



JMK
7/5/06

June 29, 2006

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

GM-688

NVS-213dlr
PE06-016

Dear Mr. Quandt:

This letter is General Motors' (GM) response to your information request (IR), dated May 12, 2006, regarding engine stall while driving on 2001-2002MY C/K 2500 and 3500 series trucks equipped with 8.1L engines.

Your questions and our corresponding replies are as follows:

1. **State, by model 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. Model Year;
 - e. Transmission (manual or automatic);
 - 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.

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

<u>Make/ Model/ Model Year</u>	<u>2001</u>	<u>2002</u>	<u>Total</u>
GMC Yukon XL	2,193	1,510	3,703
GMC Sierra 2500	9,051	7,374	16,425
GMC Sierra 3500	5,180	2,107	7,287
Chevrolet Suburban	6,838	3,592	10,430
Chevrolet Silverado 2500	25,281	17,399	42,680
Chevrolet Silverado 3500	14,279	7,447	21,726
Chevrolet Avalanche	N/A	6,087	6,087
Total	62,822	45,516	108,338

TABLE 1 VEHICLE PRODUCTION

N/A NOT APPLICABLE

The production information requested in 1a-h is provided on the Attachment 1 CD, in the folder labeled: "Response for Q1;" refer to the Microsoft Access file labeled PRODUCTION DATA. GM is providing the state where the vehicle was shipped in response to request 1h. For some of the subject vehicles, which have incomplete warranty files, the GM warranty system does not contain a warranty start date or state where the vehicle was shipped, and therefore these fields are blank in the Microsoft Access 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. **Property damage claims; and**
 - e. **Third-party arbitration proceedings where GM is or was a party to the arbitration; and**
 - f. **Lawsuits, both pending and closed, in which GM 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 GM'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.

Table 2-1 below summarizes records that indicate engine stall while driving as a result of the crankshaft position sensor failure. Table 2-2 summarizes records that indicate engine stall without indicating whether the vehicle was in motion at the time of the stall. Table 2-3 summarizes records that indicate the vehicle did not start.

To date, GM's investigation of the alleged defect has not included an assessment of the cause(s) of each incident responsive to Request No. 2. Some incident reports may not contain sufficient reliable information to accurately assess cause.

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		CORRESPONDING TO NHTSA REPORTS	NUMBER WITH PROPERTY DAMAGE	NUMBER WITH CRASH	NUMBER WITH INJURIES/FATALITIES
Owner Reports	29	1	0	0	0
Field Reports	262	1	0	0	0
Not-In-Suit Claims	0	0	0	0	0
Subrogation Claims	0	0	0	0	0
Third Party Arbitration Proceedings	0	0	0	0	0
Product Liability Lawsuits	0	0	0	0	0
Total Reports (Including Duplicates)	291	2	0	0	0
Total Vehicles with Reports (Unique VIN)	289	2	0	0	0

TABLE 2-1: REPORT BREAKDOWN- STALL WHILE DRIVING

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		CORRESPONDING TO NHTSA REPORTS	NUMBER WITH PROPERTY DAMAGE	NUMBER WITH CRASH	NUMBER WITH INJURIES/FATALITIES
Owner Reports	29	0	0	0	0
Field Reports	854	1	0	0	0
Not-In-Suit Claims	0	0	0	0	0
Subrogation Claims	0	0	0	0	0
Third Party Arbitration Proceedings	0	0	0	0	0
Product Liability Lawsuits	0	0	0	0	0
Total Reports (Including Duplicates)	883	1	0	0	0
Total Vehicles with Reports (Unique VIN)	879	1	0	0	0

TABLE 2-2: REPORT BREAKDOWN- STALLED WITH UNKNOWN DRIVING CONDITION

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		CORRESPONDING TO NHTSA REPORTS	NUMBER WITH PROPERTY DAMAGE	NUMBER WITH CRASH	NUMBER WITH INJURIES/FATALITIES
Owner Reports	13	0	0	0	0
Field Reports	30	0	0	0	0
Not-In-Suit Claims	0	0	0	0	0
Subrogation Claims	0	0	0	0	0
Third Party Arbitration Proceedings	0	0	0	0	0
Product Liability Lawsuits	0	0	0	0	0
Total Reports (Including Duplicates)	43	0	0	0	0
Total Vehicles with Reports (Unique VIN)	43	0	0	0	0

TABLE 2-3: REPORT BREAKDOWN- NO START CONDITION

SOURCE SYSTEM	LAST DATE GATHERED
Customer Assistance Center (CAC)	5/31/2006
Technical Assistance Center (TAC)	5/23/2006
Field Information Network Database (FIND)	5/18/2006
Company Vehicle Evaluation Program (CVEP)	5/22/2006
Captured Test Fleet (CTF)	5/22/2006
Early Quality Feedback (EQF)	5/22/2006
Field Product Report Database (FPRD)	5/18/2006
Legal / Employee Self Insured Services (ESIS) / Product Liability Claims and Lawsuits	5/25/2006

TABLE 2-4 DATA SOURCES

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. Vehicle speed at time of incident;

- h. Incident date;
- i. Report or claim date;
- j. Whether a crash 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.

GM is providing the requested information for 3a-e in Attachment 1 CD, folder labeled: "Response for Q3;" refer to Microsoft Access file named "Request Number Two Data." The information requested for 3f-m is also provided, where available, in the same CD.

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 2-1, Table 2-2, and Table 2-3 are embedded in the file provided in Attachment 1 CD; folder labeled: "Response for Q3," refer to the Microsoft Access file. 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.

Regular Warranty

The focus of this investigation is engine stall while driving as a result of crankshaft position sensor failure. The GM Claim Adjustment Retrieval Database (CARD) regular and the Motors

Insurance Corp (MIC) extended warranty databases were searched using the one labor code J4355 crank position sensor replacement.

In Table 5-1, GM lists five customer codes within the J4355 labor code that may relate to alleged defect and that are reviewed and summarized in Tables 5-2 through 5-5.

Customer Code	Description
PU	PERFORMANCE: STALLS-HOT ENG
PB	PERFORMANCE: CUTS OUT
PT	PERFORMANCE: STALLCOLD(FAILED EMISSION)
PR	PERFORMANCE: SLUGGISH(STALLS-HOT ENGINE)
PQ	PERFORMANCE: ROUGHIDLE-HOT(STALLCOLD)

TABLE 5-1 REGULAR WARRANTY CUSTOMER CODES

GM reviewed each warranty claim comment field where available and has counted claims in Table 5-2 where it was reported that the vehicle stalled while driving as a result of a crank sensor.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	9	0	9
GMC SIERRA 2500	11	11	22
GMC SIERRA 3500	4	1	5
CHEVROLET SUBURBAN	27	1	28
CHEVROLET SILVERADO 2500	26	21	47
CHEVROLET SILVERADO 3500	19	5	24
CHEVROLET AVALANCHE	N/A	12	12
TOTAL	96	51	147

TABLE 5-2 REGULAR WARRANTY CLAIMS - CUSTOMER INDICATED STALL WHILE DRIVING
 N/A NOT APPLICABLE

In Table 5-3, GM reviewed each warranty claim comment field where available and has identified claims where it was reported that the vehicle stalled or engine quit/ died, however, where there is not information to determine if the engine stalled while driving or when parked.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	5	3	8
GMC SIERRA 2500	10	10	20
GMC SIERRA 3500	11	1	12
CHEVROLET SUBURBAN	16	1	17
CHEVROLET SILVERADO 2500	29	21	50
CHEVROLET SILVERADO 3500	18	4	22
CHEVROLET AVALANCHE	N/A	12	12
TOTAL	89	52	141

TABLE 5-3 REGULAR WARRANTY CLAIMS - CUSTOMER INDICATED STALL WITH UNKNOWN DRIVING
 CONDITION
 N/A NOT APPLICABLE

In Table 5-4, GM reviewed each warranty claim comment field where available and has identified claims where it was reported that the vehicle would not start.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	0	0	0
GMC SIERRA 2500	1	0	1
GMC SIERRA 3500	1	0	1
CHEVROLET SUBURBAN	2	1	3
CHEVROLET SILVERADO 2500	2	1	3
CHEVROLET SILVERADO 3500	3	0	3
CHEVROLET AVALANCHE	N/A	0	0
TOTAL	9	2	11

TABLE 5-4 REGULAR WARRANTY CLAIMS – CUSTOMER CODE WITH NO START
 N/A NOT APPLICABLE

In Table 5-5, GM states the number of unique Vehicle Identification Numbers (VINs) where the comment field was left blank or where there is not information to relate to engine stall while driving condition.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	126	38	164
GMC SIERRA 2500	242	133	375
GMC SIERRA 3500	123	25	148
CHEVROLET SUBURBAN	410	58	468
CHEVROLET SILVERADO 2500	690	371	1,061
CHEVROLET SILVERADO 3500	336	100	436
CHEVROLET AVALANCHE	N/A	189	189
TOTAL	1,927	914	2,841

TABLE 5-5 REGULAR WARRANTY CLAIMS – CUSTOMER CODE WITH COMMENT FIELD BLANK
 N/A NOT APPLICABLE

Extended Warranty- Universal Warranty Corp. (UWC)

GM reviewed the UWC extended warranty claim comments and has identified claims in Table 5-6 where it was reported that the vehicle stalled while driving as a result of crankshaft position sensor failure. UWC extended warranty database was searched through a process that identifies the applicable vehicle system, parts descriptions, and keywords.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	1	0	1
GMC SIERRA 2500	1	0	1
GMC SIERRA 3500	0	0	0
CHEVROLET SUBURBAN	0	0	0
CHEVROLET SILVERADO 2500	0	0	0
CHEVROLET SILVERADO 3500	0	0	0
CHEVROLET AVALANCHE	N/A	0	0
TOTAL	2	0	2

TABLE 5-6 UWC EXTENDED WARRANTY CLAIMS - STALL WHILE DRIVING
 N/A NOT APPLICABLE

In Table 5-7, GM states the number of UWC extended warranty claims where there is not enough information to determine if the engine stalled while driving or when parked but the comment mentioned stall, engine quit/ died, or the crank sensor was broke/ replaced.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	0	1	1
GMC SIERRA 2500	2	2	4
GMC SIERRA 3500	0	0	0
CHEVROLET SUBURBAN	0	0	0
CHEVROLET SILVERADO 2500	7	0	7
CHEVROLET SILVERADO 3500	0	0	0
CHEVROLET AVALANCHE	N/A	0	0
TOTAL	9	3	12

TABLE 5-7 UWC EXTENDED WARRANTY CLAIMS - STALL WITH UNKNOWN DRIVING CONDITION
 N/A NOT APPLICABLE

In Table 5-8, GM reviewed each UWC warranty claim comment field and has identified claims where it was reported that the vehicle would not start.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	0	0	0
GMC SIERRA 2500	0	0	0
GMC SIERRA 3500	0	0	0
CHEVROLET SUBURBAN	1	0	1
CHEVROLET SILVERADO 2500	0	0	0
CHEVROLET SILVERADO 3500	0	0	0
CHEVROLET AVALANCHE	N/A	0	0
TOTAL	1	0	1

TABLE 5-8 UWC WARRANTY CLAIMS – NO START
 N/A NOT APPLICABLE

In Table 5-9, GM states the number of unique VIN where the comment field was left blank or where there is not information to relate to engine stall while driving condition, however, the claim indicated that the crank sensor was replaced.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	0	1	1
GMC SIERRA 2500	0	0	0
GMC SIERRA 3500	0	0	0
CHEVROLET SUBURBAN	0	0	0
CHEVROLET SILVERADO 2500	0	0	0
CHEVROLET SILVERADO 3500	0	0	0
CHEVROLET AVALANCHE	N/A	0	0
TOTAL	0	1	1

TABLE 5-9 UWC WARRANTY CLAIMS – COMMENT FIELD BLANK
 N/A NOT APPLICABLE

Extended Warranty- Motors Insurance Corp.

In Table 5-10, the MIC extended warranty database was searched using the same one labor code used for the regular warranty and GM states the number of unique VIN. Since there are no claim comments, GM is unable to determine the number of claims, if any, where the engine stalled while driving as a result the crank position sensor assembly failure.

MAKE/ MODEL/ MODEL YEAR	2001	2002	TOTAL
GMC YUKON XL	85	19	104
GMC SIERRA 2500	146	58	204
GMC SIERRA 3500	49	8	57
CHEVROLET SUBURBAN	217	55	272
CHEVROLET SILVERADO 2500	455	172	627
CHEVROLET SILVERADO 3500	149	31	180
CHEVROLET AVALANCHE	N/A	101	101
TOTAL	1,101	444	1,545

TABLE 5-10 MIC EXTENDED WARRANTY CLAIMS – J4355 CRANK SENSOR
 N/A NOT APPLICABLE

A summary of the warranty claims for Tables 5-2 through 5-10 are provided on the Attachment 1 CD; refer to the folder labeled: "Response for Q5." There are cases where the dealers used multiple labor codes/claims for the same VIN and incident. For this reason, the number of records provided will be greater than the counts provided in the tables.

The sources of the requested information and the last date the searches were conducted are tabulated in Table 5-11 below.

SOURCE SYSTEM	LAST DATE GATHERED
GM CARD --regular warranty	5/22/2006
Motors Insurance Corporation (MIC) – extended warranty	5/17/2006
Universal Warranty Corporation (UWC) – extended warranty	5/26/2006

TABLE 5-11: DATA SOURCES

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 numbers represent claims by our dealers for reimbursement for parts, labor, and other (such as towing and rental car) costs incurred in performing warranty service for our customers.

- 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.

See the Response for question 5 for the search criteria used to identify warranty claims.

The crankshaft position sensor is an emissions related component which is covered by a General Motors Federal Emission Control warranty for five years or 50,000 miles whichever occurs first. Many different extended warranty options are available through GM dealerships. They are offered at different prices and for varying lengths of time, based on customer's preference, up to 7 years from the date of purchase or up to a total of 100,000 vehicle miles. The GM 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.**

GM has identified the following communications that relate to the alleged defect on the subject vehicles in Table 7. Copies of the communications are provided on the Attachment 1 CD; refer to the folder labeled: "Response for Q7." GM is not planning to issue any service, warranty, or other documents within the next 120 days.

DOCUMENT I.D.	DOCUMENT TITLE	ISSUE DATE
1229999	P0335 or P0336 Crank Sensor Codes after Sensor Replacement #PI00779	01/23/2003

TABLE 7 BULLETINS AND OTHER DOCUMENTS

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 8.1L engines for the 2001-2002MY Chevrolet/GMC vehicles were built at GM's Tonawanda engine plant. Engineering responsibility for the 8.1L engine was with GM Powertrain North America.

Table 8 below summarizes the actions performed by GM and its supplier that relate to the subject condition. Documents are provided in the attachments as noted in the table. Data was gathered through June 29, 2006.

<p>Action: 8A, PIMREP Reports Start Date: 10/28/1999 End Date: 1/10/2000 Engineering Group: GM Powertrain Attachments: Documents can be found on Attachment 2 CD-GM CONFIDENTIAL, "Response for Q8" folder, "8A PIMREP" folder. Description: Beta and Prototype vehicle test incident reports on C/K 3500 with 8.1L engine with vehicle stall condition while driving due to crank position sensor. Summary of Action: The crank sensors were examined, no trouble found.</p>
<p>Action: 8B, 8.1L Engine Validation and Failure Mode Assessment Start Date: 11/23/1999 End Date: 2/28/2002 Engineering Group: GM Powertrain Attachments: Documents can be found on Attachment 2 CD-GM CONFIDENTIAL, "Response for Q8" folder, "8B Validation and DFMEA" folder Description: Validation tests and failure mode risk assessment for start of production as well as subsequent validation for process and design changes to the crank sensor. Summary of Action: Original Validation testing was completed as documented. Additional validation tests were conducted for the design and process changes subsequent to start of production.</p>
<p>Action: 8C, GM Powertrain 8.1L Engineering analysis and development Start Date: 2/20/2000 End Date: 1/8/2003 Engineering Group: GM Powertrain with sensor supplier, Optek Attachments: Documents can be found on Attachment 2 CD-GM CONFIDENTIAL, "Response for Q8" folder, "8C Eng Analysis and Dev" folder. Description: Engineering analysis from product and function focus team used to identify and understand field failures. Crank sensor was changed and the manufacturing process to eliminate solder cracks caused by mismatches of thermal coefficients between the two part epoxy fill and the solder within the sensor. Summary of Action: The primary root cause was identified within the supplier's epoxy backfill process using a two part epoxy. Focus was placed on process changes to improve epoxy mixing while design changes to the sensor body were implemented.</p>
<p>Action: 8D, GM Powertrain 8.1L Manufacturing analysis and process changes Start Date: 9/29/2000 End Date: 4/9/2002 Engineering Group: GM Powertrain and Optek (sensor supplier) Attachments: Documents can be found on Attachment 2 CD-GM CONFIDENTIAL, "Response for Q8" folder, "8D Mfgr Analysis and dev" folder Description: Manufacturing analysis Summary of Action: Supported engineering investigation, development and implementation of problem resolution.</p>
<p>Action: 8E, Management Review – Problem Resolution Focus GM Start Date: 9/30/2000 End Date: 11/12/2003 Engineering Group: GM Powertrain Attachments: Documents can be found on Attachment 1 CD, "Response for Q8" folder, "8E Mgmt</p>

<p>Review – Prob Resol Team” folder and Attachment 2 CD-GM CONFIDENTIAL, “Response for Q8” folder, “8E Mgmt Review – Prob Resol Team” folder. Description: Management reviews and focus group problem solving documents to identify root cause of crank sensor solder failures through warranty returns. Summary of Action: Identified root causes and implemented design and process change for the crank sensor.</p>
<p>Action: 8F, GM Powertrain 8.1L Engine Warranty and Field Return analysis Start Date: 11/3/2000 End Date: 10/30/2002 Engineering Group: GM Powertrain Attachments: Documents can be found on Attachment 1 CD, “Response for Q8” folder, “8F Warranty and Field Return Analysis” folder. Description: Warranty and field return analysis of J4355 crank sensor replacement. Summary of Action: Scope of crank sensor field issue identified and analyzed. Effectiveness of process changes, followed by new sensor design tracked and verified.</p>
<p>Action: 8G, Management Review – Problem Resolution Focus - Optek Supplier Start Date: 12/15/2000 End Date: 5/15/2002 Engineering Group: Optek Attachments: Documents can be found on Attachment 1 CD, “Response for Q8” folder, “8G Mgmt Review – Prob Resol Optek” folder and Attachment 4 CD- SUPPLIER CONFIDENTIAL, “Response for Q8” folder, “8G Mgmt Review – Prob Resol Optek” folder. Description: Management reviews and focus group problem solving documents to identify root cause of crank sensor solder failures through warranty returns. Summary of Action: Identified root causes and implemented design and process change for the crank sensor.</p>
<p>Action: 8H, Management Review – FPE Emissions Compliance Analysis and Reporting Start Date: 3/17/2003 End Date: 6/7/2005 Engineering Group: GM Powertrain Attachments: Documents can be found on Attachment 2 CD- GM CONFIDENTIAL, “Response for Q8” folder, “8H Mgmt Review - FPE ” folder Description: Analysis of crank sensor warranty for impact on vehicle emissions first for 2001MY and followed by 2002MY. Summary of Action: Analysis of crank sensor field failures concluded no significant impact on vehicle emissions. California Emissions Information Reports and Federal Emission Defect Information Reports were submitted to CARB and EPA respectively.</p>
<p>Action: 8I, Product Investigations Engineering Analysis Start Date: May 2006 End Date: On-going Engineering Group: GM Product Investigations and GM Powertrain Attachments: Documents can be found on Attachment 2 CD-GM CONFIDENTIAL, “Response for Q8” folder, “8I Prod Invest Analysis” folder Description: Review of engineering, manufacturing and field performance information for alleged defect. Summary of Action: GM is continuing its investigation to better understand the rate of stall while driving.</p>

TABLE 8 ACTIONS

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.

GM is providing a summary of the GM product engineering information requested in 9 (a-h) in Attachment 1 CD, folder labeled: "Response for Q9."

GM is not planning to incorporate any modifications or changes into production of the subject vehicles that relate to the alleged defect within the next 120 days.

10. Produce one of each of the following:
- An exemplar sample of each design iteration of the subject component that GM has used in the subject vehicles as either an original equipment part or as a GM service replacement part; and
 - Field return samples of each of the design iterations of the subject component exhibiting each known failure mechanism that may relate to the alleged defect (provide descriptions of each failure mechanism).
- GM is providing one sample of current production and service crankshaft position sensor (PN 12575172). Prior design versions were removed from service.
 - GM has not located a sample of a field-returned crankshaft position sensor that exhibits the subject condition at the time of this response.

The data was last gathered on June 29, 2006.

11. For each unique power braking system used in the subject vehicles, briefly describe how each system works including the major components and their locations on the vehicle(s). For each system describe in detail the reserve power assist braking and how it functions when an engine stall occurs due to the alleged defect.

All subject vehicles utilize a Hydro-BoostTM hydraulic brake booster which is part of the brake system. Below is a description of the Hydro-BoostTM operation.

Steering System with Hydro-Boost™

The hydraulic pump in the subject vehicles with Hydro-Boost provides power assist to both the steering system and the brake system.

The three primary components of the steering system on the subject vehicles with Hydro-Boost are the steering pump, brake booster, and steering gear.

Steering input from the driver is translated through the steering wheel and into the steering gear via the intermediate steering shaft assembly. Power steering fluid flows through the system from the hydraulic pump to the Hydro-Boost™ brake booster. Three hydraulic lines connect the brake booster to the steering system at the brake booster's pressure, gear, and return ports. The hydraulic pump is a common power source for the Hydro-Boost™ brake booster and the power steering gear. The power steering fluid not only assists the gear for steering, but also provides the brake booster with hydraulic fluid to "assist" the normal manual pedal brake apply. The magnitude of flow and pressure from the pump required to "power assist" both the steering gear and the brakes varies. The sizing of the steering gears and Hydro-Boost™ brake booster vary based upon the size of the vehicle. The pump flow and pressure specifications are established through the performance criteria, analysis and development testing of the various power assisted steering and brake components installed in the vehicle.

Hydro-Boost™ - Brake System

The Hydro-Boost™ brake booster is a hydro-mechanical device consisting of a spool control valve, a mechanical ratio changing mechanism, a power piston, and a gas charged accumulator transition system. Mounted on the front of dash, the booster is actuated through a suspended brake pedal. Fluid flow from the pump enters the Hydro-Boost™ brake booster through the pressure port, flows around the open center spool valve, and exits the brake booster from the gear port. Gear port flow travels to and through the power steering gear returning to the pump reservoir. The Hydro-Boost™ brake booster return port is necessary to allow a small amount of internal leakage and brake booster release flow to return to the pump reservoir. The brake booster primary valve has been designed in such a manner that the steering and braking systems do not noticeably interact.

The Hydro-Boost™ brake booster includes a gas charged hydraulic accumulator that provides a transition from power assisted brake applications to non-power assisted brake applications in the event that the hydraulic power source is interrupted and there is a loss of hydraulic pump hydraulic fluid flow and pressure supply loss.

The transition system consists of an accumulator, a check valve, a relief valve, a dump valve and an actuator. The accumulator uses nitrogen gas permanently stored in a cylinder with a movable piston. The accumulator is charged through the check valve by power steering fluid under pressure from the power steering hydraulic pump and is retained by the check valve when the charging pressure is reduced. Power steering hydraulic fluid pressure is generated by brake application and/or steering inputs. The relief valve controls the fluid pressure in the accumulator to prevent over pressurization. The dump valve is opened by the actuator to allow the stored pressurized fluid into the boost cavity providing power assisted brake applications.

The hydraulic pressure charge in the gas charged hydraulic accumulator is dependent on the prior steering or braking maneuvers. The hydraulic pressure in the accumulator will attain the highest pressure experienced in the power steering hydraulic system during prior braking or steering events. Both steering and braking maneuvers restrict the hydraulic pump flow and

thus generate the hydraulic pump pressure that provides the power assist for the steering gear or the Hydro-Boost™ brake booster. For example, with the engine running, if the steering wheel is turned to full lock and momentarily held against the steering stop, the hydraulic pump pressure relief valve will actuate and the Hydro-Boost™ accumulator will be fully charged. Similarly, an application of the brake pedal with sufficient force will actuate the hydraulic pump relief valve and the Hydro-Boost™ accumulator will be fully charged. Other steering and braking maneuvers will result in the Hydro-Boost™ accumulator being charged to the maximum pressure that was developed by the hydraulic pump.

The number of available accumulator-assisted brake applications can vary and is dependent upon the initial hydraulic pressure charge in the accumulator, the brake pedal force applied, the brake pedal travel and corresponding booster output rod travel, and the duration of each application of the brake pedal. Each brake pedal application will result in a reduction in the hydraulic pressure charge in the accumulator and a corresponding reduction in the level of power assist available in the accumulator for the next brake application. If the brake pedal is applied following a loss in the power steering hydraulic fluid flow and pressure supply, pressurized hydraulic fluid will transfer from the accumulator to the boost cavity. As fluid is discharged from the accumulator, the gas pressure in the accumulator is reduced, therefore, the available pressure is inversely proportional to the booster output stroke. It also follows that the available pressure in the accumulator is reduced with each successive brake application until the accumulator is depleted.

The accumulator hydraulic fluid depletion and corresponding reduction in accumulator pressure is a function of the duration (time) of a brake application. There is a small clearance between the booster spool valve and the housing bore which allows a small amount of internal leakage that contributes to the accumulator depletion when the brakes are applied during a loss in the hydraulic pump fluid flow and pressure supply. A brake application that does not bring the vehicle to a complete stop in the shortest possible time may cause the accumulator to become fully discharged and result in a loss of power assisted braking. The braking would then revert to the no-power manual brake operation requiring high brake pedal forces to stop the vehicle.

Additional technical information regarding the hydro-boost transition/reserve system performance, used in the subject vehicles, is contained in GM's response for question 8 of PE04-004/GM651 and question 10 of EA04-012/GM651A Information Request.

- 12. State the number of subject components that 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 (including the cut-off date for sales, if applicable).**

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.

The requested information is provided on the CD in Attachment 1, in the folder labeled: "Response for Q12." These sales numbers represent sales to dealers worldwide. This data has limited analytical value in analyzing the field performance of a motor vehicle component, because the records do not contain sufficient information to establish the reason for the part

sale. It is not possible from this data to determine the number of these parts that have been installed in the subject vehicles, or the number remaining in dealer or replacement part supplier inventory.

Monthly part sales information is available only for the most recent 24 months.

The source of the part sales information was gathered on May 18, 2006.

- 13. State by model and model year, whether the subject vehicle owner's manual gives any instruction, or discusses in any manner, the actions the vehicle operator should take, or not take, if an engine stall occurs, either while the vehicle is stopped or moving, and especially as regards the use of the brake system, movement of the gear shift selector, or restarting of the engine while the vehicle is moving. State by model and model year, whether the owner's manual gives any instruction, or discusses in any manner, changes in vehicle brake and steering system operation that result when an engine stall occurs. Provide copies of the pertinent sections of any owner's manuals.**

Drivers learn the basics of vehicle operation from formal or informal driver's education and are tested by their licensing states on various aspects of driving performance. The owner's manuals for each of these vehicles contain important cautions and information about the operation of those vehicles, but they cannot substitute for driver's education.

The operation of the brakes and steering when the engine is not running is discussed in the Braking and Power Steering sections of the manuals. In the context of the theft deterrent system and security light, restarting after an engine stall is mentioned. Poor fuel quality as a cause of stalling is mentioned in the discussion of the Malfunction Indicator Lamp. Shifting to neutral to start a moving vehicle is described in the discussion of Starting Your Engine—Automatic Transmission. Each of these owner manual sections is quoted below:

Passlock® theft-deterrent system

Passlock® is a passive theft-deterrent system. Passlock® enables fuel if the ignition lock cylinder is turned with a valid key. If a correct key is not used or the ignition lock cylinder is tampered with, fuel is disabled. During normal operation, the SECURITY light will go off approximately five seconds after the key is turned to RUN. If the engine stalls and the SECURITY light flashes, wait until the light stops flashing before trying to restart the engine. Remember to release the key from START as soon as the engine starts. If the engine is running and the SECURITY light comes on, you will be able to restart the engine if you turn the engine off. However, your Passlock® system is not working properly and must be serviced by your dealer. Your vehicle is not protected by Passlock® at this time. You may also want to check the fuses.

Security Light

The light will come on for five seconds after the key is turned to ON and then go off. If the light flashes, the Passlock® System has entered a tamper mode. If the vehicle fails to start, see "Passlock" in the Index. If the light comes on continuously while driving and stays on, there may be a problem with the Passlock® System. Your vehicle will not be protected by Passlock®, and you should see your GM dealer.

Malfunction Indicator Lamp (Service Engine Soon Light in the United States or Check Engine Light in Canada) (Gasoline Engine)

Your vehicle is equipped with a computer which monitors operation of the fuel, ignition and emission control systems. This system is called OBD II (On-Board Diagnostics – Second

Generation) and is intended to assure that emissions are at acceptable levels for the life of the vehicle, helping to produce a cleaner environment. The SERVICE ENGINE SOON or CHECK ENGINE light comes on to indicate that there is a problem and service is required. Malfunctions often will be indicated by the system before any problem is apparent. This may prevent more serious damage to your vehicle. This system is also designed to assist your service technician in correctly diagnosing any malfunction. If you keep driving your vehicle with this light on, after a while, your emission controls may not work as well, your fuel economy may not be as good and your engine may not run as smoothly. This could lead to costly repairs that may not be covered by your warranty. Modifications made to the engine, transmission, exhaust, intake, or fuel system of your vehicle or the replacement of the original tires with other than those of the same Tire Performance Criteria (TPC) can affect your vehicle's emission controls and may cause the SERVICE ENGINE SOON or CHECK ENGINE light to come on. Modifications to these systems could lead to costly repairs not covered by your warranty. This may also result in a failure to pass a required Emission Inspection/Maintenance test.

The SES light will come on during a malfunction in one of two ways:

Light Flashing – A misfire condition has been detected. A misfire increases vehicle emissions and may damage the emission control system on your vehicle. Dealer or qualified service center diagnosis and service may be required.

Light on Steady – An emission control system malfunction has been detected on your vehicle. Dealer or qualified service center diagnosis and service may be required.

If the Light is Flashing

The following may prevent more serious damage to your vehicle:

- Reducing vehicle speed.
- Avoiding hard accelerations.
- Avoiding steep uphill grades.
- If you are towing a trailer, reduce the amount of cargo being hauled as soon as it is possible.

If the light continues to flash, when it is safe to do so, *stop the vehicle*. Find a safe place to park your vehicle. Turn the key off, wait at least 10 seconds and restart the engine. If the light remains on steady, see "If the Light Is On Steady" following. If the light is still flashing, follow previous steps, and drive the vehicle to your dealer or qualified service center for service.

If the Light is On Steady

You may be able to correct the emission system malfunction by considering the following:

Did you recently put fuel into your vehicle?

Did you just drive through a deep puddle of water?

Have you recently changed brands of fuel?

If so, be sure to fuel your vehicle with quality fuel. See "Fuel" in the Index. Poor fuel quality will cause your engine not to run as efficiently as designed. You may notice this as a stalling after start-up, stalling when you put the vehicle into gear, misfiring, hesitation on acceleration or stumbling on acceleration. (These conditions may go away once the engine is warmed up.) This will be detected by the system and cause the light to turn on. If you experience one or more of these conditions, change the fuel brand you use. It will require at least one full tank of the proper fuel to turn the light off.

Starting Your Gasoline Engine – Automatic Transmission

Move your shift lever to PARK (P) or NEUTRAL (N). Your engine won't start in any other position – that's a safety feature. To start when you're already moving, use NEUTRAL (N) only. Don't try to shift to PARK (P) or REVERSE (R) if your vehicle is moving. If you do, you could damage the transmission. Shift to PARK (P) or REVERSE (R) only when your vehicle is

stopped. Shifting out of PARK (P) or NEUTRAL (N) while your engine is "racing" (running at high speed) is dangerous. Unless your foot is firmly on the brake pedal, your vehicle could move very rapidly. You could lose control and hit people or objects. Don't shift out of PARK (P) or NEUTRAL (N) while your engine is racing.

Braking

If your engine ever stops while you're driving, brake normally but don't pump your brakes. If you do, the pedal may get harder to push down. If your engine stops, you will still have some power brake assist. But you will use it when you brake. Once the power assist is used up, it may take longer to stop and the brake pedal will be harder to push.

Steering – Power Steering

If you lose power steering assist because the engine stops or the system is not functioning, you can steer but it will take much more effort.

Complete owner's manuals for the subject vehicles are in the Attachment 1 CD folder labeled Response for Q13.

14. Furnish GM'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), including the relative frequencies of subject component failures resulting in (1) stall while driving, and (2) no-start incidents;**
- d. The subject component failure rates at 12- and 36-months in service for all failure modes and the estimated percentage that have resulted in stall while driving;**
- e. The estimated failure rates at 5- and 10-years in service based on statistical modeling for all failure modes and the estimated percentage that would result in stall while driving;**
- f. The ability of an operator to restart a vehicle that has stalled while driving due to the alleged defect condition;**
- g. The risk to motor vehicle safety that it poses;**
- h. 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**
- i. The reports included with this inquiry.**

In 2003 and again in 2005, GM investigated crank position sensor failures (see Response for question 8, Action 8H, Management Review). Both investigations resulted in an Emission Defect Information Report (EDIR) and an Emissions Information Report (EIR) for given model years. GM has reviewed the data gathered for this response and believes that there is no unreasonable risk to safety for the following reasons:

- levels of stalling below four to five percent over three years are generally considered not an unreasonable risk to safety,
- customer reports and warranty claims with verbatim comments indicating stall while driving are a very low percentage (0.2 percent for 3 years of exposure) of the subject vehicle population,
- the same analysis indicates that 0.5 percent of the population may experience stall while driving over 7 years of exposure.
- customers may experience a Service Engine Soon (SES) light indicating a malfunction of the crank sensor prior to an engine stall, and
- there are no reported crashes, injuries, or fatalities.

Causal or contributory factors

The primary root cause of the crank sensor failure is internal stresses that are primarily driven by a mismatch in the coefficients of thermal expansion (CTE) characteristic between internal components within the sensor. Improperly mixed epoxy may produce differences in thermal expansion that cause breaks within the solder. The homogeneity of the epoxy greatly affects the adhesion of the epoxy to surface mount components, which affects how much stress is induced into the component.

Lack of homogeneity also results in resin-rich areas that corrode circuit board materials. Lead, copper and tin corrosion, which can short circuit areas of the circuit board, are the result of resin-rich epoxy reacting with those circuit board materials.

Failure mechanism

The powertrain control module (PCM) uses a crankshaft position sensor and camshaft position sensor to determine when each engine cylinder is in its compression or exhaust stroke.

The crank position sensor is integral to proper operation of the engine. Crank sensors can fail intermittently or permanently.

If a crank position sensor fails intermittently, the SES light may illuminate, the vehicle may run rough, the engine may stall, and may re-start immediately or after a cool down period.

If a crank position sensor fails permanently, the SES light may illuminate and the engine will quit running. The vehicle will not start, re-start, or continue running. If the vehicle is in motion, the vehicle will coast to a stop; similar to running out of gas.

Failure mode with frequencies/rates

This failure mode table summarizes information in responses to questions 2 and 5. There are additional warranty claims that were reported in Response for question 5. However, these claims do not provide enough information to identify which failure mode has occurred.

FAILURE MODES	REPORTS/%	WARRANTY/%	COMBINED/%
Stall while driving	289/0.26	147/0.14	436/0.53
Stall	879/0.81	141/0.13	1,020/0.94
No start	43/0.04	11/0.01	54/0.05

TABLE 14-1 FAILURE MODE WITH FREQUENCIES/RATES

The subject component incident rates at 1- and 3- years in service through Weibull analysis for all failure modes are shown in Tables 14-2 and 14-3. The subject component estimated incident rates at 5- and 7- years through Weibull analysis is shown in Table 14.4.

Group 1 represents vehicles built from Start of Production for 2001MY through November 15, 2000. Group 2 represents vehicles built from November 16, 2001 through End of Production for 2002MY.

FAILURE MODES	GROUP 1(%)	GROUP 2(%)	ALL 2001-2002MY (%)
Stall while driving	0.2	0.0	0.1
Stall	0.7	0.1	0.1
No start	0.1	0.01	0.02

TABLE 14-2 REPORT AND REGULAR WARRANTY INCIDENT RATES (1 YEAR)

FAILURE MODES	GROUP 1 (%)	GROUP 2 (%)	ALL 2001-2002MY (%)
Stall while driving	0.8	0.2	0.2
Stall	1.7	0.3	0.5
No start	0.2	0.02	0.04

TABLE 14-3 REPORT AND REGULAR WARRANTY INCIDENT RATES (3 YEAR)

FAILURE MODES	ALL 2001-2002MY	ALL 2001-2002MY
	5 YEAR (%)	7 YEAR (%)
Stall while driving	0.4	0.5
Stall	0.8	1.2
No start	0.05	0.07

TABLE 14-4 ESTIMATED REPORT AND REGULAR WARRANTY INCIDENT RATES

VOQ Assessment

The 11 VOQs (9 unique VINs) included with this inquiry may have resulted from the contributory factors noted above. GM has not examined the parts that are the subject of the reports; therefore, GM has not identified the specific contributory factors related to each of the complaints.

GM is continuing its investigation to better understand the rate of stall while driving.

* * *

GM claims that certain information, in documents that are part of lawsuit and claims files maintained by the GM Legal Staff, is attorney work product and/or privileged. That information includes notes, memos, reports, photographs, and evaluations by attorneys (and by consultants, claims analysts, investigators, and engineers working at the request of attorneys). GM is producing responsive documents from claims files that are neither attorney work product nor privileged, and withholding those that are attorney work product and/or privileged.

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 2000, 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,



Gay P. Kent
Director
Product Investigations

Attachments

GM-688
PE06-016

GM CONFIDENTIALITY LETTER

**GM CONFIDENTIALITY LETTER
HAS BEEN REMOVED FROM THIS
ATTACHMENT AND SUPPLIED TO
THE OFFICE OF THE CHIEF COUNSEL**

**GM-688
PE06-016**

Supplier Confidentiality Letter

**SUPPLIER CONFIDENTIALITY LETTER
HAS BEEN REMOVED FROM THIS
ATTACHMENT AND SUPPLIED TO
THE OFFICE OF THE CHIEF COUNSEL**

GM-688
PE06-016

ATTACHMENT "1"
GM NON-CONFIDENTIAL MATERIAL

**GM-688
PE06-016**

**ATTACHMENT "2"
GM CONFIDENTIAL MATERIAL**

**GM CONFIDENTIAL MATERIAL
HAS BEEN REMOVED FROM THIS
ATTACHMENT AND SUPPLIED TO
THE OFFICE OF THE CHIEF COUNSEL**

GM-688
PE06-016

ATTACHMENT "3"

DOES NOT EXIST

**GM-688
PE06-016**

**ATTACHMENT "4"
SUPPLIER CONFIDENTIAL MATERIAL**

**SUPPLIER CONFIDENTIAL MATERIAL
HAS BEEN REMOVED FROM THIS
ATTACHMENT AND SUPPLIED TO
THE OFFICE OF THE CHIEF COUNSEL**