

Log H-533



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

Date: June 8, 1989

In reply refer to: H-89-20

Honorable Diane K. Steed  
Administrator  
National Highway Traffic  
Safety Administration  
Washington, D.C. 20590

On August 28, 1987, a 1982 Thomas Built school bus carrying 21 passengers was traveling westbound on Levy County (Florida) Road C-32 when it collided with a two-axle flatbed truck traveling northbound on Levy County Road C-337 near Bronson, Florida. The school bus driver and 5 passengers died; the truckdriver sustained critical injuries and 16 school bus passengers were injured.<sup>1</sup>

The initial collision of the left front of the school bus with the right front of the truck redirected both vehicles 57° northwest from the precollision path of the school bus. After both vehicles were redirected, the right side of the truck collided with the left side of the school bus as the truck began its counterclockwise rotation and 90° overturn to the right. When this secondary side-to-side collision occurred, the floor panels aft of the school bus driver's position were subjected to side-shearing forces. At this point in the collision sequence, several, if not all, of the first seven floor panels separated from their attachment to the left and right sidewalls and at least partially from each other.

As the truck continued its counterclockwise rotation, its degree of rollover also increased; as the cargo bed was rolling over onto the left sidewall of the school bus, the left ends of floor panels one through seven were compressed downward, causing their right ends to begin to rise up into the passenger compartment. Because there were no body mounting clips installed forward of the joint between the fifth and sixth floor panel, the right ends of panels one through four, which probably had separated due to shearing forces in the initial phase of the collision sequence, were free to turn up as their left ends were deflected downward by the truck's cargo bed.

The Safety Board could not determine if the collapse of the school bus floor in the area where four passengers were seated caused their fatal injuries to the exclusion of all other possible injury sources. However, the collapse of the floor negated any passenger crash protection that may have

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<sup>1</sup>For more detailed information, read Highway Accident Report--"Collision of Levy County, Florida School Bus and Airdrome Tire Centers, Inc. Truck, near Bronson, Florida, August 28, 1987" (NTSB/HAR-89/02).

been afforded by the padded, high-backed restraining barriers and seats installed in the school bus as required by Federal Motor Vehicle Safety Standard (FMVSS) 222, School Bus Passenger Seating and Occupant Protection. Therefore, the Board believes that the collapse of the school bus floor under the first three seat rows may have exacerbated most of the injuries sustained by the passengers of the second, third, and fourth seat rows of the school bus.

The Safety Board has found in several severe accidents in which the school bus body and chassis separated, that the separation produced a positive safety benefit.<sup>2</sup> Crash forces which normally would have been transmitted to the school bus body were reduced because of the body/chassis separations. However, despite the separation of the body and chassis in this accident, the school bus floor collapsed after the separation, negating many of the passenger crash protection features required by FMVSS 222.

FMVSS 221, School Bus Body Joint Strength, requires that a body panel joint of a school bus be fastened so that it is capable of holding the body panel to the member to which it is joined when subjected to a force equal to 60 percent of the tensile strength of the weakest joined body panel. The standard states that its purpose is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

In response to a Blue Bird Body Company request for clarification of FMVSS 221 test procedures for cases in which the two body components which form the joint in question are not flat surfaces in the same or parallel planes, on April 26, 1976, the National Highway Traffic Safety Administration (NHTSA) advised that it intended to test such configurations by determining the nature of the two body components and test identical materials joined by the same means after modification of the joint into a configuration in which the two body components are flat surfaces in the same or parallel planes.

Section S6.2(a) of FMVSS 221 provides that if the mechanical properties of a material are specified by the American Society for Testing and Materials (ASTM), the relative tensile strength for such a material is the minimum tensile strength specified for that material in the 1973 edition of the Annual Book of ASTM Standards. Based on the ASTM specifications, the NHTSA determined that the minimum strength for an 8-inch floor joint specimen for four manufacturers--Blue Bird Body Company, Carpenter Body Works, Inc., Thomas Built Buses, Inc., and Ward School Bus, Inc.--was 15,228 pounds in shear.

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<sup>2</sup>Highway Accident Reports--"Collision of G & D Auto Sales, Inc, Tow Truck Towing Automobile, Branch Motor Express Company Tractor-Semitrailer, Town of Rehoboth Schoolbus, Rehoboth, Massachusetts, January 10, 1984" (NTSB/HAR-84/05); "Collision of Isle of Wight County, Virginia, Schoolbus with Chesapeake and Ohio Railway Company Freight Train, State Route 615 near Carrsville, Virginia, April 12, 1984" (NTSB/HAR-85/02); and "Schoolbus Loss of Control and Collision with Guard Rail and Sign Pillar, U.S. Highway 70 near Lucas and Hunt Road, St. Louis County, Missouri, November 11, 1985" (NTSB/HAR-87/02).

However, the NHTSA calculated that floor joint strengths for school bus floors using plywood in floor construction was considerably less than 15,228 pounds. The Crown school bus the NHTSA tested in 1978 was determined to need a floor joint strength of 1,980 pounds in shear, and the Gillig school bus was determined to need a floor joint strength of 1,680 pounds in shear in order to meet the floor joint strength requirement of FMVSS 221.

The Safety Board has no data concerning the crashworthiness of post-FMVSS 221 school bus floors that use plywood in their floor construction, and therefore, it cannot determine if such floor joints need to be strengthened. However, the Safety Board believes that the varying floor joint strength requirements that resulted from basing the requirements upon the type(s) of parent material used (steel vs. plywood) may have been the anomaly that caused the NHTSA to believe the standard was unenforceable. This needs to be addressed in the NHTSA rulemaking presently in progress.

The NHTSA perceived problems with enforcement and interpretation of FMVSS 221 as it applied to floor joints and discontinued testing floor joints for compliance with the standard in August 1982. The NHTSA Associate Administrator for Enforcement advised the Safety Board that the investigation cases involving compliance of Thomas floor panel joints were closed by the NHTSA's Office of Chief Counsel based on an "inadequate legal basis to proceed rather than on questions related to the technical merits of the test failures." Since August 1982, the NHTSA has not tested floor joints for compliance and has not attempted to enforce the existing standard in the case of school bus floor joints. In 1987, the NHTSA published an Advanced Notice of Proposed Rulemaking concerning school bus floor joint strength, and has initiated a research program involving the dynamic testing of school bus floor joints. Current research is scheduled for completion the second quarter of calendar year 1989, and a decision on whether to institute additional rulemaking is scheduled for the third quarter of calendar year 1989.

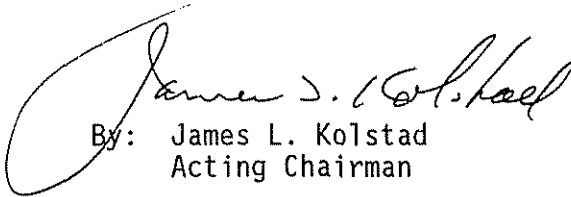
The Safety Board believes it is important that the NHTSA resume testing of school bus floor joints. However, the Board also recognizes that the NHTSA will not resume testing until it amends FMVSS 221. In amending FMVSS 221, the NHTSA must make it clear that all body panel and floor joints are subject to the standard. It also must delete the provision in subsection S5 that permits the strength of the floor joint be 60 percent of the strength of the weakest material being joined to eliminate the apparent anomaly which exists in the present standard. Further, any tests specified in any revised standards must reflect the loadings experienced in actual crashes (often tensile or peel rather than shear); and static testing of the entire floor system should be considered in conjunction with dynamics tests. Accordingly, the Board is superseding Safety Recommendations H-86-54, H-86-55, and H-86-56 with a new recommendation urging the NHTSA to expedite the process of revising FMVSS 221.

Therefore, the National Transportation Safety Board recommends that the National Highway Traffic Safety Administration:

Expedite the process of amending Federal Motor Vehicle Safety Standard (FMVSS) 221 to make clear that all floor joints are subject to FMVSS 221, to remove the apparent anomaly caused by subsection S5 (Strength Requirements), and to make tests for compliance with the standard more reflective of the type of loadings experienced by the floor joints in actual crashes. (Class II, Priority Action)(H-89-20)

Also, the Safety Board issued Safety Recommendation H-89-21 to the State of Florida.

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, and DICKINSON, Members, concurred in this recommendation. NALL, Member, did not participate.

  
By: James L. Kolstad  
Acting Chairman