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**Special Crash Investigations
On-Site Office of Defects
Investigation
Air Bag Non-Deployment
Investigation
Vehicle: 2008 Kia Optima
Location: Texas
Crash Date: July 2015**

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<i>15. Supplementary Note</i> On-site Office of Defects Investigation air bag non-deployment investigation of a 2008 Kia Optima, which struck a break-away sign post and curb, became airborne and struck a utility pole. Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team.			
<i>16. Abstract</i> This report documents the on-site investigation in the non-deployment of the front right seat-mounted side impact air bag and the right side impact inflatable curtain air bag in a 2008 Kia Optima involved in a single-vehicle crash that occurred on the east roadside of a two-lane northeast-bound service road to a six-lane, divided interstate highway. The Kia was a 4-door sedan, equipped with multi-stage frontal air bags, front-seat-mounted side impact air bags, and side impact IC air bags. A belted 25-year-old male driver and a belted 24-year-old female front right occupant occupied the vehicle. According to the police crash report, the Kia was traveling northeast at a high rate of speed and was moving in and out of traffic when it departed the right side of the roadway through the grassy roadside. The vehicle then struck a breakaway road sign, crossed the service road and struck a curb with all four wheels, became airborne and struck and sheared a wooden utility pole (Event 6) and metal utility box (Event 7). The vehicle came to final rest in contact with the top of the broken utility pole still suspended by the overhead utility wires. The driver sustained serious injuries and was transported to a trauma center where he was hospitalized for two days. The passenger sustained critical injuries and was transported by ambulance to a trauma center, where she died 35 minutes post-crash. The Kia was towed due to damage. There was no deployment of the front right seat-mounted side impact and right IC air bags. The non-deployment of these air bags was probably due to the non-horizontal force direction on the vehicle when the undercarriage struck the utility pole. The front right seat-mounted side impact air bag and right IC air bag did not deploy during the right plane impact with the breakaway sign post since it was a yielding object and the impact was probably not of sufficient severity to require their deployment. The remaining air bags did not deploy during the crash since there was no frontal impact and the impact to the driver's door was not of sufficient severity to require deployment of the driver's seat-mounted or left IC air bags.			
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TABLE OF CONTENTS

BACKGROUND	1
CRASH SUMMARY	2
Crash Site	2
Pre-Crash.....	2
Crash	2
Post-Crash.....	3
2008 KIA OPTIMA.....	4
Description.....	4
Exterior Damage	4
Interior Damage	6
Manual Restraint Systems.....	6
Supplemental Restraint Systems.....	7
Air Bag Non-Deployment Discussion	7
2008 KIA OPTIMA OCCUPANTS.....	8
Driver Demographics.....	8
Driver Injuries.....	8
Driver Kinematics.....	8
Front Row Right Occupant Demographics.....	9
Front Row Right Occupant Injuries.....	9
Front Row Right Occupant Kinematics.....	11
APPENDIX A: IN15031 Crash Diagram.....	A-1
APPENDIX B: IN15031 Expanded Crash Diagram.....	B-1

**Indiana University
Transportation Research Center
On-Site Office of Defects Investigation
Air Bag Non-Deployment Investigation
Case Number: IN15031
Vehicle: 2008 Kia Optima
Location: Texas
Crash Date: July 2015**

BACKGROUND

This report documents the on-site investigation in the non-deployment of the front right seat-mounted side impact air bag and the right side impact inflatable curtain (IC) air bag in a 2008 Kia Optima (**Figure 1**), which was involved in a single-vehicle crash. This crash was reported to the National Highway Traffic Safety Administration in November 2015 by the family of the front right passenger. The investigation of this crash was initiated in December 2015 through the Office of Defects Investigation (ODI) in Washington, DC, and was assigned to the Special Crash Investigation (SCI) Team at the Indiana University Transportation Research Center. The crash occurred in July 2015 in the evening in Texas and was investigated by local police. Cooperation with the investigating police agency was established in December 2015, and clearance to inspect the vehicle was authorized in March 2016. The scene inspection was completed in March 2016, and the vehicle inspection was completed in March 2015. The driver was incarcerated and could not be interviewed.



Figure 1: 2008 Kia Optima

This crash occurred on the east roadside of a two-lane northeast-bound service road to a six-lane, divided interstate highway. The Kia was a 4-door sedan, equipped with multi-stage frontal air bags, front-seat-mounted side impact air bags, and side impact IC air bags. A belted 25-year-old male driver and a belted 24-year-old female front right passenger occupied the vehicle.

According to the police crash report, the Kia was traveling northeast on the interstate at a high rate of speed and was moving in and out of traffic when it departed the right side of the roadway. The vehicle traveled through the grassy roadside and rotated counterclockwise. The vehicle then struck a breakaway road sign post with the right rear door (Event 1), crossed the service road and struck a curb with all four wheels (Events 2, 3, 4 and 5) as it traveled backwards. The vehicle became airborne and the undercarriage below the right rear door struck and sheared a wooden utility pole (Event 6) and a metal utility box (Event 7). A guy wire attached to the top of the utility pole snapped as a result of the impact and struck the left front door and B-pillar (Event 8). The vehicle came to final rest heading northwest, with the right plane in contact with the top portion of the broken utility pole, which was still suspended by the overhead utility wires. The Kia's

driver sustained serious injuries and was transported by ambulance to a trauma center where he was hospitalized for two days. The front right passenger sustained critical injuries and was transported by ambulance to a trauma center, where she died 35 minutes post-crash. The Kia was towed due to damage. There was no deployment of the front right-seat-mounted side-impact and right IC air bags during the impact with the utility pole. The non-deployment of these air bags was probably due to the non-horizontal force direction on the vehicle when the undercarriage struck the utility pole. In addition, the front right-seat-mounted side impact air bag and right IC air bag did not deploy during the right plane impact with the breakaway sign post since it was a yielding object and the impact was probably not of sufficient severity to require their deployment. The remaining air bags did not deploy during the crash since there was no frontal impact and the impact to the driver's door was not of sufficient severity to require deployment of the driver's seat-mounted or left IC air bags.

CRASH SUMMARY

Crash Site

This crash occurred during the day on the east roadside of a two-lane, undivided, one-way service road to a six-lane, divided interstate highway. The Kia was initially traveling northeast on the interstate. The weather conditions were clear with 16.1 kilometers (10 miles) visibility, south winds at 8 km/h (5 mph), a temperature of 26.7 °C (88 °F), and a dew point of 19.4 °C (67 °F), according to local weather reports. The interstate had three level, bituminous, northeast-bound, through lanes that were approximately 3.6 m (11.8 ft) wide. These lanes were bordered by a 5.4 m (17.7 ft) wide bituminous and grass shoulder on the west side and by a 3 m (9.8 ft) wide bituminous shoulder on the east side. The northeast-bound lanes were separated from the three southwest-bound lanes by a concrete median barrier. The interstate was separated from the service road by a grassy roadside that was 8.8 m (28.9 ft) wide. The service road's lanes were approximately 4 m (13.1 ft) wide, negatively graded 2.9 percent, and were approximately 1 m (3.3 ft) lower than the interstate. The speed limit for the interstate was 113 km/h (70 mph) and the speed limit for the service road was 89 km/h (55 mph). The crash diagrams are included on pages 12 and 13 of this report.

Pre-Crash

The Kia was traveling northeast on the interstate in an unknown lane. Witness statements on the police crash report indicated that the Kia was traveling at a very high rate of speed, well in excess of the posted speed limit and moving in and out of traffic.

Crash

The driver lost control of the vehicle and it departed the right edge of the roadway while rotating counterclockwise (**Figure 2**). The vehicle traveled down the 7 percent grade of the embankment approximately 18 m (59 ft) to the lowest part of the roadside where the right rear door

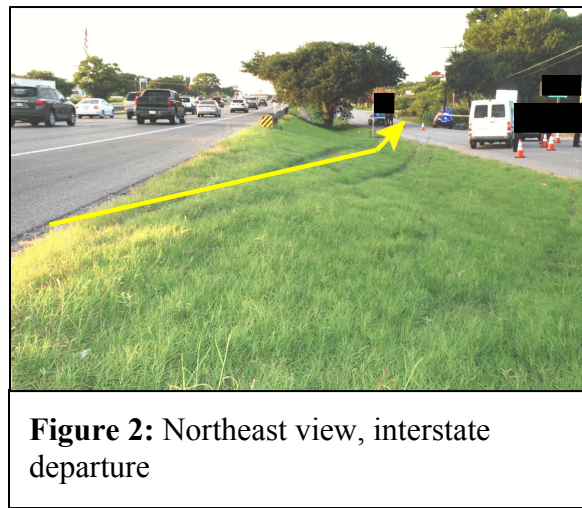


Figure 2: Northeast view, interstate departure

struck a breakaway sign post (Event 1, **Figure 3**). The impact resulted in the right rear door opening, due to a latch/striker separation. The Kia then traveled up the 4 percent grade toward the northeast-bound service road, and crossed both northeast-bound lanes. Traveling approximately 57 m (187 ft) from the interstate departure, with the back plane leading, the Kia's back wheels struck the service road's east curb (Events 2 and 3, **Figure 4**), followed by the front wheels impacting the same curb (Events 4 and 5). The vehicle then became airborne. With the right plane leading and the left side tilting downward, the sill and undercarriage at the right rear door area struck a 26 cm (10.2 in) diameter wooden utility pole (Event 6, **Figure 5**), shearing it 1 m (3.3 ft) above ground. The undercarriage of the Kia also struck a metal utility box (Event 7), which was adjacent to the pole. The WinSMASH program could not be used to calculate delta V for Events 1 to 7, since impacts with curbs, yielding objects, and non-horizontal directions of force are out of scope for the program. The severity of the damage from the utility pole impact was severe. The severity of the damage from the remaining impacts was moderate. As a result of the utility pole impact, a guy wire securing it to the ground became detached and struck the left plane (Event 8) causing minor damage to the left front door. The vehicle came to final rest approximately 2 m (6.6 ft) northeast of the utility pole impact, heading northwest, with the top portion of the utility pole against the right side of the vehicle.

Post-Crash

The police were notified of the crash at 1909 hours. An officer observed the crash and responded immediately. Rescue and medical personnel also responded. The driver sustained serious injuries, but his egress from the vehicle is unknown. The right front door was jammed shut and rescue personnel pried it open to remove the front right occupant, who had sustained critical injuries. Alcohol and drug tests were administered by the local police. The driver's blood alcohol concentration (BAC) was measured as .138 g/dL, according to medical records. The driver and front



Figure 3: Northeast view, impact with breakaway pole



Figure 4: Curb impacts



Figure 5: Utility pole impact/remains

right occupant were transported by ambulance to a trauma center where the driver was hospitalized two days. The front right occupant died at the trauma center 35 minutes post-crash according to her medical records. The vehicle was towed due to damage.

2008 KIA OPTIMA

Description

The Kia was a front-wheel-drive, 5-occupant, 4-door sedan with the VIN KNAGE123485xxxxxx) that was manufactured in February 2008. The vehicle was equipped with a 2.4-liter, I-4 engine and a 5-speed automatic transmission. The vehicle was also equipped with multi-stage frontal air bags, front-seat-mounted side impact air bags, side impact IC air bags, and front seat belt pretensioners. The vehicle had a tilt steering column, which was adjusted between the full up and center positions. The windshield glazing was AS1 laminated, the front and back row glazing was AS2 tempered, and the backlight glazing was AS3 tempered, tinted original. All non-fixed glazing was closed at the time of the crash. The vehicle mileage was 117,078 miles (188,419 kilometers). The specified wheelbase was 272 cm (107.1 in).

The vehicle manufacturer’s recommended tire size was P205/60R16 and the vehicle was equipped with an unknown model Michelin tire of the recommended size on the left front and Douglas Xtra Trac 11 tires of the recommended size on the remaining wheels. The manufacturer’s recommended cold tire pressure for the front and rear tires was 221 kPa (32 psi). All tires were in good condition prior to the crash. The tire data for the Kia are presented in the table below.

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Flat	6 mm (8 /32 in)	No	Tire De-Beaded
LR	Flat	6 mm (7 /32 in)	No	Tire De-Beaded
RR	Flat	7 mm (9 /32 in)	Yes	3 cm (1.2 in) Sidewall Cut
RF	Flat	5 mm (6 /32 in)	No	Tire De-Beaded

The front row was equipped with driver and front right occupant cloth-covered bucket seats with adjustable head restraints. The second row was equipped with a cloth-covered bench seat with folding backs and adjustable head restraints. The driver’s seat track was adjusted to the rear-most position and the seat back was upright at the time of SCI inspection. The front right occupant’s seat track was adjusted to middle position and the seat back position could not be determined due to damage and displacement of the seat back from intrusion. The top of the driver’s head restraint was located 29 cm (11.4 in) above the top of the seat back. The top of the front right occupant’s head restraint was located 26 cm (10.2 in) above the top of the seat back. The back row had non-adjustable seat tracks.

Exterior Damage

Exterior Damage Event 1: The Kia sustained damage to the right plane during the impact with the breakaway sign post (**Figure 6**). There was direct damage to the right rear door, window

frame, and roof side rail and the door opened due to a latch and striker separation. Direct damage began 200 cm (78.7 in) rear of the right front axle and was 5 cm (2 in) wide.

Damage Classification Event 1: The Collision Deformation Classification (CDC) was 03RPAN3 (90 degrees). The severity of the damage was considered moderate based on damage to the door and the roof side rail.

Exterior Damage Events 2, 3, 4, and 5: All four wheels struck the curb as the vehicle departed the service roadway. All four tires were deflated and each rim was dented.

Damage Classification Event 2, 3, 4, and 5: The CDCs were 06BLWN3, 06BRWN3, 06BLWN9, and 06BRWN9, respectively. The severity of the damage was moderate.

Exterior Damage Event 6: The Kia sustained damage to the undercarriage and right plane during the impact with the utility pole (**Figure 7**). The undercarriage, right rear wheel, and right sill were directly damaged. Direct damage to the bottom of the sill was located at the right door beginning 170 cm (66.9 in) rear of the right front axle and extended rearward 83 cm (32.7 in). The sill was fractured and displaced vertically 60 cm (23.6 in) and the seat cushion at the middle and right rear seat positions was intruded vertically 28 cm (11 in) and 40 cm (15.7 in), respectively.

Damage Classification Event 6: The CDC for the impact with the utility pole was 00UPRW3. The damage severity was considered severe due to the fracture and vertical displacement of the sill at the right rear door.

Exterior Damage Event 7: The Kia sustained damage to the undercarriage during the impact with the metal utility box. The extent of damage could not be determined since there was overlapping damage from the utility pole impact.

Damage Classification Event 7: The CDC for the impact with the metal utility box was 00UP9999. The damage severity is unknown.



Figure 6: Breakaway sign post-impact.



Figure 7: Right rear undercarriage/sill impact area.

Exterior Damage Event 8: The Kia sustained damage to the left plane (**Figure 8**) from the impact with a guy wire that snapped under tension during the utility pole impact. The left front door and B-pillar were directly damaged. Direct damage began 130 cm (51.2 in) rear of the left front axle and extended 48 cm (18.9 in) on the front door and B-pillar.

Damage Classification Event 8: The CDC for the impact with the guy wire was 09LPAN02. The damage severity was minor.

Interior Damage

The interior of the Kia sustained severe damage from intrusion of the occupant compartment.

There were 12 intrusions and the most severe intrusions to front right occupant's seating positions involved the roof side rail and B-pillar, which intruded laterally 30 cm (11.8 in) and 22 cm (8.7 in), respectively. The roof intruded vertically 12 cm (4.7 in). The vehicle was extremely dirty and unkempt at the time of SCI inspection, which was completed approximately eight months after the crash. No discernable occupant contacts were noted. All of the non-fixed glazing was closed at the time of the crash. The windshield was cracked from impact forces, but remained in place. The right and left rear glazings and the backlight were disintegrated from impact forces. The remaining glazing was undamaged. The left side doors remained closed and operational. The right front door was jammed shut and was pried open by rescue personnel. The right rear door came open during the impact with the median road sign post (Event 1), due to separation of the latch and striker.

Manual Restraint Systems

The front row seating positions were equipped with three-point lap and shoulder seat belts with sliding latch plates and adjustable upper anchors. The driver's and front right occupant's upper anchors were adjusted to the full-up and full-down positions, respectively. The front row seat belts were also equipped with retractor-mounted pretensioners that did not actuate in the crash.

The second row seating positions were equipped with three-point lap and shoulder seat belts with sliding latch plates and fixed upper anchors.

The driver was restrained by his lap and shoulder seat belt as evidenced by slight load marks on the latch plate belt guide. The front right occupant was also restrained by her lap and shoulder seat belt as evidenced by load marks on the latch plate belt guide and a length of webbing extended from the retractor, consistent with usage. The front right occupant's seat belt was locked due to damage to the right B-pillar and would not retract because of damage to the B-pillar.



Figure 8: Left front door/B-pillar damage from guy wire impact

Supplemental Restraint Systems

The Kia was equipped with multi-stage frontal air bags, front seat-mounted side impact air bags, and side impact IC air bags. No air bags deployed during the crash.

Air Bag Non-Deployment Discussion

The Safercar.gov website was searched on May 22, 2018, for air-bag-related issues with the 2008 Kia Optima. The website listed three recalls, one investigation, 115 complaints, and 24 manufacturer communications. None of the recalls pertained to this vehicle and the single investigation was not related to the air bag system. Of the 24 manufacturer communications, 8 involved failures of the front passenger Occupant Classification System (OCS) sensor mat in the front right seat reported by some vehicle owners. Of the 115 complaints, 39 were regarded problems with the right front passenger air bag light and 7 concerned non-deployments of side air bags during crashes.

A Carfax report on the Kia that was the subject of this investigation reported that the vehicle had two owners, no reported issues, and one reported manufacturer recall that did not involve air bags. There were no reported crashes for either owner. No air-bag-related maintenance was reported in the detailed history section of the Carfax.

An engineer representing Kia was present at the SCI inspection and imaged data from the vehicle via the Diagnostic Link Connector (DLC). The following Data Trouble Codes (DTC) were present.

B1413 SIS (Side Impact Sensor) Rear-Occupant Communication Error
B1410 SIS (Side Impact Sensor) Front-Occupant Communication Error

The engineer noted that the air bag warning lamp was illuminated upon vehicle power-up, but went out, as normal, after a few seconds. There were no trouble codes for the warning lamp. There were no air bag deployments in the record and the engineer detected a communication error for the right front and rear side impact sensors but could not determine when this error occurred.

The SCI investigation determined that the undercarriage impact to the utility pole resulted in a non-horizontal force direction to the vehicle. The direction of the crush to the vehicle's undercarriage and right sill was primarily along the vertical axis suggesting that there was probably insufficient lateral impact forces for the air bag sensing system to command deployment of the right IC and front right occupant's seat-mounted side impact air bags. In addition, these air bags did not deploy during the right plane impact with the breakaway sign post since it was a yielding object and the impact was probably not of sufficient severity to require their deployment. The frontal air bags did not deploy during the crash since there was no frontal impact. The left IC and driver's seat-mounted side impact air bags did not deploy since the guy wire impact to the driver's door was not of sufficient severity to require their deployment.

2008 KIA OPTIMA OCCUPANTS

Driver Demographics

Age/Sex: 25 years/male
 Height: Unknown
 Weight: 107 kg (236 lb)
 Eyewear: Unknown
 Seat Type: Bucket
 Seat Track Position: Rearmost
 Manual Restraint Usage: Lap and Shoulder seat belt
 Usage Source: Vehicle inspection
 Air Bags: Frontal, seat-mounted side impact, and IC air bags, not deployed
 Alcohol/Drug Involvement: BAC = .138 g/dL
 Egress From Vehicle: Unknown
 Transport From Scene: Ambulance to trauma center
 Medical Treatment: Hospitalized two days

Driver Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Fractured right ribs: lateral 3rd rib non-displaced, minimally displaced 4th rib posterolaterally, non-displaced 6th and 7th ribs, posterolaterally	450203.3,1	Seat back, driver's	Probable
2	Contusion, small, superior right lower lobe of lung, not further specified	441407.2,1	Seat back, driver's	Probable
3	Pneumothorax, tiny, right pleural cavity, not further specified	442202.2,1	Seat back, driver's	Probable

Sources: Emergency room records and hospitalization records. Injury Numbers 1 to 3 came from a combination of emergency room and hospitalization records.

Driver Kinematics

The driver was restrained by the lap and shoulder seat belt. The seat track was adjusted at the rear most position and the seat back was in the upright position. The top of the head restraint was located 29 cm (11.4 in) above the top of the seat back. The driver was displaced to the right in his seat belt during the counterclockwise rotation and further displaced to the right as a result of the right plane impact with the breakaway sign post. The wheel impacts with the curb displaced the driver rearward into his seat back. He sustained right side rib fractures, a lower right lung contusion, and a pneumothorax during the undercarriage impact with the utility pole, which displaced him rearward, downward, and to the right, into the seat cushion and seat back. He remained in his seat belt as the vehicle came to final rest. The driver was transported by ambulance to a trauma center where he was hospitalized for two days.

Front Row Right Occupant Demographics

Age/Sex: 24 years/female
 Height: 168 cm (66 in)
 Weight: 60 kg (133 lb)
 Eyewear: Unknown
 Seat Type: Bucket
 Seat Track Position: Middle
 Manual Restraint Usage: Lap and shoulder seat belt
 Usage Source: Vehicle inspection
 Air Bags: Frontal, seat-mounted side impact, and IC air bags, not deployed
 Alcohol/Drug Involvement: .09 g/dL
 Egress From Vehicle: Extricated through right front door
 Transport From Scene: Ambulance to trauma center
 Medical Treatment: Expired 35 minutes post-crash

Front Row Right Occupant Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Fracture, open ¹ , comminuted, complex, basilar skull fracture extending from right occipital bone through the right posterior and middle cranial fossa and involves sella turcica	150206.4,8	B-pillar, right	Probable
2	Contusions, cerebral, cortical, predominately on left side, not further specified	140620.3,3	B-pillar, right	Probable
3	Contusions, patchy, right cerebellar hemisphere, not further specified	140402.3,6	B-pillar, right	Probable
4	Hemorrhage, subarachnoid, patchy, not further specified	140693.2,9	B-pillar, right	Probable
5	Lacerated lungs: gaping right lower lung, 10 by 8 cm (3.9 x 3.1 in), and superficial left upper lung, not further specified	441451.4,3	Right front door panel, rear upper quadrant	Probable
6	Contusions, patchy, bilateral lungs, not further specified	441410.3,3	Right front door panel, rear upper quadrant	Probable

¹ Laceration was approximately 5 by 3 cm (2.0 x 1.2 in) on right posterior/inferior scalp with associated subgaleal hemorrhage

7	Fractured bilateral ribs ² : right 5th, 6th, and 10th laterally, right 2nd through 9th posterolaterally with wide displacement and left 2nd through 6th posteriorly	450203.3,3	Right front door panel, rear upper quadrant	Probable
8	Hemothoraces, bilaterally, with approximately 700 cm ² right and 200 cm ³ left	442200.3,3	Right front door panel, rear upper quadrant	Probable
9	Lacerations, multiple, liver with largest 10 by 0.3 cm (3.9 x 0.1 in) to lateral/ superior right lobe	541822.2,1	Right front door panel, rear upper quadrant	Probable
10	Laceration, 5 by 0.3 cm (2.0 x 0.1 in) lateral spleen, not further specified	544222.2,2	Right front door panel, rear upper quadrant	Probable
11 12	Injury with hemorrhage at hilum of left and right kidneys, not further specified	541620.2,1 541620.2,2	Right front door panel, rear upper quadrant	Probable
13	Fractured ⁴ right clavicle, not further specified	750500.2,1	Right front door panel, rear upper quadrant	Probable
14 15	Hematoma, subgaleal, left greater than right, not further specified	110402.1,1 110402.1,2	B-pillar, right	Probable
16	Contusion, 1.5 by 1.0 cm (0.6 x 0.4 in), left maxillary area, not further specified	210402.1,2	Interior object: other occupant–driver	Possible
17	Laceration, 0.5 cm (0.2 in) in diameter, corner of left side of lips, not further specified	210602.1,8	Interior object: other occupant–driver	Possible
18 19	Abrasions and contusion, 1 by 0.6 cm (0.4 x 0.2 in) paramedian right upper chest and abrasion, 1 by 0.8 cm (0.4 x 0.3 in) paramedian right mid chest	410202.1,1 410402.1,1	Right front door panel, rear upper quadrant	Probable
20	Contusion (bruising) abdominal wall, not further specified	510402.1,1	Right front door panel, rear upper quadrant	Probable
21	Abrasion, 6 by 0.5 cm (2.4 x 0.2 in), lateral left lower quadrant of abdomen	510202.1,2	Lap portion of seat belt system	Probable
22 23	Abrasions and contusions, 14 by 8 cm (5.5 x 3.2 in), anterolateral right pelvic area, not further specified	510202.1,8 510402.1,8	Right front door panel, rear upper quadrant	Probable
24	Laceration over right shoulder, not further specified	710600.1,1	Noncontact injury: flying glass, right front glazing	Probable
25	Laceration, superficial, 1.5 by 0.8 cm (0.6 x 0.3 in) over right elbow, not further specified	710602.1,1	Noncontact injury: flying glass, right front glazing	Probable

² Fractured with associated hemorrhage

³ Fractured with associated hemorrhage

⁴ Fractured with associated hemorrhage

26	Abrasions, few, on left leg, not further specified	810202.1,2	Noncontact injury: flying glass, right front glazing	Probable
27	Contusions, few, small, over legs, not further specified	810402.1,3	Unknown injury source	Unknown

Sources: Autopsy records, medical examiner records, emergency room records, and EMS treatment record. Injury number 19 came only from emergency room records. Injury numbers 1 to 15, 17, 19 through 22, 24, and 25 came only from autopsy records. Injury numbers 16, 18, and 23 came from a combination of autopsy and emergency room records.

Front Row Right Occupant Kinematics

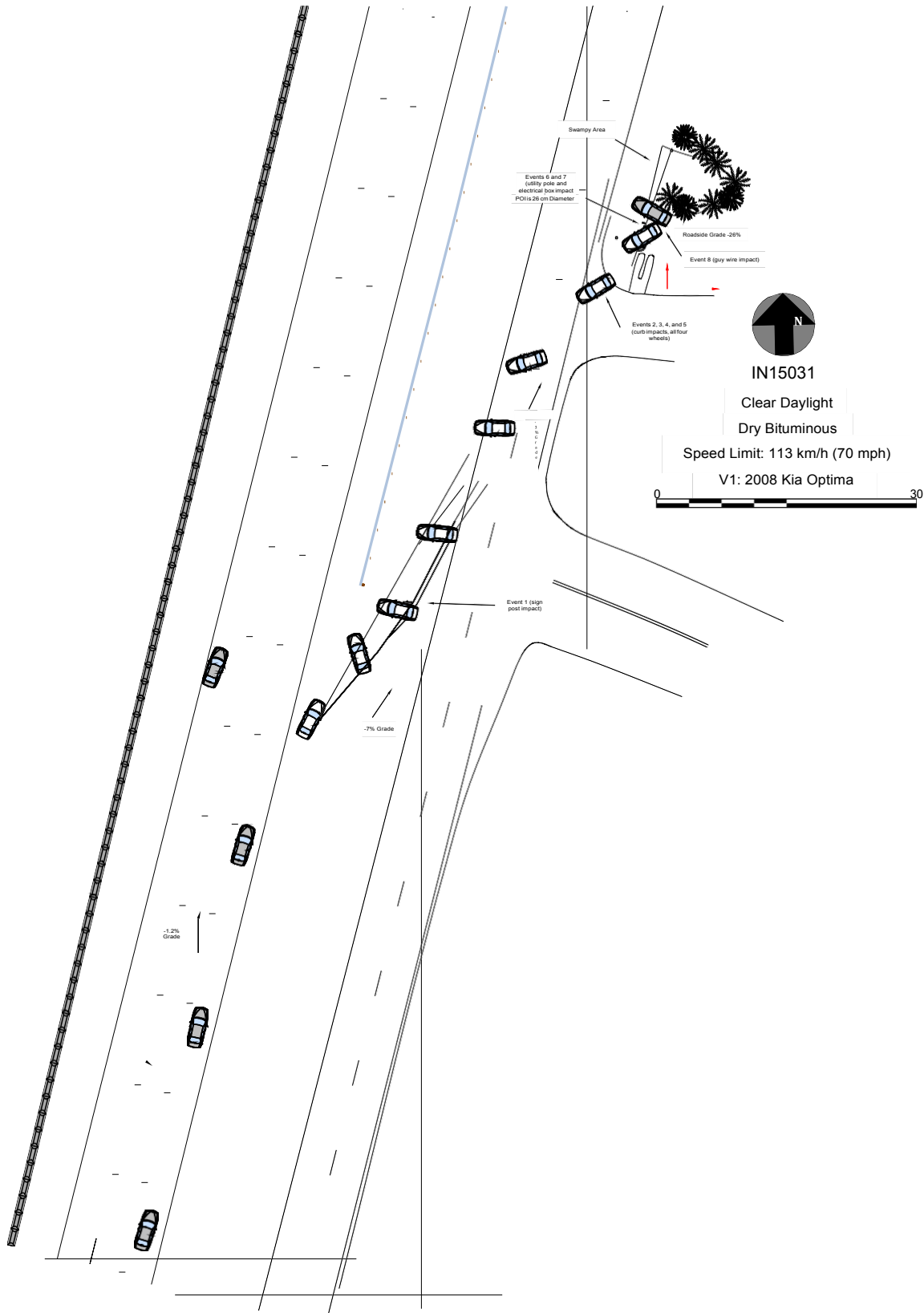
The front right occupant was restrained by the lap and shoulder seat belt. The seat track was adjusted to the middle position and the seat back recline position is unknown. The top of the head restraint was located 26 cm (11.4 in) above the top of the seat back. The front right occupant was displaced to the right in her seat belt during the counter-clockwise rotation and further displaced to the right as a result of the right plane impact with the breakaway sign post. The wheel impacts displaced the occupant rearward into the seat back and the undercarriage impact also displaced her rearward and to the right. As a result of the impact to the utility pole, her head contacted the intruded B-pillar (**Figure 9**) and she sustained an open basilar skull fracture, cerebral contusions, and a subarachnoid hemorrhage.



Figure 9: Right B-pillar intrusion

Her thorax contacted the right front door and she sustained bilateral contusions and lacerations of the lungs, bilateral fractured ribs, bilateral hemothoraces, lacerations to the liver and spleen, a hemorrhage to the hilum of both kidneys, abrasions and contusions about the right upper chest, a contusion to the abdominal wall, abrasions and contusions to the anterolateral right pelvic area, and a fractured right clavicle. She sustained an abrasion at the lower left quadrant of the abdomen from contact to the lap portion of the seat belt and lacerations to the right shoulder and elbow from flying glass. She also sustained a contusion and laceration to the left maxillary and lip areas, respectively from contact to the driver. The occupant was extricated through the right front door. She sustained critical injuries and was transported by ambulance to a hospital where she expired 35 minutes post-crash.

APPENDIX A: IN15031 CRASH DIAGRAM

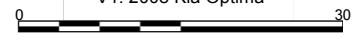


IN15031

Clear Daylight
Dry Bituminous

Speed Limit: 113 km/h (70 mph)

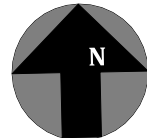
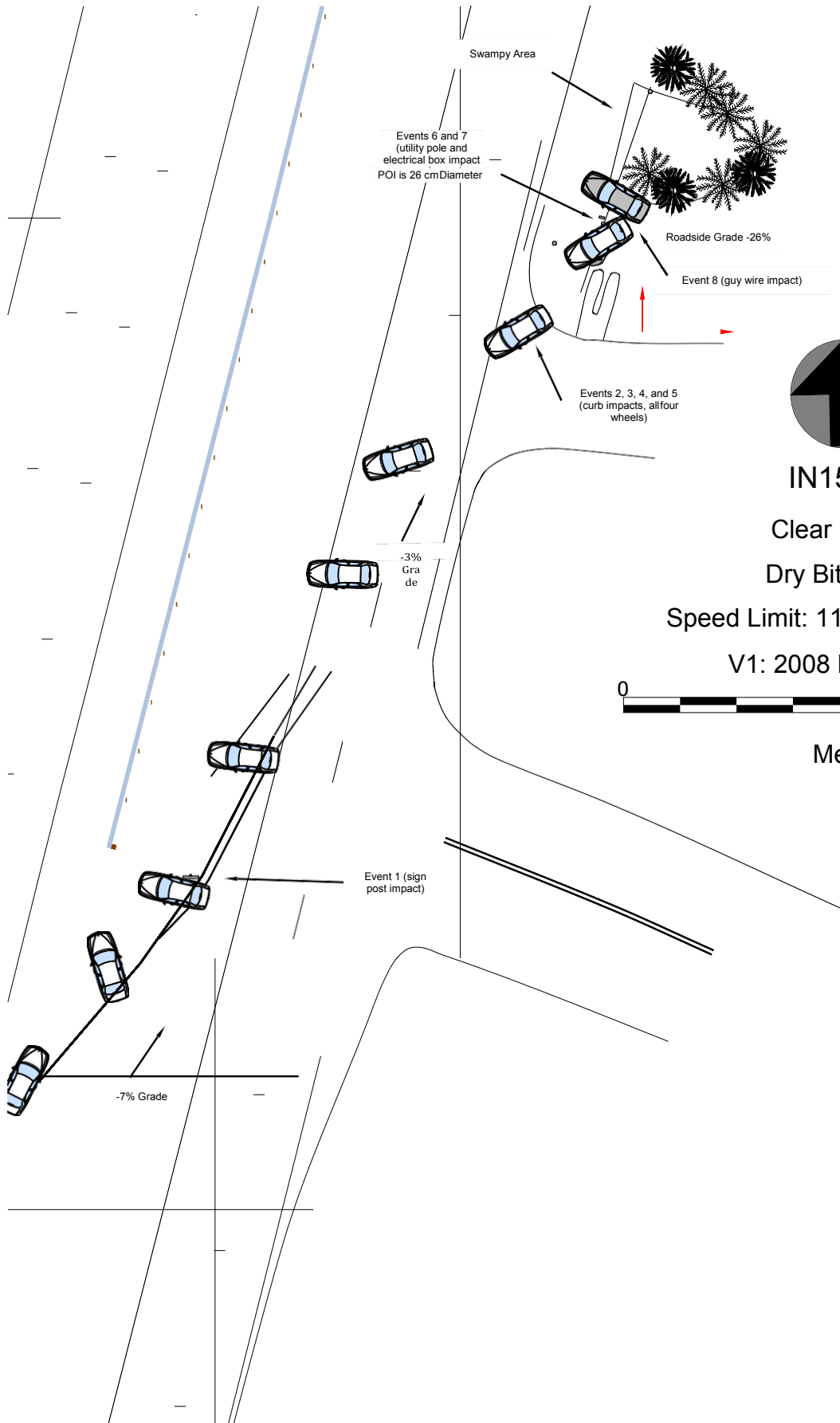
V1: 2008 Kia Optima



Police Report Indicates
Unknown Travel Path Prior To
Roadway Departure

	
<p>Case Number:</p>	<p>IN15031</p>

APPENDIX B: IN15031 EXPANDED CRASH DIAGRAM



IN15031

Clear Daylight

Dry Bituminous

Speed Limit: 113 km/h (70 mph)

V1: 2008 Kia Optima



Meters

<p>Case Number:</p>	<p>IN15031</p>

DOT HS 812 771
October 2019



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

