



GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

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OFFICE OF DEFECTS
INVESTIGATION

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

N070126

NVS-213aan
PE07-023

Dear Mr. Quandt:

This letter is General Motors (GM) response to your information request (IR), dated May 16, 2007, regarding allegations of loss of steering assist due to failure or malfunction of the electronic power steering (EPS) assist in model year (MY) 2005 through 2006 Pontiac G6 vehicles manufactured by General Motors Corporation

Your questions and our corresponding replies are as follows:

1. **State, by 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. Date of manufacture;
- f. Date warranty coverage commenced; and
- g. 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 which provides further details regarding this submission.

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

MAKE	MODEL	2005	2006	TOTAL
Pontiac	G6	62,481	152,861	215,342

TABLE 1: VEHICLE PRODUCTION

The production information requested in 1a-1g is provided on the Disc in Attachment 1, in the folder labeled "Response to Q1;" refer to the Microsoft Access 2000 file labeled "PRODUCTION DATA. 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 1g. 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 2000 file.

Product Investigations

Mail Code: 480-210-G11 • 30001 Van Dyke • Warren, MI 48090
N070126 Response.doc



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 "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 "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 "d" 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.

Tables 2-1 below summarize records that could relate to the subject condition. GM has organized the records by the GM file number within each attachment.

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		CORRESPONDING TO NHTSA REPORTS	NUMBER WITH PROPERTY DAMAGE	NUMBER WITH CRASH	NUMBER* WITH INJURIES/FATALITIES
Owner Reports	112	6	0	10	2
Field Reports	1871	8	1	3	1
Not-In-Suit Claims	4	0	0	0	0
Subrogation Claims	2	1	0	0	0
Third Party Arbitration Proceedings	0	0	0	0	0
Product Liability Lawsuits	0	0	0	0	0
Total Reports (Including Duplicates)	1989	15	1	13	3
Total Vehicles with Reports (Unique VIN)	1886	10	1	12	3

TABLE 2-1: REPORT BREAKDOWN FOR 2005-2006 PONTIAC G6

* GM IS NOT AWARE OF ANY FATALITIES REPORTED FOR THE SUBJECT CONDITION

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 property damage is alleged;
- k. Number of alleged injuries, if any; and
- l. Number of alleged fatalities, if any.

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

The requested information is provided on the Disc in Attachment 1, in a folder labeled "Response to Q3;" refer to the Microsoft Access 2000 file in the labeled "REQUEST NUMBER TWO DATA."

SOURCE SYSTEM	LAST DATE GATHERED
Customer Assistance Center	5/31/2007
Technical Assistance Center	6/15/2007
Field Information Network Database (FIND)	6/6/2007
Company Vehicle Evaluation Program (CVEP)	5/29/2007
Captured Test Fleet (CTF)	5/29/2007
Early Quality Feedback (EQF)	5/29/2007
Field Product Report Database (FPRD)	6/6/2007
Legal / Employee Self Insured Services (ESIS)	6/12/2007

TABLE 2-2: DATA SOURCES

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 identified in Item 2 are provided in the attachments listed in Table 2-1. GM has organized the records by the GM file number within each attachment.

5. State, by 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 the EPS system 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;
- k. Comment, if any, by dealer/technician relating to claim and/or repair; and
- l. GM's assessment of the claims relationship to the alleged defect – use the following categories: "related," "not related," and "insufficient information."

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 which provides further details regarding this submission.

The 4,651 regular warranty claims for the subject vehicles that may be responsive to this request are summarized in Tables 5-1 and 5-2 below. A summary of these warranty claims is provided in Attachment 1 Disc; refer to the folder labeled, "Response for Q5."

Regular Warranty Claims for Steering Column/Motor Replacement (Labor Codes E7630, E7631, E7680)

MAKE	MODEL	2005	2006	TOTAL
Pontiac	G6	2,886	1,765	4,651

TABLE 5-1: REGULAR WARRANTY CLAIMS

MAKE	MODEL	2005	2006	TOTAL
Pontiac	G6	43	11	54

TABLE 5-2: MIC EXTENDED WARRANTY CLAIMS

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. No UWC Warranty claims were found. The warranty data was last gathered on June 6, 2007.

In response to Question 5I, the warranty claims lack sufficient information to accurately assess each as it relates to the following categories: "related," "not related," and "insufficient information" therefore, GM is unable to categorize the claims.

GM's warranty database does not contain the following information: vehicle owner's name or telephone number, replacement part number description, or customer concern statement. 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 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 and labor costs incurred in performing warranty service for our customers.

A summary of warranty claims that may relate to the subject condition is provided on the Attachment 1 Disc, in the folder labeled "Response to Q5;" refer to the Microsoft Access 2000 file labeled "REQUEST NUMBER FIVE - WARRANTY DATA."

6. 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 regular warranty data from the GM CARD Database was collected by searching the labor codes listed in Table 6-1 Trouble codes associated with the warranty claims that may be related to the subject condition are included in Table 6-2 below. Warranty claims that indicate customer concerns for squeaks and rattles have been removed.

LABOR CODE	DESCRIPTION:
E7630	Upper Column and Assist Assembly, Electronic Power Steering – Replace
E7631	Motor and Controller Assembly, Electronic Power Steering – Replace
E7680	Column Assembly, Steering – Replace

TABLE 6-1 LABOR CODES USED IN WARRANTY SEARCH

TROUBLE CODE	DESCRIPTION	TROUBLE CODE	DESCRIPTION
0B	OBDII Code used	3P	POOR RELEASE
1B	CASTING DEFECT	3X	REGISTERS INCORRECTLY
1D	BROKEN	4G	STRIPPED
1H	CLOGGED/RESTRICTED/BLOCKED	4Q	WEAK
2E	CLEARANCE-EXCESSIVE	4X	WORN
2F	CLEARANCE-TOO TIGHT	6C	COMPONENT-INOPERATIVE
2L	INCORRECT PRESSURE	6D	COMPONENT-INTERMITTENT
2N	INSUFFICIENT LUBRICATION	6F	COMPONENT-OPEN
2T	INCORRECT TORQUE	6G	COMPONENT SHORTED
2W	LOOSE	7L	WIRE-CUT/BROKEN/OPEN
3A	MISADJUSTED/MISALIGNED	7W	ELECTRICAL INTERFERENCE
3L	OUT OF CALIBRATION	93	TECHNICAL SERVICE BULLETIN
3N	POOR MACHINING	98	CUSTOMER SATISFACTION

TABLE 6-2 TROUBLE CODES USED IN WARRANTY SEARCH

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 and labor costs incurred in performing warranty service for our customers.

The subject vehicles are covered by a bumper-to-bumper new vehicle warranty for three years or 36,000 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 General Motor's warranty system does not contain information on the number of vehicles that have extended warranty coverage. The number of extended warranty coverage contracts on the subject vehicles that have been sold by MIC regardless of status (in-force, expired, cancelled) as of May 31, 2007 is contained in Table 6-3.

MAKE	MODEL	2005	2006	TOTAL
Pontiac	G6	12,883 / 294	24,288 / 860	37,121 / 1,154

TABLE 6-3: MIC / UWC EXTENDED WARRANTY COVERAGE CONTRACTS SOLD

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 found two service bulletins that relate to the subject condition that have been issued to dealers, regional or zone offices, field offices, fleet purchasers or other entities.

GM is not aware of any documents or communications to dealers regarding the subject condition that may be incorporated into vehicle production within the next 120 days.

The bulletins are included in the Attachment 1 Disc, "Response to Q7." The data collection was completed on June 19, 2007. The preceding information was collected from GM Service Operations.

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:**
- Action title or identifier;**
 - The actual or planned start date;**
 - The actual or expected end date;**
 - Brief summary of the subject and objective of the action;**
 - Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and**
 - 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 information listed in Table 8-1 below is a summary of actions performed by GM regarding the subject condition on the 2005-2006 MY Pontiac G6. Documents and additional supporting information is included in the following Attachments: Attachment 1 Disc GM Data, Attachment 2 Disc GM Confidential Data and Attachment 3 Disc Delphi Confidential Data, "Response to Q8" files. The data collection was completed on June 15, 2007.

<p>Action 8-1: GM Component Technical Specifications (CTS) Start Date: January 2005 End Date: January 2005 Engineering Group: GM Engineering Attachments: Attachment 2 Disc GM Confidential Epsilon, CTS, 1010-BA-14A.doc Description: The document includes the corresponding functions, performance, and validation required of the EPS systems electronic control unit (ECU).</p>
<p>Action 8-2: EPS Electrical Requirements Start Date: April 2003 End Date: January 2005 Engineering Group: Delphi Engineering Attachment: Attachment 3 Disc Delphi Confidential Disc in the file "CONFIDENTIAL - G6 Elect. Reqmts (CL07-010-033 - 163).tif" Description: The document specifies the electrical signal characteristics and connections between the vehicle electrical system and the EPS system.</p>
<p>Action 8-3: EPS Product Validation (PV) Summary Start Date: December 2002 End Date: February 2003 Engineering Group: Delphi Engineering Attachment: Attachment 3 Disc Delphi Confidential Disc in the file "CONFIDENTIAL - PV Summary (CL07-010-010 - 12).tif" Description: The document includes the analysis, development and validation plan for the G6 EPS system. Summary of Action: The G6 EPS system met all validation requirements</p>
<p>Action 8-4: Engineering Work Orders (EWO) Start Date: July 2004 End Date: January 2007 Engineering Group: GM Engineering, Delphi Engineering Attachment: Attachment 2 Disc GM Confidential Disc in the files BLCWV_WO347666.pdf, BTLCL_WO398008.pdf, BTXKZA_WO454746.pdf, BZTPH_WO506840.pdf, CHXKY_WO614592.pdf, CMZKB_WO600501.pdf and CMZKBA_WO688867.pdf Description: GM engineering work orders that pertain to the modifications and changes to the EPS system. Summary of Action: The EWOs were implemented on the dates shown in the documents</p>
<p>Action 8-5: PRTS Reports for 2006 G6 EPS system Start Date: January 16, 2004 End Date: March 17, 2006 Engineering Group: GM Engineering. Attachment: Attachment 2 Disc GM Confidential Disc in the files PRTS N138967.pdf, PRTS N152068.doc, PRTS N152134.doc, PRTS N198417.doc, PRTS N198420.doc Description: GM reports of EPS incidents that occurred on the subject vehicles between the dates shown above Summary of Action: The EPS incidents were documented and actions were taken to prevent additional occurrences as described in the EWOs.</p>
<p>Action 8-6: EPS Warranty Presentation Start Date: 9/2005 End Date: 9/2005 Engineering Group: Delphi Engineering Attachment: Attachment 3 Disc Delphi Confidential Disc in the file - CONFIDENTIAL- EPS Warranty (CL07-010-240 thru 244).pdf Description: Plots and plans to reduce EPS warranty claims (see CL07-010-240 thru 244) Summary of Action: Presentation was made to Lake Orion assembly to review warranty data and plans to reduce warranty claims</p>

Action 8-7: Fishbone Diagram Start Date: June 2007 End Date: June 2007 Engineering Group: Delphi Engineering Attachment: Attachment 3 Disc Delphi Confidential Disc in the file CONFIDENTIAL - G6 Fishbone Analyses (CL07-010-013 - 32).tif Description: Cause and effect diagram focusing on the alleged EPS malfunction Summary of Action: List of possible causes for each diagnostic trouble code and for loss of assist for an EPS system.
Action 8-8: Analysis of NHTSA VOQs Start Date: June 2007 End Date: June 2007 Engineering Group: Delphi Description: Plots and analysis of VOQ data (see CL07-010-206 thru 227) Summary of Action: VOQ categorized, Dealership/warranty service, Claims by VIN, Charts looking at the data in different ways, Delphi conclusions
Action 8-9: Field Component Analysis Start Date: 6/20/2007 End Date: Ongoing Engineering Group: GM and Delphi Engineering Attachment: None Description: Review of field vehicles that have experienced EPS failure and determine cause Summary of Action: The field vehicle analysis is continuing

TABLE 8-1 EPS 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 system and each of its component parts, 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 table of the process changes that occurred to the subject vehicle EPS in the Attachment 3 Delphi Confidential Disc, in a folder labeled: "Response for Q9." The details for the process changes and associated Engineering Work Orders (EWOs) are included in the response to Question 8-4.

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. Describe the number of separately serviceable components used in the subject system and state the number of each that GM has sold 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.

An electronic summary table of the requested service part information for the subject component is included in the Attachment 1 CD, in a folder named Response to Q10. GM is also providing a table that identifies the vehicles which contain the EPS system installed in the subject vehicles.

These sales numbers represent sales to dealers in the US and Canada. 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.

This table contains service part numbers, part description, part usage information including other GM vehicles that contain the identical component, part sales figures by month and calendar year and the supplier's name and address, contact name and phone number.

- 11. Provide the following information regarding the subject system operation and failure modes:**

- a. Provide a detailed description of the subject system operation, including all appropriate drawings/diagrams;**
- b. Provide copies of all Failure Mode and Effects Analyses related to the subject system and identify the specific failure modes GM believes are most pertinent to the incidents described in the owner complaints identified by ODI (and identified in GM complaints and field reports);**
- c. Describe all system fault diagnostics associated with the subject system and provide a list of all relevant trouble codes with code and name of each, as well as a brief description of the effect on vehicle operation;**
- d. State the force required to turn the steering wheel in the subject vehicle for both normal operation and for any reduced operating modes, including complete EPS system failure:**
 - i) 550 foot radius curve at 35 mph;**
 - ii) 550 foot radius curve at 45 mph;**
 - iii) Right turn at 20 mph;**
 - iv) Left turn at 20 mph; and**
 - v) 360 degree turn at full lock position at 5 mph.**
- e. For each of the conditions listed in 11.d, state the uncorrected change of vehicle course that would result from an EPS failure in the middle of the maneuver (i.e., with no additional force applied by the driver) – provide diagrams to illustrate test conditions and vehicles paths; and**
- f. GM's assessment of the probability of the EPS faults occurring during steering maneuvers.**

GM's Response is as follows:

- 11a: The Electric Power Steering Assist System (EPS) in the subject vehicles provides variable steering assistance based on steering wheel torque, steering wheel position and vehicle speed. The EPS uses the powertrain control module (PCM), body control module (BCM), power steering control module (PSCM), discrete battery voltage supply circuit, steering shaft torque and position sensor, power steering motor, driver information center (DIC), and serial data circuit to perform the system functions. The steering column has an input shaft, from the steering wheel to the torque and position sensor, and an output shaft, from the torque and position sensor to the steering shaft coupler. The input and output shafts are separated by a torsion bar, where the torque and position sensor is located. The steering shaft coupler is connected to the steering rack and pinion unit that is connected to the front wheels through the tie rods. The Delphi assembly drawing (CL04-010-209) shows the major component locations in the subject vehicles.

The steering torque and position sensor utilizes resistive film technology and contains redundant wipers moving along a resistive strip. The wipers provide dual signals for torque and position to the PSCM. As the steering wheel is turned, the torsion bar twists and one of the torque signals increases as the other signal decreases. The PSCM recognizes the change in the input signals as steering position and steering column shaft torque. Using predetermined system tuning, the correct amount of power assist is applied through the power steering motor based on steering column torque, position and vehicle speed.

The PSCM also uses the steering wheel torque and position sensor to determine the steering system on-center position. As the steering wheel is turned, dual signals representing the on-center steering wheel position increase and decrease as the steering wheel is turned. Depending on the steering wheel position and vehicle speed, the PSCM will command the power steering motor to the steering system on-center position. The PSCM has the ability to detect malfunctions within the power steering system. When the input signals are out of a predetermined range, an audible chime is sounded, the DIC displays a "Power Steering" warning message, the "Service Vehicle Soon" indicator illuminates, trouble codes are set and the system is disabled. When system malfunctions occur, a calibrated, "Soft Shut-down" feature disables the EPS at a predetermined ramp down rate. The failsafe ramp down feature provides a gradual transition from power assisted steering to manual steering.

GM is providing drawings and system interconnection diagrams in a document located in the Attachment 3 Delphi Confidential Disc "Response to Q11a," in file named "CONFIDENTIAL - EPS System Description (CL07-010-207 thru 216).pdf."

- 11b: GM is providing the Delphi Failure Mode and Effects Analyses (DFMEA and PFMEA) documents related to the subject system. The documents are located in the Attachment 3 Delphi Confidential Disc, "Response to Q11b," in files named "CONFIDENTIAL - DFMEA (CL07-010-164 - 175).tif and CONFIDENTIAL - PFMEA&Control Plan (CL07-010-176 - 205).tif."

For items listed in the DFMEA and PFMEA documents, failure modes related to loss of power to EPS module (DFMEA line items:15,17,18,19,78), full or partial loss of vehicle communication (DFMEA line items:16,27,70,71,72,73,74,75,92), torque sensor faults (DFMEA line items:17,18,19,26), or module duty cycle limits (DFMEA line item:93) may be related to the incidents reviewed by GM. The items listed may cause a loss of assist and in most cases will set a DIC message and the system reverts to manual steering. None of these items causes the steering system to lock-up. Some customers have

incorrectly reported manual steering higher effort as a steering system "lock-up", particularly if the vehicle was stopped or at very low speed.

- 11c: GM is providing both the vehicle level Diagnostic Trouble Codes (DTC) and the Delphi DTC associated with the EPS in the subject vehicles. The vehicle level DTC codes are located in the Attachment 3 Delphi Confidential Disc, "Response to Q8-2" in the file "CONFIDENTIAL - G6 Elect. Reqmts (CL07-010-033 - 163).tif", on pages 87-89. The Delphi DTC codes are located in the Attachment 3 Delphi Confidential Disc, "Response to Q11c," in file named "CONFIDENTIAL-G6 EPS Diagnostic Documents CL07-010-001 thru CL07-010-008.tif."

GM has reviewed the GM reports and warranty claims and has found that most incidents are related to loss of power to EPS module, full or partial loss of vehicle communication C2100, torque sensor faults C0545, or module duty cycle limits C0176. These will all cause a loss of assist and in most cases will set of a DIC message and the system reverts to manual steering. Some customers have incorrectly reported manual steering higher effort as a steering system "lock-up", particularly if the vehicle was stopped or at very low speed.

- 11d: To date, GM has not measured the torque required to perform the specific driving maneuvers or operating modes described above. The unassisted torque required to turn the hand wheel while the subject vehicle is parked is estimated to be between 55 and 62 Nm. The subject vehicles EPS is designed to provide a maximum of 55 Nm steering assist. The level of maximum required unassisted torque will drop by 50% to 60% when the vehicle is moving.

- 11e: As stated above, GM has not performed the driving maneuvers and is therefore unable to state the uncorrected change of vehicle course that would result from an EPS failure in the middle of the driving maneuver.

GM has designed the EPS system to engage a "Soft Shut-down" feature that disables the EPS at a predetermined ramp down rate when a system fault occurs. The failsafe ramp down feature provides a gradual transition from power assisted steering to manual steering.

- 11f: The EPS diagnostics are designed to monitor system functions whenever the ignition is "on." Several of the fault conditions including some on the torque sensor and motor phase current require a torque signal or motor current to be detected so they are more likely to occur during a steering maneuver. Additional EPS faults are no more likely to occur during a steering maneuver than during straight driving.

12. 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);
- d. The risk to motor vehicle safety that it poses;
- e. 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
- f. The reports included with this inquiry.

GM reviewed the warranty and field reports for EPS failure in the subject vehicles and found that many incidents occurred with vehicles that were produced between September 2004 and February 2005.

GM reviewed process changes and EWOs from the EPS supplier and determined that a significant amount of the incidents may be related to a continuous improvement plan to improve the EPS torque and position sensor terminal crimp process. The EPS supplier found that inadequate terminal crimps on the torque and position sensor may lead to erratic or loss of torque and position signals to the EPS controller. Inadequate terminal crimps were corrected by process improvements that were implemented in February 2005.

As stated in response to Question 11 the EPS diagnostics program continuously monitors the torque and position signals. When a loss or "out of range" torque is detected, an audible chime is sounded, the Driver Information Center displays "Power Steering," the "Service Vehicle Soon" lamp is illuminated, and the "Soft Shut-down" feature is enabled. The steering system gradually transitions from power assisted to manual steering mode, such that the vehicle can be steered in a safe and controlled manner. There is no evidence of lock-up in the steering system. Some customers have incorrectly reported manual steering higher effort as a steering system "lock-up", particularly if the vehicle was stopped or at very low speed.

A document describing the torque and position sensor crimp process improvements is included in "Response to Q8" in the Attachment 3 Disc Delphi Confidential Disc in the file-"CONFIDENTIAL EPS Warranty (CL07-010-240 thru 244).pdf."

GM does not believe the subject condition presents an unreasonable risk to motor vehicle safety for the following reasons:

- The driver is alerted by an audible chime, the DIC displays "Power Steering," and the "Service Vehicle Soon" lamp is illuminated when a torque or position signal drops out as a result of an inadequate terminal crimp.
- The system has been designed so that in the event of a torque sensor error in excess of the diagnostic limits (maximum error for longer than 30 ms), the steering system will gradually transition to manual steering mode and the vehicle can be steered in a safe and controlled manner. There is no evidence of lock-up in the steering system. Some customers have incorrectly reported manual steering higher effort as a steering system "lock-up", particularly if the vehicle was stopped or at very low speed.
- The mechanical linkage between steering wheel and road surface is similar to other steering rack systems used by other motor vehicle manufacturers for many years.
- Power steering assist is generated based on vehicle speed, steering wheel torque and position. The amount of power steering assist provided is greatest at low speeds (such as parking lot maneuvers) and is reduced as vehicle speed increases. Therefore, the loss of power steering assist is unlikely to be associated with crashes on streets and highways.

In Summary

The 2005 and 2006 Pontiac G6 EPS malfunction occurs when the electrical input signals from the torque and position sensor are not within predetermined parameters. When a loss or "out of range" torque is detected, an audible chime is sounded, the Driver Information Center displays "Power Steering," the "Service Vehicle Soon" lamp is illuminated, and the "Soft Shut-down" feature is enabled. The steering system gradually transitions from power assisted to manual steering mode, such that the vehicle can be steered in a safe and controlled manner. There is no evidence of lock-up in the steering system. Some customers have incorrectly

reported manual steering higher effort as a steering system "lock-up", particularly if the vehicle was stopped or at very low speed. Failure of the EPS has no effect on the mechanical linkage between the steering wheel, steering rack and wheels. The amount of power steering assist provided is greatest at low speeds and is reduced as vehicle speed increases. Therefore, the loss of power steering assist is unlikely to be associated with a crash or injuries.

* * *

General Motors requested assistance and documents from a supplier in responding to items 8, 9 and 11, and this response includes those documents received from suppliers.

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 August 2004, 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

**N070126
PE07-023**

GM CONFIDENTIALITY LETTER

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

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SUPPLIER CONFIDENTIAL LETTER

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ATTACHMENT "1"

GM NON-CONFIDENTIAL MATERIAL

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ATTACHMENT “2”

GM CONFIDENTIAL MATERIAL

**GM CONFIDENTIAL MATERIAL
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ATTACHMENT "3"
DELPHI CORPORATION
CONFIDENTIAL MATERIAL

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