Large truck safety: what works according to research

Lifesavers Conference
April 1, 2019

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Crashes between large trucks and passenger cars

- Law of conservation of momentum, inelastic collision
- Geometric incompatibility
- Crash prevention is key, but crash mitigation also relevant

**Approx. 73 feet**

**Approx. 16 feet**

- Up to 80,000 lbs
- About 3,500 lbs
- Kinetic energy at 55 mph:
  - 10,968,400 J
  - 479,868 J
Truck underride – rear
IIHS rear underride guard tests
September, 1976
IIHS test program drives improvements for rear underride guards beyond FMVSS 224

- Comparative test program to encourage voluntary improvements
- Selected top 8 manufacturers of van trailers by sales volume
  - Over 80% of total sales in 2014

Three test configurations

1. 100% overlap (full-width) @ 35 mi/h
2. 50% overlap @ 35 mi/h
3. 30% overlap @ 35 mi/h
Vanguard redesign

2007-14 design

2015 design
Vanguard redesign: 50% overlap test
## Crash test results by model year

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Legend:
- ⬤: Pass with standard guard
- ⬤: Pass with optional guard
- ⬤: Fail
Award introduced in March 2017 to recognize trailer manufacturers with good performance in all 3 crash tests

Now the eight largest North American manufacturers have all earned this award for some or all of their trailers.
Is there a “safety marketplace” for underride guards?

In 2015, the Procurement Manager for a national grocery store chain asked IIHS for recommendations on their planned trailer purchase.
With its new, robust rear underride guard, Stoughton is making the roads safer for everyone. No one knows that better than accident survivor Terry Rice and his passenger Mark Robinson. "Early morning on March 2, we found our car headed toward the rear corner of a tractor trailer that had slid and jack knifed on a snowy, slippery I-90. But thankfully, the rear underride guard on the Stoughton® trailer prevented our car from sliding underneath the trailer."

Stoughton’s guard increases the ability to resist compartmental intrusion of a car when the location of impact is at the rear corners. And, it’s standard on new Stoughton dry van trailers – with no added cost or weight.
Truck underride – side
Angelwing side underride guard and aerodynamic side skirt
Wabash prototype side underride guard
IIHS study of risk factors for large truck crashes
Crash sample

- 26,000+ pound trucks operated by interstate carriers
- Fatal crash or injury crash involving medical transport
- Full driver/vehicle inspection
- 197 crash-involved trucks
Control sample

- One control truck inspected per crash matched on:
  - Truck type
  - Location
  - Time of day
  - Day of week
- Full driver/vehicle inspection
- 197 control trucks
Vehicle inspection violations
Percent change in crash risk

*statistically significant at 0.05 level
Driver risk factors
Percent change in crash risk

*statistically significant at 0.05 level
Carrier risk factors

Percent change in crash risk

- Owner-operator
- 10+ percent of inspections resulted in OOS driver violation
- 10+ percent of inspections resulted in OOS vehicle violation
- Carrier has at least 100 crashes per 1,000 trucks
- Short-haul exemption

*Statistically significant at 0.05 level
Conclusions from NC study

- Vehicle defects increase crash risk, especially those severe enough to put the truck out of service

- Important driver and carrier risk factors
  - Driver age 60+ or under 30
  - Less than 60,000 miles driven per year
  - More than 5 hours driving since last stop
  - At least 100 historical crashes per 1,000 power units
  - Operating under short-haul exemption

- Legislation and enforcement should continue to focus on these

- Efforts should be made to understand risk of short-haul exemption
Truck Defects Double the Danger

Tractor-trailers with defective equipment are twice as likely to be in a crash as trucks without defects, reports researchers from the Insurance Institute for Highway Safety.

To clarify the relationship between safety-related defects and the risk of crash involvement, the researchers examined the interactions of many factors that contribute to crash risk. Using data from in-depth investigations, rather than relying on self-reported data, the researchers compared tractor-trailers to a sample of trucks not in crashes.

Overall, 77 percent of tractor-trailers in crashes and 66 percent of those not involved in crashes had defective equipment warranting repairs. Forty-one percent of crashes had defective equipment warranting repairs, and the truck left the road, and 11 percent of crashes had these defects.

Brake defects were the most common, and were found in 56 percent of tractor-trailers in crashes; steering equipment defects were found in 21 percent of crash-involved trucks. The risk of crash involvement for trucks with defects had enough to take the truck off the road was about twice that of trucks without defects. For some types of crashes, including trucks rear-ending other vehicles, the risk was even higher.

Based on data from a two-year study of more than 300 crash-involved tractor-trailers on Interstate Highways in Washington state, the report used a cost-control method to study the risk factors for trucks in actual crashes compared with a random sample of trucks using the same roads. For each large truck involved in a crash, three trucks were randomly selected.

(Cont'd on Page 3)

More Than 8 Hours Behind the Wheel? Twice the Crash Risk

Drivers of big trucks are allowed to drive for 10 hours at a stretch after they have had eight hours of rest. But a new study by researchers from the Insurance Institute for Highway Safety shows that driving more than four or eight hours can be dangerous.

Drivers who had been behind the wheel for more than eight hours had nearly twice the risk of being in a crash compared with drivers who had been on the road less than two hours.

The study also found that drivers who violate highway regulations, young drivers, and interstate carriers were associated with an increased risk of crash involvement. Tractor-trailers operated without equipment.

(Cont'd on Page 3)
Crash avoidance technologies on large trucks
Truck crash avoidance technologies
Regulatory mandates that are a win for highway safety

- Antilock braking systems (ABS)
  - Improves steering and stability during hard braking
  - Reduces risk of jackknifing
- Electronic stability control (ESC)
  - Improve stability during swerve or cornering maneuvers
  - Reduces risk of rollover and other loss of control
- Electronic logging devices (ELDs)
  - Monitors actual driving hours and replaces paper logbooks
  - Reduces risk of fatigue-involved crashes for drivers that try to exceed hours-of-service laws
### Average annual large truck crashes potentially preventable by 3 crash avoidance technologies

2004-08 (Jermakian, 2012)

<table>
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<tr>
<th>Technology</th>
<th>Fatal crashes</th>
<th>Nonfatal injury (A,B) crashes</th>
<th>Police-reported crashes</th>
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<tr>
<td>Front crash prevention</td>
<td>115</td>
<td>3,000</td>
<td>31,000</td>
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<tr>
<td>Lane maintenance</td>
<td>247</td>
<td>1,000</td>
<td>10,000</td>
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<td>Side view assist</td>
<td>79</td>
<td>2,000</td>
<td>39,000</td>
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<td><strong>Total</strong>, as a percent of all crashes involving large trucks</td>
<td><strong>11%</strong></td>
<td><strong>16%</strong></td>
<td><strong>21%</strong></td>
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* Some crashes may be counted under more than one technology.
Truck crash avoidance technologies
Opportunities to improve highway safety

- Research to understand the crash effects of emerging crash avoidance technologies
  - Automatic emergency braking, forward collision warning
  - Blind spot detection/intervention
  - Lane departure warning, lane departure prevention
  - Adaptive cruise control, lane centering, SAE level 2 automated driving
  - Platooning
- Fleets that already use some of these sharing information on their experiences
DON'T CUMP
145
Opportunities to reduce harm from large truck crashes
Regulatory and non-regulatory approaches based on research

- Maintain progress on strengthening **rear underride guards**
- Encourage fitment of strong **side underride guards**
- Increase the use of **speed limiters** set at reasonable values
- Reduce **speed limits** or at least stop increasing them
- Increase use of existing **crash avoidance technologies** and understand their effectiveness
- Maintain safety as first priority as newer technologies, such as SAE level 2-5 and platooning, are developed
More information and links to our YouTube channel and Twitter feed at iihs.org

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