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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-06-032
LOCATION - TEXAS
VEHICLE - 2005 HONDA ACCORD
CRASH DATE - August 2006

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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. *Supplementary Notes* On-site manufacturer certified advanced 208-compliant vehicle investigation involving a 2005 Honda Accord equipped with manual safety belts, dual front advanced air bag system and side curtain and side impact air bags.			
16. *Abstract* This report covers an on-site investigation of a 2005 Honda Accord LX (case vehicle), which ran-off-road and impacted a utility pole. This crash is of special interest because the supplemental restraint (air bag) system in the Honda Accord is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [74-year-old, White (non-Hispanic) female] sustained a police-reported “C” (possible) injury as a result of the crash. The case vehicle was traveling north in the center northbound through-lane of a seven-lane, divided, city street. A non-contact vehicle passed the case vehicle on the left and then abruptly cut across the case vehicle’s path. As a result, the case vehicle’s driver steered right, crossed the outside lane and departed the east side of the roadway. The case vehicle impacted and ran over the east curb. The front of the case vehicle then impacted a telephone utility box and a utility pole breaking it off at the base. The utility pole impact caused both stages of the case vehicle driver’s front air bag to deploy. In addition, the left side curtain and driver’s side impact air bags deployed. The case vehicle came to final rest heading east with the back portion of the vehicle in the roadway. The driver was restrained by her manual, three-point, lap-and-shoulder safety belt. She was transported from the scene to a local hospital and admitted overnight.			
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BACKGROUND

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This in-site investigation was brought to NHTSA's attention on or before September 6, 2006 by NASS CDS/GES sampling activities. This crash involved a 2005 Honda Accord LX (case vehicle), which ran-off-road and impacted a utility pole. This crash is of special interest because the supplemental restraint (air bag) system in the Honda Accord is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [74-year-old, White (non-Hispanic) female] sustained a police-reported "C" (possible) injury as a result of the crash. This contractor inspected the case vehicle and scene on October 11 and 12, 2006. This contractor was unable to contact the case vehicle's driver for an interview. This report is based on the police crash report, scene and vehicle inspections, driver's medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling north in the center northbound through-lane of a seven-lane, divided, city street. A non-contact vehicle passed the case vehicle on the left and then abruptly cut across the case vehicle's path. As a result, the case vehicle's driver steered right, crossed the outside lane and departed the east side of the roadway. The case vehicle impacted and ran over the east curb damaging the right front, left front and left rear wheels (events 1-3). The center left portion of the front bumper impacted a telephone utility box (event 4), and the front right corner of the case vehicle then impacted a utility pole (event 5) breaking it off at the base. The utility pole impact caused both stages of the case vehicle driver's front air bag to deploy. The case vehicle's left side curtain air bag and driver's seat back-mounted side impact air bag also deployed. The impact with the utility pole caused the case vehicle to rotate clockwise approximately 90 degrees, and the case vehicle came to final rest heading east with the back portion of the vehicle in the roadway. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry.

The CDCs for the case vehicle were determined to be: **12-FRWN-3** (**0** degrees) for the right front wheel curb impact (event 1), **12-FLWN-3** (**0** degrees) for the left front wheel curb impact (event 2), **12-FLWN-9** (**0** degrees) for the left rear wheel curb impact (event 3), **12-FCLN-1** (**0** degrees) for the front impact to the telephone utility box (event 4) and **12-FREE-3** for the front right impact to the utility pole (event 5). The maximum residual crush for the utility pole impact was measured as 67 centimeters (26.4 inches) occurring at C_6. The WinSMASH reconstruction program, barrier algorithm, calculated the case vehicle's Barrier Equivalent Speed (BES) as 38 km.p.h. (23.6 m.p.h) for the utility pole impact (i.e., most severe impact). The WinSMASH program could not be used to calculate the Delta Vs for the curb impacts because wheel impacts are out-of-scope for the program. A BES could not be calculated for the telephone utility box impact because there was no residual crush to the case vehicle. The case vehicle was towed due to damage.

The case vehicle's driver (74-year-old, female) was restrained by her manual, three-point, lap-and-shoulder safety belt. As a result of the utility pole impact, the driver loaded her safety belt system, her knees impacted her knee bolster and her face, chest and right arm impacted her deployed air bag causing multiple contusions and abrasions. She was transported from the crash scene by ambulance to a hospital and admitted overnight. The driver's use of her safety belt system and the deployment of her pretensioner, front air bag, side curtain air bag and seat back-mounted side impact air bag mitigated her interaction with the interior vehicle components and reduced her injury potential.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a seven-lane, divided, city street, traversing in a north-south direction. A second city street intersected the trafficway from the east to form a three-leg (i.e., "T") intersection near the crash site. The case vehicle's roadway had three northbound through lanes and a right turn lane into the intersecting city street. The outside through lane was 6.7 meters (22 feet) in width, the center through lane was 3.4 meters (11.2 feet) in width and the inside through lane was 3.8 meters (12.5 feet) in width. The outside through lane became two designated through lanes north of the crash site. The trafficway was divided by a raised, curbed, grass median and the roadway was bordered by barrier curbs. There was a line of utility poles on both sides of the roadway and luminaires in the median. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, level concrete. See the Crash Diagram at the end of this report.

Figure 1: Approach of case vehicle northbound in center through lane, arrow shows location of utility pole impact

Pre-Crash: The case vehicle was traveling north in the center northbound through lane (**Figure 1**) and the driver was intending to continue northbound. The driver stated to police that a vehicle passed her on the left at a high rate of speed and then abruptly cut across her path. The case vehicle's driver steered right, crossed the outside lane and departed the east side of the roadway. The crash occurred on the east side of the roadway.

Figure 2: Approach of case vehicle to curb impacts, arrow shows location of right front wheel curb impact

Crash: The case vehicle impacted and ran over the east curb (**Figure 2**) damaging the right front wheel (event 1), left front wheel (event 2) and the left rear wheel (event 3). The case vehicle then

traveled through the grass and landed in a concrete drainage basin (**Figure 3**). The center left portion of the front bumper impacted a telephone utility box (event 4) north of the drainage basin. The front right of the case vehicle (**Figure 4**) then impacted a utility pole [**Figure 5** (event 5)] breaking it off at the base. The utility pole impact caused both stages of the case vehicle driver's front air bag to deploy. In addition, the driver's side curtain air bag and seat back-mounted side impact air bag deployed.

Post-Crash: The impact with the utility pole caused the case vehicle to rotate clockwise approximately 90 degrees. The case vehicle came to final rest heading east with the back portion of the vehicle in the roadway.

Figure 3: Approach of case vehicle across drainage basin to telephone utility box impact (green arrow) and utility pole impact (red arrow)

Figure 4: Overview of damage to front of case vehicle from impact with utility pole, vertical scale in tenths of meter, each increment on rods is 5 cm (2 in)

Figure 5: Overview of telephone utility box impact and utility pole impact (pole has been replaced)

CASE VEHICLE

The 2005 Honda Accord was a front wheel drive, four-door sedan (VIN: 1HGCM56405G------) equipped with a 2.4L, 4-cylinder engine; five-speed automatic transmission and power assisted, four wheel, anti-lock disc brakes. The front seating row was equipped with bucket seats with adjustable head restraints, dual stage driver and front right passenger air bags, a tilt and telescopic steering column, a front right passenger occupant detection system, 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 and retractor mounted safety belt pretensioners and safety belt usage sensors. The back seat was equipped with a bench seat with adjustable head restraints in the outboard seat positions; manual, three-point, lap-and-shoulder safety belts in all three back seat positions and side curtain air bags. In addition, the case vehicle was equipped with a LATCH system for securing

child safety seats. The case vehicle's specification wheelbase was 274 centimeters (107.9 inches). The case vehicle's odometer reading at the time of the vehicle inspection is unknown because the vehicle was equipped with an electronic odometer.

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity, safety belt usage and presence of a front right passenger to determine the front air bag inflation level appropriate for the severity of the crash. The OPDS utilizes sensors in the front right passenger's seat back to detect the height and seating position of the passenger. If a child or small-statured adult is leaning into the deployment path of the seat back-mounted side impact air bag, sensors suppress deployment of the side impact air bag.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the curb damaged the right front, left front and left rear wheels. The right front and left rear wheel rims were dented and the tires debeaded. The left front tire was debeaded and the wheel rim slightly deformed. The case vehicle's front impact with the telephone utility box involved a narrow area of the center left portion of the front bumper. The impact caused only scratches on the bumper fascia. The case vehicle's impact with the utility pole involved the front right of the vehicle. The front bumper, right headlamp/turn signal assembly, right corner of the hood and front of the right fender were directly damaged and crushed rearward. Direct damage began at the front right bumper corner and extended 16 centimeters (6.9 inches) across the bumper. Residual maximum crush was measured as 67 centimeters (26.4 inches) occurring at C_6 (**Figure 6**). The table below shows the case vehicle's front crush profile for the utility pole impact.

Figure 6: Top view of crush to front of case vehicle from the utility pole 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	5	16	67	90	0	7	23	35	48	67	46	0
in		6.3	26.4	35.4	0.0	2.8	9.1	13.8	18.9	26.4	18.1	0.0

The case vehicle's right side wheelbase was reduced 24 centimeters (9.4 inches) while the left side wheelbase was extended 4 centimeters (1.6 inches). Induced damage involved the hood, left portion of the front bumper, both fenders, right sill, left corner of the back bumper fascia, and the windshield was fractured.

The case vehicle's recommended tire size was: P205/65R15, and the case 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	32nd of an inch			
LF	Flat	Flat	207	30	7	9	Bead separated	No	Yes
RF	Flat	Flat	207	30	7	9	Small cut in tire, bead separated, rim dented	Yes	Yes
LR	Flat	Flat	200	29	7	9	Rim dented, bead separated	No	Yes
RR	179	26	200	29	7	9	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior (**Figures 7** and 8) revealed occupant contact evidence on the driver's knee bolster and a lip stick print on the upper left quadrant of the driver's air bag. No other occupant contacts were noted. There was no evidence of occupant compartment intrusions and no deformation of the steering wheel or compression of the energy absorbing steering column (**Figure 9** below).

Figure 7: View through driver's door of case vehicle's steering wheel, windshield and instrument panel

Figure 8: View through right front door of case vehicle's instrument panel, windshield and steering wheel

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **12-FRWN-3** (**0** degrees) for the right front wheel curb impact (event 1), **12-FLWN-3** (**0** degrees) for the left front wheel curb impact (event 2), **12-FLWN-9** (**0** degrees) for the left rear wheel curb impact (event 3), **12-FCLN-1** (**0** degrees) for the front impact to the telephone utility box (event 4) and **12-FREE-3** for the front right impact to the utility pole (event 5). The WinSMASH reconstruction program, barrier algorithm, calculated the case vehicle's Barrier Equivalent Speed (BES) as 38 km.p.h. (23.6 m.p.h) for the utility pole impact (i.e., the most severe impact). The WinSMASH program could not be used to calculate the Delta Vs for the curb impacts because wheel impacts are out-of-scope for the program. A BES could not be calculated

for the telephone utility box impact because there was no residual crush to the case vehicle. The case vehicle was towed due to damage.

Figure 9: Left side view of case vehicle's steering assembly

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with manufacturer certified advanced 208-compliant air bags at the driver and front right passenger positions. The driver's air bag deployed as a result of the case vehicle's front impact with the wooden utility pole. Both side curtain and front seat back-mounted side impact air bags also deployed. It is this contractor's opinion, based on the reconstruction and EDR data, that the right side curtain and right side impact air bags deployed due to side forces when the case vehicle landed in the concrete drainage area. Additionally, the case vehicle's left side curtain air bag and left front seat back-mounted side impact air bag deployed as a result of the utility pole impact and clockwise rotation. The front right passenger air bag did not deploy in this crash.

Figure 10: Case vehicle driver's air bag cover flaps

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module cover consisted of two asymmetrical flaps made of semi-pliable vinyl. The upper flap was approximately rectangular in shape with a manufacturer's logo located in the center of the flap. A portion of the logo extended from the bottom of the flap and fit into a cut-out at the center top of the lower flap. The upper flap was 12 centimeters (4.7 inches) in width and 8 centimeters (3.1 inches) in height. The lower flap was 12 centimeters (4.7 inches) in width at the top, 8 centimeters (3.1 inches) in width at the bottom and 7 centimeters (2.8 inches) in height. An inspection of the air bag module cover flaps (**Figure 10**) and the air bag fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two

Figure 11: Case vehicle driver's air bag, orange dots show lip stick imprint

tethers, each approximately 7 centimeters (2.8 inches) in width, and had two vent ports, each approximately 5 centimeters (2 inches) in diameter, located approximately at the 10 and 2 o'clock positions near the center of the back of the air bag. The deployed driver's air bag (**Figure 11** above) was round with a diameter of approximately 57 centimeters (22.4 inches). An inspection of the driver's air bag fabric revealed a lip stick print (**Figure 11** above) and blood stain on the upper left quadrant and blood stains on the lower left and right quadrant.

Figure 12: Overview of front portion of left side curtain air bag

The case vehicle's front right passenger air bag was located in the top of the instrument panel (**Figure 8** above). The front right passenger air bag did not deploy in this crash because no passenger was seated in the front right seat.

Figure 13: Overview of back portion of left side curtain air bag

The case vehicle's left side curtain air bag was located along the left roof side rail (**Figures 12** and **13**) and folded accordion style inside the headliner. The air bag was designed to provide head protection for the driver and back left 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 165 centimeters (65 inches) in length and approximately 38 centimeters (15 inches) in height. It was designed without tethers and had a large inflation chamber adjacent to the driver's seat position and a smaller inflation chamber adjacent to the back left seat position. 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 an area at the front and back of the air bag that was not stitched and appeared to be a vent for the inflation gas. 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.

Figure 14: Inside surface of case vehicle driver's seat back-mounted side impact air bag

The case vehicle's right side curtain air bag was located along the right roof side rail below the headliner. Its dimensions and features were identical to the left side curtain air bag. There were no occupant contacts or damage to this air bag.

The driver's seat back-mounted side impact air bag was located in the outboard side of the driver's seat back (**Figure 14** above). The deployed air bag was approximately oval 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 37 centimeters (14.6 inches) in width and 26 centimeters (10.2 inches) in height. The fabric tab was approximately 6 centimeters (2.4 inches) in length The air bag was designed with two circular stitch patterns each approximately 6 centimeters (2.4 inches) in diameter that stitched the inner and outer surfaces or 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 case vehicle's front right passenger seat back-mounted side impact air bag was also located in the outboard side of the passenger's seat back. Its dimensions and features were identical to the left side impact air bag. There were no occupant contacts or damage to this air bag.

CRASH DATA RECORDING

The case vehicle's Electronic Control Unit (ECU) which contains the EDR, was harvested from the case vehicle during the vehicle inspection and forwarded to Washington D.C., for transfer to the manufacturer and interpretation of the data. The manufacturer's EDR report indicated that the right side curtain air bag, front right seat back-mounted side impact air bag and driver's safety belt pretensioner deployed first. The EDR report indicated that the ECU then deployed both stages of the driver's front air bag, the left side curtain air bag and the driver's seat back-mounted side impact air bag. In addition, the EDR data indicated that the driver's safety belt status was recorded as belted.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [74-year-old, White (non-Hispanic) female; [163 centimeters and 79 kilograms (64 inches, 174 pounds] was most likely seated in an upright driving position. She most likely had both hands on the steering wheel, her left foot on the floor and her right foot on either the brake or off of the accelerator pedal. Her seat track was located in its middle position, the seat back was slightly reclined and the tilt steering column was located in its center position. The position of the telescoping steering column is not known. It is not known if she was wearing glasses or contact lenses at the time of the crash.

Based on this contractor's vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The safety belt system was equipped with a retractor-mounted pretensioner. The driver's safety

belt was found spooled out of the retractor and would not retract indicating actuation of the pretensioner and usage of the safety belt in the crash. In addition, the EDR data indicated that the driver's pretensioner actuated during the crash and the safety belt was in use during the crash. No load marks were found on the "D"-ring. It was equipped with a metal guide in the throat of the "D"-ring, which is very resistant to friction induced load marks from the safety belt.

Figure 15: Lip stick imprint on upper left quadrant of driver's air bag

Figure 16: Damage to case vehicle driver's left knee bolster from driver's left knee impact

Figure 17: Damage to case vehicle's right knee bolster from impact of driver's right knee

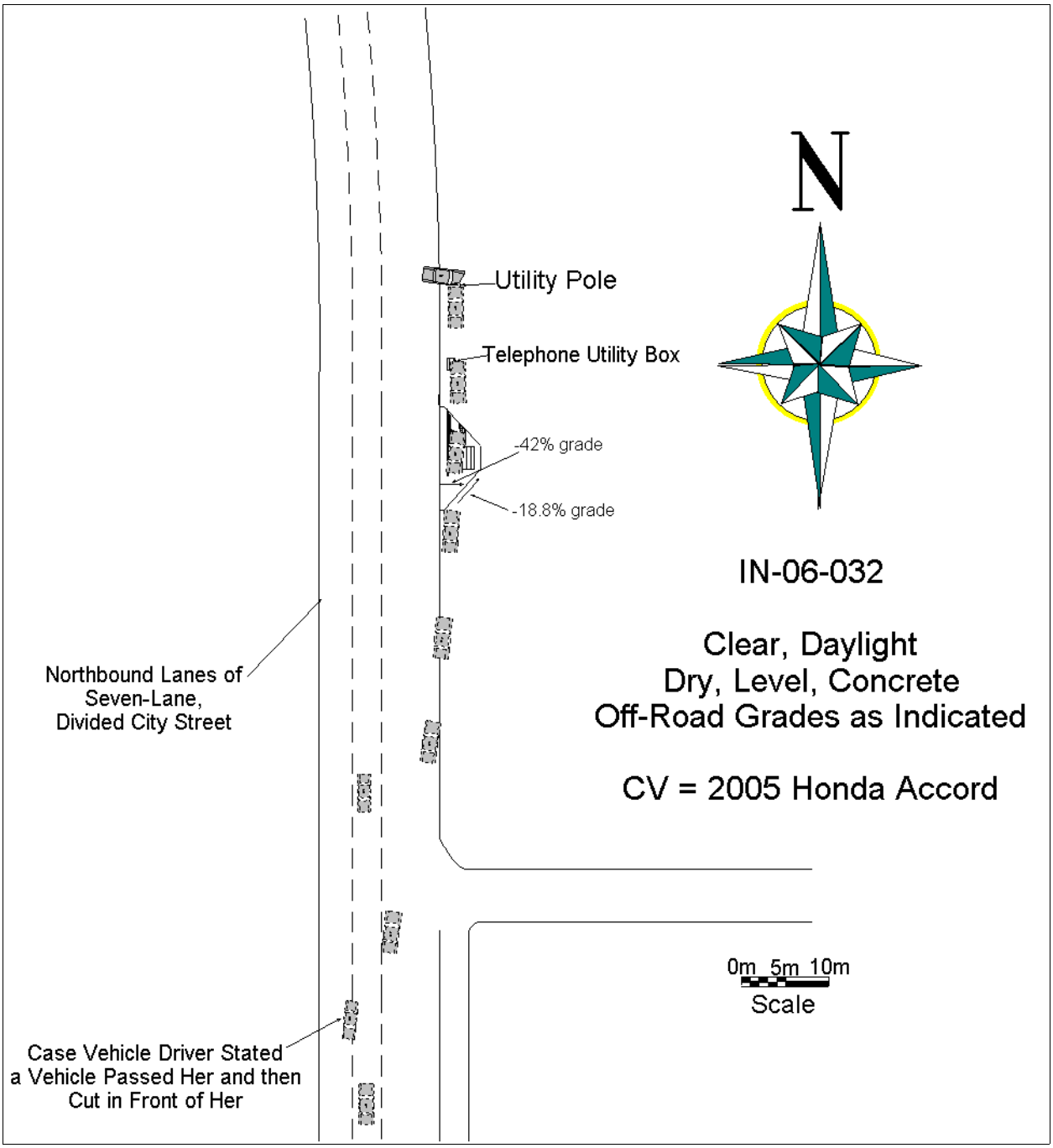
The case vehicle driver's right steer just prior to the curb impacts most likely caused the driver's upper torso to move slightly to the left. The case vehicle's front wheel impacts with the curb most likely locked the driver's safety belt retractor. The driver most likely moved down into her seat and continued forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle ran over the curb and decelerated, and the driver loaded her safety belt. She most likely rebounded back into her seat back. She then moved up and down and to the right in her seat and continued to load her safety belt as the case vehicle landed in the concrete drainage basin. The impact with the telephone utility box most likely caused little or no movement of the driver as the case vehicle traveled toward the utility pole impact. The case vehicle's front impact with the utility pole then caused the driver to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. She again loaded her safety belt and her face impacted her deployed air bag leaving a lip stick imprint on the air bag's upper left quadrant (**Figure 15**). In addition, her right forearm and chest impacted her deployed air bag. She sustained contusions and abrasions on her right forearm due to contact with the air bag, as well as abrasions to her chest and neck and a contusion to her lower abdomen due to loading her safety belt. The driver's knees also impacted the knee bolster (**Figures 16** and **17**) breaking the plastic and causing contusions to both knees. She rode down the air bag and loaded the steering wheel rim causing a large contusion on her right breast. She

also most likely contacted her thighs on the lower steering wheel rim causing contusions on her upper thighs. As the case vehicle rotated clockwise, the driver most likely moved to the left within her seat. The driver's head most likely contacted the deployed left side curtain air bag and her left arm and flank most likely loaded the deployed side impact air bag. The driver remained restrained in her seat as the case vehicle came to final rest. It is not known how the driver exited the case vehicle. The driver's use of her safety belt system and the deployment of her pretensioner, front air bag, side curtain air bag and seat back-mounted side impact air bag mitigated her interaction with the interior vehicle components and reduced her injury potential.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated that the case vehicle's driver sustained a "C" (possible) injury and was transported from the scene to a local hospital. The driver was admitted overnight for treatment of her injuries. The table below shows the case vehicle driver's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion {friction burn} left neck, not further specified	minor 390202.1,2	Torso portion of safety belt system	Certain	Hospitalization records
2	Abrasion chest, not further specified	minor 490202.1,4	Torso portion of safety belt system	Probable	EMS treatment record
3	Contusion {hematoma}, massive, large, 7.4 x 4.9 cm (2.9 x 1.9 in), right breast	minor 490402.1,1	Steering wheel hub and/or spokes and rim	Probable	Hospitalization records
4	Contusions {hematoma} lower abdominal wall suggestive of lap belt injury	minor 590402.1,8	Lap portion of safety belt system	Certain	Emergency room records
5	Abrasions right forearm, not further specified	minor 790202.1,1	Air bag, driver's	Probable	Hospitalization records
6	Contusion right arm, not further specified	minor 790402.1,1	Air bag, driver's	Probable	Emergency room records
7	Contusions {bruises}, small, over upper thighs, not further specified	minor 890402.1,3	Steering wheel rim	Probable	Hospitalization records
8	Contusion {bruising}, large, left knee, not further specified	minor 890402.1,2	Knee bolster, driver's, left of steering column	Probable	Hospitalization records
9	Contusion {bruising}, large, right knee, not further specified	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Hospitalization records


N
Utility Pole
Telephone Utility Box
42% grade
-18.8% grade
IN-06-032
Clear, Daylight
Dry, Level, Concrete
Off-Road Grades as Indicated
CV = 2005 Honda Accord
Northbound Lanes of
Seven-Lane,
Divided City Street
0m 5m 10m
Scale
Case Vehicle Driver Stated
a Vehicle Passed Her and then
Cut in Front of Her