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**CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION  
SYSTEM CRASH INVESTIGATION  
SCI CASE NO: CA09053**

**VEHICLE 1: 2007 HONDA CIVIC  
LOCATION: NEW YORK  
CRASH DATE: JULY 2009**

Contract No. DTNH22-07-C-00043

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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. <i>Abstract</i> <p>This investigation focused on the side impact inflatable occupant protection system in a 2007 Honda Civic 4-door sedan. The Honda was equipped with side impact inflatable Curtain (IC) air bags, front row seat-mounted side impact air bags, Certified Advanced 208-Compliant (CAC) frontal air bags and front row safety belt pretensioners. The crash occurred when the front plane of the Toyota impacted the left plane of the Honda, as the Honda was in the process of turning left at a 4-leg intersection. The direction of the impact force was in the 11 o'clock sector for the Honda. During the crash sequence the driver's seat-mounted air bag and the left IC air bag deployed in the Honda. This crash took place within the intersection of two undivided multilane roadways, located in a suburban/business environment. The Honda was driven by a 61-year-old restrained male. The driver had police reported possible injuries and was transported to a local hospital by ground ambulance.</p> <p>The direction of the impact force was in the 1 o'clock sector for the Toyota. This vehicle was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags. The driver CAC air bag deployed as a result of impact forces. The Toyota was driven by a 31-year-old restrained female. This vehicle was also occupied by a 5-year-old restrained female located in the second row left seating position and a 3-year-old restrained female located in the second row right seating position. Both passengers were restrained within their respective child safety seats at the time of the crash sequence. All three occupants within the Toyota were police reported as uninjured.</p>			
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SYSTEM CRASH INVESTIGATION**

**SCI CASE NO: CA09053**

**VEHICLE 1: 2007 HONDA CIVIC**

**LOCATION: NEW YORK**

**CRASH DATE: JULY 2009**

***BACKGROUND***

This investigation focused on the side impact inflatable occupant protection system in a 2007 Honda Civic 4-door sedan (**Figure 1**). The Honda was equipped with side impact Inflatable Curtain (IC) air bags, front row seat-mounted side impact air bags, Certified Advanced 208-Compliant (CAC) frontal air bags and front row safety belt pretensioners. The crash occurred when the front plane of the Toyota impacted the left plane of the Honda, as the Honda was in the process of turning left at a 4-leg intersection. The direction of force was in the 11 o'clock sector for the Honda. During the crash sequence the driver's seat-mounted air bag and the left IC air bag deployed in the Honda. This crash took place within the intersection of two undivided multilane roadways, located in a suburban/business environment. The Honda was driven by a 61-year-old restrained male. The driver had police reported possible injuries and was transported to a local hospital by ground ambulance.



**Figure 1: Left side view of the Honda Civic.**

The direction of force was in the 1 o'clock sector for the Toyota. This vehicle was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags. The Toyota's front left CAC air bag deployed as a result of impact forces. The Toyota was driven by a 31-year-old restrained female. This vehicle was also occupied by a 5-year-old restrained female located in the second row left seating position and a 3-year-old restrained female located in the second row right seating position. Both passengers were restrained within their respective Child Restraint Systems (CRS) at the time of the crash. The three occupants within the Toyota were not injured.

Notification of this crash was submitted to the Calspan Special Crash Investigations (SCI) team by the investigating police agency within hours of the event. The crash information was forwarded to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) on the same day. An on-site investigation of the crash was assigned to the Calspan SCI team on July, 30 2009. Calspan SCI initiated a follow-up investigation which consisted of an inspection of the Honda, the Toyota, the crash site and an interview with the

driver of each respective vehicle. The reporting police agency indicated that both vehicles were on police hold and available for SCI inspection at an impound facility. The vehicle inspections and the scene inspection took place on July 31, 2009.

***VEHICLE DATA***

***2007 Honda Civic***

The 2007 Honda Civic 4-door sedan was identified by the Vehicle Identification Number (VIN): 1HGFA16817L (production sequence deleted). The date of manufacturer was May 2007. The odometer reading at the time of the SCI inspection was 63,009 km (39,152 mi). The powertrain consisted of a 1.8-liter, 4-cylinder engine linked to a 5-speed automatic transmission with front wheel drive. The Honda was equipped with a 4-wheel ABS, disc brake system. The manual restraint system consisted of 3-point lap and shoulder safety belts in all five seat positions. The front safety belts were equipped with a retractor and buckle-type pretensioner system. The Honda was equipped with CAC frontal air bags, dual row side impact IC air bags and front row seat-mounted side impact air bags. The vehicle manufacturer has certified that the frontal air bags in the Honda were compliant with the advanced air bag requirements of the Federal Motor Vehicle Safety Standard No. 208. The Honda’s OEM 5-spoke alloy wheels were outfitted with Yokohama Avid V4S, P205/55R16 tires. The vehicle manufacturer recommended front and rear cold tire pressure was 221 kPa (32 PSI). The specific tire data at the time of the SCI inspection was as follows:

<b>Tire</b>	<b>Measured Pressure</b>	<b>Tread Depth</b>	<b>Restricted</b>	<b>Damage</b>
LF	214 kPa (31 PSI)	6 mm (8/32 in)	No	None
LR	228 kPa (33 PSI)	5 mm (6/32 in)	No	None
RF	214 kPa (31 PSI)	7 mm (9/32 in)	No	None
RR	207 kPa (30 PSI)	6 mm (8/32 in)	No	None

***2005 Toyota Sienna***

The 2005 Toyota Sienna, minivan was identified by the Vehicle Identification Number (VIN): 5TDZA23C85S (production sequence deleted). The date of manufacturer was March 2005. The electronic odometer was inoperative due a damaged electrical system at the time of the vehicle inspection; however, the driver/owner of the Toyota estimated that the odometer reading was approximately 69,200 km (43,000 mi) at the time of crash. The powertrain consisted of a 3.3-liter, 6-cylinder engine linked to a 5-speed automatic transmission with front wheel drive. The Toyota was equipped with a 4-wheel ABS, front disc/rear drum brake system type configuration. The manual restraint system consisted of 3-point lap and shoulder safety belts in all seven seat positions. The front safety belts were outfitted with retractor-mounted pretensioners. The Toyota was equipped with a CAC frontal air bag system. The vehicle manufacturer has certified that the frontal air bags in the Toyota were compliant with the advanced air bag requirements of the

Federal Motor Vehicle Safety Standard No. 208. The Toyota's OEM steel wheels were outfitted with Goodyear Assurance, P215/65R16 tires. The vehicle manufacturer recommended front and rear cold tire pressure was 241 kPa (35 PSI). The specific tire data at the time of the SCI inspection was as follows:

<b>Tire</b>	<b>Measured Pressure</b>	<b>Tread Depth</b>	<b>Restricted</b>	<b>Damage</b>
LF	241 kPa (35 PSI)	6 mm (7/32 in)	No	None
LR	255 kPa (37 PSI)	7 mm (9/32 in)	No	None
RF	221 kPa (32PSI)	5 mm (6/32 in)	No	None
RR	248 kPa (36 PSI)	6 mm (8/32 in)	No	None

***CRASH SITE***

The crash occurred during the daytime hours in July of 2009. At the time of the crash, the weather was clear and the bituminous roadways were dry. The crash occurred within a 4-leg intersection of a 5-lane north/south road and a 6-lane east/west road, located in a suburban/business environment. The intersection was controlled by four overhead traffic signals.

The pre-crash roadway environments for both respective vehicles included a dedicated left turn lane but contained no shoulders that were boarded by a raised concrete curb. The posted speed limit was 64 km/h (40 mph) for all roadways. The east edge of the west curb was used as the reference line (RL) and a wooden utility pole, located 8.6 m (28.2 ft) west of the RL was used as the reference point (RP) during the SCI inspection. **Figure 2** is a northbound view of the intersection which depicts the pre-crash trajectory of the Honda. A schematic of the crash is included at the end of this report as **Figure 11**.



**Figure 2: Pre-crash northbound trajectory of Honda.**

***CRASH SEQUENCE***

***Pre-Crash***

The Honda was northbound approaching the intersection within the dedicated left turn lane driven by a 61-year-old restrained male. The Toyota was on the eastbound approach to the intersection in the second travel lane from the south curb-line and was driven by a 31-year-old restrained female. As the Honda entered the intersection it began a left turn maneuver while the Toyota continued straight through the intersection. There was no pre-crash evidence indicative of evasive actions at the time of the SCI scene inspection.

### ***Crash***

The crash occurred when the front plane of the Toyota contacted the forward aspect of the Honda's left plane (Event 1). The direction of force was in the 1 o'clock sector for the Toyota and in the 11 o'clock sector for the Honda. This primary impact resulted in the actuation of the Honda's driver safety belt pretensioners and the deployment of the driver's seat-mounted air bag and left IC air bag. The Toyota's driver air bag deployed and corresponding pretensioner actuated during this same event.

The Damage Algorithm of the WinSMASH program was used to calculate delta-V. The total delta-V of the Honda was 36 km/h (22.4 mph). The longitudinal and lateral delta-V components were -28 km/h (-17.4 mph) and 23 km/h (14.3 mph), respectively. The Toyota's total delta-V was 24 km/h (14.9 mph) with longitudinal and lateral components of -21 km/h (-13 mph) and -12 km/h (-7.5 mph), respectively.

The force and direction of this impact, forward of the Honda's center of gravity, caused the vehicle to rotate clockwise (CW) approximately 55 degrees. The Toyota rotated approximately 25 degrees counterclockwise (CCW). The left quarter panel and left rear door of the Honda contacted the right side of the Toyota, rearward of the front corner apex, in a secondary side-swipe type impact (Event 2). The vehicles then separated and traveled forward to their respective final rest locations facing northeast while remaining within the intersection.

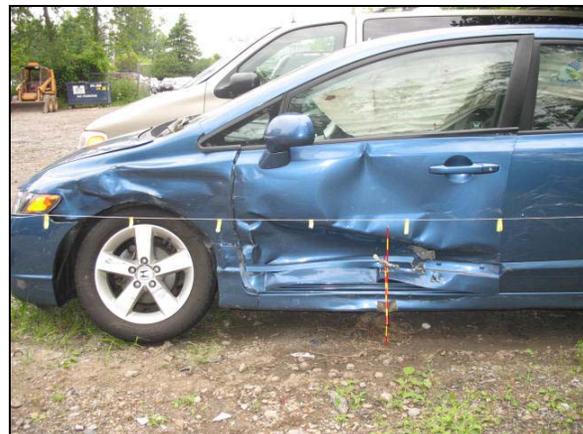
### ***Post-crash***

Police and ambulance personnel responded to the crash. The driver of the Honda exited his vehicle unassisted with moderate injuries and was transported by ground ambulance to a local hospital for evaluation and medical treatment. All occupants of the Toyota exited their vehicle unassisted and uninjured. The Honda and Toyota sustained disabling damage and were towed from the crash site.

## **2007 HONDA CIVIC**

### ***Exterior Damage***

The exterior of the Honda sustained two separate areas of direct contact damage during the vehicle-to-vehicle crash sequence. **Figure 3** is a view of the damage to the forward aspect of the left plane (Event 1) of the Honda. The direct contact damage began 106 cm (41.7 in) forward of the left rear axle and extended 190 cm (74.8 in) forward. The impact resulted in a mostly lateral deformation to the left side front fender, door panel and sill areas. The Honda's left wheelbase was reduced by 5 cm (2.0 in) when



**Figure 3: Close-up view of the Honda's impact damage.**

compared to exemplar measurements. The crush profile was measured along the mid-door level with the following results: C1 = 0 cm (0 in), C2 = 8 cm (3.1 in), C3 = 10 cm (3.9 in), C4 = 6 cm (2.4 in), C5 = 12 cm (4.7 in), C6 = 2 cm (0.8 in). The maximum crush was located at C5. At the time of the SCI inspection, all four doors were latched closed and operational. The post crash condition of the Honda's window glazing were found to be in place and undamaged from impact forces. The Collision Deformation Classification (CDC) for this direct damage pattern was 11LYEW2.

The Honda rotated CW as a result of the initial impact (event 1). The left side of the Honda then contacted the right side of the Toyota in a secondary side-swipe type impact (Event 2). The direct contact damage began 75 cm (38.2 in) aft of the left rear axle and extended 176 cm (50 in) forward. Direct contact damage (**Figure 4**) consisting of longitudinal surface scratches without sheet metal deformation was noted to the left rear door, adjacent fender and quarter panel areas. The residual crush profile yielded 0 cm for lateral deformation at all six "C" measurement locations. The CDC for this damage pattern was 12LZES1.

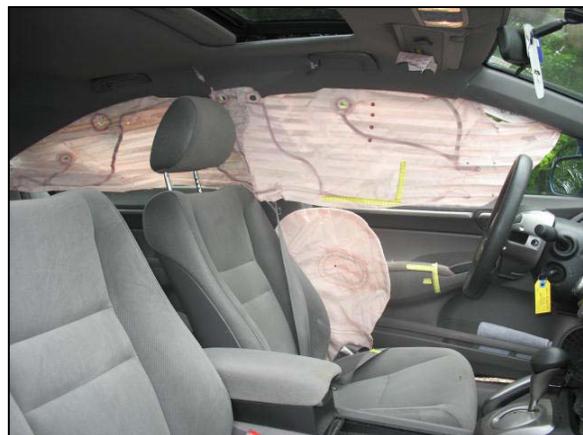


**Figure 4: Depicts the side-swipe type damage from event 2**

### ***Interior Damage***

The interior damage to the Honda consisted of the deployment of the vehicle's air bag systems, actuation of the pretensioners, occupant contact points and a greenhouse intrusion. The forward lower quadrant of the driver door sustained a 4 cm (1.6 in) lateral intrusion.

Interior component damage was identified in three separate areas in the driver seat position (**Figure 5**). Each damaged area exhibited characteristics of occupant contact. The first area of damage was located on the interior driver door panel. Multiple scuff marks were identified on the driver door armrest which were attributed to contact with the driver's left flank. The second damaged component was identified as the driver knee bolster. The right side of the knee bolster was displaced from its originally mounted position and contained a scuff mark located in the right lower corner. Further examination of this component revealed damage to the inside



**Figure 5: Lateral view of the Honda's left side interior.**

mounting brackets which held the rigid plastic bolster in place. The damage to the knee bolster was attributed to contact with the driver's right knee. The third area of damage was observed on the left IC air bag. This evidence consisted of frictional abrasions to the inboard surface of the air bag which measured 31 cm x 9 cm (12.2 in x 3.5 in), width x height. The abrasion was located 37 cm (14.6 in) aft of the leading edge and 3 cm (1.2 in) above the bottom edge of the deployed air bag. This damage pattern was attributed to contact with the driver's left shoulder.

The driver seat was located in the full-rear track position with a measured seat-back recline angle of 25 degrees aft of vertical. The longitudinal distance from the seat back to the driver air bag module measured 68 cm (26.8 in). The 2-spoke adjustable steering wheel was located in the first tilt position below full-up. There was no deformation of the steering wheel rim and no displacement of the shear capsules.

#### ***Manual Restraint System***

The driver's safety belt system consisted of continuous loop webbing, a sliding latch plate, a flexible-stalk buckle, an adjustable D-ring, a dual pretensioner system and an Emergency Locking Retractor (ELR). The dual pretensioner components were integrated in the webbing's retractor which was mounted to the B-pillar and incorporated into the flexible-stalk of the buckle. The D-ring was located in the full-down position. The safety belt webbing was found in an extended position, measuring 159 cm (63 in) in length and locked in place by the actuated retractor-mounted pretensioner. Further inspection of the latch plate revealed frictional abrasions to the full width of the threaded plastic surface as a result of the webbing being loaded by its occupant during this crash. Corresponding frictional abrasions to the webbing were located 40 cm (15.7 in) from the lower anchor and measured 17 cm (6.7) in length. Based upon the post-crash condition of this safety belt system, the driver was restrained at the time of the crash.

#### ***Frontal Air Bag System***

The Honda was equipped with a CAC frontal air bag system that was comprised of two separate air bags. The driver's CAC air bag was located in the center hub of the steering wheel rim. The front/right seating position contained a CAC air bag mounted within the front aspect of the right instrument panel. During the SCI inspection the CAC air bag system was found in an un-deployed condition.

#### ***Inflatable Curtain Air Bags***

The Honda was equipped with side impact IC air bags mounted on both roof side rails. The IC air bag system provided coverage for the outer seating positions of both rows. The left side IC curtain deployed as a result of impact forces. The deployed IC air bag measured 186 cm x 44 cm (61.0 in x 18.9 in) length x height in overall dimensions and provided coverage from the upper aspect of the A- to C-pillar area. A 33 cm (10.2 in) long, triangular shaped, sail-panel tether extended from the A-pillar and was sewn to the forward aspect of the bag. The vertical coverage of this curtain extended 8 cm (1.6 in) below the beltline for both seating rows.

### ***Seat-Mounted Side Impact Air Bags***

The Honda was also equipped with side impact air bags mounted in the outboard aspect of each front row seatback. The left seat-mounted air bag deployed as a result of impact forces. This air bag measured 54 cm x 36 cm (21.3 in x 14.2 in) height x width. The airbag deployed from a plastic tear seam opening which measured 38 cm (15.0 in) in height. The bag contained a 5 cm (2.0 in) vent port located on the outboard leading edge and a double stitched, oval shaped tether located 4 cm (1.6 in) above of the bottom edge. The tether measured 26 cm (10.2 in) in length. No discernable occupant contact evidence was identified on this air bag.

### ***2005 TOYOTA SIENNA***

#### ***Exterior Damage***

The Toyota sustained front and right plane damage as a result of the crash sequence. The first event produced distributed frontal damage (**Figure 6**) which consisted of deformation to the front bumper fascia, bumper reinforcement beam, both frame-rails and hood components. The direct contact damage included the entire front end-plane and measured 170 cm (66.9 in) in width. The crush profile, measured along the bumper reinforcement beam, was as follows: C1 = 28 cm (11.0 in), C2 = 25 cm (9.8 in), C3 = 25 cm (9.8 in), C4 = 20 cm (7.9 in), C5 = 13 cm (5.1 in), C6 = 2 cm (0.8 in). The maximum crush was located at C1. The CDC for this damage pattern was 01FDEW2.

As the Toyota rotated CCW its right plane sustained direct contact damage (**Figure 7**) that started 47 cm (18.5 in) aft of the right front bumper corner and extended forward 19 cm (7.5 in) as a result of the secondary side-swipe type impact (Event 2). This damaged region consisted of linear abrasions to the right side of the plastic bumper fascia. Due to the overlapping induced damage, possible deformation from this event could not be identified. The CDC for this damage pattern was 05RFES1.



**Figure 6: Front view of the Toyota damage.**



**Figure 7: Right oblique view depicting the side-swipe damage from Event 2.**

### ***Interior Damage***

The interior damage to the Toyota consisted of the deployment of the driver CAC air bag system and actuation of the driver pretensioner. No occupant contact points or intrusion were identified during the SCI inspection of this vehicle.

The driver seat was located 2 cm (.75 in) rear of the forward most track position with a measured seat-back recline angle of 25 degrees aft of vertical. The longitudinal distance from the seat back to the driver air bag module measured 48 cm (19 in). The 4-spoke adjustable steering wheel was located in the full-up tilt position. There was no deformation of the steering wheel rim and no displacement of the shear capsules.

The second row left seat was located 5 cm (2 in) forward of the full-rear track position with a measured seatback recline angle of 10 degrees aft of vertical. The longitudinal distance from this position's seatback to the back of the driver seatback measured 91 cm (36 in). Further examination of the seat components revealed longitudinal abrasions to the seat cushion and vertical abrasions to the front of the seatback. These markings were consistent with evidence related to historical child safety seat use.

The second row right seat was located in the full-rear track position with a measured seat-back recline angle of 25 degrees aft of vertical. The longitudinal distance from this position's seatback to the back of the right/front seatback measured 79 cm (31 in).

### ***Manual Restraint System***

The driver's safety belt system consisted of continuous loop webbing, a sliding latch plate, a rigid stalk buckle, an adjustable D-ring, a retractor-mounted pretensioner system and an Emergency Locking Retractor (ELR). The D-ring was located in the full-down position. The safety belt webbing was found in an extended position, measuring 168 cm (66 in) in length and locked in place by the actuated retractor-mounted pretensioner. Further inspection of the latch plate revealed frictional abrasions to the full width of the threaded plastic surface as a result of the webbing being loaded by its occupant. Corresponding frictional abrasions to the webbing were located 61 cm (24 in) from the lower anchor and measured 58 cm (23) in length. Based upon the post-crash condition of this safety belt system, the driver was considered restrained at the time of the crash.

The second row left safety belt system consisted of continuous loop webbing, a sliding latch plate, a flexible buckle, an adjustable D-ring, two child safety seat lower anchors, one rear-mounted tether anchor and a dual purpose Emergency Locking Retractor/Automatic Locking Retractor (ELR/ALR). At initial inspection, the D-ring was adjusted in the full-down position with the safety belt webbing fully retracted. Further inspection revealed that the safety belt retractor was in ELR mode as the belt webbing freely spooled from the retractor. No discernable loading evidence was identified on the latch plate, belt webbing or the D-ring, however; the

seat's child safety seat lower anchor points contained damage associated with historical usage. Refer to the CRS section below for further information regarding the use of safety belt in this seat position.

The second row right safety belt system consisted of continuous loop webbing, a sliding latch plate, a flexible stalk buckle, a seat-integrated D-ring, two child safety seat lower anchors, one rear-mounted tether anchor and a dual purpose Emergency Locking Retractor/Automatic Locking Retractor (ELR/ALR). At initial inspection, the integrated D-ring was located in the right aspect of the top of the seatback with the safety belt webbing fully retracted. Further inspection revealed that the safety belt retractor was in ELR mode as the belt webbing freely spooled from the retractor. No discernable loading evidence was identified on the latch plate, belt webbing or the upper anchorage D-ring, however; the seat's integrated child safety seat anchor points contained damage associated with historical usage. Refer to the CRS section below for further information regarding the use of safety belt and method of securing CRS in this seat position.

### ***Child Restraint Systems***

A backless booster CRS and a convertible CRS were installed in the Toyota at the time of the crash and were inspected at the Toyota driver's residence. The backless booster CRS (**Figure 8**) was a Graco TurboBooster model number 8E17MQE. The date of manufacture was September 27, 2008. In the backless mode, the CRS was designed for use by a child with a 101 to 145 cm (40 to 57 in) height and an 18 to 45 kg (40 to 100 lb) weight. The manufacturer's label indicated that its use was for children approximately 4 to 10 years of age. The CRS was purchased new by the driver approximately 6 months prior to the crash.



**Figure 8: Front view of the Graco TurboBooster.**

This type of CRS elevated the child in order to provide a better fit of the vehicle's 3-point safety belt system that was used to secure the occupant within the booster seat. An inspection of this CRS revealed indications of historical use. There was no loading evidence or stress marks identified on the seat.

At the time of the crash, the CRS was used by the 5-year-old female in the second row left position and she was restrained by the vehicle's 3-point lap and shoulder belt system. The driver could not recall if she had secured the child into the CRS or if the child had secured herself on the day of the crash. Typically, the driver checked to be sure the slack was pulled through the

lap belt and that the belt was “snug” on the child. The use of the booster CRS was an appropriate selection considering the child’s age, height, and weight.

The 3-year old female was restrained by the 5-point harness of a forward-facing convertible CRS in the second row right position. This CRS was an Evenflo Triumph model number 3591288P1 (**Figure 9**). The date of manufacture was October 22, 2003. In the forward-facing mode, the CRS was designed for use by a child with a 9 to 18 kg (20 to 40 lb) weight. This type of CRS required the use of the vehicle’s 3-point safety belt system or the use of the vehicle’s LATCH (Lower Anchors and Tethers for Children) system (when vehicle equipped) to secure the CRS within a vehicle’s designated seat position.



**Figure 9: Front view of the Evenflo Triumph.**

This CRS was designed with an internal 5-point harness system. There were three harness slots in the back of the shell. The harness was found to be routed through the top positioning slots. The lower base was designed with a 5-position tilt adjustment mechanism. Tilt position one was reserved for a rear-facing only installation. Tilt positions two through five were reserved for a forward-facing installation with position two being used for the most reclined forward facing position and position five being the most upright. The lower base adjustment was in tilt position four which produced an 18 degree recline angle at the time of this SCI inspection.

Further inspection of this CSS revealed indications of historical use on the LATCH system components; however, no discernable crash-related evidence was identified. The LATCH belt was creased and conformed to the shape of the forward-facing belt path from use. The driver reported that CRS was purchased new 3 year prior to the crash. Further, she indicated that she was familiar with CRS safety checkpoints and had visited one to learn about CRS installation. At the time of the crash, the CRS had been installed by LATCH for approximately 3 months without adjustments. The 5-point harness was adjusted to a “snug - one finger tightness” on the child with the chest retainer clip at the armpit level. The top tether measured 84 cm (33 in) in length and was found adjusted to its fully extended position. Based upon the age and weight of the 3-year-old female the CRS was an appropriate selection for use.

### ***Frontal Air Bag System***

The Toyota was equipped with a CAC frontal air bag system that was comprised of two separate air bags. The driver’s CAC air bag was located in the center hub of the steering wheel rim. The front/right seating position contained a CAC air bag mounted within the top aspect of the right instrument panel. Only the driver’s CAC air bag deployed as a result of impact forces.

The driver's CAC air bag deployed from an H-configuration cover flap configuration consisting of two individual flaps. Each cover flap measured 13 cm x 8 cm (5.25 in x 3.25 in) width x height. The deployed driver air bag measured 58 cm (23 in) in its deflated state. The interior of the bag contained two tether straps located in the 3/9 o'clock sectors. The rear of this bag revealed two vent ports located in the 11/1 o'clock sectors. The vent ports were constructed in a vertical slit design and measured 3.8 cm, (1.5 in) in height. The air bag's excursion from the module measured 38 cm (15 in). There was no noted contact evidence to either the cover flaps or the deployed air bag.

**2007 HONDA CIVIC**

***Driver Demographics***

Age/Sex: 61-year-old/male  
 Height: 178 cm (70 in)  
 Weight: 82 kg (180 lbs)  
 Seat Track Position: Full rear  
 Safety Belt Usage: 3-point lap & shoulder  
 Usage Source: SCI vehicle inspection  
 Egress from Vehicle: Exited vehicle unassisted  
 Type of Medical Treatment: Transported to a local hospital (treated and released)

***Driver Injuries***

<b><i>Injury</i></b>	<b><i>Injury Severity (AIS 90/Update 98)</i></b>	<b><i>Injury Source</i></b>
Left 8 <sup>th</sup> and 9 <sup>th</sup> rib fractures (2-3 ribs without hemo/pneumothorax). (1)	Moderate (450220.2,2)	Driver door armrest in rear upper quadrant
10 cm (4 in) diameter contusion; epidermis covering his left scapula. (2)	Minor (690402.1,2)	Seatback
3 cm (1 in) diameter contusion; top of head, left aspect. (2)	Minor (190402.1,2)	Roof side rail

*Source: 1 Emergency room records. 2 Interview Statements*

***Driver Kinematics***

The 61-year-old male driver of the Honda was seated in the full-rear track position and was restrained by the available 3-point safety belt system. At impact, the ELR safety belt retractor locked and the pretensioner actuated. The actuated pretensioner removed slack from the belt system and tightened the webbing around the driver. The driver seat-mounted air bag and the left IC air bag deployed. The driver responded to the 11 o'clock direction of force by initiating a forward and left collinear trajectory as he loaded the belt restraint system with his left shoulder, chest and pelvis. This was evidenced by latch plate friction marks and corresponding abrasions to the underside of the webbing. The driver rode down the force of the crash and contacted the

deployed IC curtain with his left shoulder as evidenced by the documented scuff marks to the air bag. The driver’s head contacted the roof side rail resulting in a contusion.

During maximum engagement, the left side of the driver’s torso contacted the left/front door panel armrest (**Figure 10**) which resulted in a fracture of the eighth and ninth rib bones located on the left side of the thoracic cage. Corresponding scuff marks were identified on the driver door armrest. The driver’s right knee contacted the knee bolster, which bent and displaced this vehicle component without producing injury to the driver. After maximum engagement the driver rebounded into his seatback where he received a 10 cm (4 in) diameter contusion to the dermis covering his left scapula. No discernable contact points were identified to the front aspect of the driver seatback as a result of this driver reported injury. The driver came to final rest within his original seating position.



**Figure 10: Right interior view of the contact evidence to Honda’s armrest.**

**2005 TOYOTA SIENNA**

***Driver Demographics***

Age/Sex: 31-year-old/Female  
 Height: 157 cm (62 in)  
 Weight: 52 kg (115 lbs)  
 Seat Track Position: 2 cm (.75 in) rear of full forward  
 Safety Belt Usage: 3-point lap & shoulder  
 Usage Source: SCI vehicle inspection  
 Egress from Vehicle: Exited vehicle unassisted  
 Type of Medical Treatment: No treatment

***Driver Injuries***

<b><i>Injury</i></b>	<b><i>Injury Severity (AIS 90/Update 98)</i></b>	<b><i>Injury Source</i></b>
9 cm (3.5 in) diagonal abrasion; Starts 5 cm (2 in) below left clavicle.	Minor (490202.1,4)	Safety belt system webbing

*Source: Interview Statements*

***Driver Kinematics***

The 31-year-old female driver of the Toyota was seated in a forward track position and was restrained with the available 3-point safety belt system. At impact, the ELR safety belt retractor locked and the pretensioner actuated. The driver CAC air bag deployed as the actuated pretensioner removed slack from the belt system and tightened the webbing around the driver. The driver responded to the 1 o'clock direction of force by initiating a forward and right collinear trajectory as she loaded the safety belt system with her left shoulder, chest and pelvis. This loading produced a 9 cm (3.5 in) long diagonal abrasion to the driver's chest, which originated 5 cm (2 in) below her left clavicle. The loading of the safety belt webbing was evidenced by latch plate friction marks and corresponding abrasions to the underside of the webbing. The driver rode down the force of the crash and contacted the deployed CAC air bag with her chest and head without sustaining injury. After maximum engagement the driver rebounded into her seat where she came to final rest. No discernable contact evidence was identified on any of the Toyota's exposed interior components as a result of the driver's kinematics.

***Second Row Left Passenger Demographics***

Age/Sex: 5-year-old/Female  
Height: 119 cm (47 in)  
Weight: 20 kg (44 lbs)  
Seat Track Position: 5 cm (2 in) forward of full rear  
Safety Belt Usage: Booster CRS with 3-point lap & shoulder belt  
Usage Source: SCI vehicle inspection/SCI child safety seat inspection  
Egress from Vehicle: Exited vehicle unassisted  
Type of Medical Treatment: No treatment

***Second Row Left Passenger Injury***

<b><i>Injury</i></b>	<b><i>Injury Severity (AIS 90/Update 98)</i></b>	<b><i>Injury Source</i></b>
Not Injured	N/A	N/A

*Source: Interview Statements*

***Second Row Left Passenger Kinematics***

The 5-year-old female second row left was seated in a booster CRS restrained with the Toyota's available safety belt system. At impact, the ELR safety belt retractor locked. This occupant responded to the 1 o'clock direction of force by initiating a forward and right collinear trajectory as she loaded the restraint system with her left shoulder, chest and pelvis. The second row left passenger rode down the force of the crash without injury. After maximum engagement this occupant rebounded into the CRS where she came to final rest. Neither the CRS nor the Toyota's interior components exhibited discernable contact evidence as a result of this occupant's kinematics.

***Second Row Right Passenger Demographics***

Age/Sex: 3-year-old/Female  
Height: 89 cm (35 in)  
Weight: 14 kg (31 lbs)  
Seat Track Position: Full rear  
Safety Belt Usage: Convertible CRS with LATCH system  
Usage Source: SCI vehicle inspection/SCI child safety seat inspection  
Egress from Vehicle: Exited vehicle unassisted  
Type of Medical Treatment: No treatment

***Second Row Right Passenger Injury***

<b><i>Injury</i></b>	<b><i>Injury Severity (AIS 90/Update 98)</i></b>	<b><i>Injury Source</i></b>
Not Injured	N/A	N/A

*Source: Interview Statements*

***Second Row Right Passenger Kinematics***

The 3-year-old female second row right passenger was seated in a forward facing convertible CRS restrained by the safety seat’s internal 5-point harness system. At impact, the occupant responded to the 1 o’clock direction of force by initiating a forward and right collinear trajectory as she loaded the safety harness with her shoulders, chest and groin. As this occupant rode down the force of the crash against the internal harness system, the CRS loaded the LATCH system which prevented the CSS from sliding longitudinally forward or pitching about its lateral axis. After maximum engagement, this occupant rebounded into the CRS where she came to final rest without injury. Neither the CRS nor the Toyota’s interior components exhibited discernable contact evidence as a result of this occupant’s kinematics.

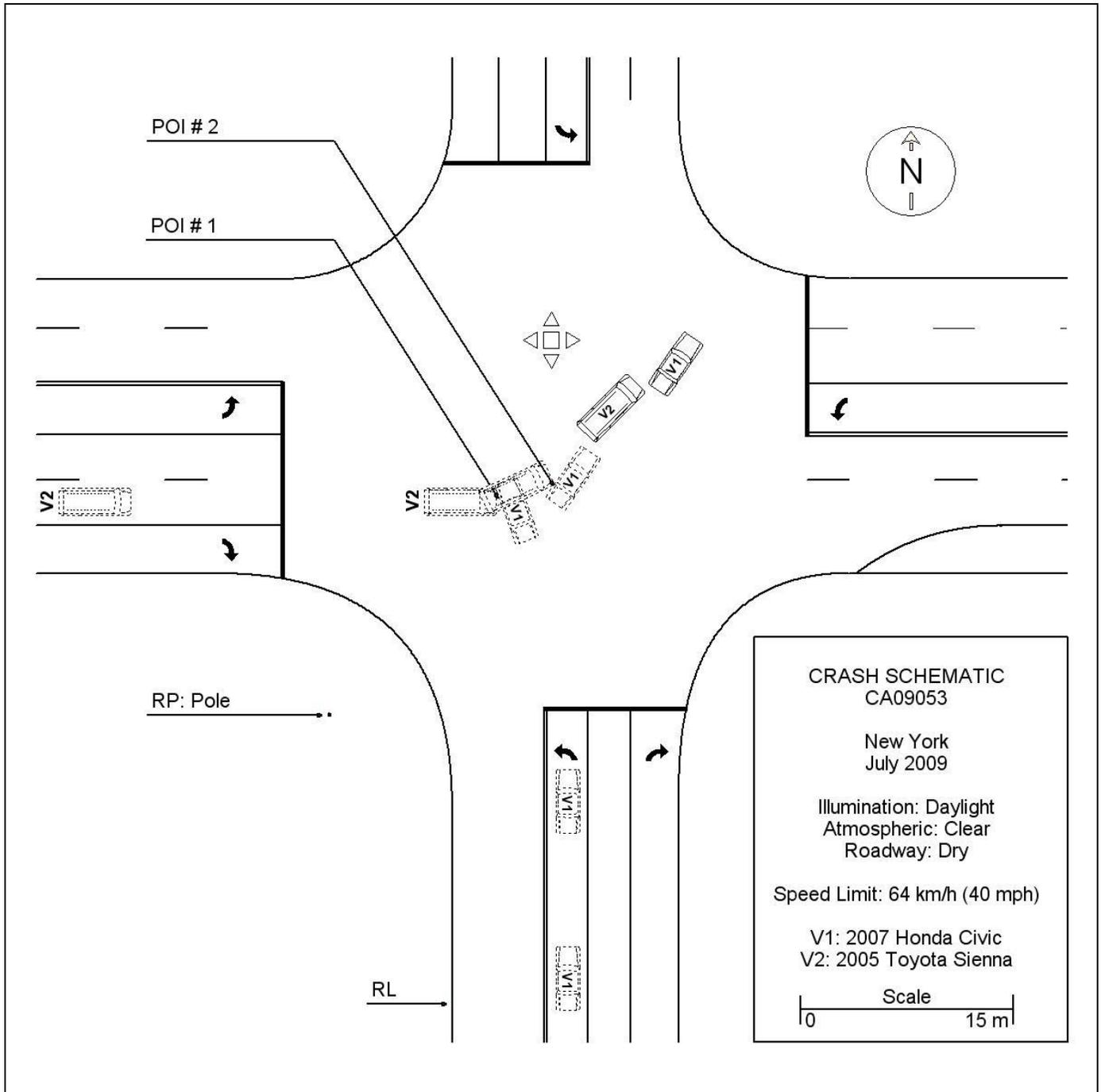


Figure 11: Crash Schematic.