NHTSA VRTC HV Forward Collision Avoidance and Mitigation Research

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Overview

- Heavy Vehicle Rear-End Crash Problem
- Definitions of Rear-End Crash Avoidance Technologies
- LV NCAP Forward Collision Warning Test
- Heavy Vehicle Rear End Collision Avoidance Research at VRTC
- Conclusions
Heavy Truck Crashes

- Rear-end Crashes accounted for 19.9% of all police reported heavy truck crashes based on GES 2004.
- Heavy truck was the striking vehicle in 60% of these rear end crashes.
Rear-End Pre Crash Scenarios

Most frequent rear-end pre-crash scenarios:

- 26%: Lead vehicle stopped
- 14.5%: Lead vehicle decelerating
- 13.3%: Lead vehicle moving at constant speed

Development of Crash Imminent Test Scenarios for Integrated Vehicle-Based Safety Systems  DOT HS 810 757
Technologies Preventing Rear-End Crashes

ACC – Autonomous Cruise Control
ICC – Intelligent Cruise Control
ACB – Active Cruise with Braking

FCW – Forward Collision Warning

CIB – Crash Imminent Braking
CMB – Collision Mitigation Braking
DBA – Dynamic Brake Assist
ABA – Automatic Brake Application

Comfort and Convenience with some safety benefits

Passive – Driver must take action.

Active – Various levels of autonomous braking
LV New Car Assessment Program

- MY 2011 New Vehicles
- NCAP Crash Avoidance Technologies
  - 1. Electronic Stability Control
  - 2. Forward Collision Avoidance
  - 3. Lane Departure Warning
- [www.regulations.gov](http://www.regulations.gov)
- Docket No. NHTSA-2006-26555
LV FCW Test Maneuvers

- SV speed, all tests: 72.4 km/h (45 mph)
- Stopped POV

<table>
<thead>
<tr>
<th>SV</th>
<th>POV stopped</th>
</tr>
</thead>
<tbody>
<tr>
<td>In same lane</td>
<td></td>
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</tbody>
</table>

- Decelerating POV
  - Initial POV speed: 72.4 km/h
  - Initial SV-to-POV Headway = 30m
  - POV deceleration: 0.3g

<table>
<thead>
<tr>
<th>Initial, SV follows POV.</th>
<th>Then, POV begins to brake.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{sv} )</td>
<td>( V_{pv} = V_{sv} ) for ( t &lt; t^* )</td>
</tr>
<tr>
<td></td>
<td>( V_{pv} = V_{sv} ) for ( t &gt; t^* )</td>
</tr>
</tbody>
</table>

- Slower Moving POV
  - POV speed: 32.2 km/h (20 mph)

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Key FCW NCAP Evaluation Criteria

• Successful Test Requirements
  • 7 trials per condition are performed
  • TTC requirements must be satisfied for 5 of the 7 trials
  • TTC requirements must no be violated 2 consecutive trials

• Time To Collision (TTC)
  • Stopped POV: 2.1 sec
  • Decelerating POV: 2.4 sec
  • Slower Moving POV: 2.0 sec
HV Rear-End CA Research Objectives

• Quantify the state-of-the-industry for HV FCW and CIB from performance testing with a POV
  • Time To Collision (TTC)
  • Delta V @ impact
• Determine if the LV FCW confirmation test can be adapted for HV evaluation
• Identify issues and challenges unique to HV
Test Vehicles

• 2006 Freightliner Century Class 6X4
  • Retrofitted MW OnGuard System

• 2006 Volvo VNL64T630 6x4
  • Retrofitted Bendix Wingman ACB System

• 28 ft Great Dane Flatbed
  • 121 style control trailer
## Test Matrix

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Freightliner</th>
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<th>Volvo</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Speed (MPH)</td>
<td>Bobtail</td>
<td>121 Style</td>
<td>Bobtail</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Loading</td>
<td></td>
</tr>
<tr>
<td>SV encounters a stopped POV</td>
<td>35</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>45</td>
<td>X</td>
<td>X</td>
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<td>35</td>
<td>X</td>
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Draft – Subject to change
Balloon Car - POV for CI B
Stopped POV: LV CIB Example
HV Example
HV Example#2
HV Example #3

1572.5 sec
accel: 41.60
vdsc: 4
spd: 50.29 kph
targ spd: 255 kph
targ dst: 255 m
targ detect: 0
Known Issues

• Current protocol designed for FCW not CIB
• Stopped Lead Vehicles
  • State-of-Industry not detecting stopped lead vehicles that were not previously tracked
• Confirm track tests and protocol not generating artificial data
  • Mass estimation
  • Accurate target response
  • RCS of target
Conclusions

• Rear-end collision avoidance technology is expected to improve automotive safety in both LV and HV
• FCW - Potential to reduce 21% of heavy vehicle rear end crashes
  • VTTI: 2/2008 DOT HS 810 910
  • Battelle: 2006 Evaluation of the Volvo IVI FOT
• CIB – Current research in support of understanding performance and determining safety benefits
Questions?

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