

CRASH DATA RESEARCH CENTER

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**CALSPAN REMOTE REDESIGNED AIR BAG VEHICLE CRASH
INVESTIGATION**

CASE NO: CA02-015

VEHICLE: 2001 PORSCHE BOXTER

LOCATION: FLORIDA

CRASH DATE: MARCH 2002

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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<i>16. Abstract</i> This remote investigation focused on the performance of the redesigned frontal air bag system in a 2001 Porsche Boxter S two-door convertible. The Porsche Boxter was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of a frontal collision with a tree. The 32-year-old male driver of the Porsche was operating the vehicle northbound on a five-lane urban divided roadway when for unknown reasons the vehicle began to track to the left and entered the center median area. As the vehicle entered the curbed grassy median, the front right area impacted a large hardwood tree resulting in severe damage to the front right corner and the right side of the vehicle. The driver was reportedly restrained and seated in an upright posture. He sustained a fractured right femur, a laceration to his scalp, and multiple soft-tissue injuries to his upper right arm. The driver was transported by air to a trauma center and hospitalized for six days.			
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CALSPAN REMOTE REDESIGNED AIR BAG SYSTEM INVESTIAGATION
CALSPAN CASE NO: CA02-015
VEHICLE: 2001 PORSCHE BOXTER S
LOCATION: FLORIDA
CRASH DATE: MARCH 2002

BACKGROUND

This remote investigation focused on the performance of the redesigned frontal air bag system in a 2001 Porsche Boxter S two-door convertible (**Figure 1**). The Porsche Boxter was equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of a frontal collision with a tree. The 32-year-old male driver of the Porsche was operating the vehicle northbound on a five-lane urban divided roadway when for unknown reasons the vehicle began to track to the left and entered the center median area. As the vehicle entered the curbed grassy median, the front right area impacted a large hardwood tree resulting in severe damage to the front right corner and the right side of the vehicle. The driver was reportedly restrained and seated in an upright posture. He sustained a fractured right femur, a laceration to his scalp, and multiple soft-tissue injuries to his upper right arm. The driver was transported by air to a trauma center and hospitalized for six days.

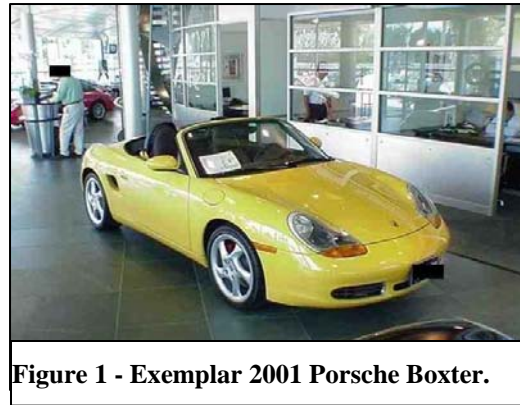


Figure 1 - Exemplar 2001 Porsche Boxter.

This crash was identified by NASS-PSU 42 in April 2002 within the course of their weekly sampling activities. Although it was not selected as a CDS case, the police report was forwarded to the Calspan SCI team who subsequently notified the National Highway Traffic Safety Administration (NHTSA). Due to the AOPS system and the deployment of the frontal air bag system, the crash was originally assigned to the Calspan SCI team for on-site investigation; however, after experiencing no success locating the vehicle, the case was converted to remote investigation, based on the investigation in April 2002 by the Crash Injury Research and Engineering Network (CIREN). The CIREN investigation included the vehicle and scene investigations, an interview of the driver, and a review of the driver's injuries. Based on these findings, the Calspan SCI team prepared this narrative report.

SUMMARY

Crash Site

The crash occurred on a five-lane urban roadway divided by a curbed grassy median. The roadway consisted of two north and southbound lanes and a southbound left turn lane. At the area of the crash, the median split allowing access to and from an intersecting roadway emanating from the east. The lanes were delineated by broken yellow lines and were surfaced with asphalt. At the time of the crash, the roadway was

dry and there were no adverse weather conditions. The posted speed limit was 56 km/h (35 mph). The scene schematic is included as **Figure 10** at the end of this narrative report.

Vehicle Data

2001 Porsche Boxter S

The subject vehicle in this crash was a 2001 Porsche Boxter two-door convertible. The Porsche was identified by the Vehicle Identification Number (VIN) WP0CA29831U (production number omitted). The Porsche was equipped with a 2.7-liter, 6-cylinder conventionally mounted engine linked to a 5-speed manual transmission. The braking system for this rear-wheel drive vehicle consisted of power-assisted four-wheel ventilated disc brakes with anti-lock (ABS). The Porsche was equipped with alloy wheels and Michelin Pilot SX P205/50R17 tires. The specific tire information was not reported in the CIREN investigation.

The single row vehicle was configured with bucket seats and integral head restraints for both frontal seating positions. The driver and front right passenger seats were adjusted to the full-rear seat track position.

Crash Sequence

Pre-Crash

The 32-year old male driver of the 2001 Porsche Boxter S was traveling northbound on the right outside lane approaching a T-intersection with no traffic controls for north/south traffic (**Figure 2**). The Porsche drifted into the inside lane through the intersection and mounted the forward edge of the center median. There was no physical evidence at the scene indicating any pre-crash evasive maneuvers such as steering or braking inputs.

Crash

Both left side tires were damaged as the Porsche mounted the curbed median. The front right corner of the Porsche then impacted a large hardwood tree that was located approximately 2.5 m (8') inboard from the curbed grassy median (**Figure 3**). The direction of force for the Porsche was 12 o'clock. The impact resulted in severe damage to the Porsche and was sufficient to deploy the frontal air bag system. The damage-only routine of the WinSMASH program calculated a total delta-V of 37 km/h (23 mph). The specific longitudinal and lateral changes in velocity were -37 km/h (-23 mph) and 0 km/h, respectively. The WinSMASH results were based on the frontal crush profile of the Porsche and were measured along the bumper level. Considering that a significant amount of the actual crush was outside the frame rails, the results are underestimated and should not be considered representative of this crash.

Following the impact, the Porsche rotated clockwise and exited the left aspect of the median, crossed both southbound lanes, and came to final rest straddling the west roadside facing in an eastbound direction

Post-Crash

Emergency personnel arrived on scene and removed the 32-year old driver from his vehicle. He was flown by helicopter to a regional trauma center where he was admitted for six days. The driver sustained a fractured right femur and multiple soft-tissue injuries. The vehicle was towed from the scene due to damage.



Figure 2 - Northbound approach of 2001 Porsche Boxter.



Figure 1 - Point of impact - hardwood tree.

Vehicle Damage

Exterior Damage

The 2001 Porsche Boxter sustained severe frontal damage as a result of the impact with the large diameter hardwood tree (**Figures 4 and 5**). The CIREN vehicle inspection revealed that the direct damage began at the front right bumper corner and extended 20 cm (7.9") to the left. The maximum crush was located at the front right bumper corner and measured 65 cm (25.6") in depth. The combined direct and induced damage encompassed the entire front end and measured 67 cm (26.4") across the compressed front bumper. The Collision Deformation Classification (CDC) for this frontal impact was 12-FREE-6. Six equidistant measurements were documented across the full width of the bumper and were as follows: C1 = 0 cm, C2 = 6 cm (2.4"), C3 = 22 cm (8.7"), C4 = 37 cm (14.6"), C5 = 46 cm (18.1"), C6 = 65 cm (25.6").

Energy was translated down the right side of the vehicle resulting in a CIREN-reported front right door opening. The compromised area appears to be the door structure as the latch and striker appear to have maintained their integrity; however, no photographic documentation of



Figure 3 – Right lateral view of the damage profile.



Figure 5 - Damaged 2001 Porsche Boxter

these components was provided to substantiate this finding. The CIREN investigation did attribute the opening to door support failure due to damage with the EDS portion of the case. Due to the severity of the impact, the windshield was holed and the front right tempered-glazing was shattered.

Both left side tires were damaged from impacting the curbed median along the path of travel to impact with the hardwood tree. The SCI revised investigation added CDC's to the left side wheels as follows: 12-FLWN-3 and 12-FLWN-9.

Interior Damage

The CIREN investigation revealed moderate interior damage associated with occupant contact and passenger compartment intrusion. Minor scuffing was present on the lower aspect of the padded knee bolster right of the steering column. This scuffing was probably the result of the driver's right knee loading the component. The CIREN investigation reported that the left sun visor was deformed and attributed this damage to interaction with the driver's head. The fractured windshield contained a transfer of an undetermined origin which was attributed to the driver's right arm. The area of this transfer was not specified.

Passenger compartment intrusions of the windshield header and front right instrument panel were documented by the CIREN investigator. This SCI review of their finding determined that the front right door intruded as well. Although the front right door was altered from its original placement, damage to the right side of the front right bucket seat exhibits a damage pattern often seen with door panel intrusion (**Figure 6**). It is likely



Figure 4 - Driver's seating position, stretched webbing of shoulder belt, deformed front right seat.

the front right toe pan intruded longitudinally; however, this could not be substantiated through images.

The specific intrusions are listed by their magnitude in the following table:

Position	Component	Magnitude	Direction
Front Right	Windshield header	34 cm (13.4")	Longitudinal
Front Right	Door panel	8 – 15 cm (3 – 6")	Lateral
Front Right	Instrument panel	2 cm (0.8")	Longitudinal

Manual Restraints

The 2001 Porsche Boxter was equipped with manual 3-point lap and shoulder belts for the front outboard seats. Both belts were configured with sliding latch plates, fixed D-rings and Emergency Locking Retractors (ELRs). The driver's belt in its relaxed state exhibited severe stretching of the webbing indicative of driver loading (**Figure 6**).

Additionally, a wear mark pattern demonstrating historical usage was visible on the sliding latch plate (**Figure 7**).

Redesigned Frontal Air Bag System – 2001 Porsche Boxter

The 2001 Porsche Boxter was equipped with redesigned frontal air bags for the driver and front right passenger positions. The driver and front right air bags deployed as a result of the frontal impact with the hardwood tree. The driver’s air bag deployed from the steering wheel hub that was configured with asymmetrical H-configuration module cover flaps. The upper flap measured 23 cm (9.1”) in width and 23 cm (9.1”) in height. The lower flap measured 18 cm (7.1”) in width and 10 cm (4”) in height. The driver’s air bag (**Figure 8**) measured 50 cm (19.7”) in diameter and was vented by a single circular port at the 12 o’clock aspect on the rear of the air bag. The air bag was not tethered. The CIREN investigator reported no occupant contact evidence on the air bag. However, as illustrated in **Figure 8**, transfers from an unknown origin are present on the right half of the air bag.



Figure 5 - Driver's latch plate.

The front right passenger’s air bag (**Figure 9**) deployed from a mid-mount cover flap on the right instrument panel that measured 29 cm (11.4”) in width and 15 cm (5.9”) in height. The deployed front right air bag measured 50 cm (19.7”) in width and 50 cm (19.7”) in height. The air bag was not tethered and was vented by a single port located in the 1 o’clock position on the back of the air bag. There was no damage or contact evidence to the bag.



Figure 8 - Driver's air bag.



Figure 9 - Deployed front right air bag.

Side Impact Inflatable Air Bags

The Porsche was equipped with door-mounted side impact air bags for both the driver and front right passenger positions. Neither side impact air bag deployed in the crash.

Occupant Demographics

Driver

Age/Sex: 32-year-old/Male
Height: 173 cm (68")
Weight: 90 kg (198 lb)
Seat Track Position: Full-rear
Manual Restraint Use: Manual 3-point lap and shoulder belt
Usage Source: CIREN Vehicle inspection
Eyewear: Unknown
Type of Medical Treatment: Transported by helicopter to a regional trauma center and admitted for six days

Driver Injuries

Injury	Injury Severity	Injury Source
Right femur fracture (NFS)	Serious (851800.3,1)	Knee bolster
Scalp laceration (NFS)	Minor (190600.1,9)	Sun visor
Multiple abrasions to upper right arm	Minor (790202.1,1)	Windshield

Source: CIREN Investigator.

Driver Kinematics

The 32-year old male driver of the 2001 Porsche Boxter was seated in an upright posture in the rear-most track position. At impact, the driver air bag deployed and the driver initiated a forward trajectory in response to the 12 o'clock direction of force. Due to the confined space within the vehicle, the driver was able to travel forward as he loaded the belt system. He probably loaded the air bag; however, this could not be corroborated. His head contacted the sun visor reinforced by the header and he sustained a scalp laceration. The driver's right arm contacted the fractured windshield causing multiple abrasions to his right upper arm. The driver's knee contacted the bolster resulting in an indirect femur fracture of his right leg. The driver was removed from the vehicle by emergency personnel due to his injuries. He was flown to a regional trauma center and admitted for six days.

Figure 10 – Scene Schematic

