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Buffalo, New York 14225

CALSPAN ON-SITE AIR BAG FATALITY INVESTIGATION

CALSPAN CASE NO. 97-003

VEHICLE - 1995 MITSUBISHI EXPO 4DR. SPORT WAGON

LOCATION - VIRGINIA

CRASH DATE - JANUARY, 1997

Contract No. DTNH22-94-D-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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16. *Abstract* This on-site investigation focused on a two-vehicle intersection collision that resulted in the death of the 57 year old male right front occupant. The front occupants of the Mitsubishi were not wearing the available manual 3-point restraint systems. The Mitsubishi was equipped with a supplemental restraint system which consisted of driver and passenger side air bags which deployed as a result of the crash. The right front adult male occupant was displaced forward by the pre-crash braking and the frontal impact force. His head impacted and fractured the windshield. This movement placed the occupant over the mid mounted passenger side air bag module assembly. The passenger side air bag deployed late in the crash sequence and contacted the lower facial area of the occupant and hyper-extended his head/neck which resulted in a fracture and subluxation of the cervical spine. The occupant was pronounced dead at the scene and there was no evasive autopsy performed on the body.			
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TABLE OF CONTENTS

CALSPAN ON-SITE AIR BAG FATALITY INVESTIGATION
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This investigation was initiated in response to a notification received from the National Highway Traffic Safety Administration (NHTSA) that a 57 year old male passenger of a 1995 Mitsubishi Expo was fatally injured in a two vehicle intersection collision. The NHTSA was notified by the insurance carrier for the Mitsubishi, which in turn notified Calspan's Special Crash Investigation Team on January 14, 1997. A Crash Reconstructionist initiated the on-site investigation on January 15, 1997.

SUMMARY

This on-site air bag deployment investigation focused on the injury mechanisms of the unrestrained right front occupant of a 1995 Mitsubishi Expo. The vehicle was equipped with driver and passenger side air bags which deployed as a result of an intersection-type crash with a 1988 Lincoln Town Car. Contact evidence within the Mitsubishi Expo indicated that the 57 year old male occupant initiated a forward trajectory in response to pre-crash braking and the frontal impact force and impacted the windshield prior to air bag deployment. The deploying passenger side air bag subsequently expanded against the underside area of his chin which hyper-extended his neck resulting in a cervical fracture with subluxation (AIS-2). The right front passenger was pronounced dead at the scene of the crash. The medical examiner performed a post-mortem examination and not an evasive autopsy.

The crash occurred in January, 1997, at an oblique four-leg intersection during evening hours. The intersection was not illuminated by overhead street lighting. The weather at the time of the crash was clear and the roads were dry. The terrain in the area of the crash was level and the intersection was free of visual obstructions. Traffic flow through the intersection was controlled by a standard overhead signal system. The speed limit in the area of the intersection was 89 km/h (55 mph).

The Mitsubishi Expo was traveling southbound in the left through lane approaching the intersection. The Lincoln Town Car was traveling northbound approaching the intersection and entered the designated left turn. The traffic signal was green for north/south traffic. The Lincoln was operated by a 15 year old male driving on a valid learners permit. The inexperienced driver of the Lincoln initiated a left turn across the path of the Mitsubishi. The driver of the Mitsubishi attempted to avoid the impending crash by braking. No skid marks were observed at the scene. A witness who was following the Mitsubishi observed the brake lights illuminate on the vehicle prior to impact. The full frontal area of the Mitsubishi impacted the right front fender area of the Lincoln. The impact resulted in an 11 o'clock/2 o'clock impact configuration for the Mitsubishi and Lincoln respectively. The Mitsubishi sustained 40.6 cm (16.0 in) of front bumper crush located at the right front corner. Direct contact damage occurred over the full 143.5 cm (56.5 in) width of the front bumper. The Collision Deformation Classification (CDC) for the Mitsubishi was 11-

FDEW-02. The direct contact damage for the Lincoln began 193.0 cm (76.0 in) forward of the right rear axle and extended forward 205.7 cm (81.0 in) to the right corner of the front bumper. The CDC for the Lincoln was 02-RYEW-02. The damage algorithm of the SMASH program computed a velocity change (delta V) of 24.2 km/h (15.0 mph) for the Mitsubishi and 22.9 km/h (14.2 mph) for the Lincoln. As a result of the impact induced deceleration, the Mitsubishi's driver and passenger side air bag systems deployed. The vehicle's engagement with the sheet metal of the Lincoln resulted in a "soft collision" with an elongated crash pulse, therefore deploying the air bag system late in the collision sequence.

After the initial impact, the vehicles rotated and impacted in a secondary sideslap configuration prior to coming to rest. The right rear quarter-panel of the Lincoln contacted the Mitsubishi's left side at the driver's door. Direct contact damage to the Mitsubishi's left side began 33.7 cm (13.25 in) aft of the left front axle and extended 111.3 cm (43.8 in) rearward onto the left door. The maximum lateral deformation was 5.7 cm (2.25 in). The CDC for the Mitsubishi was 09-LPEW-01. The secondary contact damage to the Lincoln consisted of paint transfers and superficial damage with no measurable crush profile. The damage began 26.7 cm (10.5 in) aft of the right rear axle and extended 111.8 cm (44.0 in) to the right rear bumper corner. The CDC for the Lincoln's secondary contact was 03-RBEW-01.

The driver of the Mitsubishi was not wearing the manual 3-point lap and shoulder belt system. His seat track was adjusted to the full rearward position and the tilt steering column was set to the lowest position. The driver probably braced against the steering wheel rim as he responded to the frontal impact force by initiating a forward trajectory. He probably loaded the deploying air bag, however, there was no contact evidence on the air bag or within his seated area. He was transported to a medical facility where he was treated for an unspecified soft tissue injury and released.

The right front occupant of the Mitsubishi was a 57 year old male with a reported height of 175.3 cm (69.0") and weight of 86.2 kg (190.0 lb). This occupant had a recorded blood alcohol content of 0.24% weight by volume. He was not wearing the manual 3-point lap and shoulder belt system. The restraint's webbing was found fully retracted against the right B-pillar with the D-ring adjusted to the lowest position. During the vehicle inspection, the right front seat was found in the full rearward track position with the seat back reclined. The seat's position was probably modified from its crash position during the treatment and removal of the occupant from the vehicle by rescue personnel, therefore its pre-crash position could not de determined. Prior to impact, the passenger probably attempted to brace against the instrument panel/mid mount passenger side air bag module cover as he initiated a forward trajectory in response to the pre-crash braking force. A faint scuff mark which resembled four fingers was observed on the leading edge of the passenger side air bag module cover flap. During the collision sequence, he initiated a forward trajectory prior to the air bag deployment. His forehead impacted the laminated windshield 26.4 cm (10.4 cm) right of center and 30.5 cm (12.0") above the upper instrument panel. A skin/oily transfer identified the contact point which resulted in a star-like fracture pattern to the laminated glazing. His right knee contacted and scuffed the outer aspect of the right lower instrument panel adjacent to the speaker cover. As he began to rebound from the windshield contact, the passenger side air bag deployed against the underside of the occupant's chin and anterior neck. The bottom and right side surfaces of the bag yielded large jagged bloody tissue transfers as a result of the initial deployment against the passenger's anterior

neck and chin. This contact sequence probably hyper-extended the passenger's head which resulted in a fracture with subluxation of the cervical spine (AIS-2) and probable spinal cord damage. He was pronounced dead at the scene of the crash. The medical examiner performed a post-mortem examination. An evasive autopsy was not performed, therefore additional injury was unknown.

The second seat was occupied by two adult male occupants seated in the outboard positions. These occupants were not restrained by the manual 3-point belt systems. The left rear occupant loaded and deformed the back surface of the left front seat back. The right rear occupant loaded the right seat back support. The right rear occupant's right knee traveled between the seat back and B-pillar and loaded the stowed right front restraint webbing. This loading resulted in a D-ring transfer to the belt webbing. The knee continued forward and impacted the trailing edge of the armrest of the right front door panel. The contact compressed the armrest in a forward direction. Two third seat adult male occupants were unrestrained and probably loaded the second seat back supports. There was no direct evidence to support this contact. All rear seated occupants were transported to a local hospital where they were treated for minor soft tissue injuries and released.

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VEHICLE: 1995 MITSUBISHI EXPO 4DR. SPORT WAGON
LOCATION: VIRGINIA
CRASH DATE: JANUARY, 1997

CRASH DATA

Location:	Four-leg oblique intersection
State:	Virginia
Area/Type:	Rural/Commercial
Crash Date/Time:	January, 1997/evening hours
Investigating Police Agency:	State police
Crash Type:	Two-vehicle front to side impact configuration
Air Bag Vehicle Occupant Injury Severity:	Driver - Minor (AIS-1) Right front - Fatal (AIS-2)

AMBIENCE

Viewing Conditions:	Dark, not lighted
Weather:	Clear
Precipitation:	None
Road Surface:	Dry

HIGHWAY

Type:	State Route
Number of Lanes:	Southbound - 2 through lanes, 1 left turn lane, 1 right turn lane Northbound - 2 through lanes, 1 left turn lane
Width:	20.0 m (65.7 ft)
Surface:	Asphalt
Median:	None
Edge:	Concrete rain gutter with mountable curbs
Vertical Alignment:	Level
Horizontal Alignment:	Straight

HIGHWAY (CONT'D.)

Estimated Coefficient of Friction:	0.70
Traffic Density:	Moderate

TRAFFIC CONTROLS

Signals:	Overhead traffic signal system
Signs:	None
Markings:	Double yellow centerlines, solid white lane dividers, solid white fog lines.
Speed Limit:	89 km/h (55 mph)

VEHICLES

	Air Bag Vehicle
Description:	1995 Mitsubishi Expo 4dr. Sport Wagon
V.I.N.:	JA3AD59G3SZ (Production sequence deleted)
Color:	White
Odometer:	44,846 km (27,867 miles)
Engine:	L4, 2.4 liter, MPI
Transmission:	Automatic, center console shift
Steering:	Power-assisted
Brakes:	Power-assisted front disc
Padding:	Upper and mid instrument panel, glove compartment door, soft-edged steering wheel rim, air bag module covers, door panels, door armrests, center armrest, sunvisors, adjustable head restraints
Manual Restraints:	3-point lap and shoulder belt systems, dual mode locking retractors with continuous loop belt webbing through the latch plate in the six outboard seat positions, center lap belt in the second seat
Automatic Restraints:	Supplemental driver and passenger side air bags which deployed as a result of the crash
Defects:	None
Tow Status:	Towed due to vehicle damage

VEHICLES (CONT'D.)

Vehicle #2

Description:	1988 Lincoln Town Car 4dr. sedan
V.I.N.:	1LNBM82FOJY (Production sequence deleted)
Color:	Beige/white landau top
Odometer:	175,441 km (109,017 miles)
Engine:	V8, 5.0 liter, CFI
Manual Restraints:	3-point lap and shoulder belt systems in the front outboard seat positions, center front lap belt
Defects:	None
Tow Status:	Towed due to vehicle damage

VEHICLE DAMAGE

Exterior:

Air Bag Vehicle

The 1995 Mitsubishi Expo sustained moderate frontal damage as a result of its impact sequence with the Lincoln Town Car. Maximum crush was 40.6 cm (16.0") located at the right bumper corner. The direct contact damage on the bumper fascia began 71.1 cm (28.0 in) left of center and extended 72.4 cm (28.5 in) to the right corner. The crush values at the bumper level were as follows: C_1=1.9 cm (0.75 in), C_2=12.1 cm (4.75 in), C_3=33.7 cm (13.25), C_4=30.2 cm (11.8 in), C_5=40.6 cm (16.0 in), C_6=34.0 cm (13.38 in) . The components damaged by the frontal impact sequence included the front bumper fascia and reinforcement bar, grille, right headlamp assembly, hood, and right front fender.

The Mitsubishi also sustained secondary impact damage to the left passenger compartment area as the result of a subsequent sideslap with the Lincoln as the vehicles separated following the initial engagement. The direct contact damage for the sideslap began 33.7 cm (13.25 in) rearward of the left front axle and extended 111.1 cm (43.8 in) rearward onto the left rear door. The maximum lateral deformation caused by the sideslap was 5.7 cm (2.25 in). The left front door was operational only from the inside, due to deformation of the exterior latch.

CDC: 11-FDEW-02 (Primary impact)

09-LPEW-01 (Secondary sideslap)

Repair Cost: $11,116.16 (Insurance repair estimate)

VEHICLE DAMAGE (CONT'D.)

Exterior:

Vehicle #2

The 1988 Lincoln Town Car sustained moderate damage as a result of its intersection collision with the Mitsubishi. The initial contact between the vehicles occurred aft of the right front bumper and extended rearward along the Lincoln's right front fender as the engagement developed. The direct contact damage began rearward of the corner of the front bumper and extended 205.7 cm (81.0 in) rearward to a point 193.0 cm (76.0 in) forward of the right rear axle. There was an additional 38.1 cm (15.0 in) of induced damage that ended 154.9 cm (61.0 in) forward of the rear axle. The crush profile was documented on the right front fender at bumper elevation and was as follows: C_1 = 0, C_2 = 4.4 cm (1.8 in), C_3 = 4.1 cm (1.6 in), C_4 = 10.2 cm (4.0 in), C_5 = 15.6 cm (6.1 in), C_6 = 0. The fender was crushed to a maximum depth of 22.9 cm (9.0 in) located on the leading edge of the right front wheel opening between C_4 and C_5.

The Lincoln's secondary sideslap damage consisted of paint transfers and superficial damage with no residual crush. The direct contact damage began 26.7 cm (10.5 in) aft of the right rear axle and extended 111.8 cm (44.0 in) to the right corner of the rear bumper.

CDC: 02-RYEW-02 (Primary impact)

03-RBEW-01 (Secondary sideslap)

Repair Cost: $5,000.00 estimated

Interior:

Air Bag Vehicle

Interior damage to the Mitsubishi was associated with air bag deployment and occupant contact with interior components. There was no interior damage associated with exterior deformation or intrusion of interior components. There was no evidence of occupant contact within the driver's compartment. The steering column shear capsules were not displaced and there was no steering wheel deformation. The driver's seat was adjusted to the full rearward position. The driver's seat back was deformed forward and rotated clockwise by second seat occupant loading. The seat belt showed no evidence of routine wear or evidence of use at the time of the crash. The webbing was stowed and captured between outboard aspect of the displaced left front seat back and the B-pillar trim panel (refer to Photograph Nos. 32 and 33).

VEHICLE DAMAGE (CONT'D.)

Interior (Cont'd.):

Air Bag Vehicle

The right front occupant's head impacted and fractured the laminated windshield. The star-like fracture pattern was located 26.4 cm (10.4 in) right of center and 30.5 cm (12.0 in) vertically above the top of the instrument panel (refer to Photograph No. 37). A large tissue/oily smudge surrounded the star-like fracture. The smudge was located 21.0-29.8 cm (8.25-11.75 in) right of center and 27.9-32.4 cm (11.0-12.75 in) above the instrument panel. The passenger side air bag contacted and displaced the rear view mirror laterally to the left and fractured the mirror unit from the header mount (refer to Photograph No. 49).

The right knee of the right front occupant contacted the right outboard aspect of the instrument panel, adjacent to the speaker. A scuff mark was documented 62.2-64.8 cm (24.5-25.5 in) right of center and 21.0-25.4 cm (8.25-10.0 in) below the top of the instrument panel (refer to Photograph No. 55). A scuff mark with lateral compression was noted to the right front door panel 15.2-18.4 cm (6.0-7.25 in) rearward of the leading edge of the door panel and 20.3-32.4 cm (8.0-12.75 in) below the beltline (refer to Photograph No. 54). The right front door panel had a blue fabric transfer located 27.9-35.6 cm (11.0-14.0 in) rearward of the leading edge of the door and 1.3-3.2 cm (0.5-1.25 in) below the beltline (refer to Photograph No. 53).

The second seat of the Mitsubishi was a 3 passenger split-bench with folding backs adjusted to a mid-track position. Both outboard second seat belt systems exhibited routine wear marks, however, neither belt was in-use at the time of the crash. The center lap belt appeared to have never been used. The left occupant of the second seat impacted the left front seat back with his left knee. The knee contact was located 50.8-55.9 cm (22.0-22.0 in) left of the vehicle center and 27.9-33.0 cm (11.0-13.0 in) below the top aspect of the seat back (refer to Photograph No. 58). The vinyl map pocket had a distinct indentation with no scuffing. Another knee contact was located on the inboard aspect of the left front seat back, 12.7-22.9 cm (5.0-9.0 in) left of center and 19.1-27.9 cm (7.5-11.0 in) below the top of the seat back. The left front seat back was rotated forward and left (CCW) against the left B-pillar. The back of the center console sustained a knee strike 0-4.8 cm (0-1.9 in) left of center and 8.3-11.4 cm (3.25-4.5 in) below the top of the console armrest (refer to Photograph No. 59). The plastic cover below the ashtray was separated and the base of the unit was cracked and displaced to the left. A second scuff was located on the upper right corner of the ashtray cover measuring 1.0 cm (0.375 in) in diameter and centered 4.4 cm (1.75 in) right of center and 8.9 cm (3.5 in) below the top of the console.

The right knee of the right occupant of the second seat contacted the right front seat back which produced a vertical fabric transfer on the outboard aspect seat back. The transfer was located 62.9-65.4 cm (24.75-25.75 in) right of center and 26.5-44.5 cm (10.5-17.5 in) below the top of

VEHICLE DAMAGE (CONT'D.)

Interior (Cont'd.):

Air Bag Vehicle

the seat back (refer to Photograph No. 61). The right knee trajectory continued forward between the outboard aspect of the seat back and B-pillar. His knee scuffed the trim panel covering the B-pillar and loaded the right front shoulder belt webbing. The occupant's knee continued forward as he loaded the seat back and struck the trailing edge of the right front door armrest. The B-pillar trim panel was scuffed 14.0 cm (5.5 in) horizontally at a point 15.2-19.1 cm (6.0-7.5 in) below the beltline (refer to Photograph No. 62). The contact with the right front shoulder belt webbing loaded the webbing against the D-ring as the inertia activated retractor locked during the crash sequence. The D-ring showed signs of heavy vinyl abrasions and there were heavy vinyl transfers on the belt webbing. The webbing abrasions were located 3.5-10.8 cm (1.375-4.25 in) below the D-ring on the inside surface of the webbing (refer to Photograph No. 64). The trailing edge of the padded right front door armrest was compressed 1.3 cm (0.5 in) forward with a scuff mark at the top of the compressed area. The compression was located 21.6-29.8 cm (8.5-11.75 in) below the beltline (refer to Photograph No. 66).

The rear (third) seat of the Mitsubishi was a 2 passenger spilt-bench seat with a folding back. The manual 3-point seat belt systems of the third seat positions had routine wear marks but were not used in this crash. The second row seat backs were of a hard shell construction and showed no evidence of third seat occupant contact or loading.

AUTOMATIC RESTRAINT SYSTEM

The 1995 Mitsubishi Expo was equipped with a Supplemental Restraint System (SRS) that consisted of dual driver and passenger side air bags which deployed as a result of the impact with the 1988 Lincoln Town Car. The driver side air bag was incorporated into the steering wheel hub assembly in a typical configuration while the passenger side air bag was a mid-mount design within the right side of the instrument panel.

The driver side air bag was designed to deploy from an H-configuration asymmetrical air bag module cover assembly that was contained within the four-spoke steering wheel. The spokes were located at the 3 and 9 o'clock and 5 and 7 o'clock positions. The H-configuration flaps were hinged at the top and bottom with a horizontal center tear seam and vertical perimeter seams (refer to Photograph Nos. 28 and 27). The module upper cover flap had an vertical height of 7.0 cm (2.75 in) with a 5.1 cm (2.0 in) horizontal recess to the upper hinge and was 17.1 cm (6.75 in) wide at the center tear seam. The lower module cover flap was 17.1 cm (6.75 in) wide at the center tear seam and 7.0 cm (2.75 in) vertically.

AUTOMATIC RESTRAINT SYSTEM (CONT'D.)

The driver side air bag was vented with two 3.8 cm (1.5 in) diameter vent ports on the back side at the 10 and 2 o'clock positions. The vent ports were centered 8.9 cm (3.5 in) outboard of the inflator and 19.1 cm (7.5 in) forward of the peripheral seam. The peripheral seam which represents the diameter of the bag was 66.0 cm (26.0 in) in diameter and internally sewn. Four internal tether straps, each 7.0 cm (2.75 in) wide extended from a 16.5 cm (6.5 in) diameter reinforced circle at the center of the bag. The maximum rearward excursion of the bag was 34.3 cm (13.5 in) measured from the face of the module cover. A bar coded label was affixed to the back of the bag at the 12 o'clock posiiton which provided the following identification (refer to Photograph No. 28):

BBNN006
4SS94Y904
041194
S
B17031

The passenger side air bag module was mounted into the mid aspect of the instrument panel's right side with a vertically oriented cover flap that followed the contour of the instrument panel. The center of the module cover flap was approximately 36.8 cm (14.5 in) right of the vehicle centerline. The module cover flap opened at the designated tear points along the bottom and side surfaces and was hinged at the top which allowed the cover flap to open in an upward direction (refer to Photograph No. 38). The vinyl cover flap measured 33.7 cm (13.25 in) horizontally and 16.5 cm (6.5 in) vertically. The rounded lower corners had a 2.5 cm (1.0") radius. The inside surface of the cover flap was rigid plastic with a fiber mesh extending over the upper steel hinge and under the instrument panel covering. The top of the module housing and the steel hinge, which attached the cover flap to the instrument panel, were deformed upward approximately 1.3 cm (0.5") due to bag expansion. The deformation caused the cover flap hinge to bind and remain open at negative 12 degrees from horizontal instead of the normal pre-deployment position of negative 60 degrees. SRS AIR BAG was molded into the lower left corner of the cover flap.

The top of the passenger side air bag module cover flap exhibited contact of four vertically oriented tissue type transfers which appear to be from the fingers of the occupant's right hand. The transfers began 2.9 cm (1.1 in) left of the cover flap's centerline and extended 5.7 cm (2.3 in) right of center (refer to Photograph No. 39). Vertically from the leading edge of the cover flap, the four transfers measured 3.5 cm (1.375 in), 3.7 cm (1.4 in), 2.5 cm (1.0 in), and 1.0 cm (0.375 in) in height from left to right respectively. A blue transfer measuring 1.3 cm (0.5 in) horizontally x 6.0 mm (0.25 in)

vertically was also identified on the module cover flap. The transfer was located 10.2-11.4 cm (4.0-4.5 in) right of the module cover flap centerline starting 1.0 cm (0.375") above the leading edge.

The passenger side air bag was constructed of a woven nylon-type fabric which was porous in design with no external vent ports. The bag fabric was reinforced with stitching in a 1.3 cm (0.5 in) square pattern. The face of the bag had a blue dot in the center. The dimensions of the non-tethered bag were as follows:

Dimension	Centimeters	Inches
Width at throat of bag	29.2	11.5
Height at throat of bag	12.7	5.0
Horizontal measurement of throat of bag to inflator	8.9	3.5
Horizontal measurement from throat to face of bag	48.3	19.0
Full excursion from instrument panel to face of bag	53.3	21.0
Face of bag - width	53.3	21.0
Face of bag - height	58.4	23.0

Black vinyl transfers were present on the bottom of the bag and on the lower face of the bag which resulted from the expansion of the bag against the inside surface of the module cover flap during initial deployment. A 5.1 cm (2.0 in) wide black vinyl transfer on the lower face of the bag formed an arch type shape which started 15.9 cm (6.25 in) from the left seam and was 17.1 cm (6.75 in) wide (refer to Photograph No. 47). The top of the arch was 39.4 cm (15.5 in) below the top seam of the bag. A heavy black vinyl transfer on the bottom surface of the bag was located 12.7-25.4 cm (5.0-10.0 in) outboard of the inflator and 7.0-21.6 cm (2.75-8.5 in) from the left seam (refer to Photograph No. 48).

The lower and right side surfaces of the passenger side air bag yielded large jagged bloody tissue transfers which resulted from the initial deployment against theoccupant's anterior neck and chin. The right side of the bag had two vertically oriented bloody transfers (refer to Photograph No.44).

AUTOMATIC RESTRAINT SYSTEM (CONT'D.)

The larger of the two transfers was located 28.6-19.7 cm (11.25-7.75 in) outward from the throat of the bag and 25.4-44.5 cm (10.0-17.5 in) down from the upper face of the bag. The smaller transfer was located 3.8-8.9 cm (1.5-3.5 in) above the seam and 20.3-30.5 cm (8.0-12.0 in) outward from the throat of the bag. The bottom surface of the bag had a large bloody transfer which extended from the inflator outward 25.4-40.6 cm (10.0-16.0 in) toward the face of the bag. The transfer started 5.1 cm (2.0 in) inboard of the left seam and extended 42.5 cm (16.75 in) horizontally (refer to Photograph No. 47). Identification labeling located on the bottom surface of the bag adjacent to the inflator at 6 o'clock was recorded as follows:

76284-19252
GM-4
000199

Warning labels were affixed to the face of the both sunvisors which advised the following:

- FOR MAXIMUM SAFETY PROTECTION IN ALL TYPES OF CRASHES, YOU MUST ALWAYS WEAR YOUR SAFETY BELT.
- DO NOT INSTALL REARWARD FACING CHILD RESTRAINTS IN ANY FRONT PASSENGER SEAT POSITION.
- DO NOT SIT OR LEAN UNNECESSARILY CLOSE TO THE AIR BAG.
- DO NOT PLACE ANY OBJECTS OVER THE AIR BAG OR BETWEEN THE AIR BAG AND YOURSELF.
- SEE THE OWNERS MANUAL FOR FURTHER INFORMATION AND EXPLANATIONS.

MANUAL RESTRAINTS

The Mitsubishi Expo was equipped with manual 3-point lap and shoulder belt systems in the 6 outboard seated positions. The restraints consisted of continuous loop belt webbings with sliding latchplates and dual mode locking retractors mounted in the base of the respective pillars. None of the six adult occupants of the Mitsubishi were wearing the manual lap and shoulder belts. The front outboard belt systems had adjustable D-rings, both of which were adjusted to the lowest position. The driver's latchplate had no routine wear marks. At inspection, the left front belt webbing was stowed and captured between the left front seat back and the displaced left B-pillar (refer to Photograph No. 33). The belt could not have returned to this position post-crash, which indicated the restraint was not in-use at the time of the crash. The right front restraint webbing was stowed

MANUAL RESTRAINTS (CONT'D.)

against the B-pillar at the time of the crash. The second seat right side occupant's right knee loaded the webbing against the D-ring as he responded to the frontal impact force. The loading resulted in heavy vinyl transfers to the D-ring and heavy vinyl transfers on the belt webbing. The vinyl transfers were located 3.5-10.8 cm (1.375-4.25 in) below the D-ring on the inside surface of the webbing and extended into the B-pillar trim panel (refer to Photograph Nos. 63 and 64). The latchplates of the outboard second and third seats showed routine wear marks. The split- bench second seat was equipped with a center lap belt.

CRASH SEQUENCE

Pre-Crash:

This two vehicle crash occurred during evening hours in January, 1997. The crash involved a 1995 Mitsubishi Expo 4dr. Sport Wagon and a 1988 Lincoln Town Car 4dr. sedan. At the time of the crash, viewing conditions were dark with no artificial illumination. There were no adverse weather conditions and the roads were dry. The crash occurred at an oblique four-leg intersection in a rural/commercial area of Virginia. The intersection was controlled by an overhead (red/amber/green) traffic signal system. The terrain in the area of the intersection was level and the intersection was wide and open without any obstructions that would impair visibility. The southbound travel lanes entering the intersection were configured with a total of four lanes, two through lanes, one right turn only lane and one left turn only lane. The northbound travel lanes entering the intersection were comprised of two through lanes and a left turn only lane. The posted speed limit through the intersection was 89 km/h (55 mph).

The Mitsubishi Expo was traveling southbound on the left (inboard) through lane of the roadway. There were a total of six occupants in the Mitsubishi, none of which were wearing the available manual 3-point lap and shoulder restraint. The vehicle was traveling at a police reported speed of 80 km/h (50 mph). A witness to the crash was traveling behind the Mitsubishi on the approach to the intersection. The Lincoln Town Car was traveling northbound and entered the designated left turn lane. The Lincoln was operated by a 15 year old male driver with a valid learner's permit. The driver's mother was seated in the right front of the vehicle. The traffic signal was green for both north and southbound traffic.

As the vehicles approached the intersection, the inexperienced driver of the Lincoln initiated a left turn across the path of the Mitsubishi. The driver of the Mitsubishi reacted to the left turning vehicle by applying the brakes in an attempt to avoid the collision. The witness traveling behind the

CRASH SEQUENCE (CONT'D.)

Pre-Crash (Cont'd.):

Mitsubishi reported that he saw brakes lights on the vehicle prior to the crash. Due to the lack of physical evidence at the crash scene (i.e., skid marks), the extent and level of braking was unknown.

Crash:

The vehicles impacted in a front-to-side configuration with the initial contact involving the right front bumper corner of the Mitsubishi the leading edge of the right front fender of the Lincoln Town Car. As the vehicles engaged, the full frontal area of the Mitsubishi contacted the full length of the right front fender of the Lincoln. The resultant directions of force were 11 o'clock for the Mitsubishi and 2 o'clock for the Lincoln. The damage algorithm of the SMASH program calculated delta V's for the Mitsubishi and Lincoln at 24.2 km/h (15.0 mph) and 22.9 km/h (14.2 mph) respectively. The Mitsubishi's engagement with the sheet metal of the Lincoln resulted in a "soft collision" with an elongated crash pulse which deployed the air bag system late in the collision sequence.

The impact rotated the Mitsubishi in a clockwise (CW) direction as the Lincoln rotated in counterclockwise (CCW). The vehicles impacted in a subsequent sideslap configuration which involved the right rear quarter panel of the Lincoln and the left passenger side area of the Mitsubishi. This secondary contact resulted in minor damage to both vehicles. The resultant directions of force of this secondary impact were 9 o'clock and 3 o'clock for the Mitsubishi and Lincoln, respectively.

Post Crash:

Both the Mitsubishi and Lincoln came to rest within the confines of the intersection near the point of impact. The police responded to the scene and initiated rescue and investigation activities. The right front occupant of the Mitsubishi was examined by emergency medical technicians who failed to detect vital signs at the crash scene. The medical examiner was requested to the scene and pronounced the occupant deceased. His body was transferred to the medical examiner's office where a post-mortem examination and toxicology test were performed. No evasive autopsy performed on the body, therefore complete medical data not available. The remaining five occupants of the Mitsubishi and the driver and right front occupant of the Lincoln were transported by ambulance to a local hospital where they were treated for soft tissue injuries and released. The Mitsubishi and Lincoln sustained disabling damage and were towed from the scene.

HUMAN FACTORS/OCCUPANT DATA

Air Bag Vehicle

Driver:	49 year old male
Height:	Unknown
Weight:	Unknown
Manual Restraint System Usage:	None, 3-point lap and shoulder belt system was available
Usage Source:	Vehicle inspection
Route Familiarity:	Unknown
Type of Medical Treatment:	Transported to a local hospital and released

DRIVER INJURY

Injury	Severity (AIS-90)	Injury Mechanism
Unspecified soft tissue injury	Minor (990400.19)	unknown

DRIVER KINEMATICS

The driver of the Mitsubishi was presumably in a normal upright position at impact with the seat track adjusted to the full rearward position. He was not wearing the available manual 3-point lap and shoulder belt system. The lack of belt usage was verified during vehicle inspection by displacement of the left front seat back, capturing the belt webbing against the B-pillar. The tilt mechanism of the steering column was adjusted to the lowest position. Immediately prior to impact, the driver probably braced against the steering wheel. He subsequently initiated a forward trajectory in response to the frontal impact force and loaded the deploying driver side air bag. There was no contact evidence on the air bag or deformation to the steering wheel rim and/or energy absorbing steering column. Detailed inspection of left front interior did not reveal any other driver contact points. He sustained an unspecified soft tissue injury and was transported by ambulance to a local hospital where he was treated and released.

HUMAN DEMOGRAPHICS/OCCUPANT DATA(CONT"D)

RIGHT FRONT PASSENGER DATA

Age/Sex:	57 year old male
Height:	175.3 cm (69.0")
Weight:	86.2 kg (190.0 lb)
Manual Restraint Usage:	None, 3-point lap and shoulder belt system was available
Usage Source:	Vehicle inspection
Type of Medical Treatment:	N/A, expired at scene

RIGHT FRONT OCCUPANT INJURY

Injury	Severity (AIS-90)	Injury Mechanism
*Fracture with subluxation of the cervical spine	650216.26	Deploying passenger side air bag

*****It should be noted, that it is likely the full extent of the right front occupant's injuries was not determined. The medical examiner conducted a post-mortem examination. An evasive autopsy was not performed which would have revealed the full nature and extent of the occupant's injuries.

RIGHT FRONT OCCUPANT KINEMATICS

The 57 year old male occupant was presumably seated in an upright position. Vehicle inspection revealed that post-crash rescue efforts modified the position of the right front seat and seat back, therefore the exact pre-crash position of the seat was unknown. The occupant was not wearing the manual 3-point lap and shoulder belt system. The lack of belt usage was determined from occupant contact points within the interior of the vehicle and the position of the belt system at the time of the crash. The right knee of the rear seated occupant loaded the belt webbing as he responded to the frontal impact force which produced D-rings transfers to the stowed belt system (refer to

Photograph No. 64). The result of a blood sample taken from the right front occupant indicated his blood alcohol content was 0.24% weight by volume.

Based on the contact evidence within the vehicle, the intoxicated state of the occupant, and the actions of the driver pre-crash, several scenarios could be formulated to describe the position and kinematic pattern of this occupant. The most likely scenario places the occupant in a upright seated position in the right front with the seat track adjusted to a mid to rear track position with the seat back set to an upright or slightly reclined position to allow for seated space of the right rear occupant. Prior to impact, the right front occupant is displaced forward by the pre-crash braking force and as a result he attempts to brace against the upper instrument panel and the mid mounted air bag module cover flap. This motion placed the occupant within a close proximity of the instrument panel. At impact, the occupant responded to the frontal impact force and continued forward and impacted the laminated windshield with his forehead area. A star-like crack to the glazing surrounded by a tissue/oily transfer resulted from t he contact sequence. The occupants's right knee contacted the right lower imstrument panel at the speaker cover. A scuff mark was noted to the plastic component which evidence the knee strike. The occupant initiated a rebound trajectory as the passenger side air bag deployed late in the crash sequence due to the elongated crash pulse that resulted from the "soft collision".

The mid mount passenger side air bag module cover expanded against the right hand of the occupant which produced four distinct tissue transfers to the cover flap. This contact would have displaced his hand in an upward and rearward motion. The expanding passenger side air bag membrane contacted the anterior neck and the underside of his chin which hyper-extended his neck resulting in a cervical fracture with subluxation (AIS-2). Larger irregular bloody tissue transfers on the air bag membrane evidenced the contact sequence. His close proximity to the air bag restricted the deployment path of the bag. This was evidenced by vinyl transfers on the bag from bag expansion within the module assembly.

The occupant was probably displaced in an upward and rearward trajectory by the air bag deployment, into the right front seat back where he came to rest in a slumped attitude. There was no contact evidence on the headliner, seat back support, or head restraint to confirm his rebound trajectory.

Although multiple contact points were evident within the interior of the vehicle, the lack of an evasive autopsy failed to identify additional injuries that probably resulted from these contacts. In addition,

the reported cervical injury probably involved a spinal cord injury such as a cord transection that resulted in the immediate death of the occupant.

REAR SEATED OCCUPANT KINEMATICS

In addition to the front seated occupants of the Mitsubishi, four adult male occupants were positioned in the four rear seat positions of the Sport Wagon. None of these occupants were wearing the manual 3-point lap and shoulder belt systems. The split-bench second seat was adjusted to the mid track position. The second seat left side occupant responded to the frontal impact force by initiating a forward trajectory and loading the back surface of the left front seat back. His loading force deformed the padded surface and displaced the seat back laterally to the left against the left B-pillar. The occupant's right knee contacted the back side of the center console. The contact scuffed and fractured the plastic component.

The right side occupant of the second seat moved forward as he responded to the frontal impact force. His right knee contacted the right side of the right front seat back support. The knee deflected to the right into the right B-pillar. A scuff mark on the pillar evidence the contact point. His continued forward trajectory allowed the knee to travel between the B-pillar and the seat back and load against the stowed right front belt webbing. The knee loading produced a heavy D-ring transfer on the belt webbing and abraded the polymer coating of the D-ring. The knee subsequently impacted and compressed the trailing edge of the right front door armrest. There was no evidence of additional contact from the right front occupant.

Both third seated occupants probably loaded the rigid plastic seat back supports of the second seat. No evidence of occupant loading was visible in the rear seat area. All occupants were transported by ambulance to a local hospital where they were treated for unspecified soft tissue injuries and released.