

Remote, Redesigned Air Bag Special Study

**FOR NHTSA'S INTERNAL USE ONLY**

Dynamic Science, Inc., Case Number (1999-079-803E)

2000 Audi TT 3-door hatchback

California

November/1999

**Technical Report Documentation Page**

1. Report No. 1999-079-803E		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle				5. Report Date July 6, 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 focused on the redesigned air bag system deployment of a 2000 Audi TT 3-door hatchback. This minor injury crash occurred in November, 1999 in the evening. The weather was clear and the bituminous roadway was dry. The crash occurred in a four leg intersection. The westbound leg of the intersection is a two-way undivided roadway and is comprised of six travel lanes; two westbound thru-lanes, one westbound left-turn lane, and three eastbound lanes. The speed limit for this road is 56 km/h (35 mph). It is controlled by overhead traffic signals. The road is level at this location. The northbound leg of the intersection is a two-way roadway and is comprised of five travel lanes; two northbound thru-lanes, one northbound left-turn lane, and two southbound lanes. The speed limit and grade are not known. It is controlled by overhead traffic signals. Vehicle 1, a 2000 Audi TT 3-door hatchback (case vehicle) driven by a 26 year old male (183 cm/72 in, 84 kg/185 lbs), was traveling west in the westbound left turn lane approaching the intersection at a police estimated speed of 106 km/h (65 mph). The driver was preparing to make a left turn at the intersection. The overhead traffic signal was in the green phase at this time. The driver was restrained by the manual lap and shoulder restraint. The front right seat was occupied by a 23 year old male (180 cm/71 in, 77 kg/170 lbs) who was also restrained by the available manual lap and shoulder restraint. The driver of Vehicle 1 initiated the left turn at a high rate of speed and lost control of the vehicle. Vehicle 1 struck the southwest raised concrete curb with both front wheels (12FDWN3) damaging the rims and deflating the tires (event 1). Vehicle 1 then continued off the roadway and struck a metal utility pole (event 2) with the front plane (12FLEN4). A Delta V was calculated for event 2 for Vehicle 1, utilizing the Fixed Barrier Algorithm of WinSMASH, as 42 km/h (26 mph). As a result of the frontal pole impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. The center instrument panel mounted passenger's frontal air bag shut off switch was turned to the "on" position at the time of the crash. Vehicle 1 also was equipped with seat back mounted side air bags in the front left and front right seating positions which did not deploy in this frontal impact. Vehicle 1 came to rest up against the struck utility pole facing south. Both occupants of Vehicle 1 were transported to a trauma center, however the front right occupant was uninjured and was not treated. The driver was treated and released. Vehicle 1 was disabled due to damage sustained in the crash and was towed from the scene.					
17. Key Words  Redesigned air bag system, air bag related injuries			18. Distribution Statement		
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of pages	22. Price		

Remote, Redesigned Air Bag Special Study  
**FOR NHTSA'S INTERNAL USE ONLY**  
Dynamic Science, Inc., Case Number (1999-079-803E)  
2000 Audi TT 3-door hatchback  
California  
November/1999

***Summary***

This remote investigation focused on the redesigned air bag system deployment of a 2000 Audi TT 3-door hatchback. This minor injury crash occurred in November, 1999 in the evening. The weather was clear and the bituminous roadway was dry. The crash occurred in a four leg intersection. The westbound leg of the intersection is a two-way undivided roadway and is comprised of six travel lanes; two westbound thru-lanes, one westbound left-turn lane, and three eastbound lanes. The speed limit for this road is 56 km/h (35 mph). It is controlled by overhead traffic signals. The road is level at this location. The northbound leg of the intersection is a two-way roadway and is comprised of five travel lanes; two northbound thru-lanes, one northbound left-turn lane, and two southbound lanes. The speed limit and grade are not known. It is controlled by overhead traffic signals.

Vehicle 1, a 2000 Audi TT 3-door hatchback (case vehicle) driven by a 26 year old male (183 cm/72 in, 84 kg/185 lbs), was traveling west in the westbound left-turn lane approaching the intersection at a police estimated speed of 106 km/h (65 mph). The driver was preparing to make a left turn at the intersection. The overhead traffic signal was in the green phase at this time. The driver was restrained by the manual lap and shoulder restraint. The front right seat was occupied by a 23 year old male (180 cm/71 in, 77 kg/170 lbs) who was also restrained by the available manual lap and shoulder restraint.



**Figure 1.** Crash scene. Vehicle 1 approach path.



**Figure 2.** Crash scene. Point of impact with utility pole.

## Crash Events

The driver of Vehicle 1 initiated the left turn at a high rate of speed and lost control of the vehicle. Vehicle 1 struck the southwest raised concrete curb with both front wheels (12FDWN3) damaging the rims and deflating the tires (event 1). Vehicle 1 then continued off the roadway and struck a metal utility pole (event 2) with the front plane (12FLEN4).

A Delta V was calculated for event 2 for Vehicle 1, utilizing the Fixed Barrier Algorithm of WinSMASH, as 42 km/h (26 mph).

As a result of the frontal pole impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. The center instrument panel mounted passenger's frontal air bag shut off switch was turned to the "on" position at the time of the crash.



Figure 3. Exterior, Vehicle 1 (Audi TT)

Vehicle 1 also was equipped with seat back mounted side air bags in the front left and front right seating positions which did not deploy in this frontal impact.

Vehicle 1 came to rest up against the struck utility pole facing south.

Both occupants of Vehicle 1 were transported to a trauma center, however the front right occupant was uninjured and was not treated. The driver was treated and released.

Vehicle 1 was disabled due to damage sustained in the crash and was towed from the scene.

Table 1. Delta V

	Case Vehicle	
	km/h	mph
Total	42	26.1
Longitudinal	-42	-26.1
Lateral	0	0
Barrier speed	42	26.1

**Exterior of Case Vehicle**

**Table 2. Vehicle Information**

Model year, make and model	2000 Audi TT 3-door hatchback
VIN	TRUUC28N9Y1
CDC	12FLEN4



**Figure 4.** Exterior, Vehicle 1 (2000 Audi TT 3-door hatchback)



**Figure 5.** Exterior, Vehicle 1 (2000 Audi TT 3-door hatchback)

**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.
Bumper	142	57	70	43	25	8	0
	55.9	22.4	27.6	16.9	9.8	3.1	0

## *Interior of Case Vehicle*

The interior of the Audi TT sustained minor damage from intrusion and occupant contact. There was intrusion of the toe pan in the front left position of the vehicle (see Table 4). There was occupant contact evidence to the steering column, air bags, mirror, instrument panel, and glove compartment door.

The case vehicle was equipped with bucket seats with folding backs in the front left and front right seating positions. Both front seats were adjusted between the middle and rear most track positions. Both front seats were equipped with adjustable head restraints which were not damaged. The rear of the vehicle was equipped with split bench seats with folding backs in the back left and back right seating positions.

**Table 4. Intrusions**

<b>Intruded Component</b>	<b>Location of Intrusion</b>	<b>Intruded Value cm/in.</b>		<b>Dominant Crush Direction</b>
Toe pan	Front left	8	3.1	Longitudinal

## *Case Vehicle Occupant Protection Systems*

The Audi TT 2-door coupe was equipped with a redesigned air bag system which consisted of front left and front right air bag modules which housed air bags and depowered inflator units, and a front right air bag shut off switch.

The front left air bag was housed in the steering wheel hub and was concealed by asymmetrical H-configuration cover flaps which were not damaged in the crash. The circular air bag was equipped with four tether straps and one vent port. Contact evidence consisting of blood, smudges, and scuffs was found on the front of the air bag. The bag was not damaged.



**Figure 6.** Interior, case vehicle. Driver's frontal air bag.

The front right air bag was housed in the mid-instrument panel position and was concealed by a single rectangular shaped cover flap which was not damaged in the crash. The rectangular air bag was equipped with one tether strap and two vent ports. Contact evidence consisting of “smudges” was found on the upper half of the front of the air bag. The bag was not damaged. The center instrument panel mounted passenger’s frontal air bag shut off switch was turned to the “on” position at the time of the crash.

The Audi TT was also equipped with seat back mounted side air bags in the front left and front right seating positions which did not deploy in this frontal impact.



**Figure 7.** Interior, case vehicle. Passenger’s frontal air bag.



**Figure 8.** Interior, case vehicle. Passenger’s frontal air bag shut off switch.



**Figure 9.** Interior, case vehicle. Side impact air bag system.

## Case Vehicle Occupant Demographics

**Table 5. Case Vehicle Occupant(s) Demographics**

	<b>Occupant 1</b>	<b>Occupant 2</b>
Age/Sex:	26/Male	23/Male
Seated Position:	Front left	Front right
Seat Type:	Bucket with folding back - leather covered	Bucket with folding back - leather covered
Height (cm/in):	183 72	180 71
Weight (kg/lbs):	84 185	77 170
Pre-existing Medical Condition:	None noted	None noted
Body Posture:	Upright in seat facing forward - not bracing	Upright in seat facing forward - not bracing
Hand Position:	Left - steering wheel Right - unknown	On lap
Foot Position:	On floor or foot controls	On floor
Restraint Usage:	Manual lap and shoulder restraint	Manual lap and shoulder restraint
Air bag:	Deployed redesigned frontal air bag system	Deployed redesigned frontal air bag system

## Occupant Injuries

**Table 6. Case Vehicle Occupant(s) Injuries**

<b>Occupant #</b>	<b>Injury</b>	<b>Injury Severity (AIS)</b>	<b>Injury Mechanism</b>
1	Abdominal skin contusion	1	Seat belt webbing
1	Right forearm skin abrasion	1	Driver's air bag
1	Chest skin abrasion	1	Seat belt webbing
2	Not injured		

## *Occupant Kinematics*

The driver (case occupant 01) of the Audi TT was seated in a normal upright posture in the front left position of the vehicle. He was wearing the manual lap and shoulder restraint. The front right passenger (case occupant 02) was also seated in a normal upright posture and was wearing the manual lap and shoulder restraint. Seat belt usage was determined through visual inspection by the researcher, the lack of prominent frontal contact evidence, and observations by the investigating police officer at the scene of the crash. The driver attempted to avoid the collision by steering left which may have caused the occupants to shift to the right prior to impact.

At impact, the occupants reacted to the 0 degree principle direction of force by moving forward and loading the lap and shoulder restraints. As the restraints locked, further forward movement of the occupants was prevented. The loading of the restraints by case occupant 01 caused the chest and abdominal abrasions. As the driver's frontal air bag deployed, his right wrist was struck causing the right wrist abrasion. Case occupant 02 was not injured but reportedly was suffering from "minor lower back pain". Both occupants of Vehicle 1 were transported to a trauma center, however the front right occupant was uninjured and was not treated. The driver was treated and released.



**Figure 10.** Interior, case vehicle. Driver's frontal air bag contact evidence.

Scene Diagram

