



U.S. Department  
of Transportation

**National Highway  
Traffic Safety  
Administration**

# ODI RESUME

**Investigation:** EA 15-006  
**Prompted by:** IE15-038  
**Date Opened:** 10/16/2015  
**Investigator:** Kareem Habib  
**Approver:** Otto Matheke  
**Subject:** Brake Vacuum Pump Failure

**Date Closed:** 04/28/2016  
**Reviewer:** Jeff Quandt

## MANUFACTURER & PRODUCT INFORMATION

**Manufacturer:** Ford Motor Company  
**Products:** 2011-2012 Ford F-150 equipped with 3.5L GTDI engines  
**Population:** 252,910

**Problem Description:** Moisture ingestion in the electric vacuum pump (EVP) may cause internal pump corrosion and failure resulting in excessive noise, vibration and increased brake pedal effort at cold start.

## FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
<b>Complaints:</b>	95	396	466**
<b>Crashes/Fires:</b>	2	6	7**
<b>Injury Incidents:</b>	0	0	0
<b>Fatality Incidents:</b>	0	0	0
<b>Other*:</b>	0	6,476	6,476

\***Description of Other:** Warranty claims related to electric vacuum pump buzzing noise, intermittent vibration or malfunctions caused by internal pump corrosion.

\*\* Total eliminates duplicates received by ODI and manufacturer.

## ACTION / SUMMARY INFORMATION

**Action:** This Engineering Analysis is closed.

### Summary:

On February 15, 2016, Ford Motor Company initiated Customer Satisfaction Program 15N05 to extend warranty coverage for the electric vacuum pump in certain model year (MY) 2011 through 2012 Ford F-150 pickup trucks equipped with 3.5L GTDI engines. The program extends coverage for up to 10 years of service or 150,000 miles from the warranty start date of the vehicle, all vehicles are eligible for the program through July 30, 2016 regardless of mileage. Ford's program covers all repairs related to electric vacuum pump (EVP) malfunctions including excessive noise, vibration, or change in brake pedal feel while applying the brakes at cold start.

Ford states that the engine intake manifold is the primary source of vacuum for the brake booster and is fully compliant to motor vehicle safety standards without the supplemental vacuum supplied by the EVP. The company also contends that failure modes related to the EVP are progressive and provide warning to operators by way of noise and vibration before an operator to experience any temporary change in brake pedal feel.

ODI's analysis of warranty data found that the majority of claims involved consumer concerns with EVP noise or vibration from the left front fender area when the vehicle is first started. Continued operation in this mode with pump motor noise will eventually result in the EVP seizing or becoming non-functional. Component failure analysis indicated that Ford and its supplier, Continental, identified a pump crank drive corrosion condition due to moisture entry through the vacuum intake. Corrosion damage to EVP internal components may eventually result in a blown fuse in the power distribution box and total loss of EVP function.

Analysis of consumer complaints, field reports, and warranty data related to EVP failures found that incidents predominantly occurred in driveways and parking lots in the periods immediately after cold engine starts. Many consumers operated their vehicle for some period of time with a blown EVP fuse without realizing that the pump had failed or that the vehicle had a brake system malfunction. Consumers who did experience braking performance issues reported a temporary hard brake pedal condition at start-up followed by more consistent normal pedal feel after few seconds. On June 22, 2015, Ford developed a remedy procedure and issued TSB 15-0105 instructing dealers to replace the vacuum pump and install a new vacuum pump harness kit.

In addition to reviewing test data submitted by Ford, ODI assessed safety risks associated with the alleged defect under various operating conditions, including: 1) baseline system performance with full engine and EVP vacuum available using exemplar parts, 2) disabled EVP and booster vacuum regulated to simulate worst case conditions for engine intake manifold vacuum supply to the brake booster (approximately 300 mbar); and 3) all source vacuum to the brake booster removed and Optimized Hydraulic Braking (OHB) mode active to represent complete loss of brake booster function (note: this condition is a more severe brake boost system failure mode than the alleged defect). ODI also analyzed all complaints and warranty claims to identify incidents alleging brake system performance concerns related to EVP failures. These analyses identified no brake performance issues or resulting changes in stopping distances either on highway or city traffic conditions. Two complaints alleging EVP malfunctions caused or contributed to rear-end collisions during attempted decelerations from road speeds are not believed to be related to the alleged defect. The EVP provides supplemental vacuum during initial start-up and idle with a cold engine. Both incidents

(Continued on attachment A)

involved vehicle operating conditions (i.e., warm engine, road speeds) during which booster vacuum is provided by the engine intake manifold. Although there was evidence that the EVP was not operating at the time of at least one of these crashes, it was not reported as a factor when the crash occurred and it appears that the driver had been operating the vehicle for a significant period of time with a failed EVP.

ODI identified a total of seven crash allegations that may be related to EVP failures in the subject vehicles. All seven incidents occurred in low-speed driveway maneuvers after a vehicle cold-start. One incident allegedly occurred after applying the accelerator a small amount. NHTSA's testing indicated that accelerator pedal application would result in normal engine manifold vacuum and negate the need for EVP supplemental vacuum, so this incident may not be related to the EVP. The complaints reported very minor exterior vehicle component damage with no loss of vehicle control. For example, one crash allegation reported damage to the side mirrors from contact with the garage door frame of his house (Figure 1). ODI observed that brake pedal forces required for cold start low-speed decelerations were increased from less than 10 lbs during normal operating conditions to over 20 lbs when the EVP is disabled and high accessory loads during cold-start result in relatively low engine manifold vacuum (e.g., 300 mbar). In the unlikely event that booster vacuum is completely depleted, the subject vehicles are equipped with an Optimized Hydraulic Braking (OHB) technology that will boost the brake hydraulic pressures for the driver by activating the ABS pump motor. The OHB technology is activated when booster vacuum drops below 100 mbar and begins providing boosted brake pressure at brake pedal forces of 30 lbs or greater.



Figure 1

ODI's analysis of field data indicate that the temporary reduced vacuum assist condition resulting from EVP failures in the subject vehicles occur after periods of progressively worsening noise symptoms that provide the operators ample opportunity to detect and repair the condition. The reported incidents of reduced brake performance occurred at very low speeds and were limited to specific operating conditions that could occur for a brief period of time after a cold-start. Testing demonstrated that, even when worst-case conditions were simulated, the vehicles could be stopped with moderate increases in brake pedal effort. This engineering analysis is closed. The closing of this investigation does not constitute a finding that a safety related defect does not exist. For additional information, see the investigation file for EA15-006.

**2011-2012 Ford F-150 equipped with 3.5L GTDI engines**

EA15-006

**Brake Vacuum Pump Failure**

Attachment A

The following VOQ numbers are associated with the issues discussed in this closing resume:

10542098, 10554458, 10565994, 10575987, 10604687, 10605701, 10607811, 10610491, 10615536, 10617828, 10619545, 10621605, 10640064, 10643075, 10650578, 10662151, 10664415, 10666988, 10668069, 10678844, 10695537, 10700874, 10706217, 10706271, 10712465, 10713019, 10716441, 10721465, 10723033, 10723792, 10726960, 10730549, 10730721, 10730735, 10730757, 10730837, 10730909, 10731008, 10731135, 10731165, 10731395, 10731758, 10731911, 10732609, 10732878, 10733375, 10733674, 10733804, 10734558, 10734613, 10735070, 10735717, 10743859, 10744214, 10744413, 10744507, 10747842, 10748017, 10750022, 10750395, 10759142, 10761406, 10761439, 10762038, 10762439, 10764098, 10775373, 10778587, 10778880, 10783228, 10783365, 10783518, 10783737, 10785854, 10786246, 10786563, 10787625, 10788479, 10788481, 10789258, 10789849, 10790527, 10809635, 10810166, 10816279, 10816559, 10816577, 10817284, 10819365, 10821237, 10821594, 10825604, 10836490, 10840400, 10846480.