CRASH DATA RESEARCH CENTER

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OFFICE OF DEFECTS INVESTIGATION

CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION

SCI CASE NO.: CA10002

VEHICLE: 2008 HONDA CIVIC LX

LOCATION: NEW YORK

CRASH DATE: DECEMBER 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 system.

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16. Abstract This on-site investigation focused on the deployment of the front right passenger air bag and the injury sustained by the 20-year-old female passenger of a 2008 Honda Civic. The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the driver and front right passenger positions. The manufacturer of the Honda certified that the vehicle was compliant to the advanced air bag requirements of Federal Motor Vehicle Safety Standard No. 208. The Honda was driven by a 21-year-old female. She was traveling through a commercial parking lot and struck the left side of a 1995 Ford commercial-duty cargo van. The crash resulted in moderate-severity frontal damage to the Honda and the deployment of the CAC frontal air bag system. The unrestrained front right passenger sustained a vertically oriented laceration of the forehead. She was transported from the scene of the crash to a local hospital where she was treated in the emergency room and released. The driver of the Honda complained of lower extremity pain and refused medical attention. The driver of the Ford was not injured.			
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BACKGROUND

This on-site investigation focused on the deployment of the front right passenger air bag and the injury sustained by the 20-year-old female passenger of a 2008 Honda Civic. The Honda was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the driver and front right passenger positions. The manufacturer of the Honda certified that the vehicle was compliant to the advanced air bag requirements of Federal Motor Vehicle Safety Standard No. 208. The Honda was driven by a 21-year-old female. She was traveling through a commercial parking lot and struck the left side of a 1995 Ford commercial-duty cargo van. The crash resulted in moderate-severity frontal damage to the Honda **(Figure 1)** and the deployment of the CAC frontal air bag system. The unrestrained front right passenger sustained a vertically oriented laceration of the forehead. She was transported from the scene of the crash to a local hospital where she was treated in the emergency room and released. The driver of the Honda complained of lower extremity pain and refused medical attention. The driver of the Ford was not injured.

Figure 1: On-scene image of the 2008 Honda Civic. Image supplied by the complainant.

The father of the front right passenger of the Honda submitted an on-line Vehicle Owner's Questionnaire (VOQ) to the Department of Transportation's Auto Safety Hotline on January 2, 2010. He stated that a component from the front right passenger air bag system separated during the deployment event and struck the passenger in the face causing the laceration. The VOQ was forwarded to the Calspan Special Crash Investigations (SCI) team on January 5, 2010 for follow-up. The Police Crash Report (PAR) was obtained and the SCI team contacted the complainant by telephone. A partial interview was obtained, as well as, on-scene images of the frontal damage to the Honda and the deployed frontal air bags, and an image of the sutured laceration. The complainant did not respond to multiple follow-up interview attempts by telephone and electronic mail or to a request to interview the front right passenger of the Honda. These details were forwarded to the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) on January 7, 2010. Following a review of the available data, the case was assigned for on-site follow-up. The Honda was towed from

the scene and transferred to a regional vehicle salvage facility where it was inspected for this investigation. The driver of the Ford declined an interview and an inspection of his vehicle.

SUMMARY

Crash Site

This two-vehicle crash occurred during nighttime hours in December, 2009. The crash occurred in a commercial parking lot that was delineated with parking spaces perpendicular to the driving aisle **(Figure 2)**. Each driving aisle was configured for two-way traffic and was oriented in an east/west direction. The aisles measured 5.6 m (18.4 ft.) in width and were separated by a double row of parking spaces. The delineated parking spaces measured 2.8 m (9.2 ft.) in width. The weather conditions were overcast with no precipitation. The parking lot was surfaced with asphalt and was dry with isolated areas of icy patches. The commercial area was illuminated by overhead lights, spaced 50 m (164 ft.) apart. There was no posted speed limit in the parking lot. The crash schematic is attached to the end of this report as **Figure 13.**

Figure 2: Overall view of the crash site looking east.

Vehicle Data

2008 Honda Civic LX

The 2008 Honda Civic LX, 4-door sedan was manufactured in March 2008 and was identified by the Vehicle Identification Number (VIN): 2HGFA16598H (production sequence deleted). The digital odometer reading at the time of the SCI inspection was 74,384 km, (46,220 mi). The front-wheel drive Honda was powered by a 1.8-liter, transverse-mounted 4-cylinder gasoline engine linked to a five-speed automatic transmission. The braking system consisted of a power-assisted front disc/rear drum system with four-wheel ABS brakes and electronic brake force distribution. The Honda was also equipped with a direct Tire Pressure Monitoring System (TPMS). The manufacturer's recommended tire size was P205/55R16 with a cold tire pressure of 221 kPa (32 PSI) for all four tires. This vehicle was equipped with Firestone FR 710, P205/55R16 tires, mounted on OEM steel wheels. The specific tire data at the time of the SCI inspection was as follows:

Position	Pressure	Tread Depth	Restriction	Damage
Left Front	207 kPa (30 PSI)	9 mm (11/32 in)	No	None
Left Rear	221 kPa (32 PSI)	9 mm (11/32 in)	No	None
Right Front	228 kPa (33 PSI)	9 mm (11/32 in)	No	None
Right Rear	228 kPa (33 PSI)	9 mm (11/32 in)	No	None

The interior of the Civic was configured with cloth-surfaced, five-passenger seating. The front row seating positions consisted of manually adjustable bucket seats, separated by a center console that contained the emergency brake and transmission selector levers. **Figure 3** is a right interior view of the Honda. The front row seat backs had adjustable head restraints equipped with a whiplash protection system. The driver's head restraint was adjusted 3 cm (1 in) above the seat back while the front right was 4 cm (1.5 in) above its respective seat back. The rear seat was a three-passenger bench seat with a split, forward folding seatback and adjustable head restraints at each position.

Figure 3: Right interior view of the 2008 Honda Civic.

The safety systems consisted of 3-point continuous loop lap and shoulder belt systems for the five seating positions. The front row seats were equipped with buckle and retractor pretensioners. The air bag systems included the frontal CAC air bags, front seat-mounted side impact air bags and roof side rail-mounted Inflatable Curtain (IC) air bags. The driver's buckle and retractor pretensioners actuated and the CAC air bag system deployed. The side impact systems did not deploy. The front right pretensioners did not actuate as the passenger was unrestrained. The pretensioners were designed to actuate in a crash only when the safety belt was buckled; i.e. when the safety belt buckle switch sensor considered the occupant was restrained.

1995 Ford E-Series Cargo Van

1995 Ford was an E-series cargo van. The VIN was not provided on the PAR; therefore the specific vehicle data is unknown. The owner/driver of the Ford van was contacted by the SCI team for the purposes of conducting an interview and obtaining a vehicle inspection. He refused the interview and the vehicle inspection. No other vehicle specific information was obtained to further describe the Ford van.

Crash Sequence

Pre-Crash

The 2008 Honda Civic was occupied by the 21-year-old female driver and the 20-year-old front right passenger. The driver was traveling in a westerly direction on the driving aisle within the parking lot toward a row of storefronts. The 46-year-old male driver of the 1995 Ford was traveling in a southerly direction, across the empty delineated parking spaces on an intersecting path to the Honda. There was no physical evidence at the scene to support pre-crash avoidance actions by the drivers.

Crash

The full-frontal area of the Honda Civic impacted the left side of the Ford van. The damage to the Ford began on the left door and extended rearward. The damage to the Honda contained a lateral component as the bumper fascia, hood and the left front fender were displaced to the left. The resultant directions of force were within the 1 o'clock sector for Honda and 10 o'clock for the Ford. The Missing Vehicle Algorithm of the WinSMASH program was used to compute the severity of the crash (delta V). The total delta-V of the Honda was 20 km/h (12.4 mph). The longitudinal and lateral delta-V components were -17 km/h (-10.5 mph) and -10 km/h (-6.2 mph). The total delta-V of the Ford was 11 km/h. The force of the impact deployed the Honda's CAC frontal air bag system and actuated the driver's pretensioners.

The vehicle momentum and impact configuration caused a counterclockwise rotation of the vehicles during separation. The impact and final rest locations were not documented by the police investigation. Based on the complainant-supplied on-scene image, the vehicles came to final rest in close proximity to each other in the empty parking stalls **(Figure 4).**

Figure 4: On-scene image of the involved vehicles looking east. (Image supplied by the complainant.)

Post-Crash

Local police and medical emergency personnel were notified of the crash and responded to the site. The driver of the Honda complained of lower extremity pain, but refused medical attention. The front right passenger was treated at the scene and transported by ambulance to a local hospital where she was treated for her laceration and released. The Honda was towed from the scene while the Ford remained operational and was driven from to its destination.

2008 Honda Civic LX

Exterior Damage

Figure 5: View of the Honda's frontal impact damage.

The Honda sustained moderate-severity frontal damage **(Figure 5)** from the impact event with the Ford. The direct contact damage began 55 cm (21.6 in) left of center and extended 135 cm (53.0 in) to the front right bumper corner. The damage involved the bumper fascia, grille, hood face, right front fender and right headlamp assembly. The contact damage consisted of laterally oriented abrasions to the painted surfaces and crush. The impact crushed the bumper beam to a residual depth of 8 cm (3.1 in) located at the right corner. The combined induced and direct contact damage extended the full 154 cm (47.0 in) end-width of the vehicle. The crush profile at bumper level was as follows: C1 = 3 cm (1.1 in), C2 = 3 cm (1.1 in), C3 = 4 cm (1.6 in), C4 = 5 cm (2.0 in), C5 = 5 cm (2.0 in), C6 = 8 cm (3.1 in). The Collision Deformation Classification (CDC) was 01FDEW1.

Post-crash, the responding fire department cut the outer panel of the hood to release the hood latch in order to disconnect the vehicle's battery that was located in the left front corner of the engine compartment. The four doors remained closed during the crash and were operation post-crash. The windshield glazing was fractured over the front right air bag location with a star-like fracture site and diagonally oriented cracks located above. The side and backlight glazing remained intact. There was no wheelbase reduction.

Interior Damage

The interior of the Honda sustained minimal damage that was associated with air bag deployment and occupant contact/loading of the safety systems. The interior was not reduced in size by intrusion. The CAC air bag system deployed from the respective modules and the driver's retractor and buckle pretensioners actuated. The driver loaded the safety belt system evidenced by frictional abrasions at the latch plate and the D-ring. There was no displacement of the steering wheel rim or compression of the steering column. A probable (unknown) liquid drink or food item spilled and dried to a stain on the steering wheel rim and the top of the transmission shifter **(Figure 6)**. The stain was located at the 2-3 o'clock position on the steering wheel rim.

The unrestrained front right passenger loaded the deployed air bag and compressed the air bag against the windshield glazing. As a result, the exterior surface of the glazing fractured in a star-like pattern with diagonally oriented fractures located above **(Figure 7)**. The interior surface of the windshield laminate was not fractured. This observation was consistent with the loading force that caused the fracture emanated from the occupant compartment and was directed forward. There was no evidence of air bag fabric transfers on the inside surface of the glazing or direct occupant contact to the windshield.

Figure 6: Stains to the steering wheel rim and shifter.

Figure 7: Fracture/cracks of the right aspect of the windshield.

Safety Belt Systems

The Honda was equipped with 3-point lap and shoulder belt systems for the five designated seating positions. All of the belt systems utilized continuous loop webbing and sliding latch plates. The driver's safety belt system retracted onto an Emergency Locking Retractor (ELR) while the remaining belt systems utilized ELR/Automatic Locking Retractors (ALR). The front safety belt systems utilized retractor and buckle pretensioners and adjustable D-rings. The front left D-ring was adjusted the full-down position while the front right was adjusted to the full-up position. The total adjustment height was 6 cm (2.5 in).

The driver's safety belt webbing was extended from the retractor and locked in the used position at the time of the SCI inspection. The actuated retractor pretensioner locked the retractor in the at-crash position. The exposed webbing yielded frictional abrasions from occupant loading at the latch plate and the D-ring. The latch plate loading on the webbing was located 74 cm (29 in) above the seat frame lower anchor point. The full-width of the latch plate was abraded from the loading. The frictional abrasion on the webbing from the D-ring was located 146 cm (57.5 in) above the reference seat frame anchor point.

The residual position of front left safety belt buckle was 4 cm (1.75 in) below the top of the center console **(Figure 8)**. A comparison measurement to the front right buckle revealed a height differential of 8 cm (3.0 in) associated with the actuation of the buckle pretensioner. Based on the actuation of the buckle and retractor pretensioners, and the loading evidence at the latch plate and D-ring, it was determined that the driver was restrained by the manual safety belt system at the time of the crash.

Figure 8: View of the actuated driver's buckle pretensioner.

The front right safety belt webbing was retracted against the B-pillar in a stowed position. The retractor pretensioner did not actuate as the retractor operated freely. The buckle pretensioner was positioned 4 cm (1.75 in) above the center console. The convoluted sleeve covering the stalk was not compressed, therefore, it was determined that the pretensioner did not actuate. The safety belt pretensioners were designed to actuate only if the belt the restraint system was in use. The belt webbing was free of loading evidence. Based on the condition and the status of the belt system and the pretensioners, it was determined that the front right passenger was not restrained at the time of the crash.

Air Bag Systems

The Honda was equipped with a CAC frontal air bag system that deployed as a result of the crash. The driver's air bag deployed from a steering wheel mounted module located within the two-spoke steering wheel rim. The air bag module was configured with three cover flaps consisting of a large upper flap and two symmetrical lower flaps. The module opened at the designated tear seams. The deployed front left air bag measured 61 cm (26 in) in diameter in its deflated state and was tethered internally. There was no discernable damage or contact points to the air bag or the cover flaps.

The front right air bag was mounted within the top right instrument panel and was concealed by two symmetrical H-configuration cover flaps. The forward cover flap was rectangular in shape and measured 27 cm x 8 cm (10.5 in x 3.25 in). The aft flap measured 27 cm x 6 cm (10.5 in x 2.5 in). The front right air bag was rectangular in shape and measured 37 cm x 66 cm, (14.5 in x 26 in), width by height in its deflated state. The air bag was not tethered and was vented by two lateral ports at the 3 and 9 o'clock positions; each port was 6 cm (2.5 in) in diameter. **Figure 9** is a view of the deployed front right air bag.

Figure 9: Deployed front right air bag and glazing fractures.

There was no damage or occupant contact evidence to either the air bag or the cover flaps. The flaps opened at the designated seams and the adjoining instrument panel was intact. An inspection of the front right air bag module, the cover flaps and its associated components in the instrument panel did not reveal any loose or separated components. The air bag appeared to have deployed as designed with all components and adjoining components intact. The inspection ruled out the possibility of a separated component or fragment associated with the air bag system causing the injury to the front right passenger as stated in the complainant's VOQ. **Figures 10 and 11** are of the front right air bag system.

Figure 10: Location of the windshield fracture sites in relation to the deployed front right air bag.

Figure 11: View of the front right instrument panel sand the air bag module cover flaps.

1995 Ford E-Series Cargo Van

Exterior Damage

The driver/owner of the Ford van declined a vehicle inspection. No damage measurements were obtained; however, based on the on-scene images, it appeared that the Ford sustained direct contact damage to the left door and quarter panel. This direct damage started aft of the left A-pillar and included the sill and lower body areas. The estimated CDC was 10LPEW1.

Occupant Demographics/Data

Driver - 2008 Honda Civic

Age/Sex:	21-year-old/Female.
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Track Position:	Unknown, full-rear at time of the SCI inspection
Safety Belt Use:	3-point lap and shoulder belt system
Belt Use Source:	Vehicle Inspection
Egress from Vehicle:	Exited unassisted
Type of Medical Treatment:	Evaluated at scene, but refused transport

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98))	Injury Source
Complaint of lower extremity pain	N/A per AIS rules	Impact force

Source of injury data: PAR

Driver Kinematics

The driver of the Honda was seated in an unknown track position. The seat back was reclined 20 degrees aft of vertical at the time of the SCI inspection with the head restraint adjusted 3 cm (1 in) above the seat back. She was restrained by the manual 3-point lap and shoulder belt. Safety belt use was determined from subtle loading evidence (frictional abrasions) on the latch plate and belt webbing and at the D-ring. Additionally, the pretensioners actuated during the crash locking the belt system in the used position.

The frontal crash deployed the driver's CAC air bag and actuated the buckle and retractor pretensioners. The driver initiated a forward trajectory and loaded the safety belt webbing and the deployed air bag. The combination of the safety systems prevented the drive from possible contact with the steering assembly and/or the windshield. There was no loading evidence on the deployed air bag. The driver complained to the investigating office of lower extremity pain; however, she refused medical treatment and transport.

Front Right Passenger - 2008 Honda Civic

Age/Sex:	20-year-old/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Track Position:	5 cm (2 in) forward of full-rear.
Safety Belt Use:	None
Belt Use Source:	Vehicle inspection
Egress from Vehicle:	Unknown
Type of Medical Treatment:	Initially treated at scene. Transported by ground ambulance to a local hospital where she was treated for her injury and released.

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Vertically oriented laceration of the forehead	Minor (290602.1)	Interior held object contacted face during air bag deployment/ loading (Probable)

Source of injury data: Partial interview and digital images of injury

Front Right Passenger Kinematics

The front right passenger of the Honda was seated in an unknown posture with the seat track adjusted 5 cm (2 in) forward of the full-rear track position. At the time of the SCI inspection, the seatback was reclined 18 degrees aft of vertical and the head restraint was adjusted 4 cm (1.5 in) above the seatback. She was not restrained by the manual safety belt system. There was no loading evidence of the belt system and the pretensioner did not actuate as the system utilizes an integrated buckle switch.

Although unconfirmed by interview data, the passenger was probably holding an object in her hands at the time of the crash. The on-scene images of the Honda showed a collection of school-type supplies on the front right floor of the vehicle. **Figure 12** is an on-scene image of the contents in the front right position of the Honda and the deployed air bag.

Figure 12: On-scene image of the Honda Civic's deployed frontal CAC air bags and contents on the front right floor. Image supplied by the complainant.

At impact, the front right CAC air bag deployed. The front right passenger was not restrained; therefore the pretensioners did not actuate. The passenger initiated a forward trajectory in response to the force of the crash. The unrestrained passenger loaded the deployed air bag with her torso, face and arms/hands. The passenger's forehead was either struck by the object as it was accelerated by the air bag deployment, or she contacted the object as she loaded the air bag. The probable object contact resulted in the vertically oriented laceration of the forehead. There was no noted contact evidence to the air bag module cover flaps or the deployed front right passenger air bag identified during the SCI inspection. Further, there were no dislodged vehicle components from the air bag system or instrument panel that could have caused the described injury.

The passenger displaced the air bag into the windshield, causing a star-like fracture to the outer layer of the laminated glazing. The fracture point was centered 30 cm (12 in) right of the vehicle's centerline and was located 36 cm (14.25 in) below the windshield header as measured along the profile of the glazing. In addition to the focal point fracture, several diagonally oriented fractures of the glazing were located above the previously mentioned fracture site. There was no occupant contact evidence (i.e., skin oil, hair, scuff mark) located at or near the fracture sites. There was no occupant contact evidence on the deployed air bag. The passenger rebounded into the front right seat where she came to rest. It should be noted that although she sustained a large laceration of the forehead, there was no body fluid evidence within the vehicle.

She was treated at the scene and subsequently transported by ambulance to a local hospital where the laceration required five internal and 18 external sutures to close the wound. She was released following the treatment.

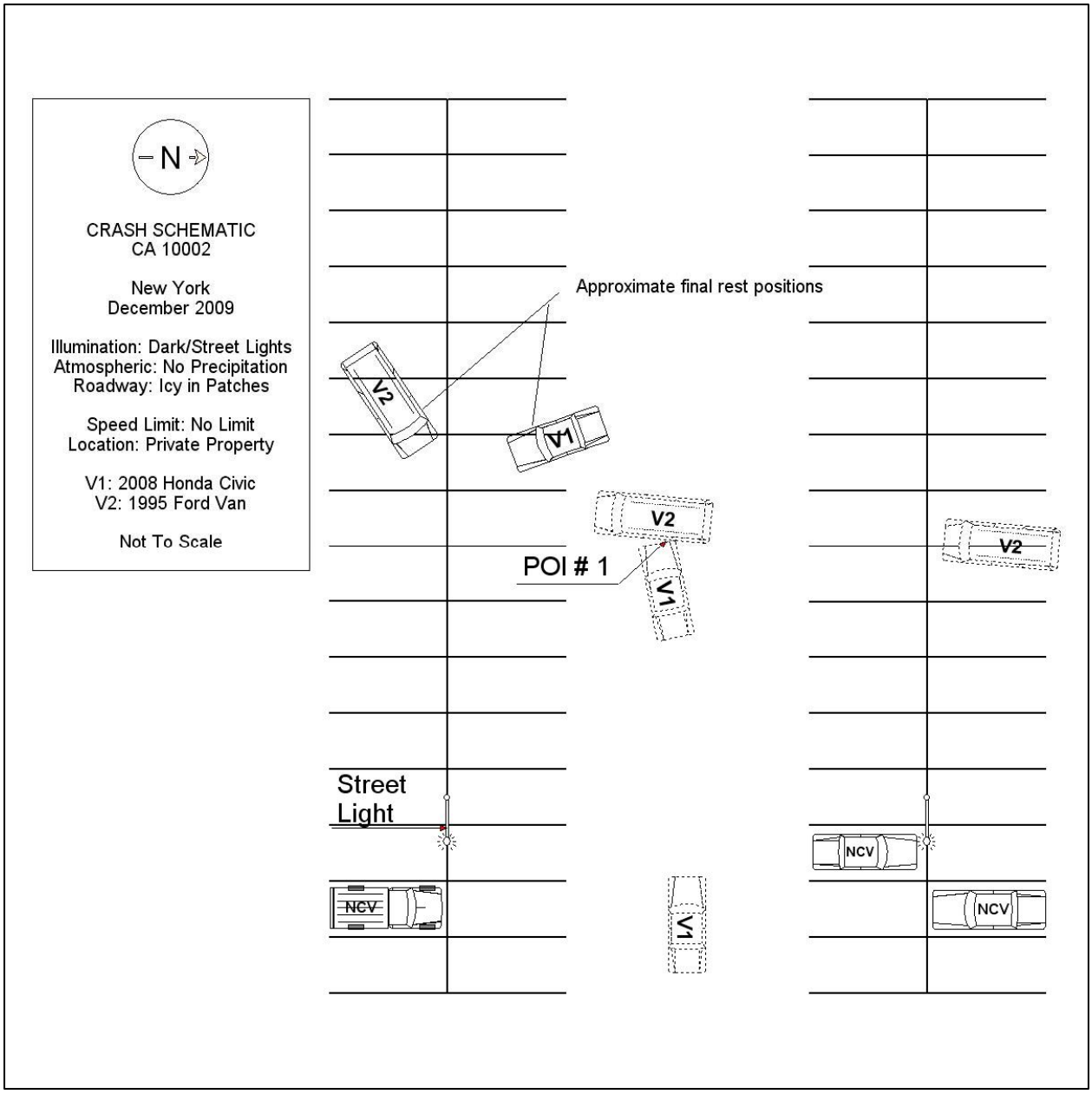

Figure 13: Crash Schematic