



Countries: CANADA, UNITED STATES, MEXICO **Document ID:** IK1201172
Availability: ISIS **Revision:** 4
Major System: ENGINES **Created:** 8/1/2014
Current Language: English **Last Modified:** 5/11/2015
Other Languages: NONE **Author:** Caleb Iverson
Viewed: 3481

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Coding Information

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Title: EPA 2010 - 2013 MaxxForce 7 Turbocharger Step-Based Diagnostics

Applies To: EPA 2010 - 2013 MaxxForce 7 Engines

CHANGE LOG

2015/05/07 - Added DTCs
 2014/12/08 - Fixed specs for CCP & Blow-by
 2014/12/02 - Minor gramatical/formatting changes
 2014/11/01 - Launch to field

QUICK LINKS

Description	Symptoms	Tools	Parts
Diagnostics	Repair-Removal	Repair-Installation	Warranty

DESCRIPTION

This document is intended to help with turbocharger diagnostics because there is no diagnostics in the Diagnostic Manual.

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SYMPTOMS

DTC/Light	Description
	Malfunction Indicator Light (MIL)
OBD Faults	
SPN 102 FMI 10	Boost slow response
SPN 102 FMI 18	Underboost
Non-OBD Faults	
SPN 1692 FMI 17	Boost unable to achieve setpoint
SPN 1692 FMI 18	Boost unable to achieve setpoint

- Low Power
- Vehicle Speed Loss with Maximum Driver Demand
- Slow Performance Response
- Excessive Regenerations
- Low Fuel Economy

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SPECIAL TOOLS

Tool Description	Tool Number	Comments	Instructions
Electronic Service Tool (EST)	E-Z Tech		
Gauge Set	ZTSE4409		
Crankcase Pressure Test adapter	ZTSE4284		
Crankcase Pressure Orifice Tool	ZTSE4146A		

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SERVICE PARTS INFORMATION

Kit Description	Part Number	Quantity	Notes
Breather Assembly w/Jet Pump	1886483C93	1	

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PROCEDURE OVERVIEW

WARNING

To prevent personal injury or death, read all safety instructions in the "Safety Information" section of the diagnostic manual, [linked here](#).

WARNING

To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

WARNING

To prevent personal injury or death, make sure the engine has cooled before removing components.

WARNING

To prevent personal injury or death, do not let engine fluids stay on your skin. Clean skin and nails using hand cleaner and wash with soap and water. Wash or discard clothing and rags contaminated with engine fluids.

WARNING

Install crankcase breather tube into shop exhaust vent. Failure to comply may result in personal injury / or death.

DIAGNOSTIC STEPS

Step	Action	Decision
1	Visually inspect the air intake system. Check for oil or coking in the intake system.	Yes. Go To Step 2
	Is there oil or coking present?	No. Go to performance diagnostic sheet.

Step	Action	Decision
2	Verify engine oil level.	Low: Top off oil, proceed to Step 3
	Park vehicle on level ground and check oil level.	Full: Go to Step 3
	Is the oil level low, full, or overfull?	Overfull: Take an oil sample for analysis and drain to normal level. Proceed to Step 3

Step	Action	Decision
3	Perform the following: Crankcase Pressure Test at engine operating temperature of 158°F (70°C) or higher. 1. Ensure the oil level is not above the full mark. 2. Remove the oil level gauge from the dipstick tube. Attach 11/16" hose with clamps and 1/4" pipe adapter to magnahelic gauge on gauge kit ZTSE4409. 3. Start engine and run at high idle (no load) RPM. Allow reading to stabilize, before recording reading. See Figure 1 or refer to Diagnostic Manual. Specification: at High Idle, Below 24" of H2O	Save results for later review. Go to Step 4.

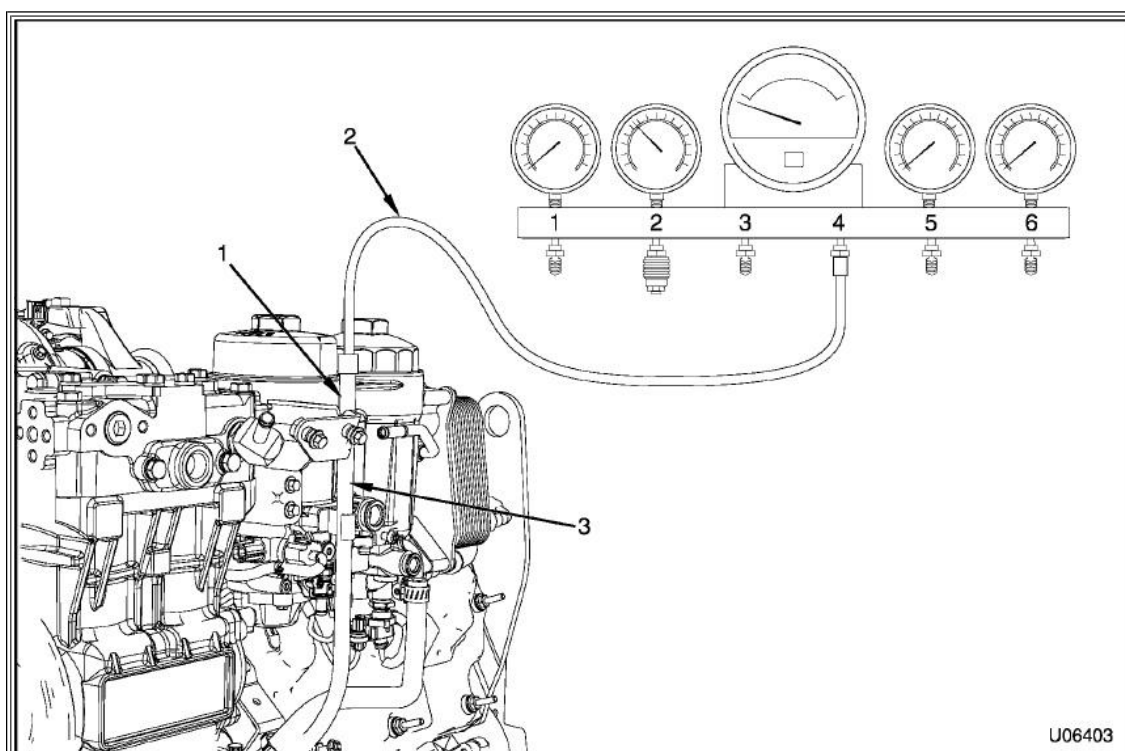


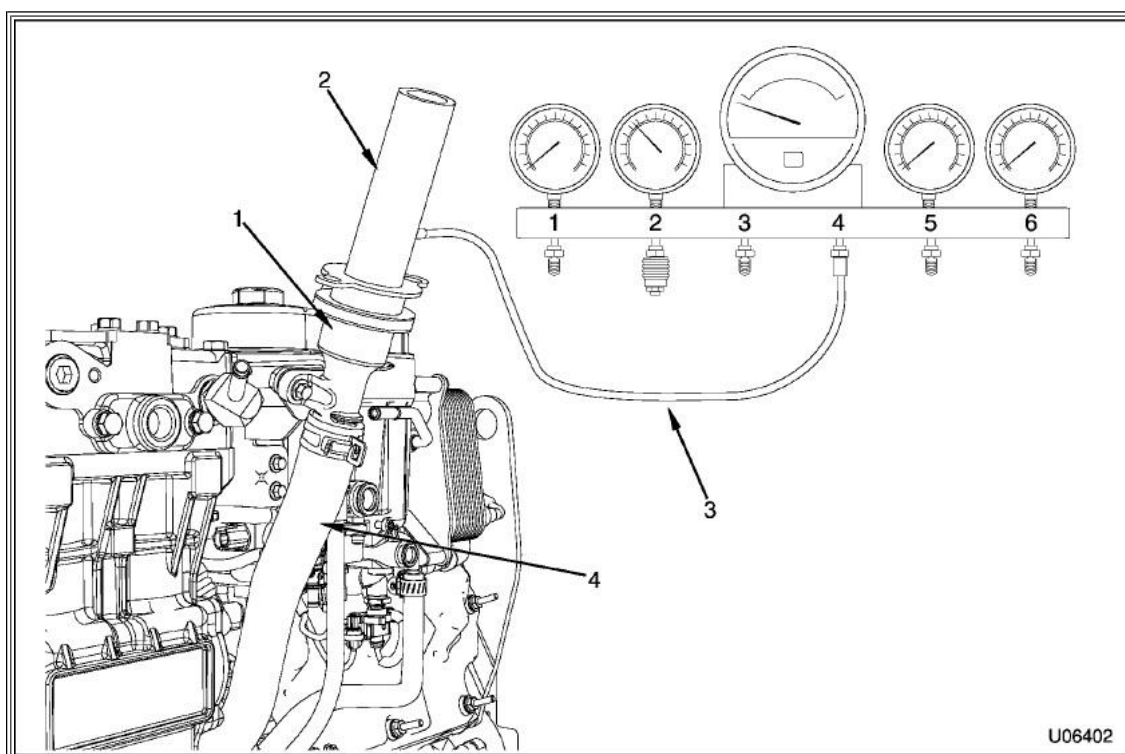
Figure 1: CrankCase Pressure Test

Item 1: Adapter (Obtain Locally)

Item 2: Line to Magnahelic Gauge (ZTSE4409)

Item 3: Oil Dipstick Tube

Step	Action	Decision
4	Perform the following: Blow-By Test at engine operating temperature of 158°F (70° C) or higher. 1. Ensure the engine oil level is not above the full mark and the oil level gauge is secured. 2. With engine OFF, remove oil fill cap. 3. Install crankcase pressure test adapter ZTS4284 to oil fill tube. 4. Connect orifice ZTSE4146A to crankcase pressure test adapter ZTSE4284. 5. Connect a line from the orifice ZTSE4146A to the magnahelic gauge on the gauge kit ZTSE4409. 6. Using a standard plug, block off the road draft tube, located on the bottom right side of the engine. 7. Run engine at high idle (no load) RPM. Monitor magnahelic gauge and record high idle blow-by pressure. See Figure 2 or refer to Diagnostic Manual. Specification: at High Idle, Below 9" of H2O	Save steps for later steps Go to Step 5.

**Figure #2: Blow-By Test**

Item 1: ZTSE4284

Item 2: ZTSE4146A

Item 3: Line to Magnahelic Gauge (ZTSE4409)

Item 4: Oil Fill Tube

Step	Action	Decision
5	Perform the following Relative Compression Test at engine operating temperature of 158°F (70°C) or higher. 1. Hook-up a battery charger before running the relative compression test. 2. Using Electronic Service Tool (EST) with ServiceMaxx software, go to Tests > KOEO Tests > Relative Compression Test. 3. Save the Relative Compression Test (RCT) results file. Refer to Diagnostic Manual. Compare Cylinders: are cylinders within 20% variation?	Save results for later steps Go to Step 6.

Step	Action	Decision
6	Review results from Steps 3, 4 and 5. Crankcase Pressure - High Idle - Below 24" of H2O Blow-By - High Idle - Below 9" of H2O Relative Compression Test - Compare cylinders, are cylinders within 20% variation? Were Step 3 Crankcase Pressure (CCP), Step 4 (Blow-by), and/or Step 5 (Relative Compression) in specification?	CCP - Yes Blow-By - Yes Relative Compression Test - Yes Go To Step 7.
		CCP - No Blow-By - No Relative Compression Test - No Go To Step 8.
		CCP - No Blow-By - Yes Relative Compression Test - Yes Go To Step 9.
		CCP - Yes Blow-By - No Relative Compression Test - Yes Go To Step 10.

Step	Action	Decision
7	Perform the following: 1. Induction Cleaning Process (IK1201173). 2. If needed, flush CAC. (refer to IK1201175). 3. Check for engine performance issues. Perform 0 to 60 MPH Test procedure below. a. Using Electronic Service Tool (EST) with ServiceMaxx™ software, go to Sessions > Performance b. Find an open stretch of road where minimum speed limit is 50 MPH or higher. c. Pull over to the side of the road. d. When driving conditions are safe and vehicle has reached normal operating temperature, select the record snapshot icon from the toolbar. e. Press accelerator pedal fully to the floor and accelerate from 0 MPH to max allowed highway speed. After 0 to 60 MPH Test is complete, stop recording and save snapshot. 4. Using an Electronic Service Tool (EST) with ServiceMaxx™ software, use the playback feature and graph the following signal values from the 0 to 60 MPH Test: • Time • Vehicle Speed (MPH) • Torque: Engine Actual Percent (%) • Torque: Driver's Engine Demand (%) • Intake Manifold Temperature (IMP) Compare the snapshot to Figure 3 and associated Graph Analysis below. Is "Torque: Engine Actual Percent (%)" meeting "Torque: Driver's Engine Demand (%)" and IMP meeting specification as per Figure 3 Graph Analysis?	Yes. Diagnostics Complete.
		No. Go to performance diagnostic sheet.

Step	Action	Decision
8	Perform the following steps: 1. Induction cleaning process (IK1201173). 2. Create iApprove for engine replacement NOTE: Run the cleaning procedure before replacing engine and swapping parts to new engine. 3. If needed Flush CAC (refer to IK1201175). 4. Check for engine performance issues. Perform 0 to 60 MPH Test procedure below. a. Using Electronic Service Tool (EST) with ServiceMaxx™ software, go to Session > Performance b. Find an open stretch of road where minimum speed limit is 50 MPH or higher. c. Pull over to the side of the road. d. When driving conditions are safe and vehicle has reached normal operating temperature, select the record snapshot icon from the toolbar. e. Press accelerator pedal fully to the floor and accelerate from 0 MPH to max allowed highway speed. After 0 to 60 MPH Test is complete, stop recording and save snapshot. 5. Using an Electronic Service Tool (EST) with ServiceMaxx™ software, use the playback feature and graph the following signal values from the 0 to 60 MPH Test: • Time • Vehicle Speed (MPH) • Torque: Engine Actual Percent (%) • Torque: Driver's Engine Demand (%) • Intake Manifold Temperature (IMP) Compare snapshot to Figure 3 and associated Graph Analysis below. Is "Torque: Engine Actual Percent (%)" meeting "Torque: Driver's Engine Demand (%)" and IMP meeting specification?	Yes. Diagnostics Complete.
		No. Go to performance diagnostic sheet.

Step	Action	Decision
9	Perform the following steps: 1. Induction cleaning process (IK1201173) 2. If needed Flush CAC. (refer to IK1201175) 3. Replace Breather (Refer to 2010 MaxxForce 7 Service Manual) 4. Check for engine performance issues. Perform 0 to 60 MPH Test procedure below. a. Using Electronic Service Tool (EST) with ServiceMaxx™ software, go to Sessions > Performance b. Find an open stretch of road where minimum speed limit is 50 MPH or higher. c. Pull over to the side of the road. d. When driving conditions are safe and vehicle has reached normal operating temperature, select the record snapshot icon from the toolbar. e. Press accelerator pedal fully to the floor and accelerate from 0 MPH to max allowed highway speed. After 0 to 60 MPH Test is complete, stop recording and save snapshot. 5. Using an Electronic Service Tool (EST) with ServiceMaxx™ software, use the playback feature and graph the following signal values from the 0 to 60 MPH Test: • Time • Vehicle Speed (MPH) • Torque: Engine Actual Percent (%) • Torque: Driver's Engine Demand (%) • Intake Manifold Temperature (IMP) Compare snapshot to Figure 3 and associated Graph Analysis below. Is "Torque: Engine Actual Percent (%)" meeting "Torque: Driver's Engine Demand (%)" and IMP meeting specification?	Yes. Diagnostics Complete
		No. Go to performance diagnostic sheet.

Step	Action	Decision
10	Perform the following steps: 1. Induction cleaning process (IK1201173). 2. Create iApprove for engine replacement NOTE: Run the cleaning procedure before replacing engine and swapping parts to new engine. 3. If needed Flush CAC. (refer to IK1201175). 4. Check for engine performance issues. Perform 0 to 60 MPH Test procedure below. a. Using Electronic Service Tool (EST) with ServiceMaxx™ software, go to Sessions > Performance b. Find an open stretch of road where minimum speed limit is 50 MPH or higher. c. Pull over to the side of the road. d. When driving conditions are safe and vehicle has reached normal operating temperature, select the record snapshot icon from the toolbar. e. Press accelerator pedal fully to the floor and accelerate from 0 MPH to max allowed highway speed. After 0 to 60 MPH Test is complete, stop recording and save snapshot. 5. Using an Electronic Service Tool (EST) with ServiceMaxx™ software, use the playback feature and graph the following signal values from the 0 to 60 MPH Test: • Time • Vehicle Speed (MPH) • Torque: Engine Actual Percent (%) • Torque: Driver's Engine Demand (%) • Intake Manifold Temperature (IMP) Analyze snapshot: Compare snapshot to Figure 3 and associated Graph Analysis below. Is "Torque: Engine Actual Percent (%)" meeting "Torque: Driver's Engine Demand (%)" and IMP meeting specification?	Yes. Diagnostics Complete
		No. Go to performance diagnostic sheet.

Select Parameters:

1. Time (s)
2. Vehicle Speed (mph)
3. Intake Manifold Pressure (psi)
4. Torque: Driver's Engine Demand – (Percent)
 - a. The amount of torque the driver is demanding from the engine (Spec: 100%)
5. Torque: Engine Actual Percent – (Percent)
 - a. The amount of torque the engine is supplying (Spec: 94-100%)

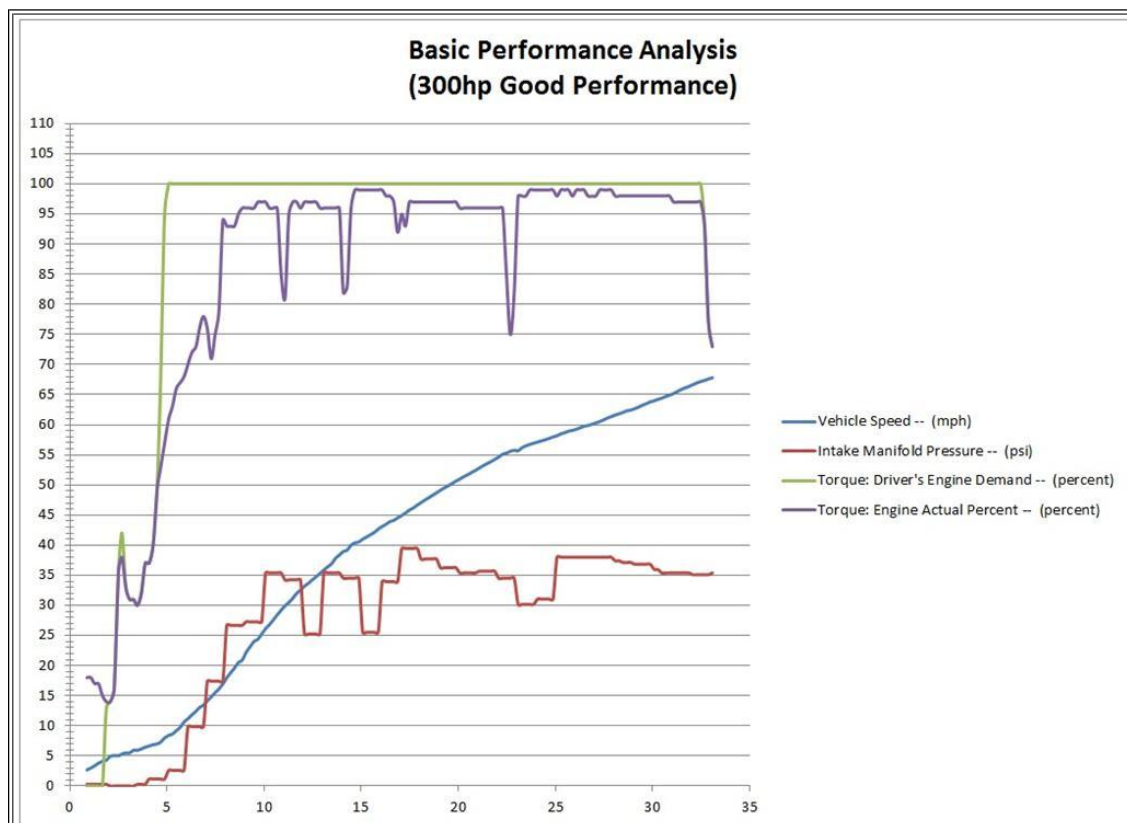


Figure 3: Analysis Parameters of a Well Performing Truck

- Item 1: Intake Manifold Pressure - Remains Above 35psi except for when shifting
- Item 2: Vehicle Speed - Reaches 60mph after 25 seconds of acceleration
- Item 3: Torque Engine Actual Percent - Remains around 96-99% excluding shift points
- Item 4: Torque Driver's Engine Demand - Remains at 100% through the entire acceleration

Figure 3 is a snapshot of an unloaded truck performing a 0 - 60 mph run plotted in Microsoft Excel for visual clarity. This is a well performing engine, taking 25 seconds to reach 60 miles per hour with an initial pedal lag. The truck was unloaded for this recording. The dips in engine torque are where the truck is shifting into a higher gear. Engine torque percentage typically stays between 96-99% on a well performing engine.

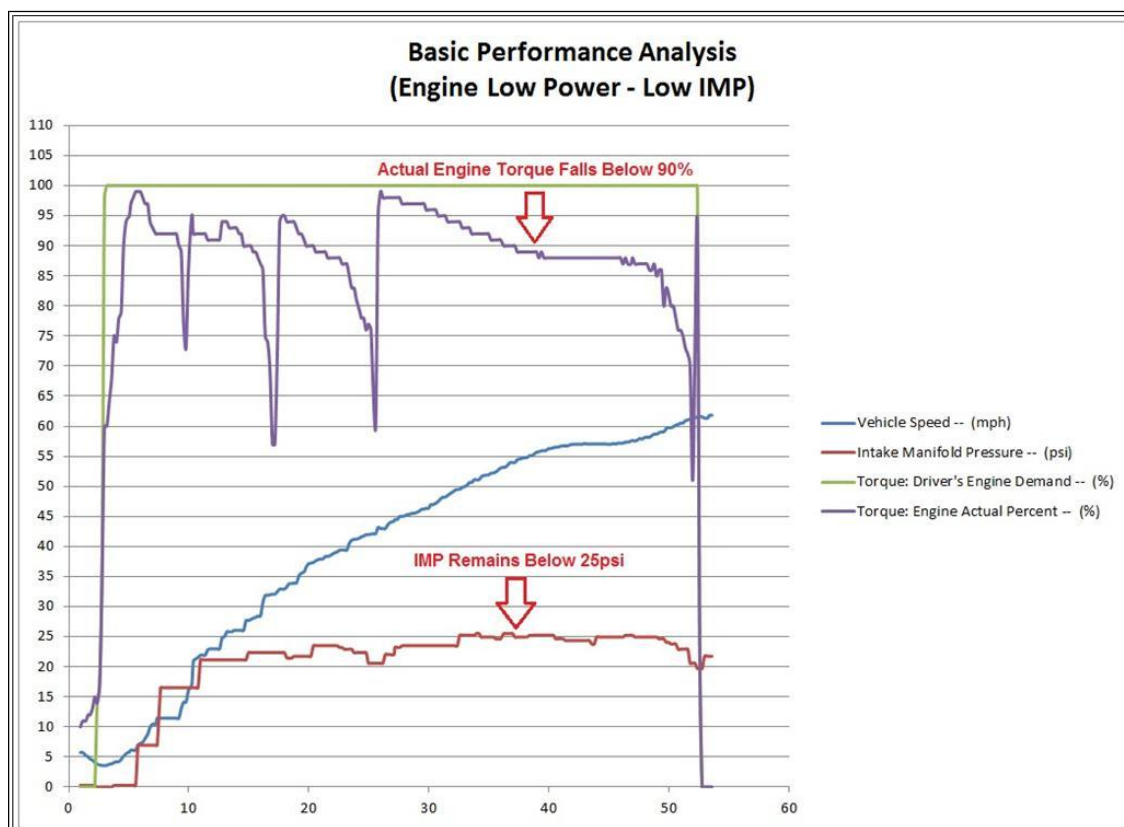


Figure 4: Analysis Parameters of a Truck with Low IMP

- Item 1: Intake Manifold Pressure - Remains Below 25psi through the entire recording
- Item 2: Vehicle Speed - Reaches 60mph after 50 seconds of acceleration
- Item 3: Torque Engine Actual Percent - Falls below 85%
- Item 4: Torque Driver's Engine Demand - Remains at 100% through the entire acceleration

The data in **Figure 4** displays a 260hp box truck with a boost leak in the CAC hoses. Boost pressure is in the low 20's and took 45-50 seconds to reach 60 mph, with a rolling start and no load. The torque percentage trace of the box truck with the boost leak quickly falls from specification as the engine rpms rise, with no boost to support it. This can lead to shift hesitations, vehicle speed loss, excessive regenerations, turbocharger coking/oil passage, etc. The entire AMS system needs to be inspected and clamps tightened to ensure there are no leaks before investigating the turbochargers.

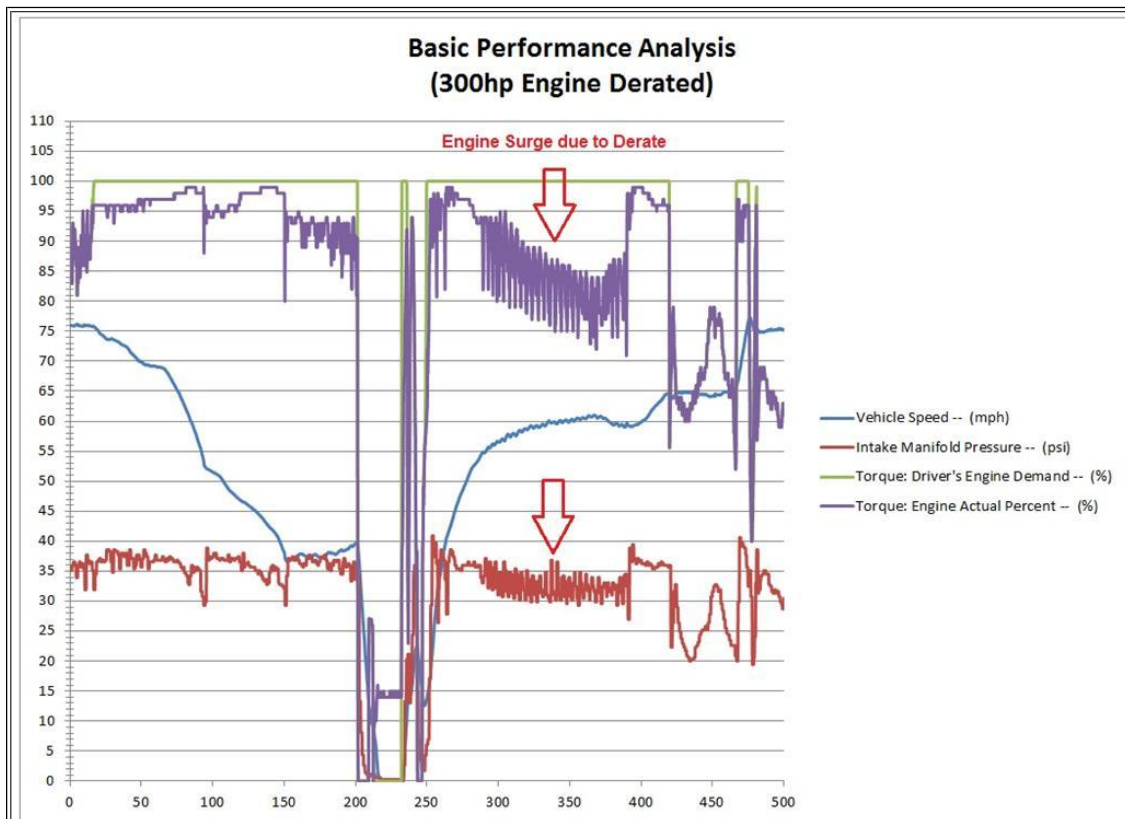


Figure 5: Analysis Parameters of a Derated Engine

- Item 1: Intake Manifold Pressure - Remains Above 35psi (Until Derate)
- Item 2: Vehicle Speed - Reaches 60mph at the 100 second mark
- Item 3: Torque Engine Actual Percent - Falls below 85% and is cycling
- Item 4: Torque Driver's Engine Demand - Remains at 100% through the entire acceleration

Figure 5 displays an engine derating due to excessive Exhaust Gas Temperature (EGT). Notice how boost remains in specification but appears to be surging. Diagnosing an engine surge can be difficult because many—if not all—signals will surge with a similar frequency. There are, however, two main types of surging and knowing which is present will help with diagnostics.



Figure 6: Analysis Parameters of a Derated Engine

Item 1: EGT Maximizes at 1350F, in a severe derate

Cyclic Surge - A slow to fast pace surge with a controlled feeling or electronic sound to it as certain engine systems (EGR, Turbochargers, ITV, Etc.) come in and out of a derated mode. This is seen in **Figure 6** and is typically due to EGT overheats.

Sporadic Surge - Typically this type of surge is not due to controlled minor derates or engine controls; it is a higher frequency and can be described as bucking. Some instances of bucking have been EOT over heats, wiring issues causing false readings, or cylinder misfires.

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REPAIR STEPS

See proper iKNOW article or service manual for service procedures. ([2010 MaxxForce 7 Service Manual](#))

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WARRANTY INFORMATION

Claim Requirements/Approvals:

No approvals or special requirements for this repair.

Warranty Claim Coding:

Group:	12000 - Description
Noun:	135 - Description

Standard Repair Times:

Due to the number of trucks and SRT possibilities, see the individual SRTs linked in each step below.

Step	Description	Chassis	Engine	SRT	Hours
1 - 2	Inspect Intake / Verify Oil Level	See Link	EPA 10 MaxxForce 7	Inspect Intake / Verify Oil Level	See Link
3	Crankcase Pressure Test	See Link	EPA 10 MaxxForce 7	Crankcase Pressure Test	See Link
4	Blow-by Test	See Link	EPA 10 MaxxForce 7	Blow-by Test	See Link
5	Relative Compression Test	See Link	EPA 10 MaxxForce 7	Relative Compression Test	See Link
8	Short Block	See Link	EPA 10 MaxxForce 7	Short Block	See Link
8	Engine Assembly R&R	See Link	EPA 10 MaxxForce 7	Engine Assembly R&R	See Link
7, 8, 9, 10	Turbocharger Cleaning	See Link	EPA 10 MaxxForce 7	Turbocharger Cleaning	See Link
7, 8, 9, 10	CAC Cleaning	See Link	EPA 10 MaxxForce 7	CAC Cleaning	See Link
9	Replace Breather	See Link	EPA 10 MaxxForce 7	Replace Breather	See Link
7, 8, 9, 10	Analyze Results / Snapshot review	See Link	EPA 10 MaxxForce 7	Road Test (0-60 MPH, Full Throttle)	See Link
10	Short Block	See Link	EPA 10 MaxxForce 7	Short Block	See Link
10	Engine Assembly R&R	See Link	EPA 10 MaxxForce 7	Engine Assembly R&R	See Link

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