
TECHNICIAN
TRAINING
BY DORMAN PRODUCTS
DORMAN
Training Seminar Series
Presents:
"Ford 6.7 Power Stroke Diesel
GENs 1 & 2"

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DORMAN
Aftermarket Innovators

2

Your Instructor For This Webinar

"G" Jerry Truglia

- **National Trainer, ASE World Class, Master Auto, Truck, School Bus, L1, L3, CNG and…**
- **ATTP Master Instructor, New York State, CT and New Jersey**
- **STS (Service Technician Society) 2003 President**
- **TST (Technicians Service Training) Founder and President**
- **Author / Co Author/ Technical adviser on 25 plus books including OBD II and Mode 6, and Understanding and Diagnosing Hybrid Vehicles**
- **Published articles for multiple newsletters, and magazines**
- **Picked as one of the Top Instructors in the country by EPA & SAE**
- **Numerous Radio, TV, Internet, and SAE Video appearances**
- **PTEN, MotorAge and TST Webcast Instructor**
- **Motor Magazine Top 20 award winner**
- **Provider of OBD II Training for 14 states, Ontario Canada and the US EPA**
- **Guest speaker at SAE Congress, IM Solutions and Clean Air Conference**

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What Will Be Covered:

- **6.7 PowerStroke - Generations 1 & 2 Out Of 4 Ford's Diesel Powerplants**
- **Maintenance Notes**
- **Essential Diagnostic Techniques**
- **Diagnosing The Ford Way!**
- **CP4 Failures - The 6.7's Achilles Heel**
- **6.7 Issues Over The Years**
- **Diagnostic Tips**

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6.7 L PowerStroke - 4 Generations Of Ford's Diesel Powerplant

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Gen 1: 2011 - 2014

Courtesy of Ford Motor Company

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The "Scorpion" Is Born!

During its development, Ford engineers codenamed this engine "Scorpion" because the exhaust manifold and turbocharger were now mounted in the engine's "valley."

Courtesy of Ford Motor Company

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Gen 1 Model Year Changes

2011

- **In response to GM's release of a new generation Duramax diesel with more potent power ratings than Ford's 6.7L Power Stroke, Ford Motor Company issued a revised calibration for the 6.7 liter that increased its power from 390 horsepower to 400 horsepower and its torque from 735 lb - ft to 800 lb - ft. This new calibration was made available to owners via a free PCM reflash available through Ford dealerships.**

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Gen 1 Model Year Changes

2012

- **A stamped steel oil pan with a conventional bolt-type oil plug replaced the plastic oil pan and plastic 1/4 turn drain valve.**
- **Revised oil cooler secures without any hidden hardware; to remove original oil cooler, the lower oil pan needed to be removed in order to access a hidden stud securing the oil cooler assembly from the back side. Revised oil cooler is secured with exterior bolts only and is serviceable without removing the lower oil pan.**
- **DPF differential pressure sensor added to exhaust system to measure the pressure differential across the diesel particulate filter for the purpose of monitoring DPF condition.**
- **Revised oil and coolant feed lines for the turbocharger, quick connect fittings replaced with conventional bolt on fittings for improved sealing and durability.**

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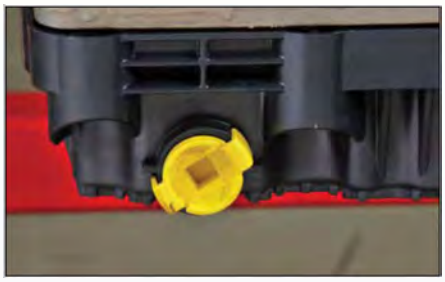
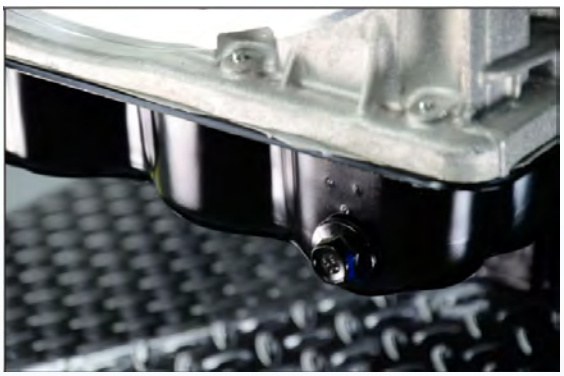
Oil Pan And Drain Plug Update



The older version oil pan used a quarter turn drain plug in a composite oil pan.



The newer oil pan is stamped steel and uses a conventional drain plug.

Courtesy of Ford Motor Company

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Oil Cooler

Courtesy of Ford Motor Company

The oil cooler was updated in 2012 where the hidden mounting points were removed. This update did away with the labor - intensive oil pan removal.

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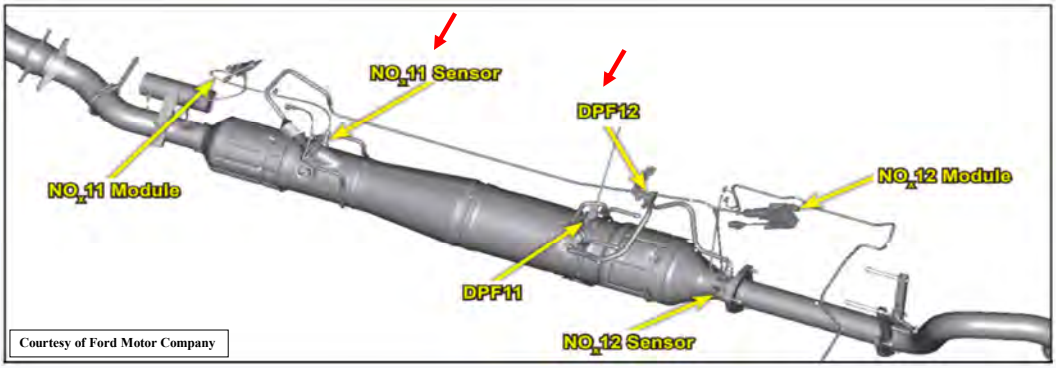
Exhaust System Example



Courtesy of Ford Motor Company

An extra NOx Sensor (NOx11) and module were added in 2012 to the aftertreatment system. For 2013 a DPF sensor (DPF 12) was added to the Diesel Particulate Filter Pressure Bank 1 Sensor 2.

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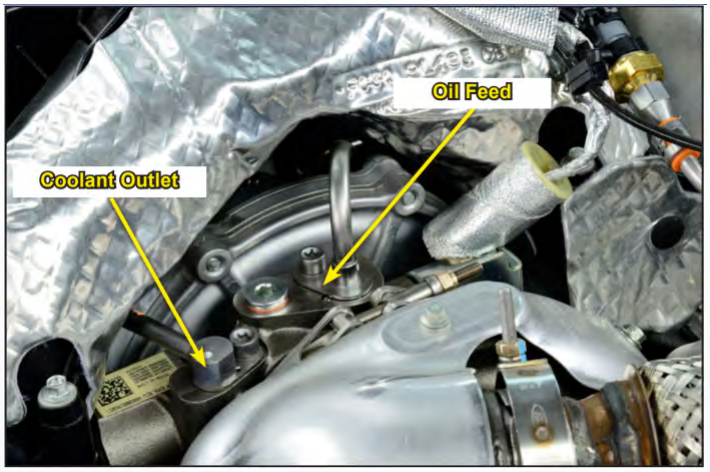
Turbocharger Cooling And Lube Lines



Courtesy of Ford Motor Company

The cooling and lube lines going to the turbocharger have been changed from quick connections, to bolt type. This update is more durable preventing leaks due to better sealing ability.

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Gen 1 Model Year Changes

2013

- **Crankcase ventilation sensor added, signals to PCM whether the crankcase vent hose is connected or disconnected.**

- **An additional NOx sensor and NOx sensor module added to the exhaust system in order to perpetually monitor the effectiveness of the SCR (Selective Catalyst Reduction) system. The new arrangement adds an NOx sensor before the inlet of the SCR catalyst, previous system only had a NOx sensor at the outlet of the catalyst**

2014

- **No significant or notable changes to the 6.7L Power Stroke engine platform.**

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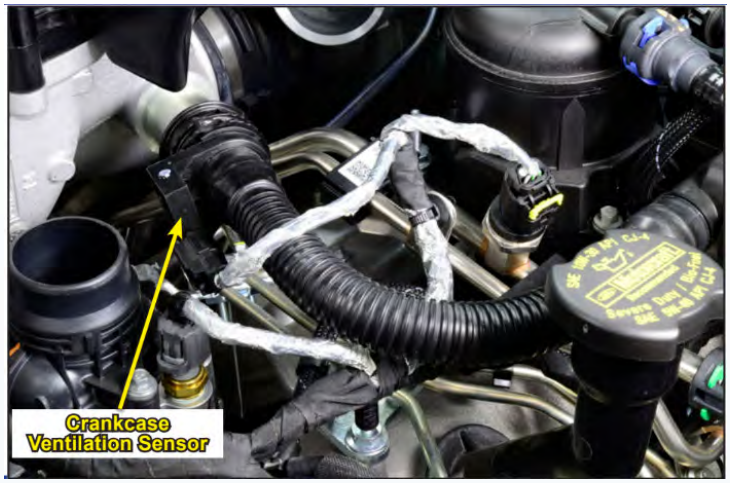
Crankcase Ventilation Sensor



Courtesy of Ford Motor Company

The Hall Effect crankcase ventilation sensor is mounted on a hose that is connected by a tamper proof connector at the air intake hose.

First used in 2013 Super Duty vehicle.

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Gen 2: 2015 - 2019

Courtesy of Ford Motor Company

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Gen 2 Model Year Changes

2015

- **Peak engine power increased from 400 to 440 horsepower for all Super Duty pickup trucks (40 horsepower increase).**
- **Peak engine torque increased from 800 to 860 lb-ft for all Super Duty pickup trucks (60 lb-ft increase).**
- **6.7L Power Stroke diesel added to Ford F-650 and F-750 medium duty trucks; available in 270, 300, and 330 horsepower configurations.**
- **Particulate matter sensor and sensor module added at the DPF outlet in order to measure filtration effectiveness.**

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Gen 2 Model Year Changes

2015

- **Updated fuel pressure and temperature sensor that measures actual fuel pressure. The previous sensor acted like a switch (no measurements, only "on" and "off " states) that identified to the PCM whether there was pressure or not but did not give the PCM an actual fuel pressure reading.**

- **Coolant flow through the EGR cooler re-routed such that both stages of cooling are managed by the primary (high temperature) cooling system circuit. The previous arrangement relied on the primary cooling system for the first stage of cooling and the secondary (low temperature) cooling system for the second stage of EGR cooling.**

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Gen 2 Model Year Changes

2015

- Temperature sensor added to the inlet of the EGR cooler (pickup trucks only).
- Revised fan clutch design with additional heat sinks in order to more effectively dissipate heat, thereby improving durability.
- IROX polymer coated lower main bearings introduced for added durability at greater performance levels.
- Larger GT37 single variable geometry turbocharger replaces the GT32 twin compressor "DualBoost" turbo. Improved throttle response and high altitude performance. Wastegate eliminated, turbocharger produces ~30 psi at max load with an impeller speed of ~130,000 rpm.

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Gen 2 Model Year Changes

2015

- New lower intake manifold, revised to accommodate the new VGT (Variable Geometry Turbocharger) with a single air inlet.
- New downpipe inlet design to accommodate the new VGT turbocharger with larger outlet size (pickup trucks only, chassis cab retains a smaller VGT).
- Turbocharger coolant return and engine oil supply line fittings changed from quick connect style to bolt-on flange type for improved sealing and increased reliability; previous quick connect fittings more prone to developing leaks.
- Manually activated, more effective exhaust braking system added, works in conjunction with new VGT.

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Gen 2 Model Year Changes

2015

- **Upgraded high pressure fuel pump (injection pump). New pump looks identical but features a longer stroke.**
- **Revised injector design, more efficiency nozzle design for reduced emissions and improved performance.**
- **Revised crankshaft damper design with added mass; necessary due to the increased torsional forces produced by the more powerful engine.**
- **Revised lower main bearings with IROX polymer coating.**
- **Strengthened cylinder head design.**
- **High capacity torque converter introduced; transmission shift schedule not significantly altered.**

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Gen 2 Model Year Changes

2015

- **DPF (Diesel Particulate Filter) differential pressure sensor removed (previously introduced as a 2012 model year update).**

- **Particulate matter sensor and module added to exhaust aftertreatment system. The PM sensor monitors and reports particulate matter density in the exhaust stream to identify probable problems with the diesel particulate filter.**

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Particulate Matter Bank 1 Sensor 1 Module

The PM11 module monitors the PM11 sensor and controls the PM11 sensor heater element. The PM11 module communicates with the PCM through the CAN network reporting the presence of particulates in the exhaust gas that may indicate a concern with the Diesel Particulate Filter aka DPF.

Courtesy of Ford Motor Company

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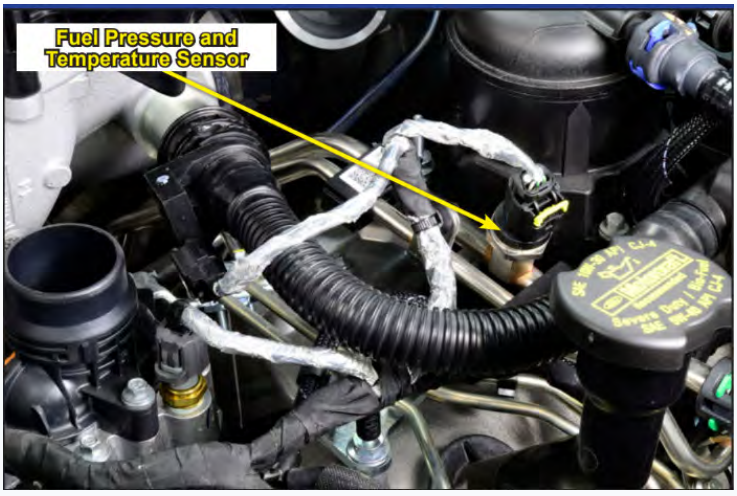
Fuel Pressure And Temp Sensor



Courtesy of Ford Motor Company

The fuel and temp sensor is a combined sensor that monitors both pressure and temperature of the low-pressure fuel system.

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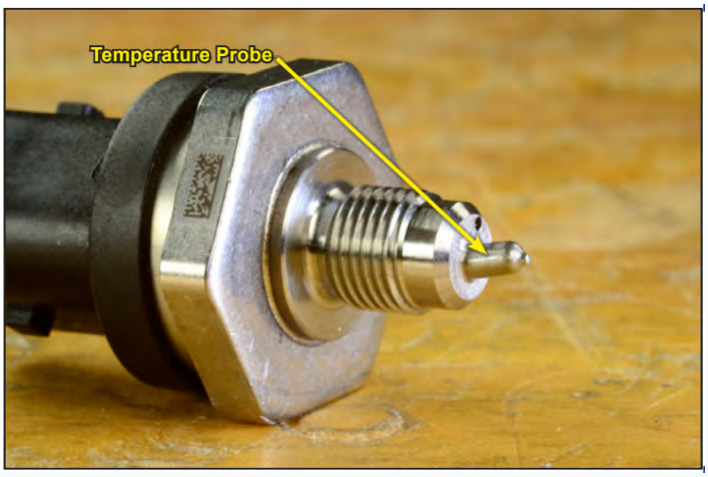
Temperature Sensor

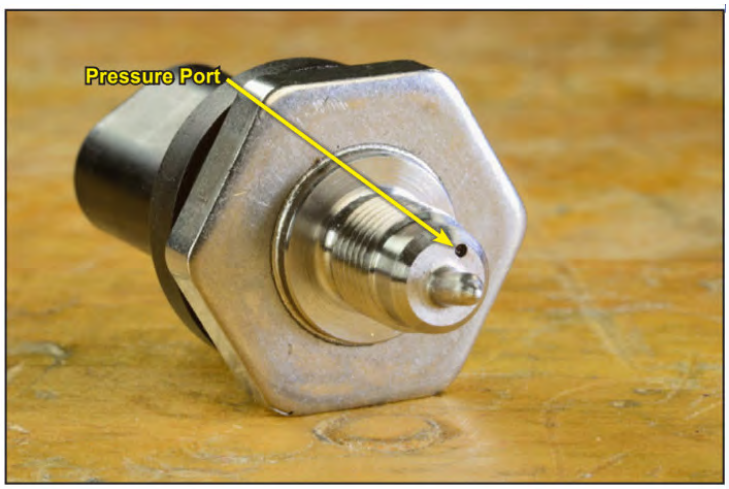


Courtesy of Ford Motor Company

This sensor is a thermistor sensor that operates by the electrical resistance decreases as temp increases. A voltage signal is sent to the PCM that is converted into a temperature reading.

25

Temperature Sensor



Courtesy of Ford Motor Company

The second part of the sensor is the fuel pressure sensor that send a signal if the fuel pressure is low. As the fuel pressure increases the sensor pressure voltage decreases.

On the older version the sensor was just a switch that changed when minimum fuel pressure was reached.

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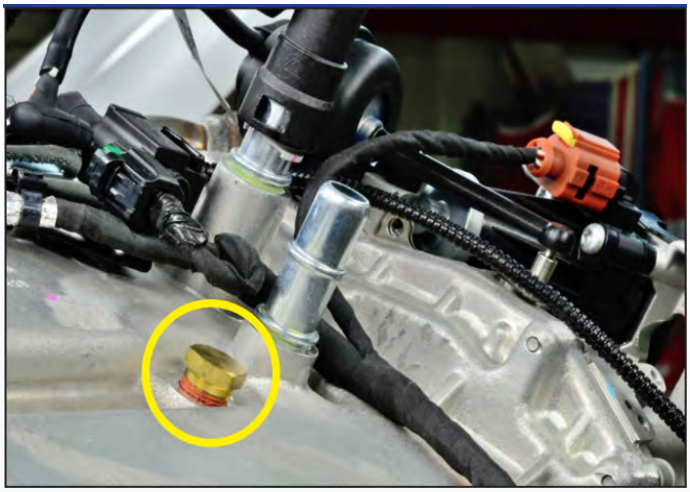
EGR Cooler



Courtesy of Ford Motor Company

The coolant flow through the EGR has changed. The EGR cooler is a carryover from the previous years but the secondary cooling systems no longer cools the EGR gases.

The newer engines use the high temperature cooling system.

As pictured the ECT2 sensor had been removed and plugged. On 2015 and newer the plug is deleted.

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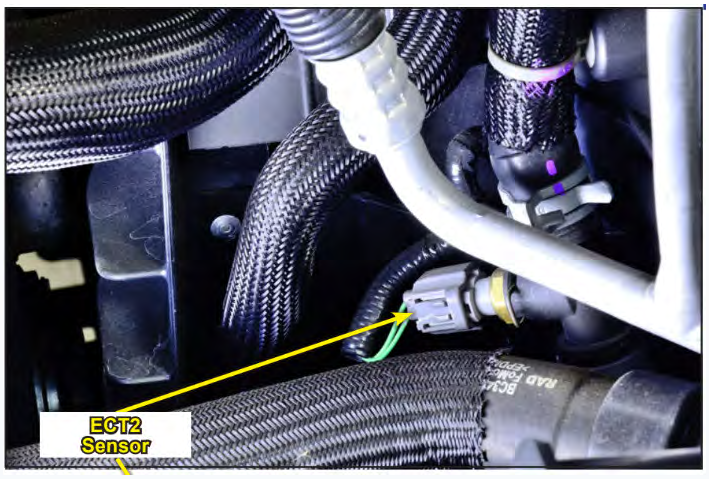
EGT2 Cooler Sensor



Courtesy of Ford Motor Company

Due to the EGR Cooler flow change the ECT2 is now mounted in a fitting in the coolant line. It's located in the right front engine compartment under the air filter box.

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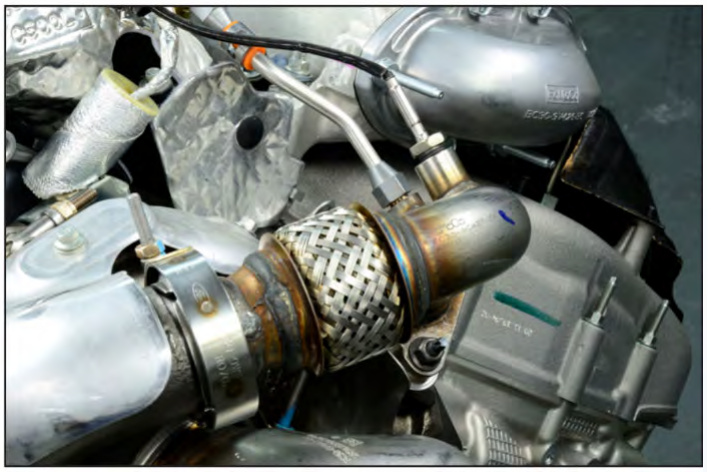
EGRT Inlet Temp Sensor



Courtesy of Ford Motor Company

The EGRT 11 sensor monitors the exhaust temp leaving the exhaust manifold prior to entering the turbo turbine housing and EGR cooler. It allows for improved driveability in loading conditions and provide engine hardware protection.

*** Pickup only**

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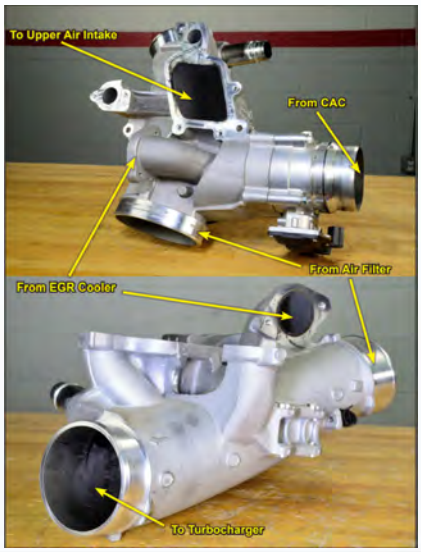
Lower Air Intake

The lower intake has been updated along with the turbo.

There is only a single air intake feeding the turbo.



Courtesy of Ford Motor Company

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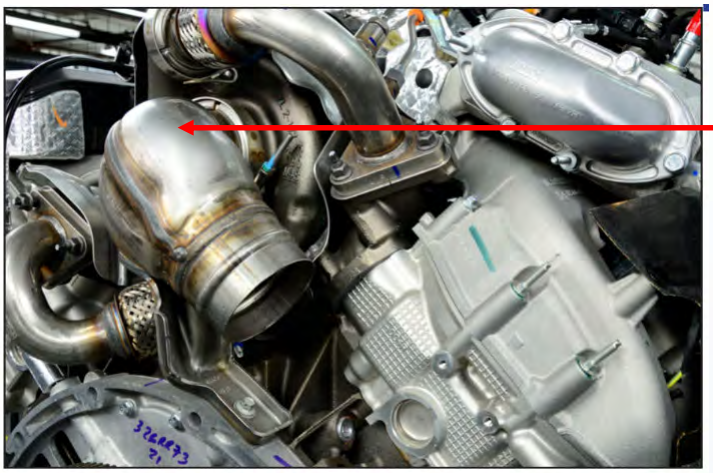
Exhaust Down Tube Off The Turbo



Courtesy of Ford Motor Company

The cobra head has been shortened and redesigned to fit the new turbo.

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Gen 2 Model Year Changes

2016

- **No significant or notable changes to the 6.7L Power Stroke engine platform**

2017

- **Peak engine torque increased from 860 lb-ft to 925 lb-ft**
- **Revised oil supply line and turbo pedestal**

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Maintenance Notes

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Water And Diesels Don’t Mix!

- **Diesel injectors produce heat during operation and must be kept cool or else they will destroy themselves.**
- **Diesel engine systems circulate fuel from the fuel tank across the injectors to dissipate some of the heat and keep the injectors cool. The hot "return fuel" is then cycled back to the fuel tank.**
- **When the hot return fuel is returned to the tank, the increased temperature causes a greater amount of water from the air inside the tank to condense into the fuel. This causes a steady build - up of water in the bottom of the fuel tank over a period of time.**
- **Water is also produced from diesel fuel storage due to vented storage tanks and humid air. Whenever there’s a 7 - degree temperature decrease, condensation can occur.**

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Water And Diesels Don't Mix!

This water has the potential to cause multiple problems - freezing in cold weather, providing a growth medium for bacteria, accelerating the aging of the fuel to produce gums and shellacs, and causing injector tips to malfunction.

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Water And Diesels Don't Mix!

- **After the fuel leaves the tank, it enters a water-fuel separator/strainer and then a fuel filter.**
- **When diagnosing diesels for drivability issues it is very important to make sure the fuel separator - strainer is free of water.**
- **Because water is heavier than diesel fuel, it will be found at the bottom of the separator - strainer.**

Courtesy of Ford Motor Company

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Water And Diesels Don't Mix!

FORD RECOMMENDS OPENING THE WATER DRAIN AND INSPECTING FOR WATER ONCE A MONTH.

USE ONLY OE FUEL FILTERS FOR SERVICE. THEY ARE DESIGNED TO FILTER WATER OUT AS WELL AS DEBRIS

PRIMARY FILTER OFFERS 10 MICRON FILTRATION, SECONDARY FILTER PROVIDES 4 MICRON FILTRATION

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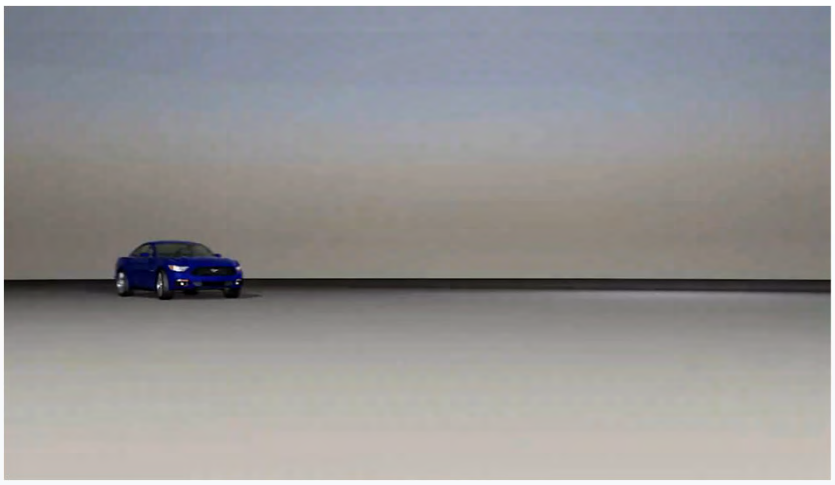
Service Tip!



Courtesy of Ford Motor Company

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Can You Tell What The Cetane Rating Is?

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Diesel Fuel

Gasoline fuel uses an Octane rating while diesel fuel uses a Cetane rating. Both ratings are a reflection of the fuel's volatility and ignition value. Most of the Number 2 rated fuel has a Cetane rating of 40, while some may be as high as 55. Most of the newer diesel vehicles that are operated on roads will require at least a 45 Cetane rating. With higher Cetane rating there is a reduction in cold starting problems, white smoke and engine emissions.

FORD RECOMMENDS A 45 CETANE MINIMUM FOR THE 6.7

A 10 CETANE DIFFERENCE WILL RESULT IN NOTICEABLE CHANGE IN ENGINE PERFORMANCE DUE TO THE DIFFERENCE IN FUEL IGNITABILITY

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FORD DOES NOT APPROVE OF THE USE OF ANY AFTERMARKET FUEL ADDITIVES

USE ONLY MOTORCRAFT ADDITIVES

- **Motorcraft Lubricity additive (PM-15)**
- **Motorcraft Cetane Booster and Performance Improver (PM-22-A)**
- **Motorcraft Anti-Gel (PM-23-A) for winter use**

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Service Tip!

Before doing any diesel diagnostic, if you don't know when the fuel filter was last replaced sell the customer on a fuel filter. They fail all the time on diesels and a clogged filter can mimic a fuel pump failure, a fuel line restriction, and other common diesel failures.

USE OE FILTERS OR THEIR EQUIVALENTS AND EDUCATE YOUR CUSTOMER ON THE IMPORTANCE OF PROPER MAINTENANCE!

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Cooling System Service

The coolant level should always be checked during a PM (service interval) and it should also be checked with a refractometer and coolant strips.

The coolant should be an Ethylene Glycol (EG) or Propylene Glycol (PG) based antifreeze and be mixed with clear water that has a hardness of less than 300 ppm and less than 100 ppm chlorine. Also avoid are softened water because of harmful chemicals it contains.

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Diesel Systems - Air Intake

- **An extremely clogged air filter can throttle the air intake passage, reducing engine performance**
- **The rule of thumb for replacing diesel air filters is to install a new one when the air monitor registers 25 inches of water or less.**
- **Older Ford models typically equipped with a filter minder**
- **6.7 uses MAF sensor to monitor for air flow restrictions**

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"Dusting" A Diesel

- **The integrity of the air intake plumbing is critical to preventing dirt/dust from entering the engine. This was a major problem with military vehicles in Iraq and Afghanistan.**
- **Dirt and debris that make it past the filter can lead to extreme damage to the turbocharger.**
- **To make things worse, metal from the failed turbocharger can find its way into the engine, circulating throughout the system. This can result in complete engine failure.**

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Diesel Systems - Air Intake

- **Inspect the air filter condition, especially the area where the filter seals to the airbox.**
- **Inspect the airbox for proper sealing between the access cover and housing.**
- **In addition to the intake tubing between the air filter and the turbo inlet, the connections on the outlet side are just as critical.**
- **This includes the hot side charge pipe from the turbo to the intercooler, the intercooler itself and the cold side charge pipe leading ultimately to the engine.**
- **Holes or leaks anywhere on this side of the system can not only lead to contaminants entering the engine, but also in complaints of low power and pressurized air from the turbo is lost.**

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Diesel Systems - Air Intake

- **The system can also be tested with a high-pressure smoke machine designed for these systems or the ATS BullsEye leak detection system.**

For informational purposes only. No endorsement of this product by Dorman Products is expressed or implied.

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6.7 Air Filter Service Tips

- **Use of the OE filter is strongly recommended in any OE application**
- **On the 6.7, replacement of the OE filter with an aftermarket filter or the installation of an aftermarket airbox could set DTCs on the 6.7 AND may require a MAF Reset using the factory scan tool or equivalent.**
- **The MAF sensor is used to detect airflow restrictions and the change in filters will most certainly impact the stock airflow.**

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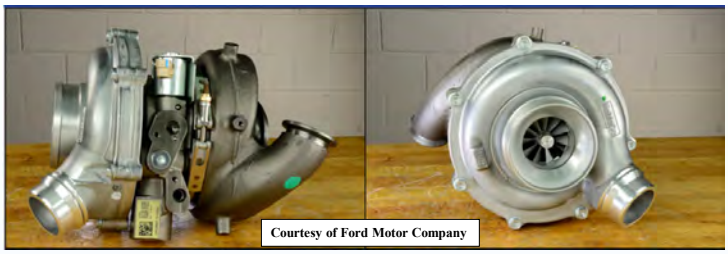
Turbocharger



The turbocharger uses variable vanes that dynamically adjust turbo speed via exhaust gases. During low speed and engine load the turbo vanes are closed to accelerate exhaust gases across the turbine wheel that results in an increase of the turbo wheel speed. The turbo outputs 30 psi of boost at high idle. Separate oil and coolant feeds flow through the turbo mounting pedestal to lube and cool the turbo and eliminate as many external connections as possible.

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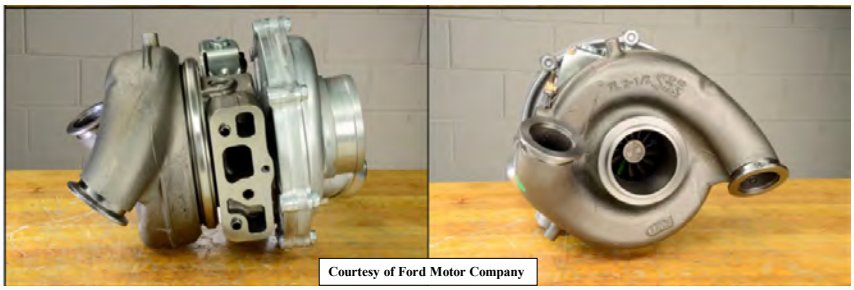
Turbocharger



The turbocharger updates include the replacement of the DualBoast turbocharge the has been replaced by a signal boost charger. The wastegate has been removed from the turbo and is internally controlled by an actuator. The newer turbo is larger.

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VGT Turbos (The New Ones)

NOTE: VANES CAN STICK AND THE 6.7 L HAS ISSUES WITH THE ACTUATOR MECHANISM BINDING. BOTH CAN CAUSE UNDERBOOST OR OVERBOOST DTCs.

BEST PRACTICE: Allow engine to idle for a few minutes as a cool down period before shutting engine down.

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When You Replace A Turbo (Gas Or Diesel), ALWAYS

- **Install a new air filter**
- **Inspect and correct any air leaks in intake tract, charge air cooler lines, and intercooler**
- **Replace the oil feed line and return line (common for the feed line to coke up and restrict oil flow to turbo)**
- **Inspect the new turbo for free movement and no sign of bearing damage**
- **Tighten all fasteners to specification, following the OE procedure**

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Diesel Exhaust Fluid (DEF) And Selective Catalytic Reduction (SCR)

- The DEF (Diesel Exhaust Fluid) is made of a nontoxic solution of 67.5% purified water and 32.5% urea.
- DEF contamination or dilution can result in a variety of DTCs and may cause the ECM to "derate" engine output or prevent the vehicle from starting.
- DEF fluid has a shelf life of approximately 3 years if stored properly.
  - Store in a cool, dry place out of direct sunlight

TEST DEF QUALITY AS PART OF YOUR DIAGNOSTIC ROUTINE

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DEF Fluid Issues

- Crystallization can occur in a couple of ways - over-dosing and hard water top ups.
- Over - dosing occurs when too much DEF is added to the system - the DEF may not fully hydrolyze which can lead to crystalized deposits in the exhaust or injector nozzle.
- Over - dosing can result from a partially open DEF injector nozzle, plugged DEF lines or DEF pump issues.
- Topping up the DEF system with hard water can also result in scale or deposits forming.
- The EGT sensors will affect DEF system operation. EGT sensor and DEF system codes that set at the same time are likely related.

In order to properly diagnose and repair the DEF system, a Ford factory scan tool or equivalent) and Ford service information is required. There are many safeguards and reset procedures that must be completed when repairs are made in order for the systems to function normally.

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DEF Fluid Issues

- **A leak in the reductant system can be located by inspecting for a build - up of crystallized diesel exhaust fluid.**
- **Dirt / metal contamination can cause abrasion of the DEF pump. Dirt, rust or tank scale can occur with improper DEF storage or handling**

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DEF Fluid Issues

- **Diluted DEF (too much water) reduces its NOx neutralization effectiveness. Most DEF is sold pre-mixed but topping up with water will affect concentrations (and could also lead to crystallization as noted).**
- **DEF may gel or freeze in colder climates (12°F (-11°C) preventing engine operation. Additives should not be used to thaw DEF as additives can throw off the concentration of the fluid and damage the SCR (Selective Catalyst Reduction) system.**
- **Contamination of the DEF tank from other fluids such as diesel fuel, coolant, or engine oil being added can cause damage to the SCR system and engine shutdown.**

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Ford Reductant (DEF) System Notes

- DEF (reductant) tank uses an ultrasonic level indicator.
  - Gauge will not change immediately
- Gauge does not move from “F” until actual level drops to 90%
  - Best to refill ONLY when low fluid warning light is on
- DO NOT overfill
  - Overfill or topping off may result in inaccurate gauge reading.
  - Overfilling leaves no room for fluid expansion should DEF freeze
  - Blockage in fill pipe may occur if overfilled and DEF freezes
- To correct or check gauge accuracy, perform and "SCR Activation" with scan tool

Due to emissions, DEF usage is higher on the Gen 4 than previous models

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Ford Reductant (DEF) System Notes

- DEF gauge may not recognize a refill until all DEF fluid has thawed.
  - DO NOT APPLY DIRECT HEAT TO DEF (Diesel Exhaust Fluid) TANK
  - Store vehicle inside to thaw complete tank. Use fans to blow ambient air over tank(s). Heaters are only designed to thaw enough fluid to meet vehicle demand.
- When frozen, level is calculated based on injection duty cycles and last known liquid level
- COMMON ISSUES RELATED TO FROZEN DEF
  - Inaccurate gauge readings
  - Inaccurate DTE (distance to empty) readings
  - Unable to fill DEF tank
  - Floating ice causing inaccurate gauge readings, possible DTCs

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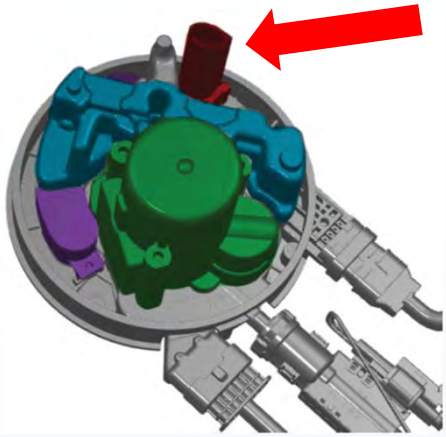
Ford Reductant (DEF) System Notes

Reductant quality module sends output to GDM on SENT line. Ultrasonic transducer is used to gauge DEF concentration by measuring the amount of time it takes for a sound wave to be sent and returned to transducer. If speed of return is not as expected, DEF is considered contaminated or diluted. Both conditions require service and may set DTCs.



Courtesy of Ford Motor Company

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Diesel Particulate Filter (DPF)

- **Exhaust gases flow through the DPF prior to flowing into the muffler and out the tail pipe. The job of the DPF Diesel particulate filters drastically decrease the amount of diesel particulates (soot) and unburned hydrocarbons released from the combustion of diesel fuel.**

The honeycomb structure of the DPF captures soot as it passes through the filter. Most DPFs reduces diesel particulate matter emissions by approximately 90 percent. Over time, soot collecting in the DPF can clog it, resulting in decreased performance and fuel efficiency.

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Essential Diagnostic Techniques

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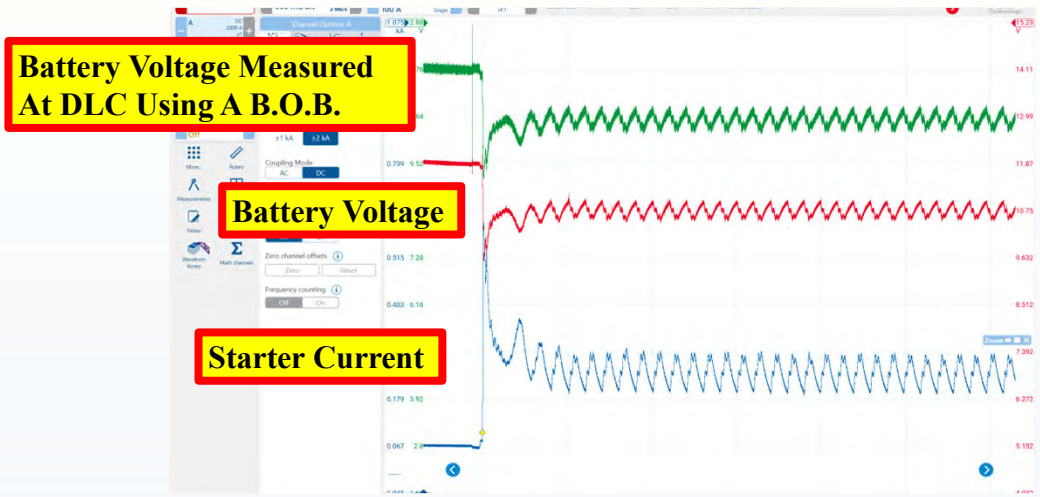
Relative Compression Test - Current Or Voltage?



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Limits To Relative Compression Testing

- **If all cylinders are low on compression (like the compression loss of an engine where the timing between the crank and cam(s) are off), the pattern will look similar. Look for the overall current change to be lower, though.**
- **If there is an intermittent loss of sealing (common today), this test may or may not pick up the loss. It will only detect the loss if it occurs during the test.**

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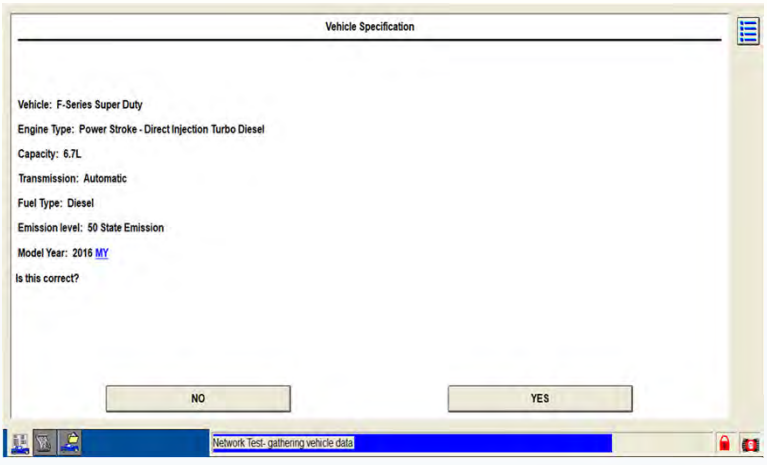
Verify Concern, Check For DTCs, And Check For TSBs

- **Customer states the Check Engine light is on, but the vehicle has no drivability issues**
- **Also, a message on dashboard to fill DEF fluid**

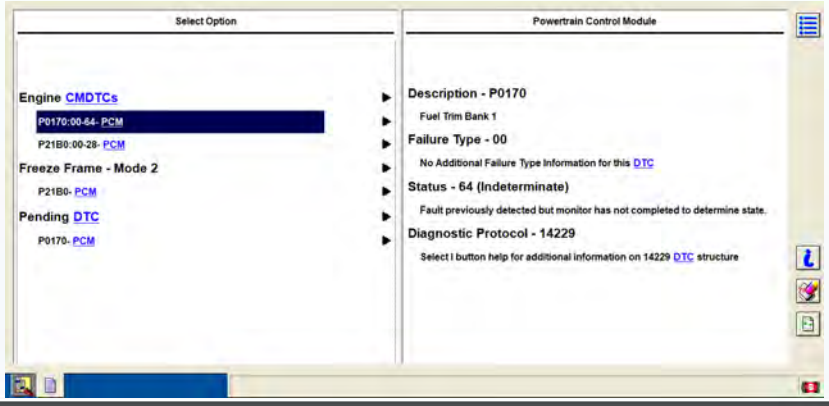


64

Verify Concern, Check For DTCs, And Check For TSBs

Codes were pulled

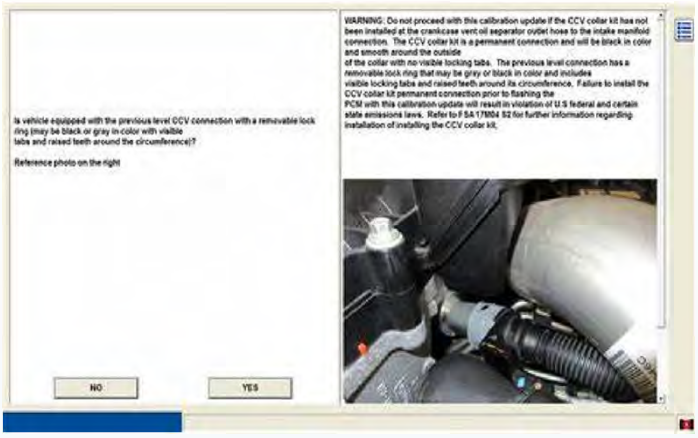
- **P0170 fuel trim bank 1**
- **P21B0 Reductant level sensor "C" circuit high**



65

P0170 Fuel Trim Bank 1

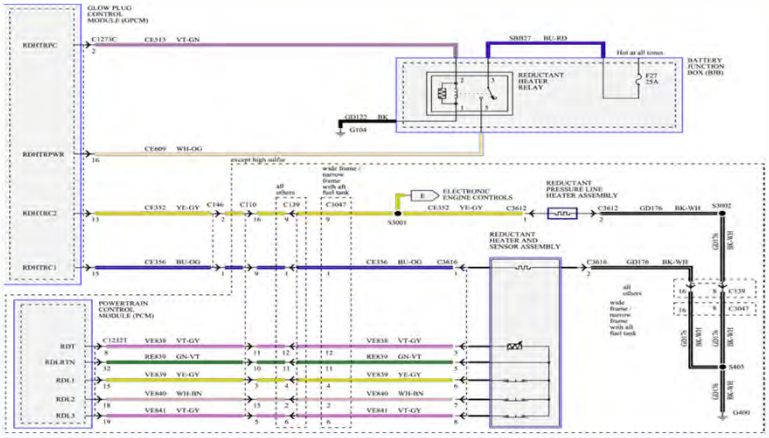
- **TSB 19-2131 addresses this concern with a reflash**
- **You will be asked a question about the crankcase vent connector. If you answer this wrong, you will set a code P04E3**
- **To correct the mistake, you must go back in and reprogram it as a new module with no VIN**



66

P21B0 Reductant Level Sensor "C" Circuit High

- **DTC chart states possibly a short to voltage for a specified period of time.**
- **If the signal return was shorted to voltage, it would set codes for the other 2 circuits, see diagram.**



67

P21B0 Reductant Level Sensor "C" Circuit High

- **Power and ground was checked at pins 5 and 8**
- **Continuity was checked at pins 5 and 8 of the level sensor**
- **Open circuit in the reductant level sensor set the code**

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6.7 Diagnostics The Ford Way

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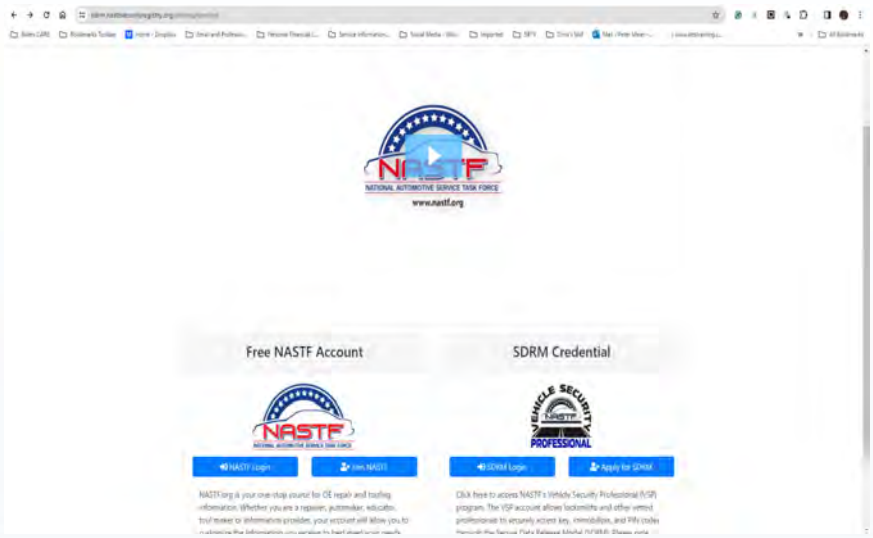
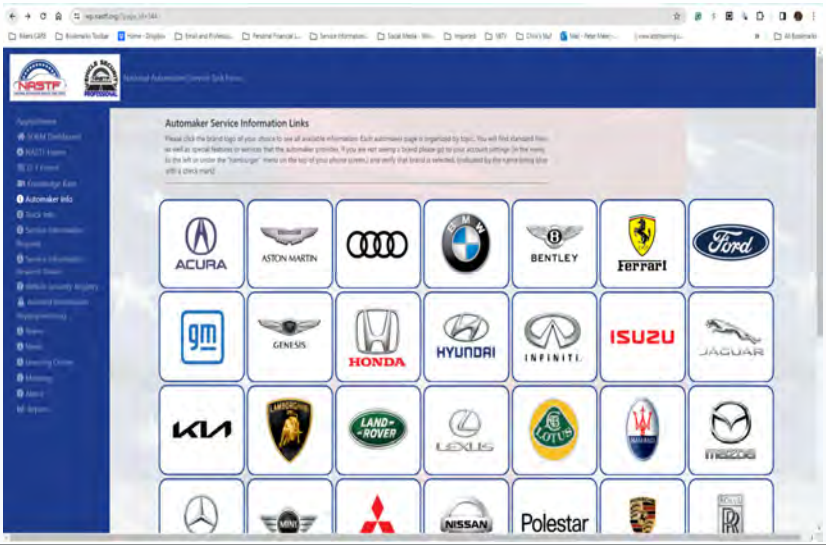
Put Power In Your Ford Diagnostics



70

Put Power In Your Ford Diagnostics



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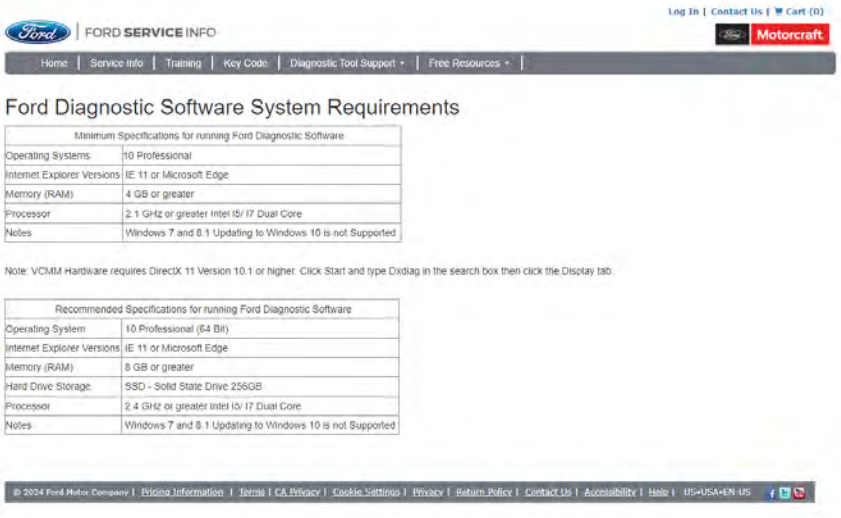
Put Power In Your Ford Diagnostics



72

Diesel Diagnostics - The Ford Method

- Symptom - System - Component - Cause (SSCC)
- SSCC based on 6 steps:
  - Verify concern
  - Gather data
  - Perform tests
  - Identify root cause
  - Repair component
  - Verify repair

73

Diesel Diagnostics - The Ford Method

- Gathering data includes looking at Warranty Action notices
- May not be available in aftermarket SI systems
- Root cause is what resulted in the failure of the broken component or system
- Be aware of any adaptive resets (returns to factory default) and advise customer that they may experience a different feel while the vehicle relearns their driving style

ALWAYS verify base engine operation and integrity BEFORE replacing system components!

74

Diesel Diagnostics - The Ford Method

3 elements needed for proper diesel operation.

- **Compression**
- **Proper amount of QUALITY fuel**
- **Proper timing (CKP, CMP and fuel injection)**

Courtesy of Ford Motor Company

75

Diesel Diagnostics - The Ford Method

- **Use scan tool to check relative compression**
- **Combine results with power balance test to identify base engine concerns**
- **Low compression in ALL cylinders can indicate cam/crank timing issue**
- **Once base engine concerns are corrected, verify there is no related component damage**
  - **Contaminated sensors**
  - **Contaminated MAF**
  - **Coking on TB**
  - **Damage to exhaust**

76

Diesel Diagnostics - The Ford Method

- DTCs are clues to the cause of a customer concern
- 2 types - component DTC or condition DTC
- Component DTC indicates a failure in the circuit or component
- Condition DTC is related to a system fault
- PCM does not have enough information to isolate the component cause
- Review and understand the conditions and criteria needed to set the DTC

77

Testing Fuel For Contamination

NOTE: The most common sources of contaminated fuel are:

- Auxiliary vehicle mounted tanks
- Local storage tanks
- Other infrequently used fuel sources
- Refueling errors (i.e. Diesel Exhaust Fluid (DEF) or gasoline introduced into the fuel tank)

The best action that can be taken to avoid concerns with the fuel system is to ensure vehicle is only fueled from sources with known quality diesel fuels verified to be free from water and other contaminants.

NOTE: Ford ONLY approves of 3 fuel additives in their products. The use of non-approved additives may cause the warranty to be forfeited.

78

If The Fuel Is Contaminated

Follow the appropriate service procedure depending on whether the engine has been started with contaminated fuel, or not.

NOTICE: Failure to follow these procedures may result in fuel system and/or engine damage and may require vehicle warranty cancellation submission. Repairs required due to the use of improper fluids and fuel are not covered by the warranty.

79

How To Test Contaminated Fuel

- **Using an appropriate container, obtain a fuel sample from the Fuel Conditioning Module water drain. DO NOT obtain sample from the fuel rail. Normal debris on threads may lead to an incorrect conclusion.**
- **Let fuel sample sit for 10 - 15 minutes.**
- **Visually inspect fuel sample to help determine type of contamination.**
- **Remove the DFCM (Diesel Fuel Conditioning Module) fuel filter cover and the primary fuel filter element.**
- **Allow both filter and cover to dry for 2 hours.**

80

How To Test Contaminated Fuel

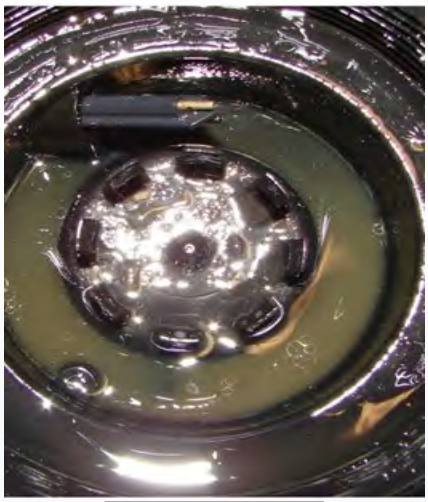
- **Visually inspect for formation of white crystals.**
- **White crystal formation is an indicator of DEF contamination.**

Courtesy of Ford Motor Company

81

How To Test Contaminated Fuel

Check the fuel filter housing for evidence of fuel contamination.



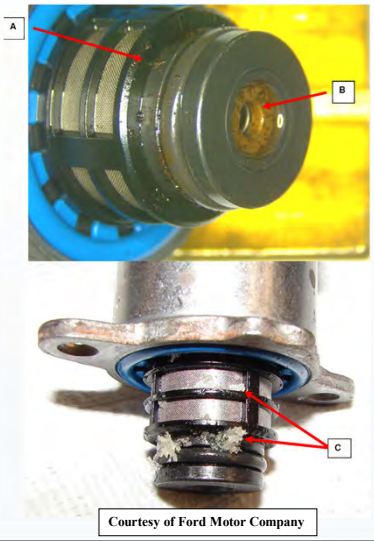
Courtesy of Ford Motor Company

82

How To Test Contaminated Fuel

Check carefully for evidence like this showing corrosion (upper) and DEF contamination (lower).

NOTE: IF YOU DO NOT FOLLOW THE OE PROCEDURE, DAMAGE WILL LIKELY REOCCUR



Courtesy of Ford Motor Company

83

Fuel Contamination - Engine Started

- **Drain fuel tank completely by removing the tank and cleaning to prevent the possibility of reintroducing contamination. (Dispose of contaminated fuel in accordance with local laws and regulations.)**
- **Fill fuel tank with fresh, clean, good quality diesel fuel.**

NOTE: Leave original fuel filters, HP injection pump, fuel lines, fuel rails and injectors in place until flushing procedure is completed to prevent contamination of replacement components.

- **Using an appropriate container, drain DFCM (Diesel Fuel Conditioning Module) of any residual liquids.**

84

Fuel Contamination - Engine Started

- **Perform fuel system flush.**

NOTE: The DFCM (Diesel Fuel Conditioning Module) must be inspected during filter replacement to verify no low-pressure fuel system damage. If DEF (Diesel Exhaust Fluid) contamination is present, the DFCM must be replaced.

- **Replace both fuel filters (primary and secondary)**

- **Replace ALL High - Pressure fuel system components.**

NOTE: All remaining low pressure fuel lines can be reused if no physical damage is present.

85

Fuel Contamination - Engine NOT Started

- **Drain fuel tank completely by removing the tank and cleaning to prevent the possibility of reintroducing contamination.**
- **Fill fuel tank with fresh, clean, good quality diesel fuel.**
- **Using an appropriate container, drain DFCM of any residual liquids.**
- **Replace both fuel filters (primary and secondary).**
- **Perform fuel system flush.**

86

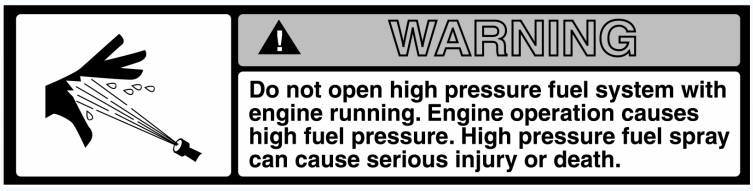
Fuel System Flush Procedure

- **Remove the rear Fuel Cooler Line that returns to the fuel tank at the fuel cooler.**
- **Install a 3 - foot length of 3/8 - inch diameter fuel hose over the fuel cooler nipple.**
- **Place the open end of the hose into a suitable container.**
- **Use Scan Tool Active Commands or cycle the ignition key to RUN to activate the low-pressure fuel pump to flush the lines.**

87

SAFETY NOTE!

REMEMBER, THE HIGH-PRESSURE FUEL SYSTEM CAN REACH PRESSURES OF UP TO 36,000 PSI. BEFORE REMOVING ANY COMPONENT ON THE HP SYSTEM, USE YOUR SCAN TOOL AND OE PROCEDURES FOR BLEEDING THE PRESSURE DOWN BEFORE OPENING THE SYSTEM.



Courtesy of FCA / Stellantis

88

CP4 Failures

The 6.7's Achilles Heels

89

Bosch CP4 Fuel Pump

The Bosch CP4 HP pump used on the 6.7L is its Achilles Heel. According to Ford, the primary cause of these failures is related to fuel quality and/or contamination. In addition, fuel quality may cause symptoms including, but not limited to, the following:

- **Crank No Start**
- **Long Crank/Hard Start**
- **Runs Rough**
- **Low Power**
- **Engine Knocking**
- **Exhaust Smoke**
- **Fuel Rail Pressure (FRP) slow to build**

90

Related: Oil In Exhaust TSB

SSM 49805: 2011 - 2021 Diesels - Draining Oil From Exhaust After Turbo Replacement

Some 2011 - 2021 diesel engines may have engine oil in the exhaust after turbo replacement for various reasons. To correct the condition, remove the exhaust and stand straight up with turbo inlet facing down using a suitable drain pan. Allow to drain for 24 hours before reinstalling.

DO NOT perform a manual regeneration.

91

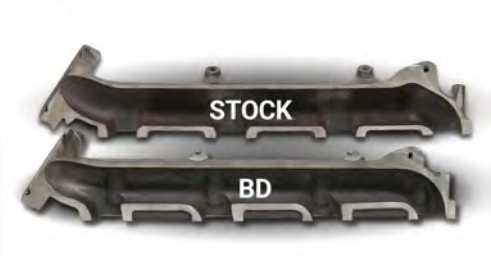
Oil Pan Leaks

- **TSB addresses oil pan leaks on 2017 - 19 models**
- **2011 oil pans had a press in rubber gasket**
- **2012 - 2021 used RTV as a gasket**
- **2022 went back to press in gasket**
- **2011 pan is interchangeable with Gen 1 through Gen 3 - NOT Gen 4**

92

High Pitch Whistle Noise

- **Exhaust manifolds in the valley under the turbo break the rear exhaust studs**
- **BD Diesel is one aftermarket source that makes an upgraded manifold that is thicker to stop from warping and breaking studs**



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93

EGR Cooler Issues

- **Causes poor performance, over heating, rough idle and decrease in fuel efficiency**
- **Cooler becomes clogged with soot on the cold side of the cooler**
- **Can be cleaned**
- **Aftermarket offers solutions with a better design for cooling and dependability (Bulletproof Diesel shown)**

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No Start Or Hard Start, Possible P0087 After Fuel Filter Replacement

- **Make sure OEM filters are used (aftermarket filters are known to suck shut under load)**
- **Make sure you follow proper service info to bleed out fuel system when replacing filters**
- **Make sure lower filter cap is installed correctly and not broken**

2. **Lower Fuel Bowl –** The lower filter bowl is not tightened to a torqued value; there are stopping tabs on the lower and upper housings that should contact each other when the lower bowl is fully tightened (Figure 1). If the lower bowl is over-tightened or if pneumatic tools are used for service, these tabs may break and cause O-ring damage allowing air to enter the system. If the tabs are broken, then that part of the DFCM will need to be replaced. Damage to the DFCM stopping tabs not warrantable.

Note how the DFCM header and bowl stopping tabs are touching and not damaged.

NOTE: If the lower bowl is not fully seated, air can be drawn past the lower bowl O-ring. Lubricating the lower bowl O-ring with clean diesel fuel will help ensure proper lower bowl installation and avoid O-ring damage

Figure 1

Courtesy of Ford Motor Company

95

Diagnostic Tips

96

No Start/Hard Start

- **This system needs 5000 PSI of fuel pressure to open the injectors. Use a scan tool to monitor rail pressure while cranking. Actual pressure should meet desired pressure under all conditions. If actual meets desired and the engine still won't start, diagnose any other codes that are in the PCM**
- **If your scan tool shows low fuel pressure cranking, check the low-pressure fuel supply first. Normal pressure is between 53 - 73 PSI**
- **If the low side is good, inspect the fuel filters**

97

No Start/Hard Start

- **If there is no contamination, remove the return hose from the Pressure Control Valve in the left fuel rail. Plug the hose leading to the fuel return system. Crank the engine and watch for fuel flow from the valve. If there is a measurable amount of return, the valve is bad. If not, the valve is holding pressure.**
- **Check the injectors for excessive return. Remove the return line and plug the rails with a suitable tool, then crank the engine while watching the injector returns. A small amount of return is normal, but more than 3 ml in 15 seconds while cranking or at idle is considered excessive. (Ford does not specify a return specification or injector return diagnostic procedures. This is a spec for the Duramax using similar system.)**

98

No Start/Hard Start

- **Verify the fuel injector return line pressure is greater than 43 PSI**
- **Remove the high - pressure regulator from the high - pressure pump and check for metal debris.**

Courtesy of Ford Motor Company

99

TST Big Event Sat April 6th 2024

Instructors:

- "Understanding Internal Combustion"
- Bernie Thompson

- "Is the Transmission to Blame? "
- Wayne Colonna

- "Cracking The Case"
- Sherwood Cooke

Keynote Speaker: Mark Warren

www.tstseminars.org

100

Hands-On Engine & Emision Class

3 Day / 24 Hours Time: 8:00am to 4:30pm

Dates: *Friday April 19th - Saturday April 20th & Sunday April 21st*

Cost:
$1200.00

Includes: Book, Lunch, Snacks & all day Beverages

Computer Diagnostic Class Hands On Class
May 17th Friday to 19th Sunday
Cost:
$1200.00

Location: *10 Lupi Plaza, Mahopac, NY 10541*
#845 628-1062
drestucci@dormantraining.com or gtruglia@dormantraining.com

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We offer greater freedom to fix cars and trucks
by engineering exclusive, labor-saving
and cost-effective repair solutions.

Thank You !

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