



GENERAL MOTORS LLC
Global Vehicle Safety

March 27, 2019

Gregory Magno, Chief
Vehicle Defects Division – A
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Room W48-334
Washington, DC 20590

VIA EMAIL
G220387

NEF-101cl
PE18-012

**Re: General Motors LLC's Response to NHTSA's February 7, 2019 Information Request
in Investigation PE18-012**

Dear Mr. Magno:

This letter contains General Motors LLC's ("GM") responses to the information requests in your February 7, 2019 letter (the "**Requests**") relating to National Highway Traffic Safety Administration ("NHTSA") Preliminary Evaluation 18-012, which is a NHTSA investigation of "allegations of Brake Vacuum Assist Pump failures in certain model year (MY) 2014-2016 Chevrolet, GMC and Cadillac light trucks and SUVs manufactured by General Motors LLC (GM)." Unless otherwise defined herein, GM's responses rely on the defined terms in the Requests.

PRELIMINARY STATEMENT

The vacuum power brake assist system in the subject vehicles, as defined in the Requests (the "**Subject Vehicles**"), uses pressure generated by a belt-driven engine-mounted pump, referred to in the Requests as the subject component (the "**Subject Component**"). The pump is lubricated with engine oil, which flows into the pump through a filter screen. Under certain conditions and over a period of time, debris such as oil sludge can accumulate on the filter screen,¹ potentially restricting the flow of oil into the pump over time and gradually reducing the amount of vacuum pressure. While GM has received reports of other causes of reduced or lost vacuum assist, most reports of the condition appear attributable to this root cause. However, for completeness this Response is inclusive of the other potential causes.

¹ GM has two suppliers for these pumps: Wabco and Magna. Although the rate of occurrence is low for both pumps, the Magna pump is more susceptible to debris accumulation because the Magna pump's oil inlet filter screen has a much finer mesh.



The Subject Vehicles are equipped with a secondary, hydraulic, power brake assist system. When the vacuum assist system's pressure falls below a certain threshold, the hydraulic system activates to continue providing power assist to the brakes. In addition, a short time after vacuum pressure falls below a certain threshold, a "Service Brake Assist" message is displayed in the Driver Information Center. At all times, the brakes remain functional and exceed the requirements of S7.11 of Federal Motor Vehicle Safety Standard (FMVSS) No. 135, "Light Vehicle Brake Systems," and GM's internal requirements.

GM's document production relating to the responses in this letter is contained on the enclosed compact discs titled ATT_1_GM and ATT_2_GM_CONF. GM identified responsive documents by conducting a reasonable keyword and/or custodian search, as appropriate, of the primary GM electronic databases and document repositories that store potentially responsive documents in the ordinary course of business. GM's document production does not contain: (i) attorney-client privileged information or information protected as attorney-work product; or (ii) documents generated or archived in these locations after the dates that GM conducted its final searches.

Certain portions of these documents are exempt from public disclosure under the Freedom of Information Act (5 U.S.C. § 552(b)(4)) and 49 CFR part 512, and have been redacted in the copy contained on the enclosed compact disc. GM has submitted the unredacted, nonpublic copy of its document production to the NHTSA Office of Chief Counsel under 49 C.F.R. part 512.

Some of the documents in GM's production contain EDR data and personally identifiable information ("PII") (e.g., vehicle registration information or VIN, employee names, and customer/employee contact information). GM today submits documents with unredacted EDR data and PII with the understanding that NHTSA (or GM, if NHTSA prefers) will redact any PII before disclosing these documents to the public.

REQUESTS AND RESPONSES

REQUEST 1:

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. Subject component supplier name, part number and design versions installed as original equipment;
 - 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 2010, or a compatible format, entitled “PRODUCTION DATA.”

GM RESPONSE:

In response to your request that GM “[s]tate, by model and model year, the number of Subject Vehicles GM has manufactured for sale or lease in the United States,” GM provides the following table:

MAKE	MODEL	MODEL YEAR			TOTAL
		2014	2015	2016	
Cadillac	Escalade	0	28,178	27,971	56,149
Cadillac	Escalade ESV	0	17,375	19,009	36,384
Chevrolet	Silverado LD Crew	214,097	188,174	134,723	536,994
Chevrolet	Silverado LD Crew LTZ	71,625	67,357	39,068	178,050
Chevrolet	Silverado LD Ext	151,224	157,899	137,177	446,300
Chevrolet	Silverado LD Ext LTZ	16,532	9,571	8,795	34,898
Chevrolet	Silverado LD Reg	48,576	29,999	31,813	110,388
Chevrolet	Suburban	0	48,295	42,721	91,016
Chevrolet	Suburban LTZ	0	31,655	23,795	55,450
Chevrolet	Tahoe	0	95,259	77,322	172,581
Chevrolet	Tahoe LTZ	0	50,660	30,981	81,641
GMC	Sierra LD Crew	115,647	100,202	58,546	274,395
GMC	Sierra LD Crew Denali	10,924	20,119	15,390	46,433
GMC	Sierra LD Ext	48,200	20,606	36,564	105,370
GMC	Sierra LD Ext Denali	0	30,989	0	30,989
GMC	Sierra LD Reg	13,859	15,213	12,789	41,861
GMC	Yukon	0	35,549	28,902	64,451
GMC	Yukon Denali	0	29,074	26,149	55,223
GMC	Yukon XL	0	23,402	20,101	43,503
GMC	Yukon XL Denali	0	21,618	21,832	43,450
	TOTAL	690,684	1,021,194	793,648	2,505,526

TABLE 1-1: SUBJECT VEHICLES

GM has produced the information requested in subparts “a” through “h” on the ATT_1_GM disc in the folder labeled “Q_01.” Refer to the Microsoft Access 2010 file labeled “Q_01_PRODUCTION DATA.”²

REQUEST 2:

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 an injury or fatality;
 - d. Reports involving a fire;
 - e. Property damage claims;
 - f. Third-party arbitration proceedings where GM is or was a party to the arbitration; and
 - g. Lawsuits, both pending and closed, in which GM is or was a defendant or codefendant.

For subparts “a” through “g,” 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 “g” provide a summary description of the alleged problem and causal and contributing factors and GM’s assessment of the problem, with a summary of the significant underlying facts and evidence. For items “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.

GM RESPONSE:

GM prepared its response to subparts “a” through “g” by conducting a reasonable keyword search for potentially responsive claims in GM Customer Assistance Center (CAC), Technical Assistance Center (TAC), Product Assistance Center (PAC) and GM Legal records.

Table 2-1 summarizes responsive claims where both the Subject Component was reported to have malfunctioned and the vehicle operator reported experiencing extended vehicle stopping distance or diminished braking feel or effectiveness (including a “hard” brake pedal). For completeness, Table 2-2 summarizes additional claims that may be responsive because either the Subject Component was reported to have malfunctioned **or** the vehicle operator reported

² Although the engine is a traceable component, the Subject Component is not a traceable component. We have identified the Subject Component supplier by VIN based on engine assembly plant where possible. However, St. Catharines Propulsion Plant was building with pumps from the two suppliers at various times and we are unable to determine which pumps were built into which engine/vehicle.

experiencing extended vehicle stopping distance or diminished braking feel or effectiveness.³

Tables 2-1 and 2-2 also include reports of malfunctions of the Subject Component that were caused by something other than debris accumulation in the pump’s oil inlet filter. Some of these other causes are listed in the response to Request 11.

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		NUMBER WITH PROPERTY DAMAGE	NUMBER WITH FIRE	NUMBER WITH CRASH	NUMBER WITH INJURIES/FATALITIES
Owner Reports	1018	50	0	77	9/0
Field Reports	876	0	0	2	1/0
Not-In-Suit Claims	40	34	0	40	15/0
Subrogation Claims	0	0	0	0	0/0
Third Party Arbitration Proceedings	0	0	0	0	0/0
Product Liability Lawsuits	1	1	0	1	0/0
Total Reports (Including Duplicates)	1935	85	0	120	25/0
Total Vehicles with Reports (Unique VIN)	1807	56	0	83	15/0

TABLE 2-1: SUMMARY OF CLAIMS RESPONSIVE TO REQUEST 2A-2G

TYPE OF REPORT	GM REPORTS	SUBCATEGORIES			
		NUMBER WITH PROPERTY DAMAGE	NUMBER WITH FIRE	NUMBER WITH CRASH	NUMBER WITH INJURIES/FATALITIES
Owner Reports	545	18	0	31	3/0
Field Reports	612	2	0	3	0/0
Not-In-Suit Claims	8	6	0	8	4/0
Subrogation Claims	0	0	0	0	0/0
Third Party Arbitration Proceedings	0	0	0	0	0/0
Product Liability Lawsuits	0	0	0	0	0/0
Total Reports (Including Duplicates)	1165	26	0	42	7/0
Total Vehicles with Reports (Unique VIN)	1137	22	0	35	4/0

TABLE 2-2: SUMMARY OF CLAIMS THAT MAY BE RESPONSIVE TO REQUEST 2A-2G

In response to subparts "f" and "g," GM is producing the responsive, nonprivileged litigation records relating to the litigation cases listed above in Table 2-1 and Table 2-2. These records contain the requested information regarding 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.

³General brake performance claims, which neither alleged Subject Component malfunction nor included allegations that the operator experienced extended vehicle stopping distance or diminished braking feel or effectiveness, were not included as responsive records in Table 2-1 or Table 2-2.

A summary of the alleged defect, as defined in the Requests (the “**Alleged Defect**”), causal and contributing factors, and GM’s assessment based on underlying facts and evidence is provided in response to Request 11.

REQUEST 3:

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), street address, email address and telephone number;
 - d. Vehicle’s VIN;
 - e. Vehicle’s make, model and model year;
 - f. Vehicle’s mileage at time of incident;
 - g. Incident date;
 - h. Report or claim date;
 - i. Whether a crash is alleged;
 - j. Whether a fire is alleged;
 - k. Whether property damage is alleged;
 - l. Number of alleged injuries, if any; and
 - m. Number of alleged fatalities, if any.

Provide this information in Microsoft Access 2010, or a compatible format, entitled “REQUEST NUMBER TWO DATA.”

GM RESPONSE:

GM has produced the requested information for the Subject Vehicles on the ATT_1_GM disc in the folder labeled “Q_03.” Refer to the Microsoft Access 2010 file labeled “Q_03_REQUEST NUMBER TWO DATA.”

REQUEST 4:

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. Describe in detail the search methods and search criteria used by GM to identify the items in response to Request No. 2.

GM RESPONSE:

GM is producing the responsive, nonprivileged documents associated with responsive claims listed in Table 2-1 and Table 2-2. GM has produced these records in the Microsoft Access file labeled "Q_03A_REQUEST NUMBER TWO DATA" on the ATT_1_GM disc in the folder labeled "Q_03." To assist in the identification of the documents referenced in the summaries provided in GM's response to Request 2, GM has organized the records by the GM file number.

This response is based on searches of 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 [GM's] 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, in or after 1995, were involved in any way with" the activities identified by the ODI in subparts "a" through "d" of the "GM" definition provided in the Requests.

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

REQUEST 5:

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), street address, email address 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(s);
- h. Problem code(s);
- i. Diagnostic trouble code(s);
- j. Replacement part number(s) and description(s);
- k. Concern stated by customer;
- l. Cause as stated on the repair order;
- m. Correction as stated on the repair order; and

n. Additional comments, if any, by dealer/technician relating to claim and/or repair.

Provide this information in Microsoft Access 2010, or a compatible format, entitled “WARRANTY DATA.”

GM RESPONSE:

To collect warranty data responsive to this request, GM searched all databases containing warranty claim information which consists of the GM Global Analysis and Reporting Tool (“GART”) for data regarding regular warranty claims.

Table 5-1 summarizes the GART claims which may relate to the Alleged Defect, and was populated using the search method criteria described in GM's response to Request 6.⁴ A total of 20,333 claims were categorized as responsive.⁵ This amounts to a relatively low rate of 7.2 Incidents Per Thousand Vehicles (IPTV) at 36 Months in Services (MIS) for the total vehicle population listed in response to Request 1.

MAKE	MODEL	NUMBER OF CLAIMS			
		2014	2015	2016	TOTAL
Cadillac	Escalade	0	88	49	137
Cadillac	Escalade ESV	0	75	64	139
Chevrolet	Silverado LD Crew	823	1634	2933	5390
Chevrolet	Silverado LD Crew LTZ	214	515	731	1460
Chevrolet	Silverado LD Ext	150	172	138	460
Chevrolet	Silverado LD Ext LTZ	20	7	10	37
Chevrolet	Silverado LD Reg	55	22	29	106
Chevrolet	Suburban	0	669	1150	1819
Chevrolet	Suburban LTZ	0	498	655	1153
Chevrolet	Tahoe	0	1118	1706	2824
Chevrolet	Tahoe LTZ	0	464	630	1094
GMC	Sierra LD Crew	488	1109	1481	3078
GMC	Sierra LD Crew Denali	45	191	427	663
GMC	Sierra LD Ext	43	21	48	112
GMC	Sierra LD Ext Denali	0	33	0	33
GMC	Sierra LD Reg	19	11	15	45

⁴ GART does not contain the vehicle owner’s name or telephone number. Additionally, some replacement part numbers, part descriptions and customer concern code descriptions are not included in the GM warranty database. In response to subpart “i,” the Diagnostic Trouble Code (DTC) is not captured separately and, if available, is included in one of the verbatim fields.

⁵ GM identified responsive records based on the information supplied to GM by the servicing dealerships, which can contain material errors and omissions. Warranty records, for example, do not always accurately or completely describe the condition of the allegedly defective part at the time of the warranty correction, and service personnel may not consistently classify warranty repairs using the correct labor and trouble codes.

GMC	Yukon	0	292	542	834
GMC	Yukon Denali	0	70	41	111
GMC	Yukon XL	0	320	396	716
GMC	Yukon XL Denali	0	66	56	122
	TOTAL	1857	7375	11101	20333

TABLE 5-1: GART WARRANTY CLAIMS

GM has produced the requested information on the ATT_1_GM disc in the folder labeled "Q_05." Refer to Microsoft Access 2010 database labeled "Q_05_WARRANTY_DATA." In response to subparts "k" and "n," GM has included in these records all available dealer-provided "verbatim text" in the GART database relating to the responsive claims that are currently in GM's possession.

REQUEST 6:

- Describe in detail the search methods and search criteria used by GM to identify the claims 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 whether the diagnostic trouble codes are automatically reported to the warranty database electronically or manually entered into the warranty database by a claims administrator.

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.

GM RESPONSE:

To populate Table 5-1, GM searched the GART warranty database for the labor codes that GM identified as potentially related to the Alleged Defect. These labor codes are summarized in Table 6-1. Each warranty record may have up to five verbatim fields. All verbatim claim fields were read and a claim was determined to be responsive if the verbatim indicated that the claim may have been related to the Alleged Defect in the Subject Component. The diagnostic trouble codes are manually entered into the warranty database by the dealer in one of the five verbatim fields.

LABOR CODE	LABOR CODE DESCRIPTION
4023850	Vacuum Pump Assembly Replacement
4062760	Vacuum Pump Belt Replacement

2480118 ⁶	Replace vacuum pump, vacuum pump to booster hose, vacuum brake booster, and brake master cylinder
2441730	Power Brake Booster
2441640	Power Vacuum Brake Booster
2441500	Power Brake Booster Vacuum Sensor
2441600	Power Brake Booster Pump Replacement

TABLE 6-1: LABOR CODES USED IN GART WARRANTY SEARCH

Table 6-2 summarizes the terms of new vehicle warranty coverage offered by GM on the Subject Vehicles:

MODEL YEAR	MAKE	WARRANTY TYPE	WARRANTY TERMS
2014-2016	Chevrolet	Limited Bumper-To-Bumper	3 year / 36,000 miles
2014-2016	GMC	Limited Bumper-To-Bumper	3 year / 36,000 miles
2014-2016	Cadillac	Limited Bumper-To-Bumper	4 year / 50,000 miles

TABLE 6-2: NEW VEHICLE WARRANTY COVERAGE OFFERED BY GM ON SUBJECT VEHICLES FOR THE SUBJECT COMPONENT

Complete new vehicle warranty coverage details are provided on the ATT_1_GM disc in the folder labeled “Q_06.”

Many different optional extended warranty plans were available for the Subject Vehicles through GM dealerships. These plans were offered at different prices and for varying lengths of time, based on a customer’s preference.

REQUEST 7:

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 RESPONSE:

All service, warranty and other documents that may relate to the subject condition and have been issued to dealers, regional or zone offices, fleet purchasers or other entities are included in ATT_1_GM disc; folder labeled “Q_07.” This information was collected from GM Service Operations and completed on February 15, 2019.

⁶ This labor code is from Service Bulletin PIT5361 (and revisions A, B, C & D) which is the subject of investigation N15-164913 and described in response to Request 8.

REQUEST 8:

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.

GM RESPONSE:

The information listed in the following Table 8-1 is a summary of actions that GM is aware of as of February 18, 2019 that are responsive to Request 8. Documents and additional supporting information will be included in GM’s supplemental response on April 10, 2019.

<u>Action 8-A: GM Internal Investigation N15-164913</u>	
Start/End Dates	April 17, 2015 – July 29, 2015
Involved Engineering Groups	GM Global Safety and Field Investigations, GM Global Engineering
Description	GM investigated claims of increased brake pedal effort, hard brake pedal, and potentially increased stopping distance in 2014-2015 Subject Vehicles, caused by O-rings in the connector (check valve) between the vacuum pump and vacuum hose assembly that were damaged during assembly at the GM assembly plant.
Outcome	On July 29, 2015, upon review of the collected data, GM’s Safety and Field Action Decision Authority (SFADA) decided to close the investigation with no field action. Damaged O-rings were an extremely low rate of occurrence. Even in the event of a reduction or loss of vacuum supply, brake performance exceeds the applicable regulatory and GM internal requirements.

Associated Documents	Information and documents contained in GM's Global Vehicle Safety-Case Observation Review & Evaluation ("GVS-CORE") database related to investigation N15-164913. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-B: GM Internal Investigation N17-208329</u>	
Start/End Dates	March 14, 2017 – June 8, 2017
Involved Engineering Groups	GM Global Safety and Field Investigations, GM Global Engineering
Description	GM investigated claims of increased brake pedal effort, hard brake pedal, and potentially increased stopping distance in 2014-2017 Subject Vehicles due to reduced or lost vacuum brake assist.
Outcome	On June 8, 2017, upon review of the collected data, GM's Safety and Field Action Decision Authority (SFADA) decided to close the investigation with no field action. GM began periodically refreshing and reviewing field data through its Directed Monitor process.
Associated Documents	Information and documents contained in GM's Global Vehicle Safety-Case Observation Review & Evaluation ("GVS-CORE") database related to investigation N17-208329. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-C: GM Internal Investigation N17-215047</u>	
Start/End Dates	February 1, 2018 – June 28, 2018
Involved Engineering Groups	GM Global Safety and Field Investigations, GM Global Engineering
Description	GM investigated claims of increased brake pedal effort, hard brake pedal, and potentially increased stopping distance in 2014-2018 Subject Vehicles due to reduced or lost vacuum brake assist. The investigation was initiated from Directed Monitor of field claims from investigation N17-208329.
Outcome	On June 28, 2018, upon review of the collected data, GM's Safety and Field Action Decision Authority (SFADA) decided to close the investigation with no field action. GM continued to periodically refresh and review field data through its Directed Monitor process.
Associated Documents	Information and documents contained in GM's Global Vehicle Safety-Case Observation Review & Evaluation ("GVS-CORE") database related to investigation N17-215047. GM will produce these documents in its supplemental response on April 10, 2018.

<u>Action 8-D: GM Internal Investigation N17-217939</u>	
Start/End Dates	August 28, 2018 – December 20, 2018
Involved Engineering Groups	GM Global Safety and Field Investigations, GM Global Engineering
Description	GM investigated claims of increased brake pedal effort, hard brake pedal, and potentially increased stopping distance occurring concurrently with loss of power steering assist at low speeds in 2014-2018 Subject Vehicles.
Outcome	On December 20, 2018, upon review of the collected data, GM's Safety and Field Action Decision Authority (SFADA) decided to close the investigation with no field action due to extremely low rate of occurrence of the alleged concurrent double failure mode. The issues were already addressed separately under other individual investigations.
Associated Documents	Information and documents contained in GM's Global Vehicle Safety-Case Observation Review & Evaluation ("GVS-CORE") database related to investigation N17-217939. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-E: GM Internal Investigation N17-220278</u>	
Start/End Dates	November 18, 2018 – December 13, 2018
Involved Engineering Groups	GM Global Safety and Field Investigations, GM Global Engineering
Description	GM investigated claims of increased brake pedal effort, hard brake pedal, and potentially increased stopping distance in 2014-2018 Subject Vehicles due to reduced or lost vacuum brake assist. The investigation was initiated from Directed Monitor of field claims from investigation N17-215047.
Outcome	On December 13, 2018, upon review of the collected data, GM's Safety and Field Action Decision Authority (SFADA) decided to initiate an extended warranty (i.e., Special Coverage field action) for the Subject Vehicles for up to 6 years or 72,000 miles.
Associated Documents	Information and documents contained in GM's Global Vehicle Safety-Case Observation Review & Evaluation ("GVS-CORE") database related to investigation N17-220278. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-F: GM Engineering Studies</u>	
Start/End Dates	April 2015 – December 2018

Involved Engineering Groups	GM Engineering
Description	Investigation activities involved root cause analysis of the failure, remedy development, and validation testing, including system-level and vehicle-level evaluations at GM test facilities in Warren, MI and its Milford Proving Grounds.
Outcome	The test results are consistent with GM's response to Request 11.
Associated Documents	Information, documents and emails related to brake vacuum assist pump testing and studies. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-G: Magna Engineering Studies</u>	
Start/End Dates	March 2017 – December 2018
Involved Engineering Groups	Magna, one of the two suppliers of Subject Components.
Description	Magna analyzed returned parts from the field.
Outcome	Magna's conclusions were consistent with GM's response to Request 11 as it relates to causal or contributory factors, failure mechanisms and failure modes.
Associated Documents	Magna documents that GM has in its possession, custody, or control presented during GM meetings and reviews. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-H: Wabco Engineering Studies</u>	
Start/End Dates	September 2017 – December 2017
Involved Engineering Groups	Wabco, one of the two suppliers of Subject Components
Description	Wabco analyzed returned parts from the field.
Outcome	Wabco concluded that the returned pumps that were manufactured by Wabco passed all testing and there was no evidence to suggest a defect.
Associated Documents	Wabco documents that GM has in its possession, custody, or control presented during GM meetings and reviews. GM will produce these documents in its supplemental response on April 10, 2019.
<u>Action 8-I: Cooper-Standard Engineering Studies</u>	
Start/End Dates	November 2014 – March 2016

Involved Engineering Groups	Cooper-Standard, the supplier of the O-ring in the connector (check valve) on the vacuum hose assembly
Description	Cooper-Standard conducted root cause analysis of the O-ring failures identified in GM's investigation N15-164913, described in further detail above.
Outcome	Cooper-Standard concluded that the O-ring was not cut or out of place during its manufacture and met all specifications. The mating piece on the vacuum pump can cause damage to the O-ring during the assembly process if not assembled properly.
Associated Documents	Copper-Standard documents that GM has in its possession, custody, or control presented during GM meetings and reviews. GM will produce these documents in its supplemental response on April 10, 2019.

REQUEST 9:

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 number(s) (service and engineering) of the original component;
 - The part number(s) (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 RESPONSE:

Documents relating to Engineering Work Order ("EWO") history are provided in the ATT_2_GM_CONF disc; folder labeled "Q_09."

REQUEST 10:

10. 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 (including the cut-off date for sales, if applicable):
- a. Subject component; and
 - b. Any subject components 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.

GM RESPONSE:

The requested sales information for the Subject Component in both the production and service versions is provided on the ATT_1_GM disc; folder labeled "Q_10." There are two files, one for dealer repair orders (RO) and one for customer pay (PT). The RO file summarizes the sales volume by make, model, model year, and month of sale, for all GM vehicles, including the Subject Vehicles, and non-GM vehicles. The make, model and model year are not provided in the customer-pay file since VIN information is not available. The files also provide all available detailed sales information of the production, service, and remedy versions of the Subject Component, including its use in production or service, as well as supplier name, address, and point of contact information. 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.

REQUEST 11:

11. Furnish GM's assessment of the alleged defect in the subject vehicle models, 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 RESPONSE:

GM's assessment of the Alleged Defect in the Subject Vehicles is as follows:

- a. The Subject Vehicles' vacuum power brake assist system is pressurized by an engine-mounted pump. The pump is lubricated with engine oil, which flows into the pump through a filter screen. Under certain conditions and over a period of time, debris such as oil sludge can accumulate on the filter screen, potentially restricting the flow of oil into the pump over time and gradually reducing the amount of vacuum pressure generated. In a small percentage of cases, the pump may fail completely due to lack of lubrication if the pump is completely starved of oil. However, the secondary, hydraulic, power brake assist system activates when the vacuum assist pressure falls below a certain threshold. Even if the vacuum assist pump completely fails, the brakes still function and exceed all applicable regulatory requirements and GM's internal requirements for brake performance.

Some claims of reduced or lost brake assist in the Subject Vehicles can be attributed to other causes, but none appear to be a significant source of field reports. These other causes may include broken or worn out pump vanes, failed bearings, leaking pump seals, a broken belt or a stuck check valve⁷ that allows oil into the vacuum system.

- b. The primary failure mechanism is the accumulation of debris on the oil inlet filter of the vacuum assist pump, potentially restricting the flow of oil into the pump over time and gradually reducing the amount of vacuum pressure generated by the pump. GM has two suppliers for these pumps: Wabco and Magna. Although the rate of occurrence is low for both pumps, the Magna pump is more susceptible to debris accumulation because the Magna pump's oil inlet filter has a finer mesh. Poor quality oil or filters, or failure to change the engine oil at appropriate/recommended service intervals, may contribute to the condition.
- c. The failure mode is reduced vacuum brake assist, which can increase the amount of pedal effort required to brake the vehicle. Brake assist continues to be provided by the hydraulic system, which activates when the vacuum assist system pressure falls below a certain threshold. Although stopping distance may increase, brake performance exceeds the requirements set forth in S7.11 of FMVSS 135 and GM's internal requirements.
- d. GM does not believe this condition poses an unreasonable risk to motor vehicle safety for the following reasons:

⁷ The subject of investigation N15-164913 and described in response to Request 8.

- (i) Even with reduced vacuum brake assist, or in the rare case where vacuum brake assist is lost, the hydraulic power brake assist system is active and provides power assist to the brakes.
- (ii) Brake performance exceeds all applicable regulatory requirements and GM's internal requirements, based on the amount of pedal force required to decelerate the vehicle.⁸
- (iii) The reduction in brake assist occurs gradually over time as debris accumulates on the pump filter screen. There is not a complete loss of assist.⁹
- (iv) Even where the pump fails completely, multiple brake applies would be required to deplete the vacuum brake booster in most cases and the hydraulic power brake assist system is active and provides power assist to the brakes. Within a short time after the vacuum brake assist pressure falls below a certain threshold, the driver will be alerted to the condition by a message in the Driver Information Center.

e. The operator and persons inside the vehicle are alerted to the malfunction, and the malfunction is detectable, in the following ways:

- (i) Some occupants may hear a ticking noise coming from the engine compartment.
- (ii) The driver may feel vibration in the brake pedal or a change in the amount of pressure required to depress the brake pedal.
- (iii) Occupants may hear or feel the hydraulic brake assist system activate.
- (iv) A "Service Brake Assist" message will appear in the Driver Information Center within two to five minutes of vacuum level less than 20 kPA.

f. A summary chart of deceleration v. pedal force throughout the power brake assist range is provided on the ATT_2_GM_CONF disc in the folder labeled "Q_11." The test data will be produced in response to Request 8.

⁸ Measurements were taken according to GM specification GMW15102 Light Vehicle Brake System Performance-FMVSS135.

⁹ 90% partially failed pumps tested at the dealer produce > 20 kPA.

CONCLUSION

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

Sincerely,



Brian Latouf, Executive Director
Global Safety and Field Investigations

cc: Mr. Chris Lash
ODI_IRresponse@dot.gov

Attachments

ATT_1_GM: Public copy of GM's document production

ATT_2_GM_CONF: Nonpublic copy of GM's document production