National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 8, 2006

In reply refer to: H-06-16

Honorable Norman Y. Mineta
Secretary
U.S. Department of Transportation
400 Seventh Street S.W.
Washington, D.C. 20590-0001

On October 1, 2003, a multivehicle accident occurred on the approach to an Interstate 90 (I-90) toll plaza near Hampshire, Illinois.[1] About 2:57 p.m., a 1995 Freightliner tractor-trailer chassis and cargo container combination unit was traveling eastbound on I-90, approaching the Hampshire–Marengo toll plaza at milepost 41.6, when it struck the rear of a 1999 Goshen GC2 25-passenger specialty bus. As both vehicles moved forward, the specialty bus struck the rear of a 2000 Chevrolet Silverado 1500 pickup truck, which was pushed into the rear of a 1998 Ford conventional tractor-box trailer. As its cargo container and chassis began to overturn, the Freightliner also struck the upper portion of the pickup truck's in-bed camper and the rear left side of the Ford trailer. The Freightliner and the specialty bus continued forward and came to rest in the median. The pickup truck was then struck by another eastbound vehicle, a 2000 Kenworth tractor with Polar tank trailer. Eight specialty bus passengers were fatally injured, and 12 passengers sustained minor-to-serious injuries. The bus driver, the pickup truck driver, and the Freightliner driver received minor injuries. The Ford driver and codriver and the Kenworth driver were not injured.

The National Transportation Safety Board determined that the probable cause of the accident was the failure of the Freightliner truck driver, who was operating his vehicle too fast for traffic conditions, to slow for traffic. Contributing to the accident was the traffic backup in a 45-mph zone, created by vehicles stopping for the Hampshire–Marengo toll plaza. The structural incompatibility between the Freightliner tractor-trailer and the specialty bus contributed to the severity of the accident.

During the Hampshire–Marengo accident sequence, the Freightliner driver stated that he did not see the brake lights on the specialty bus, that the bus suddenly stopped in front of him, and that—though he braked—he was unable to avoid a collision with the rear of the bus. When the Freightliner tractor struck the rear of the specialty bus, it overrode the bus bumper and

[1] For more information, read National Transportation Safety Board, *Multivehicle Collision on Interstate 90, Hampshire–Marengo Toll Plaza, Near Hampshire, Illinois, October 1, 2003*, Highway Accident Report NTSB/HAR-06/03 (Washington, DC: NTSB, 2006).

entered the passenger compartment because of differences in vehicle weights[2] and structural stiffness and because of geometric mismatch. The National Highway Traffic Safety Administration's (NHTSA's) Web page, "Heavy Vehicle Aggressivity Program,"[3] last updated in June 2000, states that the common belief is that not much can be done to diminish the consequences of crashes between smaller vehicles and large trucks because of the significant differences in vehicle mass.

However, research has shown that geometric height differences and a lack of forgiving front truck structures can be modified to help reduce heavy truck aggressivity and to mitigate the severity of these types of accidents.[4,5,6] Examples of these modifications, often referred to as "front underride protection systems"—which can result in reduced intrusion or occupant injury—include energy-absorbing front structures to offset the weight differences between two impacting vehicles, as well as bumpers designed to deflect the impacted vehicle away from the front of the truck, thereby reducing the total change in velocity of the smaller vehicle.

In this accident, as a result of the heavy truck's aggressivity, an almost 5-foot intrusion into the bus's passenger compartment led to loss of survivable space for many passengers seated in the rear; seven of the eight passengers seated in the last three rows of the bus were fatally injured. Except for the ejected passenger seated in row 1, who was fatally injured, the passengers seated forward in the bus (in rows 1–3) sustained minor-to-serious injuries. In other words, the crash forces experienced by the passengers seated away from the intrusion area were mitigated by the crushing of the rear of the bus. The Safety Board concludes that the combination of the large weight difference (almost 6 to 1) between the Freightliner tractor-trailer and the specialty bus, the impact speed of the tractor-trailer into the specialty bus, the difference in stiffness between the tractor front end and the bus body, and the geometric mismatch during the dynamic collision led to the truck overriding the bus's rear structure and resulted in extensive intrusion damage into the rear passenger compartment, a loss of survivable space in that area, and the deaths of seven passengers.

Occupant protection requires that survivable space be maintained for all passengers, and that the interior structure provide sufficient support and energy absorption so that crash forces are survivable. Vehicles with high aggressivity, such as heavy trucks, often compromise the survivable space in the vehicles they hit. Currently, the United States does not have a

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[2] Of the 10 passengers who provided estimates of their weight, the average weight was 144 pounds. The driver weighed about 200 pounds. The total weight of an exemplar bus (including driver) was 10,420 pounds. Combined with an average weight of 150 pounds for 20 passengers, the difference between the specialty bus weight of 13,420 pounds and the combination unit at 76,480 pounds was 63,060 pounds, or a ratio of about 6 to 1.

[3] See <www-nrd.nhtsa.dot.gov/departments/nrd-01/summaries/havp_02.html>, March 23, 2006.

[4] See A. Berg, M. Krehl, L. Riebeck, and U. Breitling, "Passive Safety of Trucks in Frontal and Rear-End Collisions With Cars," *Proceedings, 18th International Technical Conference on Enhanced Safety of Vehicles, Nagoya, Japan* (Washington, DC: NHTSA, 2003).

[5] See A. K. Prasad, R. M. Clarke, D. Willke, and M. Monk, *Reducing Heavy Truck Aggressivity in Collisions With Passenger Cars*, DOT HS 808 476 (Washington, DC: NHTSA, 1995).

[6] See K. Mendis, A. Mani, A. K. Prasad, D. Willke, M. Mond, and R. M. Clarke, "Concepts to Reduce Heavy Truck Aggressivity in Truck-to-Car Collisions, *Proceedings, 15th International Technical Conference on Enhanced Safety of Vehicles, Melbourne, Australia* (Washington, DC: NHTSA, 1996).

requirement for front underride protection[7] on heavy trucks. Europe began studying and testing such devices in 1994 and subsequently established regulations requiring these protection devices on heavy vehicles. Regulations of the Economic Commission for Europe (ECE) are in place for both front underride and rear underride protection (ECE-R 93 and ECE-R 58, respectively); the regulations provide standard specifications for the mount, dimensions, and static stability performance of these devices.

A 2004 study conducted by the National Cooperative Highway Research Program (NCHRP), entitled *A Guide for Reducing Collisions Involving Heavy Trucks*, noted that combination-unit trucks (usually tractor-semitrailers) were found to have a markedly different crash involvement profile than vehicles in general. According to the study, these vehicles

> have relatively low crash rates per mile traveled, but with much greater crash costs per year, and over their operational lives, more than four times higher than most other vehicle types. This means that from a cost-benefit standpoint, safety investments in tractor-trailers are likely to have much greater per-vehicle benefits than similar investments in other vehicle types.[8]

A 1998 NHTSA overview report on vehicle compatibility and light truck (light trucks and vans [LTV][9]) issues stated that the number of LTVs has grown dramatically since the early 1980s. A 2003 study of vehicle mismatch and injury indicated that motor vehicle registrations for the year 2000 showed 77.8 million light trucks in the United States, a 63.8 percent increase since 1990; LTVs now account for 40 percent of all registered motor vehicles. During the same 10-year period, the number of registered passenger vehicles increased by 1 percent.[10] In addition to the increase in LTVs, the number of registered large trucks increased by 30 percent between 1993 and 2003, and miles traveled by large trucks increased 35 percent.[11] If these trends continue, LTVs and large trucks will soon constitute the majority of vehicles on the road, resulting in even greater occurrences of vehicle incompatibility in accidents.

In 2003, approximately 457,000 large trucks (GVWR exceeding 10,000 pounds) were involved in traffic accidents and accounted for 8 percent of vehicles involved in fatal accidents. These traffic accidents resulted in 4,669 fatalities and 122,000 injuries; 85 percent of those killed and 78 percent of those injured were the occupants of other vehicles (passenger cars and LTVs), pedestrians, or bicyclists.[12] The initial point of impact for 62.8 percent of the fatal accidents involved the front of the truck.[13] In accidents involving a large truck during 2004, some 4,006

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[7] A front underride protection system is an energy-absorbing structure on the front of a truck that reduces injuries to occupants in a vehicle struck by the front of the truck.

[8] See Transportation Research Board of the National Academies, National Cooperative Highway Research Program, *Guidance for Implementation of the AASHTO Strategic Safety Plan, Volume 13: A Guide for Reducing Collisions Involving Heavy Trucks*, NCHRP Report 500 (Washington, DC: TRB, 2004) III-3.

[9] The LTV category consists of trucks of 10,000 pounds gross vehicle weight rating (GVWR) or less and includes pickups, vans, minivans, truck-based station wagons, and sport utility vehicles.

[10] See S. Acierno and others, "Vehicle Mismatch: Injury Patterns and Severity," *Accident Analysis and Prevention*, Vol. 36 (2004): 761.

[11] See <ai.fmcsa.dot.gov/carrierresearchresults/html/2003crashfacts/chap1.htm>, March 28, 2006.

[12] See <www.nhtsa.dot.gov/cars/rules/rulings/PriorityPlan-2005.html>, March 23, 2006.

[13] See <ai.fmcsa.dot.gov/carrierresearchresults/html/2003crashfacts/tbl42.htm>, March 28, 2006.

occupants of passenger cars and LTVs were killed, and 85,000 such occupants were injured.[14] According to the U.S. Department of Transportation (DOT), its goal is to reduce highway fatality rates from 1.46 persons per 100 million vehicle miles traveled (VMT) in 2004 to 1 person per 100 million VMT by 2008. An objective of the Federal Motor Carrier Safety Administration is to reduce commercial motor vehicle-related fatalities from 2.3 per 100 million commercial motor VMT in 2004 to 1.65 per 100 million commercial motor VMT by 2008.[15] Achieving these ambitious goals will clearly require a large reduction in fatalities resulting from accidents between large trucks and passenger vehicles.

NHTSA has made some progress in testing and evaluating measures to reduce heavy truck aggressivity; however, the agency has published little recently to indicate continued testing or the intent to implement changes in the industry. The Safety Board recognizes that NHTSA has discussed the need to reduce fatalities resulting from large truck accidents and has stated that research and implementation of intelligent transportation system technologies for accident avoidance is a priority. But the agency has not included large truck incompatibility among its priorities for rulemaking or research support for calendar years 2005–2009. The incompatibility of large trucks with passenger cars is not a new issue, and the Europeans have been doing work in this area since at least 1994. In keeping with the DOT's goal to reduce fatalities resulting from large truck accidents and the 21st Century Truck Program's goal to foster advancements in vehicle design and reduction of truck frontal aggressivity, both the department and the truck program need to increase their investments in truck design initiatives that could ameliorate the severity of collisions with large trucks. The Safety Board concludes that although NHTSA has acknowledged the seriousness of the vehicle incompatibility problem in contributing to the severity of traffic accidents, it has not allocated adequate resources to that issue as it affects heavy trucks, a major cause of death for occupants in both passenger cars and LTVs.

The National Transportation Safety Board therefore makes the following recommendation to the U.S. Department of Transportation:

> Include heavy vehicles in your research, testing, and eventual rulemaking on highway vehicle incompatibility, especially as that incompatibility affects the severity of accidents. (H-06-16)

As a result of this accident investigation, the Safety Board also issued safety recommendations to the U.S. Department of Energy, the Federal Motor Carrier Safety Administration, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the International Bridge, Tunnel and Turnpike Association. In addition, the Safety Board reiterated two recommendations to the National Highway Traffic Safety Administration.

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[14] A total of 761 truck occupants were killed, and about 27,000 were injured. See <www.nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSFAnn/TSF2004EE.pdf>, March 28, 2006.

[15] See (a) <www.fmcsa.dot.gov/facts-research/research-technology/report/rt-5year-strategicplan.htm>, March 23, 2006. (b) <www.fmcsa.dot.gov/facts-research/facts-figures/mcspr-12-31-05.htm>, March 23, 2006.

Please refer to Safety Recommendation H-06-16 in your reply. If you need additional information, you may call (202) 314-6177.

Acting Chairman ROSENKER and Members ENGLEMAN CONNERS, HERSMAN, and HIGGINS concurred in this recommendation.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman