SECTION : 303-03a Engine Cooling

CONTENTS PAGE

SPECIFICATIONS

General Specifications

Description	Specification	
Fan Speeds	Dual Fans	Single Fan
Passenger Side	1400, 2300 RPM @ 12.0V	
Driver Side	1400, 2300 RPM @ 12.0V	
Single Fan Low Speed		1120 RPM @ 13.4V 150W
Single Fan High Speed		1760 RPM @ 13.1V 300W
Fan Motor Rating	160 W	150-300W
Coolant Capacities		
6 Cylinder Engine	10.5 litres	
8 Cylinder Engine	16 litres	
Anti-Freeze		
All Engines	R133 Antifreeze/Antiboil contentrate, R135 Premixed	
Radiator Cleaner		
All Engines	Not allowed	
Radiator Cap Pressure (Supply Tank)		
All Engines	120 kPa	
Thermostat		
6 Cylinder	Starts to open 89° - 93°C	
	Fully open 103° - 106°C	
	Minimum travel of capsule from fully closed position: 7.1 mm	
8 Cylinder	Starts to open 89°C - 93°C	
	Fully open 103° - 106°C	

Coolant Additive

Level of Protection	Additive Specification	Volume of Additive	Volume of Water	Service Interval
Anti-corrosion & anti-freeze to minimum temp. of -16°C	R133 Antifreeze/Antiboil	33% (5.3 litre)	67% (10.7 litre)	3 Years 100,000 km
Anti-corrosion & anti-freeze to minimum temp. of -37°C	R133 Antifreeze/Antiboil	50% (8 litre)	50% (8 litre)	4 Years 120,000 km

Anti-Freeze Concentration

Specific Gravity	Approximate % of Anti-Freeze (by volume)	Remains Fluid to (C°)	Solidfies at (C°)
1.080	50	-37	-58
1.065	40	-25	-45
1.050	30	-16	-39
1.042	25	-13	-29
1.034	20	-9	-19
1.026	15	-7	-14
1.016	10	-4	-8

SPECIFICATIONS (Continued)

Torque Specifications - 6 & 8 Cylinder

Description	Nm
Water outlet housing	21
Radiator support bracket (lower) (thru bolt)	30
Radiator support bracket (lower) (vertical bolt)	18
Radiator support bracket (upper)	9
Radiator hose clamps	5
Transmission oil cooler tube nuts	20
Fan shroud asy screw to radiator	6
Water pump I6	20
Water pump V8	25
Water pump pulley V8	25

DESCRIPTION AND OPERATION

Engine Cooling

Radiator

The radiators are of the tube and fin-core type with the tubes arranged for horizontal coolant flow.

Two header tanks, one at each end of the core provide uniform distribution of the coolant to the tubes. The radiator outlet port is connected to the water pump inlet port. The radiator inlet port is connected to the coolant outlet housing of the engine, thereby permitting coolant circulation through the radiator when the thermostat is open.

Midway down the right hand side radiator header tank is the coolant supply tank feed port, this connects the cooling system with the supply tank. The supply tank provides a chamber to accommodate the expansion of the coolant as engine temperature increases.

A small port is located at the top of the right hand side tank. It is connected to the top of the supply tank. This port aids the self purging of air from the cooling system.

An oil cooler is located in the radiator outlet header-tank to cool transmission fluid for V8 automatic transmission vehicles.

A drain cock is located at the bottom of the left hand side tank.

The coolant supply tank cap incorporates a pressure TBA kPa (18 psi) pressure relief valve and vacuum valve. For routine coolant level inspections the tank provides a quick visual method for determining thenve coolant level without removing the tanks cap.

Should the coolant level exceed the capacity of the header tank it is discharged out the overflow channel. The header should never be overfilled; overfilling the header tank increases the system operating pressure which shortens component life.

With the engine cold the level of coolant in the supply tank should be between the cold max and min lines on the supply tank.

Electric Dual Fans

The vehicle fitted with dual electric fans is controlled by three relays linked to the PCM module.

During service operations ensure that the fans are not rotated in a direction opposing normal operation as this may damage the motor (refer to arrows on fan blades).

Two operating modes are used (excluding OFF) depending on the status of the three relays (determined by the PCM module). The different operating modes provide different cooling capabilities.

Refer to Wiring Diagrams section for a schematic of the Fan Control System.

Electric Single Fan

The vehicle fitted with a single electric fan is controlled by two relays linked to the PCM module.

During service operations, ensure that the fan is not rotated in a direction opposing normal operation as this may damage the motor (refer to arrow on fan blade).

Two operating modes are used (excluding OFF) depending on the status of the two relays (determined by the PCM module). The different operating modes provide different cooling capabilities.

Refer to Wiring Diagrams section for a schematic of the Fan Control System.

CAUTION: When the ignition is in the ON position the fans may start without warning.

CAUTION: When the engine is turned off, after running at extreme operating temperatures, the cooling fans may continue to run even with the ignition key removed.

Water Pump

A centrifugal-type water pump is mounted on the front of the cylinder block.

A vane-type impeller supplies coolant through centrifugal action to the water pump outlet port.

If the pump is found to be faulty remove and discard as it is of a sealed unit type which cannot be repaired.

Cooling System

The cooling system operates as follows:

- Coolant flows through the radiator tubes and is cooled by air passing over the cooling fins assisted by the radiator electric fans.
- Coolant expands as the temperature and pressure rise in the system.
- When the limiting system working pressure is reached, the pressure relief valve in the supply cap is lifted from its seat and allows coolant to flow through the supply tank overflow channel.
- The supply tank cap has a rubber seal on the underside to prevent leakage.
- When the system temperature and pressure drop, the coolant contracts in volume and the pressure in the radiator is reduced.

WARNING: Never remove the supply tank cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the supply tank, use extreme care when removing the supply tank cap from a hot supply tank. Wait until the engine has cooled, try squeezing the upper radiator hose to determine if the system is still under pressure. Then wrap a thick cloth around the supply tank cap and turn it slowly. Step back while the pressure is released from the cooling system.

DESCRIPTION AND OPERATION (Continued)

When certain all the pressure has been released, turn the supply tank cap (still with a cloth), and remove it.

WARNING: The engine radiator electric fans may come on at any time without warning. Disconnect battery ground cable before servicing - this will clear diagnostic trouble codes and adaptive learning. When the service is complete re-connect the battery ground. The vehicle must then be driven for 30 minutes and idled for 15 minutes to relearn, (suggest using a 9 volt memory minder in the cigar lighter to retain keep alive memory).

Cooling Maintenance

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function it must receive proper care. This includes maintaining corrosion protection, keeping radiator fins clean, and periodic inspection of the cooling system for leakage.

Use care when removing the supply tank cap to avoid injury from escaping steam or hot water.

To prevent the build up of rust, sludge and other foreign material in the cooling system, add the specified Corrosion Inhibitor at the intervals specified.

Corrosion inhibitor is within released service coolant.

Radiator or cooling system cleaner is not to be used. Flush the cooling circuits with "drinkable" water only.

If it is found necessary to remove build up of foreign material from the cylinder block or radiator owing to neglect of adding an inhibitor, use the specified radiator cleaner. Removal of such material restores cooling efficiency and avoids over-heating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method. Only use "drinkable" water or released service coolant for this cleaning process.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head bolts are properly tightened to prevent possible water leakage into the cylinders.

NOTE: Always remove the thermostat prior to pressure flushing the engine.

When pressure flushing the engine or radiator, flush in the reverse direction to normal water flow.

A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

The pressure applied to the radiator must not exceed the supply tank cap relief pressure.

The coolant is water and Ethylene Glycol antifreeze R133. Refer to specifications. All water is to be "drinkable", preferably de-ionised water. Premixed coolant (R135) comes with de-ionised water as the dilutant.

CAUTION: R133 is not compatiblewith soluble oil or soluble oil based additives, orleak-stop additives. Do not use these otheradditives in the vehicle's cooling system.

If any of these other additives have been added to the coolant, the system must be drained and cleaned with Motorcraft radiator cleaner R1-5 and then thoroughly reverse flushed before refilling with clean water and the specified quantity of Motorcraft R1-33. Refer to "DRAINING AND FILLING THE COOLING SYSTEM" in this part.

WARNING: Do not remove the coolant supply cap when the engine is hot. Allow the engine to cool before removing the cap. Even then use extreme care when removing the cap; wrap a thick cloth around the cap and turn it slowly. Step back while pressure is released from the cooling system. When sure that all pressure has been released, using the cloth, remove the cap.

WARNING: R133 Anti-Freeze/Anti-Boil Concentrate and R135 contains ethylene glycol and/or other constituents whichare toxic if taken internally and can be absorbedin toxic amounts on repeated or prolonged skincontact. To promote the safe handling of coolantthe following precautions should be adhered to:

- Maintain adequate ventilation and do not inhale vapours.
- Must never be taken internally. If accidentally swallowed seek medical advice immediately.
- Avoid skin contact. In the event of accidental spillage onto the skin, wash off as soon as possible. If clothing is splashed it should be removed and washed to avoid prolonged skin contact.
- Avoid spillage on vehicle paint work. Wash off immediately with water.
- Ensure all hose clamps are orientated in such a way to maximise clearance from the hose clamps to adjoining components.
- Ensure all shielding on hoses as released is in place to effectively guard hoses from abrasion that could lead to coolant leaks.

DIAGNOSIS AND TESTING

Engine Cooling

Special Tool(s)
Radiator Cap/Cooling System Pressure Tester Available Commercially E 9353 (Litchfield Tools)
Constant Tension Clamp Tool Drive Belt Available Commercially E 9353 (Litchfield Tools)

Inspection and Verification

1. Verify the concern by operating the engine cooling system to duplicate the concern.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Damaged hoses.	• Circuitry open/shorted.
• Loose/damaged hose clamps. • Damaged thermostat. • Damaged head gaskets. • Damaged water pump. • Damaged radiator. • Damaged supply tank • Damaged heater core. • Damaged heater water control valve • Damaged Remote Auto Transmission Oil warmer/cooler	• Damaged fan control relays • Damaged radiator electric motor, fan blade and fan shroud assembly. • Damaged or faulty PCM. • Open circuit in FAN 2 motor.

3. If the concern(s) remains after the inspection, determine the symptom(s) and proceed to the following Symptom Chart.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

Condition	Source	Action
• Loss of Engine Coolant	• Damaged radiator. • Damaged water pump. • Loose/damaged radiator hoses. • Loose/damaged heater hoses. • Loose/damaged Remote Auto transmission Oil warmer/cooler hoses • Damaged Remote Auto transmission oil warmer/cooler • Damaged heater water control valve • Damaged heater core. • Damaged engine gaskets. • Damaged supply tank. • Damaged cap relief valve. • Damaged drain cock.	• Go to Test A.
• Engine Overheats	• Damaged thermostat. • Damaged water pump. • Internal engine coolant leak. • Cooling fan(s) inoperative. • Radiator coolant flow obstruction (internal) • Radiator air flow obstruction (external fins) • Heater core blocked. • Openings or grille blocked. • Damaged or faulty PCM. • Airlock in system	• Go to Test B.
• Engine Does Not Reach Normal Operating Temperature	• Damaged thermostat. • Cooling fan(s), PCM fault. • Low engine coolant.	• Go to Test C.
• Water pump leaking	• Gasket (leak at pump/block interface)	• CHECK bolt torques. Perform pressure test both statically and dynamically and visually confirm leak. REPLACE water pump if necessary.
	• O-Ring (leak at heater tube)	• Perform pressure test both statically and dynamically and visually confirm leak. REPLACE O-Ring.
	• Weep hole	• A small amount of weep through this hole is considered normal and acceptable. Perform pressure test both statically and dynamically and visually confirm leak. REPLACE water pump if necessary. Coolant leakage rate should not require coolant circuit attention between regular recommended services.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A : LOSS OF COOLANT

Test Step		Result / Action to Take
A1	**CHECK COOLANT LEVEL**	
	NOTE: If engine is hot, allow engine to cool down before proceeding. • Check coolant level coolant supply tank. • **Is coolant level OK?**	**Yes** Go to **A2** **No** REFILL coolant. Go to **A2**
A2	**CHECK FOR VISIBLE LEAKAGE**	
	• Engine coolant has an added dye colour that makes the coolant an excellent leak detector. • Check entire cooling system for visible leakage. • **Is there visible leakage?**	**Yes** Rectify leak. RETEST system. **No** Go to **A3**
A3	**CHECK SUPPLY TANK CAP**	
	• Using a Radiator/Heater Core Pressure Tester test radiator cap as outlined in this section. • **Did supply tank cap test OK?**	**Yes** Go to **A4** **No** REPLACE damaged supply tank cap. RETEST system.
A4	**CHECK COOLANT FOR INTERNAL LEAKAGE**	
	• Visually inspect coolant in radiator and coolant supply tank for signs of transmission or engine oil. • **Is oil evident in coolant?**	**Yes** If engine oil is evident, Go to Section 308-03 If transmission oil is evident,Go to Section 307-01 or Section 308-03 **No** Go to **A5**
A5	**CHECK ENGINE AND TRANSMISSION FOR COOLANT**	
	• Remove oil level indicator from engine and transmission. • Carefully inspect oil level indicator for evidence of coolant. • **Is coolant evident?**	**Yes** If coolant is in engine,Go to Section 303-00 If coolant is in transmission, Go to Section 307-01 0r Section 308-03 **No** Go to **A6**
A6	**PRESSURE TEST COOLING SYSTEM**	
	NOTE: Check inside vehicle for possible heater core leakage. • Using a Radiator/Heater Core Pressure Tester conduct a pressure test. • Check for any signs of visible leakage. • **Is there leakage?**	**Yes** Rectify leak. RETEST system. **No** Cooling system is operational at this time. RETEST system.
A7	**CHECK RTOC**	
	• Check Remote Transmission Oil Cooler. Refer section 307-02. • **Is RTOC OK?**	**Yes** RETEST SYSTEM. **No** REPLACE RTOC.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B : ENGINE OVERHEATS

Test Step		Result / Action to Take
B1	**CHECK COOLANT LEVEL**	
	NOTE: If engine is hot, allow engine to cool down before proceeding. • Remove supply tank cap and check coolant level at supply tank. • **Is coolant level OK?**	**Yes** Go to **B2** **No** REFILL coolant. Go to **A**
B2	**CHECK COOLANT CONDITION**	
	• Check coolant for contaminants such as rust or corrosion. Also check for fluid discoloration. • **Is coolant condition OK?**	**Yes** Go to **B3** **No** RETEST system.FLUSH system.
B3	**CHECK FOR AIRFLOW OBSTRUCTION**	
	• Visually inspect A/C condenser core and radiator core for obstructions such as leaves or bugs. • **Is there any obstruction?**	**Yes** REMOVE obstruction and CLEAN A/C condenser core and radiator. RETEST system. **No** Go to **B4**
B4	**CHECK HEATER CORE OPERATION**	
	• Install supply tank cap. • As engine starts to warm up, feel the inlet and outlet heater water hoses. They should feel the same after three or four minutes. • **Is outlet heater water hose the same temperature as the inlet heater water hose?**	**Yes** Go to **B5** **No** TURN engine OFF before it overheats. SERVICE heater core. RETEST system.
B5	**CHECK WATER THERMOSTAT OPERATION**	
	• Allow engine to run for 10 minutes. • Feel the inlet and outlet heater water hoses and the underside of the upper radiator hose. • **Are the upper radiator hose and heater water hoses cold?**	**Yes** REPLACE water thermostat. RETEST system. **No** Leave engine RUNNING. Go to **B6**
B6	**CHECK COOLING FAN (S)**	
	• Refer to Cooling Fan(s) Self Test in this section.	

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST C : ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

Test Step		Result / Action to Take
C1	**CHECK ENGINE TEMPERATURE**	
	• Start engine and allow to RUN for 15 minutes. • Feel inlet and outlet heater water hoses and underside of upper radiator hose. • **Are upper radiator hose and heater water hoses cold?**	**Yes** REPLACE water thermostat. RETEST system. **No** CHECK coolant temperature gauge for correct operation.

DIAGNOSIS AND TESTING (Continued)

Pressure Test

It is recommended that a cooling system pressure test gauge be used to properly test the system for:

- Blown or leaking cooling system sealing gaskets.
- Internal or external coolant leakage.
- Pressure cap malfunction.

Many types of pressure gauges are available for use. Therefore, it is recommended that the gauge manufacturer's instructions be followed when performing the test.

NOTE: Never exceed the rated pressure indicated on the pressure cap when performing the pressure test.

Supply Tank Cap Pressure Test

1. Remove the supply tank cap.
2. Use water to clean the cap seal and the vacuum relief valve.
3. Install the cap on a pressure test unit following the manufacturer's directions.
4. Slowly depress the plunger of the test unit pump until the highest reading is achieved on the gauge.
5. This reading should be within the specification for the cap being tested.
6. Repeat the test several times. If the gauge reading is not within specification replace the cap.

Thermostat Test

Thermostat Removed

Remove the thermostat and immerse it in boiling water. Remove when open and place a .05 mm feeler gauge in the throat of the thermostat and allow the thermostat to cool and clamp on the feeler gauge.

Suspend a thermometer into a container of cool water and heat the water.

Suspend the thermostat by the feeler gauge into the container of warming water. When the thermostat opens and drops off the feeler gauge, note the temperature.

Refer to Specifications in this section for the operating temperatures and opening dimensions.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to a lighted background. Slight leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

Coolant System

In the event no engine coolant is observed in the supply tank, or when a coolant level change does not occur, check the system as follows:

1. With the engine cold, remove the supply tank cap, and inspect the filler neck sealing gasket for foreign material between the gasket and cap body. Refer to supply tank Cap Cleaning and Inspection. Rinse supply tank cap in clean water.

The supply tank cap used on this system is unique; replace only with Ford approved supply tank cap for specific vehicle usage.

2. Replenish the engine coolant at the supply tank.
3. Install the supply tank cap.

Cooling Fans Self Test - Dual Fan Models

The cooling fan motors and circuits are tested during a PCM KOEO TEST. Refer to Section 303-14 Powertrain Control Module.

Fan Speed	Relay 1	Relay 2	Relay 3	Fan 1	Fan 2
OFF	OFF	OFF	OFF	OFF	OFF
LO	ON	OFF	OFF	LOW	LOW
HI	ON	ON	ON	HIGH	HIGH

Cooling Fan Self Test - Single Fan Models

The cooling fan motor and circuits are tested during a PCM KOEO TEST. Refer to Section 303-14 Powertrain Control Module.

Fan Speed	Relay 1	Relay 2
OFF	OFF	OFF
LO	ON	OFF
HI	OFF	ON

GENERAL PROCEDURES

Coolant Level Check

The coolant level is maintained by a coolant supply tank located on the right hand fender apron just ahead of the suspension tower. If there is no coolant visible in the supply tank the procedure quoted under 'DRAINING AND FILLING THE COOLING SYSTEM' must be used.

Do not remove coolant supply tanks pressure cap for routine coolant level inspections. The coolant supply tank provides a quick visual method for determining the coolant level without removing the pressure cap. With the engine cold, the level of the coolant supply tank should be between the COLD MIN and MAX lines on itsside wall. With the engine hot, the coolant level should be between the HOT MAX and MIN lines.

WARNING: Do not attempt to remove the supply tank cap under any circumstances while the engine is operating or while the engine is hot. To do so could result in serious personal injury from hot coolant or steam blowout and might lead to damage to the cooling system and the engine. Switch off the engine and wait until it has cooled. Check system pressure by squeezing the upper radiator hose. If there is very little deflection in the hose, this indicates high system pressure; proceed with caution. Use extreme care when removing the cap and wrap a thick cloth around the cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released - still with a cloth - turn cap and remove it.

NOTE: The level of the coolant in the supply tank should only be checked when the engine is cold.

- Remove the supply tank cap.
- Fill the supply tank to the FULL/MAX mark with specified coolant.
- Refit the supply tank cap correctly (fully tighten by hand).

NOTE: If the coolant tank requires topping up to maintain the correct level of coolant, the complete cooling system should be checked without delay.

NOTE: When topping up the cooling system a mixture of clean drinkable water and Motorcraft R1-33 inhibitor should be used. Adding additional water only will dilute the inhibitor and reduce its effectiveness. Refer to specifications.

Coolant Colour Inspection

CAUTION: Check the coolant level, engine oil and transmission fluid, top up the coolant if needed, if there is engine coolant in the engine oil or transmission fluid the cause must be corrected and oil/fluid changed or major component damage may occur.

The initial factory coolant fill is a 33% by volume mixture of glycol-based anti-freeze/ant-corrosion inhibitors in water, meeting Ford specification ESE-M97B44-A / WSS-M97B51-A1. Ford R1-33 meets this specification and is green in colour. Coolants meeting this specification but not having met Ford Component Compatibility Testing may not be substituted for R133 or R135.

1. Inspect the coolant colour:
   - If Engine Coolant R-33 or equivalent meeting Ford specification ESE-M97B44-A has a clear, light green or blue colour, this indicates higher water content than required.
   - Dark brown could indicate unauthorized stop leak may have been used. Flush the system and refill with the correct mixture of water and Premium Engine Coolant.
   - A light or reddish brown colour indicates that rust may be present in the cooling system.
   - Brown discolouration of coolant may be evident in Turbo variants with high duty cycles. It is recommended in this event that coolant is replaced every 50,000km.
   - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to **Diagnosis** in this section.
   - A milky brown colour may indicate that either engine oil or transmission fluid is entering the cooling system. If transmission fluid is detected then the cause may be a leaky RTOC (Remote Transmission Oil Cooler). Pressure test the cooling system. For additional information, refer to component tests in this section. If engine oil is suspected the cause of the leak may be internal to the engine. For additional information on engine diagnosis, refer to **Diagnosis** in this section.
   - If transmission fluid is contaminated with engine coolant the cause may be a leaky radiator, pressure test the system. For additional information, refer to the component tests in this section.
2. If engine coolant appearance is good, test the engine coolant range with the battery and antifreeze tester:
   - Maximum range is 50/50.
   - Minimum range is 33/67.
3. Adjust coolant range and level if necessary:
   - If coolant is low, add specified coolant mixture only.
   - If the engine coolant tests to weak, add straight engine coolant concentrate until the readings are within acceptable levels.
   - If the engine coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.

GENERAL PROCEDURES (Continued)

NOTE: Use only clean drinkable water In the engine cooling system. It is strongly recommended that in areas of heavily mineralised water (e.g. bore water), only non-mineralised water (e.g. rain water) is used. Mineral deposits on cooling surfaces will reduce the effectiveness of an engine cooling system and lead to engine overheating.

Adjusting Anti - Freeze Protection Level

NOTE: All vehicles are factory supplied with 33% concentration of R1-33 anti-freeze, which provides protection to -16 C.

The specific gravity of the coolant should be checked at the recommended service intervals and the concentration adjusted by adding either, anti-freeze alone, a mixture of anti-freeze and water or water alone, depending on whether the specific gravity is low, correct or high. The specific gravity is checked using an anti-freeze tests hydrometer with the coolant cold.

Example: Checking a 50-50 concentration of Motorcraft R1-33 anti-freeze (1.080 coolant specific gravity).

If the hydrometer reading is 1.080 or greater, no adjustment is necessary.

If the reading is less than 1.080, add R1-33 to the cooling system at the rate of 1 litre for each 0.012 S.G. increase required (e.g. 1.068 to 1.080).

NOTE: Draw of sufficient coolant to allow for the addition of the required quantity of R-133.

Anti-Freeze Replacement

NOTE: The cooling system should be drained, flushed with clean water and refilled with water and anti-freeze according to the recommendations given in the Specifications section of this Section.

Vehicles must be refilled using specified quantities of R1-33 in the cooling system.

Draining and Filling the Cooling System

Draining

WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in personal injury.

CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly.

NOTE: About 80% of coolant capacity can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

1. Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counter-clockwise. When the pressure is released, remove the pressure relief cap.
2. Remove lower air deflector.
3. Place a suitable container below the radiator drain cock.
- Open the drain cock or remove lower radiator hose and allow to drain.
- Close the radiator drain cock when finished.

To Refill

1. Refit the lower radiator hose or drain plug.
2. Add the specified amount of anti-freeze to the coolant supply tank.
3. Fill the system with clean water to the "ADD/MIN" mark on the supply tank.
   NOTE: CAPACITY: Includes heater and coolant pressure bottle.
   Most service refills are about 80 percent of capacity listed. This is because not all coolant is drained the cooling system.
4. Install the cap one turn only or depress and turn until fully locked.
5. Set the heater control to 'HOT'(for an Automatic Climate Control system set the temperature to 32°C).
   NOTE: The heater control doesn't require setting to hot as the heater core is constantly flowing coolant.
6. Start the engine and run it at 2000 rpm for 10 minutes to open the thermostat and purge air from the system.
7. Allow engine to cool down and fill to "COLD MAX" line.
8. Replace the cap.
9. Refit the lower air deflector. This procedure must be followed to ensure correct system performance.

GENERAL PROCEDURES (Continued)

Radiator Cleaning

Condition of driving - Town, City and Casual Driving

1. Loosen the top two radiator mounting brackets.
   NOTE: Cleaning of the radiator exterior is important to obtain maximum radiator efficiency and cooling performance.
2. Tilt the radiator and fan assembly rearwards from the top.
3. Use air pressure line to clear the debris then wash by using a hose (pressure cleaning is too aggressive) between radiator and condenser. Do not point the nozzle near the radiator and condenser fins as this may damage them.
4. Reposition radiator. Refer to the Radiator removal/installation in this section for additional information.

Condition of driving - Outback, Dirt and Field Driving

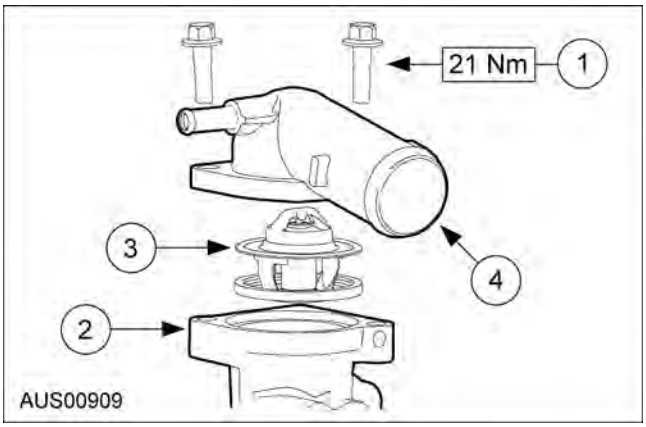
1. Remove the radiator as described in the Radiator removal in this section.
2. Use air pressure line to clear the debris then wash by using a hose (pressure cleaning is too aggressive) between radiator and condenser. Do not point the nozzle near the radiator and condenser fins as this may damage them.
3. Reinstall the radiator as described in the Radiator removal in this section.
4. Top up the coolant per specifications.

REMOVAL AND INSTALLATION

Thermostat

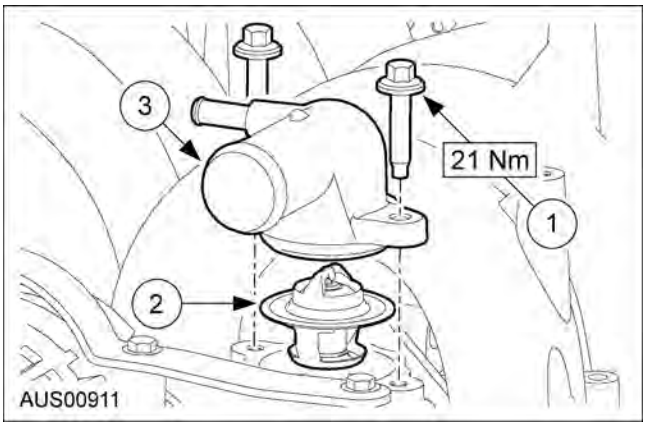
Removal and Installation

1. Partially drain the engine coolant so that the coolant level is below the thermostat. For additional information refer to Cooling System Draining Filling and Bleeding in this section.
2. Remove the two bolts and separate the water outlet adapter from the thermostat housing and slide (with hoses attached) to one side.



6 Cylinder

Item	Description
1	Bolt
2	Housing
3	Thermostat
4	Conn water outlet



8 Cylinder

Item	Description
1	Bolt
2	Thermostat
3	Housing

3. Remove the thermostat and the O-ring seal.
4. Clean and inspect the sealing surfaces.
5. To install reverse the removal procedure.
6. Refill and bleed the cooling system as previously described in this section.

NOTE: On thermostats that have a bleeder valve, the thermostat should be positioned with bleeder valve at the 12 o'clock position as viewed from front of engine.

Thermostat Housing - 8 Cylinder

Removal and Installation

NOTE: The 5.4 - 4V V8 thermostat housing is locate at the coolant cross over manifold between the cylinder heads.

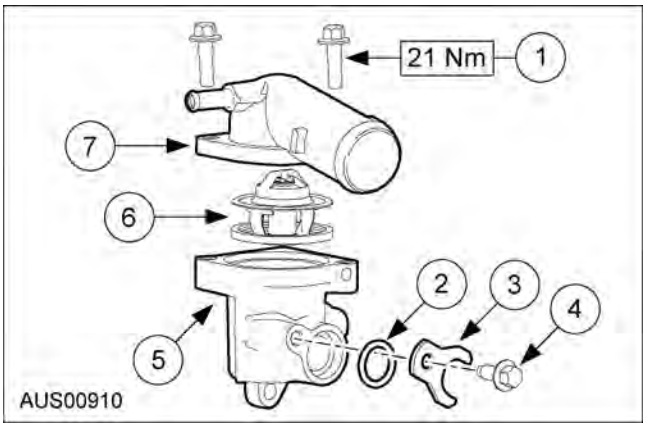
1. Disconnect the battery. For additional information refer to Electrical system section.
2. Remove engine appearance cover.
3. Remove the alternator. For additional information refer to Electrical system section.
4. Drain the engine coolant as previously described in this section.
5. Remove the Thermostat as previously described in this section.
6. Remove the two bolts securing the coolant manifold to the LHS cylinder head.
7. Remove heater hose from RH coolant manifold.
8. Remove M8 bolt on LH coolant manifold to head.
9. Remove coolant manifold.
10. Clean and inspect the O-ring.
11. Clean and inspect the sealing surfaces. To install, reverse the removal procedure.
12. Refill and bleed the cooling system as previously described in this section.
    NOTE: All hardware must be correctly installed and tightened to the torque specified.

REMOVAL AND INSTALLATION (Continued)

Thermostat Housing - 6 Cylinder

Removal and Installation

1. Remove the thermostat. For additional information, refer to Thermostat in this section.
2. Remove the bolt and clamp that holds the heater tube to the housing. Remove the bolt holding the heater tube on the inlet manifold. Withdraw the heater tube from the thermostat housing.
3. Remove the two bolts and separate the thermostat housing from the cylinder head.



Item	Description
1	Bolt
2	O-ring
3	Seal
4	Bolt
5	Housing
6	Thermostat
7	Conn Water outlet

4. Clean and inspect the sealing surfaces after removing all traces of gasket material.
5. Fit a new gasket and O-ring.
6. To install, reverse the removal instructions.
7. Refill and bleed the cooling system as previously described in this section.

Water Pump - 6 Cylinder

Special Tool(s)

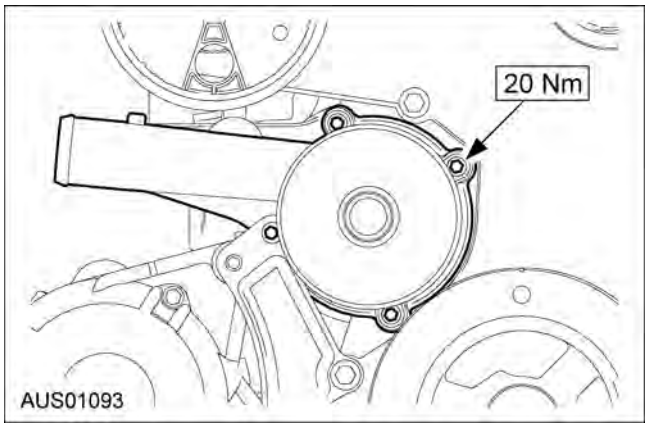
 SST416-D001	**Installer Power Steering Pump Pulley (6 & 8 Cylinder) 416-D001 (A7005)**

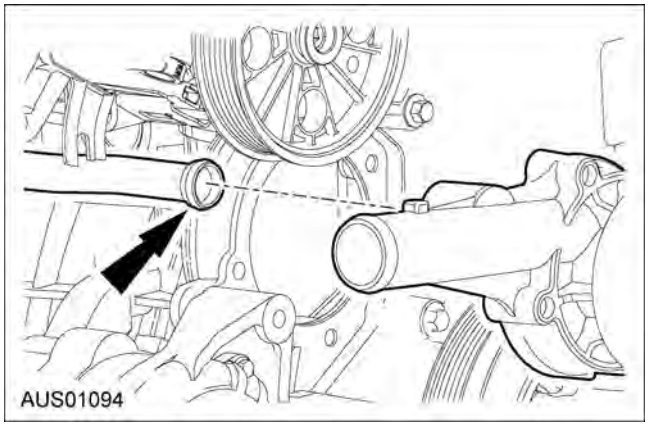
Special Tool(s)

 SST888-000	**Remover Power Steering Pump Pulley (6 & 8 Cylinder) 888-000 (A7185)**

Removal

1. Drain the cooling system as described in Section 303-03a.
2. Remove the accessory drive belt.
3. Remove lower radiator hose.
4. Remove bolt and clamp retaining heater pipe to rear of water pump.
5. Remove the water pump from the cylinder block being careful not to damage the heater pipe. This pipe is a slide fit with an "O" ring seal.





6. If necessary, the water pump pulley can be removed using 888-000.

Installation

NOTE: If necessary, install the water pump pulley before installing the water pump, using 416-D001.

1. Clean the heater outlet pipe and the matching opening in the water pump. Lubricate a new 'O' ring seal and install on the heater pipe.
2. Clean the pump and cylinder block mating surfaces and install a new gasket coated with water resistant sealer.

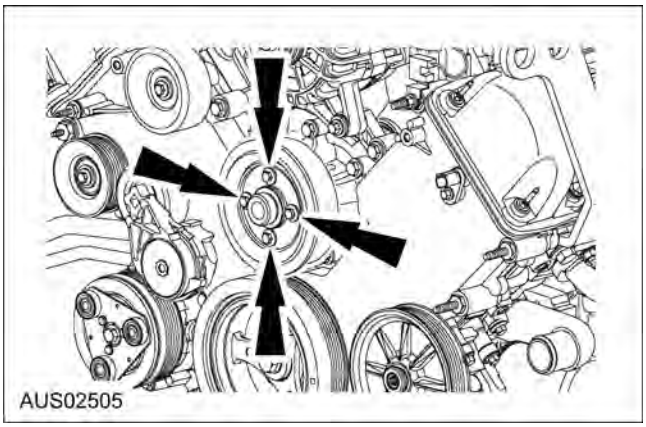
REMOVAL AND INSTALLATION (Continued)

3. Position the water pump on the cylinder block and heater pipe. Install the bolts and lock washers.
4. Refit the lower radiator hose.
5. Install the drive belt, refer to Section 303-03a
6. Fill the cooling system as described in Section 303-03a
   NOTE: All hardware must be correctly installed and tightened to the torque specified.

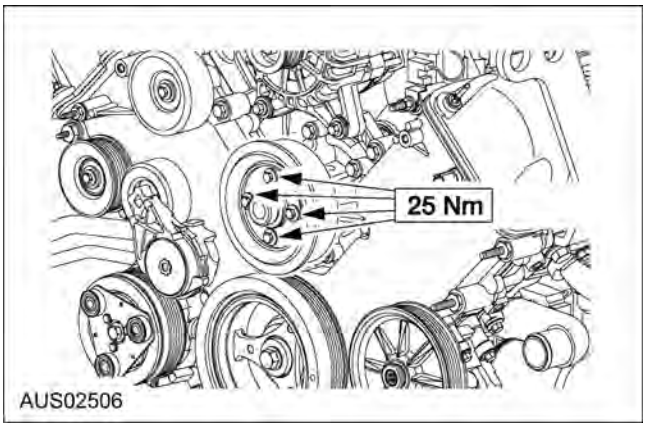
Water Pump - V8

Removal

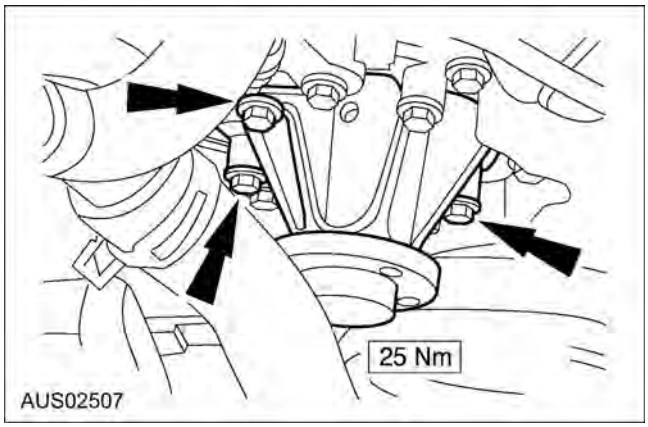
1. Drain the engine coolant. For additional information, refer to General Procedures in this section.
2. Loosen the coolant pump pulley bolts.



3. Remove the accessory drive belt. For additional information, Section 303-05
4. Remove the bolts and the coolant pump pulley.



5. Remove the four bolts.
6. Remove the coolant pump.



7. If necessary wipe the coolant pump mounting surface with a soft cloth.

   CAUTION: Do not rotate the coolant pump housing once installed in the engine. Damage to the O-Ring seal can occur, causing the coolant pump to leak.
   NOTE: Install a new O-Ring seal and lubricate with the same clean engine coolant that is present in the system. Do not mix coolant types.

Installation

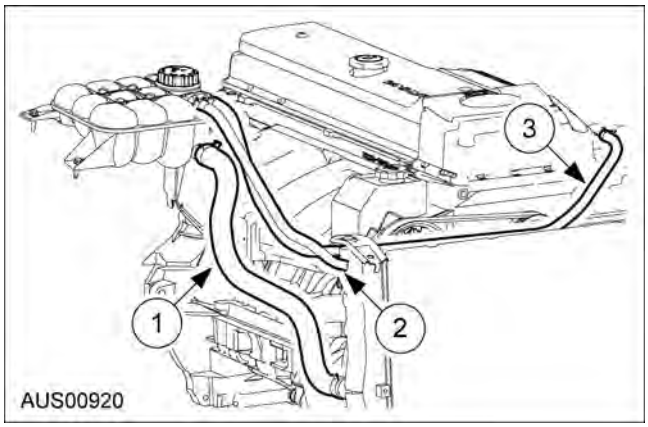
1. To install, reverse the removal procedure.

Radiator

Removal

1. Drain the cooling system as described in General Procedures Section. Disconnect the upper and lower radiator hoses.
2. Disconnect the coolant supply hose from the side of the radiator and the bleed hose from the top of the radiator.

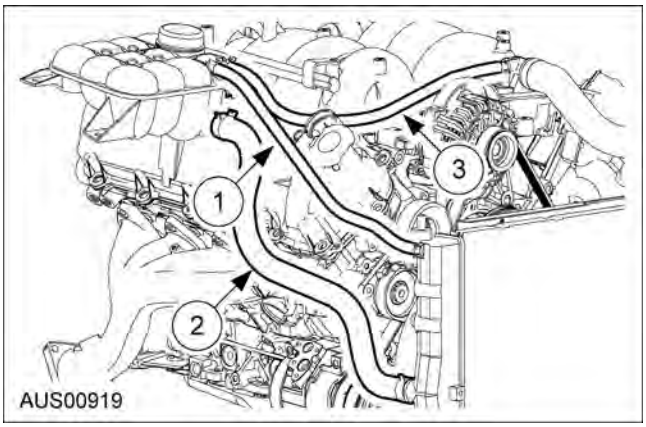
6 Cylinder



Item	Description
1	Hose assy. Upper
2	Hose assy. Bleed
3	Hose to engine vent

REMOVAL AND INSTALLATION (Continued)

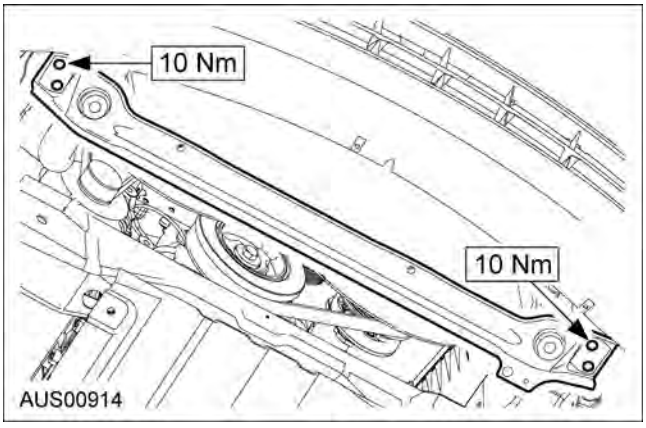
8 Cylinder



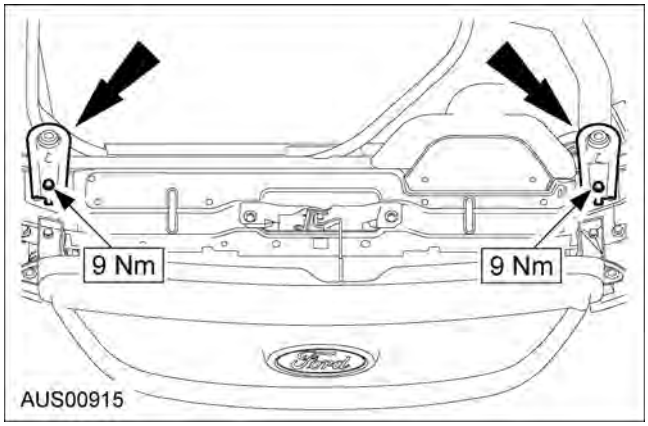
Item	Description
1	Hose assy. to bleed
2	Hose assy. Upper
3	Hose assy. Radiator overflow

3. On V8 vehicles equipped with automatic transmission disconnect the oil cooler lines at the radiator by removing retaining spring clips on radiator quick connects. Plug to guard against contamination entry.

   NOTE: Do not remove quick connect fitting from radiator end tanks as they are non-serviceable items.
4. Remove the air cleaner intake duct.
5. Remove the modesty panel.
6. Remove the 4 bolts holding the A/C condenser and wire or cable tie the condenser to the top cross-member.



7. Disconnect the electrical connections to the fans.
8. Remove the screws securing the fan shroud and fans to the top of the radiator, lift the shroud from the clips on the bottom of the radiator and lay it back.



9. Remove the radiator upper mounting brackets and carefully lift the radiator from the vehicle.

Installation

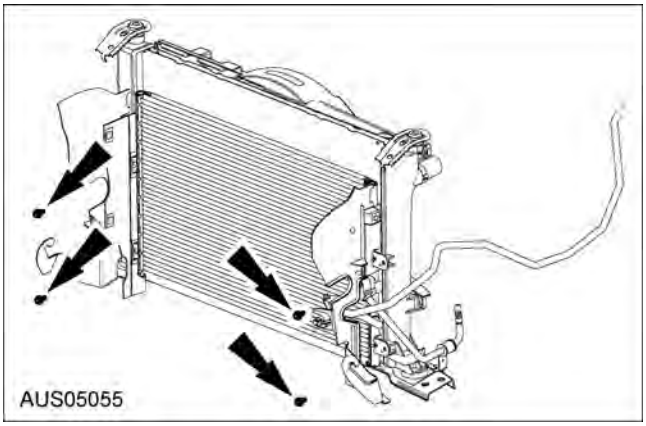
1. Locate the radiator in the vehicle and install the upper support brackets.
2. Locate the fan shroud in the brackets on the bottom of the radiator and install the two securing screws at the top of the shroud.
3. Connect the upper and lower hoses and the coolant supply hose. Connect the bleed hose to the radiator.
4. Connect the electrical connections to the fans.
5. Remove the support cable tie/wire from the top condenser and install the 4 A/C condenser mounting bolts.
6. Install the air cleaner intake duct.
7. Connect the oil cooler lines (V8 auto only) by pushing the transmission lines quick connect over the radiator spigot and check for securing by pulling rearward on the quick connect.
8. Install the modesty panel.
9. Fill the cooling system as described in General Procedures Section.

REMOVAL AND INSTALLATION (Continued)

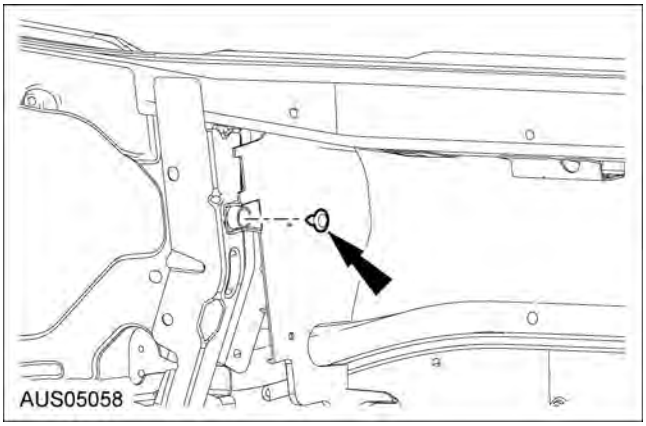
Radiator Side Shields - 6 Cylinder (non-turbo)

Removal

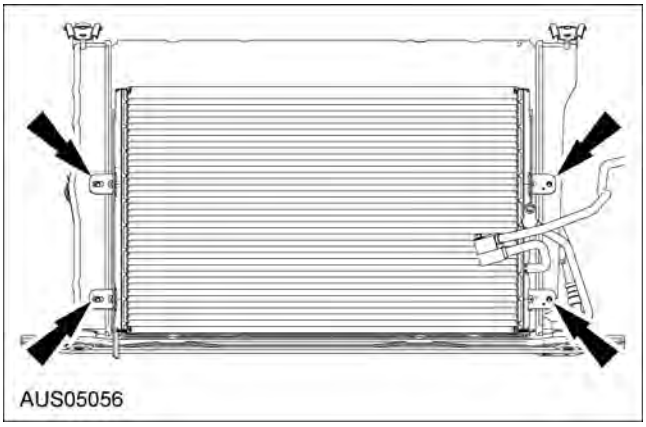
1. Remove scrivets connecting Radiator side shield 8310/1 to Radiator side shield 8110/1 on both LH and RH side. 4 in total



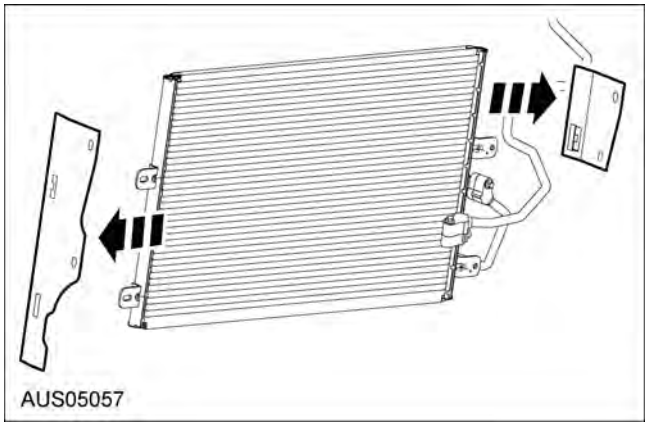
2. Remove M10 firtree attaching Radiator side shield 8110/1 to headlamp support panel on LH and RH side. 2 in total
3. Unclip Radiator side shield 8110/1 from lower cross on both LH and RHS



4. Remove screws connecting condenser to radiator on both LH and RH side. 4 in total



5. Remove Radiator side shield 8310/1 from condenser on both LH and RH side



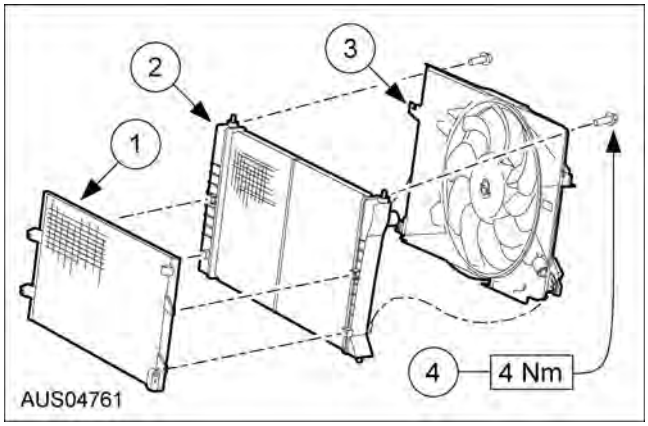
Installation

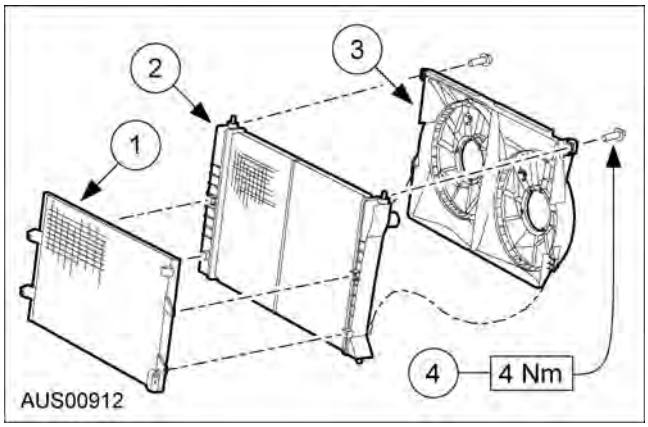
1. Reverse the procedure for fitment

Fan

Removal

1. Remove fan and shroud from vehicle.

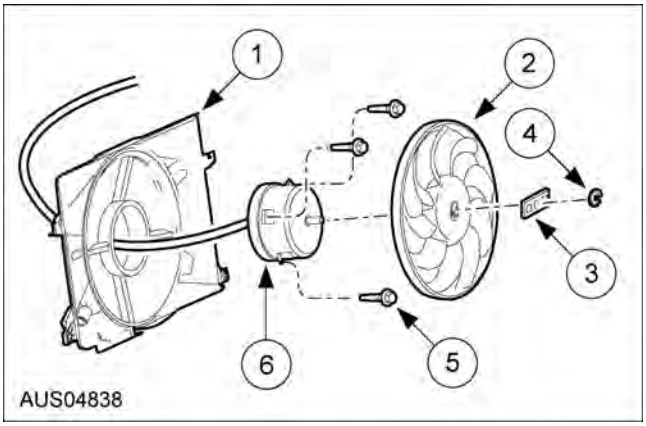




REMOVAL AND INSTALLATION (Continued)

Item	Description
1	Condenser assy.
2	Radiator assy.
3	Motor and Fan assy.
4	Screw and washer assy.

2. Lay the assembly flat.
3. Remove and discard the 'C' Spring Clip by gently sliding sideways.
4. Gently prise drive plate from cavity.
5. Remove fan.



Item	Description
1	Shroud
2	Fan
3	Drive plate
4	'C' Spring clip
5	Screw
6	Motor

Installation

1. Place fan on spindle.
2. Install drive plate ensuring locating peg fits into hole correctly.
3. Insert a new 'C' Spring Clip. Do not re-use the old clip.
4. Rotate fan (in the direction of normal operation) to ensure it rotates freely.
5. Install fan and shroud assembly into vehicle.

Radiator Hose

Removal and Installation

NOTE: Radiator hoses should be replaced whenever they become cracked, rotted or have a tendency to collapse, See Draining and Filling the Cooling System.

1. Drain radiator: then loosen the clamps at each end of hose to be removed. Slide hose off radiator connection and the cylinder head water outlet or water pump connection.
2. Position the clamps and hoses as shown in the applicable installation in this chapter. Tighten clamps.
3. Fill coolant supply tank to the "FULL/MAX" mark.
4. Fill and bleed the cooling system as described in Draining and Filling the Cooling System in this section.

NOTE: The hose clamps initial factory fit make use of a torque limiting cap that's drive shears off once the torque valve is reached.

For service remove the cap body by prying off to reveal the hand tool drive feature.

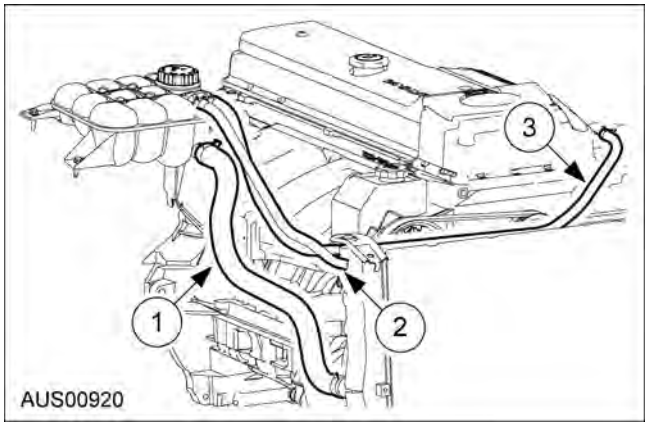
Install the hose clamps as close as possible to the bead on the inlet and outlet pipes. Use only Ford approved hoses and clamps when replacement is necessary. Clamps with a " bow spring'' show improved resistance to compression set of the rubber hoses

Coolant Supply Tank

Removal

1. Remove supply tank cap and loosen radiator drain tap and drain cooling system until no coolant remains in the supply tank.
2. Remove the bleed tubes found on upper surface of supply tank.

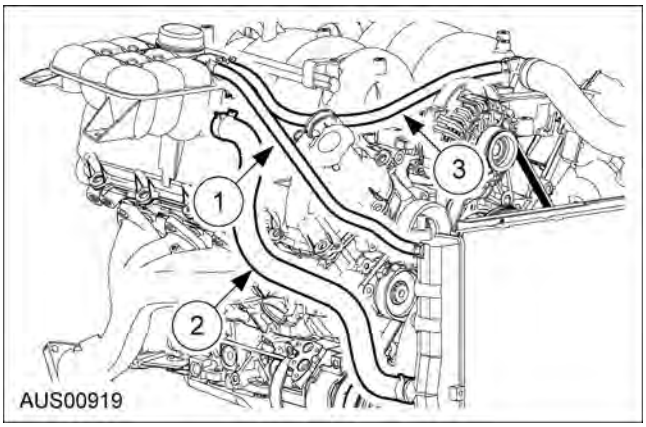
6 Cylinder



Item	Description
1	Hose assy. Upper
2	Hose assy. Bleed
3	Hose to engine vent

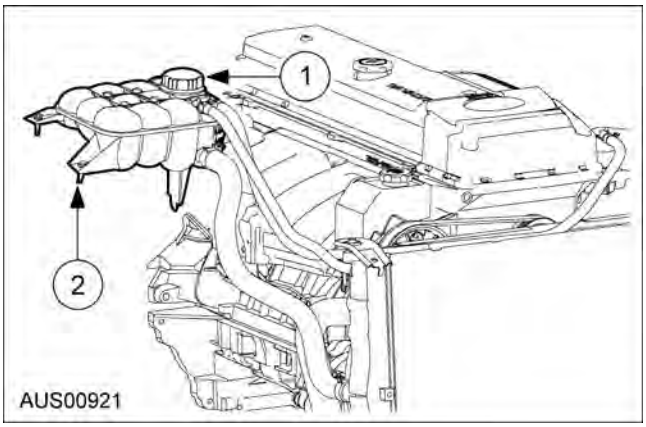
REMOVAL AND INSTALLATION (Continued)

8 Cylinder



Item	Description
1	Hose assy. to bleed
2	Hose assy. Upper
3	Hose assy. Radiator overflow

3. Remove the two bolts which retain the supply tank to the vehicle and release the leg to the RH suspension tower.



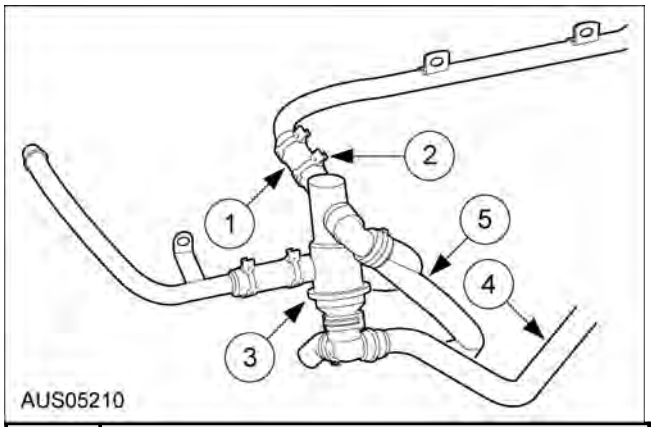
Item	Description
1	Supply tank cap
2	Screw

4. Remove coolant feed hose on side surface of supply tank.

Installation

1. Remove supply tank cap.
2. Position coolant feed hose onto supply tank.
3. Position supply tank in vehicle and tighten coolant feed hose.
4. Attach supply tank to vehicle using the locating leg and two attaching screws.
5. Attach bleed tubes to the top of the supply tank.
6. Fill the supply tank with coolant as described in General Procedures Section.

Heater Water Control Valve (I6 Auto engines only)



Item	Description
1	Hose connector
2	Hose clamp constant tension
3	Heater Water Control Valve
4	Coolant supply hose to RTOW/C
5	Coolant return hose from RTOW/C

REMOVAL AND INSTALLATION (Continued)

Removal and Installation

NOTE: Heater water control hoses should be replaced whenever they become cracked, rotted or have a tendency to collapse, See Draining and Filling the Cooling System.

1. Drain the cooling system as described in General Procedures Section.
2. The coolant supply/return hose connections to/from the Heater Flow control valve uses Quick Connects which do not require a special release tool to separate the connection. Simply pull up the retention clip and withdraw the hose from the spigot.
3. Raise the vehicle and disconnect the hose connectors and withdraw the valve.

   NOTE: The Heater Flow control valve is not a serviceable item
4. To install, reverse the removal procedure. Position the clamps and hoses as shown in the applicable installation in this chapter, then secure clamps.

   NOTE: The coolant hose QC do not require a tool to make connection, coolant hoses to **Heater Flow control valve**, are a push on self securing connection. (make sure retention clip is pushed home prior to fitment)
5. Fill coolant supply tank to the "FULL/MAX" mark.
6. Fill and bleed the cooling system as described in Draining and Filling the Cooling System in this section.

   NOTE: Install the hose clamps as close as possible to the bead on the inlet and outlet pipes. Use only Ford approved hoses and clamps when replacement is necessary. Clamps with a " bow spring'' show improved resistance to compression set of the rubber hoses.