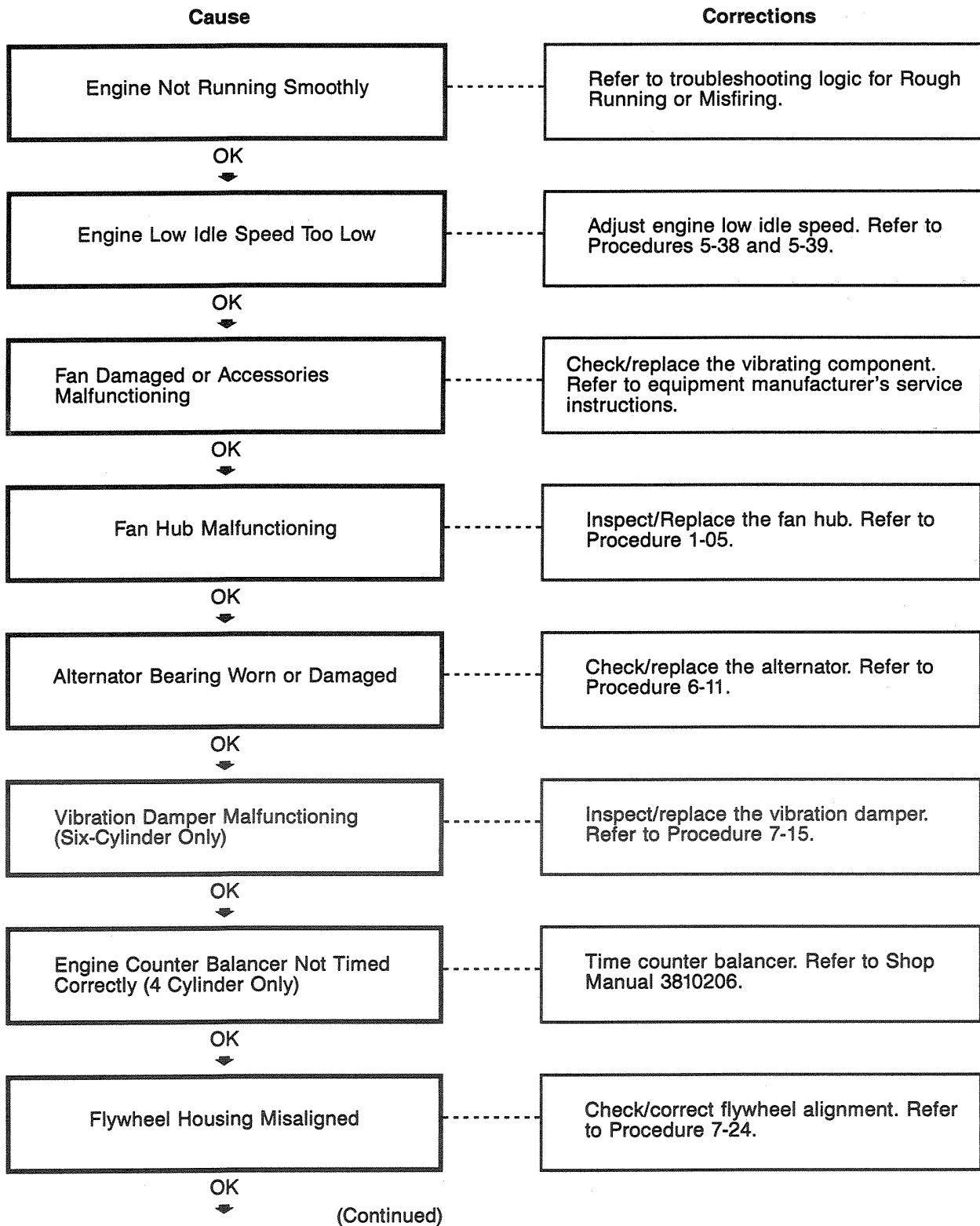
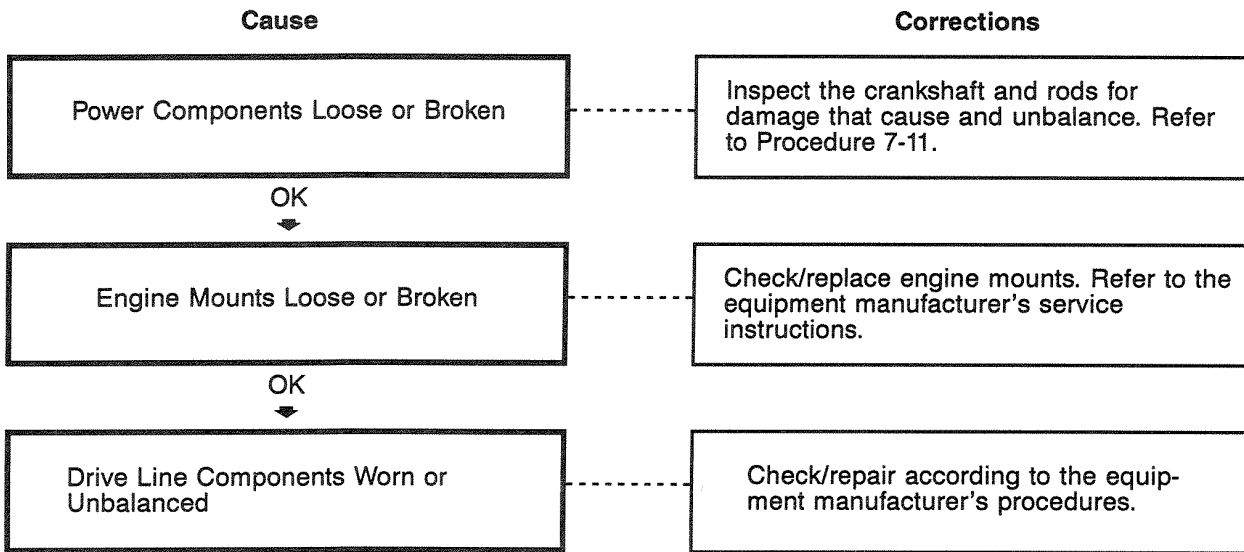


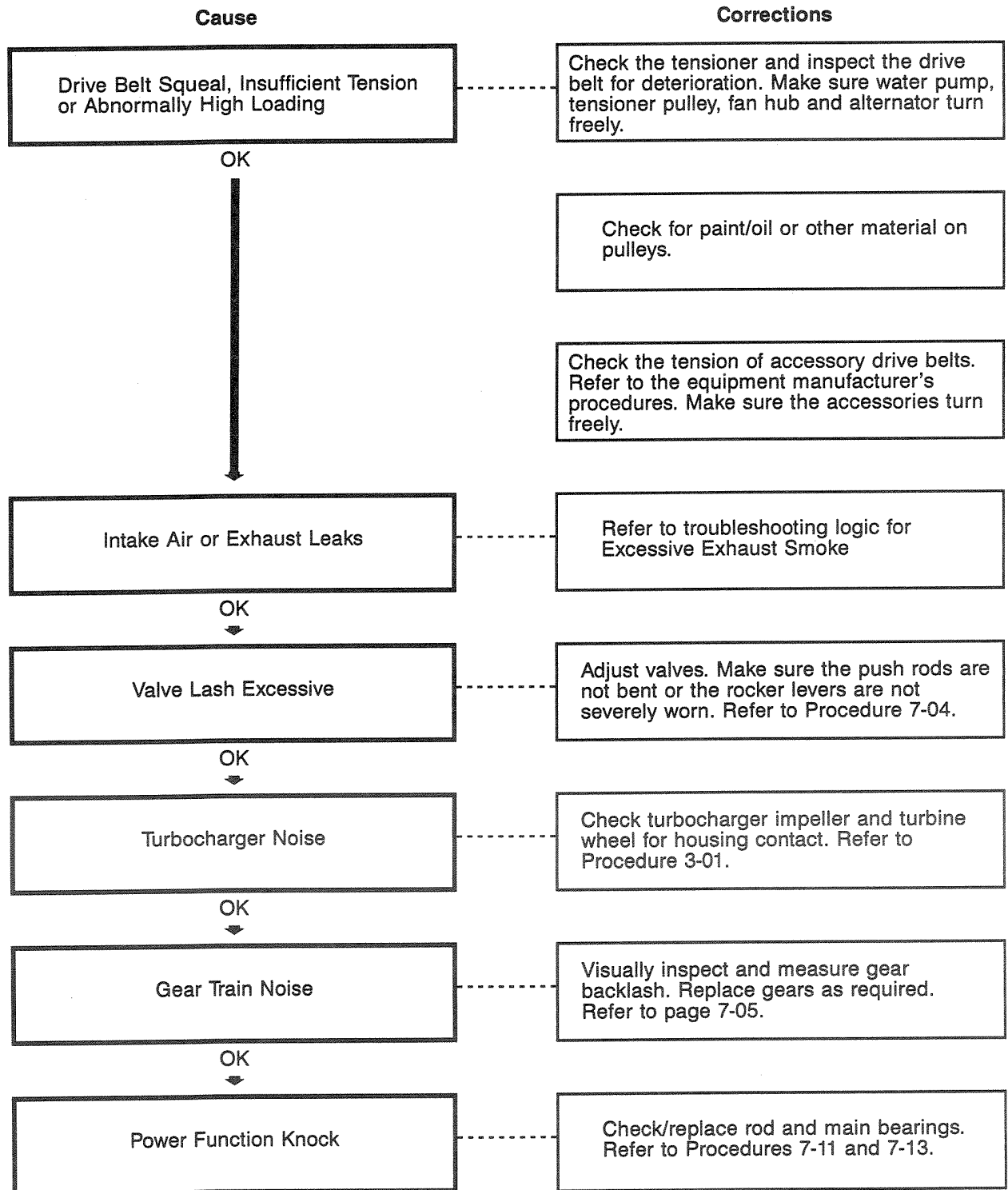
Engine Vibration Excessive



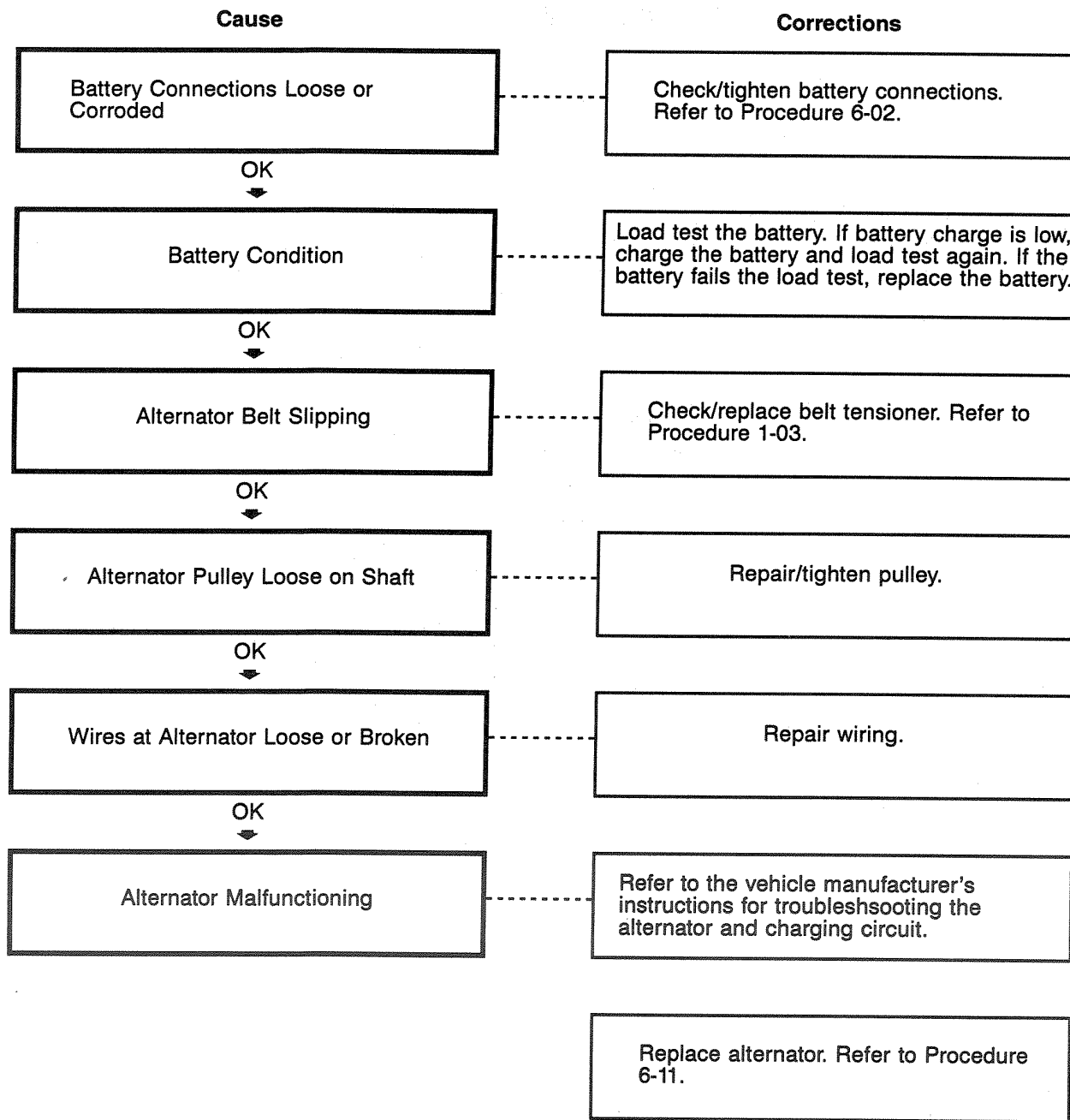
Engine Vibration Excessive (Continued)



Engine Noises Excessive



Alternator Not Charging Or Insufficient Charging



Section 1 - Cooling System

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Coolant System Components and Flow

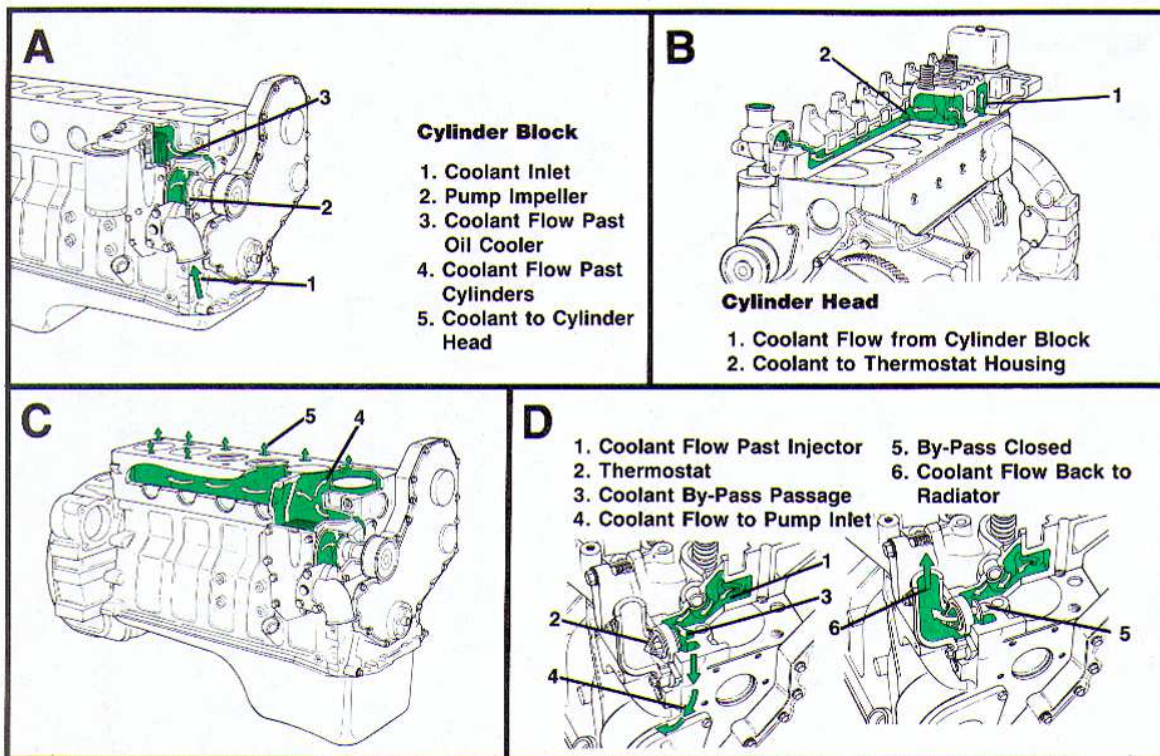
The following illustration identifies the significant features of the coolant system.

- A. Coolant is drawn from the radiator by the integrally mounted water pump. The output from the water pump empties into the oil cooler cavity of the cylinder block.
- B. The coolant then circulates around each cylinder and crosses the block to the fuel pump side of the engine.
- C. Coolant then flows up into the cylinder head, crosses over the valve bridges and down the exhaust manifold side of the engine to the integral thermostat housing.
- D. As the coolant flows across the head toward the thermostat housing, it provides cooling for the injector. When the engine is below operating temperature, the thermostat is closed, and the coolant flow bypasses the radiator and goes to the water pump inlet through internal drillings in the block and cylinder head.

When operating temperature is reached, the thermostat opens, blocking the bypass passage to the water pump and opening the outlet to the radiator.

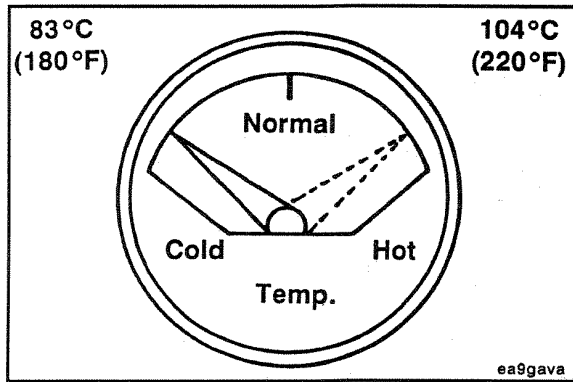
⚠ Caution: Never operate the engine without a thermostat. Without a thermostat, the coolant will not flow to the radiator and the engine will overheat.

Coolant System



Cooling System Specifications

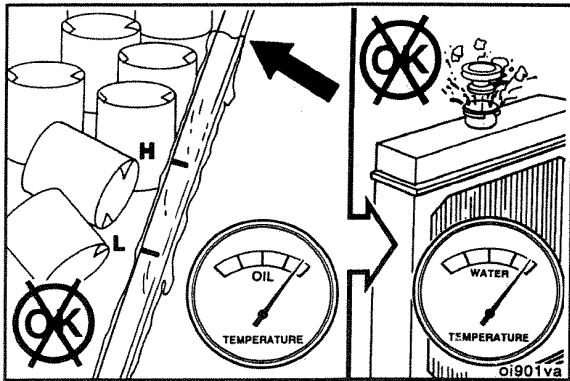
Cooling System Specifications	<u>B3.9, 4B3.9</u>	<u>4BT3.9</u>	<u>4BTA3.9</u>	<u>6B5.9, 6BT5.9, B5.9</u>	<u>6BTA5.9</u>
Coolant Capacity (Engine Only)- Litre [U.S. Qts.]..	7 [7.4]	7 [7.4]	9.7 [10.3]	10.5 [11.1]	14.5 [15.3]
Standard Modulating Thermostat - Range - °C [°F].....	-----	Start 83 [181]	-----	Fully Open 95 [203]	-----
Pressure Cap (kPa [PSI]) 104°C [220°F] Systems.....	103 [15]	103[15]	103 [15]	103 [15]	103 [15]
Pressure Cap (kPa [PSI]) 99°C [210°F] Systems.....	48 [7]	48 [7]	48 [7]	48 [7]	48 [7]



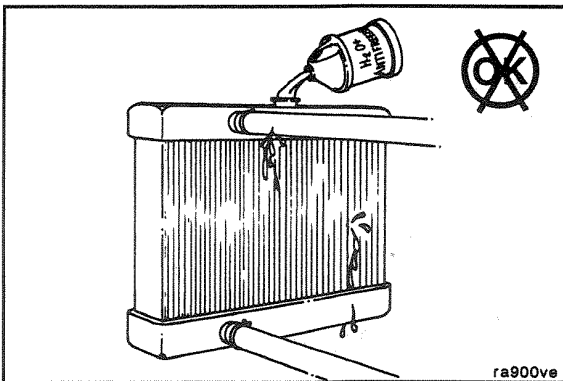
Coolant System Malfunctions (1-01)

Diagnosis

The function of the coolant system is to maintain a specified operating temperature for the engine. Some of the heat generated by the engine is absorbed by the coolant flowing through the passages in the cylinder block and head. Then, heat is removed from the coolant as it flows through the radiator. When you troubleshoot overheating, remember that too much oil in the oil pan can cause additional heat from friction when the rod journals are submerged in oil.

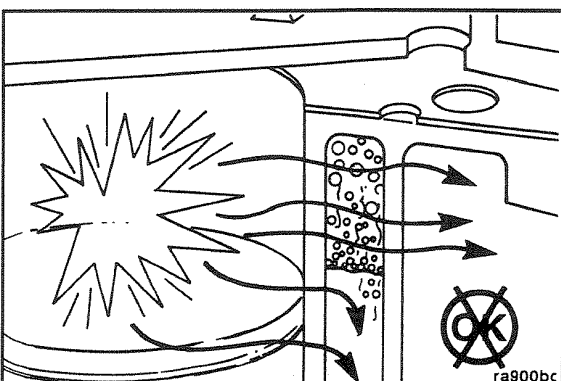


Overfilling with oil raises the oil temperature which is transferred to the coolant system at the oil cooler.



The system is designed to use a specific quantity of coolant. If the coolant level is low, the engine will run hot.

NOTE: The engine or system has a leak if frequent addition of coolant is necessary. Find and repair the leak.

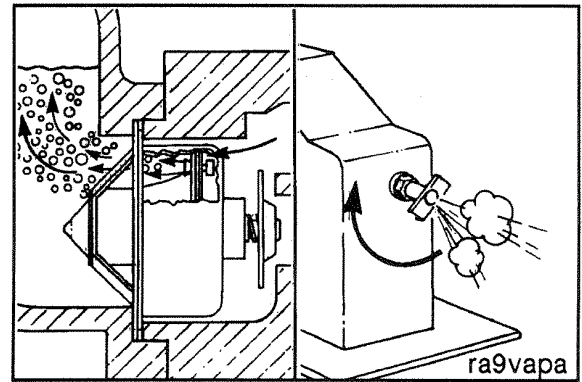


Caution: The engine coolant passages must be completely filled with coolant.

During operation entrapped air mixes with the coolant which results in cavitation corrosion and poor heat transfer. Highly aerated coolant can cause localized overheating of the cylinder head and block which can result in a cracked head, scored cylinder or blown head gasket.

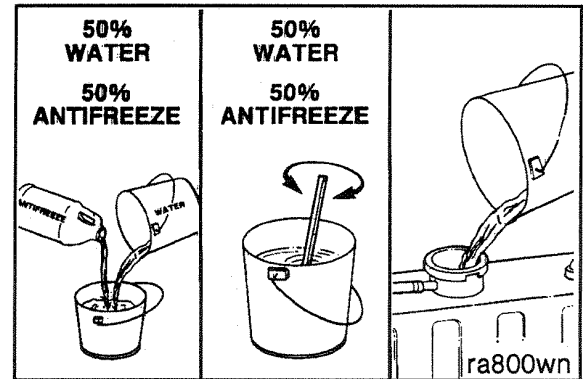
During filling, air must be vented from the engine coolant passages. The air vents through the "jiggle pin" openings to the top radiator hose and out the fill opening. Additional venting is provided for engines equipped with an aftercooler. Open the petcock during filling.

NOTE: Adequate venting is provided for a fill rate of 14 liters/minute [3.5 U.S. Gallon/minute].



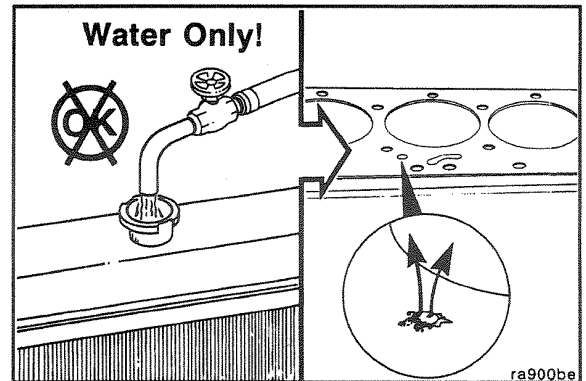
NOTE: A 50 percent mixture of antifreeze and water **must** be premixed before filling the system. The ability of antifreeze to remove heat from the engine is not as good as water, so pouring antifreeze into the engine first could contribute to an over heated condition before the liquids are completely mixed.

A mixture of 50% ethylene-glycol base antifreeze is required for operation of the engine in temperature environments above -37°C [-34°F]. A mixture of 40% water and 60% antifreeze is recommended for temperatures below -37°C [-34°F]. Never use more than 60% antifreeze.



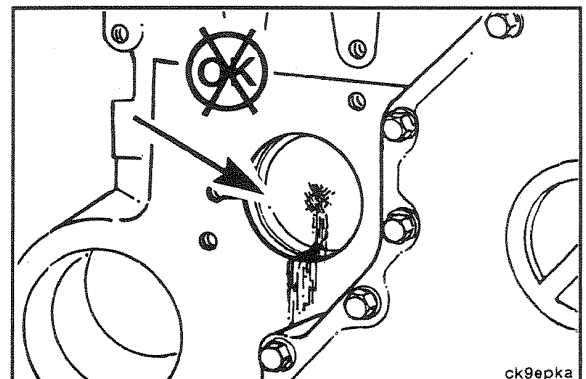
Caution: Never use water alone for coolant. Damage from corrosion can be the result of using water alone for coolant. The small holes in the head gasket are especially susceptible to plugging. These holes are orifices and their size is critical. Do not enlarge the size of the orifices. To do so will disturb the coolant flow and will not solve an overheating problem.

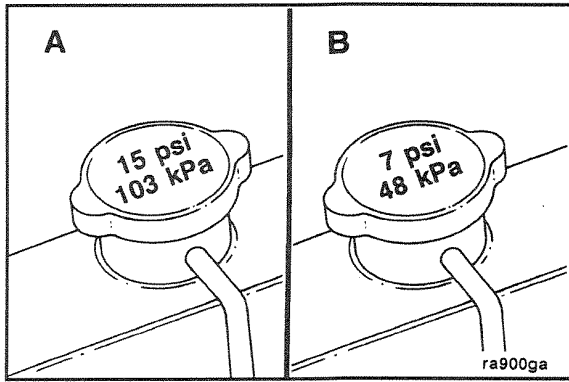
Water will cause rust formation reducing the flow in the smaller coolant passages.



Also, water used as a coolant for even a relatively short period can result in the cup plugs rusting through allowing the coolant to leak.

NOTE: A sudden loss of coolant from a heavily loaded engine can result in severe damage to the pistons and cylinder bore.



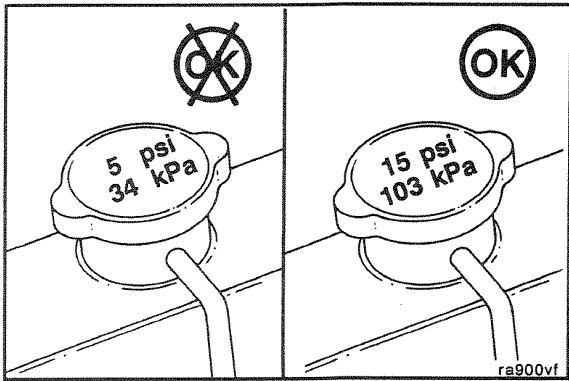


Pressure Caps

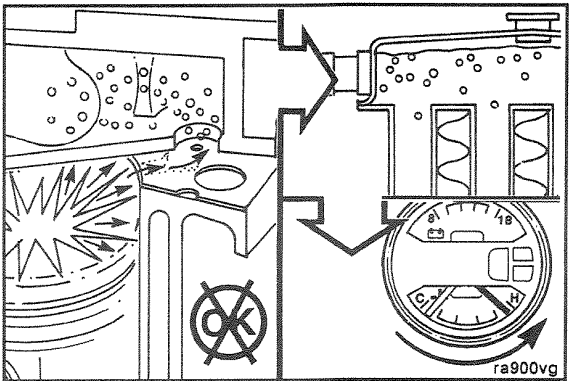
The system is designed to use a pressure cap to prevent boiling of the coolant.

Different caps are specified for the two recommended systems:

	<u>System</u>	<u>Cap</u>
A (Normal Duty)	104°C [220°F]	103kPa [15 PSI]
B (Light Duty)	99°C [210°F]	48kPa [7 PSI]

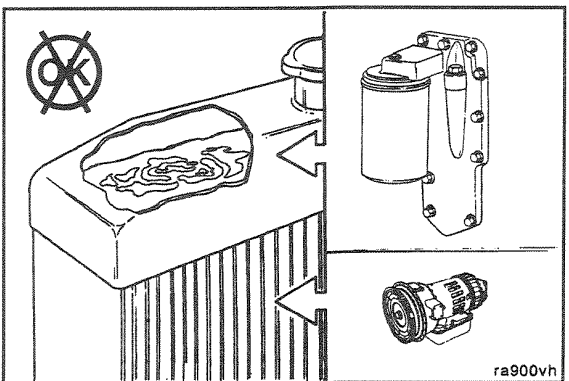


An incorrect or malfunctioning cap can result in the loss of coolant and the engine running hot.



Air in the coolant can result in loss of coolant from the overflow when the aerated coolant is hot. The heated air expands, increasing the pressure in the system causing the cap to open.

Similarly, coolant can be displaced through the overflow if the head gasket leaks compression gasses to the coolant system.

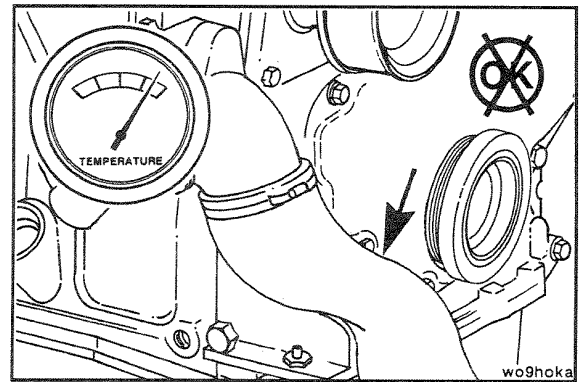


The operating pressure of the coolant system and the lubricating system can result in the mixing of the fluids if there is a leak between the systems: head gasket, oil cooler, etc. (refer to the Lubricating System).

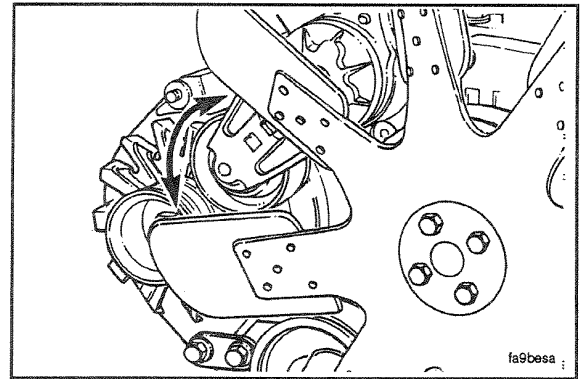
NOTE: Transmission fluid can also leak into the coolant through radiator bottom tank transmission oil coolers.

Water (Coolant) Pump

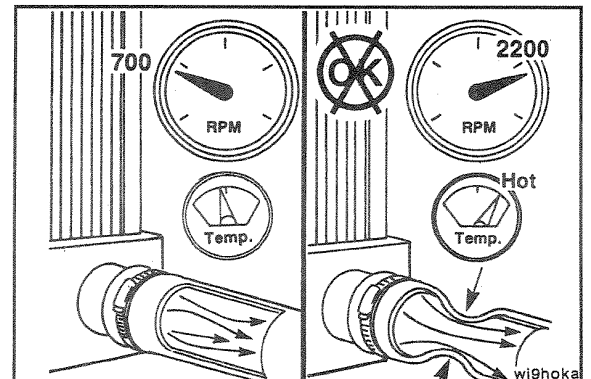
The water pump pulls coolant from the bottom of the radiator and pumps it through the engine back to the top of the radiator for cooling. Reduced or interrupted flow will result in the engine running hot.



The pump is belt driven from the crankshaft pulley. An automatic belt tensioner is used to prevent the belt from slipping on the pump pulley. A malfunction of the tensioner will cause the water pump impeller to rotate at a slower speed reducing the amount of coolant flow.



The coolant flow can also be reduced if the inlet hose to the water pump collapses. A hose will usually not collapse while the engine is running at low speed. Check the hose while the engine is running at rated speed.



NOTE: Be sure the engine is warm, a minimum of 95°C [203°F], so the thermostat is open.

A worn or malfunctioning water pump will not produce the flow required to prevent the engine from running hot. However, be sure to check the other possibilities indicated in the Troubleshooting Logic before checking the flow or replacing the pump.

