

**CRASH DATA RESEARCH CENTER**

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**CALSPAN ON-SITE OFFICE OF DEFECTS CRASH INVESTIGATION**

**SCI CASE NO.: CA08023**

**VEHICLE: 2007 DODGE CALIBER**

**CRASH LOCATION: CONNECTICUT**

**CRASH DATE: MARCH 2008**

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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**BACKGROUND**

This on-site investigation focused on the undercarriage components of a 2008 Dodge Caliber (**Figure 1**) that possibly contributed to the driver's allegations of a loss of control and a run-off-road rollover crash. The driver of the Dodge was a 22-year-old female. She rented the vehicle from a local rental car company and drove approximately 30 minutes prior to the crash. The Dodge was equipped with a Certified Advanced 208-Compliant frontal air bag system, front seat belt retractor pretensioners, Inflatable Curtain (IC) air bags for the four outboard seated positions, and a driver's knee air bag. The Dodge was not equipped with the optional Electronic Stability Control (ESC). The driver's frontal air bag, knee air bag, and both IC air bags deployed during the crash. The driver was restrained by the manual safety belt system and sustained a dislocation of the left shoulder, bilateral pulmonary contusions with a right pneumothorax, cervical strain, and soft tissue injuries during the crash. She was transported by ground ambulance to a local hospital where she was admitted for treatment of her injuries.



**Figure 1. Left side view of the 2007 Dodge Caliber.**

The driver's attorney provided notification of the crash to NHTSA's Office of Defects Investigation (ODI). The notification was forwarded to the Crash Investigation Division and assigned to the Calspan Special Crash Investigations (SCI) team on June 18, 2008 for on-site follow-up. The SCI team located the vehicle through the insurance company and conducted the on-site investigation on June 25, 2008. An interview was conducted with the driver's attorney; however, the driver did not respond to SCI requests for an interview.

**SUMMARY**

*Crash Site*

This single vehicle rollover crash occurred on a divided Interstate roadway during daylight hours. At the time of the crash, the conditions were clear and dry. In the vicinity of the crash site (**Figure 2**), the north/southbound travel lanes were separated by a grass median with scattered trees. The southbound lanes consisted on two through lanes and an acceleration lane that extended from an on-ramp. All three lanes were surfaced with asphalt and were 3.7 m (12 ft) in width. The



**Figure 2. Overall view of the reported crash site.**

travel lanes were bordered by asphalt shoulder's that were 1.2 m (4 ft) in width with tactile warning devices (rumble strips) cut into the surface of the shoulder immediately outboard of the painted edge lines. The road was straight with a slight positive grade for southbound traffic. The posted speed limit was 105 km/h (65 mph). The Crash Schematic is included as **Figure 19** of this report.

It should be noted that no physical evidence associated with the crash was identified during the on-site inspection of the crash scene. The SCI investigator searched the area prior to and beyond the referenced location of the crash on the Police Crash Report (PAR). Additionally, the tow facility was contacted by telephone in an attempt to locate a more precise location of the crash. The proprietor referred the SCI investigator to the investigating police agency who only logged the call with the location reference on the PAR. During the second attempt to locate the scene, the SCI investigator was instructed to leave the Interstate by a police officer who cited State policy and safety concerns.

***Vehicle Data***

The involved vehicle in this crash was a 2007 Dodge Caliber SXT 5-door hatchback. The vehicle was manufactured in May 2007 and was identified by Vehicle Identification Number (VIN): 1B3HB48B37D (production number deleted). Although the VIN identified this vehicle as a 2007 model year, the vehicle registration listed the Dodge as a 2008. The Caliber was powered by a 2.0-liter four-cylinder engine that was transversely mounted and linked to a Continuously Variable Transaxle (CVT) with a console mounted shifter. The service brakes were power-assisted front disc/rear drum with anti-lock. The Caliber was placarded with a Gross Vehicle Weight Rating of 2,012 kg (4,435 lb) with a distribution of 1,000 kg (2,300 lb) at the front axle and 999 kg (2,200 lb) at the rear axle. The Caliber was not equipped with Electronic Stability Program. The vehicle was equipped with OEM steel wheels and plastic hubcaps with P215/60R17 Firestone Affinity Touring T4 all-season tires. The vehicle manufacturer cold tire pressure was 221 kPa (32 PSI), front and rear. The Caliber was equipped with an indirect Tire Pressure Monitoring System (TPMS). The measured tire pressures and tread depths at the time of the SCI inspection are reported in the following table:

<b>Position</b>	<b>Measured Pressure</b>	<b>Measured Tread Depth</b>	<b>Damage</b>
Left Front	231 kPa (33.5 PSI)	7 mm (8/32 in)	None
Left Rear	Tire flat	7 mm (8/32 in)	None, outer sidewall debanded
Right Front	Tire flat	7 mm (8/32 in)	None
Right Rear	Tire flat	7 mm (8/32 in)	Outer bead of wheel deformed

The interior of the Caliber was configured with five-passenger seating consisting of front bucket seats with adjustable head restraints and a split bench rear seat (70/30 right side wide) with integral head restraints for the outboard positions. The driver's head restraint was adjusted 5 cm (2 in) above the seat back and the front right position was adjusted 7 cm (2.75 in) above the seat back.

The vehicle mileage for the rental vehicle was unknown. The driver was licensed to drive at age 16 and claimed approximately 5-6 years of driving experience. The Dodge was not equipped with a roof window or a roof rack.

### ***Crash Sequence***

#### ***Pre-Crash***

The driver rented the Dodge Caliber was operating the vehicle southbound on the Interstate roadway at a driver estimated speed of 97 km/h (60 mph). She was traveling on a straight segment of road in the outboard lane. The driver stated to the investigating police officer that as she was traveling southbound, she approached a slower moving vehicle and initiated a lane change maneuver to the left to pass this vehicle. The driver further stated in another interview that the vehicle began to shake and she lost directional control. The police report noted yaw marks that originated in the left travel lane and continued into the median. The inspection of the vehicle identified a delineator post impact to the left A-pillar area of the vehicle that supported a clockwise (CW) yaw as the vehicle departed the travel lane and the outboard shoulder. Based on the yaw marks and the delineator impact location, the driver apparently applied a rapid CW steering maneuver that resulted in a loss of directional control and the CW yaw.

#### ***Crash***

The forward aspect of the left front door impacted a delineator post as the Caliber departed the left (inboard shoulder). The impact was lateral to the vehicle resulting in a direction of force within the 9 o'clock sector. This impact suggested the Dodge had rotated to a near broadside trajectory at the point of departure from the paved shoulder. The vehicle traversed a shallow ditch that was incorporated into the median that tripped the Caliber into a lateral left side leading rollover event.

The Caliber rolled into a line of trees or tree branches in the median. Tree bark was embedded into the right A- and D-pillars. Additionally, an impact occurred to the wiper cowl, hood and windshield base adjacent to the right A-pillar. This non-horizontal impact crushed these components vertically downward. The Caliber rolled four-quarter turns before coming to rest.

During the rollover event, the driver's safety belt pretensioner actuated and the driver's frontal air bag and knee air bag deployed. Both IC air bags also deployed during the rollover event. These air bags probably deployed from side contact to the ground as the Caliber was not equipped with a rollover sensing system.

#### ***Post-Crash***

The Dodge caliber came to rest in the median on its wheels. The driver complained of injury at the crash site and was transported by ambulance to a local hospital where she was admitted for treatment injuries (2-days). The Caliber was towed from the crash site.

The Dodge was subsequently transferred to a Dodge dealership where it was inspected by a Dodge representative. The insurance agency for the rental car company had the vehicle towed to a secure facility. The agency hired an independent consultant to inspect the

vehicle at this facility. The SCI investigator conducted the third inspection of the vehicle at this facility. The insurance agency classified this case as active; therefore the SCI investigator was prohibited from removing components from the vehicle during the inspection process.

### ***Vehicle Damage***

#### ***Exterior***

As the vehicle yawed CW off the left road edge, the forward aspect of the left front door impacted a delineator post located at the outboard edge of the paved shoulder. The direct contact damage began 53 cm (21 in) aft of the left front axle and extended 14 cm (5.5 in) rearward (**Figure 3**). The combined induced and direct contact damage length (Field L) was 30 cm (12 in), originating 47 cm (18.5 in) aft of the referenced axle, extending rearward. Maximum crush was 4 cm (1.75 in) on the sill and was located 58 cm (23 in) aft of the axle position. The direct contact damage extended vertically 75 cm (29.5 in) and included contact and separation of the rear view mirror. The Collision Deformation Classification (CDC) for this event was 09-LPAN-1.



**Figure 3. Delineator impact to the left front door.**

The Caliber sustained moderate severity damage from the rollover event that involved direct contact damage and deformation to all body panels. Maximum vertical roof crush was 4 cm (1.5 in), located on the side rail at the right C-pillar area. The maximum lateral crush at this same location was 6 cm (2.5 in). The crush values are depicted in **Figure 4**. The roof panel was bonded to the side rails with two continuous beads of adhesive. The full length of the right side bond separated from the A-pillar to a point immediately forward of the right D-pillar (**Figure 5**). It appeared that the inboard bead of adhesive had minimal contact with the roof panel (**Figure 6**). The outer bead was at the edge of the roof panel and was painted over during the assembly process. The CDC for the rollover event was 00-TDDO-2.



**Figure 4. Vertical and lateral crush to the right C-pillar area.**



**Figure 5. Separated roof panel.**



**Figure 6. Separated adhesive beads.**



During the rollover, a tree(s) or tree branches (cedar) were impacted by the right D-pillar area and the base of the right upper A-pillar area. The D-pillar impact was lateral in direction and involved the pillar, lift gate window frame, and the quarter panel above the tail lamp lens (**Figure 7**). The damage involved a non-horizontal impact force that resulted in 32 cm (12.5 in) of direct contact damage. The maximum lateral crush was estimated at 17 cm (6.5 in). The CDC for this impact was 00-RBHN-3.



**Figure 7. Right D-pillar area damage.**



**Figure 8. Vertical impact to the right cowl / lower windshield area.**

The vertically oriented impact damage to the base of the upper right A-pillar area involved the pillar, windshield, wiper cowl area, hood and the right front fender (**Figure 8**). Tree bark was embedded into the upper A-pillar area. This non-horizontal impact crushed the hood and cowl area downward to a depth of 17 cm (6.5 in). The CDC for this impact was 00-TFRN-6.

The left front and left rear doors remained closed during the crash and were operational post-crash. The right front and right rear doors remained closed and were jammed by body deformation resulting from the rollover. The rear lift gate was deformed by the tree impact to the left D-pillar area. The deformation resulted in a probable stress overload to the latch which subsequently released. The hood appeared to have remained latched and closed during the crash. Post-crash, and possibly during an inspection of the vehicle, the hood latch was released and the hood opened. Both hinges were intact and operational.

The windshield was cracked full width and height and was found folded on the driver's seat and floor areas. The perimeter bond was intact; therefore it appears that the windshield was cut from the vehicle by the first responders during the removal of the driver. The left front door glazing was closed at the time of the crash and disintegrated during the crash events. The left rear door glazing (AS2) was closed and intact post-crash. The fixed left side quarter windows remained intact. The AS2 backlight glazing was disintegrated by the impact to the right D-pillar. The right quarter window that was fixed between the upper C- and D-pillars was also disintegrated. The glazings for the right side doors were closed and intact.

### *Interior*

The interior of the Caliber sustained minor severity damage that was attributed to the rollover event. The right roof side rail minimally intruded in a lateral direction into the right front and right rear seating positions. This displacement buckled the midline of the roof upward. The right upper D-pillar area intruded approximately 17 cm (6.5 in) into the rear cargo area aft of the rear right seat position.

The driver was belted by the manual safety restraint system. Loading evidence of the webbing and hardware components supported belt usage and actuation of the retractor pretensioner. There were no additional contact points identified within the interior of the vehicle at the time of the SCI inspection.

### *Front Suspension*

The 2007 Dodge Caliber was equipped with an independent front suspension system that consisted of McPherson struts with an external coil-over spring on the strut, a stamped steel lower control arm that was mounted with bushings to the engine cradle with a non-greaseable lower ball joint affixed to the cast iron steering spindle, an anti-sway bar that was mounted aft of the axle position, and vertically mounted sway bar stabilizers that attached the outboard end of the sway bar to the lower strut assembly.

The SCI investigator used a hydraulic floor jack to lift the left side of the Caliber off the ground. With the left front tire elevated, the investigator checked for looseness in the front wheel bearing and suspension by attempting to move the tire/wheel assembly in a side-to-side motion vertically and horizontally. There was no free-play detected.

The left front tire was blocked approximately 30 cm (12 in) off the ground to facilitate an undercarriage inspection of the vehicle. A visual inspection of the front undercarriage revealed that all components identified above were intact. The lower control arm bushings were tight and free of visual wear, the lower ball joints were tight with the rubber boots intact, and the sway bar bushings were intact free of visual damage and wear.

The vertical stabilizer links that connected the sway bar to the strut were deformed. These links consisted of a solid rod with a small tie-rod-type pivot at the top and bottom ends. The studs were fastened to the sway bar and the strut housing. Based on an exemplar vehicle, these stabilizer links were 27 cm (10.5 in) in length (centerline of bearing studs) and were 6 mm (0.25 in) in diameter. The left stabilizer link was bowed at the upper third in a lateral inboard direction. The upper third aspect of the right link was bowed in a forward direction. There was no evidence of contact from adjacent suspension/steering components. These links probably deformed during the rollover as the front suspension was fully compressed by tire contact to the ground. The pivots remained intact and tight on both links. **Figures 9 and 11** are of the front stabilizer links of an exemplar vehicle. **Figures 10 and 12** are the deformed links from the 2007 Dodge Caliber case vehicle.



**Figure 9. Left front stabilizer link of an exemplar vehicle.**



**Figure 10. Deformed left front stabilizer link of the case vehicle.**



**Figure 11. Right front stabilizer link of an exemplar vehicle.**



**Figure 12. Deformed right front stabilizer link of the case vehicle.**

### ***Steering System***

The Dodge Caliber was equipped with a power-assisted rack-and-pinion steering system. The steering rack was mounted aft of the axle with a rubber boot extending over the inner tie rod link and a typical outer tie rod mounted to the steering spindle. During the SCI inspection of the vehicle, the steering wheel was rotated in a left-right-left manner to check for free-play in the system. The steering system exhibited minimal free-play of the wheel of less than 1 cm (0.5 in). There was no excessive free-play or binding in the system. The inner and outer tie rods were tight. The outer tie rod



**Figure 13. Intact lower left ball joint and outer tie rod of the 2007 Dodge Caliber.**

boots were intact and the tie rods pivoted on the bearing stud/socket joint with no free-play or indication of binding. The tapered studs were fully engaged in the steering knuckles and the retaining nuts were fully engaged. Minimal surface rust was present on the outer surface of the tie rods and the steering knuckles. Based on the extent of rust on the brake rotors, the majority of the undercarriage rust was attributed to the vehicle sitting idle for the past three months. **Figure 13** is a view of the intact left tie rod and ball joint.

### ***Rear Suspension System***

The rear of the Caliber was equipped with an independent suspension system that consisted of struts with coil over springs, a lower control arm, and a sway bar with vertically positioned stabilizer links that connected the outer end of the forward mounted sway bar to the lower control arm. The control arms were stamped steel with bushings at the inboard and outboard ends. All components of the rear suspension were intact and free of visual wear or damage. There was minimal surface rust to the rear undercarriage of the Caliber.

The rear stabilizer links were similar to the fronts with knuckles at the mounting points. Both rear stabilizers were intact and tight at the knuckle joints; however, both were deformed at the lower aspect due to the forward displacement of the rear axle. An inspection of an exemplar vehicle indicated that these stabilizer links were originally straight (**Figure 14**) with a length of 8 cm (3.1 in) at the mid points of the knuckles and a diameter of 6 mm (0.25 in). The deformed links from the 2007 Dodge Caliber are shown in **Figures 15 and 16**.



**Figure 14.** Left rear stabilizer link of an exemplar vehicle.



**Figure 15.** Deformed left rear stabilizer link of the 2007 Dodge Caliber.



**Figure 16.** Deformed right rear stabilizer link of the 2007 Dodge Caliber.



### ***Manual Safety Belts***

The Dodge Caliber was equipped with 3-point lap and shoulder belts for the five seating positions. All safety belts utilized continuous loop webbings and sliding latch plates. The driver's belt system retracted on an Emergency Locking Retractor (ELR) with a pretensioner that actuated during the crash. The driver was wearing the safety belt during the crash.

Evidence to support driver belt use during the crash included the locked position of the retractor and the spooled out webbing due to pretensioner activation and frictional abrasions of the latch plate and D-ring. The spooled-out belt webbing was 136 cm (53.5 in) in length from the D-ring to the seat frame anchor. The inside surface of the latch plate was abraded full width from the lap belt webbing as the driver loaded the belt system. The outboard aspect of the D-ring was abraded full width that resulted from driver loading and actuation of the retractor pretensioner. The belt webbing was abraded 136-142 cm (53.5-55.75 in) above the seat anchor point. It should be noted that the webbing abrasion was on the downside of the D-ring toward the retractor indicating the spool-up of the webbing due the pretensioner.

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

The 2007 Dodge Caliber was equipped with a Certified Advanced 208-Complaint frontal air bag system. The manufacturer of the vehicle has certified that the Caliber meets the requirements of the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system consisted of dual stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, safety belt buckle switch sensors, safety belt retractor pretensioners, and an occupant presence sensor for the front right seat. The driver's air bag deployed during the crash while the front right air bag was suppressed as this seat was unoccupied. The driver's safety belt retractor pretensioner activated and locked the belt webbing in its worn position.

The driver air bag module was mounted within the 4-spoke steering wheel rim. The air bag was concealed by two H-configuration cover flaps. The horizontal tear seam was 14 cm (5.6 in) in width with the vertical dimensions of the upper and lower flaps at 4 cm (1.75 in) and 8 cm (3 in) respectively. The driver air bag was not directly vented with ports; however, the bag was tethered with two straps at the 3 and 9 o'clock positions. There was no occupant contact evidence on the driver air bag and the bag fabric was not damaged. The bag was wet and stained from exposure to the weather over the past three months.

### ***Driver's Knee Air Bag System***

The 2007 Dodge Caliber was equipped with a knee bolster-mounted knee air bag for the driver's position. As a result of the crash the knee air bag deployed. There were no occupant contact points or damage noted to the knee air bag.

### *Inflatable Curtain Air Bag System*

The Caliber was equipped with IC air bags as standard equipment. The vehicle was not equipped with the optional seat back-mounted side impact air bags. The 2007 Dodge Caliber was not equipped with rollover sensing.

The IC air bags were mounted within the headliner at the roof side rails and provided head protection to the four outboard seating positions. Both IC air bags deployed during the crash.

The IC air bags were 168 cm (66 in) in length and 46 cm (18 in) in height. The vertical dimension of the IC provided full coverage to the side glazing. A void in IC coverage was located at the A-pillar area (**Figure 17**). This area was 30 cm (12 in) in length at the top of the door, 18 cm (7.25 in) in height at the forward aspect adjacent to the A-pillar, 34 cm (13.5 in) from the pillar rearward at the side rail, and 46 cm (18 in) in height at the forward edge of the curtain. This void in coverage was located a 4 cm (1.5 in) aft of the mid point of the steering wheel rim, extending forward.

The ICs were tethered to the A- and C-pillars. The A-pillar tether was 48 cm (19 in) in length and the C-pillar tether was 46 cm (18 in) in length. The tethers on both ICs were intact. There was no evidence of occupant contact or crash related damage to the ICs. **Figure 18** is an interior view of the deployed air bags in the driver's position.



**Figure 17.** Exterior view of the deployed left IC air bag.



**Figure 18.** Interior view of the deployed air bags for the driver's position.

### *Driver Demographics/Data*

Age/Sex:	22-year-old/Female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Track Position:	Mid-track
Manual Safety Belt Use:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited unassisted
Mode of Transport from Scene:	Ambulance
Type of Medical Treatment:	Transported to a local hospital where she was admitted for two days for treatment of her injuries

***Driver Injuries***

<b>Injury</b>	<b>Injury Severity</b>	<b>Injury Source</b>
Bilateral pulmonary contusions with a small right apical pneumothorax	Severe (441410.4,3)	Shoulder belt
Grade 1 left acromioclavicular joint separation	Moderate (750230.2,2)	Shoulder belt
Cervical strain	Minor (640278.1,6)	Impact force
Minor abrasions and contusions of the left lateral neck	Minor (390202.1,2; 390402.1,2)	Shoulder belt webbing
Left knee abrasions and contusions	Minor (890202.1,2; 890402.1,2)	Knee bolster air bag
Swelling of the right hand with an abrasion in the interspace between the index and middle finger	Minor (790202.1,1)	Possible flying glass

*Source – Hospital Discharge Summary*

***Driver Kinematics***

The 22-year-old female driver of the Dodge Caliber was seated in a mid-track position with the head restraint adjusted 5 cm (2 in) above the seat back. She was restrained by the manual safety belt system as evidenced by loading on the belt webbing, D-ring, and latch plate.

The driver responded to her left lane change maneuver by applying a rapid clockwise steering input which induced a CW yaw to the vehicle. As the Caliber yawed CW, the driver was displaced slightly to her left. Her left trajectory continued as the left door impacted the delineator post. The vehicle subsequently overturned in a left side leading rollover event. The driver loaded the shoulder belt webbing as the retractor pretensioner actuated. Additionally, the driver’s frontal, knee air bag, and both IC air bags deployed during the rollover event. Her loading of the belt system resulted in a dislocation of the acromioclavicular joint separation, the bilateral pulmonary contusions with the right apical pneumothorax, and the minor abrasions and contusions to the left lateral neck. The driver also sustained abrasions and contusions to the left knee from contact with the deploying knee air bag. There was no occupant contact evidence within the vehicle. The driver sustained a cervical strain from the impact forces and swelling of the right hand with an abrasion in the interspace between the index and middle finger from displaced glass.

The combination of deployed air bags and safety belt use prevented the driver from potential serious injury.

Following the crash, the driver exited the vehicle unassisted and crossed the Interstate roadway to a passing motorist who witnessed the crash. She waited in this person’s

vehicle for the arrival of emergency personnel. The driver was subsequently transported by ground ambulance to a local hospital where she was admitted for two days for treatment of her injuries.

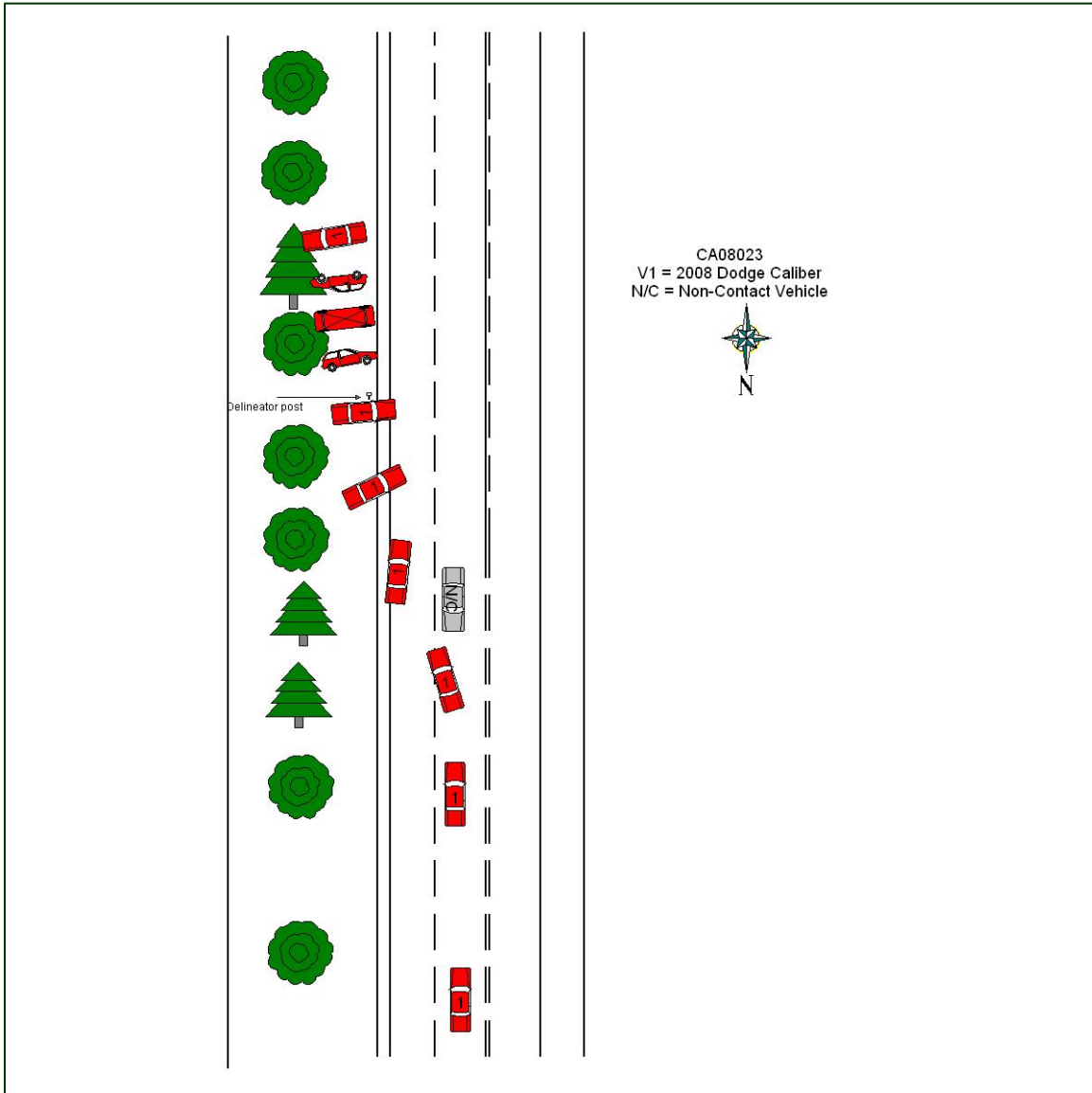


Figure 19. Crash Schematic