TRANSPORTATION SCIENCES
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VERIDIAN ON-SITE SPLIT AIR BAG DEPLOYMENT INVESTIGATION
VERIDIAN CASE NO. CA00-014
VEHICLE: 2000 HONDA ACCORD
LOCATION: VIRGINIA
CRASH DATE: MAY 2000

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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 are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. *Abstract* This on-site investigation focused on the split deployment of the frontal air bag system in a 2000 Honda Accord EX. The Honda was equipped with redesigned frontal air bags and side impact air bags for the driver and right passenger positions. The vehicle was involved in an intersection-type crash with a 1991 Toyota Celica that resulted in frontal damage to the Honda. The frontal impact resulted in a sufficient longitudinal deceleration to deploy the frontal air bag system. The front right air bag deployed, however, the driver air bag failed to deploy. The focus on this investigation was to determine the cause of the split deployment. The Honda was occupied by a 27 year old female driver who alleged she was belted by the manual belt system. The short stature driver initiated a forward trajectory in response to the frontal impact force and loaded the manual belt system and the knee bolster. She sustained cervical strain and bilateral knee contusions.			
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BACKGROUND

This on-site investigation focused on the split deployment of the frontal air bag system in a 2000 Honda Accord EX. The Honda was equipped with redesigned frontal air bags and side impact air bags for the driver and right passenger positions. The vehicle was involved in an intersection-type crash with a 1991 Toyota Celica that resulted in frontal damage **(Figure 1)** to the Honda. The impact resulted in a sufficient longitudinal deceleration to deploy the Honda's frontal air bag system. The front right air bag deployed, however, the driver air bag failed to deploy. The focus on this investigation was to determine the cause of the split deployment.

Figure 1. Frontal damage to the Honda Accord.

The Honda was occupied by a 27 year old female driver stated she was belted by the manual belt system. The driver initiated a forward trajectory in response to the frontal impact force and loaded the manual belt system and the knee bolster. She sustained cervical strain and bilateral knee contusions.

The crash occurred in the Northern Virginia area in May 2000. Notification of the crash was provided to NHTSA by the driver/owner of the vehicle on Monday, May 8, and the case was immediately assigned to the Veridian Special Crash Investigation team. A joint inspection of the vehicle was conducted by SCI and Office of Defects Investigation personnel on Wednesday, May 10.

SUMMARY

Crash Site

The crash occurred at a four-leg intersection during daylight hours. The Honda Accord was traveling in an easterly direction on a four-lane divided roadway that was straight with a grade. A service road paralleled the divided roadway with a grass median separating the service road from the divided roadway. A four-lane non-divided roadway intersected the service road and the divided roadway forming a four-leg intersection. Traffic flow on the divided roadway was not controlled while stop signs regulated east/westbound traffic flow on the intersecting roadway. The posted speed limits were 64 km/h (40 mph) and 40 km/h (25 mph) for the Honda and Toyota respectively. At the time of the crash, the asphalt road surfaces were dry and the weather was clear with temperatures in the mid 20s C (mid 80s F).

Vehicle Data

The 2000 Honda Accord EX was a two-door coupe that was manufactured on 12/99 and identified by vehicle identification number 1HGCG2257YA (production number depleted). At the time if the inspection,

the vehicle's odometer had recorded 6,651 km (4,133 miles). The Honda Accord was equipped with a 3.0 liter, V-6 gasoline engine linked to a four-speed automatic overdrive transmission with a console mounted shifter. In addition to the drive train, the Accord was equipped with four-wheel power-assisted disc brakes with anti-lock (ABS), power-assisted rack-and-pinion steering, leather seating with side impact air bags incorporated into the seat back supports, power front bucket seats, power windows, power door locks, a factory security system, and a dealer installed cassette player mounted in the mid center instrument panel at the console junction.

Vehicle History

The driver purchased the Honda Accord on Monday, January 31, 2000, as a new vehicle from a local Honda dealership. On Saturday, February 5, the driver noted the SRS lamp was illuminated with a constant light. She returned the vehicle to the dealership on Monday, February 7. The odometer reading at this repair was 515 km (320 miles). This service was documented on a copy of a repair invoice that was provided by the driver to this investigation.

A technician at the dealership used a Honda electronic scan tool (PGM tester) to test the SRS control module for faults. According to the invoice, the check light code 05-8 was detected by the scan tool. This code was cleared from the control module and the module was reset which canceled the constant light for the SRS indicator lamp.

The only additional service performed on the vehicle was a scheduled oil change.

Crash Sequence

Pre-Crash

The driver of the Honda Accord was traveling in a easterly direction on the outboard travel lane of the divided roadway at a driver estimated speed of 72 km/h (45 mph). As she approached the four-leg intersection, the driver noted tall grass growing on the median at the southeast quadrant of the intersection. The Toyota Celica was traveling in a northerly direction on the intersecting roadway. It was unknown if the driver of the Toyota brought his vehicle to a complete stop or rolled through the intersection as he prepared for a left turn onto the divided roadway. As the Celica entered the Honda's path of travel from right to left, the driver of the Honda braked the ABS equipped vehicle and steered to the right in an attempt to avoid the crash.

Crash

The front center and left area of the Honda Accord impacted the left rear quarter panel area of the Toyota Celica. Resultant directions of force were within the 1 o'clock sector for the Honda and probably within the 10 o'clock sector for the struck Toyota. The Honda crushed to a maximum depth of 19.7 cm (7.75") located on the bumper reinforcement bar. The barrier equivalent algorithm of the WinSMASH program computed total delta V of 16.7 km/h (10.4 mph) for the Honda Accord. The specific longitudinal and lateral components were -15.7 km/h (-9.7 mph) and -5.7 km/h (-3.5 mph) respectively. The longitudinal

component was of sufficient magnitude to trigger the deployment of the frontal air bag system, however, only the front right air bag deployed. The front left (driver) air bag did not deploy.

Post-Crash

Based on the crash dynamics, the Honda was deflected slightly in a clockwise direction and came to rest near the point of impact. The Toyota was struck rearward of its center of gravity and rotated in a counterclockwise direction. The driver of the Honda noted that the driver of the Toyota attempted to flee the scene of the crash, however, the damage restricted the left rear tire and wheel assembly. Both driver's exited their vehicles unassisted and waited for the arrival of the local police. The driver of the Honda sustained minor severity injuries, however, she refused medical treatment. Both vehicles were towed from the scene.

VEHICLE DAMAGE

Exterior - Honda Accord

The 2000 Honda Accord sustained moderate frontal damage as a result of the intersection-type crash with the Toyota Celica. The direct contact damage **(Figure 2)** began on the bumper fascia 38.1 cm (15.0") right of center and extended 113.7 cm (44.75") to the left corner. Maximum crush was 19.7 cm (7.75") located on the bumper reinforcement bar, 12.1 cm (4.75") left of the vehicle's centerline **(Figure 3)**. The frontal impact deformed the entire width of the energy absorbing frontal structure resulting in a combined induced and direct contact damage length of 153.7 cm (60.5"). The bumper fascia crushed and returned to its original form while the reinforcement bar retained the deformation pattern. Therefore, the crush profile was documented at the reinforcement bar by removing the grille and plastic filler panels. The crush profile was as follows: C1 = 3.8 cm (1.5"), C2 = 8.3 cm (3.25"), C3 = 17.1 cm (6.75"), C4 = 5.1 cm (13.0"), C5 = 3.8 cm (1.5"), C6 = 0 cm. The Collision Deformation Classification (CDC) for this frontal impact sequence was 01-FDEW-1.

Figure 2. Frontal damage to the Honda Accord.

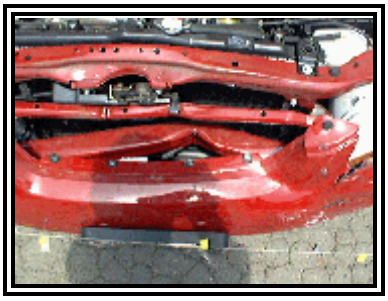

Figure 3. Maximum crush to the bumper reinforcement bar.

Damaged components included the front bumper fascia, styro-foam backer material, bumper reinforcement bar, grille, hood, radiator support panel, air conditioning condenser, and the radiator.

Interior - Honda Accord

Interior damage to the Honda Accord was minor and was associated with air bag deployment and driver contact. There was no intrusion of interior components or damage associated with exterior deformation. The front right passenger air bag deployed from a top mount module within the right upper instrument panel. Although the deployment path of the air bag was not impeded, the air bag membrane did contact the laminate windshield glazing. This was evidenced by several superficial air bag fabric transfers to the glazing.

The driver's knee's contacted the knee bolster. Her left knee scuffed the bolster 41.9-45.7 cm (16.5-18.0") left of center and 38.1-40.6 cm (15.0-16.0") below the brow of the upper instrument panel. There was no evidence of contact from the left knee contact.

AUTOMATIC RESTRAINT SYSTEM

2000 Honda Accord

The Honda Accord was equipped with a Supplemental Restraint System (SRS) that consisted of redesigned frontal air bags for the driver and right passenger positions. In addition, this vehicle was equipped with side impact air bags for the front seated positions. The Honda was involved in a frontal crash sequence which exceeded the threshold for deployment. The front right air bag deployed, however, the front left (driver) air bag failed to deploy **(Figure 4)**. The crash did not warrant deployment of the side impact air bags.

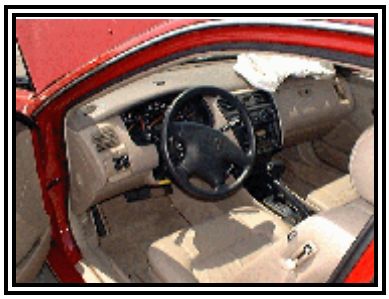

Figure 4. Split deployment of the frontal air bag system.

The frontal air bag system consisted of the front air bag modules and a single point sensing and diagnostic control module that was mounted within the passenger compartment of the vehicle. An instrument panel mounted air bag indicator lamp provided the driver with a light for system readiness.

The front left air bag module was mounted in a conventional configuration within the four-spoke steering wheel assembly. The steering wheel spokes were located at the 3/9 and 5/7 o'clock positions. A clock spring switch provided electrical current from the steering assembly to the air bag module. The clock spring and the non-deployed driver air bag module were not removed from the steering assembly during this on-site inspection of the vehicle.

The front right air bag was a top mount module in the upper right instrument panel **(Figure 5)**. The module assembly was retained in the instrument panel by a series of friction fit (push) clips. Symmetrical H-configuration cover flaps concealed the air bag membrane within the module assembly. The cover flaps were 5.1 x 25.4 cm (2.0 x 10.0") and hinged at the fore and aft segment segments.

Figure 5. Top mount and flap configuration of the front right air bag.

The front right air bag was approximately square in shape with a horizontal dimension of 61.0 cm (24.0") and a vertical dimension of 63.5 cm (25.0"). The bag was not tethered internally. Venting was accomplished through two 5.7 cm (2.25") diameter vent ports located at the 3 and 9 o'clock sectors of the bag. During deployment, the front right air bag contacted the windshield above the module assembly. Several small fabric transfers were noted to the laminated glazing. No damage resulted to the glass.

Post-Deployment Diagnostic Test

The 2000 Honda Accord was driven from the body shop to a neighboring service facility that was equipped with a hand-held diagnostic scan tool. The technician connected the scan tool to the diagnostic port, however, the software card could not read the 2000 model year vehicle.

Cooperation was obtained at a local Honda dealership and the vehicle was driven to this facility. The service technician used a Honda PGM tester (hand-held diagnostic scan tool) and plugged the tool via an interface cable into the diagnostic test port located under the right instrument panel. He entered the vehicle identification number into the PGM tester to access the appropriate software. The tool retrieved a diagnostic trouble code (DTC) of 10-1. This code was then interpreted by a look-up table in the service manual which identified the DTC as a SRS Unit Replacement. This was the standard code that followed a deployment event which requires the replacement of the electronic control unit.

The technician further explored the control module for stored fault codes in the history mode. There were no stored DTCs in the unit. Therefore, it was not possible to detect system malfunctions for this split deployment using this PGM tester. NHTSA's Office of Defects Investigation (ODI) will explore the possibility of further diagnostic testing of the air bag control module through Honda.

REPAIR OF THE 2000 HONDA ACCORD

A local body shop was scheduled to repair the structural and sheet metal damage to the Honda Accord. Following this repair process, the Accord will be transported to a local Honda dealership for repair and replacement of the frontal air bag system. The insurance carrier will cover the required replacement of the deployed front right air bag module and the air bag control module. Honda will replace the non-deployed front left air bag module and the clock spring assembly under warranty. The air bag control module will be available to ODI following the repair process.

DRIVER DEMOGRAPHICS

Honda Accord

Age/Sex:	27 year old female
Height:	157.5 cm (62.0")
Weight:	63.5 kg (140.0 lb)
Manual Restraint	
Usage:	3-point lap and shoulder belt system
Usage Source:	Driver statements, vehicle inspection
Medical Treatment:	Examined by personal physician four days following the crash

DRIVER INJURIES

Injury	Injury Severity (AIS Update 98)	Injury Mechanism
Cervical strain (whiplash)	Minor (640278.1,6)	Non-contact, induced from loading the manual belt system
Bilateral knee contusions	Minor (890402.1,3)	Knee bolster

DRIVER KINEMATICS

The driver of the 2000 Honda Accord was seated in a mid track position with the seat back support reclined to approximately 25 degrees and the adjustable head restraint set to the lowest position. In this position, the seat track was adjusted 10.4 cm (4.1") rearward of the full forward position and 13.7 cm (5.4") forward of the full rear position **(Figure 6)**. The horizontal distance between the mid point of the front left air bag module cover and the seat back support was 55.9 cm (22.0"), thus providing the driver with a safe distance between herself and the steering assembly and the front left air bag module. The driver stated she was wearing the manual belt system although there was no loading evidence on the belt system.

Figure 6. Adjusted seat track position for the female driver.

At impact, the driver initiated a forward trajectory in response to the frontal impact force. She loaded the manual restraint system which allowed her head to continue forward. The forward motion of the head resulted in a non-contact whiplash injury of the cervical spine. Her knees impacted the knee bolster resulting in bilateral knee contusions. The manual restraint system prevented the driver from contact against the steering assembly and/or windshield.

The driver rebounded into the seat back support where she came to rest. She immediately exited the vehicle and approached the driver of Toyota Celica. At the scene, she refused medical attention. The driver scheduled an appointment with a private physician four days following the crash. The whiplash was diagnosed and she was advised to seek physical therapy.