



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

ODI RESUME

Investigation: PE 04-060
Date Opened: 08/17/2004 Date Closed: 02/03/2005
Principal Investigator: Mark Swanson
Subject: Failing Seat Belt Buckles

Manufacturer: General Motors Corp.
Products: 2000-2001 Cadillac Deville
Population: 176,734

Problem Description: The driver and/or front passenger seat belt buckle allegedly fails in a crash releasing the latch plate.

FAILURE REPORT SUMMARY

	ODI	Manufacturer	Total
Complaints:	2	18	20
Crashes/Fires:	2	18	20
Injury Incidents:	2	13	15
# Injuries:	3	13	16
Fatality Incidents:	0	2	2
# Fatalities:	0	2	2
Other*:	1	0	1

*Description of Other: State Farm Insurance claim (crash with an injury).

Action: The Preliminary Evaluation is closed.

Engineer: Mark B. Swanson

Date: 02/03/2005

Div. Chief: Thomas Z. Cooper TZC

Date: 02/03/2005

Office Dir.: Kathleen C. DeMeter

Date: 02/03/2005

Summary: On August 17, 2004, ODI opened an investigation based on two complaints and one insurance company report alleging driver and/or front passenger seatbelt unbuckling during crashes on Model Year (MY) 2000 and 2001 Cadillac Deville sedans. On October 8, 2004, GM submitted data to ODI related to the alleged defect for the subject vehicles. This data contained information about system design, system operation, seat belt buckle testing and consumer complaints.

Based on its analysis of the data, ODI has determined that a safety-related defect trend has not been identified regarding specific allegations of unwanted seatbelt unbuckling during a crash. At this time, further use of agency resources does not appear to be warranted. The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect exists. The agency reserves the right to take further action if warranted by the circumstances.

See attached summary report.

TZC
2-4-05

On August 17, 2004, ODI opened an investigation based on two complaints and one insurance company report alleging driver and/or front passenger seatbelt unbuckling during crashes on Model Year (MY) 2000 and 2001 Cadillac Deville sedans. On October 8, 2004, GM submitted data to ODI related to the alleged defect for the subject vehicles. This data contained information about system design, system operation, seat belt buckle testing and consumer complaints.

The driver and front passenger seat belt buckles for the 2000 and 2001 Cadillac Deville sedans are provided with a belt pretensioner device that will tighten the seat belt in response to a signal (to deploy) from the vehicle's crash detection system. The pretensioner is a pyrotechnic device that pulls, via a cable, the buckle housing and reduces the length of the buckle and webbing by about 2 inches. The signal to deploy the belt pretensioner is given by the Sensing Diagnostic Module (SDM). It processes information from crash sensors and determines when to deploy the belt pretensioners.

The SDM also receives a signal from the driver's seat belt buckle (this feature is not on the front passenger's seat belt buckle) to indicate if the driver's buckle is latched or not. This data is stored in the SDM and retained if the system deploys the belt pretensioners. Finally, the SDM also performs many other functions such as sending the signal to deploy the frontal airbags and/or the side airbags; and it provides crash data recording capability and a serial data link for vehicle systems communications.

GM's supplier for the seat belt buckle assembly is Takata. In September of 2004, Takata conducted testing for GM of the seat belt buckle assembly in response to this investigation. The test consisted of three pairs of seat belt tests, three without and three with the latch plate inserted during pretensioner deployment. The test results showed that when the latch plate was not inserted into the buckle assembly ("unbuckled"), the top of the plastic red release button was damaged (producing fracturing of the button or a witness mark) as a result of deployment of the pretensioner. See Figure 1 below. Test results also showed that when the latch plate is inserted into the buckle assembly ("buckled"), there is no damage to the red release button (see Figure 2). The fracture or witness mark on the red button during the "unbuckled" test is a result of the motion of the buckle and the red button when the pretensioner is deployed. The inertia of the red button causes it to impact metal components in the buckle when the buckle's motion is abruptly stopped at the end of the pretensioner stroke. As a result of the impact, an unbuckled buckle can result with a fracture or other witness marks on the top of the red plastic push-button.

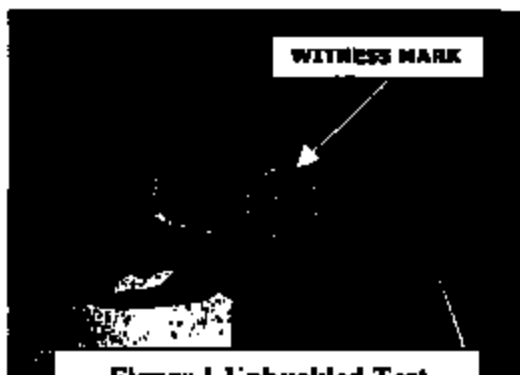


Figure 1 Unbuckled Test



Figure 2 Buckled Test

The absence of any fracture or witness marks when the pretensioner deploys and the buckle is "buckled" is due to specific features in the design of the buckle that prevent inertial movement of the red button during deployment. When a latch plate is inserted into the buckle assembly, a mechanism is activated that blocks inertial movement between the red button and the buckle assembly during pretensioner deployment.

GM reported 23 complaints alleging seatbelt failure during crashes. Three reports did not have enough information for review, no owner name, no SDM data and no photographs. Two reports were found not to allege a problem with the buckle releasing. ODI contacted the owner of one of the reports to verify that the allegation was webbing releasing and not the buckle releasing. ODI was not able to make contact with the other complainant but the written report stated that the webbing released.

The group of 18 remaining complaints includes the 2 ODI complaints listed with the opening resume. The opening resume also included a report from an insurance company, but owner information was not available for follow up by ODI. The driver side buckle was the subject of complaint more often than the passenger side and a few reports complained of both driver and passenger buckles failing (13-driver, 3-driver & passenger, 1-passenger and 1-unknown).

ODI's analysis of these complaints was principally guided by SDM data that GM provided reporting the status of the driver's buckle during the crash, test data, photographs of complaint buckles, phone conversations with complainants, and examination of exemplar buckles provided by GM.

The 18 reports had a varying degree of information. ODI supplemented this with phone calls to those complainants who provided correct phone numbers (11). ODI was able to speak with 7 complainants.

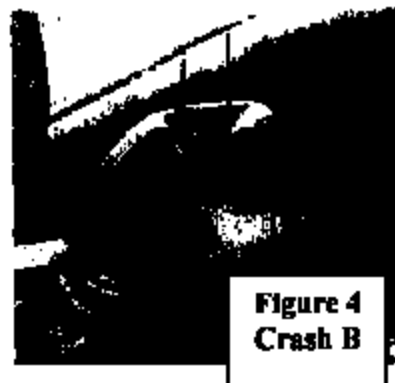
GM provided to ODI the SDM data for 7 reports. This gave the status of buckle usage for the driver's side in those vehicles. Four reports indicated that the buckle was not buckled and 3 indicated that the buckle was buckled. However in two of the 3 "buckled" incidents, photographs were provided showing that the buckle case was split open. When the pretensioner deploys and pulls the buckle to tighten the webbing and the buckle is not "buckled," the inertial forces may cause the buckle case to separate. When this happens, the switch that senses whether or not the buckle is "buckled" may not give a reliable reading of the buckle status. This is described below.

The subject buckle contains a feature for the driver's buckle that senses if the latch plate is inserted into the buckle. The sensor sends a signal to the SDM that records and stores the data if there is a deployment. The sensor is a sliding element that moves along an electrical track as the latch is inserted in the buckle. The position of the sensor closes a circuit when the buckle is "unbuckled" and opens the circuit when the buckle is "buckled." If the buckle is not buckled during pretensioner deployment, inertial forces move the sensor from the "unbuckled" position toward the "buckled" position on the electrical track. After the pretension movement of the buckle stops and inertial forces are no longer present, the sensor return spring moves the sensor

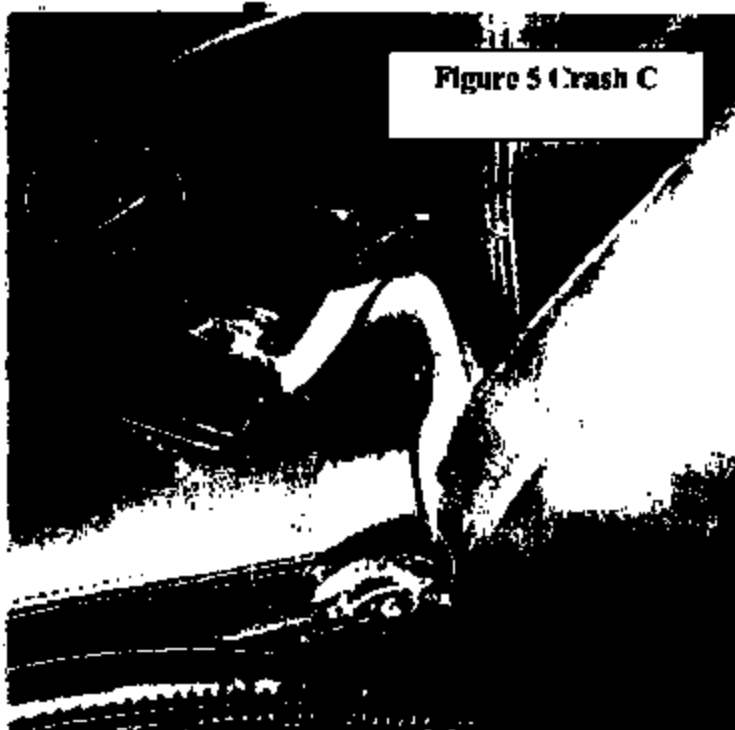
back to "unbuckled" position. However, in some cases, the inertial forces of pretensioner deployment may cause the buckle case to split open and this will disengage the sensor from its return spring. That can leave the sensor in the "buckled" position and send a false signal to the SDM. In two of the reports that the SDM indicated "buckled," the photographs showed that the buckle case was split open. (Photographs are not available in the third "buckled" report). It appears that the SDM reading of "buckled" could be a false reading based on the case splitting open.

With regard to the integrity of the buckle to stay "buckled" with the case split open, ODI examined a sample buckle and determined that the buckle is functional with the case removed; the latch can be latched and unlatched. Based on a review of these reports, it appears that splitting of the buckle case is a possible outcome of an unbuckled latch and deployment of the pretensioner. The splitting of the case does not appear to be a causal factor in the allegations of unwanted release of the buckle latch plated during a crash.

ODI's evaluation of the data included review of photographs of complainants' buckles. Four reports contained photographs; however, one was very poor quality and was not helpful. The photographs with the remaining three reports (Crash A, B & C) show damage to the red release button in the form of holes or fractures at the top of the button (witness marks). Figures 3, 4 and 5 below show excerpts of photographs from these three crashes.



These marks are caused when a buckle is unbuckled and the pretensioner deploys. The inertial force from the movement of the buckle causes the red release button to make impact against certain metal parts within the buckle. The red button cannot make contact with those metal parts if the buckle is buckled, as demonstrated during the Takata testing described above.



Based on its analysis of the data, ODI has determined that a safety-related defect trend has not been identified regarding specific allegations of unwanted seatbelt unbuckling during a crash. At this time, further use of agency resources does not appear to be warranted. The closing of this investigation does not constitute a finding by NHTSA that no safety-related defect exists. The agency reserves the right to take further action if warranted by the circumstances.