

Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1999-48-802C)

1998 Nissan Frontier

Alabama

July/1999

Technical Report Documentation Page

1. Report No. 1999-48-802C		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle				5. Report Date April 4, 2000	
				6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.				8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401				10. Work Unit No. (TRAIS)	
				11. Contract or Grant no. DTNH22-94-D-27058	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590				13. Type of report and period Covered [Report Month, Year]	
				14. Sponsoring Agency Code	
15. Supplemental Notes					
16. Abstract This remote investigation was focused on the redesigned air bag system deployment of a 1998 Nissan Frontier pickup truck. This two vehicle, head-on axial collision occurred during the afternoon hours of a summer weekday in July, 1999. The collision took place on an undivided two lane roadway. The bituminous roadway surface was dry and the westbound travel lane had a slight negative grade (-2%) while the eastbound travel lane had a slight positive grade of (2%). A dirt/gravel shoulder borders the roadway and the posted speed limit is 89 km/h (55 mph). The crash occurred at a transitional area where the westbound travel lane is a straight section of roadway and the eastbound travel lane is curved to the left. Vehicle 1, a 1989 Mercury Sable four-door sedan was being driven by a 29 year-old-male (unknown height and weight) who reportedly was wearing the lap and shoulder restraint. Driver 1 was traveling westbound and was in the process of passing a tractor-trailer (non-contact vehicle). Vehicle 1 traversed the no passing center line, entering the eastbound travel lane. Vehicle 2, a 1999 Nissan Frontier pickup truck was being driven by a 25 year-old-male (190 cm/ 75 in., 100 kg/220 lbs.) who was wearing the available three-point manual lap and shoulder belt. The driver of Vehicle 2 was negotiating the left curve in the roadway, when he detected Vehicle 1 encroaching his lane of travel. Driver 2 braked and steered to the right in an attempt to avoid the impending impact. Vehicle 2 initiated a longitudinal skid pattern. The driver of Vehicle 1 (Mercury Sable) also anticipated the impact by braking and steering to the left. Vehicle 1 initiated a longitudinal skid pattern leading up to the point of impact. The front of Vehicle 1 (12FYEW3) impacted the front of Vehicle 2 (12FYEW3) in an offset head-on impact. The calculated delta V was 37.1 km/h (23 mph) for Vehicle 2 with a longitudinal delta V of -37.1 km/h (-23 mph) which was of a sufficient change in velocity to deploy the frontal air bags. Vehicle 1 underwent a calculated delta V of 36.6 km/h (22.7 mph). Vehicle 2 rotated counterclockwise coming to rest straddling the south road edge line and facing in a southerly direction. Vehicle 2 (Nissan Frontier) continued in its forward trajectory, coming to rest facing in an easterly direction. Driver 1 (Mercury sable) apparently had been drinking and was given a field alcohol sensor field test with .043% results, which is below the legal limit of .08% required for operating a motor vehicle. He was transported to a local hospital with unknown incapacitating injuries. Driver 2 (Nissan Frontier) was transported to a local hospital where he was treated and released the same day. He sustained contusions (AIS-1) to his left shoulder and chest from engaging the applied shoulder belt webbing. He sustained an abrasion to the ventral aspect of his left forearm (AIS-1) and a cervical neck strain, both due to the deploying air bag.					
17. Key Words Redesigned, air bag.			18. Distribution Statement		
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No of pages	22. Price

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Nissan Frontier pickup truck. This two vehicle, head-on axile collision occurred during the afternoon hours of a summer weekday in July, 1999. The collision took place on an undivided two lane roadway. The bituminous roadway surface was dry and the westbound travel lane had a slight negative grade (-2%) while the eastbound travel lane had a slight positive grade of (2%). A dirt/gravel shoulder borders the roadway and the posted speed limit is 89 km/h (55 mph). The crash occurred at a transitional area where the westbound travel lane is a straight section of roadway and the eastbound travel lane is curved to the left.

Vehicle 1, a 1989 Mercury Sable four-door sedan was being driven by a 29 year-old-male (unknown height and weight) who reportedly was wearing the lap and shoulder restraint. Driver 1 was traveling westbound and was in the process of passing a tractor-trailer (non-contacted vehicle). Vehicle 1 traversed the no passing center line, entering the eastbound travel lane.

Vehicle 2, a 1999 Nissan Frontier pickup truck was being driven by a 25 year-old-male (190 cm/ 75 in., 100 kg/220 lbs.) who was wearing the available three-point manual lap and shoulder belt. The driver of Vehicle 2 was negotiating the left curve in the roadway, when he detected Vehicle 1 encroaching his lane of travel. Driver 2 braked and steered to the right in an attempt to avoid the impending impact. Vehicle 2 initiated a longitudinal skid pattern. The driver of Vehicle 1 (Mercury Sable) also anticipated the impact by braking and steering to the left. Vehicle 1 initiated a longitudinal skid pattern leading up to the point of impact.



Figure 1. Pre-crash trajectory for Vehicle 1



Figure 2. Pre-crash trajectory for Vehicle 2



Figure 3. Frontal damage to Vehicle 1 (1989 Mercury Sable)



Figure 4. Frontal Deformation to Vehicle 2 (1998 Nissan Frontier)

Crash Events

The front of Vehicle 1 (12FYEW3) impacted the front of Vehicle 2 (12FYEW3) in an offset head-on impact. The calculated delta V was 37.1 km/h (23 mph) for Vehicle 2 with a longitudinal delta V of -37.1 km/h (-23 mph) which was of a sufficient change in velocity to deploy the frontal air bags. Vehicle 1 underwent a calculated delta V of 36.6 km/h (22.7 mph)¹.

Vehicle 2 rotated counterclockwise coming to rest straddling the south road edge line and facing in a southerly direction. Vehicle 2 (Nissan Frontier) continued in its forward trajectory, coming to rest facing in an easterly direction. Driver 1 (Mercury sable) apparently had been drinking and was given a field alcohol sensor field test with .043% results, which is below the legal limit of .08% required for operating a motor vehicle. He was transported to a local hospital with unknown incapacitating injuries. Driver 2 (Nissan Frontier) was transported to a local hospital where he was treated and released the same day. He sustained contusions (AIS-1) to his left shoulder and chest from engaging the applied shoulder belt webbing. He sustained an abrasion to the ventral aspect of his left forearm (AIS-1) and a cervical neck strain, both due to the deploying air bag.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	37.1	23.1	36.6	22.7
Longitudinal	-37.1	-23.1	-36.1	-22.4
Lateral	0.0	0	-6.4	-4

¹ Calculated utilizing the Damage Only Routine of the WinSmash 1.2.1 program

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Nissan Frontier
VIN	1N6DD26S7WC
CDC	12FYEW3



Figure 5. Exterior front view, Vehicle 2 (case vehicle)



Figure 6. Perpendicular view, Vehicle 1

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Front Bumper	141	61	45	35	17	3	0
	55.5	24	17.7	13.8	6.7	1.2	0

Interior of Case Vehicle

The interior of the Nissan Frontier pickup truck maintained its integrity and there were no intruding components. The driver's right hand contacted and broke the windshield glazing as evidenced by a spider web crack configuration. The driver's left knee and left hand contacted and cracked the plastic instrument panel covering and the fuse box door was displaced due to occupant contact. The windshield wiper lever was completely separated from the steering column. The center console cover/ transmission selector shroud was cracked and broken due to occupant contact. The case vehicle is equipped with cloth covered front bucket seats. The front bucket seats have a folding feature in order to gain access to the rear jump seat/cargo area. The folding jump seats are located at the rear outboard positions. The front seat backs are equipped with adjustable head restraints that were undamaged. Both front bucket seats were adjusted to their rearmost track position and the driver's shoulder belt adjustment was placed in the up position.

Case Vehicle Occupant Protection Systems

The 1998 Nissan Frontier pickup truck was equipped with redesigned air bag systems. This system consists of three sensors. The front crash zone sensor is located under the hood at the mid-upper radiator support². The G sensor and safing sensor are located in the diagnosis sensor unit. The air bag diagnosis sensor unit is located in the center of the vehicle, concealed within the transmission tunnel/center console. The diagnosis sensor unit is also equipped with an auxiliary power source condenser. The backup power feature is sufficient to deploy the air bags in the event that the battery or battery cables are damaged in a collision before the crash sensors are activated. This system is offered with the passenger air bag deactivation switch which is located in the middle/ lower instrument panel, immediately above the transmission tunnel. The deactivation shut off switch was activated which rendered the passenger air bag inoperative. Subsequently, the front passenger air bag did not deploy. An air bag indicator lamp is located in the front, left instrument panel.



Figure 7. Three-quarter view of driver's seating area



Figure 8. View showing deployed driver's air bag

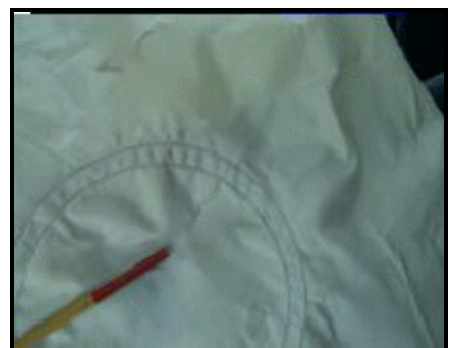


Figure 9. Close up of driver's air bag

² Refer to the 1998 Nissan Frontier Pickup Truck Passive Restraint Systems and Wiring Mapping Views

The driver's air bag is housed in the steering wheel hub and encases the nylon air bag unit. The double symmetric, horizontal module cover flaps opened at their designated tear points and were undamaged. The circular air bag is tethered by two straps and two exhaust vent port holes are present. The lower instrument panel is shrouded by a rigid plastic knee bolster. The upper knee bolster was contacted and damaged due to left knee loading by the driver. There was a dark cloth transfer to the air bag fabric due to driver contact.

The front, right passenger air bag is located on the instrument panel (top mount). The module deployment door is rectangular in shape. The passenger air bag did not deploy due to the activation of the air bag shut off switch.



Figure 10. Passenger side air bag module cover (non-deployed)



Figure 11. View showing air bag shut off switch

Case Vehicle Occupant Demographics

	Occupant 1
Age/Sex:	25/Male
Seated Position:	Front, Left
Seat Type:	Bucket with folding back(s) Fabric covered
Height (cm/in.):	190 74.8
Weight (kg/lbs):	100 220.5
Pre-existing Medical Condition:	None Reported
Body Posture:	Upright, facing forward. Normal Posture
Hand Position:	Both hands on steering wheel rim. Left hand at the 11 o'clock position and right hand at the 1 o'clock position.
Foot Position:	Right foot on brake pedal and left foot on the floor panel
Restraint Usage:	Active, three-point lap and shoulder belt worn in a snug and proper fashion.
Air bag:	Driver air bag deployed as a result of the significant frontal impact

Occupant Injuries

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Left forearm abrasion (ventral aspect)	1	driver's air bag
Left shoulder contusion	1	Shoulder belt webbing
Left chest contusion	1	Shoulder belt webbing
Cervical/neck strain	1	Driver's air bag

Occupant Kinematics

The 25 year-old-male driver of the 1998 Nissan Frontier pickup truck was fully restrained by the available three-point manual lap and shoulder belt. He was in an upright position, facing forward, with both hands on the steering wheel rim (11 o'clock and 1 o'clock respectively). His right foot was depressing the brake pedal while his left foot was on the floor.



Figure 12. Driver's seated position

He responded to the 12 o'clock direction of force by moving directly forward. His lower torso was prohibited from extended forward motion as his upper torso loaded the applied lap and shoulder belt. He sustained a left shoulder contusion and left chest contusion (AIS-1) attributed to the shoulder belt webbing.

Due to the driver's large stature, his left knee contacted and broke the rigid plastic cover to the upper knee bolster. His right leg contacted and broke the center console cover.

When the driver's air bag deployed, both of his hands were thrust from the steering wheel rim. His right hand contacted and broke the windshield wiper lever. His right hand flailed upward, contacting and breaking the laminated windshield glazing. His left hand contacted and cracked the instrument panel cover (refer to Figure 18). The driver's upper chest and face contacted the deploying air bag. This was evidenced by a documented dark cloth transfer to the air bag fabric. He sustained a left forearm abrasion (AIS-1) to his ventral aspect as a result of contacting the air bag. He also sustained a cervical neck strain (AIS-1) due to his involvement with the driver's air bag. He rebounded directly rearward into his respective seat back support where he came to rest.



Figure 13. Close up view showing damaged center console due to right leg contact. Note: air bag shut off switch in off position

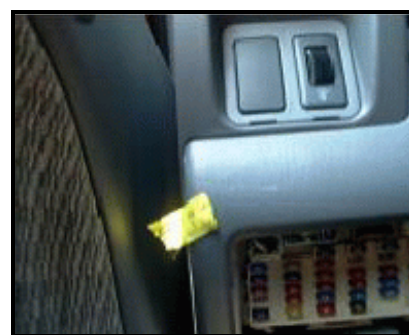
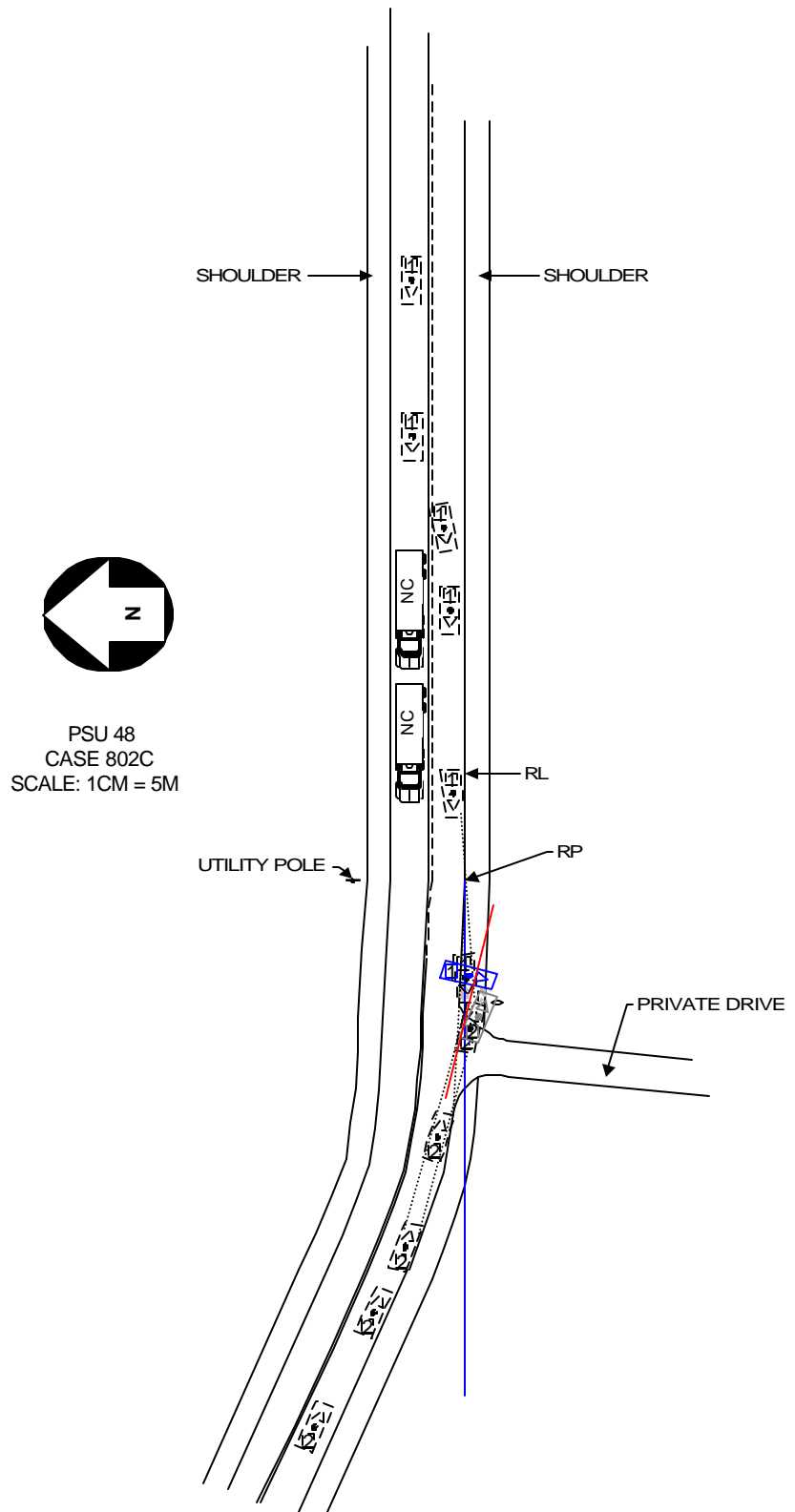


Figure 14. Left hand contact to instrument panel

Scene Diagram



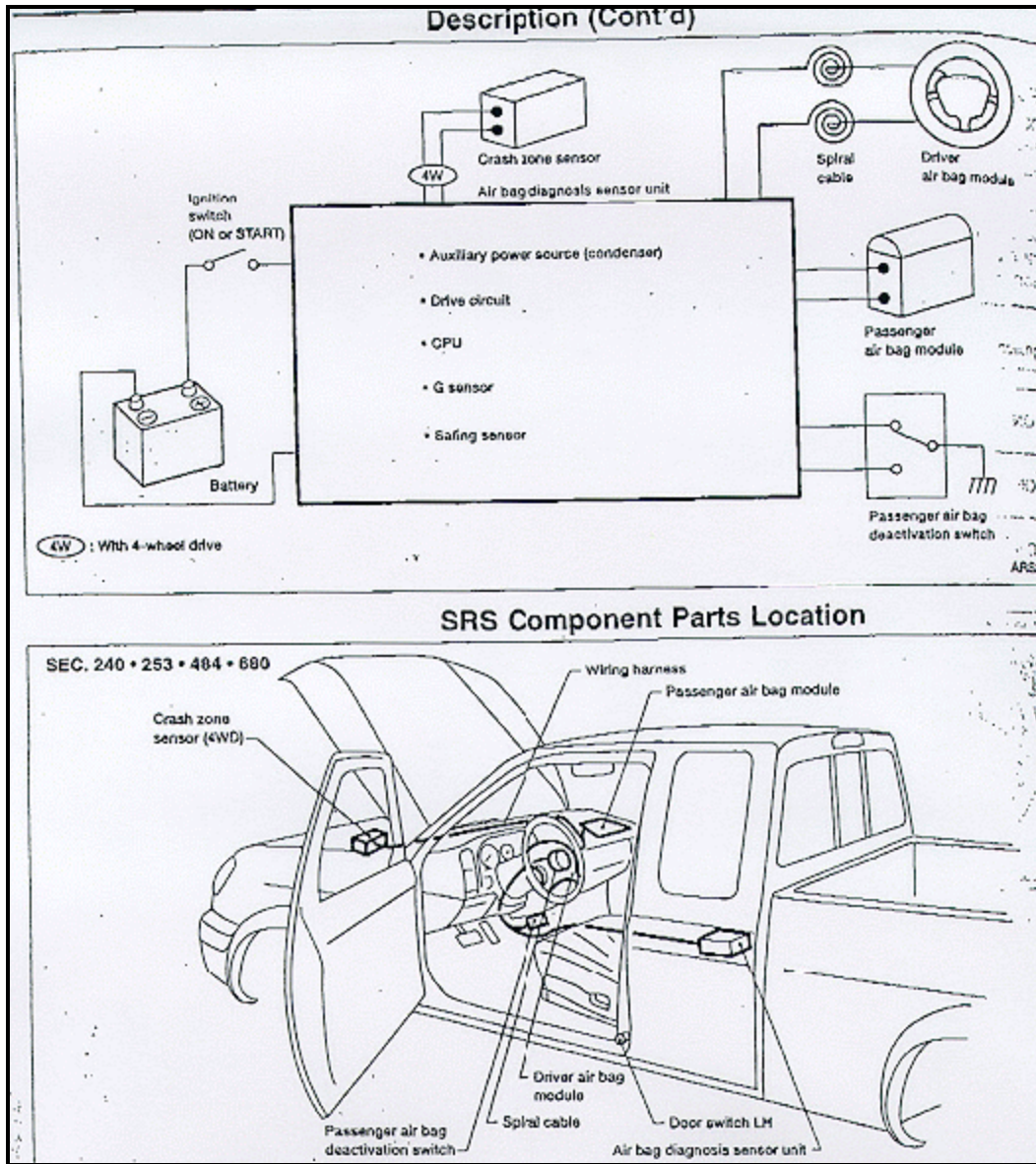


Figure 16. SRS components