

SECTION 05: COOLING SYSTEM

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1. DESCRIPTION

A radiator and thermo-modulated fan are used to effectively dissipate the heat generated by the engine. A centrifugal-type water pump is used to circulate the engine coolant (Fig. 1).

Two full blocking-type thermostats are used in the water outlet passage to control the flow of coolant, providing fast engine warm-up and regulating coolant temperature.

The engine coolant is drawn from the lower portion of the radiator by the water pump and is forced through the transmission cooler before going through the oil cooler and into the cylinder block.

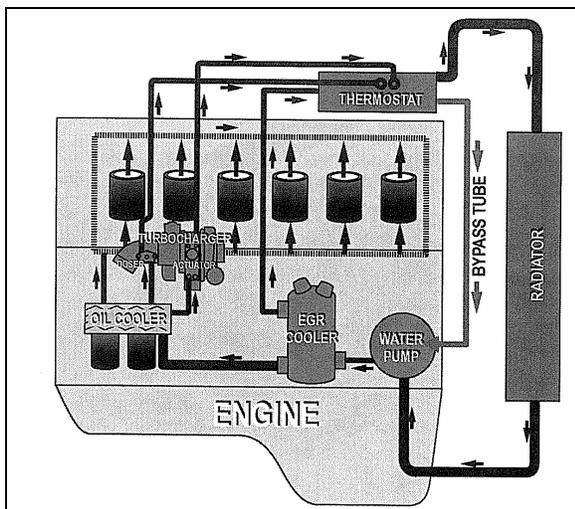


FIGURE 1: COOLANT FLOW SCHEMATIC (IMAGE DDC)

From the cylinder block, the coolant passes up through the cylinder head and, when the engine is at normal operating temperature, it goes through the thermostat housing and into the upper portion of the radiator. The coolant then passes through a series of tubes where its heat is dissipated by air streams created by the revolving fan and the motion of the vehicle.

Upon starting a cold engine or when the coolant is below normal operating temperature, the closed thermostats direct coolant flow from the thermostat housing through the by-pass tube to the water pump. Coolant is recirculated through the engine to aid engine warm up.

When the thermostat opening temperature is reached, coolant flow is divided between the radiator inlet and the by-pass tube. When the thermostats are completely open, all of the coolant flow is to the radiator inlet.

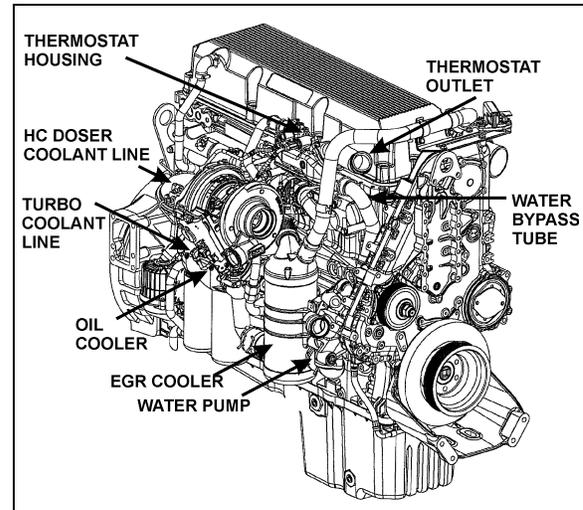


FIGURE 2: COOLING SYSTEM COMPONENTS 05116

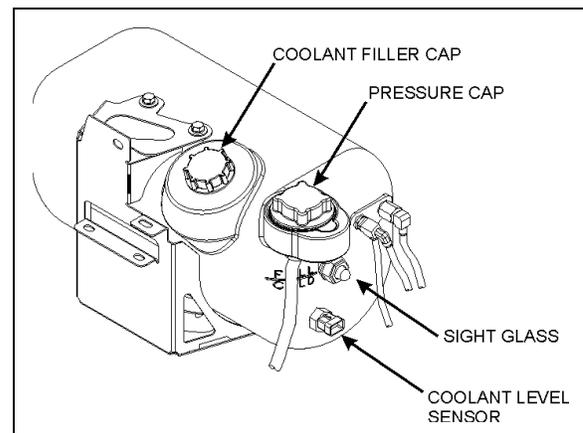


FIGURE 3: COOLANT SURGE TANK 05132

The cooling system is filled through a filler cap on the surge tank (Fig. 3). A pressure cap underneath the surge tank is used to maintain pressure within the system. When system exceeds normal pressure rating (14 psi - 96.53 kPa), the cap releases air and if necessary, coolant through the overflow tube (Fig. 4). Two thermostats are located in the housing attached to the right side of the cylinder head (Fig. 2). Furthermore, a water temperature sensor mounted on the cylinder head (radiator side) is also supplied for engine protection purposes.

The engine cooling system also provides hot coolant fluid for the vehicle heating system. Refer to section 22, "HEATING AND AIR CONDITIONING" in this manual for information relating to heating system water circulation.

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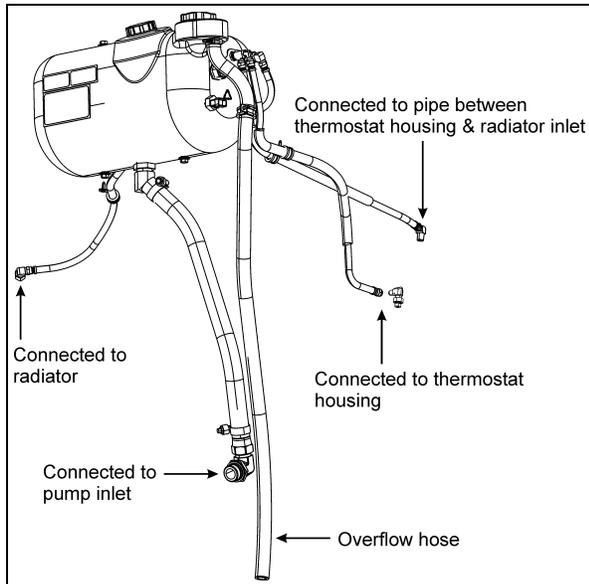


FIGURE 4: COOLANT SURGE TANK

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2. MAINTENANCE

A systematic routine inspection of cooling system components is essential to ensure maximum engine and heating system efficiency.

- Check coolant level in the surge tank daily, and correct if required. Test antifreeze strength.



MAINTENANCE

Maintain the prescribed inhibitor strength levels as required. Coolant and inhibitor concentration must be checked at each engine oil change, every 12,500 miles (20 000 km) or once a year, whichever comes first to ensure inhibitor strength. For vehicles equipped with coolant filters replace precharge element filter with a maintenance element filter as per "SPIN-ON COOLANT FILTER" in this section. If the vehicle is not equipped with a filter, add the recommended inhibitor concentration to the antifreeze/water solution.



MAINTENANCE

Drain, flush, thoroughly clean and refill the system every two years or every 200,000 miles (320 000 km), whichever comes first. For vehicle equipped with coolant filters, change the precharge element filter or the existing maintenance element filter for a new precharge

element filter. If the vehicle is not equipped with filters add the recommended inhibitor concentration to the antifreeze/water solution.

NOTE

Do not add inhibitors to the antifreeze / water solution if vehicle is equipped with a coolant filter.

Coolant must be discarded in an environmentally safe manner.

2.1 VEHICLES WITHOUT COOLANT FILTERS

Refer to Nalcool 3000 with Stabil-Aid bulletin annexed to the end of this section for preventive maintenance (at each oil change) and initial treatment instructions (each time the cooling system is drained and flushed).

2.2 VEHICLES WITH COOLANT FILTERS

Change the coolant precharge element filter for a maintenance element filter at initial oil change (see "Specifications" at the end of this section) and replace existing maintenance element filter with a new one as per "SPIN-ON COOLANT FILTER" in this section. A precharge element filter must be installed each time the cooling system is drained and flushed prior to installing a maintenance element filter.

- Check belts for proper tension; adjust as necessary and replace any frayed or badly worn belts.
- Check radiator cores for leaks and make sure the cores are not clogged with dirt or insects. To avoid damaging the fins, clean cores with a low-pressure air hose. Steam clean if required.
- Inspect the water pump operation. A leaky pump sucks in air, increasing corrosion.
- Repair all leaks promptly. Unrepaired leaks can lead to trouble. Inspect and tighten radiator mounts periodically. Test and replace thermostats regularly.

NOTE

In order to ensure the integrity of the system, it is recommended that a periodic cooling system pressure check be made. Pressurize the cooling system to 103-138 kPa (15-20 psi) using Radiator and Cooling System Tester, J24460-1. Do not exceed 138 kPa (20 psi).

Any measurable drop in pressure may indicate a leak. Whenever the oil pan is removed, the cooling system should be pressure checked as a means of identifying any incipient coolant leaks. Make sure the cause of the internal leak has been corrected before flushing the contaminated system.

Leaks at the thermostat housing hose connections may be caused by deformation of connections or by rough surfaces on the castings of the hose mounting surfaces. It is recommended that "Dow Corning RTV-102 Compound" or any equivalent product be applied on cast surfaces prior to hose installation.



CAUTION

Castings should be clean and free of oil and grease before applying compound. No other sealer should be used with RTV-102 compound.

3. HOSES

Rotten, swollen, and worn out hoses or loose connections are frequent causes of cooling system problems.

Serious overheating is often caused by an old hose collapsing or from rotten rubber shedding from hoses and clogging the coolant passages.

Connections should be inspected periodically and hose clamps tightened. Replace any hose found to be cracked or swollen.

When installing a new hose, clean pipe connections and apply a thin layer of a non-hardening sealing compound. Replace worn out clamps or clamps that pinch hoses.

3.1 CONSTANT-TORQUE HOSE CLAMPS ON COOLANT LINES

All hose clamps of 1 3/8" ID and over, used on the heating and cooling systems, are of the "Constant-torque" type. These clamps are worm-driven, made of stainless steel, and supplied with a series of Belleville spring washers. They also feature an extended integral liner that covers the band slots to protect soft/silicone hoses from damage, and help maintain consistent sealing pressure.

This type of clamp is designed to automatically adjust its diameter to compensate for the normal expansion/contraction of a hose and metal

connection that occurs during vehicle operation and shutdown. The constant-torque clamp virtually eliminates coolant losses due to "Cold flow" leakage and greatly minimizes clamp maintenance.

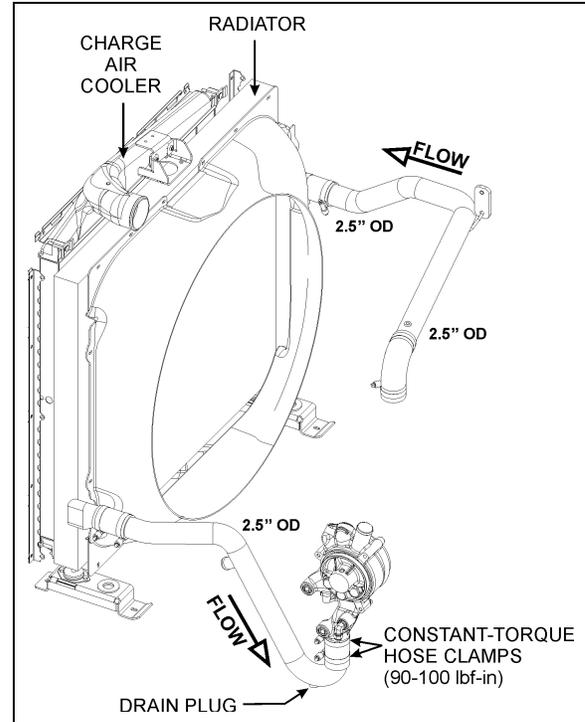


FIGURE 5: COOLANT FLOW TO RADIATOR 05133

3.1.1 Installation

A torque wrench should be used for proper installation. The recommended torque is 90 to 100 lbf-in. (10 to 11 Nm). The Belleville spring washer stacks should be nearly collapsed flat and the screw tip should extend 1/4" (6 mm) beyond the housing (Fig. 6).

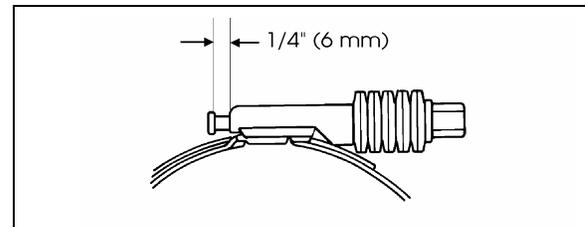


FIGURE 6: CONSTANT-TORQUE CLAMP 05037



CAUTION

The hose clamps will break if over-torqued. Do not over-tighten, especially during cold weather when hose has contracted.

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3.1.2 Maintenance

The constant-torque clamps contain a "Visual torque check" feature. When the tip of the screw is extending $\frac{1}{4}$ " (6 mm) out of the housing, the clamp is properly installed and maintains a leak-proof connection. Since the constant-torque clamp automatically adjusts to keep a consistent sealing pressure, there is no need to re-torque hose clamps on a regular basis. During vehicle operation and shutdown, the screw tip will adjust according to the temperature and pressure changes. **Checking for proper torque should be done at room temperature.**

3.2 CONSTANT-TORQUE HOSE CLAMPS ON CHARGE AIR COOLER (CAC)

If for any reason such as an accident, hose clamps need to be changed; install and tighten hose clamps to 10 ± 1 lbf-ft (dry) (Fig. 7).

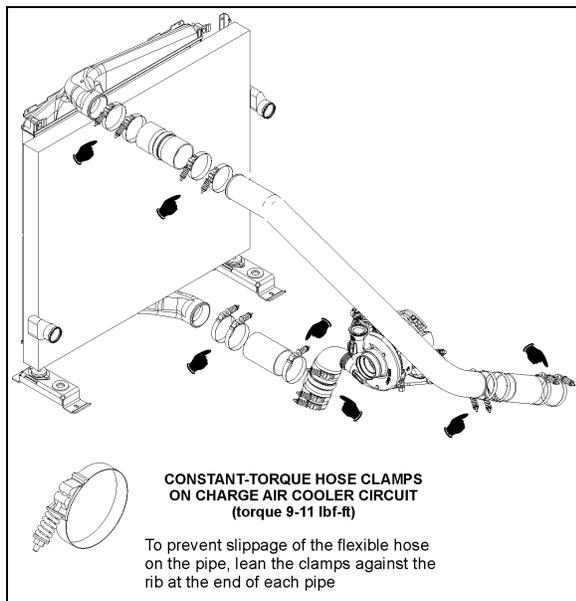


FIGURE 7: CHARGE AIR COOLER HOSE CLAMPS 05134



CAUTION

The hose clamps will break if over-tighten. Do not over-tighten, especially during cold weather when hose has contracted.

3.2.1 Maintenance

Since the constant-torque clamp automatically adjusts to keep a consistent sealing pressure, there is no need to retorque hose clamps on a regular basis. During vehicle operation and

shutdown, the screw tip will adjust according to the temperature and pressure changes.

Checking for proper torque should be done at room temperature.

4. THERMOSTAT OPERATION

Coolant temperature is controlled by two blocking-type thermostats located in a housing attached to the cylinder head, on the turbo side of the engine (Fig. 8).

At coolant temperature below approximately 182°F - 188°F (83°C - 86°C), the thermostat valves remain closed and block the flow of coolant from the engine to the radiator. During this period, all of the coolant in the system is recirculated through the engine and directed back to the suction side of the water pump via a bypass tube. As the coolant temperature rises above 182°F - 188°F (83°C - 86°C) the thermostat valves start to open, restricting the bypass system, and allowing a portion of the coolant to recirculate through the radiator. When the coolant temperature reaches approximately 202°F (95°C) thermostat valves are fully open, the bypass system is blocked off and the coolant is directed through the radiator.

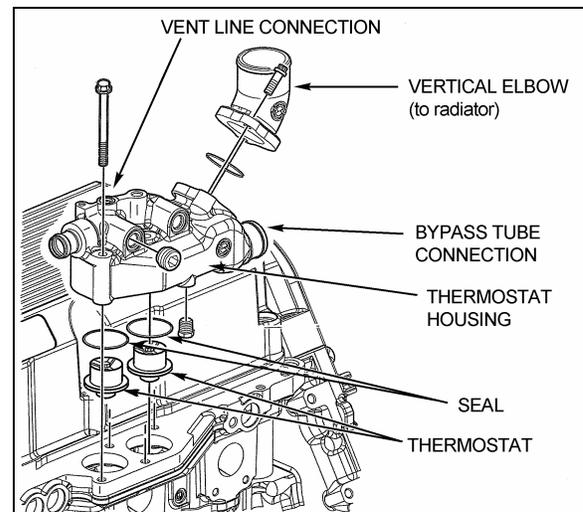


FIGURE 8: THERMOSTAT HOUSING (IMAGE DDC) 05117

5. COOLANT

5.1 COOLANT LEVEL VERIFICATION

Coolant level is correct when cold coolant is visible through the surge tank sight glass (Fig. 9). If coolant level is low, fill cooling system.

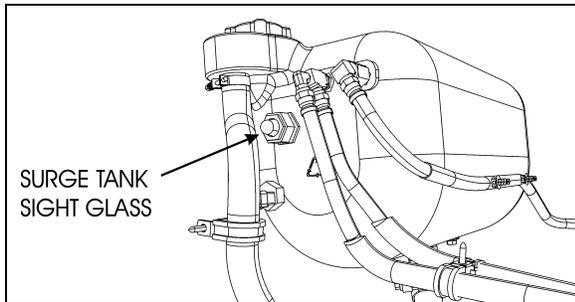


FIGURE 9: SURGE TANK SIGHT GLASS 05114

5.2 COOLANT LEVEL SENSOR

This warning device consists of a fluid level probe mounted on the surge tank. The probe sends a signal to the MCM to indicate coolant level. If the coolant level drops below the probe, the "Check Engine" light flashes and a diagnostic code is registered (see section 01 "ENGINE").

| |
|--|
|  CAUTION |
| Do not run engine with the "Check Engine" light flashing. |

The level probe is mounted on the R.H. side of the surge tank while the electronic module is mounted inside the rear electric junction box.

5.3 THAWING COOLING SYSTEM

If the cooling system becomes frozen solid, place the coach in a warm area until the ice is completely thawed. Under no circumstances should the engine be operated when the cooling system is frozen, as it will result in engine overheating due to insufficient coolant.

Once thawed, check engine, radiator and related components for damage caused by expansion of frozen coolant fluid.

5.4 COOLANT REQUIREMENTS

The coolant provides a medium for heat transfer and controls the internal temperature of the engine during operation. In an engine having proper coolant flow, some of the combustion heat is conveyed through the cylinder walls and the cylinder head into the coolant. Without adequate coolant, normal heat transfer cannot take place within the engine, and engine temperature rapidly rises. Coolant must therefore be carefully selected and properly maintained.

Select and maintain coolant in order to meet the following basic requirements:

- Provide for adequate heat transfer.
- Provide protection from cavitation damage.
- Provide a corrosion and erosion resistant environment within the cooling system.
- Prevent formation of scale or sludge deposits in the cooling system.
- Be compatible with the cooling system hose and seal materials.
- Provide adequate freeze protection during cold weather operation.

Combining suitable water with reliable inhibitors satisfies the first five requirements. When freeze protection is required, a solution of suitable water and antifreeze containing adequate inhibitors will provide a satisfactory coolant fluid. Ethylene glycol-based antifreeze is recommended for use in Series 60 engines. The cooling system capacity is 24 US gal (91 liters).

| |
|--|
| <p>NOTE</p> <p>In general, antifreeze does not contain adequate inhibitors. For this reason, supplemental coolant additives are required.</p> |
|--|

For a complete overview of engine coolants used with Detroit Diesel Engines, refer to "Coolant Selections" For Engine Cooling Systems Guide at the end of this section (#7se298).

5.5 COOLING SYSTEM RECOMMENDATIONS

Always maintain cooling system at the proper coolant level. Check daily.

The cooling system must be pressurized to prevent localized boiling of coolant. The system must be kept clean and leak-free. The filler and pressure caps must be checked periodically for proper operation.

A decal (052635) located on the surge tank provides information on recommended coolants.

| | | |
|--|---|--|
| <p>ANTI GEL</p> <p>ANTI FREEZE</p> |  | <p>AVERTISSEMENT NE PAS OUVRIR A CHAUD CAUTION NEVER OPEN WHEN HOT</p> <p>ANTI GEL RECOMMANDE : RECOMMENDED ANTI FREEZE : PREVOST#685125 DETROIT DIESEL POWER COOL 23512138 PRESTONE HEAVY-DUTY 72702, 70119, 70102</p> <p style="text-align: right;">052635 05104</p> |
|--|---|--|

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Recommended phosphate free coolants:

- Prevost #685125;
- Detroit Diesel "DDC Power Cool" (P/N 23512138);
- Prestone AF977 (bulk), 72702 (3.78 L), 70119 (205L), 70102 (4L).

coolant analysis program is available through Detroit Diesel distributors under part number 23508774.

5.6 INHIBITORS

A coolant solution, which has insufficient inhibitors or no inhibitors at all, invites the formation of rust, scale, sludge and mineral deposits within the cooling system. These deposits can cause water pump seal wear and coat the interior of coolant system passages. Heat transfer is reduced as deposits build up, leading to an overheating condition. Continued operation with this condition can lead to serious engine damage: liner scuffing, scoring, piston seizure and cylinder head cracking. These damages can occur quickly or over a longer period of time, depending of location and amount of deposits. Improperly inhibited coolants can become corrosive enough to "eat away" coolant passages and seal ring grooves and cause leaks to develop. Hydrostatic lock can occur if leak is internal and accumulates on top of a piston. The result may be a bent connecting rod. Cavitation erosion may occur in improperly inhibited coolants. Cavitation erosion is caused by the implosion of tiny bubbles against localized surfaces of the system. Such implosion causes pinpoint pressures high enough to erode pump impellers, cylinder liners and cylinder blocks. In extreme cases, their surfaces are so deeply pitted that they appear to be spongy, and holes can develop completely through them.

5.6.1 Inhibitor Test Procedures

Test Kits are commercially available to check engine coolant for nitrite concentration. Nitrite concentration is an indication of Supplemental Coolant Additive (SCA) level. Nitrite must be maintained within recommended levels. Coolant must be tested at each oil change to insure that inhibitor levels are maintained within the ranges shown hereafter:

NOTE

Above SCA values with Detroit Diesel #7se298 or TMC RP-329 "Type A". Use Nalco Chemical Company nitrite test kits (CO-318). A factory

DDC Fully Formulated Glycol Coolant Limits

| | |
|----------------|-------------------|
| -30 — 50(°F) | Freeze Point (°F) |
| 125 — 500 ppm | Boron (ppm) |
| 800 — 3200 ppm | Nitrite (ppm) |
| 200 — 750 ppm | Nitrate (ppm) |
| 50 — 250 ppm | Silicon (ppm) |
| 0 ppm MAX | Phosphorus (ppm) |
| 8.0 — 11.0 | pH |
| 40 ppm MAX | Chlorides (ppm) |
| 100 ppm MAX | Sulfates (ppm) |

5.7 COOLANT RECOMMENDATIONS

1. Always use recommended antifreeze, inhibitor and water at proper concentration levels. A 50% coolant/water solution is normally used as factory fill. Antifreeze concentration over 70% is not recommended because of poor heat transfer capability, adverse freeze protection and silicate dropout. Antifreeze concentration below 30% offers little freeze, boilover or corrosion protection.
2. Use only ethylene glycol antifreeze meeting the Detroit Diesel #7se298 or TMC RP-329 "Type A" formulation.
3. Use an antifreeze solution year-round for freeze and boil-over protection. Seasonal changing of coolant from an antifreeze solution to an inhibitor/water solution is recommended.
4. Pre-mix coolant makeup solutions at proper concentrations before adding to the cooling system.
5. Maintain the prescribed inhibitor strength levels as required.
6. Do not mix different base inhibitor packages.
7. Always maintain proper coolant level.



CAUTION

Always test the solution before adding water or antifreeze.

8. If cooling system is not at the proper protection level. Mix coolant/water solution to the proper concentration before adding to the cooling system
9. Use only non-chromate inhibitors.
10. Distilled water is recommended.

5.7.1 Coolant Not Recommended

- All antifreeze and coolant containing phosphorous;
- Automotive type coolants;
- Methoxy propanol-base antifreeze;
- Methyl alcohol-base antifreeze;
- Sealer additives or antifreezes containing sealer additives.

5.7.2 Additives Not Recommended

- Soluble Oils;
- Chromates.



WARNING

Never remove filler cap while coolant is hot. When coolant is at ambient temperature, release pressure from system by turning the pressure cap counterclockwise 1/4 turn; then remove filler cap slowly. A sudden release of pressure from the heated cooling system can result in severe burns from the expulsion of hot coolant fluid.

5.7.3 Vehicles Without Coolant Filters

Refer to Nalcool 3000 with Stabil-Aid bulletin annexed to the end of this section for preventive maintenance (at each oil change) and initial treatment instructions (each time the cooling system is drained and flushed).

5.7.4 Vehicles With Coolant Filters

Change the coolant precharge element filter for a maintenance element filter at initial oil changes (see Specifications at the end of this section) and replace existing maintenance element filter with a new one as per "SPIN-ON COOLANT FILTER" in this section. A precharge element filter must be installed each time the cooling system is drained and flushed before installing a maintenance element filter.

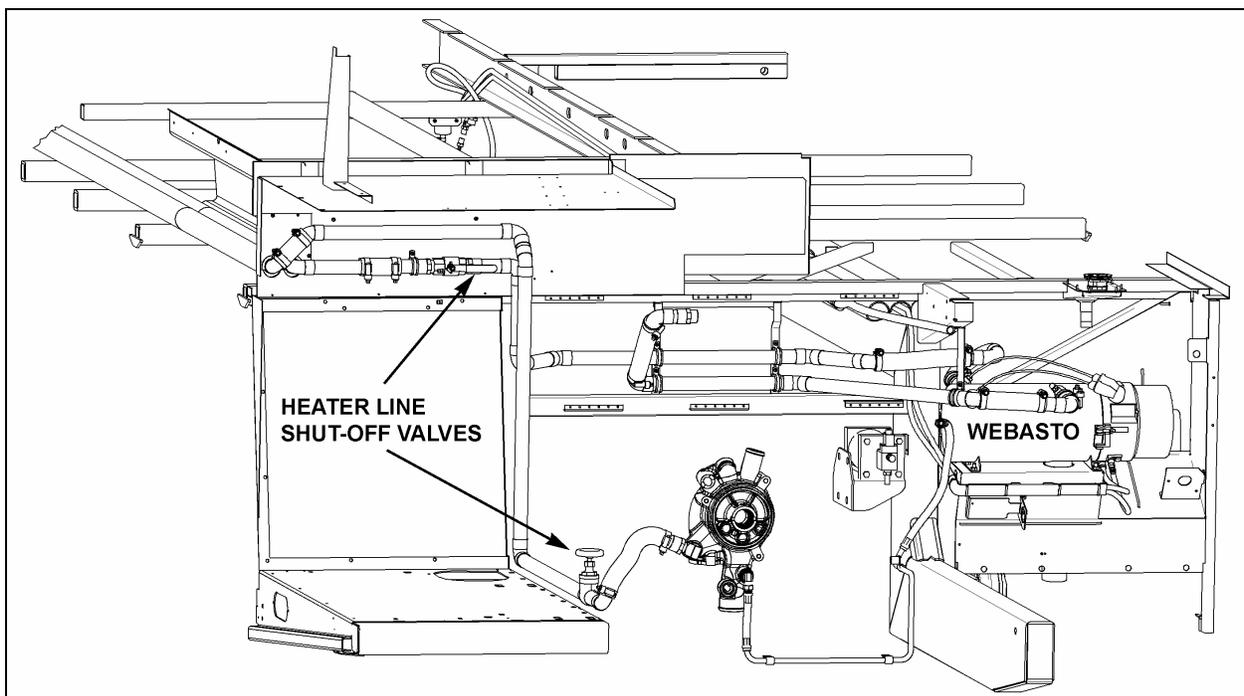


FIGURE 10: LOCATION OF HEATER LINE SHUT-OFF VALVES IN ENGINE COMPARTMENT

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NOTE

The coolant filter contains inhibitors.

6. DRAINING COOLING SYSTEM

Use the following procedures to drain the cooling system partially or completely.

To drain engine and related components:

1. Stop engine and allow engine to cool. Close both heater line shutoff valves.

On X3- 45 coaches, the valves are located in the engine compartment. One is located under the cooling fan right angle gearbox; another valve is on the L.H. side of the engine compartment in front of the radiator (Fig. 10).

NOTE

Refer to section 22 under "Preheating System" for information about preheater access and heater line shutoff valve.



WARNING

Before proceeding with the following steps, make sure the coolant has cooled down. The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury (scalding) from the hot liquid.

2. Unscrew the surge tank pressure cap counterclockwise, $\frac{1}{4}$ turn to let air enter the system and permit the coolant to drain completely from system.
3. Unscrew the water pump housing inlet line drain plug (Fig. 11).
4. Open drain cock at bottom of thermostat housing to drain the coolant trapped above the thermostats (Fig. 8).
5. Open the radiator drain cock.

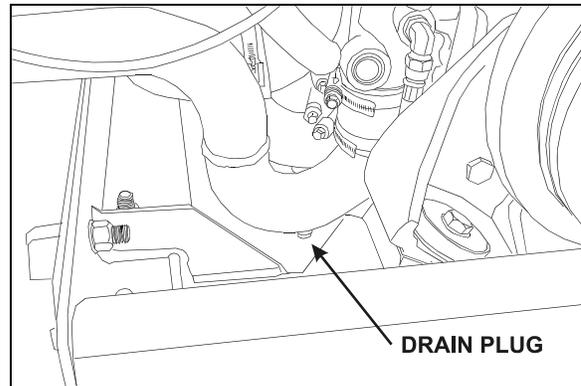


FIGURE 11: WATER PUMP DRAIN PLUG

05093

6. Open engine drain cock.
7. Remove the transmission oil cooler. Drain, flush and inspect. Refer to Section 7, "TRANSMISSION" for oil cooler maintenance or preventive replacement.



CAUTION

Drain water pump completely before extended storage to avoid possible water pump damage.

If freezing weather is anticipated and the engine is not protected with antifreeze, drain the cooling system completely when vehicle is not in use. Trapped water in the cylinder block, radiator or other components may freeze and expand resulting in damages. Leave the drain plugs open until the cooling system can be filled with coolant fluid. Do not run engine with cooling system empty.

To drain the entire system, do the previous steps while maintaining the shutoff valves in the open position; then follow the procedure under "9.2 Draining Heating System" in Section 22.

7. FILLING COOLING SYSTEM

If only the engine and related components were drained, maintain the two heater line shutoff valves in their closed position, then proceed as follows.

1. Close all drain cocks. Refer to draining procedure for the location of draining points.
2. Refill cooling system from the surge tank filler cap inlet with a recommended ethylene glycol-based antifreeze and water solution of the required concentration. Add Detroit Diesel selected product cooling system inhibitors (if required).

NOTE

The coolant level should remain within two inches of the surge tank filler neck.

NOTE

Make sure the vent line at top of thermostat housing is properly connected and not obstructed. The vent line (thermostat housing dome to radiator top tank) is required to ensure complete engine fill and proper venting of air in the system.

3. Install the filler and pressure caps, then start the engine and run it at fast idle until reaching normal operating temperature. Check for leaks.

NOTE

If for any reason, the coolant level drops below the surge tank level probe, the Check Engine light will flash.

4. Stop engine and allow cooling.
5. Open the two heater line shutoff valves, check the coolant level in the surge tank, and then add as required.



CAUTION

Never pour cold coolant into a hot engine. The sudden change in temperature may crack the cylinder head or block.

If the entire system has been drained, redo the previous steps while maintaining the two heater line shutoff valves in the "Open" position. With engine running, activate the driver's and central heating systems to permit coolant circulation. Complete the procedure by bleeding the heater cores as explained in Section 22, under "9.4 Bleeding Heating System".

8. FLUSHING

If the cooling system is contaminated, flush the cooling system as follows:

1. Drain the coolant from the engine.
2. Refill with clean water.



CAUTION

If the engine is hot, fill slowly to prevent rapid cooling and distortion of the engine castings.

3. To thoroughly circulate the water, start and run the engine for 15 minutes after the thermostats have opened.
4. Fully drain system.
5. Refill with clean water and operate for 15 minutes after the thermostats have opened.
6. Stop engine and allow cooling.
7. Fully drain system.

Vehicles without coolant filters:

Fill with a 50/50-antifreeze/water solution and add required inhibitors.

Vehicles with coolant filters:

Replace the coolant filter with a precharge element filter; in this case do not mix inhibitors with antifreeze/water solution.

Dispose of spent fluids in an environmentally responsible manner according to regulations in effect in your area.

8.1 COOLING SYSTEM DESCALERS

If the engine overheats and the fan belt tension, coolant level and thermostat operation have been found to be satisfactory, it may be necessary to de-scale and flush the entire cooling system.

Remove scale formation by using a reputable and safe de-scaling solvent. Immediately after using the de-scaling solvent, neutralize with a neutralizing agent. It is important that product directions be thoroughly read and followed.

After using the solvent and neutralizer, fully drain the system, and then reverse flush the engine and radiator (see "Reverse Flushing" in this section) before filling the system with coolant solution.

8.2 REVERSE FLUSHING

After the engine and radiator have been thoroughly de-scaled, they should be reverse-flushed. The water pump should be removed and the radiator and engine reverse-flushed separately to prevent dirt and scale deposits from clogging the radiator tubes or being forced through the pump. Reverse flushing is accomplished by hot water, under pressure, being forced through the cooling system in a direction opposite to the normal flow of coolant, loosening and forcing deposits out.

The radiator is reverse flushed as follows:

Section 05: COOLING SYSTEM

1. Remove the radiator inlet and outlet hoses and replace existing radiator cap with a new one.
2. Attach a hose to the top of the radiator to lead water away from the engine.
3. Attach a hose at the bottom of the radiator and insert a flushing gun in the hose.
4. Connect the water hose of the gun to the water outlet and the air hose to the compressed air outlet.
5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts.

NOTE

Apply air gradually. Do not exert more than 138 kPa (20 psi) air pressure. Too great a pressure may rupture a radiator tube.

6. Continue flushing until only clean water is expelled from the radiator.

The cylinder block and cylinder head water passages are reverse flushed as follows:

1. Remove the thermostats and the water pump.
2. Attach a hose to the water inlet of oil cooler housing to drain water away from engine.
3. Attach a hose to the water outlet at the top of the cylinder head (thermostat housing) and insert the flushing gun in the hose.
4. Turn on the water until the jackets are filled, and then turn on the air in short blasts. Allow jackets to fill with water between air blasts.
5. Continue flushing until the water from the engine runs clean.

If scale deposits in the radiator cannot be removed by chemical cleaners or reverse flushing as outlined above, it may be necessary to remove the upper tank and rod out the individual radiator tubes with flat steel rods. Circulate the water through the radiator core from the bottom to the top during this operation.

9. SPIN-ON COOLANT FILTER

The optional engine cooling system filter is used to filter out impurities such as scale or sand from the coolant and it also eliminates the process of adding inhibitors to the antifreeze/water solution.

The filter is mounted onto the cooling fan drive mechanism aluminum casting (Fig. 12).

NOTE

If a coolant filter is to be installed on an engine already in service, drain and flush the cooling system before installing the filter.

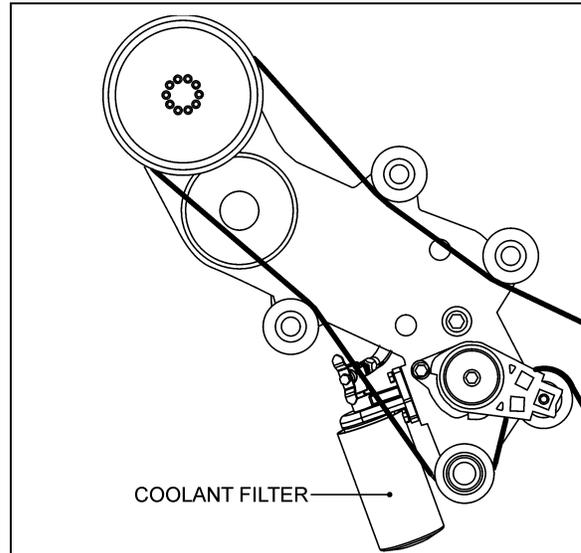


FIGURE 12: COOLANT FILTER

05138

To replace a filter:

1. Close the two filter shutoff cocks on the filter mounting head and unscrew the old filter from mounting.



WARNING

Failure to relieve cooling system pressure may result in personal injury.

2. Remove and discard the filter.
3. Clean the filter adapter with a clean, lint-free cloth.
4. Coat surface of gasket with oil, tighten 2/3 to 1 turn after gasket makes contact with head.
5. Open the two filter shutoff cocks.
6. Start engine and check for leaks.



CAUTION

Do not exceed recommended service intervals.

 **MAINTENANCE**

The precharge element filter lasts for 12,500 miles (20 000 km) or one year, whichever comes first. Replace the precharge element filter with a maintenance element filter, which lasts for 200,000 miles (320 000 km) or two years, whichever comes first. Each time the coolant is renewed, a precharge element filter must be installed before installing a maintenance element filter.

PRECHARGE ELEMENT FILTER
 Prevost number: 550629

MAINTENANCE ELEMENT FILTER
 Prevost number: 550630

CORROSION INHIBITOR & COOLANT STABILIZER
 Make: Detroit Diesel Number: 23507857
 Make: Nalco Number: DD3000-15

10. RADIATOR

The radiator is mounted on the L.H. side of engine compartment. It is designed to reduce the temperature of the coolant under all operating conditions. It is essential that the radiator core be kept clean and free from corrosion and scale at all times.

10.1 MAINTENANCE

 **MAINTENANCE**

Inspect the exterior of the radiator core every 25,000 miles (40 000 km) or once a year, whichever comes first. Clean with a quality grease solvent, such as a mineral spirits and dry with compressed air. Do not use fuel oil, kerosene, gasoline, or any caustic material. It may be necessary to clean the radiator more frequently if the vehicle is operated in extremely dusty or dirty areas. Refer to coolant system flushing and reverse flushing in this section for maintenance of radiator interior.

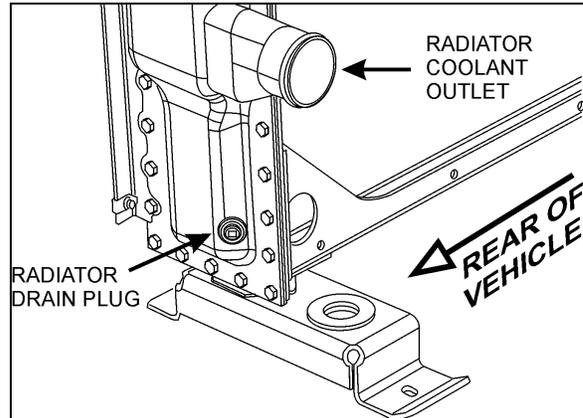


FIGURE 13: RADIATOR DRAIN PLUG 05139

11. CHARGE AIR COOLER LEAKAGE

Spec for CAC acceptable leakage:

“The CAC is considered acceptable if it can hold 30 psi (206 kpa) gauge pressure with less than 5 psi (34.5 kpa) loss in 15 seconds after turning off the hand valve.”

NOTE

This spec does not apply if there is any evidence that the leak was caused by a foreign object impact.

12. COOLING FAN DRIVE MECHANISM

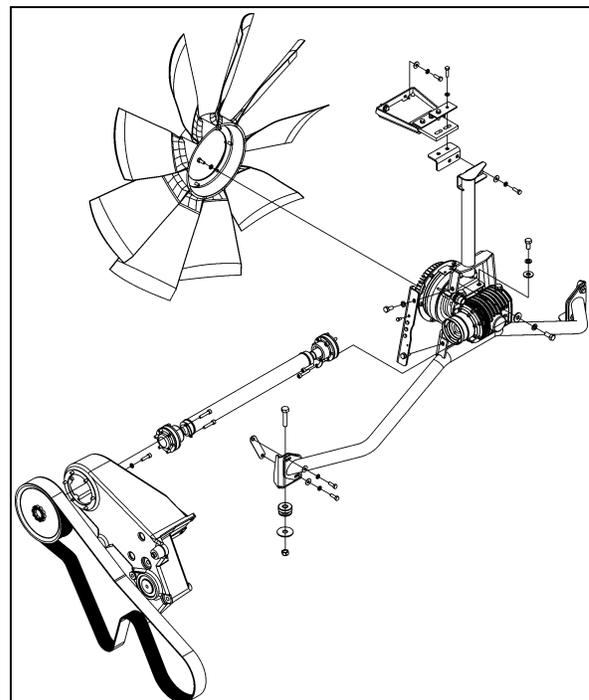


FIGURE 14: COOLING FAN DRIVE MECHANISM

Section 05: COOLING SYSTEM

12.1 DRIVE PULLEY AND UNIVERSAL JOINT SHAFT

To disconnect the universal shaft, proceed as follow:



WARNING

Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.

1. Unwrap the drive belt from around the pulley (see paragraph MOUNTING THE DRIVE BELT).
2. Dismount the drive pulley. Gain access to the 6 mounting bolts from behind the pulley, through the opening in the cast aluminum support (Fig. 15).
3. Unscrew and remove the universal joint shaft mounting bolts (6) at the right angle gearbox.
4. Slowly, move the shaft toward the rear of the vehicle.
5. Finally, dismount the universal joint shaft from the drive pulley (6 bolts).

Installation of the universal joint shaft is the same as removal, but in reverse order.

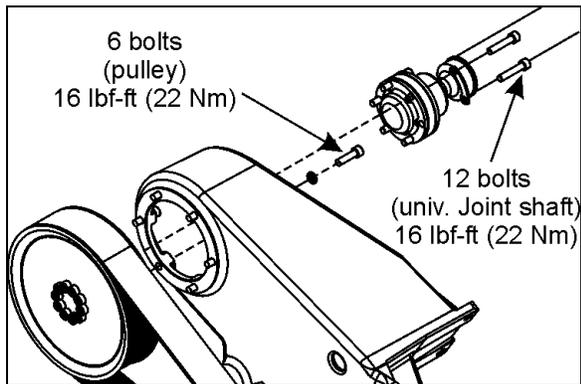


FIGURE 15: TIGHTENING SPECIFICATION

05123A

12.2 IDLER REPLACEMENT

If an idler is defective, replace as follow:



WARNING

Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.

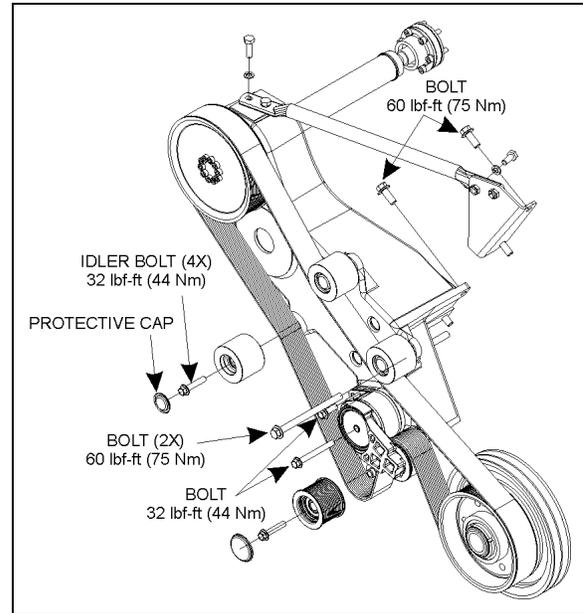


FIGURE 16: TIGHTENING SPECIFICATION

05140

1. Remove the protective cap (replace with a new one).
2. Unscrew the idler mounting bolt.
3. Replace idler with a new one.



CAUTION

When installing the idler, make sure it rests perfectly against the bearing surface on the cast aluminum support. If not, the drive belt may slip of the idler. See figure below.

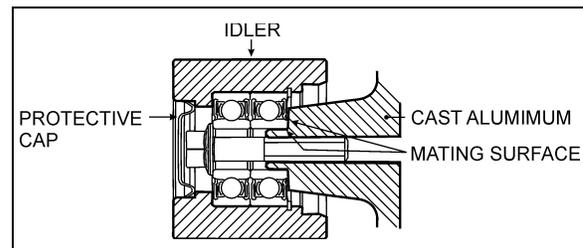


FIGURE 17: IDLER MOUNTED ON THE CAST ALUMINUM SUPPORT

4. Bolt the new idler on the cast aluminum support. Tighten to 32 lbf-ft (44 Nm).
5. Place a new protective cap.

13. VARIABLE SPEED COOLING FAN

The cooling fan clutch has two thermostatically controlled speeds, plus a neutral (clutch disengaged). The MCM controls the speed by

comparing data from engine coolant temperature, charge air temperature, Allison transmission oil temperature and small A/C High side pressure to a set of calibration data. The fan drive clutch is electromagnetic; the MCM sends an electric current to regulate speed by activating one magnetic coil for the first speed and two magnetic coils for the second speed.

The settings are:

| | Engine coolant temp. | Air intake temp. | Allison trans. oil temp. |
|---|----------------------------------|----------------------------------|----------------------------------|
| temperature rising  | 208°F: fan engages in HIGH SPEED | 194°F: fan engages in HIGH SPEED | 230°F: fan engages in HIGH SPEED |
| | 203°F: fan engages in LOW SPEED | 176°F: fan engages in LOW SPEED | 216°F: fan engages in LOW SPEED |
| temperature dropping  | 203°F: fan HIGH SPEED disengages | 189°F: fan HIGH SPEED disengages | 225°F: fan HIGH SPEED disengages |
| | 198°F: fan LOW SPEED disengages | 170°F: fan LOW SPEED disengages | 210°F: fan LOW SPEED disengages |

| | Small A/C high side pressure |
|--|------------------------------------|
| pressure rising  | 170 psi: fan engages in HIGH SPEED |
| | 120 psi: fan engages in LOW SPEED |
| pressure dropping  | 130 psi: fan HIGH SPEED disengages |
| | 90 psi: fan LOW SPEED disengages |

 **WARNING**

DO NOT work near the fan with the engine running or the ignition in the ON position. The engine fan can engage at any time without warning. Anyone near the fan when it turns on could be seriously injured.

13.1 LOCKING RADIATOR FAN FOR EMERGENCY OPERATION

13.1.1 Electrical Locking

If the cooling fan clutch does not function due to an electrical control system malfunction and the engine is overheating, execute the following procedure:

1. Set the ignition key to the ON position.
2. Activate the dashboard Telltale Light Test switch 3 times within 4 seconds.
3. In the engine compartment, set the starter selector switch to REAR START and then start the engine from the rear.

 **WARNING**

Potential Accident Risk. Always use extreme caution when working in the vicinity of hot, rotating or moving parts.

While in this mode, the rear start push-button can be used to manually engage the fan clutch. The multiplex system knows when the engine is already running, and it will not activate the starter.

4. Press the push-button one time to engage the clutch to 1st speed, press a second time to engage to 2nd speed, press a third time to stop the fan, press once again to return to 1st speed.

NOTE

If the fan clutch does not engage using this procedure then the clutch is faulty or the wiring between the multiplex module and the clutch is faulty. Mechanically lock the fan as described in section 14.1.2.

13.1.2 Mechanical Locking

Once mechanically locked, the fan is rigidly connected to the drive mechanism and will rotate continuously, with no considerations for the cooling needs. This is an emergency situation and the vehicle shall not be operated in that situation for an extended period.

In case of a magnetic clutch malfunction:

1. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.

Section 05: COOLING SYSTEM

2. Disconnect the fan clutch electrical connector.
3. Unscrew and remove the 4 spare bolts screwed to the angle on the fan gearbox mounting support.
4. Turn the fan blades in order to position the locking plate bores over the rotor's threaded sockets.
5. Screw in and tighten the spare bolts (Fig. 18).
6. Using the automatic belt tensioner, release tension on the drive belt in order to be able to rotate the fan clutch drive mechanism by hand.
7. Rotate the shaft to get access to the second locking plate and rotor threaded sockets.
8. Screw in and tighten the spare bolts.

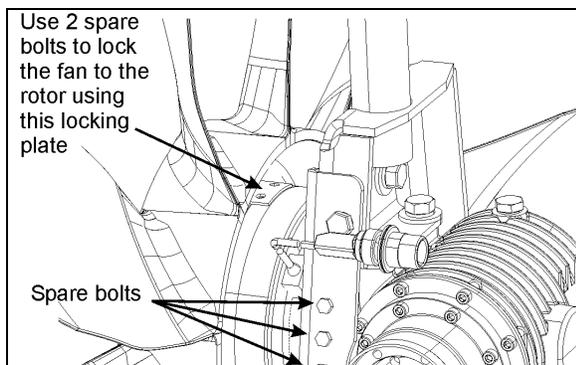


FIGURE 18: MECHANICAL LOCKING

05124

13.2 MAINTENANCE

1. Clean the fan and related parts with clean fuel oil and dry them with compressed air. Do not clean with steam or high-pressure jet.
2. Check the fan blades for cracks or other damage. Replace the fan if the blades are cracked or deformed.
3. Remove any rust or rough spots in the grooves of the fan pulley. If the grooves are damaged or severely worn, replace the pulley.
4. Do not restrict fan rotation during engine operation for any reason.
5. Do not operate fan-driving mechanism with a damaged fan assembly. Replace a damaged fan as soon as the fault is noted.

6. Immediately investigate and correct any operator complaint involving driving mechanism or cooling system performance.
7. When questions arise, obtain answers before proceeding. Assistance is available through the authorized Field Sales distributor serving your area.

13.3 INSPECTION



DANGER

Set the starter selector switch in engine compartment to the "Off" position to prevent accidental starting of the engine.

- Check security of fasteners securing fan blade assembly to fan driving mechanism.
- Check coupling installation between fan blade assembly and gearbox.
- Visually inspect fan driving mechanism, fan blade assembly, shroud, radiator, and surrounding area for evidence of contact between rotating and non-rotating parts.
- Check drive belt for fraying, cracking, and proper tension.
- Turn fan through at least 360° of rotation. It should turn smoothly with no resistance.

13.4 FAN REMOVAL / INSTALLATION

The fan is bolted to the magnetic clutch. To remove the fan:

1. Unscrew and remove the mounting bolts and washers.

To reinstall the fan:

1. If the fan is still in the radiator fan shroud, place 2 of the mounting bolts on the opposite side of the clutch, in reverse direction, in order to use them as guide pins to position the fan.
2. Once properly positioned, screw the 4 remaining bolts back in and tighten properly (16 lbf-ft; 22 Nm).
3. Finally, take the 2 bolts that were used as guide pins and screw them back in on the proper side of the clutch and tighten properly.

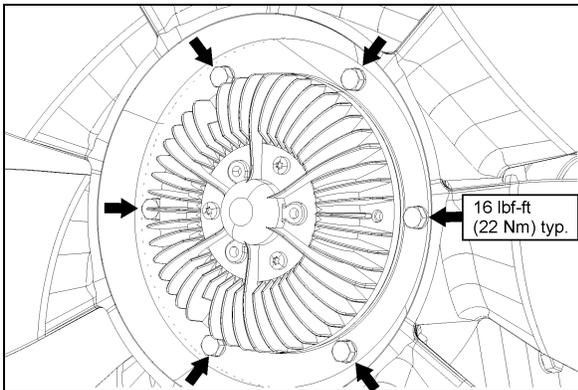


FIGURE 19: RADIATOR FAN MOUNTING BOLTS 05125

14. FAN RIGHT ANGLE GEARBOX

The radiator fan is belt driven from the engine crankshaft pulley through a drive belt, a universal joint shaft, a right angle gear and clutch assembly.

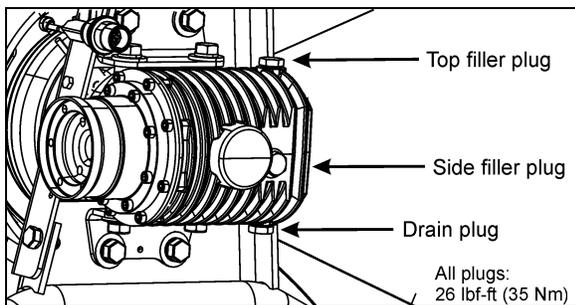


FIGURE 20: RIGHT ANGLE GEARBOX 05118

14.1 MAINTENANCE

MAINTENANCE

Change the right angle gearbox oil every 50,000 miles (80,000-km) or once a year, whichever comes first.

Use **Synthetic Gear Lubricant SAE 75W-90**.

14.2 OIL CHANGE

1. Stop engine and make sure that all engine safety precautions have been observed.
2. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine or set the rear start panel selector switch to the OFF position.

3. Remove the drain plug located underneath the right angle gearbox case and allow the oil to drain into a suitable container.
4. Replace the seal and screw the drain plug back in (torque: 26 lbf-ft).
5. Unscrew and remove the side filler plug.
6. Unscrew and remove the top filler plug.
7. Add gear lubricant. The oil level is correct once the top of the oil has reached the bottom of the side filling point.
8. Replace the seals and screw side and top filler plug back in (torque: 26 lbf-ft).
9. Clean gear case carefully.
10. Start the engine and allow running a few minutes. Stop the engine and check for leaks.

14.3 REMOVAL / INSTALLATION

To remove the right angle gearbox, proceed as follow:

1. Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.
2. Disconnect the fan clutch electrical connector.
3. Dismount the fan and lean it against the radiator (refer to previous paragraph).
4. Disconnect the universal joint shaft.

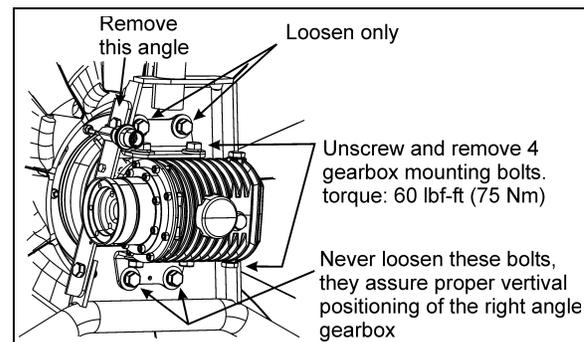


FIGURE 21: RIGHT ANGLE GEARBOX MOUNTING 05126

5. Dismount the angle (see fig. 21).
6. Loosen the gearbox support bracket top bolts.
7. Unscrew and remove 4 gearbox mounting bolts.

Section 05: COOLING SYSTEM

- Slide the gearbox out of the support assembly.

Installation procedure is the same as removal but in reverse order. Tighten the 4 mounting bolts as specified.

15. COOLING FAN DRIVE BELT

15.1 MOUNTING THE DRIVE BELT

To install the cooling fan drive belt, proceed as follow:



WARNING

Set the ignition to the OFF position and remove the key from the contact switch to prevent accidental starting of the engine.



WARNING

Potential Accident Risk. Always use extreme caution when working in the vicinity of hot, rotating or moving parts.

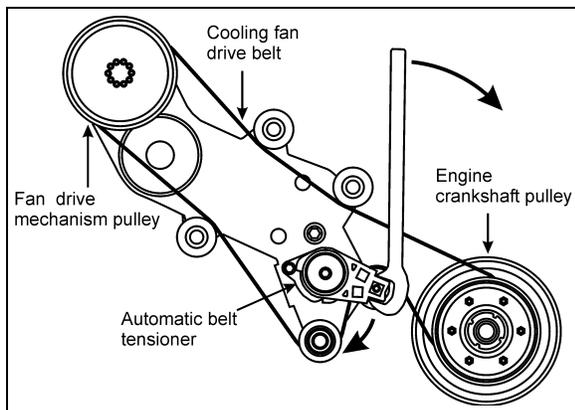


FIGURE 22: DRIVE BELT ROUTING

05137

- Finally, place the drive belt around the engine crankshaft pulley.
- Release the tensioner slowly and let it return to its natural position.

COOLING FAN DRIVE BELT

Make: Dayco

Type: 14PK2605

Prevost number: 550926

- Wrap the new drive belt around the fan drive mechanism pulley, the idlers and the automatic tensioner idler as shown on figure 22.
- Using a $\frac{1}{2}$ " breaker bar or a $1 \frac{1}{2}$ " open end wrench, rotate the automatic tensioner in clockwise direction to relieve tension on the belt and hold the tensioner in that position (Fig. 22).

16. SPECIFICATIONS

Cooling System Capacity (Approximation)

Includes heating system..... 24 US gal (91 liters)

Thermostat

Number used 2
 Start to open 182-188°F (83-86°C)
 Fully open 202°F (95°C)

Cooling Fan Drive Belt

Make Dayco
 Type Poly-Rib 14PK2605
 Qty 1
 Prevost number 550926

Coolant

Prevost Number 685125
 DDC (Power Cool) 23512138
 Prestone (Heavy Duty)..... AF977 (bulk), 72702 (3.78 L), 70119 (205L), 70102 (4L)

Corrosion Inhibitor and Coolant Stabilizer

Supplier number..... Detroit Diesel 23507857
 Supplier number..... Nalco..... DD3000-15

Coolant Filter

Number used 1
 Make Nalco
 Type Spin-on

MAINTENANCE ELEMENT FILTER

Supplier number. Detroit Diesel 23507545
 Supplier number..... Nalco..... DDF3000
 Prevost number 550630

PRECHARGE ELEMENT FILTER

Supplier number..... Detroit Diesel 23507189
 Supplier number..... Nalco..... DDF60
 Prevost number 550629