

# INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER  
School of Public and Environmental Affairs

## ON-SITE CHILD RESTRAINT SYSTEM INVESTIGATION

CASE NUMBER - IN11005  
LOCATION - MINNESOTA  
VEHICLE - 2002 DODGE DURANGO  
CRASH DATE - January 2011

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

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

**Technical Report Documentation Page**

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16. <i>Abstract</i> The focus of this on-site investigation was the second row right passenger of a 2002 Dodge Durango SXT and the Child Restraint System (CRS) in which the passenger was seated. The vehicle was occupied by a unrestrained 25-year-old female driver and a 2-year-old female second row right passenger that was restrained in a Dorel Safety 1st All-In-One CRS. The Dodge was traveling north on a 4-lane, divided, interstate highway. For an unknown reason, the vehicle departed the west side of the roadway into the median where it rolled over (event 1) and sustained multiple impacts with a cable guardrail (events 2-6). The vehicle came to final rest on the west roadside heading northwest. The driver was ejected during the rollover and sustained fatal injuries. The second row right passenger was not injured.					
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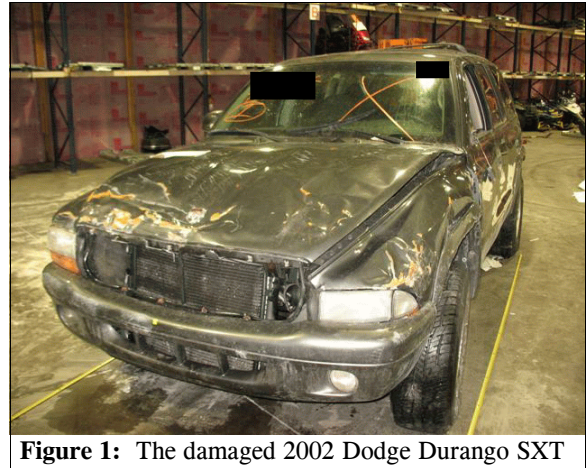
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The focus of this on-site investigation was the second row right passenger of a 2002 Dodge Durango SXT (**Figure 1**) and the Child Restraint System (CRS) in which she was seated. This crash was initiated by the National Highway Traffic Safety Administration (NHTSA) on January 19, 2011. The crash was brought to NHTSA's attention by Special Crash Investigation Team 3. This investigation was assigned on January 28, 2011. The crash occurred in January, 2011, at 0717 hours, in Minnesota and was investigated by the state patrol. The crash occurred when the Dodge departed the roadway and impacted a cable guard rail and rolled over. The Dodge was inspected on February 9, 2011. The crash scene was photographed and the CRS was inspected on February 10, 2011. The driver sustained fatal injuries and no surrogate could be located for an interview.



**Figure 1:** The damaged 2002 Dodge Durango SXT

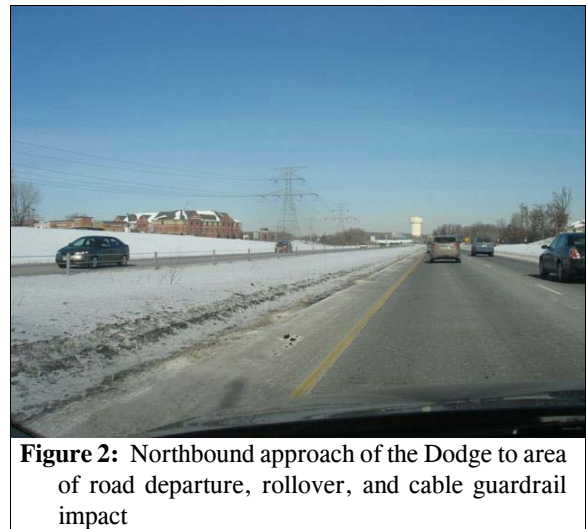
The Dodge was a 4-door, sport utility vehicle with frontal air bags, which did not deploy. The vehicle was occupied by a unrestrained 25-year-old female driver and a 2-year-old female second row right passenger that was restrained in a Dorel Safety 1stAll-In-One CRS. The driver was ejected during the crash and sustained fatal injuries. The second row right passenger was transported by ground ambulance to a hospital where she was examined and sustained no injuries.

## CRASH SUMMARY

**Crash Site:** The crash occurred on a 4-lane, divided, interstate highway at dawn and during clear weather conditions. The trafficway was straight and traversed in a north-south direction. It was bordered by wide bituminous shoulders and a double steel cable guardrail that was located in the median adjacent to the shoulder of the southbound lanes. The roadway pavement markings consisted of a solid white edge line, broken white center lines, and a solid yellow median edge line.

The roadway surface was level, dry bituminous and the speed limit was 97 km/h (60 mph). Due to heavy traffic volume on the interstate highway, a drive-through scene inspection was conducted. The Crash Diagram is on page 8 of this report.

**Pre-Crash:** The Dodge was traveling north (**Figure 2**) and the driver intended to continue straight ahead. For an unknown reason, the vehicle departed the west side of the roadway. It is unknown if the driver made any avoidance maneuvers.



**Figure 2:** Northbound approach of the Dodge to area of road departure, rollover, and cable guardrail impact

**Crash:** After departing the roadway the Dodge began to rotate counter clockwise and entered a shallow ditch in the median. The Dodge rolled over, right side leading (event 1). During the rollover, the front plane of the Dodge impacted the cable guardrail (event 2). The cable guardrail also impacted the top plane (event 3), left fender/left front door area (event 4), right rear door (event 5), and the left quarter panel (event 6) at multiple locations on the vehicle. The Dodge rolled over four quarter turns and the driver was ejected through the disintegrated left front glazing. The driver came to final rest on the median shoulder of the southbound roadway. The Dodge continued across the southbound lanes on its wheels and came to final rest on the west roadside, heading northwest. The driver of the Dodge was subsequently struck and run over by a 2002 Toyota Camry when the Toyota’s driver swerved onto the shoulder to avoid a collision with a flatbed truck, whose driver was slowing to render assistance.

**Post-Crash:** The police were notified of the crash and responded along with emergency medical and rescue services. The driver was pronounced deceased at the crash scene. The second row right passenger was transported by ambulance to a hospital. She was examined in the emergency room and sustained no injuries. The vehicle was towed from the crash scene due to damage.

**2002 DODGE DURANGO SXT**

The Dodge was a 4-wheel drive, 5-passenger, 4-door, sport utility vehicle (VIN: 1B4HS38N72F-----), equipped with a 4.7-liter, V-8 engine, a 5-speed automatic transmission, rear-wheel anti-lock brakes with electronic brake force distribution, and redesigned driver and passenger frontal air bags. The windshield glazing was AS-1 laminated, while the front window glazings were AS-2 tempered and the remainder of the glazings were AS-3 tempered-tinted (original). Prior to the crash, all of the glazings were either closed for adjustable windows or fixed for the others. The tilt steering column was adjusted between the full up and center position. The specified wheelbase was 295 cm (116.1 in) and the odometer reading was 116,831 km (72,595 mi).

The vehicle manufacturer’s standard recommended tire size was P235/75R15 or optional size P265/70R16. The vehicle was equipped with P265/70R16 tires. The recommended cold tire pressure for the front tires was 207 kPa (30 psi) and 241 kPa (35 psi) for the rear tires. The tire data for the Dodge are presented in the table below.

<i>Position</i>	<i>Measured Pressure</i>	<i>Measured Tread Depth</i>	<i>Restricted</i>	<i>Damage</i>
LF	207 kPa ( 30 psi)	9 mm ( 11/32 in)	No	None
LR	193 kPa ( 28 psi)	7 mm ( 9/32 in)	No	None
RR	83 kPa ( 12 psi)	6 mm ( 8/32 in)	No	None
RF	207 kPa ( 30 psi)	9 mm ( 11/32 in)	No	None

The front row was equipped with cloth-covered bucket seats with integral head restraints for the driver and front right passenger. The second row was equipped with cloth-covered bench seats with folding backs and adjustable head restraints. The driver's seat track was adjusted to between the forward and middle positions. The front right passenger's seat track was adjusted to the middle position. The second row seat track was not adjustable. None of the seats were damaged or displaced as a result of the crash.

### EXTERIOR DAMAGE

**Exterior Damage Event 1:** The Dodge sustained damage on the hood, left fender, and luggage rack during the rollover. The direct damage on the hood began 4 cm (1.7 in) left of the right front bumper corner and extended 125 cm (49.2 in) left, across the hood and onto the left fender (**Figure 3**). The damage on the luggage rack consisted of scuffs and scratch marks. There was no lateral or vertical crush to the roof of the vehicle from ground contact.



**Figure 3:** Rollover and cable guardrail damage to hood/left fender of the Dodge

**Damage Classification Event 1:** The Collision Damage Classification (CDC) was 00TYDO1. The WinSMASH program could not be used on this event since rollovers are out of scope for the program. The severity of the damage from the rollover was minor based on the extent of the roof damage.



**Figure 4:** Damage from cable guardrail on roof of the Dodge

**Exterior Damage Event 2:** The Dodge sustained damage on the frontal plane from contact with the cable guardrail during the rollover. The direct damage began 3 cm (1.2 in) left of the front right bumper corner and extended 74 cm (29.1 in) to the left.

**Damage Classification Event 2:** The CDC was 00FZLW1. The WinSMASH program could not be used to calculate Delta V for this event since non-horizontal impacts and impacts with a yielding object are out of scope for WinSMASH. The severity of the damage was minor based on the extent of the front bumper damage.

**Exterior Damage Event 3:** The Dodge sustained damage on the top plane from contact with the cable guardrail. Direct damage began at the front of the hood, 4 cm (1.6 in) inside the right front bumper corner and extended across the hood. Direct damage was also found on the roof (**Figure 4**), beginning 96 cm (37.8 in) forward of the right rear axle and extending 100 cm (39.4 in) rearward and toward the center.

**Damage Classification Event 3:** The CDC was 00TDDW2. The WinSMASH program could not be used to calculate Delta V for this event. The severity of the damage was minor based on the extent of the roof damage.

**Exterior Damage Event 4:** The Dodge sustained damage on the left plane from contact with the cable guardrail. The direct damage began 20 cm (7.9 in) rear of the left front axle and extended 78 cm (30.7 in) rearward on the fender and front door.

**Damage Classification Event 4:** The CDC was 00LYEW1. The WinSMASH program could not be used to calculate Delta V on this event. The severity of the damage was minor based on the extent of side plane damage

**Exterior Damage Event 5:** The Dodge sustained damage on the right plane from contact with the cable guardrail. The direct damage started 123 cm (48.4 in ) forward of the right rear axle and extended rearward 95 cm (37.4 in) along the right rear door, from the sill to the roof side rail.

**Damage Classification Event 5:** The CDC was 00RZAW3. The WinSMASH program could not be used to calculate Delta V for this event. The severity of the damage from the cable guardrail was minor based on the extent of side plane damage.

**Exterior Damage Event 6:** The Dodge sustained damage on the left plane due to contact with the cable guardrail. The direct damage started 32 cm (12.6 in) rear of the left rear axle and extended 52 cm (20.5 in) rearward.

**Damage Classification Event 6:** The CDC was 00LBEW2. The WinSMASH program could not be used to calculate Delta V for this event. The severity of the damage was minor based on extent of side plane damage.

## INTERIOR DAMAGE

Inspection of the interior of the Dodge revealed a scuff on the top of the driver's door at the beltline (**Figure 5**), probably from contact by the left side of the driver. This scuff occurred as the driver was ejected from the vehicle through the disintegrated left front glazing. No other damage or occupant contacts were noted. There was no damage to the steering wheel or compression of the steering column.

All of the vehicle's doors and the hatch remained closed and operational. Only the left front window glazing was disintegrated from impact forces.



**Figure 5:** Scuff on beltline of driver's door of the Dodge



There was no intrusion to the front row. The roof and roof side rail intruded vertically (5 cm (2 in) and 2 cm (0.8 in), respectively) into the second row right seating area

#### **MANUAL RESTRAINT SYSTEMS**

The front row was equipped with driver and front right passenger lap-and-shoulder safety belts with retractor-mounted pretensioners. The driver's safety belt was equipped with continuous loop belt webbing, a sliding latch plate, an Emergency Locking Retractor (ELR), and an adjustable upper anchor that was in the full-down position. The front right passenger's safety belt was equipped the same as the driver but had a locking latch plate. The adjustable upper anchor was also in the full-down position. There was no evidence that the pretensioners actuated during the crash. The second row was equipped with lap-and shoulder-safety belts for the outboard seating positions and a lap belt for the center position. The outboard safety belts were equipped with continuous loop belt webbing, locking latch plates, ELRs, and non-adjustable upper anchors. The center position had a sewn latch plate and a switchable ELR/Automatic Locking Retractor (ALR).

The inspection of the driver's safety belt assembly revealed no load marks on the belt webbing, latch plate, or D-ring. The lack of loading evidence on the belt coupled with the ejection of the driver from the vehicle indicated she was not restrained at the time of the crash.

The inspection of the second row right safety belt assembly revealed light load marks on the belt webbing made by the shell of the CRS, 46 cm (18.1 in) from the stop button. This evidence indicated that the safety belt was in use with the CRS at the time of the crash.

#### **SUPPLEMENTAL RESTRAINT SYSTEMS**

The Dodge was equipped with redesigned driver and front right passenger frontal air bags. These air bags did not deploy in the crash.

#### **ROLLOVER DISCUSSION**

The NHTSA has given the Dodge a three star rollover rating on a five star scale<sup>1</sup>.

The rollover of the Dodge was initiated when the vehicle rotated counter clockwise and traveled into the shallow ditch in the median of the two roadways. The ground engaged the right side wheels and the vehicle tripped and rolled over, right side leading four quarter turns. Due to heavy traffic volume on the interstate highway, a drive-through scene inspection was conducted. The specific location of the rollover and the distance traveled during the rollover could not be determined.

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<sup>1</sup> [www.safercar.gov](http://www.safercar.gov), 2/28/11

The second row right passenger of the Dodge (2-year-old female) was seated in a Dorel Safety 1<sup>st</sup> All-In-One convertible CRS (**Figure 8**). The CRS was manufactured on April 9, 2009 and the model number was 22177-SNP. It was equipped with a 5-point harness and Lower Anchors and Tethers For Children (LATCH) system. When used in the forward-facing position, the CRS was designed for children who weigh between 10.1 and 22.6 kg (22 and 50 lbs) and were between 85.1-114.3cm (34-45 in) in height.

The CRS was constructed of a one-piece plastic shell that connected to a non-detachable base and was covered with a 1 cm (0.4 in) thick cloth cover. The shell reclined to three different positions and was set to the upright position. The harness straps were height adjustable to five different levels, which could be adjusted on the back of the CRS. The harness straps were set one level above the bottom at the time of SCI inspection. The harness retainer clip was positioned at an unknown level.



**Figure 6:** Dorel Safety 1<sup>st</sup> All-In-One CRS

Visual inspection of the CRS revealed no crash related damage to the plastic shell or base. Very light load abrasions were present on the forward-facing safety belt paths. This evidence suggests that the lap-and-shoulder belt was routed through the forward-facing belt path.

## 2002 DODGE DURANGO SXT OCCUPANTS

### DRIVER DEMOGRAPHICS

Age/Sex:	25 years, female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Bucket seat
Seat Track Position:	Between forward and middle position
Restraint Usage:	None
Usage Source:	Vehicle inspection
Air Bags	Frontal, not deployed
Egress from Vehicle:	Total ejection through disintegrated left front glazing
Transport from Scene:	None
Medical Treatment:	Deceased at crash scene

No injury data was obtained for the driver.

**DRIVER KINEMATICS**

During the rollover, the driver was displaced to the left and ejected through the disintegrated left front glazing. She contacted the top of the door as she was ejected from the vehicle. The driver came to rest on the median shoulder of the southbound lanes. She was struck and run over by a 2002 Toyota Camry when the driver swerved onto the shoulder to avoid a collision with a flatbed truck, whose driver was slowing to render assistance.

**SECOND ROW RIGHT PASSENGER DEMOGRAPHICS**

Age/Sex:	2 years, female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Dorel Safety 1 <sup>st</sup> All-In-One CRS
Seat Track Position:	Not adjustable
Restraint Usage:	CRS
Usage Source:	Vehicle inspection
Air Bags	None
Egress from Vehicle:	Removed from vehicle by EMS
Transport from Scene:	Ground ambulance
Medical Treatment:	Examined in emergency room and released

**SECOND ROW RIGHT PASSENGER INJURIES**

The emergency room records indicated that the passenger did not sustain any injuries.

**SECOND ROW RIGHT PASSENGER KINEMATICS**

The second row right passenger remained restrained in the CRS throughout the crash.

