National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 21, 2005

In reply refer to: H-05-17

Honorable Jeffrey W. Runge, M.D.
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

On February 14, 2003, about 9:59 a.m., central standard time, a 1996 Dina Viaggio motorcoach, operated by Central Texas Trails, Inc., and occupied by a driver and 34 passengers, was traveling northbound on Interstate 35 near Hewitt, Texas.[1] The weather was overcast with reduced visibility due to fog, haze, and heavy rain. As the motorcoach approached the crest of a hill, the bus driver said he observed brake lights ahead of him and began to brake lightly. The bus driver said that as he moved from the right lane into the left lane, another vehicle ahead of the bus also moved over, so he braked harder and the rear of the bus skidded. The bus driver was unable to maintain control of the bus as it departed the left side of the roadway, crossed the grassy median, entered the southbound lanes, and collided with a 2002 Chevrolet Suburban sport utility vehicle (Suburban) occupied by a driver and two passengers. The right mirror of a southbound 1996 Chevrolet C1500 Z71 pickup truck, occupied by a driver, was also struck by the motorcoach. The motorcoach then overturned on its right side, rotated, and slid to final rest facing south against a concrete embankment on the side of the road. The Suburban rotated 180 degrees, began to climb the embankment, slid back down, and came to rest facing north and against the roof of the bus.

Five motorcoach passengers, the Suburban driver, and one Suburban passenger sustained fatal injuries. The bus driver sustained serious injuries; the remaining passengers on the bus and in the Suburban sustained injuries ranging from minor to serious. The pickup truck driver was not injured.

The National Transportation Safety Board determined that the probable cause of this accident was Texas's decision to set a speed limit on Interstate 35, in the vicinity of the accident, that did not take into account the roadway's limited sight distance or its poor conditions in wet weather; as a result, the bus driver was unable to detect the stopped vehicles as he approached the traffic queue and lost control of the motorcoach due to low pavement friction. Exacerbating the poor roadway conditions were the minimum tread depths on the motorcoach's drive axle tires

[1] For more information, read National Transportation Safety Board, *Motorcoach Median Crossover and Collision With Sport Utility Vehicle, Hewitt, Texas, February 14, 2003,* Highway Accident Report NTSB/HAR-05/02 (Washington, DC: NTSB, 2005).

and differing tread depths on its front and rear tires, both of which were allowed under the *Federal Motor Carrier Safety Regulations* (FMCSRs) but reduced the friction available to the motorcoach. Contributing to the severity of the accident were the lack of a temporary or permanent median barrier, which might have redirected the motorcoach or reduced the speed at which it crossed the median into the southbound lanes, and the lack of an occupant protection system for the motorcoach passengers.

Testing conducted during the investigation[2] found coefficients of friction for the drive axle tires of 0.10 on 0.19 inch of water and 0.15 on 0.02 inch of water (equivalent to performance on ice), values significantly lower than those of the front tires (0.28 to 0.30), primarily because the drive axle tires had a much lower tread depth (2/32 versus 14/32 inch). As was demonstrated by the testing, the tread depth can significantly affect the friction available in wet weather; available friction is critical to the vehicle's ability to stop.

Calculations, based on the tire coefficients of friction derived from friction testing[3] and the configuration of the brakes, indicated that the drive axle brakes would have locked up at a brake application pressure of about 22 pounds per square inch (psi). The front and tag axle tires would have required a brake pressure of about 32 and 33 psi, respectively, before they locked up on the same low friction surface of the right lane. This difference can lead to instability of the vehicle during hard braking or emergency maneuvers. Had the drive axle tires been the same tread depth as the front axle tires, they would not have locked up until a brake application pressure of 47 psi was applied.[4] The Safety Board's simulation of this accident indicated that the driver likely applied the brakes at a pressure of 35 psi and further showed that when tires with tread depths similar to those of the front tires (14/32 or 15/32 inch on all the wheels) were used, the driver would likely have been able to maintain sufficient control of the motorcoach to avoid crossing into the southbound lanes. While the motorcoach would have left the roadway, the Suburban would not have been hit and the motorcoach probably would not have rolled over.

Research and testing on passenger cars indicate that "friction forces at highway speeds are reduced to half or less of the new tire value if the tire wear exceeds about 50 percent,"[5] as it did on the drive axle tires. This research also indicated that the lateral friction of tires decreases well before hydroplaning is expected to occur.[6] Further, when the worn tires are placed on the rear of passenger cars, the handling of the vehicle changes, since the rear tires have more tendency to slide.

Tire friction testing also indicated that the lateral friction, the stability of a tire during turns and lateral maneuvers, was much lower for the rear tires (0.23 to 0.26)[7] than the front tires

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[2] See NTSB/HAR-05/02, *Tests and Research* section, and appendix C, *Tire Friction Testing Results,* for more information.

[3] These tire coefficients of friction were measured on a roadway surface similar to the surface measured on scene.

[4] The drive axle wheels require more brake pressure to lock than other wheels because the drive axle supports more of the motorcoach's weight than the other axles.

[5] William Blythe and Terry D. Day, *Single Vehicle Wet Road Loss of Control; Effects of Tire Tread Depth and Placement*, SAE 2002-01-0553 (Warrendale, PA: Society of Automotive Engineers: 2002).

[6] Blythe and Day, 10.

[7] At 60 mph and 0.11-inch water depth.

(0.46 to 0.54). Thus, when a maneuver such as braking or steering is attempted, the worn rear tires, with reduced longitudinal and lateral friction, are unable to maintain their grip on the road and will begin to slide rather than follow the front tires through the intended maneuver. Research on passenger vehicles found that "normal lane change maneuvers can lead to loss of control on a wet road if sufficient difference in tread depth exists front to rear, with the better treaded tires on the front axle of a passenger car."[8] Lower tread depths on the rear tires of passenger vehicles create an inherent safety problem, and while they are likely to have the same effect on commercial vehicles, which was confirmed in the simulation, the extent of this effect cannot be determined. In this accident, when the driver tried to brake and then to abruptly turn the wheel back to the right when the drive axle tires started to slip, little lateral friction was available for the maneuver, and thus the motorcoach continued to rotate counterclockwise. Yet, with tires that had a greater tread depth, the motorcoach probably would have responded to the rapid right steering maneuver and would not have continued its counterclockwise rotation. The Safety Board concludes that the minimum tread depths of the drive axle tires, including the smaller tread depth on the left drive axle tires, particularly in combination with the nearly new front tires, contributed to wheel lockup and the subsequent rotation of the motorcoach.

The FMCSRs[9] currently require that the tread depth for the front wheels of a commercial vehicle be at least 4/32 inch and the tread depth for all other tires be at least 2/32 inch. The Commercial Vehicle Safety Alliance guidelines for placing a vehicle out of service include steer axle tire treads of less than 2/32 inch in two adjacent grooves and any other tire treads less than 1/32 inch in two adjacent grooves. The effect of tread depth on commercial vehicle handling has not been evaluated since these requirements were instituted over 30 years ago, and no data are available to determine how these tread depth requirements were determined. The Safety Board previously made a recommendation to the National Highway Traffic Safety Administration (NHTSA) on this matter as a result of its investigation of the November 16, 1980, motorcoach accident near Luling, Texas,[10] in which the motorcoach lost traction on the wet pavement and skidded off the road:

> H-81-33
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> Accelerate activity to establish rulemaking action for minimum frictional quality standards for commercial vehicle tires.

Yet nothing was done, and the recommendation was classified "Closed—Unacceptable Action" on August 21, 1986. In 1988, the Safety Board issued the following recommendation to the Federal Highway Administration:

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[8] Blythe and Day, 14.

[9] Title 49 *Code of Federal Regulations* 393.75.

[10] National Transportation Safety Board, *East Side Church of Christ Bus Skid and Overturn U.S. Route 183 Near Luling, Texas, November 16, 1980,* Highway Accident Report NTSB/HAR-81/04 (Washington, DC: NTSB, 1981).

H-88-1

Revise Sections 393.75(B) and (C) of the *Federal Motor Carrier Safety Regulations* to prohibit the use of tires worn below 4/32 inch on any axle of a commercial interstate vehicle.

Again, no action was taken and the recommendation was classified "Closed—Unacceptable Action" on May 19, 1989. Yet, this accident and recent research[11] show that reduced tread depth can lead to reduced friction and, ultimately, loss of control. Because no requirement exists that the tires have similar tread depths, the Safety Board believes that NHTSA should conduct testing on the effects of differing tread depths for the steer and drive axle tires. The Safety Board has also recommended that once NHTSA's testing is complete, the Federal Motor Carrier Safety Administration should modify the tread depth requirements for each axle to reflect the results of the research. In addition, because the adverse effects of mounting worn tires on the rear axle of vehicles are not widely known,[12] it is important that both commercial vehicle owners and consumers are aware of this information. The Safety Board will inform the United Motorcoach Association, the American Bus Association, the American Trucking Associations, the Owner-Operator Independent Drivers Association, the American Automobile Association, and the National Safety Council of the adverse handling that can result when worn tires are placed on the rear axles of vehicles, particularly when the front tires are fairly new with good tread depths.

The National Transportation Safety Board therefore makes the following recommendation to the National Highway Traffic Safety Administration:

Conduct testing on the effects of differing tread depths for the steer and drive axle tires. (H-05-17)

The Safety Board also issued safety recommendations to the Federal Highway Administration, the Federal Motor Carrier Safety Administration, and the Texas Department of Transportation. Please refer to Safety Recommendation H-05-17 in your reply. If you need additional information, you may call (202) 314-6177.

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

Original Signed

By: Mark V. Rosenker
Acting Chairman

[11] Blythe and Day.

[12] Tire manufacturers do disseminate this information to their maintenance facilities.