

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

Does vehicle production after the production of the subject vehicle population to date include the installation of the remedy drain tube as a stock component?

Answer

It is important to note that the BC injector has a lower leak rate than the BB injector and that both types of injectors are insulated within the modular power unit interface to prevent spray. The drain tube was not included in vehicle production after production of the subject vehicle population because the FMEM software, included in production vehicles, removes the unreasonable safety risk of fire due to a cracked injector. While the drain tube was included as part of the subject recall remedy on vehicles that use BC injectors, inclusion of the drain tube in the subject recall remedy was done for consistency with the peer recall, which covers vehicles that use BB injectors. While Ford did not believe that a drain tube was necessary to effectively mitigate the safety risk, Ford believed that NHTSA would be favorable to this remedy since it was identical to the remedy used for the peer recall.

If a fuel injector cracks and releases fuel, the FMEM software effectively mitigates any safety risk due to a fire caused by a cracked injector within the subject vehicle population. The FMEM software deactivates the high-pressure fuel pump (while maintaining low pressure fuel pump operation to prevent a loss of motive power condition). This significantly reduces the fuel pressure driving fuel leakage. The FMEM software also limits the torque capacity of the engine, which reduces temperatures of the exhaust/turbo system surfaces to the point that it is unlikely ignition and propagation would occur. The software also notifies the driver to seek service so that the driver can seek repairs.

Leak testing of injectors returned in warranty shows BC-injectors leak at lower rates than BB-injectors for a given fuel rail pressure. Figure 1 below shows injector leak rates at 100 bar.¹ This leak testing shows that the highest-leaking BC injector observed among returned parts has a 1.44 L/hour leak rate at 5.2 bar. The leak rate for a BC injector is lower than the leak rate for a BB injector because BC injector geometry is different than BB injector geometry. The differences in geometry lead to less hoop stress on the injector valve body and smaller crack openings.

The leak path involves no fuel spray for either BB or BC injectors because the fuel injector cracking occurs in the valve body of an injector, which is surrounded by a modular power unit interface.² Due to this packaging configuration, the modular power unit interface prevents fuel spray in the engine bay. This is significant because it means that the BC injector, which has a lower leak rate than the BB injector, is leaking fuel into the cylinder head valley, which exits the valley via the drain hole, regardless of which injector the leaked fuel originated from. There is no spray and there are no differing obstruction conditions between injector locations. The FMEM strategy further reduces the fuel leak of a leaking BC injector upon detection and derates the engine, lowering the temperatures of the exhaust/turbo system surfaces. The cylinder head

¹ See Response 11 for further discussion and Appendix 13A below

² See slide 3 of the included file "RQ24-008 Supplemental IR Request 10 Leak Path Details.pdf" for more detail on the modular power unit interface, and the included video "Engine Bay with Cracked BB Injector and No FMEM.MOV" showing no visible fuel spray on a vehicle operating with a cracked BB-injector and without FMEM.

space is designed to drain all fluid that enters it. In the event that a minimal amount of fuel remains after a BC-injector crack, the surface temperature of this space is controlled by engine coolant temperature, resulting in a surface temperature in the range of 100 degrees C. This surface temperature would quickly evaporate any remaining fluid and is not high enough to present an ignition and propagation risk.

Ford has repaired 30,268 vehicles out of the 42,652 vehicles in the 24V187 recall population and Ford is not aware of any underhood engine fires among remedied vehicles that relate or may relate to the alleged defect. The FMEM software effectively mitigates the safety risk of a fire caused by a cracked-injector.

Appendix 13-A

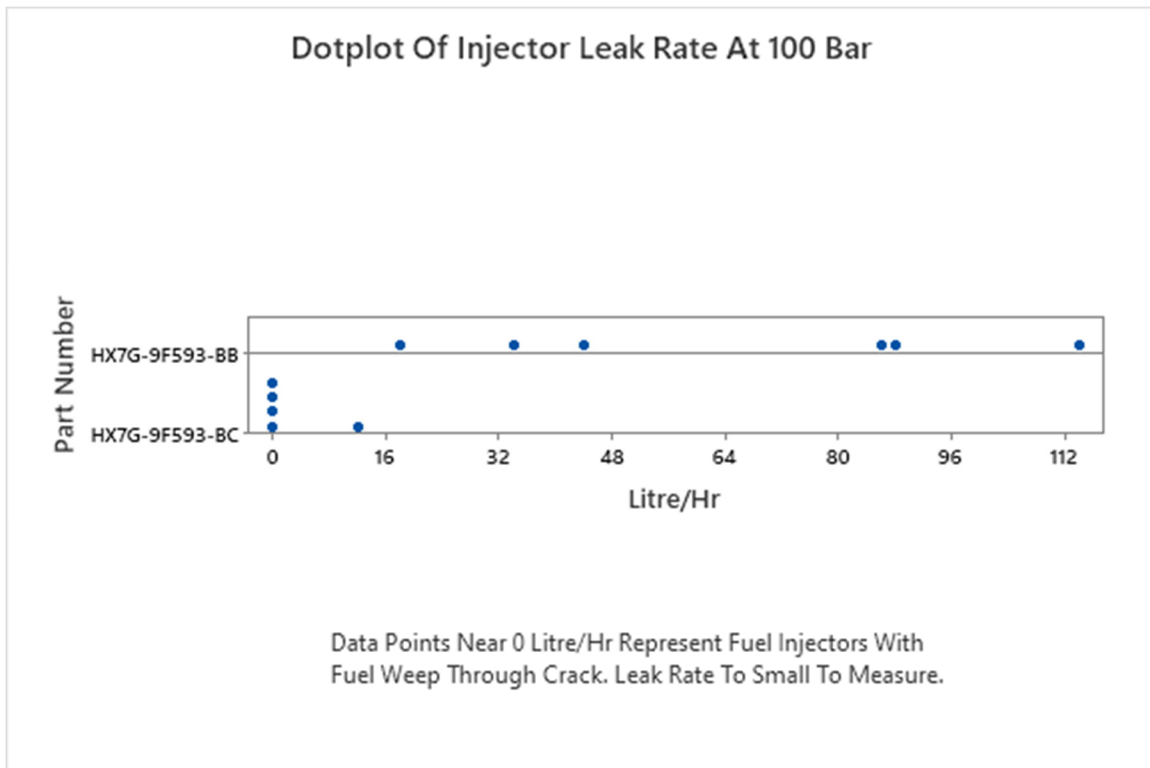


Figure 1: Returned Injector Leak Rates at 100 Bar

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