COOLING SYSTEM

CONTENTS

DESCRIPTION AND OPERATION

WATER PUMP AND COOLING SYSTEM

The engine cooling system is the semi-closed pressure type, with thermostatic coolant temperature control and water pump circulation. In such a system, coolant is checked and added to a separate reservoir and not at the radiator. It should be noted, however, that if a quantity of coolant is needed because of a leak, repair, or for complete replacement, the coolant should be added directly to the radiator to insure that the system is filled.

The reservoir is built into the fan shroud and is connected to the radiator by a hose. See Figure 6B-1. As the car is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the reservoir. When the car is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency.

A single contact temperature sensitive switch is located in the intake manifold. Engine water temperature above 246 degrees causes the set of contacts to close and light a red signal on the instrument panel.

There is also a temperature sensitive switch located in the rear of the left cylinder head (on upper series

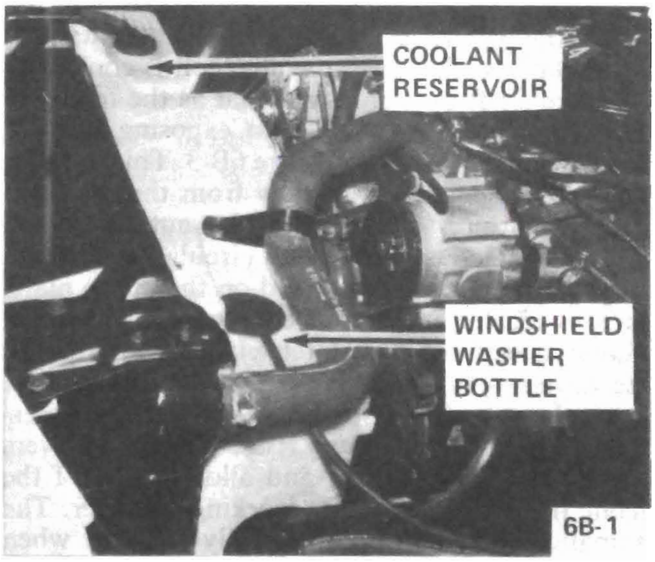


Figure 6B-1 Fan Shroud

vehicles). If engine temperature should go above 265 degrees plus or minus 10 degrees, a set of contacts are closed and lights a red "stop engine" signal on the instrument panel.

A Harrison cross flow type radiator core made of brass and copper is used on all models. The outlet radiator tank houses the tranamission oil cooler.

> **WARNING: A bent or damaged fan or fan clutch must always be replaced and repair not attempted. This is essential to maintain balance and durability.**

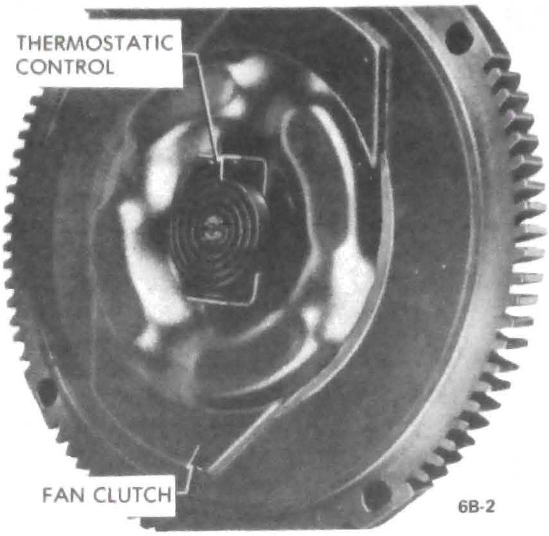


Figure 6B-2 - Fan Clutch

Automatic Fan Clutch

The automatic fan clutch has two modes of operation, the engaged mode and the disengaged mode. The disengaged mode (engine cold or high-speed driving) occurs when the silicone fluid is contained in the reservoir area of the fan clutch. As the temperature of the engine rises so does the temperature of the bimetallic coil. This bimetallic coil is connected to the arm shaft in such a way that as the temperature rises, the shaft moves the arm, exposing an opening in the pump plate. See Figure 6B-3. This opening allows the silicone fluid to flow from the reservoir into the working chamber of the automatic fan clutch. The silicone fluid is kept circulating through the fan clutch by wipers located on the pump plate. A hole is located in front of each wiper. The speed differential between the clutch plate and the pump plate develops high pressure areas in front of the wipers, thus the fluid is forced back into the reservoir. But, as the temperature rises, the arm uncovers more of the large opening and allows more of the silicone fluid to re- enter the working chamber. The automatic fan clutch becomes fully engaged when the silicone fluid, circulating between the working chamber and the reservoir, reaches a sufficient level in the working chamber to completely fill the grooves in the clutch body and clutch plate. The resistance of the silicone fluid to the shearing action, caused by the speed differential between the grooves, transmits torque to the clutch body. The reverse situation occurs when the temperature drops. The arm slowly closes off the return hole, thus blocking the fluid flow from the reservoir into the working chamber. The continuous action of the wipers removes the silicone fluid from the grooves in the working chamber and reduces the shearing action. Thus, less torque is transmitted to the clutch body and the speed of the fan decreases.

The temperature at which the automatic fan clutch engages and disengages is controlled by the setting of the bimetallic coil. This setting is tailored to satisfy the cooling requirements of each car model.

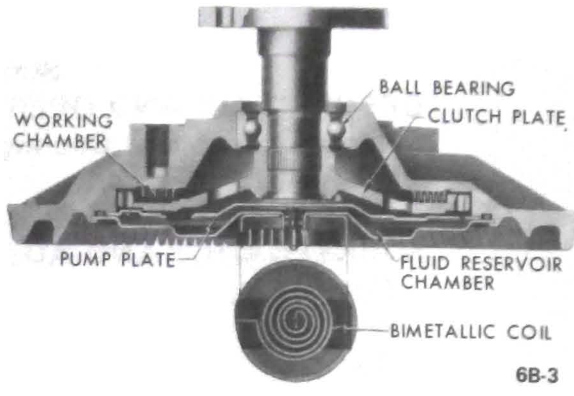


Figure 6B-3 Automatic Fan Clutch Components

Radiator Cap

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of coolant and increases the cooling efficiency of the radiator. The 15 pound pressure cap used on all series permits a possible increase of approximately 38 degrees F. in boiling point of coolant.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See Figure 6B-4. The pressure valve is held against its seat by a spring of pre-determined strength which protects the radiator by relieving the pressure if an extreme case of internal pressure should exceed that for which the cooling system is designed. 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 coolant hoses to collapse.

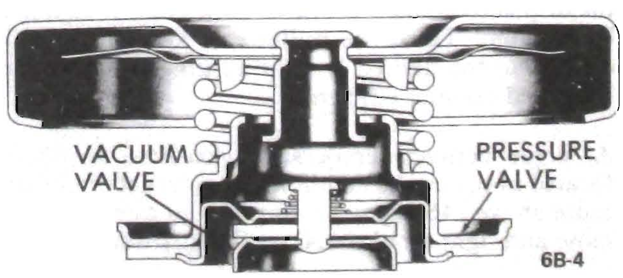


Figure 6B-4 - Pressure Type Radiator Cap

Water Pump

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The fan and pulley(s) are bolted to the forward end of the pump shaft. In this manner both the fan and pump are belt driven by a crankshaft driven pulley integral with harmonic balancer.

The pump shaft is supported on a double row ball bearing shrunk fit in the aluminum water pump cover. The bearings are permanently lubricated during manufacture and sealed to prevent loss of lubricant and entry of dirt.

The pump is sealed against coolant leakage by a packless non-adjustable seal assembly mounted in the pump cover in position to bear against a ceramic face assembly.

The inlet pipe case on the timing chain cover feeds into the passage formed by the cover and the front face of the impeller, which is mounted on the bearing shaft with the vanes facing rearward. Coolant flows through the inlet passage to the low pressure area at the center, where it then flows rearward through holes in the impeller. Vanes on the rotating impeller cause the coolant to flow radially outward into two discharge passages cast in the timing chain cover, and these passages deliver an equal quantity of coolant to each cylinder bank water jacket.

Cylinder water jackets extend down below the lower limits of piston ring travel and the coolant completely surrounds each cylinder barrel to provide uniform cooling.

The coolant leaves the cylinder heads through the intake manifold that provides a common connection between both heads and the radiator. The intake manifold also houses the "pellet" type radiator thermostat and outlet provides the by-pass passage through which coolant returns to the water pump for recirculation whenever the thermostat valve closes to block circulation through the radiator. This thermostatically operated by-pass type of water temperature control permits the engine to reach its normal operating temperature quickly. The thermostat valve opens at 190 degrees F.

DIAGNOSIS

COOLING SYSTEM

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no damage.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to proper level.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to overflow pipe.

3. Run engine in neutral at a safe high speed until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

Cooling System Overheating

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of permanent type anti-freeze may go considerably above 212 degrees F. without danger of boiling.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss.

2. Slipping or broken fan belt.

3. Radiator thermostat stuck, radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Defective fan clutch.

5. Improper ignition timing.

6. Shortage of engine oil or improper lubrication due to internal conditions.

7. Dragging brakes.

Condition	Possible Cause	Correction
Loss of Coolant due to Leaks	1. Check for obvious external leaks, broken or loose fan belt, collapsed radiator hoses, and check external condition of radiator. Check for leak at heater water valve.	Repair, adjust, clean or replace parts as necessary.
Loss of Coolant due to Boiling	1. Loss of coolant due to boiling indicates a defective part in the cooling system, see conditions: Hot light "ON" engine overheats during normal highway driving and "HOT" light on engine overheats when idling for extended periods of time or after extensive city driving, for possible causes and corrections.	
Hot LIGHT "ON" Engine Not Hot	1. Defective temperature sending unit.	Replace.
	2. Grounded wire in electrical circuit between hot light bulb and sending unit.	Locate grounded wire and repair.
Hot light "ON" Engine Overheats During Normal Highway Driving	1. Loose or broken fan belt.	Adjust or replace.
	2. Leaks.	Repair.
	3. Low coolant level.	Refill.
	4. Defective water pump.	Replace.
	5. Defective thermostat.	Replace.
	6. Radiator plugged internally.	Rod radiator.
	7. Radiator plugged externally.	Clean radiator.

Condition	Possible Cause	Correction
	8. Obstruction in air flow through radiator such as bent fins.	Replace radiator.
	9. Air conditioning condenser not parallel with the radiator.	Reposition as necessary.
	10. Incorrect radiator.	See usage chart at the end of the Cooling System Section.
	11. Ignition timing not set to specifications.	Set timing.
	12. Hang on air conditioning system. 13. Trailer hauling.	Heavy duty cooling system must be used.
	14. Defective radiator cap.	Replace.
	15. Restriction in coolant passages in the heads or block.	Replace as necessary.
Hot Light "ON" Engine Overheats when Idling for Extended Periods of time or after NORMAL Around Town Driving	1. Thermovacuum switch defective.	Replace switch
	2. Ignition timing not set to specifications.	Set timing.
	3. Leaks or low coolant level.	Locate leak and repair or replace parts as necessary and, refill system.
	4. Defective radiator cap.	Replace.
	5. Defective water pump.	Replace.
	6. Radiator plugged internally.	Rod radiator
	7. Radiator plugged externally.	Clean radiator
	8. Defective thermostat.	Replace.
	9. Collapsed radiator hose.	Replace.
	10. Fan clutch defective.	Replace
	11. Incorrect radiator.	See Usage Chart at the end of the Cooling System Section.

CAUTION: *Whenever an engine has been severely overheated, always test cooling system for a combustion gas leak due to a bad head gasket caused by the extreme heat. Retorquing the head bolts may solve the problem. If not, the head gaskets will have to be replaced.*

MAINTENANCE AND ADJUSTMENTS

COOLING SYSTEM SERVICE

Checking and Filling Cooling System

Engine coolant level is checked by raising the car's hood and glancing at the translucent reservoir. The radiator cap is *not removed.* The design of the radiator cap has been changed to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It must be pushed downward before it can be turned. A decal has been added to the cap cautioning against its being opened and indicating the proper closed position.

The proper coolant level at *normal operating temperature* is between the "Full" and the "Add" marks on the coolant reservoir. Since the level may be below the "Add" mark when the system cools and the coolant is below its normal operating temperature, *always* check the coolant level after the car has been driven.

Coolant freeze protection should be checked at the radiator and not at the reservoir.

> **WARNING: Never remove the radiator cap quickly when the radiator is HOT. Sudden release of cooling system pressure may cause the coolant to boil and escape with some force.**

If the cap must be removed when the engine is at normal or above temperature, a cloth should be placed over the cap. The cap should then be rotated *counterclockwise* without pressing downward until the relief position is reached. The pressure must be allowed to escape completely. This may take more than 10 minutes for a large, hot engine. The cap should then be depressed and rotated again *counterclockwise* to the removal position.

Draining and Flushing the Cooling System

When the cooling system has been drained, reinstall an ethylene glycol typ anti-corrosion e cooling system protection solution developed for year around use (General Motors Specification GM 1899-M). *Water alone, methanol, or alcohol type anti-freeze is definitely not recommended.* To drain the cooling system, remove radiator cap, open the drain at the bottom of the radiator and remove the drain plugs on both sides of cylinder block. If car is air- conditioned equipped, set heater temperature control valve at "HOT" position.

After the cooling system is drained, plugs reinstalled, and drain cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system then completely drain the cooling system before sediment has a chance to settle.

Conditioning the Cooling System

It is very important to make certain that the cooling system is properly prepared before an anti- freeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed. All joints should be pressure checked for leakage and corrected.

Inspect the water pump, radiator core, heater core, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

Using and Testing Anti-Freeze Solutions

Inhibited year around (ethylene gylcol type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times (not less than 0 degrees F., to freeze protection should be provided to protect against corrosion). When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20 degrees F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

Alcohol base coolants are not recommended for this vehicle at any time.

If for any reason water is used as a coolant in a emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant or equivalent be added to the cooling system as soon as possible. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Sepcification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that ethylene glycol type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two years. At this time, also add GM cooling system inhibitor and sealer or equivalent. It is advisable to check the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporization or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature. Obtain a table or similar means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30 degrees F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

Fan Belt Adjustment and Replacement

A tight fan belt will cause rapid wear of the Delcotron generator and water pump bearings. A loose belt will slip and wear excessively causing noise, engine overheating and unsteady generator output. A fan belt which is cracked or frayed, or is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends, slightly loosening the generator mounting bolts, and moving generator inward to provide maximum slack in the belt.

The Delcotron generator must be moved outboard to adjust the fan belt. After the Delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked. See Figure 6B-5.

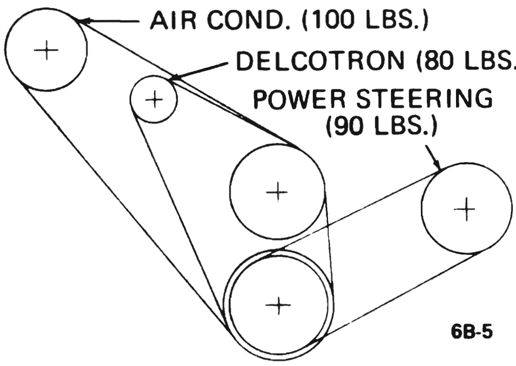


Figure 6B-5 Engine Belt Tension Chart

If the power steering oil pump belt is removed it should be adjusted to tension specified, in Figure 6B-5.

If the Air Conditioner compressor belt is disturbed it should be adjusted as specified, in Figure 6B-5. If A.I.R. pump belt is loosened, it should be tightened to 65-80 lbs. tension.

Radiator Thermostat Inspection and Test

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat sticks in the closed position, overheating will result.

The thermostat may be removed for inspection by partially draining the cooling system and removing the thermostat housing.

If the thermostat valve does not fully close when cold, check for the presence of foreign material that could hold it open. If no foreign material is present and valve still does not close, replace the thermostat.

Test the thermmostat for correct opening temperature by immersing the unit and a thermomoeter in a container of water. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to register a higher temperature than the water. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard temperature (190 degrees) thermostat valve should start to open at approximately 190 degrees F., and should be fully open at approximately 212 degrees F. If thermostat does not operate at specified temperatures, it must be replaced as it cannot be adjusted.

MAJOR REPAIR

WATER PUMP

The water pump cover is die cast aluminum into which the water pump bearing outer race is shrunk fit. For this reason the cover, shaft bearing, and hub are not replaceable.

Removal of Water Pump

1. Drain coolant into a clean container.
2. Loosen belt or belts, then remove fan blade, and pulley or pulleys from hub on water pump shaft. Remove belts.
3. Disconnect hose from water pump inlet and heater hose from nipple. Remove bolts, pump assembly, and gasket from timing chain cover.
4. Check pump shaft bearings for end play or roughness in operation. If bearings are not in serviceable condition, the assembly must be replaced.

Installation of Water Pump

1. Make sure the gasket surfaces on pump and timing chain cover are clean. Install pump assembly with new gasket. Bolts must be tightened uniformly.
2. Connect radiator hose to pump inlet and heater hose to nipple. Fill cooling system and check for leaks at pump and hose joints.
3. Install fan pulley or pulleys and fan blade, tighten attaching bolts securely. Install belts and adjust for proper tension. See Figure 6B-5.

FAN SHROUD

Removal

1. Disconnect battery.
2. Drain radiator.
3. Remove 4 bolts from fan blade and remove fan blade.

4. Disconnect upper radiator hose at the radiator and swing hose out of the way.

5. Disconnect windshield washer hose.

6. Disconnect hose from coolant reservoir to radiator.

7. Remove two screws at top of fan shroud assembly and lift fan shroud assembly out.

Installation

1. Reverse removal procedures.

RADIATOR MOUNTING

The radiator mounting is a four-point system using rubber inserts on "U" shaped brackets (for the lower mounting). The radiator upper mounting points are part of the upper radiator panel. The lower brackets mount on the lower portion of the radiator mounting panel.

SPECIFICATIONS

BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench to obtain the figures listed below. This will prevent straining or distorting the parts, as well as preventing thread damage. These specifications are for clean and lightly-lubricated threads only. Dry or dirty threads produce friction which prevents accurate measurement of the actual torque. It is important that these specifications be strictly observed. Overtightening can damage threads. This will prevent attainment of the proper torque and will require replacement of the damaged part.

Water Pump Cover to Timing Chain Cover	7
Fan Driven Pulley	20
Thermostat Housing to Intake Manifold	20
Fan Shroud to Radiator Upper Mounting Panel	90-120 lb.in.

COOLING SYSTEM SPECIFICATIONS

System Type	Pressure
Radiator Cap Relief Pressure	15 PSI
Thermostat	Choke Type Opening at 190°
Water Pump	
Type	Centrifugal
GPM at RPM	(350) 10 at 1000 (455) 15 at 1000
Drive	V-Belt
Bearings	Double Row
By-Pass Recirculation Type	External

COOLING SYSTEM CAPACITIES

350 Cubic Inch "A" Series	
With Heater	16.5 Qts.
With A/C	15.5 Qts.
350 Cubic Inch "B" Series	
With Heater	16.2 Qts.
With A/C	16.6 Qts.
455 Cubic Inch	
With Heater	19.7 Qts.
With A/C	20.0 Qts.
Fan Diameter & Number of Blades	
350 Cubic Inch Less A/C	18"x4
350 Cubic Inch With A/C	"Flex" Fan 18"x5
455 Cubic Inch Less A/C	18"x5
455 Cubic Inch With A/C	20"x5
Fan Drive	
350 Cubic Inch	Water Pump Shaft
455 Cubic Inch Less A/C	Water Pump Shaft
455 Cubic Inch With A/C	Torque & Temperature Sensitive Clutch

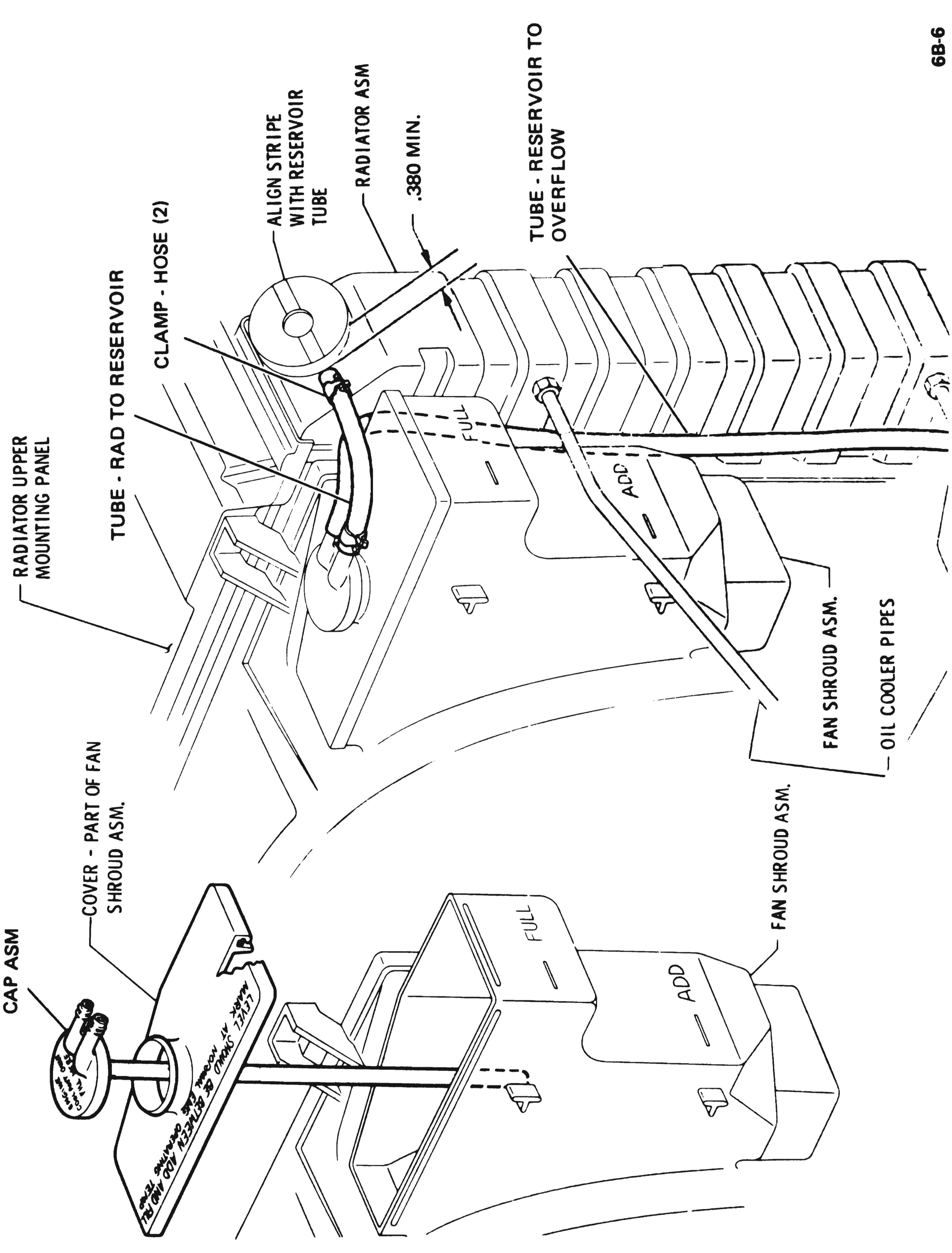


Figure 6B-6 Radiator Reservoir All Series

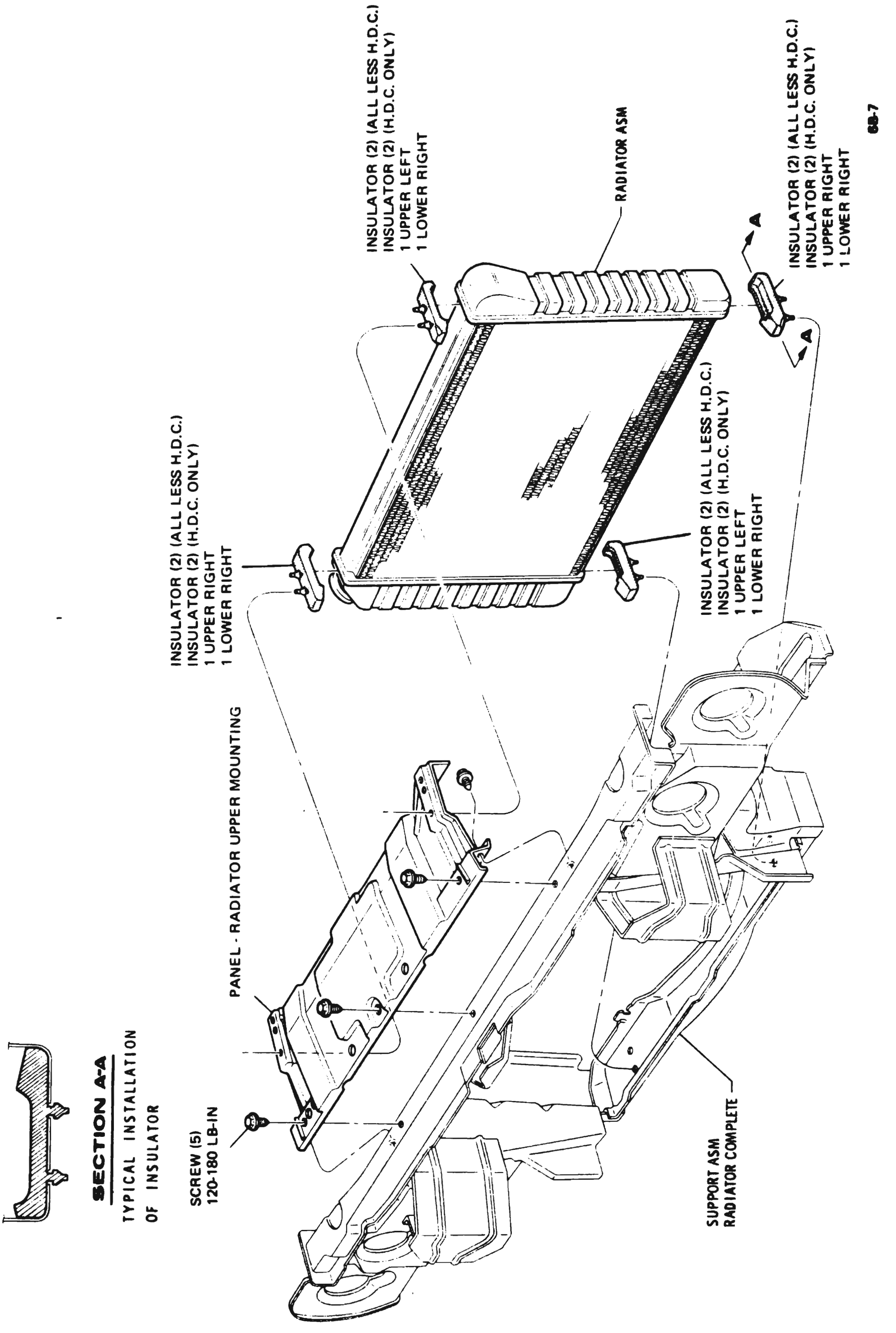


Figure 6B-7 Upper Mounting Panel and Radiator Installation B-C-E Series

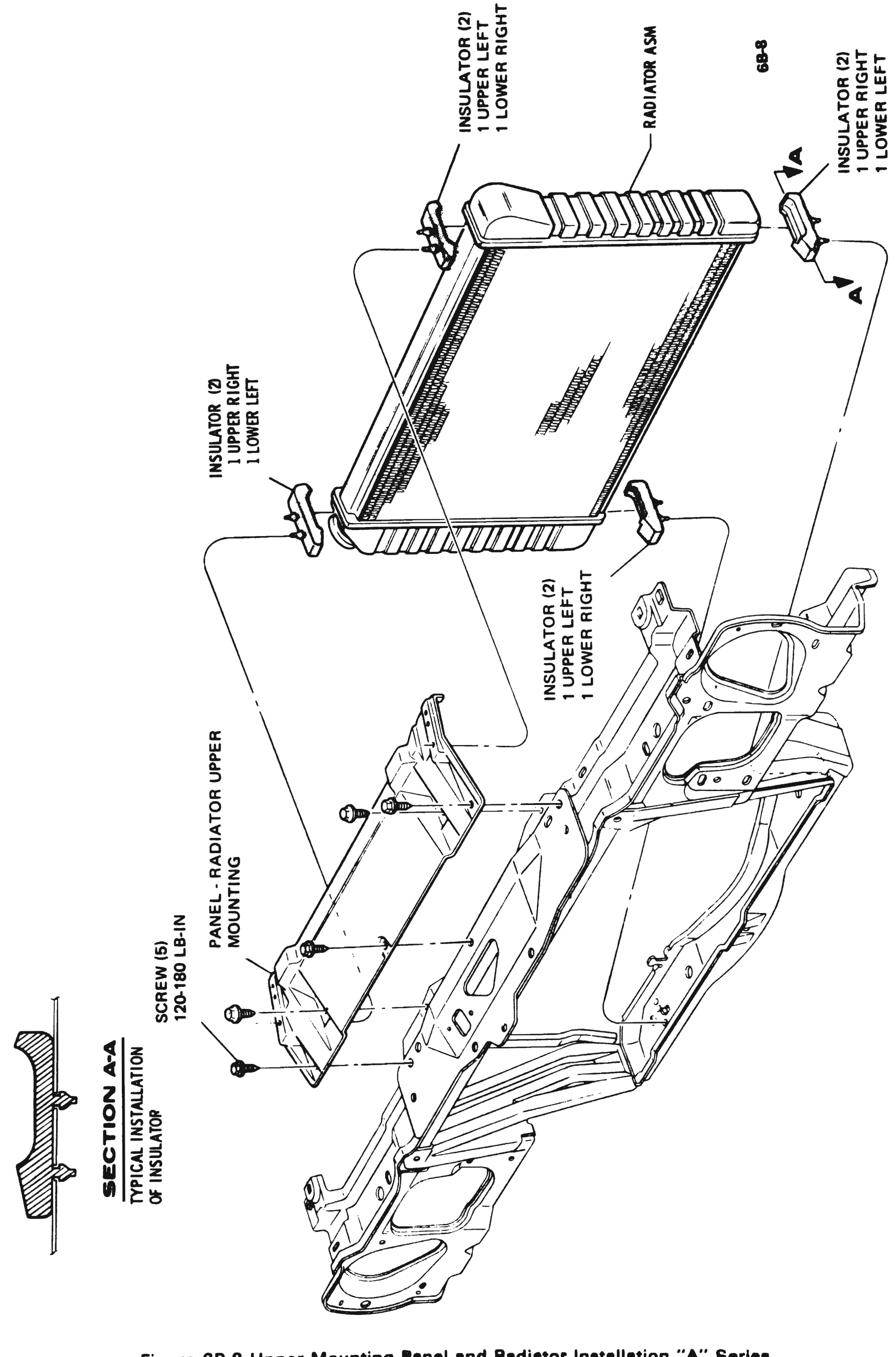


Figure 6B-8 Upper Mounting Panel and Radiator Installation "A" Series

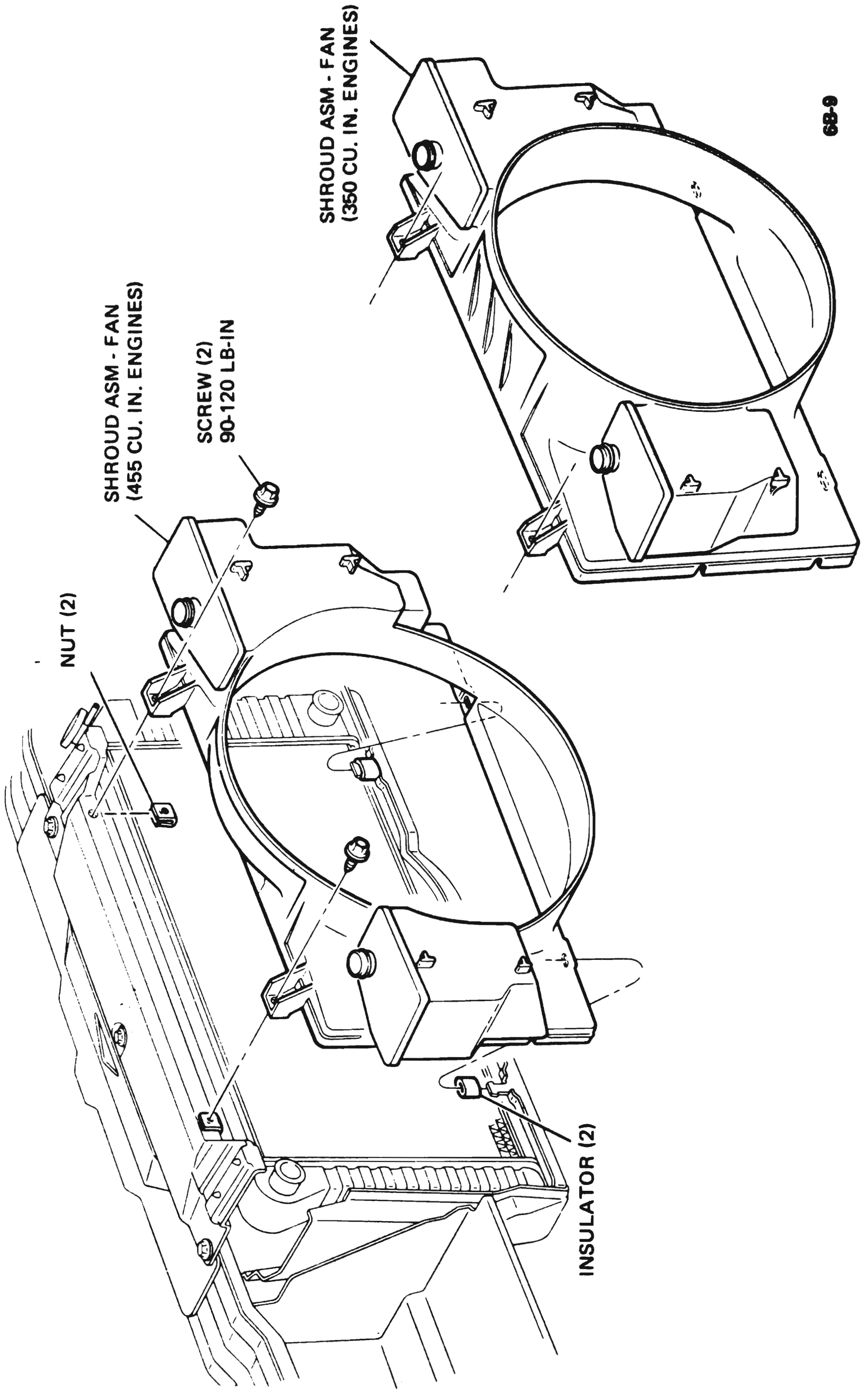
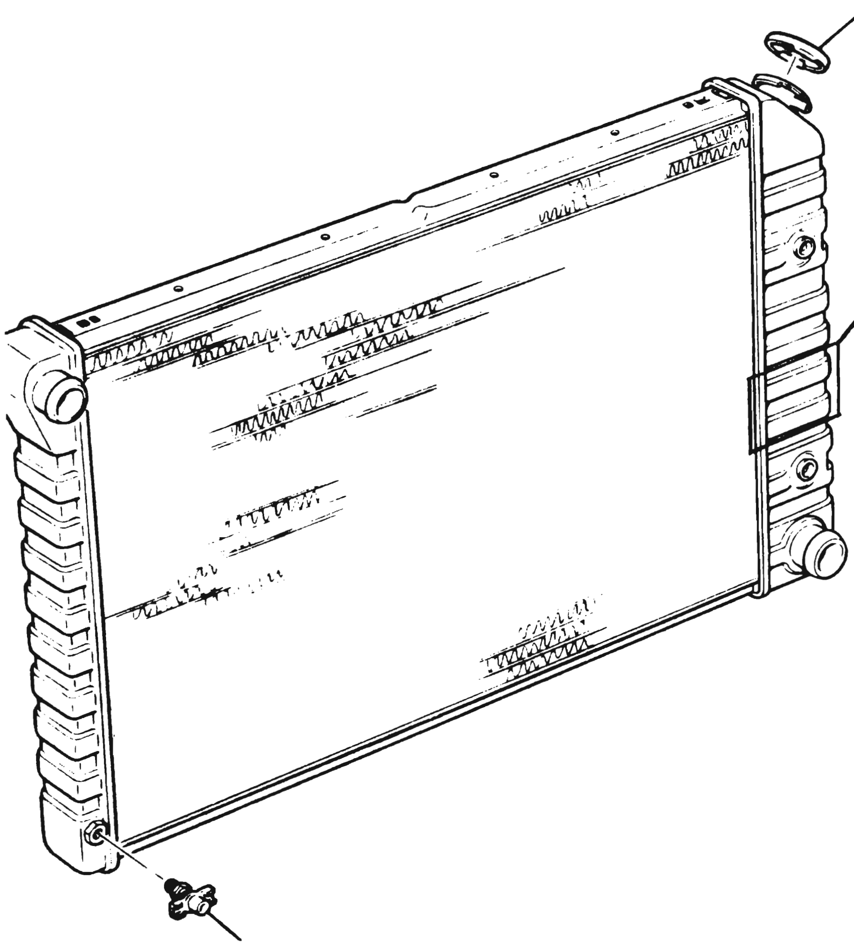


Figure 6B-9 Fan Shroud Mounting All Series



CODE	ENGINES		TRANSMISSION			A/C (C-60 C-61)	H. D. C. (Y40)	SERIES & MODELS
	350	455	MAN	M38	M40			
CL	X		X					"A"
CL	X	X	X					GS "A"
OF		X			X			"A"
OF	X			X				"A"
CC	X		X	X		X		"A"
CC		X	X		X	X		"A"
CF	X		X	X			X	"A"
CF		X	X		X		X	"A"
CF		X	X					"A" STAGE 1
CF	X			X			X	"B"
CB	X			X		X		"B"
CD		X			X			"B-C-E"
CD	X			X				"B"
CA		X			X	X		"B-C-E"
ZM		X			X		X	"B-C-E"

NOTE: COOLING SYSTEM TO BE FREE OF LEAKS AT 14-17 LBS PRESSURE.

A SEALING SURFACES INSIDE RADIATOR FILLER NECK MUST BE CLEAN & FREE OF FOREIGN MATERIAL WHEN CAP IS INSTALLED.

6B-10

Figure 6B-10 Radiator Usage Chart