UPDATE ON NHTSA'S OBLIQUE RESEARCH PROGRAM

James Saunders
Dan Parent
National Highway Traffic Safety Administration
AGENDA

• BACKGROUND
  ▫ NHTSA Oblique RMDB Procedure
  ▫ IIHS Small Overlap Procedure

• FINDINGS TO DATE

• CURRENT RESEARCH
  ▫ Objective
  ▫ Additional Vehicle Tests
  ▫ New Methodologies

• RESULTS
  ▫ Vehicle Response
  ▫ Occupant Response

• CONCLUSIONS

• NEXT STEPS
Research Moving Deformable Barrier (RMDB)

<table>
<thead>
<tr>
<th>RMDB Speed</th>
<th>56 mph (90 kph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlap</td>
<td>35 percent</td>
</tr>
<tr>
<td>Impact Angle</td>
<td>15 degrees (PDOF = 345)</td>
</tr>
<tr>
<td>Occupants</td>
<td></td>
</tr>
<tr>
<td>Near-side</td>
<td>THOR Mod Kit</td>
</tr>
<tr>
<td>(Driver)</td>
<td>50th Male</td>
</tr>
<tr>
<td>Far-side</td>
<td>THOR Mod Kit</td>
</tr>
<tr>
<td>(Passenger)</td>
<td>50th Male</td>
</tr>
</tbody>
</table>
BACKGROUND – IIHS SMALL OVERLAP

• **IIHS TOP SAFETY PICK+ RATING CRITERIA**
  - *Top Safety Pick* and
  - Overall rating of “Good” or “Acceptable” in IIHS Small Overlap Impact
  - New for 2014 *Top Safety Pick+:* vehicle must have basic, advanced or superior rating for front crash prevention

• **IIHS SMALL OVERLAP IMPACT RATING CRITERIA**
  - Overall
  - Structural
  - Head/Neck
  - Chest
  - Knee/Thigh
  - Leg/Foot
  - Kinematics
NHTSA OBLIQUE FINDINGS TO DATE

- **OBLIQUE RMDB TESTS**
  - 18 vehicle tests to date, two occupants in each vehicle

- **2012 SAE WORLD CONGRESS**
  - Oblique test procedure representative of vehicle-to-vehicle crash test

- **2013 SAE WORLD CONGRESS**
  - Oblique test procedure is repeatable

- **2013 ESV**
  - Newer, high sales volume vehicles show similar injury risk trends to previous test vehicles
  - Far-side occupant response demonstrated high head rotational velocity with high brain injury risk (BrIC)
CURRENT RESEARCH OBJECTIVE

• QUESTION
  ▫ Would vehicles that perform well in the IIHS Small Overlap test procedure require additional countermeasures to perform well in the NHTSA Oblique RMDB test procedure?

• APPROACH
  ▫ Test five vehicles that achieved an IIHS Top Safety Pick+ designation in the NHTSA Oblique RMDB test procedure

<table>
<thead>
<tr>
<th>NHTSA TEST #</th>
<th>YEAR</th>
<th>MAKE</th>
<th>MODEL</th>
<th>TEST WEIGHT (KG)</th>
<th>VEHICLE CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8477</td>
<td>2013</td>
<td>Honda</td>
<td>Civic</td>
<td>1544</td>
<td>Small PC</td>
</tr>
<tr>
<td>8089</td>
<td>2013</td>
<td>Hyundai</td>
<td>Elantra</td>
<td>1590</td>
<td>Small PC</td>
</tr>
<tr>
<td>8476</td>
<td>2013</td>
<td>Dodge</td>
<td>Dart</td>
<td>1738</td>
<td>Small PC</td>
</tr>
<tr>
<td>8488</td>
<td>2012</td>
<td>Volvo</td>
<td>S60</td>
<td>N/A</td>
<td>Midsize PC</td>
</tr>
<tr>
<td>8478</td>
<td>2014</td>
<td>Subaru</td>
<td>Forester</td>
<td>1803</td>
<td>Small SUV</td>
</tr>
<tr>
<td>8475</td>
<td>2013</td>
<td>Volvo</td>
<td>XC60</td>
<td>2153</td>
<td>Midsize SUV</td>
</tr>
</tbody>
</table>
UPDATES TO OCCUPANT RESPONSE METHODOLOGY

• TEST DEVICES
  ▫ Both THOR ATDs updated to newest Mod Kit design level including w/SD-3 shoulder

• INJURY CRITERIA
  ▫ Updated BrIC methodology applied
    • Takhounts, 2013 Stapp
  ▫ Updated thoracic injury criterion applied
    • See G105 Biomechanics, “4-Point Thoracic Injury Criteria for THOR”
### RESULTS: METHODOLOGY

<table>
<thead>
<tr>
<th>Group Name</th>
<th>TSP+</th>
<th>Non-TSP+</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Vehicles that achieved an IIHS <em>Top Safety Pick</em>+ designation for their given model year</td>
<td>Vehicles that did not achieve a IIHS <em>Top Safety Pick</em>+ designation for their given model year</td>
</tr>
<tr>
<td><strong>Number of Vehicles</strong></td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td><strong>Number of Near-side Occupants</strong></td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td><strong>Number of Far-side Occupants</strong></td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

*Note that several vehicle model years were tested before TSP+ designation was developed.*
RESULTS: VEHICLE RESPONSE
RESULTS: NEAR-SIDE OCCUPANT RESPONSE
RESULTS: FAR-SIDE OCCUPANT RESPONSE
EXAMPLE CHART

TTest (<.05 Statistically Significant Difference)

Value

Mean + S.D.

Mean

Mean - S.D.

TSP+ (N=5)

NOT TSP+ (N=14)
INTRUSION MEASUREMENTS
TOEPAN INTRUSIONS
STEERING WHEEL (SW) Y AND Z

SW Y

TSP+ (N=5)  NOT TSP+ (N=14)

SW Z

TSP+ (N=5)  NOT TSP+ (N=14)

*
LEFT AND RIGHT INSTRUMENT PANEL (IP)

**Left IP**
- TSP+ (N=5)
- NOT TSP+ (N=14)

**Right IP**
- TSP+ (N=5)
- NOT TSP+ (N=14)
For the far side occupant, brain injury risk predicted using BrIC is on average higher for TSP+ vehicles than for Non-TSP+ vehicles but not statistically-significant.
No statistically-significant differences in chest injury risk between TSP+ and Non-TSP+
No statistically-significant differences in acetabulum, femur, or tibia injury risk between TSP+ vehicles and Non-TSP+ vehicles.
OBSERVATIONS

• TOP SAFETY PICK+ VEHICLES IN NHTSA OBLIQUE
  ▪ Less intrusion (some statistically significant)
    • Average interior intrusion points were smaller for the TSP+ when compared Non-TSP+, except for SW Y
  ▪ Similar injury risk (none statistically significant)
    • Even with interior intrusion being less for TSP+ there were no statistically-significant differences in injury risk between TSP+ and non-TSP+ groups
  ▪ Some vehicles that perform well in the IIHS Small Overlap frontal impact test may require additional countermeasures in the NHTSA Oblique test mode

• LIMITATIONS
  ▪ Preliminary data
  ▪ Relatively small sample size (N=5 vs N=14)
NEXT STEPS

• PUBLISH TEST DATA AND REPORTS – 2014

• NHTSA AGENCY DECISION – 2014

• LOAN AGREEMENT
  ▫ An agreement is place to allow manufacturers to perform Oblique and Small Overlap testing
    ▪ RMDB only
    ▪ RMDB and THOR ATD(s)
  ▫ Allows manufacturers to gain experience and provide feedback on NHTSA’s Small Overlap/Oblique test procedures
  ▫ Contact James Saunders (james.saunders@dot.gov)