Caterpillar

Service Manual

3145, 3150 & 3160 Engines

S/n 96M1, 97M1, 98M1 & up

Service® Manual

CT-S-ENG3145+

SERVICE MANUAL

3145-3150-3160 INDUSTRIAL ENGINES

SERIAL NUMBERS

96M1-UP

97M1-UP

98M1-UP

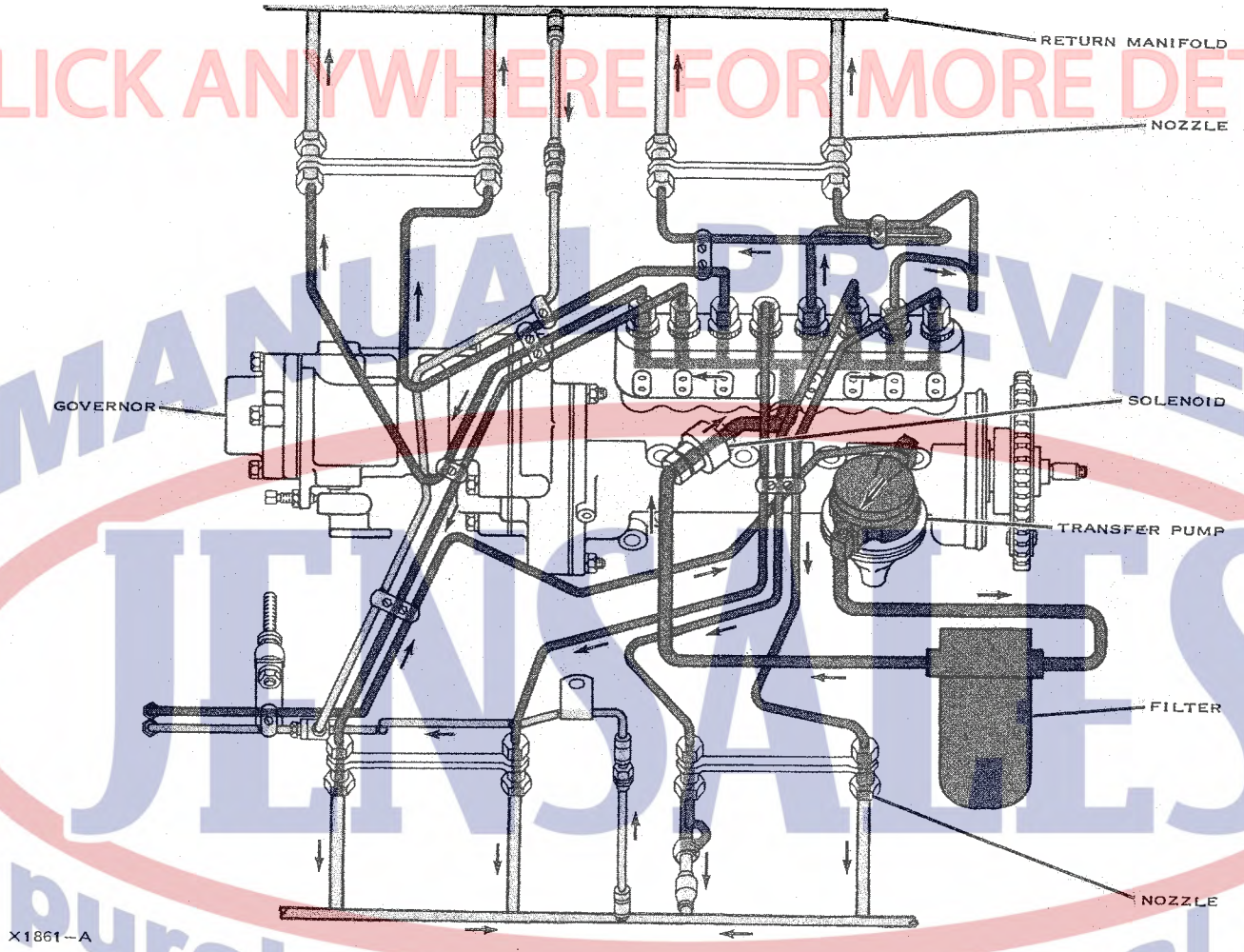
SYSTEMS OPERATION

TESTING AND ADJUSTING

SPECIFICATIONS

NOTE: For Specifications with illustrations, make reference to ENGINE SPECIFICATIONS FOR 3145, 3150, 3160 INDUSTRIAL ENGINES Form No. REG01436. If the Specifications in Form No. REG01436 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specifications given in the book with the latest date.

FUEL SYSTEM



The diaphragm-type fuel transfer pump mounts on the fuel injection pump housing and is driven by a lobe on the injection pump camshaft. The pump draws fuel from the tank and delivers it to a spin-on throw-away type filter. The filter has a combination primary-secondary type construction. A primary fuel filter attachment can be installed between the fuel supply and the transfer pump to strain larger particles from the fuel.

Filtered fuel flows through a shutoff solenoid, mounted on the fuel injection pump housing, into a fuel manifold. The solenoid operates electrically and stops fuel flow when the engine electrical system is shut off.

Fuel in the manifold flows through the barrel assembly inlet port into the area above the injection pump plunger. During injection, the camshaft forces the plunger upward in the barrel. The end of the plunger closes the inlet port and forces the fuel out through high pressure injection lines to the nozzles.

The injection nozzles are located under the valve cover and are held in place by clamps. The nozzle tip projects from the head into the cylinder bore. Atomized fuel is sprayed in a cone-shaped pattern through four .0128 in. (0.325 mm) orifices into the cylinder.

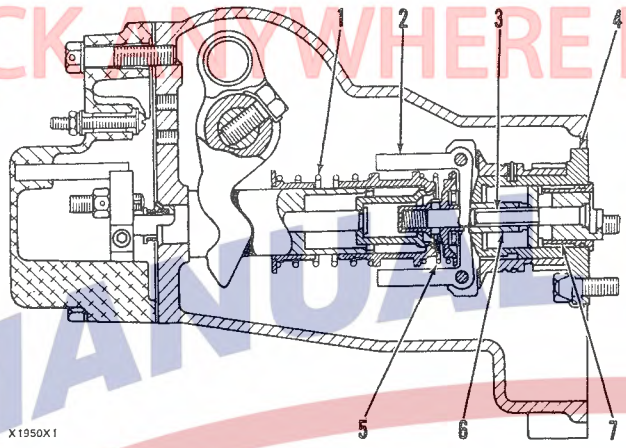
During injection, a small amount of fuel leaks past the valve guide in the nozzle body to lubricate its moving parts. Any excess leakage flows from the nozzle to a fuel return manifold under the valve cover of each cylinder head. External lines connect the manifolds and return the fuel to the tank.

GOVERNOR OPERATION

The hydraulic governor maintains speed at the rpm selected.

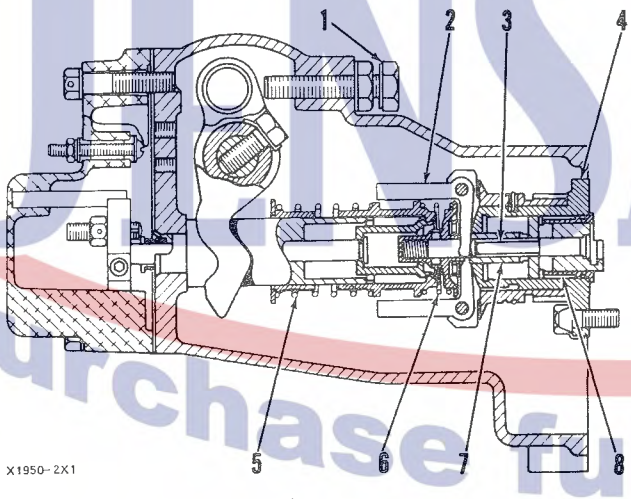
When the engine is operating, the balance between the centrifugal force of the revolving weights and the force of the governor spring controls the movement of the valve. The valve directs pressure oil to either side of a rack-positioning piston. Depending upon the position of the

valve, the rack is moved to increase or decrease the amount of fuel to the engine to compensate for load variation.



GOVERNOR
(Earlier Governor)

1. High idle spring. 2. Weights. 3. Valve. 4. Cylinder. 5. Low idle spring. 6. Piston. 7. Sleeve.



GOVERNOR
(Later Governor)

1. Low idle screw. 2. Weights. 3. Valve. 4. Cylinder. 5. High idle spring. 6. Low idle spring. 7. Piston. 8. Sleeve.

Pressurized lubrication oil, directed through passages in the fuel injection pump housing, enters a passage in the governor cylinder. The oil encircles a sleeve within the cylinder. This oil is then directed through a passage in the piston, where it contacts the valve.

When engine load increases, the revolving weights slow down. The weights move toward each other and allow the governor spring to move the valve forward. As the valve moves, a small passage in the piston opens to pressure oil. Oil flows through this passage and fills the chamber behind the piston. The pressure forces the piston and rack forward, increasing the amount of fuel to the engine. Engine rpm increases until the revolving weights rotate fast enough to balance the force of the governor spring.

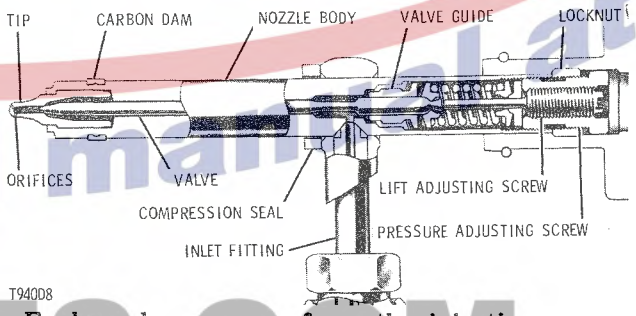
When engine load decreases, the revolving weights speed up and the toes on the weights move the valve rearward, allowing oil behind the piston to flow through a drain passage opened at the rear of the piston. At the same time, pressure oil between the sleeve and the piston forces the piston and rack rearward. This decreases the amount of fuel to the engine and the engine slows down. When the force of the revolving weights balances governor spring force, engine rpm will be the same as before.

At engine shut down, a low idle spring returns the valve guide and valve to the full load position. This moves the fuel rack to the full travel position, and assures full fuel flow through the fuel injection pump at engine start up.

INJECTION NOZZLE OPERATION
9L9263 NOZZLES

The nozzle is an inward opening, differential hydraulically-operated, hole-type nozzle.

The nozzle body incorporates the inlet fitting, tip and valve guide. The inward opening valve is spring-loaded. Spring preload is adjusted through the pressure adjusting screw; valve lift is controlled by the adjustable lift screw. Both adjusting screws are secured by the locknut. A nylon compression seal under the inlet fitting "banjo" prevents cylinder compression leakage. The carbon dam at the lower end of the body prevents carbon accumulation in the cylinder head bore.



Fuel, under pressure from the injection pump, flows through the inlet, around the valve, filling the nozzle body. When the pressure acting on the differential area overcomes the spring force, the nozzle valve lifts off its seat. Fuel under high pressure sprays through four .0128 in. (0.325 mm) orifices into the cylinder. When delivery to the nozzle ends and pressure drops to the predetermined closing pressure, the spring returns the valve to its seat.

Positive sealing is maintained by line contact of the interference angle between valve and tip seat.

During injection, a small quantity of fuel leaks through a controlled clearance at the valve guide, lubricating all moving parts. This fuel flows through a leak off boot at the top of the nozzle body and returns to the fuel tank.

AIR INDUCTION AND EXHAUST

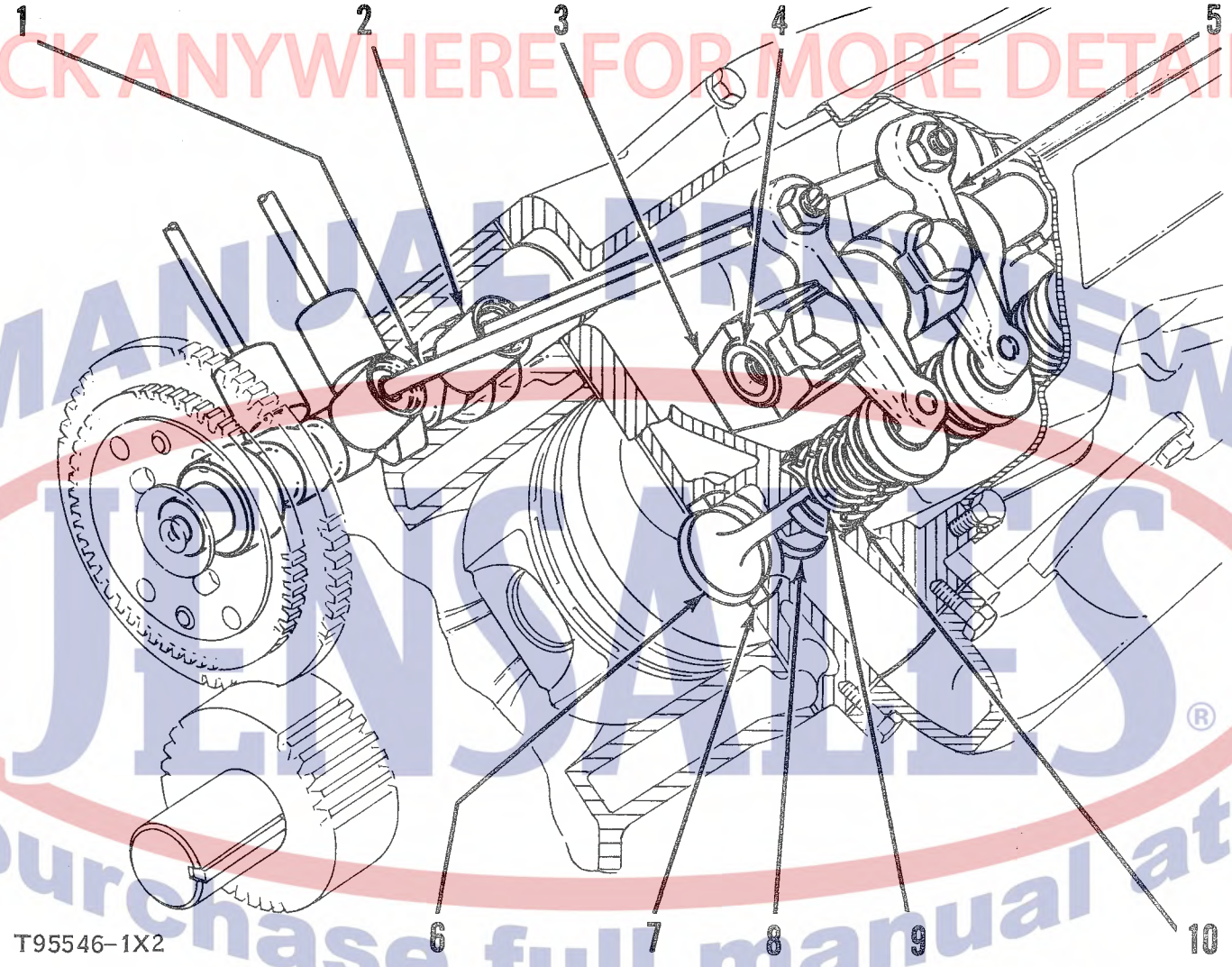
The air inlet system is located on top of the engine. The intake pipe provides a mounting for the air cleaner. The pipe directs air to each cylinder head. The pipe cannot be turned end-for-end because the air cleaner mounting flange sets at a slight angle toward the front of the engine.

The inlet manifolds are integrally cast in the cylinder heads. The manifolding, porting and combustion chamber design generates the air turbulence necessary for complete combustion.

The exhaust system is located on each side of the engine. The exhaust manifolds mount along the outside of the cylinder heads and are not interchangeable.

A positive crankcase ventilator mounts on top of the rocker arm cover. The valve vents crankcase fumes back to the engine through the intake pipe. The rocker arm cover on which the valve mounts is interchangeable between banks. However, the ventilator return pipe fitting must be interchanged with a plug in the intake pipe.

CYLINDER HEAD AND VALVES



CYLINDER HEAD AND VALVES

1. Push rod. 2. Cam follower. 3. Guide support. 4. Rocker arm shaft. 5. Rocker arm. 6. Exhaust valve. 7. Valve seat insert. 8. Intake valve. 9. Inner valve spring. 10. Outer valve spring.

The cylinder heads are interchangeable among the 4.1 in., 4.5 in., and 5.0 in. stroke engines. In addition, the heads can be used on either the right or left bank by installing a core plug in the unused water outlet in the end of the head. The air inlet manifold is cast into the head.

The camshaft actuates the valve mechanism. A drive gear is secured to the end of the camshaft and driven at one-half engine speed by the crankshaft gear. Five bearings in the cylinder block support the camshaft. A thrust pin, which locates in a groove in the camshaft adjacent to the rear support bearing, positions the shaft and absorbs any thrust.

Solid-type cam followers are located in the cylinder block and follow the cam lobe profile. The push rods transmit the lifting motion to the rocker arms.

The rocker arms mount on the rocker arm shaft. There is a single rocker shaft for each head. The shaft mounts in a support guide which spaces the rocker arms. The entire guide, shaft and rocker arm assemblies can be removed and replaced as a unit. The valve lash must be checked and adjusted, if necessary, after installing the unit.

Each cylinder has one intake and one exhaust valve. The exhaust valve uses a replaceable valve seat insert which is pressed into the cylinder head. The intake valve seat is machined in the head. The air inlet port design above the intake valve seat gives the proper swirl to the incoming air. The valve guide bores are cast integrally and machined in the cylinder head. There are two springs, an inner and outer, per valve. The springs are interchangeable between the intake and exhaust valves.

LUBRICATION SYSTEM

T94001-A

Oil moves through the screen and suction tube to the inlet passage in the oil pump cover. The oil pump cover bolts to the back of the engine front cover. The inlet passage directs oil to the pump.

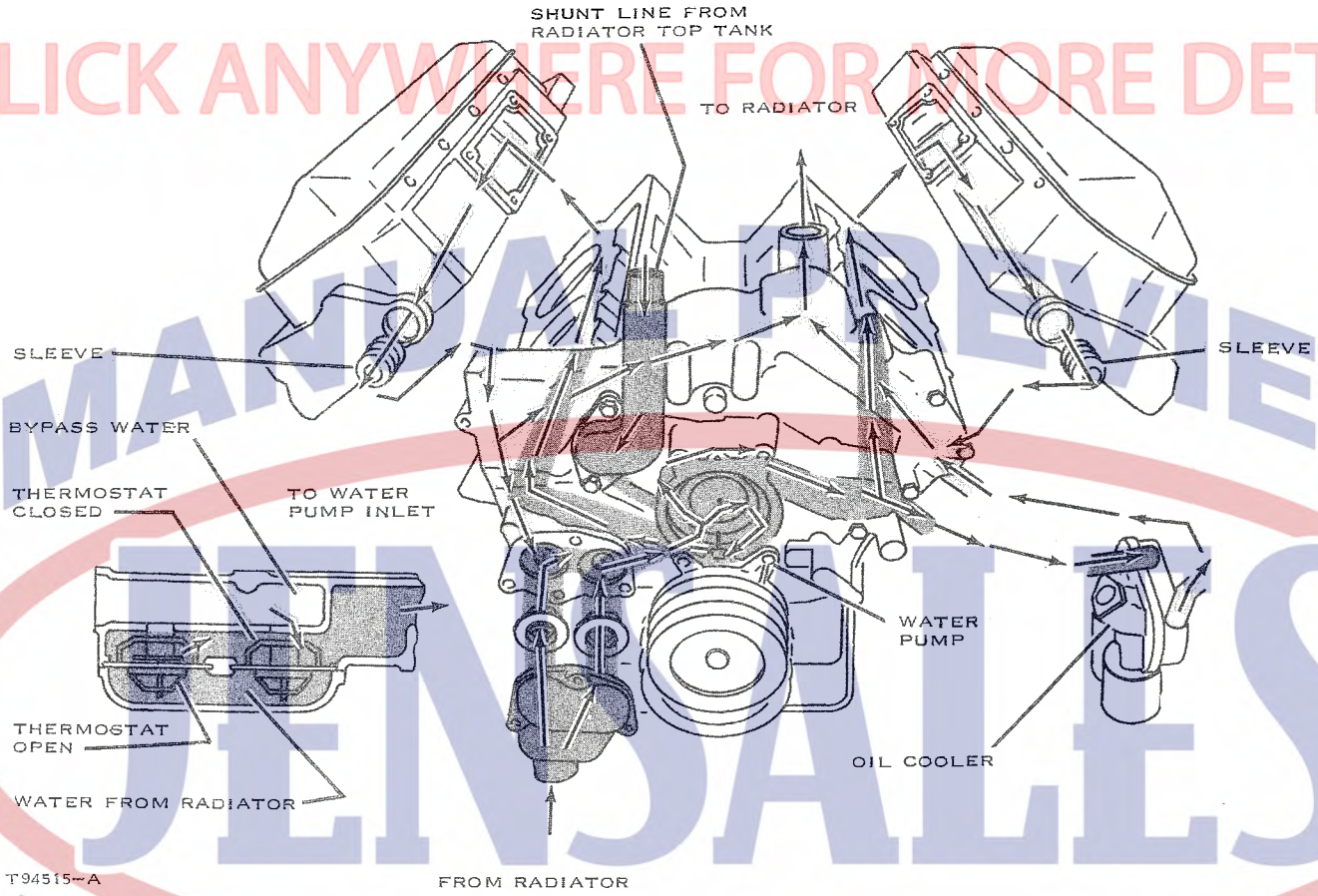
The oil pump is a six lobe, rotor-type. The crankshaft gear drives the outer rotor which rotates in a bearing in the front cover. The inner rotor mounts on a stub shaft in the front cover and is driven by the outer rotor.

A bypass valve in the pump cover senses pump outlet pressure. The valve opens at approximately 72 psi (5.1 kg/cm^2) and bypasses oil back to the inlet side of the pump.

Oil from the pump flows through a passage in the front cover to the cylinder block and on to the oil cooler base. The base mounts on the left side of the engine. A valve in the base bypasses oil around the cooler when the oil is cold or the oil cooler restriction is greater than the rest of the system. A 14 to 22 psi (0.89 to 1.55 kg/cm^2) pressure differential opens the valve.

Oil from the cooler flows to two spin-on, throw-away filters mounted on the oil cooler base. Each filter contains a bypass valve. If the filters become clogged, oil is bypassed around them. An 18 to 20 psi (1.27 to 1.41 kg/cm^2) pressure differential opens the valves.

COOLING SYSTEM



The centrifugal-type water pump mounts on the front cover and is belt driven by the crankshaft pulley. The pump has two outlets. Coolant from the outlet on the right side of the pump flows through a passage in the front cover to the left bank of the engine, and coolant from the outlet on the left flows to the right bank.

The coolant circulates through the block to the cylinder head. Coolant flows from the heads through connecting sleeves to the return manifold in the front cover. Orifices in the sleeves control the flow from the heads.

Part of the coolant to the left bank is diverted from the block to the oil cooler. External lines direct coolant from the block to the cooler and back to the return manifold in the front cover.

An internal passage in the front cover directs the coolant from the return manifold to the water pump inlet. If the thermostats are closed the coolant flows to the pump and is recirculated through the engine. If they are open, coolant flows from the return manifold to the radiator and from there to the pump.

The two thermostats are located at the inlet to the water pump. The inlet-regulated cooling system maintains positive coolant temperature control with decreased engine warm up time.

When the thermostats are closed, coolant is circulated through the block and heads and back to the water pump by way of an internal passage in the front cover. When the thermostats are open, the bypass flow is restricted and the engine coolant flows through the radiator and returns through the inlet elbow to the water pump. Without the thermostats installed, the coolant will continually bypass the radiator, and overheating will result.

The radiator is constructed with a top tank above the core and an expansion tank either above or separate from the top tank. A vent tube connects the radiator top tank and the expansion tank. A cross flow radiator can also be used. The cross flow radiator is constructed with a tank on the left side and a tank on the right side. The expansion tank is either a part of the right side tank, which is separated by an internal baffle, or a tank separate from the radiator. A vent tube connects the expansion tank to the radiator. The expansion tank has a shunt line which connects to the water pump inlet. This shunt system maintains a positive, static head of coolant at the pump inlet to prevent cavitation under all operating conditions. When filling the cooling system, coolant