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May 2018

Special Crash Investigations Remote Vehicle Fire/ Child Restraint System Investigation

Vehicle: 1995 Chevrolet Astro
Location: California
Crash Date: January 2012

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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 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 vehicles or their safety systems.

This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

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16. Abstract

The interest of this Remote Vehicle Fire/Child Restraint System (CRS) Investigation is the post-impact fire in a 1995 Chevrolet Astro involved in an angled crash with another vehicle, and the two child occupants of the Chevrolet who were seated in CRSs. This two-vehicle crash occurred within a four-leg intersection. The Chevrolet was being driven by a 20-year-old male and traveling northbound approaching the intersection. The front right seat was occupied by a 19-year-old female. The second row left seat was occupied by a 2-year-old male who was seated in a forward-facing CRS. The second row middle seat was occupied by a 1-year-old female who was seated in forward-facing CRS. A 1997 Ford F150 was being driven by a belted 42-year-old male and traveling eastbound approaching the intersection. As the Chevrolet entered the intersection it was struck on the left plane by the front plane of the Ford. Both vehicles were displaced in a northeast direction. They departed the roadway and came to rest in a dirt field. The Chevrolet caught on fire and sustained major fire damage. Both front row occupants of the Chevrolet sustained "K" (fatal) injuries and were declared deceased on scene by fire paramedics. Both second row occupants sustained "B" (other visible) injuries and were removed by passersby and transported by ambulance to a local hospital. The driver of the Ford sustained "B" (other visible) injuries and was transported by ambulance to a local hospital.

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Special Crash Investigations
Remote Vehicle Fire/Child Restraint System
Investigation Case Number: DS16025
Vehicle: 1995 Chevrolet Astro
Location: California
Crash Date: January 2012

BACKGROUND

The interest of this Remote Vehicle Fire/Child Restraint System (CRS) Investigation is the post-impact fire in a 1995 Chevrolet Astro (**Figure 1**) involved in an angled crash with another vehicle, and the two child occupants of the Chevrolet who were seated in CRSs. The investigation was intended to determine the events leading to the fire, how quickly the fire spread to the occupant compartment, the magnitude of the fire, how quickly EMS and other responders arrived on-scene, occupant restraint usage, injury and CRS data. The crash was identified during a review of Fatality Analysis Reporting System (FARS) crash reports. The case was initiated by the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration on December 19, 2016. The SCI team later obtained the police report and on-scene images.

Figure 1. 1995 Chevrolet Astro van (police photo)

This two-vehicle crash occurred within a four-leg intersection. The Chevrolet was being driven by a 20-year-old male and traveling northbound approaching the intersection. The front right seat was occupied by a 19-year-old female. The second row left seat was occupied by a 2-year-old male who was seated in a forward-facing CRS. The second row middle seat was occupied by a 1-year-old female who was seated in forward-facing CRS. A 1997 Ford F150 was being driven by a belted 42- year-old male and traveling eastbound approaching the intersection. As the Chevrolet entered the intersection it was struck on the left plane by the front plane of the Ford. Both vehicles were displaced in a northeast direction. They departed the roadway and came to rest in a dirt field. The Chevrolet caught on fire and sustained major fire damage.

Both front row occupants of the Chevrolet sustained “K” (fatal) injuries and were declared deceased on scene by fire paramedics. Both second row occupants sustained “B” (other visible) injuries and were removed by passersby and transported by ambulance to a local hospital. The driver of the Ford sustained “B” (other visible) injuries and was transported by ambulance to a local hospital.

SUMMARY

Crash Site

This crash occurred at 2038 hours within an unlit four-leg intersection. The north/south roadway was straight and level. It had one lane of travel for each direction that were separated by solid/dashed yellow lines. The traffic lanes were bordered by dirt shoulders. Northbound and southbound traffic was controlled by posted stop signs. There were yellow "Cross Traffic Does Not Stop" warning signs posted just below the stop signs on the posts. The east/west roadway was straight and level. It had one lane of travel for each direction that were separated by solid/dashed yellow lines. The traffic lanes were bordered by dirt shoulders. The speed limit in all directions was 89 km/h (55 mph). It was dark at the time of the crash and there were no streetlights present.

Conditions at the time of the crash as reported by the nearest reporting station was 30 degrees C (86 degrees F), 18 percent humidity, 16 km (10 miles) visibility, and winds were out of the north northwest at 14.8 km/h (9.2 mph). A crash diagram is included on page 10.

Pre-Crash

The Chevrolet was being driven by a 20-year-old male and traveling northbound approaching the intersection. The front right seat was occupied by a 19-year-old female. The restraint usage for the front row occupants could not be determined. The second row left seat was occupied by a 2-year-old male who was seated in a forward-facing CRS. The second row middle seat was occupied by a 1-year-old female who was seated in forward-facing CRS. The Ford was being driven by a belted 42-year-old male and traveling eastbound approaching the intersection. The Chevrolet entered the intersection without stopping. The driver of the Ford reported that he saw the Chevrolet but was unable to stop in time.

Crash

The front plane of the Ford struck the left plane of the Chevrolet. The impact speed was calculated as 121 km/h (75 mph) for the Ford and 61 km/h (47 mph) for the Chevrolet using a conservation of linear momentum calculation (**Figure 2**). The after- impact speeds were calculated using average coefficients of friction. Both vehicles were displaced in a northeast direction. They departed the roadway and came to rest in a dirt field.

$$V2 = \frac{W1 \times V3 \times SinT}{W2 \times Sin?} + \frac{V4 \times SinF}{Sin?}$$

V1 = The Speed of Veh 1 in MPH.
V2 = The Speed of Veh 2 in MPH.
V3 = The Spd After Impact, Veh 1.
V4 = The Spd After Impact, Veh 2.

$$V2 = \frac{3721.00 \times 52.30 \times -0.93}{5435.00 \times -1.00} + \frac{46.47 \times -0.90}{-1.00}$$

$$V2 = \frac{-181666.84}{-5435.00} + \frac{-42.11}{-1.00}$$

W1 = The Wt of Veh 1 in Pounds.
W2 = The Wt of Veh 2 in Pounds.
T = The Departure Angle(°), Veh 1.
F = The Departure Angle(°), Veh 2.
? = The Approach Angle(°), Veh 2.

V2 = 33.42 + 42.11
V2 = 75.53

$$V1 = V3 \times CosT + \frac{W2 \times V4 \times CosF}{W1} - \frac{W2 \times V2 \times Cos?}{W1}$$

$$V1 = 52.30 \times 0.35 + \frac{5435.00 \times 46.47 \times 0.42}{3721.00} - \frac{5435.00 \times 75.53 \times 0.00}{3721.00}$$

$$V1 = 52.30 \times 0.35 + \frac{106733.73}{3721.00} - \frac{0.00}{3721.00}$$

V1 = 18.73 + 28.68 - 0.00
V1 = 47.41

Figure 2. Conservation of linear momentum calculation

Post-Crash

Two passersby traveling in the same vehicle arrived on scene 4 to 5 minutes after the crash. The time between the crash and their arrival was based on information the passersby obtained later from the Ford driver. As they arrived they saw that a fire had started in the engine compartment and was spreading under the Chevrolet. They exited their vehicle and noted that the driver of the Ford was dazed but not in any distress. They heard children crying and went to the Chevrolet. They noted that the front row passengers appeared deceased and the children in the second row were crying. The second row left door was jammed shut and the glazing disintegrated. Both CRSs were tilted to the right and jammed against one another due to left side intrusion. One of the passersby was able to reach through the second row left window and remove the female second row middle occupant after unlatching the CRS harness. The other passerby cut both the CRS harness straps and the vehicle safety belt before removing the male second row left occupant. It took approximately 4 to 5 minutes to remove both children. Seconds after removing the male child, the vehicle became fully involved in flames. The passersby estimated the time from the crash to the vehicle being fully on fire was 8 to 10 minutes.

SCI obtained a copy of an interagency report of incident and dispatch action from the responding fire department which documented dispatch, arrival and departure times for fire personnel. Fire personnel arrived 10 minutes after the crash and extinguished the fire. The vehicle was fully consumed upon their arrival.

	Engine 1	Engine 2	EMS
Incident call received	2040	2040	2040
Dispatched	2041	2041	2050
Enroute	2043	2043	2050
On Scene	2048	2049	Not reported
Return to Quarters	2233	2121	Not reported
Available	2240	2133	2125
Scene Cleared	2250	2250	2250

Source: Interagency Report of Incident and Dispatch Action

Both front row occupants of the Chevrolet sustained “K” (fatal) injuries and were declared deceased on scene by fire paramedics. The cause of death for the driver was head and chest trauma due to blunt impact. The cause of death for the front right occupant was head injury due to blunt impact. Both second row occupants sustained “B” (other visible) injuries and were transported by ambulance to a local hospital. The driver of the Ford sustained “B” (other visible) injuries and was transported by ambulance to a local hospital.

1995 CHEVROLET ASTRO VAN

Description

The 1995 Chevrolet Astro 8-passenger van was identified by the license plate number. The Chevrolet was configured with a 4.3-liter 6-cylinder gasoline engine, automatic transmission, and rear wheel drive.

Exterior Damage

Exterior images of the Chevrolet taken by the police were used to conduct a partial exterior vehicle inspection. The Chevrolet sustained moderate left plane damage from the impact with the front plane of the Ford (**Figure 3**). The Collision Deformation Classification (CDC) was 10LYEW3. The vehicle also sustained moderate damage to the left, top, and right planes due to the fire (**Figure 4**).

Figure 3. Left side damage, 1995 Chevrolet Astro (police photo)

Figure 4. Burn damage, 1995 Chevrolet Astro (police photo)

NHTSA Recalls and Investigations

A search using the year/make/model revealed seven recalls and three investigations. Three of the recalls were fuel-system-related. NHTSA Campaign Number 94V188000 indicated the fuel lines attached to the fuel tank were not properly tightened and this could cause a fire. In this crash, the source of the fire was restricted to the front of the vehicle, though there was fire damage to the interior and all planes. Campaign Number 06E041000 indicated that certain replacement fuel return lines have a bleed valve that was not installed at the proper torque. It is not known if this vehicle had the replacement return lines. Campaign Number 06E043000 indicated that certain replacement fuel filters were not manufactured to specification and the O-ring might not seat correctly on the fuel line. It is not known if the vehicle used the replacement fuel filter.

Interior Damage

The interior of the Chevrolet was configured with seating for eight occupants. The front row was configured with box-mounted type seats. The second and third rows were configured with bench seats with folding backs. The vehicle sustained moderate left side damage due to lateral intrusion. The entire interior was consumed by fire with the seats being burned down to their metal frames.

Manual Restraint Systems
The Chevrolet was equipped with manual lap and shoulder safety belts for all eight seat positions. The seat belt usage for the front row occupants is not known. The second row left and center safety belts were used in conjunction with two CRSs.

Supplemental Restraint Systems
The Chevrolet was equipped with a driver frontal air bag. It is unknown if the air bag deployed.

Child Restraint Systems
The two children in the second row were seated in forward facing CRSs that were secured to the vehicle using the vehicle's lap and shoulder safety belts. This information is based on passersby statements. No information on the CRSs was available for this report. It is unknown if the children met the age, height and weight parameters for these seats or if the CRSs were used correctly.

1995 CHEVROLET ASTRO VAN OCCUPANTS

Driver Demographics

Age/Sex:	20 years/male
Height:	178 cm (70 in)
Weight:	91 kg (200 lbs)
Eyewear:	Unknown
Seat type:	Box mounted
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder belt usage unknown
Usage source:	Unknown
Air bags:	Frontal air bag available, unknown if deployed
Alcohol/drug data:	Tested negative for alcohol, positive for cannabinoids
Egress from vehicle:	Removed due to fatal injuries
Transport from scene:	Transferred to coroner's office
Type of medical treatment:	None. Pronounced on scene at 2050 hours

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	2nd or 3rd degree burn involving entire body; partial or full thickness $90%; perimortem	912032.6	Fire	Certain
2	Linear fracture of the base of the middle cranial fossa separating frontal and sphenoid bone (hinge fracture)	150206.4	A-pillar	Possible
3	Radiating fracture, right occipital and right parietal	150400.2	Occupant 2	Possible

4	Subdural/subarachnoid hemorrhage, base of brain	140693.2	A-pillar	Possible
5 6	Left pulmonary artery laceration (750 mL blood left, 600 mL blood right), left and right hemothorax	421004.3 442200.3	Door	Probable
7	Fracture, left rib 1, posterior	450201.1	Door	Probable
	Extremity injuries masked by thermal damage	NA	NA	NA

Source: Autopsy report

Driver Kinematics

The 20-year-old male driver of the Chevrolet was seated in an unknown posture. It is not known if he was using the available lap and shoulder belt. The driver was displaced forward and to the left at impact with the Ford. He likely contacted the intruding driver's door and possibly the left A- pillar. Passersby indicated that they believed the driver was deceased upon their arrival. The vehicle caught on fire and the interior was completely consumed.

Front Right Passenger Demographics

Age/Sex:	19 years/female
Height:	152 cm (59 in)
Weight:	61 kg (134 lbs)
Eyewear:	Unknown
Seat type:	Box mounted
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder belt usage unknown
Usage source:	Unknown
Air bags:	None
Egress from vehicle:	Removed due to fatal injuries
Transport from scene:	Transferred to coroner's office
Type of medical treatment:	None. Pronounced on scene at 2050 hours

Front Right Passenger Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	2nd or 3rd degree; partial or full thickness 90%; perimortem	912032.6	Fire	Certain
2	Slight tonsillar herniation	140202.5	Occupant 1	Possible
3	Fracture, middle cranial fossa	150000.2	Occupant 1	Possible
4	Subdural hemorrhage, right parietoccipital lobes	140629.3	Occupant 1	Possible

Source: Autopsy report

Front Right Passenger Kinematics

The 19-year-old female front right of the Chevrolet was seated in an unknown posture. It is not known if she was using the available lap and shoulder belt. At impact with the Ford she was displaced forward and to the left. Passersby indicated that they believed that this passenger was deceased upon their arrival. The vehicle caught on fire and the interior was completely consumed.

Second Row Left Passenger Demographics

Age/Sex:	2 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bench with folding back
Manual restraint usage:	Lap and shoulder belt used with CRS
Usage source:	Passersby, police
Egress from vehicle:	Removed through second row left window by passersby
Transport from scene:	Ambulance

Type of medical treatment: Treated and released

Second Row Left Passenger Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Facial abrasions	210202.1	Flying glass	Probable

Source: Police report

Second Row Left Passenger Kinematics

The 2-year-old male second row left passenger was seated in a forward-facing CRS. The CRS was anchored to the Chevrolet using the vehicle's lap and shoulder belt. At impact with the Ford, he was displaced forward and to the left. The CRS was displaced to the right due to intrusion. The left side glass disintegrated and he probably sustained the facial abrasion from the flying glass. The child remained in the CRS as the vehicle came to rest. One of the passersby cut both the CRS harness straps and the vehicle safety belt before removing him through the second row left window.

Second Row Middle Passenger Demographics

Age/Sex:	1 year/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bench with folding back
Manual restraint usage:	Lap and shoulder belt used with CRS
Usage source:	Passersby, police
Egress from vehicle:	Removed through second row left window by passersby
Transport from scene:	Ambulance
Type of medical treatment:	Treated and released

Second Row Middle Passenger Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Facial abrasions	210202.1	Flying glass	Probable

Source: Police report

Second Row Middle Passenger Kinematics

The 1-year-old female second row middle passenger was seated in a forward-facing CRS. The CRS was anchored to the Chevrolet using the vehicle's lap and shoulder belt. At impact with the Ford, she was displaced forward and to the left. The CRS was displaced to the right due to intrusion and contact with the other CRS. The left side glass disintegrated and she probably sustained the facial abrasion from the flying glass. The child remained in the CRS as the vehicle came to rest. One of the passersby was able to unfasten the CRS harness and removed the child through the second row left window.

1997 FORD F150 PICKUP

Description

The 1997 Ford F150 supercab pickup was identified by the license plate number.

Exterior Damage

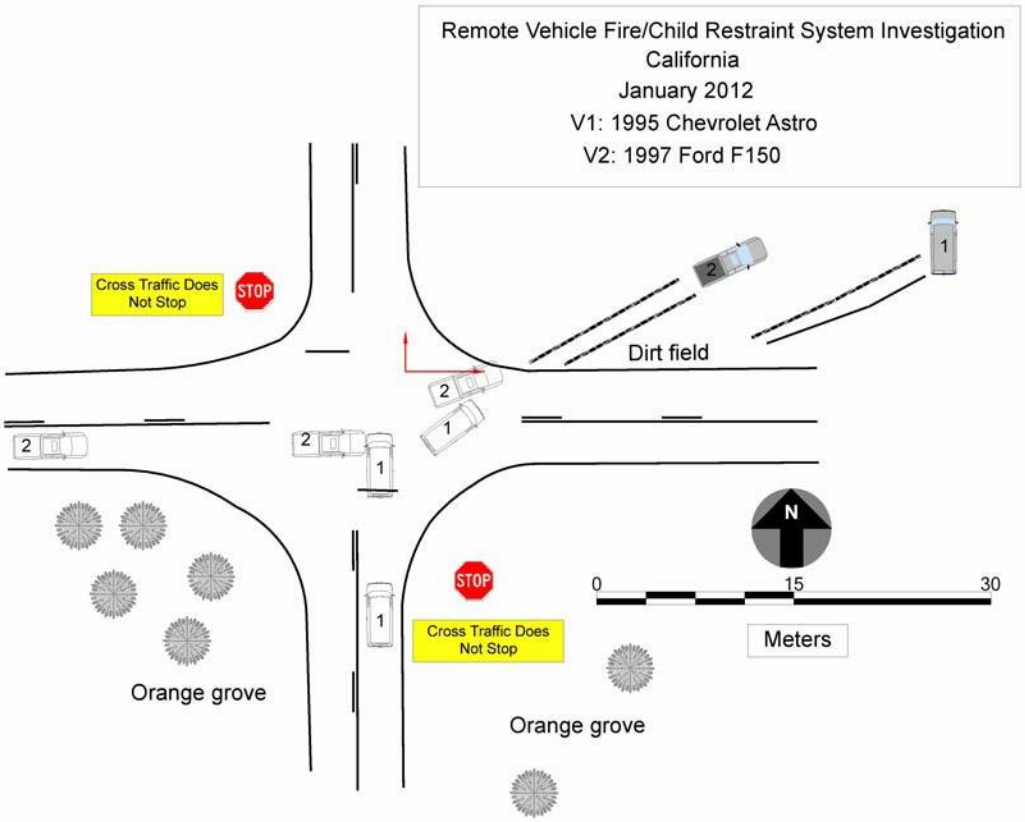
The Ford sustained moderate front plane damage from the impact with the Chevrolet (**Figure 4**). The CDC was 01FDEW1. The vehicle was towed due to damage.

Figure 5. 1997 Ford F150 (police photo)

Occupant Data

The 42-year-old male driver of the Ford was reported by passersby to be unconscious/dazed shortly after the crash. According to the police he sustained a bloody nose and complained of pain to his head, chest, arms, and feet. Police detected the presence of alcohol and administered a blood alcohol test which indicated that the blood alcohol concentration was below .08 grams per deciliter. The driver was determined not to be under the influence of alcohol. He was transported by ambulance to a local hospital for treatment.

CRASH DIAGRAM



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