

6.0l Ford Diesel Engine Reliability Issues, Detection and Preventive Measures

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1. Engine Development History

- Emission laws require substantial emissions improvement
- Exhaust Gas Recirculation (EGR) returns exhaust (cooled in an engine coolant heat exchanger) into the intake to reduce combustion temperatures
- Hydraulic, Electronic Unit Injector (HEUI) fuel injection & high pressure oil pump (Electronic control of multistage fuel injection produces more power with less emissions)
- Variable Geometry Turbocharger (VGT) controls inlet vanes to regulate exhaust flow into turbine side to alter boost.

2. Known 'Pattern Failures' (Cascade Failures)

Engine Overheating/Ruptured EGR cooler

ROOT CAUSE(S)

- Overloading the engine exceeds the temperature tolerance of the EGR cooler, resulting in small cracks developing in the EGR's coolant tubes. Up to 40psi exhaust backpressure leaked into and over pressurized the cooling system. Coolant is ejected out the 16psi relief valve in the degas tank cap.
- A loss of coolant resulting from the early OEM coolant system cap failing to hold 16psi, allowing

coolant to overflow during normal operation.

- Factory temperature gauges are ineffective in reporting over temperature (ECT>230F).
- Improper coolant (Ford 'Gold' or Shell Rotella ELC), coolant mix (distilled water) or lack of periodic changes (30k change interval).

RESULT: Overheated EGR resulting in cracking

- Overheat causes loss of coolant resulting in greater and more frequent overheating.
- Coolant contamination produces particles which become lodged to increasingly greater degrees in the small channels in the oil cooler's 'fin-plate' heat exchanger.



1 EGR Cooler location



2 Coolant Degas Bottle/16psi Pressure Cap

SYMPTOM(S):

- Coolant enters the exhaust stream at idle from the cracks in the EGR cooler and vaporizes, producing white exhaust clouds.
- High pressure in the coolant system, overrides the 16psi pressure cap and vents coolant from the degas bottle. Weak coolant caps can mimic this problem.

COMPOUND FAILURES: Loss of coolant increases the frequency and degree of overheating. Engine overheating eventually results in head gasket failure. Only 4 bolts per cylinder rather than the normal 6 bolts.

REPAIR: Replace the EGR and oil coolers

DETECTION:

- (Proactive) Monitor engine oil temperature (EOT)/Engine coolant temperature (ECT) for a differential greater than 15F. Requires external gauging. Temperature information is available from the ECU using and OBDII Bluetooth adapter and phone/tablet running an engine monitoring app such as Torque Pro.
- (Reactive) Monitor coolant system Ph (test strips) for evidence of exhaust contamination.
- (Reactive) Monitor coolant system pressure (custom sensor made by PowerstrokeHelp.com and some tuner manufacturers such as Edge) to detect above 16PSI.



4 Torque Pro Dashboard section

PREVENTION:

- Proactively replace the EGR cooler with an aftermarket unit that is more robust (Bulletproof Diesel).
- On detection of oil cooler clogging (high temperature differential), proactively replace the OEM oil cooler with either an OEM or an external cooler (Bullet proof Diesel).
- Proactively replace the OEM head bolts with high strength studs (Advanced Racing Products) 245ft lbs vs 85 ft lbs.
- Add a coolant bypass filter (multiple manufacturers).
- Test/replace coolant filler cap (early models fail to hold 16psi)



5 Coolant Bypass Filter

1) Low of Primary Fuel Pressure

a) ROOT CAUSE

- Clogged primary or secondary fuel filter (change every other oil change ~15k)
- Disintegration of aftermarket fuel filters
- HFCM fuel pump degradation

b) CAUSAL RESULT: Fuel starvation

- ##### c) PRECIPITATED FAILURE: Insufficient filling of injectors causes cavitation damage to fuel atomizer (tip of injector).



6 Motorcraft FD-4616 Fuel Filter Set

d) SYMPTOM: Poor/sluggish performance

e) REPAIR:

- Test fuel pressure/replace HFCM pump
- Flush/clean fuel system
- Replace filters
- Test/replace injectors



7 Racor PFP58054: HFCM Fuel Pump



8 Fuel Pressure Test Port

f) DETECTION: Measure primary fuel pressure UNDER LOAD using a test gauge installed into the pressure port at the base of the engine fuel filter housing or onto a replacement filter housing cap (58psi nominal w/o blue spring, 45psi minimum).

g) PREVENTION:

- Proactively, permanently install a manual pressure gauge in the cab connected to the fuel pressure test port.
- Install the 'Blue spring kit' into the pressure regulator of the secondary fuel filter to increase primary fuel pressure to 66-68psi.
- Use only Motocraft (OEM) fuel filters (3C3Z-9N184-CB). Aftermarket filters are restricted from employing several patented features which make the filter work as intended.



9 3C3Z-9C407-AB Horizontal Fuel Conditioning Module



2) EGR Valve Stuck

3) Oil quality critical in high pressure oil system.

- a) Use synthetic oil made for diesels
- b) Use additive to lubricate injectors (Arch Oil 9100)
- c) High pressure oil pump- 500psi minimum to start up to ~4000psi
- d) Injection Pressure Regulator (IPR) opens to bleed off oil pressure to maintain the desired pressure.
- e) Injection Control Pressure (ICP) sensor, measures the oil pressure at the end of the oil rail.

4) Exhaust gas temperature (EGT) monitoring with simple thermocouple/meter (1250F max).

5) Fuel Injection Control Module (FICM)

- a) Power supply weakness

6) High pressure oil pump (HPOP) connector

7) Premature driver side battery failure.

8) MAP sensor hose leakage

2) Ground cable from driver battery to engine

10 Ford PN: 3C3Z-9T517-AG Fuel Pressure Regulator

