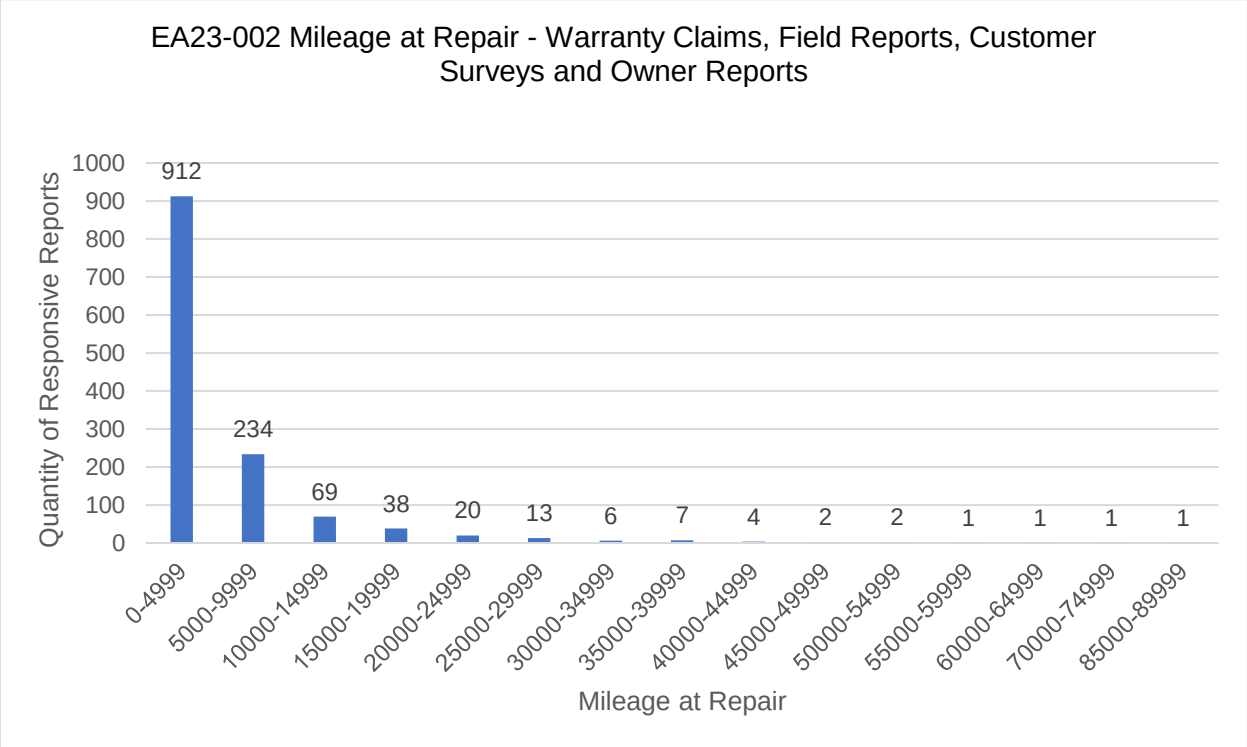
Request 18

Separately, furnish Ford's assessment of how time-in-service affects the frequency of intake valve fractures resulting from the identified manufacturing problem, including:

a) Any testing/analysis conducted to evaluate the effect of time-in-service on the subject defect in the subject vehicles;
b) A detailed technical explanation of why the alleged defect is not expected to occur during mid-to-long term vehicle usage;
c) Any analysis conducted to estimate the population of vehicles in the field that have intake valves which were produced with grinding burn or out of specification hardness;
d) A detailed description of all statistical analyses used to evaluate the future performance of the subject vehicles; and
e) The results of all statistical analyses used to evaluate the future performance of the subject vehicles.

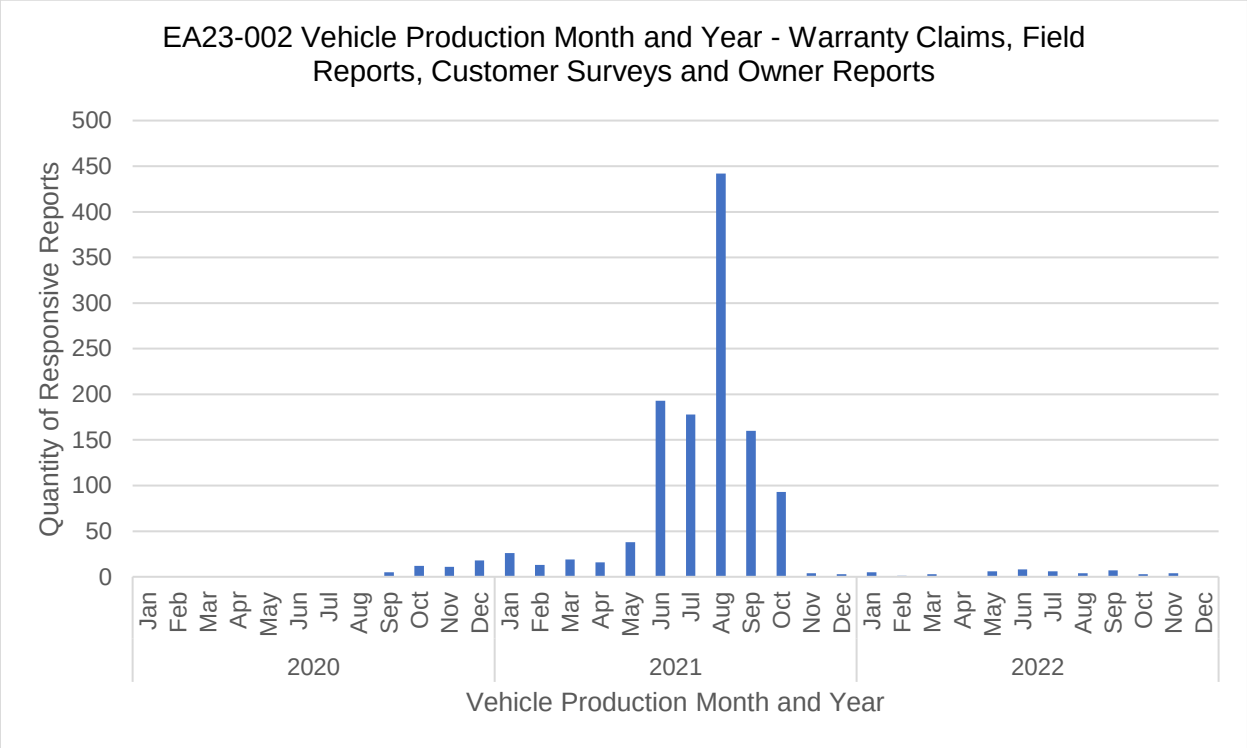
Answer

Ford's expectation of this alleged defect occurring at low time in service is supported by the responsive warranty claims, field reports, customer surveys, and owner reports submitted by Ford in Responses 3 and 5. Eighty-seven percent (87%) of the responsive claims had a reported mileage at the time of repair equal to or less than 10,000 miles. As of this IR submission, Ford estimates that over 95% of subject vehicles built during the period of intake valve grinding burn have been driven for more than 10,000 miles.

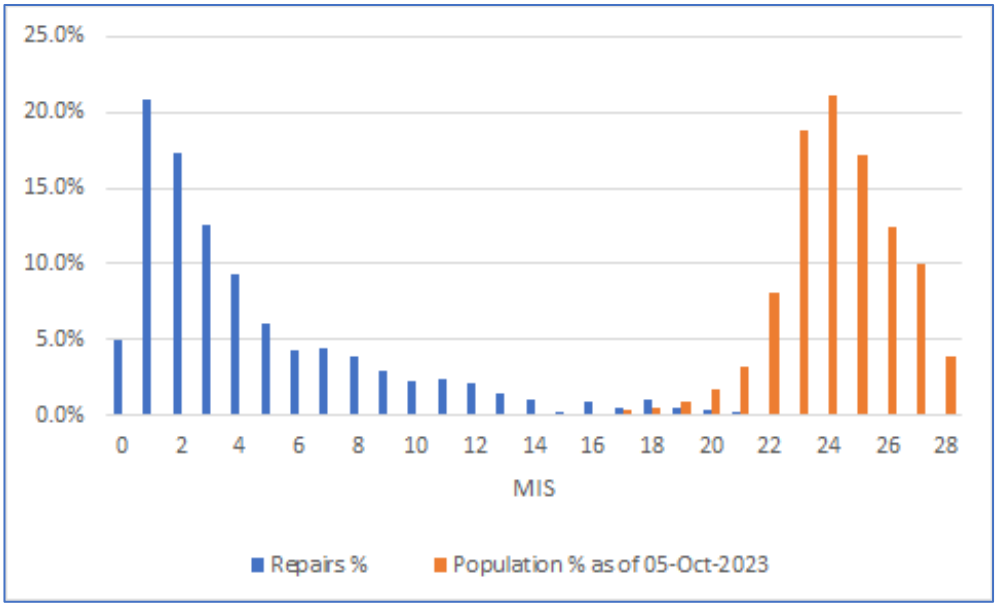


Ford's analysis of responsive reports submitted in Responses 3 and 5 demonstrates that the number of alleged failures in the field related to this EA drop dramatically on vehicles

produced after October 2021. October 2021 is also when the intake valve design changed to the Silchrome 1 material which is more robust to uncontrolled keeper groove grinding due to the material's higher austenitizing temperature as discussed in Response 13. A "spike period" of higher than ambient level of repairs is observed for vehicles produced between May 1 and October 31, 2021, as shown in the figure below. The start of the spike period corresponds to the vehicle production dates of vehicles with engines containing intake valves manufactured during a period of capacity uplift at the valve supplier manufacturing facility. Ford's basis that vehicles produced before or after this time period are not likely to be equipped with the alleged defect in the subject component(s) is supported by field data in the figures below and correlates to our understanding of events in manufacturing.



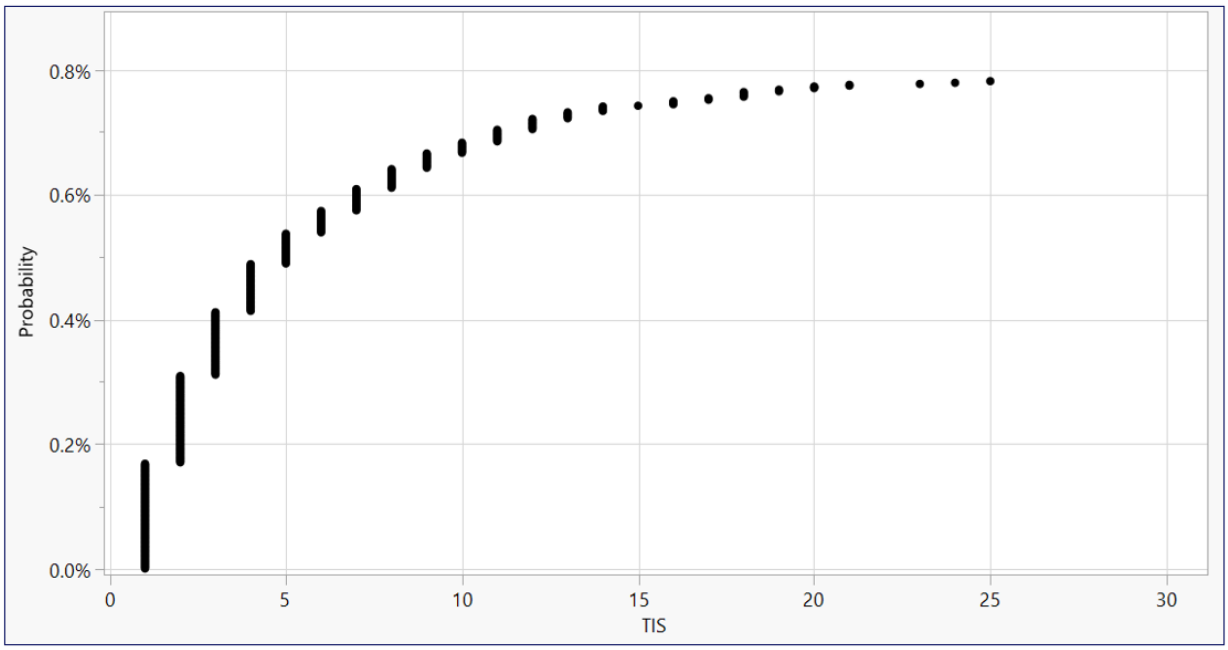
Ford also often uses a time in service or Months in Service (MIS) metric while conducting safety investigations. This metric states how many months a vehicle has been sold before having a warranty claim, VOQ, field report, or owner report alleging a defect. The chart below shows the percentage of subject vehicles produced in the spike period that have a responsive warranty claim and at how many MIS the vehicle was at the time of the warranty claim. The chart also shows the MIS of all subject vehicles produced in the spike period. The chart demonstrates that the vast majority of vehicles produced in the spike period allegedly experienced the alleged defect within the first 16 months of vehicle ownership (blue bars). The chart also shows that the overwhelming majority of all vehicles produced during the spike period have accumulated more MIS (orange bars) than when the alleged defect typically occurs. This suggests the majority of occurrences relating to intake valve stem fracture in these vehicles has already occurred.



A statistical analysis using a defective subpopulation model was used to project the failure probability of vehicles that were produced between May 1, 2021 and October 31, 2021.[1] As explained in further detail in the confidential file "EA23-002 Request 18 – Statistical Analysis," a defective subpopulation model recognizes that only the portion of units containing a specific defect can fail, while units without the defect do not fail. In contract, a typical reliability analysis assumes all units can fail due to a specific defect.

A defective subpopulation model may be a suitable model choice when the nonparametric data points appear to curve away from the cumulative probability axis. As seen in the figure below, the nonparametric data points related to this investigation indicate the defective subpopulation model is applicable to this study.

[1] Ford updates the statistical analysis on a routine basis and is only providing the most recent statistical analysis prepared in response to the expansion of the EA23-002 subject population..



The results of this analysis can be seen below and in more detail in the confidential file "EA23-002 Request 18 – Statistical Analysis." The defective subpopulation model projects that at ten years in service or at 150,000 miles, an estimated 0.8% of the vehicles produced from May 01, 2021 to October 31, 2021 will experience a fractured intake valve. The data source for the statistical analysis comes from the "Request 10 – Engine Engineering" file provided in the response to Request 10. This file contains analysis, through teardown or engineering judgment, of each Nano engine with a confirmed or suspected intake valve fracture and was used in order to provide the most accurate statistical analysis.

	Failure Probability	
Time/Mileage	Oct. 2023 Cutoff (May - Oct-31, 2021 Prod)	
	Estimate	95% UB
10YIS|150k	0.8%	0.9%

Vehicle Population	88,187
Repairs Used in Analysis	683

The overall rate of reports relating to fractured intake valve stems in the subject vehicles is 2 R/1000. The rate of reports for vehicles produced during the spike period is 8 R/1000. As discussed in Response 17, over half describe symptoms other than loss of mobility while the vehicle is in motion. Ford acknowledges that the condition has been a dissatisfier for our customers, with significant inconvenience for those who experience resultant engine failure on

a new Ford or Lincoln product. However, Ford believes that this does not present an unreasonable safety risk in the field at this time, as indicated by the current average MIS of the fleet and minimal expected failures. Engineering analysis and statistical review finds that most vehicles are not susceptible to this condition, and that issues, should they exist, would be expected to have occurred at low time in service. As evidenced by field data and case information, valve stem fracture in vehicles can result in a variety of symptoms other than engine stall while the vehicle is in motion, including engine no-start, warning lights without engine stall, or engine stall while the vehicle is not in motion. Ford will continue to actively monitor this subject through our internal investigation process and can keep the agency informed of our findings or new developments related to this investigation.