SECTION 6B1

ENGINE COOLING

CAUTION: On vehicles equipped with Supplemental Inflatable Restraint (SIR), refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

CONTENTS (cont'd)

GENERAL DESCRIPTION

COOLING SYSTEM

All C/K-Model vehicles have pressure-type engine cooling systems with thermostatic control of the coolant circulation. The cooling system is sealed by a pressure-type cap that allows the system to operate at higher than atmospheric pressure. The high pressure operation raises the boiling point of the coolant, which increases the cooling efficiency of the radiator. The 105 kPa (15 psi) pressure cap raises the boiling point of the coolant to about 125°C (257°F) at sea level.

The radiator cap has an integral pressure-vacuum valve. This valve releases the expanding coolant when it reaches approximately 105 kPa (15 psi) and routes it to the coolant recovery reservoir. The vent function allows the coolant to return to the radiator. As the system cools, the extra coolant in the reservoir is drawn into the radiator through the vent valve. The nominal 105 kPa (15 psi) pressure will not be reached until the system is working at maximum capacity. Any air or vapor in the cooling system will be forced to the coolant reservoir and out through the vent tube at the top of the reservoir. In this manner, the radiator keeps itself full at all times.

COOLANT RECOVERY TANK

Gasoline engines use a plastic reservoir, connected to the radiator by a hose. As the vehicle is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the recovery bottle. When the vehicle is stopped and the coolant cools and contracts, vacuum draws the displaced coolant back into the radiator. This keeps the radiator full at all times, resulting in maximum cooling efficiency.

Keep the coolant level between the "HOT" and "COLD" marks on the recovery bottle. These marks are about one liter (one quart) apart. Use a 50/50 mixture of ethylene glycol anti-freeze and soft or distilled water.

DIESEL SURGE TANK

The diesel engine uses a cooling system with a surge tank. The pressure cap for the diesel engine is different than the gasoline engine pressure cap and is located on the surge tank. The surge tank used with the diesel engine cooling system is pressurized. Coolant circulates through the surge tank to allow any air that is in the system to be removed and to provide room for the coolant to expand when the coolant is hot.

COOLANT PUMP

The pump is of the centrifugal vane impeller type. The impeller turns on a steel shaft that rotates in a permanently lubricated ball bearing.

The pump inlet is connected to the bottom of the radiator by a rubber hose. From the pump, coolant passes through the engine front cover into the coolant passages in the block to pick up excess engine heat.

THERMOSTAT

A pellet-type thermostat in the coolant outlet passage controls the flow of engine coolant to provide fast engine warm-up and regulate coolant temperatures. A wax pellet element in the thermostat expands when heated and contracts when cooled. The pellet is connected through a piston to a valve. When the pellet is heated, pressure is exerted against a rubber diaphragm to force the valve open. As the pellet cools, the contraction allows a spring to close the valve. This allows the valve to remain closed while the coolant is cold, preventing circulation of coolant through the radiator. At this point, coolant circulates throughout the engine to warm the engine quickly and evenly.

As the engine warms, the pellet expands and the thermostat valve opens. The coolant then flows through the radiator where heat is passed through the radiator walls. This opening and closing of the thermostat allows the cooling system to keep the engine in the correct operating temperature range.

DIAGNOSIS OF ENGINE COOLING

SYSTEM CHECKS

DRIVE BELT - MULTIPLE RIBBED BELT

Check the drive belt for looseness, damage, or fabric delamination. If the belt is loose, check the belt tensioner for proper operation. The belt tensioner is not adjustable. If it is not working properly, it must be replaced. If the belt is delaminated or damaged, replace it.

Important

- Cracks across the rib material are a normal part of the belt aging process. Cracks do not affect belt operation, and do not indicate a need to replace it.

Check the belt length scale on the tensioner. If it reads outside the "acceptable" range, check for proper routing as shown on the belt routing label and in this section. Also check for proper tracking of belt ribs in the pulley grooves, correct pulley sizes (including idlers), and correct belt length.

Important

- Multiple rib belts stretch and wear very little. Normal stretch and wear rarely exceeds 10 mm (3/8 inch) on the belt length scale.

EXHAUST LEAKS

To check for exhaust leaking into the cooling system, drain the system until the coolant level stands just above the top of the cylinder heads, then disconnect the upper radiator hose and remove the thermostat and belt. Start the engine and accelerate several times. At the same time, note any appreciable coolant rise or the appearance of bubbles that may indicate that exhaust gases are leaking into the cooling system.

NOTICE: A worn head gasket may allow exhaust gases to leak into the cooling system. This can damage the cooling system as the gases combine with the water to form acids that are harmful to the radiator and engine.

COOLANT PUMP

Check coolant pump operation by running the engine while squeezing the upper radiator hose. When the engine warms, a pressure surge should be felt. Check for a plugged vent hole in the pump.

RADIATOR

Test for restrictions in the radiator by warming the engine up, turning the engine off, and feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

THERMOSTAT

Make an operational check of the thermostat by hanging the thermostat on a hook in a 33 percent glycol solution, -12°C (10°F) below the temperature indicated on the valve. With the valve submerged and the coolant agitated, the valve should close.

OVERHEAT AND/OR NOISE

Restrictions in the cooling system can cause engine overheating and/or cooling system noise.

Components prone to this condition are the cylinder head, coolant pump, block, thermostat housing, and inlet manifold.

Symptoms are:

- Engine may make snapping/cracking noises.
- Heater core may gurgle or surge.
- Radiator hoses may collapse and expand.
- Heater hoses may vibrate and thump.
- Overheat light may or may not come on.

Symptoms are caused by coolant boiling at some localized area and may be noticed after extended idling and/or while driving. Determine which side of the engine is involved and whether it is at the front or rear of the engine.

Diagnosis/Inspection

1. Isolate the area by probing the engine with a sounding bar (large screwdriver).

CAUTION: The radiator or diesel surge tank cap should be removed from a cool engine only. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

2. With the radiator cap removed, observe the coolant being circulated in the radiator. Feel the front area of the radiator for cold spots which indicate blockage. Blocked radiators generally occur on units that have accrued miles and not on new vehicles.
3. Inspect the thermostat to see if it opens.
4. Inspect the thermostat housing to make sure it is free of obstructions.
5. Remove the coolant pump from the vehicle and remove the back cover on the pump. Inspect all internal passages using a flashlight.
6. Inspect the crossover at the front of the inlet manifold. This entire passage can be seen only with the thermostat removed.
7. Remove the heads and check the block with a pen light flashlight. Never replace a block unless the restricted area can be seen.
8. Inspect the heads if the problem is not found. Heads with blocked coolant passages generally have more than one area that is blocked. Look for signs of overheat discoloration (a dark blue or black area). If none are found, look in the coolant passages for blockage and probe all accessible passages. The head is intricate, and all the passages cannot be reached. Use a substantial wire to go through or around a partially blocked area. If nothing is found by visual inspection and probing, inspect the passages for a rough, ragged appearance. The roughest internal passages are probably the ones that are blocked. Replace a blocked or suspect head and inspect the replacement head before installation.

FAN CLUTCH DIAGNOSIS

NOISE

Fan noise is sometimes evident under the following normal conditions.

- When the clutch is engaged for maximum cooling.
- During the first 15 seconds to one minute after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition (after overnight settling).

Fan noise or an excessive roar will generally occur continuously under all high engine speed conditions (2500 rpm and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, replace the clutch. Refer to "Fan and Fan Clutch Replacement."

LOOSENESS

Check a loose fan assembly for wear and replace as necessary. Under various temperature conditions, there is a visible lateral movement at the tip of the fan blade. Approximately 6.5 mm (1/4 inch) maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

SILICONE FLUID LEAKS

The fan clutch operation is affected by fluid leaks which may occur in the area around the bearing assembly. If leakage appears, replace the fan clutch. Refer to "Fan and Fan Clutch Replacement."

ENGINE OVERHEATING

1. Start with a cool engine to ensure complete fan clutch disengagement.
2. If the fan and clutch assembly free-wheels with no drag (revolves more than five times when spun by hand), replace the clutch. Refer to "Fan and Fan Clutch Replacement." If the clutch performs properly with a slight drag, go to step C.
   - Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.
3. Position a thermometer so it is located between the fan blades and the radiator. This can be achieved by inserting the thermometer sensor through one of the existing holes in the fan shroud or by placing it between the radiator and the shroud. On some models, it may be necessary to drill a 5-mm (3/16-inch) hole in the fan shroud to insert the thermometer.

NOTICE: Check for adequate clearance between fan blades and the thermometer sensor before starting engine, as damage could occur.

4. With the thermometer in position, cover the radiator grille sufficiently to induce a high engine temperature, start the engine, turn air conditioning on, and operate at 2000 rpm.
5. Observe thermometer reading when the clutch engages. It will take approximately 5 to 10 minutes for the temperature to become high enough to allow engagement of the fan clutch on gasoline engines and 15 to 20 minutes on diesel engines. This will be indicated by an increase or roar in fan air noise and by a drop in the thermometer reading of approximately 3°C to 10°C (5°F to 15°F).
   - If the clutch did not engage between 65°C to 96°C (150°F to 205°F) the unit should be replaced. Be sure the fan clutch was disengaged at the beginning of the test.
   - If no sharp increase in fan noise or temperature drop was observed and the fan noise level was constantly high from start of test to 88°C (190°F), the unit should be replaced. Do not continue the test past a thermometer reading of 96°C (205°F) to prevent engine overheating.

6. As soon as the clutch engages, remove the radiator grille cover and turn the air conditioning off to assist in engine cooling. Run the engine at approximately 1500 rpm.
7. After several minutes, the fan clutch should disengage as indicated by a reduction in fan speed and roar. If the fan clutch fails to function as described, it should be replaced.

THERMOSTAT DIAGNOSIS

Refer to the thermostat diagnostic chart for thermostat diagnosis procedures (figure 1).

COOLANT DIAGNOSIS

HYDROMETER

Due to changes in commercially available antifreeze, the use of a hydrometer may give an incorrect reading. The hydrometer should be used to test ethylene glycol base antifreeze only. Ethylene glycol base antifreeze is recommended for year round use.

COOLANT TESTER

Coolant testers J 26568 (Centigrade Scale) and J 23688 (Fahrenheit Scale) can be used to check the anti-freeze protection of the coolant. Make sure the hydrometer readings are correct. Unless J 26568 or J 23688 has a provision for temperature correction, test the temperature at which J 26568 or J 23688 is calibrated. If the coolant is warmer or cooler, the reading may be incorrect. Follow the manufacturer's directions for using J 26568 or J 23688.

Cleaning

- Before each use, swing the plastic cover back at the slanted end of J 26568 or J 23688, exposing the measuring window and the bottom of the plastic cover (figure 2).
- Wipe dry with tissue or clean soft cloth.
- Close the plastic cover.

Testing

Tools Required:
J 26568 or J 23688 Coolant Tester

- Do not remove the clear plastic pump from the tester.

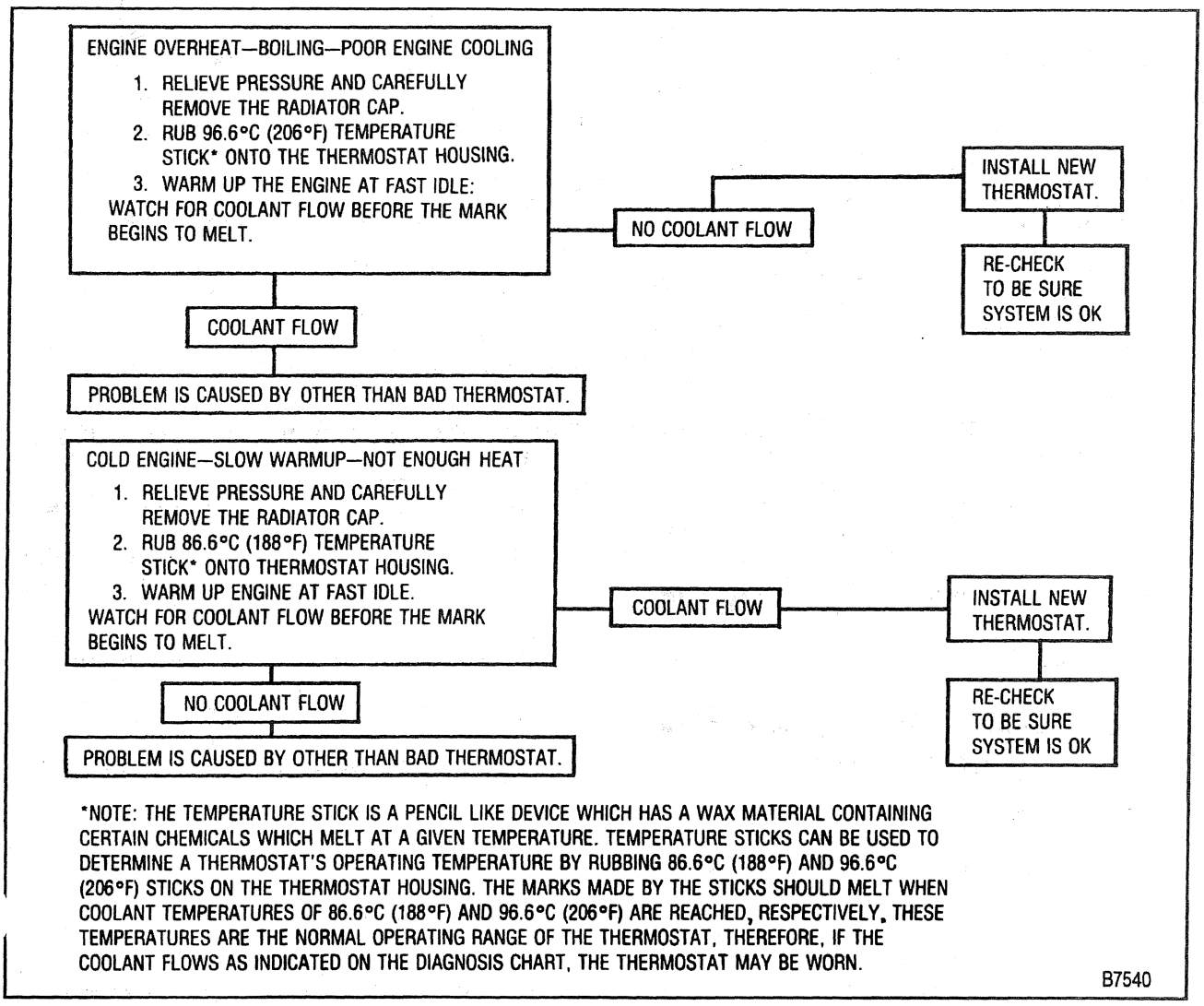


Figure 1—Thermostat Diagnosis Chart

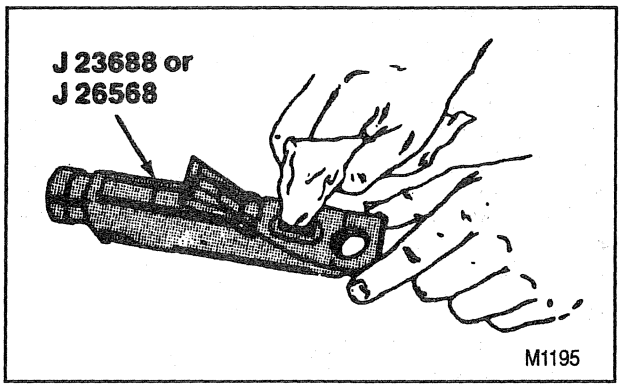


Figure 2—Cleaning the Coolant Tester

1. Release the tip of the pump from J 26568 or J 23688.
2. Insert the tip of the pump into the radiator filler neck (figure 3).
3. Make sure the tip of the pump is below the level of the coolant.
4. Press and release the bulb to draw a sample.
5. Insert the tip of the pump into the cover plate opening.
6. Press the bulb and inject a few drops of coolant onto the measuring surface.
   - Do not open the plastic cover when taking readings because water evaporation can change the reading.

Reading

- Point J 26568 or J 23688 toward any light source and look into the eyepiece (figure 4).
  - Coolant protection reading is at the point where the dividing line between light and dark crosses the scale (antifreeze protection is the scale on the right).
  - Temperature scale is reversed from a standard thermometer scale.
  - Below zero readings are on upper half of the scale.
  - Readings on the lower half of the scale indicate solutions without enough antifreeze concentration to provide adequate rust protection.
  - If the readings are not clear, the measuring surfaces were not cleaned and dried properly. Wipe dry and make a new test.

COOLING SYSTEM DIAGNOSIS

Refer to the cooling system diagnosis charts for detailed cooling system diagnostic procedures (figures 5 and 6).

UNCOMMON COOLING SYSTEM PROBLEMS

Problems Not Requiring Disassembly of the Cooling System

1. Remove large obstructions (equipment not approved by GM) blocking the radiator or condenser.
   - Auxiliary oil cooler(s).
   - License plates.
   - Spare tires.
   - Ice, mud, or snow obstructing the grille.
   - Fog lamps.

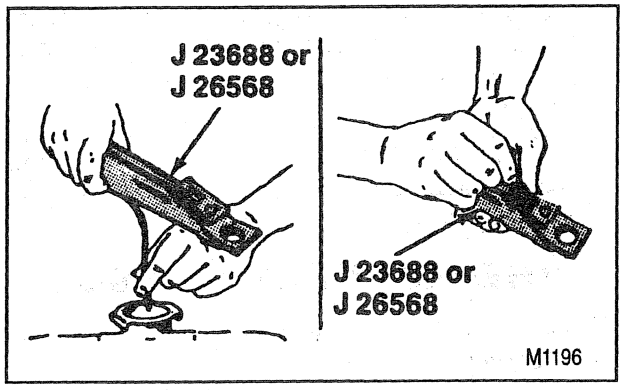


Figure 3—Collecting the Coolant

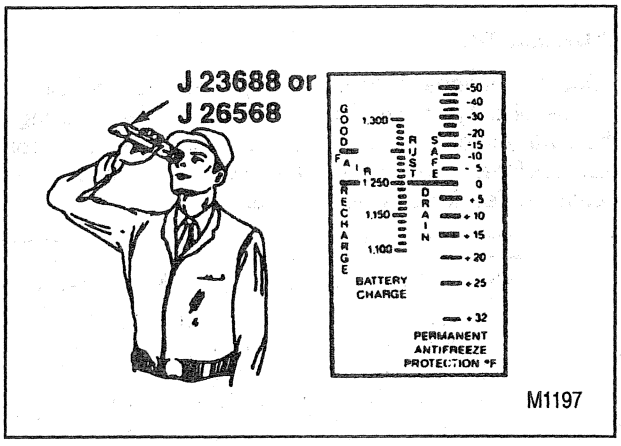


Figure 4—Reading the Coolant Tester

2. Engine oil is overfilled.
3. Incorrect radiator for the application.
   - Check the part number.
4. Loose, damaged, or missing air seals.
5. Missing or damaged lower air baffle.
6. Incorrect ignition timing.

Problems Requiring Disassembly of the Cooling System

1. Incorrect or damaged fan.
2. Worn or damaged emission system components.
   - Could cause overheating at idle.
   - Damaged positive crankcase ventilation (PCV) valve, thermal vacuum valve (TVV), or engine coolant temperature switch (ECT).
3. Radiator filler neck damage.
   - Shows if the pressure cap leaks because of radiator filler neck damage.
4. Worn or damaged coolant pump.
   - Impeller vanes eroded or broken.
   - Worn or damaged bearing and/or seal. Check for shaft or bearing play.
5. Plugged radiator tubes.
   - Perform a flow check.
6. Internal system leaks.
   - Head gasket.
   - Cracked block.
   - Timing chain cover.
   - Intake manifold gasket.
7. Plugged coolant passages in the cylinder heads.
   - Visual check.

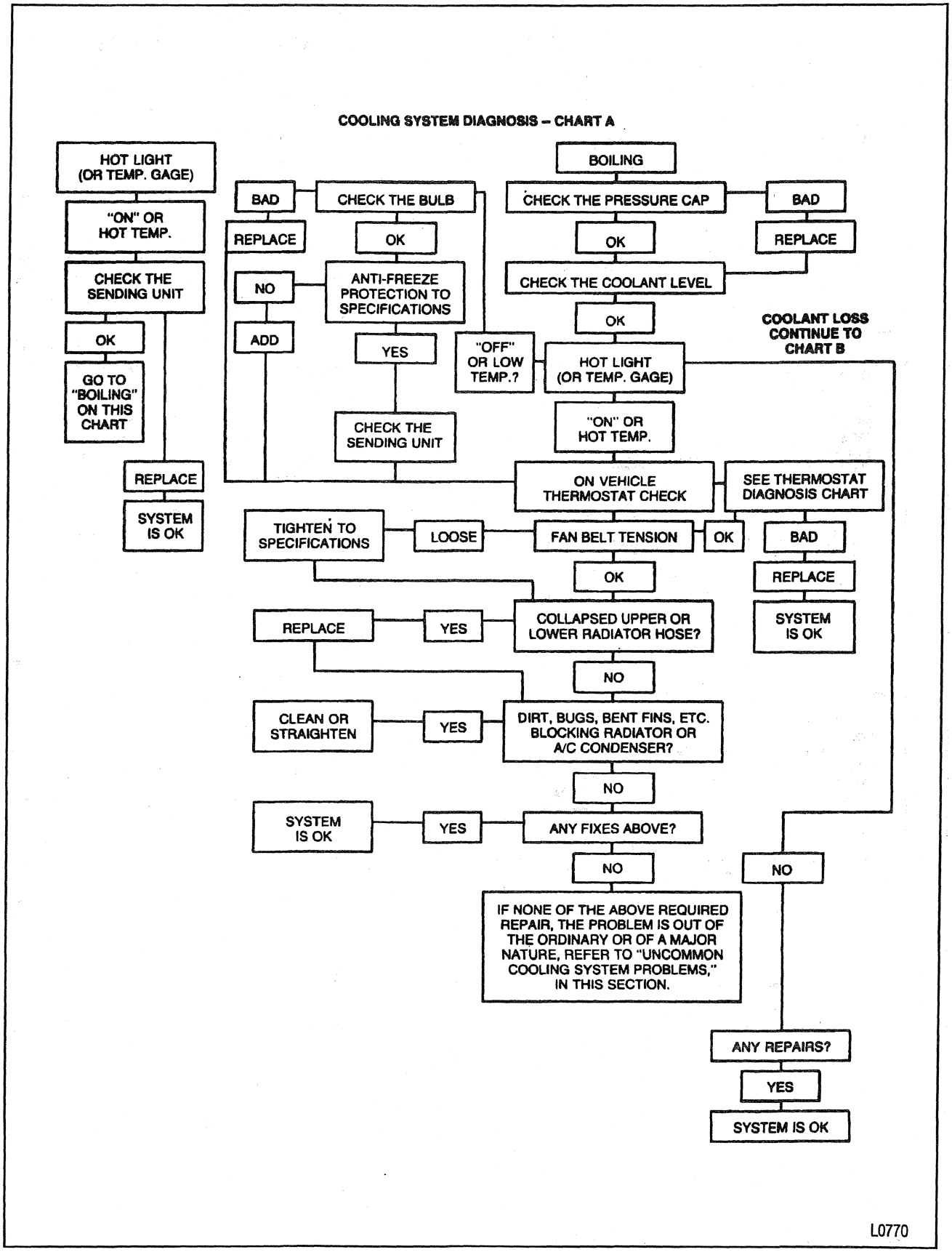


Figure 5—Cooling System Diagnosis Chart

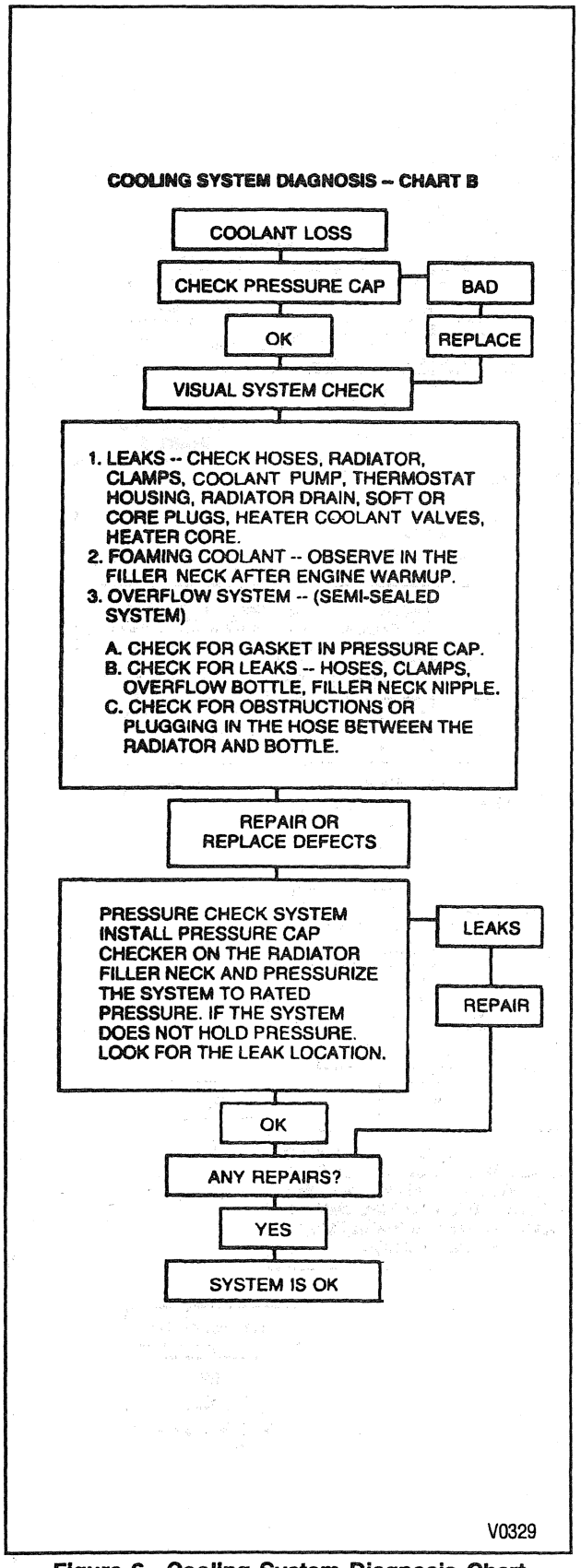


Figure 6—Cooling System Diagnosis Chart

COOLANT LEVEL INDICATOR DIAGNOSIS

DIESEL ENGINES

The coolant level indicator circuit is shown in figure 7.

Indicator Lamp Will Not Illuminate

1. Turn the ignition switch to the "ON" position.
   - If the lamp illuminates, the lamp is OK and the connector is properly installed on the module. Go to step 2.
   - If the lamp does not illuminate, check the bulb, socket, and wiring between the socket and the module connector, as well as the connector on the module. Replace or repair as required.
2. Turn the ignition switch to the "ON" position and disconnect the electrical lead at the coolant level sensor on the radiator.
   - If the lamp fails to illuminate, check the wiring between the coolant level sensor connector and the module for a short circuit to ground. If the circuit is OK, replace the module.

Indicator Lamp Remains Illuminated

1. Turn the ignition switch to the "ON" position.
   - Check the coolant level. Add coolant if necessary.
   - If the lamp remains illuminated, go to step 2.
2. Disconnect the electrical lead at the coolant level sensor on the surge tank and use a jumper wire and "G" type electrical connector.
   - If the lamp does not illuminate, replace the sensor.
   - If the lamp remains illuminated, connect the electrical lead and go to step 3.
3. Check for an open circuit between the sensor and the module.
   - If an open circuit is found, repair it.
   - If no open circuit is found, replace the module.

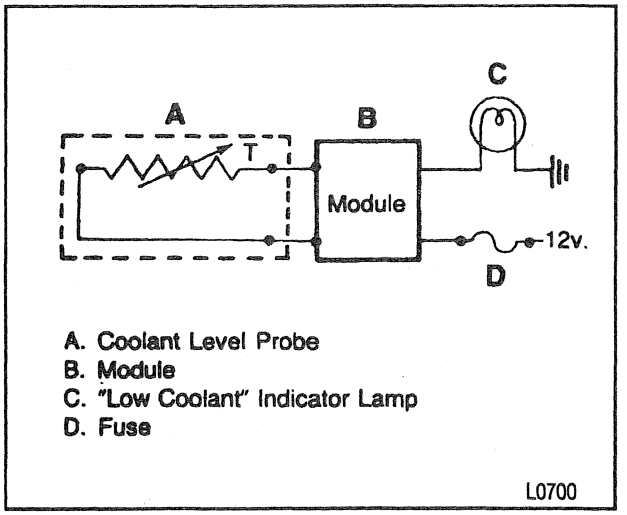


Figure 7—Low Coolant Level Sensor Circuit

DIAGNOSIS OF DRIVE BELT SYSTEM

Drive belts and pulleys wear evenly with use. Unusual signs of wear indicate some correction is needed. The following diagnostic chart will aid in diagnosing multiple ribbed belt system problems.

DEFINITIONS:

Chirping: Chirping is a high pitched noise that is usually heard once per revolution of a pulley or belt. It is also usually heard at idle and is most common on cold damp mornings. By squirting water onto a chirping belt, the noise will momentarily go away.

Squeal: Squeal is a loud screeching noise that is usually caused by a slipping belt. The noise usually occurs when a heavy load is applied to the belt, such as compressor engagement, accelerating the engine, or the belt slipping on seized pulley.

Whine: Whine is a high pitched continuous noise that may be caused by a failed bearing.

Faint Cyclic Rumbling: Faint cyclic rumbling is a deep low frequency noise (once per revolution of the belt).

Pilling: Pilling is the random accumulation of rubber dust in the bottom of the multi-ribbed belt grooves. A small amount of pilling is normal. Operation of the drive belt system will not be affected unless buildup exceeds 1/3 of the belt groove depth.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Chirp	1. Misalignment of pulleys. A. Power steering pump pulley. B. Bent or cracked brackets. C. Loose or missing fasteners. 2. Bent pulley flange. 3. Severe pilling, exceeding 1/3 of belt groove depth.	1. Check pulley alignment. A. Refer to SECTION 3B. B. Replace as necessary. C. Check and re-torque. Replace as necessary. 2. Replace as necessary. 3. Replace belt.
Squeal	1. Seized bearings. 2. Insufficient tension. A. Incorrect belt length. B. Incorrect pulley size. C. Malfunctioning tensioner. D. Incorrect drive belt routing.	1. Replace as necessary. 2. Tighten as needed. A. Replace belt. B. Replace pulley. C. Replace tensioner. D. Refer to drive belt routing.
Whine	Worn bearings.	Replace as necessary.
Faint Cyclic Rumbling	Severe pilling.	Replace belt.
Belt Falls Off	1. Misalignment of pulleys. A. Bent or cracked brackets. B. Loose or missing fasteners. C. Misaligned power steering pump pulley. 2. Damaged belt. 3. Malfunctioning tensioner. 4. Worn idler or tensioner pulley bearings.	1. Check pulley alignment. A. Replace as necessary. B. Check and re-torque, replace as necessary. C. Refer to SECTION 3B. 2. Replace as necessary. 3. Replace as necessary. 4. Replace as necessary.
Vibration	1. Bent or cracked brackets. 2. Loose or missing fasteners. 3. Damaged fan blades. 4. Bent fan clutch or coolant pump shaft.	1. Replace as necessary. 2. Check and re-torque, replace as necessary. 3. Replace as necessary. 4. Replace as necessary.
Excessive Wear in Either Outside Groove of Drive Belt	Ribs in the drive belt do not match the grooves in the pulley.	Replace damaged belt as necessary. Refer to Drive Belt Replacement in this section.

D0270

ON-VEHICLE SERVICE

DRAINING AND FILLING THE COOLING SYSTEM

Draining

1. Place a drain pan under the radiator drain cock.
2. Install a tube on the drain cock.
3. Place the end of the tube in the pail or pan.
4. Make sure the cooling system is cool, then remove the radiator cap.
5. Open the drain cock completely.
6. Let the cooling system drain until the flow stops.
7. Place a drain pan under the engine.
8. Remove the drain plug in the engine block.
9. Let the engine block drain until the flow stops.
   - There may be more drainage from the radiator at this time.
10. Replace the engine block drain plug.
11. Close the radiator drain cock.

Filling (Gasoline Engines)

NOTICE: Two sealant pellets GMSPO part no. 3634621 must be added to the radiator whenever the coolant system is drained and refilled with fresh coolant. Failure to use the correct sealant pellets may result in premature coolant pump leakage. Do not add the pellets to the coolant recovery bottle since this may prevent the coolant system from operating properly. Do not add the sealant pellets to the diesel cooling system due to the unique coolant pump shaft seal.

1. Check the radiator drain cock to be sure it is closed.
2. Check the engine drain plug to be sure it is tight.
3. Premix the antifreeze with clear water in 50/50 mixture.
   - If the old coolant is being used, check it for glycol/water mix of 50/50.
4. Place a large top funnel in the radiator fill hole.
5. Slowly pour in the coolant. The filling may be slowed because of the thermostat being closed.
6. After the cooling system is filled to 1/2 inch below the fill hole, start the engine and let the cooling system warm up. When the thermostat opens, the coolant level may drop. If the level drops, add coolant until the level is up to the fill hole.
7. Replace the radiator cap.
8. Check the coolant level in the recovery tank. Add coolant if needed.

Filling (Diesel Engines)

1. Open the air bleed valve in the engine coolant outlet (thermostat housing).
2. Fill the surge tank bottle until coolant comes out of the air bleed valve.
3. Close the air bleed valve and install the pressure cap on the surge tank.
4. On vehicles with a rear heater, close the air bleed valve. Start the engine and bring the engine speed to 2000 RPM for 2 to 3 minutes to flush any air for the rear heater. Shut the engine off and reopen the air bleed valve. Fill the surge tank until coolant comes out the air bleed valve. Close the air bleed valve and install the pressure cap on the surge tank.
5. Monitor the cold coolant level in the surge tank. Add coolant as needed to bring the coolant level to the "Full Cold" mark.

FLUSHING THE COOLING SYSTEM

Various methods and equipment can be used to flush the cooling system. If special equipment such as a back flusher is used, follow the equipment manufacturer's instructions.

NOTICE: If the engine is damaged internally and a new engine assembly is installed in the vehicle, make sure all foreign material is completely flushed out of the cooling system. The oil cooler system should also be flushed out (if equipped). Failure to rid the oil or cooling system of debris can result in damage to the replacement engine.

Important

- Remove the thermostat before flushing the cooling system.

COOLANT RECOVERY/SURGE TANK REPLACEMENT

Remove or Disconnect (Figures 8 and 9)

1. Coolant from the recovery tank.
2. Clamps.
3. Coolant recovery reservoir hose from the recovery tank.
4. Overflow hose.
5. Bolts.
6. Coolant recovery tank from the vehicle.

Install or Connect (Figures 8 and 9)

1. Coolant recovery tank to the vehicle.
2. Bolts.

Tighten

- Bolts to 10 N.m (89 lbs. in.).

3. Coolant overflow hose to the recovery tank.
4. Coolant recovery reservoir hose to the recovery tank.
5. Clamps.
6. Coolant in the recovery tank.

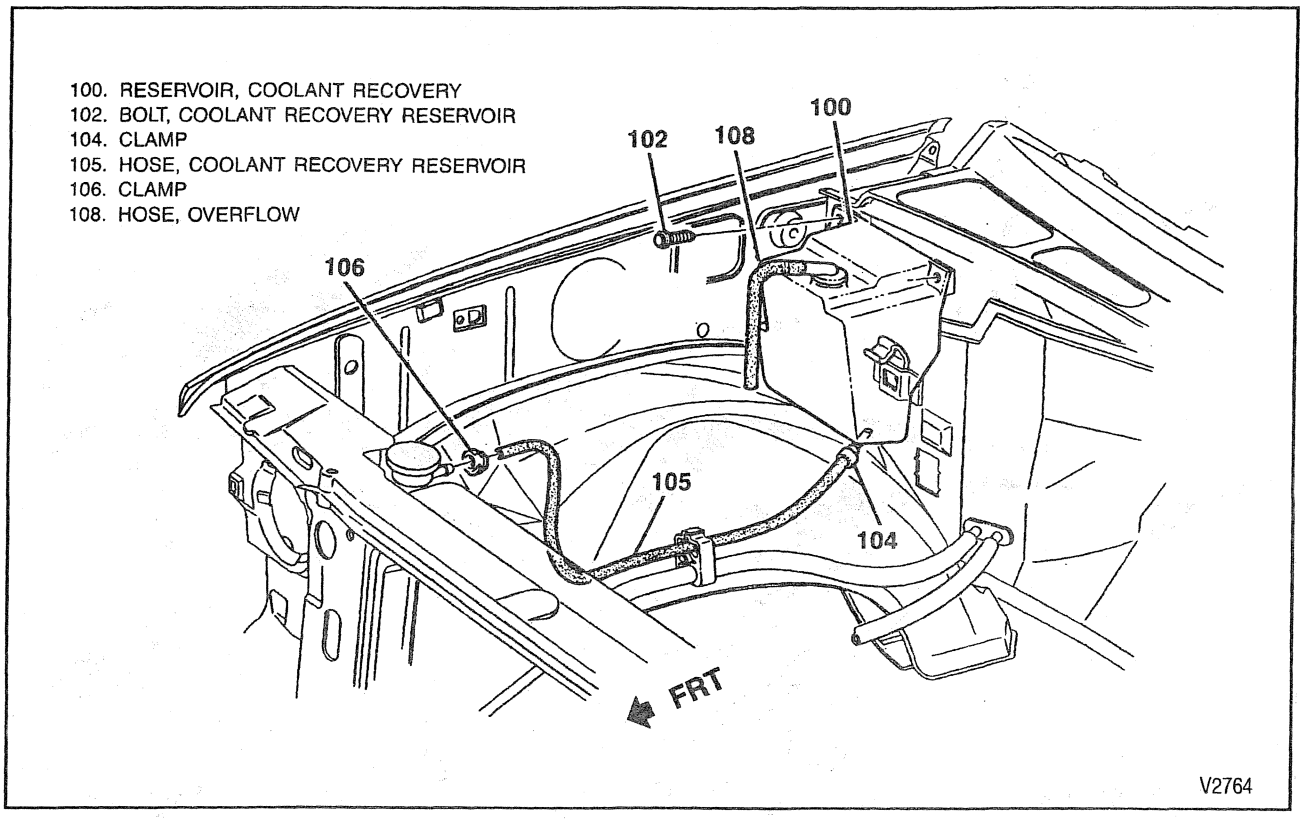


Figure 8—Coolant Recovery System (Gasoline)

RADIATOR HOSE REPLACEMENT

Most C/K-Models use a spring-type clamp at the radiator hose connections. When this type of clamp is used, the radiator hoses should be installed on dry, non-painted surfaces to ensure proper sealing. Reusing the spring-type clamps on aftermarket hoses is not recommended.

4.3L ENGINES

Remove or Disconnect (Figure 10)

- Drain the cooling system.

1. Retaining strap from the upper fan shroud.
2. Clamps from the inlet and outlet radiator hoses.
3. Radiator inlet hose.
4. Radiator outlet hose.

Install or Connect (Figure 10)

1. Radiator outlet hose.
2. Radiator inlet hose.
3. Clamps to the inlet and outlet radiator hoses.

Tighten

- Screw type clamps to 3 N·m (27 lbs. in.).

4. Retaining strap to the upper fan shroud.

- Fill the cooling system to the proper level.
- Check for leaks.

5.0L, 5.7L, and 7.4L ENGINES

Remove or Disconnect (Figure 11)

- Drain the cooling system.

1. Retaining strap from the upper fan shroud.
2. Bolt from the hose support.
3. Hose support.
4. Hose clamps from the inlet and outlet hoses.
5. Radiator inlet hose.
6. Radiator outlet hose.

Install or Connect (Figure 11)

1. Radiator outlet hose.
2. Radiator inlet hose.
3. Clamps to the radiator inlet and outlet hoses.

Tighten

- Screw type clamps to 3 N·m (27 lbs. in.).

4. Hose support to inlet hose.
5. Bolt.

Tighten

- Bolt to 3 N·m (27 lbs. in.).

6. Retaining strap to the upper fan shroud.

- Fill the cooling system to the proper level.
- Check for leaks.

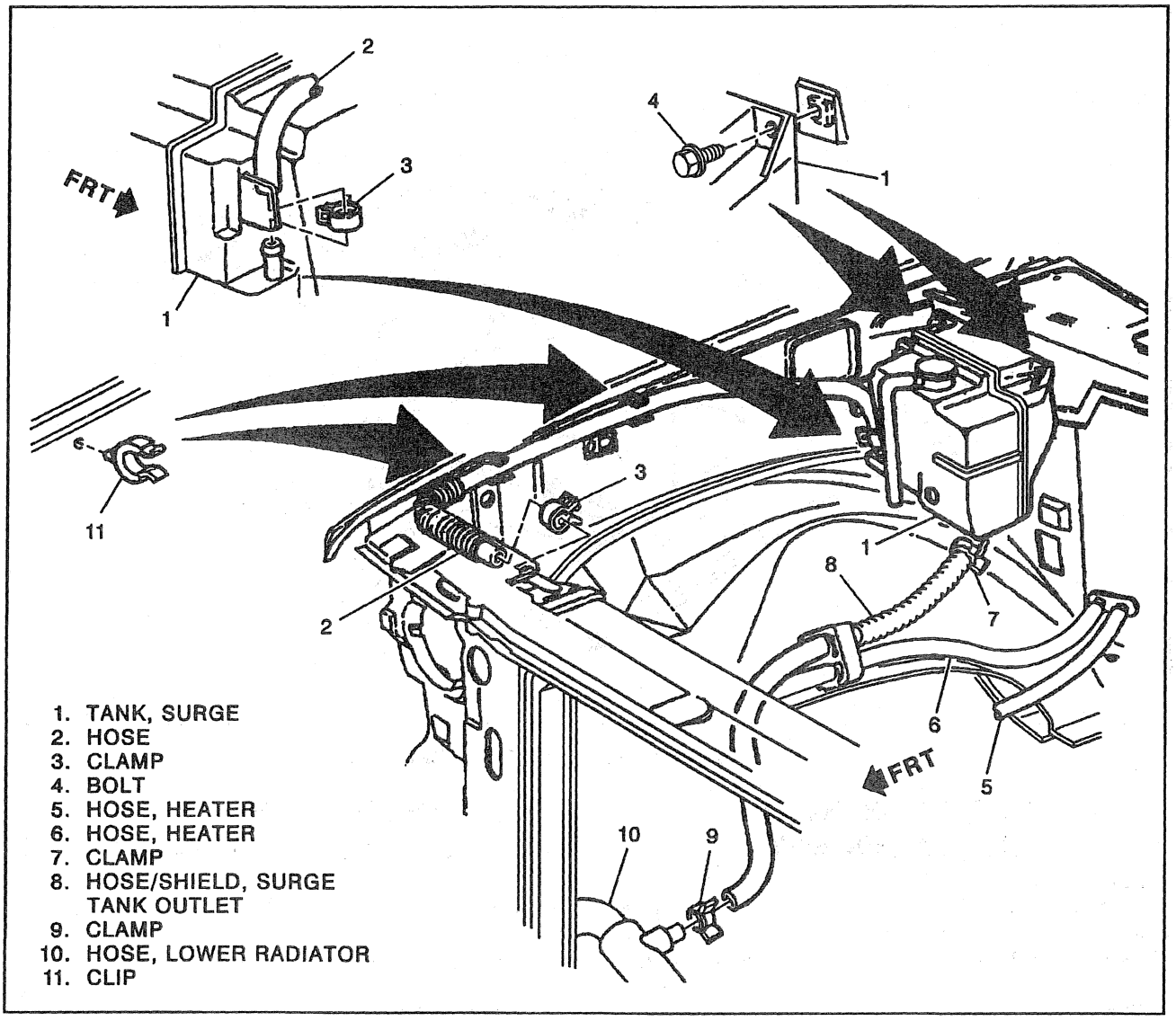


Figure 9—Coolant Surge Tank (Diesel)

DIESEL ENGINES

Remove or Disconnect (Figure 12)

- Drain the cooling system.

1. Bolts from the inlet hose support.
2. Support.
3. Strap from the outlet hose.
4. Clamps.
5. Radiator inlet hose.
6. Radiator outlet hose.

Install or Connect (Figure 12)

1. Radiator outlet hose.
2. Radiator inlet hose.
3. Clamps.

Tighten

- Screw type clamps to 3 N·m (27 lbs. in.).

4. Strap to the lower fan shroud.
5. Support to the inlet hose.
6. Support.
7. Bolt.

Tighten

- Bolt to 9 N·m (80 lbs. in.).
- Fill the cooling system to the proper level.
- Check for leaks.

FAN AND FAN CLUTCH REPLACEMENT

Remove or Disconnect (Figures 13 and 14)

1. Radiator fan shroud. Refer to SECTION 6B2.
   - Locate the yellow dot on the fan clutch hub and mark the coolant pump pulley.
2. Nuts.
3. Fan and fan clutch from the coolant pump pulley.
4. Bolts.
5. Fan from the fan clutch.

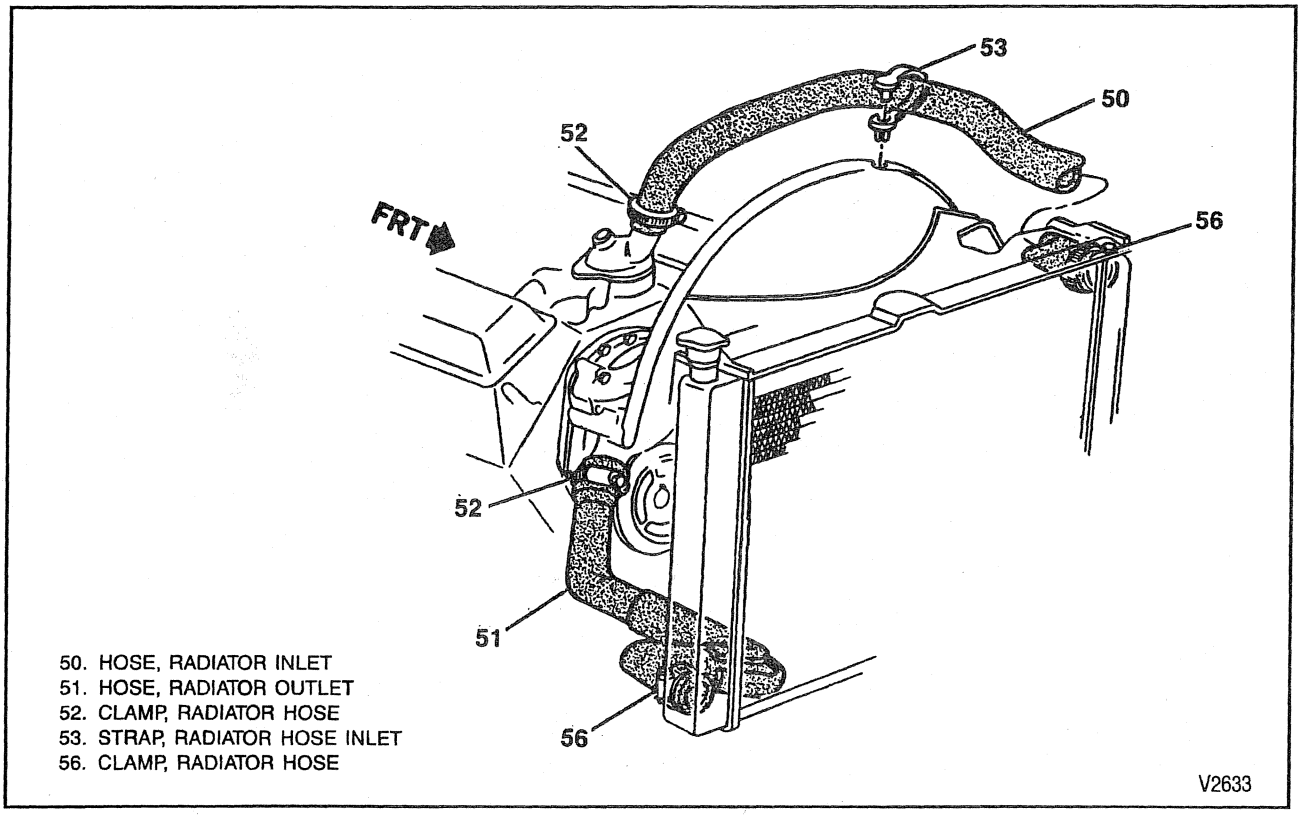


Figure 10—Radiator and Hoses (4.3L Engine)

Inspect

- Inspect the mating surfaces (the coolant pump hub and the fan clutch hub) for smoothness. Rework as necessary to eliminate any burrs or other imperfections.

Install or Connect (Figures 13 and 14)

CAUTION: Do not repair and reuse a fan with a bent, cracked, or damaged blade. Replace the fan as an assembly. A damaged blade can change the balance of a fan. A fan out of balance or cracked could fly apart during use and cause personal injury or damage to the vehicle.

1. Fan to the fan clutch.
2. Bolts.

Tighten

- Bolts to 24 N·m (18 lbs. ft.).

3. Fan and clutch assembly to the coolant pump pulley.
4. Nuts.
   - Align the yellow reference marks on the coolant pump pulley and the fan clutch hub.

Tighten

- Nuts to 24 N·m (18 lbs. ft.).

5. Fan shroud. Refer to SECTION 6B2.

AUXILIARY COOLING FAN REPLACEMENT

The auxiliary cooling fan provides additional cooling for low-speed vehicle operations, extended idle, stop-and-go conditions, and running the air conditioning system.

The auxiliary cooling fan circuit consists of a coolant temperature sensor, relay, and auxiliary fan. When the coolant sensor reaches a predetermined temperature, it closes the circuit to the relay coil. This energizes the relay, applying 12 volts to the auxiliary fan. When the coolant temperature decreases below the setpoint of the sensor, the circuit to the relay opens and voltage is no longer applied to the auxiliary fan. The cooling fan only operates when the ignition is on and the coolant temperature sensor is above the set temperature.

Refer to figure 15 for the auxiliary cooling fan circuit diagram, and figure 16 for auxiliary cooling fan system diagnosis.

FAN RELAY

Remove or Disconnect

1. Negative battery cable. Refer to SECTION 0A.
2. Wiring harness connector.
3. Fan relay.

Install or Connect

1. Fan relay.
2. Wiring harness connector.
3. Negative battery cable. Refer to SECTION 0A.

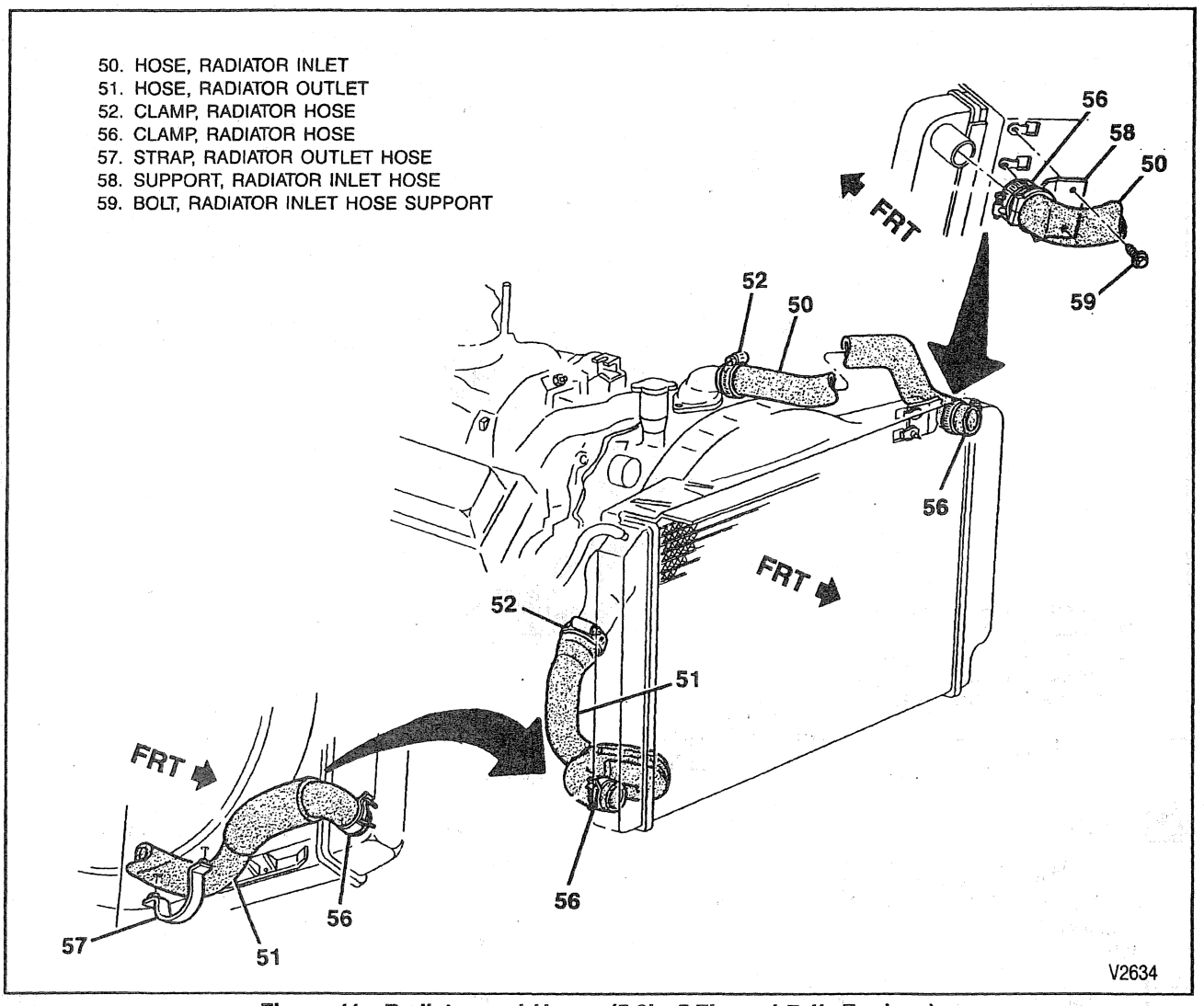


Figure 11—Radiator and Hoses (5.0L, 5.7L, and 7.4L Engines)

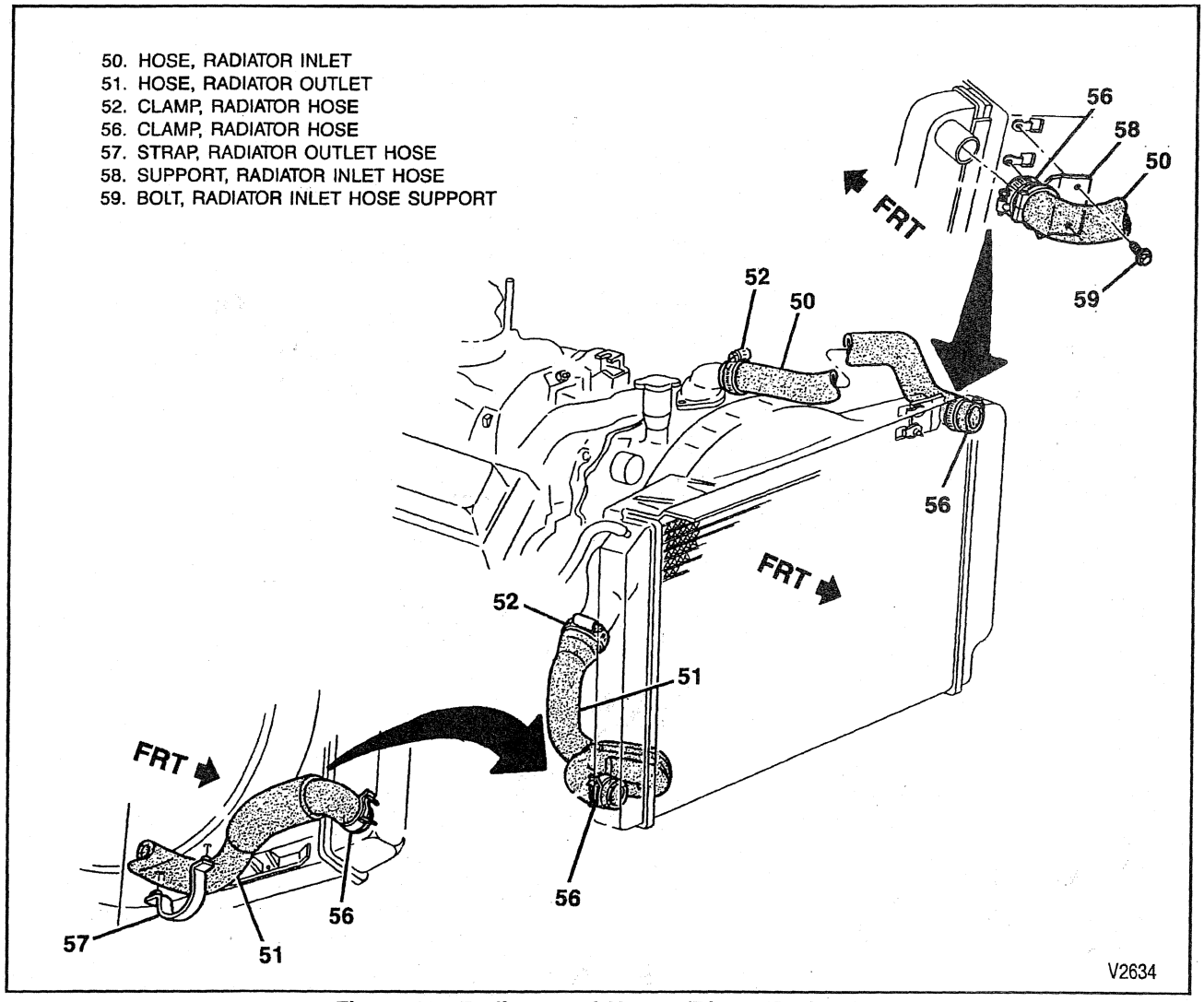


Figure 12—Radiator and Hoses (Diesel Engines)

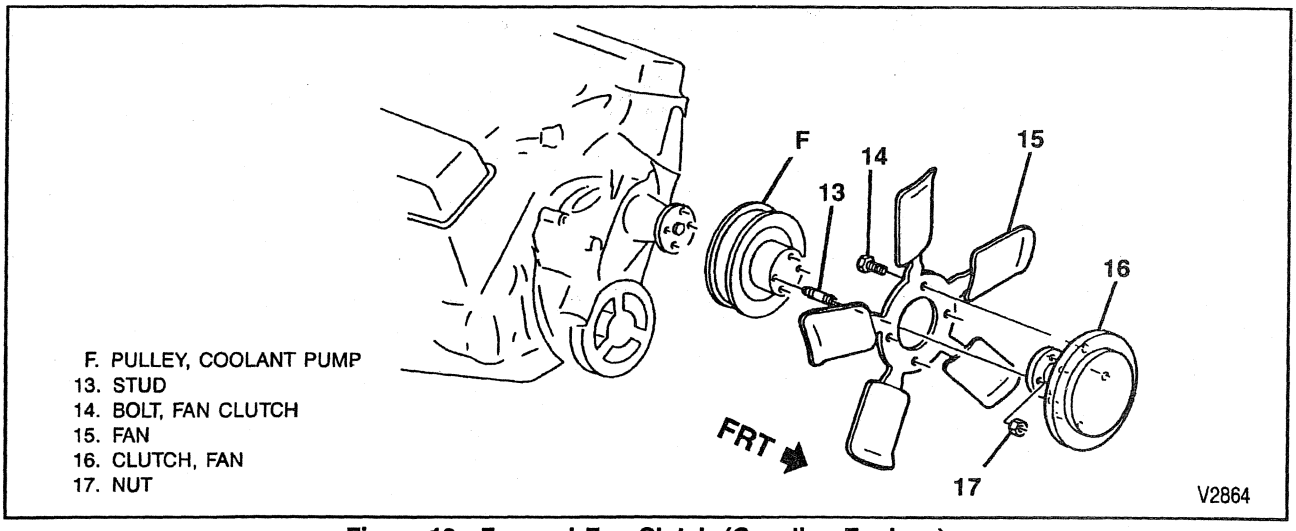
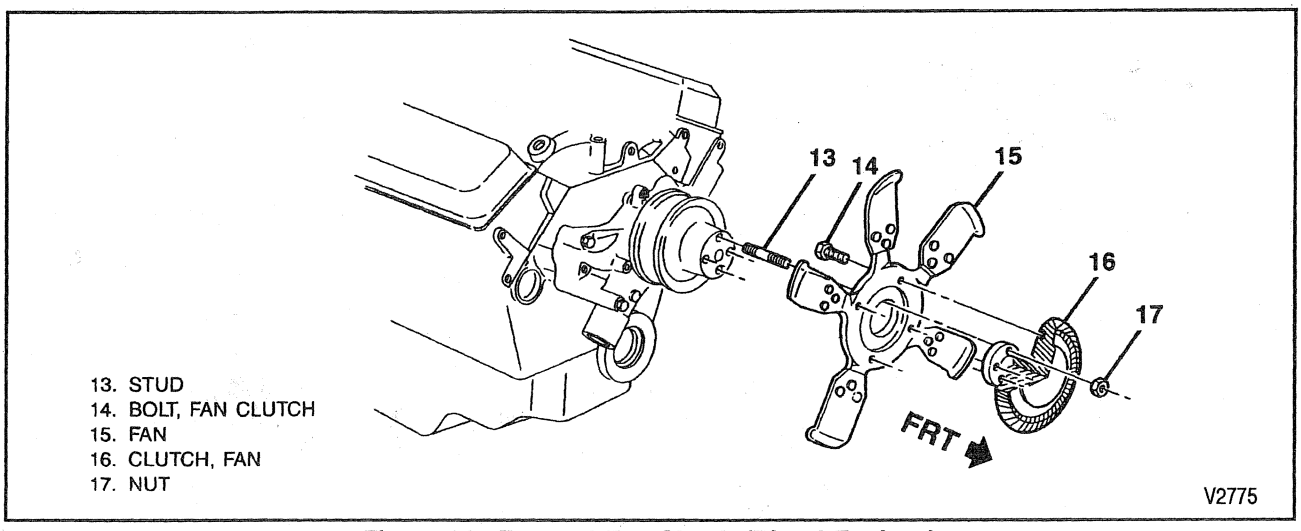


Figure 13—Fan and Fan Clutch (Gasoline Engines)



13. STUD
14. BOLT, FAN CLUTCH
15. FAN
16. CLUTCH, FAN
17. NUT

Figure 14—Fan and Fan Clutch (Diesel Engines)

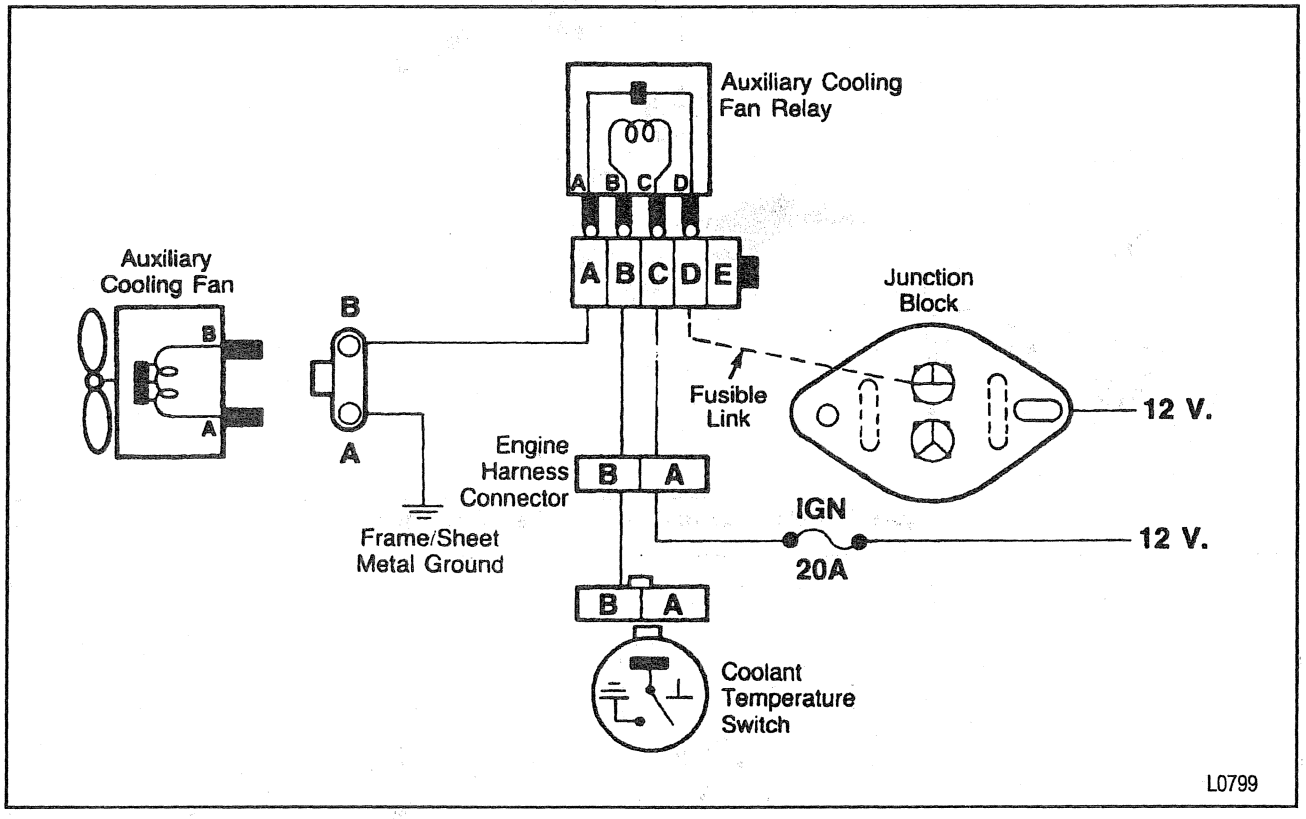


Figure 15—Auxiliary Cooling Fan Circuit Diagram

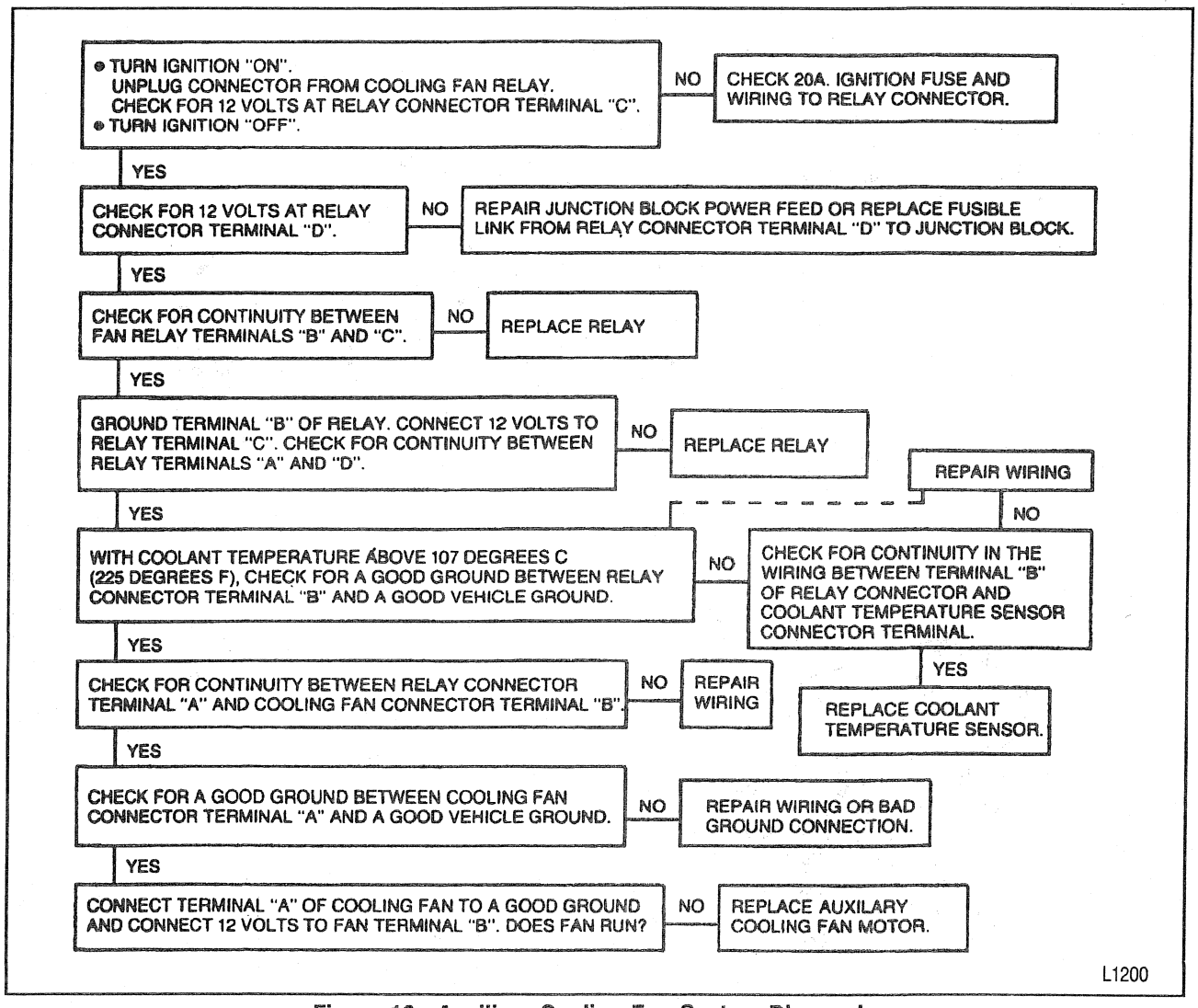


Figure 16—Auxiliary Cooling Fan System Diagnosis

ENGINE COOLANT TEMPERATURE SENSOR

Remove or Disconnect (Figure 17)

1. Negative battery cable. Refer to SECTION 0A.
2. Wiring harness connector.
3. Engine coolant temperature sensor.

Install or Connect (Figure 17)

1. Engine coolant temperature sensor.

Tighten

- Engine coolant temperature sensor to 23 N·m (17 lbs. ft.).

2. Wiring harness connector.
3. Negative battery cable. Refer to SECTION 0A.

THERMOSTAT REPLACEMENT

GASOLINE ENGINES

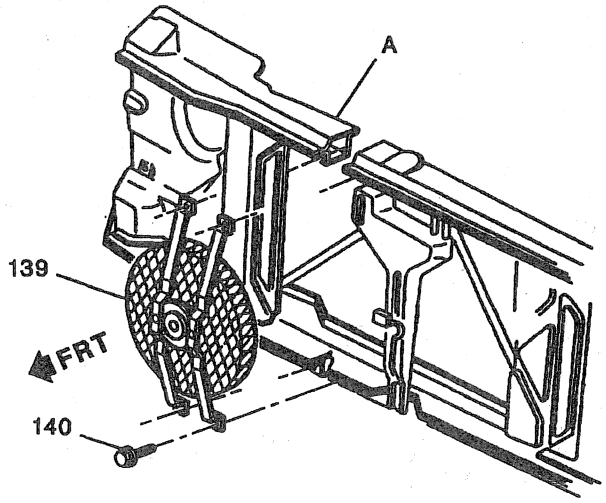
Remove or Disconnect (Figures 18 through 20)

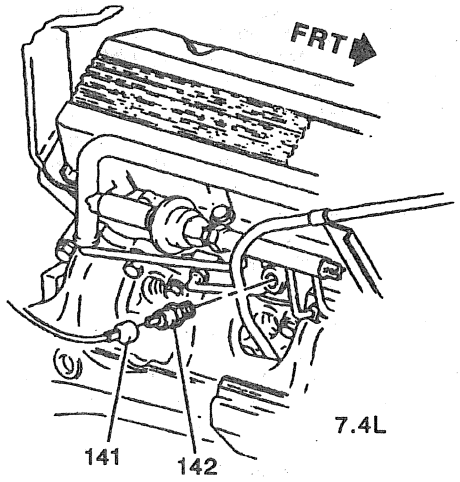
1. Drain the cooling system until the radiator coolant level is below the thermostat.
2. Bolts or studs.
3. Coolant outlet.
4. Thermostat from its housing.
5. Gasket (if necessary).

Clean

- Thermostat housing and coolant outlet sealing surfaces.

A. SUPPORT RADIATOR
139. FAN, AUXILIARY
140. BOLT
141. HARNESS, ENGINE WIRING
142. SWITCH, AUXILIARY FAN





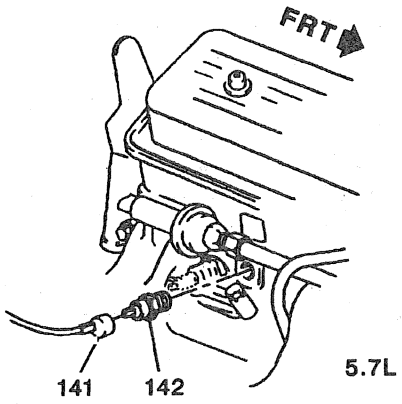


Figure 17—Auxiliary Cooling Fan System Components

Install or Connect (Figures 18 through 20)

1. Thermostat in its housing.
2. New gasket into position (if necessary).
3. Coolant outlet.
4. Bolt and studs.

Tighten

- Bolts and studs to 28 N·m (21 lbs. ft.) on 4.3L, 5.0L, and 5.7L engines.
- Studs to 37 N·m (27 lbs. ft.) on 7.4L engines.

5. Fill the cooling system.
6. Start the engine and run with the radiator cap removed until the radiator upper hose becomes hot (thermostat is open).
7. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
8. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.
9. Check for leaks.

DIESEL ENGINES

Remove or Disconnect (Figure 21)

1. Upper fan shroud. Refer to SECTION 6B2.
2. Drain the cooling system until the radiator coolant level is below the thermostat.
3. Engine oil dipstick tube brace and the oil fill brace. Refer to SECTION 6A6.
4. Upper radiator (inlet) hose.
5. Bolt, stud, and the coolant outlet.
6. Gasket.
7. Thermostat from its housing.

Clean

- Thermostat housing and coolant outlet sealing surfaces.

Install or Connect (Figure 21)

1. Thermostat into its housing.
2. Gasket into position.

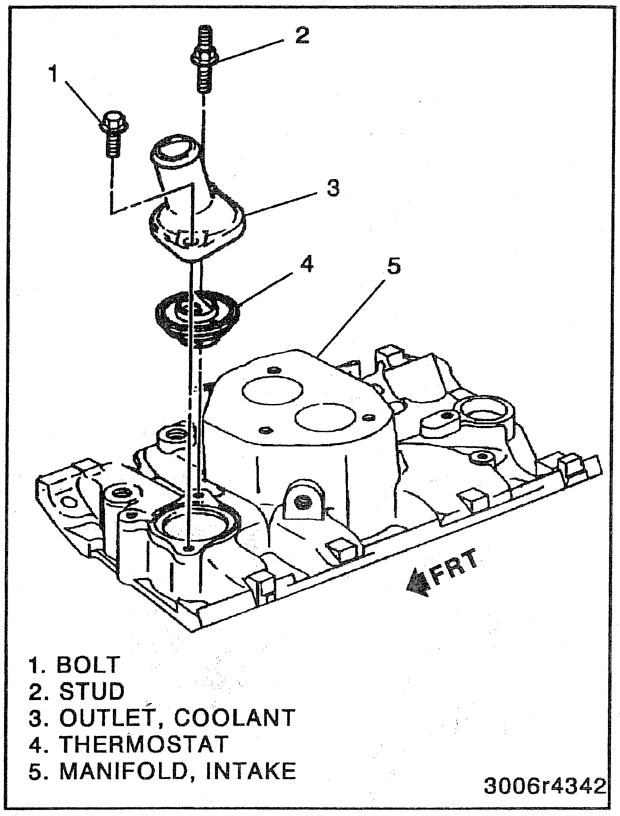


Figure 18—Thermostat and Components (4.3L Engine)

3. Coolant outlet.
4. Bolt and stud.

Tighten

- Bolt and stud to 42 N·m (31 lbs. ft.).

5. Upper radiator (inlet) hose.
6. Engine oil dipstick tube brace and the oil fill brace. Refer to SECTION 6A6.
7. Upper fan shroud. Refer to SECTION 6B2.
8. Fill the cooling system.
9. Start the engine and run with the radiator cap removed, until the upper radiator hose becomes hot (thermostat is open).
10. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
11. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.
12. Check for leaks.

THERMOSTAT HOUSING CROSSOVER REPLACEMENT

DIESEL ENGINES

Remove or Disconnect (Figure 22)

1. Coolant from the radiator.
2. Crankcase depression regulator valve.
3. Generator upper bracket.
4. Bypass hose, upper radiator (inlet) hose, and heater hose.

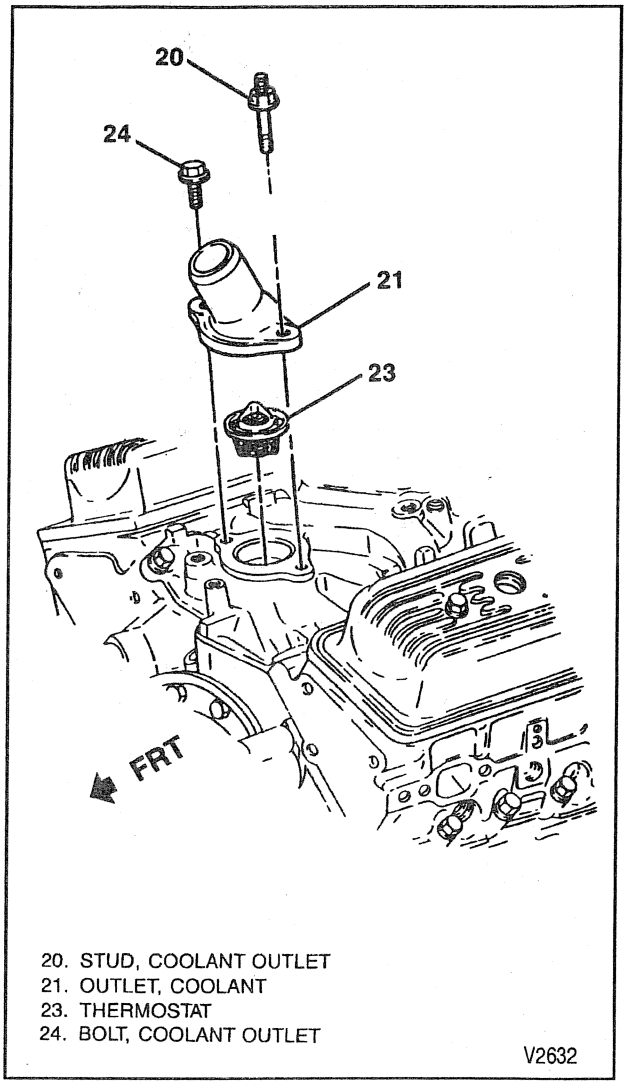


Figure 19—Thermostat and Components (5.0L and 5.7L Engines)

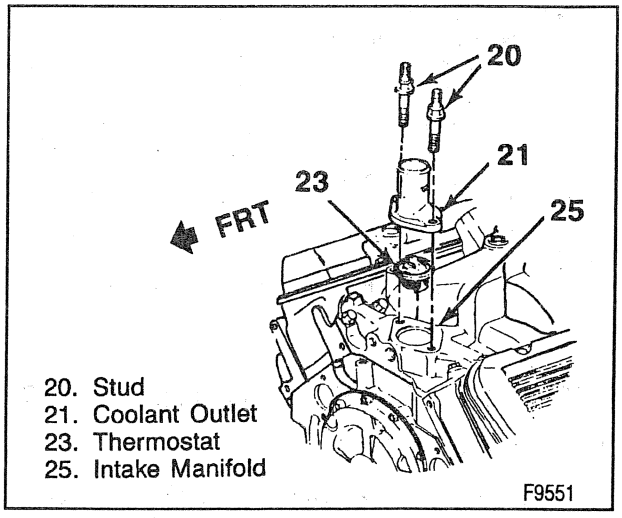
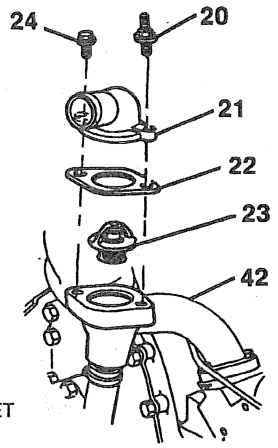


Figure 20—Thermostat and Components (7.4L Engine)



20. STUD, COOLANT OUTLET
21. OUTLET, COOLANT
22. GASKET, COOLANT OUTLET
23. THERMOSTAT
24. BOLT, COOLANT OUTLET
42. HOUSING, COOLANT CROSSOVER

Figure 21—Thermostat and Components (Diesel Engines)

5. Studs and bolts.
6. Coolant crossover housing assembly from the vehicle.
   - The thermostat and coolant outlet are attached to the crossover housing assembly along with the thermal bypass nipple.

Clean

- Coolant crossover housing sealing surfaces.

Install or Connect (Figure 22)

1. New gaskets.
2. Coolant crossover housing assembly.
3. Studs and bolts.

Tighten

- Studs and bolts to 42 N.m (31 lbs. ft.).

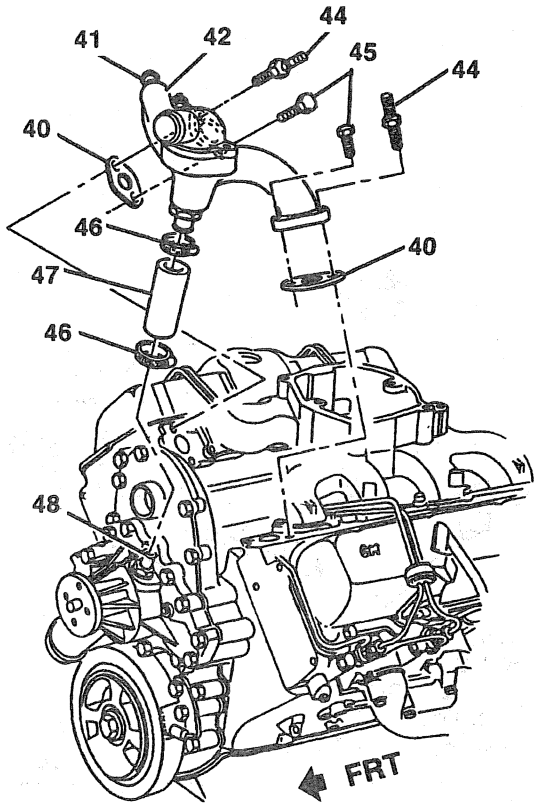
4. Heater hose, upper radiator (inlet) hose, and bypass hose.
5. Generator upper bracket.
6. Crankcase depression regulator valve.
7. Coolant in the radiator.
8. Start the engine and run, with the radiator cap removed, until the upper radiator hose becomes hot (thermostat is open).
9. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
10. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.
11. Check for leaks.

COOLANT PUMP REPLACEMENT

GASOLINE ENGINES

Remove or Disconnect (Figures 23, 24, and 25)

1. Coolant from the radiator.
2. Upper fan shroud. Refer to SECTION 6B2.



40. GASKET, COOLANT CROSSOVER HOUSING
41. NIPPLE, COOLANT CROSSOVER
42. HOUSING, COOLANT CROSSOVER
44. STUD, COOLANT CROSSOVER HOUSING
45. BOLT, COOLANT CROSSOVER HOUSING
46. CLAMP, BY-PASS HOSE
47. HOSE, BY-PASS
48. NIPPLE, COOLANT PUMP

Figure 22—Coolant Crossover and Components (Diesel Engines)

3. Drive belt. Refer to "Drive Belt Replacement."
4. Fan, fan clutch, and pulley from the coolant pump. Refer to "Fan and Fan Clutch Replacement."
5. Lower radiator (outlet) hose and heater hose from the coolant pump.
   - On the 7.4L engine, remove the bypass hose.
6. Bolts.
7. Coolant pump from the engine block.

Clean

- Mating surfaces on the coolant pump and the engine block.

Install or Connect (Figures 23, 24, and 25)

1. Coolant pump to the engine block.
2. New gaskets.
3. Bolts.

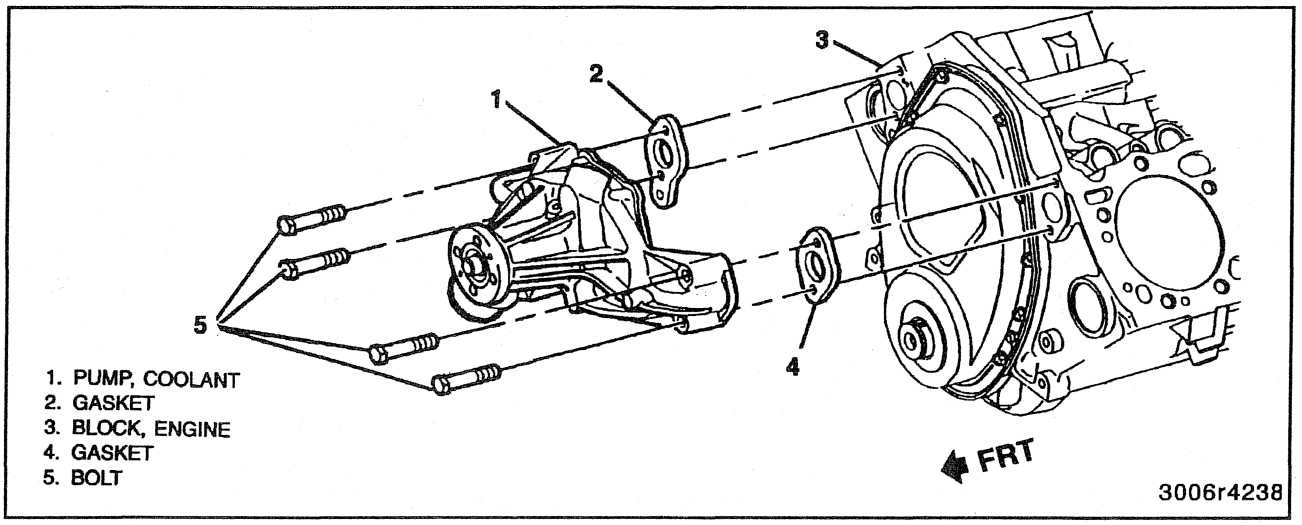


Figure 23—Coolant Pump and Components (4.3L Engine)

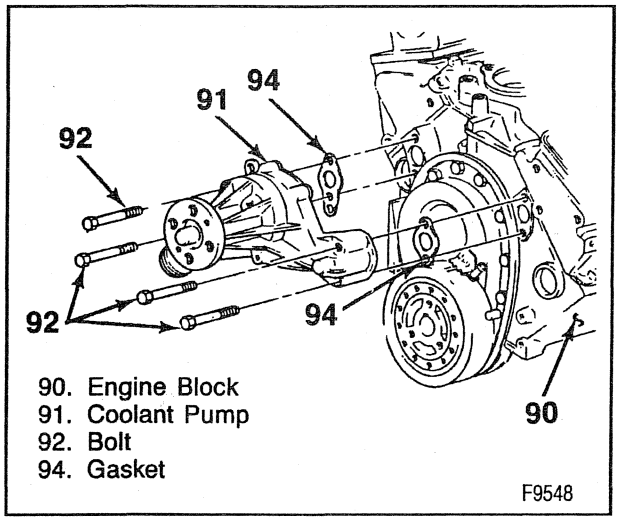


Figure 24—Coolant Pump and Components (5.0L and 5.7L Engines)

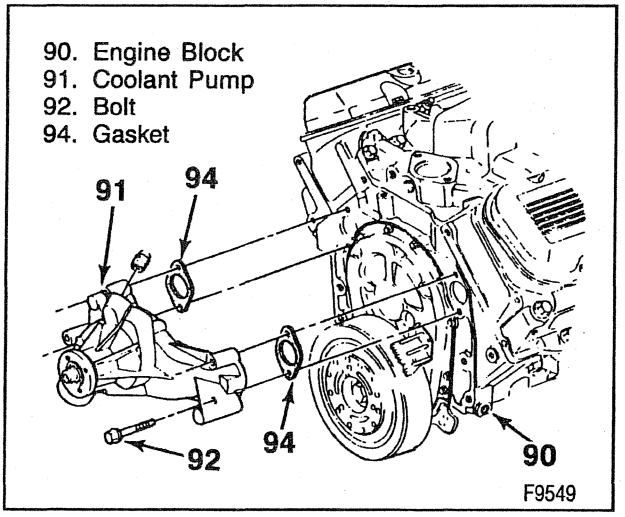


Figure 25—Coolant Pump and Components (7.4L Engine)

Tighten

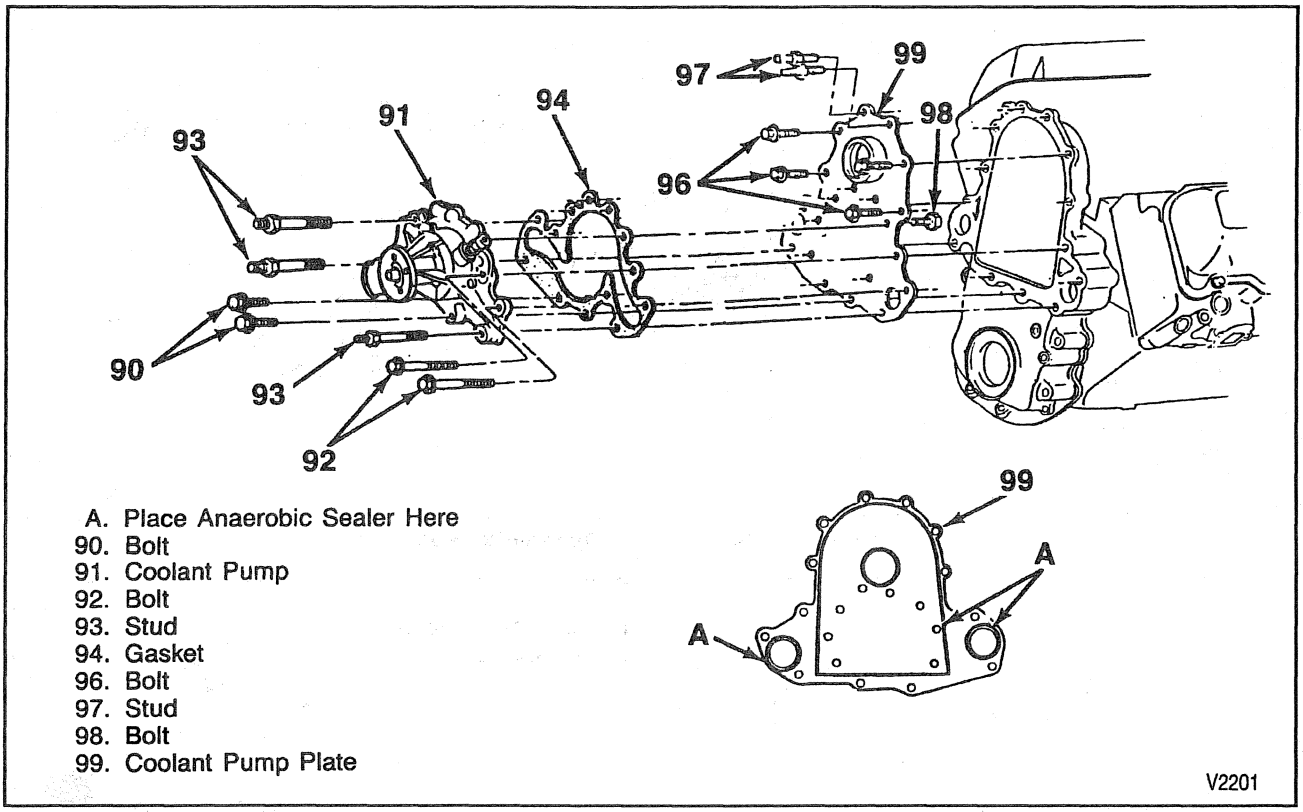
- Bolts to 41 N.m (30 lbs. ft.).

4. Lower radiator (outlet) hose and heater hose to the coolant pump.
   - Bypass hose on the 7.4L engine.
5. Coolant pump pulley, fan, and fan clutch to the coolant pump hub. Refer to "Fan and Fan Clutch Replacement."
6. Drive belt. Refer to "Drive Belt Replacement."
7. Upper fan shroud. Refer to SECTION 6B2.
8. Start the engine and run, with the radiator cap removed, until the upper radiator hose becomes hot (thermostat is open).
9. Add coolant to the radiator until the level reaches the bottom of the filler neck.
   - Engine must be running at idle speed.
10. Radiator cap, making sure the arrows line up with the overflow tube.
11. Check for leaks.

DIESEL ENGINES

Remove or Disconnect (Figure 26)

1. Negative battery cable. Refer to SECTION 0A.
2. Coolant from the radiator.
3. Fan shroud. Refer to SECTION 6B2.
4. Fan. Refer to "Fan and Fan Clutch Replacement."
5. Drive belt. Refer to "Drive Belt Replacement."
6. Raise vehicle. Support with safety stands.
7. Vacuum pump mounting bracket nuts.
8. Bolt holding vacuum pump bracket and generator.
9. Vacuum pump with bracket.
10. Power steering pump lay aside. Refer to SECTION 3B1.
11. Power steering pump mounting bracket. Refer to SECTION 3B1.
    - Lower vehicle.
12. Lower radiator hose from pump.
13. Bypass hose from pump.



A. Place Anaerobic Sealer Here
90. Bolt
91. Coolant Pump
92. Bolt
93. Stud
94. Gasket
96. Bolt
97. Stud
98. Bolt
99. Coolant Pump Plate

V2201

Figure 26—Coolant Pump and Components (Diesel Engines)

14. Bolts (90, 92, and 96), studs (93 and 97), coolant pump plate (99), and the coolant pump (91) (figure 26).
15. Bolt (98) from the rear of the coolant pump plate.
16. Coolant pump (91) and gasket (94) from the plate (99).

Clean

- All flanges must be free of oil. Clean the mating surfaces on the coolant pump, both sides of the coolant pump plate, and the engine block.

Install or Connect (Figure 26)

1. Gasket (94).
2. Coolant pump (91) to the coolant pump plate (99).
3. Bolt (98).

Tighten

- Bolt (98) to 23 N·m (17 lbs. ft.).

4. Coolant pump (91) and coolant pump plate (99) to the engine.
   - Apply anaerobic sealer (GM P/N 1052357).
   - The sealer must be wet to the touch when the bolts are tightened.
5. Bolts (90, 92, and 96) and studs (93 and 97).

Tighten

- Bolts (90 and 96) and studs (97) to 23 N·m (17 lbs. ft.).
- Bolts (92) and studs (93) to 42 N·m (31 lbs. ft.).

6. Bypass hose and lower radiator hose.
   - Raise vehicle. Support with safety stands.
7. Power steering bracket and pump. Refer to SECTION 3B1.
8. Vacuum pump and bracket.
9. Bolt holding vacuum pump and generator. Refer to SECTION 6H.
   - Lower vehicle.
10. Fan and pulley. Refer to "Fan Clutch Replacement."
11. Drive belt. Refer to "Drive Belt Replacement."
12. Fan shroud. Refer to SECTION 6B2.
13. Negative battery cable.
14. Coolant in the radiator or surge tank. Refer to "Draining and Filling the Cooling System."
15. Radiator or surge tank cap, making sure the arrows line up with the overflow tube.
16. Check for leaks.

DRIVE BELT TENSIONER INSPECTION

Remove or Disconnect

1. Negative battery cable. Refer to SECTION 0A.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
   - Position a hex head socket on the belt tensioner pulley bolt head.
   - Move the drive belt tensioner through its full travel.

NOTICE: Do not allow the drive belt tensioner to snap into the "free" position. This may result in damage to the tensioner.

- Movement should feel smooth and return freely without any binding. If any binding is observed, replace the tensioner.

Install or Connect

1. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
2. Negative battery cable.

DRIVE BELT TENSIONER REPLACEMENT

4.3L, 5.0L, AND 5.7L ENGINES

Remove or Disconnect (Figure 27)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Bolt.
4. Tensioner.

Install or Connect (Figure 27)

1. Tensioner to mounting bracket.
2. Bolt.

Tighten

- Bolt to 83 N·m (61 lbs. ft.).

3. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
4. Negative battery cable.

C/K 2 AND 3 WITH 7.4L ENGINE AND A/C

Remove or Disconnect (Figure 28)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Bolt.
4. Tensioner.
5. Idler pulley with bolt.

Install or Connect (Figure 28)

1. Tensioner to mounting bracket.
2. Bolt.

Tighten

- Bolt to 50 N·m (37 lbs. ft.).

3. Idler pulley with bolt to bracket.

Tighten

- Bolt to 85 N·m (63 lbs. ft.).

4. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
5. Negative battery cable.

DIESEL ENGINE

Remove or Disconnect (Figure 29)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Bolt and nut from upper brace.
4. Tensioner.

Install or Connect (Figure 29)

1. Tensioner to generator bracket.
2. Bolt and nut.

Tighten

- Nut to 50 N·m (37 lbs. ft.).

3. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
4. Negative battery cable.

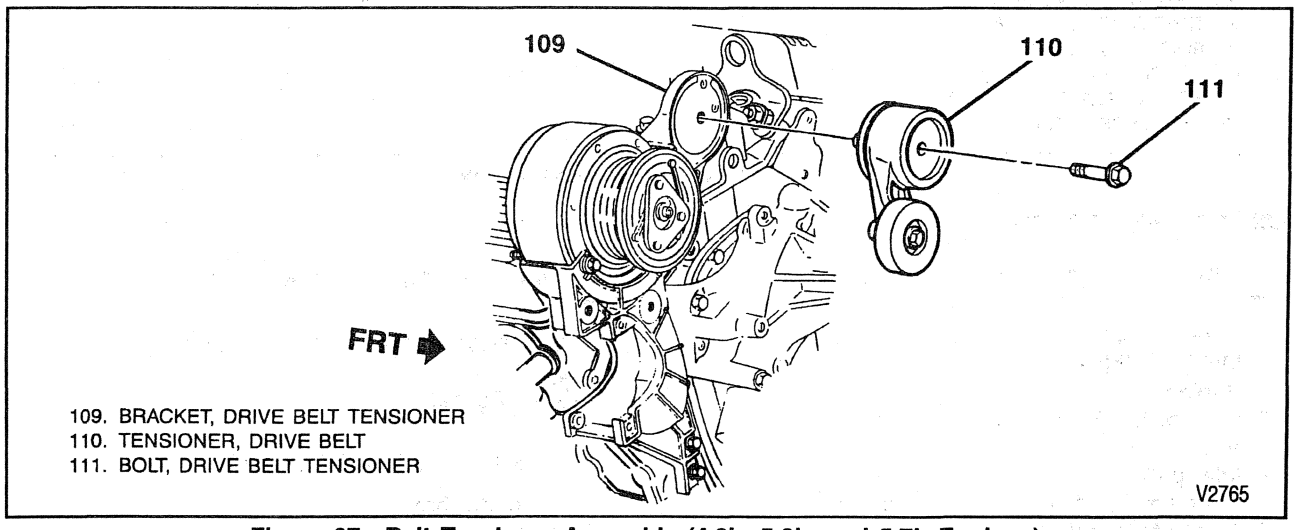
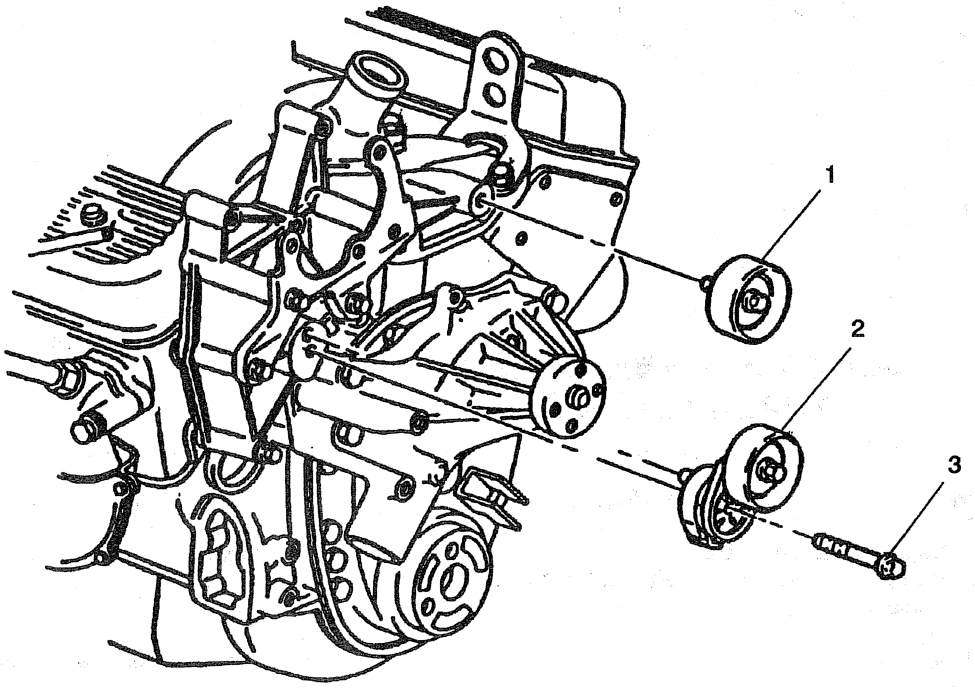


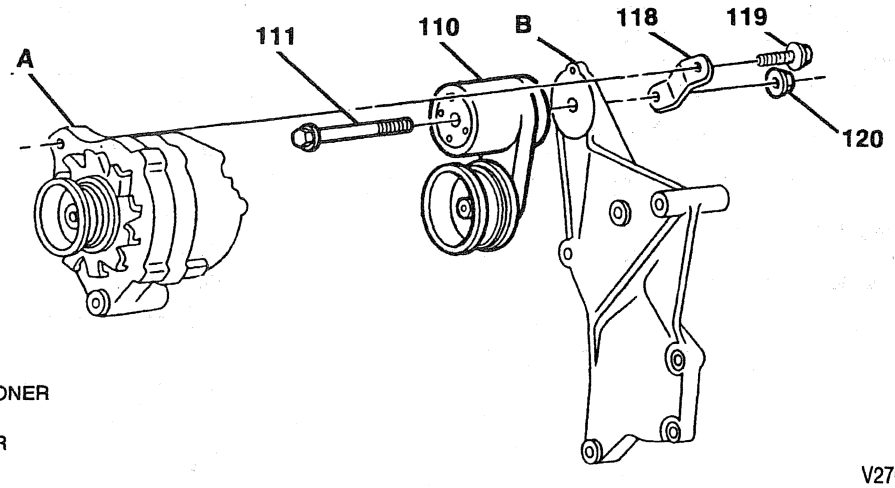
Figure 27—Belt Tensioner Assembly (4.3L, 5.0L, and 5.7L Engines)



1. PULLEY, IDLER
2. TENSIONER, DRIVE BELT
3. BOLT

3106r4242

Figure 28—Belt Tensioner Assembly (C/K 2 and 3 with 7.4L Engine and A/C)



A. GENERATOR
B. BRACKET, GENERATOR
110. TENSIONER, DRIVE BELT
111. BOLT, DRIVE BELT TENSIONER
118. BRACE, UPPER
119. BOLT, UPPER GENERATOR
120. NUT, UPPER BRACE

V2767

Figure 29—Belt Tensioner Assembly (Diesel Engines)

4.3L, 5.0L, AND 5.7L ENGINES

Remove or Disconnect (Figure 30)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Idler pulley bolts and nuts from bracket (without A/C).
4. Idler pulley.
5. Bolts and nut from generator bracket.
6. Generator bracket.
7. Stud (if needed).

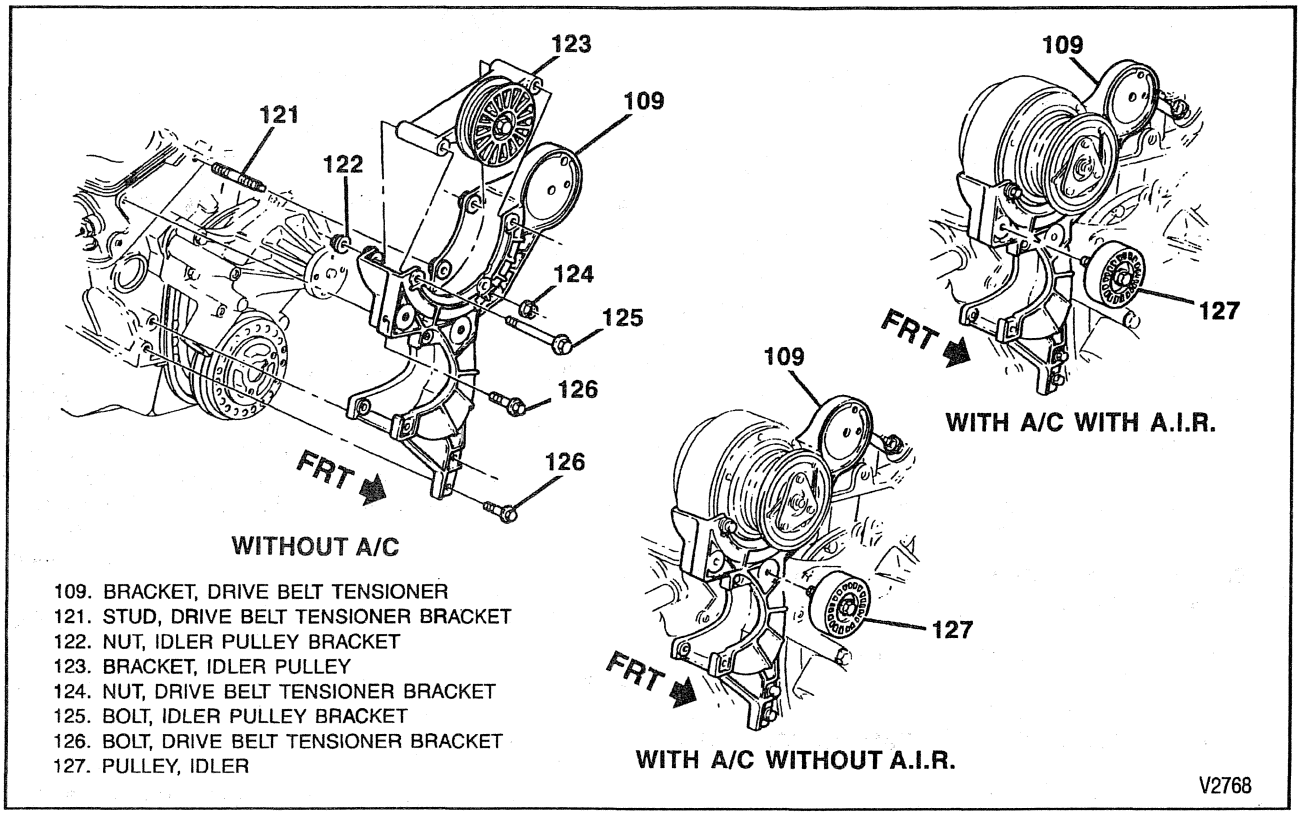
Install or Connect (Figure 30)

1. Generator bracket stud (if removed).

Tighten

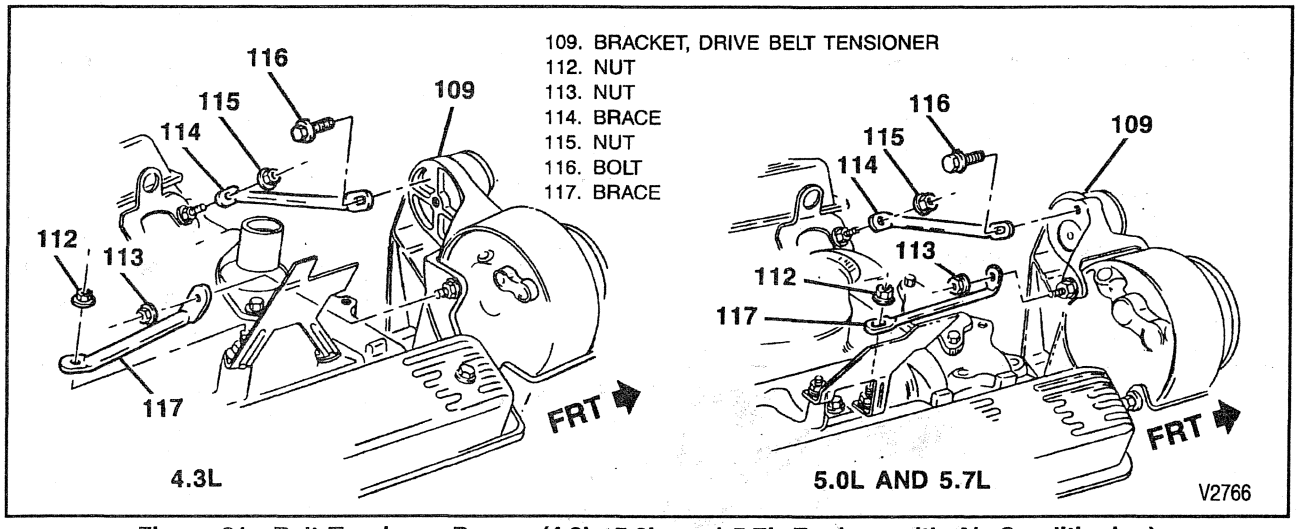
- Stud to 20 N·m (15 lbs. ft.).

2. Generator bracket.
3. Bolts and nut.



109. BRACKET, DRIVE BELT TENSIONER
121. STUD, DRIVE BELT TENSIONER BRACKET
122. NUT, IDLER PULLEY BRACKET
123. BRACKET, IDLER PULLEY
124. NUT, DRIVE BELT TENSIONER BRACKET
125. BOLT, IDLER PULLEY BRACKET
126. BOLT, DRIVE BELT TENSIONER BRACKET
127. PULLEY, IDLER

Figure 30—Idler Pulley and Bracket (4.3L, 5.0L, and 5.7L Engines)



109. BRACKET, DRIVE BELT TENSIONER
112. NUT
113. NUT
114. BRACE
115. NUT
116. BOLT
117. BRACE

Figure 31—Belt Tensioner Braces (4.3L, 5.0L, and 5.7L Engines with Air Conditioning)

Tighten

- Bolts and nut to 33 N·m (24 lbs. ft.).

4. Idler pulley.
5. Bolts and nuts.

Tighten

- Nuts to 33 N·m (24 lbs. ft.).

6. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
7. Negative battery cable.

BELT TENSIONER BRACES 4.3L, 5.0L, AND 5.7L ENGINES WITH AIR CONDITIONING

Remove or Disconnect (Figure 31)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Bolts and nuts from braces.
4. Braces.

Install or Connect (Figure 31)

1. Brace (114).
2. Bolt (116) finger tight.
3. Nut (115).

Tighten

- Nut (115) to 33 N·m (24 lbs. ft.).
- Bolt (116) to 50 N·m (37 lbs. ft.).

4. Brace (117) over bolt at compressor and then over stud at manifold.
5. Nut (112) finger tight.
6. Nut (113).

Tighten

- Nut (113) to 33 N·m (24 lbs. ft.).
- Nut 112) to 33 N·m (24 lbs. ft.).

IDLER PULLEY AND BRACKET (C/K 2 AND 3 WITH 7.4L ENGINE WITHOUT A/C)

Remove or Disconnect (Figure 32)

1. Negative battery cable.
2. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
3. Tensioner bolt.
4. Tensioner.
5. Bracket bolts.
6. Bracket.

Install or Connect (Figure 32)

1. Bracket to cylinder head holes.
2. Bolts.

Tighten

- Bolts to 66 N·m (49 lbs. ft.).

3. Tensioner.
4. Bolt.

Tighten

- Bolt to 50 N·m (37 lbs. ft.).

5. Multiple ribbed drive belt. Refer to "Drive Belt Replacement."
6. Negative battery cable.

DRIVE BELT SERVICE

Maintaining the multiple ribbed drive belt and pulleys can extend the normal life of a drive belt.

PULLEY INSPECTION

Examine the pulleys for chips, nicks, tool marks, cracks, bent sidewalls, corrosion, or other damage.

1. Place a straightedge or position a cord across the two pulleys so they touch at all points (figure 34).
2. Turn each pulley one half revolution and recheck with a straightedge or cord. Full contact at all points must be made. If contact is not made at all points, the pulley may be warped or its shaft could be bent. Replace any parts found to be damaged.
3. If the belt becomes loose and squeals or the belt comes off the engine drive pulleys, refer to "Diagnosis of Drive Belt System."

DRIVE BELT INSPECTION

Important

- Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and are not a basis for belt replacement. If sections of the belt are missing, the belt should be replaced.

Do not use drive belt dressings to extend belt life. Use of belt dressing will soften the belts and cause deterioration. Oil or grease contamination on the belt or pulleys will also deteriorate the belt.

DRIVE BELT INSTALLATION

Install a multiple ribbed belt following the belt routings shown in figures 35, 36, 37, and 38. The grooves in the belt must match the grooves in the pulleys. The tensioner is spring loaded. After removing the belt, the tensioner will return to the tension position.

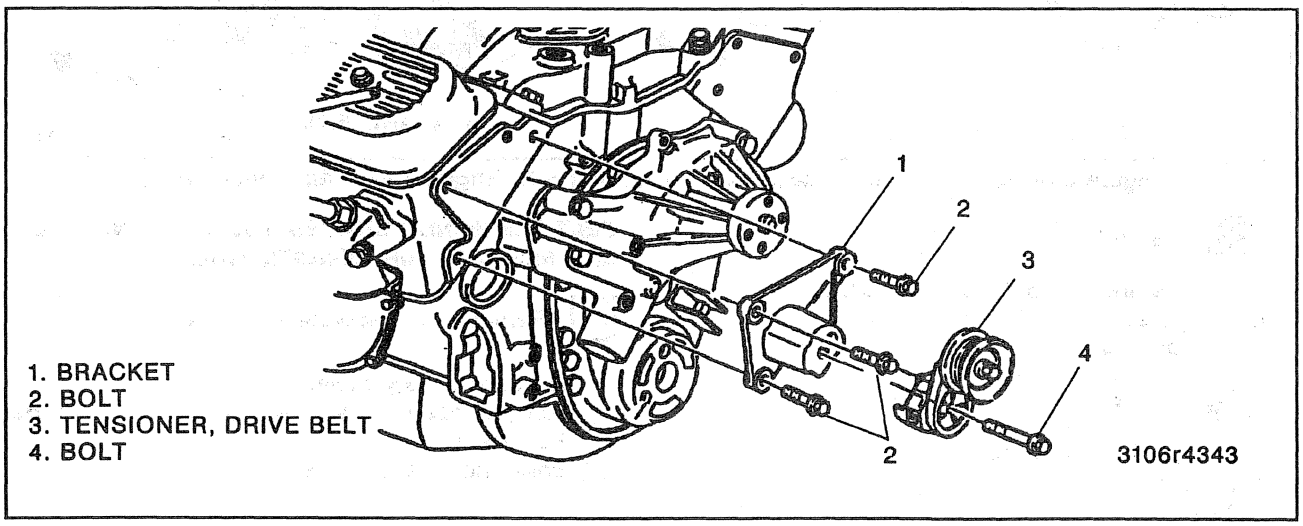
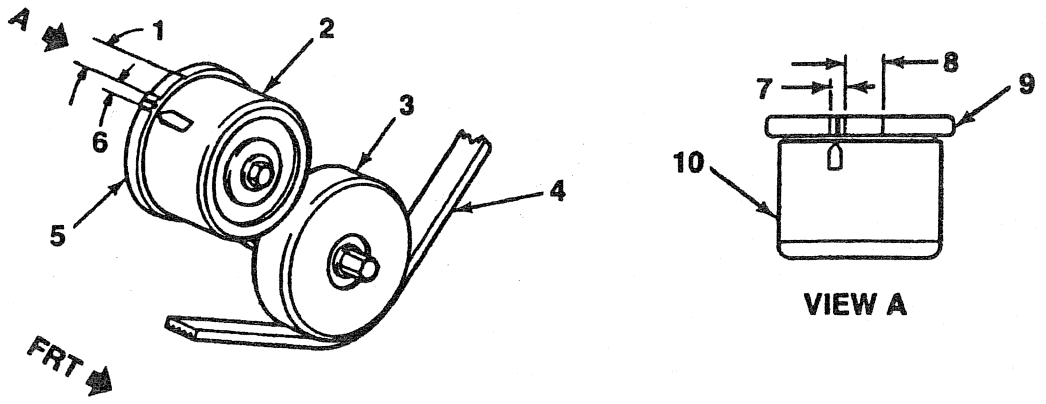


Figure 32—Idler Pulley and Bracket (C/K 2 and 3 with 7.4L Engine without A/C)



1. Used Belt Acceptable Wear Range
2. Arm
3. Pulley
4. Belt
5. Spindle
6. New Belt Range
7. New Belt Length Range
8. Used Belt Length Range
9. Spindle
10. Arm

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Figure 33—Automatic Belt Tensioner and Belt Length Scale

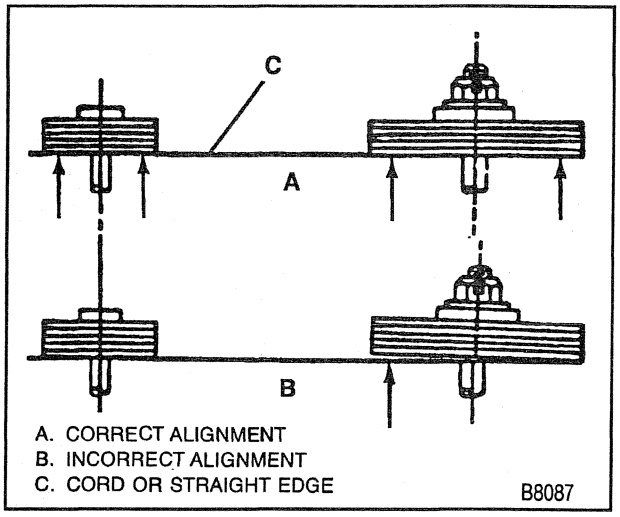


Figure 34—Checking the Pulley Alignment

DRIVE BELT REPLACEMENT

Remove or Disconnect (Figures 35 through 38)

NOTICE: Do not allow the drive belt tensioner to snap into the "free" position. This may result in damage to the tensioner.

1. Use a 1/2-inch breaker bar with a socket placed on the tensioner pulley axis bolt and rotate the tensioner to release belt tension.
2. Belt.

Install or Connect (Figures 35 through 38)

1. Route belt over all the pulleys except the belt tensioner.
2. Use a 1/2-inch breaker bar with a socket placed on the tensioner pulley axis bolt and rotate the tensioner to the released position.
3. Belt over the belt tensioner pulley.
4. Check the belt for correct "V" groove tracking around each pulley.

ENGINE OIL COOLER LINE REPLACEMENT

The optional oil cooler is either an integral part of the radiator or a separate unit placed in front of the radiator. If an integral type cooler needs repair, refer to SECTION 6B2. Cooler lines and hoses are serviceable. Refer to figures 39 through 43 for the applicable engine being serviced.

OIL COOLER SYSTEM SERVICE

If foreign material has entered the oil cooler or if the engine has been damaged internally, flush the oil cooler, connecting lines, and filter adapter assembly in the following manner.

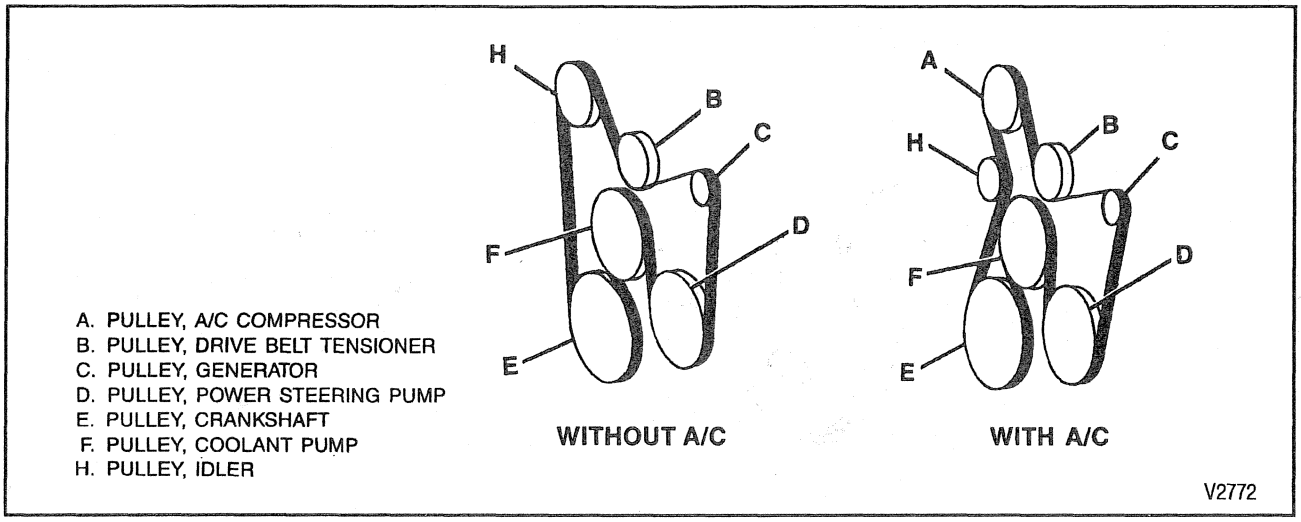


Figure 35—Multiple Rib Drive Belt Routing (4.3L, 5.0L, and 5.7L Engines without A.I.R.)

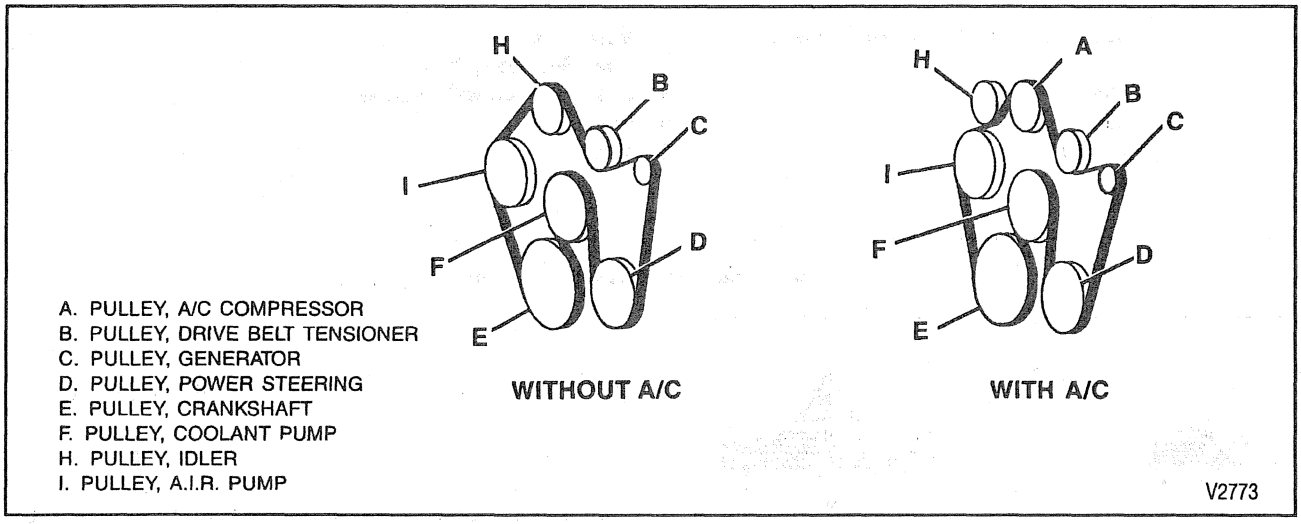


Figure 36—Multiple Rib Drive Belt Routing (4.3L and 5.7L Engines with A.I.R.)

Remove or Disconnect (Figures 39 through 46)

- Set the parking brake.

1. Oil cooler lines from the connector.
   - Using a small pick-type tool and your thumb (A in figure 45), grasp the connector end and pull the clip from the connector (B in figure 45). This releases the cooler line from the connector.

NOTICE: Do not use more than 690 kPa (100 psi) air to clean the cooler and lines. Exceeding 690 kPa (100 psi) could damage the cooler or lines.

   A. Using clean solvent and compressed air, back-flush the oil cooler and lines.
   B. Using compressed air, remove the cleaning solvent.
   C. Flush the system using the same type of oil normally circulated through the cooler.
2. Bolt or nut from bracket or clamp.
3. Bolt and clip from its bracket (diesel engines only) figure 43.
4. Oil filter and discard.
5. Oil cooler lines from the clip or strap.
6. Oil cooler lines from the oil cooler at fitting.
7. Oil cooler line connector fittings at block (diesel only).

Clean

- All components in a suitable solvent and dry with compressed air.

Inspect

- All fittings, connectors, and cooler lines for damage or distortion.

Install or Connect (Figures 39 through 46)

- Using your thumb and forefinger, insert the connector clip into one of the three recesses in the connector (C in figure 46). With one end of the clip engaged in the connector slot, use your thumb and rotate the clip around the connector until it snaps into place (D and E in figure 46).

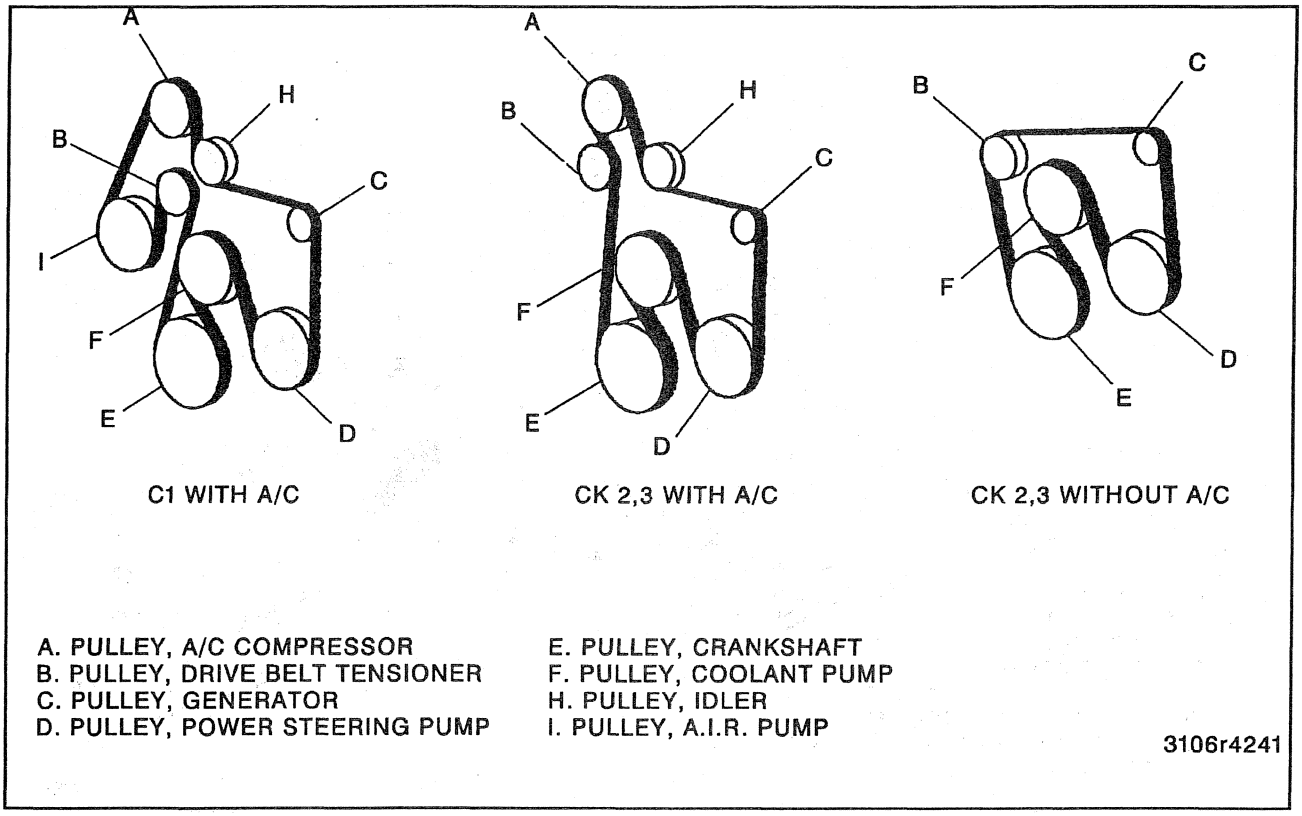


Figure 37—Multiple Rib Drive Belt Routing (C1, C/K 2,3 with 7.4L Engine)

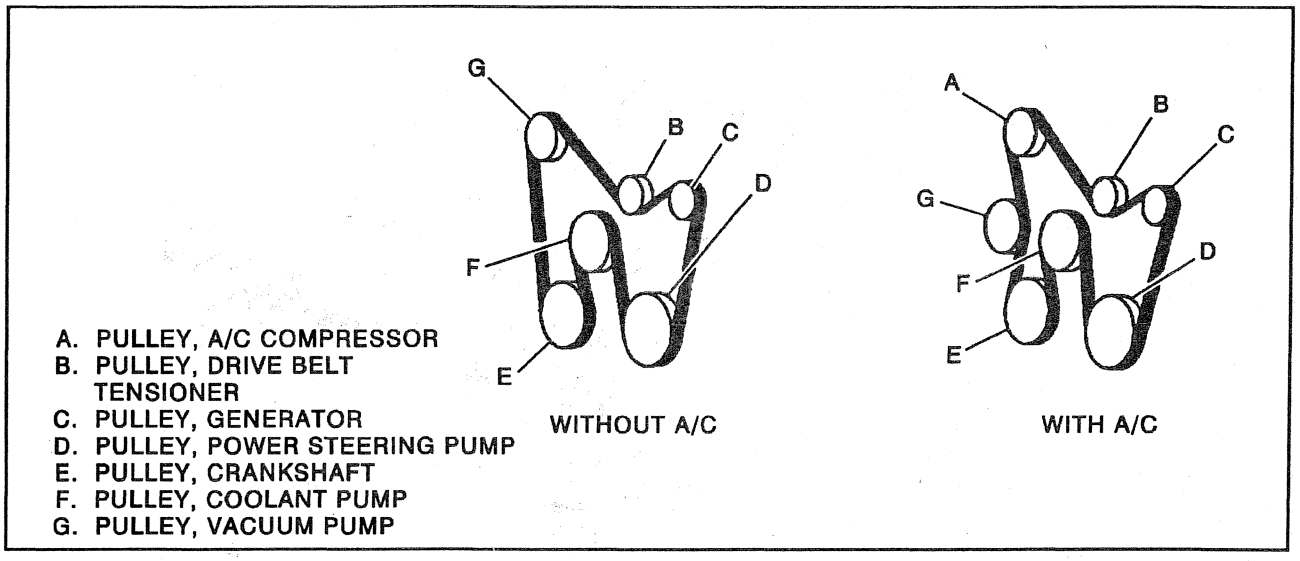


Figure 38—Multiple Rib Drive Belt Routing (Diesel Engines)

NOTICE: Make sure the connector clip engages all three slots in the connector. Failure to properly install the connector clip could cause the oil cooler line to come loose and cause damage to the engine.

1. Oil cooler lines to the oil cooler (gasoline engines). Diesel engines install fittings into the block and use teflon sealer GM P/N 1052080 on the threads of the oil cooler lines.

Tighten

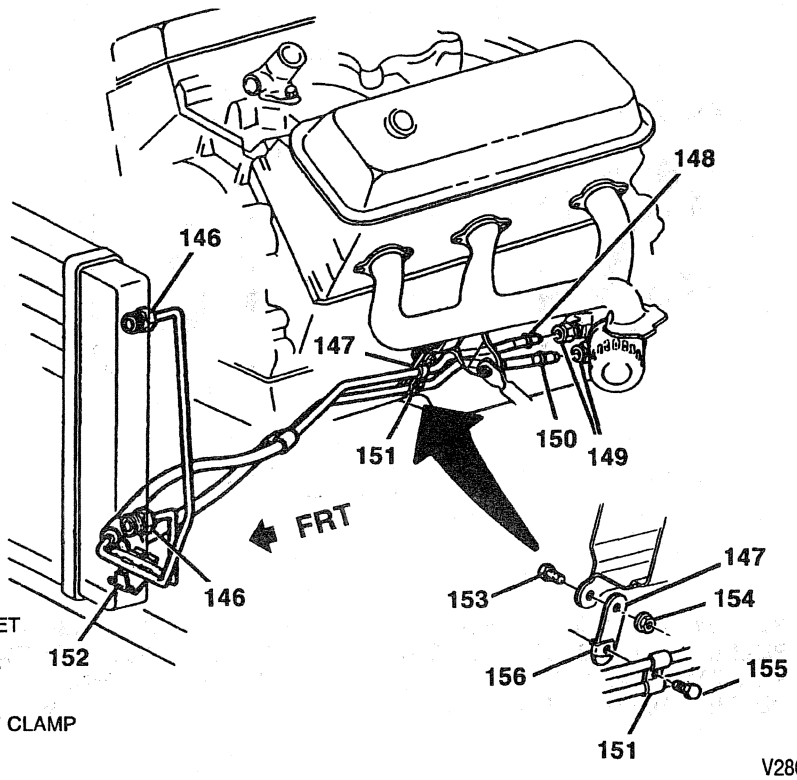
- Oil cooler line fittings to 23 N·m (17 lbs. ft.).

2. Oil cooler lines to the clip or strap.
3. Bolt and clip to its bracket (diesel engines only) figure 43 .

Tighten

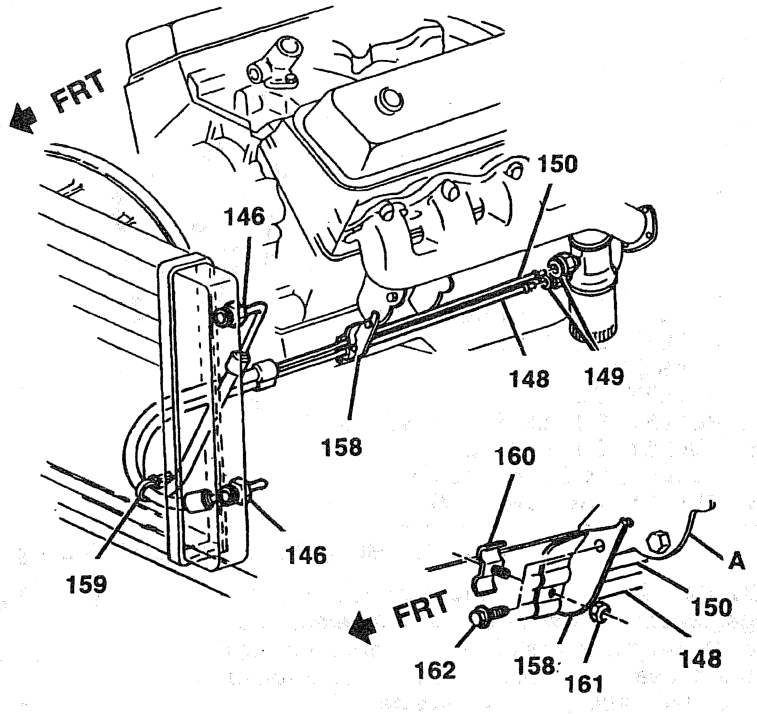
- Bolt to 6 N·m (53 lbs. in.).

4. Bolt or nut to bracket or clamp.



146. FITTING, OIL COOLER HOSE
147. BRACKET, OIL COOLER HOSE
148. HOSE, OIL COOLER INLET
149. CONNECTOR, OIL FILTER ADAPTER
150. HOSE, OIL COOLER OUTLET
151. CLAMP, OIL COOLER HOSE BRACKET
152. CLIP, OIL COOLER HOSE
153. BOLT, OIL COOLER HOSE BRACKET
154. NUT, OIL COOLER HOSE BRACKET
155. BOLT, OIL COOLER HOSE BRACKET CLAMP
156. NUT, SPRING

Figure 39—Engine Oil Cooler Lines and Components (4.3L Engine)



A. MOUNT, ENGINE
146. FITTING, OIL COOLER HOSE
148. HOSE, OIL COOLER INLET
149. CONNECTOR, OIL FILTER ADAPTER
150. HOSE, OIL COOLER OUTLET
158. BRACKET, OIL COOLER HOSE
159. STRAP, OIL COOLER HOSE
160. CLAMP, OIL COOLER HOSE BRACKET
161. NUT, OIL COOLER HOSE BRACKET CLAMP
162. BOLT, OIL COOLER HOSE BRACKET

Figure 40—Engine Oil Cooler Lines and Components (5.0/5.7L Engines with KC4 Cooling)

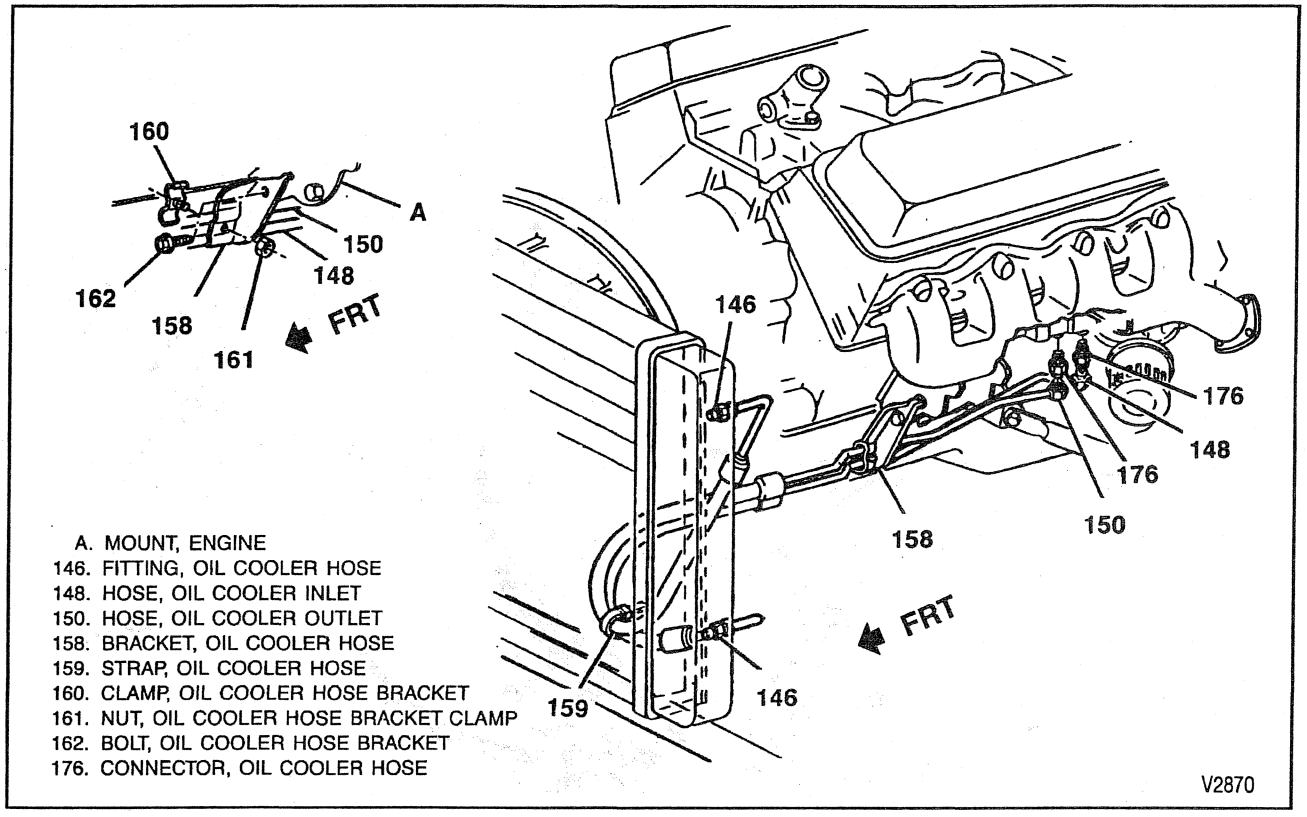


Figure 41—Engine Oil Cooler Lines and Components (7.4L Engine)

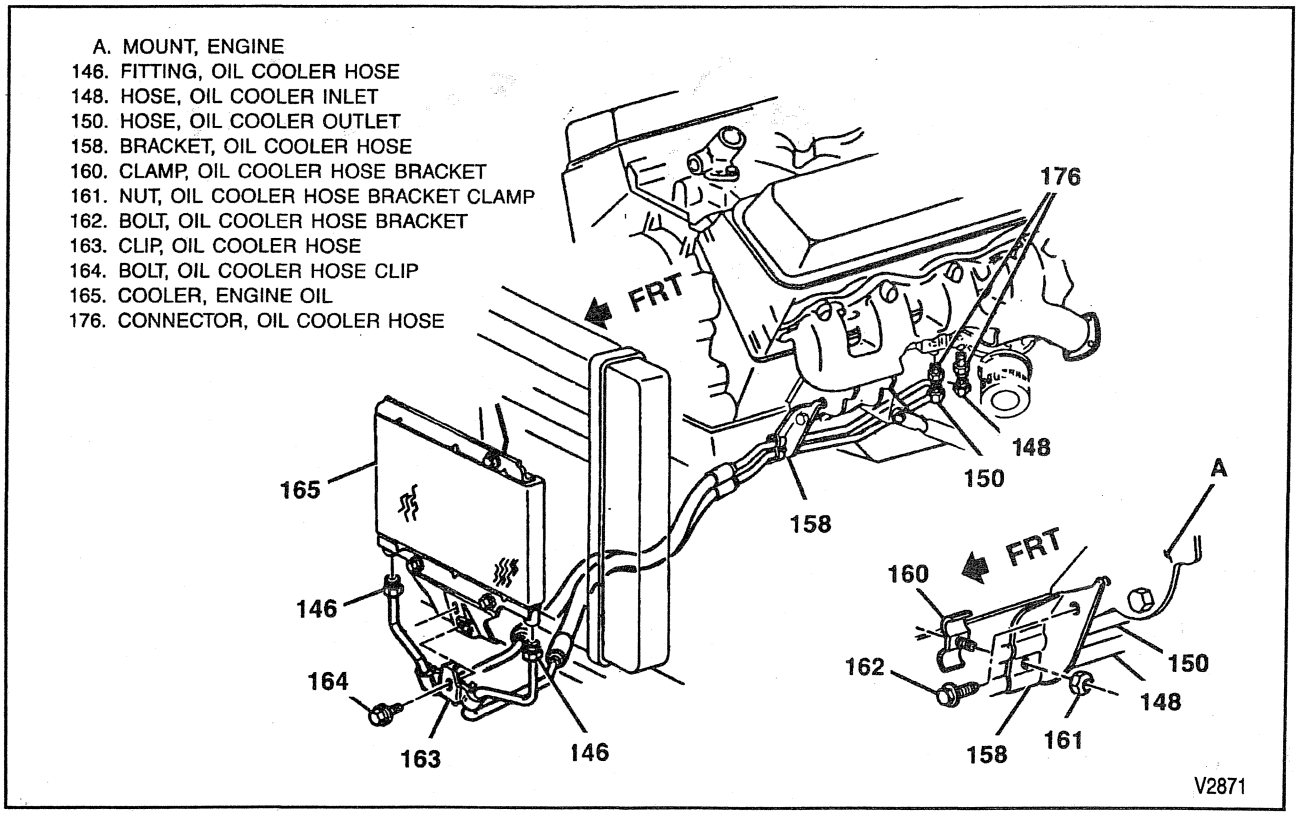
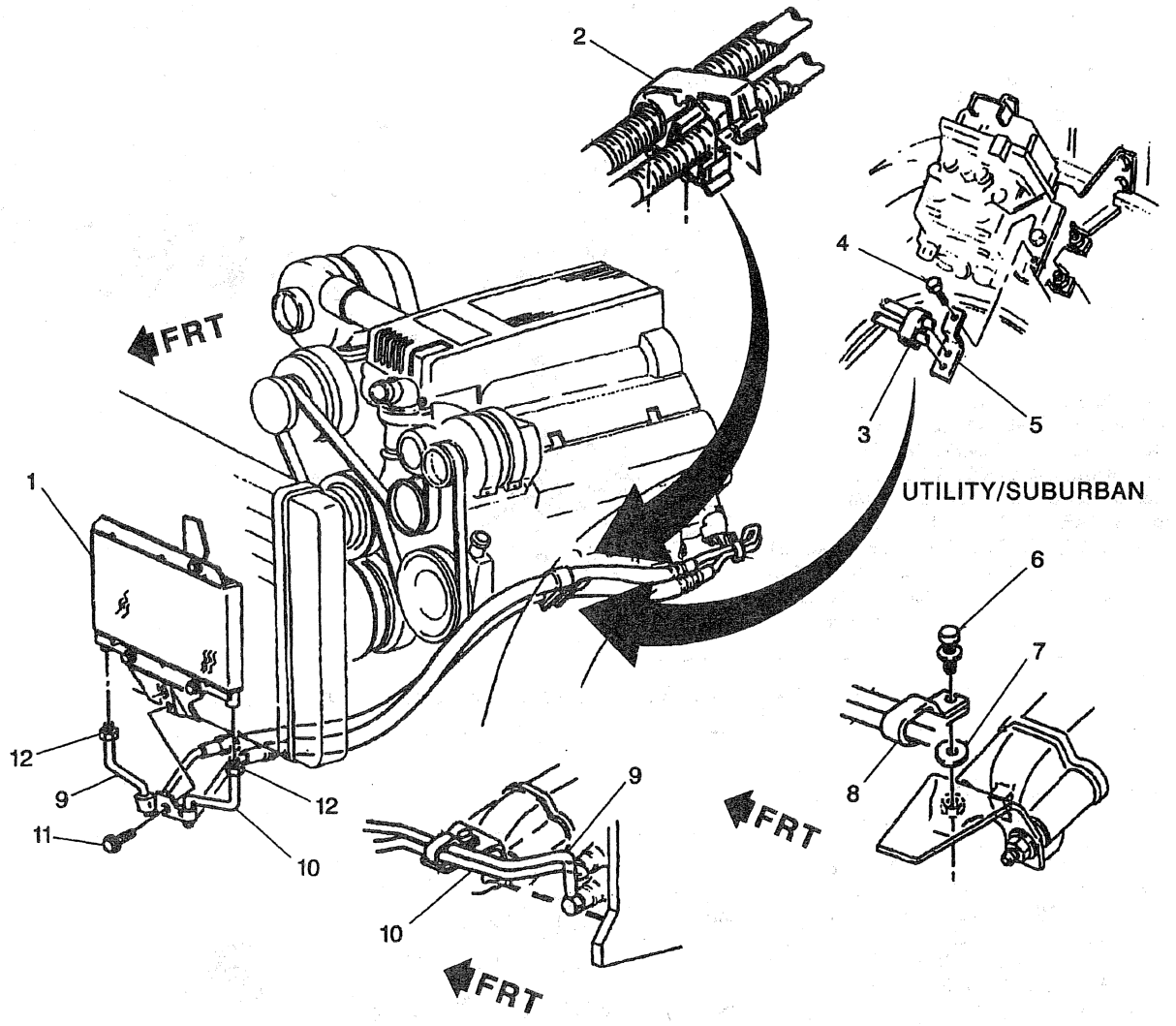


Figure 42—Engine Oil Cooler Lines and Components (7.4L Engine with 5D4 Export)



1. COOLER, ENGINE OIL
2. CLIP
3. CLIP
4. BOLT
5. BRACKET
6. BOLT
7. WASHER
8. CLIP
9. HOSE, OUTLET
10. HOSE, INLET
11. BOLT, OIL COOLER HOSE CLIP
12. FITTING, OIL COOLER HOSE

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Figure 43—Engine Oil Cooler Lines and Components (Diesel)

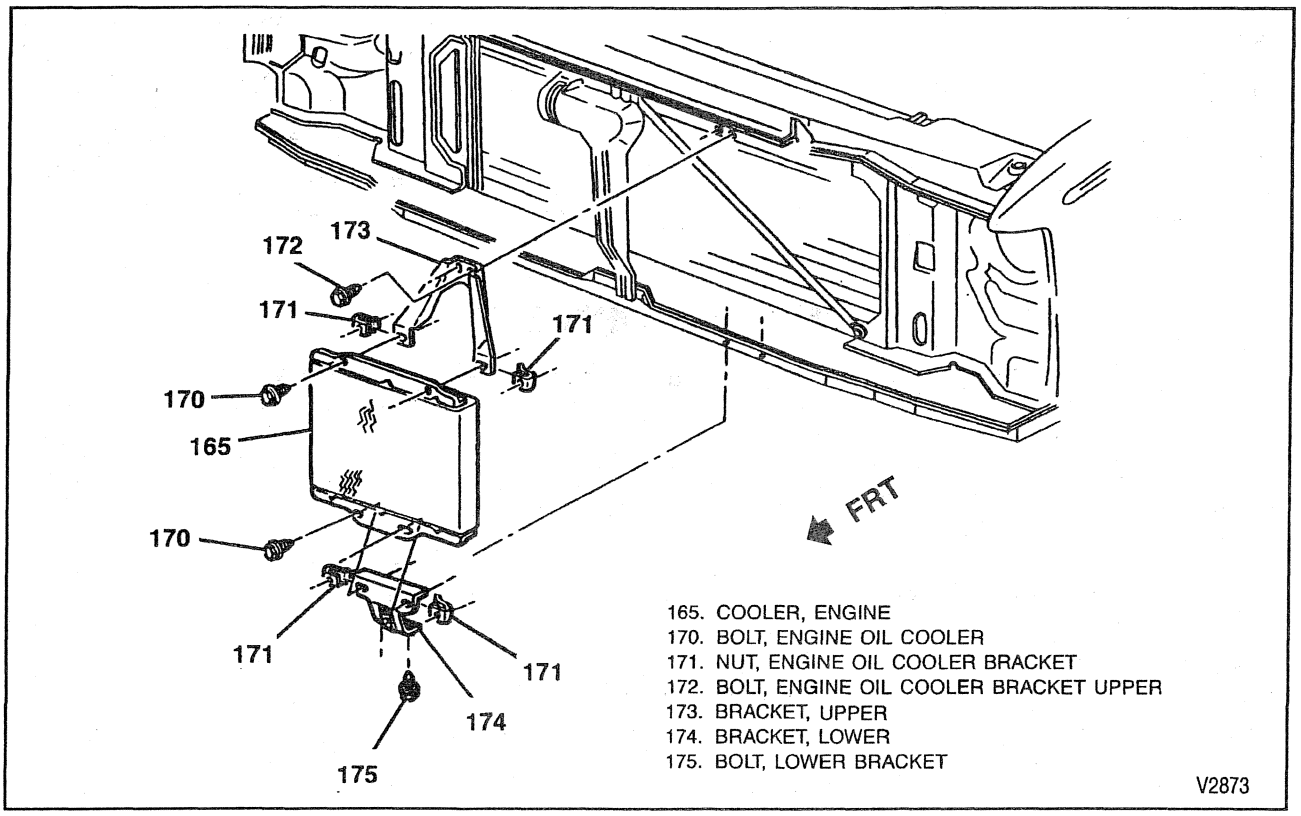

Figure 44—Auxiliary Engine Oil Cooler Assembly

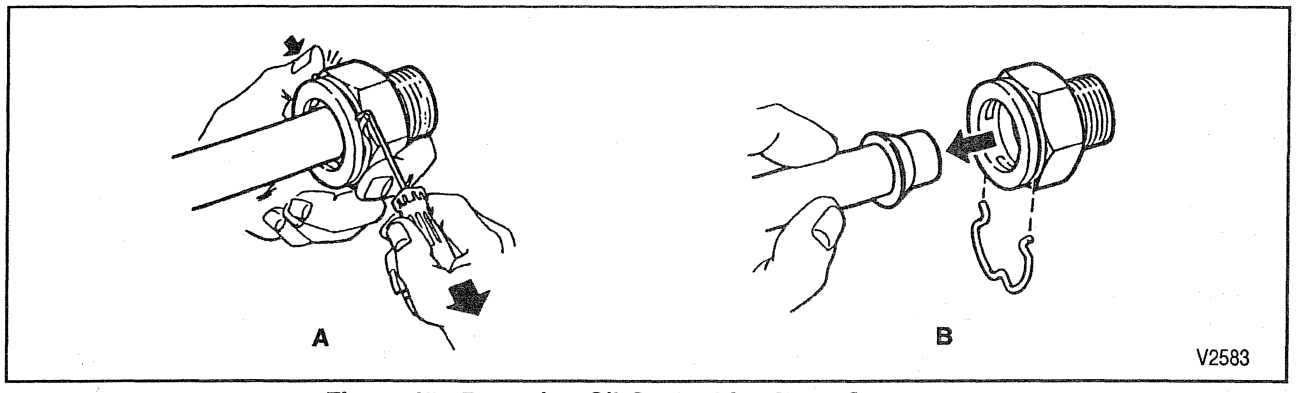

Figure 45—Removing Oil Cooler Line From Connector

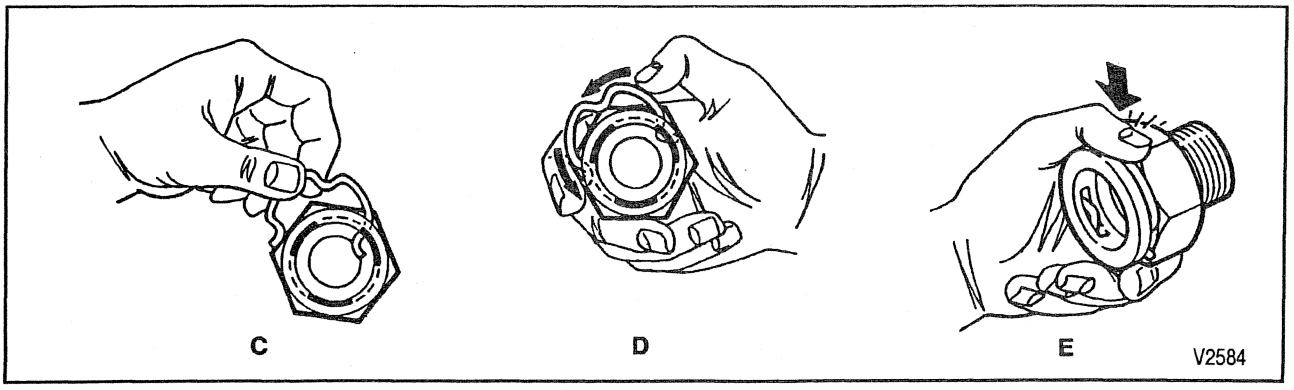

Figure 46—Installing Oil Cooler Line Clip Into Connector

Tighten

- Bolt to 9 N·m (80 lbs. in.).
- Nut to 13 N·m (115 lbs. in.).

5. New oil filter.
   - Test the flow of oil through the cooler before connecting the lines.
   - If the flow is not restricted, connect the oil lines to the connector.
   - A distinct "snap" should be heard when assembling the oil cooler line to the quick connector. The oil cooler line must be fully inserted into the quick connector. Check this by applying a forceful pull to the fitting.
   - If the flow is restricted, replace the radiator. Refer to SECTION 6B2.
- Run the engine and check for leaks.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Lbs. Ft.	Lbs. In.
Coolant Crossover Housing to Cylinder Head Bolt (45) or Stud (44) (Diesel Engines)	42	31	—
Coolant Outlet to Crossover Housing Bolt (24) or Stud (22) (Diesel Engines)	42	31	—
Coolant Outlet to Intake Manifold Bolt (24) or Stud (20) (4.3L, 5.0L, and 5.7 Engines)	28	21	—
Coolant Outlet to Intake Manifold Stud (20) (7.4L Engines)	37	27	—
Coolant Pump Bolts (92) (Gasoline Engines)	41	30	—
Coolant Pump Plate to Block Bolts (96) (Diesel Engines)	23	17	—
Coolant Pump Plate to Block Studs (97) (Diesel Engines)	23	17	—
Coolant Pump Plate to Coolant Pump Bolt (98) (Diesel Engines)	23	17	—
Coolant Pump to Block Bolts (90) (Diesel Engines)	23	17	—
Coolant Pump to Block Bolts (92) (Diesel Engines)	42	31	—
Coolant Pump to Block Stud (93) (Diesel Engines)	42	31	—
Coolant Recovery Reservoir Bolts (102)	10	—	89
Coolant Temperature Sensor (145)	23	17	—
Drive Belt Tensioner Bolt (111) (Gasoline Engines)	83	61	—
Drive Belt Tensioner Bolt Nut (120) (Diesel Engines)	49	36	—
Fan Clutch to Coolant Pump Stud (13)	8	—	71
Fan Clutch to Coolant Pump Stud Nuts (17)	24	18	—
Fan to Fan Clutch Bolts (14)	24	18	—
Oil Cooler Line Bracket Bolt (155)	9	—	80
Oil Cooler Line Clamp Nut (161)	13	—	115
Oil Cooler Line Clip Bolt (167)	6	—	53
Oil Cooler Line Fittings (146)	24	18	—
Radiator Hose Clamps (52) (Diesel Engines)	3	—	27
Radiator Inlet Hose Support Bolt (55) (5.7L and 7.4L Engines)	3	—	27
Radiator Inlet Hose Support Bolt (59) (Diesel Engines)	9	—	80

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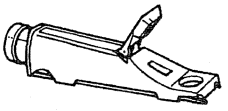
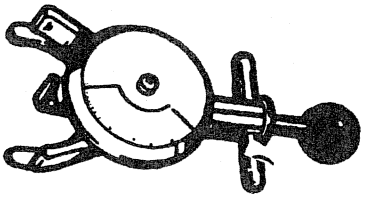
SPECIAL TOOLS

1. 

J 23688 (FARENHEIT SCALE)
J 26568 (CENTIGRADE SCALE)

2. 

BT-33-97 M
(MULTIPLE RIBBED BELT)

1. COOLANT TESTERS
2. BELT TENSION GAGE

V3294

NOTES

SECTION 6B2

RADIATOR

CAUTION: On vehicles equipped with Supplemental Inflatable Restraint (SIR), refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- *Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.*
- *Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.*

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

RADIATOR

C/K radiators are crossflow, tube and center type, using an aluminum core with plastic side tanks. The core and side tanks can be replaced separately. Core repair is easily made with the hot melt adhesive method.

All radiators are fitted with a shroud designed to assist the fan in directing air flow through the radiator core and also serve as a fan guard. Provision for coolant expansion is achieved with a coolant recovery tank. This retards coolant overflow and reduces frequent refills.

Pressure is maintained in the radiator and system by a pressure cap. The pressure cap has two valves; one relieves pressure and the other compensates for coolant contraction when the engine is stopped. Radiator caps are provided in 103 kPa (15 psi) rating.

Radiators used with some automatic transmissions have transmission oil coolers built into the right tank, with inlet and outlet fittings for transmission fluid circulation.

In some applications there is an engine oil cooler available that is built into the left tank, with inlet and outlet fittings for engine oil circulation.

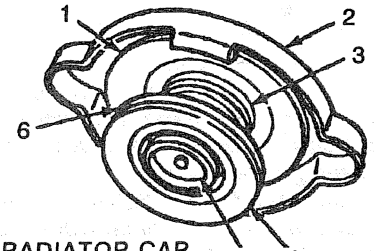
RADIATOR CAP

A pressure-vent cap allows a buildup of 103 kPa (15 psi) in the cooling system. This pressure raises the boiling point of the coolant to about 128°C (262°F) at sea level. Do not remove the radiator cap to check the engine coolant level; check the coolant visually at the see-through coolant reservoir. Add coolant to the reservoir when the system cools.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while the engine is hot and the pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over the engine, fenders, and person removing the cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.

The pressure-type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring of pre-determined strength, which protects the radiator by relieving internal pressure when it exceeds cooling system design limits. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse (figure 1).

The radiator cap is designed to discourage inadvertent removal. To safely remove the cap, rotate the cap slowly to the left, without pressing down, to the detent (figure 2). Allow any pressure to relieve. Next, press down on the cap and continue to rotate the cap to the left and lift off the cap.



1. SEAL, RADIATOR CAP
2. CAP, RADIATOR
3. SPRING, PRESSURE VALVE
4. SEAL, PRESSURE VALVE
5. VALVE, VACUUM
6. VALVE, PRESSURE RELIEF

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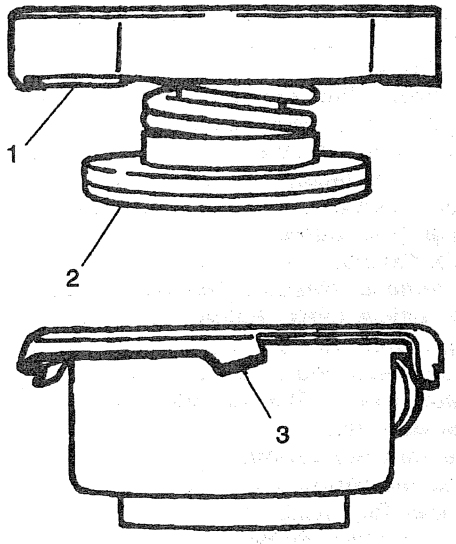
Figure 1—Radiator Cap Pressure and Vacuum Valves



1. TANG
2. SEAL, PRESSURE VALVE
3. DETENT

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Figure 2—Radiator Cap and Filler Neck

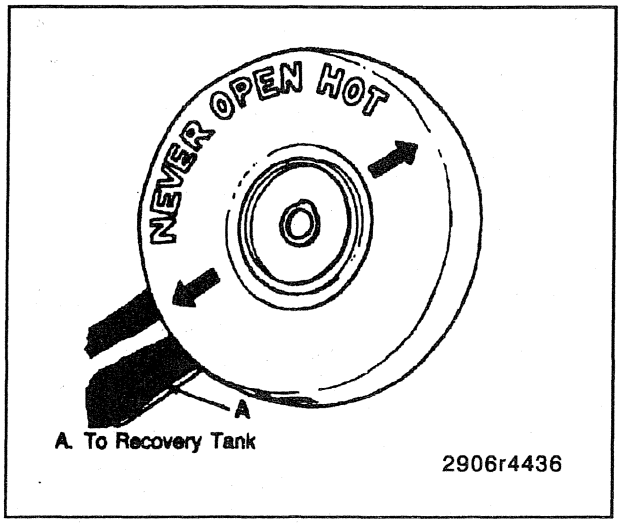

Figure 3—Radiator Cap Alignment Arrows

Under the diaphragm spring at the top of the cap is a gasket. Embossed on the cap is a caution against its being opened and arrows indicating the proper closed position (figure 3).

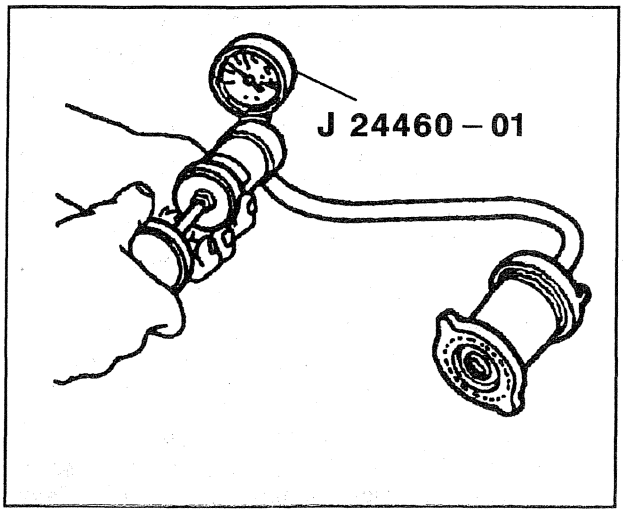

Figure 4—Testing the Radiator Pressure Cap

The seal of the filler cap and the operation of the pressure relief valve can be checked using a conventional cooling system testing kit such as J 24460-01 (figure 4).

DIAGNOSIS OF RADIATOR

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Overheats	1. Cooling area obstructed.	1. Remove or relocate added on parts that may block air to the radiator.
	2. Radiator fins plugged.	2. Remove any debris (bugs, leaves, etc.) from the radiator fins.
	3. Leaking radiator.	3. Repair leaks or replace seals.
	4. Bent fins.	4. Repair or replace.
Radiator Loose	1. Loose screws.	1. Tighten screws.
	2. Missing insulators.	2. Replace insulators.
		D0133

MAINTENANCE RECOMMENDATIONS

Check the outside of the radiator for bent fins or signs of leakage. Repair leaking radiator cores.

Do not seal temporarily with a sealer type antifreeze or coolant additive. Remove any stones between the fins. Clean loose debris and road film from the radiator core with a quality grease solvent and compressed air.

Remove the grille, and fan shroud, to ensure a thorough cleaning.

Remove the radiator cap and look for plugging and scale on the inside of the tank. Replace a badly plugged radiator. Test the radiator and system as described in SECTION 6B1.

1. Check the coolant level. If low, add recommended coolant as required.
2. Check the hose conditions and tighten the clamps if leakage is evident. Replace cracked, stripped, or corroded clamps.
3. Check the coolant hoses for spongy or cracked appearance. Replace deteriorated hoses or bursting could occur, which would result in coolant loss and extensive damage due to overheating.
4. Check the radiator core for leaks and for accumulation of dirt which may obstruct the air passages and reduce heat transfer.
5. Check the recovery tank for leaks. Plastic bottles may develop cracks from being damaged by flying objects.
6. Inspect the radiator rubber mountings and bumpers for deterioration and replace as necessary. Check the mounting bolts, supports, braces, tie rods, and stabilizer rods. Components should be securely fastened in place if mounting bolts are missing, loose, or stripped. Check for damage to the core, side flanges, and supporting components.
7. Check for clearance between the fan blades, core, and shroud. Make sure the fan attaching bolts are tight and that none are missing. Replace the fan if any blade is bent.

8. Inspect the filler cap for evidence of cracking, separation, or deterioration. Replace as required.
9. An occasional external flushing with water will remove the majority of dirt accumulation and foreign matter from between the core fins and will help to maintain efficient heat dissipation. Direct water under moderate pressure from behind the core to force debris out in the opposite direction of its entry. Remove the grille and fan shroud and direct the water stream in line with the fins to reduce the possibility of bending fins.

RADIATOR INTERNAL DEPOSITS

A radiator with a dirty, obstructed, or leaking core will cause the engine to overheat. A scale deposit inside the radiator is a result of using hard, high mineral content water in the cooling system. The effect of heat on the minerals in the water causes the formation of scale, or hard coating, on metal surfaces within the radiator, thereby reducing the transfer of heat. Some hard water will produce a silt-like deposit which restricts the flow of water. Replace a radiator that is plugged or has a heavy scale on the core.

SCALE REMOVAL

To remove the hardened scale, a direct chemical action is necessary. A flushing compound at the specified rate of 30 grams per liter (4 oz. per gallon) of radiator capacity should be added to the coolant solution in the form of a dissolved solution while the engine is running. Operate the engine for 15 minutes or until it reaches normal operating temperature, then drain and flush the system with clean water.

There are various types of flushing compounds commercially available, but they should be obtained from a reliable source. Most compounds attack metals and should not remain in the engine for more than a few minutes. A neutralizer should be used in the cooling system immediately after a descaling solvent is used.

For extremely hard, stubborn coatings, such as lime scale, use a stronger solution. The corrosive action of a stronger solution will affect the thin metals of the radiator, thereby reducing its operating life. A complete flushing and rinsing is mandatory and must be accomplished skillfully.

After the solvent and neutralizer have been used and the cooling system is flushed, drain the entire system and fill it with clean, soft water plus a high boiling type antifreeze that meets GM 6038-M specifications. After filling the cooling system, check for radiator, hose, and engine coolant leaks.

ON-VEHICLE SERVICE

DRAIN COCK

CAUTION: To help avoid the danger of being burned, do not remove the radiator cap or diesel surge tank cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon. Remove the radiator cap before draining the coolant, so the coolant is not forced out under pressure.

Remove or Disconnect (Figure 5)

- Drain radiator of coolant.

1. Drain cock stem.
   - Seal will usually come out attached to stem.
2. Drain cock body.
   - Squeeze sides of body with fingers or needlenose pliers to disengage body locking tangs from side tank.

Install or Connect (Figure 5)

1. Drain cock body.
   - Make sure body is fully seated in side tank and that locking tangs are engaged.
2. Seal to stem.
3. Stem into body. Turn lock in place.

- Add proper coolant as specified in SECTION 0B.
- Start engine and check for leaks.

FAN SHROUD REPLACEMENT

UPPER FAN SHROUD

Remove or Disconnect (Figures 6 through 8)

1. Upper radiator nose from the radiator.
2. Negative battery cable (dual batteries only).
3. Upper shroud bolts and upper shroud.

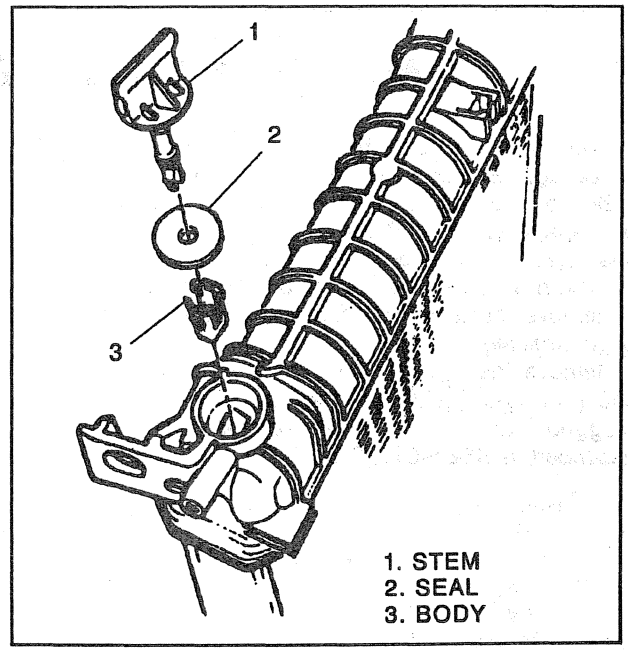

Figure 5—Radiator Drain Cock

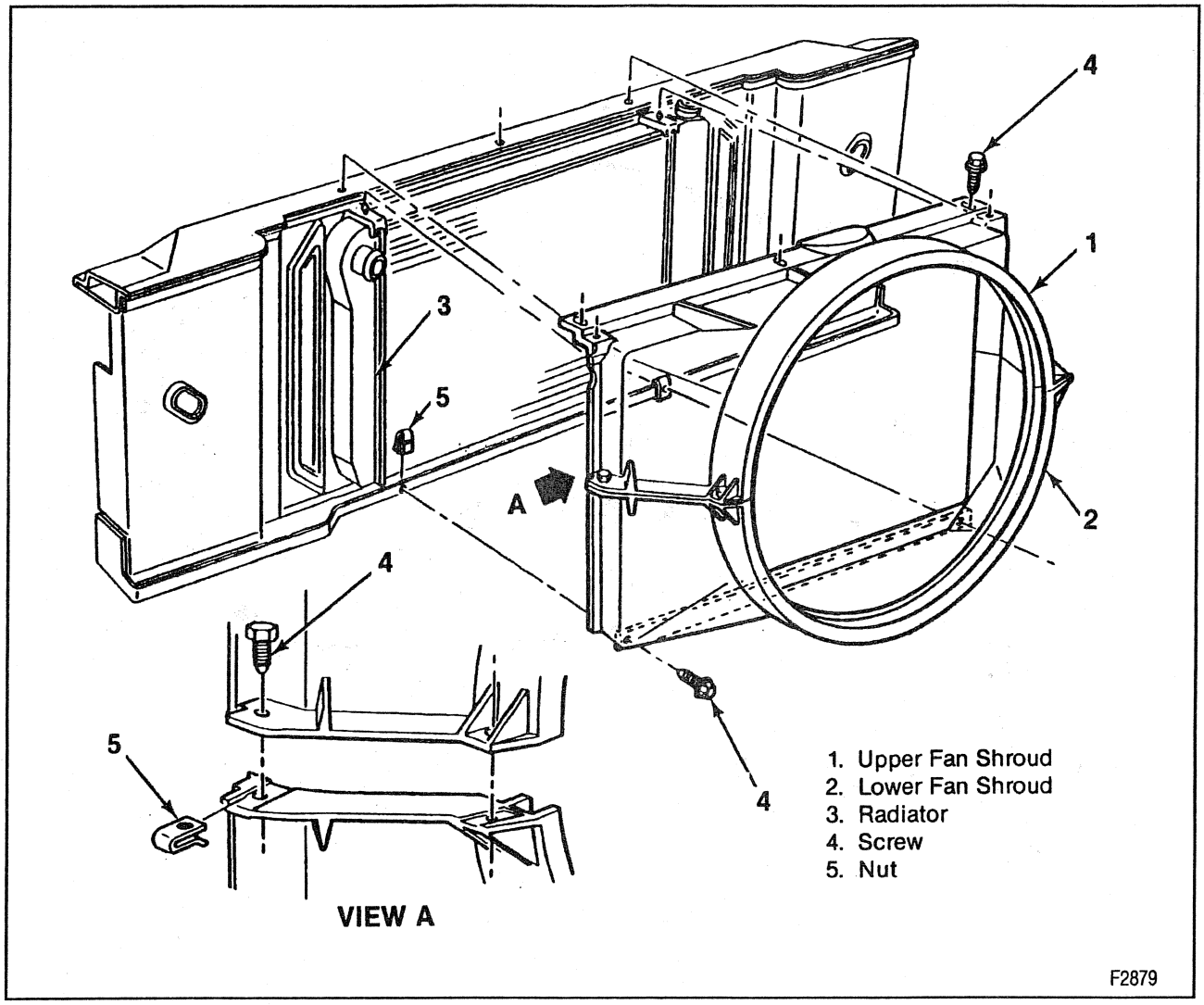

Figure 6—Fan Shroud and Components (4.3L, 5.0L and 5.7L Engines)

Inspect

- Upper shroud for signs of damage. Replace if necessary.

Install or Connect (Figures 6 through 8)

1. Upper shroud and upper shroud bolts.

Tighten

- Bolts (4) to 9 N·m (71 lbs. in.).

2. Upper radiator hose to the radiator.
3. Negative battery cable (dual batteries only).

LOWER FAN SHROUD

Remove or Disconnect (Figures 6 through 8)

1. Upper shroud, as outlined previously.
   - Raise the vehicle.
2. Underbody shield (if equipped).
3. Lower shroud bolts and lower shroud.

Inspect

- Lower shroud for signs of damage. Replace if necessary.

Install or Connect (Figures 6 through 8)

1. Lower shroud and bolts.

Tighten

- Bolts to 9 N·m (71 lbs. in.).

2. Underbody shield (if equipped).
   - Lower the vehicle.
3. Upper shroud, as outlined previously.

RADIATOR REPLACEMENT

Remove or Disconnect (Figures 6 through 8)

1. Coolant from the radiator.
2. Upper fan shroud bolts and upper fan shroud.
3. Upper insulators and brackets.
4. Upper and lower radiator hoses.
5. Transmission fluid cooler pipes.

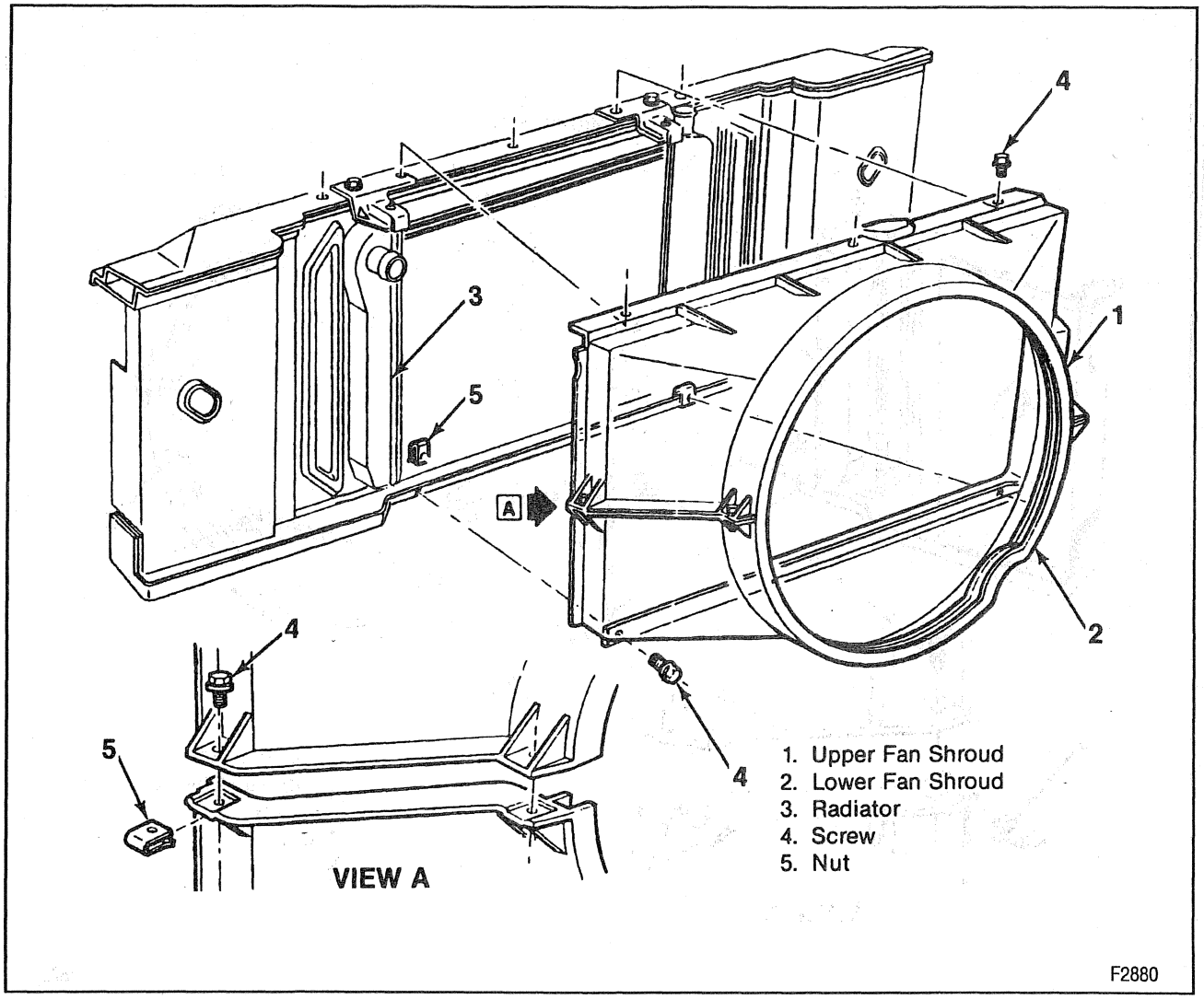

Figure 7—Fan Shroud and Components (7.4L, 6.5L Diesel and some 5.7L applications)

6. Engine oil cooler pipes.
7. Lower fan shroud bolts and lower fan shroud.
8. Overflow hose.
9. Radiator from the lower insulators and brackets.

Inspect

- All parts and connections for leaks and wear. Replace if necessary.

Install or Connect (Figures 6 through 8)

1. Radiator on the lower insulators.
2. Overflow hose.
3. Lower fan shroud bolts and lower fan shroud.

Tighten

- Bolts to 9 N·m (71 lbs. in.).

4. Engine oil cooler pipes.

Tighten

- Fittings to 24 N·m (18 lbs. ft.).

5. Transmission fluid cooler pipes.

Tighten

- Fittings to 26 N·m (19 lbs. ft.).

6. Upper and lower radiator hoses.
7. Upper insulators.
8. Upper fan shroud and fan shroud bolts.

Tighten

- Bolts to 9 N·m (71 lbs. in.).

9. Coolant in the radiator.
- Leak test.

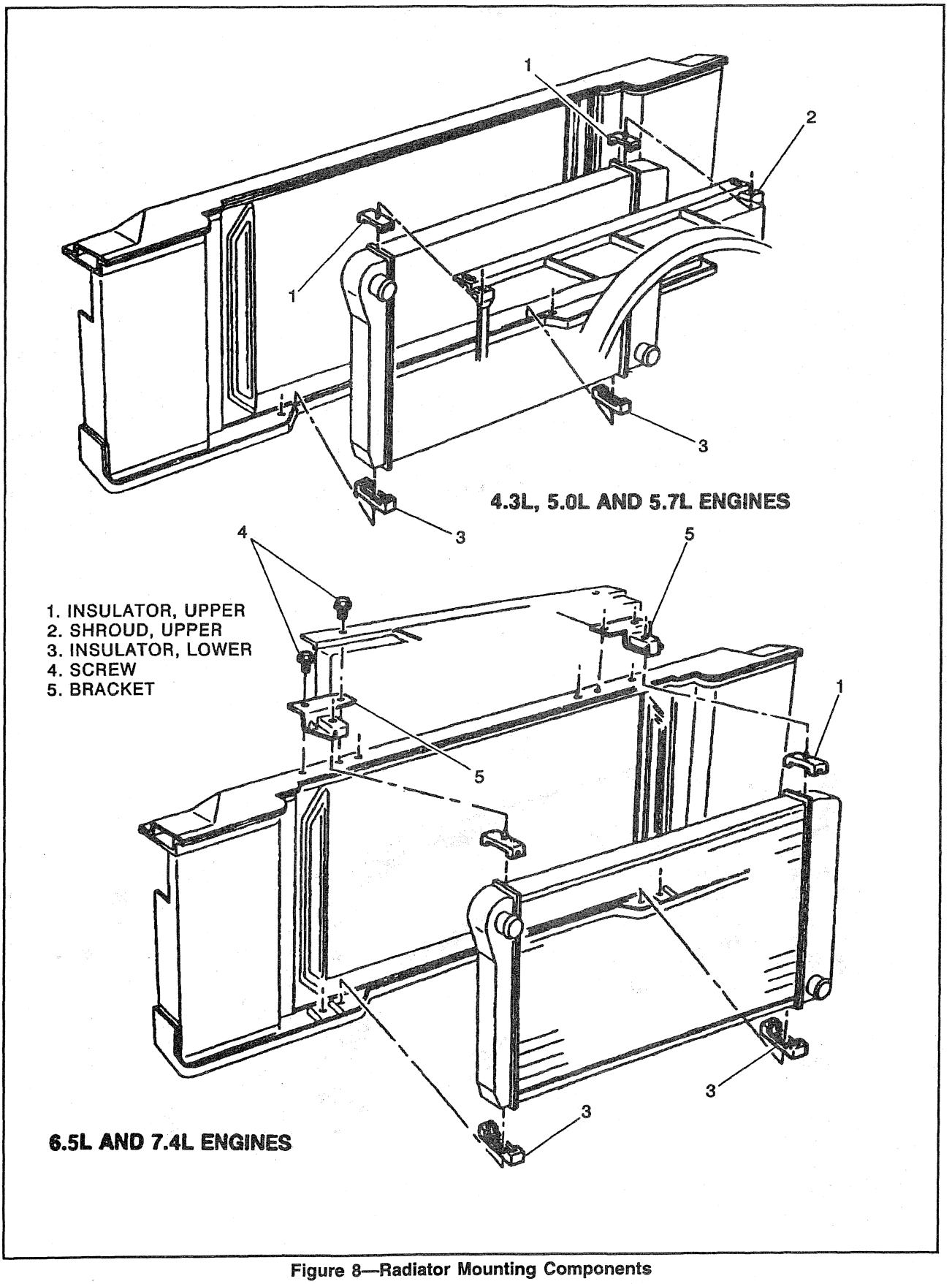

Figure 8—Radiator Mounting Components

RADIATOR SERVICE

TESTING PROCEDURES

LEAK TESTING

Some core leaks can be detected by adding water to the radiator. Clean the core so that the damaged area can be found. Refer to figure 9 for a radiator component view.

1. Remove dirt and insects from the fins with a common water hose without a nozzle. Excessive water pressure could damage the fins.
2. Scrub the core with a soft-bristle brush using clean, hot water, or hot water with a mild detergent.

ON-VEHICLE PRESSURE TESTING

Pressure-test the aluminum-plastic radiator with J 24460-01 Cooling System Tester (figure 10). With the system at a cool temperature, remove the radiator cap, connect the gage, and apply normal system operating pressure. Do not exceed 138 kPa (20 psi). Watch the gage needle for an indication of a leak, and examine the radiator and other cooling system parts for escaping coolant.

Repair hose and hose connections as required. Check the radiator cap to ensure that it will maintain the correct pressure.

If the radiator leaks during the pressure test, mark the leak area.

OFF-VEHICLE LEAK TESTING

NOTICE: Do not use boil-out tanks, vats, or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. Use a separate test tank containing clean water for servicing aluminum/plastic radiators.

1. Install test fittings or rubber test caps in the inlet and outlet necks and seal the oil cooler fittings with metal plugs to protect the cooler and keep the fluid from running out (figure 11).
2. Attach the pressure tester and gradually apply air pressure until 138 kPa (20 psi) is attained. Do not exceed 138 kPa (20 psi). Check the pressure gage to see if there is a pressure loss. To ensure that there are no small leaks, run water over the repair area and look for bubbles. (A mild detergent is helpful). If a large water tank is available, submerge the radiator and check for air bubbles.

REPAIRABLE LEAKS

There are two types of leaks that can be repaired on the aluminum-plastic radiator: core leaks and gasket or seal leaks. Leaks in the plastic tanks cannot be repaired (figure 12).

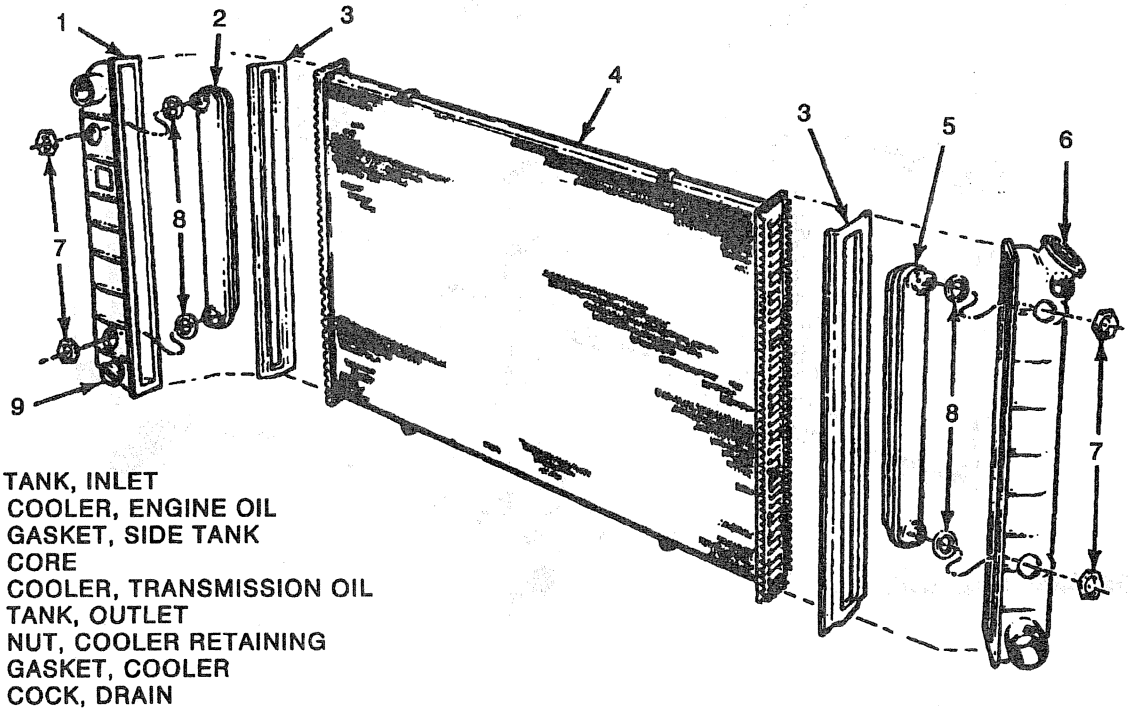

Figure 9—Radiator Components

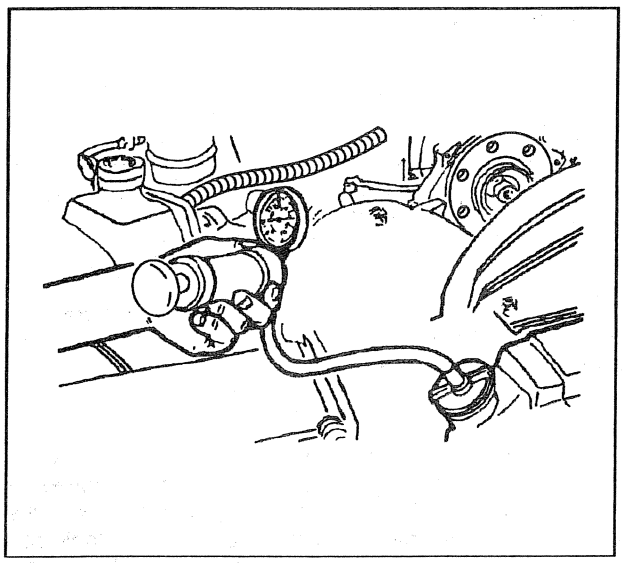

Figure 10—Pressure Testing

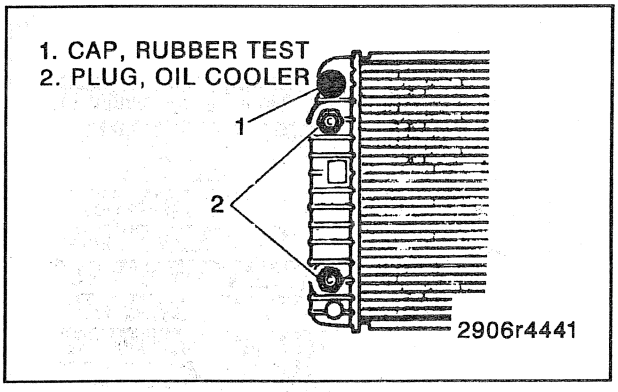

Figure 11—Oil Cooler Plugs

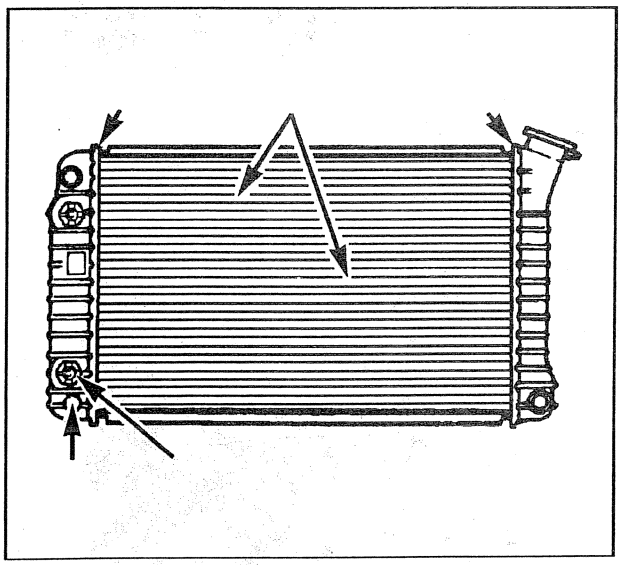

Figure 12—Possible Leak Areas

Core leaks can occur in a tube or in the joints between the tubes and headers. Gasket leaks can occur in the joints between the plastic tanks and the headers or in the joints between the oil cooler fittings and the tank. Some leaks can be repaired while the radiator is on the vehicle; however, it is usually best to remove the radiator.

REPAIR METHODS

There are several methods that can be used to repair the radiator core, but the hot melt adhesive method repair kit is the most simple and effective.

The kit contains adhesive sticks, cotton swabs, a wire brush, and the primer. The adhesive stick is reusable, has an indefinite shelf life, and is waste-free. Store the sticks in a sealed container to keep them dry (figure 13).

RADIATOR REPAIR PROCEDURES

The aluminum-plastic radiator can be repaired. The following components can be replaced:

- Core
- Tanks and gaskets
- Oil coolers and gaskets
- Drain cock and gasket

The tanks cannot be repaired if broken or cracked. The radiator core can be replaced and the new core used with the original tanks and oil cooler.

PRECAUTIONS

As with all cooling system service, take measures to prevent personal injury and damage to the system.

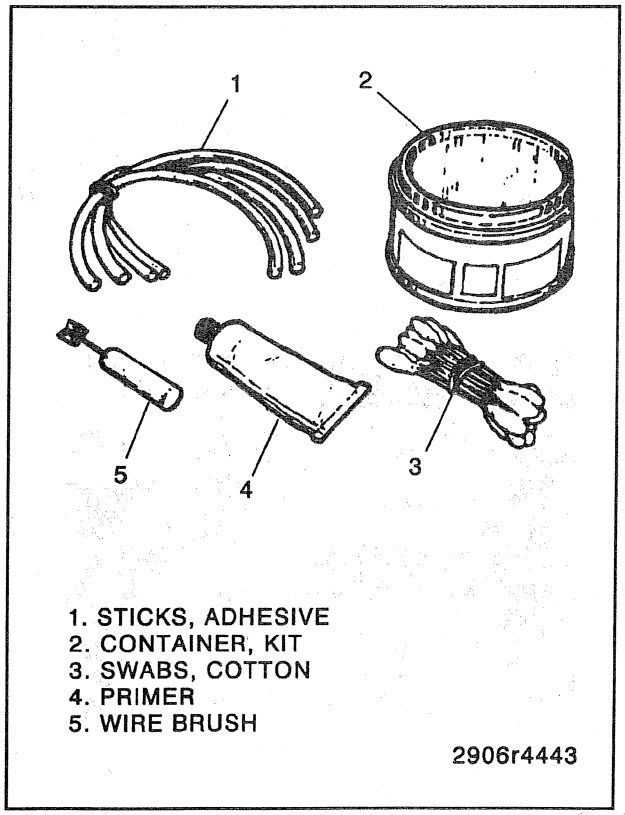

Figure 13—Hot Melt Repair Kit

CAUTION: To help avoid being burned, do not remove the radiator cap while the engine and radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon.

NOTICE: DO NOT USE "BOIL OUT" TANKS OR VATS. Common service methods may destroy an aluminum radiator. Do not use caustic or lye cleaning solutions for aluminum radiators. USE CLEAN WATER WHEN SERVICING ALUMINUM RADIATORS.

- Do not open the hood if you can see or hear steam or coolant escaping from the engine compartment.
- Do not remove the radiator cap if the radiator feels warm.
- Do not remove the radiator cap or coolant recovery cap if the coolant in the recovery tank looks like it is boiling.
- Wear eye protection.
- Wear gloves to protect your hands against excessive heat of the effects of chemicals on your skin.
- Prevent dirt and water from entering the transmission oil cooler.
- Do not use boil-out vats or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners in these tanks will attack the aluminum and cause radiator failure. Use a separate test tank containing clean water for servicing aluminum/plastic radiators.

NOTICE: Never use shop air to pressure test radiators that is not regulated at 138 kPa (20 psi). Pressures over 138 kPa (20 psi) will damage the radiator.

SPECIAL PREPARATION

For damaged areas between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than necessary. Usually 6 mm (1/4 inch) beyond the leak or damaged area is enough to make an effective repair (figure 14).

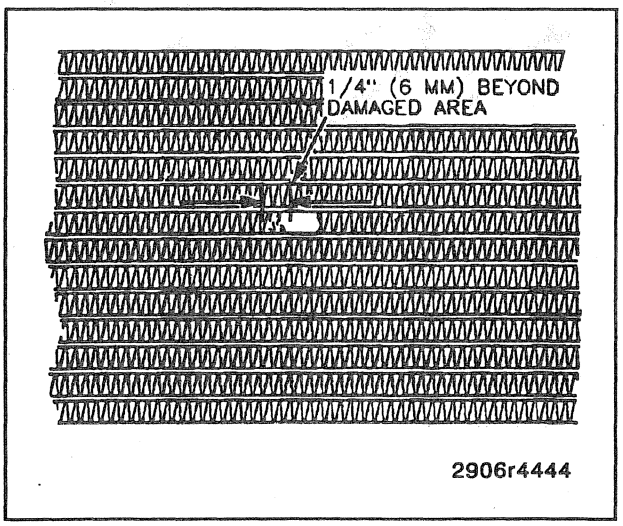

Figure 14—Fins Removed from the Damaged Area

TUBE BLOCKING

If a tube is severely damaged, it can be blocked off (figure 15).

NOTICE: Do not block off more than two tubes in a radiator. Blocking off more than two tubes will significantly reduce the cooling capacity of the system.

Cut the tube off 6 mm (1/4 inch) from the header and pinch shut before it is cleaned and sealed. Refer to "General Core Repair."

HEADER REPAIR

If the header or a tube near the header requires a repair, the side tank does not have to be removed. A wet cloth can be placed against the side tank where the repair has to be made (figure 16). The side tank can also be submerged in a tank of water up to the header (figure 17).

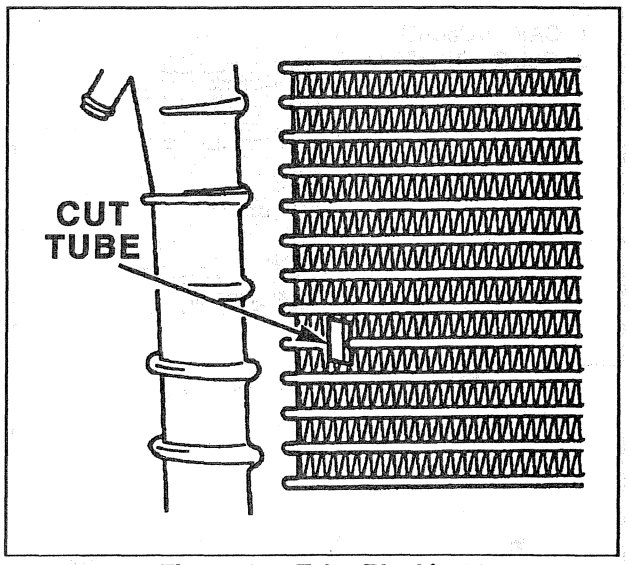

Figure 15—Tube Blocking

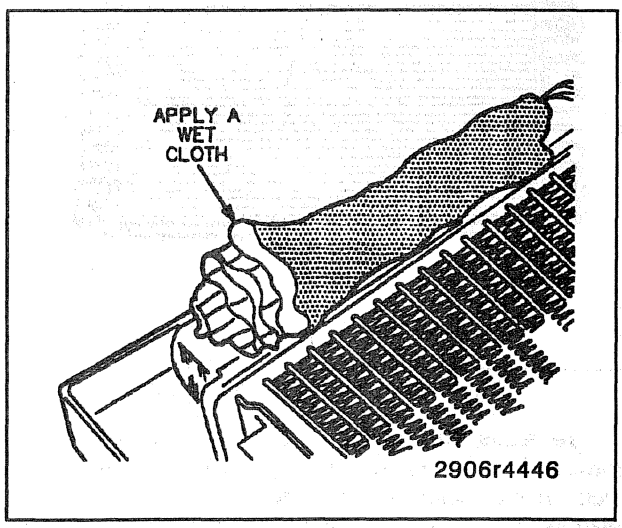

Figure 16—Using a Wet Cloth on a Side Tank

NOTICE: One of these procedures must be used when repairs are made on or near the header to prevent damage to the tank or gasket.

GENERAL CORE REPAIR

Preparation of the repair area surface cannot be over-emphasized. If the leak area surface is not clean, the repair materials will not stick to the surface.

1. Position the core so the repair is accessible.
2. Apply a wet cloth if you are working near the plastic tanks or the joints between the core tubes and header (figure 16), or submerge the tank in water (figure 17).
3. Heat the repair area slightly with a small torch or heat gun to be sure it is dry. Do not use a blow torch.
4. Brush the area to be repaired with the small steel brush that is supplied in the kit and blow dust away from the repair area (figure 18).

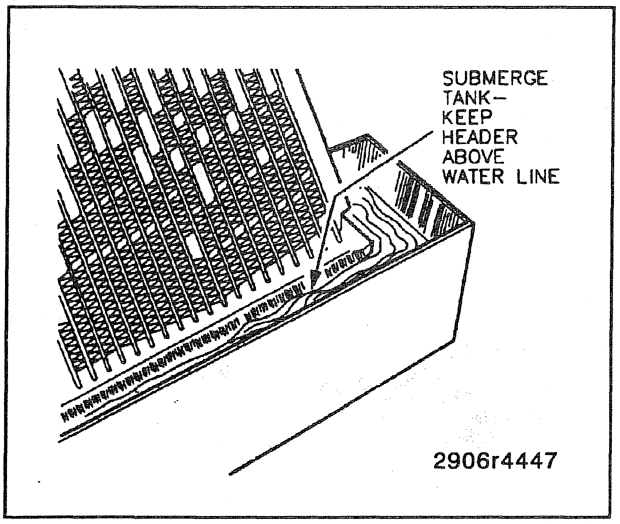

Figure 17—Submerging the Side Tank

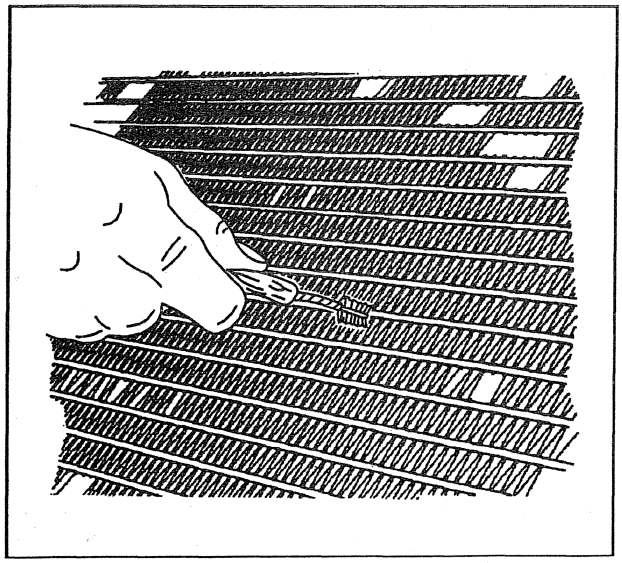

Figure 18—Cleaning the Area with a Steel Brush

5. Open the tube of primer, using the spurred cap or a pin, and apply primer to the repair area only. Use of the primer produces a stronger repair. Do not heat the primer.

CAUTION: The primer contains trichloroethane. It could be harmful or fatal if swallowed. If swallowed, get medical attention. Use with adequate ventilation. In case of eye contact, flush with water and get medical attention. In case of body contact, wash with soap and water. Do not mix the primer with water.

6. Scrub the repair area with a cotton swab until a fresh swab stays clean (figure 19). The clear, yellow-brown coating does not have to be removed.
7. Heat the repair area with a heat gun or by moving the torch in a circular pattern (figure 20). Use a soft, small, blue flame (like a gas stove flame).

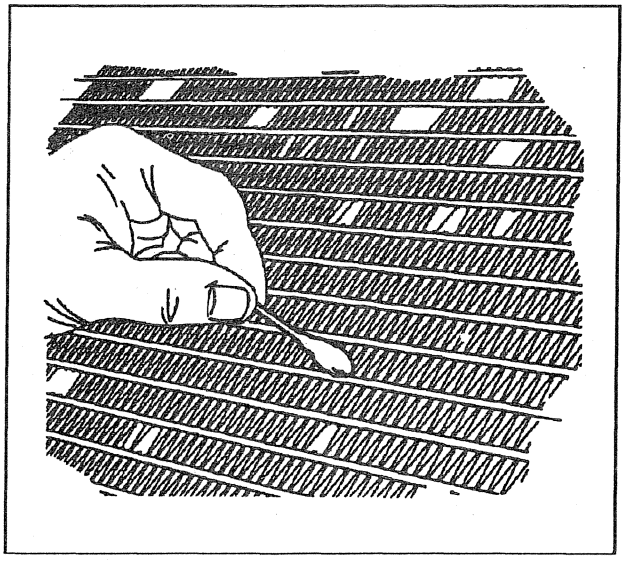

Figure 19—Scrubbing the Area with a Cotton Swab

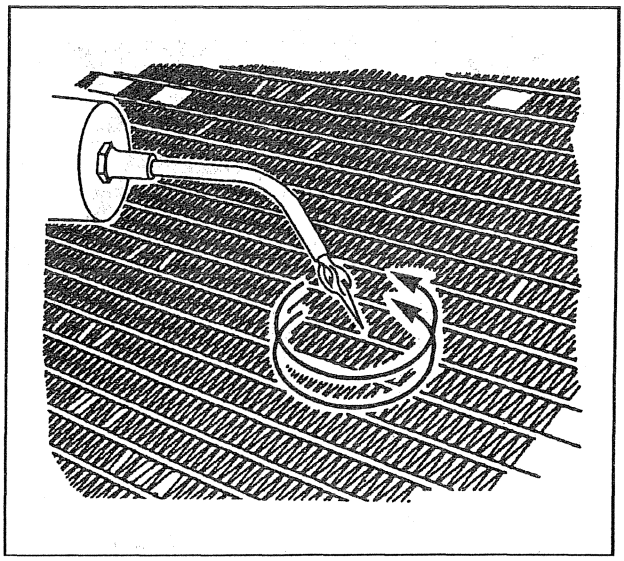

Figure 20—Heating the Repair Area

8. Withdraw the torch and rub the adhesive stick on the repair area (figure 21). The adhesive will flow at a temperature of approximately 260°C (500°F). If the stick doesn't melt, remove it and re-apply the heat. Do not heat the stick with a flame. High heat will burn and char the adhesive.
9. Continue heating until the adhesive flows and wets the entire repair area and fills the joint. If a hole is in the center of a tube, heat the tube and let the hot surface melt and pull in the adhesive. The force of the flame or heat gun will also tend to guide the adhesive toward the hole. For leaks between a tube and header, flow the adhesive around the tube and header joint with the tank installed.
10. Heat the repair area until the adhesive is bubble-free and smooth, with a light yellow color. Curing is not required.
11. Test the radiator for leaks when cool. If the repair area still leaks, reheat it gently to dry it. Heat and reflow the adhesive or apply more as necessary to repair the leak.

TANK GASKET LEAK REPAIR

Tank gasket leaks can be mistaken for tank or header leaks. If a plastic tank leaks from the header joint gasket, tighten the clinch tabs with locking-type pliers or with BT 8260 Radiator Core Remover/Installer (figure 22). If this method doesn't seal the leak, remove the tank for further inspection.

1. Pry open the clinch tabs, except those under the inlet, outlet, and filler necks, using BT 8260 Radiator Core Remover/ Installer (figure 23) or a screwdriver (figure 25). Lift the tabs only enough to allow removal.

NOTICE: Do not overbend the tabs. Overbending could result in breakage. If there are more than three tabs broken on one side of the header, or more than two adjacent tabs together, replace the core.

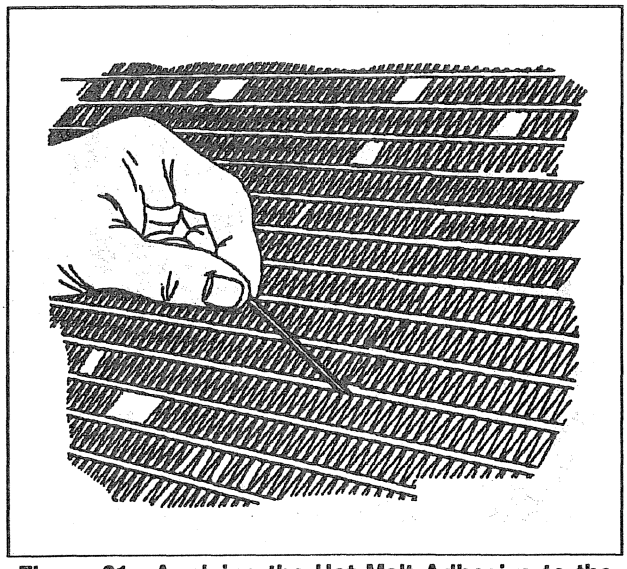

Figure 21—Applying the Hot Melt Adhesive to the Repair Area

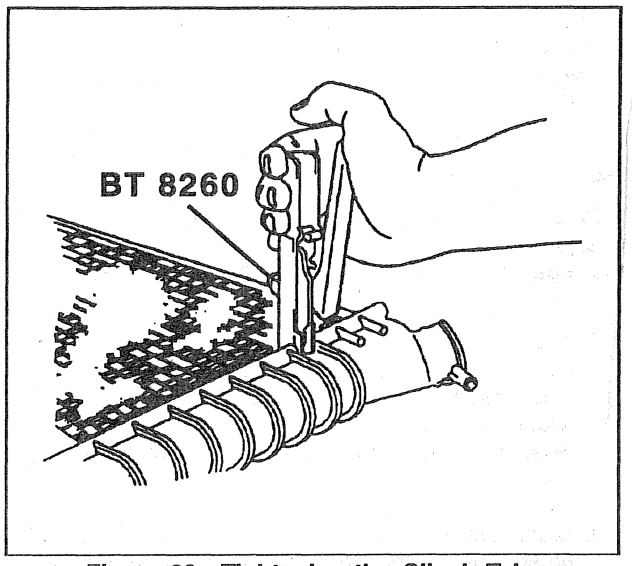

Figure 22—Tightening the Clinch Tabs

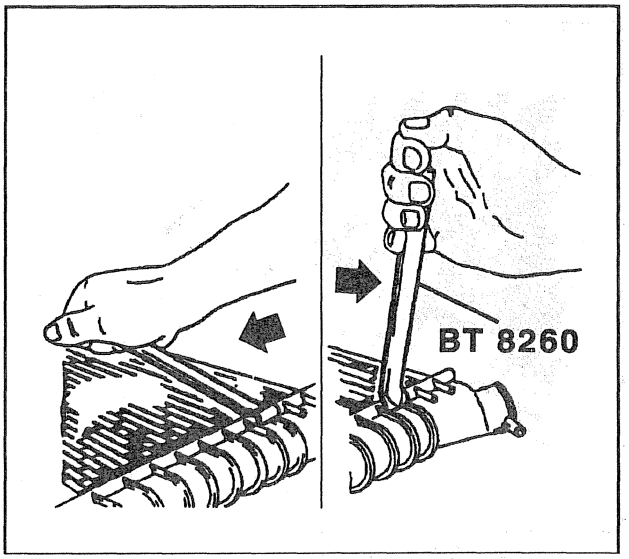

Figure 23—Opening the Clinch Tabs

2. Lift the tank and slide it out from under the remaining clinched tab. You may have to tap the tank with your hand to dislodge the gasket. Lift the remaining tab(s) with pliers.
3. Remove the gasket.
4. Clean the header and gasket groove of all dirt and old rubber.
5. Clean the sealing edge of the plastic tank.
6. Examine the header gasket and surface and tank flange for evidence of leakage. Clean or repair the surface to remove dirt, burrs, and bumps.
7. Remove the oil cooler, if equipped, and install it in the new tank.
8. Dip or coat the new tank gasket in engine coolant and position it on the header surface. The coolant helps hold the gasket in place.
9. Position the tank and gasket to the header. Clamp it in place and secure it by bending four clinch tabs as shown in figure 25.

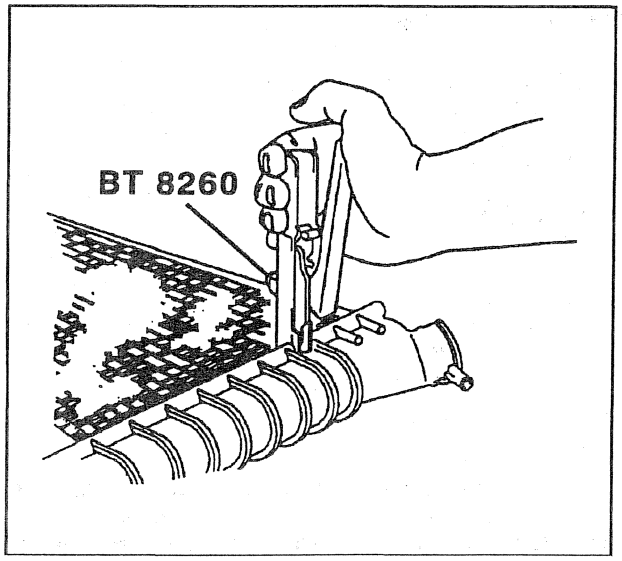

Figure 24—Opening the Clinch Tabs

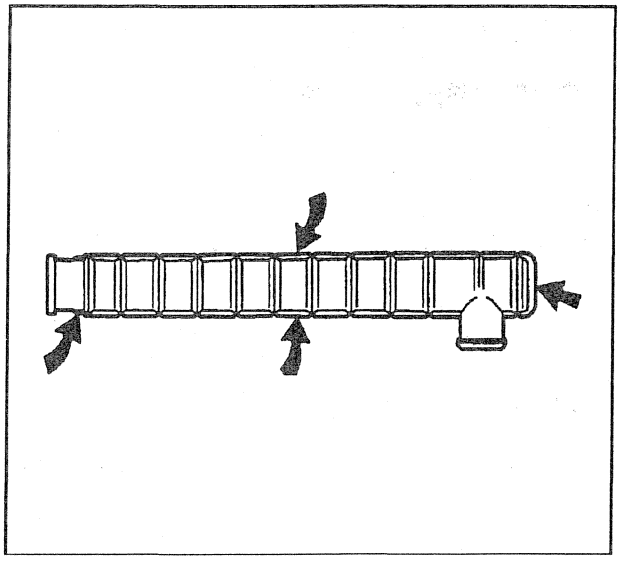

Figure 25—Seating the Tank to the Radiator Tank

10. Clamp the remaining clinch tabs around the header using the clinching tool or pliers following the clinching sequence in figure 26.

Important

- Tighten the clinch tabs starting at the center and working out to the ends.

11. Replace the core if there are more than three tabs broken on one side or two adjacent tabs broken.
12. Install the drain cock, if removed.
13. Test the radiator.

OIL COOLER GASKET REPLACEMENT

Remove the outlet tank to replace the oil cooler. The oil cooler gaskets can be replaced without removing the tank.

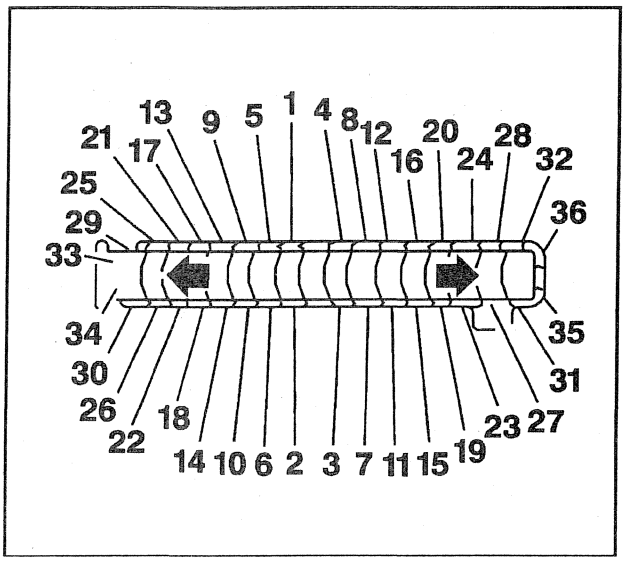

Figure 26—Clinching Sequence

Remove or Disconnect (Figure 27)

1. Radiator and lay it on a flat surface.
2. Bottom oil cooler nut and loosen the top nut.
3. Press the oil cooler into the hole and remove the gasket using a small hook (figure 27).
4. Blow-dry all surfaces on the tank and oil cooler.

Install or Connect (Figure 27)

1. New gasket without lubrication.
   - Be sure it is seated properly inside the tip of the fitting.
   - Reach into the oil cooler and push it into position against the tank.
2. Loosely assemble the oil cooler nut.
3. Replace the other gasket by following the same procedure.
4. Oil cooler nuts.

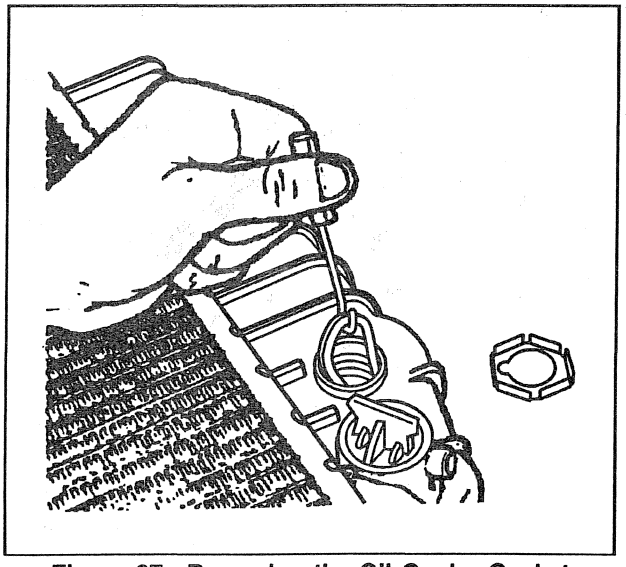

Figure 27—Removing the Oil Cooler Gasket

Tighten

- Engine oil cooler nuts to 20 N·m (15 lbs. ft.).
- Transmission oil cooler nuts to 27 N·m (20 lbs. ft.).
- Do not overtighten.

5. Leak test.

OIL COOLER REPLACEMENT

Remove or Disconnect (Figure 9)

1. Side tank or from the radiator.
2. Nuts from the oil cooler fitting.
3. Oil cooler and/or gaskets.
4. Rubber gaskets from the oil cooler.

Clean

- Oil cooler gasket areas.

Install or Connect (Figure 10)

1. Rubber gaskets to the oil cooler.
2. Oil cooler to the side tank.
   - Do not loosen or misalign the gaskets.
3. Retaining nuts.

Tighten

- Transmission oil cooler nuts to 27 N·m (20 lbs. ft.).
- Engine oil cooler nuts (117) to 20 N·m (15 lbs. ft.).

4. Side tank to the radiator.
5. Leak test.

RECORE

If the radiator core is damaged beyond repair and the other parts are serviceable, install the original inlet and outlet tanks, oil cooler, radiator cap, and drain valve, along with the new core and new gaskets.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Item	N·m	Lbs. Ft	Lbs. In.
Engine Oil Cooler Nuts	20	15	—
Engine Oil Cooler Pipe Connections	24	18	—
Shroud and Radiator Screws	9	—	71
Transmission Fluid Cooler Nuts	20	15	—
Transmission Fluid Cooler Pipe Connections	26	19	—

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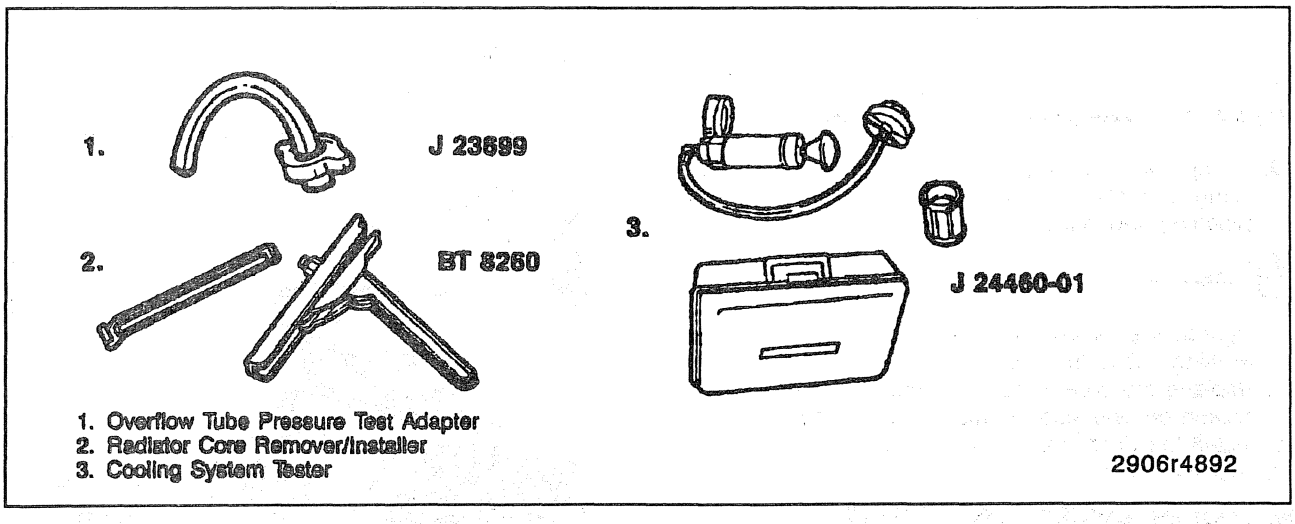
SPECIAL TOOLS



1. Overflow Tube Pressure Test Adapter
2. Radiator Core Remover/Installer
3. Cooling System Tester

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SECTION 6C

FUEL SYSTEM (Diesel Engines Only)

For information on the diesel engine fuel system, refer to the appropriate Driveability, Emissions, and Electrical Diagnosis Manual, GMT/95-CK-2.

NOTES

SECTION 6C2

DIESEL FUEL INJECTION

The diesel engines used in C/K vehicles use an electronic fuel injection pump. For information about the electronic fuel injection pump, refer to the Driveability, Emissions, and Electrical Diagnosis Manual, GMT/95-CK-2.

NOTES

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

GENERAL DESCRIPTION

6D1 - BATTERY

This section contains information on the maintenance, diagnosis, storage, charging, and jump starting of batteries. Battery cable and ground strap routing also appear in this section.

6D2 - CRANKING SYSTEM

This section covers the diagnosis, on-vehicle servicing, and specifications of the cranking circuit and starter. Disassembly and repair procedures are covered in the Light Duty Truck Unit Repair Manual.

6D3 - CHARGING SYSTEM

Generator diagnosis, on-vehicle servicing, and specifications are covered in this section. Disassembly and repair procedures are covered in the Light Duty Truck Unit Repair Manual.

6D4 - IGNITION SYSTEM

This section contains information on spark plugs and primary and secondary wiring. On-vehicle service is limited to distributor, pickup coil, and ignition coil testing. Procedures to replace the spark plugs, ignition coil, and distributor are located here. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual for ignition timing instructions and diagnosis. Servicing of distributor assemblies and electronic ignition systems can be found in the Light Duty Truck Unit Repair Manual.

6D5 - ENGINE WIRING

Engine wiring views are shown in SECTION 6D5. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual for engine wiring schematics and diagnosis. Forward lamp harness views are found in SECTION 8B.

Important

Where a driveablility complaint exists, or a Diagnostic Trouble Code is set, refer to the Driveability, Emissions, and Electrical Diagnosis Manual. Wiring diagrams, component locations, and system checks are located in the Driveability, Emissions, and Electrical Diagnosis Manual.

6D6 - DIESEL GLOW PLUG ELECTRICAL SYSTEM

Diesel engines with electronic throttle controls have a glow plug electrical system that is controlled by the Powertrain Control Module (PCM). Information, including diagnosis on the PCM controlled system is in the Driveability, Emissions, and Electrical Diagnosis Manual.

NOTES

SECTION 6D1

BATTERY

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

BATTERY

The maintenance-free battery is standard in all vehicles (figure 1). Refer to "Specifications" for specific applications. These vehicles may be equipped with one or more batteries, depending on the powertrain used and optional equipment. The battery is completely sealed except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The battery has three functions in the electrical system: first, it provides a source of energy for cranking the engine; second, it acts as a voltage stabilizer for the electrical system; and third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

The battery specification label, as shown in figure 2, contains information pertinent to the servicing of the battery. This information includes test ratings and both original equipment and recommended replacement part numbers. This information is also included in the specifications at the end of this section.

BATTERY RATINGS

A battery has two ratings: reserve capacity and cold cranking amperage.

RESERVE CAPACITY

Reserve capacity is an estimate of how long the vehicle can be driven with no generator output, the headlamps turned on, and minimum electrical load (most accessories turned off). It is the maximum amount of time (in minutes) it will take for a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27° C (80° F), to reach a terminal voltage of 10.5 volts. Other temperatures or current draws, the state of charge, the condition of the battery, etc., will affect how long the battery will actually last when the vehicle is being driven and there is no generator output.

COLD CRANKING AMPERAGE

Cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. This rating is the minimum amperage the battery must maintain for 30 seconds at -18° C (0° F), while maintaining at least 7.2 volts. The actual performance of a battery will vary with actual temperature, etc.

COMMON CAUSES OF FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good, but fails to perform satisfactorily in service for no apparent reason, the following are some important factors that may point to the cause of trouble:

1. Vehicle accessories left on overnight.
2. Slow average driving speeds for long periods, or short trips, as the battery may not have sufficient time to recharge.
3. The vehicle's electrical load is more than generator output, particularly with the addition of aftermarket equipment.
4. Conditions in the charging system such as poor ground circuits, electrical shorts, slipping drive belt, or a faulty generator.
5. Battery abuse, including failure to keep battery cable terminals clean and tight or operating with a loose battery hold-down.
6. Mechanical conditions in the electrical system, such as shorted or pinched wires or a cracked battery case resulting from a collision.

The outside of the battery should be checked periodically for damage, such as a cracked cover or case.

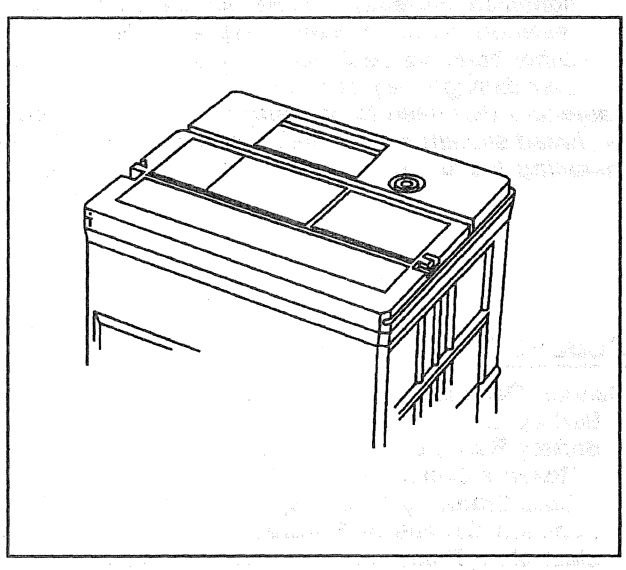


Figure 1—Maintenance-Free Battery (Side Terminals)

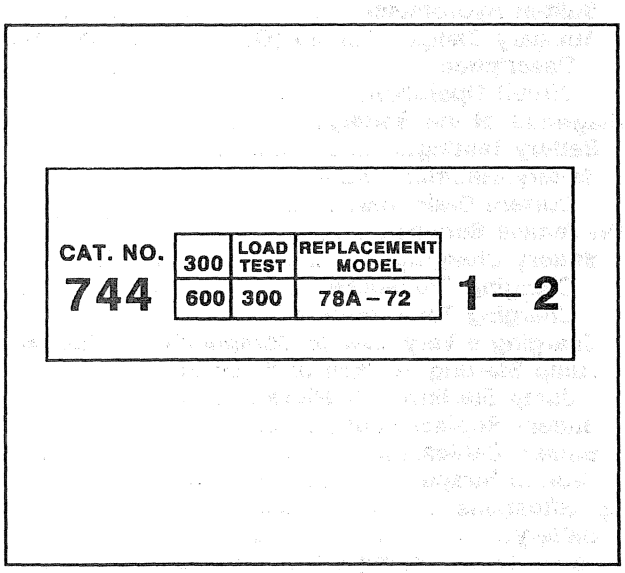


Figure 2—Battery Label (Typical)

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, protect it against freezing by keeping it in a charged condition. As long as the green dot shows in the built-in hydrometer, the battery will not freeze unless the temperature drops below -32° C (-25° F). A fully charged battery will not freeze unless the temperature drops below -54° C (-65° F).

CARRIER AND HOLD-DOWN

The battery carrier and hold-down clamp should be clean and free from corrosion before installing the battery.

The carrier should be in sound condition so it will hold the battery securely and keep it level. Make sure there are no parts in the carrier before installing the battery.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tightened to the specifications given at the end of this section.

BATTERY PROTECTION DURING VEHICLE STORAGE

CAUTION: Follow all safety precautions. Refer to figure 3.

Some electronic devices on the vehicle impose small continuous current drains on the battery; this is commonly called "parasitic load." If the vehicle is not used for an extended time, these parasitic loads can discharge and eventually cause permanent damage to the battery. Discharged batteries can also freeze in cold weather. Refer to "Electrolyte Freezing."

NOTICE: Always turn off the ignition switch when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the powertrain control module (PCM) or other electronic components.

To help keep the battery in a charged state while storing the vehicle:

- If the vehicle is likely to be stored for over 30 days, make sure the green dot is visible, then disconnect the negative battery cable at the battery. This will protect the battery from being discharged by parasitic current drains from the vehicle's electrical system. When it is time to reconnect the battery:
  - A. Use a wire brush to lightly clean any oxidation from the contact face of the battery terminal before reattaching the cable.
  - B. Tighten the cable bolt to 15 N·m (11 lbs. ft.).
  - C. Reset the clock, pushbutton radio tuning, etc., before the vehicle is put back in service.
- If the battery cannot be disconnected, establish a regular schedule of recharging the battery every 20-45 days to maintain a high state of charge. Any time a battery is found with the green dot not visible in the hydrometer, promptly recharge the battery.

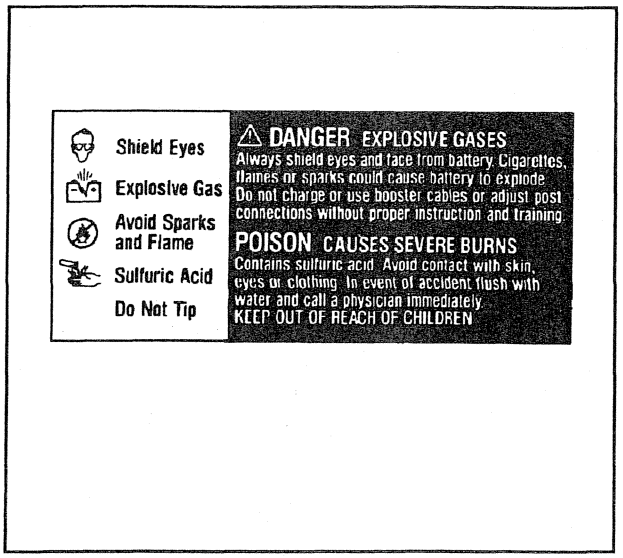


Figure 3—Safety Precautions

- To keep charge time low, use a battery charger that is capable of providing a charging voltage of at least 16 volts. Original equipment maintenance free batteries will not be damaged by charge rates of 50 amps or more, as long as the battery does not spew electrolyte from the vents, or get too hot - over 52° C (125° F). Every 45-60 minutes, inspect the battery being charged and stop or reduce the charge if necessary. To avoid overcharging, be sure to stop charging within one hour after the green dot appears in the hydrometer.
- Allow ample charging time. Refer to "Battery Charging."
- A battery that is allowed to remain in a discharged state for a long period of time will be difficult to recharge, and may even permanently damage the battery if it is allowed to stay discharged.

BUILT-IN HYDROMETER

Molded into the top of the maintenance-free battery is a built-in temperature compensated hydrometer (figure 4). Use this hydrometer with the following diagnostic procedure.

When observing the hydrometer, make sure the battery has a clean top. A light may be required in some poorly-lit areas.

Under normal operation, one of three indications can be observed:

1. GREEN DOT VISIBLE
   - Any green appearance in the hydrometer is interpreted as a "green dot." This meams the battery is ready for testing.
2. DARK DOT, GREEN DOT NOT VISIBLE
   - If the green dot cannot be seen and there is a cranking complaint, proceed to "Diagnosis of the Battery" for further testing. The charging system should be tested for output and the electrical system should be tested for excessive draws.

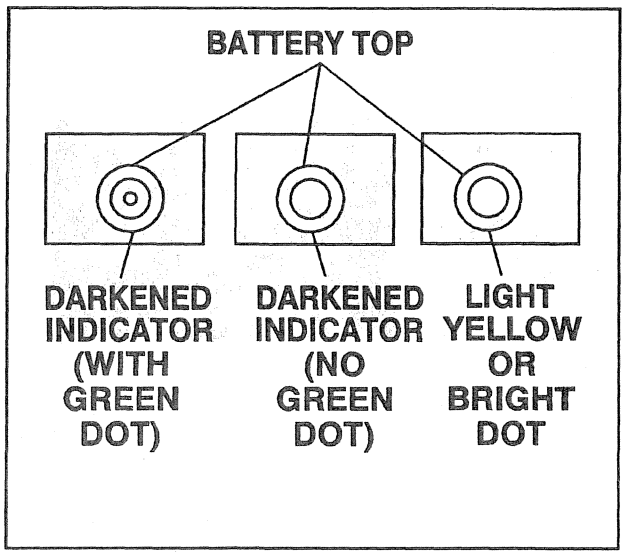


Figure 4—Built-In Hydrometer

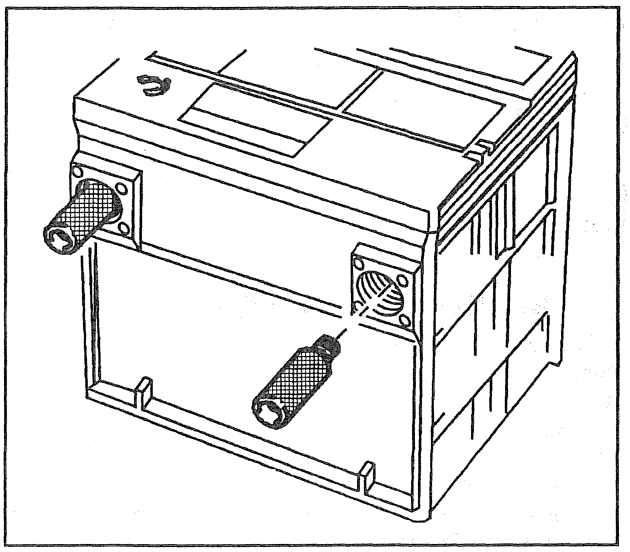


Figure 5—Battery Terminal Adapters

3. CLEAR OR LIGHT YELLOW DOT
   - This means the electrolyte level is below the bottom of the hydrometer and is too low for diagnosis. This may have been caused by excessive or prolonged charging, a broken case, or excessive tipping. When finding a battery in this condition it may indicate high charging voltages caused by a faulty charging system. Therefore, the charging and electrical systems must be tested. The battery should be replaced if a cranking complaint exists and the battery has a yellow or clear hydrometer.

AUXILIARY CAMPER BATTERY (GAS ENGINE VEHICLES)

DESCRIPTION

An auxiliary battery is available for pickup models.

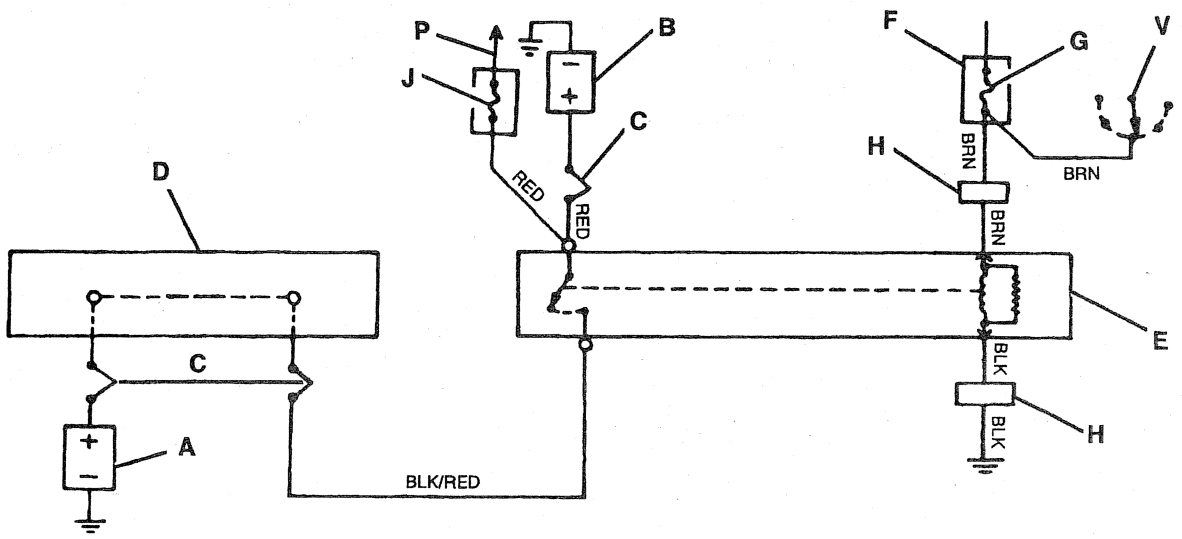
The auxiliary battery mounts to the left front of the engine compartment and is connected through a relay on the left wheelwell to the battery junction block on the right side of the cowl in the engine compartment. The relay is activated and grounded through the convenience center located on the left side of the cab behind the instrument panel.

CIRCUIT OPERATION

Circuit operation is shown in figure 6. Constant voltage is supplied from the main battery (A) through the junction block (D) and the black/red wire to the relay. Constant voltage is also supplied by the auxiliary battery (B) to the relay and through the red feed wire (P) to the camper. When the ignition switch is turned to RUN, current flows through the heater/air conditioning fuse in the fuse block, through the convenience center, and across the coil in the relay. The relay energizes and the contacts close. The auxiliary battery can now be charged by the vehicle's charging system.

If voltage is not reaching the camper unit feed wire (P), check the following:

1. Auxiliary battery (B) state of charge.
2. Battery and convenience center (H) ground wires.
3. Heater fuse (G) by operating the heater or A/C with the engine running.
4. Fusible links (C).
5. Feed wire in-line fuse (J).



A. BATTERY
B. BATTERY, AUXILIARY
C. LINK, FUSIBLE
D. BLOCK, JUNCTION (HOT AT ALL TIMES)
E. RELAY, AUXILIARY
F. BLOCK, FUSE
G. FUSE, A/C HEATER — HOT IN RUN
H. CENTER, CONVENIENCE
J. FUSE, IN-LINE
P. WIRE, CAMPER FEED
V. SWITCH, IGNITION — RUN POSITION

F6923

Figure 6—Auxiliary Battery Schematic

DIAGNOSIS OF THE BATTERY

BATTERY TESTING

Tools Required:
GM P/N 12303040 (or equivalent) Battery Terminal Adapters
J 39200 Digital Multimeter

The following procedure should be used for testing batteries (figure 3):

1. VISUAL INSPECTION
   - Check for obvious damage, such as a cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine the cause of the damage and correct as needed. If not, proceed to step 2.
2. HYDROMETER CHECK (figure 4)
   A. GREEN DOT VISIBLE - Go to step 3
   B. DARK; GREEN DOT NOT VISIBLE
      - Charge the battery as outlined under "Battery Charging," then proceed to step 3.
   C. CLEAR OR YELLOW
      - If the hydrometer is clear or light yellow, the battery is low on electrolyte and should be replaced.
3. LOAD TEST
   - Load testing requires the use of battery side terminal adapters (figure 5), (GM P/N 12303040 or equivalent) to ensure good connections. Do not load test a frozen battery. Replace it.

   A. Use J 39200 digital multimeter to measure voltage across the terminals. With all loads off, and the green dot showing in the hydrometer, voltage should be 12 volts or higher. Unless the battery has just been discharged (such as by load test or cranking the engine), replace the battery if the voltage is below 12 volts.
   B. With J 39200 still attached, connect a battery load tester across the battery terminals.

C. If the battery has been charging, apply a 300 ampere load for 15 seconds to remove the surface charge from the battery. Remove load. (Do not complete this step if the battery has not been recently charged.)
D. Wait 15 seconds to let the battery recover. Apply the specified load located on the battery label or listed in "Specifications." Read the voltage after 15 seconds, then remove the load.
E. If the voltage does not drop below the minimum value listed in figure 7, the battery is good and should be returned to service. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the proceeding few hours.)
F. If voltage drops below the minimum value listed, replace the battery.

BATTERY ELECTRICAL DRAIN

If the vehicle exhibits a low or dead battery after an overnight period, or discharges over a period of 2 or 3 days, the electrical system should be tested for an excessive electrical drain. This is referred to as "parasitic current drain."

If a battery needs recharging and no cause is evident, test the vehicle for excessive parasitic current drain.

One or more on-board solid state control modules, such as the PCM, may, at some time, exhibit a failure mode that causes a high parasitic drain on the vehicle's battery. When the battery is disconnected to install an ammeter, etc., the excessive current drain may not occur once circuit continuity is restored. Even though cycling the ignition key to the RUN and then to the OFF position may at times cause such a drain to recur, there may be drains that will not recur unless the vehicle systems are reactivated in a road test. Since the ignition switch must not be rotated to the ACCESSORY, RUN, or START position with an ammeter installed between the battery terminal and the battery cable, a current drain test tool must be used as described in the following procedures.

Before starting this procedure, make sure the ignition switch is in the "LOCK" position, all electrical accessories are turned off, and the doors are closed.

CURRENT DRAIN TEST

Tools Required:
Terminal Adapters (GM P/N 12303040)
J 38758 Parasitic Draw Test Switch
J 39200 Digital Multimeter

NOTICE: The parasitic draw test switch should never be turned to the "OFF" position with the engine running or damage could occur to the vehicle electrical system.

1. Remove the negative battery cable at the main battery.
   - The main battery will be wired from the positive battery terminal to the starter motor.
2. Install the male end of J 38758 to the negative battery terminal (figure 8).
3. Turn the test switch to the "OFF" position.
4. Install the negative battery cable to the female end of the test switch.
5. Turn the test switch to the "ON" position.
6. Road test the vehicle while activating all accessories, such as the radio and air conditioning.
7. Turn the ignition switch to the "OFF" position and remove the key.

Important

- From this point on, electrical continuity must be maintained in the ground circuit to the battery, either through the J 38758 (in the "ON" position) or through the ammeter.

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW −18° C.)	8.0

Figure 7—Battery Temperature vs. Voltage Drop

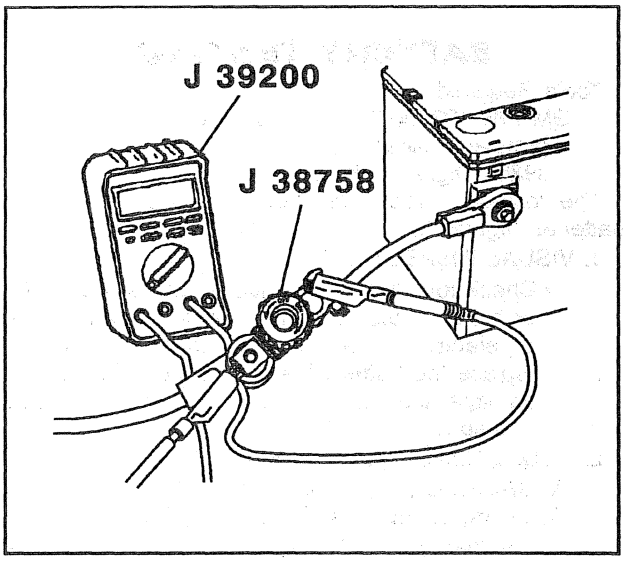


Figure 8—Parasitic Draw Test Switch Installed

8. Some components, such as PCM's, have timers that draw several amps of current while they cycle down. This can give a false parasitic drain reading. Wait 15 minutes for these components to power down before continuing this test.

Important

- Before performing step 9, if a digital multimeter is being used other than J 39200, make sure the vehicle does not have a high current drain that might damage the multimeter when it is installed. This can be done using the following procedure.
  - Connect a jumper wire with an in-line 10-amp fuse to the terminals on the test switch. Then turn the test switch to the "OFF" position. Wait about 10 seconds. If the fuse does not blow, current draw is less than 10 amps, and the digital multimeter can be used safely. Before removing the fused jumper wire and installing the multimeter, turn the test switch to the "ON" position.

9. Set the multimeter to the 10-amp scale and connect it to the terminals on the test switch.
10. Turn the test switch to the "OFF" position to allow current to flow through the meter.
11. Wait at least 60 seconds. Check the current reading. If the current reading is at or below two amps, turn the test switch to the "ON" position (to maintain continuity in the electrical system) and switch down to the two amp scale for a more accurate reading when the test switch is reopened.
12. Take the reading in milliamps.
13. Find the reserve capacity of the battery in "Specifications" at the end of this section. Divide this number by 4. Compare this to the digital multimeter reading. The current drain reading should not exceed this number. (Example: If a battery has a reserve capacity of 100 minutes, the current drain should not exceed 25 milliamps). If the vehicle has a diesel engine with 2 batteries, add the reserve capacities together and divide this total by four. If a vehicle is equipped with an auxiliary battery, use only the reserve capacity of the main battery.

NOTICE: Always turn the test switch knob to the "ON" position before removing each fuse to maintain continuity in the electrical system and to avoid damaging the meter due to accidental overloading, such as opening a door to change a fuse.

14. If current draw is too high, remove system fuses one at a time until the draw returns to a value less than or equal to the specifications. Start with fuses that are hot at all times. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual. To remove the fuse, the door must be opened. This may cause a high enough current draw to damage the multimeter. To protect the meter without disrupting electrical continuity, turn the test tool to the "ON" position before opening the door. Then remove the courtesy lamp fuse. Note the meter reading. If the parasitic load is still excessive, start removing the other fuses, one at a time. Leave the courtesy lamp fuse out during diagnosis so the vehicle door can be left open.
    Perform steps 10 through 12 each time a fuse is removed.
15. Removing the PCM fuse should cause a drop of less than 10 milliamps.
    - If the drop is more than 10 milliamps, check the orange wires for a short to ground. Also check the components connected to the orange wires. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual.
    - If there is no drop in the milliamp reading, the PCM is not drawing current. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual.
16. Repeat the parasitic current drain procedure after any repair has been completed.
17. When the cause of excessive current draw has been located and repaired, remove the meter, test switch, and terminal adapters and connect the negative battery cable to the negative battery terminal.

Tighten

- Negative battery cable bolt to 15 N·m (11 lbs. ft.).

ON-VEHICLE SERVICE

BATTERY CHARGING

Refer to Figures 2, 3, 4, and 5

When it is necessary to charge the battery, the following basic rules must be followed (figure 3):

1. Use a charger with an end of charge voltage of 16.0 volts and equipped with a voltmeter that is accurate within 1 percent.
2. Ambient (surrounding) temperature should be 15° C to 38° C (60° F to 100° F). A battery that is extremely cold may not accept measurable current for several hours after starting the charger.
3. Charging area should be well ventilated.
4. Do not charge the battery if the built-in hydrometer is clear or light yellow. If cranking problems exist, replace the battery.
5. Do not charge a battery if it seems to be frozen. Replace it.
6. Batteries with a green dot showing in the hydrometer do not require charging unless they have just been discharged (such as cranking the vehicle).

CHARGING PROCEDURE

CAUTION: Always turn off the ignition switch when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failure to do so may result in personal injury and damage to the powertrain control module or other electronic components.

When charging the battery in the vehicle, proceed to step 1. If charging side terminal batteries out of the vehicle, install an adapter kit (GM P/N 12303040 or equivalent) (figure 5).

The adapters should be tightened against the lead terminals of the battery to keep resistance between the adapter and the battery terminals to a minimum.

1. Make sure all charger connections are clean and tight.
2. Charge the battery using the charger setting for 12-volt batteries that gives the highest charge rate to the battery until the green dot appears. (Do not use charger settings for jump-starting vehicles to charge the battery. Refer to the charger manufacturer's instructions). The battery should be checked periodically while charging. Tap the hydrometer lightly on the top to dislodge any air bubbles that may prevent a correct indication.
3. If the battery feels hot 52° C (125° F), or if violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce the charging rate.
4. After charging, the battery should be tested as outlined in "Diagnosis of the Battery."

CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

A. Size of the Battery - A completely discharged heavy-duty battery requires more than twice the recharging time as a completely discharged light-duty battery.

B. Temperature - The colder the battery, the more time it takes to recharge. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. In time the battery will accept a higher rate as the battery warms.

C. Charger Capacity - The higher the charger amperage, the less time it will take to charge the battery.

D. State-Of-Charge - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, charging current will also increase.

Any battery discharged by parasitic current drain, and then allowed to stand in this condition for a period of time, may not accept a charge readily. However, if recharged long enough, many batteries will return to a usable condition.

If the battery remains in an extremely discharged condition for a prolonged period, it can become permanently damaged. This damage can be accelerated by changes in temperatures. Batteries that are extremely discharged can freeze at temperatures as high as -7° C (20° F) and be permanently damaged.

To prevent battery damage and recharge problems, vehicles that are not going to be in service within a 30 day period should have the negative battery cable disconnected to remove the constant drain on the battery. If this is not possible, recharge the battery periodically every 30-45 days until the green dot is visible.

CHARGING A VERY LOW OR COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a very low or completely discharged battery. Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with J 39200 digital multimeter. If voltage is below 11 volts, charge current will be very low and it could take some time before it accepts current in excess of a few milliamperes.
2. Set the battery charger on the high setting.
3. Some chargers feature polarity protection circuitry that prevents charging unless the charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instructions telling how to bypass or override the circuitry so the charger will turn on and charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:
   - 16.0 volts or more up to 4 hours
   - 14.0 to 15.9 volts up to 8 hours
   - 13.9 volts or less up to 16 hours

   Important

   - If the charge current **is not** measurable at the end of the above charging times, replace the battery.
   - If the charge current **is** measurable during the charging time, the battery is considered to be good. Complete the charging in the normal manner.
5. It is critical to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a useable state. As a rule of thumb, use the reserve capacity rating of the battery to determine how long it will take to completely recharge the battery. For capacity ratings, refer to "Specifications." Divide the reserve capacity rating by the amount of ampere charge to determine how many hours of charging are needed. (Rating divided by amps = hours.)
   - For example: a battery with a reserve capacity rating of 75, charged at a rate of 10 amperes, will take 7.5 hours to fully recharge (75 divided by 10 = 7.5). The same battery, charged at a rate of 25 amperes, will take 3 hours to fully recharge (75 divided by 25 = 3).
6. Any battery recharged by this procedure should be load tested to determine serviceability. Refer to "Diagnosis of the Battery."

JUMP STARTING IN CASE OF EMERGENCY

Do not try to jump start a vehicle if you are unsure of the other vehicle's voltage or ground, or if the other vehicle's voltage and ground are different.

Diesel engine vehicles have more than one battery. Should the vehicle have an optional diesel engine or an auxiliary battery option, use only the battery on the passenger side of the vehicle.

This procedure can be used to start a single-battery vehicle from any of the diesel engine vehicle's batteries. However, at low temperatures, it may not be possible to start a diesel engine vehicle from a single battery in another vehicle.

The booster battery and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks.

CAUTION: Batteries produce explosive gasses, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- **Always shield your eyes and avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow battery acid to contact the eyes or skin. Flush any contacted areas with water immediately and thoroughly, and get medical help.**
- **Follow each step in the jump starting instructions.**

NOTICE: Do not push or tow the vehicle to start it. Under some conditions this may damage the catalytic converter or other parts of the vehicle. Also, since this vehicle has a 12-volt negative ground electrical system, make sure the vehicle or equipment used to jump start the engine has a 12-volt negative ground electrical system. Use of any other type system may damage the vehicle's electrical components.

JUMP STARTING PROCEDURE

1. Position the vehicle with the good (charged) battery so that the jumper cables will reach, but NEVER let the vehicles touch. Also, make sure the jumper cables do not have loose or missing insulation.
2. Set the parking brake and place the transmission in neutral. Block the wheels. Turn off the ignition switch, lights, and all other electrical loads that aren't needed except for the hazard flasher or any lamps needed for the work area.
3. Check the built-in hydrometer. If it is clear or light yellow, do not attempt to jump start the battery. Replace it.
4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery (figure 9). A is the charged battery, B is the dead battery.
5. Attach one end of the remaining negative jumper cable to the negative terminal of the booster battery.
6. Make the final connection of the negative cable to a solid ground (such as an A/C compressor bracket), at least 450 mm (18 inches) from the battery of the vehicle being started (figure 9).
7. Start the engine of the vehicle that is providing the jump start and turn off all electrical accessories. Then start the engine in the vehicle with the discharged battery.
8. Reverse steps 4, 5, and 6 exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first (figure 10).

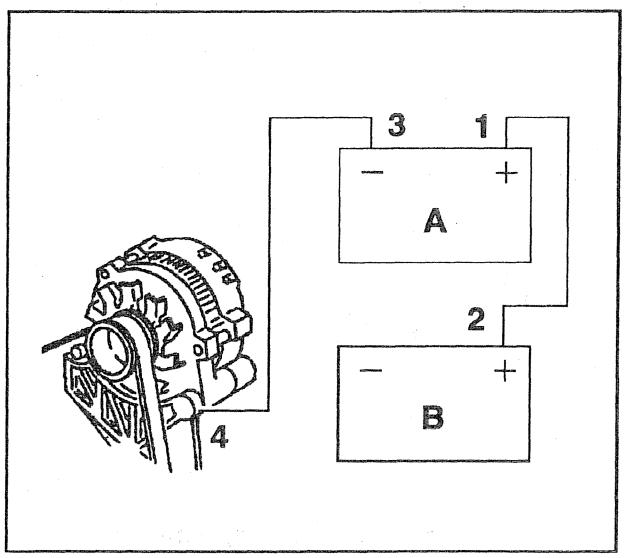


Figure 9—Installing Jumper Cables

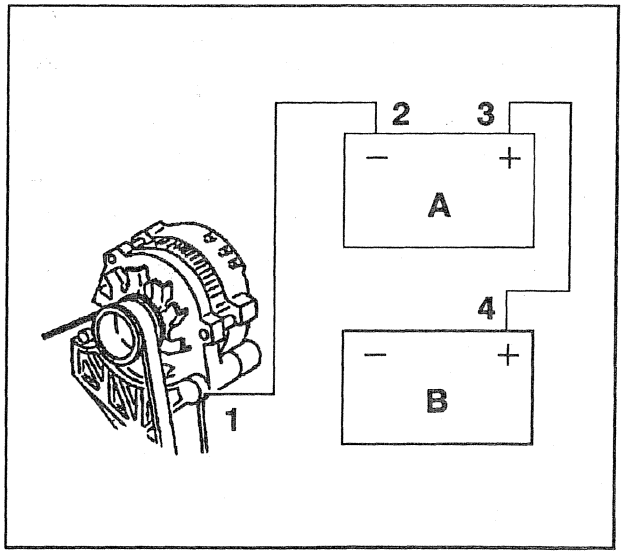


Figure 10—Removing Jumper Cables

BATTERY REPLACEMENT

Remove or Disconnect (Figures 11 and 12)

1. Negative cable from the negative battery terminal.
2. Positive cable from the positive battery terminal.
3. Battery hold-down retainer.
4. Battery.

Inspect

1. Battery for damage.
2. Cables and connectors for corrosion or wear.
3. Carrier for damage or foreign objects.

   • If damage is noted, find and correct the cause.

Install or Connect (Figures 11 and 12)

1. Battery into cleaned carrier.
2. Hold-down retainer.

Tighten

   • Retainer bolt to 15 N·m (11 lbs. ft.).

3. Positive cable and positive battery terminal to the battery.
4. Negative cable and negative battery terminal to the battery.

Tighten

   • Side terminals to 15 N·m (11 lbs. ft.).

BATTERY CABLES

Excessive resistance caused by poor terminal connections and partial short circuits through worn cable insulation will result in an abnormal voltage drop in the starter cable. Low voltage at the starter will prevent normal starter operation and cause hard starting.

Whenever battery cables are replaced, always use a replacement cable that is the same type, diameter, and length. Some positive cables have additional feed wires attached to them and some negative cables have additional ground leads attached.

Always be certain when replacing a battery cable to route it the same as the original cable.

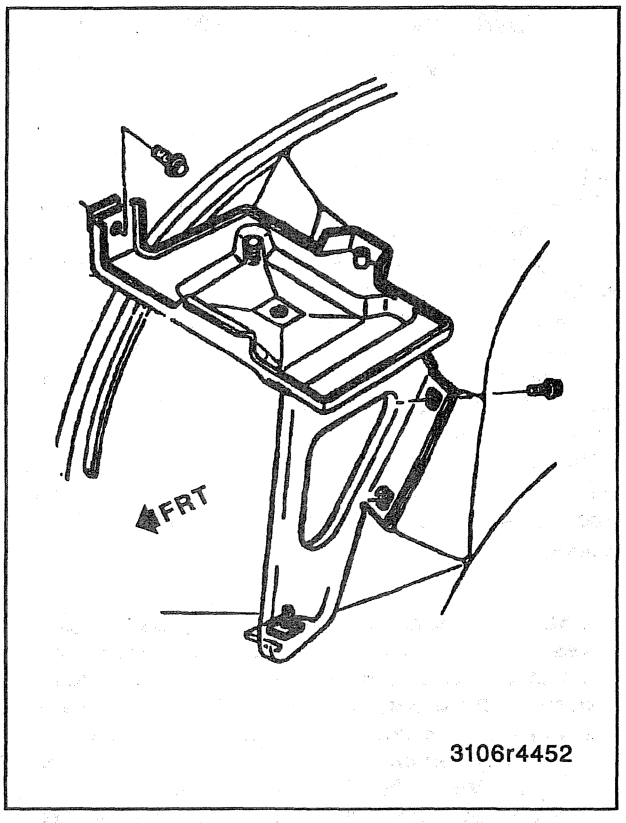


Figure 11—Battery Tray

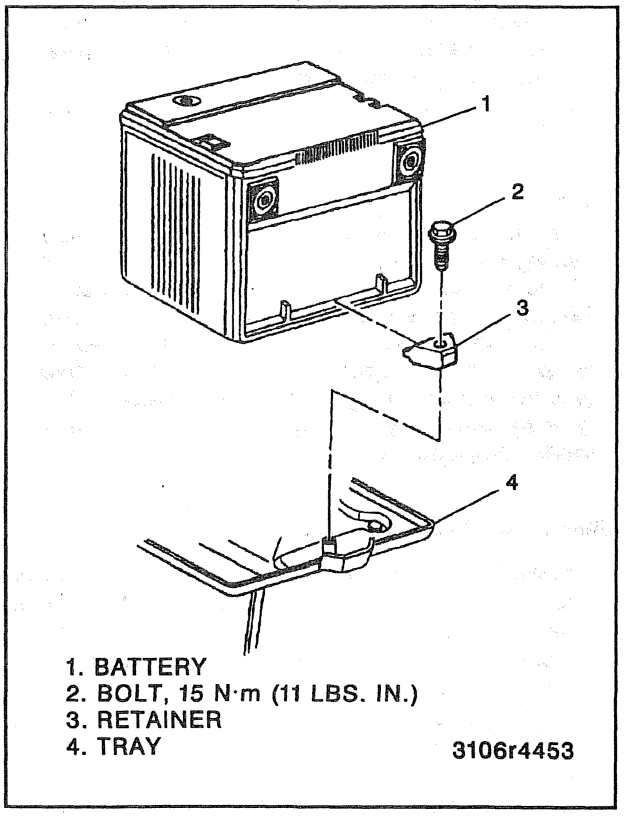


Figure 12—Battery Retainer

NOTICE: When installing the positive battery cable to the starter solenoid, the inner nut on the solenoid battery terminal must be tightened before the battery cable and other leads are installed. Failure to do so may result in solenoid terminal and/or solenoid damage.

CAUTION: To prevent possible personal injury from a moving vehicle or operating engine, do the following before performing the tests:

1. **Engage the parking brakes and block the wheels.**
2. **Place the manual transmission in the neutral position or the automatic transmission in park.**
3. **On gas engines, disconnect the battery feed at the distributor. On diesel engines, disconnect the battery feed at the engine shutoff (ESO) solenoid.**

1. Test the voltage drop between ground (negative battery terminal) and the vehicle frame. Place one probe of J 39200 on the grounded battery post (not on the cable clamp) and the other on the frame. Operate the starter and note the voltage reading.
2. Test the voltage drop between the positive battery terminal and starter terminal stud with the starter operating.
3. Test the voltage drop between the starter housing and the frame with the starter operating.
4. If the voltage drop in any of the above is more than 0.5 volt, there is excessive resistance in the circuit. To eliminate resistance, the cables should be disconnected and connections cleaned. If cables are frayed or the clamps corroded, the cables should be replaced. When selecting new cables, be sure they are the same length and diameter as the ones being replaced. Battery cable routing is shown in figures 13 through 15.

GROUND STRAPS

Additional ground straps are used to connect the body and frame to the engine and transmission. Always connect all ground straps to ensure a good ground path to the battery from all electrical components. For illustrations and ground strap locations, refer to SECTION 6D5.

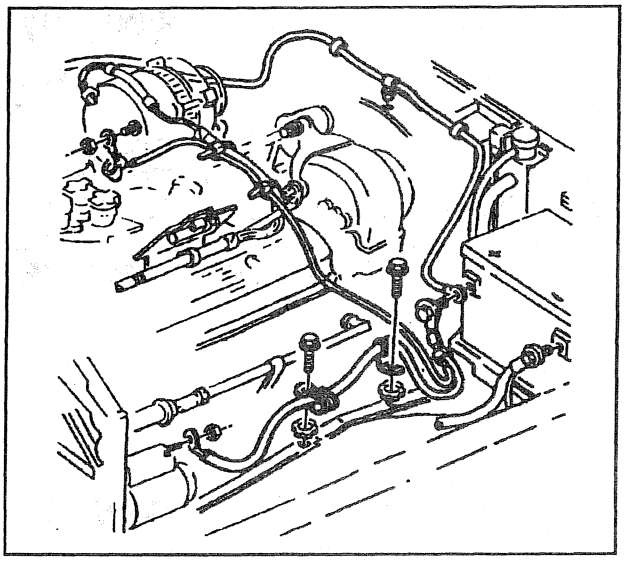


Figure 13—Battery Cable Routing (Gas Engines)

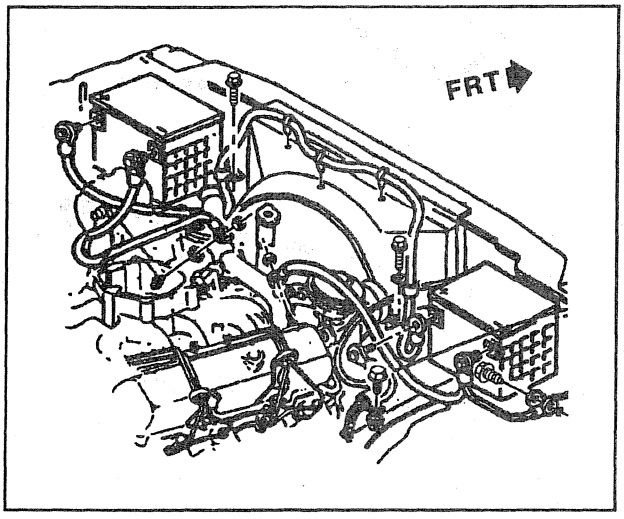


Figure 14—Battery Cable Routing (6.5L)

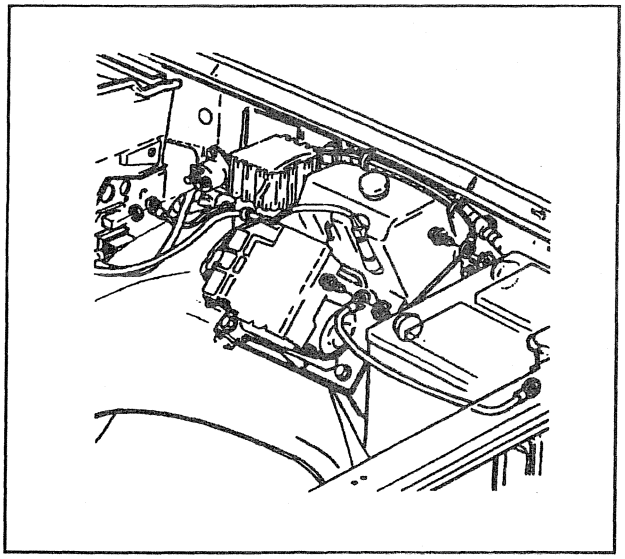


Figure 15—Auxiliary Battery, Relay, and Wiring

SPECIFICATIONS

BATTERY

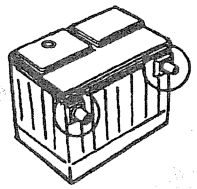
Catalog Number	Application	Catalog Replacement Number	Volts	Cold Cranking Amperes Rating @ -18° (0°F)	Reserve Capacity (Minutes at 25 Amps)	Load Test (Amperes)
1983744	All	78A-72	12	600	130	300

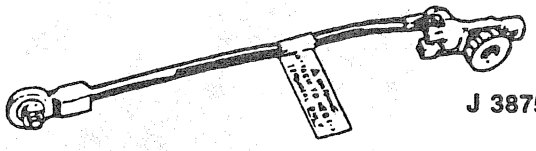
FASTENER TIGHTENING SPECIFICATIONS

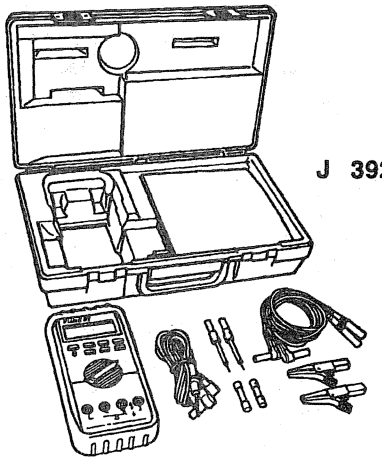
	N·m	Lbs. Ft.
Battery		
Retainer Bolt	15	11
Terminals	15	11

T2080

SPECIAL TOOLS

1.  S/T ADAPTERS

2.  J 38758

3.  J 39200

1. BATTERY TERMINAL ADAPTERS—GM P/N 12303040
2. CURRENT DRAIN TOOL
3. MULTIMETER

V1331

SECTION 6D2

CRANKING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

CRANKING CIRCUIT

The cranking circuit consists of the battery, starter motor, ignition switch (gasoline engines), engine control switch (diesel engines), neutral start switch (manual transmission), and related electrical wiring (figures 1 and 2).

For detailed schematics of the cranking system, refer to the Driveability, Emissions, and Electrical Diagnosis Manual.

STARTER MOTOR

Three starter motors are used on these engines.

The SD-260 is a straight drive starter with the pinion driven directly by the armature shaft. Pole pieces are arranged around the armature that is energized by wound field coils (figure 3). This type is used on gas engines.

The PG-260 achieves gear reduction at a ratio of 5:1 through planetary gears. Its relatively small size and light weight offers improved cranking performance and reduced current requirements for larger gasoline engines (figures 4 and 5).

The 28-MT, used on diesel engines, is a gear reduction starter with an overrunning roller type clutch and an enclosed shift lever (figures 6 and 7).

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions, and splash.

Solenoid windings are energized when the ignition switch is in the start position. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear, the solenoid main contacts to close, and cranking takes place. When the engine starts, the pinion overruning clutch protects the armature from excessive speed until the ignition switch is released, at which time the plunger return spring causes the pinion to disengage. To prevent excessive overruning, release the switch from the crank position as soon as the engine starts.

UNIT REPAIR INFORMATION

For bench repair of the SD-260, or 28-MT starter motors, refer to the Light Duty Truck Unit Repair Manual.

PG-260 model starters are serviced by replacement only.

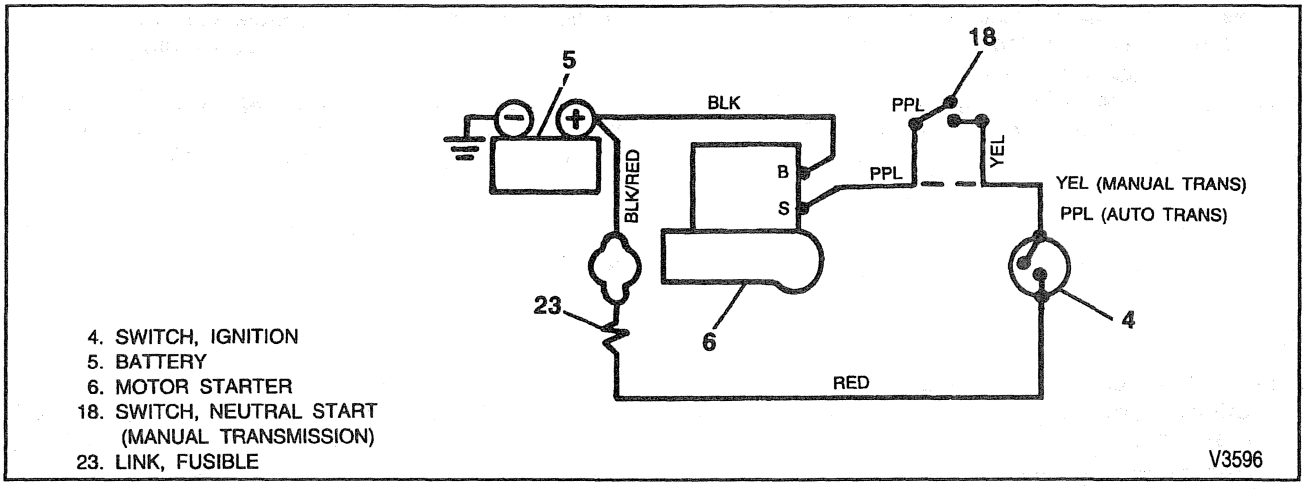


Figure 1—Cranking Circuit (Gas Engines)

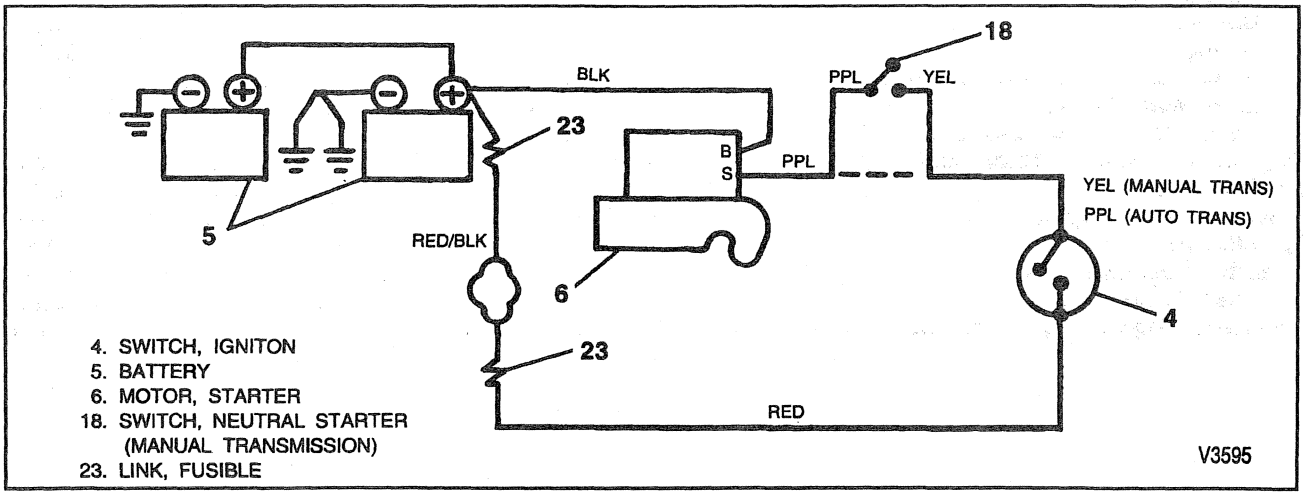


Figure 2—Cranking Circuit (Diesel Engine)

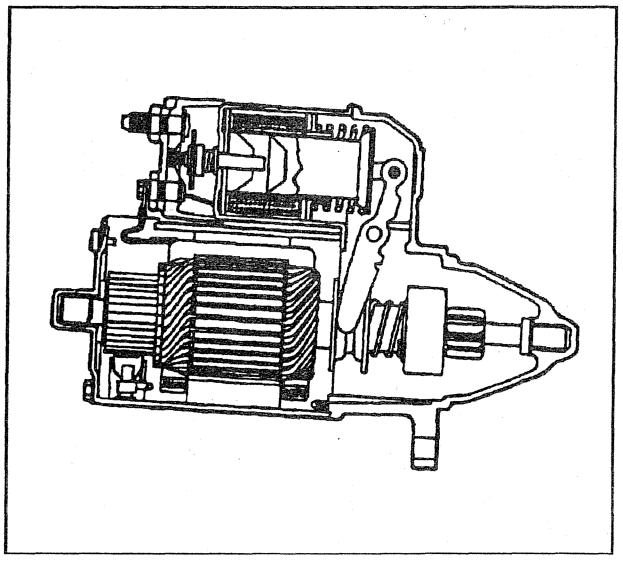


Figure 3—SD Series Starter Motor (Typical)

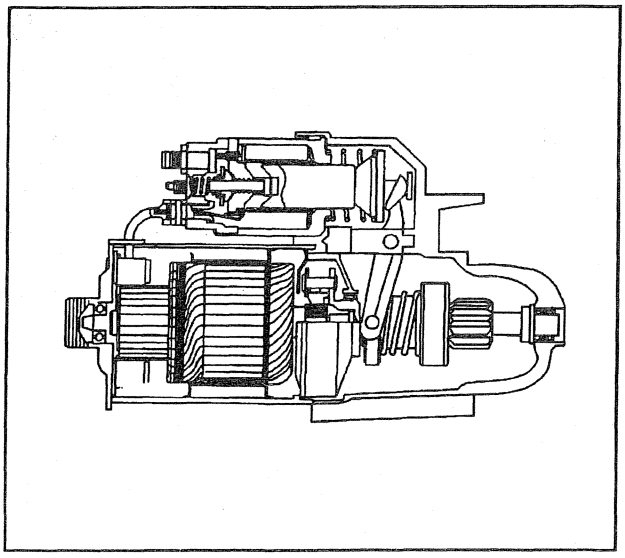


Figure 5—PG Series Components (Typical)

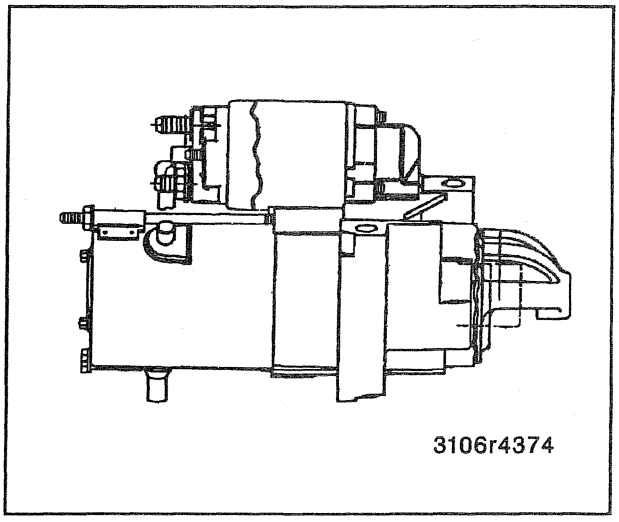


Figure 4—PG-260 Starter Motor

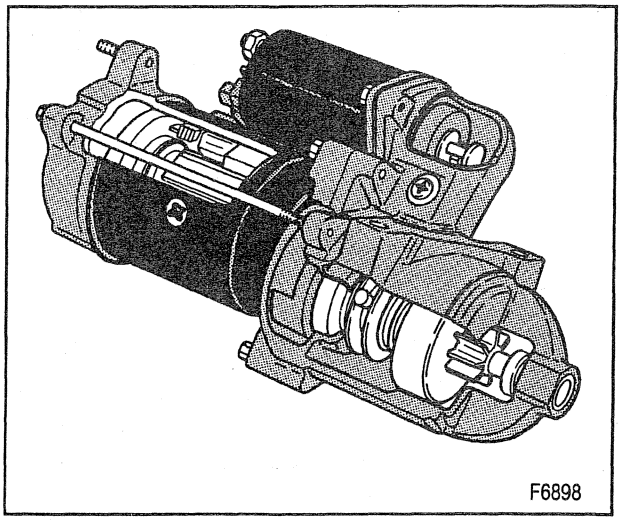
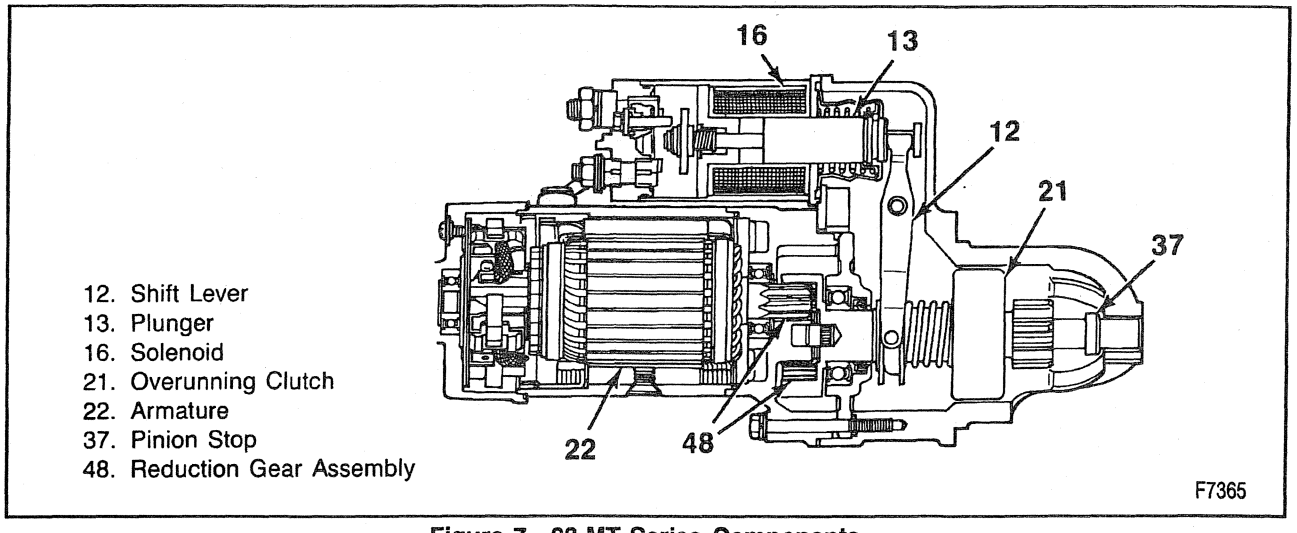


Figure 6—28-MT Starter Motor



12. Shift Lever
13. Plunger
16. Solenoid
21. Overunning Clutch
22. Armature
37. Pinion Stop
48. Reduction Gear Assembly

Figure 7—28-MT Series Components

DIAGNOSIS OF THE CRANKING SYSTEM

Refer to figures 8 and 9 for diagnosis of the cranking system. Before removing any component in the system for repair, make the following checks.

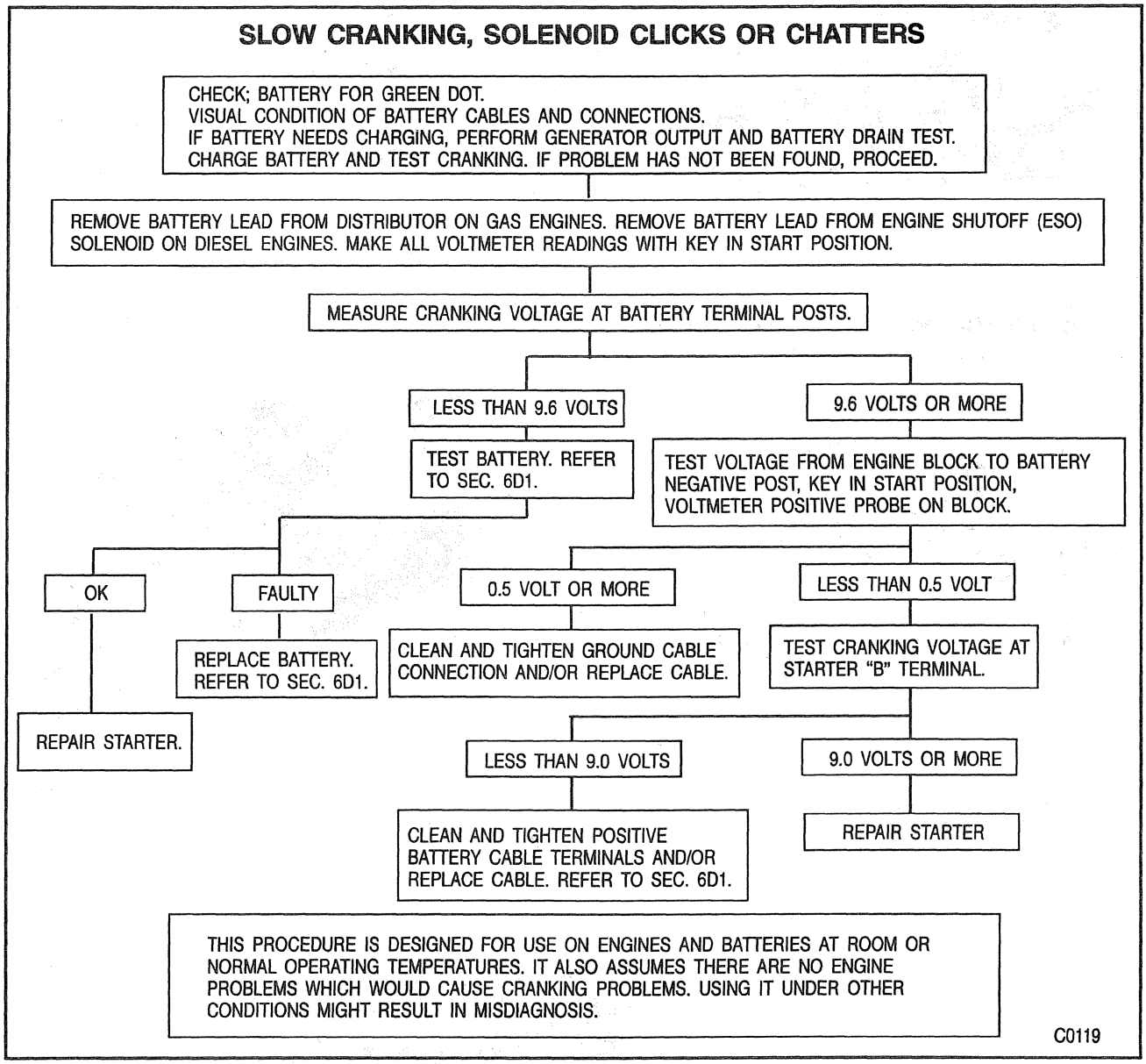


Figure 8—Cranking System Diagnosis (1 of 2)

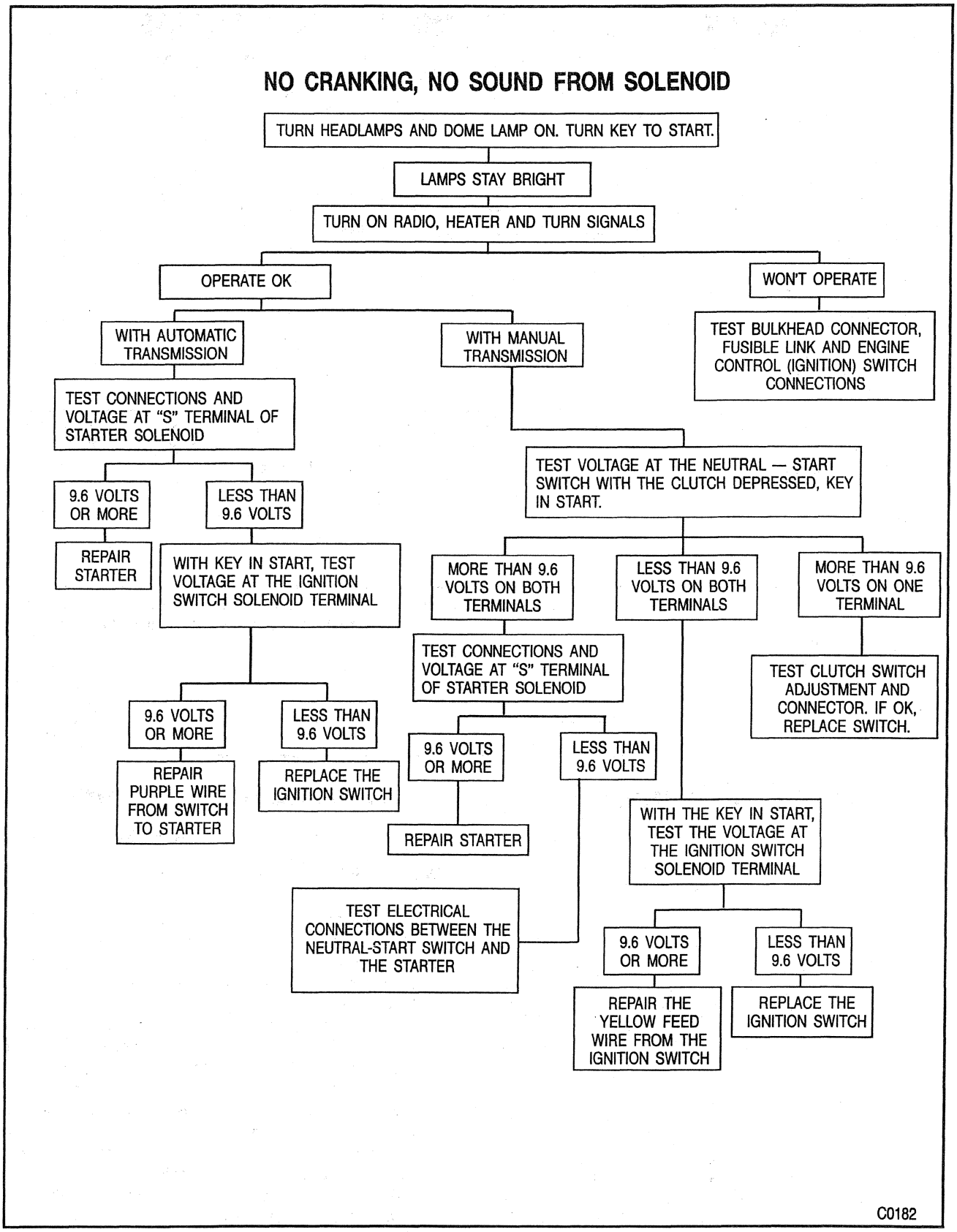


Figure 9—Cranking System Diagnosis (2 of 2)

DIAGNOSIS OF STARTER MOTOR NOISE

PROBLEM	POSSIBLE CAUSE	CORRECTION
High-pitched whine during cranking (before engine fires) but engine cranks and fires normally.	Distance too great between the starter pinion and the flywheel.	Remove shims at the starter mount. Refer to "Starter Motor Noise."
High-pitched whine after the engine fires as key is being released. The engine cranks and fires normally. This complaint is often diagnosed as "starter hang-in" or "solenoid weak."	Distance too small between the starter pinion and the flywheel. Flywheel runout contributes to the intermittent nature of the problem.	Add shims at the starter mount. Refer to "Starter Motor Noise."
A loud "whoop" after the engine fires but while the starter is still held engaged. Sounds like a siren if the engine is revved while the starter is engaged.	Usually due to a worn starter motor clutch.	Remove the starter motor and check the clutch. Refer to the Light Duty Truck Unit Repair Manual.
A "rumble," "growl" or (in severe cases) a "knock" as the starter is coasting down to a stop after starting the engine.	Usually due to a bent or unbalanced starter armature.	Remove the starter motor and check the armature. Refer to the Light Duty Truck Unit Repair Manual.
		D0134

CRANKING CIRCUIT

BATTERY

Determine the condition of the battery. Refer to SECTION 6D1 for battery diagnosis and testing.

WIRING

Check the 10-amp CRANK fuse. Inspect the system for open circuits, loose terminals inside connectors, corrosion, and damage. Verify that no wires are pierced by screws and no harnesses are missing insulation by rubbing on components. Inspect all connections to the starter motor, solenoid, ignition (or engine control) switch, and battery, including all ground connections. Clean and tighten all connections as required.

SOLENOID AND CONTROL SWITCHES

Inspect all switches to determine their condition.

Vehicles equipped with manual transmissions have a neutral start switch attached to the clutch pedal that closes when the pedal is depressed. Vehicles with automatic transmissions have a mechanical interlock in the steering column that does not allow the ignition switch to turn to START unless the transmission is in PARK or NEUTRAL.

STARTER MOTOR NOISE

Refer to "Diagnosis of Starter Motor Noise."

PINION CLEARANCE (Gas Engines)

1. Remove the lower flywheel housing cover.
2. Inspect the flywheel for signs of unusual wear such as chipped or missing gear teeth or the flywheel being bent. If the flywheel needs replacing, refer to SECTION 6.
3. Start the engine and gently touch the outside diameter of the rotating flywheel ring gear with chalk or crayon to show the high point of tooth runout after the engine is turned off. Turn the engine off and rotate the flywheel so the marked teeth are in the area of the starter pinion gear.
4. Disconnect the negative battery cable to prevent accidental cranking of the engine.
5. Measure the clearance between the top of the ring gear tooth and the bottom of the pinion tooth using the width of a wire gage or standard feeler stock (figure 10). Normal clearance is 0.5 to 1.5 mm (0.02 to 0.06 inch).

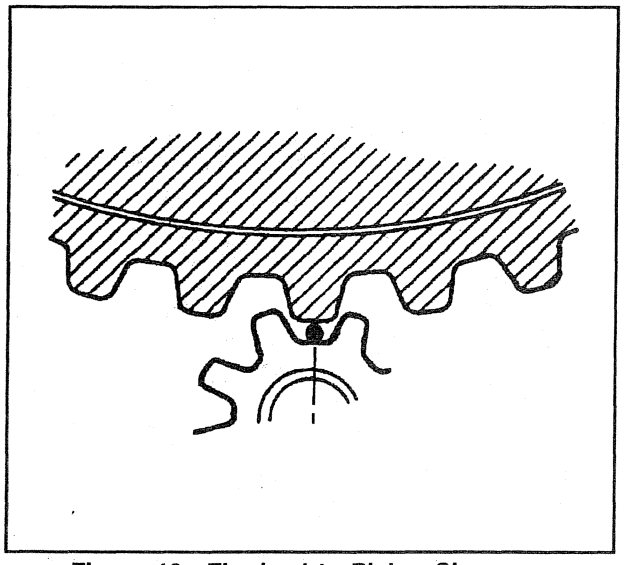


Figure 10—Flywheel to Pinion Clearance

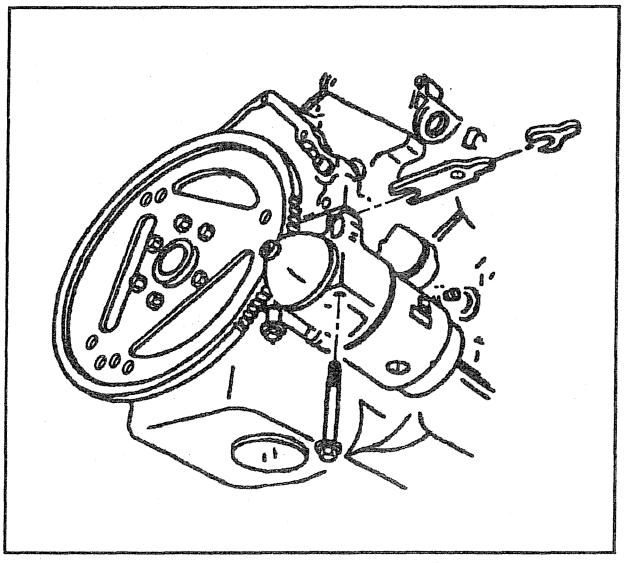


Figure 11—Shimming Gas Engine Starter Motors

6. If clearance is less than 0.5 mm (0.02 inch), and the starter whines after firing, shim the starter away from the flywheel.
   - Add 1.0-mm (0.04-inch) shims, one at a time, to both long bolts between starter mounting pads and the engine until the noise problem is corrected. Do not use more than 2 shims total.
7. If the pinion clearance is more than 1.5 mm (0.06 inch) and the starter whines during cranking, shim the starter toward the flywheel.
   - Add 0.33-mm (0.013-inch) shims between the outboard starter mounting pad and the engine mount until the noise stops. Do not add more than 4 shims total.
8. When shimming is done, tighten the mounting bolts (figure 11).

Tighten

- Mounting bolts to 45 N·m (35 lbs. ft.).

ON-VEHICLE SERVICE

Starter motors do not require lubrication except during overhaul.

If the battery, wiring, and switches are in good condition, and the engine is functioning properly, but cranking problems remain, remove the starter motor. Refer to the Light Duty Truck Unit Repair Manual for repair procedures.

Never operate the starter motor more than 30 seconds at a time without pausing to allow it to cool for at least 2 minutes. Overheating, caused by excessive cranking, will damage the starter motor.

STARTER MOTOR REPLACEMENT

Remove or Disconnect (Figures 12, 13, 14, and 15)

1. Negative battery cable. Refer to CAUTION on page 6D2-1.
2. Starter brackets and/or shields, if equipped.
3. Wires from the starter solenoid.
   - Raise the vehicle and support with safety stands.
4. Two bolts and washers (where present) holding the starter to the engine.
5. Starter from the engine.

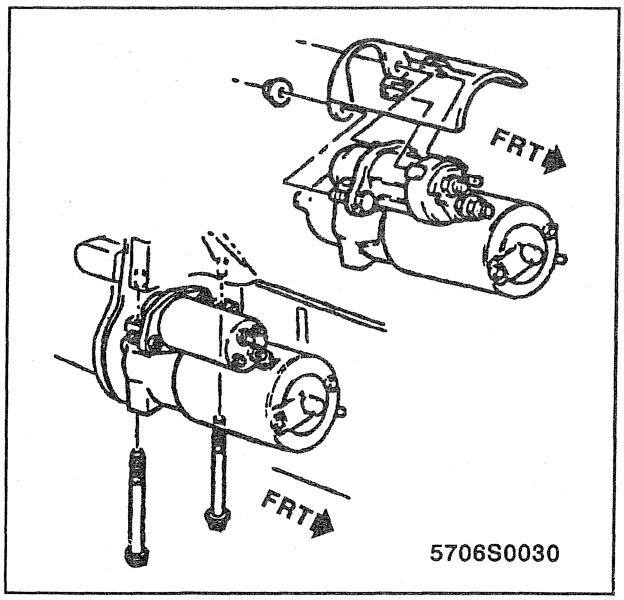


Figure 12—Gas Engine Starter Motors and Heat Shield

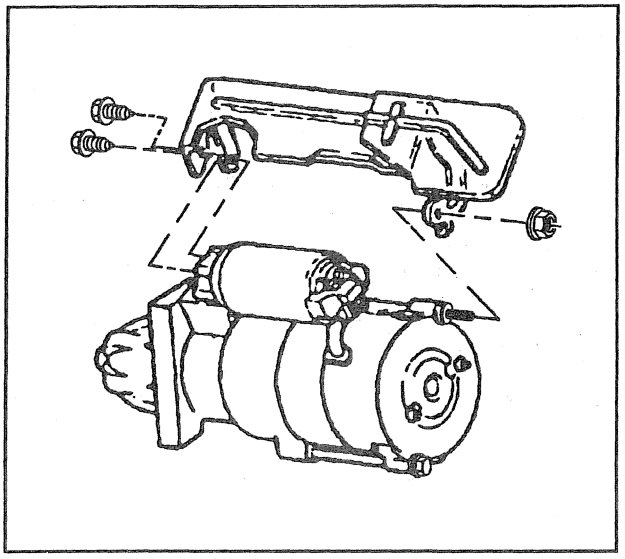


Figure 13—Gas Engine Starter Motors and Heat Shield (5.7 - 7.4L)

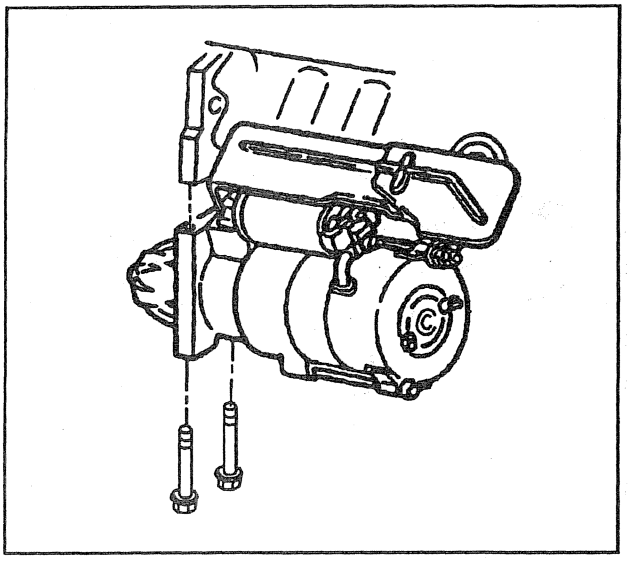


Figure 14—Gas Engine Starter Motor Mounting

Install or Connect (Figures 12, 13, 14, and 15)

1. Two bolts and washers (where used) through the starter to the engine.

   Tighten

   - Through bolts to 45 N·m (35 lbs. ft.).
   - Bracket bolt (diesel) to 33 N·m (24 lbs. ft.).
   - Nut (diesel) to 8.5 N·m (75 lbs. in.).

   • Lower the vehicle.
2. Wires to the solenoid terminals.
3. Brackets and/or shields, if equipped.
4. Negative battery cable.

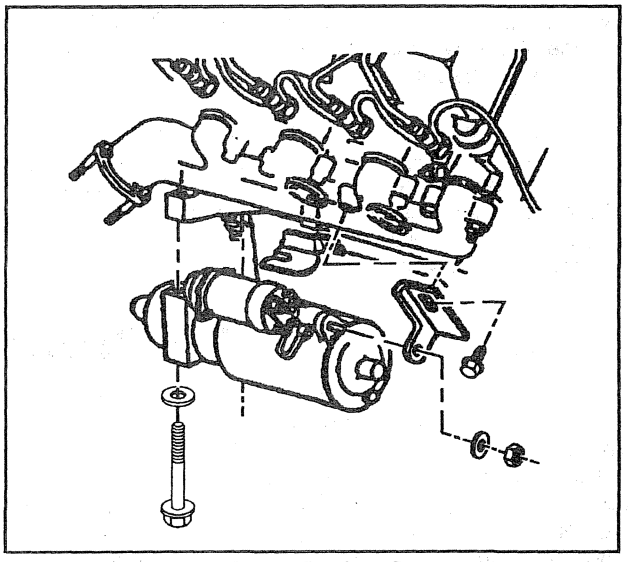


Figure 15—Diesel Engine Starter Motor

SPECIFICATIONS

STARTER SPECIFICATIONS

Engine Application			Load Test @ 10 Volts			
			AMPS		RPM	
	Part No.	Series	Minimum	Maximum	Minimum	Maximum
4.3L, 5.0L	10455013	SD-260	50	62	8500	10700
5.7L, 7.4L	9000786	PG-260	65	95	2825	3275
Diesel	1113296	28MT	130	190	2300	5600

T2135

STARTER SHIMS

Gas Engines

Shim	Part No.
0.33 mm (0.013-inch)	12456249
1.0 mm (0.04-inch)	14036090

T2937

FASTENER TIGHTENING SPECIFICATIONS

	N·m	Lbs. Ft.	Lbs. In.
Starter Motor Mounting Bolts:			
Gas Engines			
4.3L, 5.0L	45	35	—
5.7L, 7.4L	45	35	—
Diesel Engines			
Through Bolts	45	35	—
Nut	8	—	75
Bolt	32	24	—

T2137

NOTES

SECTION 6D3

CHARGING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components.

NOTICE: Always use the correct fastener in the correct location. Use the correct fastener part number to replace a fastener. If the correct fastener part number is not available, a fastener of equal size and strength may be used. Do not use a fastener that is stronger when the correct fastener part number is not available in the following applications:

- ***Some bolts are designed to permanently stretch, and if a stronger fastener is used, the part will not be tightened correctly. These permanently stretching bolts will be called out. The correct part number fasteners must be used to replace this type of fastener because there is no available equivalent.***
- ***Other bolts are designed to break if over tightened to prevent part damage. If a stronger fastener is used part damage may occur.***

Fasteners that need to be replaced when removed will be called out. Fasteners that require thread lockers or thread sealant will be called out. The correct tightening specification and sequence must be used when installing fasteners. Part or system damage may occur if the above instructions are not followed.

CONTENTS

GENERAL DESCRIPTION

The charging system consists of the battery, the generator, the regulator, and the charging system indicator lamp circuitry. The generator supplies electrical power for charging the battery and operating accessories.

CS-130 GENERATOR

The CS-130 (figure 1) generator features a high ampere output per pound of weight. The CS stands for charging system and 130 is the measurement in millimeters of the outside diameter of the stator laminations.

This generator with integral regulator does not have a diode trio. The delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to other CS-series generators. A conventional fan and pulley is used and an internal fan cools the slip rings, end frame, rectifier bridge, and regulator.

The charge indicator, that appears on the instrument panel as a battery symbol, turns on when the ignition switch is closed and turns off when the engine is running. If the charge indicator is on with the engine run-

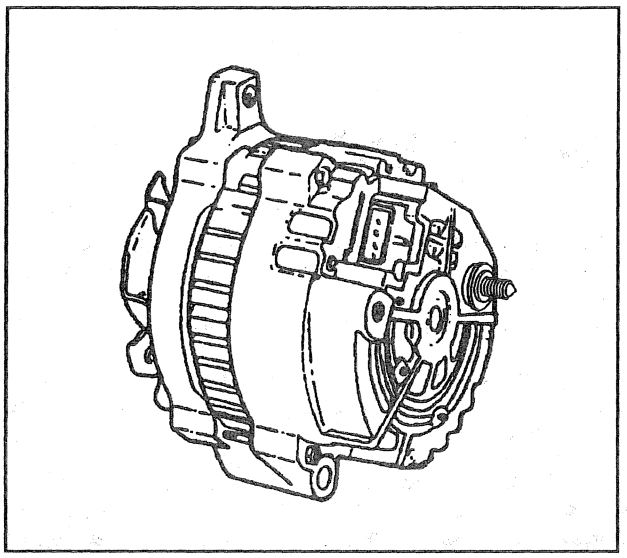


Figure 1—CS-130 Generator

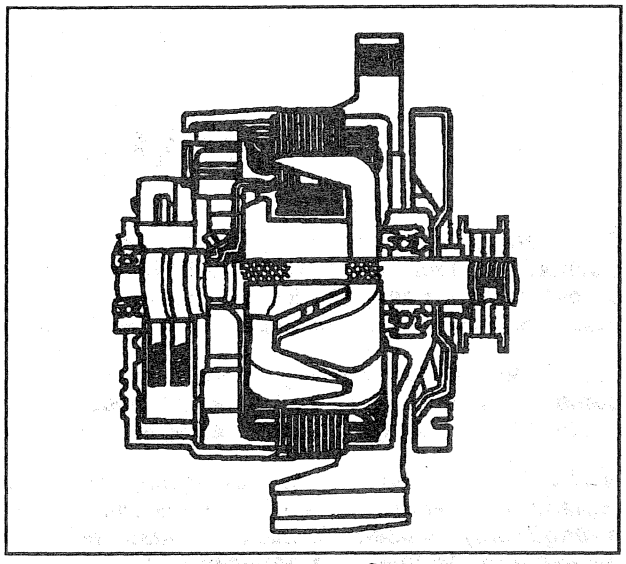


Figure 2—Generator Components

ning, a charging system problem is indicated. This indicator will glow at full brilliance, not half lit, if any charging problem occurs or the system voltage is too high or low.

The regulator voltage setting varies with temperature and limits system voltage by controlling rotor field current. When the field current is "ON," the regulator actually switches the rotor field current on and off at a fixed rate of about 400 cycles per second. By varying the overall on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, on-off time may be 90 percent and 10 percent respectively.

The regulator has four terminals, "P," "L," "I," and "S" (figure 2). The regulator and/or the connector may be stamped "PLI/FS," or "PLFS."

Either the "L" or "I" terminal (or both) turns the regulator on and allow field current to flow when the switch is closed. The "L" terminal must be connected through an indicator lamp or a suitable resistor. The "I" terminal may be connected either directly to battery positive or through a resistor. These two terminals are often used in parallel, connected to two different vehicle circuits. The "P" terminal is connected internally to the stator and may be wired to a tachometer or other device. The "S" terminal may be used to sense voltage at another location on the vehicle for voltage control. If the "S" terminal is not used, the generator uses an internal voltage sense for control. Refer to the Driveability, Emissions, and Electrical Diagnosis Manual.

The generator is not serviceable and no periodic maintenance is required. It should not be disassembled for any reason.

DIAGNOSIS

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, worn stator, or worn rectifier bridge. If the pulley and mounting bolts are snug and the noise continues, replace the generator. Refer to "Generator Replacement."

Do not disassemble the generator. Separating the end frames will damage the slip ring end bearing. This generator is serviceable by complete replacement only.

ELECTRICAL TESTS

Before performing the diagnosis procedures on the vehicle, make sure the system wiring is good and the belt is not slipping. Also, the battery must be fully charged for a valid test of the charging system.

NOTICE: To avoid damage to the vehicle electrical system, observe the following precautions:

- ***Do not polarize the generator.***
- ***Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.***
- ***NEVER disconnect the output terminal while the generator is operating.***
- ***Make sure the generator and battery have the same ground polarity.***
- ***When connecting a charger or booster battery to the vehicle battery, connect negative to negative and positive to positive.***

CIRCUIT DIAGNOSIS

Trouble in the charging system will show up as one or more of the following conditions:

- Abnormal indicator lamp operation.

- A high or low voltage indication with the engine running and all accessories off.
- An undercharged battery as evidenced by slow cranking or a dark hydrometer.
- An overcharged battery as evidenced by excessive spewing of electrolyte from the vents.

A basic wiring diagram for the charging system is shown in figure 3. When the system is operating normally, the indicator lamp will turn on when the ignition switch is turned on and turn off when the engine starts. If the lamp operates abnormally or an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight or by a switch stuck closed that allows a lamp, such as an instrument panel compartment lamp, to stay on.

This generator does not have a test hole.

DIAGNOSTIC TEST FOR CS-130

Tool Required:
J 39200 Digital Multimeter

1. Check the belt for wear and tension. Refer to SECTION 6B1 for belt diagnosis. Check the wiring.
2. With the ignition switch on and the engine off, the lamp should be on. If not, detach the wiring harness at the generator and use a fused jumper wire (J 36169 or equivalent with a 5-amp fuse) to ground the "L" terminal lead in the wiring harness (figure 3).
   - If the lamp lights, replace the generator.
   - If the lamp does not light, locate the open circuit between the grounding lead and the ignition switch. The lamp may be open.
3. With the ignition switch on and the engine running at moderate speed, the lamp should be off. If not, stop the engine, turn the ignition switch on, and disconnect the wiring harness at the generator.
   - If the lamp goes out, replace the generator.
   - If the lamp stays on, check for a grounded "L" terminal wire in the harness.
4. If the battery is undercharged or overcharged or the vehicles voltmeter shows high or low voltage with the engine running:
   A. Disconnect the wiring harness connector from the generator.
   B. With the ignition switch on and the engine not running, connect J 39200, set on DC voltage scale, from ground to the "L" terminal in the wiring harness. Voltage should be B+, other readings indicate an open, high resistence or grounded circuit between the terminal and the battery. Correct as required.
   C. Connect the harness connector to the generator and run the engine at 2500 RPM with accessories off.
   D. Measure the voltage across the battery. If it is above 16 volts, replace the generator.
   E. With the engine off, connect an ammeter at the generator output terminal. The ammeter must have the capability to measure 115 amps of current. Connect J 39200 across the generator and a carbon pile across the battery.
      - Run the engine at 2500 RPM, turn on the accessories, and load the battery with a carbon pile to obtain maximum amperage. Maintain voltage at 13 volts or above.
      - If the output in amperes is within 15 amperes of the rated output, the generator is OK. Refer to "Specifications."
      - If the output is not within 15 amperes of the rated output, replace the generator.

GENERATOR BENCH TEST

This test requires both a fully charged battery and a generator test stand to operate the generator.

1. Make connections as shown in figure 4, except leave the carbon pile turned off. The ground polarity of the generator and battery must be the same. The battery must be fully charged. Use a 30 to 500 ohm resistor between the battery and the "L" terminal.

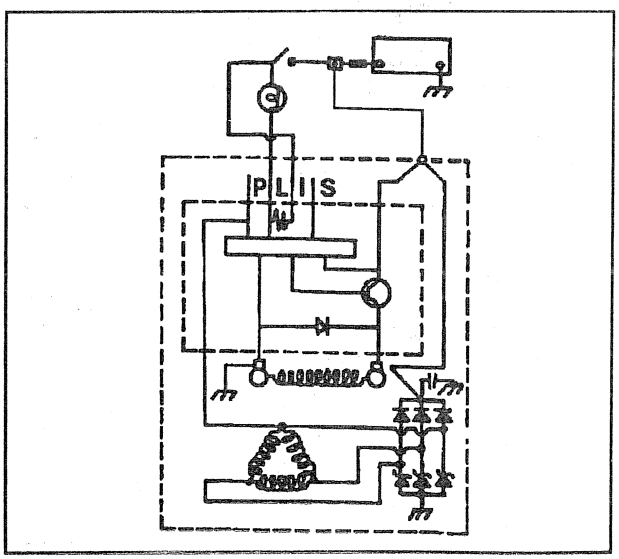


Figure 3—CS-130 Generator Schematic

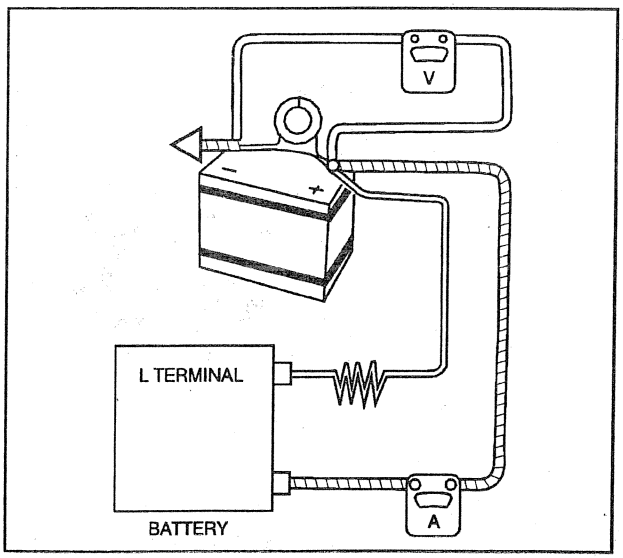


Figure 4—Connections for Generator Output Test

2. Slowly increase the generator speed and observe the voltage.
3. If the voltage is uncontrolled and increases above 16 volts, the rotor field is shorted, the regulator is not working properly, or both. A shorted rotor field coil can cause repeat regulator failure.
4. If the voltage is below 16 volts, increase speed and turn on and adjust the carbon pile to obtain maximum amperage output. Maintain the voltage above 13 volts.
5. If the output is within 15 amperes of the rated output, the generator is good.
6. If the output is not within 15 amperes of the rated output, replace the generator.

ON-VEHICLE SERVICE

GENERATOR REPLACEMENT

The removal and installation instructions serve only as a guide. Additional operations may be required on some vehicles to remove other equipment to gain access to the generator, drive belt, and brackets.

CAUTION: Failure to observe step 1 in this procedure may result in an injury from the hot battery lead at the generator.

Remove or Disconnect (Figures 5, 6, and 7)

1. Negative battery cable. Refer to CAUTION on page 6D3-1.
2. Terminal plug and battery lead from the back of the generator.
3. Drive belt. Refer to SECTION 6A.
4. Two mounting bolts.
5. Generator from the mounting bracket.

Install or Connect (Figures 5, 6, and 7)

Gasoline Engines:

1. Loosely install generator to the bracket with two bolts.

Tighten

A. Right mounting bolt to 25 N·m (18 lbs. ft.).
B. Left mounting bolt to 50 N·m (37 lbs. ft.).
C. Bolt through the bracket and back of the generator to 25 N·m (18 lbs. ft.).

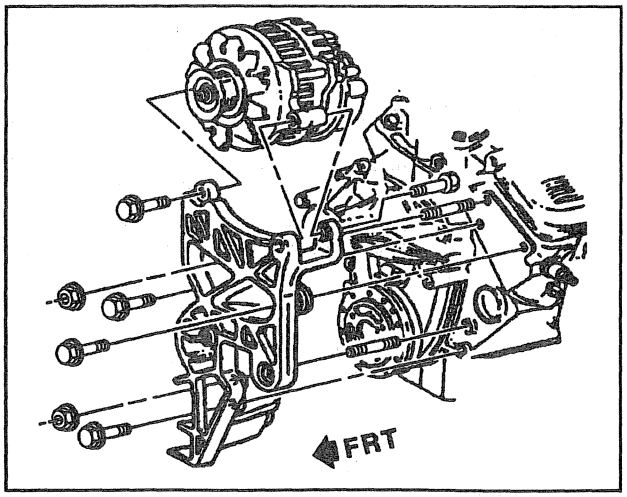


Figure 5—Generator Mounting (4.3L, 5.0L, and 5.7L Engines)

Diesel Engines:

2. Generator to the mounting bracket with bolts.

Tighten

A. Top mounting bolt to 25 N·m (18 lbs. ft.).
B. Bottom mounting nut to 23 N·m (17 lbs. ft.).
C. Bolt at the back of the generator to 25 N·m (18 lbs. ft.).

3. Drive belt. Refer to SECTION 6A.
4. Terminal plug and battery lead to the back of the generator.

Tighten

- Battery terminal nut to 8 N·m (71 lbs. in.).

5. Negative battery cable.

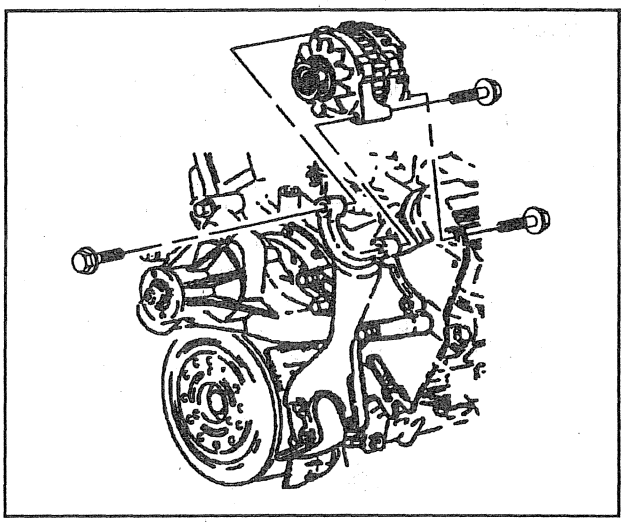


Figure 6—Generator Mounting (7.4L Engine)

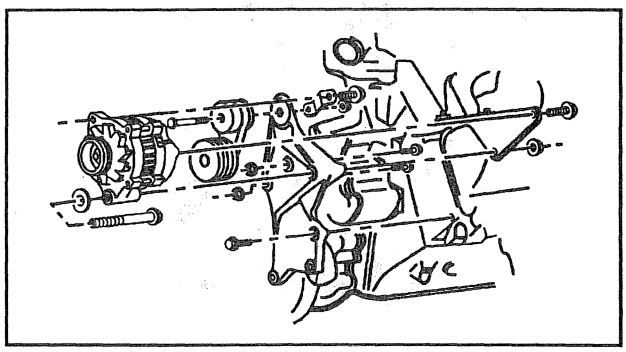


Figure 7—Generator Mounting (Diesel Engines)

SPECIFICATIONS

GENERATOR SPECIFICATIONS

Part No.	Series (Type 100)	Rotation Viewing Drive End	Cold Output AMPS
10480094	CS130	CW	100
10480084	CS130	CW	105
10480086	CS130	CW	100
10480099	CS130	CW	105

T3094

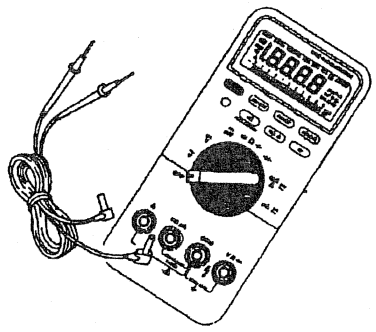
FASTENER TIGHTENING SPECIFICATIONS

Engine	Generator	Part Number	Top Bracket Bolt		Bottom Bracket Bolt	
			N·m	Lbs. Ft.	N·m	Lbs. Ft.
4.3L	K60	10480094	25	18	50	37
With Dual A/C	K68	10480084	25	18	50	37
5.0L	K60	10480094	25	18	50	37
With Dual A/C	K68	10480084	25	18	50	37
5.7L	K60	10480094	25	18	50	37
With Dual A/C	K68	10480084	25	18	50	37
7.4L	K60	10480094	50	37	25	18
With Dual A/C	K68	10480084	50	37	25	18
6.5L	K60	10480086	25	18	23*	17*
With Dual A/C	K68	10480099	25	18	23*	17*

* Nut Torque

T3095

SPECIAL TOOLS

1. 

J 39200

1. J 39200 DIGITAL MULTMETER

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NOTES