
Side Impact Inflatable Restraint Systems

Real World Experience of Side Impact Air Bags in the Special Crash Investigations (SCI) Program

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Various Types of Side Air Bags



Inflatable Curtains



Door / Inflatable Tubular Structures



Seat



**Seat
Head/Thorax**



Door

Case Selection Criteria

- February 1995 to January 2000
 - Any Side Bag and/or curtain deployment
- February 2000 to Present
 - Side air bag and / or inflatable head protection deployment into an occupied position



92 Side Air Bag Cases (Oct 2003)

PLANE						
Type of Air Bag	LEFT	FRONT	RIGHT	ROLLOVER	No IMPACT	TOTAL
Seat	27	3	7	1	2	40
Seat/IC	7	1	1	1	0	10
Seat/H/T	2	0	1	0	0	3
Door	11	1	8	3	0	23
Door/ITS	7	2	2	0	0	11
Door/IC	0	0	1	0	0	1
IC	1	0	1	2	0	4
	55	7	21	7	2	92

92 Side Air Bag Cases (Oct, 2003)

Audi	1
BMW	17
Daimler-Chrysler	11
Ford	4
GM	17
Honda	3
Jaguar	1
KIA	1
Nissan	4
Porsche	1
Toyota	8
VW	10
Volvo	14
TOTAL	92

14 Fatalities in Side Air Bag Investigations

NO-SIDE-AIR-BAG-DEPLOYMENT-RELATED-FATALITIES

8* - Driver Fatalities

- 4 Left side impacts with a seat mounted thorax air bag
 - 2 Rollover (driver ejection) with a deployment
- 3 Left side impacts with a door mounted head / thorax air bag

6 – Right Front Passenger Fatalities

- 3 Right side impacts with a thorax air bag deployment
 - 1 Frontal Impact
- 3 Right side impacts with a Head and Thorax deployment

*1 driver fatality was a roll over where the driver was ejected via the passenger side.



55 Left Side Impacts

- 38 - Thorax only side air bag deployments
 - 4 - Fatal (severe intrusion)
 - 4- AIS – 3
 - Air Bag – Door mounted side air bag compartment cover
 - Left side hardware/armrest (To be discussed later)
 - Left door/ shoulder belt
 - Front of other vehicle & left side intruding door
 - 4 - AIS - 2 - Concussions, Fractures, Contusions
 - 20 - AIS - 1
 - 6 – No injury, a complaint of pain or unknown if injured

55 Left Side Impacts (Continued)

- 16- Head and thorax side air bag deployments
 - 1- Fatal (severe intrusion) struck in driver's door by school bus
 - Lacerated Aorta but No Head Injury
 - 3- Serious Injury
 - (severe intrusion) struck in driver's door by a pick up truck
 - Fractured Ribs, Collapsed Lung, Lacerated Spleen, Torn Diaphragm, Torn Bladder but, No Head Injury
 - 1- Moderate
 - 6- Minor
 - 3- To be determined (new cases)
 - 2-Not Injured
- 1- Inflatable Curtain (head protection only)
 - 1- Minor injury



21 Right Side Impacts

- 15- Thorax only side air bag deployments
 - 2 - Fatal (severe intrusion)
 - 2- AIS - 3
 - 3 - AIS - 2
 - 4 - AIS - 1
 - 2- No injury
 - 2- TBD



21 Right Side Impacts (Continued)

■ 5- Head and Thorax

■ 1 Fatal

- severe intrusion

■ 2 Not Injured

■ 2 TBD

■ 1- Inflatable Curtain (**Head Protection Only**)

■ No injury



8 Children in Side Air Bag Deployments

National Center for Statistics and Analysis **NCSA**

- Children 12 and under
- No Serious Injuries
 - 5 AIS-1
 - 2 Not Injured
 - 1 TBD



Serious Injury Related to a Side Air Bag Deployment

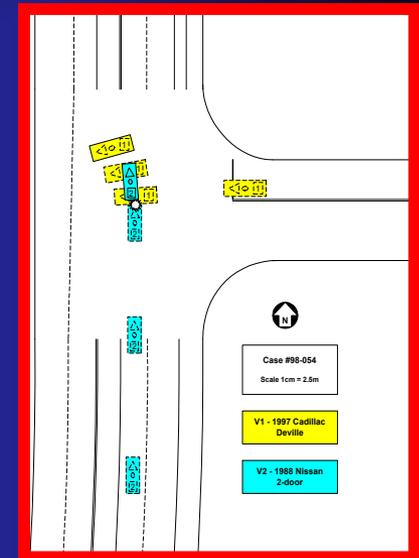
■ Vehicle Damage

■ Collision Deformation Classification

■ 09LPEW3

■ 11.4" (29 cm) of Maximum Crush

■ 9 MPH (14.5 KMPH) Barrier Equivalent ΔV



■ Driver Demographics

■ 76 y/o male

■ 6'2" 180 lbs

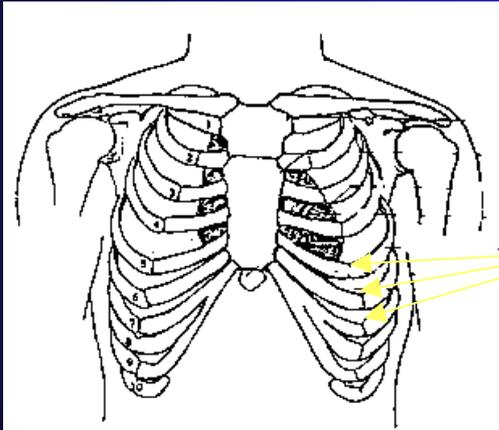
■ 3 point manual restraint in use

■ Door mounted air bag

Serious Injury Related to a Side Air Bag Deployment

■ Driver Injuries

- Closed fracture 6, 7 & 8th left lateral ribs (3) with left anterior pneumothorax
- Abrasion left lateral chest



Exemplar Vehicle & Occupant

Serious Injury Related to a Side Air Bag Deployment

- **Side Air Bag as the Driver Injury Source**
 - **Closed fracture 6, 7 & 8th left lateral ribs (3) with left anterior pneumothorax**
 - Resulted from a narrow focused impact
 - Located proximal to the side air bag
 - **Abrasion left lateral chest**
 - Crushing injuries related to intrusion are typically contusions
 - Swiping injuries are abrasions



Serious Injury – Previously reported as Unknown Source

■ Vehicle Damage

- The driver side impact air bag deployed as a result of a left side impact with two wooden signposts and a fence.
- Collision Deformation Classification
 - 09LYAW2
- 5.5” (14 cm) of Maximum Crush
- 7 MPH (11.5 KMPH) Barrier Equivalent ΔV



Serious Injury – Determined to be from Armrest

- **Driver Demographics**
 - **61 y/o Male driver**
 - **6'1" (185cm) 175 lbs. (79kg)**
 - **3 point manual restraint in use**
 - **Seat Mounted Air Bag Deployed**



Serious Injury – Determined to be from Armrest

- Driver Injuries
- Splenic contusion (4 cm) **Serious**
- Splenic laceration **Moderate** (grade 2-3 splenic injury with high density hemoperitoneum surrounding the splenic capsule)
- Multiple left rib fractures **Moderate**
 - (not further specified - with bilateral pleural effusions and associated bibasilar atelectasis)
- Contusion lateral left chest **Minor**
 - (left lower flank area - 10 cm diameter)

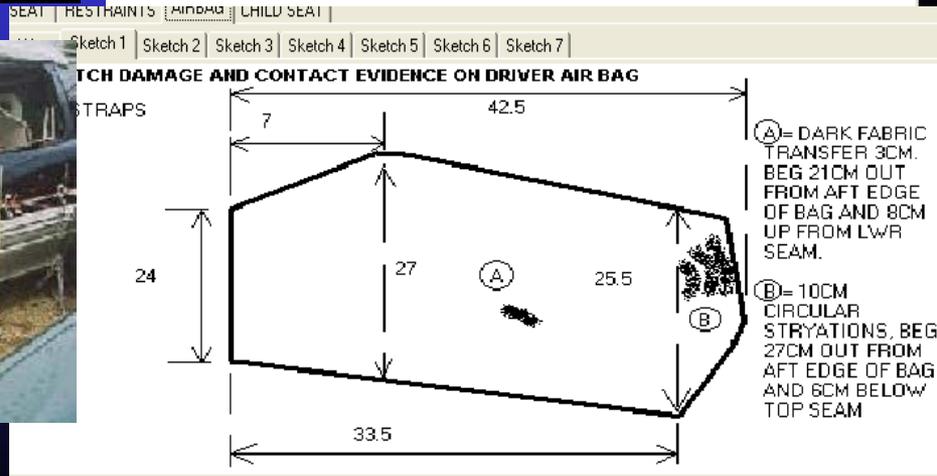
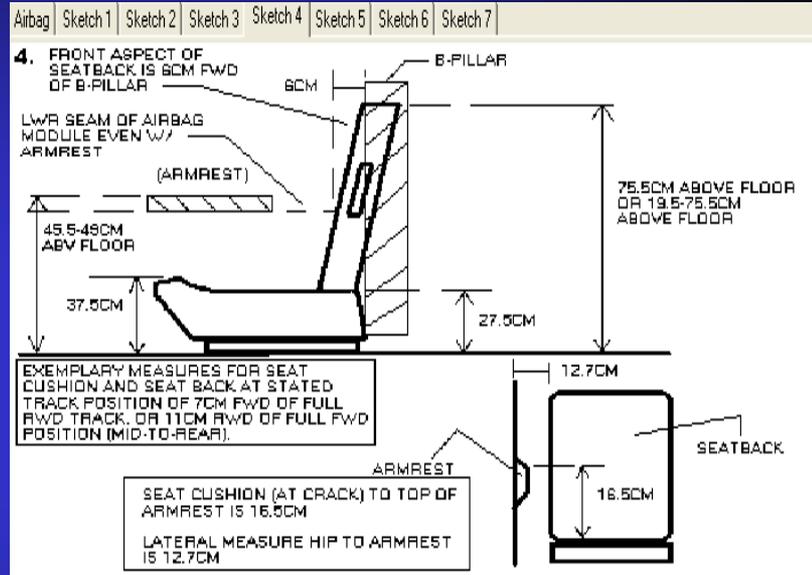


Serious Injury – Determined to be from Armrest

- Received and reviewed CAT scans
- Consulted with medical professionals
 - Medical Physician
 - Radiologist
 - X-Ray Technician
 - Bio-mechanics scientist
- Determined injury type not to be consistent with air bag deployment
 - Lateral v.s. Longitudinal Injury pattern
 - Compression v.s. tearing



Serious Injury- Determined to be from Armrest



Seat Mounted Thorax Side Air Bag Issues – 40 Cases

- Inadvertent deployments. (2)
 - Objects against the seat mounted firing trigger.
- The air bag has produced minor (AIS-1) injuries
- The occupant may “miss the air bag” in crashes with a Principal Direction Of Force (PDOF) of one or eleven o’clock.
- No head protection



Door Mounted Thorax Side Air Bag Issues – 23 Cases

Inadvertent deployments.

- **GM Recall on Cadillac**
- **The cover flap has produced one case with serious (AIS-3) injuries**
 - **Vehicle no longer in production with this air bag configuration**
- The occupant may “miss the air bag” in crashes with a PDOF of one or eleven o’clock.
- No head protection



Head Protection Side Air Bag Issues

- The head protection side air bag has not been attributed to any injuries
- In most of the cases with head protection, the occupant received no life threatening **head** injuries



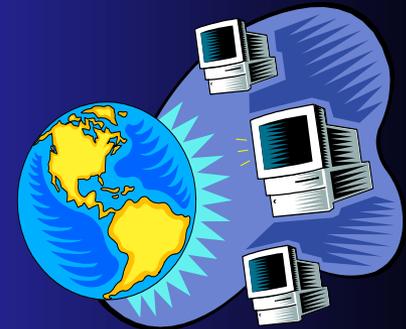
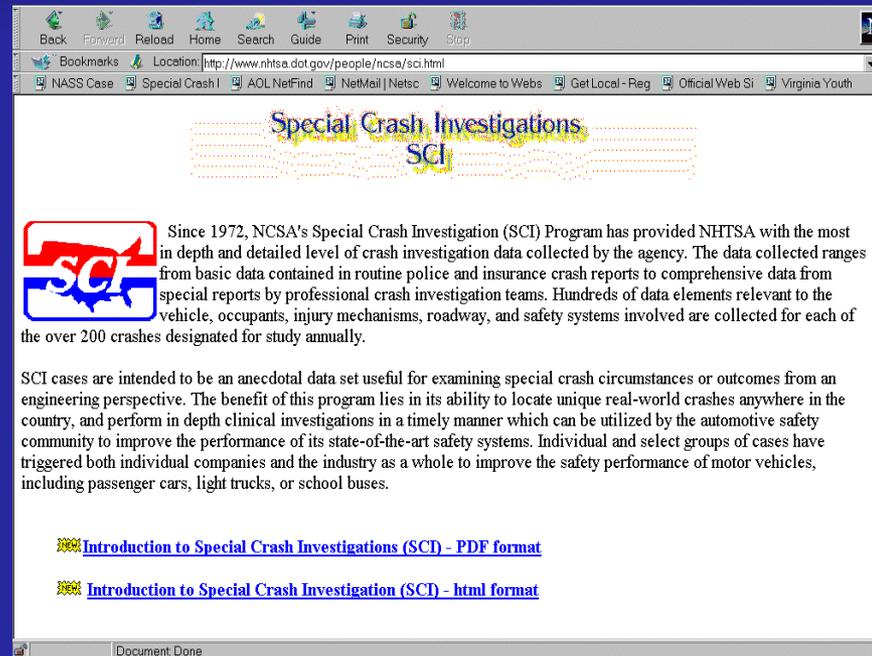
Conclusions from 92 SCI Cases

- No fatalities have been attributed to the deployment of a side air bag
- One seriously injured occupant (AIS-3) has been attributed to the deployment of a door mounted side air bag
- In the 8 cases involving children, the side air bags afforded occupant protection.
- The head protection side air bag has been successful in reducing head injury.
- Crashes with a force sufficient to cause significant passenger compartment intrusion are correlated with high injury



Public Access to Data

National Center for Statistics and Analysis **NCSA**



– Internet accessible through Web site

– <http://www.nhtsa.dot.gov/people/nca/sci.html>