

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

Veridian Engineering
Buffalo, New York 14225

**REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT**

NASS CDS CASE NO. 1998-11-197K

RABSS VEHICLE - 1998 DODGE STRATUS

LOCATION - STATE OF MICHIGAN

CRASH DATE - OCTOBER, 1998

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 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. <i>Supplementary Notes</i> NASS investigation of a right angle collision that involved a 1998 Dodge Stratus equipped with redesigned frontal air bags.			
16. <i>Abstract</i> This investigation focused on a two vehicle crash involving a 1998 Dodge Stratus 4-door sedan (subject vehicle) and a 1994 Ford Tempo GL 4-door sedan. The Dodge Stratus was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a right angle collision with the Ford Tempo. The driver of the Ford was operating the vehicle southbound when she failed to observe the westbound Dodge as she proceeded straight through a 4-leg intersection. As the Ford entered the intersection, the frontal area of the Dodge impacted the right passenger area of the Ford resulting in moderate damage to both vehicles. The restrained 33 year old female driver of the Dodge Stratus initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the left shoulder and chest. She also sustained multiple soft tissue injuries to the knees from contact to the knee bolster. The restrained 7 year old female front right passenger also initiated a forward trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral abrasions. Loading of the manual restraint resulted in contusions to the abdomen and right shoulder. The rear left/right seating positions were occupied by 11 year old males who sustained multiple belt related injuries. The front right/rear left child occupants of the Dodge were transported by ambulance to the emergency room of a local trauma center for treatment and released. The rear right child occupant was transported (accompanied by the driver) to a local trauma center for treatment and admitted for 4 days.			
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CRASH DATE - OCTOBER, 1998**

BACKGROUND

This investigation focused on a two vehicle crash involving a 1998 Dodge Stratus 4-door sedan (subject vehicle) and a 1994 Ford Tempo GL 4-door sedan. The Dodge Stratus was equipped with redesigned frontal air bags for the driver and right passenger positions which deployed as a result of a right angle collision with the Ford Tempo. The driver of the Ford was operating the vehicle southbound when she failed to observe the westbound Dodge as she proceeded straight through a 4-leg intersection. As the Ford entered the intersection, the frontal area of the Dodge impacted the right passenger area of the Ford resulting in moderate damage to both vehicles. The restrained 33 year old female driver of the Dodge Stratus initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the left shoulder and chest. She also sustained multiple soft tissue injuries to the knees from contact to the knee bolster. The restrained 7 year old female front right passenger also initiated a forward trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral abrasions. Loading of the manual restraint resulted in contusions to the abdomen and right shoulder. The rear left/right seating positions were occupied by 11 year old males who sustained multiple belt related injuries. The front right/rear left child occupants of the Dodge were transported by ambulance to the emergency room of a local trauma center for treatment and released. The rear right child occupant was transported (accompanied by the driver) to a local trauma center for treatment and admitted for 4 days.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 98-11-197K and also included in the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian the task of case review and final report preparation.

SUMMARY

Crash Site

This two vehicle crash occurred during the morning hours of October, 1998. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred in the westbound lane of a level/asphalt 4-leg intersection (see **Figure 7 - page 6**) which curved left for westbound traffic. The southern leg of the intersection was designated as an interstate entrance ramp with southbound traffic controlled by a stop sign. The posted speed limit at the crash site was 72 km/h (45 mph).

Pre-Crash

The 77 year old female driver of the 1994 Ford Tempo was operating the vehicle southbound (**Figure 1**) when she stopped at the stop sign and attempted to proceed straight through the 4-leg intersection. The 33 year old female driver of the 1998 Dodge Stratus was operating the vehicle westbound (**Figure 2**) at a

(driver reported) speed of 80 km/h (50 mph) when she observed the Ford cross her path of travel. The driver of the Dodge reported no avoidance maneuvers in anticipation of the impending crash.



Figure 1. Southbound approach for the 1994 Ford Tempo GL.



Figure 2. Westbound approach for the 1998 Dodge Stratus.

Crash

As the Ford Tempo crossed the westbound lane of the 4-leg intersection, the frontal area of the Dodge impacted the right passenger area of the Ford resulting in moderate damage to both vehicles. *Although the input data was questionable*, the missing vehicle algorithm of the WinSMASH program computed velocity changes of 37.4 km/h (23.2 mph) for the subject vehicle and 45.4 km/h (28.2 mph) for the struck Ford Tempo. Respective longitudinal components were -35.2 km/h (-21.9 mph) and -15.5 km/h (-9.6 mph). The impact induced deceleration was sufficient to deploy the Dodge's redesigned frontal air bag system. Both vehicles came to rest in the west sector of the intersection with the Dodge facing southwest and the Ford facing southeast.

Post-Crash

The occupants of the Dodge Stratus exited the vehicle under their own power. The exit status of the Ford Tempo driver was unknown. Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). The front right/rear left child occupants of the Dodge were transported by ambulance to the emergency room of a local trauma center for treatment and released. The rear right child passenger was transported (accompanied by the driver) to a local trauma center for treatment and admitted for 4 days. The driver of the Ford Tempo was transported by ambulance to a local trauma center for treatment and admitted for an unknown length of time. Both vehicles were towed from the scene due to disabling damage.

RABSS VEHICLE

The 1998 Dodge Stratus was identified by the Vehicle Identification Number (VIN): 1B3EJ46C1WN (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 2.0 liter, 4-cylinder engine. The vehicle's odometer reading was approximately 12,874 km (8,000 miles) at the time of the crash. The police report did not specify the owner of the vehicle. The seating was configured with front bucket and rear bench seats (with folding backs). The driver reported no previous crashes or maintenance on the air bag system (original equipment). A cellular phone was present but not in-use at the time of the collision.

VEHICLE DAMAGE

Exterior Damage

The 1998 Dodge Stratus sustained moderate frontal damage as a result of the impact with the Ford Tempo (**Figure 3**). The direct contact damage encompassed the entire frontal width resulting in a combined direct and induced damage length (Field L) of 108.0 cm (42.5 in). Six crush measurements were documented at the level of the reinforcement bar (*bumper fascia separation*): C1= 50.0 cm (19.7 in), C2= 48.0 cm (18.9 in), C3= 49.0 cm (19.3 in), C4= 33.0 cm (13.0 in), C5= 12.0 cm (4.7 in), C6= 0 cm. The Collision Deformation Classification (CDC) for this impact to the Dodge was 01-FDEW-3 with a principal direction of force of (+)20 degrees. The bumper assembly shifted approximately 12.0 cm (4.7 in) to the left (*entire end structure must shift to increment the principal direction of force*). White paint transfers were documented along the bumper fascia and hood. An indentation was noted to the center area of the bumper fascia attributed to the B-pillar on the Ford. The left fender was displaced rearward which restricted the left front wheel/tire (not deflated). The hood was displaced up and rearward from engagement against the side surface of the Ford. Reduction in the left side wheelbase measured 17.0 cm (6.7 in). A tear of the lamination which measured 48cm x 5cm was identified at the left windshield area.



Figure 3. Frontal damage to the 1998 Dodge Stratus .

Interior Damage

Damage to the interior surfaces of the Dodge Stratus were minimal and attributed to occupant contact (**Figure 4**). A spider-web fracture pattern was documented to the left mid-windshield area. Scuff marks were identified on the left A-pillar and knee bolster (rigid plastic type). No intrusions were found in the vehicle.

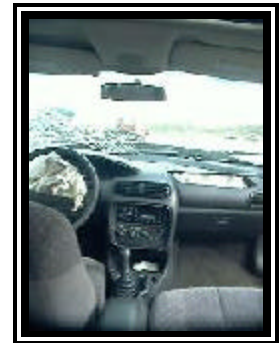


Figure 4. Interior view of the 1998 Dodge Stratus.

REDESIGNED AIR BAG SYSTEM

The 1998 Dodge Stratus was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had deployed as a result of the crash. The driver air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). The flaps were nearly symmetrical in shape as the upper flap measured 21.0 cm (8.3 in) in width and 10.0 cm (3.9 in) in height while the lower flap measured 21.0 cm (8.3 in) in width and 7.0 cm (2.8 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, blue fabric transfers were documented on the lower left quadrant of the air bag face which measured 5.0 cm x 4.0 cm (2.0 in x 1.6 in). Multiple black vinyl transfers were also noted to the upper left quadrant of the air bag from expansion within the module. The NASS researcher measured the diameter of the driver air bag at 52.0 cm (20.5 in) in its deflated state (**Figure 5**). The bag was tethered by two internal straps and reportedly vented by one port located at the 12 o'clock sector on the rear aspect of the air bag.

The front right passenger air bag deployed from the right top instrument panel area with a single cover flap

design hinged at the forward aspect. No contact evidence was identified on the exterior surface of the module cover flap. The cover flap was oval shaped and measured 36.0 cm (14.2 in) in width along the lower portion and 40.0 cm (15.7 in) in width along the upper portion. The cover flap measured 20.5 cm (8.1 in) in height along the left edge and 17.0 cm (6.7 in) in height along the right edge. Blood spattering was noted to the rear lower (centered) section of the air bag which measured 7.0 cm x 6.0 cm (2.8 in x 2.4 in). The NASS researcher measured the passenger air bag at 62.0 cm (24.4 in) in width and 53.0 cm (20.9 in) in height in its deflated state (**Figure 6**). The bag was tethered by two internal tether straps. No vent ports or cutoff switch were reported for the front right air bag.



Figure 5. 1998 Dodge Stratus redesigned driver air bag.



Figure 6. 1998 Dodge Stratus redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex: 33 year old female
 Height: 168 cm (66 in)
 Weight: 61 kg (135 lb)
 Seat Track Position: Mid-to-forward position
 Manual Restraint Use: 3-point lap and shoulder belt system
 Usage Source: NASS vehicle inspection, driver interview, police report
 Eyeware: None
 Type of Medical Treatment: Refused treatment

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Contusion left shoulder	Minor (790402.1,2)	Shoulder belt webbing
Contusion central chest	Minor (490402.1,4)	Shoulder belt webbing
Contusion bilateral knees	Minor (890402.1,3)	Left knee bolster

Laceration bilateral knees (multiple)	Minor (890602.1,3)	Left knee bolster
Laceration anterior left shin (7in long)	Minor (890602.1,2)	Hood release lever

Driver Kinematics

The 33 year old female driver of the 1998 Dodge Stratus was properly restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the mid-to-forward position. Her hands were *braced* at the 10 o'clock and 2 o'clock positions on the steering wheel rim. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the left shoulder/chest area as evidenced by the size and location of the injury. Contact to the deployed air bag was evidenced by the blue fabric transfers identified on the lower left quadrant of the air bag face. She also sustained multiple soft tissue injuries to the knees from contact to the knee bolster, evidenced by the scuff marks documented to this component. The combination of restraint options provided protection against further contact to the steering wheel hub/rim and potential serious injury. The driver refused treatment but accompanied her injured child to the trauma center.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex:	7 year old female
Height:	122 cm (48 in)
Weight:	32 kg (70 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system (<i>improper usage</i>)
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyewear:	None
Type of Medical Treatment:	Transported to the emergency room of a local trauma center and released

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
Contusion left cheek	Minor (290402.1,2)	Front right air bag
Abrasion left cheek	Minor (290202.1,2)	Front right air bag
Contusion right shoulder	Minor (790402.1,1)	Shoulder belt webbing
Abrasion anterior forearms	Minor (790202.1,3)	Expanding front right air bag
Contusion abdomen (5in x 2in)	Minor (590402.1,9)	Lap belt webbing

Front Right Passenger Kinematics

The 7 year old female front right passenger of the 1998 Dodge Stratus was improperly restrained by the available 3-point manual lap and shoulder belt system with the lap belt placed over the abdomen. She was seated in an upright posture with her hands extended forward in a bracing position and the seat track adjusted

to the middle position. Belt usage was confirmed by the type of injuries sustained in conjunction with the lack of significant interior contacts. At impact, she initiated a forward trajectory in response to the 1 o'clock impact force as the expanding air bag contacted the anterior aspect of her forearms resulting in bilateral abrasions. Loading of the manual restraint resulted in contusions to the abdomen and right shoulder, evidenced by the size and location of the injury relative to the occupant's reported placement of the harness. Contact to the *deployed* redesigned air bag resulted in a contusion/abrasion to the left cheek. The front right child passenger was transported by ambulance to the emergency room of a local trauma center for treatment and released.

REAR PASSENGER DEMOGRAPHICS / INJURIES

The 11 year old male rear left passenger of the 1998 Dodge Stratus was (upright) restrained by the available 3-point manual lap and shoulder belt system and initiated a forward trajectory in response to the 1 o'clock impact force. He loaded the manual restraint which resulted in abrasions to the hips and left shoulder, evidenced by the size and location of the injuries. The child passenger was transported by ambulance to the emergency room of a local trauma center for treatment and released.

The 11 year old male rear right passenger of the 1998 Dodge Stratus was improperly restrained by the available 3-point manual lap and shoulder belt system with the shoulder belt placed under the arm and the lap belt placed over the abdomen. He was seated in an upright posture with his hands extended forward in a bracing position. At impact, he initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint resulting in contusions across the abdomen and central chest area. Due to the improper use of the belt system, the child passenger jack knifed over the manual belt webbing and loaded the seat back which resulted in a fracture of the lumbar spine at the L5 position and an associated mesentery contusion (*with a small bleed*). The rear right child passenger was transported by ambulance to a local trauma center for treatment and admitted for 4 days.

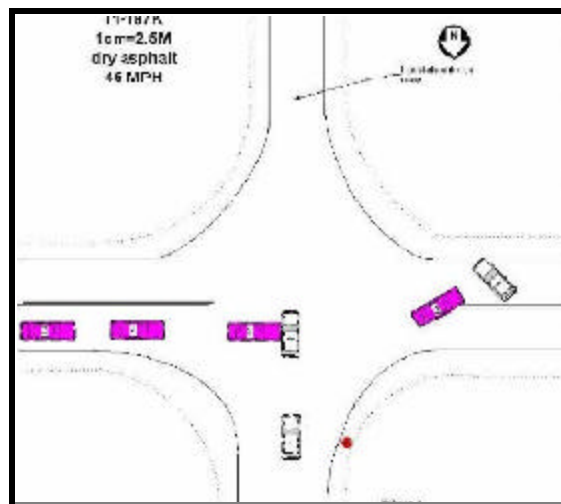


Figure 7. NASS Scene Diagram.