

CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

**CALSPAN REMOTE ADULT AIR BAG RELATED SERIOUS
INJURY CRASH INVESTIGATION**

CASE NO: 2004-08-087J

VEHICLE: 2001 MITSUBISHI GALANT

LOCATION: PENNSYLVANIA

CRASH DATE: MAY 2004

Contract No. DTNH22-01-C-17002

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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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<p><i>16. Abstract</i> This remote investigation focused on the severity of the crash and the injury sources for a restrained 52-year-old female driver of a 2001 Mitsubishi Galant. The Mitsubishi was equipped with a redesigned frontal air bag system for the driver and front right positions that deployed as result of the crash. The restrained 52-year-old female driver was operating the Mitsubishi northbound on a two-lane, one-way roadway. A 53-year-old male driver was operating a 2003 Dodge Dakota and was attempting to merge into traffic from a parked position. The Dodge was coasting northbound at a driver-estimated 13 km/h (5 mph) rate of speed. Reportedly, the driver of the Mitsubishi fell asleep and departed the left roadside. The Mitsubishi mounted the curb and was straddling the road edge with its left side wheels on the sidewalk and its right side wheels on the roadway. The vehicle impacted a small diameter tree with its front left corner and a breakaway light standard with the left aspect of the frontal plane. The light standard separated from its base and impacted the hood, the right aspect of the windshield, and possibly the roof of the Mitsubishi. The Galant continued northbound straddling the road edge and its frontal plane impacted the back bumper beam of the Dodge. As a result of the front-to-rear impact, the redesigned frontal air bag system deployed in the Mitsubishi. The driver of the Mitsubishi, who was already displaced forward by the previous events, sustained a closed head injury, from the air bag, a fractured ulna from contacting the center instrument panel, and an aortic laceration and a chest contusion from the driver's air bag cover flaps. She was transported to a local trauma center by ambulance and was hospitalized. The treatment administered included repair surgery of the aorta before being released after 11 days.</p>			
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**CALSPAN REMOTE ADULT AIR BAG RELATED SERIOUS INJURY CRASH
INVESTIGATION**

NASS/SCI COMBO CASE NO.: 04-08-087J

LOCATION: PENNSYLVANIA

VEHICLE: 2001 MITSUBISHI GALANT

CRASH DATE: MAY 2004

BACKGROUND

This remote investigation focused on the severity of the crash and the injury sources for a restrained 52-year-old female driver of a 2001 Mitsubishi Galant. The Mitsubishi (**Figure 1**) was equipped with a redesigned frontal air bag system for the driver and front right positions that deployed as result of the crash. The restrained 52-year-old female driver was operating the Mitsubishi northbound on a two-lane, one-way roadway. A 53-year-old male driver was operating a 2003 Dodge Dakota and was attempting to merge into traffic from a parked position. The Dodge was coasting



Figure 1. Subject 2001 Mitsubishi Galant.

northbound at a driver-estimated 13 km/h (5 mph) rate of speed. Reportedly, the driver of the Mitsubishi fell asleep and departed the left roadside. The Mitsubishi mounted the curb and was straddling the road edge with its left side wheels on the sidewalk and its right side wheels on the roadway. The vehicle impacted a small diameter tree with its front left corner and a breakaway light standard with the left aspect of the frontal plane. The light standard separated from its base and impacted the hood, the right aspect of the windshield, and possibly the roof of the Mitsubishi. The Galant continued northbound straddling the road edge and its frontal plane impacted the back bumper beam of the Dodge. As a result of the front-to-rear impact, the redesigned frontal air bag system deployed in the Mitsubishi. The driver of the Mitsubishi, who was already displaced forward by the previous events, sustained a closed head injury, from the air bag, a fractured ulna from contacting the center instrument panel, and an aortic laceration and a chest contusion from the driver's air bag cover flaps. She was transported to a local trauma center by ambulance and was hospitalized. The treatment administered included repair surgery of the aorta before being released after 11 days.

This crash was initially selected for research by the National Automotive Sampling System (NASS). During the Zone Center quality control process, the crash was identified by the Calspan Special Crash Investigations (SCI) team due to the frontal air bag deployment and serious injuries sustained by the driver of the Mitsubishi. Subsequently, the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned a remote level investigation to the Calspan SCI team on February 24, 2005. This remote investigation included a review of the NASS CDS data and a detailed narrative report.

SUMMARY

Crash Site

The crash occurred on a two-lane, one-way roadway in an urban setting during daylight hours. The roadway was configured with two northbound through lanes with two outboard parking lanes. The roadway was surfaced with worn asphalt and there were no adverse weather conditions at the time of the crash. The through lanes were 3 meters (10') in width and were delineated by broken painted white lines. The roadway was bordered by asphalt shoulders and white fog lines and accommodated short-term business parking. The roadside environment consisted of multiple business dwellings, concrete sidewalks, driveways, and alleyways. The posted speed limit was 64 km/h (40 mph). An SCI revised scene schematic is included as **Figure 13** at the end of this narrative report.

Vehicle Data

2001 Mitsubishi Galant

The 2001 Mitsubishi Galant was identified by the Vehicle Identification Number (VIN): 4A3AA46G81E (production number omitted). The vehicle's odometer recorded 40,234 km (25,000 miles) at the time of the NASS inspection. The Galant was a four-door sedan with a 3.0-liter, 6-cylinder engine linked to an automatic transmission. The front-wheel drive vehicle was equipped with four-wheel disc brakes. The vehicle had a total GVWR of 1,810 kg (3,990 lb) that distributed 971 kg (2,140 lb) to the front and 839 kg (1,850 lb) to the rear. The vehicle was equipped with 38 cm (15") steel wheels and varied P195/65R15 tires. The specific tire information at the time of the NASS inspection was as follows:

Position	Tire Manufacture	Measured Pressure	Measured Tread Depth	Damage
LF	Kelly Magna Grip	207 kPa (30 PSI)	10 mm (13/32")	None
LR	Bridgestone	269 kPa (39 PSI)	6 mm (8/32")	None
RF	Kelly Magna Grip	Unknown	Unknown	None
RR	Bridgestone	Unknown	Unknown	None

The front row of the Galant was configured with bucket seats and adjustable head restraints, both of which were in the full-down position at the time of the NASS inspection. The driver's seat was adjusted to between mid-track and full-forward. The second row consisted of a fixed bench seat with integral head restraints for the outboard seating positions.

Vehicle Data – 2003 Dodge Dakota

The 2003 Dodge Dakota was identified by the VIN: 1D7HL48X63S (production number omitted). The vehicle was a four-door quad-cab pickup truck equipped with a 3.7-liter, 6-cylinder engine linked to automatic transmission. The rear-wheel drive vehicle was equipped with 41 cm (16") steel wheels and Futura P245/70R16 tires. The specific tire information at the time of the NASS vehicle inspection was as follows:

Position	Measured Pressure	Measured Tread Depth	Damage
LF	221 kPa (32 PSI)	10 mm (13/32")	None
LR	228 kPa (33 PSI)	10 mm (13/32")	None
RF	221 kPa (32 PSI)	10 mm (13/32")	None
RR	193 kPa (28 PSI)	10 mm (13/32")	None

Crash Sequence

Pre-Crash

The 52-year old driver of the 2001 Mitsubishi Galant was traveling northbound on the left lane of two-lane, one-way roadway (**Figure 2**). The 53-year old male driver of the 2003 Dodge Dakota was on the west shoulder and was rolling forward while he anticipated a break in traffic to merge into the traffic lane (**Figure 3**). An onlooker, who was seated in her parked vehicle behind the Dodge, witnessed the events as they occurred. The driver of the Galant drifted to the left and partially off the left roadside. The driver of the Galant believed that she fell asleep prior to the road departure. The left side wheels mounted the curb, evidenced by tire marks on the curb.



Figure 2 - Northbound approach of Mitsubishi.



Figure 3 - Vicinity of Dodge Dakota as it rolled to merge.

Crash

The Galant continued northbound with its left wheels on the curb and right wheels on the roadway and traveled approximately 6 meters (20') from the point of departure until the front left corner swiped a small diameter tree (**Figures 4 and 5**). The Galant continued forward another 12 meters (40') and struck a breakaway light standard with the left aspect of its frontal plane (**Figure 6**). This impact separated the post of the light standard from its base causing the post to fall to the ground. As the lamp was descending, it impacted the hood, the right side of the windshield and possibly the roof of the Galant before resting on the roadway. The Galant continued its forward trajectory until its frontal plane contacted the back plane of the Dodge as the Dodge was attempting to merge into northbound traffic. Based on the damage to the pickup's back bumper, it was probably angled approximately 20 degrees to the northeast. The NASS Researcher completed a missing vehicle algorithm with the WinSMASH program using the damage profile of the Dodge. Based on the minimal resultant damage from the first two events, the SCI review was able to separate the impacts and thereby utilize both crush profiles to complete a damage algorithm of the WinSMASH program. The subsequent results from

the damage algorithm computed total velocity changes of 21 km/h (13 mph) to the Mitsubishi and 15 km/h (9.3 mph) to the Dodge. The specific longitudinal and lateral components were -21 km/h (-13 mph) and 0 km/h to the Mitsubishi and 14 km/h (8.7 mph) and -5 km/h (-2) to the Dodge. The impact was sufficient to deploy the redesigned frontal air bags in the Mitsubishi. Following the impact, the Mitsubishi rotated clockwise and came to rest in a private driveway facing northeast. The Dodge was displaced forward and came to rest facing north.



Figure 4 - Departure area of Mitsubishi traveling to first event.



Figure 5 - Impacted small diameter tree.



Figure 6 - Base of light standard.

Post-Crash

Emergency personnel arrived on scene and removed the 52-year old female driver of the Galant due to perceived serious injuries. She was transported by ambulance to a local hospital where she was admitted for 11 days. The driver and front right passenger of the Dodge were transported to a local hospital for minor-to-moderate injuries. The front right passenger was hospitalized for one day.

2001 Mitsubishi Galant

Exterior

The 2001 Mitsubishi Galant sustained minor frontal damage as a result of the impact with the small diameter tree and light standard. The NASS investigation was unable to produce a specific crush profile for the first two events due to overlapping damage from the third event. The SCI revised Collision Deformation Classifications (CDC's) for these events were 12-FLEE-1 and 12-FLES-1, respectively.



Figure 7 - Damaged 2001 Mitsubishi Galant.

The Galant (**Figure 7**) sustained moderate severity frontal damage as a result of the impact with the 2003 Dodge Dakota pickup. Both the direct contact damage and the combined direct and induced damage encompassed the entire front end and measured 111 cm (43.7") in width. The maximum crush was located at the front right bumper corner and was 9 cm (3.5") in depth. Six

equidistant crush measurements were taken to the vehicle's bumper beam and were as follows: C1 = 6 cm (2.4"), C2 = 7 cm (2.8"), C3 = 7 cm (2.8"), C4 = 6 cm (2.4"), C5 = 5 cm (2") and C6 = 9 cm (3.5"). The SCI revised CDC for this impact was 12-FDEW-1.

The SCI review included an additional CDC in this narrative for the light standard impacting the top plane of the Galant. No specific damage values were available for this event; however, a CDC was determined as 00-TYRO-1.

Interior

The interior of the 2001 Mitsubishi Galant sustained minor damage as a result of the impact with the 2003 Dodge Dakota (Figure 8). The only discernable contact evidence identified during the NASS inspection was a red fabric transfer to the driver's single air bag cover flap (Figure 13). The steering wheel rim contained no contact evidence and the column shows no sign of compression. There were no passenger compartment intrusions or component damage inside the Galant.



Figure 8 - Overall view of driver's area.

2003 Dodge Dakota Pickup Truck – Exterior

The 2003 Dodge Dakota Pickup truck (Figure 9) sustained moderate severity back plane damage as a result of the impact with the 2001 Mitsubishi Galant. The SCI revised direct contact damage began at the left back bumper corner and extended 117 cm (46") to the right. The combined direct and induced damage encompassed the entire back bumper and measured 137 cm (54") in width. The maximum crush was located 41 cm right the vehicle's centerline on the back bumper and measured 24 cm (9.4") in depth. Six equidistant measurements were taken to the vehicle's back bumper and were as follows: C1 = 7 cm (2.8"), C2 = 11 cm (4.3"), C3 = 17 cm (6.7"), C4 = 18 cm (7.1"), C5 = 24 cm (9.4") and C6 = 0 cm. Due to the angle of this vehicle at impact, the Principal Direction of Force (PDOF) to the vehicle was 160 degrees, and the back bumper was shifted to the left. The SCI revised CDC for this impact was 05-BDEW-1.



Figure 9 - Damaged 2003 Dodge Dakota.

Manual Restraints – 2001 Mitsubishi Galant

The 2001 Mitsubishi Galant was equipped with 3-point manual lap and shoulder belts for all five seating positions. The driver's safety belt was designed with continuous loop webbing, sliding latch plates, Emergency Locking Retractors (ELR's), and an adjustable D-ring, which was in the full-up position at the time of the NASS inspection. The

remaining safety belts were designed with continuous loop webbing, sliding latch plates, and switchable ELR/Automatic Locking Retractors (ALR's). The NASS inspection determined the driver's belt as being in use during the crash. There are minor usage marks on the driver's sliding latch plate in the form of metal peening. No obvious loading evidence can be identified on the belt webbing from images within the NASS case.

Redesigned Frontal Air Bag System
2001 Mitsubishi Galant

The 2001 Mitsubishi Galant was equipped with redesigned frontal air bags for the driver and front right seating position. The frontal air bags deployed as a result of the impact with the 2003 Dodge Dakota. The driver's air bag (**Figure 10**) deployed through a single top-mounted trapezoidal air bag cover flap. The cover flap measured 17 cm (6.7") horizontally along its upper edge and 8 cm (3.1") in length horizontally along its lower edge. The cover flap was 12 cm (4.7") in height. The deployed driver's air bag measured 60 cm (23.6) in diameter in its deflated state. The NASS coding reported that the driver's air bag was not tethered; however, circular stitching is present indicative of an internal tether. The NASS coding reported that the air bag contained no vent ports. No occupant loading evidence on the air bag membrane was identified during the NASS inspection.

The front right passenger's air bag (**Figure 11**) deployed from a top-mount module configured with a single rectangular cover flap hinged at the top aspect. The cover flap measured 32 cm (12.6") horizontally and 17 cm (6.7") vertically. The deployed front right passenger's air bag measured 40 cm (16") horizontally and 50 cm (20") vertically in its deflated state. The air bag was tethered by a full-width tether strap at the horizontal centerline. It was vented by two circular ports located at the 4 and 8 o'clock aspects on the back of the air bag. There was no contact evidence on the front right passenger's air bag.



Figure 10 - Deployed driver's air bag.



Figure 11 - Deployed front right air bag.

Occupant Demographics

Driver

Age/Sex: 52-year old/Female
 Height: 157 cm (62")
 Weight: 64 kg (141 lb)
 Seat Track Position: Between mid track and full-forward
 Manual Restraint Use: 3-point lap and shoulder belt
 Usage Source: Vehicle inspection, injury data
 Eyewear: None
 Type of medical treatment: Transported to a local trauma center by ambulance and admitted for 11 days.

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Lacerated aorta (major)	Critical (420210.5,4)	Driver's air bag cover flap
Fractured right ulna (comminuted)	Serious (753204.3,1)	Center instrument panel
Closed head injury (LOC)	Minor (160499.1,0)	Expanding driver's air bag
Chest contusion	Minor (490402.1,4)	Driver's air bag cover flap

Source: Medical Records

Driver Kinematics

The 52-year old female driver was seated in an upright position and was restrained by the 3-point manual lap and shoulder belt. During an interview, the driver admitted to falling asleep and was probably out of position as she approached the fixed objects and 2003 Dodge Dakota. The driver responded to the initial events with a forward trajectory toward the steering column. The Galant then impacted the back bumper and pickup bed of the Dodge and the frontal air bags in the Galant deployed. As the cover flaps opened, they contacted the driver's chest resulting in a linear bruising pattern vertically along the driver's sternum and a major laceration to the driver's aorta. This contact was supported by the red fabric transfer located on the air bag cover flap (**Figure 12**). As the driver continued forward, the expanding air bag driver's contacted the driver's head resulting in a closed head injury. As she loaded the air bag, her right arm simultaneously contacted the center instrument panel, causing a comminuted fracture to her right ulna. The driver briefly lost consciousness following the crash and was removed from her vehicle post-crash by emergency personnel. She was transported to a local trauma center by ambulance complaining of pain to her chest and right wrist. The facility began treating her for her head and wrist injury as the intensity of pain to her chest increased. After a



Figure 12 - Driver's cover flap.

cursory examination of her chest, they discovered the lacerated aorta and performed emergency surgery. The driver remained hospitalized for 11 days following the crash.

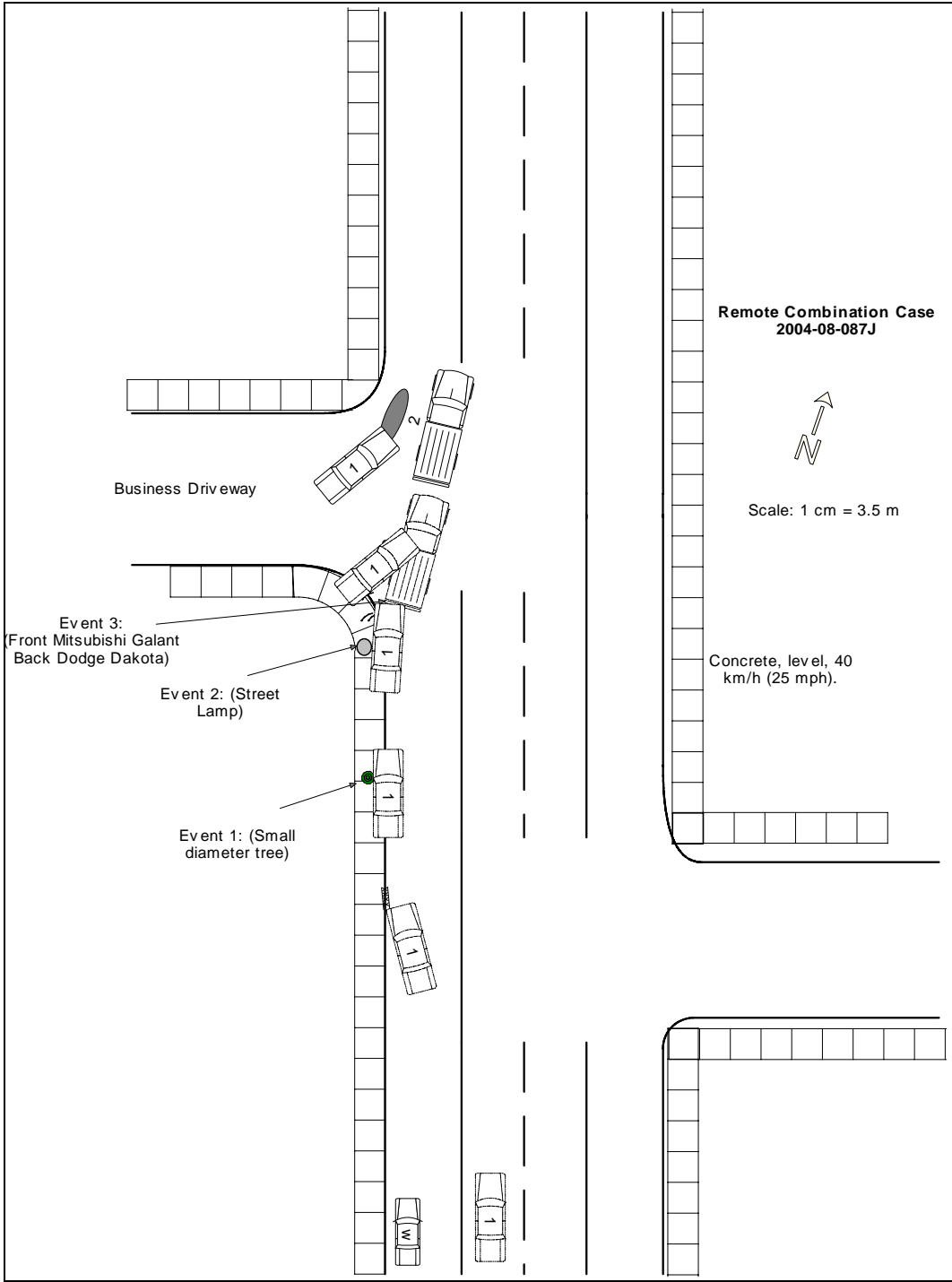


Figure 13 – SCI Revised Scene Schematic