FORD MOTOR COMPANY (FORD) RESPONSE TO RQ24-008 Supplemental IR Request 11

Request 11

Regarding Ford's Response to Request #15 of the Initial Information Request dated June 21, 2024:

a) Please furnish a copy of the filed EPA Emission Defect Information Report; and
b) Please present in detail the calculations performed within this response, including all parameters, variables, and associated values, as well as connected vehicle data, that were utilized in these calculations of leaked fuel during pre-software activation and post-software activation scenarios.

Answer

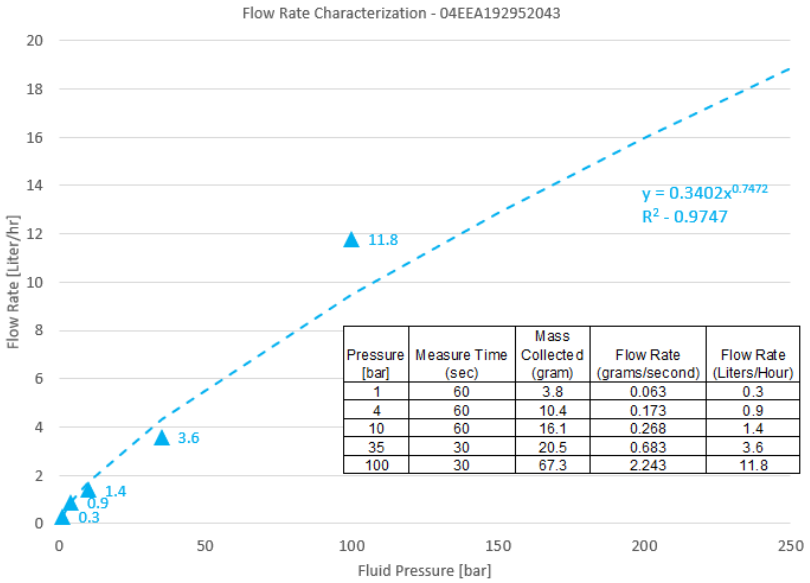
a) The requested emissions defect report is provided in "EPA_CDX_EDIR_24-092.pdf".

b) Part a of Ford's Response to Request #15 of the Initial Information Request dated June 21, 2024, includes details of methodology for testing cracked fuel injectors that supports leak rate calculation and is reproduced here for reference.

Ford completed the testing at Ford testing facilities. Ford performed testing on cracked injectors that were returned from the field. Ford personnel placed injectors in an enclosed container and pressurized the injector with n-Heptane. Ford performed pressure sweeps at various levels of pressure to inspect for evidence of fluid. All leaked fluid drained into a flask below the test setup. The mass of the fluid was measured by a scale. The volumetric leak flow rate was calculated based on the mass, collection time, and the density of heptane.'

The fuel leak rate of 19L/hour stated in the subject and peer recall is derived from leak-testing of a cracked HX7G-9f593-BB injector returned in warranty using the above methodology. Figure 1 below captures leak rates at various pressures used during

testing. A curve was fit to this data, and the resulting equation was used to calculate a leak rate of 19 L/hr at the 250 bar fuel rail pressure used in during non-Failure Mode Effects Management (FMEM) operation.



Pressure [bar]	Measure Time (sec)	Mass Collected (gram)	Flow Rate (grams/second)	Flow Rate (Liters/Hour)
1	60	3.8	0.063	0.3
4	60	10.4	0.173	0.9
10	60	16.1	0.268	1.4
35	30	20.5	0.683	3.6
100	30	67.3	2.243	11.8

Figure 1: Flow Rate Characterization – 04EEA192925043

Part b of Ford's Response to Request #15 estimates a total estimated fuel leakage of 2.2 L for vehicles that have received the 24S16 recall repair and have experienced one or more cracked injectors.

This 2.2 L estimate is based on a median mileage traveled by vehicles with cracked injectors from the point of leak detection to point when that vehicle is serviced of 14 miles. The connected vehicle data used to determine this median mileage is included in the spreadsheet "Connected VehicleData P0087 MIL.xlsx". Miles travelled is calculated from the vehicle mileage at the time of malfunction indicator lamp (MIL) triggering and the vehicle mileage at the time of corresponding warranty service.

The 2.2 L estimate assumes those 14 miles are travelled at 30 mph, resulting in 0.467 hours of driving time before vehicle service. This 30 mph assumption is based on vehicle speed being limited to 40 mph by the FMEM.

The 2.2 L estimate is calculated using an average vehicle leak rate of 4.78 L/hour for those 0.467 hours of driving time before vehicle service. The 4.78 L/hour leak rate is based on leak rate testing of a series of returned parts using the above methodology.

For each returned injector tested, leak rates at various pressures were measured and a curve was fit to the data. The curve was used to calculate the returned injectors' leak rates at the 5.2 bar pressure of the low-pressure fuel pump operation during FMEM.

The 4.78 L/hour is an average of those calculated leak rates. This data and calculation is detailed in the spreadsheet “ReturnedInjectorLeakRates_FMEMPressure.xlsx”.

Note that the 4.78 L/hour leak rate at 5.2 bar described above is based on average performance of BB-level and BC-level returned injectors. Leak testing of injectors returned in warranty shows BC-injectors leak at lower rates than BB level-injectors for a given pressure. Figure 2 below shows injector leak rates at 100 bar. BC injector leak rates are lower than those of BB injectors. BC injector geometry is different than BB injector geometry leading to less hoop stress on the injector valve body and smaller crack openings.

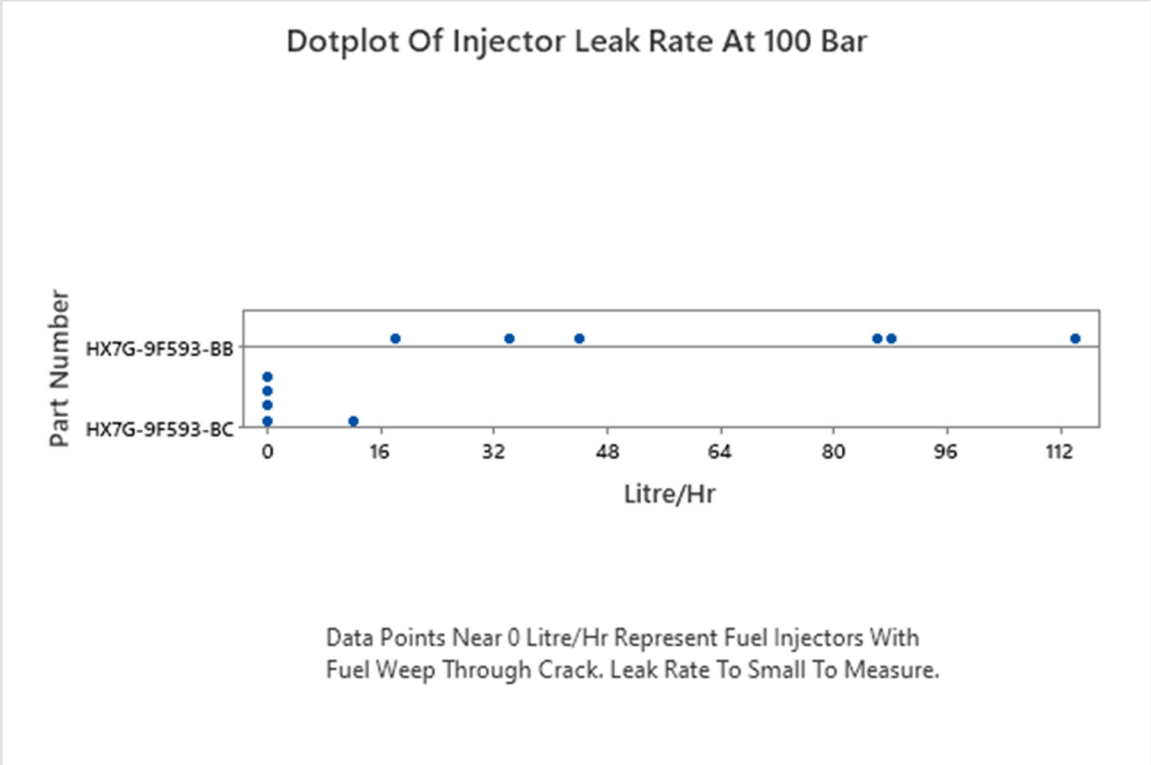


Figure 2: Returned Injector Leak Rates at 100 Bar

The highest-leaking BC injector observed in returned part testing has a 1.44 L/hour leak rate at 5.2 bar. Using the methodology described above that estimated 2.2 L of fuel leakage with a 4.78 L/hour leak rate, a 1.44 L/hour leak rate at 5.2 bar would result in a corresponding fuel leakage estimate of 0.67 L.

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