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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-05-038

LOCATION - TEXAS

VEHICLE - 2005 TOYOTA TACOMA

CRASH DATE - September 2005

Submitted:

August 7, 2006

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

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

Technical Report Documentation Page

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| 15. <i>Supplementary Notes</i> On-site air bag investigation involving a 2005 Toyota Tacoma with manual safety belts and dual front certified advanced 208-compliant air bags. | | | | | |
| 16. <i>Abstract</i> This crash involved a 2005 Toyota Tacoma (case vehicle) that ran-off-road and struck two metal traffic signal poles. This crash is of special interest because the supplemental restraint (air bag) system in the Toyota Tacoma is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle's driver [35-year-old, White (non-Hispanic) male] sustained a police reported "C" (possible) injury as a result of the crash. The case vehicle was traveling northwest in the outside through lane of a left curved, four-lane, undivided city street. The case vehicle's driver stated that a car crossed his path through the intersection on a red light. The driver stated he steered right to avoid a crash. The case vehicle entered the traffic island on the southeast corner of the intersection, and the front right impacted a metal traffic signal pole causing the case vehicle's driver air bag to deploy. The impact broke the signal pole off its base, and the case vehicle continued across the intersection. The case vehicle then departed the northeast corner of the intersection. The front of the vehicle impacted a second metal traffic signal pole displacing the pole. The case vehicle came to rest on the northeast corner of the intersection facing northwest with the front of the case vehicle against the traffic signal pole. The case vehicle's driver was not restrained by his manual, three-point, lap-and-shoulder safety belt system. He impacted his face, chest and lower left forearm on his air bag causing an abrasion and lacerations to his face and lacerations to his left forearm. He also impacted his knees on the knee bolster causing a contusion to both knees. He was refused medical transport and sought no subsequent treatment for his injuries. | | | | | |
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This investigation was brought to NHTSA's attention on October 14, 2005 by the NASS CDS/GES sampling activities. This crash involved a 2005 Toyota Tacoma (case vehicle) that ran-off-road and struck two metal traffic signal poles. The crash occurred in September, 2005, at 7:56 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the supplemental restraint (air bag) system in the Toyota Tacoma is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle's driver [35-year-old, White (non-Hispanic) male] sustained a police reported "C" (possible) injury as a result of the crash. This contractor inspected the case vehicle and scene on 27-28 October, 2005. The interview with the case vehicle's driver was conducted on November 2, 2005. This report is based on the police crash report, scene and vehicle inspections, driver interview, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling northwest in the outside through lane of a left curved, four-lane, undivided city street. The case vehicle's driver stated that a car crossed his path through the intersection on a red light. The driver stated he steered right to avoid a crash. The case vehicle entered the traffic island on the southeast corner of the intersection, and the front right impacted a metal traffic signal pole causing the case vehicle's driver air bag to deploy. The case vehicle's front right passenger air bag did not deploy because there was no front right passenger in the vehicle at the time of the crash. The impact broke the signal pole off its base, and the case vehicle continued across the intersection. The case vehicle then departed the northeast corner of the intersection. The front of the vehicle impacted a second metal traffic signal pole displacing the pole. The case vehicle came to rest on the northeast corner of the intersection facing northwest with the front of the case vehicle against the traffic signal pole. At the time of the crash the light condition was dark, but illuminated with street lights; the atmospheric condition was clear, and the roadway pavement was dry, level, traffic polished bituminous with an estimated coefficient of friction of 0.65. Traffic density was moderate, and the site of the crash was urban.

The impact with the two traffic signal poles occurred in the same area of the front of the case vehicle, and the two damages could not be separated. Therefore, one CDC was assigned to describe the totality of the damage. It was determined to be: **12-FZEW-3 (0-degrees)**. A second partially known CDC was assigned to account for the second impact. It was determined to be: **12-F999-9 (0 degrees)**. The maximum residual crush to the front of the case vehicle was measured as 60 centimeters (23.6 inches) occurring at C₅.

The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's Delta Vs due to the overlapping damage from the two impacts. In addition, yielding object impacts are out-of-scope for the program. Based on the overall damage to the front of the case vehicle and the displacement of the first impacted traffic signal pole, this contractor estimates the crash severity of the first impact to be in a range of 19-27 km.p.h. (12-17 m.p.h). The crash severity of the impact with the second traffic signal pole was minor. The case vehicle was towed due to damage.

Immediately prior to the crash the case vehicle's driver [35-year-old, White (non-Hispanic) male; 175 centimeters and 75 kilograms (69 inches, 165 pounds)] was seated in an upright driving position with both hands on the steering wheel, his left foot on the floor and his right foot on the accelerator. The driver's seat track was located in its middle position, the seat back was slightly reclined, and the tilt steering column was adjusted to its center position. The driver was not restrained by his manual, three-point, lap-and-shoulder safety belt system. The driver was not wearing glasses or contact lenses at the time of the crash.

Just prior to the crash, the case vehicle's driver stated he steered right to avoid a car passing through the intersection. As a result, the driver most likely moved slightly to his left within his seat, and then down, up and slightly forward in his seat as the case vehicle ran over the curb of the traffic island just prior to the first impact. The driver was also most likely bracing for the impact against the steering wheel with both arms. The case vehicle's front impact with the first metal traffic signal pole caused the driver to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver's face, chest and left arm impacted his deployed air bag and both of his knees impacted the knee bolster. The impact with the air bag caused an abrasion over his right eye, two small lacerations on his nose, a laceration to his lower lip and scratches on the inside of his left arm near the wrist. He also sustained bruises to both knees due to the impact with the knee bolster. The driver most likely rebounded back into his seat and remained in his seat as the case vehicle crossed the intersection. The front impact with the second metal traffic signal pole caused the driver to continue forward opposite the case vehicle's 0 degree of principal force as the case vehicle decelerated to a stop. His chest most likely impacted the now deflated air bag and underlying steering wheel. The driver was able to exit the case vehicle without assistance. The driver refused transport to the hospital. He sought no treatment for his injuries and missed five work days as a result of the crash

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a four-lane, undivided city street, traversing in a northwesterly and southeasterly direction. The case vehicle was approaching a four-leg intersection with three-phase traffic signals. The case vehicle's approach roadway had two northwestbound and two southeastbound through lanes and was curved to the northwest. The width of the case vehicle's travel lane was 3.6 meters (11.8 feet). The average lane width of the four through lanes was 3.5 meters (11.5 feet). At the intersection, the case vehicle's roadway had a channelized right turn lane that was approximately 5.3 meters (17.4 feet) in width. The traffic signal pole that was initially impacted was located in a small concrete, curbed traffic island at the southeast corner of the intersection, adjacent to the right turn lane. Pavement markings consisted of broken white lane lines and a double yellow center line. The speed limit was 56 km.p.h. (35 m.p.h). There was no regulatory speed limit sign posted near the crash site. At the time of the crash the light condition was dark, but illuminated with street lights; the atmospheric condition was clear, and the roadway pavement was dry, level, traffic polished bituminous with an estimated coefficient of friction of 0.65. Traffic density was moderate, and the site of the crash was urban.

Pre-Crash: The case vehicle was traveling northwest in the outside through lane (**Figure 1**). The driver was intending to continue northwestbound through the intersection. The case vehicle's driver stated that a car crossed his path through the intersection on a red light. The driver stated he steered right to avoid a crash. The case vehicle entered the traffic island on the southeast corner of the intersection where the crash occurred.



Figure 1: Approach of case vehicle northwestbound in outside lane, arrows show locations of impacted traffic signal poles

Crash: The front right of the case vehicle (**Figure 2**) impacted a metal traffic signal pole (**Figure 3**) causing the case vehicle's driver air bag to deploy. It is likely that only the first stage of the dual stage air bag deployed. The case vehicle's front right passenger air bag did not deploy because there was no front right passenger in the vehicle at the time of the crash. The impact broke the signal pole off its base, and the case vehicle continued across the intersection. The case vehicle then departed the northeast corner of the intersection, and the front right of the vehicle impacted a second metal traffic signal pole displacing the pole on its base.



Figure 2: Overview of damage to front of case vehicle from impact with metal traffic signal poles, front bumper cover and grille have been removed, vertical scale in tenths of meters

Post-Crash: The case vehicle came to rest on the northeast corner of the intersection facing northwest with the front of the case vehicle against the traffic signal pole (**Figure 3**).

CASE VEHICLE

The 2005 Toyota Tacoma PreRunner was a four-door, rear wheel drive, extended cab pickup truck (VIN: 5TEJU62N-----) equipped with a V6 engine, five-speed automatic transmission and four wheel, anti-lock brakes. The front seating row was equipped with bucket seats with adjustable head restraints, tilt steering column, dual stage driver and front right passenger air bags; driver and front right passenger manual, three-point, lap and shoulder safety belt systems with safety belt usage sensors, retractor mounted pretensioners and force limiters, and a front right passenger seat



Figure 3: Overview of location of two struck traffic signal poles, pole in foreground was broken off its base, pole in background was displaced, arrow shows case vehicle's area of final rest

position sensor. The back seating row was equipped with a bench seat with folding backs, adjustable head restraints and manual, three-point, lap-and-shoulder safety belts. The case vehicle was also equipped with an occupant detection system in the front right seat and a LATCH system for securing child safety seats. The case vehicle’s wheelbase was 325 centimeters (127.8 inches). The case vehicle’s mileage at the time of the inspection was 8,509 kilometers (5,288 miles).

The various sensors in the case vehicle’s advanced occupant restraint system analyze a combination of factors including the predicted crash severity, safety belt usage and the presence and seat track position of a front right passenger to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant weight sensor in the seat cushion determines if an occupant is on the seat and enables or suppresses deployment of the air bag based on the amount of weight on the seat.



Figure 4: Overview of damage to case vehicle from front right corner

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle’s impacts with the two metal traffic signal poles involved the front right portion of the case vehicle. The front bumper, grille and hood were directly damaged (Figure 4) and crushed rearward. The two damages could not be separated, so the totality of the damage from both impacts was measured. The direct damage began 29 centimeters (11.4 inches) left of the front right bumper corner and extended approximately 50 centimeters (19.7 inches) across the front bumper. Crush measurements were taken at the bumper and the maximum residual crush was measured as 60 centimeters (23.6 inches) occurring at C₅ (Figure 5). The table below shows the case vehicle’s crush profile.

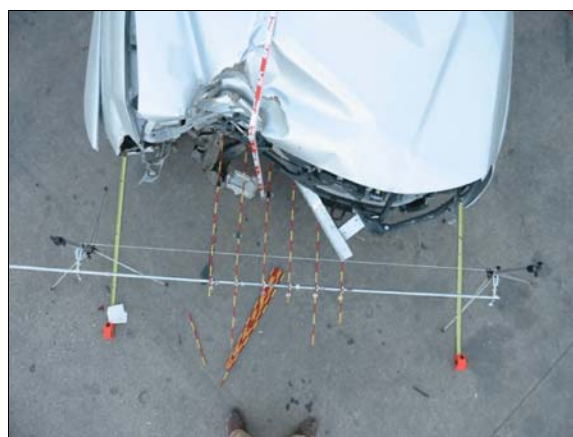


Figure 5: Top view of crush to case vehicle’s front bumper bar, each increment on measurement rods is 5 cm (2 in)

| Units | Event | Direct Damage | | Field L | C ₁ | C ₂ | C ₃ | C ₄ | C ₅ | C ₆ | Direct | Field L |
|-------|-------|---------------|-----------|---------|----------------|----------------|----------------|----------------|----------------|----------------|--------|---------|
| | | Width CDC | Max Crush | | | | | | | | ±D | ±D |
| cm | 1 | 50 | 60 | 64 | 0 | 14 | 34 | 52 | 60 | 53 | 26 | 0 |
| in | | 19.7 | 23.6 | 25.2 | 0.0 | 5.5 | 13.4 | 20.5 | 23.6 | 20.9 | 10.2 | 0.0 |

The case vehicle’s right side wheelbase was reduced 5 centimeters (2 inches). The left side wheelbase was extended 4 centimeters (1.6 inches). Induced damage involved the left portion of the front bumper, grille, hood and right fender. In addition, the windshield was cracked.

The case vehicle’s recommended tire size was: P245/75R16. The size of the case vehicle’s tires at the time of the crash is not known. The case vehicle’s tire data are shown in the table below.

| Tire | Measured Pressure | | Recommend Pressure | | Tread Depth | | Damage | Restricted | Deflated |
|------|-------------------|-----|--------------------|-----|--------------|-----------------------------|--------|------------|----------|
| | kpa | psi | kpa | psi | milli-meters | 32 nd of an inch | | | |
| LF | 0 | 0 | 200 | 29 | Unk | Unk | None | No | Yes |
| RF | Unk | Unk | 200 | 29 | Unk | Unk | None | No | No |
| LR | Unk | Unk | 200 | 29 | Unk | Unk | None | No | No |
| RR | Unk | Unk | 200 | 29 | Unk | Unk | None | No | No |

Vehicle Interior: Inspection of the case vehicle’s interior (**Figure 6**) revealed no occupant contact marks on any interior surfaces or components. The energy absorbing steering column appeared to be slightly compressed; however, no deformation of the steering wheel rim was observed (**Figure 7**). Lastly, there was no intrusion of the case vehicle’s passenger compartment.



Figure 6: Overview of instrument panel, steering wheel and windshield



Figure 7: Left side view of case vehicle’s steering wheel and steering column

Damage Classification: The impact with the two traffic signal poles occurred in the same area of the front of the case vehicle, and the two damages could not be separated. Therefore, one CDC was assigned to describe the totality of the damage. It was determined to be: **12-FZEW-3 (0-degrees)**. A second partially known CDC was assigned to account for the second impact. It was determined to be: **12-F999-9 (0 degrees)**.

The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's Delta Vs due to the overlapping damage from the two impacts. In addition, yielding object impacts are out-of-scope for the program. Based on the overall damage to the front of the case vehicle and the displacement of the first impacted traffic signal pole, this contractor estimates the crash severity of the first impact to be in a range of 19-27 km.p.h. (12-17 m.p.h). The crash severity of the impact with the second traffic signal pole was minor. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a certified advanced 208-compliant air bag system at the driver and front right passenger positions. The driver's air bag deployed in this crash. The front right passenger's air bag did not deploy in this crash.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag module cover flaps (**Figure 8**) or the air bag. The air bag module cover consisted of two cover flaps constructed of semi-pliable vinyl. The top flap was approximately rectangular in shape with angled upper corners. It was 13 centimeters (5.1 inches) in width and 7 centimeters (2.8 inches) in height. The deployed driver's air bag (**Figure 9**) was round with a diameter of approximately 62 centimeters (24.4 inches). The air bag was designed with two tethers, each approximately 6.5 centimeters (2.6 inches) in width and had two vent ports (**Figure 10**), each approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. Inspection of the air bag fabric revealed no evidence of occupant contact.



Figure 8: Case vehicle driver's air bag module cover flaps



Figure 9: Case vehicle driver's air bag



Figure 10: Arrows show locations of case vehicle's driver air bag vent ports

The front right passenger air bag was located in the middle of the instrument panel (Figure 11). The deployment of the front right passenger air bag was properly suppressed by the case vehicle's advanced occupant protection system because there was no front right passenger in the case vehicle at the time of the crash.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [35-year-old, White (non-Hispanic) male; 175 centimeters and 75 kilograms (69 inches, 165 pounds)] was seated in an upright driving position with both hands on the steering wheel, his left foot on the floor and his right foot on the accelerator. The driver's seat track was located in its middle position, the seat back was slightly reclined, and the tilt steering column was adjusted to its center position. The driver was not wearing glasses at the time of the crash.

The evidence observed during the vehicle inspection indicates the case vehicle's driver was not restrained by his manual, three-point, lap-and-shoulder safety belt system. The pretensioner had activated during the crash pulling the driver's safety belt tight and jamming it in the retracted position (Figure 12).

Just prior to the crash, the case vehicle's driver stated he steered right to avoid a car passing through the intersection. As a result, the driver most likely moved slightly to his left within his seat. He then most likely moved down, up and slightly forward in his seat as the case vehicle ran over the curb of the traffic island just prior to the first impact. The driver was also most likely bracing for the impact against the steering wheel with both arms. The case vehicle's front impact with the metal traffic signal pole caused the driver to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver's face, chest and left arm impacted his deployed air bag and both of his knees impacted the knee bolster. The impact with the air bag caused an abrasion over his right eye, two small lacerations on his nose, a laceration to his lower lip and three, 5 centimeter (2 inch) diagonal scratches on the inside of his left arm near the wrist. He also sustained bruises to both knees due to the impact



Figure 11: Overview of instrument panel, windshield and location of front right passenger's air bag, above glove box door



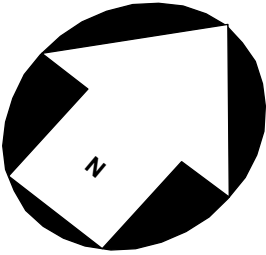
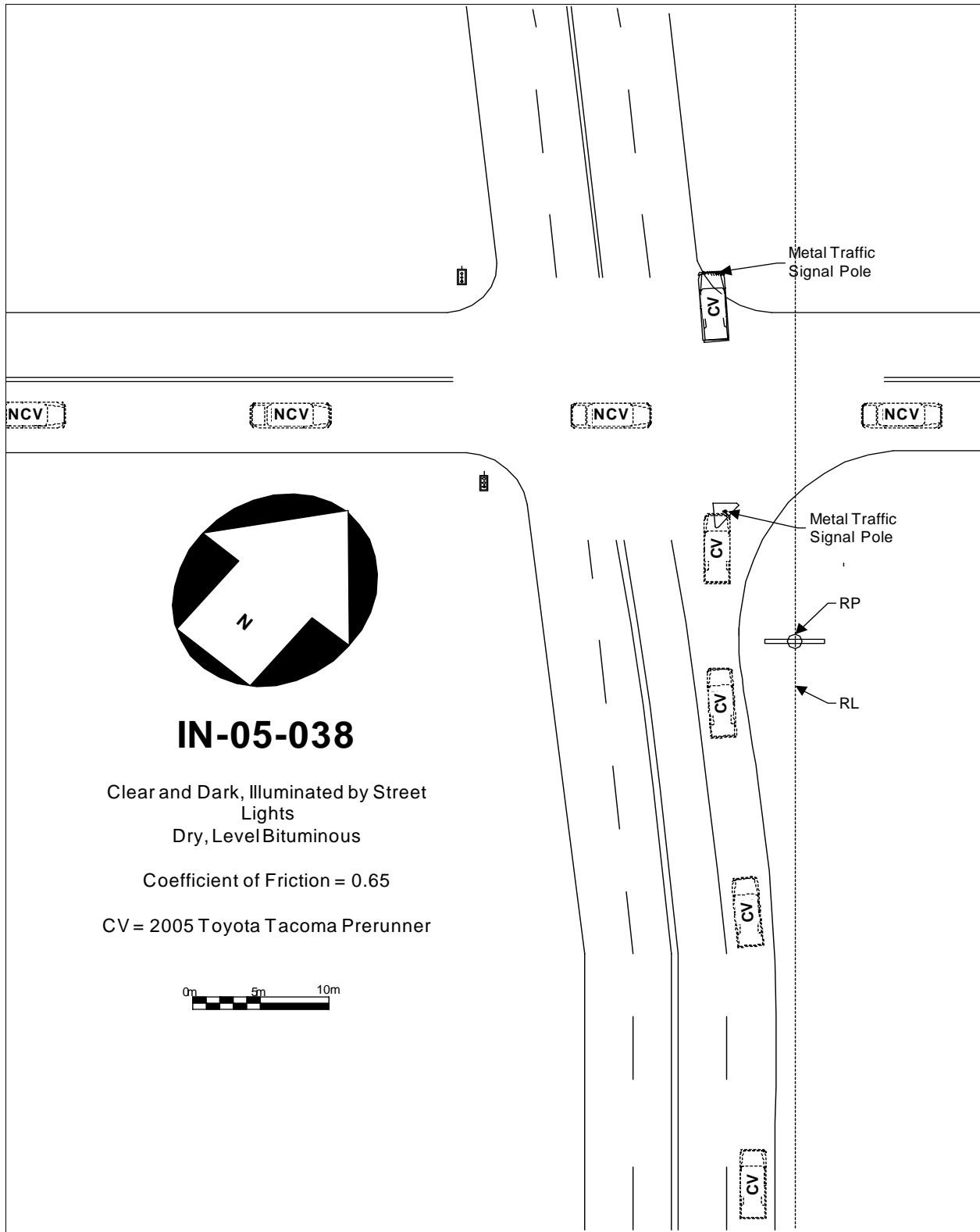
Figure 12: Case vehicle driver's safety belt jammed tightly in the retracted position indicating activation of the pretensioner

with the knee bolster. The driver most likely rebounded back into his seat and remained in his seat as the case vehicle crossed the intersection. The front impact with the second metal traffic signal pole caused the driver to continue forward opposite the case vehicle's 0 degree of principal force as the case vehicle decelerated to a stop. His chest likely impacted the now deflated air bag and underlying steering wheel. The driver was able to exit the case vehicle without assistance.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated that the driver sustained a "C" (possible) injury. The driver refused transport to the hospital. He sought no treatment for his injuries and missed five work days as a result of the crash. The table below shows the case vehicle driver's injuries and injury mechanisms.

| Injury Number | Injury Description (including Aspect) | NASS Injury Code & AIS 90 | Injury Source (Mechanism) | Source Confidence | Source of Injury Data |
|---------------|---|---------------------------|--|-------------------|---------------------------|
| 1 | Abrasion, 7.6 x 10.2 cm (3 x 4 in), over right eye | minor 290202.1,7 | Air bag, driver's | Probable | Interviewee (same person) |
| 2 | Lacerations {cuts} x 2 on nose, not further specified | minor 290602.1,4 | Air bag, driver's | Probable | Interviewee (same person) |
| 3 | Laceration {cut} lower {bottom} lip, not further specified | minor 290602.1,8 | Air bag, driver's | Probable | Interviewee (same person) |
| 4 | Lacerations {scratches} x 3, 5.1 cm (2 in), diagonally oriented, on anterior {inside} lower left forearm near wrist | minor 790602.1,2 | Air bag, driver's | Probable | Interviewee (same person) |
| 5 | Contusion {bruise}, 7.6 x 10.2 cm (3 x 4 in), left anterior knee, not further specified | minor 890402.1,2 | Knee bolster, driver's, left of steering column | Probable | Interviewee (same person) |
| 6 | Contusion {bruise}, 7.6 x 10.2 cm (3 x 4 in), right anterior knee, not further specified | minor 890402.1,1 | Knee bolster, driver's, right of steering column | Probable | Interviewee (same person) |



IN-05-038

Clear and Dark, Illuminated by Street Lights

Dry, Level Bituminous

Coefficient of Friction = 0.65

CV = 2005 Toyota Tacoma Prerunner

