Request 14

Please provide responses to each of the follow items:

a. All risk-based evaluation tools used by Ford to make safety determinations regarding unexpected, unintended transmission downshifting and/or wheel lock-up, and Ford's criteria and process for evaluating whether unexpected, unintended transmission downshifting and/or wheel lock up is in fact a safety-related defect;
b. Ford's assessment of the cause and consequence of the failures reported in the VOQs regarding unexpected, unintended transmission downshifting and/or wheel lock-up;
c. Ford's decision-making criteria used in deciding to issue the subject recalls and the decision-making criteria used in selecting the remedies for the subject recalls;
d. Ford's assessment on the effectiveness of the remedies for the subject recalls;
e. A detailed description of Ford's molded lead frame suppliers' component quality improvements that have occurred with each supplier for MY 2011 Ford F-150 vehicle production through MY 2015 Ford F-150 vehicle production; and
f. A detailed summary outlining any differences that may exist between the subject recall remedies (specifically the Output Speed Sensor plausibility check), as well as the Output Speed Sensor plausibility check incorporated into MY 2015 Ford F-150 vehicle production.

Answer

Regarding all risk-based evaluation tools used by Ford, NHTSA did not provide a definition of "risk-based evaluation tools" 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. Based on previous ODI Information Request letters with similar questions, Ford believes the request is for an overview of Ford's safety investigation process. Ford is available for follow-up discussion of this topic. In general, issues such as unintended transmission downshifting are investigated and evaluated following Ford's Critical Concern Group (CCRG) and 14D processes, which are documented procedures. Analysis of warranty reports, field reports, owner reports, lawsuits, and legal claims through categorization helps evaluate the criticality of certain issues. 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 (FSA), including prior vehicle model years, and responses to NHTSA information requests from Ford and other manufacturers are reviewed to support evaluation.

For the VOQs with VIN numbers provided, any associated records available have been included in the Part 1 submission for this Information Request letter. In certain cases, Ford is unable to verify the causal factors for the incidents reported in the VOQs as there may not be any corresponding reports or parts analyzed. As described in Request 13, some vehicles may experience an intermittent loss of the transmission Output Shaft Speed (OSS) sensor signal to the Powertrain Control Module (PCM), potentially resulting in a temporary, unintended downshift into first gear. A predominant root cause for the intermittent OSS signal has not been identified outside of the original 16S19 (NHTSA Recall Number 16V-248) recall population. Depending on the vehicle speed at the time of an intermittent OSS failure, an abrupt transmission downshift to first gear could occur. A downshift to first gear without warning could result in a loss of vehicle control, increasing the risk of a crash.

As previously described in response to question 13(f), Ford reviewed the eighty-six (86) VOQs provided by NHTSA and found that thirty (30) claims were responsive to the A1 category, thirty-seven (37) claims were responsive to the A2 category, and six (6) claims were responsive to the B2 category. The thirteen (13) remaining VOQs were not considered responsive since either their symptoms did not match the focus of this investigation, or the root cause was related to a component(s) not included in the list of potential subject components.

Category	Definition
A1	Wheel Lock-Up due to Sudden (Unexpected) Downshift
A2	Sudden (Unexpected) Transmission Downshift
B1	Wheel Lock Up Unknown Cause
B2	Harsh Downshift and Other Downshifting Issues

Ford utilized its robust, established process and considered a variety of decision-making criteria, in addition to Agency guidance, when issuing subject recalls 19S07 and 19S19 with their associated remedies.

On January 16, 2018, NHTSA opened RQ17-010 to assess the scope and remedy effectiveness of 16S19. After its March 9, 2018, response, Ford reviewed this subject with NHTSA personnel on December 12, 2018, and discussed Ford's recommendations to address ongoing customer concerns. The subject was also reviewed with Transport Canada personnel on November 27, 2018. Based on feedback received during these conversations and in the weeks that followed, this issue was taken to Ford's Field Review Committee for review. On February 4, 2019, Ford's Field Review Committee reviewed the concern and approved Field Service Action 19S07. Ford expanded the original scope of 16S19 to cover model years 2011-2013 of Ford F-150 vehicles, although an attributable pattern to the cause of intermittent OSS signal loss in the population outside of 16S19 was not identified.

Ford's safety recall, Field Service Action 19S07, addressed the ongoing customer concerns at the time regarding scope and implemented the same service remedy used in 16S19. When NHTSA closed RQ17-010 on October 22, 2019, the closing resume further indicated that the remedy appeared to address the safety risks and the issue of remedy effectiveness was closed. As stated by the Agency in this Information Request letter, Ford Field Service Action 19S07 addressed the issue of unintended transmission downshifting, as well as the remedy and scope associated with the prior 16S19 action, in MY 2011-2013 Ford F-150 vehicles.

Ford issued safety recall 19S19 as the PCM software used to service 2013MY Ford F-150 5.0L and 6.2L vehicles in accordance with recall 19S07 did not have the updates necessary to prevent a potentially unintended downshift into first gear. The software issue with the 19S07 remedy was brought to the attention of Ford's Critical Concern Review Group on May 16, 2019. Ford's Field Review Committee reviewed the concern and approved Field Service Action 19S19 on June 3, 2019, to ensure that the 19S07 remedy functioned as intended.

Safety recalls 16S19, 19S07 and 19S19 were approved to install updated PCM software involving MY 2011 – 2013 Ford F-150 vehicles (among others) to prevent an unexpected downshift from 6th to 1st gear caused by an intermitted loss of the OSS signal. The remedy software adds an OSS plausibility check to also compare the ABS speed signal prior to

commanding a downshift into first gear. In the case of complete OSS signal loss, the PCM will still default to 5th gear operation if the vehicle is in 4/5/6th gears when the fault occurred, or 3rd gear operation if the vehicle is in 1/2/3rd gears.

As stated in the closure rational by the Agency for RQ17-010, the PCM remedy appeared to address the safety risks of concern to ODI and the issue of remedy effectiveness was closed. Ford has previously investigated other allegations of unexpected downshift from 6th to 1st gear on vehicles with the safety recall remedies, and have consistently found them to likely relate to the software functioning as intended and described above, and not an actual downshift from 6th to 1st gear. When analyzing VOQs for MY 2011 – 2013 Ford F-150 vehicles included in the subject recalls 19S07 and 19S19 received through April 08, 2024 (date of this Information Request letter), the overall rate of reports relating to wheel slip due to sudden downshift is 0.07 R/1000, compared to the overall rate of 0.24 R/1000 of the same population of vehicles at the time of the RQ17-010 Information Request.

A timeline of Ford's molded lead frame suppliers' component quality improvements that have occurred for MY 2011-2015 Ford F-150 vehicle production is provided below:

August 4, 2011: Potting material was changed from ES100 to Hysol E7038 to meet the design rule ban on Halides.

November 2011: Continental Juarez was having challenges with potting equipment downtime and Ford was requesting an increase in capacity. Continental's potting expert was sent to Juarez to evaluate the process and recommended a number of process improvements including First-In First-Out (FIFO) material handling, material storage and potting equipment cleaning.

December 1, 2011: As an improvement, the following actions were implemented:

Continental modified their OSS manufacturing line dispensing process cleaning to include the entire system (tanks, pipes, valves, etc.) and scheduled these tasks to occur weekly. The supplier electronic circuit board Failure Modes and Effects Analysis (FMEA) and maintenance system was updated. This action would avoid residues in the system that could obstruct the system or change the properties of the OSS epoxy. In addition, the OSS epoxy storage FIFO procedure was implemented at the supplier's warehouse to the plant and refrigerators were located in both locations to maintain correct material storage temperatures.

Continental did not know about the cracked solder at that time, but later learned the new potting material was sensitive to mix ratio, storage procedures, quantity of epoxy, filler content, oven profile temperature and solder dispensing equipment cleanliness.

January 2012: During warranty analysis on returned parts, a short circuit from power (PWR) to ground (GND) in the OSS circuit was identified. The short circuit was caused by an intermittent condition between the PWR lead of the OSS Hall IC device to the GND plane on the Printed Circuit Board (PCB) where it is mounted to. The following actions were implemented:

- Remove the ground plane from under the PWR and Output Hall pads on the OSS PCB. The change consisted of an increase of the distance between the PWR pad and the copper plane.

- Shorten length of the IC terminals to avoid contact with the ground plane on the PCB.

October 2012: During warranty analysis on returned parts, sensors with intermittent OSS related failure codes were declared No Trouble Found (NTF), the manufacturing date codes were from August 2011 to November 2011. After further analysis, the failure was isolated to a resistor on the OSS circuit board and x-ray teardowns identified solder joint cracks located on the OSS circuit board.

Continental containment actions to address solder cracks seen in some returned parts spanned from October 2012 to November 2013. The following actions were implemented:

- Certification of R1 electrical resistance at the PCB level.
- Inspection of resistor gap to PCB.
- PCB cross section to evaluate the condition and quality of solder joints under a microscope.
- Perform mechanical stress testing while monitoring OSS output.
- Resistance check after IC solder.

January 19, 2013: A pre-agitation process before transferring potting from the storage can to the dispensing tank was implemented. The intention was to avoid sedimentation on the bottom of the can that could change the potting properties.

February 15, 2013: Optimization of oven profile on the PCB room used on the 6R80 production line; the intention was to avoid the micro voids found on some of returned parts and improve the quality of the soldering process.

October 1, 2013: To further improve supplier quality related to the integrity of the solder joint, a change to the potting material on the AL3P-7G276-AG version of the lead frame was made.

February 2014: Add alignment features to mating connector to address bent pins.

March - November 2014: Capacity increase activities. New tooling and second production line.

There are two main PCM programming logics utilized to prevent the transmission from unintentionally downshifting to first gear in the event the OSS signal is lost. For cases of complete OSS signal loss, the PCM will set a fault code which results in 5th gear operation if the vehicle was in 4/5/6th gears when the fault occurred, or 3rd gear operation if the vehicle was in 1/2/3rd gears. This logic has been in place on Ford F-150 vehicles with 6R80 transmissions as design intent, and is therefore included in the subject model year 2014 Ford F-150 vehicles.

Secondly, an OSS plausibility check logic was developed as a robustness improvement, and introduced to prevent the transmission from unintentionally downshifting to first gear if the OSS signal intermittently drops out. The OSS plausibility check was added to the diagnostic controls strategy beginning with 2015 model year Ford F-150 vehicles with 6R80 transmissions. This software was later used as the service remedy for the PCM reflash updates of Ford recalls 16S19, 19S07 and 19S19. The new PCM software performs a secondary speed check utilizing the ABS speed signal prior to commanding a downshift into first gear and will illuminate the wrench light and set DTC code P0721 if an OSS failure is detected.

A copy of the design verification plan of the updated PCM logic, including the confirmation testing of the plausibility logic, is provided in the file "RQ24-005 Request 14 – Conf Bus Info – Design Verification Plan."[1]

In conclusion, as stated by the Agency in this Information Request letter, the issue of unintended transmission downshifting has been remedied through subject recalls 19S07 and 19S19 for MY 2011-2013 Ford F-150 vehicles. Ford's analysis of the alleged defect for the subject vehicles included analysis of warranty reports, field reports, owner reports, lawsuits, and legal claims for reports related to this Recall Query. These reports are occurring at a much lower rate than those vehicles previously recalled. Analysis of the reports continues to indicate that, for most reports, even those reporting wheel lock up, drivers were able to maintain vehicle control, safely stop the vehicle, and resume driving. Ford continues to evaluate reports related to this investigation and will keep the Agency apprised of our findings.

[1] The confidential business information provided by Ford in response to Request 14 is provided with a request for confidentiality in a separate file transfer to the agency's Office of the Chief Counsel pursuant to 49 CFR Part 512. Redacted copies of the confidential documents are also provided and are labeled "Public."