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ON-SITE CERTIFIED ADVANCED 208- COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-05-007
LOCATION - OHIO
VEHICLE - 2005 HONDA ACCORD
CRASH DATE - January 2005

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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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15. <i>Supplementary Notes</i> On-site air bag investigation involving a 2005 Honda Accord with manual safety belts and dual front certified advanced 208-compliant air bag system.					
16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 2005 Honda Accord (case vehicle) that ran-off-road and impacted a median guardrail and concrete bridge rail. This crash is of special interest because the case vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208, and neither the case vehicle's driver [24-year-old, White (non-Hispanic) female] or the front right passenger [26-year-old, White (non-Hispanic) female] sustained any injury as a result of this crash. The case vehicle was traveling west in a left curve in the inside lane of a four lane, divided U.S. highway approaching a bridge over a secondary roadway. The driver lost control of the vehicle when it contacted an area of "black ice" on the partially snow covered roadway as she was changing lanes. The driver pumped the brakes and steered right in an attempt to avoid the crash. The case vehicle departed the south edge of the roadway, and the front right of the vehicle impacted a median guardrail. The case vehicle continued to rotate counterclockwise and the right quarter panel impacted the median guardrail causing the front right passenger's seat back-mounted side impact air bag and right side curtain air bag to deploy. The case vehicle's driver air bag and the front right passenger air bag did not deploy. Following the second impact, the case vehicle continued to rotate counterclockwise and the back right bumper corner impacted the concrete bridge rail. The case vehicle came to rest on the south side of the roadway facing northeast. The driver and front right passenger were both restrained by their manual, three-point, lap-and-shoulder safety belts. The use of their safety belts mitigated their interaction with the case vehicle's interior surfaces. The deployment of the front right passenger's seat back mounted side impact air bag and right side curtain air bag mitigated her interaction with the interior side surfaces during the right side impact and most likely prevented her from sustaining any injury.					
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This investigation was brought to NHTSA's attention on or about February 10, 2005 by Nationwide Insurance Company. This crash involved a 2005 Honda Accord EX (case vehicle) that ran-off-road and impacted a median guardrail and concrete bridge rail. The crash occurred in January, 2005, at 9:53 p.m., in Ohio and was investigated by the applicable city police department. This crash is of special interest because the case vehicle is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208, and neither the case vehicle's driver [24-year-old, White (non-Hispanic) female] or the front right passenger [26-year-old, White (non-Hispanic) female] sustained any injury as a result of this crash. This contractor inspected the case vehicle and scene on February 22, 2005, and conducted a follow-up scene inspection on February 24, 2005. The case vehicle's driver was interviewed on March 15, 2005. This report is based on the police crash report, scene and vehicle inspections, an interview with the case vehicle's driver, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling west in a left curve in the inside lane of a four lane, divided U.S. highway approaching a bridge over a secondary roadway. The driver lost control of the vehicle when it contacted an area of "black ice" on the partially snow covered roadway as she was changing lanes. The case vehicle initially started to rotate clockwise and then immediately began to rotate counterclockwise. The driver pumped the brakes and steered right in an attempt to avoid the crash. The case vehicle departed the south edge of the roadway, and the front right of the vehicle impacted a median guardrail. The case vehicle continued to rotate counterclockwise and the right quarter panel impacted the median guardrail causing the front right passenger's seat back-mounted side impact air bag and right side curtain air bag to deploy. The case vehicle's driver air bag and the front right passenger air bag did not deploy. Following the second impact, the case vehicle continued to rotate counterclockwise and the back right bumper corner impacted the concrete bridge rail. The case vehicle came to rest on the south side of the roadway facing northeast.

The CDCs for the case vehicle were determined to be: **02-FZEW-2 (70-degrees)** for the first median guardrail impact, **03-RBEW-2 (100 degrees)** for the second median guardrail impact and **07-BLEE-1 (220 degrees)** for the concrete bridge rail impact. Since the guardrail did not yield, the WinSMASH reconstruction program, barrier algorithm, was used to reconstruct the case vehicle's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs for the front impact are, respectively: 7.0 km.p.h. (4.3 m.p.h.), -2.4 km.p.h. (-1.5 m.p.h.), and -6.6 km.p.h. (-4.1 m.p.h.). The Total, Longitudinal, and Lateral Delta Vs for the right quarter panel impact are, respectively: 8.0 km.p.h. (4.9 m.p.h.), 1.4 km.p.h. (0.9 m.p.h.), and -7.9 km.p.h. (-4.9 m.p.h.). The collision fits the reconstruction model, but the results appear low.

Immediately prior to the crash the case vehicle's driver was seated in an upright driving position with her back against the seat back, both hands on the steering wheel and her right foot was pumping the brake. Her seat track was located in its forward most position, the seat back was upright, and the tilt steering column was in its center position. The driver was wearing a heavy

winter coat at the time of the crash and was not wearing glasses. The driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The driver's use of her safety belt restrained her in her seat throughout the crash and mitigated her interaction with the vehicle's interior surfaces. She was not injured in the crash.

Immediately prior to the crash, the case vehicle's front right passenger was seated in an upright posture with her back against the seat back and both feet on the floor. The position of her hands is not known. Her seat track was located between its middle and forward most position, and the seat back was upright. The passenger was wearing a medium weight winter coat and contact lenses at the time of the crash. The passenger was restrained by her manual, three-point, lap-and-shoulder safety belt system. The passenger's use of her safety belt restrained her in her seat throughout the crash and mitigated her interaction with the vehicle's interior surfaces. The deployment of her seat back-mounted side impact air bag and the right side curtain air bag mitigated her interaction with the vehicle's side interior surfaces during the right side impact with the median guardrail and most likely prevented her from sustaining any injury.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a four lane, divided, U.S. highway traversing in a west and east direction. Each roadway had two travel lanes with improved shoulders and was divided by a grass median. The case vehicle's roadway curved to the left and approached a bridge. Each travel lane was 3.6 meters (11.8 feet) in width. The outside shoulder was composed of bituminous and was 2.5 meters (8.2 feet) in width. The inside shoulder was composed of bituminous and was 1 meter in width (3.3 feet). The width of the grass median was not measured. The curve had an approximate positive superelevation of 8%. Roadway markings consisted of a broken white center line, solid white edge line and a solid yellow median edge line. The case vehicle's approach to the crash location was uncontrolled and the speed limit was 105 km.p.h. (65 m.p.h.). At the time of the crash the light condition was dark with street lights, the atmospheric condition was cloudy, and the roadway pavement was partially snow covered, level, bituminous with patches of ice. The estimated coefficient of friction was 0.25. Traffic density was light and the site of the crash was urban residential. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling west in a left curve in the inside lane approaching a bridge over a secondary roadway. The case vehicle's driver was intending to change lanes to the outside lane and continue westbound (**Figure 1**). The driver lost control of the vehicle when it contacted an area of "black ice" on the partially snow covered roadway as she was changing lanes. The case vehicle initially started to rotate clockwise and then immediately began to rotate counterclockwise. The driver pumped the brakes



Figure 1: Approach of case vehicle to impacts with guardrail (arrow)

and steered right in an attempt to avoid the crash. The crash occurred on the south side of the roadway

Crash: The case vehicle departed the south edge of the roadway, crossed the shoulder, and the front right of the case vehicle (**Figure 2**) impacted a median guardrail (**Figure 3**). The impact broke a reflector on the guardrail and left scrape marks on the guardrail and a guardrail post. The case vehicle continued to rotate counterclockwise and the right quarter panel (**Figure 4**) impacted the median guardrail (**Figure 5**) causing the front right passenger’s seat back-mounted, side impact air bag and the right side curtain air bag to deploy. The case vehicle’s driver air bag and the front right passenger air bag did not deploy. Following the second impact, the case vehicle continued to rotate counterclockwise and the back right bumper corner (**Figure 6** below) impacted the concrete bridge rail (**Figure 7** below).



Figure 2: Damage to front of case vehicle from first impact with the guardrail



Figure 3: Location of case vehicle’s first impact with the guardrail, each stripe on rod is 5 cm (2 in)



Figure 4: Damage to case vehicle’s right quarter panel from second impact with guardrail



Figure 5: Location of case vehicle’s second impact to the guardrail (arrows)

Post-Crash: The case vehicle came to rest on the south side of the roadway facing northeast. The case vehicle was blocking the inside westbound lane, and the back right corner of the vehicle was still in contact with the concrete bridge rail.



Figure 6: Damage to right corner of back bumper from impact with concrete bridge rail (arrow)

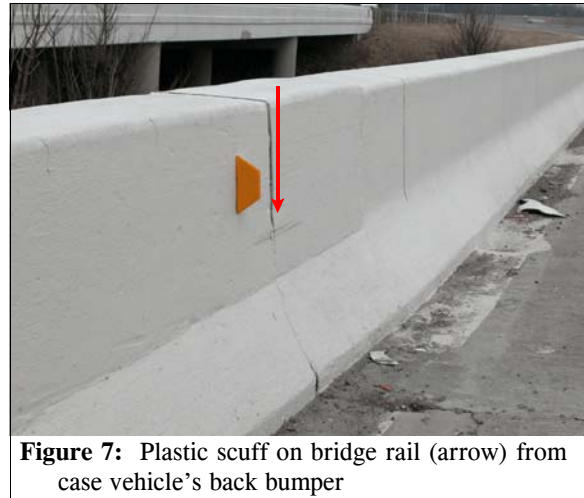


Figure 7: Plastic scuff on bridge rail (arrow) from case vehicle's back bumper

CASE VEHICLE

The 2005 Honda Accord EX was a four-door, front wheel drive sedan (VIN: 1HGCM56815A-----) equipped with a 2.4L, I4 engine; five speed automatic transmission and four wheel, anti-lock brakes. The front seating row was equipped with bucket seats with adjustable head restraints, dual stage driver and front right passenger air bags; front seat back-mounted, side impact air bags with front right passenger "Occupant Position Detection System" (OPDS); side curtain air bags; driver and front right passenger manual, three-point, lap-and-shoulder safety belts with adjustable upper anchors, retractor mounted safety belt pretensioners and safety belt usage sensors. The back seat was equipped with manual, three-point, lap-and-shoulder safety belts in all three seat positions, side curtain air bags and adjustable head restraints in the outboard seat positions. In addition, the case vehicle was equipped with a LATCH system for securing child safety seats. The case vehicle's wheelbase was 274 centimeters (106.3 inches). The case vehicle's odometer reading at the time of the inspection was 5,892 kilometers (3,661 miles).

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including driver safety belt use and the predicted crash severity to determine the front air bag inflation level appropriate for the severity of the crash. The OPDS monitors the position of the front right passenger. If a small statured person is in the deployment path of the seat back-mounted side impact air bag, the OPDS system suppresses deployment of the side impact air bag.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's initial impact with the median guardrail involved approximately the front right two thirds of the



Figure 8: Overview of damage to case vehicle's front end and right quarter panel from guardrail impacts

vehicle (**Figure 8**). The grille, hood, right headlamp/ turn signal assembly and right fender were directly contacted and crushed rearward. Direct damage most likely involved the front bumper cover as well, but it was not present at the vehicle inspection. Direct damage began on the right fender above the right corner of the front bumper bar and extended 73 centimeters (28.7 inches) along the front of the fender, grille and hood. Crush measurements were taken at hood level and at the bumper bar. The maximum crush at hood level was measured as 21 centimeters (8.3 inches) occurring at C₆ (**Figure 9**). There was no measurable crush to the bumper bar. The table below shows the average of the bumper and above bumper crush.

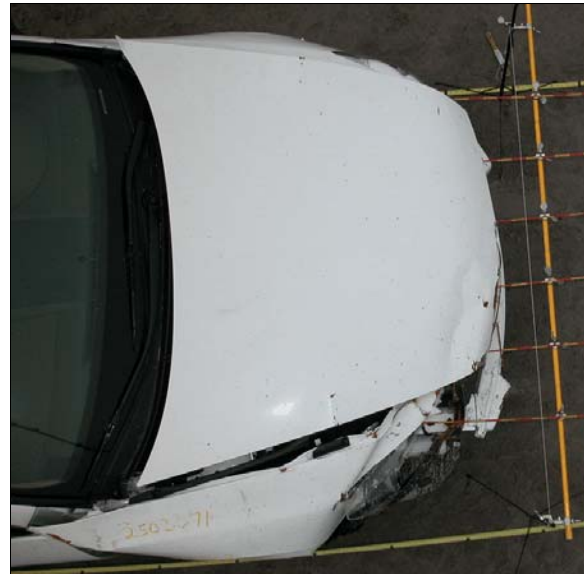


Figure 9: Top view of hood level crush from first guardrail impact

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	73	21	153	0	0	0	0	0	11	18	0
in		28.7	8.3	60.2	0.0	0.0	0.0	0.0	0.0	4.3	7.1	0.0

The case vehicle’s second impact with the median guardrail involved the right quarter panel. The portion of the quarter panel rear of the right rear axle was directly contacted and crushed inward and the plastic at the right corner of the back bumper cover was broken, and the corner of the back bumper bar was damaged. Direct damage began 20 centimeters (7.9 inches) rear of the right rear axle and extended 78 centimeters rearward along the quarter panel. Crush measurements were taken at the lower mid-quarter panel level. Maximum crush was measured as 19 centimeters (7.5 inches) occurring at C₂ (**Figure 10**). The table below shows the case vehicle’s crush profile for the seconds median guardrail impact.



Figure 10: Top view of crush to case vehicle’s right quarter panel from second guardrail impact

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	2	78	19	83	11	19	16	11	5	0	-196	-193
in		30.7	7.5	32.7	4.3	7.5	6.3	4.3	2.0	0.0	-77.2	-76.0

The third impact to the case vehicle involved the right corner of the back bumper. This was a minor contact with the concrete bridge rail that scratched and also likely broke some of the plastic of the back bumper cover. Direct damage began at the back right bumper corner and extended 21 centimeters (8.3 inches) along the bumper cover. There was no measurable crush to the back bumper, only broken plastic.

The case vehicle’s wheelbase was unchanged by the crash. Induced damage involved the grille, hood, right fender, right quarter panel, back bumper cover and, most likely, the front bumper cover.

The recommended tire size was: P205/60R16 and the vehicle was equipped with tires of this size. The case vehicle’s tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	179	26	221	32	7	9	None	No	No
RF	186	27	221	32	7	9	None	No	No
LR	172	25	207	30	7	9	None	No	No
RR	179	26	207	30	8	10	None	No	No

Vehicle Interior: Inspection of the case vehicle’s interior (**Figure 11** and **Figure 12** below) revealed no evidence of occupant contact to any interior surfaces or components. In addition, there was no evidence of compression of the energy absorbing steering column, and no deformation of the steering wheel rim was observed (**Figure 13** below). In addition, the case vehicle sustained no passenger compartment intrusion.



Figure 11: Overview of steering wheel, windshield and instrument panel



Figure 12: Overview of front right instrument panel, front right air bag located in top of instrument panel (arrow)



Figure 13: Case vehicle's steering column and steering wheel showing lack of deformation

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **02-FZEW-2 (70-degrees)** for the first median guardrail impact, **03-RBEW-2 (100 degrees)** for the second median guardrail impact and **07-BLEE-1 (220 degrees)** for the concrete bridge rail impact. Since the guardrail did not yield, the WinSMASH reconstruction program, barrier algorithm, was used to reconstruct the case vehicle's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs for the front impact are, respectively: 7.0 km.p.h. (4.3 m.p.h.), -2.4 km.p.h. (-1.5 m.p.h.), and -6.6 km.p.h. (-4.1 m.p.h.). The Total, Longitudinal, and Lateral Delta Vs for the right quarter panel impact are, respectively: 8.0 km.p.h. (4.9 m.p.h.), 1.4 km.p.h. (0.9 m.p.h.), and -7.9 km.p.h. (-4.9 m.p.h.). The collision fits the reconstruction model, but the results appear low. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with certified advanced 208-compliant air bags at the driver and front right passenger positions. The case vehicle was also equipped with driver and front right passenger seat back-mounted side impact air bags and side curtain air bags. The front right passenger's seat back-mounted side impact air bag and right side curtain air bag deployed as a result of the second impact with the median guardrail.

The driver's air bag was located in the steering wheel hub and the front right passenger's air bag was located in the top of the instrument panel. Neither of these air bags deployed in this crash. The reconstruction indicates that the case vehicle's crash sensing algorithm most likely determined that the longitudinal deceleration would not be severe enough to require their deployment.

The front right passenger's side impact air bag was located in the front right seat back (**Figure 14** below). The deployed air bag was oblong in shape and had a fabric tab on its leading edge that was separated from the body of the air bag by a stitch seam. The dimensions of the air bag were approximately 35 centimeters (13.8 inches) in width and 26 centimeters (10.2 inches) in length. The air bag was designed with two circular stitch patterns (**Figure 15** below), each

approximately 6 centimeters (2.4 inches) in diameter that stitched the inner and outer surfaces of the air bag together and shaped the air bag inflation chambers during deployment. The air bag was designed without tethers and vent ports. There was no module flap on the side of the seat back. The air bag deployed through a tear-seam in the side of the seat back. There was no evidence of damage to the air bag due to deployment, and no evidence of occupant contact was found on the air bag.

The right side curtain air bag was located along the right roof side rail (**Figure 16**) and folded accordion style inside the headliner. The air bag was designed to provide head protection for the front right passenger and back right passenger seat positions. The air bag was anchored to the upper right A-pillar by an approximate 10 centimeters (4 inches) long cloth cord. The side curtain air bag was approximately 168 centimeters (66.1 inches) in length and approximately 43 centimeters (16.9 inches) in height. It was designed without tethers and had a large inflation chamber adjacent to the front right seat, and a smaller inflation chamber adjacent to the back right seat. The inside and outside sections of the air bag material were stitched together in single stitch seams and double stitched circular areas to form the air bag inflation chambers. There was no evidence of damage due to deployment to the air bag, and no evidence of occupant contact was found on the air bag.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [24-year-old, White (non-Hispanic) female; 158 centimeters and 57 kilograms (62 inches and 125 pounds)] was seated in an upright driving position with her back against the seat back, both hands on the steering wheel and her right foot was pumping the brake. Her seat track was located in its forward most position, the seat back was upright and the tilt steering column was in its center position. The driver was wearing a heavy winter coat and was not wearing glasses.



Figure 14: Front right passenger's seat back-mounted side impact air bag



Figure 15: Circular stitch pattern in front right seat back-mounted side impact air bag



Figure 16: Front right side curtain air bag and front right seat

The case vehicle's driver stated she was restrained by her manual, three-point, lap-and-shoulder safety belt system. Inspection of the safety belt assembly revealed no load marks on the belt assembly, but there was some scratching on the latch plate indicating evidence of prior usage.

Just prior to the crash, the case vehicle's driver was continuing to pump the brake and steer to the right as the case vehicle rotated counterclockwise. The case vehicle's front impact with the guardrail caused the driver to continue forward and move to the right along a path opposite the case vehicle's 70 degree direction of principal force as the vehicle decelerated. The driver's safety belt retractor locked, and she loaded her safety belt to some degree. The safety belt retractor most likely remained locked as the vehicle continued to rotate counterclockwise and the vehicle's right quarter panel impacted the guardrail. The second guardrail impact caused the driver to continue to the right along a path opposite the case vehicle's 100 degree direction of principal force as the case vehicle decelerated. The driver then most likely moved back and to her left into her seat along a path opposite the case vehicle's 220 degree direction of principal force due to the back right corner impact with the concrete bridge rail. The case vehicle's driver remained restrained in her seat as the case vehicle came to final rest. The driver was able to exit the case vehicle without assistance through the driver's door. The driver's use of her manual, three-point, lap-and-shoulder safety belt restrained her in her seat throughout the crash and mitigated her interaction with the case vehicle's interior.

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver sustained no injury as a result of the crash. She was not transported from the scene and lost no work days.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash, the case vehicle's front right passenger [26-year-old, White (non-Hispanic) female; 170 centimeters and 64 kilograms (67 inches and 140 pounds)] was seated in an upright position with her back against the seat back and both feet on the floor. The position of her hands is not known. Her seat track was located between its middle and forward most position, and the seat back was upright. The passenger was wearing a medium weight winter coat and contact lenses.

Based on the case vehicle driver's interview and the evidence observed during the vehicle inspection, the case vehicle's front right passenger was restrained by her manual, three-point, lap-and-shoulder safety belt system. The inspection of the safety belt assembly revealed no load marks on the belt assembly, but the retractor mounted



Figure 18: Front right passenger seat with safety belt buckled showing length of belt extended out of jammed retractor

pretensioner had activated, jamming the retractor and leaving about 83 centimeters (32.7 inches) of the safety belt extended out of the retractor (**Figure 18** above).

Just prior to the crash the front right passenger may have been leaned to the right to some degree due to the counterclockwise rotation of the case vehicle. It is likely she may have been bracing for the impact as well. The case vehicle's front impact with the guardrail caused the front right passenger to continue forward and move to the right along a path opposite the case vehicle's 70 degree direction of principal force as the case vehicle decelerated. Her safety belt retractor locked, and she most likely loaded the safety belt to some degree. Her safety belt most likely remained locked as the case vehicle continued to rotate counterclockwise and the right quarter panel impacted the guardrail causing the case vehicle's front right, seat back-mounted side impact air bag and right side curtain air bag to deploy. The passenger's safety belt pretensioner most likely activated during this impact as well. This impact caused the front right passenger to continue to the right along a path opposite the case vehicle's 100 degree direction of principal force as the case vehicle decelerated, and her right arm and shoulder most likely contacted her deployed seat back-mounted, side impact air bag and her head most likely contacted her deployed side curtain air bag. The front right passenger then likely moved back and to the left in her seat along a path opposite the case vehicle's 220 degree direction of principal force due to the back right impact with the concrete bridge rail. The front right passenger remained restrained in her seat as the case vehicle came to final rest. She was able exit the case vehicle without assistance through the right front door. The front right passenger's use of her manual, three-point, lap and shoulder safety belt restrained her in her seat throughout the crash and mitigated her interaction with the vehicle's interior surfaces. The deployment of her seat back-mounted side impact air bag and the right side curtain air bag mitigated her interaction with the vehicle's side interior surfaces during the right side impact with the median guardrail and most likely prevented her from sustaining any injury.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger sustained no injury as a result of the crash. She was not transported from the scene and lost no work days.

