



# INDIANA UNIVERSITY

## TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs

222 West Second Street

Bloomington, Indiana 47403-1501

(812) 855-3908 Fax: (812) 855-3537

## SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-2000-73-160E

LOCATION - Indiana

VEHICLE - 1999 KIA SPORTAGE

CRASH DATE - September 2000

Submitted:

May 17, 2001



Contract Number: DTNH22-94-D-17058

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National Center for Statistics and Analysis  
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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.

**Technical Report Documentation Page**

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16. <i>Abstract</i> This report covers a SCI/NASS combination investigation concerning a 1999 Kia Sportage (case vehicle) and a 1998 Dodge Caravan (other vehicle). This case is of special interest because the case vehicle was equipped with a knee bolster air bag that deployed as a result of the collision events. The case vehicle had been traveling north in the northbound lane of a two-lane, undivided local road and was in the process of executing a left turn onto an intersecting roadway, intending to travel west. The other vehicle was traveling east in the eastbound lane of the intersecting roadway, intending to pass through the intersection and continue east. The crash occurred within the intersection. The front left corner of the case vehicle was impacted by the front right corner of the other vehicle, causing the case vehicle's driver and front right passenger front air bags and the driver's knee bolster air bag to deploy. The other vehicle was also equipped with front air bags that deployed. The case vehicle rotated clockwise, the other vehicle was displaced northeastward and both vehicles came to rest within the intersection, a short distance from the point of impact. This was a crash of low severity for the case vehicle. The case vehicle driver (35-year-old female) was restrained by the available, manual, three-point, lap-and-shoulder safety belt system, which was equipped with a pretensioner that did actuate. The driver exited the vehicle under her own power and declined treatment at the scene. Approximately 24 hours post-crash, she presented herself at a hospital emergency department. She was treated for multiple contusions and abrasions and released. The case vehicle's back right passenger (5-year-old female) was restrained by the available, manual, lap-and-shoulder safety belt system. She did not sustain any injuries. Both vehicles were towed from the scene due to disabling damage.					
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This combination SCI/NASS crash investigation concerns a 1999 Kia Sportage (case vehicle) and a 1998 Dodge Caravan (other vehicle). The crash occurred in September 2000, at 12:20 p.m., in Indiana, and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle was equipped with a knee bolster air bag at the driver's seat position that deployed as a result of the collision events. The restrained driver (35-year-old female) sustained minor contusions and abrasions on her upper extremities and face. The restrained back right passenger (5-year-old female) was not injured. The NASS researcher inspected the scene and vehicles and interviewed both drivers in September 2000. This report is based on the Police Crash Report, the NASS researcher's coded forms and photographs, the interviews, occupant kinematic principles, and this contractor's evaluation of the evidence.

### CRASH CIRCUMSTANCES

The case vehicle had been traveling north in the northbound lane of a two-lane, undivided local road and was in the process of executing a left turn onto an intersecting roadway, intending to travel west (**Figure 1**). The other vehicle was traveling east in the eastbound lane of the intersecting roadway, intending to pass through the intersection and continue east. It was daylight with no adverse weather conditions, both roadways were dry, straight and level, paved with asphalt and with no defects. The four-leg intersection was controlled by overhead automatic signals. Both roadways were undivided with one lane in each direction and solid double yellow painted lane separators, but both roadways were widened to four lanes to accommodate turning traffic in the intersection area. The speed limit for both roadways was 48 km.p.h. [30 m.p.h.]. The two vehicles entered the intersection simultaneously (**Figure 2**).

The crash occurred within the intersection. The front left corner of the case vehicle was impacted by the front right corner of the other vehicle, causing the case vehicle's driver and front right passenger front air bags and the driver's knee bolster air bag to deploy. The other vehicle was also equipped with front air bags that deployed. The case vehicle rotated clockwise, the other vehicle was displaced northeastward and both vehicles came to rest within the intersection, a short distance from the point of impact.



**Figure 1:** Case vehicle's northbound approach toward left turn at intersection



**Figure 2:** Area of impact approximately at the center of the intersection, looking west (lookback view of other vehicle's eastbound approach)

The case vehicle was a four wheel drive 1999 Kia Sportage four-door, five passenger sport utility vehicle (VIN: KNDJA7230X5-----), equipped with a 2.0 liter I-4 engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were an option for this model, but it is not known if the case vehicle was so equipped. The wheelbase was 265 centimeters [104.3 inches]. The odometer reading was 29,395 kilometers [18,266 miles]. The case vehicle was towed from the scene of the crash due to disabling damage.

### CASE VEHICLE DAMAGE

The case vehicle sustained direct contact damage beginning at the front left corner and extending 72 centimeters [28.3 inches] inward across the front, with maximum crush of 36 centimeters [14.2 inches] at the front left bumper corner (**Figures 3 and 4**). Direct damaged was confined to the area forward of the front axle: the bumper cover was torn off; the forward area of the left fender, the headlight assembly and the bumper were crushed rearward and inward; the front left corner of the engine hood was bent under and folded double; the grille was shattered; and the radiator and fan were displaced rearward. The NASS researcher indicated that the front left wheel was restricted by the bending of the left fender, but this is not apparent in the photographs. No tires were deflated and the wheelbase was essentially unchanged on both sides. There was no glazing damage, and no intrusions into the passenger compartment. The CDC was determined to be **10-FYEW-2 (310)**. The WinSMASH reconstruction program, damage only algorithm based on the measured crush profiles of the two vehicles, indicated Total, Longitudinal and Lateral Delta V's, respectively: 20 km.p.h. [12.4 m.p.h.], -13 km.p.h. [-8.1 m.p.h.] and +15 km.p.h. [+9.3 m.p.h.] for the case vehicle. These results appear somewhat low but basically reasonable, indicating that the crash was of low severity (14 - 23 km.p.h. [9 - 14 m.p.h.]) for the case vehicle.



**Figure 3:** Case vehicle's front left damage



**Figure 4:** Case vehicle's front crush profile

### AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with redesigned front air bags at the driver and front right passenger seat positions, and a knee bolster air bag at the driver's seat position, for a total of three air bags. In addition, the manual, three-point, lap-and-shoulder safety belt systems at the two front seat positions were equipped with pretensioners. The three air bags did deploy and the two pretensioners did actuate as a result of the frontal impact.

The driver's knee bolster air bag was mounted in the knee bolster, directly beneath the left instrument panel<sup>1</sup> (**Figure 5**). The module's one-piece cover flap was shaped so that it could fit around the steering column (**Figure 6**). The cover flap and the air bag were attached to each other. When the air bag deployed, the cover flap separated entirely from the module and rotated downward as the air bag inflated so that, when the air bag was fully deployed, the cover flap was on the bottom (**Figure 7**). The cover flap measured 32 centimeters [12.6 inches] horizontally and 31 centimeters [12.2 inches] vertically.

The deployed air bag measured 44 centimeters [17.3 inches] horizontally and 32 centimeters [12.6 inches] vertically (**Figure 8**). There was no evidence of damage to the knee bolster air bag nor its cover flap.



**Figure 5:** Driver's seat area showing general location of the driver's knee bolster air bag



**Figure 6:** Knee bolster air bag cover flap held in place



**Figure 7:** Knee bolster air bag viewed from left



**Figure 8:** Knee bolster air bag viewed from right

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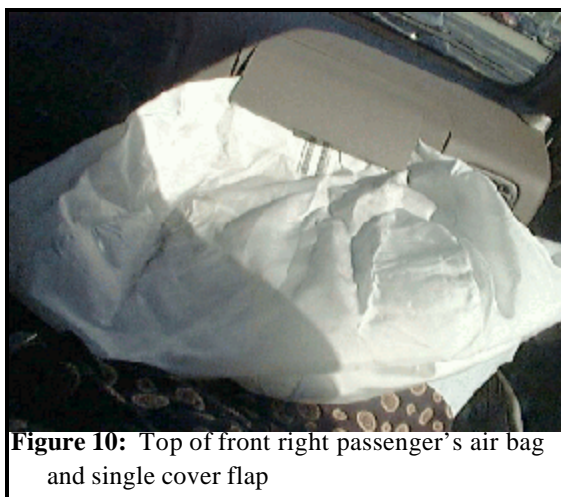
<sup>1</sup>The NASS case coding indicates that the knee bolster air bag module was mounted in the lower instrument panel, but it was actually below the instrument panel in the knee bolster.

The driver's front air bag was mounted in the steering wheel hub (**Figure 9**). The deployed air bag was round with diameter 62 centimeters [24.4 inches]. There was one vent port at the 12 o'clock position on the back of the air bag, and no tethers. The module cover flaps opened at the designated tear points and there was no damage to the air bag or the cover flaps. There was no physical evidence of contact on the driver's air bag, except a smudge of dirt on the lower edge of the front.



**Figure 9:** Front of driver's air bag

The front right passenger's front air bag was mounted in the mid-instrument panel (**Figure 10**). The deployed air bag was rectangular and measured 75 centimeters [39.5 inches] horizontally and 70 centimeters [27.6 inches] vertically. There were two tether straps and no vent ports. The module's single cover flap opened at the designated tear points and there was no evidence of damage to the air bag, the cover flap or the adjacent instrument panel. There was no occupant seated in the front right position and there was no evidence of contact, nor any other evidence, on the air bag.



**Figure 10:** Top of front right passenger's air bag and single cover flap

#### **CASE VEHICLE DRIVER**

The case vehicle driver (35-year-old<sup>2</sup> female, white, non-Hispanic, 170 centimeters, 64 kilograms [67 inches, 140 pounds]) was restrained by the available, manual, three-point, lap-and-shoulder safety belt system. She exited the vehicle under her own power, declined treatment at the scene and was recorded by the investigating officer as sustaining "B" (evident, non-incapacitating) injuries. Approximately 24 hours post-crash, she presented herself at a hospital emergency department complaining of pain in her neck and abrasions on her forearms.

The case vehicle driver was seated in an upright posture with her back against the seat back, her

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<sup>2</sup>The NASS case is coded age 40 years, but the Police Crash Report and the medical records both record her date of birth which indicates age 35 years on the date of the crash.



hands on the steering wheel and her feet on the floor and foot controls. She had begun a left turn steering maneuver and so would have tended to shift slightly to the right. It is not known if she attempted any avoidance maneuvers. The impact caused the air bags to deploy and caused her to move forward and leftward, toward the 10 o'clock direction of principal force, but her forward motion was restricted because she was wearing her safety belt and the pretensioner did actuate. The deploying air bag brushed across her forearms causing bilateral abrasions. She probably encountered the deployed air bag with her face, causing a contusion to one of her eyelids (aspect unknown). As she moved forward, she pivoted with her right side leading because her left shoulder was held in place by the shoulder portion of her lap-and-shoulder belt and her right shoulder contacted the steering wheel rim as the air bag deflated, causing a contusion on her right shoulder.

#### CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Contusion, right shoulder	790402.1 minor	steering wheel rim	probable	Emergency Room
2.	Abrasions, bilateral forearms	790202.1 minor	driver's air bag	probable	Interview
3.	Contusion, eyelid, aspect unknown	297402.1 minor	driver's air bag	probable	Interview

#### CASE VEHICLE BACK RIGHT PASSENGER

The case vehicle back right passenger (5-year-old female, white, non-Hispanic, unknown height, 18 kilograms [40 pounds]) was restrained by the available, manual, lap-and-shoulder safety belt system. She exited the vehicle under her own power and was recorded by the investigating officer as uninjured. The interviewee (driver) confirmed that the back right passenger did not sustain any injuries as a result of the crash.

The back right passenger was seated in an upright posture, with her back against the seat back and her legs dangling down in front of the seat cushion. As the driver began the left turn maneuver, the passenger moved slightly to the right. The impact caused her to move forward and leftward, toward the 10 o'clock direction of principal force, but her movement was restricted by her safety belt. She probably loaded the safety belt and rebounded back into the seat and was not injured.

#### OTHER VEHICLE

The other vehicle was a front wheel drive 1998 Dodge Caravan four-door hatchback minivan (VIN: 2B4FP2530WR-----), equipped with a 3.0 liter V-6 engine and an automatic transmission with a column-mounted selector lever. Four-wheel anti-lock brakes were an option for this model, but it is not known if this vehicle was so equipped. The wheelbase was 288 centimeters [113 inches] and the odometer reading is unknown due to the non-functional electronic instrument panel.

The Caravan sustained direct contact at the front right corner (**Figure 11**). The CDC was determined to be **12-FZEW-2 (10)**. The WinSMASH reconstruction program, damage only algorithm based on measured crush profiles from both vehicles, indicated Total, Longitudinal and Lateral Delta Vs, respectively: 20 km.p.h. [12.4 m.p.h.], -19 km.p.h. [-11.8 m.p.h.] and -3 km.p.h. [-1.9 m.p.h.].



**Figure 11:** Front and right side of other vehicle

# SCENE DIAGRAM

