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November 19, 2009

Ms. Kathleen C. DeMeter, Director
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE, Room W45-302
Washington, DC 20590

Dear Ms. DeMeter:

Subject: PE09-046:NVS-212pco

The Ford Motor Company (Ford) response to the agency's September 29, 2009, letter concerning reports of alleged air bag wiring chafing/shorting condition resulting in the inadvertent deployment of the driver side frontal air bag in 2004 through 2006 model year Ford F-150 vehicles is attached.

Beginning in January, 2006, Ford conducted an extensive investigation into reports of un-commanded driver air bag deployments resulting from a squib jumper wire chafe that had been received on 2004 and 2005 model year Ford F-150 vehicles. Pictures relating to those reports indicated that the air bag squib jumper harness had chafed on the edge of the lower horn plate leading to a short to ground. Protective tape was added to the lower horn plate flange in vehicle production in January, 2006, to address the potential chafe condition and an extensive analysis was undertaken.

Engineering identified two possible conditions that could contribute to inadvertent driver air bag deployment. If a driver air bag squib wire comes in contact with the flange on the lower horn plate and the insulation becomes chafed, the exposed wire may experience an intermittent short to ground due to engine or road vibration. In this instance, the squib return jumper wire would not be in contact with the lower horn plate during ten successive squib circuit impedance and leakage tests. The squib return jumper wire would then contact the lower horn plate during the squib firing circuit driver test, which lasts for 65 to 115 μ seconds and could produce a short-circuit. Another condition may exist if an air bag squib jumper wire were to chafe resulting in exposed copper wire, there would be the potential for a thin oxidation film layer to form on the exposed copper over time. Under the low electrical potentials used during squib circuit impedance or the squib circuit leakage tests, such oxidation film might act as an insulation barrier between the air bag squib circuit and ground and could prevent current flow from the wire to the horn plate. If this were to occur, system diagnostics may not detect the short-circuit on the squib return jumper wire and could proceed to the squib firing circuit driver tests. The higher electrical potentials used during the squib firing circuit driver test could possibly overcome the resistance provided by the oxidation film resulting in a short-circuit condition. If this were to occur, sufficient current could flow through one of the air bag igniters, potentially resulting in an un-commanded driver air bag deployment. Analysis found that the restraint system would still command the driver air bag to



deploy in the event of a crash even if a DTC fault code were present and the air bag squib jumper harness had chafed and shorted to ground on the lower horn plate.

During Ford's investigation that concluded in June, 2006, a search of Ford's data systems identified 21 allegations of un-commanded driver air bag deployment in 2004 and 2005 model year F-150 vehicles. Ford conducted inspections on customer vehicles associated with un-commanded driver air bag deployment allegations and observed that the driver air bag squib jumper had chafed on the lower horn plate. Two field audits were conducted on F-150 fleets to assess the propensity for the jumper wire to contact, chafe, and short on the lower horn plate. One vehicle out of 124 that were inspected was found to have a squib jumper wire chafe to bare copper wire.

Engineering also inspected a total of ten vehicles associated with un-commanded driver air bag deployment allegations. Wiring, restraints, and electrical components were inspected on each of these vehicles and no damage was observed with the exception that the squib jumper wire insulation was found to have chafed on the lower horn plate. Data from the restraint control modules (RCM) were downloaded and showed that the air bag warning light had been illuminated for at least 256 key-on cycles before the un-commanded deployment on eight vehicles, while the other two had a significant number of key-on cycles before the un-commanded deployment. The audit also concluded that, while squib jumper wire contact with the lower horn plate could occur, a unique orientation of the leads is necessary to cause contact with the edge of the horn plate resulting in chafing through the insulation to copper wire.

Following extensive analysis, Ford closed its investigation, based on the fact that the rate of reports was low, that the air bag indicator lamp would illuminate alerting the driver that the vehicle need to be serviced, that the incidents predominantly occurred during system diagnostic check which is typically completed within two seconds at vehicle start-up, and that the system would still command the frontal air bags to deploy if required in a crash.

Ford's review of the reports responsive to the agency's request indentified 74 incidents involving an allegation of un-commanded driver air bag deployment attributable to squib jumper wire chafing. This equates to an extremely low rate of approximately 0.056 R/1000 on subject vehicles that were produced prior to implementation of the interim fix in January, 2006. Even including reports of an un-commanded driver air bag deployment where the cause is unknown, the incident rate is still very low at only 0.17 R/1000, though, it is possible that these ambiguous reports do not relate to this subject.

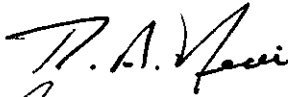
Ford believes that un-commanded deployment resulting from this condition is most likely to occur immediately upon vehicle start-up and not while being driven. An analysis of reports attributable to the condition identified only one "accident" involving an un-commanded river air bag deployment. In the report, the customer stated she abandoned the vehicle with the engine running and in reverse after the air bag deployed. Ford believes this behavior is not typical of customers that have experienced this issue.

Most importantly, if an air bag system malfunction is detected during vehicle diagnostics, the air bag warning lamp indicates to the driver, as it is designed to do, that the system diagnostics has detected an issue and they should bring their vehicle in for service. Each of the vehicles or RCMs inspected that were involved in un-commanded deployments were found

to have illuminated air bag warning lamps for a significant number, even hundreds, of key-on cycles prior to deployment. Ford believes that consideration of all these factors supports a conclusion that this condition does not present an unreasonable risk to safety in these vehicles.

If you have any questions concerning this response, please feel free to contact me.

Sincerely,



James P. Vondale

Attachment

FORD MOTOR COMPANY (FORD) RESPONSE TO PE09-046

Ford's response to this Preliminary Evaluation information request was prepared pursuant to a diligent search for the information requested. While we have employed our best efforts to provide responsive information, the breadth of the agency's request and the requirement that information be provided on an expedited basis make this a difficult task. We nevertheless have made substantial effort to provide thorough and accurate information, and we would be pleased to meet with agency personnel to discuss any aspect of this Preliminary Evaluation.

The scope of Ford's investigation conducted to locate responsive information focused on Ford employees most likely to be knowledgeable about the subject matter of this inquiry and on review of Ford files in which responsive information ordinarily would be expected to be found and to which Ford ordinarily would refer. Ford notes that although electronic information was included within the scope of its search, Ford has not attempted to retrieve from computer storage electronic files that were overwritten or deleted. As the agency is aware, such files generally are unavailable to the computer user even if they still exist and are retrievable through expert means. To the extent that the agency's definition of Ford includes suppliers, contractors, and affiliated enterprises for which Ford does not exercise day-to-day operational control, we note that information belonging to such entities ordinarily is not in Ford's possession, custody, or control.

Ford has construed this request as pertaining to vehicles manufactured for sale in the United States, its protectorates, and territories.

Ford notes that some of the information being produced pursuant to this inquiry may contain personal information such as customer names, addresses, telephone numbers, and complete Vehicle Identification Numbers (VINs). Ford is producing such personal information in an unredacted form to facilitate the agency's investigation with the understanding that the agency will not make such personal information available to the public under FOIA Exemption 6, 5 U.S.C. 552(b)(6).

Answers to your specific questions are set forth below. As requested, after each numeric designation, we have set forth verbatim the request for information, followed by our response. Unless otherwise stated, Ford has undertaken to provide responsive documents dated up to and including September 29, 2009, the date of your inquiry. Ford has searched within the following offices for responsive documents: Sustainability, Environment and Safety Engineering, Ford Customer Service Division, Marketing and Sales Operations, Global Core Engineering, Office of the General Counsel, Vehicle Operations, Global Product Development.

In its information request, the agency has defined the subject vehicles as "all MY 2004-2006 F150 Series vehicles and all other MY F150 Series vehicles equipped with the same MY2005 F150 air bag/horn assembly mounting bracket." Ford introduced a Lincoln Mark LT in the 2006 model year that uses an air bag/horn assembly mounting bracket that is substantially similar to that used on the F-150. Ford has interpreted the subject vehicle population to only include F-150 series vehicles and not Lincoln vehicles, as defined by the agency and has responded to the agency's requests accordingly. We will provide information for the Mark LT if the agency desires.

Request 1

State within the body of the response letter a summary, by model and model year, the number of subject vehicles Ford has manufactured for sale or lease in the United States. Separately, for each subject vehicle manufactured to date by Ford, state the following:

- a. Vehicle identification number (VIN);
- b. Make;
- c. Model;
- d. Model Year;
- e. Date of manufacture (in "yyyy/mm/dd" date format);
- f. Date warranty coverage commenced (in "yyyy/mm/dd" date format); and
- g. The State in the United States where the vehicle was originally sold or leased (or delivered for sale or lease).

Provide the detailed information in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA."

Answer

Ford records indicate that the approximate total number of 2004 through 2006 model year F-150 vehicles sold in the United States (the 50 states and the District of Columbia), protectorates, and territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and Virgin Islands) is 1,563,098.

The number of subject vehicles sold in the United States by model and model year is shown below:

Model	2004 MY	2005 MY	2006 MY
Ford F-150	529,594	528,021	505,483

The requested data for each subject vehicle is provided in Appendix A.

Request 2

State within the body of the response letter, the number of each of the following, received by Ford, or of which Ford are otherwise aware, which relate to, or may relate to, the alleged defect in the subject vehicles:

- a. Consumer complaints, including those from fleet operators;
- b. Field reports, including dealer field reports;
- c. Reports involving a fire, crash, injury, or fatality, based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in a subject vehicle, property damage claims, consumer complaints, or field reports;
- d. Property damage claims;
- e. Third-party arbitration proceedings where Ford is or was a party to the arbitration; and
- f. Lawsuits, both pending and closed, in which Ford is or was a defendant or codefendant.

For subparts "a" through "d," state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same vehicle are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are to be counted as a crash report, a field report and a consumer complaint).

In addition, for items "c" through "f," provide a summary description of the alleged problem and causal and contributing factors and Ford's assessment of the problem, with a summary of the significant underlying facts and evidence. For items "e" and "f," identify the parties to the action, as well as the caption, court, docket number, and date on which the complaint or other document initiating the action was filed.

Answer

For purposes of identifying reports of incidents that may be related to the alleged defect and any related documents, Ford has gathered "owner reports" and "field reports" maintained by Ford Customer Service Division (FCSD), and claim and lawsuit information maintained by Ford's Office of the General Counsel (OGC).

Descriptions of the FCSD owner and field report systems and the criteria used to search each of these are provided in Appendix B.

The following categorizations were used in the review of reports located in each of these searches:

Category	Allegation
A1	Clockspring wiring chafe/short condition resulting in an inadvertent driver frontal air bag deployment
A2	Clockspring wiring chafe/short condition resulting in an illumination of the air bag warning lamp
B1	Inadvertent driver frontal air bag deployment, cause not specified
B2	Air bag warning light illuminated, ambiguous cause
B3	Air bag warning light illuminated, clockspring replaced, cause not specified

We are providing electronic copies of reports categorized as "B" as "non-specific allegations" for your review because of the broad scope of the request. Based on our engineering judgment, the information in these reports is insufficient to support a determination that they pertain to the alleged defect.

Owner Reports: Records identified in a search of the Master Owner Relations Systems (MORS) database, as described in Appendix B, were reviewed for relevance and sorted in accordance with the categories described above. The number and copies of relevant owner reports identified in this search that may relate to the agency's investigation are provided in the MORS III portion of the database contained in Appendix C. The categorization of each report is identified in the "Category" field.

When we were able to identify that responsive (i.e., not ambiguous) duplicate owner reports for an alleged incident were received, each of these duplicate reports was marked accordingly, and the group counted as one report.

Legal Contacts: Ford is providing, in Appendix B, a description of Legal Contacts and the activity that is responsible for this information. To the extent that responsive (i.e., not ambiguous) owner reports indicate that they are Legal Contacts, Ford has gathered the related files from the Office of General Counsel (OGC). Non-privileged documents for files that were located that are related to the responsive owner reports are provided in Appendix D.

Field Reports: Records identified in a search of the Common Quality Indicator System (CQIS) database, as described in Appendix B, were reviewed for relevance and sorted in accordance with the categories described above. The number and copies of relevant field reports identified in this search that may relate to the agency's investigation are provided in the CQIS portion of the database contained in Appendix C. The categorization of each report is identified in the "Category" field.

When we were able to identify that responsive duplicate field reports for an alleged incident were received, each of these duplicate reports was marked accordingly, and the group counted as one report. In other cases, certain vehicles may have experienced more than one incident and have more than one report associated with their VINs. These reports have been counted separately. In addition, field reports that are duplicative of owner reports are provided in Appendix C but are not included in the field report count.

VOQ Data: This information request had an attachment that included eight Vehicle Owner Questionnaires (VOQs), two of which were duplicative. Ford made inquiries of its MORS database for customer contacts, and its CQIS database for field reports regarding the vehicles identified on the VOQs. Ford notes that in some instances where the VOQ does not contain the VIN or the owner's last name and zip code, it is not possible to query the databases for owner and field reports specifically corresponding to the VOQs. Any reports located on a vehicle identified in the VOQs related to the alleged defect are included in the MORS and CQIS portions of the database provided in Appendix C and have been identified by a "Y" in the "VOQ Dup" field.

Crash/Injury Incident Claims: For purposes of identifying allegations of accidents or injuries that may have resulted from the alleged defect, Ford has reviewed responsive owner and field reports, and lawsuits and claims. A chart identifying potentially relevant allegations is being provided in Appendix G. Copies of reports corresponding to these alleged incidents are provided in the MORS, CQIS, and Analytical Warranty System (AWS) portions of the database provided in Appendix C.

Claims, Lawsuits, and Arbitrations: For purposes of identifying incidents that may relate to the alleged defect, Ford has gathered claim and lawsuit information maintained by Ford's OGC. Ford's OGC is responsible for handling product liability lawsuits, claims, and consumer breach of warranty lawsuits and arbitrations against the Company. Lawsuits and claims gathered in this manner were reviewed for relevance and sorted in accordance with the categories described above.

We are providing the requested detailed information, where available, on the responsive and ambiguous lawsuits and claims in our Log of Lawsuits and Claims, as Appendix E1. The number of relevant lawsuits and claims identified is also provided in this log. To the extent available, copies of complaints, first notices, or MORS reports relating to matters shown on the log are provided. With regard to these lawsuits and claims, Ford has not undertaken to contact outside law firms to obtain additional documentation. Ford notes that it was unable to

locate six claim files and, therefore, is unable to determine if the cases are related to the alleged defect.

Request 3

Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 2, state the following information:

- a. Ford's file number or other identifier used;
- b. The category of the item, as identified in Request No. 2 (i.e., consumer complaint, field report, etc.);
- c. Vehicle owner or fleet name (and fleet contact person), address, and telephone number;
- d. Vehicle's VIN;
- e. Vehicle's make, model and model year;
- f. Vehicle's mileage at time of incident;
- g. Incident date (in "yyyy/mm/dd" date format);
- h. Report or claim date (in "yyyy/mm/dd" date format);
- i. Whether a fire or crash is alleged;
- j. Whether property damage is alleged;
- k. Number of alleged injuries, if any; and
- l. Number of alleged fatalities, if any.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "REQUEST NUMBER TWO DATA."

Answer

Ford is providing owner and field reports in the database contained in Appendix C in response to Request 2. To the extent information sought in Request 3 is available for owner and field reports, it is provided in the database. To the extent information sought in Request 3 is available for lawsuits and claims, it is provided in the Log of Lawsuits and Claims as Appendix E.

Request 4

Produce copies of all documents related to each item within the scope of Request No. 2. Organize the documents separately by category (i.e., consumer complaints, field reports, etc.) and describe the method Ford used for organizing the documents.

Answer

Ford is providing owner and field reports in the database contained in Appendix C in response to Request 2. Copies of complaints, first notices, or MORS reports relating to matters shown on the Log of Lawsuits and Claims as Appendix E1 are provided in Appendix E2. To the extent information sought in Request 4 is available, it is provided in the referenced appendices.

Request 5

State within the body of the response letter a summary, by model and model year, a total count for all of the following categories of claims, collectively, that

have been paid by Ford to date that relate to, or may relate to, the alleged defect in the subject vehicles: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign.

Separately, for each such claim, state the following information:

- a. Ford's claim number;
- b. Vehicle owner or fleet name (and fleet contact person) and telephone number;
- c. VIN;
- d. Repair date (in "yyyy/mm/dd" date format);
- e. Vehicle mileage at time of repair;
- f. Repairing dealer's or facility's name, telephone number, city and state or ZIP code;
- g. Labor operation number;
- h. Problem code;
- i. Replacement part number(s) and description(s);
- j. Concern stated by customer; and
- k. Comment, if any, by dealer/technician relating to claim and/or repair; and
- l. Type of claim/issue (Air bag light illumination or inadvertent deployment if not readily identifiable from the repair code or the part replacement fields).

Provide this information in Microsoft Access 2000, or a compatible format, entitled "WARRANTY DATA."

Answer

Records identified in a search of the AWS database, as described in Appendix B, were reviewed for relevance and sorted in accordance with the categories described in the response to Request 2. The number and copies of relevant warranty claims identified in this search that may relate to the agency's investigation are provided in the AWS portion of the database contained in Appendix C. The categorization of each report is identified in the "Category" field.

When we were able to identify that duplicate claims for an alleged incident were received, each of these duplicate claims was marked accordingly and the group counted as one report. In other cases, certain vehicles may have experienced more than one incident and have more than one claim associated with their VINs. These claims have been counted separately. Warranty claims that are duplicative of owner and field reports are provided in Appendix C but are not included in the report count above.

Requests for "goodwill, field, or zone adjustments" received by Ford to date that relate to the alleged defect that were not honored, if any, would be included in the MORS reports identified above in response to Request 2. Such claims that were honored are included in the warranty data provided.

Ford assumes that providing the warranty claims in the electronic database format meets the requirements of this request because the agency can review or order the claims as desired.

Request 6

Describe in detail the search criteria used by Ford to identify the claims identified in response to Request 5, including the labor operations, problem codes, part numbers and any other pertinent parameters used. Provide a list of all labor operations, labor operation descriptions, problem codes, and problem code descriptions applicable to the alleged defect in the subject vehicles. State, by make and model year, the terms of the new vehicle warranty coverage offered by Ford on the subject vehicles (i.e., the number of months and mileage for which coverage is provided and the vehicle systems that are covered). Describe any extended warranty coverage option(s) that Ford offered for the subject vehicles and state by option, model, and model year, the number of vehicles that are covered under each such extended warranty.

Answer

Detailed descriptions of the search criteria, including all pertinent parameters, used to identify the claims provided in response to Request 5 are described in Appendix B.

For 2004 through 2006 model year Ford F-150 vehicles, the New Vehicle Limited Warranty, Bumper-to-Bumper Coverage begins at the warranty start date and lasts for three years or 36,000 miles, whichever occurs first. Under the New Vehicle Limited Warranty, Safety Restraint Coverage for Ford and Lincoln products begins at the warranty start date and lasts for five years or 50,000 miles, whichever occurs first.

Optional Extended Service Plans (ESPs) are available to cover various vehicle systems, time in service, and mileage increments. The details of the various plans are provided in Appendix F. As of the date of the information request, 183,566 new vehicle ESP policies covering the driver air bag assembly and 17,701 new vehicle ESP policies covering the clockspring assembly had been purchased on 2004 through 2006 model year Ford F-150 vehicles.

Request 7

Produce copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject vehicles, that Ford has issued to any dealers, regional or zone offices, field offices, fleet purchasers, or other entities. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that Ford is planning to issue within the next 120 days.

Answer

For purposes of identifying communications to dealers, zone offices, or field offices pertaining, at least in part, to air bag wiring chafing/shorting condition resulting in the inadvertent deployment of the driver side frontal air bag and/or the illumination of the air bag warning lamp, Ford has reviewed the following FCSD databases and files: The On-Line Automotive Service Information System (OASIS) containing Technical Service Bulletins (TSBs) and Special Service Messages (SSMs); Internal Service Messages (ISMs) contained in CQIS; and Field Review Committee (FRC) files. We assume this request does not seek information related to electronic communications between Ford and its dealers regarding the order,

delivery, or payment for replacement parts, so we have not included these kinds of information in our answer.

A description of Ford's OASIS messages, ISMs, and the Field Review Committee files and the search criteria used are provided in Appendix B.

OASIS Messages: Ford has identified no SSMS and no TSBs that may relate to the alleged defect in the subject vehicles.

Internal Service Messages: Ford has identified one ISM concerning replacement of the clockspring and is providing a copy in Appendix G.

Field Review Committee: Ford has identified no field service action communications that may relate to the alleged defect.

Ford is not aware of any forthcoming communications related to the alleged defect in the subject vehicles.

Request 8

Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, Ford. For each such action, provide the following information:

- a. Action title or identifier;
- b. The actual or planned start date;
- c. The actual or expected end date;
- d. Brief summary of the subject and objective of the action;
- e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and
- f. A brief summary of the findings and/or conclusions resulting from the action.

For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.

Answer

Ford is construing this request broadly and is providing not only studies, surveys, and investigations related to the alleged defect, but also notes, correspondence, and other communications that were located pursuant to a diligent search for the requested information. Ford is providing the responsive non-confidential Ford documentation in Appendix H.

To the extent that the information requested is available, it is included in the documents provided. If the agency should have questions concerning any of the documents, please advise.

Ford is submitting additional responsive documentation in Appendix I with a request for confidentiality under separate cover to the agency's Office of the Chief Counsel pursuant to 49 CFR, Part 512.

A table summarizing responsive documents containing privileged information are provided in Appendix J.

In the interest of ensuring a timely and meaningful submission, Ford is not producing non-responsive materials or items containing little substantive information. Examples of the types of materials not being produced are meeting notices, raw data lists (such as part numbers or VINs) without any analytical content, duplicate copies, non-responsive elements of responsive materials, and draft electronic files for which later versions of the materials are being submitted. Through this method, Ford is seeking to provide the agency with substantive responsive materials in our possession in the timing set forth for our response. We believe our response meets this goal. Should the agency request additional materials, Ford will cooperate with the request.

Request 9

State within the body of the response letter, describe all modifications or changes made by, or on behalf of, Ford in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:

- a. The date or approximate date on which the modification or change was incorporated into vehicle production;
- b. A detailed description of the modification or change;
- c. The reason(s) for the modification or change;
- d. The part number(s) (service and engineering) of the original component;
- e. The part number(s) (service and engineering) of the modified component;
- f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
- g. When the modified component was made available as a service component; and
- h. Whether the modified component can be interchanged with earlier production components.

Also, provide the above information for any modification or change that Ford is aware of which may be incorporated into vehicle production within the next 120 days.

Answer

A table of the requested changes is provided in Appendix K. Ford is not aware of any forthcoming modifications related to the subject components in the subject vehicles.

Request 10

Provide an overall functional and electrical diagrams illustrating and describing the operation and relation of the driver side frontal air bag, horn assembly and the clockspring assembly during vehicle steering operation and horn usage. Also describe how air bag wiring chafing near the air bag/horn assembly mounting bracket can cause the driver side air bag to deploy. Where are the sources of positive 12V/BATT power within the confine of the air bag/horn mounting bracket? Describe the DTC fault codes

that are generated as a result of the alleged defect and the impact on air bag system operation.

Answer

Overall functional and electrical diagrams illustrating operation of the driver side frontal air bag and clockspring assembly are provided in Appendix L.

The Restraint Control Module (RCM) utilized on the 2004 through 2006 model year Ford F-150 vehicles is derived from the ARM 400 series of modules currently produced by Autoliv, Inc. A technical description of the RCM diagnostic logic is provided in Confidential Appendix I (Supplier Documents – Bates Numbers: 0246-0253) for its predecessor the ARM 300 series module, which is consistent with the diagnostic logic in the subsequent 400 series module. Additional information pertaining to the overall function and operation of the RCM, driver air bag assembly, and clockspring is provided in Ford's response to Request 13.

Ford has identified two sources of battery power within the confines of the air bag/horn mounting bracket. The driver air bag squib jumper wires can supply battery power during system diagnostic test when the squib firing circuit driver test temporarily energizes each half of the inflator circuit. Also, during a crash, the RCM energizes the squib firing circuits for a commanded deployment, battery voltage is applied. The upper horn plate is supplied with battery power, while the electronically insulated lower horn plate is connected to ground. If the electrical system experiences a loss of ground, various other electrical components could potentially feedback battery power to the upper or lower horn plates.

Diagnostic Troubleshooting Codes are provided in Appendix N. In the event the system diagnostics detects a fault with the driver air bag circuit, a DTC 2293 code is set and an air bag warning lamp is illuminated to inform the customer to have their vehicle serviced. The diagnostic software will continue to evaluate driver air bag squib circuit impedance and leakage until the system meets criteria or key-off. Even if the system detects a fault, the RCM will execute deployment signals to the supplemental restraint system.

Request 11

Produce one each of the following:

- a. Exemplar sample of each design version of the subject components (all driver side frontal air bag modules shall be deployed) from the subject vehicle;
- b. Field return sample of the MY2005 F150 subject components (the driver side frontal air bag modules shall be deployed) exhibiting the subject failure mode; and;
- c. Any kits that have been released, or developed, by Ford for use in service repairs to the subject component/assembly which relate, or may relate, to the alleged defect in the subject vehicles.

Answer

Ford is providing the following parts to comply with the agency's request:

- Driver Air Bag Module - P/N 7L34-15043B13-CB32NC
2007 MY Production Part
- Clockspring Assembly - P/N 8L3T-14A664-AA
2008 MY Production Part

- Clockspring Assembly (squib jumper wire) - P/N 4L2T-14A664-AA
2004 MY production part referenced in the CQIS portion of Appendix C
(CQIS #: 6APB2177).
- Driver Air Bag Module - P/N 4L34-15043B13-BF33TC
2004 MY production part referenced in the CQIS portion of Appendix C
(CQIS #: 6AMEN001).

No kits have been developed or released for use in service repairs that relate to this request. At the time of this response, Ford has not been able to locate any field return parts that have interim containment action modifications.

Request 12

State the number of each of the following that Ford has sold that may be used in the subject vehicles by component name, part number (both service and engineering/production), model and model year of the vehicle in which it is used and month/year of the sale (including the cut-off date for sales, if applicable).

- a. Subject component; and
- b. Any kits that have been released, or developed, by Ford for use in service repairs to the subject component/assembly.

Answer

As the agency is aware, Ford service parts are sold in the U.S. to authorized Ford and Lincoln-Mercury dealers. Ford has no means to determine how many of the parts were actually installed on vehicles, the vehicle model or model year on which a particular part was installed, the reason for any given installation, or the purchaser's intended use of the components sold.

Ford is providing the total number of Ford service replacement driver air bag and clockspring assemblies by part number (both service and engineering) and year of sale, where available, in Appendix O. Information pertaining to production and service usage for each part number, and supplier point of contact information, is included in Appendix O.

Request 13

Furnish Ford's assessment of the alleged defect in the subject vehicle, including:

- a. The causal or contributory factor(s);
- b. The failure mechanism(s);
- c. The failure mode(s);
- d. The risk to motor vehicle safety that it poses;
- e. What warnings, if any, the operator would have that the alleged defect was occurring or subject component was malfunctioning; and
- f. The reports included with this inquiry.

Answer

Overview - Restraint Control Module (RCM) Diagnostics Procedure

When a key-on cycle is initiated, the RCM conducts a diagnostic routine to evaluate the condition of various components of the restraint system, including: front crash severity sensors, occupant classification system, passenger air bag On/Off indicator light, restraint usage sensors, pyrotechnic pretensioning buckles, and the driver and passenger frontal air bags. The air bag warning lamp is illuminated while the RCM runs system diagnostic tests, which typically takes two seconds, and then turns off if no malfunction is detected. In the event that a malfunction is detected, the air bag warning lamp will stay illuminated to alert an operator that the vehicle needs to be serviced.

The driver frontal air bag portion of the diagnostic routine includes a series of tests to evaluate the electrical operating condition of the driver air bag components including: the squib circuit impedance, squib circuit leakage, and squib firing circuit driver. First, the diagnostic software evaluates the impedance for each of the driver air bag circuits. Impedance below the acceptable range might result from a short-circuit in the air bag igniter. Impedance above the acceptable range might result from an open in the driver air bag circuit. Second, the diagnostic software performs a squib circuit leak test to check for a potential driver air bag squib short-circuit to battery or short-circuit to ground. The squib circuit impedance and squib circuit leakage tests must be successfully completed ten consecutive times so that the system can identify intermittent system issues. If the squib circuit impedance and squib circuit leakage tests do not detect a fault, the RCM will then perform a squib firing circuit test which isolates each half of the air bag squib circuit and applies a voltage across the circuit in order to validate its firing capability. This squib firing circuit test is only performed once during a key-on cycle. Once the firing capability is confirmed, system diagnostics continue to monitor intermittent squib circuit impedance and leakage faults until key-off.

If a fault is detected either on the squib circuit impedance test or the squib circuit leakage test, a diagnostic troubleshooting code (DTC) is recorded in the RCM, the air bag warning lamp is illuminated, and the RCM will not perform the squib firing circuit driver test. The RCM will continue to perform the squib circuit impedance and the squib circuit leakage tests until either ten successive tests that meet criteria are achieved or the customer turns off the ignition. If ten successive tests that meet the criteria are completed, system diagnostics will then perform the squib firing circuit driver test. This diagnostic procedure still allows for system functionality even in the event an intermittent fault is detected at key-on.

Overview – Driver Air Bag Assembly

The 2004 through 2006 model year Ford F-150 vehicles combine the supplemental restraint system and horn switch functions in one driver air bag assembly. The air bag is attached to a horn plate assembly consisting of the upper and lower horn plates and springs. The upper horn plate is supplied with battery voltage while the lower horn plate provides physical attachments to the steering wheels and is attached to vehicle ground. The two plates are separated by electrically insulated springs. To activate the horn, the driver pushes the center of the steering wheel causing the upper and lower horn plate to contact, completing the horn circuit.

Overview - Clockspring Assembly

The clockspring assembly acts as an electrical bridge from a stationary wire harness mounted on the steering column assembly to the electrical components contained within the rotating steering wheel. The assembly consists of two components that carry electrical circuits. A flex cable, internal to the clockspring case, carries all of the circuits found on the steering wheel including: first and second stage inflator squibs, horn, speed control, radio, and climate control functions. The flex cable is wound around the steering column shaft and has the capability to rotate from a full lock left turn to a full lock right turn. Two jumper wire harnesses attach to the driver air bag assembly on the rear face of the clockspring. One harness carries the wires for the first and second stage driver air bag inflators and the other carries the wires for the horn switch. The jumper harnesses allow the air bag electrical connections to be made before the air bag assembly is attached to the steering wheel during vehicle assembly.

2006 Investigation by Ford

In January, 2006, Ford engineering received and analyzed two reports alleging un-commanded driver air bag deployments on F-150 vehicles. Pictures relating to those reports indicated that the air bag squib jumper harness had chafed on the edge of the lower horn plate, potentially leading to a short to ground. Protective tape was immediately added to the lower horn plate flange in vehicle production to address this potential chafe condition, and an extensive analysis was undertaken.

Engineering review found that if the driver air bag squib jumper wire insulation were to chafe resulting in bare copper wire contact with the grounded horn plate, as was observed on the two F-150 vehicles, the RCM would detect a short-circuit condition during squib circuit leakage tests and set a corresponding DTC. The air bag warning lamp would also be illuminated. The RCM would not proceed to the squib firing circuit driver test, but would rather continue to perform the squib circuit impedance and squib circuit leakage tests until either ten successive tests that met criteria were achieved or the customer turned off the ignition, as previously described.

During its investigation in 2006, engineering identified two possible conditions that could contribute to inadvertent driver air bag deployment. If a driver air bag squib wire comes in contact with the flange on the lower horn plate and the insulation becomes chafed, the exposed wire may experience an intermittent short to ground due to engine or road vibration. In this instance, the squib return jumper wire would not be in contact with the lower horn plate during ten successive squib circuit impedance and leakage tests. The squib return jumper wire would then contact the lower horn plate during the squib firing circuit driver test, which lasts for 65 to 115 μ seconds and could produce a short-circuit. Another condition may exist if an air bag squib jumper wire were to chafe resulting in exposed copper wire. In that instance, there would be the potential for a thin oxidation film layer to form on the exposed copper over time. Under the low electrical potentials used during squib circuit impedance or the squib circuit leakage tests, such oxidation film might act as an insulation barrier between the air bag squib circuit and ground and could prevent current flow from the wire to the horn plate. If this were to occur, system diagnostics may not detect the short-circuit on the squib return jumper wire and could proceed to the squib firing circuit driver tests. The higher electrical potentials used during the squib firing circuit driver test could possibly overcome the resistance provided by the oxidation film resulting in a short-circuit condition. If this were to occur, sufficient current could flow through one of the air bag igniters, potentially resulting in an un-commanded driver air bag deployment. Analysis found that the restraint system would still

command the driver air bag to deploy in the event of a crash even if a DTC fault code were present and the air bag squib jumper harness had chafed and shorted to ground on the lower horn plate.

During Ford's investigation that concluded in June, 2006, a search of Ford's data systems identified 21 allegations of un-commanded driver air bag deployment in 2004 and 2005 model year F-150 vehicles. Engineering examined seven RCMs from vehicles associated with these allegations and found the air bag warning lamp had been illuminated for at least 256 key-on cycles (the maximum number stored by the RCM) prior to deployment on six of the vehicles, while the other vehicle had 46 key-on cycles with the air bag warning lamp illuminated prior to deployment.

Engineering also inspected three vehicles associated with un-commanded driver air bag deployment allegations. Wiring, restraints, and electrical components were inspected on each of these vehicles and no damage was observed with the exception that the squib jumper wire insulation was found to have chafed on the lower horn plate. Again, data from the RCMs indicated that the air bag warning lamp had been illuminated for a significant number of key-on cycles on each vehicle prior to deployment, with two vehicles having at least 256 key-on cycles with an illuminated lamp. This was confirmed by statements from the vehicle owners.

Ford also conducted field audits at that time on two fleets to assess the propensity for the jumper harness to contact, chafe, and short on the lower horn plate in these vehicles. One vehicle out of 124 that were inspected was found to have a squib jumper wire chafe to bare copper wire. The RCM data was downloaded and showed that the air bag warning light had been illuminated on this vehicle for at least 256 key-on cycles. This vehicle had not experienced an un-commanded deployment. The audit concluded that, while squib jumper wire contact with the horn plate can occur, a unique orientation of the leads is necessary to cause contact with the edge of the horn plate resulting in chafing through the insulation to copper wire.

Few of the reports identified during that investigation alleged an un-commanded deployment while driving. Ford evaluated the potential for a deployment while driving due to this issue and determined that a very unique set of circumstances would be required. First, the system diagnostic check must detect an intermittent fault, in which case, the software will continue to run the squib circuit impedance and leakage tests as the customer pulls away from a parked position. Second, the exposed squib return wire must not be in contact with the lower horn plate long enough for system diagnostics to complete ten successive impedance and leakage tests allowing the diagnostic software to proceed to the squib firing circuit test. Third, the exposed portion of the return squib wire must then short to ground immediately following completion of the impedance and leakage tests at the same time the squib circuit driver test is being performed, which lasts for 65 to 115 μ seconds. In this case, the amount and time duration of the energy supplied to the igniter would be sufficient to deploy the driver air bag. This extremely variable and unique sequence of events explains the low number of incidents alleged to have occurred while driving.

Following extensive analysis, Ford closed its investigation in June, 2006, based on the fact that the rate of reports was low, that the air bag indicator lamp would illuminate alerting the driver that the vehicle need to be serviced, that the incidents predominantly occurred during system diagnostic check which is typically completed within two seconds at vehicle start-up, and that the system would still command the frontal air bags to deploy if required in a crash. Those factors remain unchanged.

Analysis of Reports

Ford's review of the reports responsive to the agency's request identified 74 incidents involving an allegation of un-commanded driver air bag deployment attributable to squib jumper wire chafing. This equates to an extremely low rate of approximately 0.056 R/1000 on subject vehicles that were produced prior to implementation of the interim fix in January, 2006. Even including reports of an un-commanded driver air bag deployment where the cause is unknown (category B1), the incident rate is still very low at only 0.17 R/1000, though, it is possible that these ambiguous reports do not relate to this subject. As the agency is aware, air bags can also deploy inadvertently for other reasons, such as miss-installed aftermarket electronic devices that compromise the air bag circuit, damaged body wiring harnesses, or isolated RCM internal faults, for example.

The majority of reports involve deployment upon vehicle start-up; very few involve deployment while driving. As described earlier, un-commanded driver air bag deployment resulting from a chafed squib return wire is most likely to occur during system diagnostics within the first two seconds after key-on. Of the 74 reports responsive to the agency's request, only nine give any indication that the incident occurred, or may have occurred, while driving. Of those, two incidents were reported to have occurred in a parking lot, one in an intersection, and one on an interstate. Five provide no clarifying information whatsoever, and some of these could simply be characterized as "while driving" simply because the vehicle had already been started.

Ford identified one report that is ambiguous whether it relates to this subject [MORS: Case # 639982248, VOQ: ODI #: 10231592] where the customer alleges an accident resulting from an un-commanded driver air bag deployment. In the report, the customer states the driver air bag immediately deployed after she shifted the vehicle into reverse and that as a result she "was scared so bad that she jumped out of the veh – veh went down hill and ran into some trees and the customer actually had a stroke from being scared so bad." While Ford has not investigated this report, the report shows this incident occurred because the driver abandoned their vehicle while still in gear with the motor running and is not typical of the behavior of other customers who had experienced this issue.

Air Bag Warning Lamp

As earlier described, if an air bag system malfunction is detected during vehicle diagnostics, the air bag warning lamp indicates to the driver that the system diagnostics has detected an issue and they should bring their vehicle in for service. During Ford's field inspection in 2006, all of the vehicles or RCMs inspected that were involved in un-commanded deployments were found to have illuminated air bag warning lamps for numerous, even hundreds, of key-on cycles prior to deployment.

The data supports the fact that customers who experience the illumination of an air bag warning light do indeed bring their vehicles in for service. Of the numerous reports provided in this response that relate to vehicles serviced for an air bag warning lamp, 98 relate to reports where the technician diagnosed a chafe on an air bag jumper wire. Additionally, 380 ambiguous (Category B3) warranty claims and field reports mention an illuminated air bag warning light due to an issue with the clockspring. These reports do not specify whether the clockspring was replaced due to an internal issue with the flex cable or squib jumper wire chafe, but demonstrate that customers have their vehicles repaired without issue. With respect to other reports resulting from an air bag warning lamp, it cannot be concluded that they relate to this subject. In fact, an issue with any of the following components can cause

the air bag warning lamp to be illuminated: front crash severity sensors, occupant classification system, passenger air bag On/Off indicator light, restraint usage sensors, pyrotechnic pretensioning buckles, and driver and passenger frontal air bags.

Conclusion

Ford conducted an extensive investigation into reports of un-commanded driver air bag deployment resulting from a squib jumper wire chafe on the 2004 through 2006 model year Ford F-150 vehicles and found the incident rate attributable to the alleged defect was, and remains, very low (0.056 R/1000).

Ford believes that un-commanded deployment resulting from this condition is most likely to occur immediately upon vehicle start-up and not while being driven. An analysis of reports attributable to the condition identified only one "accident" involving an un-commanded driver air bag deployment. In the report, the customer stated she abandoned the vehicle with the engine running and in reverse after the air bag deployed. Ford believes this behavior is not typical of customers that have experienced this issue.

Most importantly, if an air bag system malfunction is detected during vehicle diagnostics, the air bag warning lamp indicates to the driver, as it is designed to do, that the system diagnostics has detected an issue and they should bring their vehicle in for service. Each of the vehicles or RCMs inspected that were involved in un-commanded deployments were found to have illuminated air bag warning lamps for numerous, even hundreds, of key-on cycles prior to deployment. Ford believes that consideration of all these factors supports a conclusion that this condition does not present an unreasonable risk to safety in these vehicles.

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