

**TRANSPORTATION SCIENCES  
CRASH RESEARCH SECTION**

Veridian Engineering  
Buffalo, New York 14225

**REDESIGNED AIR BAG SPECIAL STUDY (RABSS)  
SCI TECHNICAL SUMMARY REPORT**

**NASS RABSS CASE NO. 1998-11-811G**

**RABSS VEHICLE - 1998 JEEP CHEROKEE SPORT**

**LOCATION - STATE OF MICHIGAN**

**CRASH DATE - OCTOBER, 1998**

Contract No. DTNH22-94-D-07058

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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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<p>16. <i>Abstract</i> This investigation focused on a single vehicle crash involving a 1998 Jeep Cherokee 4-door sport utility vehicle. The Jeep Cherokee was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a concrete median barrier. The driver was operating the vehicle eastbound on the inboard lane of a 4-lane divided highway when she failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, the driver steered left/braked in avoidance and entered the median divider where the frontal area impacted a concrete barrier resulting in moderate damage. The vehicle rotated counterclockwise as the right rear area struck the concrete barrier a second time which resulted in minor damage. The Jeep came to rest in the median divider facing west. The 21 year old female driver of the Jeep Cherokee was restrained by the available 3-point manual lap and shoulder belt system and seated in an upright posture. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. She sustained a contusion of the right lower leg from contact to the brake pedal (no other injury reported). Although treated on-scene, the driver refused further medical attention.</p>			
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***BACKGROUND***

This investigation focused on a single vehicle crash involving a 1998 Jeep Cherokee 4-door sport utility vehicle. The Jeep Cherokee was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a concrete median barrier. The driver was operating the vehicle eastbound on the inboard lane of a 4-lane divided highway when she failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, the driver steered left/braked in avoidance and entered the median divider where the frontal area impacted a concrete barrier resulting in moderate damage. The vehicle rotated counterclockwise as the right rear area struck the concrete barrier a second time which resulted in minor damage. The Jeep came to rest in the median divider facing west. The 21 year old female driver of the Jeep Cherokee was restrained by the available 3-point manual lap and shoulder belt system and seated in an upright posture. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. She sustained a contusion of the right lower leg from contact to the brake pedal (no other injury reported). Although treated on-scene, the driver refused further medical attention.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-11-811G for the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian the task of case review and final report preparation.

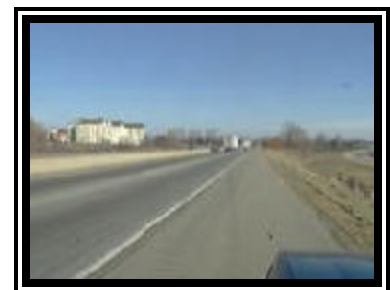
***SUMMARY***

**Crash Site**

This single vehicle crash occurred during the afternoon hours of October, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the median area of a straight and level 4-lane east/west highway (see **Figure 7 - page 4**). The asphalt roadway was bordered by paved shoulders and divided by a concrete (jersey) barrier. No traffic control was present at the scene which had a posted speed limit of 113 km/h (70 mph).

**Pre-Crash**

The 21 year old female driver of the 1998 Jeep Cherokee was operating the vehicle eastbound (**Figure 1**) on the inboard lane at a (driver reported) speed of 105 km/h (65 mph) when she failed to notice traffic slowing ahead. Upon recognition of the impending harmful event, she steered left/braked and entered the median divider in a counterclockwise rotation.



**Figure 1. East view showing environment and vehicle approach.**

## Crash

As the Jeep entered the median area of the 4-lane divided highway, the front left area impacted the concrete barrier which intensified the counterclockwise rotation as the center and front right areas subsequently engaged the concrete barrier resulting in moderate damage. The impact induced deceleration was sufficient to deploy the Jeep's redesigned frontal air bag system. The damage algorithm of the WinSMASH program computed a (barrier equivalent) velocity change of 25.4 km/h (15.8 mph) with a longitudinal component of -23.9 km/h (-14.9 mph). The Collision Deformation Classification (CDC) for this initial impact to the Jeep Cherokee was 01-FDEW-2 with a principal direction of force of (+)20 degrees. At this point, the vehicle continued to rotate counterclockwise as the right rear area struck the concrete barrier a second time resulting in minor damage. The CDC for this second and final impact to the Jeep Cherokee was 05-RBLE-1 with a principal direction of force of (+)160 degrees. The Jeep came to rest in the median divider facing west.

## Post-Crash

The driver exited the vehicle under her own power and was treated on-scene by emergency medical technicians (EMTs). No ambulance was summoned to the crash site. The vehicle was towed from the scene due to disabling damage.

## RABSS VEHICLE

The 1998 Jeep Cherokee was manufactured on January, 1998 and identified by the Vehicle Identification Number (VIN): 1J4FJ68S4WL (production sequence deleted). The vehicle was a 4-door sport utility equipped with four wheel drive and a 4.0 liter, 6 cylinder engine. The vehicle's odometer reading was approximately 9,656 km (6,000 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with front bucket and rear (folding back) bench seats. The driver reported no previous crashes or maintenance on the air bag system (original equipment). A cellular "flip" phone was present but not in-use at the time of the collision.

## VEHICLE DAMAGE

### Exterior Damage

The 1998 Jeep Cherokee sustained moderate frontal damage as a result of the impact with the concrete barrier (**Figure 2**). The direct contact damage encompassed the full frontal width resulting in a combined direct and induced damage length (Field L) of 140.0 cm (55.1 in). Six crush measurements were documented at the level of the bumper: C1= 11.0 cm (4.3 in), C2= 12.0 cm (4.7 in), C3= 14.0 cm (5.5 in), C4= 19.0 cm (7.5 in), C5= 19.0 cm (7.5 in), C6= 27.0 cm (10.6 in). The left fender was deformed (no wheels restricted or deflated) with minor hood displacement noted. Direct contact damage was also documented to the right rear area attributed to the second barrier impact. This direct damage began at the right rear bumper corner and extended forward 20.0 cm (7.9 in) with no sheet metal crush noted. All glazing was undamaged. No reduction in the wheelbase was identified.



**Figure 2. Frontal damage to the 1998 Jeep Cherokee.**

## Interior Damage

There was no damage to the interior surfaces of the Jeep Cherokee from intrusions or occupant contact (**Figure 3**).

### **REDESIGNED AIR BAG SYSTEM**

The 1998 Jeep Cherokee was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash. The driver air bag was housed in the center of the steering wheel with a single cover flap design hinged at the top aspect. The flap was rectangular in shape and measured 16.0 cm (6.3 in) in width and 13.0 cm (5.1 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flap, several transfers were identified on the face of the air bag. Eye makeup was documented to the right upper quadrant of the air bag along with lipstick transfers to the lower right quadrant (**Figure 5**). In addition, base makeup transfers were documented to the upper and lower sections of the air bag. The NASS researcher measured the diameter of the driver air bag at 54.0 cm (21.3 in) in its deflated state (**Figure 4**). The bag was tethered by four internal straps. No vent ports were present.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 38.0 cm (15.0 in) in width and 16.0 cm (6.3 in) in height. The NASS researcher measured the passenger air bag at 50.0 cm (19.7 in) in width and 56.0 cm (22.0 in) in height in its deflated state (**Figure 6**). No internal tether straps or vent ports were present. No cutoff switch was reported for the front right redesigned passenger air bag.



**Figure 3. Interior view of the 1998 Jeep Cherokee.**



**Figure 4. 1998 Jeep Cherokee redesigned driver air bag.**



**Figure 5. Lipstick transfer to the driver redesigned air bag.**



**Figure 6. 1998 Jeep Cherokee redesigned passenger air bag.**

**DRIVER DEMOGRAPHICS**

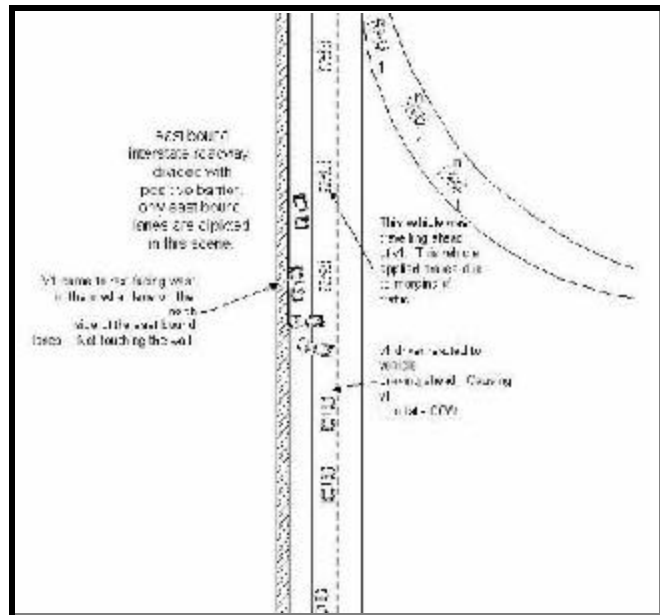
Age/Sex: 21 year old female  
 Height: 165 cm (65 in)  
 Weight: 53 kg (117 lb)  
 Seat Track Position: Middle position  
 Manual Restraint Use: 3-point lap and shoulder belt system  
 Usage Source: NASS vehicle inspection, driver interview, police report  
 Eyewear: Contact lenses  
 Type of Medical Treatment: None

**Driver Injuries**

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Contusion right (inner) shin	Minor (890402.1,1)	Brake pedal

**Driver Kinematics**

The 21 year old female driver of the 1998 Jeep Cherokee was properly restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the middle position. The NASS interview stated she was restrained, further evidenced by the lack of significant interior contacts and injury. At impact with the concrete barrier, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the driver air bag was confirmed by the makeup and lipstick transfers documented to the face of the bag at the tether stitching. The combination of restraint options provided protection against further contact to the steering wheel hub/rim, and potential injury. She sustained a small contusion to the inner right shin which was probably a result of contact to the brake pedal (*source listed as the knee bolster in the NASS case file*), evidenced by the location of the injury relative to the pre-crash placement of the right foot on the brake pedal. The secondary (minor) impact with the barrier initiated a lateral/rearward trajectory in response to the 5 o'clock impact force, with no resulting injury reported. Although treated on-scene, the driver refused further medical attention.



**Figure 7. NASS Scene Diagram.**