Calculating Benefits for Oblique Pole Side Impact Rulemaking

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Process for Calculating Benefits

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
VEHICLE CRASHES
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.
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
ANALYZE CRASHES
Distribution of Side-impact Crashes by Collision Partner

Percentage (of all side-impact crashes)

- Passenger Cars
- Light Trucks
- Narrow Objects
- Heavy Vehicles

Source: 1995-2001 NASS/CDS Nearside Impacts Struck Vehicle MY 95+(Equivalent Fatalities)
# 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>
EVALUATE CURRENT SAFETY REGULATIONS
FMVSS No. 214 MDB
Dynamic Crash Test
DEVELOP NEW SAFETY REQUIREMENT
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, chest, and pelvis areas
Oblique Pole Test

- Longitudinal Centerline
- Impact Reference Line (as projected onto the roof)
- Dummy Head CG
- Rigid Pole

Direction of Vehicle Forward Motion
Use of Dummies to Represent Occupants

- Drivers (females and elderly) 163 cm or less compromise ~25% of seriously or fatally injured drivers in narrow object side impacts*

- The 5th Female (150 cm) and 50th Male (175 cm) represent the range of occupants protected.

- Drivers less than 163 cm are best represented by the 5th Female dummy

*Based on 2002-2004 NASS CDS data (value is 35% for 1997-2001 data)
## 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
Air Bags Designed for Side Impacts (continued)

- There are two types for thorax protection
  - Thorax air bag
  - Combination air bag
ESTIMATE THE EFFECTIVENESS OF THE NEW SAFETY REQUIREMENT
Pole test results with and without side air bag

Test results

<table>
<thead>
<tr>
<th>Body region</th>
<th>5th female test dummy</th>
<th>50th male test dummy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side air bag</td>
<td>W/o</td>
<td>W/o</td>
</tr>
<tr>
<td>Head</td>
<td>11,534 HIC</td>
<td>14,292 HIC</td>
</tr>
<tr>
<td>Chest</td>
<td>114 g</td>
<td>41 mm</td>
</tr>
<tr>
<td>Abdomen</td>
<td>N/A</td>
<td>3.7 kN</td>
</tr>
<tr>
<td>Pelvis</td>
<td>7.8 kN</td>
<td>2.5 kN</td>
</tr>
</tbody>
</table>
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
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 19 km/h and Upper range of 40 km/h
    - 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
Characteristics of side air bag system meeting oblique pole test requirements (continued)

- Effective for side impacts with 2, 3 O'clock and 9, 10 O'clock impact directions
  - Based on the test configuration
SAFETY BENEFITS
Impact of ESC on Benefits

- Develop adjustment factors based on
  - Portion of target population impacted by ESC
  - ESC Effectiveness rates
  - Percent of future on-road fleet equipped with ESC
- ESC effectiveness in single vehicle run-off-road crashes
  - 35% for passenger cars
  - 67% for SUVs
- Adjustment factors calculated for passenger cars and SUVs, then weighted based on percentage in fleet.
  - ESC estimated to prevent 41% of fatal crashes
  - ESC estimated to prevent 35% of serious injuries
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
Thank You

References
FMVSS 214 – Final Regulatory Impact Analysis
August 2007

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