

# INSURANCE INSTITUTE FOR HIGHWAY SAFETY

April 14, 2014

The Honorable David J. Friedman  
Acting Administrator  
National Highway Traffic Safety Administration  
1200 New Jersey Avenue, SE  
Washington, DC 20590

**Request for Comments on Technical Report: Effectiveness of Pretensioners and Load Limiters for Enhancing Fatality Reduction by Seat Belts; Docket No. NHTSA-2013-0130**

Dear Acting Administrator Friedman:

The National Highway Traffic Safety Administration (NHTSA) has published its analysis of seat belt pretensioners and load limiters (Kahane, 2013). The Insurance Institute for Highway Safety (IIHS) welcomes the opportunity to comment on this report.

The driver and right front passenger seat belts of every new vehicle are equipped with pretensioners and load limiters, so it is important to understand what effect these technologies have in real-world crashes. Kahane (2013) found that belted front-seat occupants of cars, crossover SUVs, and minivans with pretensioners and load limiters had a 12.8 percent lower fatality risk compared with occupants restrained by belts without either of these technologies. No significant effect was found for pickups, truck-based SUVs, and full-sized vans. The benefit for the first group of vehicles is in contrast with an IIHS analysis that suggested fatality risks were not being reduced by these technologies (Brumbelow et al., 2007).

A major challenge in studying any crashworthiness feature is the difficulty in isolating it from other improvements that have been made during a similar time frame. The Kahane (2013) report and Brumbelow et al. (2007) study employ fundamentally different approaches to this problem. Understanding these differences is important in the effort to evaluate the effect of seat belt pretensioners and load limiters. Table 1 presents a comparison of some of the relevant considerations. While NHTSA’s approach allows

**Table 1. Comparison of NHTSA and IIHS evaluations of load limiters and pretensioners**

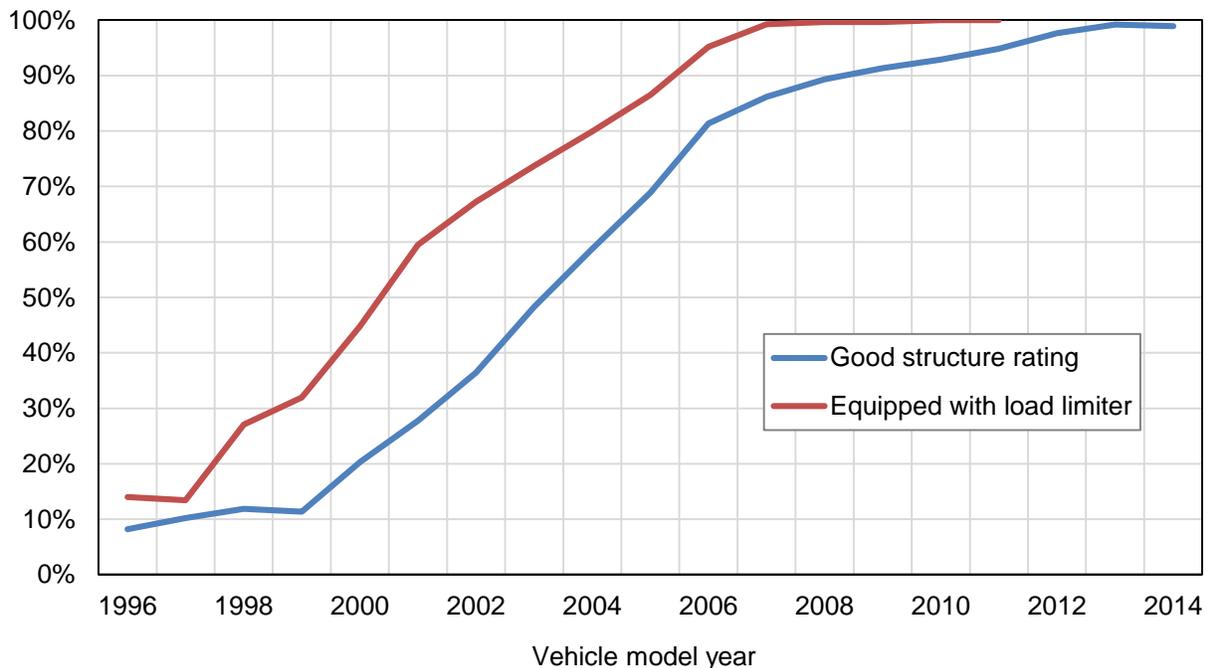
	<b>NHTSA: Kahane (2013)</b>	<b>IIHS: Brumbelow et al. (2007)</b>
<b>Vehicles included</b>	<ul style="list-style-type: none"> <li>All 1986-2011 passenger vehicles with dual front airbags</li> </ul>	<ul style="list-style-type: none"> <li>Only passenger vehicle designs that received pretensioners and/or load limiters without concurrent structural changes</li> </ul>
<b>Method of analysis</b>	<ul style="list-style-type: none"> <li>Seat belt effectiveness relative to unrestrained occupants for vehicles with and without pretensioners and load limiters</li> </ul>	<ul style="list-style-type: none"> <li>Fatality rates per registered vehicle year for the same vehicle model before and after load limiters and pretensioners were introduced</li> </ul>
<b>Strengths</b>	<ul style="list-style-type: none"> <li>Large dataset</li> <li>Not dependent on crash rates</li> </ul>	<ul style="list-style-type: none"> <li>Seat belt technology is isolated (same vehicle designs with and without)</li> </ul>
<b>Limitations</b>	<ul style="list-style-type: none"> <li>Seat belt technology not isolated (completely different vehicles with and without); assumes other crashworthiness changes affect belted and unbelted occupants similarly</li> </ul>	<ul style="list-style-type: none"> <li>Small dataset</li> <li>Assumes crash rates per registration are similar before and after introduction of seat belt technology (or that rates can be adjusted with control vehicles)</li> <li>Subsequent advances that may work in tandem with seat belt technologies are not included</li> </ul>

for a larger dataset and can include newer vehicles, it does not isolate the effect of load limiters and pretensioners. Instead, the “double-paired” methodology relies on the assumption that any other differences between the groups of vehicles with these two seat belt technologies and those without had a similar effect on belted and unbelted front-seat occupants. This assumption was not made for the IIHS analysis. Instead, fatality rate changes were calculated for individual vehicle makes and models that were identical apart from the updated restraint system.

Kahane (2013) recognized that other crashworthiness changes could influence the overall results, but the sub-analysis he performed to evaluate this issue still did not adequately control for these changes. The sub-analysis was restricted to vehicle models that received load limiters and/or pretensioners at some point in their design. This was opposed to the overall analysis, which included many models that were only produced before load limiters became prevalent as well as models only produced with load limiters. However, the additional restriction still did not eliminate vehicles where structural changes accompanied the introduction of load limiters. In addition, airbag changes were likely to have been made in many vehicles at the same time.

There is reason to believe that the introduction of load limiters and pretensioners was commonly associated with concurrent structural and airbag changes, and that these other changes may be confounding NHTSA’s analysis. In the late 1990s and early 2000s, many vehicle designs were being upgraded to achieve better ratings in the IIHS moderate overlap frontal crash test, and this was the same time frame load limiters and pretensioners were introduced into most vehicles (Figure 1). It seems plausible that these concurrent design changes, which improved crash test performance with a belted dummy, conferred greater benefit on belted than unbelted real-world occupants. To the extent this is true, the effect being attributed by Kahane (2013) to load limiters and pretensioners includes the additional benefits of these other crashworthiness changes.

**Figure 1. Vehicles with good structure rating in IIHS 40 percent frontal overlap crash test by model year and vehicles in Kahane (2003) study equipped with load limiters by model year**



While the 2007 IIHS study did not find consistent benefits for pretensioners and load limiters when limited to vehicles that did not have other design changes, such benefits may still exist. The vehicles in that study were 1995-2002 models and are not representative of modern designs. Only 3 of the 17 models had good structural ratings, and only one had both pretensioners and load limiters. In combination with all the other crashworthiness improvements in the fleet during the past 15 years, these technologies may be beneficial. However, it will be difficult, if not impossible, to measure the precise benefit given the fact that all modern vehicles have these technologies.

While not a direct evaluation of load limiters and pretensioners, a 2013 IIHS study indicates that limiting seat belt loads on the driver reduces injury risk in certain types of frontal crashes but increases them in others (Brumbelow and Farmer, 2013). Limited to vehicles with pretensioners, load limiters, and good structural performance in the IIHS 40 percent frontal overlap crash test, the study found that vehicles with lower dummy chest deflections in that test had lower rates of serious injury in real-world frontal crashes with similar or greater overlap. However, in real-world small overlap crashes, the same vehicles had higher rates of serious injury. In other words, there may be a trade-off between reducing injury risk in moderate/ large overlap crashes (by reducing belt loads) and increasing injury risk in small overlap crashes (by increasing excursion). This trade-off could be eliminated by structural and airbag designs that improve performance in small overlap crashes.

In conclusion, IIHS appreciates that NHTSA continues to evaluate important crashworthiness technologies such as seat belt load limiters and pretensioners. However, the Kahane (2013) study does not isolate the effects of these technologies; the concurrent fleet-wide shift in frontal crashworthiness design to accommodate moderate overlap protection may be confounding the results. The effects measured by Kahane should not be attributed simply to the presence of a load limiter and pretensioner. Furthermore, because these seat belt technologies already are incorporated fully into the passenger vehicle fleet, determining their overall effects may be less critical than questions related to the ideal magnitudes of load limiting and pretensioning, and how these magnitudes may vary for different occupants and different frontal crash modes.

Sincerely,



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## References

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- Brumbelow, M.L. and Farmer, C.M. 2013. Real-world injury patterns associated with Hybrid III sternal deflections in frontal crash tests. *Traffic Injury Prevention* 14:807-15.
- Kahane, C.J. 2013. Effectiveness of pretensioners and load limiters for enhancing fatality reduction by seat belts. Report no. DOT HS-811-835. Washington, DC: National Highway Traffic Safety Administration.