CRASH DATA RESEARCH CENTER

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

SCI CASE NO. – CA04-025

SUBJECT VEHICLE – 2004 HONDA ACCORD EX

LOCATION – STATE OF PENNSYLVANIA

CRASH DATE – APRIL 2004

Contract No. DTNH22-01-C-17002

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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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BACKGROUND

This on-site investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2004 Honda Accord EX **(Figure 1)**. The manufacturer of this vehicle has certified that this 2004 Honda Accord meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The safety system included dual stage frontal air bags, safety belt pretensioners, and an occupant detection sensor for the front right seat. In addition, the Honda was equipped with seatback-mounted side impact air bags for the front seating positions and Inflatable Curtains (IC) for the four outboard seating positions. The Honda also contained a Supplemental Restraints System (SRS) module, which had Event Data Recording (EDR) capabilities. The SRS module was retrieved from the vehicle and was forwarded to NHTSA for download by Honda. The EDR data is summarized in this report. The Honda was occupied by a restrained 39-year-old female driver and was involved in an intersection collision with a 1999 Dodge Ram pickup truck and a 1998 Ford F-150 pickup truck. The impacts resulted in the driver's frontal air bag, front right seatback-mounted air bag, and IC deployment, and fired driver's safety belt pretensioner in the Honda. The driver of the Honda declined medical attention; however, she was later transported to a local hospital where she was treated for minor severity injuries and released.

Figure 1. Subject 2004 Honda Accord.

This crash was identified from a list of claims provided by an insurance company to the National Highway Traffic Safety Administration (NHTSA) that identified Certified Advanced 208-Compliant vehicles that were involved in crashes. The Honda was located and cooperation was established with the repair facility. The case was assigned to the Calspan Special Crash Investigations (SCI) team on June 4 as an on-site investigative effort. The Honda and the crash site were inspected on June 8, 2004.

SUMMARY

Crash Site

This intersection crash occurred during the daylight hours of April 2004. At the time of the crash, the weather was clear with no adverse conditions. The crash occurred at a four-leg intersection of two local roadways **(Figure 2)**. The north and south legs of the intersection were configured with two through traffic lanes and a center left turn lane. The travel lanes of the north/south legs were separated by double yellow centerlines. The east leg of the intersection was configured with one through/left-turn lane and a right turn only lane and was separated by double yellow centerlines. The west leg was configured with one lane in each direction and was delineated by double yellow centerlines. The roadways were constructed of asphalt and were bordered by concrete barrier curbs. Traffic flow through the intersection was controlled by overhead three-phase traffic signals. There were no speed limits posted in the vicinity of the crash site. The scene schematic is included as **(Figure 17)** of this report.

Figure 2. Southwest view of the crash site.

Vehicle Data – 2004 Honda Accord EX

The 2004 Honda Accord was identified by the Vehicle Identification Number (VIN): 1HGCM56884 (production sequence omitted). The odometer reading at the time of the inspection was unknown due to the vehicle having no power. The vehicle was a four-door sedan that was equipped with a 2.4-liter, four-cylinder engine, 5-speed automatic transmission, front-wheel drive, power-front and rear disc brakes with anti-lock, OEM alloy wheels, power-steering, and a tilt steering wheel.

The seating positions in the Honda were configured with leather trimmed front buckets seats with height adjustable head restraints. The front seat head restraints were both adjusted to the full-down position at the time of the vehicle inspection. The second row was configured with a leather trimmed three-passenger bench seat with a forward folding back and height adjustable head restraints for the outboard seating positions. The head restraints were adjusted to the full-down position.

1999 Dodge Ram

The 1999 Dodge Ram was identified by the VIN: 1B7HF16YXX (production sequence omitted). The odometer reading at the time of the inspection was unknown due to the lack of power to the vehicle. The vehicle was a large two-door pick up truck that was equipped with a 5.2 liter, eight-cylinder engine, 5-speed manual transmission, four-wheel drive, power front disc/rear drum brakes. The seating positions in the Dodge were configured with a three-passenger split bench seat and integrated head restraints for the outboard seating positions.

1998 Ford F-150

The 1998 Ford F-150 was repaired and returned to the owner prior to the assignment of this on-site investigative effort. The Ford was not located for inspection.

Crash Sequence

Pre-Crash

The restrained 39-year-old female driver of the 2004 Honda Accord was operating the vehicle eastbound on the three-lane roadway approaching the intersection **(Figure 3)**. A 34-year-old male driver was operating the 1999 Dodge Ram northbound on the intersecting roadway. The 1998 Ford F-l50 was occupied by a 64-year-old male driver that was operating the vehicle southbound on the intersecting roadway. The Ford was stopped at the intersection due to the red traffic signal phase. The driver of the Honda proceeded into the intersection on a green light phase. The driver of the Dodge failed to stop for the red traffic signal and entered the intersection.

Figure 3. Eastbound approach to the intersection from the path of the 2004 Honda Accord.

Crash

The front of the Honda impacted the front left aspect of the Dodge within the intersection **(Figure 4)**. The resulting directions of force were within the 1 o'clock sector for the Honda and 10 o'clock sector for the Dodge. The damage algorithm of the WINSMASH program was used to calculate a delta V for this impact. The total delta V for the Honda was 16.0 km/h (9.9 mph). The longitudinal and lateral components were -13.9 (-8.6 mph) and -8.0 (-5.0 mph), respectively. The total delta V for the Dodge was 12.0 km/h (7.5 mph). The longitudinal and lateral components were -6.0 km/h (-3.7) and 10.4 km/h (6.5 mph), respectively. The Honda's EDR recorded delta V was 23.8 km/h (14.8 mph). The EDR recorded delta V was a more accurate representation of the crash severity. The WINSMASH model underestimated the crash severity due to the use of the default stiffness category for the Dodge. The Honda impacted a locally stiff area of the Dodge (axle) which reduced the calculated value by the model.

Figure 4. Northbound view of area of impact.

Figure 5. Area of impact between the Honda and the Ford.

As a result of the initial impact with the Dodge, the driver's frontal air bag, right seatback- mounted air bag, and right IC air bag deployed, and the driver's safety belt pretensioner fired in the Honda. The Dodge's frontal air bags did not deploy as result of the crash.

As a result of the frontal impact, the Honda was redirected in a northeast trajectory and began a counterclockwise rotation. The Dodge was redirected in a northeast trajectory and initiated a clockwise rotation, which resulted in a secondary side slap impact with the right rear aspect of the Honda impacting the left rear aspect of the Dodge. The resulting directions of force were with the 3 o'clock sector for the Honda and 9 o'clock sector for the Dodge.

The damage algorithm of the WINSMASH program was to calculate a delta V for this impact. The total delta V for the Honda was 7.0 km/h (4.3 mph). The longitudinal and lateral components were 0.0 and -7.0 km/h (-4.3 mph), respectively. The total delta V for the Dodge was 5.0 km/h (3.1 mph) and the longitudinal and lateral components were 0.0 and 5.0 km/h (3.1 mph), respectively. The Honda began a northwest trajectory subsequent to the side slap and entered the southbound lanes where the 1998 Ford F-150 was stopped. The frontal aspect of the Honda impacted the left rear of the stopped Ford **(Figure 5)**.

Post-Crash

The driver of the Honda sustained minor injuries and refused transport to a medical facility from the crash site. She was later transported by private vehicle to a local hospital where she was treated for minor severity injuries and released. The driver of the Dodge sustained police reported moderate injury and was not transported to a hospital. The front right passenger of the Dodge was not injured or transported. The driver of the Ford was not injured. All three vehicles came to rest within the intersection. The Honda and Dodge sustained moderate damage and were towed from the crash site. The Ford sustained minor damage and was towed from the crash site.

Vehicle Damage

Exterior Damage – 2004 Honda Accord EX

The initial impact with the Dodge resulted in moderate frontal damage to the Honda. The direct and induced damage involved the bumper fascia and bumper beam, frame rails, upper and lower radiator supports, fenders, and hood. The bumper beam was separated from the vehicle; therefore two crush profiles were documented at the levels of the upper and lower radiator supports **(Figure 6)**. The direct damage measured 48.0 cm (18.9") and began at the front right end of the lower radiator support and extended left. The maximum crush measured 12.0 cm (4.7") and was located 16.0 cm (6.3")

Figure 6. Lower radiator crush profile.

right of the centerline. The crush profile was measured using a combined direct and induced damage width of 80.0 cm (31.5”). The crush was documented using six equidistant points along the lower radiator support and were as follows: C1 = 3.0 cm (1.2”), C2 = 0, C3 = 2.0 cm (0.8”), C4 = 5.0 cm (2.0”), C5 = 9.0 cm (3.5”), C6 = 12.0 cm (4.7”).

Six crush measurements were documented at the upper radiator support **(Figure 7)**, and were as follows: C1 = 12.0 cm (4.7”), C2 = 13.0 cm (5.2”), C3 = 17.0 cm (6.7”), C4 = 23.0 cm (9.1”), C5 = 27.0 cm (10.6”), C6 = 30.0 cm (11.8”). The Collision Deformation Classification (CDC) for this impact was 01-FREW-2.

Figure 7. Upper radiator crush profile.

The average of the upper and lower radiator support crush measurements were used for WINSMASH to calculate a delta V. The crush measurements were as follows: C1 = 3.0 cm (1.2”), C2 = 7.0 cm (2.8”), C3 = 10.0 cm (4.0”), C4 = 14.0 cm (5.5”), C5 = 18.0 cm (7.1”), C6 = 21.0 cm (8.3”).

The right rear aspect of the Honda sustained moderate damage as a result of the secondary impact with the Dodge **(Figure 8)**. The damaged components included the rear axle, right rear quarter panel, C-pillar, bumper cover, right rear taillight, trunk, and the backlight. The direct damage measured 90.0 cm (35.4”) and began 265.0 cm (104.3”) rear of the right front axle. The residual damage was documented along the mid-door level using a combined direct and induced damage width of 110.0 cm (43.3”). Six crush measurements were documented and were as follows: C1 = 0, C2 = 1.0 cm (0.4”), C3 = 3.0 cm (1.2”), C4 = 7.0 cm (2.8”), C5 = 4.0 cm (1.6”), C6 = 0. The CDC for this impact was 03-RZAW-2.

Figure 8. Crush profile for secondary impact.

The third impact involved the front of the Honda impacting the left rear of the Ford. The damage for this impact was located left of the centerline and consisted of minor deformation to the hood and lower radiator support. A crush profile was not documented for this impact due to the overlapping damage from the first impact. The CDC for this impact was 12-FYEW-1.

The Honda’s windshield was fractured at the base of the right A-pillar from contact with the hood edge. The backlight was disintegrated from the secondary impact with the

Dodge. The remainder of the glazing remained intact and all four doors remained closed during the crash and operational post-crash.

1999 Dodge Ram

The 1999 Dodge Ram sustained moderate damage as a result of the initial impact with the Honda **(Figure 9)**. The direct damage began 264.0 cm (103.9") forward of the left rear axle and measured 96.0 cm (37.8") to the front left corner. The maximum crush measured 40.5 cm (15.9) and was located 408.0 cm (160.6") forward of the left rear axle. A crush profile was documented at the mid-door level using a combined direct and induced damage width of 131.0 cm (51.6"). Six crush measurements were used to document the residual crush, which were as follows: C1 = 0, C2 = 0.5 cm (0.2"), C3 = 5.5 cm (2.2"), C4 = 12.5 cm (4.9"), C5 = 14.5 cm (5.7"), C6 = 40.5 cm (15.9"). The CDC for this impact was 10-LFEW-2.

Figure 9. Overall view of the 1999 Dodge Ram and crush profile for initial impact.

The secondary impact resulted in minor damage to the left rear aspect of the bed **(Figure 10)**. The direct damage measured 104.0 cm (40.9") and began 7.0 cm (2.8") rear of the left rear axle. The maximum crush for this impact was 7.0 cm (2.8") and was located 45.0 cm (17.7") rear of the left rear axle. Six crush measurements were used to document the crush and were as follows: C1 = 6.0 cm (2.4"), C2 = 6.0 cm (2.4"), C3 = 7.0 cm (2.8"), C4 = 7.5 cm (3.0"), C5 = 0, C6 = 0. The CDC for this impact was 09-LBEW-1.

Figure 10. Left crush profile for secondary impact.

Interior Damage – 2004 Honda Accord EX

There were no occupant contact points or intrusion of the passenger compartment. The interior sustained minor damage from the deployment of the multiple air bags. No interior damage resulted from the driver's frontal air bag deployment. The outboard panel of the right seatback was torn at the designated tear points during the right side impact air bag deployment. The resulting damage required the replacement of the front right seatback. The headliner of the Honda was deformed at the

Figure 11. Overall view of the interior first row.

right roof side rail from the deployment of the right curtain air bag, which warranted the replacement of the headliner. **Figure 11** is an overall view of the interior first row.

Certified Advanced 208-Compliant Safety System – 2004 Honda Accord EX

The 2004 Honda Accord was equipped with a Certified Advanced 208-Compliant (CAC) safety system. The system consisted of dual stage frontal air bags, an occupant presence sensor for the front right seat, and front safety belt pretensioners. A single point control module was mounted on the center tunnel of the Accord. The module measures and predicts crash severity, monitors safety belt status, and occupant presence to deploy the appropriate safety system. The module had Event Data Recording (EDR) capabilities. The EDR output is summarized in this report.

Figure 12. Deployed driver's frontal air bag.

The driver's air bag was located in the center of the steering wheel hub **(Figure 12).** Two H-configuration cover flaps concealed the air bag. The top cover flap measured 12.0 cm (4.7") in width and 9.5 cm (3.7") in height. The lower cover flap measured 12.0 cm (4.7) in width and 6.5 cm (2.6) in height. The air bag module also contained two pliable, symmetrical, I-configuration vinyl flaps behind the exterior module cover flaps. The air bag membrane measured 61.0 cm (24.0") in diameter in its deflated state and was configured with a 16.0 cm (6.3") diameter center circular stitching for the tethers. Four tethers were attached to the circular stitching and two vent ports at the 11 and 1 o'clock positions on the rear panel vented the air bag. No occupant contacts were present on the air bag membrane, however; dirt transfers were noted on the membrane from post-crash handling. The driver bag was identified by the following nomenclature printed on the rear panel at the 12 o'clock position of the air bag:

2401994
PE03X14G06T
230104

The front right passenger air bag was a top-mount design in the right instrument panel **(Figure 12)**. The front right seating position was not occupied, therefore the CAC system did not warrant the deployment of the front right air bag.

Event Data Recorder Output – 2004 Honda Accord EX

The 2004 Honda Accord was equipped with an air bag control module that had event data recording capabilities. The module was removed from the vehicle during the SCI inspection and was forwarded to NHTSA for download by Honda. The unit wake-up was at 19 milliseconds of Algorithm Enable (AE) with the front and side impact crash sensors detecting the crash at 1 millisecond of AE. The EDR recorded data indicated that the crash severity was high with an estimated time of deployment of 24 milliseconds of AE for the frontal air bag. The EDR recorded delta V was 23.8 km/h (14.8 mph). The recorded data indicated that the driver utilized her safety belt and fired the pretensioner,

and that the front right seat was not occupied. Additionally, the EDR data did not indicate a deployment time for the right side impact and right IC air bags; however, based on the recorded data, it appears that the side impact and right IC air bags deployed during the first impact.

Inflatable Curtain Air Bags – 2004 Honda Accord EX

The 2004 Honda Accord was equipped Inflatable Curtain (IC) air bags for the outboard seating positions. In the subject vehicle the right side IC deployed during the initial impact with the Dodge. The IC deployed downward from the right roof side rail and extended from the right A-pillar to the right C-pillar. The IC measured 180.0 cm (70.9") in width and 46.0 cm (18.1") in height **(Figure 13)**. A fabric liner housed the non-deployed IC, and the IC deployed through a tear seam in the bottom aspect of the headliner. The IC consisted of the two chambers for the front and rear outboard seating positions **(Figure 14)**. The front right chamber measured 100.0 cm (39.4") in width and 42.0 cm (16.5") in height. The rear right chamber measured 38.0 cm (15.0") in width and 32.0 cm (12.6") in height. The IC inflator canister was concealed within the C-pillar area and utilized compressed helium to deploy the IC. No occupant contact points were present on the air bag; however, dirt transfers were noted to the right front chamber from post-crash handling. The following nomenclature was noted on the IC rear of the front chamber:

1020064
PF03X28F03T
151103-P
S

Figure 13. Overall view of deployed right side IC.

Figure 14. Deployed IC with front and rear chambers inflated.

Side Impact Air Bags – 2004 Honda Accord EX

The 2004 Honda Accord was equipped with seatback-mounted side impact air bags for the front seat positions. The right side impact air bag deployed during the initial impact with the Dodge. The air bag membrane was of a semi-circular shape and measured 36.0 cm (14.2") in height and 24.0 cm (9.4") in width from the

Figure 15. Deployed right seatback mounted side impact air bag.

seatback to maximum forward excursion **(Figure 15)**. The air bag membrane continued an additional 6.0 cm (2.4") into the seatback module. A small non-inflatable tab that measured 5.0 cm (2.0") in length and 7.0 cm (2.8") in height was attached to the forward aspect of the air bag. The air bag contained two circular stitch patterns that created tethers between the front and rear panels. The upper stitching measured 6.0 cm (2.4") in diameter and was located 5.0 cm (2.0") rear of the forward seam and 5.0 cm (2.0") cm below the top seam. The center of the stitching contained a 0.7 cm (0.3") diameter hole. The lower stitch measured 7.5 cm (2.9") in diameter and was located 10.0 cm (3.9") above the lower seam and 10.5 cm (4.1") inboard of the forward seam. The lower stitch also contained 0.7 cm (0.3") diameter hole in the center. No occupant contact points were present on the air bag; however, dirt transfers were noted from post-crash handling. The air bag membrane contained a bar code and the following identifier:

R

603393700AA06
HAZR1U0AAYT

Manual Restraint Systems – 2004 Honda Accord EX

The 2004 Honda Accord was equipped with continuous loop manual 3-point lap and shoulder safety belts for the five seating positions. The driver safety belt was configured with a sliding latch plate, Emergency Locking Retractor (ELR), height adjustable D-ring, and a retractor pretensioner **(Figure 16)**. The driver utilized her safety belt in the crash; however, no crash related evidence such as stretching or transfers were present on the belt system. Additionally, the safety belt was located in the used position, which was restricted by the fired pretensioner. The front right safety belt was configured with a sliding latch plate, switchable ELR/Automatic Locking Retractor (ALR), height adjustable D-ring, and a retractor pretensioner. The front right seat was not occupied, therefore the pretensioner did not deploy in the subject crash. The rear safety belts were configured with sliding latch plates and switchable ELR/ALR retractors.

Figure 16. Driver's safety belt.

Occupant Demographics – 2004 Honda Accord EX

Driver

Age/Sex:	39-year-old/Female
Height:	160.0 cm (63.0")
Weight:	72.5 kg (160.0 lbs)
Seat Track Position:	Mid-track [23.0 cm (9.1") track travel]
Manual Restraint Use:	Manual 3-point lap and shoulder safety belt
Usage Source:	Vehicle inspection
Eyewear:	Sunglasses
Type of Medical Treatment:	Transported by private vehicle to a hospital where she was treated and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Left breast contusion	Minor (490420.1,2)	Shoulder belt
Upper right thigh contusion	Minor (890402.1,1)	Lap belt
Left wrist strain	Minor (751420.1,2)	Bracing against the steering wheel
Left upper back strain	Minor (640478.1,7)	Impact forces

Source = Driver

Driver Kinematics

The 39-year-old female driver of the 2004 Honda Accord was seated in a presumed upright posture and was restrained by the manual 3-point lap and shoulder safety belt. The initial impact with the Dodge deployed the frontal air bag, right side IC, right seatback-mounted air bag, and fired the safety belt pretensioner fired. The driver braced against the steering wheel rim as she initiated a forward and right trajectory in response to the 1 o'clock direction of force. Her bracing against the steering wheel rim resulted in the left wrist strain. She loaded the lap and shoulder safety belt, which resulted in the left breast contusion and the right upper thigh contusion.

The right rear aspect of the Honda impacted the left rear aspect of the Dodge in a secondary impact. The driver responded in a lateral right trajectory to the 3 o'clock impact force. The impact forces from the both events resulted in the upper left back strain.

The front of the Honda subsequently impacted the left rear aspect of the stopped Ford. The force of this impact was minor and probably did not displace the driver. The driver of the Honda sustained minor injuries and refused transport to a medical facility from the crash site. She was later transported to a local hospital where she was treated for the minor injuries and released. The treating hospital required a signed medical release in order to obtain the driver's medical records. The driver refused to sign the medical release; therefore the medical records could not be obtained.

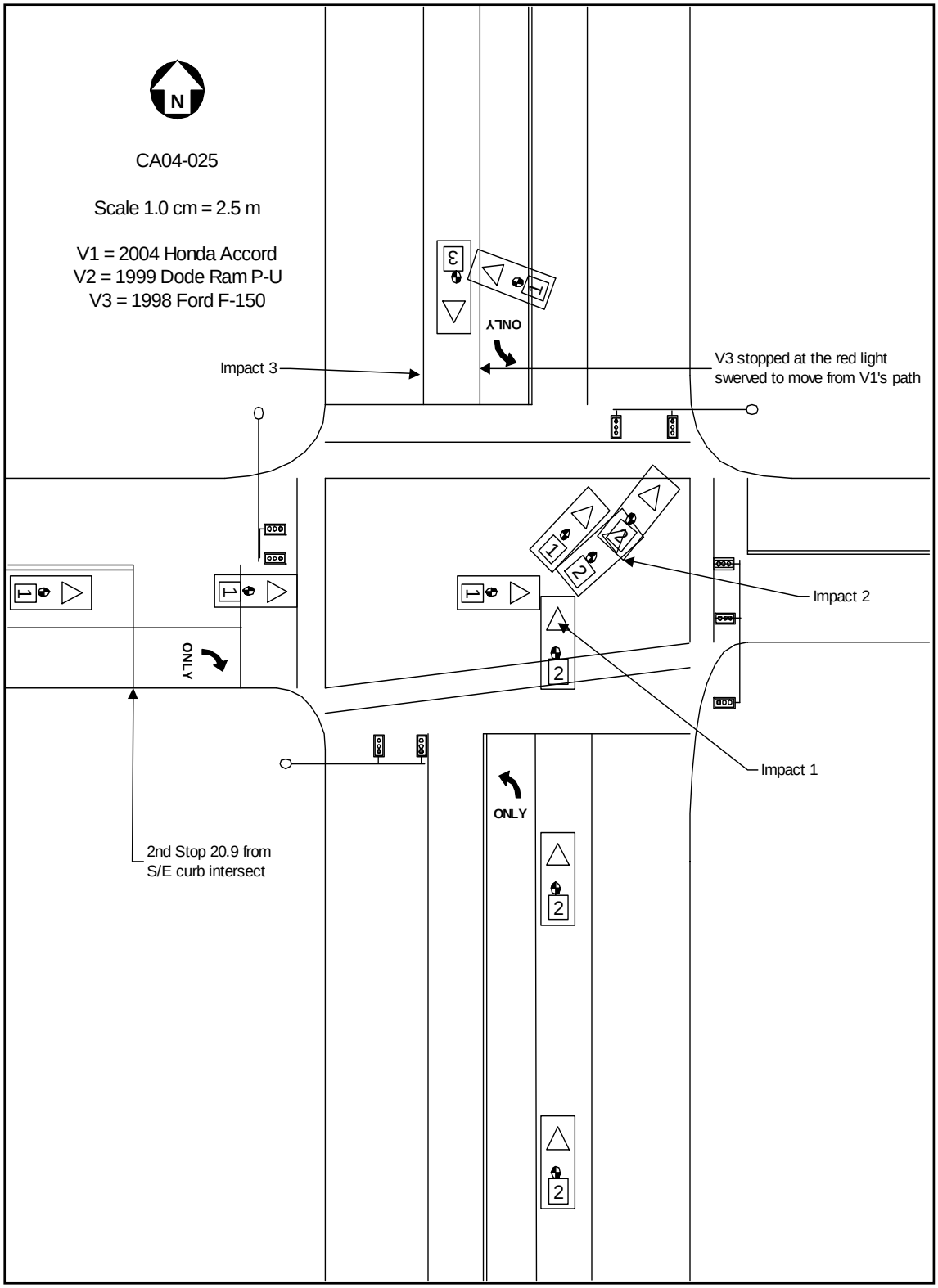

Figure 17. Scene schematic