TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION

Veridian/Calspan Operations
Buffalo, New York 14225

CALSPAN REMOTE SIDE IMPACT AIR BAG DEPLOYMENT INVESTIGATION

CALSPAN CASE NO. CA98-013

VEHICLE - 1998 VOLVO S90

LOCATION - FLORIDA

CRASH DATE - DECEMBER, 1997

Contract No. DTNH22-94-07058

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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 of the involved vehicle(s) or their safety systems.

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17. *Abstract*

This remote investigation focused on the injury mechanisms and deployment characteristics of a 1998 Volvo S90, 4 door sedan, equipped with a Supplemental Restraint System (SRS). The vehicle's SRS consisted of a dual front air bags and a Side Impact Protection System (SIPS) that consisted of front seat mounted side impact air bags. The Volvo's front SRS and left side impact air bag deployed as a result of an intersection crash with a 1997 Nissan Pathfinder.

The 1997 Nissan Pathfinder was traveling north in the outboard lane approaching the intersection. The 1998 Volvo S90 was westbound, initially stopped at the intersection for the red traffic signal. Upon the change of the traffic signal to green for east/west traffic, the westbound Volvo accelerated into the intersection intending to turn left (south). The crash occurred when the Nissan entered the intersection against the red traffic signal. The front plane of the Nissan impacted the left side plane of the Volvo in a 12 o'clock/9 o'clock impact configuration. The force of the impact deployed both the frontal SRS and left SIPS of the Volvo. The impact caused the Volvo to rotate counterclockwise and slide to rest in the intersection, straddling the center and inboard northbound lanes, facing southwest. The Nissan rotated counterclockwise and came to rest straddling the center and outboard northbound lanes, facing northwest. The police report estimated the speed of the Nissan was 40 to 48 km/h (25 to 30 mph). The 16 year old female driver of the Volvo was restrained and suffered (police reported) non-incapacitating injuries.

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VEHICLE: 1998 VOLVO S90

CALSPAN CASE NO. CA98-13
LOCATION: FLORIDA
CRASH DATE: DECEMBER, 1997

BACKGROUND

This remote investigation focused on the injury mechanisms and deployment characteristics of a 1998 Volvo S90, 4 door sedan, equipped with a Supplemental Restraint System (SRS). The vehicle's SRS consisted of a dual front air bags and a Side Impact Protection System (SIPS) that consisted of front seat mounted side impact air bags. The Volvo's front SRS and left side impact air bag deployed as a result of an intersection crash with a 1997 Nissan Pathfinder. NHTSA was informed of the crash through the GES system on March 9, 1998 and assigned an investigation of the crash to the Special Crash Investigation (SCI) Team at Calspan on the same day. A remote investigation was conducted as the initial investigation revealed the Volvo had been repaired prior to SCI notification.

SUMMARY

This two vehicle crash occurred in the afternoon hours of December, 1997. At the time of the crash, it was daylight and there was no adverse weather; the roads were dry. The crash occurred at the intersection of a five lane north/south roadway and a two lane east/west roadway. The northbound lanes of the primary road were three lanes in width, with the inboard lane designated as left turn only. The intersection was controlled by standard (red/amber/green) traffic signals. The speed limit in the area of the crash was 72 km/h (45 mph).

The 1997 Nissan Pathfinder was traveling north in the outboard lane approaching the intersection. (It should be noted the police report indicated the striking vehicle was a 1994 Nissan Altima. Records from the insurance company indicated the insured vehicle in the crash was a Nissan Pathfinder.) The 1998 Volvo S90 was westbound, initially stopped at the intersection for the red traffic signal. Upon the change of the traffic signal to green for east/west traffic, the westbound Volvo accelerated into the intersection intending to turn left (south). The crash occurred when the Nissan entered the intersection against the red traffic signal. The front plane of the Nissan impacted the left side plane of the Volvo in a 12 o'clock/9 o'clock impact configuration. The force of the impact deployed both the frontal SRS and left SIPS of the Volvo. The impact caused the Volvo to rotate counterclockwise and slide to rest in the intersection, straddling the center and inboard northbound lanes, facing southwest. The Nissan rotated counterclockwise and came to rest straddling the center and outboard northbound lanes, facing northwest. The police report estimated the speed of the Nissan was 40 to 48 km/h (25 to 30 mph).

The Volvo was driven by a 16 year old female. The police report indicated she was restrained by the 3-point lap and shoulder belt and suffered non-incapacitating injuries. The insurance company reported the driver's injuries consisted primarily of left side contusions. The driver of the Nissan was a 47 year old female and was not injured in the crash.

AIR BAG VEHICLE

The 1998 Volvo S90, 4-door sedan, was identified by a Vehicle Identification Number (VIN) of YV1KS9601W1 (production sequence deleted). The vehicle was equipped with a 2.9 liter, V-6 engine linked to a four-speed automatic transmission. The braking system consisted of power assist, four-wheel disc brakes with an anti-lock braking system (ABS). The vehicle's mileage at the time of the crash was 7,424 km (4,613 miles).

The Volvo's manual restraint system was comprised of 3-point lap and shoulder belts for the five seating positions. The front restraints were equipped with automatic pre-tensioners. The vehicle's Supplemental Restraint System (SRS) consisted of frontal air bags for the driver and right front passenger. The vehicle was also equipped with Volvo's patented Side Impact Protection System (SIPS) - an integrated protection system designed to dissipate the energy of a side impact through the structural members of the occupant compartment. Additionally, the vehicle was equipped with the SIPS BAG, a side impact air bag designed into the outboard aspect of the front seat backs. The air bag was seat-mounted to ensure the proper geometry relative to the occupant regardless of seat track position.

VEHICLE 2

The 1997 Nissan Pathfinder was identified by the Vehicle Identification Number (VIN): JN8AR05Y9VW (production sequence deleted). The vehicle was equipped with a 2.4 liter, V-6 engine linked to a 5-speed manual transmission. The vehicle was equipped with 4-wheel drive. The brake system was a standard front disc/rear drum hydraulic system. The vehicle was not ABS equipped. The Nissan was equipped with a manual 3-point restraint system; it was not equipped with a Supplemental Restraint System. The odometer read 5,954 km (3,700 miles) at the time of the crash.

The repair record for the Nissan, obtained from the insurance company, indicated the total cost for the vehicle's repair (parts and labor) was approximately $7,865. The major vehicle components replaced as a result of the crash were: the front bumper, bumper cover and bumper mounts, grille, headlamp assemblies, radiator and radiator support, left and right front fenders, and hood. There were no photographs available of the damaged Nissan.

AIR BAG VEHICLE DAMAGE

Figures 1 through 3 are the left front, left rear and left side views of the damaged 1998 Volvo S90. The insurance company's repair estimate for the Volvo indicated the total cost of the Volvo's repair (parts and labor) was approximately $21,800. Investigation revealed, the Volvo was repaired and subsequently sold, it was not available for inspection. The replaced exterior components included the left front quarter panel, left front and rear doors, and the left rear quarter panel. The damaged structural body components replaced included: the center floor member, center rocker panel, center pillar (B-pillar), and roof member. The interior components replaced included the windshield, left window glazings, instrument panel, left front seat, and the Supplemental Restraint System. The specific components of the SRS replaced were the driver air bag module, front passenger air bag module, clock spring, front air bag impact sensor and left side air bag module. Neither the front nor rear suspension required repair, other than realignment.

Figure 1: Left front view of the 1998 Volvo S90.

Figure 2: Left rear view of the Volvo.

Figure 3: View of the left side damage.

The direct contact damage to the Volvo S90 was centered between the vehicle's axles and was approximately 190 cm (75 in) in width. The maximum lateral deformation was estimated to be 25 cm (10 in) and occurred approximately at the B-pillar. The Collision Deformation Classification (CDC) of the vehicle was 09-LPEW-03. Forensic analysis of the Volvo's damage indicated the barrier equivalent delta V of the vehicle was approximately 16 to 24 km/h (10 to 15 mph).

DRIVER DEMOGRAPHICS

Age/Sex:	16 year old/female
Height:	157 cm (62 in)
Weight:	50 kg (110 lb)
Restraint Usage:	3-point lap and shoulder w/ pretensioner
Usage Source:	Police report

DRIVER ISSUES

The driver's family was uncooperative and specific details regarding the crash and the driver's injuries are unknown. Information obtained from the insurance adjuster indicated the driver's injuries consisted primarily of left side contusions, however that information was unsubstantiated.

The driver of the Volvo was restrained and probably seated in a mid-to-forward track position consistent with her stature. At impact, the left side bag of the Volvo deployed and the pretensioners in the front restraint systems activated. The pretensioners removed any slack in the restraint's webbing and the restraint cinched down on the driver. The driver responded to the 9 o'clock direction of the impact force by initiating a left trajectory with her upper torso. The lap belt probably kept the driver's pelvis positioned with the seat. The driver contacted the deployed left front seat-mounted side impact air bag and intruding door with the left side of her body. The left side contusions were caused at that time. The vehicle's frontal air bag system probably deployed later in the collision sequence. The driver probably had minimal contact with the deployed driver air bag due to her lateral trajectory and the 9 o'clock principle direction of force (PDOF).