GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

February 23, 2004

Richard Boyd, Chief
Medium & Heavy Duty Vehicle Division
Office of Defects Investigation
NHTSA Safety Assurance
Room #5326
400 Seventh Street, S.W.
Washington, D.C. 20590

GM-651

NVS-214njs
PE04-004

Dear Mr. Boyd:

This letter is General Motors (GM) response to your information request (IR), dated January 12, 2004, regarding shaft failures of the hydraulic pump used in the steering and/or brake systems installed on 2000 - 2002 model year (MY) 2500 and 3500 series trucks and vans.

The subject vehicles for this investigation are:

Chevrolet Avalanche, Silverado, Fleetside, Suburban, and Express; GMC Sierra, Savana and Yukon XL.

Your questions and our corresponding replies are as follows:

1. **Separately state, by model and model year, the number of subject vehicles, equipped with hydro-Boost and those without hydro-Boost that 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; and**
   f. **Date warranty coverage commenced.**

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

MODEL	2000 MY	2001 MY	2002 MY	TOTAL
Chevrolet Avalanche	0	0	6087	6087
Chevrolet Silverado/Fleetside	193,386	186,969	206,086	586,431
Chevrolet Suburban	7,918	17,199	7,881	32,998
Chevrolet Express	82,489	74,188	75,321	231,978
GMC Sierra	62,606	57,292	62,775	182,675
GMC Yukon XL	2,604	5,518	2,590	10,712
GMC Savana	31,988	28,523	26,381	86,872
TOTAL	380,973	369,659	387,121	1,137,753

Table 1 Vehicle Production

Product Investigations
Mail Code: 480-106-304 • 30500 Mound Road • Warren, MI 48090-9055
Phone: (586) 986-8029 • Fax: (586) 947-2318

The production information requested in 1a-1f is provided on the CD in Attachment 1; refer to the Microsoft Access 2000 file in the folder labeled "PRODUCTION DATA". All of the subject vehicles are equipped with Hydro-Boost except 43,947 Express and Savana vans. A column has been added to the "PRODUCTION DATA" file indicating for each Vehicle Identification Number (VIN) if the subject vehicle is equipped with Hydro-Boost.

The production information requested in 1a-1f does not include the state where an individual vehicle was sold, however, the "Data Collection Disc", Enclosure 1, provided with this request, does include a field for the two-digit abbreviation for the state where the vehicle was sold. GM is providing the state where the vehicle was shipped in response to this request. The GM database that contains VIN information does not include information on the state where an individual vehicle was sold. 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.

2. **For each brake system (hydro-boost and non-hydro-boost) 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 " f," 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 could relate to the subject condition. A summary of the non-privileged information related to the product liability lawsuit cases is provided in Attachment 2F.

Type of Report	Count (including duplicates)	GM Reports	GM Reports Corresponding to NHTSA Reports	Location of Reports (Attachment)	Number with Property Damage	Number with Injuries/ Fatalities*	Number with Crash
Owner Reports	245	242	3	2A	4	3	10
Field Reports and Technical Assistance System Reports	22	22	0	2B	5	0	12
Not-in-Suit Claims	1	1	0	2C	0	0	1
Subrogation Claims	0	0	0	N/A	0	0	0
Third Party Arbitration Proceedings	0	0	0	N/A	0	0	0
Product Liability Lawsuits	1	0	1	2F	0	0	1
Total (Including Duplicates)	269	265	4	N/A	9	3	1
Total (Excluding Duplicates)	261	257	4	N/A	8	3	19

Table 2-1: Report Breakdown

N/A Not Applicable
* GM is not aware of any fatalities related to the subject condition.

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

Source System	Last Date Gathered
Corporate Central File	01/20/2004
Customer Assistance Center	02/02/2004
Technical Assistance Center	01/23/2004
Field Information Network Database (FIND)	01/16/2004
Company Vehicle Evaluation Program (CVEP)	01/15/2004
Captured Test Fleet (CTF)	01/15/2004
Early Quality Feedback (EQF)	01/22/2004
Field Product Report Database (FPRD)	01/20/2004
Legal / Employee Self Insured Services (ESIS)	02/02/2004

Table 2-2: 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. **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 CD in Attachment 1, in a folder labeled Response to Q3; refer to the Microsoft Access 2000 file in the labeled " REQUEST NUMBER TWO DATA".

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.).**

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. **For each brake system (hydro-boost and non-hydro-boost) state, by model and model year, and hydraulic pump part number the 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, which provides further details regarding this submission.

The 18,607 regular warranty claims and 1,797 extended warranty claims for the subject vehicles that may be responsive to this request, are summarized by model and model year in Tables 5A and 5B. The combined regular and extended warranty claims are also summarized in Table 5C by hydraulic pump part numbers. A Hydraulic Pump Usage Chart, Attachment 5, has been provided that identifies the hydraulic pump assembly part number for the pumps installed on the subject vehicles by model and model year.

Regular Warranty Claims for Power Steering Pump Replace (Labor Code E9040)

MODEL	2000MY	2001MY	2002MY	TOTAL
Chevrolet Avalanche	0	0	35	35
Chevrolet Silverado/Fleetside	5,509	3,510	1,110	10,129
Chevrolet Suburban	146	340	35	521
Chevrolet Express	2,084	979	350	3,413
GMC Sierra	1,617	932	275	2,824
GMC Yukon XL	43	102	13	158
GMC Savana	879	499	149	1,527
TOTAL	10,278	6,362	1,967	18,607

TABLE 5A

Extended Warranty Claims for Power Steering Pump Replace

MODEL	2000MY	2001MY	2002MY	TOTAL
Chevrolet Avalanche			2	2
Chevrolet Silverado/Fleetside	516	344	54	914
Chevrolet Suburban	35	35	3	73
Chevrolet Express	303	80	25	408
GMC Sierra	157	99	18	274
GMC Yukon XL	72	26	2	100
GMC Savana	13	12	1	26
TOTAL	1,096	696	105	1,797

TABLE 5B

Regular and Extended Warranty Claims for Power Steering Pump Replace by Part Number

PART NUMBER	2000MY	2001MY	2002MY
26070099/26070078	3,338	1,584	528
26081016	4,114	3,376	878
15772444	0	496	336
15754191	0	1440	314
26069036	3,536	0	0
26041539	386	62	18

TABLE 5C

GM searched the GM North America Claim Adjustment Retrieval Database (CARD-regular warranty), the Motors Insurance Corporation (MIC – extended warranty), and the Universal Warranty Corporation (UWC – extended warranty) databases to collect the warranty data for this response. The warranty data was last gathered on January 13, 2004.

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

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 MIC and UWC extended warranty systems do not contain the following information: repair dealer name or code, trouble code, trouble code description, part number, or verbatim.

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.

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) related to the alleged defect that GM offered for the subject vehicles and state by option, model, and model year, the number of vehicles that are covered under each such extended warranty.**

The GM regular warranty data was collected by searching for the following labor code and trouble codes. The MIC extended warranty data was collected by searching only for the labor codes.

LABOR CODE	DESCRIPTION:
E9050	Pump Assembly, Power Steering - Replace

TROUBLE CODE	DESCRIPTION:
1A	Bent
1D	Broken
4D	Sheared
6C	Component Inoperative

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.

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 is not aware of any service or warranty documents that relate to the subject condition, that GM has issued to dealers, regional or zone offices, field offices, fleet purchasers or other entities.

General Motors is not planning to issue in the next 120 days, any service, warranty or other technical documents or communications to its dealers, regional offices, zone offices or other entities regarding the subject condition.

The preceding information was collected from GM Service Operations. The data collection was completed on February 2, 2004.

8. **For the two systems (hydro-boost and non-hydro-boost) provide a full technical description of the power steering and/or power brake systems as applicable.**

<u>Hydro-Boost - Steering System</u>
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 (reference Attachment 8 - Steering Component Schematic included on the Attachment 1 CD, in a folder labeled Response to Q8).

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 power steering pump to the hydro-booster. Three hydraulic lines connect the booster to the steering system at the booster's pressure, gear, and return ports. The hydraulic power steering pump is a common power source for the hydraulic brake booster and the power steering gear. The power steering fluid not only assists the gear for steering, but also provides the 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 brake hydro-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. Typically, the hydraulic power steering pump supplies 2 to 4 gallons per minute and has a 1000 to 1500 psi relief pressure.

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

The Hydro-Boost unit includes a pneumatic accumulator. The accumulator provides a transition between power assisted braking and manual braking in the event of pressure supply loss, i.e. the engine stalls, belt breaks, etc. The number of accumulator-assisted stops varies with previous inputs from the steering and braking maneuvers.

Non-Hydro-Boost - Steering System
The hydraulic pump in the subject vehicles with non-Hydro-Boost steering systems provides power assist only to the power steering system.

The two primary components of the power steering system on the subject vehicles that do not have hydro-boost are the power steering pump and steering gear.

Driver input is translated directly through the steering wheel and into the steering gear via the intermediate steering shaft assembly. As illustrated on Attachment 8, power steering fluid flows from the hydraulic pump to the steering gear through a single pressure line. The fluid then flows from the steering gear through a single return line back to the hydraulic pump.

The magnitude of flow and pressure from the pump required to provide power assist to the steering gear in non-Hydro-Boost steering systems varies just as it varies with Hydro-Boost systems. The sizing of the steering gear internal components, pump flow and pressure requirements are adjusted to meet the specifications established through performance criteria, analysis and development testing of the various power assisted steering components installed in the vehicle.

9. **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.

Hydraulic pump performance and early subject vehicle warranty data was discussed and evaluated with the pump supplier in the fall of 1999. GM has not identified documentation regarding this discussion and evaluation.

The supplier of the hydraulic pump in the subject vehicles is Delphi Automotive Systems. In order to assist General Motors in responding to this NHTSA Information Request, Delphi Automotive Systems has provided responsive information for items 8 through 12.

As a result of a search conducted January 30, 2004, for "actions" that relate to or may relate to hydraulic pump shaft failures, GM has identified a General Motors Problem Resolution Tracking System (PRTS) analysis summary that may relate to hydraulic pump shaft failure in the subject vehicles. A copy of the (PRTS) analysis summary is provided on the Attachment 1 CD, in a folder labeled Response to Q9; refer to the folder labeled "Attachment 9A" – in Microsoft Excel format. Attachment 9A contains the specific responses to items 9a-9f. The Problem Definition Form (PDF) documents referenced in Attachment 9A are included as Attachment 9B. The information contained in Attachment 9B was evaluated with the help of the supplier of the hydraulic pump in the subject vehicles.

In June 2001, Delphi conducted studies to assess hydraulic pump seizures, which can result in pump shaft failure. The Delphi documentation related to these studies is contained in Attachment 9C (Warranty and Ring/Rotor Clearance Analysis). The conclusions resulting from these "actions" indicate that the spinning pump rotor (which is connected to the pump shaft) can seize with the pump pressure and thrust plates causing the pump shaft to fracture. The Delphi information specifically responsive to items 9a-9f is contained on the documents. As a result of these "actions" Delphi developed and implemented a hydraulic pump seizure test in May 2003.

10. **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 and for similar model vehicles for model year 2003. For each such modification or change, provide the following information:**

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

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

Delphi has provided the information that follows regarding changes to manufacturing/quality control, which may relate to hydraulic pump shaft failure.

- November 1, 1999: Delphi Plant 3 retargeted the Pump Ring/Rotor clearance by 0.00005", and changed the housing surface flatness manufacturing limits from 0.0001" convex/0.0005" concave to 0.0001"convex/0.0006" concave.

- February 15, 2000: redundant Marposs gauging was added to measure Rotor thickness.

- May 15, 2001: Rotor surfaces taper controlled thru monitoring.

General Motors requested that Delphi make quality improvements to the hydraulic pump, on our behalf.

The hydraulic pressure plate design was modified from the current version to a Post Pressure plate design. Engineering Work Order (EWO) AZJZS (Attachment 10A) details the pump modification, indicates the reasons for the change and pump number information.

The Post Pressure plate design went into Delphi production on February 2, 2004; the previous design pressure plate was discontinued. The modified hydraulic pump was incorporated into vehicle production in February 2004. The new Post Pressure plate design is interchangeable with previous designs. The original unmodified pump was not withdrawn from production. The EWO indicates that existing stock is to be used. The modified pump was available as a service component in February 2004.

The Post Pressure plate consists of the addition of raised areas of material (posts) at the intake areas of the plate. Additional material was also added in the intake under-vane grooves to increase stiffness. These two raised surfaces rest on the cam ring and limit the intake surface areas of the pressure plate's deflection towards the pump rotor for given pressures compared to the original design. Attachment 10B contains section views of the hydraulic pump with the current pressure plate and the Post pressure plate.

11. State the number of each of the following 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:

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

For each component part number, provide the supplier's name, address, and appropriate point of contact (name, title, and telephone number) Also identify by make, model and model year, any other vehicles of which GM is aware that contain the identical component, whether installed in production or in service, and state the applicable dates of production or service usage.

An electronic summary table of the requested service part information for the subject component is provided on the Attachment 1 CD; refer to the Microsoft Excel file in the folder

labeled "Response for Q11." GM does not offer any kits that have been released or developed for use in service repairs specifically related to the subject condition.

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. The General Motors Service Parts System does not contain a title of a contact person for each component and is therefore unable to provide this information.

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.

The hydraulic power steering pump is the only hydraulic pump used in the brake and/or steering systems installed on the subject vehicles. The hydraulic pump in the subject vehicles with Hydro-Boost provides power assist to both the steering system and the brake system. The hydraulic pump in the subject vehicles that do not have Hydro-Boost supplies hydraulic pressure only to the power steering system. Failure of the hydraulic pump shaft in vehicles with and without Hydro-Boost, does not eliminate the ability to stop and steer the vehicle. Therefore, no unreasonable risk to motor vehicle safety exists. A driver can continue to stop and steer the vehicle after the loss of power assist.

Failure of the hydraulic pump shaft would contribute to loss of hydraulic pressure supplied by the pump to the hydro-booster, eventually resulting in depletion of brake power assist. The hydro-booster includes a pneumatic accumulator. The accumulator provides a transition between power assisted braking and manual braking in the event of pressure supply loss. After the accumulator supplied power assist is depleted, the brake system operates in the manual mode with increased brake pedal force required to attain desired stopping distances. The subject vehicles comply with the no-power brake assist condition stopping distance requirements identified in the Federal Motor Vehicle Safety Standards (FMVSS).

A failure of the hydraulic pump shaft could also result in steering control reverting to manual steering with the loss of the hydraulic pressure supplied by the pump for power steering assist. The power steering system is designed so that the driver can maintain control if the hydraulic pump exhibits a low fluid flow or no fluid flow condition. The effect of power steering assist is greatest at very low speeds (such as when parking) and lowest at highway speeds. Gradual changes in vehicle direction (low lateral g-levels) would require the least increase in steering wheel force. Therefore, the loss of power steering assist is unlikely to be associated in any way with serious injuries that might occur in a high-speed crash.

Investigation and analysis (collectively, "actions") taken to determine factors contributing to the alleged hydraulic pump shaft failures are identified in response to Item 9. Factors that may contribute to hydraulic pump shaft failures include:

- Pressure plate deflection/pump seizure
- Pressure plate flatness
- Improper ring/rotor clearance
- Oversized/tapered rotor

Failure of the hydraulic pump shaft resulting from any of the above contributory factors leads to degradation of the power steering and power brake assist resulting in steering control reverting to manual steering and increased brake pedal effort. The change in steering and braking effort indicate to the vehicle operator that there may be a malfunction in the hydraulic pump. Increased pump noise may be another indicator to the vehicle operator of hydraulic pump malfunction.

General Motors assessment of the reports included with this inquiry indicate that the alleged hydraulic pump shaft failures may have resulted from any of the contributory factors noted above. GM has not analyzed the hydraulic pumps alleged to have shaft failures; therefore, GM has not identified the specific contributory factors related to each of the alleged pump shaft failures.

* * *

GM claims that certain information, in documents that are part of 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 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 January 1, 1998, 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