FORD MOTOR COMPANY (FORD) RESPONSE TO RQ24-008 Request 13

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Please provide responses to the following items for the subject recall and the peer recall, separately:

a) A summary of Ford's assessment of the root cause and consequences of the alleged defect, and a summary of Ford's assessment of the remedy program's effectiveness;
b) A summary of any test programs conducted that validated the remedy was sufficient in resolving the alleged defect, and whether hardware repairs are needed; and;
c) A summary of any alternative remedy programs that were considered, and any associated cost-benefit analyses that were conducted when selecting the remedy program.

In addition, please provide a summary of Ford's investigative process, and Ford's findings, which culminated in the issuing of Customer Satisfaction Program 22N18, and whether Ford plans on issuing a similar Customer Satisfaction Program for the subject vehicles.

Answer

For both the subject (24S16) and peer (22S73) recalls, Ford assesses the root cause as a cracked fuel injector in the engine that allows for fuel to leak into the cylinder head, which can travel out via a drain hole and down onto hot surfaces where it may combust. The crack is attributed to excessive stress in the valve body/pole piece interference. Additionally, the drain hole location in the cylinder head is directly above the exhaust/turbo system, allowing for flammable fluid to reach a surface at or above 600 degrees Celsius which can initiate combustion of gasoline. Figure 1 below describes the potential leak path of fuel.

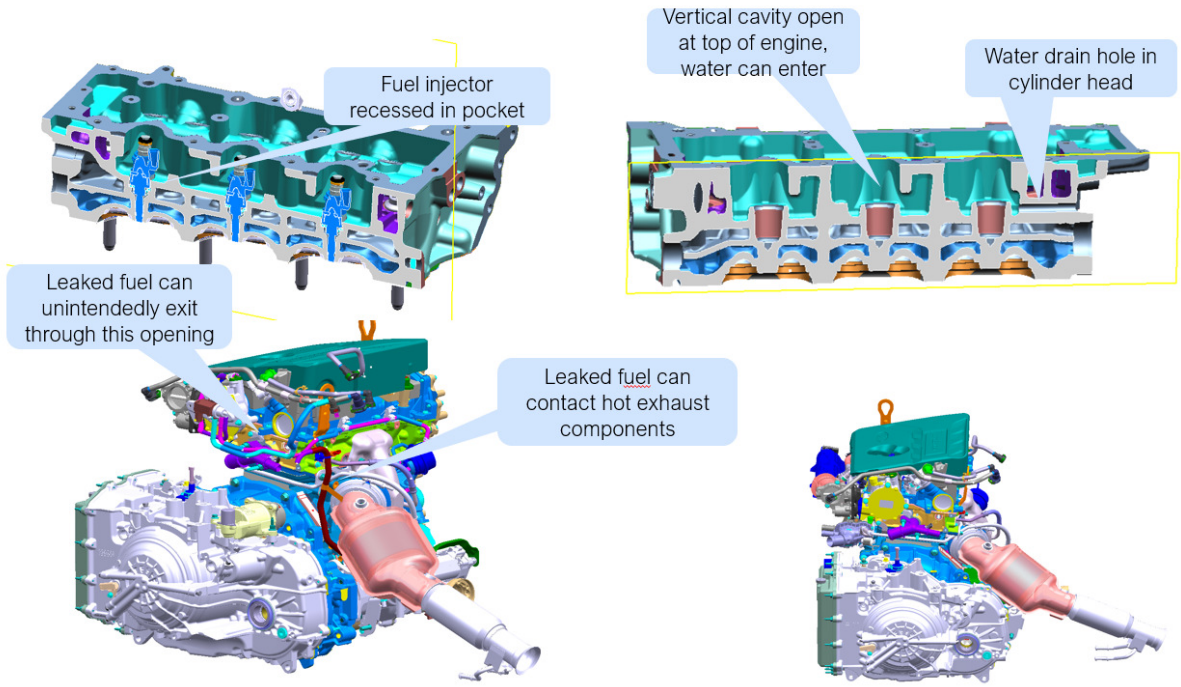

Figure 1: Potential Cracked Injector Fuel Leak Path

Vehicles in the subject recall population were produced with “BC-level” fuel injectors from supplier Vitesco beginning October 17, 2022. Vitesco’s data indicated the BC-level injector modifications relative to the BB-level injectors, used in the peer recall population of vehicles, would improve robustness. BC-level injectors have a reduced knurl diameter relative to the BB-level injectors, which reduces stresses leading to cracking. Ford reviewed field data from vehicles produced with BC-Level injectors in China that supported Vitesco’s data.

Ford subsequently identified leaks during component-level injector flow testing on fuel injectors recovered from two Bronco Sport vehicles produced during the subject recall range of production that had experienced underhood fires. For both the subject and peer recalls, a fuel leak from a cracked fuel injector is expected to result in fuel odor both outside and inside the vehicle. If conditions to initiate and sustain underhood fire are achieved, the customer may experience drivability symptoms and instrument cluster warnings as the fire damages underhood components or as vehicle failure mode effects management (FMEM) strategies are invoked. As the fire progresses, the customer may notice smoke or flames emanating from the engine compartment or underbody. Progression from fire initiation to drivability symptoms, instrument cluster warnings, or smoke/flame are expected to occur within minutes in most cases. Liquid fuel and/or fuel vapor that accumulates near a sufficiently hot surface, below the combustion initiation flame speed, may ignite resulting in an underhood fire, and increasing the risk of injury.

Ford considered two possible remedies associated with the fuel injector: a hardware replacement option and a software algorithm option. The hardware replacement option posed significant challenges to providing a timely remedy to owners. This was due to the volume of injectors required and the lead time associated with designing revised injector hardware, getting the new hardware into production, and calibrating the new design for proper operation in vehicles. The peer (22S73) and subject (24S16) recalls involve approximately 700,000 vehicles and 2.1 million fuel injectors. Because of the significant lead time involved with manufacturing 2.1 million injectors, Ford also considered and ultimately implemented the FMEM software algorithm and drain tube. A software solution could be made available to all customers very quickly, and the drain tube had a very short lead time for production. This option was the fastest way for Ford to protect the most customers.

If a fuel injector does crack and releases fuel, Ford’s recall repair seeks to mitigates any safety risk to the customer and to reduce the amount of fuel that actually can leak from the vehicle. The recall repair software is designed to immediately deactivate the high-pressure fuel pump and limit the torque capacity of the engine. This significantly limits fuel leakage. The software also notifies the driver to seek service so that the driver can seek repairs before there is further fuel leakage. The drain tube ensures that if there is a fuel leak, it is redirected from hot surfaces to further mitigate the risk of a fire.

At the time of the peer recall, Ford verified the remedy through the following tests:

1) Bench flow tests to confirm reduced leak rate with FMEM software algorithm (summarized in Figure 2 below):

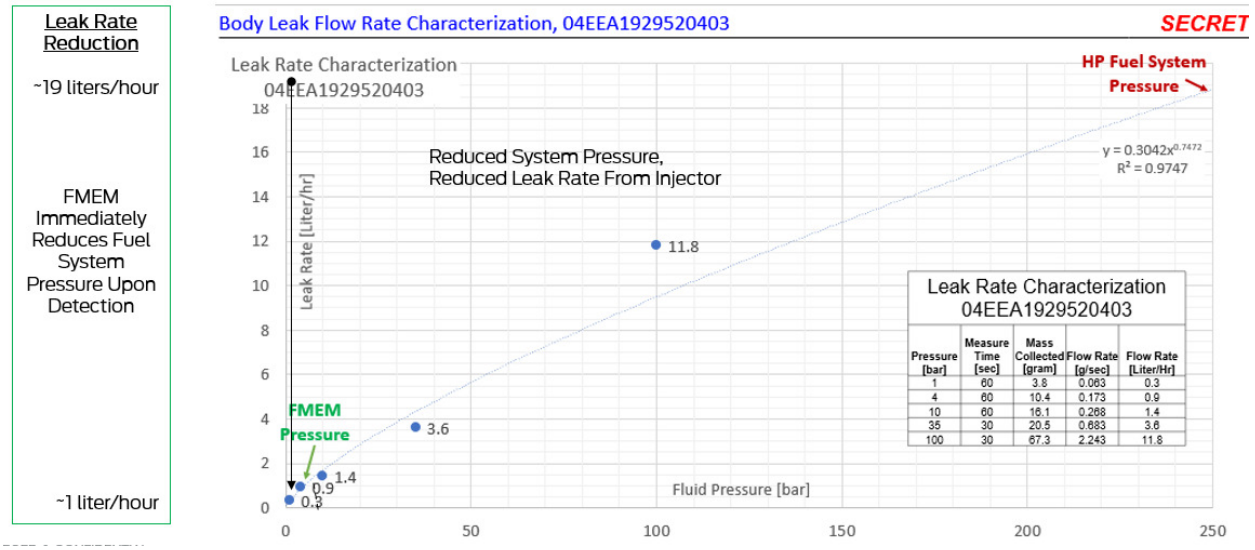

Figure 2: Bench Flow Tests To Confirm Reduced Leak Rate At FMEM Pressure

2) Review of engine mapping data to confirm reduced temperatures and FMEM software algorithm vehicle performance (summarized in Figure 3 below):

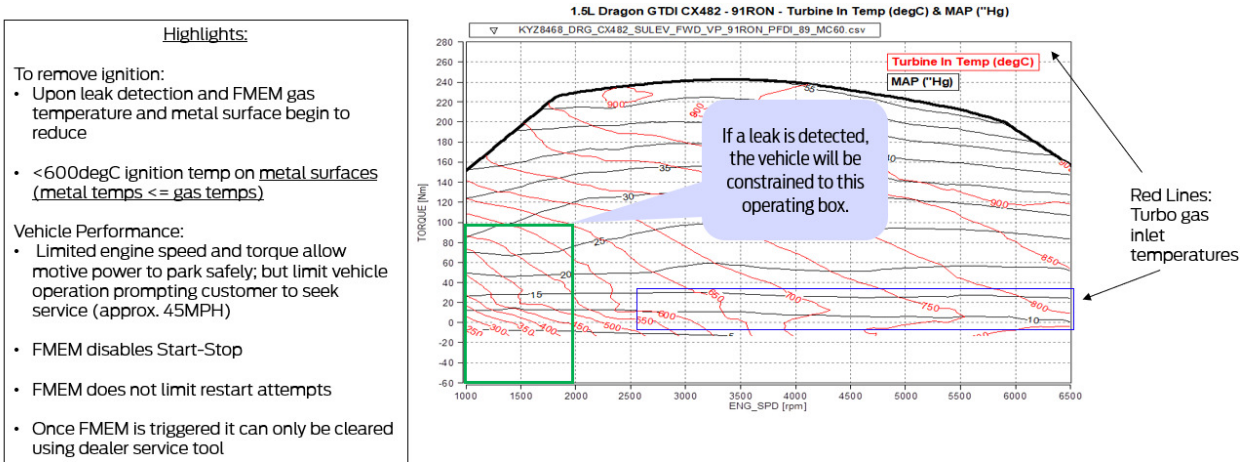

Figure 3: Engine Mapping Data Reviewed To Confirm Reduced Temps with FMEM

3) Fluid/fluorescing dye test to confirm effectiveness of leaked fuel rerouting with drain tube (summarized in Figure 4 below):

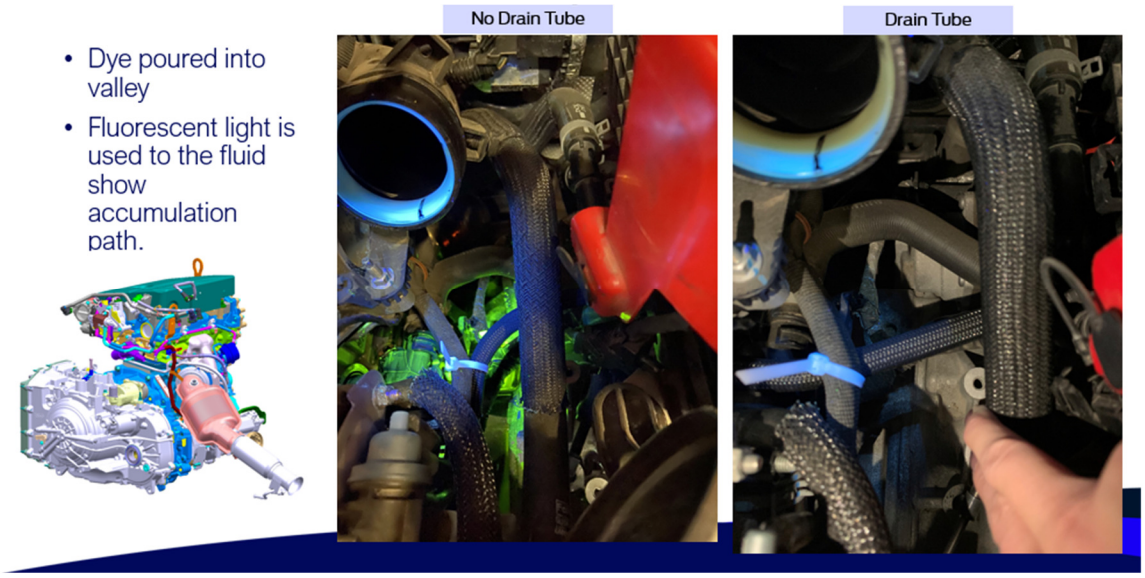

Figure 4: Fluid/Fluorescing Dye Test To Confirm Effectiveness OF Leaked Fuel Rerouting With Drain Tube

4) FMEM software algorithm was verified using in-vehicle testing of an actual cracked injector.

Ford believes the subject and peer recall remedies are effective. Approximately 600k vehicles in the U.S. and Federal Territories have received the fuel leak detection FMEM strategy (between vehicles that received the recall remedy and vehicles produced with the FMEM software algorithm). Potentially 1,154 injector leaks have occurred on vehicles in the U.S. and Federal Territories with the leak detection FMEM software algorithm (these vehicles have had injector replacements under the 22N18 customer satisfaction companion program to 22S73). Ford continues to monitor for customer claims of vehicle fire from cracked injectors; Ford has not confirmed any fires resulting from cracked injectors on vehicles with the leak detection FMEM software algorithm.

Ford's Field Review Committee (FRC) approved the companion customer satisfaction program 22N18 at the time of peer recall (22S73) approval. This program provides extended coverage to 15 years/150,000 miles for vehicles in the 22S73 population in the unlikely event a cracked fuel injector is detected and fuel injector replacement is required. The peer recall was intended to mitigate the safety risks of the alleged defect, while the customer satisfaction program was intended to ensure that Ford's customers would not have to pay out of pocket to replace a cracked injector over the full useful life of their vehicle. At this time, Ford does not plan on issuing a similar Customer Satisfaction Program for the subject vehicles.

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