Ford Powerstroke 6.0L Turbo Diesel Cooling System Overview and Flush

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1.0 Introduction

The 2003-2007 Ford Powerstroke 6.0L diesel engine often suffers from cooling system related problems, specifically the engine oil cooler clogging up. This document provides options which, if followed, can result in the most comprehensive flushing of the 6.0L engine.

The key to fully flushing the cooling system on the 6.0 is the complete removal of any loose contaminates such as silicate fallout, casting sand, rust and scale. This in addition to an inner cleansing of the coolant passages using Fleetguard Restore and Motorcraft VC-9 chemicals (or Fleetguard Restore +). Before beginning the comprehensive flush process, it is important to fully drain and prepare your engine.

This document is broken down into several sections. Although it is not necessary to understand the cooling system on your vehicle, knowing how it works will often benefit the owner to maintain peak performance.

First the infamous disclaimer:

WARNING: *The processes described in this document are* ***not*** *authorized by* ***Ford Motor Company or International Corporation****. The material provided is for educational purposes only. The authors and forum members who contributed information hold no responsibility for any damages that may occur to your vehicle. Before performing any maintenance on your vehicle it is a good idea to check with the vehicle manufacturer to insure compliance with your warranty specifications. The use of coolants and / or chemicals described in this document may void your warranty. Ensure that you comply with your local and EPA regulations regarding the proper disposal of any chemicals, including those used to flush your engine.*

Part numbers listed are for reference only, part numbers are subject to change.

IMPORTANT: *Use this information at your own risk. It is recommended that repairs and maintenance be performed by trained professionals.*

CAUTION *– Removing degas cap*
• Never attempt to remove the degas cap while the engine is operating or hot. Doing so may lead to cooling system and/or engine damage and could result in serious personal injury from escaping hot coolant or steam.
• Turn the engine off and wait until it cools. Use extreme care when removing the degas cap. Wrap a thick towel around it, and turn it counterclockwise slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, continue turning counterclockwise to remove it.
• Even if the engine is not operating, do not remove the degas cap or the drain plug while the engine and radiator are hot. Hot coolant and steam may still blow out under pressure, causing serious injury.

2.0 Cooling System Basics

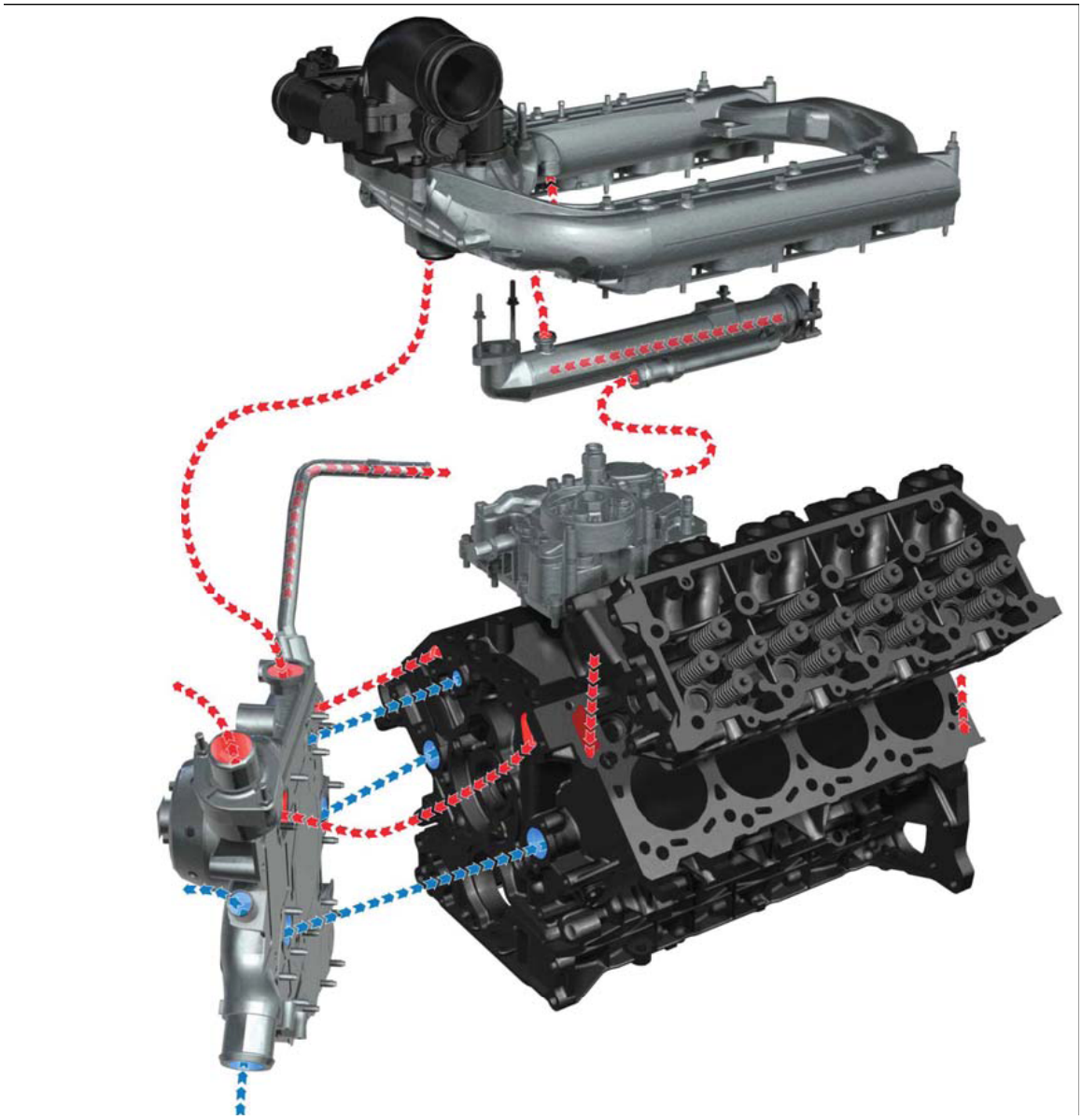

Fig. 2.1 - Reference: 6.0 Power Stroke 2003.25 “F” Series Super Duty Features Descriptions Unique Service Procedures and General Diagnostics

The diagram above shows the 3 circuits that the engine coolant takes from the water pump. There is a circuit for each side of the engine and one to the oil cooler / EGR cooler. During normal operation, coolant circulates through these circuits transferring heat from the engine to the coolant. Heated coolant is then directed to the thermostat. If the thermostat is open, that coolant is sent to the radiator to transfer heat from the coolant to the air. If closed, the coolant is returned to the water pump via a bypass circuit in the front cover.

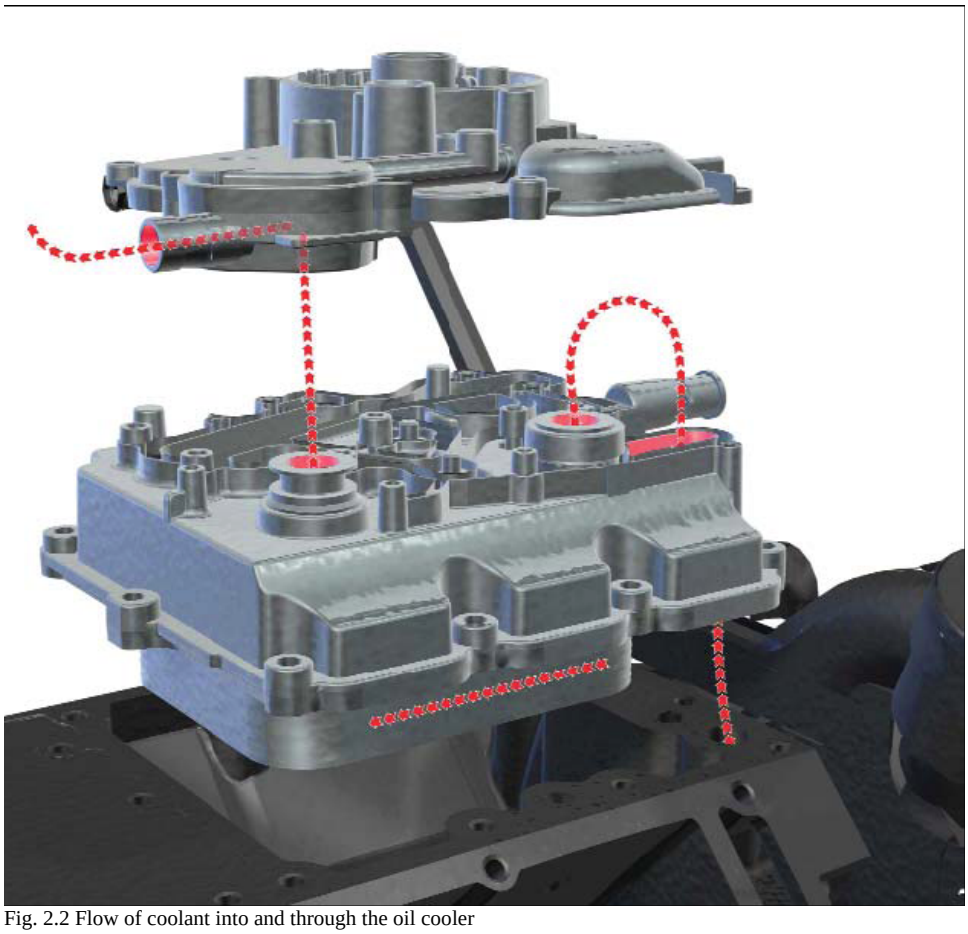

Fig. 2.2 Flow of coolant into and through the oil cooler

The oil cooler is a liquid to liquid heat exchanger. Coolant enters the oil cooler from a passageway in the block, flows into the cooler through a port on top of the oil cooler housing, flows through the coolant passages within the cooler, then exits the oil cooler through another port on the top. The coolant is then fed to the EGR cooler to cool the hot exhaust gasses before they are reintroduced into the engine. This is an efficient design when things are working within specifications.

3.0 Oil cooler contamination

The factory oil cooler contains passages to allow coolant and oil to be separated. The coolant passages can become plugged with contaminates as shown below.

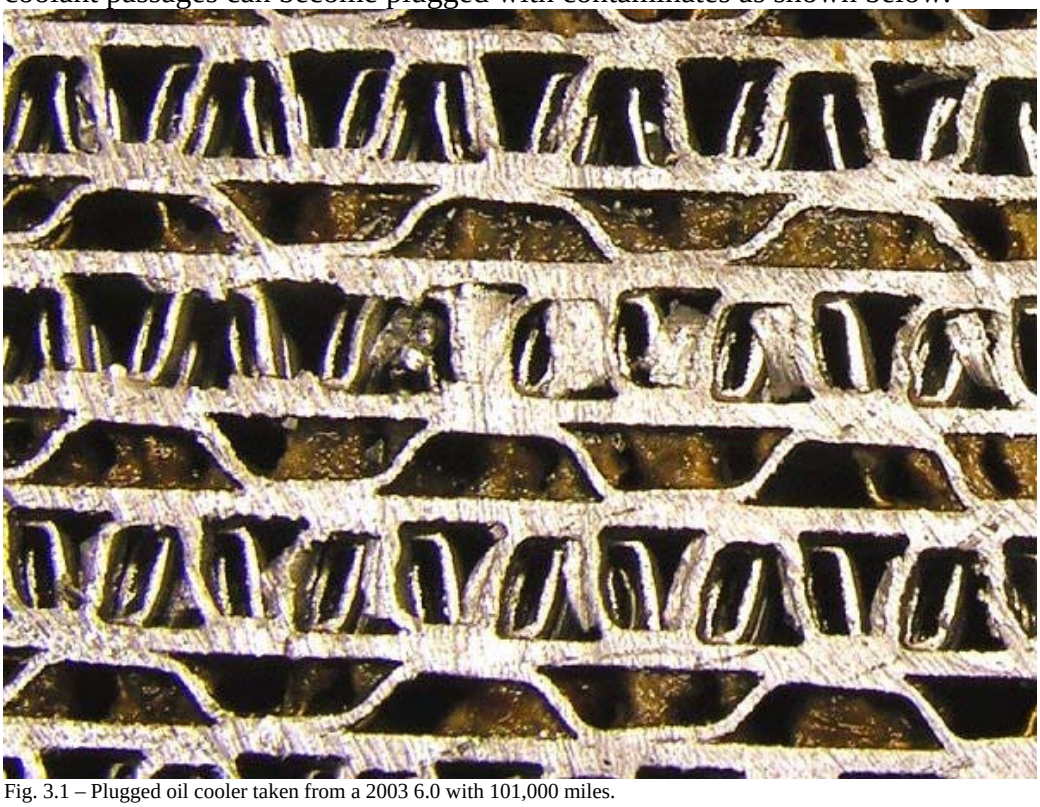

Fig. 3.1 – Plugged oil cooler taken from a 2003 6.0 with 101,000 miles.

There is speculation that the “goo” that is seen in the oil cooler pictured above is silicate goo. As of this writing I am unaware of any tests which have confirmed this. Other oil coolers that have failed have revealed a “sand like” material, which is often thought to be casting sand. Again, I am unaware of any analysis to identify the material.

When the oil cooler becomes plugged, it restricts coolant flow to the EGR cooler. This restricted flow cannot supply an adequate amount of coolant to the EGR cooler. This will eventually result in “flash boiling” of the coolant. The “flash boiling” in turn eventually results in the failure of the EGR cooler. Symptoms of an EGR cooler failure can be a “tea kettle” whistle (high pressure coolant escaping from the degas cap), white smoke coming out of the tail pipe, loss of coolant with no visible leaks except from around the degas cap, and visible liquid discharge from the exhaust pipe. This document will not go into the details of oil cooler replacement / EGR cooler replacement, diagnosis or detailed analysis.

4.0 Determining cooling system health

Following the recommended coolant maintenance procedure as outlined in your owners' manual may not be sufficient to maintain cooling system health. It is important to follow Ford's TSB recommendations for coolant maintenance. There has been a TSB issued for this (TSB: 09-8-5). Details of this TSB can be found in the references section of this document.

Ford issued a TSB 09-8-3 which deals with coolant loss. The purpose of this TSB is to address coolant loss both external and internal (EGR coolers / head gaskets). Step 5 of this TSB is to road test for restricted oil cooler. This step reads as follows:

> *5. Road Test For Restricted Oil Cooler – Setup and Observations:*
> *a. Install integrated diagnostic system (IDS) select engine coolant temperature (ECT) and engine oil temperature (EOT) PID's on IDS Datalogger*
> *b. Carefully drive the vehicle at wide open throttle (WOT) / high load to achieve maximum boost.*
>
> ***NOTE***
> *FOR ACCURATE TEST RESULTS, ECT TEMPERATURE MUST BE GREATER THAN 190° F (88 °C) WHEN MEASURING THE ECT AND EOT MAXIMUM TEMPERATURE DIFFERENTIAL*
>
> ***NOTE***
> *PERFORMING THIS TEST STEP OUT OF SEQUENCE CAN RESULT IN INACCRUATE TEST RESULTS. THIS CAN BE CAUSED BY A LEAKING EGR COOLER ALLOWING (HOT) COMBUSTION GASES TO ENTER THE ENGINE COOLANT AND ARTIFICALLY RAISING THE ECT READINGS.*
>
> *c. Observe ECT and EOT PID's on IDS Datalogger. EOT maximum temperature differential might occur at throttle tip-out.*
> *(1) If EOT is within 15° F (8.4° C) degrees of the ect, go to Step 7.*
> *(2) If EOT exceeds ECT by 15° F (8.4° C) or more at any time during the test, go to Step 6*
>
> **Step 6** is to replace the oil cooler
> **Step 7** is to test head gaskets.

Without any additional TSB's specifically for clogging oil coolers, the above statement has been adopted by the community as the benchmark to determine a clogged or clogging oil cooler. For the lack of a more in depth test process we will assume that a delta of less than 15° Fahrenheit your oil cooler is operating within specifications. If it is above 15° Fahrenheit oil cooler maintenance is required, which may include replacement of the oil cooler core.

According to Ford's procedures, replacement of the oil cooler and testing / replacing of the EGR cooler is recommended if the delta is out of specification. This document supports that recommendation but offers a potential alternative to help revive partially clogged oil coolers using recent discoveries in flushing. The following processes DO NOT take the place of professional advice and repairs, and do not guarantee that you will be successful, or that an oil cooler replacement is not required. If your oil cooler is leaking oil it MUST be replaced, your cooling system flushed, and you must replace every rubber component within the cooling system according to Ford's procedure TSB 8-23-1

5.0 Draining coolant

5.1 Radiator

Coolant is drained from the cooling system by backing out the radiator drain petcock and capturing the fluid for recycling. The process is straight forward. Using a 19mm wrench loosen the drain petcock located on the bottom drivers' side of the radiator. The drain petcock is a white plastic nut. As you loosen the petcock, fluid will begin to drain from the discharge port on the radiator. Be sure to capture the fluid for recycling. When the fluid stops draining, you can snug the petcock back up. Hand pressure is all that should be needed here. Do not over-tighten the petcock as it is prone to breaking.

5.2 Engine block

The 6.0 Power Stroke Diesel is equipped with 2 engine drain plugs on each side of the block. These plugs are removed by a 5/16" allen (or 8mm) allen head socket. The plugs are accessed from under the truck. The left hand side (driver's side) is easily accessible and removable

Fig 5.2.1 location of drivers side drain plug shown with Fumoto Valve installed.

but the passenger side requires the removal of the starter

Fig 5.2.2 location of passenger side drain plug shown with Fumoto valve installed.

When the fluid stops draining lightly oil the o-ring on the plug and re-install. Do not over tighten drain plugs.

5.3 Heater core

The heater core does not have a drain. Coolant flows from the front cover to the heater core located inside the vehicle. There is often a vacuum operated valve in line.

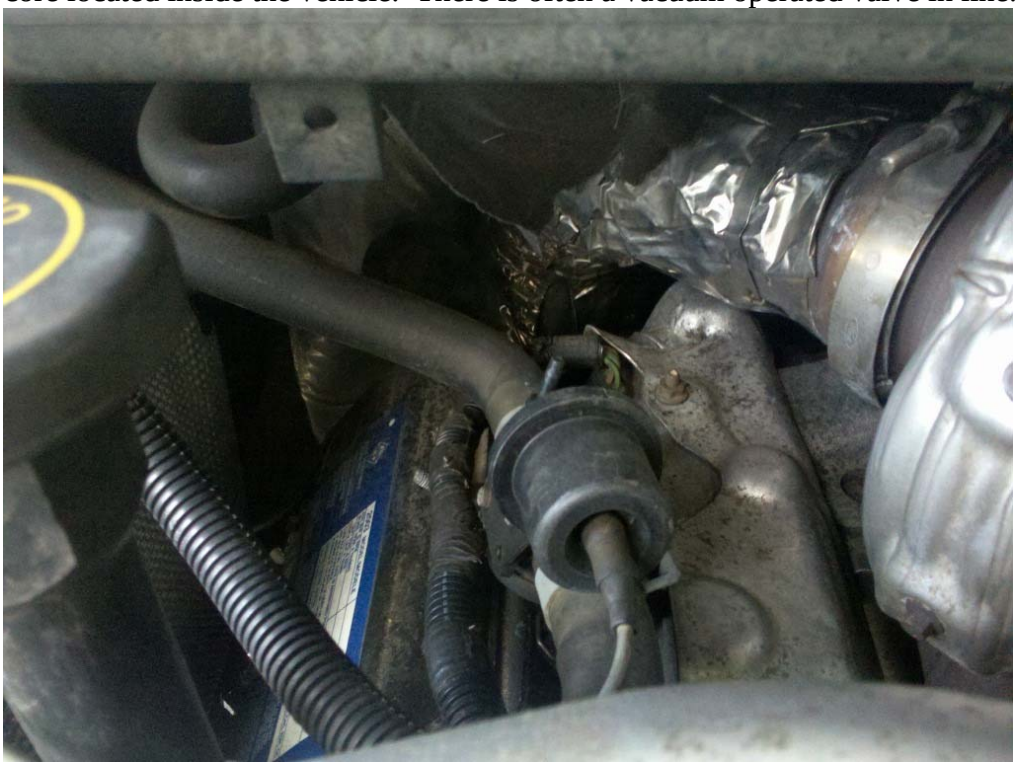

Fig 5.3.1

The warm coolant then circulates in the heater core and exits the heater core into the passenger side of the engine compartment. A crossover hose routes the coolant to the bottom of the degas bottle at the Y connection shown below. The heater core can be partially drained by removing both hoses and using 20lbs of compressed air to remove as much fluid as possible. Reconnect hoses when the heater core has been drained.

6.0 Flushing the system

Once the system has been drained you need to flush the remaining fluids out. This flush can be a simple refill and drain process, involve chemicals, or a more in-depth "reverse flush" of cooling system components. We'll start with the basic ***Flush 'n' Fill*** process which will be used often.

6.1 Flush 'n' Fill

The flush 'n' fill is used to remove old liquids from the system and replace with clean fresh distilled water. You start by draining your old fluids. Insure that all hoses are re-installed, plugs installed and drain petcock is snug. Using the degas bottle, fill using distilled water. Once the degas bottle is filled, start the engine and operate the heat on high. It is likely that the fluid level in the degas bottle will drop, continue to add distilled water until the level no longer drops. Operate the truck for 1 hour either at high idle or driving at highway speeds. Let the engine cool enough to be safe, then drain the fluid and repeat the flush 'n' fill until the liquid drains clear.

6.1.1 Optional remove thermostat

We consider removing the thermostat optional and dependent on the cooling system concern. If the thermostat is removed, coolant will flow through the radiator and less quickly though the engine and heater core. In addition it will take far longer for the engine to obtain proper operating temperature to enable chemical flushes to be most effective. Leaving the thermostat in will concentrate the flushing on the engine core, heads and oil cooler. We consider it optional depending on your flushing requirements.

6.2 Chemical flush

6.2.1 Flush using Fleetguard Restore®

Fleetguard Restore® is a chemical designed to remove silicates left behind by many antifreeze types including the Ford Gold® coolant (AKA: Zerex G-05). Silicates can form a goo type substance and lodge in the radiator, heater core and oil cooler of your vehicle. To use Restore® drain then flush 'n' fill with distilled water. On the final fill add ½ - ¾ of a gallon of Fleetguard Restore® and operate the engine at operating temperature for 1 to 3 hours. ***Do not allow Restore® to remain in your engine for longer than 3 hours***. After the Restore, perform a complete flush 'n' fill to remove the Restore and dislodged particles from your cooling system.

6.2.2 Flush using Fleetguard Restore+® or Ford VC-9®

Fleetguard Restore+® and Fords' VC-9® are acidic cleaners designed to remove rust. To use these cleaners you will need to drain and flush 'n' fill. On the last fill use ½ gallon of Restore+®, or 2 quarts of VC-9®, and top off with distilled water. Operate the vehicle for 1–3 hours, then drain completely, flush 'n' fill.

TIP: Use PH test strips to test your flushes. The Restore and Restore+ (VC-9) are removed when the PH of the water is about 7.0 PH. Test strips can be found in the pool section of your local markets.

7.0 Optional Reverse Flushing

Some cooling systems may require additional procedures to remove more contaminates than a flush 'n' fill can perform. Additionally it is thought that the inclusion of a chemical flush may dislodge particles which may become trapped in other parts of the cooling system such as the heater core, radiator and / or oil cooler. These specific components can be isolated and reverse flushed by the following methods. When reverse flushing, massive quantities of water will be required. Using distilled water is impractical and would be highly expensive, so using TAP water would be necessary. Use HOT tap water when possible and use an RV style water filter to keep solids from entering your cooling system.

Fig 7.1 RV style water filter

CAUTION: Your cooling system is equipped with a 16psi cap designed to release pressure in excess of 16psi. Using excessive pressure in your cooling system may cause damage. If there appears to be excessive blockage where you are flushing, you should stop the reverse flush and determine and repair the blockage so damage does not occur. A steady stream of water with little restriction is unlikely to cause issue however.

7.1 Reverse Oil Cooler Flush

Purchase a ¾” hose or plastic tubing and adapters to connect that tubing to a standard garden hose. Here is a picture using combination of brass and plastic adapters.

fig 7.1.1 Oil cooler flush adapter

You will need to remove the cap on the oil cooler cover behind where the orange hose is as indicated in the picture. The color of this hose may be different (blue is also common). This hose connects to the oil cooler cover and the EGR cooler. Its purpose is to feed coolant to your EGR cooler (if so equipped).


fig 7.1.2 Oil cooler removed from engine

Insert hose into oil cooler coolant outlet (it's a perfect fit).


Fig 7.1.3 Adapter fits snuggly into the oil cooler coolant outlet port

Connect the adapter to your garden hose open the engine block drain plugs and radiator petcock drain and reverse flush the oil cooler for 30 minutes. Occasionally kink the hose and release to create a surge of water pressure to help force particles out of the oil cooler.

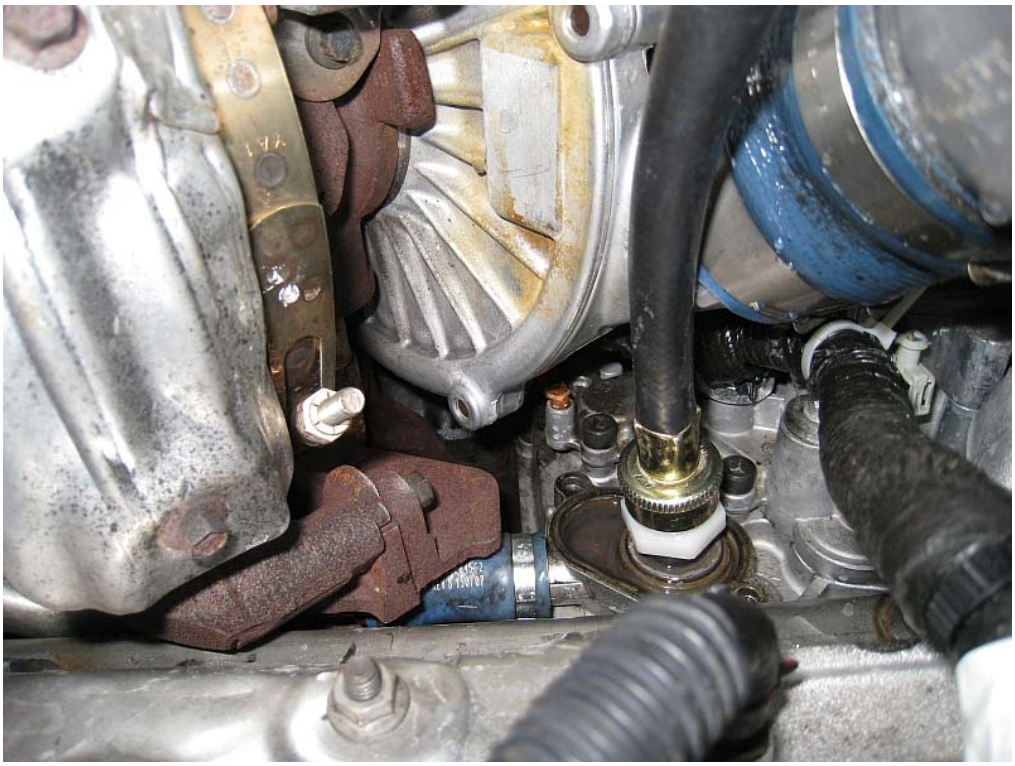
Fig 7.1.5 similar type adapter inserted in installed oil cooler

This is an effective method of flushing the oil cooler and for maximum benefit should be performed at the beginning of the flush ‘n’ fill process, and during any and all flushing types. It is critical to remove any particles, scale, silicates, sand or other contaminates which may have become dislodged during the flushing cycle. Removing these loose particles should prevent the clogging of the oil cooler during a flush that have been encountered by some.

When completed, reinstall block plugs, oil cooler cap using a new gasket and snug radiator drain petcock.

TIP: Stuff old rags around the oil cooler coolant outlet to prevent tools from getting lost in the engine valley.

7.2 Heater Core Reverse Flush

Reverse flushing the heater core can help remove sediment which may accumulate in the vehicles heater core.
Purchase hardware to adapt your garden hose to the inside diameter of the heater core return line at the bottom of the degas bottle. There are many ways to build an adapter, here’s one method used by thedieselstop.com member FMTRVT

> *When you do the reverse flush of the heater core and it's downstream, the easiest thing to do is grap some 3/4" hose from HD and the like, about 4 to 6 foot, and get hose repair ends from the garden area. This way you can attach your watering hose to the inlet, and if you have a spare hose to wherever you are*

draining it to. I used 5/8" copper tube to act as a union between an additional hose rather then putting the female repair end on the vehicles hose directly. You can also grab a 3/4" hose repair union instead of the copper, but I don't care for them.

Fig 7.2.1

Fig 7.2.2

Fig 7.2.3

Fig 7.2.4

Fig 7.2.5

Remove the heater core supply line at the heater valve.

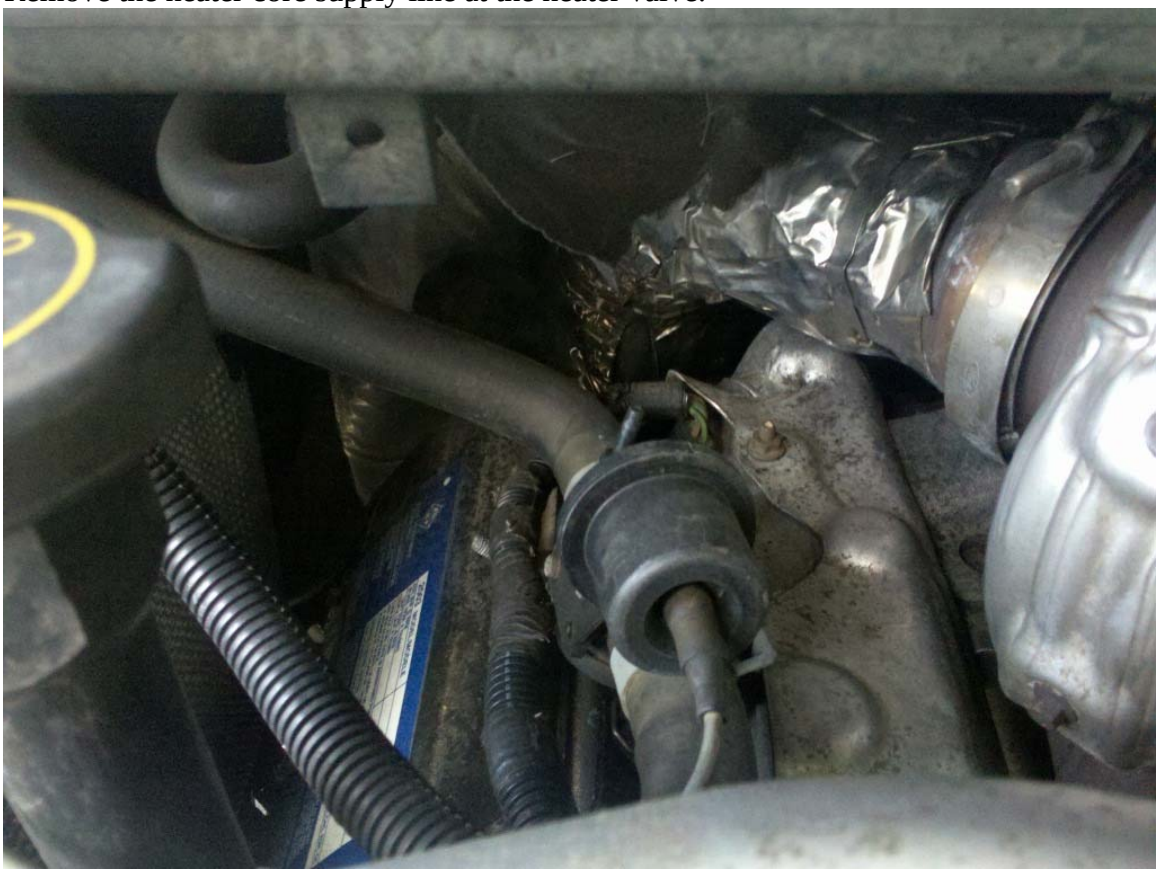

Fig 7.2.1 Heater control valve. Disconnect hose closest to the firewall of the vehicle

Hook up the hose and reverse flush the heater core for 30 minutes.

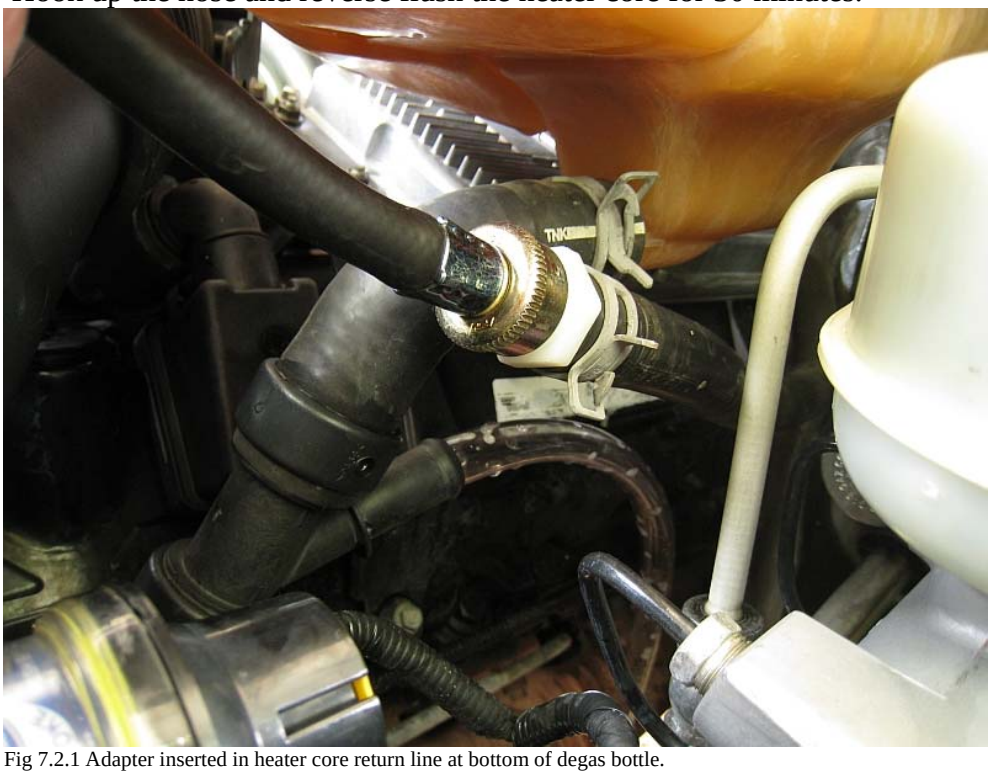

Fig 7.2.1 Adapter inserted in heater core return line at bottom of degas bottle.

Reinstall hoses and clamps. If desired, you can use compressed air (20 PSI max) to blow out excess tap water from the lines. This will reduce the percentage of tap water left in your system. Remember when refilling your cooling system to have the heater in the full hot position. This will open the valve allowing new coolant to enter the heater core.

7.3 Radiator Reverse Flush

Flushing the radiator will help remove any loose sediment which may have accumulated in the in the radiator. In extreme cases the radiator should be removed from the vehicle and professionally cleaned both inside and out. This document will not address radiator removal, but an in-vehicle flush.

Remove both upper and lower radiator hoses. Insert your water hose into the upper radiator hose port and flush for 30 minutes. Occasionally block the lower opening to allow water to fill the radiator and release. This will cause a surge to help remove more particles from the radiator.

When completed, replace both upper and lower radiator hoses.

7.4 Degas Flush

Often the degas bottle will have contaminates in the bottom. You can simply remove the degas bottle from the vehicle by removing the 2 top hoses, 2 8mm bolts and disconnect the larger hose from the bottom of the bottle. Remove the bottle and wash as necessary.

8.0 Options for block draining

Because of the location of the passenger side block drain, access is hindered by the engines starter. It is recommended that the starter be removed to allow sufficient access to this drain plug, but performing this task is difficult to do during the course of the flushing process. A member on the Ford Truck forum (www.ford-trucks.com) using the screen name "jfirstford" came up with a fantastic solution to draining the block.

Fumoto valves can be inserted into the engine block as shown in the following 3 pictures. Once these valves are installed, flushing of the system can be performed without the removal of the starter. In addition the installation of hoses on these valves will allow you to capture the used fluids for proper recycling.

Fig 8.1 Fumoto valve inserted in drivers side drain plug with optional drain hose.

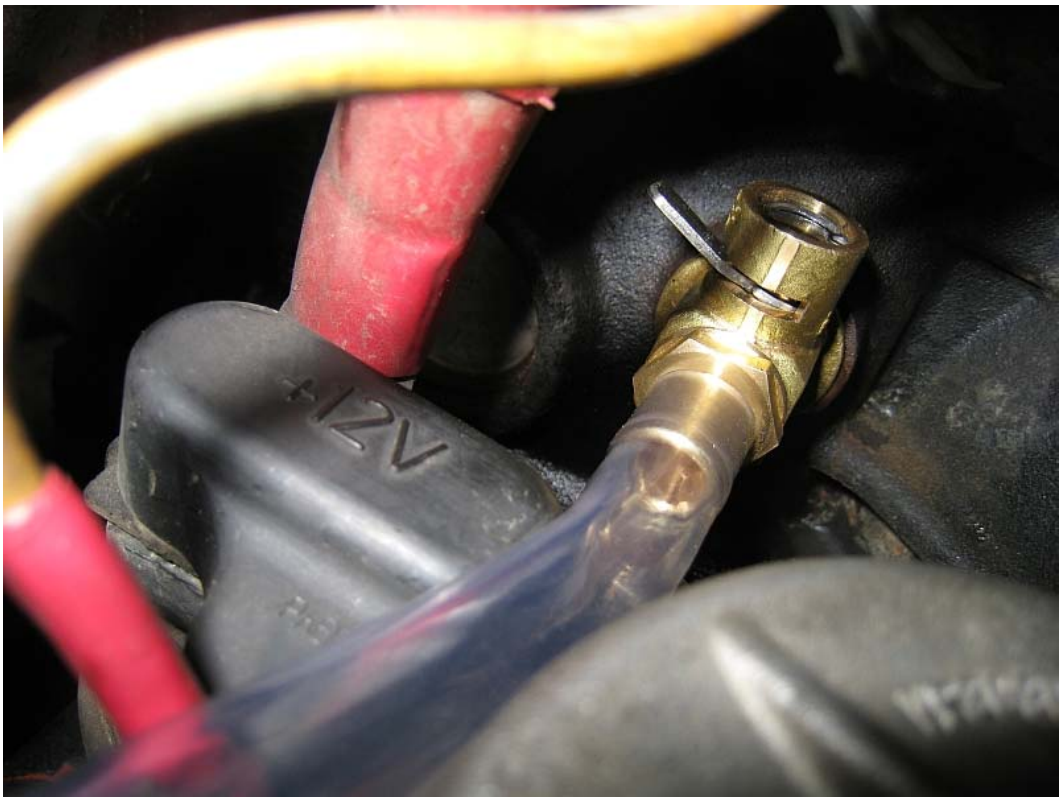

Fig 8.2 Fumoto valve inserted in passengers side drain plug with optional drain hose.


Fig 8.3 Drain hoses routed to underside of vehicle for collection

Once the block drain valves and hoses are installed you can begin the flushing procedure. Begin by draining the radiator using the petcock. Capture used fluids for recycling. Drain engine block capturing fluids. Remove heater core feed hose from degas bottle as shown and insert heater core flush kit.

9.0 Coolant Choices

The F series Super Duty cooling system holds roughly 7 gallons of coolant (Excursions may hold more). **Always refer to your owners' manual for proper capacities for your vehicle.** The cooling system requires a 50 / 50 mix of coolant and distilled water for most conditions. It is important that you mix the coolant with clean distilled water only. If you used any of the reverse flush procedures above, you will need to complete flush 'n' fill using a minimum of 24 gallons of distilled water to sufficiently dilute the tap water that remains in the block.

Drain all coolant from the radiator and block (drivers side only is fine). Insure all valves are closed, and hoses connected. Pour 3.5 gallons of coolant concentrate (NOT premixed) into the degas bottle and fill to the minimum line with distilled water. Start vehicle and idle. Carefully maintain the minimum level until it seems to not require additional distilled water. Test drive vehicle check level and top off with distilled water.

You have choices when it comes to coolant types and brands. This document will not debate the qualities of any brand or type of coolant except to say that HD ELC (CAT EC-1 approved) coolant is preferred. It must be noted however that Ford does NOT recommend any coolant other than Ford Gold® (G-05). If your vehicle is under warranty it is recommended to check with your dealer before using alternate fluids.

It is believed, though not confirmed, that the G-05 type coolants may be partially responsible for oil cooler failure.

International Corporation, the manufacturer of the engine, uses this engine in several medium duty trucks. The coolant they use is an ELC coolant conforming to the CAT EC-1 specification. This indicates that the use of an HD ELC coolant is safe for your engine. It is also important to note that International trucks equipped with this engine do not appear to have as high of an oil cooler failure rate as compared to the Ford Super Duty trucks. The choice of coolant is yours to make but consider using a coolant conforming to the CAT EC-1 specification.

Replace HD ELC every 3 years or 300,000 miles and perform a complete flush as listed in this document. There are supplements which can be added to extend the life of the coolant to 6 years, but it makes more sense to replace the coolant instead of extending it. You want the cleanest cooling system possible.

10.0 Coolant Filter

The Ford 6.0L engine is not equipped with a coolant filter. It is recommended to purchase an aftermarket coolant filter kit to install on your vehicle. These filters are bypass filters and will help trap floating contaminates in your cooling system. Although not considered a fix, the addition of the filter has been shown to be effective in removing particles from the coolant.

11.0 FAQ

Q. While performing the flush ‘n’ fills, my ECT / EOT deltas were small. Once I put in antifreeze that delta grew, did my oil cooler plug up?
A. No, straight water has a higher heat transfer rate than antifreeze.

Q. My delta increased after doing the chemical flushes, what should I do.
A. Perform the complete reverse flush, paying particular attention to the oil cooler.

Q. My delta is still higher after the reverse flush. What now?
A. You will need to replace your oil cooler. The good news is that your cooling system should be clean now, so your new oil cooler should last a long time.

Q. Great document, can I make a donation?
A. No, this information is a collection from many individuals hard work. If you meet anyone in person, a handshake and thank you is all that’s needed.

Q. Do I really need to do this complete of a flush?
A. Probably not. But by performing the options listed here, your cooling system will be cleaner than most flush routines. Besides, it can’t hurt.

Q. Which option is for me?
A. The choice is up to you, but in my opinion performing the reverse flushing of all the components will yield the best results, specifically reverse flushing the oil cooler. While it won’t repair an existing clogged oil cooler it will remove any particles which have not become completely embedded in the oil cooler. It doesn’t take too long to do and the results are well worth the effort.

12.0 Conclusion

Keeping your cooling system clean is an important part of any vehicle maintenance program. The Powerstroke diesel is not unique when it comes to cooling system maintenance, but it is unforgiving when this maintenance is not performed and the coolant is allowed to degrade.

If you are experiencing serious cooling system issues such as an oil cooler that has become clogged over an extended period of time, no amount of flushing will repair the issue and replacement may be the only alternative. Following these procedures however, will help you recognize better results when completing the required repairs by removing as much contaminates as possible.

There have been cases of back to back repeat oil cooler clogging which in all likely hood would have been reduced had a more through flush taken place. Ford recommends a complete flush AFTER an oil cooler replacement. This recommendation doesn't make sense. You should do a complete flush PRIOR to an oil cooler replacement to minimize or eliminate the possibility of clogging the new oil cooler.

It happened to me.

Parts:

Oil cooler cap gasket: 3C3Z-9N693-EA (International: 1846977C1)
Engine block plug: 3Z3Z-6026-DA
Block Fumoto valve: F-108N (16mm-1.5)
Replace gasket with an o-ring to fit valve about 3/32" thick and about 5/8" ID

Water filter: Camco 40043 RV KDF Carbon water filter
Radiator drain petcock – FOAZ-8115-A
New degas (coolant overflow) bottlecap - 9C3Z-8101-A
Thermostat Housing O-ring - 3C3Z-8255-AA

Chemicals:

1 gallon Fleetguard Restore
1 gallon Fleetguard Restore+ or 2 quarts Ford VC-9
24 Gallons of distilled water (+ or – depending on your cooling system condition)
3.5 Gallons of the coolant of your choice.

Tools:

5/16” or 8mm Allen head socket
T30 Torx bit
19mm combination wrench
Regular “slotted” screwdriver
Slip-joint pliers

References:

TSB: 09-8-5

TSB
09-8-5 DIESEL COOLANT MAINTENANCE - SERVICE TIPS

Publication Date: April 14, 2009

FORD: 2003-2005 Excursion
2003-2008 E-350, E-450, E-550, F-Super Duty

ISSUE:
This TSB is to provide additional information to supplement the Workshop Manual (WSM) and Owner Guide information on the importance of cooling system maintenance for diesel engine equipped vehicles. Some customers, using their trucks under special operating conditions, indicate that operating with insufficient coolant strength (antifreeze or anticorrosion) can result in significant engine damage. Insufficient coolant strength can result when:

- Cooling system pressure and coolant is lost.
- The coolant level is topped off using the incorrect coolant.
- The coolant is mixed with hard water.
- Coolant is mixed at the incorrect concentration.
- Vehicles are operated under the special operating conditions as defined in the maintenance schedule (heavy commercial use that results in frequent or extensive idling, frequent low speed/rush hour traffic use; vehicles operated under special conditions such as: sustained high speed driving at maximum GVWR load, towing a trailer, using a slide in camper (F-Super Duty) or car top carrier (E-Series).

Proper cooling system maintenance is critical for maximum engine performance and efficiency on today's high technology diesel engines. It is essential that; the proper coolant is used, the coolant level is checked routinely, the coolant strength (antifreeze and anticorrosion property) is tested frequently and that the cooling system is flushed (with Motorcraft® Engine Cooling System Iron Cleaner) at the proper intervals.

ACTION:
Check and maintain the coolant strength (antifreeze and anticorrosion) and flush the cooling system using the recommended service procedures and frequencies detailed below.

SERVICE PROCEDURE

1. Inspect the coolant color as stated in the WSM, Section 303-03. If the coolant is not a clear or pale yellow color and has not had any coolant additive added, flush the cooling system with Motorcraft® Engine Cooling System Iron Cleaner and refill with a 50/50 mix of Motorcraft® Premium Gold Coolant and distilled water. No further action is required at this time. If the coolant is clear or pale yellow, proceed to Step 2.

2. Recommend measure coolant antifreeze strength. Measure the antifreeze strength following the recommended frequencies detailed in the chart below. A 50/50 mix provides protection to -34 °F (-36 °C), for operation below this level, refer to the 3. applicable Owner Guide and WSM for specifications. Proceed to Step 3.

3. Recommend checking coolant anticorrosion strength. Check the anticorrosion strength (nitrite level) of the coolant using the Rotunda 3-Way HD Antifreeze Test Strip Kit part number 328-00001 , 1-800-

Rotunda (768-8632) option 2 or equivalent. Perform coolant anticorrosion strength at the frequencies recommended. (Figure 1)
NOTE: FAILURE TO FOLLOW THE SERVICE PROCEDURE AS INDICATED CAN RESULT IN INACCURATE TEST RESULTS.

4. Instructions for coolant testing:
Start with clean, dry hands and utensils.
NOTE: COOLANT MUST BE BETWEEN 50 °F AND 130 °F (10 °C 54 °C) WHEN TESTED. ROOM TEMPERATURE IS PREFERRED.

Collect coolant sample from the (degas bottle) or radiator drain valve.
Remove one strip from the bottle. Do not touch the pads on the end of the strip. Discard strip if nitrite test pad has turned brown.
Dip strip in coolant sample for one second, remove, and shake strip briskly to remove excess liquid.
NOTE: FOR BEST RESULTS FOLLOW TEST TIMES CAREFULLY. USE A STOPWATCH OR CLOCK WITH A SWEEP SECOND HAND.

Wait 45 seconds but no longer than 75 seconds after dipping strip to compare and record results in the following order:

Compare FREEZEPOINT (end pad) to color chart on bottle and record result.
Compare NITRITE (end pad closest to handle) test to color chart on bottle.
The middle pad is for MOLYBDATE which is not a performance measurement used in determining maintenance requirements for these applications.

It is okay to estimate a value between color blocks, but if uncertain about the color match, pick the lower numbered block, for example if nitrite color is between F and E, use column E.

5. Coolant test results:
If the nitrite level exceeds 800 parts per million (PPM), no action is required, anticorrosion strength meets specification.
If the nitrite level is between 300 PPM and 800 PPM, anticorrosion strength is low. Add 32 fluid ounces of Motorcraft® Diesel Cooling System Additive.

If nitrite level is less than 300 PPM, anticorrosion strength is very low and cannot be restored. Refer to Step 6.

6. Flush the cooling system with Motorcraft® Engine Cooling System Iron Cleaner and refill with 50/50 mix of Motorcraft® Premium Gold Engine Coolant with Bittering Agent and distilled water as stated in the WSM, Section 303-03. A 50/50 mix of the Motorcraft® Premium Gold Engine Coolant with Bittering Agent and distilled water provides the proper cooling system protection and nitrite level for operating temperatures to -34 °F (-36 °C).

CAUTION: DO NOT ADD MOTORCRAFT® DIESEL COOLING SYSTEM ADDITIVE WHEN REFILLING THE COOLING SYSTEM AFTER A COOLING SYSTEM FLUSH WITH MOTORCRAFT® ENGINE COOLING SYSTEM IRON CLEANER. THIS MAY LEAD TO POSSIBLE ENGINE DAMAGE DUE TO VERY HIGH NITRITE LEVEL CONCENTRATIONS.

Verify pressure relief cap integrity by using the WSM, Section 303-03.
Follow recommended coolant service intervals: Perform the updated flush and fill procedures under the special operating conditions and frequencies recommended in the chart below: (Figure 1)

PART NUMBER PART NAME
VC-8 Motorcraft® Diesel Cooling System Additive
VC-9 Motorcraft® Engine Cooling System Iron Cleaner
VC-7-B Motorcraft® Premium Gold Engine Coolant with Bittering Agent

9C3Z-8101-A Pressure Relief Cap
328-00001 Rotunda 3-Way HD Antifreeze Test Strip Kit (1-800-Rotunda (768-8632) Option 2)

WARRANTY STATUS:
Information Only - Not Warrantable

TSB 8-23-1

FORD: 2003-2005 Excursion
2003-2007 F-Super Duty
2004-2008 E-Series

ISSUE:
Some 2003-2005 Excursion, 2003-2007 F-Super Duty and 2004-2008 E-Series vehicles equipped with a 6.0L engine may experience engine oil, transmission fluid or diesel fuel contaminating the cooling system. This flushing procedure is to be performed after the source of the cooling system contamination has been identified and repaired.

ACTION:
Follow the Service Procedure steps to correct the condition.

SERVICE PROCEDURE

Follow the steps in sequence to effectively repair the vehicle:

Drain cooling system contaminates.
Clean cooling system with Simple Green® Heavy Duty Cleaner and Degreaser.
Clean cooling system with Motorcraft® Engine Cooling System Iron Cleaner.
NOTE: ALL STEPS MUST BE COMPLETED IN ORDER TO PROPERLY CLEAN THE COOLING SYSTEM. ANY DEVIATION FROM THE SERVICE PROCEDURE WILL RESULT IN SHORTENED COOLANT PROTECTION AGAINST CORROSION IN THE COOLING SYSTEM.

Determine cooling system condition. Is the contaminated coolant in a flowable, liquid or milky state?
No - Do not proceed as this procedure does not apply. (Non-Flushable Examples Figures 1-3)

Figure 1 - Article 08-23-1

Figure 2 - Article 08-23-1

Figure 3 - Article 08-23-1

Yes - Proceed to Step 2. (Flushable Examples Figures 4-5)

Figure 4 - Article 08-23-1

Figure 5 - Article 08-23-1

Fabrication - Prior to starting the flush procedure, obtain the following items.

Locally Obtained Supplies
Quantity Description
3 Gal. Simple Green Heavy-Duty Cleaner And Degreaser
2 Heater Hose 3/4" (19 mm) diameter hose by 24" (61 cm) long
1 Garden Hose 5/8" (16 mm) or 3/4" (19 mm) diameter
6 Hose Clamps Number 12
3 Hose Coupling Adaptors 3" (7.6 cm) to 4" (10 cm) in lengh
* Using 5/8" (16 mm) garden hose - use 5/8" (16 mm) x 3/4" (19 mm) coupling adaptors
* Using 3/4" (19 mm) garden hose - use 3/4" (19 mm) x 3/4" (19 mm) coupling adaptors

Obtain two (2) hose coupling adapters and one (1) garden hose. The garden hose can be either a 5/8" or 3/4". The couplings can be 5/8" x 3/4" or 3/4" x 3/4" depending on the size garden hose used. On the vehicle the hose and thermostat ports are 3/4" in size. (Figure 6)

Figure 6 - Article 08-23-1

Using a 3/4" coupling adapter and hose clamps, cut the garden hose to length (the hose must reach from the vehicle to a fresh water supply faucet). Attach a 2' (61 cm) length of heater hose to the garden hose to be used as the fresh water supply. (the heater hose will prevent kinking at the tight area of the engine compartment). (Figure 7)

Figure 7 - Article 08-23-1

Using a 3/4" coupling adapter and hose clamps, attach a 2' (61 cm) length of heater hose to the remaining section of garden hose to be used as the drain hose (the heater hose will prevent kinking at the tight area of the engine compartment). (Figure 8)

Figure 8 - Article 08-23-1

WARNING: ALWAYS ALLOW ENGINE TO COOL BEFORE OPENING THE COOLING SYSTEM. DO NOT UNSCREW THE COOLANT PRESSURE RELIEF CAP WHEN THE ENGINE IS OPERATING OR COOLING SYSTEM IS HOT. THE COOLING SYSTEM UNDER PRESSURE; STEAM AND HOT LIQUID CAN COME OUT FORCEFULLY WHEN THE CAP IS LOOSENED SLIGHTLY.

NOTE: USE OF HOT WATER, DURING THIS PROCEDURE IF AVAILABLE, WILL IMPROVE REMOVAL OF PETROLEUM BASED COOLING SYSTEM CONTAMINATES.

Drain the cooling system. Refer to Workshop Manual (WSM), Section 303-03, Cooling System Draining, Filling and Bleeding . Leave the radiator draincock open.
Remove the thermostat. Refer to WSM, Section 303-03.
Position the thermostat housing assembly in the vise. Press down on the thermostat crossbar and rotate the thermostat to remove it from the thermostat housing assembly. (Figure 9)

Figure 9 - Article 08-23-1

Reuse the old O-ring seal during the flushing procedure. Install the thermostat housing assembly without the thermostat. Install the bolts. Tighten to 17 lb-ft (23 N-m).
NOTE: E-SERIES ONLY - DO NOT INSTALL THE AIR DEFLECTOR AT THIS TIME.

Remove the left hand (LH) cylinder block drain plug and drain the cylinder block. (Figure 10)

Figure 10 - Article 08-23-1

Insert the fresh water supply hose into the degas bottle. Flush the left hand LH cylinder block with fresh water through the degas bottle to remove contaminates.
Lightly lubricate the O-ring seal on the cylinder block drain plug with clean engine oil before installing. Install the LH cylinder block drain plug. Tighten to 177 lb-in (20 N-m).
Remove the starter. Refer WSM, Section 303-06B.
Remove the right hand (RH) cylinder block drain plug and drain the cylinder block. (Figure 11)

Figure 11 - Article 08-23-1

Insert the fresh water supply hose into the degas bottle. Flush the RH cylinder block with fresh water through the degas bottle to remove contaminates.
Lightly lubricate the O-ring seal on the cylinder block drain plug with clean engine oil before installing. Install the RH cylinder block drain plug. Tighten to 177 lb-in (20 N-m).
Install the starter. Refer to WSM, Section 303-06B.
NOTE: FIGURES SHOWN AND IDENTIFIED AS F-SERIES APPLY TO EXCURSION.

Disconnect the heater return hose at the heater return port below the coolant recovery tank. (Figures 12-13)

Figure 12 - Article 08-23-1

Figure 13 - Article 08-23-1

Connect the fabricated fresh water supply hose to the heater return port below the coolant recovery tank. (Figures 14-15)

Figure 14 - Article 08-23-1

Figure 15 - Article 08-23-1

Using a 3/4" coupling adapter and clamps, attach the fabricated drain hose to the heater return hose. (Figures 14-16)

Figure 16 - Article 08-23-1

Turn on the fresh water supply and allow the water to flush the cooling system of contaminates.
E-Series vehicles, proceed to Step 19.
F-Series and Excursion vehicles,
Vehicles with standard heater, disconnect the vacuum hose at the heater control valve to open the heater core flow.
Vehicles with an Electronic Automatic Temperature Control (EATC) heater, turn the ignition key to the on position and adjust the heater control to the full hot position to allow coolant flow during the cooling system flush.
Disconnect the flush hoses from the heater return port and heater return hose. (Figures 14 through 16)
Connect the heater return hose to the heater return port.
Close the radiator draincock.
Fill the cooling system with an appropriate mixture of water and Simple Green® Heavy Duty Cleaner and Degreaser. Follow the manufacturer's direction for heavy cleaning.
Using a scan tool, select the active command and set the engine RPM to 1,175. Run the engine for one (1) hour.
NOTE: FAILURE TO RUN THE ENGINE AT 1,175 RPM FOR ONE (1) HOUR WILL RESULT IN INSUFFICIENT CLEANING OF THE COOLING SYSTEM.

NOTE: ADJUST THE HEATER CONTROL TO THE FULL HOT POSITION TO ALLOW COOLANT FLOW DURING THE COOLING SYSTEM FLUSH. RECONNECT THE HEATER CONTROL VALVE VACUUM HOSE IF PREVIOUSLY DISCONNECTED.

Return the engine to idle speed, shut the engine off and allow the engine to cool before opening the cooling system. Do not unscrew coolant pressure relief cap when the cooling system is hot. Once pressure is released, remove the pressure relief cap and drain the cooling system. Refer to WSM, Section 303-03 Cooling System Draining, Filling and Bleeding. Leave the radiator draincock open.
Remove the LH cylinder block drain plug and drain the cylinder block.

NOTE: THE RH CYLINDER BLOCK DRAIN PLUG IS NOT REMOVED AT THIS TIME.

Disconnect the heater return hose at the heater return port below the coolant recovery tank. (Figures 12-13)
Connect the fabricated fresh water supply hose to the heater return port below the coolant recovery tank. (Figures 14-15)
Using a 3/4" coupling adapter and clamps, attach the drain hose to the heater return hose. (Figures 14-16)
Turn on the fresh water supply and allow the water to rinse the cooling system until the water is clear of foam, bubbles or discoloration.
E-Series vehicles, proceed to Step 30.
F-Series and Excursion vehicles,
Vehicles with standard heater, disconnect the vacuum hose at the heater control valve to open the heater core flow.
Vehicles with an EATC heater, turn the ignition key to the on position and adjust the heater control to the full hot position to allow coolant flow during the cooling system flush.
Disconnect the flush hoses from the heater return port and heater return hose. (Figures 14 through 16)
Reconnect the heater return hose to the heater return port.
Lightly lubricate the O-ring seal on the cylinder block drain plug with clean engine oil before installing. Install the LH cylinder block drain plug and tighten to 177 lb-in (20 N-m).
Close the radiator draincock.
Fill the cooling system with water and two (2) quarts (1.89 L) of Motorcraft® Engine Cooling System Iron Cleaner.
For vehicles with auxiliary or aftermarket heaters, use three (3) quarts (2.83 L) of Motorcraft® Engine Cooling System Iron Cleaner.
Adjust heater controls to full hot position.
E-Series vehicles, proceed to Step 36.
F-Series and Excursion vehicles,
Vehicles with standard heater, disconnect the vacuum hose at the heater control valve to open the heater core flow.
Vehicles with an EATC heater, turn the ignition key to the on position and adjust the heater control to the full hot position to allow coolant flow during the cooling system flush.
Using a scan tool, select the active command and set the engine RPM to 1,175. Run the engine for one (1) hour.
NOTE: FAILURE TO RUN THE ENGINE AT 1,175 RPM FOR ONE (1) HOUR WILL RESULT IN INSUFFICIENT CLEANING OF THE COOLING SYSTEM.

Return the engine to idle speed, shut the engine off and allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the cooling system is hot. Once pressure is released, remove the pressure relief cap and drain the cooling system. Refer to WSM, Section 303-03. Leave the draincock open.
Remove the LH cylinder block drain plug and drain the cylinder block.
Remove the starter. Refer to WSM, Section 303-06B.
Remove the RH cylinder block drain plug and drain the cylinder block.
Flush the cooling system with clean water through the degas bottle to completely remove the Motorcraft® Engine Cooling System Iron Cleaner, until the water is free of foam, bubbles or discoloration.
E-Series vehicles, proceed to Step 43.
F-Series and Excursion vehicles,
Vehicles with standard heater, disconnect the vacuum hose at the heater control valve to open the heater core flow.

Vehicles with an EATC heater, turn the ignition key to the on position and adjust the heater control to the full hot position to allow coolant flow during the cooling system flush.
NOTE: FAILURE TO FLUSH ALL THE MOTORCRAFT® ENGINE COOLING SYSTEM IRON CLEANER FROM THE COOLING SYSTEM WILL RESULT IN SHORTENED COOLANT PROTECTION AGAINST CORROSION OF THE COOLING SYSTEM.

Disconnect the heater return hose at the heater return port below the coolant recovery tank. (Figures 12-13)
Connect the fabricated fresh water supply hose to the heater return port below the coolant recovery tank. (Figures 14-15)
Using a 3/4" coupling adapter and clamps, attach the drain hose to the heater return hose. (Figures 14 and 16)
Turn on the fresh water supply and allow the water to rinse the heater core system until the water is clear of foam, bubbles or discoloration.
Disconnect the flush hoses from the heater return port and heater return hose.
Reconnect the heater return hose to the heater return port.
Repeat flushing of the cooling system with clean water through the degas bottle to completely remove the Motorcraft® Engine Cooling System Iron Cleaner until the water is free of foam, bubbles or discoloration.
NOTE: FAILURE TO PERFORM STEP 49 WILL RESULT IN SHORTENED COOLANT PROTECTION AGAINST CORROSION OF THE COOLING SYSTEM.

F-Series and Excursion vehicles only, reconnect the vacuum hose to the heater control valve.
NOTE: IF VEHICLE IS EQUIPPED WITH AN AUXILIARY OR AFTERMARKET HEATER, BACKFLUSH THIS HEATER CORE. REFER TO WSM, SECTION 303-03.

Close the radiator draincock.
Remove the thermostat housing assembly. Refer to WSM, Section 303-03.
Remove and discard the O-ring seal.
Position the thermostat housing assembly in a suitable vise. Press down on the thermostat crossbar and rotate the thermostat to install it in the thermostat housing assembly. (Figure 9)
Install a new O-ring seal and install the thermostat housing assembly. Tighten to 177 lb-in (20 N-m). Refer to WSM, Section 303-03.
Lightly lubricate the O-ring seal on the cylinder block drain plug with clean engine oil and install the RH cylinder block drain plug. Tighten to 177 lb-in (20 N-m).
Install the starter. Refer to WSM, Section 303-06B.
Lightly lubricate the O-ring seal on the cylinder block drain plug with clean engine oil and install the LH cylinder block drain plug. Tighten to 177 lb-in (20 N-m).
Fill the cooling system. Refer to WSM, Section 303-03.

PART NUMBER PART NAME
3C3Z-8255-AA O-Ring
VC-9 Motorcraft® Engine Cooling System Iron Cleaner
VC-7-B Motorcraft® Premium Gold Engine Coolant with Bittering Agent
Obtain Locally Simple Green® Heavy Duty Cleaner and Degreaser (3 Gallons Required)
Obtain Locally Garden Hose 5/8" (16 mm) or 3/4" (19 mm) diameter
Obtain Locally Hose Clamps Number 12 (6 Required)
Obtain Locally Hose Coupling Adaptors 5/8" (16 mm) by 3/4" (19 mm) or 3/4" (19 mm) by 3/4" (19 mm) depending on Garden Hose size (3 Required)
Obtain Locally Heater Hose 3/4" (19 mm) diameter hose by 24" (61 cm) long

WARRANTY STATUS:
Eligible Under Provisions Of New Vehicle Limited Warranty Coverage
IMPORTANT: Warranty coverage limits/policies are not altered by a TSB. Warranty coverage limits are determined by the identified causal part.

OPERATION DESCRIPTION TIME
082301A 2003-2007 F-Super Duty 6.0L: Flush The Engine Cooling System (Do Not Use With 8005B) 4.3 Hrs.
082301A 2004-2008 E-Series 6.0L: Flush The Engine Cooling System (Do Not Use With 8005B) 5.4 Hrs.
082301A 2003-2005 Excursion 4X2, 4X4: Flush the Engine Cooling System. Includes Time For Rear Heater Core If Necessary 4.5 Hrs.

DEALER CODING
BASIC PART NO. CONDITION CODE
6A642 d1

Suppliers:

Fumoto Valve: http://www.oildrainvalve.net/products/F108N-%3A-16mm%252d1.5.html

Credits:

This document was made possible by the generous members of:

www.powerstroke.org
www.ford-trucks.com
www.thedieselstop.com

With particular thanks to:
Jason, also known as “jfirstford” on the ford-truck.com forum, who provided much of the detail on the reverse oil cooler flush in the thread:
http://www.ford-trucks.com/forums/1059625-55-eot-ect-working-400mi-from-home-need-tech-advice.html

Derek, also known as “ex mounty” on thedieselstop.com forum and “NYC F-350” on powerstroke.org and ford-trucks.com for his insight, editing and keeping things honest.

Jack, also known as FMTRVT on thedieselsite.com and TooManyToys on Powerstroke.org. Jack spent a lot of time and effort cutting apart my original oil cooler and performing tests on it. His analysis is the basis of much of the knowledge around clogging oil coolers.

Special mention to “juzatheman” on the powerstroke.org forum for his persistence on clearing a clogged oil cooler.

For a more detailed look into oil coolers, the thread on powerstroke.org:
http://www.powerstroke.org/forum/6-0-motor-problems/149749-replaced-oil-cooler-still-difference-temps.html
provides quite a bit of analysis.

For questions or additions to this document please send me a private message on any of the above forums. I can be found under the username “nylyon.”

To your cooling system success!

Karl Lyon