

Evaluation of Injury Risk from Side Impact Airbags

Aloke Kumar Prasad, NHTSA

Randa Radwan Samaha, NHTSA

Allison E. Loudon, TRC, Inc.

Introduction

- ❧ Several types of side impact air bag (SAB) systems
 - Thorax
 - Head and thorax
 - Head

- ❧ Different designs
 - Seat mounted
 - Door mounted
 - Window curtain
 - Inflatable tubular

Background



- ❧ Fall 1998 – NHTSA study at Medical College of Wisconsin (MCW) – Paper 99SC03, 43rd Stapp Conf. 1999
- ❧ 1998 – Transport Canada study – Paper 2000-01-ST-02, 44th Stapp Conf., 2000
- ❧ April 1999 – NHTSA Public Meeting
- ❧ May 1999 – Letter from Dr. Martinez to Alliance, AIAM
- ❧ Summer 1999 – Research initiated at VRTC/NHTSA
- ❧ Aug 2000 – Technical Working Group (TWG – Alliance, AIAM, AORC, IIHS) recommendations – ISO WG3
- ❧ June 2001 – Evaluation of Injury Risk from Side Impact Air Bags - Prasad, A. K., Samaha, R. R., and Loudon, A. E., 17th ESV Conf., Paper No. 331.

Test Conditions Vehicle Selection



Seat Mounted		Door Mounted	Roof Mounted
Thorax	Head/Thorax		
99 Geo Prizm	99 Ford Windstar	99 Cadillac Deville	99 Volvo S80
99 VW Jetta	99 Mercury Cougar	00 Mercedes S430 (F+R)	00 Mercedes S430
00 Audi A6 (F+R)	00 Nissan Maxima	00 BMW 528i (F+R)	00 BMW 528i
99 Volvo S80	99 Saab 95		00 Audi A6
00 Cadillac Deville (R)			01 Saturn L200

(F+R) = Front and rear seat air bags

(R) = Rear seat air bags

Test Conditions Test Positions



- ❧ TWG recommended positions – Baseline
- ❧ Study high speed videos of “blank deployments”
- ❧ Develop additional test positions, variations of TWG positions, MCW positions
- ❧ Goal – most severe loads for dummies of various sizes

Test Conditions Dummies Used



- Hybrid III 3 year old
- Hybrid III 6 year old
- SID-IIs
- 12 month CRABI**
- 95% Adult Male**
- All were instrumented according to TWG recommendations

-**Not included in TWG procedures

Test Conditions Injury Criteria



- ❧ Interim values used – TWG recommendations
- ❧ Evaluation of injury criteria and IARV -pending
- ❧ 3 YO chest deflection, 6 YO HIC - FMVSS 208
 - 3YO Chest: 34g (FMVSS 208) 36g (TWG)
 - 6YO HIC: 700 (FMVSS 208) 723 (TWG)

Status of Research



- 3 TO, 6 TO, 12 MONTH CRABI Seat and door mounted SAB – completed
- door mounted bags including 5 to 15 & 70 – 70 Adult Male – completed
- Seat and door mounted bags with 5 to 15 – ongoing

Selecting Dummy Positions



- ❧ Use “blank deployments” to see the deployment envelope of selected airbags
- ❧ Use TWG recommended positions
- ❧ Make modifications to get “worst case” for the vehicles, if needed
- ❧ With 20 different airbag setups, 3 YU, 6 YU, CRABI,

NHTSA Modifications (3YO) Seat Mounted Bags

❧ TWG 3.3.2.1

- NHTSA Seat-02-3
- NHTSA Seat-03-3
- NHTSA Seat-07-3
- NHTSA Seat-08-3
- NHTSA Seat-09-3
- NHTSA Seat-10-3

❧ Gets head closer to the airbag

❧ Places head at different locations along the seatback



NHTSA Modifications (3YO) Seat Mounted Bags

❧ TWG 3.3.2.2

- NHTSA Seat-01-3

- 📦 Allows dummy closer to the seat edge



❧ TWG 3.3.2.2

- NHTSA Seat-04-3

- 📦 Gets head closer to the seatback

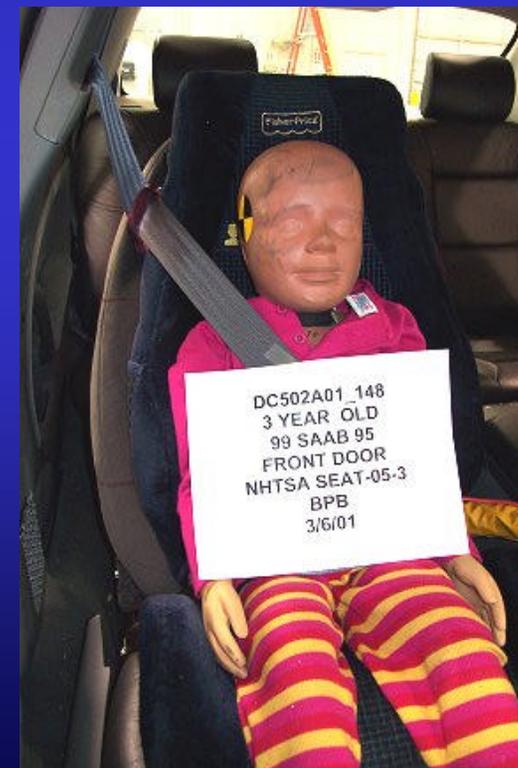


NHTSA Modifications (3YO) Seat Mounted Bags

Booster Seats not addressed by TWG

- NHTSA Seat-05-3
- NHTSA Seat-06-3

⌘ Restrained dummy



NHTSA Modifications (3YO) Door Mounted Bags

❧ TWG 3.3.3.1

- NHTSA Door-01-3
- NHTSA Door-02-3

🔒 Allows the chest to be closer to the airbag

❧ TWG 3.3.3.2

- NHTSA Door-03-3

🔒 Places neck at higher location on the airbag



NHTSA Modifications (3YO) Door Mounted Bags

- ❧ Leaning Sideways for Door Mounted Bags
Not addressed by TWG
 - NHTSA Door-04-3
 - NHTSA Door-05-3
 - NHTSA Door-06-3

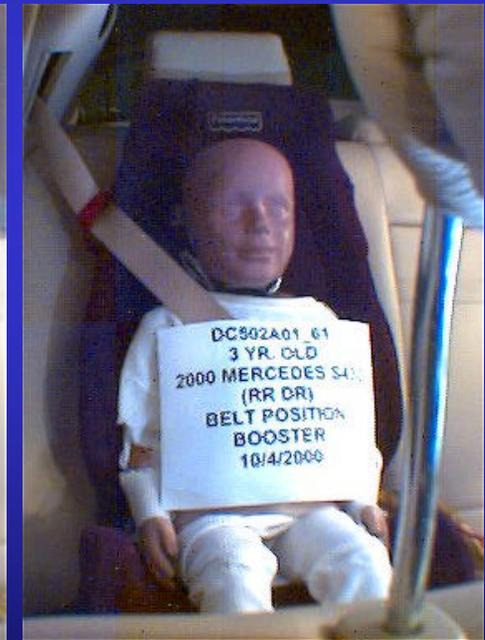


NHTSA Modifications (3YO) Door Mounted Bags

❧ Booster Seats Not addressed by TWG

- NHTSA Door-07-3
- NHTSA Door-08-3

❧ Restrained dummy



NHTSA Modifications (6YO) Seat Mounted Bags

❧ TWG 3.3.2.5

- NHTSA Seat-01-6
- NHTSA Seat-02-6
- NHTSA Seat-03-6
- NHTSA Seat-04-6
- NHTSA Seat-05-6

❧ Gets head closer to the airbag

❧ Places head at different locations on the seatback



NHTSA Modifications (6YO) Door Mounted Bags

❧ TWG has no positions for 6 YO for door mounted systems

❧ Back at Door

- NHTSA Door-01-6

 - ☑ Places neck against the airbag



❧ Leaning Sideways for Door Mounted Bags
NHTSA Door-02-6

- NHTSA Door-03-6

- NHTSA Door-04-6

- NHTSA Door-05-6



NHTSA Modifications (6YO) Roof Mounted Bags

⌘ TWG 3.3.4.1

- NHTSA Head-01-6

- ☑ Places head next to opening of the airbag



Dummy Seating for 12 month CRABI

- ❧ Infants not addressed by TWG
- ❧ Seat & Door Mounted Side Airbag
 - NHTSA Seat-01-12 – FWD Facing CRS with Flip over tray
 - NHTSA Seat-02-12 – Rear Facing CRS
- ❧ CRABI dummies properly restrained



Dummy Seating for 95th % Adult Male

- ❧ TWG did not address large occupants
- ❧ Roof Mounted Airbags
 - NHTSA Head-01-95 – Leaning sideways with center of head at airbag opening



Observations

- 3 & 6 YO - high loads possible in most SAB systems, especially from door mounted bags and seat mounted head-thorax combination bags.



181.avi



157.avi

15ms HIC: 1.33

NIJ: 1.70

-FZ(Comp.): 1.40

NIJ: 0.90

+FZ(Tension): 1.56

Observations (Cont.)

- ❧ The TWG 3.3.2.2 (peek-a-boo) - good procedure for measuring injuries to the chest of 3 YO.



Chest Def.: 1.25 Def. Rate: 1.93

Chest Def.: 1.15 Def. Rate: 2.21

Observations (Cont.)

- TWG 3.3.2.1 (Leaning Sideways on a booster) - good the 3 YO. In certain vehicles, the TWG position



99 Saab 95



99 Ford Windstar



99 Mercury Cougar

Observations (Cont.)

- ↻ Seat mounted air bags are located at different
place the head of the 3 year old at a range of



Observations (Cont.)

⌘ Suggest adding procedures that places the head CG closer to the airbag.

📄 NHTSA Seat-02-3

📄 NHTSA Seat-07-3



Observations (Cont.)

- α A “leaning sideways” type position is not included in IIWG occupants
- α Suggest adding leaning sideways positions for the Hybrid III 3YO for Door Mounted Systems
 - 📄 NHTSA Door-04-3
 - 📄 NHTSA Door-06-3



Observations (Cont.)

⌘ Suggest adding leaning sideways positions for the Hybrid III 6YO for Door Mounted Systems

📁 NHTSA Seat-04-6

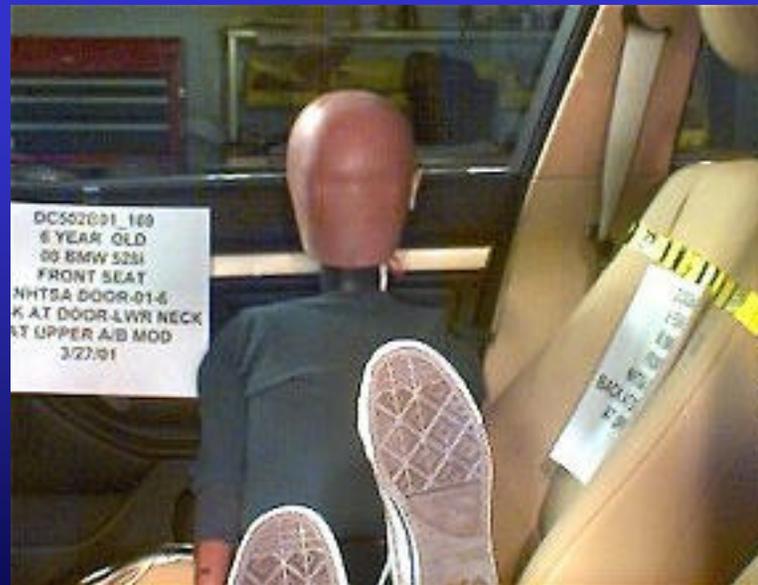
📁 NHTSA Seat-05-6



Observations (Cont.)

- ⌘ Suggest adding back against door position for the Hybrid III 6 year old for Door Mounted Systems

📄 NHTSA Door-01-6



Observations (Cont.)

❧ SID-IIs dummy durability issues

- Broke the shoulder potentiometer and bent the shoulder rib in a TWG procedure – door mounted (TWG 3.3.3.5)
- High Injury in the rib deflection

Max Rib Def.: 1.27

Def. Rate: 1.35



Observations (Cont.)

For TWG and NHTSA procedures:

✎ Seat mounted bags

- 3 YO

- ☒ 4/10 exceeded Injury Reference Values

- ☒ 8/10 exceeded Injury Reference and Research Values

- 6 YO

- ☒ 2/10 exceeded Injury Reference Values

- ☒ 5/10 exceeded Injury Reference and Research Values

✎ Door mounted bags

- 3 YO

- ☒ 5/5 exceeded Injury Reference Values

- ☒ 5/5 exceeded Injury Reference and Research Values

- 6 YO

- ☒ 0/5 exceeded Injury Reference Values

- ☒ 1/5 exceeded Injury Reference and Research Values

Conclusions

- ❧ One vehicle did not exceed Injury Reference or Research Values in any test
- ❧ Six vehicles (out of 13) did not exceed Injury Reference Values in any test
- ❧ Tests with in-position, properly restrained occupants in loads
- ❧ Tests with Roof Mounted bags did not produce significant loads
- ❧ Considerable efforts were spent in locating the correct replacement parts for the side air bag systems (module, mounting hardware, etc.)

Conclusions (Cont.)

- ❧ TWG procedures are generally capable of discriminating air bag systems over a wide variety of systems.
- ❧ Certain TWG positions may not be attainable in some vehicles.
- ❧ Certain TWG positions not expected to produce any significant loads on the dummies
- ❧ Several vehicles exceeded IARV's with the NHTSA procedures but did not with the TWG procedures