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Tutorial: Fleetguard Cooling System Test Strips

UNDERHOOD

FORD Power Stroke Truck

Thank you for your purchase from Geno's Garage. As we work to provide the right mix of maintenance and accessory items for your trucks, we also have the opportunity to answer some of your questions. We have found that there are many misconceptions about cooling system maintenance.

For the correct answers to cooling system maintenance, we went back to the basics - your Owner's Manual. We also asked *Power Stroke Registry* writer, James Langan, to incorporate the Owner's Manual information with his insightful text and interviews with International Truck and Engine Representatives to bring about a complete understanding of the issue. The following is a report that we are providing to try to eliminate the confusion. Go forth! Understand, test, and maintain your Powerstroke engine's cooling system.

CAVITATION EROSION

When it comes to routine maintenance on your Power Stroke, there are a few key areas that need special attention, even if you chose to neglect the others. One can argue that there is no real "tune-up" needed on a Diesel, and modern cars can be driven for thousands of miles, maybe even 100,000 miles, before they need a tune-up.

With a Power Stroke Diesel, the only thing that might qualify as a tune-up could be an engine oil change. Since the fuel-injectors are actuated by engine oil, changing your engine's oil regularly is very important. Another area that is important on every Diesel is fuel cleanliness.

The interesting thing about the above two maintenance needs are that if you fail to care for your engine's oil or fuel, your truck will eventually draw your attention to the neglect by running poorly. If you correct the problem early enough you will probably be okay. When it comes to coolant maintenance the signs of neglect take too long to appear, maybe just before your engine dies, prematurely.

HOW DOES CAVITATION EROSION OCCUR?

How does this happen? The energy generated during the high-compression combustion process of a Diesel engine causes a high-frequency vibration inside the engine similar to the ringing of a bell. This occurs when the piston strikes or "slaps" the cylinder wall as the piston travels up and down. This "piston-slap" starts the cavitation process.

The cylinder walls, or wet liners on many large Diesel engines, distort and move away from the engine coolant fast enough to form vapor bubbles. The vapor bubbles form because the movement of the block (or liner) causes the localized pressure of the coolant to drop below the vapor pressure of the coolant. This process causes a small amount of coolant to change into its vapor state. As the cylinder-block returns to its original geometry, the vapor bubbles return to their liquid state and implode (violently collapse inward) against the coolant side of the block. When these vapor bubbles implode against the wet side of the cylinder wall, they produce a very high-velocity jet of water. These water-jets can act on the cylinder wall with a pressure of over 15,000 psi and remove a microscopic piece of the cylinder block like a liquid sand-blaster.

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The bubbles often attach themselves to a casting mark or scratch on the block, causing the bubbles to implode in the same spot repeatedly. Over a period of time, enough of the block is eaten away, and a hole develops in the engine block. This is cavitation erosion. When a hole develops in your engine, and allows cooling and combustion processes to mix, you have a very serious problem.

The rate at which the cavitation progresses, is related to the duty-cycle of the engine. It is not unheard-of for an improperly maintained cast-block Diesel engine with less than 150,000 miles to develop holes in its cylinder walls. A wet-liner equipped engine can cavitate much sooner.

Prevention Is The Solution Since the cost of having a new engine installed in your rig will easily cost upwards of $10,000.00, we suggest you not overlook this area of required maintenance.

You can't stop the bubbles from forming, but you can stop them from eating your engine. To prevent vapor bubbles from causing the above damage, most Diesel engines, including Power Strokes, require that Diesel coolant additives (DCA), also known as supplemental coolant additives (SCA) be added to the cooling system. In the correct concentration, these Diesel coolant additives form a tough but invisible film on the wet side of the block or liner surface. The vapor bubbles are still being formed, but the additives keep them from collapsing against the engine block.

A SIMPLE ANALOGY

Need a simple analogy: Waxing your car.

Q. Why do we wax our cars?

A. Because we want to put a thin film or coating on the vehicle to protect the paint and to keep "stuff" from damaging the painted surface. When it rains we want the water "bubbles" to roll off the paint. Well, we want the coolant vapor bubbles to slide off the inside of our engine blocks in much the same manner.

Just as the additives in oils are depleted over time, supplemental coolant additives sacrifice themselves so that your engine can live to see another day and several thousand more miles. Think of DCA as the martyr of the Diesel-engine world. Although the coolant additives do prevent cavitation, this is a situation where you can have too much of a good thing. Do not over-treat your cooling system.

What Should You Add? Power Stroke Diesel engines come from the factory pre-treated with Diesel coolant additive. The Power Stroke Owner's Manual clearly states that 8-10 ounces of FW-16, Ford's DCA, should be added to the cooling system after every 15,000 miles. Since coolant additive is sold in 16-ounce bottles, adding half a bottle every 15,000 miles is easy. A readily available and much cheaper alternative to Ford¹s FW-16 is DCA-4 made by Fleetguard.

When you change your engine's coolant you need to add four pints of DCA-4 to the new 50/50 coolant and water mixture, unless you are buying Diesel engine coolant that is pre-charged with coolant additives. Don't forget to save your receipts and log your maintenance in the event you have a coolant-related, serious engine failure covered under your Ford warranty.

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What Coolant? Quoting from the Spring 2001 issue of the *PSR* magazine and author Mark Wildman, Field Service Representative for International Truck and Engine Corporation:

Ford Premium Coolant (part number E2FZ-19549-AA, Ford Reference #VC-4-A) or the equivalent that meets specification ESE-M97B44-A, should be used during cooling system service. Mix the coolant with distilled water. Water that has minerals in it, or hard-water, should not be used because the minerals will lower the boiling point and increase corrosion in the system. Under normal driving conditions, the coolant should be changed every 75,000 miles, or every 30,000 miles under harsh driving conditions such as towing, carrying heavy loads or operating in extreme temperatures.[2]

Coolant is coolant, right? Can I just buy some antifreeze at my local auto-parts store? Prestone, Zerex or whatever they have on-sale will work, right? WRONG! The coolant requirements of Diesel engines are not the same as those of a typical gasoline-powered engine. The correct coolant for your Power Stroke Diesel is an ethylene glycol (EG) type antifreeze. Ford Premium Coolant is one appropriate ethylene glycol coolant.

Coolant for your Power Stroke Diesel needs to be more than just ethylene glycol based. The coolants marketed to the general automotive world are blended with a higher concentration of silicates (for dissimilar metal protection) than are found in antifreeze formulated specifically for Diesel engines. Mixing the DCA additives needed to protect against cavitation erosion with these high-silicate antifreezes can cause the silicates to drop-out. This chemical drop-out can form a paste that may plug heater cores, radiator tubes and cause water pumps to fail. The water pump seal can fail when a large amount of silicate paste gets between the seal lip and the seal's riding surface. In some cases it can even plug small passages in the engine, causing hot spots that lead to engine damage. (Mark Wildman quoted from the Spring 2001 *PSR*). Be sure to specify a low-silicate, made-for-Diesel, type of antifreeze. If you want to play it safe use Ford's Premium Coolant mentioned above.

What About Permanent or Long-Life Coolants? Nothing is truly permanent. Although model year 2002 Power Strokes are compatible with extended service coolants, the earlier trucks are not. Specifically, the water-pump and front-cover-to-crankcase gaskets are not chemically compatible with extended service coolants. Power Stroke engines starting with a serial number of 0940614 ARE compatible with these long-life coolants.

TESTING YOUR COOLANT

Testing your DCA levels: For those who wish to be a bit more scientific than just adding eight ounces of FW-16 or DCA-4 every 15,000 miles, there is another option. Test kits are available from Geno's Garage or your local International dealer which allow you to test your DCA level at home. You can use Fleetguard's CC2602 test kit for the measurement of proper chemical concentration.

The standard for the International Power Stroke Diesel is 2-3.0 units of supplemental coolant additive per gallon of coolant capacity. Testing the coolant is simple, but remember to read and follow the directions carefully. The following is a paraphrased version of International's heavy-duty coolant test instructions:

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- Collect a coolant sample from the radiator or petcock. Do not collect the sample from the coolant recovery-bottle. (It should be noted that later Power Strokes do not have a radiator cap on the radiator. The pressure cap is on the coolant reservoir, which is in the 'loop' of circulated coolant. Collecting coolant samples from these recovery bottles is acceptable.) Before testing, the coolant must be between 50-130 degrees Fahrenheit. Room temperature is preferred.
- Remove a test strip from the bottle and replace the cap. Do not touch the pads on the end of the test strip. If the test strips have turned brown, throw them away. There should be an expiration date on your test kit.
- Dip the strip into the coolant sample for one second, remove, then shake the strip briskly to remove excess coolant.
- After 45 seconds compare and record the results starting at the top of the strip (the end you are not holding) matching each pad with the appropriate color chart.

A. The first/end pad indicates the coolant's freeze-point.

B. The middle pad is for the molybdate level.

C. The last pad indicates the nitrite level.

All of your readings must be completed not later than 75 seconds after you dipped the test strip.

- It is okay to estimate the valve between color blocks. If you are uncertain about the color, pick the lower block.
- Where the molybdate and nitrite levels intersect on the chart is the amount of DCA units per gallon in your cooling system.
- If your DCA level is below 2 units per gallon, add the appropriate amount of DCA-4 per gallon to bring your engine into the 2-3.0 units-per-gallon range.

This will require some simple math calculations. Checking my Owner's Manual (vintage 1999 Power Stroke), I find that my cooling system holds 4.85 gallons.

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NOTE: This capacity will change by model year. Reference your Owner's Manual for cooling system capacity for your specific truck. From the side of the DCA-4 bottle, I note that there is one unit of charge in each increment of 3.2 ounces (i.e. the 16 ounce bottle has 5 units of charge in the bottle).

As an example, let's say that the test strip showed a reading of 1.0 units (Hey, we're running a bit low here! We've obviously neglected the cooling system for quite some time.). To move back to the top of the range (3.0 units), I will need 2.0 units of charge per gallon of cooling system capacity. Total charge units needed: 2.0×4.85 gallons $= 9.7$ charge units. Since there is 1.0 charge unit per 3.2 ounces of DCA-4, let's add 31 ounces (two bottles) to the system. Simple math?

* * *

Thank you again for your purchase from Geno's Garage. Hopefully our tutorial and cooling system maintenance proves helpful to you.