



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 15-026
Date Opened: 06/22/2015
Investigator: Kareem Habib
Approver: Otto Matheke
Subject: Brake Vacuum Pump Failure

Date Closed: 10/19/2015
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: The electric vacuum pump may fail, resulting in increased brake pedal effort during driving modes in which vacuum pump is required to produce supplemental vacuum to the brake booster (e.g., low speed braking after cold start, braking while operating in boost mode) with no warning indicators or diagnostic trouble codes.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	53	396	432**
Crashes/Fires:	2	7	7**
Injury Incidents:	1	0	1
Fatality Incidents:	0	0	0
Other*:	0	6,476	6,476

*Description of Other: Warranty claims related to the electric vacuum pump.

** Total eliminates duplicates received by ODI and manufacturer.

ACTION / SUMMARY INFORMATION

Action: This Preliminary Evaluation has been upgraded to Engineering Analysis EA15-006.

Summary:

On June 22, 2015, the Office of Defects Investigations (ODI) opened Preliminary Evaluation PE15-026 to investigate incidents of increased brake pedal effort at cold start and extended stopping distance while driving in traffic, resulting from failures of the electric brake vacuum assist pump in model year (MY) 2011-2012 Ford F-150 pickup trucks equipped with 3.5L GTDI engines. In response to ODI's Information Request (IR) for PE15-026, Ford provided ODI with 396 complaints and field reports relating to incidents of increased brake pedal effort or malfunctions in the electric vacuum pump (EVP). ODI's analysis of the data provided by Ford identified 7 crashes and 1,851 warranty claims related to either a hard brake pedal condition or reduced brake effectiveness. Additionally, ODI identified one report in its database alleging an injury to an occupant of a vehicle struck in the rear by a subject F-150 vehicle with a failed EVP as documented in the police accident report referencing a dealer assessment of the pump.

According to Ford, the subject vehicles utilize a traditional brake vacuum booster to provide power assist for braking and the EVP is intended to operate to maintain consistent brake pedal feel. The engine intake manifold is the primary source of vacuum for the booster and is fully compliant to motor vehicle safety standards without the EVP. Ford described the conditions related to a change in brake pedal feel as limited and temporary and provided component failure analysis showing evidence of water entry into the EVP which caused internal pump corrosion. Ford indicated that the EVP failure mode is progressive and provides warning to operators by way of noise and vibration before an operator is likely to experience any temporary change in brake pedal feel. Damage to the EVP motor bearing may eventually result in a blown EVP fuse and total loss of EVP function.

Ford provided test data showing the brake pedal forces and pedal travel curves over time for 0.3g decelerations to a stop from 80kph (50mph) for: 1) normal system (full engine and EVP vacuum available); 2) Ford's approximation of worst case booster performance with EVP failure (EVP disabled and booster vacuum regulated to 300mbar to simulate cold start, all accessory loads on, and starting at 0 vacuum); and 3) with all source vacuum to the brake booster removed and Hydraulic Boost Compensation (HBC) active to represent complete loss of brake booster function. The Ford tests showed that the brake pedal forces required for achieving the 0.3g decelerations were relatively low for the normal condition, 35-40 N (8-9 lbf), increased by approximately 2-3 times normal when the EVP is disabled, 75-115 N (17-26 lbf), and increased by about 5-6 times normal for the complete brake booster failure condition, 205-215 N (46-48 lbf). This Preliminary Evaluation has been upgraded to Engineering Analysis (EA15-006) to test for EVP malfunctions under other vehicle operating conditions (e.g., low-speed driveway braking after cold-start with failed EVP), potential human factors contributions and to further assess the scope, frequency, and safety-related consequences of the alleged defect.

The VOQs associated with the opening of this investigation are:

10565994, 10575987, 10598351, 10604687, 10605701, 10607811, 10610491, 10615536, 10617828, 10619545, 10643075, 10650578, 10662151, 10664415, 10666988, 10668069, 10678844, 10695537, 10700874, 10706217, 10706271, 10712465, 10723033, 10723792, 10726960, 10730549, 10730721, 10730735, 10730837, 10730909, 10731008, 10731135, 10731157, 10731165, 10731395, 10731758, 10732609, 10732878, 10733375, 10733804, 10734558, 10734613, 10743859, 10744214, 10744413, 10744507, 10747842, 10748017, 10750395, 10759142, 10761406, 10762038, 10762439.