

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

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**VERIDIAN ON-SITE INADVERTENT DEPLOYMENT INVESTIGATION
VERIDIAN CASE NO. CA99-010
VEHICLE: 1997 JEEP CHEROKEE
LOCATION: MICHIGAN
CRASH DATE: MAY 1999**

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. <i>Abstract</i> This on-site investigation focused on the driver's allegation of an inadvertent deployment of the frontal air bag system in a police 1997 Jeep Cherokee. The driver and passenger air bag system deployed as the driver was traveling on the inboard lane of a divided interstate roadway at an estimated speed of 120 km/h (75 mph). The driver brought the vehicle to a controlled stop on the inboard shoulder approximately 0.2-0.4 km (1/8-1/4 mile) beyond the deployment site. He complained of a superficial contusion of the right anterior forearm that resulted from air bag deployment. Although there was no damage to the body of the vehicle, superficial damage was observed to the right undercarriage of the vehicle. Therefore, this deployment was either inadvertent or attributed to an over-sensitive deployment that resulted from the undercarriage contact.			
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BACKGROUND

This on-site investigation focused on the driver's allegation of an inadvertent deployment of the frontal air bag system in a police 1997 Jeep Cherokee. The driver and passenger air bag system deployed as the driver was traveling on the inboard lane of a divided interstate roadway at an estimated speed of 120 km/h (75 mph). The driver brought the vehicle to a controlled stop on the inboard shoulder approximately 0.2-0.4 km (1/8-1/4 mile) beyond the deployment site. He complained of a superficial contusion of the right anterior forearm that resulted from air bag deployment. Although there was no damage to the body of the vehicle (**Figure 1**), superficial damage was observed to the right undercarriage of the vehicle. Therefore, this deployment was either inadvertent or attributed to an over-sensitive deployment that resulted from the undercarriage contact.



Figure 1. Front left view of the 1997 Jeep Cherokee.

The police department notified NHTSA on Monday, May 17 of the alleged inadvertent deployment. The task was assigned to the Veridian Special Crash Investigation Team of the afternoon of the 17th and an on-site investigation was conducted on Tuesday, May 18th.

SUMMARY

Vehicle Data

This incident involved a 1997 Jeep Cherokee 4x2 K-9 police vehicle. The vehicle was configured with four doors, an I-6 cylinder engine, and was initially sold to the police department through the state bid process as a police unit. The Cherokee was equipped with the police equipment by an in-house mechanical shop and two outside contractors. This equipment included two A-pillar spot lights, roof mounted light bar with the power unit mounted under the driver's seat, console mounted police radio, radar unit, data terminal, and the controls for the light bar/siren. In addition to the electronics, the rear seat had been removed and an aluminum kennel cage was positioned to house the K-9 dog. The left rear door was equipped with a remote release mechanism.

The Cherokee was manufactured on 5/97 and identified by vehicle identification number 1J4T68S9VL (production number deleted). At the time of the alleged inadvertent deployment, the vehicle's odometer had recorded 44,141 km (27,429 miles). The vehicle was assigned to the K-9 officer in September 1997, and had been used exclusively by this officer over the past 20 months. There were no previous repairs performed on the air bag system. Furthermore, there was no major mechanical work performed outside of routine maintenance (i.e., oil changes, etc.) on the vehicle. The Cherokee was involved in a previous rear-end crash approximately one month prior to this event. The vehicle was struck

on the rear left bumper corner which resulted in minor damage. The damage was not repaired at the time of this event. It should be noted that the Cherokee was equipped with front bumper push bars. The driver indicated that he has pushed vehicles off-road with the push bars at very low speeds. There was no damage to the push bars or to the integral rub strips.

Incident Site

This air bag deployment incident occurred on a divided interstate roadway during daylight hours. The weather was clear with an ambient temperature of approximately 21 degrees C (70 degrees F). In the vicinity of the deployment site, the three northbound travel lanes were surfaced with concrete and curved to the left with respect to the vehicle's direction of travel. Paved shoulders bordered both road edges with an inboard shoulder width of 10 m (33') which terminated at the concrete median barrier **Figure 2**). There were no defects (i.e., potholes, etc.) of the road surface in the vicinity of the deployment site.

Pre-Incident

The driver of the Jeep Cherokee was an on-duty police officer. He was traveling on the inboard lane at a driver estimated speed of 120 km/h (75 mph) en route to assist with a traffic stop of a suspected drug suspect. The driver reported traffic flow was heavy due to the beginning of the evening rush hour. While traveling on the interstate, the driver noted that the vehicle's on board data terminal was in the on-position as were the police radio and the vehicle's AM/FM radio. The overhead light bar, siren, and radar unit were in the off-position. The K-9 dog was in the rear seat area kennel with its head positioned between the front bucket seat backs.



Figure 2. Northbound view of the left shoulder and tire fragments.

Incident

As the driver was negotiating the left curve, he stated that he was not wearing the manual belt system. Although he is a frequent belt user, due to the nature of the impending traffic stop, the driver elected to not wear the belt to provide greater freedom of movement within the vehicle and to provide direct access to his service revolver and utility belt. Without impact, the driver stated that the frontal driver and passenger air bags deployed (**Figure 3**). The driver stated that he heard a loud "bang" and noted a smoke-like substance within the vehicle. He observed the deployed air bags and stated that the bags did not impede his line of sight. The driver further noted that both bags deflated rapidly following the deployment. Without losing control of the vehicle, the driver steered the vehicle onto the left shoulder of the interstate and brought the Cherokee to a controlled stop approximately 0.2-0.4 km (1/8-1/4 mile) north of the deployment site. The driver did report a brief ringing in his ears which is common to occupants of a vehicle involved in air bag deployments.



Figure 3. Deployed frontal air bags.

Post-Incident

The driver exited the vehicle and began to walk back toward the site of the deployment to examine the site for possible objects that the vehicle could have struck. The driver stated that he did not hear or feel an impact to the vehicle and did not note any objects in the travel lane prior to the deployment. He did detect three pieces of truck tire tread that had separated from a recap-type tire. The driver further noted that all three tread pieces were located on the left (inboard) shoulder of the interstate. The driver subsequently called for assistance. The Cherokee was towed from the scene on a flat-bed tow truck and transported to the local dealership where it was held for inspection.

DRIVER DEMOGRAPHICS/INJURY DATA

The driver of the Jeep Cherokee was a 29 year old male with a stated height of 177.8 cm (70.0") and weight of 106.6 kg (235.0 lb). He was dressed in his police issue fatigues with a short sleeve shirt. The driver was seated in an upright attitude with the seat track adjusted to the full rear position. He was not wearing eyeglasses or jewelry (rings, watch) on his hands or wrists. The driver did report a superficial contusion of the anterior right forearm proximal to the wrist. This contusion was attributed to deployment of the front driver air bag.

SCI INSPECTION OF THE JEEP CHEROKEE

The vehicle was transported to the local dealership and at the time of the SCI inspection, it was located indoors. The vehicle was driveable, however, the battery had discharged over the four days between the incident and the inspection.

Exterior - The exterior of the Jeep Cherokee was free of impact damage (**Figure 4**) except for the minor rear left bumper corner damage that resulted from a front-to-rear crash that occurred approximately one month prior to this event (**Figure 5**). The surface of the vehicle was covered with a light layer of road film. None of the road film had been removed, thus supporting the lack of a minor crash that did not result in residual body damage. The front push bars were in good condition with no recent evidence of contact.

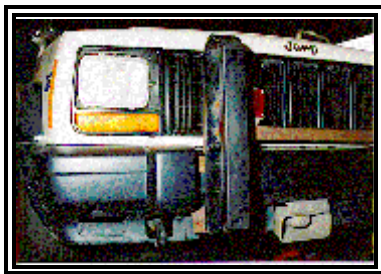


Figure 4. Front right view of the bumper area.



Figure 5. Previous damage to the rear left bumper corner.

Undercarriage - Following the exterior inspection of the vehicle, the Cherokee was jump started and driven into the service facility and placed on a lift. The lift arms were positioned on the frame of the vehicle by a trained service technician at the dealership. The Cherokee was elevated to a height of approximately

1.8 m (6.0'). Although no significant damage occurred to the undercarriage of the vehicle, several superficial areas of recent contact evidence were noted and documented. These contact areas area as follows:

- C The bottom surface of the right tow hook that was mounted to the leading edge of the frame was abraded (**Figure 6**) with a 1.2 cm (0.5") wipe mark (area where the road film had been removed). This abrasion was free of rust and road film and appeared to be recent to the vehicle. The abrasion was extremely minor in severity.



Figure 6. Tow hook (top left) and front undercarriage components.

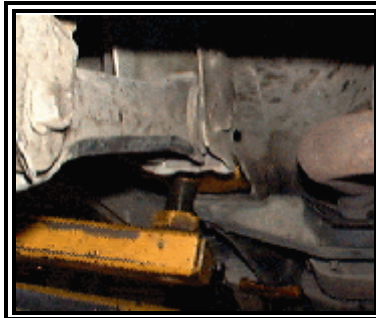


Figure 7. Wipe mark to the front right trailing arm.



Figure 8. Abrasion to the muffler.

- C The inboard bottom edge of the right trailing arm aft of the solid front axle was superficially contacted. A wipe mark that extended 43.2 cm (17.0") rearward of the front bushing appeared to be recent (**Figure 7**). There was no damage or abrasion to the painted surface associated with this contact point.
- C A superficial abrasion was noted to the bottom surface of the muffler (**Figure 8**). The abrasion was 1.9 cm (0.75") in width and approximately 0.9 cm (0.375") in length (longitudinal to the vehicle) and was located approximately 2.5 cm (1.0") rearward of the leading edge of the muffler. There was no dent associated with this abrasion. Again, the abrasion was free of rust which indicated it was recent to the vehicle.
- C The most significant damage to the vehicle was located to the right rear shock absorber. The standard OEM-type shock was mounted forward of the rear axle and consisted of the lower hydraulic/gas unit and the top (female) shield that, when compressed, partially covered the lower unit. While on the lift, the shock was fully extended. A 4.4 cm (1.75") horizontal by 2.5 cm (1.0") vertically oriented dent with abrasion was noted to the lower unit of the shock (**Figure 9**). The dent was approximately 3.2 mm (0.125") in depth. A matching 1.9 x 4.4 cm (0.75 x 1.75") dent with abrasion was noted to the upper shield of the shock. A 14.6 cm (5.75") vertically oriented wipe mark surrounded this abrasion/dent (**Figure 10**). The shock damage appeared to be recent to the vehicle.



Figure 9. Dent to the lower unit of the right rear shock.



Figure 10. Dent and wipe mark to the upper shield of the shock absorber.

- Ⓒ The right rear parking brake cable extended in an arc below the rear axle forward of the shock mount. The leading edge of the cable was wiped clean of road film. There was no damage associated with the wipe mark.
- Ⓒ The undercoating at the lower frame shock mount was chipped over an area of 3.2 x 1.3 cm (1.25 x 0.5"). There was no deformation to the mount.

All of the above damage to the undercarriage of the Jeep Cherokee was extremely minor in severity. The contact/damage extended in a near straight line to the undercarriage from the right tow hook to the rear shock area. There was no contact or damage to the left side of the Cherokee in the vicinity of the air bag control module (single point) that was mounted under the driver's seat.

DIAGNOSTIC READOUT OF THE AIR BAG SYSTEM

The dealer service manager and a certified technician used a *BRB II Electronic Scan Tool* (Model CH 8515) to check the air bag control module for active and stored faults. The software version was reported as Version 6.7. The unit was connected to a *16-Way Data Link Connector* that was mounted under the left side of the knee bolster. Power was supplied to the vehicle by a charging system connected to the vehicle's battery. Active and stored faults were retrieved as follows:

- Ⓒ 1st Test - Body Module Results - None.
- Ⓒ 2nd Test - Engine Results - No DTC's detected, 6 engine starts.
- Ⓒ Air Bag Test Results - **Active** - Driver Squib Circuit Open. Either Squib Terminal Shorted to Ground (**Figure 11**)

 Stored- Driver Squib Circuit Open, Minutes 91, Ignition Counts 0 (**Figure 12**)

 Passenger Squib Open, Minutes 47, Ignition Counts 15 (**Figure 12**)



Figure 11. Active codes of the BRB II readout.



Figure 12. Stored codes of the DRB II readout.

CONCLUSIONS

The driver stated the air bag system deployed inadvertently without impact. Immediately following the deployment event, the driver walked back to the site and noted three pieces of truck tire tread that had separated from a recap casing. The tire pieces were located on the inboard shoulder and not on the travel lane. Although the driver did not see, hear, or feel an impact to the vehicle, the minor undercarriage damage suggests that the vehicle ran over an object that produced the damage. The superficial damage was consistent in nature with contact to a piece of the truck tire tread. Therefore, it was possible that the air bag system deployed as a result of the undercarriage contact. The contact/impact did not induce a deceleration that was required for a normal deployment, however, an over-sensitive deployment could have occurred.

The stored fault codes do not appear to be consistent. That is, the number of minutes and the ignition cycles recorded by the control module for the driver and passenger air bag squibs varied by 44 minutes and 15 cycles. This issue needs to be further researched through Chrysler for interpretation of the data.