

FORD MOTOR COMPANY (FORD) RESPONSE TO REQUEST 13Request 13

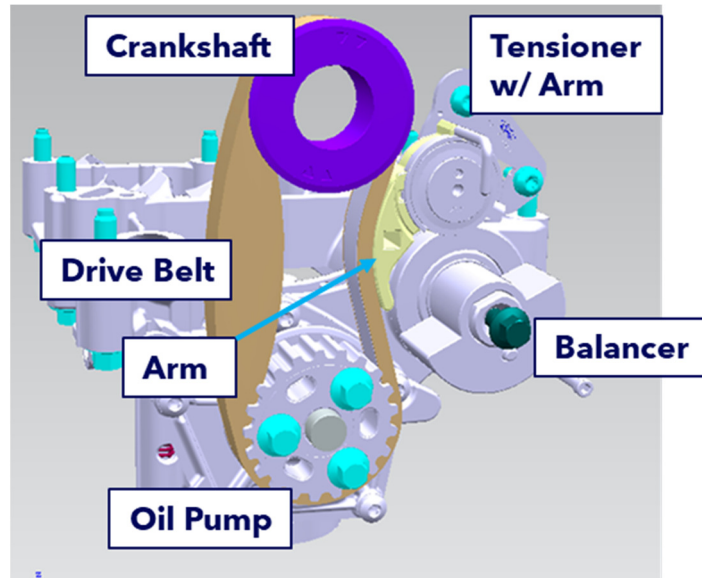
Furnish Ford's assessment of the alleged defect in the subject and peer vehicles, including:

- a) The causal or contributory factor(s);
- b) The failure mechanism(s);
- c) The failure mode(s);
- d) The risk(s) to motor vehicle safety that it poses, including risk(s) categorized by failure mode(s);
- e) What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring, or subject component was malfunctioning; and
- f) Furnish Ford's criteria and process for evaluating whether a loss or reduction of motive power is a safety related defect, whether Ford utilizes a risk-based evaluation tool to make safety determinations on loss or reduction of motive power, and how the failure mode(s) of the alleged defect were evaluated with respect to the said safety defect evaluation criteria; and
- g) The reports included with this inquiry.

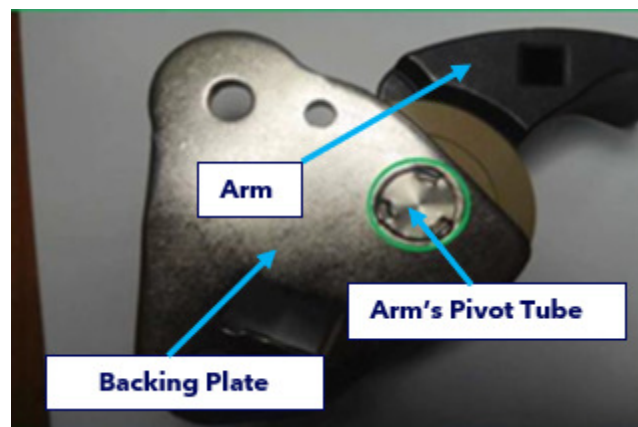
Answer:

NHTSA's Office of Defects Investigation (ODI) opened this Preliminary Evaluation based on "consumer complaints alleging engine failure due to loss of oil pressure in model year (MY) 2018-2021 Ford EcoSport vehicles". Ford has investigated this subject, including the cause of these reports, the circumstances under which they occur, and the anticipated performance of the subject and peer vehicles moving forward.

Subject and peer vehicles use Ford's 1.0L Fox Classic engine and 6F15 automatic transmission. Components related to this powertrain's oil pump and oil pump belt tensioner system are pictured on the following page.



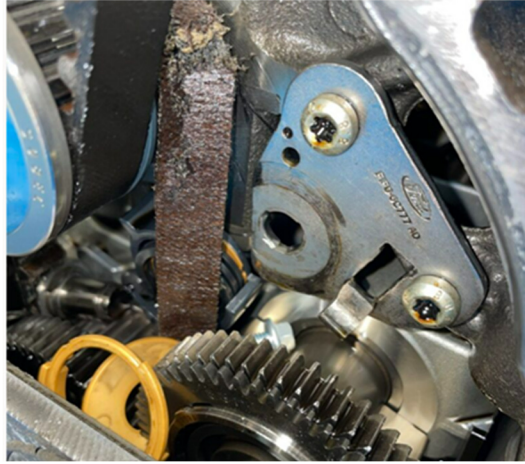
The engine's oil pump is driven via belt by the engine's crankshaft. This interaction also drives a balancer shaft in the engine. Due to the increased load requirements to drive the balancer shaft as well as the oil pump, an oil pump belt tensioner system is also used. The tensioner system consists of an arm retained to a backing plate via press fit of the arm's pivot tube into the plate. Components of the tensioner system are shown below.



The use of the balancer shaft and oil pump belt tensioner system are unique to 6F15 automatic transmission applications of the 1.0L Fox Classic engine (i.e., manual transmission vehicles do not have these components).

Teardown analysis of engines replaced in warranty for suspected failed oil pumps have identified 3 types of failure:

- Tensioner arms separating from backing plates as shown below:



- Ends of tensioner arms broken off (while still retained to backing plate):



- Oil pump drive belts degraded/missing teeth:



For tensioner arms separating from the backing plate, the press fit retention method of the arm to the backing plate does not appear robust to the torsional vibration experienced by the components over time. For broken tensioner arms, it appears excessive arm rotation about the arm's pivot point is leading to contact with the balancer shaft resulting in fracture. Oil pump drive belt degradation/missing teeth is believed to be caused by a greater than expected load on the belt, which may result in failure prior to the belt's 150,000 mile service interval. Rubber and debris from the degraded belt may clog the oil pump pickup filter, causing an eventual loss of oil pressure.

These failure types were not observed during development and design verification. All Ford durability testing was passed. Ford is in the process of working to understand if evaluation criteria was sufficiently representative of conditions (i.e., belt loads or engine vibration) experienced in the field.

Regarding retention of the tensioner arm to the backing plate, a caulking (also referred to as staking) operation is performed during component manufacturing in addition to the pivot tube's press fit. Material is deformed at three points on the pivot tube to increase interference to the backing plate. Early warranty part returns showed that in some cases this caulking was offset, resulting in less interference than design intent at some points as shown below:



In February 2019, the supplier implemented a position monitoring system at their facility that ensures caulking is properly centered, however failures involving tensioner arms falling off backing plates have still been observed on parts produced after this change.

In the event of a tensioner arm falling off the backing plate, or the tensioner arm breaking after contact with the balancer shaft, the engine will lose oil pressure immediately. Following loss of oil pressure, the driver will receive a low oil pressure warning message on the instrument cluster and may see a check engine light, alerting them to concern. If the vehicle continues to be driven, an FMEM (failure mode effect management)/limp home mode may occur which will reduce the level of power available. This FMEM occurs when the vehicle's turbo experiences an underboost condition due to a lack of oil pressure. Ultimately, the engine will start to exhibit a noise consistent with either camshaft or bearing failure and cause the engine to seize resulting in a loss of motive power and an inability to restart the vehicle.

In the event of the oil pump drive belt degrading, similar effects will be observed. Rubber from the degraded belt will clog the oil pump pickup filter. If this occurs, the driver of the vehicle will see a low oil pressure warning light and may see a check engine light. The vehicle should not immediately lose full oil pressure. The customer may experience an FMEM/limp home mode, engine noise, loss of motive power, and an inability to restart the vehicle if the vehicle continues to be driven.

In an effort to better understand the progression of symptoms resulting from an oil pump failure, Ford simulated the failure on a 2021 Model Year EcoSport. The vehicle's oil pump belt tensioner was removed, and the oil pump drive gear was welded to the balancer shaft prior to vehicle testing. The vehicle's oil pressure light was present upon starting the vehicle. The test driver then applied 100% throttle, but the vehicle would not accelerate past 60 miles per hour (due to the vehicle's FMEM/limp home mode). After approximately 7 minutes, 45 seconds of driving, engine noise consistent with a camshaft or bearing failure became audible. After approximately 8 minutes, 30 seconds of driving, the vehicle slowed to approximately 20 miles per hour. The test driver entered a test track braking zone, where they released the throttle and the vehicle stalled. The vehicle could not be restarted after this.

Regarding whether Ford uses a risk-based evaluation tool (question 13(f)), NHTSA did not provide a definition of "a risk-based evaluation tool" and it is not clear to Ford whether NHTSA is inquiring about a specific risk-based evaluation software program or some other specific evaluation methodology. Ford is available for follow-up discussion of this topic. In general, loss or reduced motive power issues are investigated and evaluated following Ford's Critical Concern Group and 14D processes, which are documented procedures. Multiple factors including severity of failure mode, current and projected rates of occurrence, warning symptoms and issue progression timing are all considered in evaluating issues. Additionally, past safety field service actions and responses to NHTSA information requests from Ford and other manufacturers, as well as NHTSA guidance on loss of motive power, are reviewed to support evaluation.

Ford's CCRG and 14D processes for this investigation are in process. Factors under consideration as Ford evaluates this issue are summarized below.

Ford reviewed its warranty and field report data for both subject and peer vehicles to better understand what combination of symptoms customers cited. This is detailed in the following table.

Category	Allegation	Occurrences	R/1000
A1	Oil Pump Failure w/ Loss of Motive Power and No Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light, Reduced Power/Limp Mode)	319	2.3
A2	Oil Pump Failure w/ Loss of Motive Power and Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light, Reduced Power/Limp Mode)	741	5.5
B1	Oil Pump Failure w/ Reduced Power/Limp Mode	432	3.2
B2	Oil Pump Failure w/ Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light) and No Mention of Reduced Power/Limp Mode	2696	19.9
C	Oil Pump Failure w/ Ambiguous Customer Symptoms	409	3.0

Some warranty and field reports noted the customer also experiencing a hard brake pedal (~1.4%, 65 of 4,597 reports). The vehicle's mechanical vacuum pump is driven by the engine's camshaft. If the engine seizes, the pump will stop functioning. Depending on brake pedal travel initiated by the driver, vacuum assist may be depleted after 1 to 3 fully assisted brake applications. The customer will still have brake functionality, even after vacuum assist is depleted.

Fourteen (14) reports of block breaches potentially related to subject component failure resulting in noise, vibration, harshness, or loss of motive power have been received.

Twelve (12) reports of melting of components internal to the engine have been received by Ford, as well as one (1) report of smoke being observed.

Ford identified one VIN with underhood fire allegations (there are three reports associated with this occurrence). The customer's insurer alleged the fire was caused by an oil pump failure. Ford inspected this vehicle and found a slight crack in the engine block, but no evidence of a fire. Two of the three reports related to this occurrence contained property damage allegations, but no allegations of personal injury. Ford has received no other property damage allegations.

Ford identified 1 lawsuit with allegations of physical injury potentially related to the alleged defect. Ford has not confirmed the root cause of the occurrence and the plaintiff did not allege an oil pump defect, but in the spirit of transparency, Ford is providing this information. The complaint alleges the vehicle lost motive power due to low oil resulting in 2 customers that were alleged to be injured in this occurrence. This lawsuit also includes an allegation of an accident, the only such allegation Ford has identified.

Ford identified no reports of fatalities pertaining to the alleged defect in subject vehicles.

Current oil pump failure rate in the field (independent of failure type) is 3.3%. Statistical models show a predicted cumulative failure probability of 18.2% at 10 years and 150,000 miles.

Ford does not have an Oil Pump Drive Belt-specific DFMEA. Ford's Powertrain Team's engineering judgement is that the Timing Belt DFMEA document is a close surrogate for providing insight into the effects of failures related to the oil pump drive belt and/or tensioner system. Based on that document, the Powertrain Engineering Team would rate the failure modes under consideration here at a severity 8.

The 95 Vehicle Owner Questionnaires (VOQs) that were provided with this information request were reviewed and categorized as shown below. The categorization of each report is identified in the "Category" field in the document "PE23-015 Request 13 - VOQ Data.xlsx".

Category	Allegation	Occurrences
A1	Oil Pump Failure w/ Loss of Motive Power and No Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light, Reduced Power/Limp Mode)	7
A2	Oil Pump Failure w/ Loss of Motive Power and Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light, Reduced Power/Limp Mode)	30
B1	Oil Pump Failure w/ Reduced Power/Limp Mode	8
B2	Oil Pump Failure w/ Mention of "Progression" Symptoms (NVH, Check Engine Light, Oil Pressure Light) and No Mention of Reduced Power/Limp Mode	42
C	Oil Pump Failure w/ Ambiguous Customer Symptoms	8

###