



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 15-021
Date Opened: 06/01/2015
Investigator: Kareem Habib
Approver: Michael Brown
Subject: False Positive Automated Braking
Date Closed: 09/28/2016
Reviewer: Jeff Quandt

MANUFACTURER & PRODUCT INFORMATION

Manufacturer: Chrysler (FCA US LLC)
Products: 2014-2015 Jeep Grand Cherokee w/Forward Collision Warning
Population: 95,178
Problem Description: The Forward Collision Warning (FCW) system may activate with no apparent threat of collision evident to the driver, resulting in unexpected deceleration.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	22	163	176**
Crashes/Fires:	0	0	0
Injury Incidents:	0	0	0
Fatality Incidents:	0	0	0

** Total eliminates duplicates received by ODI and manufacturer.

ACTION / SUMMARY INFORMATION

Action: This Preliminary Evaluation is closed.

Summary:

On June 1, 2015, the Office of Defects Investigation (ODI) opened Preliminary Evaluation PE15-021 to investigate 9 complaints alleging incidents of unintended braking in model year (MY) 2014 Jeep Grand Cherokee vehicles, including 2 alleging incidents of full ABS braking. ODI expanded the scope to include MY 2015 Grand Cherokee vehicles and identified a total of 176 incidents in complaints provided by FCA or submitted to ODI by consumers.

ODI conducted the following work to assess the alleged defect in the subject vehicles: 1) evaluated the design of the subject Forward Collision Warning (FCW) system, including the maximum braking authority during automated braking; 2) analyzed the frequency and severity of field incidents of unintended braking; 3) analyzed warranty data for evidence of system faults that may be related to the alleged defect; and 4) reviewed the performance of the subject system in testing conducted as part of NHTSA's 2014 Automatic Emergency Braking (AEB) test program.

ODI's analysis found that the maximum brake activations that can be commanded by the subject system are limited in both braking force and duration. The system is not capable of achieving full ABS braking, as alleged in some complaints, unless driver brake application triggers the Advanced Brake Assist (ABA) mode. Analysis of field data found that unintended braking events occur randomly for a variety of causes and are not driven by any single environmental factor, traffic condition, or vehicle fault. The incidents involve short duration moderate braking events with minimal changes in vehicle speed. None of the incidents resulted in crash or injuries. The subject vehicles performed as well or better than peer vehicles in testing conducted as part of NHTSA's AEB test program.

This preliminary evaluation is closed. The closing of this investigation does not constitute a finding that a safety related defect does not exist. For additional information, see the closing resume appendix and the investigation file for PE15-021.

APPENDIX

SYSTEM DESCRIPTION: The Forward Collision Warning (FCW) system is a driver assistance feature that is available as a purchase option in four of the six trim levels available for the subject vehicles. The system functions to mitigate the risk or severity of rear end collisions that may result from driver inattention.

Component	Supplier	Model	Location
Driver Assistance System Module (Figure 1)	Bosch	LRR3 Long Range Radar 76.5 GHz	Front lower grill: Horizontal offset = 0.0m Height = 0.424m
Forward Facing Camera (Figure 2)	TRW	S-CAM2 Mobileye EyeQ2	Behind windshield near rear view mirror
Brake System Module (BSM)	TRW	TRW 450 – 2 Piston Pump	Under hood, driver side

Table 1. FCW Components.

Table 1 provides basic information about the three main components of the FCW system: 1) the Driver Assistance System Module (DASM); 2) the Forward Facing Camera (FFC); and 3) the Brake System Module. The general locations of the DASM and FFC are shown in Figure 3.

The FCW functions when the system is switched ON (Figure 4), the vehicle is in Drive gear, the vehicle is not in 4WD Low gear¹, and vehicle speed is ≥ 2 m/s (4.5 mph). If the DASM detects an object in the path of travel and predicts that a collision is possible, it provides an auditory alert to the driver and displays a visual warning in the Driver Information Display. If the driver does not respond to these warnings with sufficient steering or braking, the DASM may request a brief brake application (“Brake Jerk”) as a further warning to the driver of the potential collision. If the driver still does not take action in response to the progressive warnings, the FCW system will provide a limited level of Autonomous Emergency Brake (“AEB”) to slow the vehicle and mitigate the risk and severity of a forward collision.

Brake applications associated with Brake Jerk are intended as haptic alerts to prompt driver braking. These are very short in duration (300 – 400 ms), provide limited braking (decelerations of approximately -3 m/s²) and do not cause significant reductions in vehicle speed (less than 3 mph). Brake applications associated with AEB are also limited in duration (less than 2 s), maximum deceleration (-3 m/s²) and speed reduction (maximum 15 mph). The brake lamps are illuminated during all Brake Jerk and AEB braking events.

The FCW system is designed to retain the last setting selected by the driver after turning off the vehicle and owners have the ability to turn FCW features ON or OFF through a switch on the center stack area of the dashboard. Two programmable features in the radio allow the user to select the sensitivity of the FCW system engagement (Figure 4). The FCW setting is responsible for the distance threshold at which

¹ The system is not intended for off-road environments - if the vehicle enters 4WD Low, the FCW system will automatically deactivate.

the system will begin to warn the driver of a possible collision and the default selection for this feature is FAR. At the FAR setting, the FCW system will warn the driver earlier of a possible collision. The second setting- forward collision warning active braking- turns on or off all autonomous braking and the default position for this feature is set to ON. Starting MY 14.5, FCW warnings do not include haptic alerts related to Brake Jerk and the haptic feature will turn on only when the forward collision warning active braking setting is enabled.

FIELD EXPERIENCE: FCA made several changes in the programming of the FCW system during production of the subject vehicles to update system activations on certain driving scenarios (e.g. McDonalds turns, target detection improvements, driving mode threshold calibrations...etc.), with the changes in calibration noted by Assistance Feature Release Number (AFRN). ODI's analysis of the vehicle production, vehicle exposure, incident count, failure rate and exposure adjusted failure rate data for each AFRN are shown in Table 2. The analysis shows that there was a 41 percent reduction in incident rate per year of exposure in calibrations implemented after April 2014. Complaint analysis indicated low severity for activation incidents occurring for all AFRN's, with incident characteristics involving extremely brief durations and limited braking, as noted in the System Description section of this report. No crashes or injuries were identified in ODI's analysis of unintended braking incidents. Additionally, ODI requested endurance data and AEB robustness verification including data collected over approximately 150,000 miles, the data indicates that unintended braking events are extremely short (less than 1 second) and result in less than 5% speed reduction.

Assistance Feature Release Number	Production Range	Vehicles Sold	Vehicle Exposure (VehYrs)	Unintended Braking Incidents	Failure Rate (IPTV)	Exposure Adjusted Failure Rate (IPTVY)
68109355AF	07/12 to 02/14	17,263	46,057	69	4.0	1.5
68223771AD	07/13 to 08/13	3,657	8,880	14	3.8	1.6
68223771AE	08/13 to 01/14	15,309	32,652	39	2.5	1.2
68223771AF	01/14 to 04/14	8,922	16,098	17	1.9	1.1
68109355AG	02/14 to 04/14	688	1,276	1	1.5	0.8
68109355AI	04/14 to 07/14	1,158	1,864	1	0.9	0.5
68223771AH	04/14 to 07/14	7,349	11,778	8	1.1	0.7
68259548AA	07/14 to 12/15	40,832	32,192	27	0.7	0.8
Grand Total	07/12 to 12/15	95,178	150,798	176	1.8	1.2

Table 2. Field Experience by Software Version.

WARRANTY DATA: ODI evaluated 1,476 warranty claims related to FCW system malfunctions. This analysis found that approximately 98 percent of warranty part replacements were related to either a damaged sensor mounting or malfunctions in the radar sensor. In the event of a malfunction, a system unavailable message will displayed and owners have the ability to turn FCW features ON or OFF through a switch on the center stack area of the dashboard. The Long Range Radar (LRR) is mounted on the lower center portion of the fascia as shown in Figure 3. It is protected by a cover and surrounded by

fascia material. A damaged sensor will not cause AEB events but may trigger faults and corresponding messaging to the customer. In the event of any sensor misalignment, a fault will be stored in the vehicle and messaging will be presented to the customer in the Driver Information Display (DID) noting that the system is disabled. Repair records indicate that misalignment reports typically involved non-OEM fascia modifications or evidence of frontal impacts. None of the reports indicated that an LRR sensor could become misaligned or dislodged as a result of normal driving and FCA modified the radar sensor clip geometry to include higher retention force.

TESTING: NHTSA’s 2014 light vehicle automatic emergency braking (AEB) test program evaluated the ability of four vehicles, including a 2014 Jeep Grand Cherokee, tested with the agency’s August 2014 draft crash-imminent braking (CIB) and Dynamic Brake Support (DBS) test procedures.² Crash-imminent braking is fully automated braking (no driver braking) and DBS braking measures AEB performance in supplementing driver brake application. Table 3 shows the 2014 AEB test matrix used to evaluate the vehicles.

Maneuver	Test Speeds; mph (km/h)		Initial Headway; ft (m)	Brake Apply Headway (DBS only); ft (m)
	SV	POV		
Stopped Lead Vehicle (LVS_25_0)	25 (40)	0	>187 (>57)	40 (12)
Slower Moving Lead Vehicle LVM_45_20	45 (72)	20 (32)	>183 (>56)	37 (11)
Slower Moving Lead Vehicle LVM_25_10	25 (40)	10 (16)	>34 (>110)	22 (7)
Decelerating Lead Vehicle LVD1_35_35	35 (56)	35 (56)	45 (14)	32 (10)
Decelerating Lead Vehicle (to a stop) LVD2_25_25	25 (40)	25 (40)	328 (100)	40 (12)
Steel Trench Plate STP_45	45 (72)	--	>337 (>106)	73 (22)
Steel Trench Plate STP_25	25 (40)	--	>187 (>57)	40 (12)

Table 3. NHTSA 2014 AEB Test Matrix.

Table 4 shows the draft CIB and DBS Assessment Reference Values (ARVs) used to evaluate system performance in the AEB test matrix.

AEB System	LVS 25_0	LVM 45_20	LVM 25_10	LVD1 35_35	LVD2 25_25	STP_45 (FP)	STP_25 (FP)
CIB	Speed Reduction ≥ 9.8 mph (15.8 km/h)	Speed Reduction ≥ 9.8 mph (15.8 km/h)	Crash Avoidance	Speed Reduction ≥ 10.5 mph (16.9 km/h)	Speed Reduction ≥ 9.8 mph (15.8 km/h)	No Activation ¹	
DBS	Crash Avoidance					No Activation ²	

¹ CIB activation is said to occur if SV deceleration ≥ 0.25g within the validity period

² DBS activation is said to occur if SV deceleration ≥ 125% of a baseline average

Table 4. CIB and DBS Draft Assessment Reference Values (ARVs).

² Forkenbrock, G. J., & Snyder, A. S. (2015, June). *NHTSA’s 2014 automatic emergency braking test track evaluations*. (Report No. DOT HS 812 166). Washington, DC: National Highway Traffic Safety Administration.

The Jeep Grand Cherokee AEB speed reductions observed during CIB testing ranged from 7.7 to 13.4 mph, consistent with system limitations discussed in the System Description section. In general, the Grand Cherokee performed as well or better than the other vehicles evaluated in the 2014 testing. The Grand Cherokee met 5 of 7 CIB ARVs, including both Steel Trench Plate (STP) false positive ARVs, and was the only vehicle to meet all 7 DBS ARVs, including the STP false positive ARVs.

VOQs: The 22 ODI complaints associated with the closing of this investigation are ODI ID Numbers:

10876263, 10875085, 10865819, 10854550, 10837725, 10836605, 10823839, 10817088, 10785790, 10777838, 10761133, 10735739, 10732842, 10731350, 10725072, 10724795, 10724290, 10724011, 10713629, 10690650, 10596913, 10533622



Figure 1. Driver Assistance System Module (long-range radar).

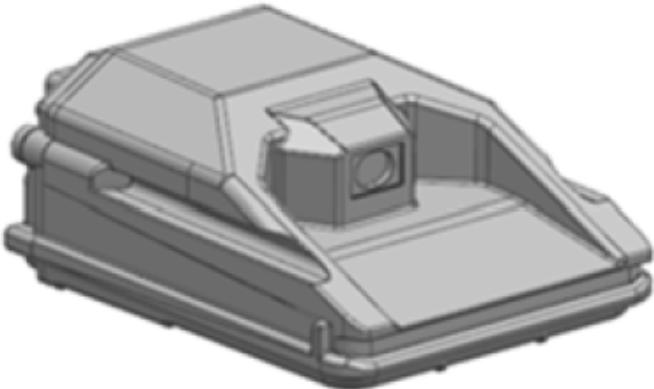


Figure 2. Forward Facing Camera.



Figure 3. Locations of FFC and DASM.

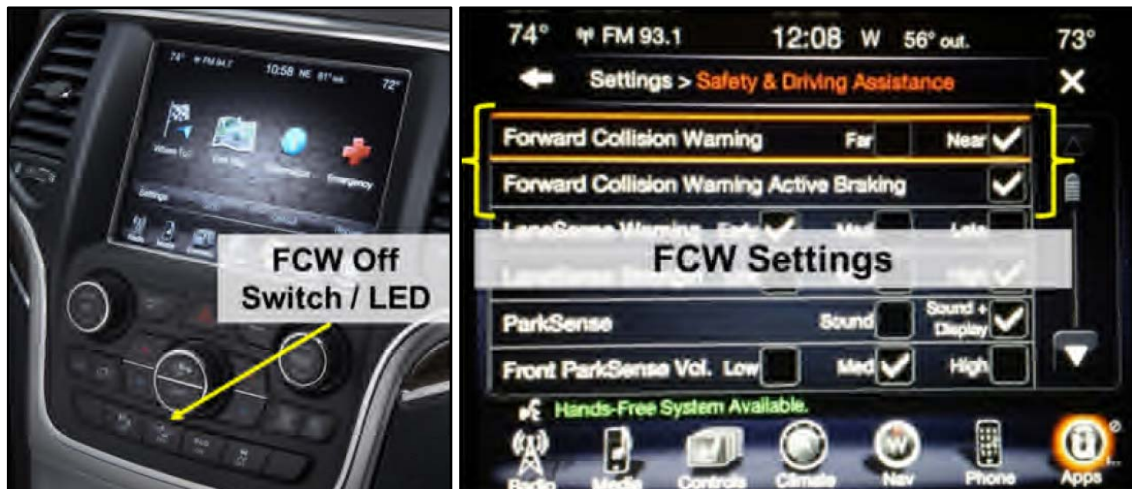


Figure 4. 2015 Jeep Grand Cherokee center-stack with FCW switch and personal settings screen.