On-scene Investigation / Vehicle to object
Dynamic Science, Inc. / Case Number: DS01-016
1998 Chevrolet K-2500 pickup
Oregon
November, 2001

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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 be 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 case was originally initiated in response to a report of a fatality involving a non-deployed air bag. The report of a non-deployed air bag was incorrect. The case vehicle was not equipped with an air bag because it met the >3855 kg (8500 lbs) Gross Vehicle Weight (GVW) cutoff. The case was continued to be investigated because of its borderline nature and to determine if the existence of the air bag might have mitigated the resulting fatal injuries.

The crash occurred on an east/west curved, two lane roadway. The roadway is level at this location. The asphalt-covered surface has one lane in each direction separated by a double-yellow centerline. There is a paved shoulder as well as a small dirt shoulder and a ditch on both sides of the roadway. On the south side of the road there is a dirt embankment. The approach to the area of the crash has a gradual right-hand curve. There was clear visibility for both directions of travel for several hundred feet. The weather at the time of the crash was clear and the roadway was dry. The roadway was dark and no streetlights were available. The case vehicle was traveling eastbound at an unknown rate of speed. The driver had a blood alcohol level of 0.35%. As the case vehicle negotiated the right hand curve, it appears that the vehicle crossed into the westbound travel lanes. Approximately 91.4 m (300 ft) before the impact, the driver corrected his vehicle and brought it back into the eastbound lanes. Approximately 60.9 m (200 ft) before impact, the case vehicle's right side departed the roadway. After traveling another 30.4 m (100 ft), the front of the case vehicle struck the embankment–possibly several times. The right front tire was knocked off. The case vehicle continued on for another 30.4 m (100 ft) before the front left tire and bumper dug into the ground and the vehicle came to rest. Medical personnel responded and arrived on-scene at 2218 hours. The driver was removed by emergency personnel and transported by ground ambulance to a local hospital. At approximately 0025 hours, it was reported that the driver was being transported a local trauma center. He arrived unconscious with a Glasgow Coma Scale of 3. He was hospitalized for six days at this location before dying due to extensive head injuries.

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Dynamic Science, Inc.
Accident Investigation
Case Number: DS01-016

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BACKGROUND:

Description:	This case was originally initiated in response to a report of a fatality involving a non-deployed air bag. The report of a non-deployed air bag was incorrect. The case vehicle was not equipped with an air bag because it met the >3855 kg (8500 lbs) Gross Vehicle Weight (GVW) cutoff. The case was continued to be investigated because of its borderline nature and to determine if the existence of the air bag might have mitigated the resulting fatal injuries. This crash was generated from a fax to the NHTSA via a Special Crash Investigations Notification Form. The crash occurred in November, 2001 at approximately 2205[1] hours. DSI was notified on December 3, 2001. DSI inspected the case vehicle on December 13, 2001.
Investigation Type:	On-scene
Crash Location:	Oregon
Crash Date:	November, 2001
Notification Date:	December 3, 2001
Field Work Completed:	December 13, 2001

SUMMARY:

This single vehicle, off-road crash occurred in Oregon on a US highway. The case vehicle is a 1998 Chevrolet K2500 series 4 x 4 conventional cab pickup with a GVW of 3901 kg (8600 lbs) driven by an unrestrained 48-year-old male (183 cm/72 in, 73 kg/160 lbs). There were no stretch marks or any other indicators of belt use that would normally be found in a crash of this kind.

The crash occurred on an east/west curved, two lane roadway. The roadway is level at this location. The asphalt-covered surface has one lane in each direction separated by a double-yellow centerline. There is a paved shoulder as well as a small dirt shoulder and a ditch on both sides of the roadway. On the south side of the road there is a dirt embankment. The approach to the area of the crash has a gradual right-hand curve. There was clear visibility for both directions of travel for several hundred feet. The weather at the time of the crash was clear and the roadway was dry. The temperature was approximately -1degrees C (30 degrees F). The vehicle's windshield defroster was on[2]. The temperature was set to the highest setting. The fan was on LOW. The roadway was dark and no

[1]Time of EMS notification

[2]Status of environmental controls at the time of the vehicle inspection

streetlights were available.

The driver was seated in what appears to be an upright position–in line with the steering wheel. The driver was not wearing the available lap and shoulder belt. The gray, cloth-covered bench seat was adjusted to the mid position.

The case vehicle was traveling eastbound at an unknown rate of speed. The driver had a blood alcohol level of 0.35%. As the case vehicle negotiated the right hand curve, it appears that the vehicle crossed into the westbound travel lanes. Approximately 91.4 m (300 ft) before the impact, the driver corrected his vehicle and brought it back into the eastbound lanes. Approximately 60.9 m (200 ft) before impact, the case vehicle's right side departed the roadway. After traveling another 30.4 m (100 ft), the front of the case vehicle struck the embankment–possibly several times. The right front tire was knocked off. The case vehicle continued on for another 30.4 m (100 ft) before the front left tire and bumper dug into the ground and the vehicle came to rest.

Figure 1. Final rest–south

Figure 2. Final rest–east

The crash was reported by a citizen to a local police officer who was working radar in the area. He responded to the crash scene. He was the first to open the door. He found the driver face down on the passenger floor and unresponsive to verbal commands.

Medical personnel responded and arrived on-scene at 2218 hours. The driver was removed by emergency personnel and transported by ground ambulance to a local hospital. At approximately 0025 hours, it was reported that the driver was being transported a local trauma center. He arrived unconscious with a Glasgow Coma Scale of 3. He was hospitalized for six days at this location. He sustained the following injuries: comminuted nasal bone fracture, subarachnoid hemorrhage, fracture at the region of the left zygomaticoaxillart suture, bilateral frontal lobe contusions, cervical fracture, liver laceration, multiple rib fractures, and lacerations to the nasal bridge. The police were notified at 1237 hours on the sixth day after admission that the driver had died to his extensive head injuries.

The case vehicle sustained moderate frontal damage (12FDEW1). The front right wheel was knocked

off. The wheelbase on the left side was shortened by 16 cm (6.2 in). There was 173 cm (68.1 in) of direct contact along the bumper–mostly dirt and grass. The maximum crush of 9 cm (3.5 in) was found at C_1. There was direct contact damage to the left front fender that may have happened at some earlier time. The case vehicle sustained a longitudinal delta v of -12.1 km/h (-7.5 mph)[3]. The results are low and the damage to the wheels is not accounted for in any fashion. The case vehicle was towed from the scene and later declared a total loss by the insurance company.

[3]Calculated using WinSmash 1.2.1 (barrier option)

Scene Diagram

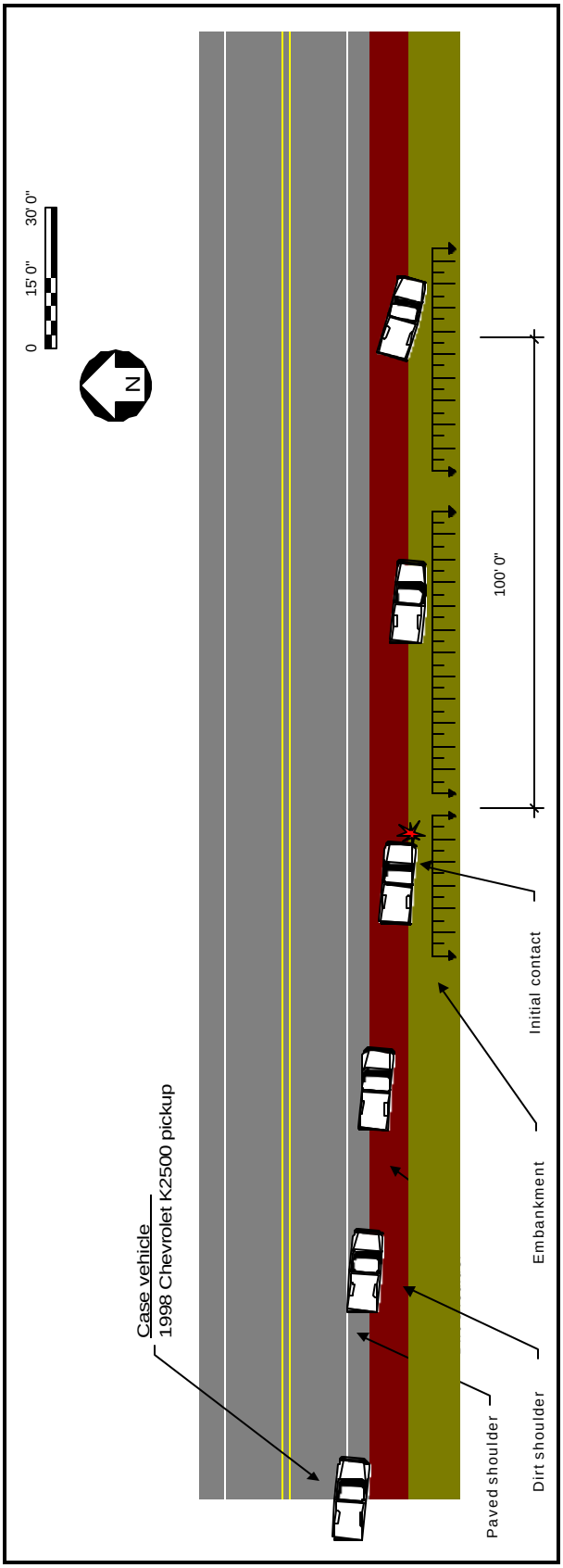

Figure 3. Scene diagram

COLLISION MEASUREMENTS						
Reference point:	Cross street					
Reference line:	South edge of roadway at edge of paved shoulder					
Data Point	**Distance and Direction from RP**			**Distance and Direction from RL**		
	ft	m	d	ft	m	d
LF corner of vehicle	106	32.3	E		0	
LF axle	102.9	31.4	E	8.8	2.7	S
LR axle	93.2	28.4	E	7.4	2.3	S
Width of eastbound paved shoulder	93.0	28.3	E	4.0	1.2	N
Width of eastbound travel lane	93.0	28.3	E	24.0	7.3	N
Width of westbound paved shoulder	93.0	28.3	E	35.6	10.9	N
LR tire mark leaves paved shoulder to dirt shoulder	94.4	28.8	W			
Right tire mark leaves paved shoulder to dirt shoulder	148.9	45.4	W			
Tire mark on centerline coming from westbound lane	311.9	95.1	W			
East edge of cross street from highway	411.9	125.5	W			

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	1998 Chevrolet K2500 series 4 x 4 conventional cab pickup with a GVW of 3901 kg (8600 lb)	
VIN:	1GCGK24R3WEXXXXXX	
Odometer:	Unknown	
Engine:	5.7 L V8	
Reported Defects:	None	
Cargo:	Spare tire in pickup bed.	
Damage Description:	Moderate frontal damage. Front right wheel was knocked off. Wheelbase on the left side was shortened by 16 cm (6.2 in). 173 cm (68.1 in) of direct contact along the bumper–mostly dirt and grass. Left side of windshield starred by occupant contact. Seat back failed. Vehicle declared a total loss by the insurance company.	
CDC:	12FDEW1	
Delta V:	Total	12.1 km/h (7.5 mph)
	Longitudinal	-12.1 km/h (-7.5 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	13,848 joules (10,221 ft-lbs)

Figure 4. Front right, case vehicle

Figure 5. Front left, case vehicle

Air Bag Exemption Discussion

As stated earlier, this case was originally initiated in response to a report of a fatality involving a non-deployed air bag. The report of a non-deployed air bag was incorrect. The case vehicle was not equipped with air bags because it met the >3856 kg (8500 lbs) GVW cutoff as described in the Federal Motor Vehicle Safety Standard, Standard No. 208 -- Occupant Crash Protection shown below:

> **Front, outboard designated seating positions for Passenger Cars and Multipurpose Passenger Vehicles, Trucks and Buses as listed below *with a Gross Vehicle Weight Rating of 3856 kg (8,500 lbs.) or less* and Unloaded Vehicle Weight of 2495 kg (5,500 lbs.) or less:**
>
> **Passenger Cars (Effective 9-1-86), Multipurpose Passenger Vehicles, Trucks and Buses (Effective 9-1-94)**
>
> Shall meet passive restraint phase-in requirements.
>
> **Multipurpose Passenger Vehicles, Trucks and Buses (Effective 9-1-91)**
>
> Shall meet 48 km/h (30 mph) crash test requirements with seat belts fastened.
>
> **Passenger Cars (Effective 9-1-89), Multipurpose Passenger Vehicles and Trucks (Effective 9-1-97)**
>
> Shall meet passive restraint requirements.
>
> **Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses (Effective 6-22-95 until 9-1-2000)**
>
> Vehicles with no rear seats or rear seats too small to accommodate a rear-facing infant seat may be equipped with an air bag cut-off switch for the right front passenger air bag.
>
> **Passenger Cars (Effective 9-1-96), Multipurpose Passenger Vehicles, Trucks and Buses (Effective 9-1-97)**
>
> Shall meet phase-in requiring air bags.
>
> **Passenger Cars (Effective 9-1-97), Multipurpose Passenger Vehicles, Trucks and Buses (Effective 9-1-98)**
>
> Shall be equipped with air bags.

The case continued to be investigated because of its borderline nature and to determine if the existence of the air bag might have mitigated the resulting fatal injuries. It is this investigator's opinion that the existence of a steering wheel mounted air bag would have greatly reduced the number of injuries sustained by the driver as well as their severity. In particular, the air bag might have prevented the driver's head from ever reaching the windshield thus mitigating the inevitable fatal injuries. The air bag would also have likely eliminated the chest and abdomen injuries.

Figure 6. Horn button

Figure 7. Behind horn membrane

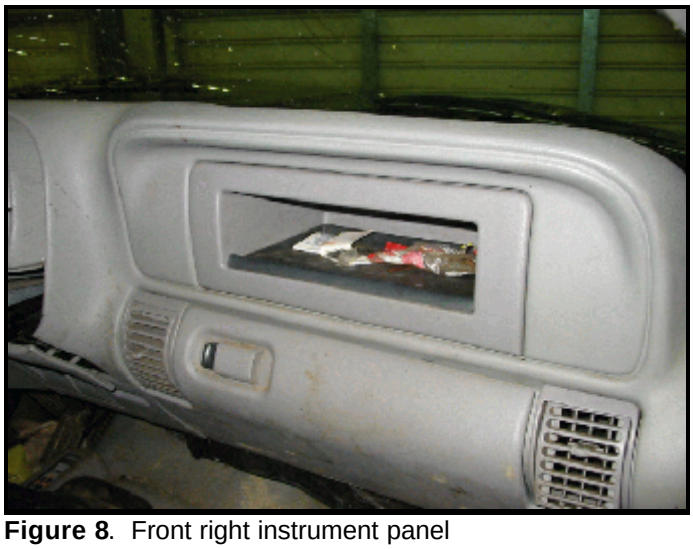

Figure 8. Front right instrument panel

Occupants

Case vehicle	Occupant 1
Age/Sex:	48/Male
Seated Position:	Front left
Seat Type:	Cloth-covered bench with folding back. Adjusted to the mid track position.
Height:	183 cm (72 in.)
Weight:	73 kg (160 lbs)
Occupation:	Unemployed
Pre-existing Medical Condition:	History of alcoholism. Asthmatic. Reports of motor vehicle crash in 1971 that caused head and leg injuries.
Alcohol/Drug Involvement:	ETOH level of 0.353 at initial hospital, 0.293 at trauma center
Driving Experience:	Presumed to be greater than 20 years.
Body Posture:	Upright, actively maneuvering vehicle.
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, not used
Air bag:	None available

Injuries and Injury Mechanisms

Case vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
	Based on information found in CT scan report			
Driver:	Comminuted fracture, nasal bone	251004.2,4	802.0	Windshield
	Fracture at the region of the left zygomaticoaxillart suture	251800.2,2	802.4	Windshield
	Bilateral frontal lobe contusions	140620.3,3	851.06	Windshield
	Interparechymal hemorrhage, bilateral subarachnoid hemorrhage	140684.3,1 140684.3,2	800.2	Windshield
	Soft tissue swelling, left frontal area of head (coded as contusion)	290402.1,7	920.0	Windshield
	Unconscious upon arrival	Not codeable	NA	NA
	Based on information reported in medical examiner report			
	Cervical fracture	650216.2,6	805.00	Windshield
	Liver laceration	541820.2,1	864.02	Steering wheel
	Multiple rib fractures	450210.2,9	807.09	Steering wheel
	Lacerations to nasal bridge	290600.1,4	873.20	Windshield

Occupant Kinematics

It appears that the driver was seated in a normal, upright fashion prior to the crash. He was not wearing the available lap and shoulder belt. The driver was likely conscious. As the vehicle negotiated the right hand curve, he made a steering maneuver to the right and lost control of the vehicle. The vehicle departed the roadway on the right, went down into a ditch, and impacted an embankment. The driver was in a higher than normal–as compared to the position the driver would be on a level surface. The driver responded to the 12 o'clock direction of force by moving forward. He loaded and collapsed the steering wheel with his torso–causing the rib fractures and the liver laceration. As his body wrapped around the wheel, his head struck the windshield–causing the fatal head injuries. Strands of hair and small pieces of tissue were embedded in the windshield at the impact point. As the vehicle came to rest, the driver fell to the right. He struck and dislodged the center cup holder. He was found lying face down on the passenger side floor by the investigating officer.

The seat back appears to have failed during the crash. In police photos it can be seen that the seat is no longer in its locked position. At the time of the inspection the investigator was unable to put the seat back into the latched position. The reason for the failure may have been inertial forces. There was no indication of loading from the rear.

Figure 9. Exterior view of windshield contact

Figure 10. Head contact to windshield

Figure 11. Passenger side view of driver's seated position

Figure 12. Driver's seated position–note seat back and deformed steering wheel

Figure 13. Center cup holder–dislodged by driver