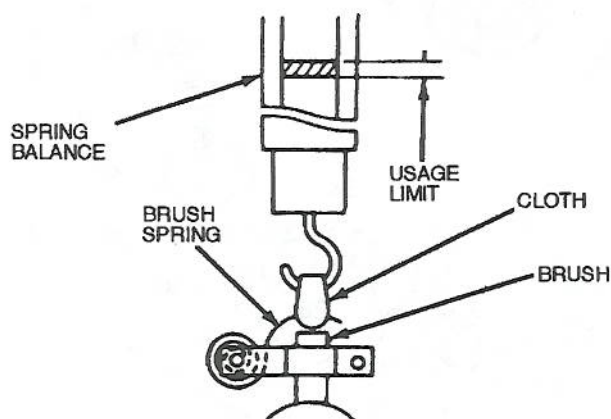


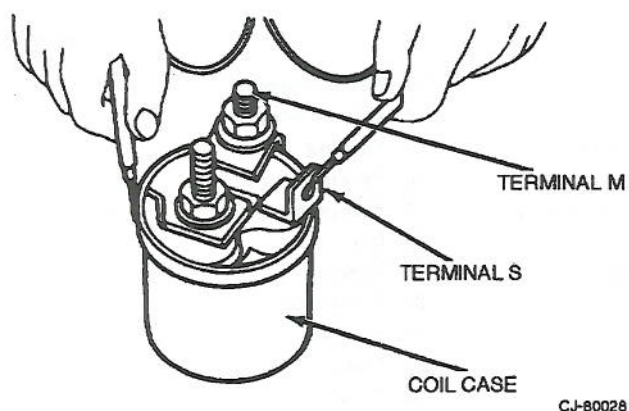
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Figure 5-19. Brush Wear Test



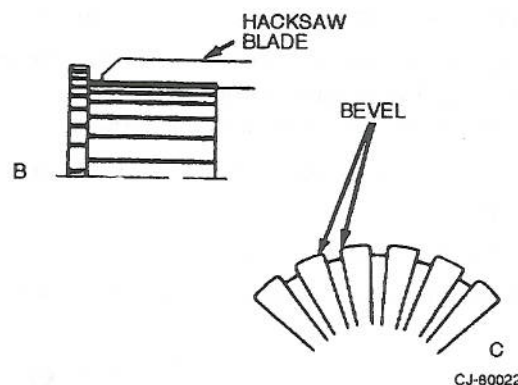
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Figure 5-20. Brush Spring Tension Test



CJ-80028

Figure 5-21. Shunt Coil Continuity Test



CJ-80022

Figure 5-22. Commutator Insulation Repair

- (7) Place armature assembly (11) in gear case (16) and install bushing (17).
- (8) Slide frame and field coil assembly (9) on armature assembly (11).
- (9) Thread pin of shift lever (19) in gear case (16) and tighten.
- (10) Slide thrust washers (10) and brush holder assembly (5) on shaft of armature assembly (11).
- (11) Insert brushes (6) and (7) and brush springs (8) in brush holders (5).
- (12) Place rear cover bushing (4) and rear cover (3) on starting motor assembly. Thread through bolts (1) with washers (2) in starter motor assembly. Thread screws into rear cover (3) and tighten.
- (13) Place magnetic switch assembly (18) on dust cover (20) and tighten bolts.
- (14) Place wire on bottom terminal of magnetic switch assembly and tighten nut.
- (15) Check the operation of the starting motor and, if necessary, adjust it as follows:
 - (a) Connect 12 vdc power source between top and bottom terminals of magnetic switch assembly (18).
 - (b) Measure distance between pinion (14) and pinion stopper (15).

NOTE

The two available dust covers act as adjusting plates. One is 0.057 inch thick. The other is 0.0314 inch thick.

- (c) If gap is not between figures specified by table 6-1, install alternate dust cover.

f. Installation. Install starting motor assembly.

5-5.1.8 *Alternator and Vacuum Pump Group*. Refer to figure 5-23, and perform the following steps to overhaul the alternator and vacuum pump group.

a. Removal. Remove the alternator and vacuum pump group as follows:

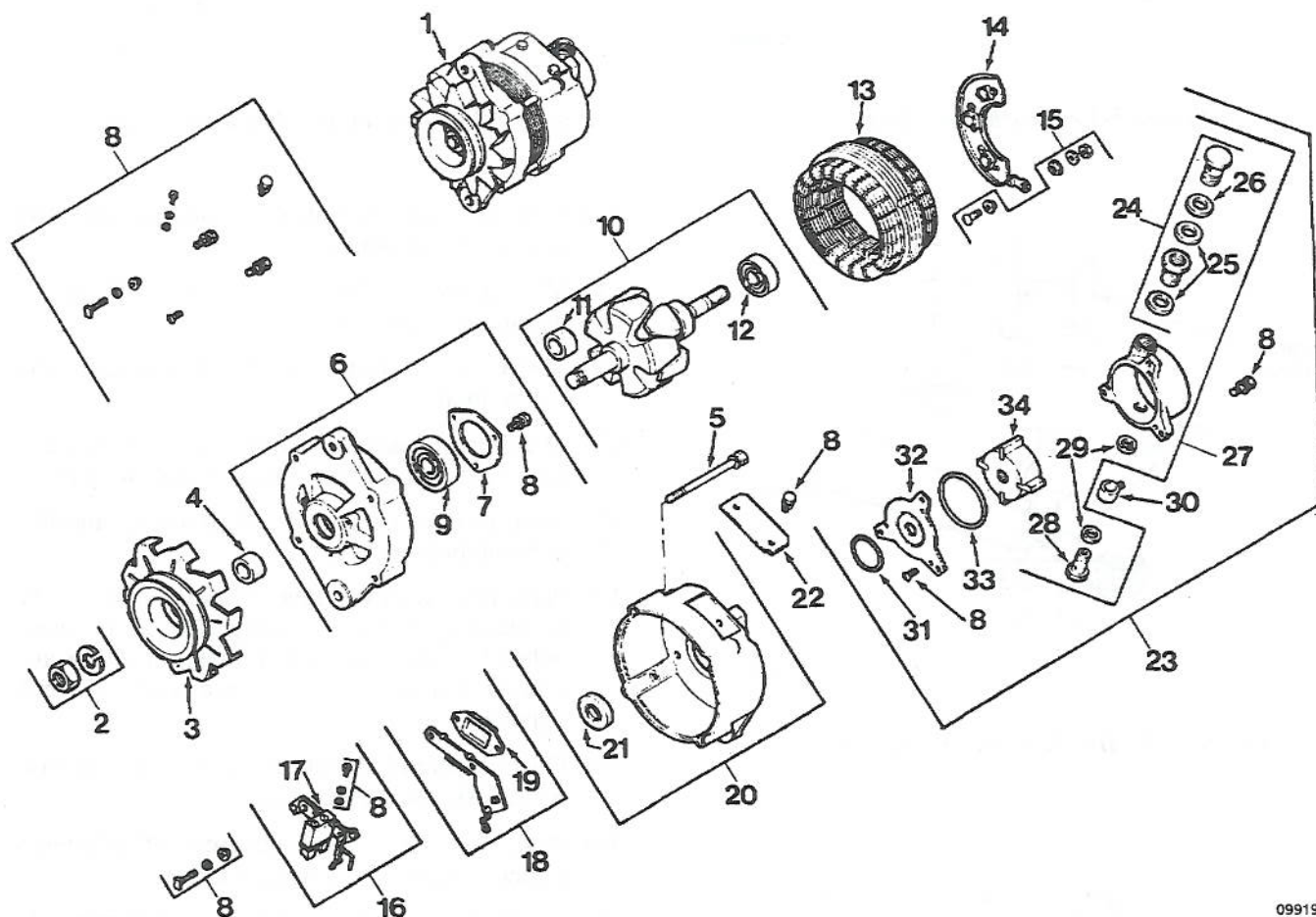
- (1) Disconnect battery negative cable.
- (2) Disconnect alternator electrical connector.

(3) Refer to paragraph 5-5.1.6 and remove all alternator mounting parts.

(4) Remove alternator drive belt from alternator pulley assembly (3), and remove alternator assembly (1).

b. Disassembly. Disassemble the alternator and vacuum pump group as follows:

- (1) Remove bolts (5).



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|----------------------------|--------------------------|---------------------|
| 1. Alternator Assembly | 12. Bearing | 23. Pump Assembly |
| 2. Nut And Washer Assembly | 13. Stator Assembly | 24. Valve Assembly |
| 3. Pulley Assembly | 14. Diode Assembly | 25. Packing |
| 4. Spacer | 15. Bolt Assembly | 26. Packing |
| 5. Bolts | 16. Brushholder Assembly | 27. Flange Assembly |
| 6. Front Cover Assembly | 17. Brush | 28. Bolt |
| 7. Bearing Retainer | 18. Terminal Assembly | 29. Packing |
| 8. Screw Kit | 19. Block | 30. Connector |
| 9. Bearing | 20. Rear Cover | 31. Packing |
| 10. Rotor Assembly | 21. Oil Seal | 32. Plate |
| 11. Spacer | 22. Cover | 33. Packing |
| | | 34. Rotor |

Figure 5-23. Alternator and Vacuum Pump Group

- (2) Remove screws from screw kit (8) and cover (22).
- (3) Remove screws from screw kit (8), and remove brushes (17) from brushholder assembly (16).

CAUTION

Separate front and rear covers carefully to avoid damage to rear cover oil seal.

- (4) Separate front cover assembly (6) and rear cover assembly (20).
- (5) Clamp front end of rotor assembly (10) in vise with soft jaws and remove nut and washer assembly (2), pulley assembly (3) and spacer (4).
- (6) Remove oil seal (21) from rear cover (20).
- (7) Remove screw kit (8) screws, bearing retainer (7) and bearing (9).
- (8) Separate front cover assembly (6) and rotor assembly (10) by tapping front cover with suitable mallet.
- (9) Remove spacer (11) and bearing (12).
- (10) Remove bolt assembly (15), stator assembly (13) and diode assembly (14).
- (11) Remove brushholder portion of brushholder assembly (16).

WARNING

Avoid breathing fumes generated by soldering or unsoldering as injury to personnel may result.

CAUTION

When disconnecting stator assembly from diode assembly, use soldering gun with a high heating capacity to melt solder quickly, and use suitable pliers to group leads immediately below soldering iron or heat may damage diode assembly.

NOTE

Tag and mark all wires before disconnecting.

- (12) Melt solder at leads and disconnect stator assembly (13) and diode assembly (14).
- (13) Melt solder at terminal assembly (18) and lead wire connection and separate brushholder assembly (16), terminal assembly (18) and diode assembly (14).
- (14) Melt solder as required and remove block (19) from terminal assembly (18).

- (15) Remove screw kit (8) screws and pump assembly (23).
- (16) Separate plate (32) from flange assembly (27) and remove packings (31) and (33).
- (17) Remove rotor (34) from flange assembly (27).
- (18) Remove bolt (28), two packings (29) and connector (30).
- (19) Remove valve assembly (24) and packings (25) and (26).
- c. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection procedures. In addition, perform the following steps:

WARNING

Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure shall not exceed 30 psi and wearing of goggles is required.

- (1) Clean all vacuum pump assembly parts in solvent and dry them using filtered compressed air.
- (2) Inspect rotor surfaces and flange assembly bore for pitting, wear, cracks or scoring, and check all rotor vanes for free movement in rotor slots. Vanes must not stick or bind. Any part exhibiting these conditions is defective.
- (3) Measure length and height of rotor vanes for vanes that are worn beyond limits specified in table 6-1. Vanes worn beyond limits are defective.

CAUTION

Do not clean rotor with degreasing solvent or damage to rotor may result.

- (4) Clean rotor poles by brushing with Isopropyl alcohol (17, table 5-1) or equivalent.

WARNING

Isopropyl alcohol is flammable and toxic to the skin, eyes and respiratory tract. Avoid skin and eye contact. Keep away from open flame or any other ignition source.

CAUTION

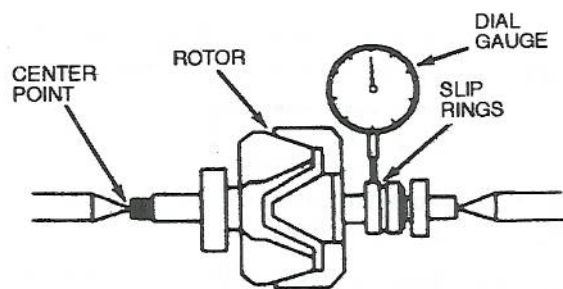
When using abrasive, support the rotor while spinning to clean slip rings evenly. Cleaning slip rings without support may result in flat spots on slip rings which may cause brush noise and premature brush wear.

- (5) Inspect slip rings for dirt, roughness or pitting, and clean with solvent. If necessary, clean and finish slip rings with commutator paper or equally abrasive polishing cloth.
- (6) Clean stator assembly (13) by brushing with Isopropyl alcohol or equivalent.
- (7) Inspect brush springs for damage or corrosion.
- (8) Inspect brushes for wear or contamination. Brushes must not be worn past limit specified in table 6-1. Also check for uneven wear of loose pigtailed. If brushes are to be used again, clean with soft dry cloth until completely free of lubricant.
- (9) Measure slip ring out-of-round with dial gauge as shown in figure 5-24 to make sure slip rings are within limits specified by table 6-1.
- (10) Measure slip ring diameter, as shown in figure 5-25, to make sure wear does not exceed limit specified in table 6-1.
- (11) Inspect bearings (21) and (9) for wear or damage.
- (12) Check for continuity of three stator terminals.
- (13) Check continuity, as shown in figure 5-26, between three terminals and core. If continuity exists, coil is grounded and must be replaced.
- (14) Refer to table 5-2 and figures 5-27 and 5-28 to check continuity of diodes in reverse direction of diodes. If there is continuity in one direction (correct forward direction), diode is all right. If there is continuity in both directions, or if there is no continuity in either direction, diode is defective.

Table 5-2. Diode Continuity Chart

Result	Ohmmeter Probes		Acceptable Result
	(+)	(-)	
N-P Diode(-)	Diode Holder	Holder Diode	Continuity
	Diode	Holder (rear cover)	No Continuity
P-N Diode(+)	Holder (rear cover)	Diode	Continuity
	Diode	Holder	No Continuity

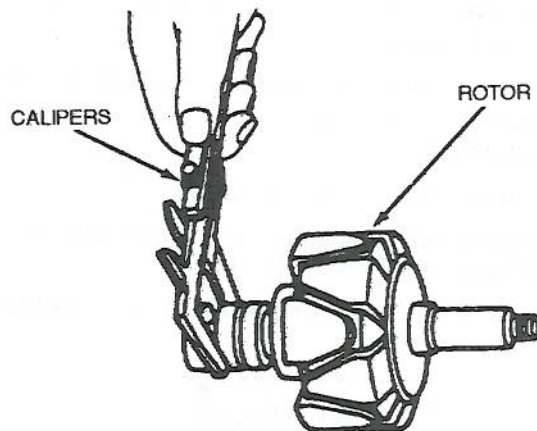
Repair limit 0.012 in. (0.3 mm)



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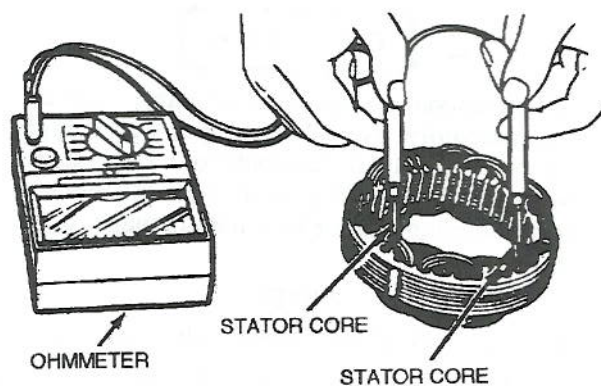
Figure 5-24. Slip Ring Out-of-Round Measurement

O.D. wear limit 1.20 in. (30.6 mm)



CJ-70016

Figure 5-25. Slip Ring Wear Measurement



CJ-70021

Figure 5-26. Stator Coil Continuity Test

(15) Refer to figure 5-29, and test the regulator assembly as follows:

- (a) Connect regulator assembly as shown in figure 5-29, using a variable resistor, two 12-volt batteries, a resistor and a voltmeter.
 - (b) Check V1 (voltage of battery 1). If voltage reading is between 10 volts and 13 volts, BAT 1 is satisfactory.
 - (c) Check V3 (voltage of BAT 1 + BAT 2). If voltage reading is between 20 volts and 26 volts, both BAT 1 and BAT 2 are satisfactory.
 - (d) Measure V2 (voltage between terminals F and E) by slowly moving variable resistor from 300 ohms. Check if any voltage of V2 becomes equivalent to V1 of BAT 1 measured in step (b). If there is no point where the voltage changes, the regulator is defective.
 - (e) Measure V4 (voltage between the middle tap of variable resistor and terminal E). With the variable resistor (RV) held in a fixed position, measure V4. Voltmeter should show 14 volts. If voltage shown is correct, the regulator is satisfactory. If voltage shown is incorrect, the regulator is defective and must be replaced.
- d. Repair and replacement. Replace all worn or damaged parts. In addition, perform the following steps:
- (1) Replace pump assembly (23) parts found to be defective.

CAUTION

When using an abrasive, support rotor while spinning to clean slip rings evenly. Cleaning slip rings without support may result in flat spots on slip rings, which may result in brush noise and premature brush wear.

- (2) Repair rough or out-of-round slip rings in lathe to obtain maximum out-of-round limit as specified in table 6-1. Remove only enough material to make rings smooth and round. Finish with commutator paper or 400 grit polishing cloth, and blow away all dust. If slip ring wear exceeds limit specified in table 6-1, replace rotor assembly (10).
- (3) Replace brushes (17) if they are worn beyond limits specified in table 6-1, if they show uneven wear or loose pigtails, or if brush

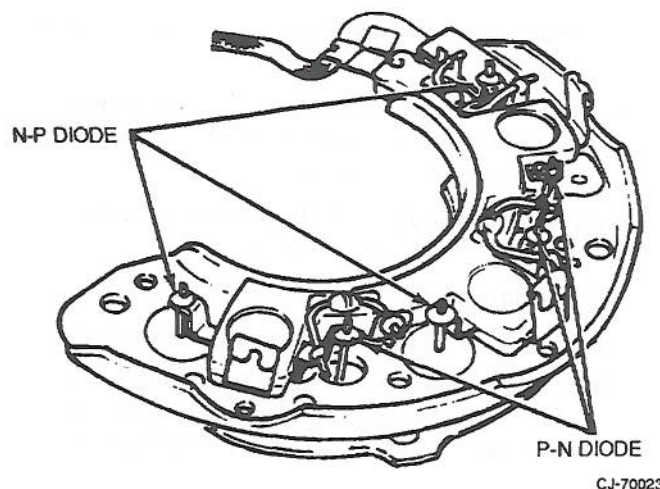


Figure 5-27. Diode Locations

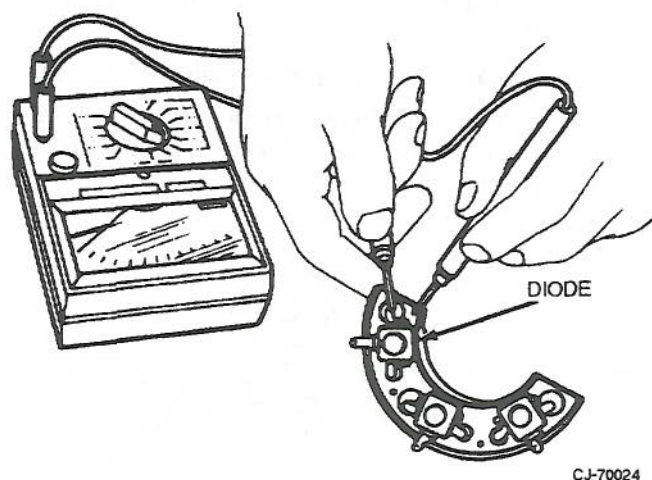
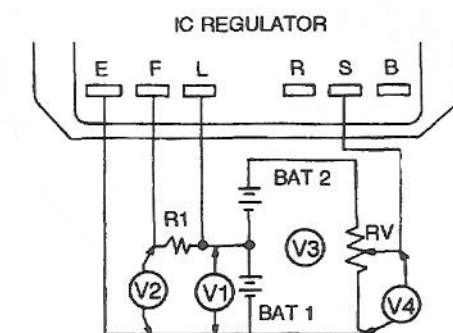


Figure 5-28. Current Flow of Diode Test



RESISTOR (R1)
VARIABLE RESISTOR (RV)
BATTERY (BAT 1, BAT 2)
DC VOLTMETER
(4-POINT MEASUREMENT)

10 OHMS 3W
0-300 3W
12V 2 PCS
0-30V
0.5 CLASS

Figure 5-29. IC Regulator Test Circuit Diagram

springs show any evidence of damage or corrosion.

- (4) Replace stator assembly (13) or diode assembly (14) if stator, diode or regulator assembly are found to be defective.
- e. Testing. Refer to figure 5-30, and perform the following tests on an assembled alternator:

- (1) Measure voltage regulation as follows:

- (a) Set up test circuit as shown in figure 5-30.
- (b) Hold switch 2 open and close switch 1. Rotate alternator, gradually increasing the speed. As speed is increased, lamp should go out.

NOTE

Voltage should be measured between terminals "S" and "E".

- (c) Increase speed to approximately 5000 rpm.
- (d) Measure amperage. If amperage is more than 5 amps, connect a 0.25 ohm resistor as shown in figure 5-30.

- (e) Voltmeter reading must be at regulating voltage and within specified value.

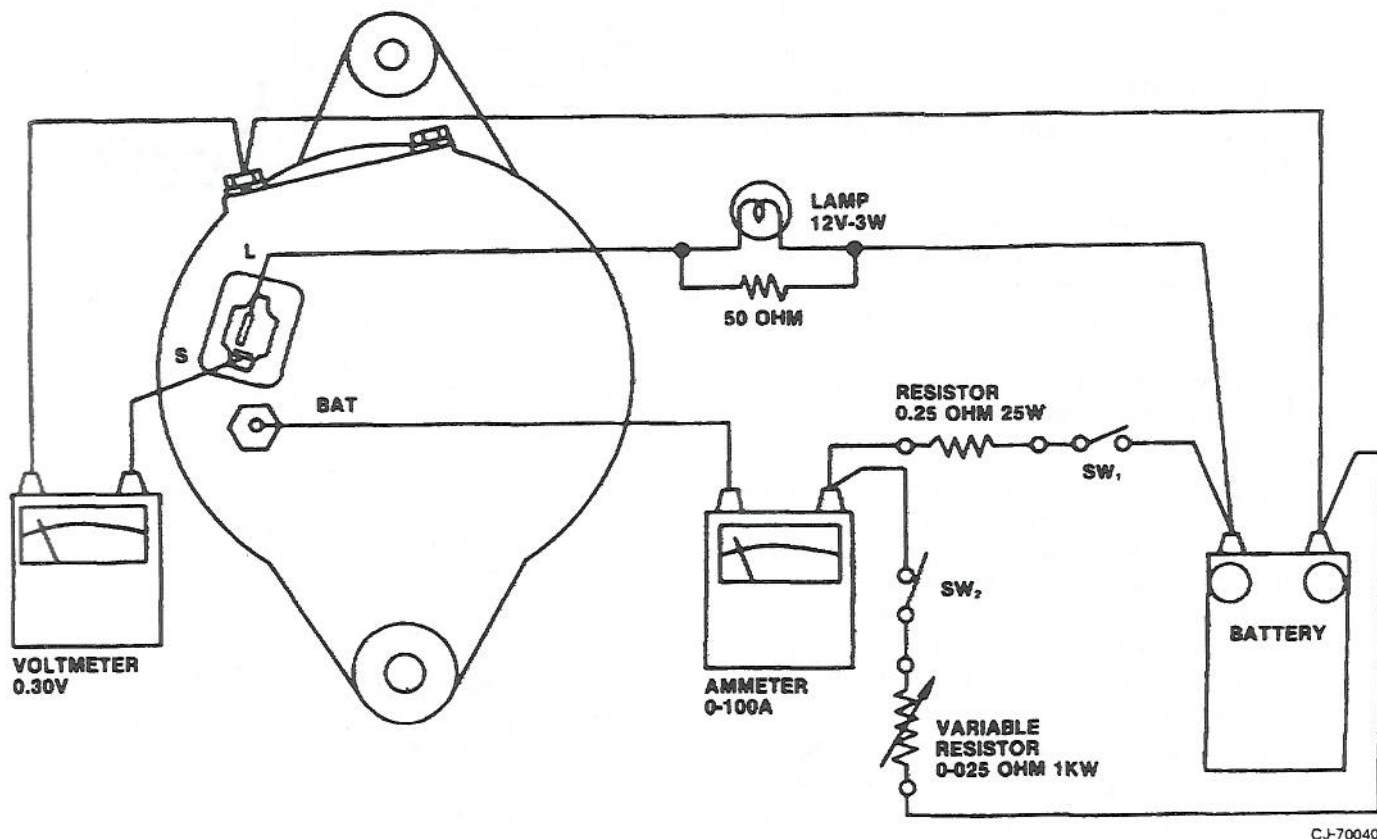
- (f) Increase speed further and observe whether the regulating voltage varies with the changes in speed or not.

- (2) Measure voltage at running speed, as follows:

- (a) Hold switch 1 and switch 2 open. Rotate alternator at 2000 rpm.
- (b) Observe voltmeter reading and gradually lower alternator speed to obtain 14 volts on terminal "B" of alternator.
- (c) If alternator running speed is 1050 rpm or less at 14 volts, the cut-in speed is satisfactory.

- (3) Measure output current as follows:

- (a) Adjust variable resistor to maximum resistance and close switch 1 and switch 2.
- (b) Rotate alternator and maintain 14 volts by regulating variable resistor.



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Figure 5-30. Alternator Voltage Regulation Test Circuit Diagram

- (c) Increase alternator speed to 5000 rpm and note ammeter reading.
- (d) If ammeter reading is higher than specified 50 amps, the output current is satisfactory.
- f. Assembly. Assemble the alternator and vacuum pump group as follows:

WARNING

Avoid breathing the fumes generated by soldering or unsoldering as injury to personnel may result.

- (1) Install regulator assembly portion of diode assembly (14), as marked during disassembly, to terminal block (19) using rosincore solder (18, table 5-1).
- (2) Install holder assembly (16) to diode assembly (14) using screws from screw kit (8). Connect terminal block (19) and lead wire, as marked during disassembly, using rosin-core solder (item 18, table 5-1).
- (3) Lubricate bearing (12) with lubricant (19, table 5-1) and press bearing (12) onto shaft of rotor assembly (10).
- (4) Carefully press oil seal (21) into place in rear cover (20).
- (5) Using screws from screw kit (8), install brush-holder assembly (16) and terminal assembly (18) in rear cover assembly (6).
- (6) Install diode assembly (14) using bolt assembly (15).
- (7) Install stator assembly (13).
- (8) Fill cavity between bearing (9) and retainer (7) with lubricant (19, table 5-1) and press bearing (9) into front cover (6).
- (9) Install retainer (7) with screws from screw kit (8).
- (10) Install spacer (11). Then install rotor assembly (10) in front core assembly (6).
- (11) Secure rotor carefully in a vise with soft jaws and install spacer (4) and pulley assembly (3) with nut and washer assembly (2). Tighten nut to torque specified in table 6-2.
- (12) Align and install rear cover (20) to front cover assembly (6) and secure with four bolts (5).
- (13) Install brushes (17) and secure with screws from screw kit (8).
- (14) Install cover (22) with screws from screw kit (8).
- (15) Apply a light coat of oil to all vacuum pump assembly (23) parts.
- (16) Support alternator assembly (1) vertically and position packing (31) on plate (32).
- (17) Install plate (32) and position packing (33) on plate (32).
- (18) Position rotor (34) on shaft of alternator assembly (1) so that flat end of rotor (34) is away from alternator assembly (1).
- (19) Install valve assembly (24) with packings (25) and (26) assembled.
- (20) Install connector bolts (28) and connector (30) with packings (29).
- (21) Install housing portion of flange assembly (27), align mounting holes with holes for rear cover (20) and plate (32), and secure with screws from screw kit (8).
- g. Installation. Install alternator and vacuum pump as follows:
 - (1) Refer to figure 5-23, and install alternator assembly (1) and alternator pulley assembly.
 - (2) Refer to paragraph 5-5.1.6 and install all alternator mounting parts.
 - (3) Connect alternator electrical connector.
 - (4) Connect battery negative cable.

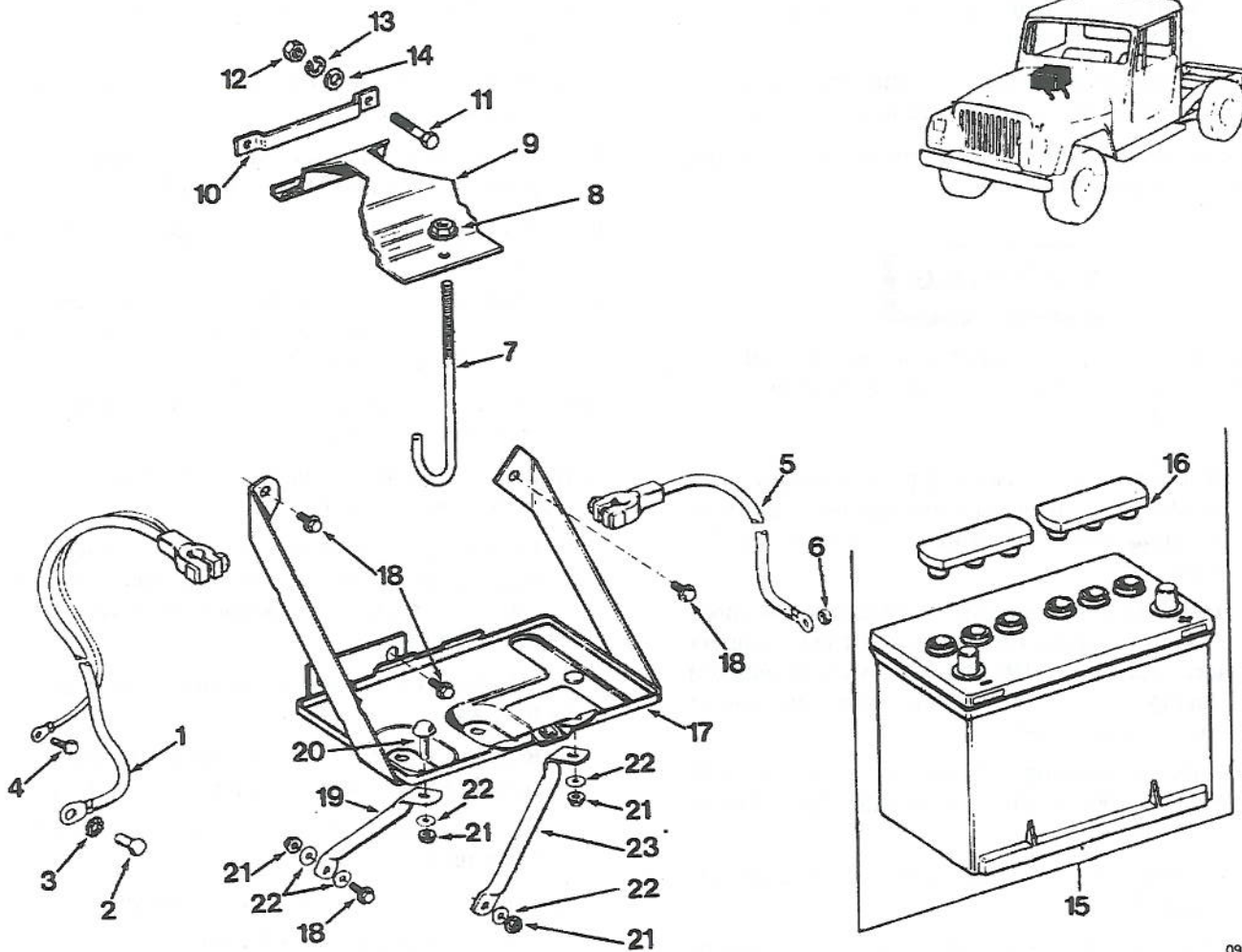
5-5.1.9 Battery and Mounting Group. Refer to figure 5-31, and perform the following steps to overhaul the battery and mounting group.

- a. Removal and disassembly. Disassembly is accomplished during removal. Remove battery and mounting group as follows:

WARNING

Whenever disconnecting battery terminals, always disconnect GROUND terminal first to eliminate danger of explosion.

- (1) Remove ground cable assembly (1) from battery assembly (15).
- (2) Remove positive cable assembly (5) from battery assembly (15).
- (3) Remove locknut (8) and remove bracket hold-down (9).
- (4) Remove J-bolt (7).



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|----------------------------|----------------------|-------------------|
| 1. Ground Cable Assembly | 9. Bracket Holddown | 17. Tray Assembly |
| 2. Machine Bolt | 10. Footman Loop | 18. Capscrew |
| 3. Lockwasher | 11. Capscrew | 19. Brace |
| 4. Screw and Lockwasher | 12. Hex Nut | 20. Capscrew |
| 5. Positive Cable Assembly | 13. Lockwasher | 21. Hex Nut |
| 6. Nut and Washer | 14. Flat Washer | 22. Flat Washer |
| 7. J-Bolt | 15. Battery Assembly | 23. Brace |
| 8. Locknut | 16. Vent Cap | |

Figure 5-31. Battery and Mounting Group

WARNING

When storing battery, always wear protection (face shield), acid resistant rubber apron and gloves.

- (5) Remove battery assembly (15).
- (6) Remove vent caps (16) from battery.
- (7) Remove capscrews (11), hex nuts (12), lockwashers (13), flat washers (14) and footman loop (18).
- (8) Remove screw and lockwasher (4), machine bolt (2), lockwasher (3) and ground cable assembly (1).
- (9) Remove nut and washer (6) and positive cable assembly (5).

- (10) Remove capscrew (18), hex nut (21) and flat washers (22).
- (11) Remove capscrew (20), hex nut (21), and flat washer (22) and brace (19).
- (12) Remove hex nuts (21), washers (22) and brace (23).
- (13) Remove capscrews (18) and tray assembly (17).
- b. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection procedures. In addition perform the following steps:
 - (1) Inspect electrolyte level in each cell of battery. Electrolyte should reach bottom of vent walls. If electrolyte is low in any cells, add distilled water until electrolyte reaches proper level.
 - (2) Inspect cables for corrosion and damage. Remove corrosion using wire brush. Damaged cables must be replaced.
 - (3) Inspect battery tray and holddowns for corrosion. Remove corrosion using wire brush. Paint any exposed metal. Any damaged components must be replaced.



Make sure vent caps are tightly secured to battery before cleaning to avoid contaminating electrolyte with cleaning solution.

- (4) Clean outside of battery case. Clean top cover with diluted ammonia/soda solution to remove acid film. Flush with clean water.
- c. Repair and replacement. Replace all worn or damaged parts.
- d. Testing. Refer to the figure 5-32, and test battery and mounting group as follows:

NOTE

Battery must be cleaned prior to testing.

- (1) Hydrometer test. This procedure tests for state of battery charge.
 - (a) Inspect paper inside hydrometer. If it is brown, hydrometer is defective and must be discarded.
 - (b) Remove battery vent caps and insert hydrometer.
 - (c) Draw in only enough electrolyte to keep the float off the bottom of hydrometer barrel with bulb released.

- (d) Test specific gravity of electrolyte in each cell. Specific gravity should be between figures specified by table 6-1.
- (e) If specific gravity of all cells is above 1.235, but variation between cells is more than 0.050, it is an indication that battery is unservicable and further testing should be performed.
- (f) If specific gravity of one or more cells is less than 1.235, recharge battery at a rate of 5 amperes until three consecutive specific gravity tests at 1-hour intervals are constant.
- (g) If cell variation is more than 0.050 at end of charge period, battery must be replaced.
- (h) When specific gravity of all cells is above 1.235 and variation between cells is less than 0.050, heavy load test may be performed. Refer to table 5-3.

Table 5-3. Specific Gravity Chart

Specific Gravity State of Charge	Specific Gravity (Cold and Temperate Climates)
Fully Charged	1.265
75% Charged	1.225
50% Charged	1.190
25% Charged	1.155
Discharged	1.120

- (2) Heavy load test.

NOTE

Before performing heavy load test, battery must be fully charged.

- (a) Refer to figure 5-32 and turn carbon pile rheostat knob of battery tester to OFF position.
- (b) Turn selector knob to AMP position.
- (c) Connect test leads as shown in figure 5-32.
- (d) Turn carbon pile rheostat knob clockwise until ammeter indicates correct test amperage (refer to table 5-4.)
- (e) Maintain load for 15 seconds. Turn selector switch to VOLTS and note voltage. Voltage should be 9.6 volts or higher at minimum battery temperature of 70°F. If voltage is less than 9.6 volts, battery must be replaced.

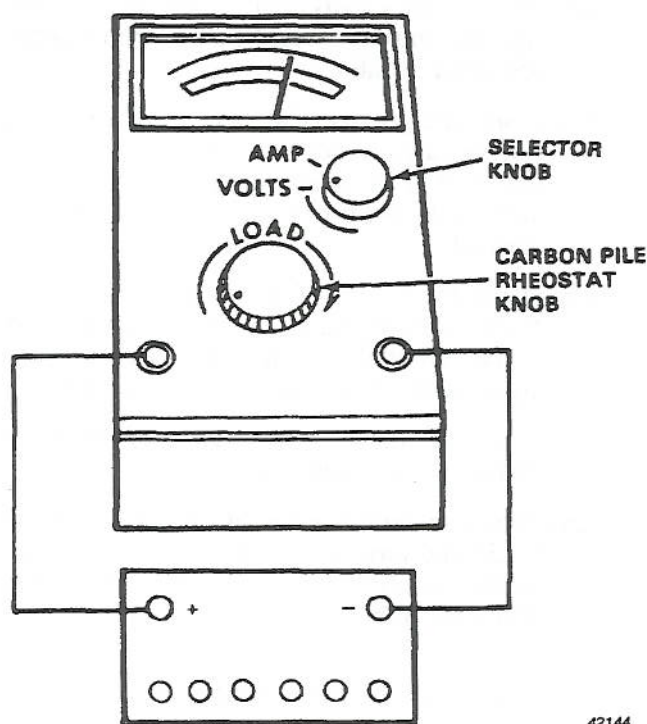


Figure 5-32. Heavy Load Test

Table 5-4. Test Amperages

Amperage	Battery Type
135 amperes	55-380 (75 reserve capacity minutes, 380 cold crank amps)
180 amperes	55-450 (90 reserve capacity minutes, 450 cold crank amps)
230 amperes	24-440 (135 reserve capacity minutes, 440 cold crank amps)

e. Assembly and installation. Assembly is accomplished during installation. Install battery and mounting group as follows:

- (1) Install tray assembly (17) using capscrews (18).
- (2) Install brace (23) using washers (22) and hex nuts (21).
- (3) Install brace (19) on tray assembly (17) using capscrew (20), flat washer (22) and hex nut (21).
- (4) Install brace (19) on vehicle using capscrews (18), flat washers (22) and hex nut (21).

- (5) Install positive cable assembly (5) using nut and washer (6).
- (6) Install ground cable assembly (1) using machine bolt (2), lockwasher (3) and screw and lockwasher (4).
- (7) Install footman loop (10) using capscrews (11), flat washers (17), lockwashers (13) and hex nuts (12).
- (8) Install vent caps (16) on battery.

WARNING

When servicing battery, always wear eye protection (face shield), acid resistant rubber apron and gloves.

- (9) Install battery assembly (15).
- (10) Install J-bolt (7) and bracket holddown (9) using locknut (8).

WARNING

When connecting battery terminals, always connect **POSITIVE** terminal first.

- (11) Connect positive cable assembly (5) to battery **POSITIVE** terminal. Tighten connector to torque specified by table 6-2.
- (12) Connect ground cable assembly (1) to battery **GROUND** terminal. Tighten connector to torque specified by table 6-2.

5-5.1.10. *Belts Group.* Refer to figure 5-33, and perform the following steps to overhaul the belts group.

a. Removal. Remove belts group as follows:

- (1) If vehicle is equipped with the optional air system, proceed as follows:
 - (a) Turn adjustment screw, located on the idler mounting pulley assembly attached to the thermostat assembly, counterclockwise.
 - (b) Remove belt from idler and air compressor pulleys.
- (2) Loosen alternator adjusting bolts and move alternator toward engine.
- (3) Remove alternator belt (1).
- (4) Loosen power steering pump belt adjusting bolts and push pump toward engine. Adjust if necessary.
- (5) Remove power steering pump belt (2).

b. Cleaning and inspection. No cleaning is required. Inspect belt for wear or damage.

c. Repair and replacement. Replace worn or damaged belts.

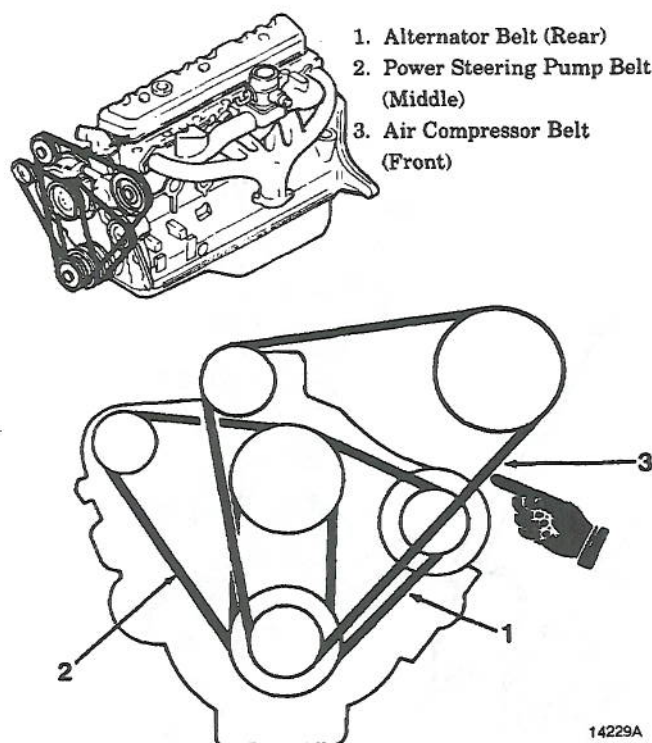


Figure 5-33. Belts Group

d. Installation. Install belts group as follows:

- (1) Install power steering pump belt (2) on pulleys.
- (2) Apply tension to power steering pump belt (2) using pry bar between engine block and power steering pump.
- (3) Check belt tension using tension gauge #J-23600.
- (4) Install alternator belt (1) on pulleys.
- (5) Apply tension to alternator belt (1) by using pry bar between engine block and alternator.
- (6) Check belt tension by applying 22 pounds pressure midway between alternator pulley and fan pulley. Belt should deflect to the figure prescribed by table 6-1.
- (7) If vehicle is equipped with the optional air system, install the air compressor belt as follows:
 - (a) Position belt according to figure 5-33.
 - (b) Apply tension to belt turning adjusting screw, located on the idler mounting pulley assembly attached to the thermostat assembly, clockwise.
 - (c) Tighten belt until a deflection of 0.3 to 0.5 inch is attained.

5-5-1.11 *Water Pump and Fan Group*. Refer to figure 5-34 and perform the following steps to overhaul the

water pump and fan group. If vehicle is equipped with the optional air system, refer to paragraph 5-5.11 for thermostat removal.

- a. Removal. Remove water pump and fan group as follows:

WARNING

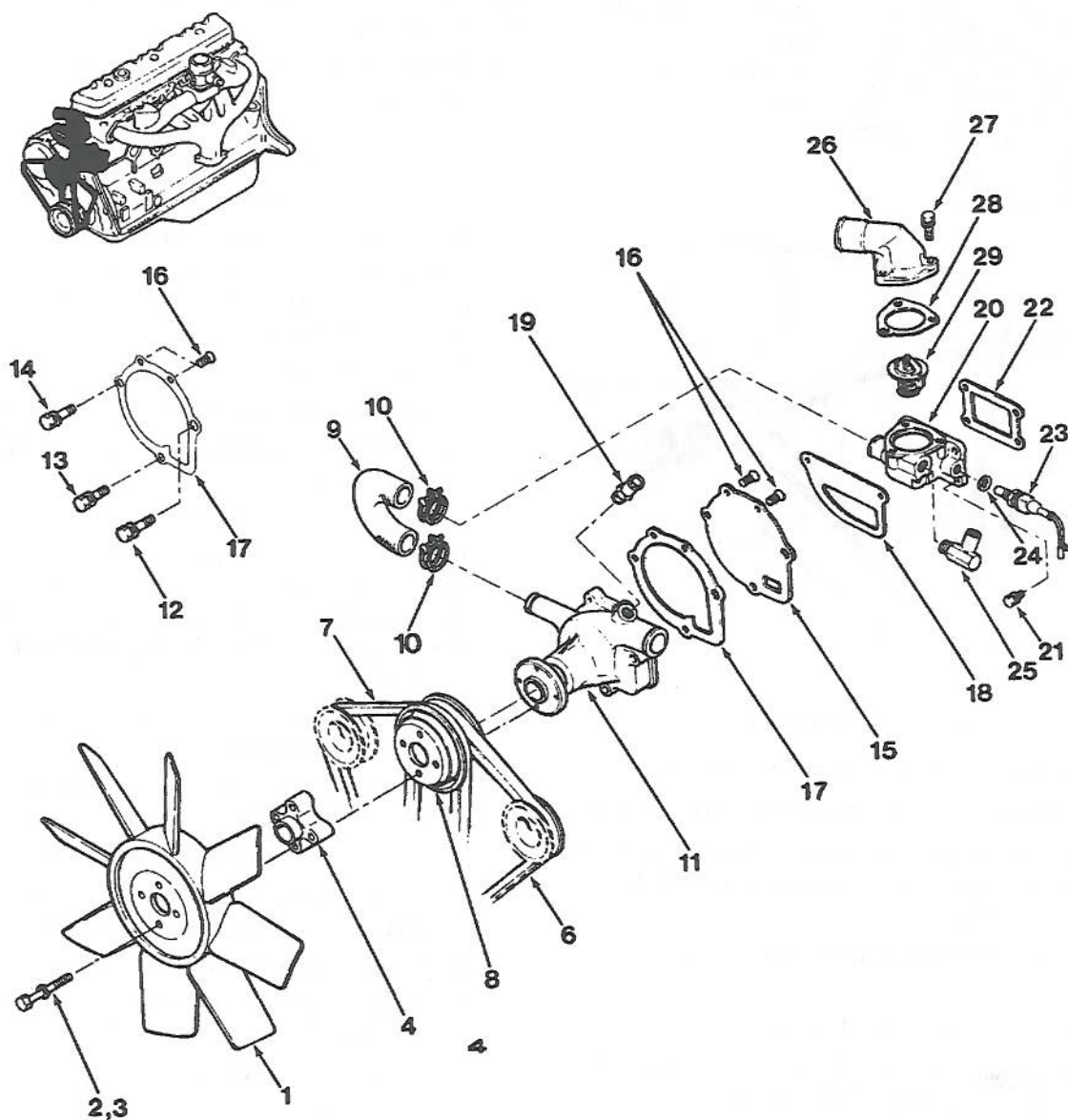
Do not remove cylinder block drain plugs or loosen radiator draincock when the system is hot and under pressure or personnel could receive serious burns.

- (1) Drain coolant.
- (2) Remove capscrew (2) and lockwasher (3).
- (3) Remove fan assembly (1), fan drive belt and fan spacer (4).

NOTE

Do not place temperature coupling on work bench with rear mounting facing downward. This may result in the unit's silicone lubricant draining into the drive bearing and being contaminated.

- (4) Remove fan pulley (8), alternator belt (6) and power steering belt (7).
- (5) Loosen hose clamps (10) and remove water hose (9) and hose clamps (10).
- (6) Disconnect radiator and heater hoses.
- (7) Remove screws and washers (12), (13), and (14), and remove centrifugal pump (11).
- (8) Remove gasket (18).
- (9) Remove screws and washers (21), thermostat housing (20) and gasket (22).
- b. Disassembly. Disassemble water pump and fan group as follows:
 - (1) Remove connector (19).
 - (2) Remove machine screws (16), cover (15) and gasket (17).
 - (3) Remove screws and washers (27) and water outlet (26).
 - (4) Remove gasket (28) and thermostat (29).
 - (5) Remove temperature sensor (23), gasket (24) and coupling hose (25).
- c. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection procedures. In addition, perform the following steps:
 - (1) Check pump parts and hoses for cracking, wear or damage. If pump or hose is in any way damaged, it must be replaced.



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|-----------------------------|----------------------|------------------------|
| 1. Fan Assembly | 10. Hose Clamp | 20. Thermostat Housing |
| 2. Capscrew | 11. Centrifugal Pump | 21. Screw W/Washer |
| 3. Lockwasher | 12. Screw W/Washer | 22. Gasket |
| 4. Fan Spacer | 13. Screw W/Washer | 23. Thermostat Sensor |
| 5. (Deleted) | 14. Screw W/Washer | 24. Gasket |
| 6. Alternator Belt | 15. Cover | 25. Coupling Hose |
| 7. Power Steering Pump Belt | 16. Machine Screw | 26. Water Outlet |
| 8. Fan Pulley | 17. Gasket | 27. Screw W/Washer |
| 9. Water Hose | 18. Gasket | 28. Gasket |
| | 19. Connector | 29. Thermostat |

Figure 5-34. Water Pump and Fan Group

- (2) Clean all gasket mating surfaces.
- (3) Insert 0.003-inch feeler gauge with wire or string attached between valve and seat of thermostat (29).

WARNING

Ethylene glycol is toxic to the eyes, skin and respiratory tract. Eye and skin protection is required. Use only in a well-ventilated area.

- (4) Submerge thermostat (29) in container of pure antifreeze and suspend it so that it does not touch sides or bottom of container.
- (5) Heat solution.
- (6) Apply slight tension to feeler gauge. When valve opens to 0.003 inch, feeler gauge will slip out of valve. Note temperature. If temperature exceeds figure given in table 6-1 thermostat must be replaced.
- d. Repair and replacement. Replace all worn and damaged parts, including parts found defective in inspection and testing procedures.
- e. Assembly. Assemble water pump and fan group as follows:

NOTE

When installing gaskets, coat gasket with gasket sealer.

- (1) Install temperature sensor (23), gasket (24) and coupling hose (25).
- (2) Install thermostat (29) and gasket (28).
- (3) Install water outlet (26) using screws and washers (27).
- (4) Install gasket (17) and cover (15) using machine screws (16).
- (5) Install connector (19).
- f. Installation. Install water pump and fan group as follows:
 - (1) Install gasket (22) and thermostat housing (20) using screws and washers (21).
 - (2) Install gasket (18).
 - (3) Install centrifugal pump (11) using screws and washers (12), (13) and (14). Tighten screws to torque specified by table 6-2.
 - (4) Connect radiator and heater hoses.
 - (5) Install water hose (9) and hose clamps (10). Tighten hose clamps (10).

- (6) Install fan pulley (8), alternator belt (6) and power steering belt (7).
- (7) Install fan spacer (4).
- (8) Install fan assembly (1) and fan spacer (4) using capscrews (2) and lockwashers (3).
- (9) Install drive belt.

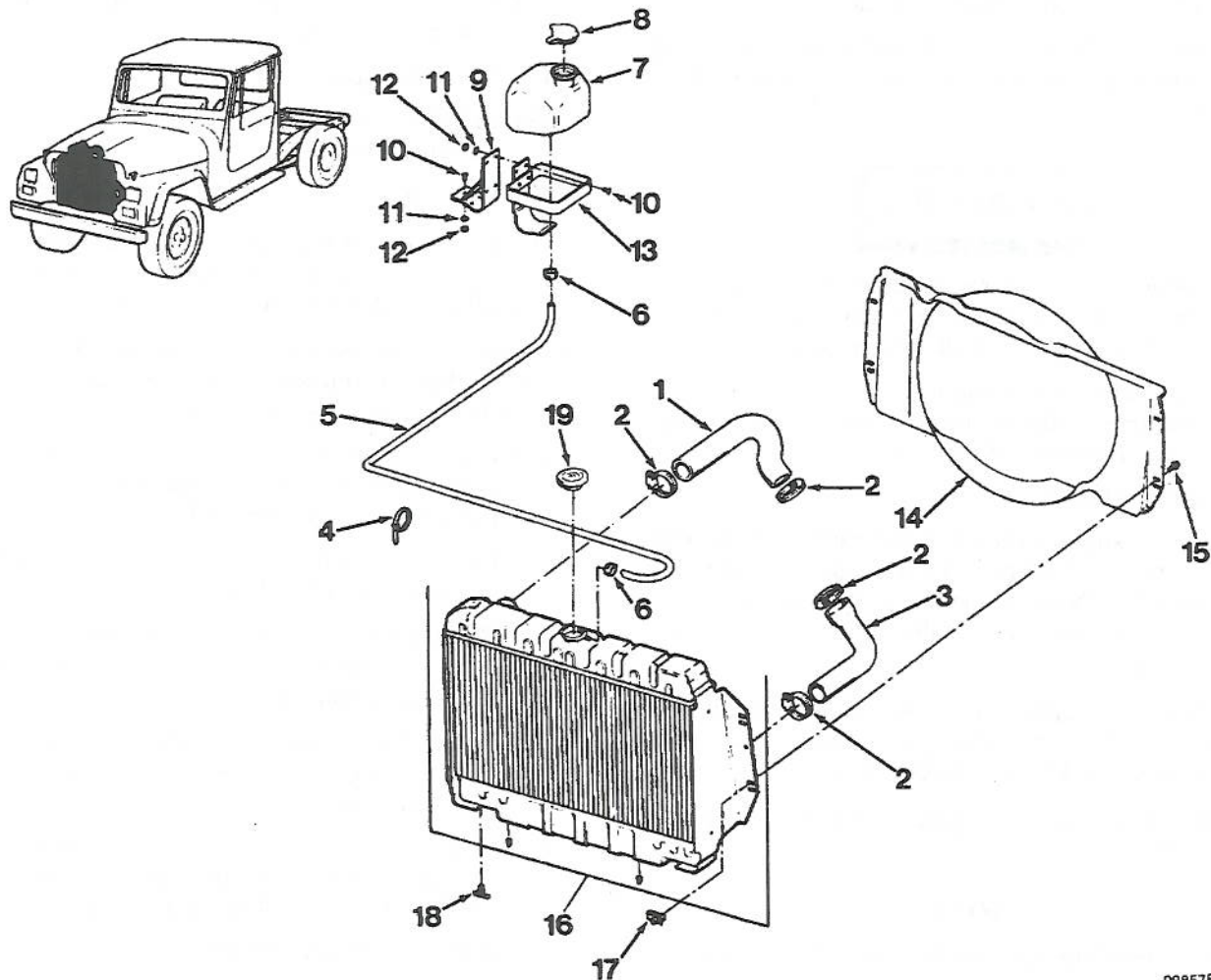
5-5.1.12 *Radiator, Hose and Coolant Recovery Group.* Refer to figure 5-35, and perform the following steps to repair the radiator, hose and coolant recovery group.

- a. Removal and disassembly. Disassembly is accomplished during removal. Remove radiator, hose and coolant recovery group as follows:
 - (1) Loosen hose clamp (6) and remove coolant recovery hose (5) from radiator assembly (16). Pinch hose (5) to prevent loss of coolant.
 - (2) Remove coolant recovery reservoir (7) from reservoir mounting bracket (13).
 - (3) Remove reservoir cap (8) from reservoir (7) and drain coolant from hose (5) and reservoir (7) into clean container.
 - (4) Remove hose clamp (6) at reservoir (7); remove hose strap (4) and remove coolant recovery hose (5) from reservoir (7).
 - (5) Remove machine screws (10), lockwashers (11) and hex nuts (12) holding reservoir mounting bracket (13) to bracket assembly (9).
 - (6) Remove mounting bracket (13).
 - (7) Remove machine screws (10), lockwashers (11) and hex nuts (12) holding bracket assembly (9) to vehicle body. Remove bracket assembly (9).
 - (8) Remove screws and washers (15) and U-spring nuts (17). Remove fan shroud (14).

WARNING

Do not remove cylinder block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant may occur.

- (9) Position drain pan under radiator assembly (16) and remove draincock (18).
- (10) Remove radiator cap (19).
- (11) Loosen hose clamps (2) and remove inlet hose (1).
- (12) Loosen hose clamps (2) and remove lower hose (3).
- (13) Remove top radiator attaching screws.



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|---------------|---------------------|-----------------------|
| 1. Inlet Hose | 7. Reservoir | 13. Mounting Bracket |
| 2. Clamp | 8. Reservoir Cap | 14. Fan Shroud |
| 3. Lower Hose | 9. Bracket Assembly | 15. Screw and Washer |
| 4. Strap | 10. Machine Screw | 16. Radiator Assembly |
| 5. Hose | 11. Lockwasher | 17. U-Spring Nut |
| 6. Clamp | 12. Hex Nut | 18. Draincock |
| | | 19. Radiator Cap |

Figure 5-35. Radiator, Hose and Coolant Recovery Group

- (14) Disconnect and plug transmission fluid cooler pipes.
- (15) Remove bottom radiator attaching screw.
- (16) Remove radiator using sling attached to suitable lift.
- b. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection instructions. In addition, perform the following steps:

WARNING

Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure should not exceed 30 psi and goggles must be worn.

- (1) Inspect radiator (16) for clogs. If clogged, clean by blowing compressed air at 3 to 5 psi from engine side of radiator through cooling fins.

- (2) Inspect radiator (16) for leaks by applying 3 to 5 psi air pressure to radiator (16) submerged in water.
- (3) Clean clogged radiator (16) with solvent or reverse flushing.
- c. Repair and replacement. Replace all worn or damaged parts. In addition, perform the following step:

WARNING

Avoid breathing fumes generated by soldering as they can be dangerous to personnel. Good general ventilation is normally adequate. Eye protection is required.

- (1) Seal all radiator leaks with solder.
- d. Assembly and installation. Assembly is accomplished during installation. Install radiator, hose and coolant recovery group as follows:
 - (1) Install radiator (16) and secure with radiator attaching screws.
 - (2) Install fan shroud (14) using screws and washers (15) and U-spring nuts (17).
 - (3) Install draincock (18).
 - (4) Remove plugs and connect transmission fluid cooler pipes.

NOTE

Use new clamps if necessary when installing hoses.

- (5) Install lower radiator hose (3) and hose clamps (2). Tighten hose clamps (2).
- (6) Install inlet hose (1) and hose clamps (2). Tighten hose clamps (2).
- (7) Install radiator cap (19).
- (8) Install bracket assembly (9) to vehicle body using machine screws (10), lockwashers (11) and hex nuts (12).
- (9) Install mounting bracket (13) on bracket assembly (9) using machine screws (10), lockwashers (11) and hex nuts (12).

NOTE

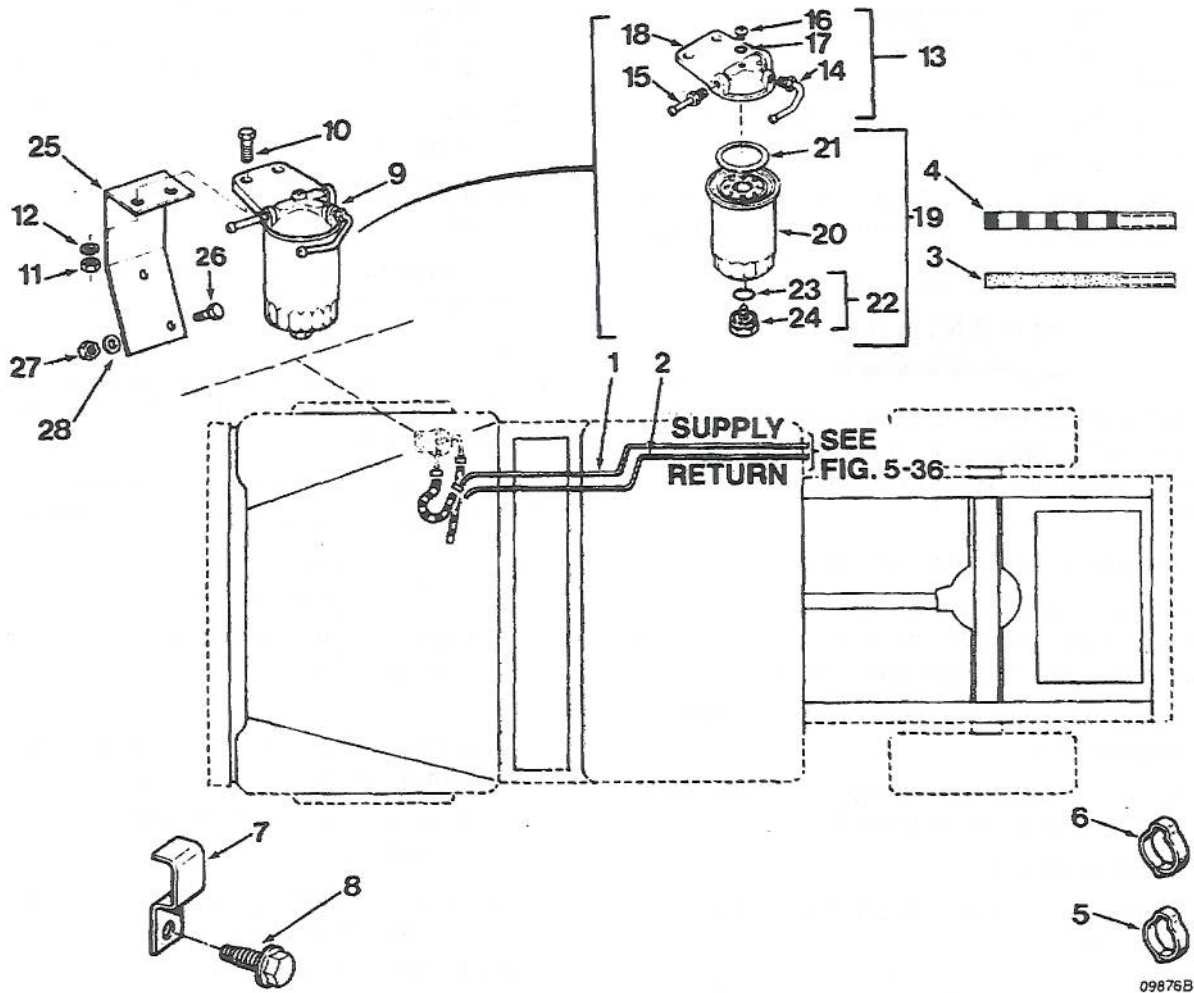
Use new clamps if necessary when installing hoses.

- (10) Install coolant recovery hose (5) and hose clamp (6) at radiator (16). Tighten hose clamp (6).

- (11) Install coolant recovery hose (5) and hose clamp (6) through reservoir mount bracket at coolant recovery reservoir (7). Tighten hose clamp (6).
- (12) Secure coolant recovery hose (5) to vehicle body using hose strap (4).
- (13) Install coolant recovery reservoir (7) and reservoir cap (8).

5-5.1.13 *Fuel Lines Group*. Refer to figure 5-36, and perform the following steps to overhaul the fuel lines group.

- a. Removal and disassembly. Disassembly is accomplished during removal. Remove the fuel lines group as follows:
 - (1) Loosen and remove hose clamps and remove tubes (1) and (2) from strainer assembly (9).
 - (2) Remove capscrews (10), hex nuts (11), lockwashers (12) and strainer assembly (9).
 - (3) Loosen and remove hose clamps (5) and (6) and remove fuel lines (1) and (2) from hoses (3) and (4).
 - (4) Remove machine screws (8) and clips (7) and remove fuel lines (1) and (2) from vehicle.
 - (5) Remove hose clamps (5) and (6); remove hoses (3) and (4).
 - (6) Remove capscrews (26), self-locking nut (29) and flat washer (28).
 - (7) Remove mounting bracket (25).
 - (8) Remove machine screw (16) and packing (17); remove cover assembly (13) and packing (21).
 - (9) Remove connector assemblies (14) and (15) from cover (18).
 - (10) Remove drain plug assembly (22) components-drain plug (24) and packing (23) from cartridge (19) or cartridge (20), whichever is used.
- b. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection procedures.
- c. Repair and replacement. Replace all worn or damaged parts.
- d. Assembly and installation. Assembly is accomplished during installation. Install fuel lines group as follows:
 - (1) Install drain plug assembly (22) components-drain plug (24) and packing (23) in cartridge (19) or cartridge (20), whichever is used.
 - (2) Install connector assemblies (14) and (15) in cover (18).



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|---------------|------------------------|------------------------|-----------------------|
| 1. Tube | 8. Machine Screw | 15. Connector Assembly | 22. Plug Assembly |
| 2. Tube | 9. Strainer Assembly | 16. Machine Screw | 23. Preformed Packing |
| 3. Hose | 10. Capscrew | 17. Packing | 24. Drain Plug |
| 4. Hose | 11. Hex Nut | 18. Cover | 25. Mounting Bracket |
| 5. Hose Clamp | 12. Lockwasher | 19. Cartridge Assembly | 26. Capscrew |
| 6. Hose Clamp | 13. Cover Assembly | 20. Cartridge Assembly | 27. Self-locking Nut |
| 7. Clip | 14. Connector Assembly | 21. Packing | 28. Washer |

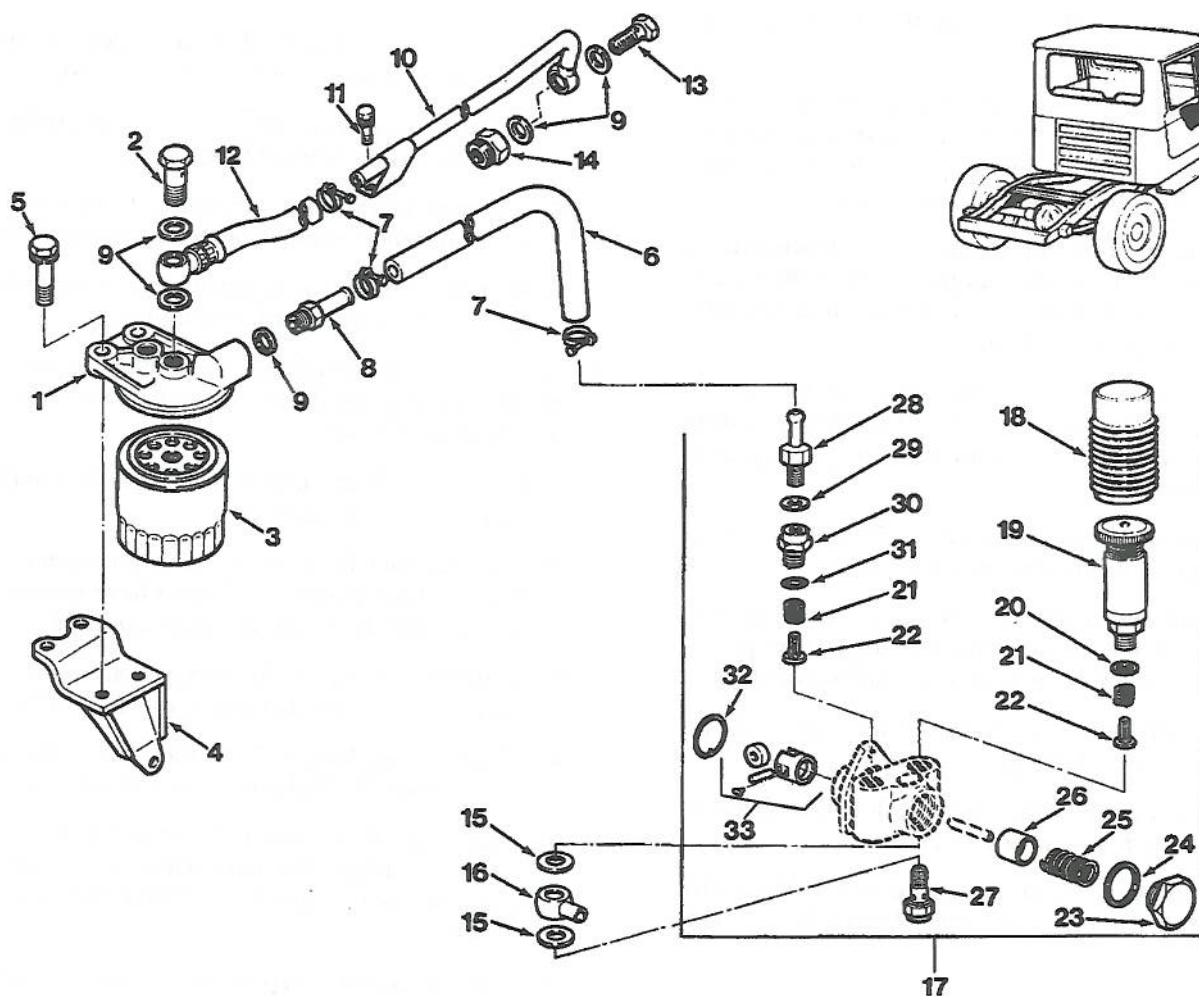
Figure 5-36. Fuel Lines Group.

- (3) Install cover assembly (13) and packing (21) using machine screw (16) and packing (17).
- (4) Install mounting bracket (25) using capscrews (26), flat washers (28) and self-locking nuts (27).
- (5) Install tubes (1) and (2) using clips (7) and machine screws (8).
- (6) Connect hoses (3) and (4) to gas tank using hose clamps (5) and (6).
- (7) Connect tubes (1) and (2) to hoses (3) and (4) using hose clamps (5) and (6).
- (8) Connect tubes (1) and (2) to strainer (9) using hose clamps (5) and (6).
- (9) Install strainer (9) using capscrews (10), lockwashers (12) and hex nuts (11).

5-5.1.14 *Fuel Pump and Fuel Filter Assembly Group.* Refer to figure 5-37, and perform the following steps to overhaul the fuel pump and fuel filter assembly group.

- a. Removal and disassembly. Disassembly is accomplished during removal. Remove the fuel pump and filter as follows:

- (1) Remove cover (18), priming pump (19), washer (20), check valve (22) and check valve spring (21) from top of feed pump assembly (17).
- (2) Loosen hose clamp (7) located on lower end of fuel hose (6). Remove hose joint (28), adapter (30), gasket (29), preformed packing (31),



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|-----------------------|------------------------|-----------------------|
| 1. Cover | 12. Fuel Hose | 23. Plug |
| 2. Connector | 13. Eye Bolt | 24. Washer |
| 3. Cartridge Assembly | 14. Adapter | 25. Piston Spring |
| 4. Filter Bracket | 15. Gasket | 26. Piston |
| 5. Screw W/Washer | 16. Fuel Pipe | 27. Eye Bolt |
| 6. Fuel Hose | 17. Feed Pump Assembly | 28. Hose Joint |
| 7. Hose Clamp | 18. Cover | 29. Gasket |
| 8. Hose Connector | 19. Priming Pump | 30. Adapter |
| 9. Gaskets | 20. Washer | 31. Preformed Packing |
| 10. Fuel Pipe | 21. Check Valve Spring | 32. Tappet Ring |
| 11. Screw W/Washer | 22. Check Valve | 33. Tappet Assembly |

Figure 5-37. Fuel Filter and Fuel Pump Assembly Group

- check valve (22) and check valve spring (21) from top of feed pump assembly (17).
- (3) Remove tappet ring (32), tappet assembly (33) and push rod.
 - (4) Remove piston chamber plug (23), washer (24), piston (26) and piston spring (25).
 - (5) Remove eye bolt (27), gaskets (15) and fuel pipe (16) from the housing.
 - (6) Remove fuel filter cartridge assembly (3) from the fuel filter cover (1). Remove connector to injector pump screw (2), gaskets (9) and fuel hose (12) from the fuel filter cover (1).
 - (7) Remove screw and washer (11) and loosen hose clamp (7) from the fuel pipe (10). Remove eye bolt (13), adapter (14), gaskets (9) and fuel pipe (10) from injection pump.
 - (8) Remove hose connector (8) and gasket (9) from fuel filter cover (1). Loosen hose clamp (7) and remove fuel hose (6) from hose connector (8).
 - (9) Remove screw and washer (5) and fuel filter cover (1) from filter bracket (4).
- b. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for cleaning and inspection procedures. In addition, perform the following steps:
- (1) Inspect fuel filter cartridge assembly (3) for clogging or damage.
 - (2) Inspect press-fitted check valve seat insert in housing for wear or damage.
 - (3) Insert push rod into housing and press in with thumb. Slight resistance should be encountered.
 - (4) Measure housing-to-piston (26) clearance. Refer to table 6-1 for clearance.
 - (5) Inspect tappet roller for scoring or wear beyond 0.587 inch.
 - (6) Measure tapped roller-to-pin clearance. Refer to table 6-1 for clearance.
 - (7) Inspect check valve springs (21) and piston spring (25) for damage or fatigue.
- c. Repair and replacement. Replace all parts found to be defective. In addition, replace the following parts if the associated conditions occur.
- (1) If press-fitted check valve seat is worn or damaged, replace housing and/or push rod.
 - (2) If slight resistance is not encountered when pressing push rod into housing with thumb, replace housing and/or push rod.
 - (3) If check valve seat is worn or scored, replace check valve (22).
 - (4) Replace piston (26) or tappet assembly (33) if worn or scored.
 - (5) If housing-to-piston (26) clearance exceeds clearance tolerance, replace piston (26).
 - (6) Replace tappet assembly (33) if tappet roller is worn or scored beyond 0.587 inch.
 - (7) If tappet roller-to-pin clearance exceeds clearance tolerance, replace tappet assembly (33).
 - (8) Replace check valve springs (21) or piston spring (25) if damaged or fatigued.
- d. Assembly and installation. Assembly is accomplished during installation. Install the fuel pump and filter as follows:
- (1) Install fuel filter cover (1) on filter bracket (4) with screw and washer (5).
 - (2) Connect fuel hose (6) to hose connector (8). Tighten hose clamp (7). Install hose connector (8) and gasket (9) on fuel filter cover (1).
 - (3) Connect fuel pipe (10) to injection pump with adapter (14), gaskets (9) and eye bolt (13).
 - (4) Connect fuel hose (12) to fuel pipe (10) with hose clamp (7). Tighten screw and washer (11).
 - (5) Install fuel filter hose (12) on fuel filter cover (1) with gaskets (9) and connector to injector pump screw (2). Install fuel filter cartridge assembly (3).
 - (6) Coat all parts of feed pump assembly (14) lightly with engine oil.

NOTE

Refer to table 6-2 for torque limits for feed pump stud bolt and feed pump locknut.

- (7) Install fuel pipe (16) with gaskets (15) and eye bolt (27) to housing of feed pump assembly (14).

NOTE

Tighten piston chamber plug slowly to assure spring remains in groove.

- (8) Install piston (26), piston spring (25), washer (24) and piston chamber plug (23) in housing.

- (9) Insert push rod and tappet assembly (33) into housing. Install tappet ring (32).
 - (10) Install check valve (22), check valve spring (21), preformed packing (31), adapter (30), gasket (29) and hose joint (28) on discharge side of housing. Connect hose joint to fuel hose (6) with hose clamp (7).
 - (11) Install check valve (22), check valve spring (21), washer (20), priming pump (19) and cover (18) on intake side of housing.
- e. Testing. With feed pump assembled, but not connected to fuel pipe (16) or fuel hose (6), test the following items:
- (1) Air tightness of push rod. With discharge side closed and air pressure of 28.4 psi applied to inlet port, submerge feed pump in oil tank; no air leak should be detected in area of push rod.
 - (2) Priming pump (19). When priming pump is operated at the rate of 60 to 100 strokes per minute, the number of pumping operations needed to begin sucking fuel must be less than 25 strokes.
 - (3) Fuel feeding quantity. With a suction pipe inside diameter (I.D.) 0.315 inch by length 78.74 inch and cam lift 0.189 inch-SD22, 0.236 inch-SD33, run the pump at 1000 rpm for 15 seconds. The quantity of fuel fed must exceed 300 cc.
 - (4) Fuel feeding pressure. With a suction pipe I.D. 0.315 inch by length 78.74 inch and cam lift 0.189 inch-SD22, 0.236 inch-SD33, run the pump at 600 rpm. The time needed to reach feeding pressure of 25.6 psi must be less than 30 seconds.

5-5.1.15 *Injector Nozzles and Tubes Group.* Refer to figure 5-38, and perform the following steps to overhaul the injector nozzles and tubes group.

- a. Removal and disassembly. Disassembly is accomplished during removal. Remove the injector nozzles and tubes as follows:
- (1) Remove valve (15), gaskets (16), and connector (17) from fuel filter.
 - (2) Loosen hose clamps (14) and remove fuel hose (13) from connector (17) and spill tube (1).
 - (3) Remove machine screws (1) and tube supports (2), (3) and (4).
 - (4) Remove hex nuts (12) and injector tubes (5), (6), (7), (8), (9) and (10).

CAUTION

Cover injection pump with clean rag to prevent entry of dirt which may cause damage to injection pump.

- (5) Remove nozzle and holder assemblies (19) and gaskets (18) with special tool #J99724Z5000.
 - (6) Remove one gasket (20) from each of the nozzle and holder assemblies (19).
- b. Cleaning and inspection. Refer to paragraphs 5-4.3 and 5-4.4 for general cleaning and inspection procedures. In addition, make the following inspections:
- (1) Inspect each nozzle and holder assembly (19) for seizure, damage or excessive discoloration.
 - (2) Inspect nozzle spray for correct pattern.
 - (3) Inspect nozzle for leaks.
- c. Repair and replacement. Replace all worn or damaged parts including all parts found defective during inspection and testing procedures above.
- d. Testing. Refer to figure 5-39, and perform operational test of nozzle and holder assembly (19) as follows:

WARNING

Diesel fuel is combustible and an irritant. Skin and eye protection are required. Good general ventilation is normally adequate. Keep away from open flame and other ignition sources.

- (1) Fill reservoir of pressure tester with filtered, clean No. 2 diesel fuel.
- (2) Mount nozzle and holder assembly (11) in pressure tester.

WARNING

The fuel spray from an injector can penetrate the skin. Fuel oil that penetrates the skin can cause a serious infection or death.

- (3) Operate tester pump for several strokes to bleed air from nozzle. Verify that fuel sprays from nozzle.
- (4) Cycle pump in smooth, even strokes at 1-second intervals and observe fuel spray pattern. Refer to figure 5-40 for correct spray pattern. Fuel should spray at an angle in thin symmetrical jet. It should not be vaporized, stepped, branched or uneven.

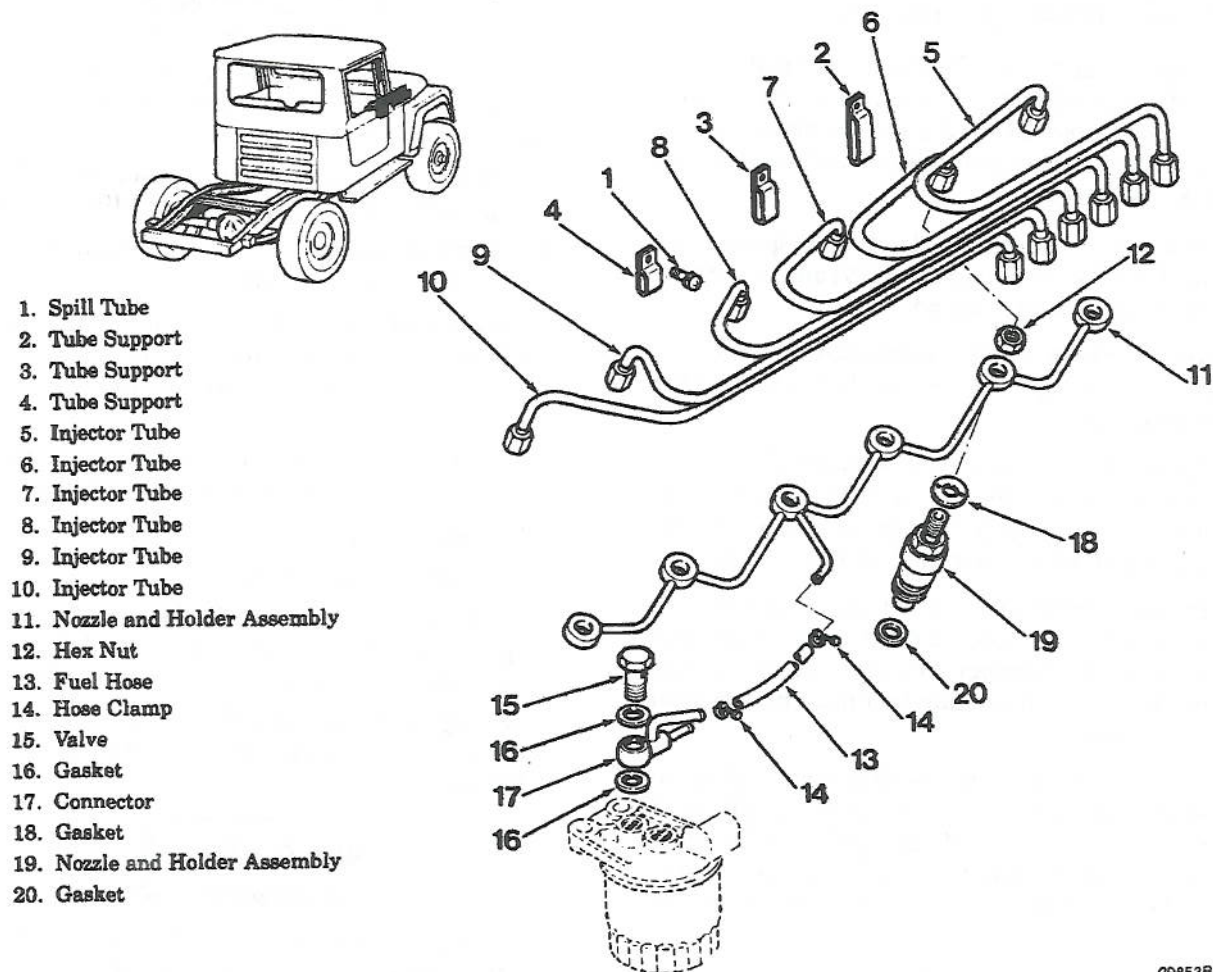


Figure 5-38. Injector Nozzles and Tubes Group

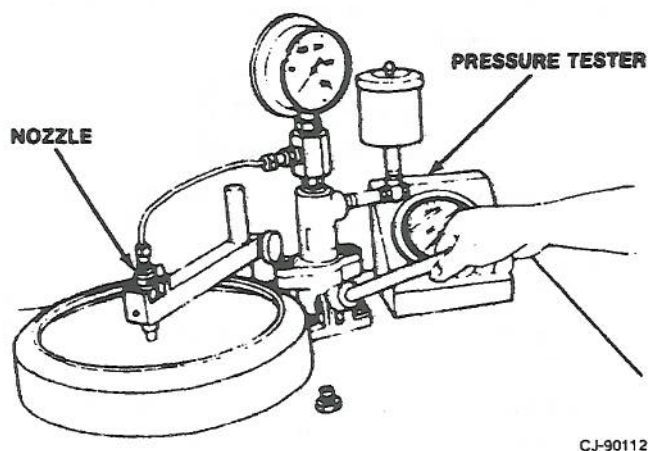


Figure 5-39. Pressure Test Setup

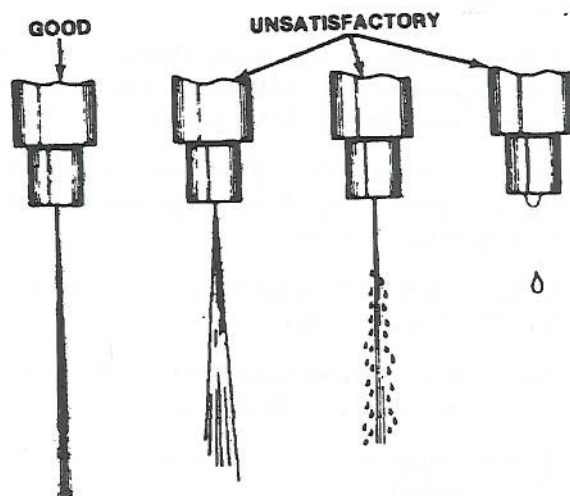


Figure 5-40. Fuel Spray Patterns