



GENERAL MOTORS LLC
Global Vehicle Safety

September 19, 2014

Jeffrey L. Quandt, Chief
Vehicle Control Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Ave, SE, Room W48-312
Washington, DC 20590

N140165
Supplement 2

NVS -213krh
PE14-010

Dear Mr. Quandt:

This letter is General Motors' (GM) supplemental response to your request for additional information made during our August 21, 2014, Technical Discussion regarding allegations of inappropriate autonomous braking and other Electronic Park Brake (EPB) information while driving in model year (MY) 2014 Chevrolet Impala and 2013 MY Cadillac ATS peer vehicles.

Your email requests and our corresponding replies are as follows:

1. Please provide EPB diagnostic and FMEA for potential failures and what checks it does to prevent setting PB without driver actuation.

There are mechanisms that are part of the EPB module software to prevent inadvertent actuation of the EPB system. These mechanisms include switch state checks, appropriate message communication and EPB module health checks and internal ECU failure detections within timers or memory, this is within Mando Co. Ltd. (Mando) core software.

The responsive Mando information is not GM owned documentation. Mando has not completed their review of the documents for confidential information. GM will provide the Mando information as soon as their review is completed.

2. Please provide EMC results from testing, EMC equipment type used.

The production validation EMC testing reports indicate that all requirements are met.



GM requested assistance from suppliers in responding to this question. The responsive TRW EMC testing reports and Mando documents are not GM documents. TRW Automotive and Mando have not completed their review of the documents for confidential information. GM will provide the EMC test reports as soon as the supplier's review is completed.

3. Re: EPB - Hertz 2014 Impala, VIN# 2G1115SL8E9[REDACTED]. Please provide;

- **Hertz Rental Records (# of rentals/miles prior to alleged incident)**

The requested information is provided on the ATT_1_GM disk; folder labeled "Q_03", in the file labeled "rental records".

- **GM inspection/analysis summary**

General Motors has thoroughly investigated the subject vehicle and concludes that no anomalies in the vehicle are present that would allow the vehicle to apply the brake or electric park brake system (EPB) autonomously without driver interaction.

This conclusion is based on several areas of expertise inspecting and testing the subject vehicle. The Electrical system was tested in its received state both in Florida during the initial portion of this investigation as well subsequently in more detail at GM's Milford Proving Grounds test facility. In the received state all relevant systems were functioning normally and meeting requirements. This includes the Powertrain, EPB, Service Brake and Electrical Wiring associated with these subsystems. After gathering the data in the as-received state, our technicians began removing components and subsystems to allow wiring grounds and harnesses to be inspected. The wiring inspections did not yield any anomalies within the harness, individual wires, or ground locations. No chaffing or other evidence of wire damage in the relevant subsystems was found. Inspection of the base brake system found all hardware to be operational within specifications and no anomalies reported. Inspection and testing of the EPB system yielded the system fully functioning per design requirements with no anomalies detected. Finally, the EPB switch was measured and inspected within the Instrument Panel (IP) and confirmed it had proper clearance (and meets design tolerance requirements) and no physical conditions that would interfere with its operation. Once removed, the EPB switch was tested at the supplier (Omron) test facility and confirmed to be operational, with no suspect mechanical or corrosion anomalies on the physical parts.

In interviews with the driver and the driver of the trailing vehicle involved in the incident, the brake lights were illuminated at the time of the event. The brake lights were functional upon inspection of the vehicle in all cases. If the service brake or park brake system is applied while the vehicle is moving, brake lights are illuminated. The description of the type of deceleration incurred from the trailing vehicle driver indicated an “emergency” maneuver type stop. All indications lead the investigation to conclude the park brake was being applied. Based upon the inspections and detailed failure mode investigation, the conclusion of GM is the park brake switch did not fail causing the park brake to apply, that it was actuated by the driver.

- **EDR data report**

The requested information is provided on the ATT_1_GM disk; folder labeled “Q_03”, in the file labeled “EDR report”.

- **EPB switch supplier (Omron) x-ray and analysis report**

The EPB switch supplier (Omron), x-ray and analysis report indicate no abnormalities in the EPB switch. Omron has not completed their review of the document for confidential information. GM will provide the Omron analysis report as soon as the supplier review is completed.

4. Re: EPB - Enterprise 2014 Impala VIN# 2G1125S36E9 [REDACTED]. Please provide;

- **GM inspection/analysis status update**

Based on the CDR data, the event experienced by the driver in this incident is consistent with the EPB system apply state. The driver initially reported an engine stall, but the CDR data does not support this as engine speed is above 800 RPM during the pre-crash data log. While the police report indicates the rear wheels appear to be locked up when the vehicle was being moved off the road, it does not indicate if anyone had applied the system immediately at the scene while the car was on the road. It also does not indicate whether the wheels once the accelerator pedal was depressed were able to move freely. In normal operation of the park brake system, when the park brake system is engaged at 0 kph, if the driver does not release the system with the park brake switch, when they depress the accelerator pedal the system begins to disengage. There is a momentary “drag” feel when hitting the accelerator and starting to drive away while the system is releasing the physical cable puller. The rear wheels could appear “locked up” in this instance but “unlock” upon driving away. On September 10, 2014, during the vehicle inspection by ESIS and our GM expert team, the EPB system was functional and operating as

designed with no unexpected drag or application without applying the park brake switch.

Our ability to inspect this vehicle was limited to it's as-is state at the Enterprise service facility in Jacksonville Florida. We were not able to tear-down the vehicle as we did on the Hertz vehicle. We were limited to removing the EPB switch to x-ray and physically inspect it on site. The rest of the vehicle evaluation was limited to physical inspection of the EPB switch, the EPB wiring harness and the EPB module. We also collected a vehicle wide DTC report.

The results of this inspection found no anomalies in the relevant systems and could not duplicate the customer complaint. GM's position is that the driver actuated the park brake switch causing the park brake system to apply while driving down the road.

- **Records for any prior complaints (if any) on Enterprise vehicle.**

The requested information is provided on the ATT_1_GM disk; folder labeled "Q_04". This GM information was also provided on June 26, 2014 in our response to PE14-010.

- **EDR data report showing .3 to .6 transition and pedal applies.**

The requested information is provided on the ATT_1_GM disk; folder labeled "Q_04" in the file labeled "VIN 885 CDR Analysis 18SEP2014".

5. Re: EPB - Mt. Pleasant 2015 Impala VIN# 2G1125S3XF9 [REDACTED]. Please provide;

- **GM inspection/analysis/testing status update.**

On July 25, 2014, GM inspected this vehicle and interviewed the driver at the time of the alleged incident. GM then took ownership of the vehicle and drove it to Milford Proving Grounds for further inspection, testing and data analysis.

The vehicle was instrumented for data collection then driven 19,253 miles while simulated FCA alerts were generated every two minutes at a vehicle speed of 75 mph. The customer complaint could not be duplicated. GM has concluded that the alleged incident resulted from the cruise control disengaging or dropping-out. The cruise control drop-out and resulting deceleration appear to be perceived by some drivers as a braking event. By design, if an FCA alert is generated while the vehicle is in normal cruise control (vs. Adaptive Cruise Control), the cruise control system is disengaged.

6. Re: Driver awareness of the EPB 0.3g or 0.6g brake system authorizations;

- **Description of EPB switch functions when service brake applied.**

The EPB switch function is not affected by service brake pedal application and service brake system authorizations are not communicated to the driver.

- **For KSG equipped vehicles, how long does it retain its CDR data and in volatile or non-volatile memory. Is there any?**

The EDR, Event Data Recorder, for the Long Range Radar module stores information when it makes an Active Emergency Braking Request.

The Long Range Radar module stores event data according to the following:

When the Emergency Braking algorithm commands braking, the EDR data is stored in RAM (Volatile memory).

Once the vehicle is cycled from Run to OFF or Accessory mode, the module writes the data from RAM to EEPROM (Non-Volatile memory)

This data is time stamped. There is no time limit for data retention.

The EDR has only one buffer file, so only the most recent event is stored and time stamped.

- **Exponent report on EPB and EBCM software review.**

Exponent has reviewed the customer complaints associated with braking in Impala and Malibu vehicles. As part of their review and analysis, they have studied the overall architecture of the braking system in the 2013 and 2014 Impala and the 2013 Malibu. They have also reviewed the GM specifications for the electronic parking brake (EPB) module and the front camera module (FCM).

Exponent's analysis to date has involved a detailed review of:

- The hardware design documents and the source code of the EPB module provided to Exponent by Mando.
- The source code of the FCM module provided to Exponent by Magna (It is Exponent's understanding that the image processing and object detection hardware and software that are part of the FCM are included in an off-the-shelf sub-assembly manufactured by Mobileye. Exponent did not review the hardware or software of this sub-assembly).

Exponent has had several meetings with TRW on the overall architecture and design of the electronic brake control module (EBCM). However, they did not so far receive source code from TRW to conduct similar in-depth review of the software. Exponent believes it is important that such a review is done, together with the other modules they reviewed. They are currently waiting for access to the EBCM hardware design documents and the source code to complete their analysis prior to completing their review and making available their report.

- **Summary of EPB theory how the PB could apply with running reset.**
 - a) **Mechanical failure of the switch.**
 - b) **Corrosion failure from electrochemical cleaning products or water.**

The responsive information is provided on the ATT_1_GM disk; folder labeled "Q_06" in the file labeled "2014_Impala_CLUSTER_EPB system" and on the ATT_2_GM_CONF disk in folder "Q_06".

7. Re: EPB GM China-related engineering investigation N140471 Brake Drag

- **PB drag root cause and an example of issue customer experienced.**

The root cause is when the driver disengages the electronic parking brake, the piston actuation arm does not travel back far enough due to a defect in the electronic parking brake software, which may cause the brake pads to stay partially engaged with the rotor. In this condition, the parking brake indicator may not illuminate even though the parking brake is engaged, which would render a vehicle noncompliant with FMVSS 135. General Motors has decided that certain 2013 – 2015 model year (MY) Cadillac XTS and 2014 – 2015 MY Chevrolet Impala vehicles may fail to conform to S5.5 of Federal Motor Vehicle Safety Standard (FMVSS) 135 (Brake system warning indicator). Refer to NHTSA Recall 14V541.

The customer may experience brake drag causing the vehicle not to move when trying to accelerate, poor vehicle acceleration or undesired deceleration during an idle coast down. The customer complaint is "brakes dragging", "brakes locked", or "brakes applied". Brake drag could result in excessive heat and premature wear to some brake components over time. This is the customer experience described in VOQ 10622353.

- **Analysis summary showing why it's not related to PE14-010.**

PE14-010 is related to a sudden significant deceleration, resulting from any one or more of the following symptoms or conditions:

1. Active Emergency Braking system failure or malfunction, including all associated fault codes;
2. Automatic collision preparation system failure or malfunction, including all associated fault codes;
3. Allegations of driver warnings due to false forward sensing surveillance;
4. Allegations of missed emergency braking activations; or
5. Allegations of brakes activating without driver application.

While the issue in GM investigation N140471 is a park brake drag issue stemming from a continuous low level of deceleration imparted to the vehicle noticed by the driver immediately upon driving, or gradually becoming aware of, while driving at higher speeds. In the worst cases there is a potential for the rear brakes to generate smoke and/or sparks.

GM's analysis of the alleged condition in PE14-010 was provided in our June 6, 2014 response. GM's analysis of the EPB drag issue is contained in the N140471 Safety Field Action Decision Authority (SFADA) presentation provided on the ATT_2_GM_CONF disk in folder "Q_07".

- **GM's assessment of whether the incidents described in the two VOQ's (10627565 & 10622353) are related to the issue addressed by the non-compliance recall.**

VOQ 10627565: 2013 Cadillac XTS VIN 2G61N5S3XD9 [REDACTED]:

This vehicle was jointly evaluated by GM and NHTSA Engineer Bill Collins on September 5, 2014 in Dublin, Ohio. The evaluation and data collection confirmed that the incident described in the VOQ is related to the issue addressed by the Recall 14V541. The evaluation also confirmed that there was no evidence of an open flame around either rear wheel. Recall 14V541 remedy (software update) was installed on the vehicle and demonstrated that the electronic park brake module returned to a position that addressed the drag issue.

VOQ 10622353: 2014 Chevrolet Impala VIN 2G1125S34E9 [REDACTED]:

Warranty claim information for this vehicle, included in the SFADA presentation and review of the VOQ information indicate the issue on this vehicle is related to Recall 14V541.

- **GM's assessment of the drivers' allegations of brake lock-up and fire.**

Our assessment of the driver allegations, warranty claim information and vehicle inspections indicates there is a potential to experience brake drag. Brake drag could result in excessive heat and premature wear to some brake components over time. The fire comments from drivers could be from the rear brake smoke caused by drag, but may not be actual "fires". This was supported by the investigation on a "fire" complaint vehicle at Dublin, Ohio on Sept. 8, 2014, where the NHTSA investigator Bill Collins felt that there was never a fire present due to the good condition found of all the rubber and plastic components in the vehicle.

- **Explanation of range of rear brake clamp forces from mechanical park brake system (normal operation) and how these forces are calculated and achieved;**

The vehicle is held on grades via retarding torque imparted to the rotor by increasing the caliper clamp load through a caliper lever pulled on by a cable system. The required torque for a given vehicle is calculated (using GVM and maximum tire/wheel radii) and compared to the cable input vs. static torque information from supplier testing, and the target cable force is then known. The cable force efficiency losses are then considered to attain the target force for the EPB module. This EPB target force is then achieved in the module by direct measurement of the cable force via an internal module force transducer.

- **GM assessment of range of residual rear brake clamp/drag forces resulting from the incomplete release/drag condition addressed by the non-compliance recall (this information relates to detectability and length of time vehicle may be operated with drag condition). Also, please include an explanation of how this may relate to brake lamp illumination during brake drag condition, including a full explanation of factors affecting lamp illumination during each type of park brake application;**

The EPB does not detect a range of residual rear brake clamp/drag forces resulting from the incomplete release/drag condition. The vehicle may operate indefinitely while in this condition if the driver does not perceive and react to the residual rear brake drag.

There are two types of park brake application requests. A Static request (for vehicles speeds from 0-4 kph) accomplished via park brake cable force and travel on the rear brakes, and a Dynamic request (vehicle speeds over 4 kph), accomplished via the hydraulic brake system. An EPB switch activation only requests brake lamp illumination when it is pulled for Dynamic requests. In the Dynamic request, when the EPB switch is released back to the neutral position the request for brake lamp illumination is terminated.

This residual rear brake drag resulting from the incomplete release of the park brake stems from an incomplete release after a Static apply. Since there is no request for EPB action for Static requests, there is no brake lamp illumination request from the EPB during the Apply or subsequent attempted release.

- **Copies of all EFADC (SFADA) presentations associated with the brake drag issue;**

The requested information is provided on the ATT_2_GM_CONF disk in folder "Q_07".

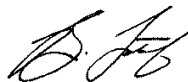
- **Description of the remedy procedure for the recall.**

The remedy for Recall 14V451 is provided in the SFADA presentation on the ATT_2_GM_CONF disk in folder "Q_07".

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Please contact me if you require further information about this supplemental response.

Sincerely,



Brian Latouf, Director
Field Product Investigations & Evaluations

Attachments