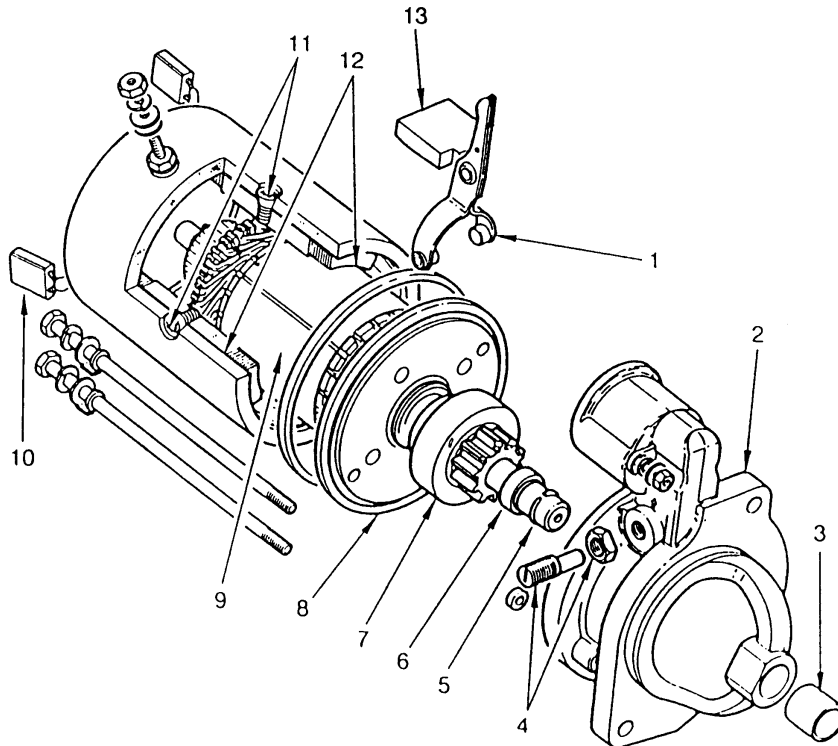
1. Remove the starter motor, refer to page 4.
2. Remove the solenoid assembly, refer to page 14.
3. Remove the end-cover, refer to page 12 (steps 3 through 6).
4. Remove the field winding brushes (10) from brush plate.
5. Remove the rubber grommet (13).
6. Slacken the locknut and remove the pivot pin (4). (The pivot is eccentric to the screw thread to allow adjustment of the pinion gear end-clearance).
7. Remove housing (2) and the pinion engagement lever (1).
8. Remove the armature and pinion assembly (9) from the motor body.
9. Use a suitable tube to punch the thrust-collar (6) towards the pinion and expose the snap-ring (5).
10. Remove the snap-ring (5).
11. Remove the thrust-collar (6).
12. Pull the pinion and the roller clutch (7), off the armature shaft.
13. Pull the intermediate plate (8) off the armature shaft.
14. Remove the four screws (11) and carefully pull the field windings (12) from the motor body.
15. Inspect and test the starter motor, refer to page 14.

Assembling the starter motor

NOTE : *The assembly of the starter motor is the reverse of the disassembly.*

Assemble the starter motor in the reverse order of the disassembly but note the following:

1. Apply Shell Retinax "A" grease or its equivalent onto the drive shaft splines, the thrust-collar (6) and the engagement lever (1).



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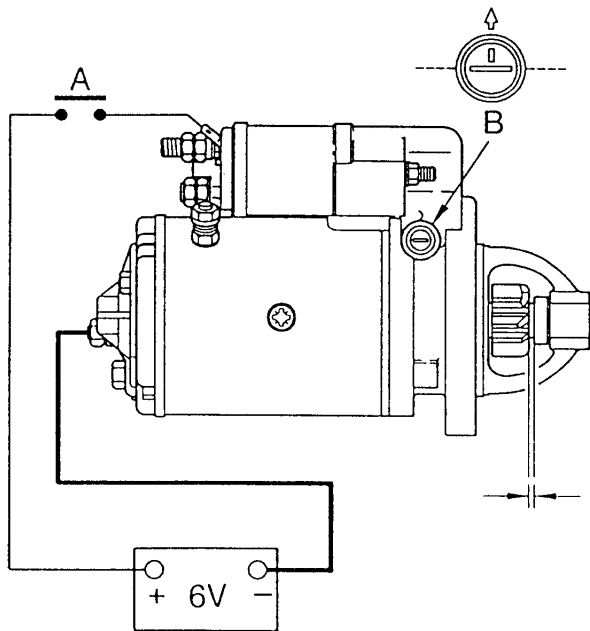
Adjusting the pinion stroke

Adjust the pinion stroke as follows:

1. Remove the starter motor, refer to page 4.
2. Screw the pivot pin (B) fully into the casting and then slacken off one full turn and position the marks on the head as shown.
3. Connect the solenoid to a 6V supply as shown, which will operate the solenoid only.
4. While the solenoid is energized push the pinion lightly, back against the yoke, to eliminate any free play and measure the gap between the pinion end face and the snap ring collar.
5. If necessary, turn the pivot pin (8) to obtain a clearance of 0.13 to 1.14 mm (0.005 to 0.045 in).
6. Tighten the locknut to 20 Nm (15 lbf ft).
7. Install the starter motor, refer to page 4.

Key

- A STARTER SWITCH
B PIVOT PIN



789M051A

Testing the battery voltage under load

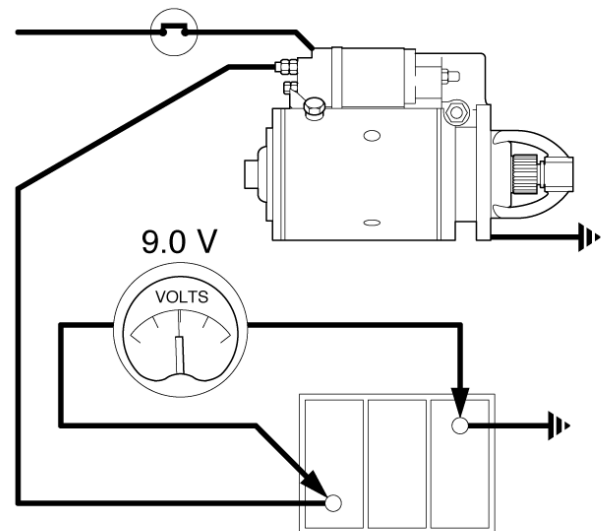
Test equipment

0 to 20 V dc voltmeter

NOTE : This test can be made with the starter motor still installed on the machine.

Do the battery voltage under load test as follows:

1. Check condition of battery or batteries, refer to page 9.
2. Open the hood.
3. Disconnect the wire from fuel injection pump to prevent the engine from starting.
4. Connect the voltmeter across the terminals as shown and with the engine fuel supply cut off, operate the starter.
5. The voltmeter should read approximately 9 V. A low voltage reading indicates excessive current flow in the circuit due to low resistance.
6. Reconnect the wire to the fuel injection pump if no further tests are required.
7. Close the hood.



789M052A

Testing the starter motor terminal voltage under load

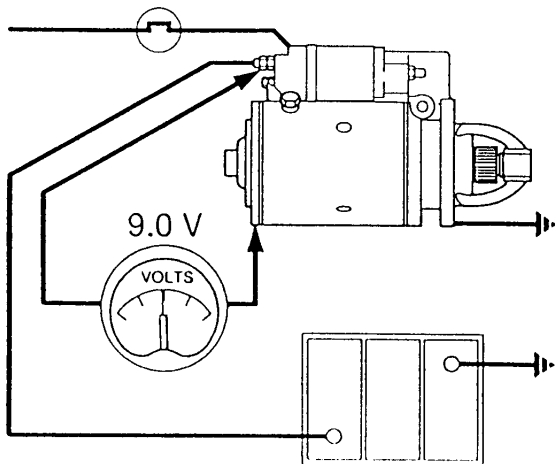
Test equipment

0 to 20 V dc voltmeter

NOTE : This test can be made with the starter motor still installed on the machine.

Do the starter motor terminal voltage under load test as follows:

1. Open the hood.
2. Remove the protective cover (13), the nut (12) and the cover (14), refer to page 4.
3. Disconnect the wire from the fuel injection pump, to prevent the engine from starting.
4. Connect the voltmeter between the starter input terminal and earth (end bracket). Crank the engine with the fuel cut off. The voltmeter reading should not be more than 0.5 V lower than in the battery voltage under load test, refer to page 7.
5. A low reading (more than 0.5 V difference between tests 1 and 2) indicates high resistance in cables or contacts.
6. High readings indicate high resistance in the starter motor itself.
7. Reconnect the wire to fuel injection pump if no further tests are required.
8. Install the cover (14), the nut (12) and the protective cover (13), refer to page 4.
9. Close the hood.



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Testing the voltage drop on the insulated line

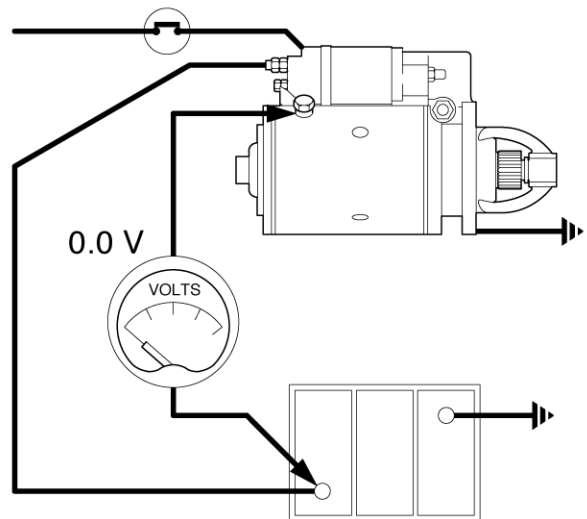
Test equipment

0 to 20 V dc voltmeter

NOTE : This test can be made with the starter motor still installed on the machine.

Do the voltage drop on the insulated line as follows:

1. Open the hood.
2. Connect the voltmeter between the starter terminal and the battery terminal.
3. When the starter switch is open, the voltmeter should register battery voltage. When the starter switch is closed, the voltmeter should read practically zero.
4. A high voltmeter reading indicates a high resistance in the starter circuit. Check all the insulated connections.
5. Do the voltage drop across the solenoid contacts test, refer to page 9.



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Testing the voltage drop across the solenoid contacts

Test equipment

0 to 20 V dc voltmeter

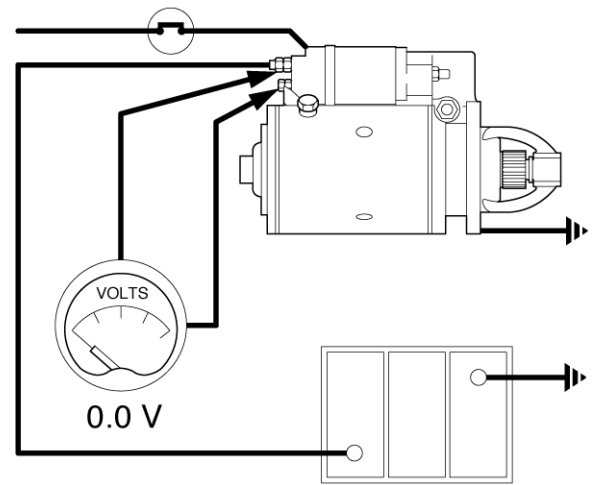
NOTE : *This test can be made with the starter motor still installed on the machine.*

Do the voltage drop across the solenoid contacts test as follows:

1. Remove the protective cover (13), the nut (12) and the cover (14), refer to page 4.
2. Connect the voltmeter across the two main solenoid terminals.
3. When the starter switch is open, the voltmeter should register battery voltage. When the starter switch is closed the reading should be zero or fractional value.
4. A zero or fractional reading indicates that the high resistance deduced in the voltage drop on the insulated line test must be due either to high resistance in the starter cables or soldered connections. A high reading (similar to the voltage drop on the insulated line test) indicates a faulty solenoid or connection, refer to page 8.
5. Install the cover (14), the nut (12) and the protective cover (13), refer to page 4.
6. Close the hood.

Key

- A STARTER SWITCH
B TACHOMETER POSITION



789M055A

Testing the voltage drop in earth line

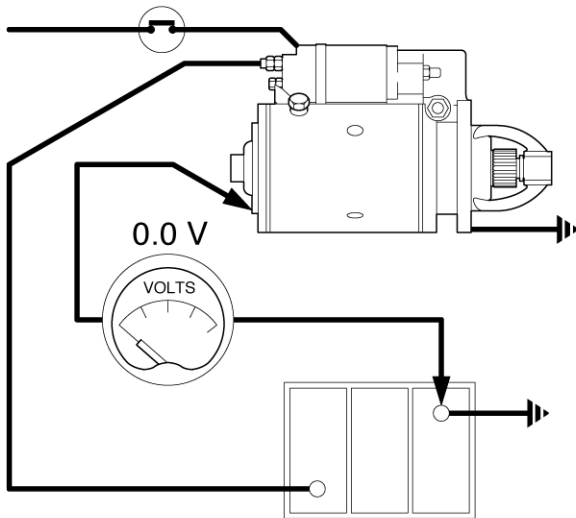
Test equipment

0 to 20 V dc voltmeter

NOTE : This test can be made with the starter motor still installed on the machine.

Do the voltage drop in earth line test as follows:

1. Open the hood.
2. Connect the voltmeter between the battery earth terminal and the starter earth (commutator end bracket).
3. When the starter switch is closed the voltmeter should read practically zero.
4. If reading is high, clean and tighten all earth connections and check bonding strap.
5. Close the hood.



789M056A

Testing the no-load current and speed

Test equipment

Test bench

Mechanical tachometer 0 to 10,000 rpm

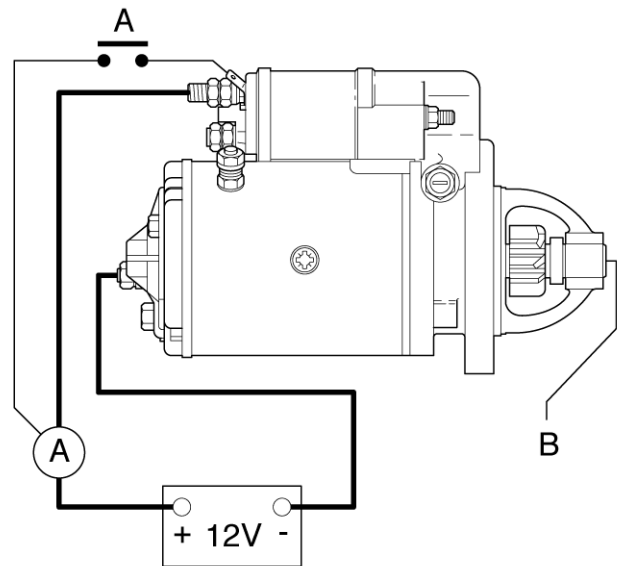
Ammeter up to 150 A capacity

Do the no-load current and speed test as follows:

1. If necessary, remove the starter motor from the machine, refer to page 4.
2. Connect an ammeter in circuit between the starter solenoid and battery.
3. Hold the tachometer against the end of the pinion shaft and operate the starter switch.
4. Max. current: 115 A at 11 V.
Max. speed: 5500 to 8000 rpm.
Excess current indicates that starter is faulty.
5. If low current is registered, do the continuity of contacts test, refer to page 11.
6. If starter fails to operate and there is no audible operation of solenoid, then connect the ammeter across the "STA" terminal and the battery.

Key

- A STARTER SWITCH
B TACHOMETER POSITION



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7. Operate the starter switch, the starter motor should run, indicating a faulty solenoid which must be replaced.
8. If the starter motor does not run, the motor itself is faulty.
9. If the starter motor fails to operate but the solenoid operation is audible, do the continuity of contacts test, refer to page 11.

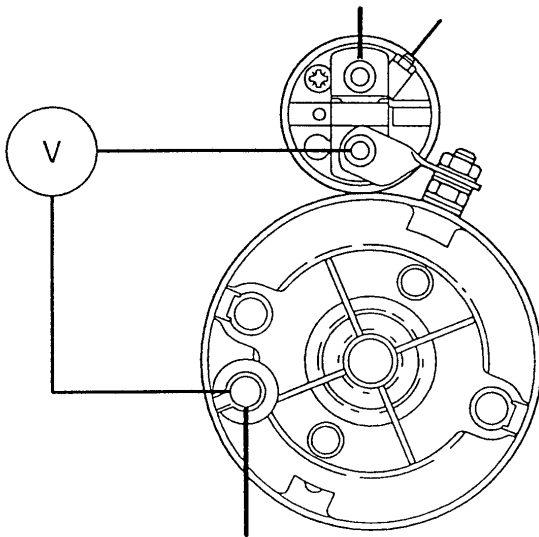
Testing the continuity of contacts

Test equipment

0 to 20 V dc voltmeter

Test the continuity of contacts as follows:

1. Open the hood.
2. Remove the protective cover (13), the nut (12) and the cover (14), refer to page 4.
3. Connect the voltmeter between motor and solenoid negative terminals and operate starter switch.
4. No voltage indicates a faulty solenoid. Replace the solenoid, refer to page 14.



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5. 12 V registered but motor fails to operate indicates faulty motor. Replace the starter motor, refer to page 4.
6. 12 V registered and motor operates, test the voltage drop across the contacts, refer to page 11.

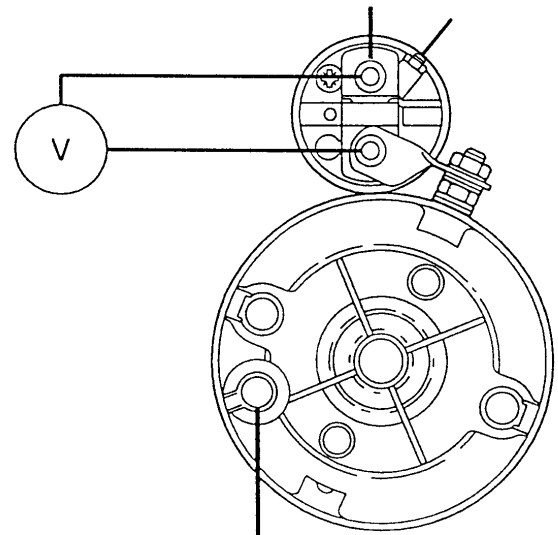
Testing the voltage drop across the contacts

Test equipment

0 to 20 V dc voltmeter

Test the voltage drop across the contacts as follows:

1. Connect the voltmeter across the solenoid terminals and operate starter switch.
2. Voltage across the terminals should be zero, if more, the solenoid is faulty and must be changed, refer to page 13.
3. If solenoid is satisfactory, service the starter motor, refer to page 14.



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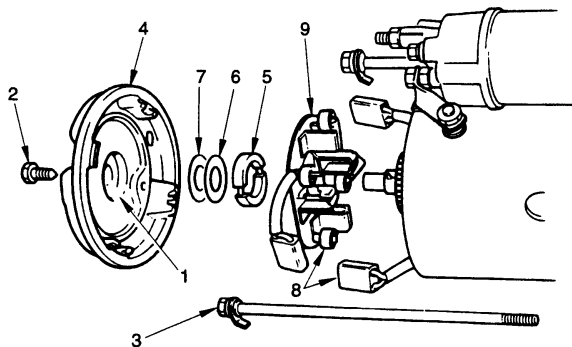
Servicing the end cover and brush carrier

Service the end cover and brush carrier as follows:

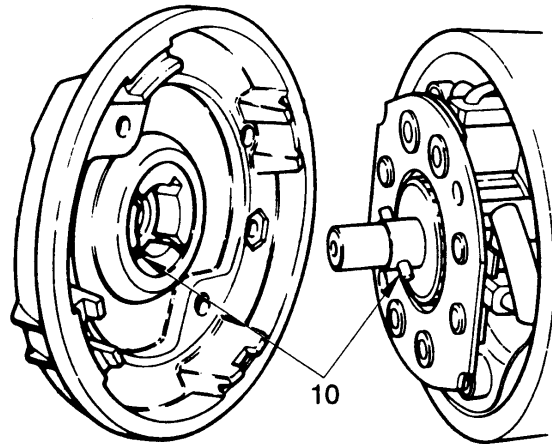
1. Open the hood.

NOTE : If space within the engine compartment permits the removal of the motor body bolts (3), the end cover can be serviced without removing the starter motor from the engine, provided that the electrical cables to the starter are disconnected.

2. If the end cover cannot be removed in situ, remove the starter motor, refer to page 4.
3. Remove the end cover securing screws (2), and both long bolts (3).
4. Lift off the cover (4) complete with brake assembly.
5. Remove the brake shoes (5) from the cover (4).
6. Remove the steel washer (6) and fibre washer (7).
7. Lift the springs and disengage the field coil brushes (8).
8. Remove the brush carrier assembly (9).
9. Polish the commutator with 600 to 1200 grade abrasive cloth/paper.
10. Thoroughly clean all components with white spirit and dry with compressed air.
11. Measure the length of the brushes (8). Replace the brushes which are 8 mm (5/16 in) or less in length, refer to page 13.
12. Install the brush carrier assembly (9).



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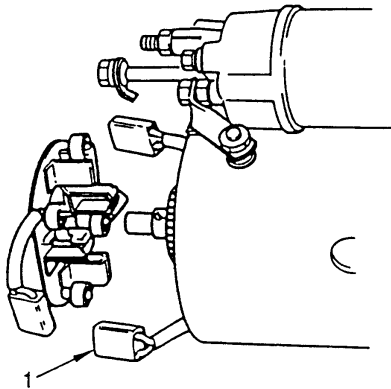
789M061A

13. Lift the springs and engage the brushes (8).
14. Test the strength of each brush spring and replace any which exert less than 11.6 N (42 oz.) with new brushes fitted.
15. Install the fibre washer (7), the steel washer (6) and the brake shoes (5) in the cover (4).
16. Turn the armature to position to drive-dogs (10) to engage the brake shoes (5).
17. Install the cover (4), the long bolts (3) and the screws (2).
18. Torque tighten the long bolts (3) to 11 Nm (8 lbf ft).
19. Check the clearance between the armature spindle and the brush (1). If the clearance is noticeable, replace the brush (1), refer to page 13.
20. If necessary, install the starter motor, refer to page 4.
21. Close the hood.

Replacing the starter motor brushes

Replace the brushes as follows:

1. Gain access to the brushes, refer to page 12 (steps 1 through 10).
2. On earth brushes, cut the flexible wires adjacent to the old brushes (1) and solder new brushes on to the flexible wires.
3. On insulated brushes, cut the flexible wires adjacent to the old brushes (1). Open the eyelet on the new brush. Apply a thin coat of solder and crimp the eyelet onto the flexible wire and solder together.
4. Install the cover, refer to page 12 (steps 12 through 21).



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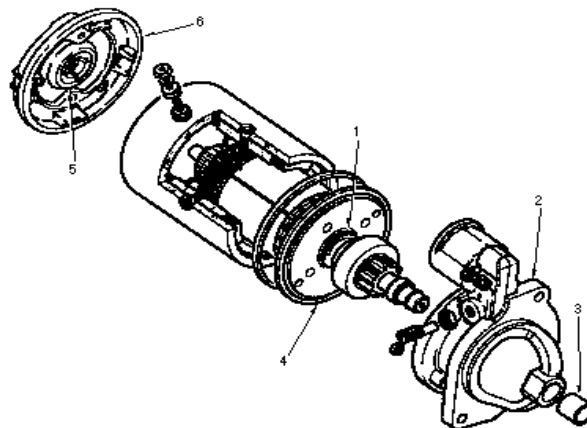
Replacing the bushes in the starter motor

Replace the bushes in the starter motor as follows:

1. Gain access, as necessary to the bush (1), (3) or (5) to be replaced, refer to page 6 or page 12.
2. If the bush (5) in the end cover (6) is to be replaced, remove the bush (5) using a 9/16 in, Whitworth tap.
3. If the bush (1) in the intermediate plate (4) is to be replaced, remove the bush (1) using a drift with a pilot diameter of 28.51 mm (1.226 in).
4. If the bush (3) in the housing (2) is to be replaced, remove the bush (3) using a drift having a pilot diameter of 17.03 mm (0.6705 in).
5. Immerse the replacement bush (1), (3) or (5) in clean engine oil for 24 hours.

NOTE : *The oil absorption time can be reduced by heating the oil to 100°C (212°F) for 2 hours and allowing it to cool before removing the brush. A thermometer is essential to prevent overheating the oil.*

6. Install the bush (5) into the end cover (6) using a drift having a pilot diameter of 12.71 mm (0.5 in).
7. Install the bush (1) into the intermediate plate (4) using a drift having a pilot diameter of 28.51 mm (1.226 in).
8. Install the bush (3) into the housing (2) using a drift having a pilot diameter of 17.03 mm (0.6705 in).
9. Assemble the starter motor as necessary, refer to page 6 or 12.



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Suggest:

If the above button click is invalid.

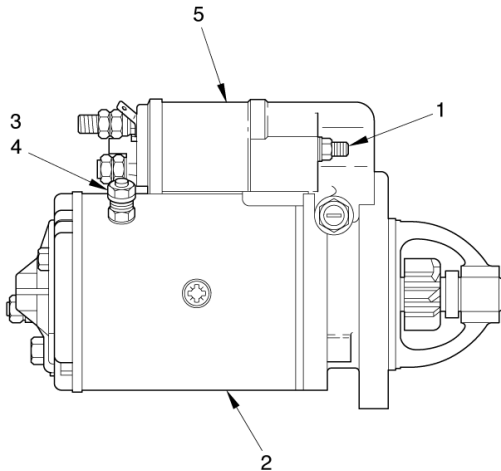
Please download this document first, and then click the above link to download the complete manual.

Thank you so much for reading

Removing the starter motor solenoid

Remove the starter motor solenoid as follows:

1. Remove the starter motor, refer to page 4.
2. Remove the two nuts (3) and the copper link (4).
3. Remove the two nuts (1) which secure the solenoid (5) to the starter motor (2).
4. Remove the solenoid body (5).
5. Remove the solenoid plunger from the engagement lever.



789M064A

Installing the starter motor solenoid

NOTE : The installation of the starter motor solenoid is the reverse of the removal.

Install the starter motor solenoid in the reverse order of the removal but note the following:

1. Torque tighten the nuts (1), refer to page 3.
2. Torque tighten the nuts (3), refer to page 3.

Inspecting and testing the starter motor

Test equipment

110 volt insulation tester or ohmmeter

Inspect and test the starter motor as follows:

1. Inspect the bush (7) in the alternator cap (8). If the clearance between the bush (7) and the shaft (6) is noticeable, replace the bush (7), refer to page 13.
2. Partially disassemble the starter motor, refer to page 6 (steps 1 through 6).
3. Inspect the bush (3) in the drive housing (2). If the clearance between the bush (3) and the shaft (4) is noticeable, replace the bush (3), refer to page 13.
4. Continue to disassemble the starter motor, refer to page 6 (steps 7 through 12).
5. Inspect the bush (1) in the intermediate plate (5). If the clearance between the bush (1) and the shaft (4) is noticeable, replace the bush (1), refer to page 13.
6. Complete the disassembly of the starter motor, refer to page 6 (steps 13 and 14).
7. Use a 110 V insulation tester or ohmmeter, to check the insulation of the electrical components (steps 8 through 10).



WARNING : Only trained electrical personnel must do these checks.

8. Touch one test probe (9) onto an insulated brush holder and the other (10) on an unpainted part of the carrier plate, refer to page 15. The ohmmeter must read infinity, as no current should pass between the probes. If the meter reads less than infinity, replace the brush holder.
9. Touch one probe (11) on the field terminal, the other (12) on a clean part of the motor body, but ensure neither brush touches the body, refer to page 15. The ohmmeter must read infinity, if the meter indicates less than infinity the field coils are shorting and must be replaced.
10. Touch one probe (14) onto the armature shaft, the other probe (13) onto a commutator segment, refer to page 15. The ohmmeter must read infinity. If the meter indicates less than infinity, the armature must be replaced.
11. Assemble the starter motor, refer page 6.

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