

The Side Impact Problem & Side Impact Airbags

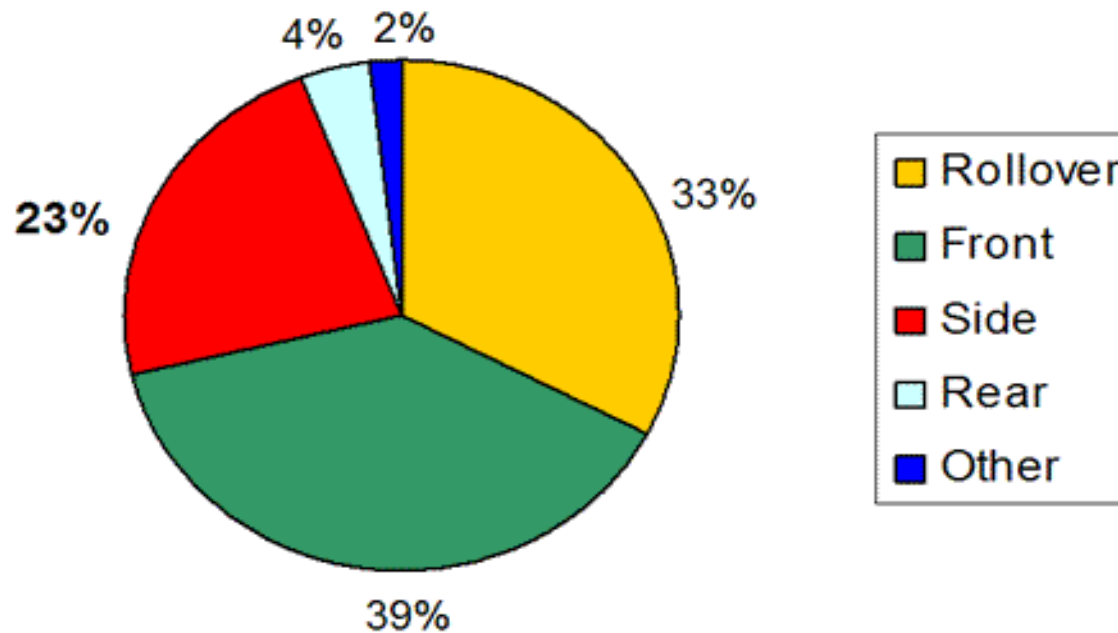
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The Side Impact Problem

Passenger Vehicle Occupant Fatalities

by type of crash



N=32,335
Source: 2002 FARS

The Side Impact Problem

- 23% of all fatal crashes involve a side-impact
- Side impacts accounted for 9,088 deaths in 2001 (FARS).
- According to NHTSA 6 out of 10 side impact fatalities involve a brain injury.
- Chest injuries result in a significant number of fatalities.

The Side Impact Problem

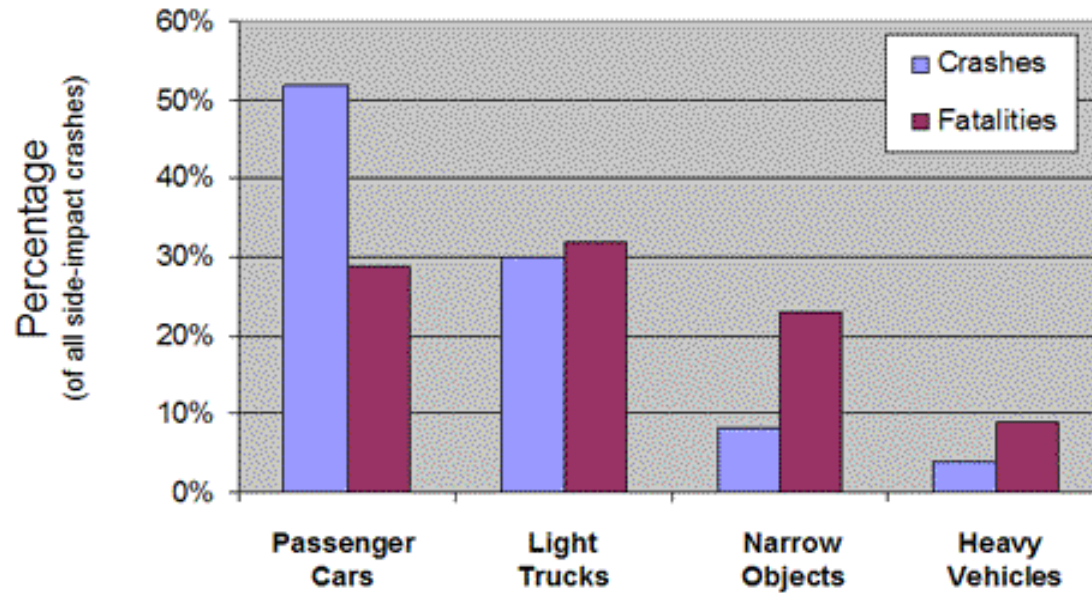
- The percentage of deaths in side impacts has grown significantly.
- Reason: Frontal crash protection has improved and increased LTV population worsened mismatch problem.
 - Side impacts accounted for 51% of driver deaths in crashes with other passenger vehicles in 2000-2001.
 - In 1980-1981 side impacts accounted for 31% of driver deaths.

The Side Impact Problem

- NHTSA analyses of 1991, 1995, and 1999 FARS files using non-rollover, near-side impact data:
 - Vehicle-to-rigid narrow object impacts remained stable at 21% of the total number of fatal side impacts.
 - Percentage of collisions with LTVs has increased from 26% in 1991 to 36% in 1999.
 - Percentage of collisions with passenger cars has decreased over time from 29% to 21%.

The Side Impact Problem

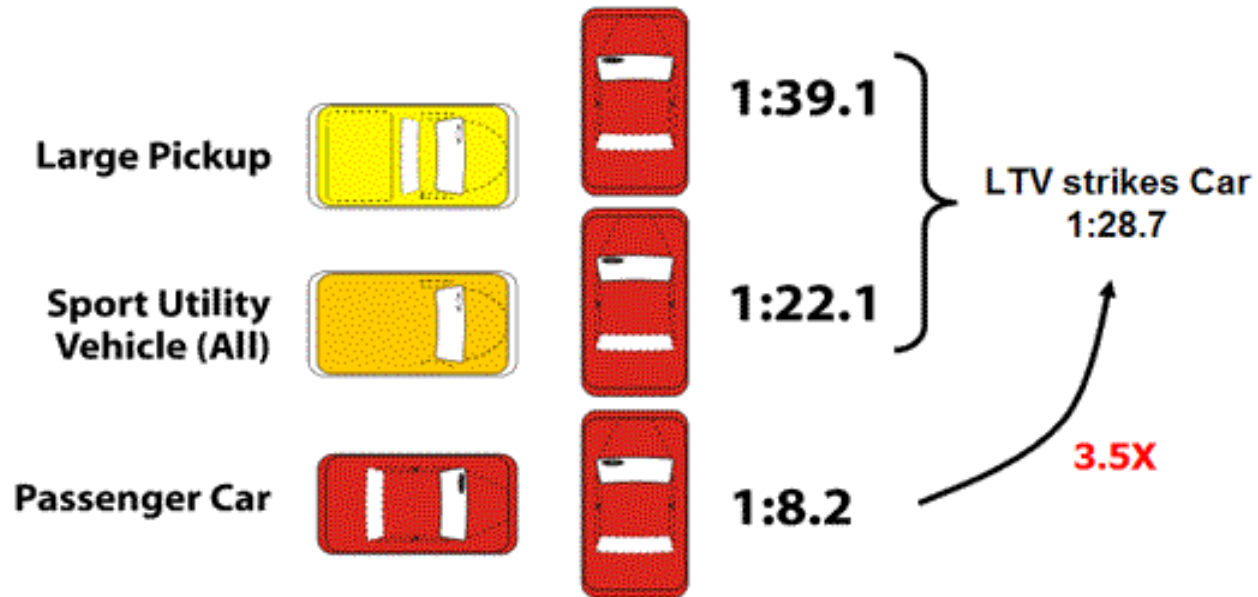
Distribution of Side-impact Crashes
by What Hits You



Source: NHTSA

The Side Impact Problem

Driver Fatality Ratios for Side-impact Crashes



3.5 times more likely to be killed by an LTV than a PC in a side-impact crash.

Source: 1995-2001 FARS

Types of Side Impact Airbags

- Torso only (door or seat mounted)



Types of Side Impact Airbags

- Torso / head combination – Door or seat mounted.



Types of Side Impact Airbags

- Side curtain or Side curtain torso combination



Types of Side Impact Airbags

- Inflatable Tube



History: Side Impact Airbags

- Introduced in 1994 Volvo 850 as torso-only. Supplied by Autoliv.
- BMW and Mercedes followed with introductions in 1996 MY's.
- More introductions in 1997 (Ford, GM, Audi)
- Early side bags were torso-only and didn't address head protection.

History: Side Impact Airbags

- During the mid-1990s head protection is widely acknowledged as the next step.
- In 1994 Autoliv publicly announced its development of the Inflatable Tubular Structure (ITS) and side curtain designs.

History: Side Impact Airbags

- Ford VP of Advanced Tech. Neil Ressler (1995):
“our analysis of the data suggested side airbags needed above all else to protect the head . . .
Otherwise a whole category of injuries would not be addressed.” [Ford introduces torso-only bags in 1997.]
- Head protection side bags first offered in 1997 (Autoliv) BMW’s with ITS (in conjunction with torso bags).

History: Side Impact Airbags

- Major suppliers of airbags see significant gains from side airbag contracts in the 1990s.
- Supplier annual reports state side-impact bags are the major growth area.
- By late 1990s side airbags in hundreds of models worldwide—most are front seat torso-only designs.

History: Side Impact Airbags

- By 1997 every supplier is developing head protecting SABs. Autoliv describes its Inflatable Curtain (IC).
- For 1998 IC introduced in Toyota, Mercedes, and Volvo.
- Also in 1998 Autoliv describes IC used in conjunction with rollover protection system.
- Curtains offered in low-cost cars for 2001 MY (Saturn, Chrysler).

NHTSA & Side Impact Airbags

- No federal requirements regulating the performance of side-impact air bags.
- Agency tests revealed that serious injury to OOP children could occur, particularly in door and seat mounted bags.
- Requested the industry develop voluntary test procedures for assessing side-impact air bag safety focusing on out-of-position occupants.

NHTSA & Side Impact Airbags

- October 1999 NHTSA issued a Consumer Advisory warning that side airbags can injure children and released this video:



NHTSA & Side Impact Airbags

- NHTSA asked OE's for assurance that side air bags were safe and warned that "it is imperative that they [side air bags] be designed to 'do no harm' to occupants."
- The agency also stated that the devices should be thoroughly tested with out-of-position child and adult test dummies to ensure that they pose no risk of serious injury.

NHTSA & Side Impact Airbags

- Beginning in July 1999 the OE's, Automotive Occupant Restraints Council (AORC), and IIHS formed the *Side Airbag Out-of-Position Injury Technical Working Group* to develop tests to examine side air bag deployments and ways to minimize risks.
- The Technical Working Group (TWG) developed a voluntary standards for assessing these risks, specifically to small women, adolescents, and children.

NHTSA & Side Impact Airbags

- NHTSA evaluation of TWG test procedures found that they were generally able to discriminate side airbag performance.
- Found that some positions not tested by the TWG can result in increased likelihood of injury.
- High loads are possible in OOP children in belt positioning boosters in vehicles with door-mounted bags.
- Real-world cases investigated by SCI don't show significant problems. No fatalities due to SABs.

NHTSA & Side Impact Airbags

- Side impact testing does not measure head impact and the barrier used represents car-to-car, not LT to car impacts.
- Vehicles with torso-only bags showed little or no significant improvement in crash testing.
- Under pressure to improve the side impact requirements NHTSA proposed changes (last week) that will force the use of side curtain airbags to meet the new criteria which includes head impact.

NHTSA & Side Impact Airbags

- Current side impact testing does not measure head impact and the barrier used represents car-to-car, not LT to car impacts.
- Vehicles with torso-only bags showed little or no significant improvement in crash testing.
- Separate test for head impact (FMVSS 201) to upper interior areas.

NHTSA & Side Impact Airbags

- NHTSA proposed changes in May 2004 that will force the use of side curtain airbags to meet the new criteria which includes head impact.
- New NHTSA test includes a pole impact in two test configurations, using 2nd gen. 50th% adult male and 5th female dummies.
- Crash barrier test is maintained using the old barrier, but now measures head impacts.

IIHS & Side Impact Airbags

- Tested vehicles with side SABs since 1997. Results show improved head protection on vehicles with head-protecting SABs.
- IIHS more stringent than NHTSA. Barrier simulates the front end of a pickup or SUV and test includes 5th female dummy.
- Effectiveness study of 1997-2002 vehicles found 45% driver fatality reduction in vehicles with head protecting SAB and 11 percent reduction in vehicles with torso-only SAB.

Side Airbag Issues

- Torso-only designs can offer improved side impact performance (excluding head), but good structures and padding can equal this performance. (Many torso-only SABs were added due to marketing.)
- Testing shows not all curtains perform well.

Side Airbag Issues

2004 Saturn L300 w/optional curtain.

Driver head strikes barrier in IIHS test.



Side Airbag Issues

- Saturn exemplifies bag volume trade-offs.
Limiting volume limits protection.
- Larger volume bags require larger inflators, better sensing, and more packaging space.
- First generation curtains 10 to 25 liters—current curtains can exceed 30 liters.
- Volume control achieved through “chambering” or “zero-length tethers.”
- Chambering creates strike-through areas. Head impacts in strike-through areas can cause high HIC.

Side Airbag Issues

- NHTSA oblique pole testing: 2002 Explorer with side curtain produced high HICs—likely from head contact in strike-through area.
- Explorer test revealed sensor problems. The sensor failed to activate and had to be remotely activated.
- G-sensors are the norm in U.S. market—but very sensitive to location. (Designed to meet the test.)
- European market uses pressure and G-sensors.

Side Airbag Issues

- Pressure sensors offer good discrimination.
- Best performance achieved with combination pressure/G-sensors: Pressure sensor primary, G-sensor on B-pillar for safing (rather than SDM).
- Safing sensor in the SDM delays the deployment time.

Side Airbag Issues

- Timing is critical: Thorax bag should deploy in 13 ms or less, curtain should deploy in 20 ms or less.
- Honda presentation in 2003 on benchmarking side curtains: Slow firing time resulted in occupant head outside the widow before deployment.

Side Airbag Issues

- Good SABs don't compensate for poor structures.
 - Hyundai Santa Fe V. Hyundai Sonata: Same SAB, torso and pelvis injuries were poor in the Sonata.
- Other Design decisions: High pressure, low volume (i.e., Autoliv) creates more rebound compared to lower pressure, thicker bag (i.e., Breed).

END