TRANSPORTATION SCIENCES
Crash Research Section

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CALSPAN LIMITED ON-SITE REDESIGNED AIR BAG INVESTIGATION
CALSPAN CASE NO. CA98-031
VEHICLE: 1998 JEEP GRAND CHEROKEE
LOCATION: NEW YORK
CRASH DATE: MAY 1998

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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. *Abstract* This limited on-site investigation focused on a two-vehicle crash that involved a 1998 Jeep Grand Cherokee Laredo, 4-door sport utility vehicle, and a 1993 Ford Escort. The Cherokee was equipped with a redesigned front left air bag for the driver position and a full-power front right passenger air bag. The air bag system deployed as a result an intersection crash with the Ford Escort. The Cherokee sustained minor front right damage that resulted in deployment of the frontal air bag system. The belted 17 year old female driver of the Cherokee complained of neck pain and was examined at a local hospital and released.			
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BACKGROUND

This limited on-site investigation focused on a two-vehicle crash that involved a 1998 Jeep Grand Cherokee Laredo, 4-door sport utility vehicle, and a 1993 Ford Escort. The Cherokee was equipped with a redesigned front left air bag for the driver position and a full-power front right passenger air bag. The air bag system deployed as a result an intersection crash with the Ford Escort. The Cherokee sustained minor front right **(Figure 1)** damage that resulted in deployment of the frontal air bag system. The belted 17 year old female driver of the Cherokee complained of neck pain and was examined at a local hospital and released.

Figure 1. Front right damage to the Jeep Cherokee.

The 1998 Jeep Grand Cherokee was identified during another non-SCI related investigation by the Special Crash Investigation (SCI) team at Calspan. The redesigned status of the air bag system was confirmed through the NHTSA COTR and the case was assigned to Calspan's SCI team on August 12. A limited on-site investigation was initiated.

SUMMARY

Vehicle Data

The 1998 Jeep Grand Cherokee Laredo, 4-door sport utility vehicle, was manufactured in 3/98 and was identified by vehicle identification number (V.I.N.) 1J4GZ58S5WC (production number omitted). The Cherokee was a four-wheel drive configuration, powered by a 4.0 liter 6 cylinder engine coupled to a 4-speed automatic overdrive transmission. Additional equipment included power-assisted rack-and-pinion steering, power-assisted front disc/rear drum brakes, power windows and door locks, and a tilt steering assembly.

The interior of the Cherokee was configured with front bucket seats and a rear bench with a folding backrest. The four outboard seated positions were equipped with 3-point manual lap and shoulder belts with height adjusters at the D-rings. The center rear seat was equipped with a manual lap belt. The front belt systems used a continuous loop webbing and a sliding latchplate. The emergency locking retractors were located in the base of the B-pillars.

Crash Sequence

Pre-Crash

The driver of the 1998 Jeep Cherokee was traveling in a northerly direction on a two lane city street and was decelerating in preparation for a left turn at a signalized four-leg intersection. On her approach to the

intersection, the overhead signal system changed from a green phase to amber then red for north/southbound traffic flow. The driver continued into the intersection and initiated her left turn. The driver of the 1993 Ford Escort was traveling in a southerly direction and proceeded into the intersection as the overhead signal phase changed to red. Consequently, both driver's entered the intersection on a red signal phase.

Crash

The front left corner of the left turning Jeep Cherokee impacted the front left and center area of the Ford Escort in an off-set head-on configuration. The crash resulted in an impact force within the 12 o'clock sector for the Cherokee and probably within the 11 o'clock sector for the Ford Escort. Although the Cherokee was dismantled at the time of inspection, a crush profile was estimated which yielded a barrier equivalent velocity change of 13.7 km/h (8.5 mph) with a longitudinal component of -13.5 km/h (-8.4 mph). The impact resulted in a sufficient longitudinal deceleration to deploy the Cherokee's frontal air bag system. Although the Cherokee sustained minor damage to the front right corner area, the single point sensing system is predicting the overall severity of the crash early in the event. The -13.5 km/h (-8.4 mph) velocity change is probably within the "may" deploy threshold for this vehicle.

Post-Crash

The vehicles came to rest near the point of impact. The driver of the Jeep Cherokee unbuckled the manual restraint system and exited the vehicle unassisted. She was transported by ambulance to a local hospital where she was examined for possible injury and released.

VEHICLE DAMAGE

Jeep Cherokee - Exterior

The left turn-across-path crash resulted in front right damage to the Cherokee. The direct contact damage began 27.9 cm (11.0 in) right of center on the bumper fascia and extended 43.2 cm (17.0 in) to the right corner. The vehicle was dismantled at the time of this SCI inspection, therefore maximum crush was estimated at 10 cm (4 in), located at the front right corner. Damaged components included the front bumper fascia, reinforcement bar, front right head lamp assembly, right front fender, and the right front frame rail. The damage profile is documented in **Figure 2**. The Collision Deformation Classification (CDC) for this impact sequence was 12-FZEW-1.

Figure 2. Front right three-quarter view of the damage to the Grand Cherokee.

Jeep Cherokee - Interior

Interior damage to the Jeep Cherokee was minor and was associated with frontal air bag deployment and driver contact. There was no damage that resulted from exterior deformation of intrusion of interior components.

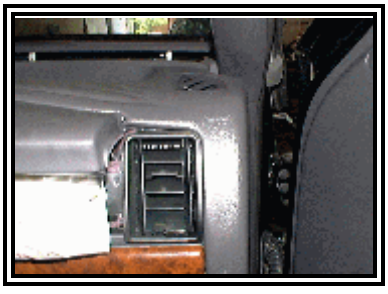

Figure 3. Displaced vent louver fins.

Both frontal air bags deployed as designed from the respective module assemblies. The front right air bag expanded against the right door panel which deposited membrane transfers onto the right door panel. Several areas of vinyl transfers were noted to the bag from expansion within the module assembly. The deployment of the front right passenger air bag resulted in deflection of the right mid instrument panel with displacement of the right vent louver fins **(Figure 3)**. There were no tears or damage to the deployed air bag membranes.

The driver's left knee contacted and scuffed the plastic knee bolster panel at the protruding base of the steering column. The scuff mark abraded the plastic surface, however, there was no underlying damage.

AUTOMATIC RESTRAINT SYSTEM

The 1998 Jeep Cherokee was equipped with a Supplemental Restraint System (SRS) that consisted of a single-point sensing system and frontal air bags for the driver and right passenger positions **(Figure 4)**. The front left (driver) air bag was identified by Chrysler as a redesigned air bag while the front passenger air bag remained as a full power module. The driver module was housed in a conventional configuration in the steering assembly while the front right air bag was mounted in the mid right instrument panel. Both air bags deployed as a result of the vehicle's front right corner impact sequence with the Ford Escort. The front left (driver) air bag deployed from asymmetrical H-configuration module cover flaps. The upper flap had a maximum width of 15 cm (6 in) at the horizontal tear seam and a height of 3.6 cm (1.4 in). The lower aspect of the flap shared the same width as the upper flap with a height of 8.9 cm (3.5 in) in height. There was no contact evidence or damage to the cover flaps.

Figure 4. Left lateral view of the Cherokee's passenger compartment and deployment of the frontal air bag system.

The front left air bag membrane had a seam-to-seam diameter of 68.0 cm (26.7 in) in its deflated state. The air bag was not equipped with vent ports, however, it was tethered by two internal wide band tethers with a width of 8.5 cm (3.3 in). The tethers were located at the 3 and 9 o'clock positions. The maximum excursion of the bag was of 25.0 cm (9.8 in) from the face of the module. Gray vinyl transfers were located on the upper right quadrant of the air bag which resulted from expansion of the membrane within the interior of the module assembly and cover flaps. Vinyl fibers were also evident on the right side of the air bag which resulted from expansion of the air bag against the module cover flap. There was no tearing of the bag membrane. The bag membrane was identified by the following alphanumeric bar code:

P118137-02C TMJ0717D1107.

The front right air bag deployed from a mid-mount module assembly in the right instrument panel. The single, top hinged air bag module cover flap was molded of rigid vinyl and was identified by the following:

4732048 REVP
CH 96-520
CAV-1
SAE TPO

The front right module cover flap measured 36.5 cm (14.4 in) in width and 10.5 cm (4.1 in) in height. There was no damage to the module cover flap. The face of the front right air bag had a measured seam-to-seam width of 45.0 cm (17.7 in) and height of 57 cm (22.4 in). The top surface of the air bag exhibited a gray vinyl transfer that resulted from expansion within the module assembly and against the cover flap. Another gray vinyl transfer was located on the right side of the air bag and resulted from contact with the forward aspect of the front right door and the right most portion of the upper instrument panel area. The transfer began 18 cm (7 in) below the juncture of the top and right air bag seam and 9 cm (3.5 in) forward (with respect to the vehicle) of the right air bag seam. It measured 17.0 cm (6.7 in) in length and 2.5 cm (1.0 in) in width. Air bag fiber transfers were located on the forward most aspect of the right front door **(Figure 5).** Bag deployment displaced the fins of the right vent louver.

Figure 5. Air bag transfers located on the right front door and right instrument panel area.

The air bag was not tethered and had a maximum rearward excursion of 79 cm (31 in) from the inflator unit (Figure 5). Exhaust residue from the air bag gases was deposited on the right A-pillar.

Air bag warning labels were located on both sunvisors. In addition, an orange sport utility vehicle warning label (identification: SF 8955014372) was located on the front left sunvisor **(Figure 6)** which read:

"This utility vehicle handles and maneuvers differently from many passenger cars, both on-road and off-road. You must drive it safely. As with other utility vehicles, if you make sudden sharp turns or abrupt maneuvers, you may cause this vehicle to go out of control and rollover or crash - you or your passengers may be seriously injured. Read the driving guidelines in the owner's manual".

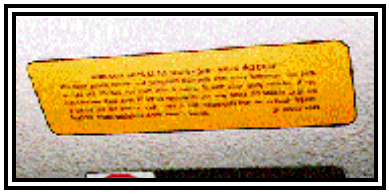

Figure 6. Sport utility vehicle warning label on the left sunvisor.

DRIVER DEMOGRAPHICS

Jeep Cherokee

Age/Sex:	17 year old female
Height/Weight:	Unknown
Manual Restraint Usage:	3-point lap and shoulder belt
Usage Source:	Driver interview
Mode of Transport From Scene:	Ambulance
Type of Medical Treatment:	Examined at a local hospital and released

DRIVER INJURIES

Injury	Injury Severity	Injury Mechanism
Complaint of neck pain	N/A	Impact force (indirect)

DRIVER KINEMATICS

The 17 year old female driver of the rented Jeep Grand Cherokee was seated in a mid track position with the back rest slightly reclined **(Figure 7)**. At the time of the SCI inspection of the Cherokee, the seat back angle was reclined to 30 degrees. Although there was no loading evidence on the manual belt system, the driver alleged she was properly restrained by the 3-point lap and shoulder belt system with the D-ring adjusted to the top (full-up) position.

Figure 7. Profile view of the driver's seated position with respect to the steering assembly and the deployed redesigned front left air bag.

At impact, she responded to the 1 o'clock impact force by moving forward and laterally to the right. She loaded the manual belt system which allowed her head to flex forward into the deployed redesigned front left air bag. The flexion motion of the head resulted in her complaint of cervical pain. The driver's left knee contacted the protruding aspect of the knee bolster at the base of the steering column. A scuff mark evidence the contact point. No injury occurred from the knee loading.

The driver rebounded into the front left seat where she came to rest. Immediately following the crash, she unbuckled the belt system and exited the vehicle from the left front door. The driver was subsequently transported by ambulance to a local hospital where was examined for a possible neck injury following her complaint of pain.