Use of NASS CDS Data in Oblique Pole Side Impact Rulemaking
SAE 2010

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Type of NASS Data

NASS – National Automotive Sampling System

- Crashworthiness Data System (CDS):
  - Has detailed data on a representative, random sample of 4,000 – 5,000 tow-away crashes annually. Includes some with no injury, minor, serious and fatal injuries.
  - Trained crash investigators obtain data from crash site, vehicles involved, police report, and hospital records.

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Use of NASS CDS Data

NASS CDS data related to occupant in Side Impacts

What we have in CDS:
- Collision partner – vehicle or fixed objects including pole or tree
- Injured body location
- Belt use
- Complete & partial ejections
- Degree of injury
- Injured occupant size
- Delta-V in side impacts

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Distribution of Side-impact Crashes by Collision Partner

**Source:** 1995-2001 NASS/CDS Nearside Impacts

<table>
<thead>
<tr>
<th>Collision Partner</th>
<th>Percentage (of all side-impact crashes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Cars</td>
<td>50%</td>
</tr>
<tr>
<td>Light Trucks</td>
<td>30%</td>
</tr>
<tr>
<td>Narrow Objects</td>
<td>20%</td>
</tr>
<tr>
<td>Heavy Vehicles</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Source:** 1995-2001 NASS/CDS Nearside Impacts

Struck Vehicle MY 95+(Equivalent Fatalities)

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### 2000 - 2004 Annualized NASS CDS Data* Used by Injured Body Region

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Vehicle-to-Pole/tree</th>
<th>Vehicle-to-vehicle</th>
<th>Total, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Injury**</td>
<td>Fatal</td>
<td>Injury**</td>
</tr>
<tr>
<td>Head</td>
<td>266</td>
<td>298</td>
<td>903</td>
</tr>
<tr>
<td>Chest</td>
<td>419</td>
<td>46</td>
<td>2,809</td>
</tr>
<tr>
<td>Abdomen</td>
<td>0</td>
<td>0</td>
<td>128</td>
</tr>
<tr>
<td>Pelvis</td>
<td>0</td>
<td>0</td>
<td>288</td>
</tr>
<tr>
<td>Others</td>
<td>315</td>
<td>28</td>
<td>763</td>
</tr>
<tr>
<td>Total</td>
<td>1,000</td>
<td>372</td>
<td>4,891</td>
</tr>
</tbody>
</table>

*delta-V of 12 -25 mph,

**AIS 3 -5 serious injuries.

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FMVSS No. 214 MDB
Dynamic Crash Test
Why do we need a pole test?

- NASS CDS data show that head injuries are serious safety problem
  - However, current Moving Deformable Barrier does not adequately address this safety problem
  - With the pole test, vehicles would need to be equipped with a countermeasure to protect the head
FMVSS No. 214 Oblique Pole Dynamic Crash Test
Oblique Pole Test

Direction of Vehicle Forward Motion

Longitudinal Centerline

Impact Reference Line (as projected onto the roof)

Dummy Head CG

Rigid Pole

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## Side impact test injury requirements

### Injury criteria

<table>
<thead>
<tr>
<th>Body region</th>
<th>5th female test dummy (SID-IIIs)</th>
<th>50th male test dummy (ES-2re)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>1,000 HIC</td>
<td>1,000 HIC</td>
</tr>
<tr>
<td>Chest</td>
<td>82 g lower spine acceleration</td>
<td>44 mm deflection</td>
</tr>
<tr>
<td>Abdomen</td>
<td>N/A</td>
<td>2.5 kN</td>
</tr>
<tr>
<td>Pelvis</td>
<td>5.5 kN</td>
<td>6.0 kN</td>
</tr>
</tbody>
</table>
How do manufacturers meet the pole test requirements?

- **Head requirement**
  - Installed head air bags

- **Chest**
  - Strengthen vehicle’s side structure or/and
  - Install thorax air bags

- **Abdomen**
  - Strengthen vehicle side structure or/and
  - Install thorax air bags

- **Pelvis**
  - Strengthen vehicle side structure
Air Bags Designed for Side Impacts

There are three types for head protection:
- Window Curtain
- Tubing
- Combination – head and thorax protection

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Air Bags Designed for Side Impacts (continued)

- There are two types for thorax protection
  - Thorax air bag
  - Combination air bag
## Pole test results with and without side air bag

### Test results

<table>
<thead>
<tr>
<th>Body region</th>
<th>5\textsuperscript{th} female test dummy</th>
<th>50\textsuperscript{th} male test dummy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side air bag</td>
<td>W/o</td>
<td>With</td>
</tr>
<tr>
<td>Head</td>
<td>11,534 HIC</td>
<td>508 HIC</td>
</tr>
<tr>
<td>Chest</td>
<td>114 g</td>
<td>63 g</td>
</tr>
<tr>
<td>Abdomen</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Pelvis</td>
<td>7.8 kN</td>
<td>6.9 kN</td>
</tr>
</tbody>
</table>

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Effectiveness of Side Air Bag

- Based on risk of injury
- For example, probability of AIS 3+ and AIS 4+ injury as function of maximum rib deflection of the 50th male test dummy

![Prob. of Injury vs. Max. Rib Defl.](image)

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Characteristics of side air bag system meeting oblique pole test requirements

- Not necessarily effective in rollovers
  - No rollover sensors

- Relatively narrow range of operation
  - Lower range of 12 mph and Upper range of 25 mph
    - Based on side crash test results performed at different impact speeds

- Assumed side air bags are not wide enough to
  - Prevent complete ejections, and
  - Protect children from partial or complete ejections

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Characteristics of side air bag system meeting oblique pole test requirements (continued)

- Effective for side impacts with 2, 3, 4 O'clock and 8, 9, 10 O’clock impact directions

Based on the test configuration
Estimated benefits with side air bags

- Based on characteristics of side air bags, some side crashes were excluded from NASS data, such as:
  - Rollovers followed by side impacts
  - Delta-V’s lower than 12 mph and higher than 25 mph
  - Complete ejections
  - Children
  - Occupants in rear seat

- Side air bag effectiveness:
  - Based on pole test results and injury curves

- Estimated benefits:
  - Apply the effectiveness to the target population
  - Estimated 311 lives and 361 serious injuries would be prevented when all light vehicles meet the test requirements
Summary of How We used NASS CDS for Side Impact Rule Making

Vehicle crashes

Analyze crashes

Evaluate current safety regulations

Develop a new safety requirement

Estimate the effectiveness of the new safety requirement

Reduction in crashes

Safety benefits

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