



GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

RECEIVED
NVS-210

Inter-Organization

JUN 30 A 6 58

OFFICE OF DEFECT
INVESTIGATION

Date: June 25, 2004

GM-657 (PE04-042)

On The Cover:

GM Assigned IR Number
NHTSA Assigned Evaluation Number
Number of Books
Allegation Title, Model Year and Make
Date Received from NHTSA
GM Reply Date

Book 1:

Tab (1) GM Response Letter to NHTSA
Tab (2) NHTSA Letter
Tab (3) GM Response with (1) CD
Tab (4) GM Response To Q11 Confidential CD sent to Office of
Chief Counsel
Tab (5) Delphi Response with (1) CD



GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

RECEIVED
NVS-210

June 25, 2004

JUN 30 A 6 58

OFFICE OF DEFECTS
INVESTIGATION

Jeffrey L. Quandt, Chief
Vehicle Control Division
Office of Defects Investigation
NHTSA Safety Assurance
Room #5326
400 Seventh Street, S.W.
Washington, D.C. 20590

GM-857

NVS-213cla
PE04-042

Dear Mr. Quandt:

This letter is General Motors (GM) response to your information request (IR), dated May 13, 2004, regarding allegations of overheated fuel pump wiring resulting in fuel tank leakage and/or engine stall from melted pump electrical connectors in model year (MY) 2000 through 2001 Chevrolet Suburban sport utility vehicles.

The subject vehicles for this inquiry are all MY 2000 through 2002 C/K-series sport utility vehicles and pickup trucks, including Chevrolet Silverado, Tahoe, Suburban, and Avalanche; GMC Sierra, Yukon, and Yukon XL; and Cadillac Escalade and Escalade EXT models. The GM response includes information related to the modular reservoir assemblies (MRA) for the gasoline, flexible fuel (E86), and diesel fuel systems used in these models, although the subject condition only applies to gasoline MRA's. The wiring and electrical connectors involved in the allegations, where used, are part of these MRA's.

There can be many reasons for the failure of the MRA, including failures of the wiring and/or connectors. Accordingly, searches conducted in formulating this response focus on failure modes that relate to, or may relate to, the alleged condition of overheated fuel pump wiring and/or connectors.

Your questions and our corresponding replies are as follows:

1. State, by model, fuel tank, and model year, the number of subject vehicles GM has manufactured for sale or lease in the United States. Separately, for each subject vehicle manufactured to date by GM, state the following:
 - a. Vehicle identification number (VIN);
 - b. Make;
 - c. Model;
 - d. Fuel tank;
 - e. Model Year;
 - f. Date of manufacture;
 - g. Date warranty coverage commenced; and
 - h. The State in the United States where the vehicle was originally sold or leased (or delivered for sale or lease).

Provide the table in Microsoft Access 2000, or a compatible format, entitled "PRODUCTION DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table that provides further details regarding this submission.

PRODUCT INVESTIGATIONS

Mail Code: 480-105-304 • 30500 Mound Road • Warren, MI 48090-8055
Phone: (586) 988-8029 • Fax: (586) 947-2318
GM857 Response



General Motors is providing a summary of the number of subject vehicles produced for sale or lease in the United States by model and model year in Table 1 below:

MAKE / MODEL	2000 MY	2001 MY	2002 MY
Chevrolet Silverado	846,618	812,570	832,671
GMC Sierra	216,821	177,322	193,008
Chevrolet Tahoe	99,187	194,332	207,226
GMC Yukon	44,178	70,850	75,929
Cadillac Escalade	33,664	0	54,008
Chevrolet Suburban	85,387	162,776	148,242
GMC Yukon XL	31,577	70,068	88,307
Chevrolet Avalanche	0	0	128,437
Cadillac Escalade EXT	0	0	12,513
Chevrolet Incomplete Vehicle	98,485	18,110	13,742
GMC Incomplete Vehicle	10,522	6,305	4,060
Total Production	1,285,427	1,310,333	1,538,141

The specific production information requested in 1a-1h is provided in Attachment 1 GM; folder labeled "Response to Q1"; refer to the Microsoft Access 2000 file. The GM database that contains Vehicle Identification Number (VIN) information does not include information on the state where an individual vehicle was sold. GM is providing the state where the vehicle was shipped in response to request 1h. For some of the subject vehicles, the GM warranty system does not contain a warranty start date or state where the vehicle was shipped and therefore these fields are blank.

For the fuel tank information requested in 1d, GM is providing a reference chart that contains the platform series, model and fuel tank capacity for every vehicle produced; refer to the Excel file in Attachment 1 CD GM; folder labeled "Response to Q1." This information summarizes the different fuel tank assembly configurations released for these vehicles and can be used to determine the specific fuel tank assembly used for every vehicle in the production file.

2. State the number of each of the following, received by GM, or of which GM is 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 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. Reports involving a fire, 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;
 - e. Property damage claims; and
 - f. Third-party arbitration proceedings where GM is or was a party to the arbitration; and
 - g. Lawsuits, both pending and closed, in which GM is or was a defendant or codefendant.

For subparts "a" through "d, / e," 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 "d/e/f/g," provide a summary description of the alleged problem and causal and contributing factors and GM's assessment of the problem, with a summary of the significant underlying facts and evidence. For items f and g, 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.

Table 2A below summarizes records that may relate to the subject condition.

REPORT BREAKDOWN

TYPE OF REPORT	COUNT (INCLUDING DUPLICATES)	GM REPORTS	GM REPORTS CORRESPONDING TO NHTSA REPORTS	LOCATION OF REPORTS (ATTACHED)	NUMBER OF PROPERTY DAMAGE REPORTS	NUMBER OF CRASH INCIDENT REPORTS	NUMBER OF REPORTED INJURIES/ FATALITIES*	FIRES**
Owner Reports	82	82	0	2A	0	0	0	0
Field Reports and Technical Assistance System Reports	80	80	0	2B	0	0	0	2
Not-In-Suit Claims	1	1	0	2C	0	0	0	1
Subrogation Claims	1	1	0	2D	0	0	0	1
Third Party Arbitration Proceedings	0	0	0	N/A	0	0	0	0
Product Liability Lawsuits	0	0	0	N/A	0	0	0	0
Total (Including Duplicates)	114	114	0	N/A	0	0	0	4
Total (Excluding Duplicates)	113	113	0	N/A	0	0	0	3

TABLE 2A

N/A Not Applicable

* There are no reported injuries or fatalities.

** Based on available documentation, all three vehicle fires are believed to have started in the rear of the vehicle at or near the fuel tank assembly, but none have been linked to a fuel leak or an ignition source related to the subject component and the subject condition.

The sources of the requested information and the last date the searches were conducted are tabulated in Table 2B below.

DATA SOURCES

SOURCE SYSTEM	LAST DATE GATHERED
Corporate Central File	June 2004
Customer Assistance Center (CAC)	June 2004
Technical Assistance Center (TAC)	June 2004
Field Information Network Database (FIND)	May 2004
Problem Resolution Tracking System (PRTS)	June 2004
Company Vehicle Evaluation Program (CVEP)	May 2004
Captured Test Fleet (CTF)	May 2004
Early Quality Feedback (EQF)	June 2004
Field Product Report Database (FPRD)	May 2004
Legal / Employee Self Insured Services (ESIS)	June 2004
Lawpack	June 2004

TABLE 2B

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. GM'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;
 - h. Report or claim date;
 - i. Whether a crash is alleged;
 - j. Whether a fire is alleged;
 - k. Whether property damage is alleged;
 - l. Number of alleged injuries, if any; and
 - m. Number of alleged fatalities, if any.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table that provides further details regarding this submission.

The requested information for 3 a-m is provided in Attachment 1 CD GM; folder labeled "Response to Q3" (refer to the Microsoft Access 2000 file).

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 GM used for organizing the documents.

Copies of the records summarized in Table 2A are provided in Attachment 1 CD GM; folder labeled "Response to Q3." GM has organized the records by the GM file number within each attachment.

5. State, by model and model year, a total count for all of the following categories of claims, collectively, that have been paid by GM 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. GM's claim number;
- b. Vehicle owner or fleet name (and fleet contact person) and telephone number;
- c. VIN;
- d. Repair date;
- 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.

Provide this information in Microsoft Access 2000, or a compatible format, entitled "WARRANTY DATA." See Enclosure 1, Data Collection Disc, for a pre-formatted table that provides further details regarding this submission.

The regular and extended warranty claims that may be responsive to this request are provided in Attachment 1 CD GM; folder labeled "Response to Q5." Not all of the warranty claims included on the CD relate to the alleged defect. Based on the analysis of field returned parts for gasoline vehicles that is explained in response to questions 6 and 8, only 3.2% of the claims are believed to involve overheated wiring and/or connectors. Moreover, claims for E85 and diesel vehicles are included in this file, yet they do not exhibit the alleged condition. Table 5 below characterizes the number of claims that GM believes specifically relate to the alleged condition.

WARRANTY CLAIMS ESTIMATE

	2000 MY	2001 MY	2002 MY	TOTAL
Regular Warranty	844	4,134	938	5,714
Extended Warranty	4,588	1,209	62	5,859
			Total	11,573

TABLE 5

GM searched the GM North America Claim Adjustment Retrieval Database (CARD-regular warranty), the Motors Insurance Corporation (MIC-extended warranty), and the Universal Warranty Corporation (UWC-extended warranty) databases to collect the warranty data for this response. The warranty data was last gathered on June 18, 2004.

The information requested in 5b is not being provided, as GM's warranty database does not contain the vehicle owner's name or telephone number. Relative to 5i and 5j, some of the replacement part numbers, part descriptions, and customer concern code descriptions are not included in the GM warranty database. GM is providing a field labeled "Verbatim Text" in

response to request 5k (dealer/technician comment). The verbatim text is an optional field in the GM warranty system for the dealer to enter any additional comments that may be applicable to the warranty claim. The verbatim text field is not required to be completed for every warranty claim.

The MIC extended warranty system does not contain the following information: repairing dealer code, vehicle owner information, trouble code, trouble code description, part number, part description or verbatim. The UWC extended warranty system does not use the GM labor code or labor code description and it does not contain the repairing dealer code, trouble code or trouble code description.

The warranty data provided has limited analytical value in analyzing the field performance of a motor vehicle component. The warranty records do not contain sufficient information to establish the condition of the part at the time of the warranty correction; and service personnel may not consistently use the appropriate labor and trouble codes. Warranty records represent claims by our dealers for reimbursement for parts and labor costs incurred in performing warranty service for our customers.

8. Describe in detail the search criteria used by GM to identify the claims identified in response to Request No. 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 GM 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 GM 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.

The GM regular warranty data was collected by searching GM CARD for the labor codes and trouble codes that may relate to the subject condition. A list of the labor codes used in this search is provided below in Table 6A. The corresponding trouble codes for each of these labor codes is identified in Attachment 1 CD GM; folder labeled "Response to Q8" (refer to the Microsoft Excel file).

LABOR CODES USED FOR REGULAR WARRANTY CLAIMS SEARCH

LABOR CODE	DESCRIPTION
L1197	SENSOR, FUEL LEVEL (TANK UNIT - ALL)
L1200	SENDER/PUMP, FUEL TANK UNIT - REPLACE
L1224	SENDER/PUMP - RGT - TNK UNIT - REPLACE
L1225	SENDER/PUMP - LFT TNK UNIT - REPLACE
L1228	SENDER/PUMP - RR TNK UNIT - REPLACE
N6288	WIRE/CONN, FUEL PUMP - REPAIR
J5487	PUMP, AUX FUEL TANK TRANSFER - REPLACE

TABLE 6A

The MIC and UWC extended warranty data was collected using a search of the labor codes listed in Tables 6B and 6C. The MIC and UWC extended warranty databases do not contain trouble

codes. No additional filtering of the extended warranty data was performed, due to the lack of part number information.

LABOR CODES USED FOR MIG EXTENDED WARRANTY CLAIMS SEARCH

LABOR CODE	DESCRIPTION
L1196	SEAL, FUEL SENDER/PUMP ASSEMBLY (TANK UNIT) - REPLACE ALL
L1200	SENDER ASSEMBLY, FUEL (TANK UNIT) - REPLACE
L1225	SENDER ASSEMBLY - LEFT TANK UNIT - REPLACE
L1226	SENDER ASSEMBLY - REAR TANK UNIT - REPLACE
J5430	PUMP AND/OR GASKET, ENGINE FUEL - REPLACE

TABLE 6B

LABOR CODES USED FOR UWC EXTENDED WARRANTY CLAIMS SEARCH

LABOR CODE	DESCRIPTION
10000	Fuel Delivery - Fuel Pump
10020	Fuel Delivery - Fuel Tank Send Unit
10098	Fuel Delivery - Misc BmprToBmpr
12098	Enhanced Electrical Misc Bmpr2Bmpr

TABLE 6C

Again, the warranty data provided has limited analytical value in analyzing the field performance of a motor vehicle component, like the gasoline modular reservoir assembly (MRA) that contains the subject wiring and connectors. The labor operation codes listed above may be applicable to the alleged defect, but are also related to other issues affecting the MRA. For example, an MRA may be replaced for unrelated issues affecting fuel level sensing and/or fuel pump operation. In addition, claims for diesel and E85 MRA replacements, which do not exhibit the alleged condition, have been included in the warranty file.

Further illustration of this point appears in response to Question 8, where the analyses of warranty return parts by the gasoline MRA manufacturer is described. Out of the 1,979 MRA assemblies that were inspected during the model year build of the subject vehicles by the component manufacturer, sixty-four (64) were found to have the subject condition. In other words, only 3.2% of the claims processed at that time using the same labor codes that were used in the GM search for regular warranty claims described above were found to relate to the subject condition. An estimate of the number of warranty claims that may relate to the alleged condition for the subject vehicles was provided earlier in Table 5.

All models and model years of the subject vehicles, with the exception of Cadillac, are covered by a bumper-to-bumper new vehicle warranty for three years or 36,000 miles, whichever occurs first. Cadillac models are covered by a four-year, 60,000-mile plan. In addition, many different extended warranty options are available through GM dealerships. They are offered at different prices and for varying lengths of time, based on the customer's preference, up to 7 years from the date of purchase or up to a total of 100,000 vehicle miles. The General Motor's warranty system does not contain information on the number of vehicles that have extended warranty coverage.

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 GM 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 GM is planning to issue within the next 120 days.

As of June 03, 2004 when a search was completed, GM had not issued any service, warranty, or other documents to the field that relate to, or may relate to, the alleged defect in the subject vehicles. At this time, there are no bulletins planned for release within the next 120 days.

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, GM. 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.

The pass-through connectors and fuel pump wiring associated with the alleged defect in the subject vehicles are part of the modular reservoir assembly (MRA). The conditions depicted in the pictures provided by NHTSA with this inquiry indicate thermal damage to these connectors and/or wiring. In the course of this investigation, GM has determined that the subject condition only applies to the MRA assemblies released for the gasoline fuel systems on the subject vehicles, not those for E85 (flexible fuel) and diesel fuel systems of the subject vehicles. MRA's for the E85 fuel system do not contain the 150 Metri-Pak connector that is involved in the subject condition. Similarly, the diesel MRA's do not contain a fuel pump or its associated wiring.

During the model years of the subject vehicle production, MRA warranty part returns for gasoline and diesel fuel systems were inspected and assessed by the component supplier. The total number of parts inspected for the 2000, 2001 and 2002 model years were 766, 868 and 562, respectively. Out of the 1,979 total parts that were inspected, only 84 parts (13 for MY 2000, 50 for MY 2001 and 1 for MY 2002), all for gasoline fuel systems, were found to have a condition that may relate to the alleged defect. The conditions include melted insulation on B+ (power) and ground wires for the fuel pump, and damaged or melted pass-through electrical connectors. A list including the VIN number, dealer repair order, analysis and other remarks for the vehicles from which these parts were removed is contained in Attachment 3 CD Supplier; folder labeled "Delphi Non-confidential Response" (refer to the list entitled "2000 Thru 2002 Model Year Fuel Pump and Sender Warranty Analysis").

In a similar manner, the supplier for the MRA's used in the E85 fuel system released on the subject vehicles inspected warranty returns of their parts. While these components do contain a fuel pump, they do not have an under-cover connector and none of the warranty returned parts inspected were found to have a condition that may relate to the alleged defect; refer to the Adobe Acrobat file in Attachment 1 CD GM; folder labeled "Response to Q8."

At present, a number of actions are in the process of being completed. A list of these actions is provided below:

1. Conduct internal product investigation - ongoing
2. Complete root cause analysis of NHTSA part - ongoing
 - o (Refer to analysis report in Attachment 3 CD Supplier; folder labeled "Delphi Non-Confidential Response")
3. Review supplier subject component validation - complete
 - o (Refer to validation documents contained in Attachment 4 CD Supplier Confidential; folder labeled "Delphi Confidential Response.")
4. Review GM vehicle validation - complete
5. Conduct Warranty Parts Center review of subject components - completed one review
 - o (Refer to Excel file in Attachment 1 CD GM; folder labeled "Response to Q8")
6. Complete root cause analysis of warranty returns with conditions that may relate to alleged defect - ongoing
 - o (Refer to four analysis reports contained in Attachment 3 CD Supplier; folder labeled "Delphi Non-confidential Response.")
 - o (Refer to manufacturing audit summary letter contained in Attachment 3 CD Supplier; folder labeled "Delphi Non-confidential Response.")
 - o Review warranty analysis presentations provided by subject component supplier - ongoing
 - o (Refer to presentations contained in Attachment 3 CD Supplier; folder labeled "Delphi Non-confidential Response")

The findings so far are that the subject condition was not seen in the component or vehicle validation for the subject vehicles. The physics of the thermal degradation seen on the NHTSA part are understood and are consistent with what has been found on other subject components obtained through a recent warranty parts return request.

To date, the gasoline component manufacturer has completed an analysis of four of the fifteen field returned parts exhibiting the subject condition. The analysis concluded that the thermal damage was the result of elevated resistance arcing caused by a damaged female electrical connector. Consequently, preliminary audits were conducted on the following manufacturing processes within the value stream for the MRA: fuel pump wiring harness, fuel card subassembly, and MRA final assembly, with no conclusive findings. While the physics and contributory factors have been identified, the specific cause or causes have not. As a result, no corrective actions have been identified.

9. Describe all modifications or changes made by, or on behalf of, GM 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:
- The date or approximate date on which the modification or change was incorporated into vehicle production;
 - A detailed description of the modification or change;
 - The reason(s) for the modification or change;
 - The part numbers (service and engineering) of the original component;
 - The part number (service and engineering) of the modified component;
 - Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
 - When the modified component was made available as a service component; and
 - Whether the modified component can be interchanged with earlier production components.

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

The modifications and changes made to the subject component that are responsive to this question are listed with the information requested in 9a-h in Attachment 1 CD GM; folder labeled "Response to Q9" (refer to the Microsoft Word file).

For model year 2002 Chevrolet Avalanche & Suburban models, Delphi wrote Engineering Work Orders KK573, KU577 and KK578, which released a metal MRA cover and a 280 Metri-Pak connector in place of the 150 Metri-Pak connector used previously. These changes were made to help meet vehicle crash test requirements and new MRA component technical specifications.

Presently there are no modifications or changes planned for the subject component that relate to, or may relate to, the alleged defect.

Delphi requests that some of this information stamped "Confidential Information" included on the engineering drawings, material specifications, technical specifications, and validation plans and prints, be afforded confidential treatment by the NHTSA. These documents are in response to questions 8, 10, 11, 14 and are contained in Attachment 4 CD Supplier Confidential; folder labeled "Delphi Confidential Response." This information is not customarily made public by Delphi and contains trade secrets and commercial information which is privileged or confidential under 5 U.S.C. Section 552(b)(4), 49 CFR Part 512 and 49 U.S.C Section 30167(a). The engineering drawings, material specifications, technical specifications, and validation plans and prints are accompanied by a written claim for confidentiality and a Certificate in support of Delphi's request for confidentiality.

10. Provide the following information relating to the subject fuel pump module(s):
- Identify the material composition of each polymer used in the pump module (including the electrical connector and the pump wiring insulation) by common name, trade name, ASTM abbreviation, and supplier name;
 - State the softening, melting, and ignition temperatures of each polymer identified in item "a;"

- c. State the gage and nominal and maximum currents of each wire in the pump module;
- d. Describe the conditions that would cause the internal fuel pump wire insulation to melt in the subject components; and
- e. Describe the electrical and thermal fault protection used in the fuel pump module circuit.

Material composition and melting temperatures are being provided for the materials used in the gasoline MRA fuel pump wiring and connectors (refer to exploded part views contained in Attachment 4 CD Supplier Confidential; folder labeled "Delphi Confidential Response").

Information on the components used in the diesel and E85 fuel systems is not being provided, as they have not exhibited the subject condition.

As electrical current passes through the fuel pump wiring and connectors, heat is generated in proportion to the amount of resistance in them. When the ability of these components to dissipate heat is exceeded by the amount of heat being generated, the temperatures may rise above the melting points of the insulation materials. Localized high resistance between the mating terminals or components of an electrical connection will cause temperatures to rise in these areas. As the terminals or other mating components get hot, the heat will travel along the wires and into adjacent materials, and may cause the wire insulation or connector material to melt. Among the possible causes for localized high contact resistance at a terminal or other electrical interface are: contamination, insufficient contact area and insufficient contact pressure. These causes may be the result of insufficient terminal-to-wire crimping and damage and/or mismatch between mating male and female terminals in an electrical connection.

The electrical circuit protection for the primary fuel pump is a 20 amp mini-fuse (ECM-B) located in the under hood Bussed Electrical Center (BEC). Voltage is provided to the Fuel Pump from the ECM B fuse through the Fuel Pump Relay, which is controlled by the Powertrain Control Module (PCM). On vehicles equipped with an auxiliary fuel tank, the circuit protection is a 20 amp fuse for the primary fuel pump and a 10 amp fuse for the secondary auxiliary fuel pump. Electrical schematics are provided in Attachment 1 CD GM; folder labeled "Response to Q10" (refer to the Adobe Acrobat file).

11. Provide the following information regarding the fuel tank assemblies used in the subject vehicles:
 - a. Diagrams showing the position of each tank on the vehicle chassis;
 - b. State the fuel and vapor volumes of each tank when filled using the SAE reference fill procedure;
 - c. Diagrams of the side and rear views of the tank shell/profile that show: (1) the fuel pump module and associated wiring and electrical connector; (2) the SAE reference fill level in the tank; and (3) all fuel tubes/valves;
 - d. In the side view diagram, provide the following heights referenced to either the lowest point of the tank or to the parking surface for a vehicle resting on a flat level surface: (1) SAE reference fill level; (2) fuel pump module electrical connector; and (3) all tube/valve openings;
 - e. State the volume of fuel that is above the height of the fuel pump module electrical connector in a tank filled to the SAE reference fill level when the vehicle is parked on a flat level surface; and

- f. State the maximum volume of fuel that can be above the height of the fuel pump module electrical connector in a tank filled to the SAE reference fill level when the vehicle is parked on inclined surfaces (longitudinal and lateral slopes).

GM is providing diagrams showing the position of each tank assembly configuration for each vehicle model in the subject population along with a summary worksheet that identifies each tank configuration and provides its corresponding file name (refer to diagrams and layout drawings provided in Attachment 2 CD GM Confidential; folder labeled "GM Confidential Response." and Microsoft Excel file named "FuelTankConfigDiag.xls" on Attachment 1 CD GM; folder labeled "Response to Q11."

GM does not collect fuel and vapor volume data using the SAE J398 reference fill level procedure. GM customer fill data is available in Attachment 1 CD GM; folder labeled "Response to Q11" (refer to Excel file).

The GM math data used to show the position of each tank configuration on the vehicle chassis and the side and rear views of the tank shell/profile does not contain the detail requested for the fuel pump electrical connector and fuel tubes and valves. However, the diagrams provided in response to Questions 11a and 11c do contain the requested information for the MRA. Together with the MRA part drawings provided by the subject component supplier (reference MRA part drawings provided in Attachment 4 CD Supplier Confidential; folder labeled "Delphi Confidential Response"), these diagrams can be used to obtain the reference heights requested for the fuel pump module electrical connector.

GM does not collect data using the SAE J398 reference fill level procedure and cannot provide the specific information requested for the volumes in 11e and 11f.

12. Produce one of each of the following:

- a. Exemplar samples of each design version of the subject component; and
- b. Field return samples of each version of the subject component that exhibit the subject failure mode.

GM is providing sample parts in response to 12a and 12b. A list of these parts, including part numbers and a part description, are provided in Attachment 1 CD; folder labeled "Response to Q12" (refer to the Microsoft Word file). Where possible, an unused part has been provided. Otherwise, field return samples were provided.

13. State the number of subject components GM 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 sale:

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

For each component part number, provide the supplier's name, address, and appropriate point of contact (name, title, and telephone number). Also identify by make, model and

model year, any other vehicles of which GM is aware that contain the identical component, whether installed in production or in service, and state the applicable dates of production or service usage.

A summary table of the requested service part information for the subject component is provided in Attachment 1 CD GM; folder labeled "Response to Q13."

14. Furnish GM's assessment of the alleged defect in the subject vehicles, including:
- a. The factors contributing to overheating of fuel pump wiring in the subject vehicle population;
 - b. The failure mechanism(s) for each failure mode associated with the alleged defect condition, including: (1) fuel leakage; and (2) engine stall.
 - c. The circumstances under which fuel can leak from a melted electrical connector in each version of fuel tank and fuel pump module used in the subject vehicles;
 - d. The maximum amount of fuel that could leak from a hole in the fuel pump electrical connector when: (1) the vehicle is parked in a level orientation; (2) the vehicle is parked at an angle; and (3) the vehicle is being driven;
 - e. The frequencies of fuel leakage and engine stall incidents GM believes have resulted from the alleged defect in the subject vehicles and GM's estimate of the number of such failures that will occur by model and model year in the next 24-months;
 - f. The risk to motor vehicle safety that it poses;
 - g. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning; and
 - h. The reports included with this inquiry.

GM has identified one factor that contributes to the overheating of the fuel pump wiring and connector in the subject vehicle population. According to the analysis reports for the NHTSA return part and the four warranty field returned parts, the condition is caused by elevated resistance/arcng at the MRA undercover B cavity terminal of the four-way 150 Metri-Pak connector (refer to analysis reports contained in Attachment 3 CD Supplier, folder labeled "Delphi Non-confidential Response.") The elevated resistance/arcng occurring on these five parts was caused by a depressed contact arm at the 150 Metri-Pak B cavity female terminal. It is not clear how the female connector became depressed creating a gap to the male terminal, it is believed to have been caused by engagement with a misaligned, fixtured object.

Fuel leakage may occur through the subject electrical connectors on the cover of the MRA assembly if sufficient heat is generated by the electrical components to produce a hole large enough for liquid fuel to flow through it. Depending on the level of fuel in the tank, fuel may flow through the hole at a rate influenced by the physics surrounding the state and environment of the fuel system (vapor volumes, temperature, etc.). Based on differences in the softening and melting points between the insulation on the wiring and the plastic used on the pass-through connector, the insulation will begin to melt first. Depending on several factors, including the amount of heat generated, the thermal effects of the resistance arcng may be limited to the wiring and may not affect the connector. Therefore, not all of the components with the subject condition will develop a hole in the pass-through connector that may lead to a fuel leak.

Engine stall may occur only if a short occurs in the fuel pump wiring within the MRA assembly and the fuse for the fuel pump relay is blown. This can happen if the insulation on the B+ (power) wire has melted away and the bare wire shorts against a ground or ground wire in the MRA assembly.

Engine stall may also occur if the vehicle operator runs the vehicle out of fuel as a result of an inaccurate fuel gage reading, caused by an electrical short between the fuel pump wiring and the wiring for the fuel level sensor.

No fuel level grade line data is presently available to assess the maximum amount of fuel that could leak from a hole in the fuel pump electrical connector under conditions of varied road grade and vehicle operation.

There are no diagnostics that warn the vehicle operator that resistance arcing and/or elevated temperatures exist at the MRA. However, when sufficient heat is generated at the pass-through connector to produce a hole of approximately 0.040 inches or greater, a routine in the on-board emissions diagnostics may detect the hole and set a Service Engine Soon warning light. It is also possible, and has been observed, that a fuel pump wire with the subject condition can short out against adjacent wiring for the fuel level sensor, causing noticeable erratic or inaccurate gage readings. Lastly, it is possible that intermittent grounding of the B+ (power) wire for the fuel pump will cause the pump speed and corresponding noise coming from the pump to be discernible by some customers.

NHTSA has provided a total of seventeen (17) Vehicle Owner's Questionnaires with this request. Thirteen (13) of the seventeen VOQ's appear to relate to the subject condition. Three (NHTSA Reference No.'s 754085, 8008162 and 10062106) may relate to the subject condition. One (NHTSA Reference No. 10045487) does not relate to the subject condition.

Based on the nature of the alleged complaints, which include vehicle stalls and fuel leaks, GM is continuing its investigation of this issue for the purposes of completing the root cause analysis and its ongoing evaluation of the risk to motor vehicle safety. At this time, based on our understanding of the physics involved and the low incident rate, GM does not believe this issue poses an unreasonable safety risk. In addition, GM believes the absence of any reports of vehicle crashes or injuries related to the alleged condition is a relevant consideration.

* * *

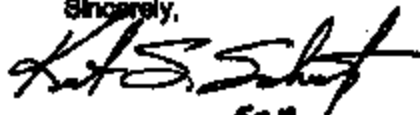
This response is based on searches of General Motors Corporation (GM) locations where documents determined to be responsive to your request would ordinarily be found. As a result, the scope of this search did not include, nor could it reasonably include, "all of its divisions, subsidiaries (whether or not incorporated) and affiliated enterprises and all of their headquarters, regional, zone and other offices and their employees, and all agents, contractors, consultants, attorneys and law firms and other persons engaged directly or indirectly (e.g., employee of a consultant) by or under the control of GM (including all business units and persons previously referred to), who are or, in or after January 1, 1994, were involved in any way with any of the following related to the alleged defect in the subject vehicles:

- a. "Design, engineering, analysis, modification or production (e.g. quality control);
- b. "Testing, assessment or evaluation;
- c. "Consideration, or recognition of potential or actual defects, reporting, record-keeping and information management, (e.g., complaints, field reports, warranty information, part sales), analysis, claims, or lawsuits; or
- d. "Communication to, from or intended for zone representatives, fleets, dealers, or other field locations, including but not limited to people who have the capacity to obtain information from dealers."

This response was compiled and prepared by this office upon review of the documents produced by various GM locations, and does not include documents generated or received at those GM locations subsequent to their searches.

Please contact me if you require further information about this response or the nature or scope of our searches.

Sincerely,

A handwritten signature in black ink, appearing to read "Gay P. Kent".

Gay P. Kent *For*
Director
Product Investigations

Attachments