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TRANSPORTATION SCIENCES CENTER
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Division of Arvin/Calspan
[redacted]

CALSPAN REMOTE AIR BAG DEPLOYMENT INVESTIGATION

CALSPAN CASE NO. 93-4

VEHICLE - 1992 VOLVO 960
LOCATION - [redacted]
ACCIDENT DATE - [redacted] 1992

Contract No. DTNH22-93-C-07222

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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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15. *Supplementary Notes* Remote investigation of a minor severity air bag deployment crash that resulted in fractures of the driver's left forearm.		

16. *Abstract*

This remote investigation focused on a single vehicle roadside departure crash that involved a 1992 Volvo 960 equipped with a Supplemental Restraint System (SRS). All data for this report was obtained from extensive interviews with the driver. She refused to provide Calspan with copies of her medical records and the SRS components that were replaced on her vehicle.

The driver stated that her vehicle slid on an icy road surface as she approached her residence and impacted a tree with the left front bumper area which resulted in minor vehicle damage. The SRS deployed following the impact sequence. She was wearing the manual 3-point lap and shoulder belt system.

As a result of air bag deployment, the driver sustained fractures of the left wrist, ulna, and elbow from her probable involvement with the air bag module cover flaps. In addition, she sustained an abrasion/friction burn of the left anterior forearm.

17. *Key Words* Minor frontal impact sequence Sufficient longitudinal deceleration Supplemental Restraint System (SRS) Forearm fractures	18. *Distribution Statement* General Public		
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CALSPAN REMOTE AIR BAG DEPLOYMENT INVESTIGATION
CALSPAN CASE NO. 93-4
VEHICLE - 1992 VOLVO 960
LOCATION - [redacted], MN

SUMMARY

This single vehicle roadside departure crash occurred on a two lane residential street in [redacted], MN on [redacted] 1992, during daylight hours. The road surface was icy and was covered with a layer of light snow. The vehicle was a 1992 Volvo 960 station wagon that was equipped with a Supplemental Restraint System (SRS) that consisted of a driver's side air bag system and pyrotechnic pretensioners in the front outboard manual 3-point lap and shoulder belt systems. The vehicle was owned and driven by a 42 year old female with a stated height of 162.6 cm (64") and weight of 58.5 kg (130 lbs.). She provided extensive interview data regarding the crash and her resultant injuries; however, she refused to provide copies of her medical records to confirm the severity of the injuries and the replaced components of the SRS.

The driver stated that she was returning to her residence and was approximately 15 m (50') from her driveway when she stopped her vehicle for a neighbor who was attempting to back into his driveway. A utility company truck was parked on the street and was blocking the right travel lane. The driver stated that as she attempted to maneuver around the truck, her vehicle began to slide to the left on the icy road surface. She initiated a clockwise steering input; however, the vehicle continued to slide toward the left curbline.

The left front bumper area of the Volvo impacted a large diameter tree which resulted in minimal damage to the bumper facia and compression of the bumper energy absorbing device (EAD). The vehicle underwent a sufficient longitudinal deceleration from the 12 o'clock impact force which deployed the SRS. At impact the driver stated that she was wearing the manual 3-point belt system and was in a normal driving position with both hands on the steering wheel rim. She estimated her hand positions at the 1-2 o'clock and 4 o'clock sectors due to the clockwise steering maneuver. As the driver's side air bag system deployed, the air bag module cover flaps probably contacted the anterior aspect of the driver's left forearm which resulted in an abrasion (AIS-1) to the forearm and fractures (AIS-2) of the left wrist, ulna, and elbow. The deploying air bag displaced the driver's left arm rearward into her face which produced a minor nose bleed. In addition, the driver loaded the manual belt system as she responded to the minor severity frontal impact. Her loading force and spool-up of the pyrotechnic pretensioners resulted in minor pain across the ribs. Immediately following the crash, the driver noted a smoke-like substance within the vehicle (SRS deployment) and reached with her left hand to unfasten the manual belt system. She stated that the movement of the left arm set off tremendous pain in the left elbow area. The driver was assisted from the vehicle by a neighbor and was transported to a local hospital where she was admitted for surgical repair of the fractures.

The vehicle sustained minimal damage and was repaired at a driver stated cost of $3,000. Inclusive of the repairs were replacement of the SRS crash sensor, the steering wheel clockspring assembly, air bag module assembly, and the front 3-point seat belt systems complete with the pyrotechnic pretensioners.

CALSPAN REMOTE AIR BAG DEPLOYMENT INVESTIGATION
CALSPAN CASE NO. 93-4
VEHICLE - 1992 VOLVO 960
LOCATION - [redacted], MN

ACCIDENT DATA

Location:	Local street
City/Township:	[redacted], MN
Area/Type:	Urban/Residential
Accident Date/Time:	[redacted] 1992, daylight hours
Accident Type:	Car/Tree, left frontal impact sequence
Air Bag Vehicle Driver Injury Severity:	Moderate (AIS-2)

AMBIENCE

Viewing Conditions:	Daylight
Weather:	Overcast
Precipitation:	Light snow
Road Surface:	Snow covered ice

HIGHWAY

Type:	Local street
Number of Lanes:	2
Median:	None
Vertical Alignment:	Level
Horizontal Alignment:	Straight
Superelevation:	Normal crown
Traffic Density:	Light
Traffic Controls:	None

VEHICLE

Description:	1992 Volvo 960 station wagon
V.I.N.:	Unknown
Color:	White
Odometer:	Unknown
Manual Restraints:	3-point lap and shoulder belts in the four outboard seated positions, center rear lap belt (unknown if equipped with third seat)
Automatic Restraints:	Supplemental Restraint System (SRS) that consisted of a driver's side air bag and pyrotechnical pretensioners in the front outboard 3-point manual belt systems. The SRS deployed as a result of a minor severity frontal crash with a tree.
Defects:	None reported

VEHICLE DAMAGE

Exterior: The driver reported that the left frontal area of the Volvo impacted a tree that was located immediately outboard of the left curbline and approximately 15 m (50') from her driveway. She stated that the front bumper facia was scuffed in the area below the left headlamp assembly and that the bumper reinforcement bar was slightly deformed in a rearward direction.

The body shop that repaired the vehicle replaced the bumper facia, bumper reinforcement bar, and the left bumper energy absorbing device. There was no additional damage to the exterior of the vehicle.

CDC: 12-FLEN-1 (estimated)

Interior: Damage to the interior of the vehicle was limited to deployment of the SRS. There was no occupant related damage or contact evidence reported by the driver. The body shop replaced the interior mounted crash sensor, the steering wheel clockspring assembly, the air bag module assembly, and the front seat belt systems.

The total repair cost for both the exterior and interior components was reported by the driver as $3,000.

COLLISION SEQUENCE

Pre-Crash: The driver stated that she was returning to her residence and stopped in the roadway for a neighbor who was attempting to back into his driveway. A utility company truck was parked on the street and was blocking the right travel lane. The driver stated that the road surface was icy from melting snow and that light snow had covered the icy surface.

As she attempted to maneuver around the utility company truck and traveled approximately 15 m (50') toward her driveway, the driver reported that the vehicle began to slide on the icy surface toward the left curbline, following the crown in the roadway. She attempted to steer in a clockwise direction; however, the vehicle continued to slide toward the left curbline.

Crash: The left frontal area of the bumper facia impacted a tree located directly outboard of the curbline. The 12 o'clock direction of force impact compressed the left front bumper energy absorbing device (EAD) and slightly deformed the bumper reinforcement bar. As a result, the vehicle underwent a sufficient longitudinal deceleration which deployed the Supplemental Restraint System. Based on the driver-described vehicle damage, the Volvo probably sustained a velocity change that was within the 11-14 KPH (7-9 mph) range.

Post-Crash: The vehicle came to rest against the struck tree. The driver detected a smoke-like substance within the vehicle and immediately attempted to exit the vehicle. A neighbor assisted her from the vehicle and she was transported to a local hospital for treatment of her injuries.

SUPPLEMENTAL RESTRAINT SYSTEM

The 1992 Volvo 960 was equipped with a Supplemental Restraint System (SRS) that consisted of a driver's side air bag, driver's side knee bolster, and pyrotechnical seat belt tensioners in the front 3-point lap and shoulder belt systems. The SRS was activated as a result of the Volvo's minor left frontal impact sequence with a tree.

Based on previous investigations, these module cover flaps open in an H-configuration at designated tear points. The upper flap typically measures 7 cm (2.75") vertically x 19.1 cm (7.5") horizontally while the lower flap has respective measurements of 6.4 cm (2.5") and 19.1 cm (7.5"). The module cover flaps were reinforced with sheetmetal laminated within the vinyl cover. The sheetmetal resulted in a rigid flap which probably contributed to the severity of the driver's forearm injuries. She reported that there was no damage to the rigid flaps or to the air bag.

HUMAN FACTORS/OCCUPANT DATA

Driver:	42 year old female
Height:	162.6 cm (64")
Weight:	58.5 kg (130 lbs.)
Manual Restraint System Usage:	3-point lap and shoulder belt system with pyrotechnic pretensioners
Usage Source:	Driver interview
Eyewear:	None reported
Vehicle Familiarity:	Approximately one year
Route Familiarity:	Daily, crash occurred in front of residence
Trip Plan:	Returning to residence
Mode of Transport From Scene:	Ambulance
Type of Medical Treatment:	Admitted to local hospital for treatment of left arm fractures

DRIVER INJURIES

Injury	Severity (OIC/AIS)	Probable Injury Source
Fracture of the left wrist	Moderate (751800.22)	Air bag module cover flap
Fracture of the left ulna	Moderate (753200.22)	Air bag module cover flap
Fracture of the left elbow	Moderate (751800.22)	Air bag module cover flap
Abrasion/friction burn to the anterior aspect of left forearm	Minor (790202.12)	Air bag module cover flap

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The injuries were stated by the driver and were not verified by medical records.

DRIVER KINEMATICS

The driver of the 1992 Volvo stated that she was in a normal driving position with both hands positioned on the steering wheel rim as she attempted to turn left into her driveway. She was wearing a heavyweight winter parka that consisted of several layers of denim with a flannel lining. The driver further stated that she was wearing a watch on her left wrist and that the parka had several riveted buttons on each sleeve.

As she attempted to maneuver around the utility truck, the vehicle slid to the left and the driver applied a clockwise steering input in an attempt to regain control of the vehicle. At impact with the tree, the driver estimated that her right hand was at the 4 o'clock position on the steering wheel rim while her left hand was at the 1-2 o'clock position, with her left forearm extended across the air bag module. The SRS deployed as a result of the tree impact. The driver stated that the pyrotechnic seat belt pre-tensioner held her firmly against the left front seat back. The air bag module cover flaps probably contacted the anterior aspect of her left forearm which resulted in fractures of the left wrist, ulna, and elbow. In addition, the driver stated that she sustained an abrasive type friction burn to the anterior aspect of her left forearm. The deploying air bag subsequently displaced her left arm into her face which resulted in a minor nose bleed.

Immediately following the minor severity crash, the driver stated that she noted a smoke-like substance within the vehicle and reached with her left hand to unfasten the manual belt system. She reported that the arm movement set off tremendous pain in the left elbow area. The driver was assisted from the vehicle by a neighbor and was transported to a local hospital for treatment of her arm injuries.

In addition to the left arm fractures, the driver stated that her ribs were sore for several days from her involvement with the pyrotechnic seat belt system. She also complained of a ringing in the ears that persisted for several hours after the crash. The driver reported that the air bag had separated the watch from her left wrist and that two of the riveted buttons were separated from the left sleeve of the parka.

The driver stated that she has had two separate surgeries on her left forearm and that the arm was fitted with a tension wire system to ensure proper healing of the elbow fracture. She estimated that her medical expenses have exceeded $15,000 to date and that an additional surgery may be required in the near future. The driver also projected a monthly loss of earnings of $12-15,000 due to the injuries.