National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 4, 2003

In reply refer to: H-03-12 through -17

Honorable Jeffrey W. Runge, MD
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, SW
Washington, DC 20590

On May 8, 2001, about 8:57 a.m., central daylight time, a 1993 Dodge 15-passenger van was eastbound on U.S. Route 82 near Henrietta, Texas, en route from Burkburnett, Texas, to an outlet mall in Gainesville, Texas. The driver and 11 passengers, all members of the First Assembly of God Church, occupied the van. As the vehicle approached milepost 538 in the left lane, at a calculated speed of 61 to 67 mph, the left rear tire experienced a tread separation and blowout; subsequently, the van departed the roadway and rolled over at least two times in the median, ejecting seven passengers before coming to final rest. The driver and three of the ejected passengers sustained fatal injuries, and eight passengers sustained serious injuries.[1]

On July 1, 2001, about 2:30 p.m., eastern daylight time, a 1989 Dodge Ram 15-passenger van was northbound in the left lane on U.S. Route 220, near Randleman, North Carolina, en route from Myrtle Beach, South Carolina, to Roanoke, Virginia. The van, owned by Virginia Heights Baptist Church of Roanoke, Virginia, was occupied by the driver and 13 passengers, ages 13 to 19. As the vehicle approached the Level Cross, North Carolina, exit, at a witness-estimated speed of 65 mph, the left rear tire experienced a tread separation and blowout; subsequently, the van moved from the left lane into the right lane, then back into the left lane, where it overturned and came to rest in the travel lanes. During the accident sequence, four passengers were ejected, one of whom was fatally injured and three of whom sustained serious injuries; the driver and the other nine passengers sustained injuries ranging from none to serious.[2]

The National Transportation Safety Board determined that the probable cause of the accidents was tire failure, the drivers' response to that failure, and the drivers' inability to maintain control of their vans. Contributing to the accidents was the deteriorated condition of the tires, as a result of the churches' lack of tire maintenance, and the handling characteristics of the vans. Contributing to the severity of the injuries was the lack of appropriate *Federal Motor*

[1] For additional information, read National Transportation Safety Board, *Dodge 15-Passenger Van Rollover on U.S. Route 82 Near Henrietta, Texas, on May 8, 2001, and Dodge 15-Passenger Van Overturn on U.S. Route 220 Near Randleman, North Carolina, on July 1, 2001*, Highway Accident Report NTSB/HAR-03/03 (Washington, DC: NTSB, 2003).

[2] For additional information, read NTSB/HAR-03/03.

Vehicle Safety Standards applicable to 15-passenger vans in the areas of restraints and occupant protection.

According to National Highway Traffic Safety Administration's (NHTSA's) *Federal Motor Vehicle Safety Standards*, 12- and 15- passenger vans, which can carry more than 10 passengers, are buses and therefore not required to meet the same safety and occupant protection requirements as passenger vehicles. Yet these vans are built neither to the standards for school buses nor to the industry standards for motorcoaches. Moreover, vans are often used in the same manner as passenger vehicles, even though they have different safety requirements and are required to meet different safety standards in some areas. Vans have a higher center of gravity and can accommodate more occupants than passenger vehicles, but are currently held to less stringent occupant protection and roof crush requirements than passenger vehicles. Even though these vans are used in a manner similar to passenger cars, the occupants are not afforded the same level of safety as those occupants riding in passenger cars.

Although NHTSA classifies 12- and 15-passenger vans as buses, the Federal Motor Carrier Safety Administration (FMCSA) considers them commercial vehicles only if they are used for compensation, in which case a van designed to carry 8 or more passengers is considered a commercial vehicle. Therefore, any individual who has a driver's license and is not operating the vehicle for compensation can operate a 12- or 15-passenger van without additional training, despite NHTSA's statement in its consumer advisory that they have different operating characteristics from passenger cars. Because the vans in the Henrietta and Randleman accidents were not used for compensation, the FMCSA did not consider them commercial vehicles; therefore, the operators were not required to have a commercial driver's license. The FMCSA regards 12- and 15-passenger vans as commercial vehicles based solely on their intended use (for compensation), not on their handling characteristics. Yet the van's handling characteristics are the same, regardless of whether the driver is being paid. These vans are the only type of vehicle that may or may not be classified as commercial, depending on use; all other vehicles, such as trucks over 26,000 pounds or buses carrying more than 15 passengers, are always defined as commercial vehicles.

Despite NHTSA's consumer advisory, the general public may not be aware that 12- and 15-passenger vans, which are not sold or used differently from passenger vehicles, have unique operating characteristics. Church officials in the Henrietta and Randleman accidents did not know that the vans differed from passenger cars in any way except size, even though the accident vans were not required to meet the same safety standards as passenger vehicles. Additionally, the vans may or may not be defined as commercial vehicles, depending on their use, leading to further confusion on the part of the public and a lack of consistent requirements for training and licensure.

The Safety Board concludes that NHTSA's and the FMCSA's inadequate and inconsistent vehicle classification of 12- and 15-passenger vans leaves a gap that adversely affects regulations pertaining to the manufacture and safe operation of these vehicles. The Safety Board believes that NHTSA and the FMCSA should revise their definitions of buses and commercial motor vehicles to apply consistently to 12- and 15-passenger vans, taking into account the unique operating characteristics and multiple functions of these vans.

NHTSA's study on *The Rollover Propensity of Fifteen-Passenger Vans* demonstrated that 15-passenger vans are inherently unstable when loaded to the level for which they are designed—carrying more than 10 passengers. NHTSA therefore advises all van drivers to obtain specific training on the handling and operation of these vehicles. However, as investigators found during the Henrietta and Randleman accident investigations, the van owners were not aware of the information provided by NHTSA in its consumer advisory. The advisory has not reached all 15-passenger van operators, even those within the target group, such as churches, and the Henrietta and Randleman operators did not know that they should have specific training to operate the vans safely. Both accident drivers had experience operating 15-passenger vans, but no specialized training on the handling and driving characteristics of these vehicles; neither driver was able to control the van in an emergency.

As shown in the testing by Standards Testing Laboratories, Inc., and Safety Board staff, the van was controllable during an anticipated blowout, and the test driver thought that the effort required to control the vehicle was within the range of an unimpaired driver. However, even the professional test driver was unable to maintain the lane of travel in test 3 when the tires were inflated below the manufacturer's recommended inflation pressures, which were similar to those in the Henrietta accident; the van swayed from side to side as the test driver brought it under control. The professional test driver also stated that the van was more difficult to control at higher speeds, particularly with lower tire inflation pressures, and that steering inputs were magnified after the blowout. The test driver had experience operating 15-passenger vans during a blowout, and he triggered the tire blowout himself, so the situation was not unexpected, as it was during the accidents. Further, an experiment on driver reaction to tread separation that was conducted in the National Advanced Driving Simulator found that

> findings from test track studies in which test drivers were aware of an imminent tread separation may underestimate the extent to which tread separation occurring in the real world leads to instability and loss of vehicle control.[3]

Thus, even though the test van was configured similarly to the Henrietta van, the test did not replicate either accident in the critical area of operator behavior.

While both accident drivers were familiar with their respective vans and had driven them previously, investigators did not find evidence that either driver had experienced an emergency situation, such as tire failure, while operating the van. Both drivers are likely to have overcorrected and braked following the blowout because they did not know how to respond appropriately to the vehicle dynamics that occurred after the blowout and did not understand the potential instability problems associated with 15-passenger vans. The drivers are likely to have reacted instinctively by attempting to correct the rotation of the van while braking to slow it. Had the two drivers maintained their speed, not applied the brakes, and exerted more controlled steering, as the professional driver did during the tests, they may have been able to control their vans. Braking, the likely response on the part of both drivers, can lead to further vehicle instability during a tire failure, particularly in a fully loaded 15-passenger van with a high, rearward center of gravity. The drivers' lack of training on their vehicles' operating and handling

[3] T.A. Ranney, G. Heydinger, G. Watson, K Salaani, E.N. Mazzae, and P. Grygier, *Investigation of Driver Reactions to Tread Separation Scenarios in the National Advanced Driving Simulator (NADS)*, DOT HS 809 523 (Washington, DC: National Highway Traffic Safety Administration, 2002).

characteristics, particularly in emergency situations, put them at a disadvantage in reacting to the blowout.

As the National Safety Council, the American Automobile Association, and most driver education programs recognize, acceleration is the appropriate response to a blowout, but that response is counterintuitive to the general public. Therefore, such groups emphasize that drivers need to refrain from braking and to decelerate slowly in the event of a tire blowout. This strategy requires that the driver provide steering input to counteract the lateral dragging force created by the blown tire. If a driver brakes, the lateral steering force experienced by the vehicle is greater, and the driver must provide more steering input to maintain control of the vehicle. If the driver provides too much steering input, he or she will have to try to correct the direction of the vehicle and may oversteer. When the vehicle has a high, rearward center of gravity, as a loaded 15-passenger van does, the rapid changes in steering direction can lead to instability and rollover. A similar driver reaction to a blowout in a passenger car is unlikely to have such severe consequences because the passenger car's lower center of gravity makes it more forgiving of inappropriate driver inputs.

Impressing upon 15-passenger van drivers the inherent dangers of operating these vehicles, particularly when fully loaded, and educating them about proper handling and control, particularly during emergency situations, can reduce the risk of rollover. Such training can also help dispel the expectation that these vans operate like large passenger cars. While the accident drivers had experience operating the vans, they did not have experience with how the vehicles would respond in this type of emergency situation or other emergency situations or the consequences of their instinctive reactions to such situations. Educating drivers on how such vehicles respond to, and on the consequences of, different driver input could help operators approach 15-passenger van driving more cautiously.

In addition, training would provide a forum for educating drivers about the tire pressures and maintenance required for 15-passenger vans. The rear tires on a fully loaded van, for instance, must be inflated to 80 pounds per square inch (psi), which is much higher than the rear tire pressure for most passenger cars. Stressing the importance of proper tire inflation during training will help drivers avoid potential problems. Drivers should also be taught to check the tires and tire pressure before driving the vehicle. In both these accidents, the tires were in very poor condition, which should have been readily apparent to someone who knew to look for cracks and rotting rubber.

Although NHTSA recommends that 15-passenger van drivers be trained to operate the vehicles, the agency does not provide information on the source of such training. The National Safety Council offers computer-based training, "Coaching the Van Driver," and many colleges and universities use this program to train their employees who drive vans. But this course does not educate drivers about emergency handling of the vans, nor does it discuss tire pressure and maintenance.

As NHTSA has acknowledged, 15-passenger van operators need training in the handling of those vehicles, and testing has demonstrated that controlling 15-passenger vans in a blowout is possible, albeit difficult, for a trained driver. The Safety Board concludes that safe operation of 15-passenger vans requires a knowledge and skill level different from and above that for passenger vehicles, particularly when the vans are fully loaded or drivers experience an emergency situation. Therefore, the Safety Board believes that NHTSA, in cooperation with the American Driver and Traffic Safety Education Association, the National Safety Council, the American Automobile Association, General Motors Corporation, and Ford Motor Company, should develop a training program that incorporates the skills required for safe operation of 12- and 15-passenger vans and addresses the consequences of unsafe operation, including, but not limited to, operating in a fully loaded condition, emergency braking, high-speed lane changes, tire blowouts, and tire pressure and maintenance.

Research into rollover crashes shows that a systems approach to occupant protection, involving seat belts, seats, the roof, and interior structures, is necessary to minimize occupant exposure to injury-causing mechanisms.[4] While much of this research was performed on passenger cars, it applies equally to 15-passenger vans, whose occupants also need to be protected during accidents.

In a rollover accident, the accelerations experienced by occupants at the vehicle's center of gravity can be low compared to the accelerations experienced by occupants in frontal or side impact collisions. Nonetheless, the severity of rollovers can still be significant. Researchers have found that the acceleration at a roof rail can be three times that at the center of gravity,[5] posing risks for occupants located near the accelerating roof rail. In the Henrietta simulation, the unbelted occupants sustained severe injuries, even though maximum accelerations experienced by the passengers at the van's center of gravity were less than 10 times the acceleration of gravity in the first rollover.

The Henrietta, Randleman, and other accidents, as well as the simulations conducted for this investigation, demonstrate that when a 15-passenger van is involved in a rollover accident, occupant protection needs to be improved in order to save lives and reduce injuries. Specifically, changes are needed in interior surfaces, seat belts, and roof crush protection.

Federal Motor Vehicle Safety Standard (FMVSS) 201, "Occupant Protection in Interior Impact," specifies requirements for protecting occupants inside passenger cars, multipurpose vehicles, trucks, and buses that have a gross vehicle weight rating (GVWR) less than 4,536 kilograms (kg) (10,000 pounds); the requirements for upper interior components do not apply to buses, including 15-passenger vans, that have a GVWR greater than 3,860 kg (8,510 pounds). The requirements that apply to 15-passenger vans include those for instrument panels, seatbacks, interior compartment doors, sun visors, and armrests. Fifteen-passenger vans do not have to meet the phased-in requirement for upper interior components in passenger vehicles manufactured after September 1, 1998, which mandates that vehicles meet head injury criteria for impacts with the front header, rear header, side rails, sliding door track, all pillars, roof braces or stiffeners, and seat belt anchorages.

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[4] M.W. Arndt, G.A. Mowry, C.P. Dickerson, and S.M. Arndt, "Evaluation of Experimental Restraints in Rollover Conditions," SAE Paper 95712 (Warrendale, PA: Society of Automotive Engineers, 1995).

[5] J.W. Carter, J.L. Habberstad, and J. Croteau, "A Comparison of the Controller Rollover Impact System (CRIS) with the J2114 Rollover Dolly," SAE Paper 2002-01-0694 (Warrendale, PA: Society of Automotive Engineers, 2002).

In both the Henrietta and Randleman accidents, occupants contacted and sustained injuries from one or more interior surfaces that are required to be protected in passenger vehicles but not in 15-passenger vans. The front passenger in the Henrietta accident was restrained by a lap/shoulder belt but sustained injuries due to contact with the interior roof and B-pillar during the rollover sequence. Four passengers in the Henrietta accident were seated on the left side of the vehicle (seats 3, 6, 9, and 12). A possible source of their injuries prior to ejection was deceleration into the noncrash-protected interior surfaces, including the roof, exposed window frame, and collapsed sidewalls, during the initial rollover and subsequent roof crush. Two passengers in the Henrietta van (seats 5 and 14) were unbelted but remained inside the vehicle, and both sustained serious injuries. The passenger in seat 14, for example, sustained a first rib fracture, which is rare unless extreme force is applied to the upper torso.[6] The injuries to these passengers most likely resulted from contact with interior vehicle components, roof crush deformation into the survivable space of the vehicle compartment, or striking or being struck by other occupants during the rollover.

While restraint use in rollovers increases an occupant's chance of survival by preventing ejections, seat belts cannot prevent head contact with the adjacent roof or window.[7] The most frequent harmful contact points for nonejected occupants are the roof, pillars, rails, and headers (28.1 percent combined).[8] Therefore, vehicles need to be designed with impact protection to minimize injuries when an individual's head strikes the roof or windows.

The Henrietta and Randleman accident vans did not afford passengers the occupant-protected surfaces that passenger cars would have provided. The Safety Board concludes that during the rollover sequences in the Henrietta and Randleman accidents, passengers remaining inside the vehicles, as well as some ejected occupants, sustained injuries as a result of contact with interior surfaces, which were not required to be protected from occupant impact. Even if these accidents had occurred in vans manufactured today, those passengers who remained within the vehicles or struck surfaces before being ejected may still have sustained injuries, since parts of FMVSS 201 do not apply to 15-passenger vans. FMVSS 201 reduces fatal injuries because it mandates use of technologies such as side airbags, curtain airbags, or energy-absorbing materials. Passenger cars today incorporate these technologies, but occupants of 15-passenger vans do not benefit from such protection. The Safety Board believes that NHTSA should include 12- and 15-passenger vans in FMVSS 201, Section 6, "Requirements for Upper Interior Component Protection."

In the Henrietta accident, 7 of the 12 occupants were ejected from the van during the rollover, and 3 of the 7 ejected occupants sustained fatal injuries; none of the 3 belted occupants were ejected. In the Randleman accident, 4 of 14 occupants were ejected from the van during the rollover, 1 of whom sustained fatal injuries. None of the ejected Randleman occupants was wearing his or her seat belt, and at least five of the vehicle's lap belts were unusable.

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[6] David Viano, *Chest: Anatomy, Types and Mechanisms of Injury, Tolerance Criteria and Limits, and Injury Factors*, AAM and IRCOBI Biomechanics of Trauma Course Book, October 1997, p. 9.

[7] G.S. Bahling, R.T. Bundorf, G.S. Kaspzyk, E.A. Moffatt, K.O. Orlowski, and J.E. Stocke, "Rollover and Drop Tests – The Influence of Roof Strength on Injury Mechanics Using Belted Dummies," *Stapp Car Crash Conference 34th Proceedings, Orlando, Florida* (Warrendale, PA: Society of Automotive Engineers, 1990) 101-112.

[8] M.W. Arndt, G.A. Mowry, C.P. Dickerson, and S.M. Arndt.

When a passenger is ejected from a vehicle during an accident, he or she is exposed to rapid deceleration into injury-causing surfaces outside the vehicle. The orientation and speed of the passenger and the kind of surface struck are important factors in determining the nature and extent of the injuries sustained.

In both accidents, the ejected passengers' injuries were significantly more severe than those sustained by passengers who remained in the vehicles. Had the passengers been restrained, they may have benefited from the protection provided by the vehicle. The one exception was the Henrietta driver, whose injuries were due to roof crush and the loss of survivable space (see roof crush section below). One of the five passengers who remained within the vehicle (seat 11) in the Henrietta accident was restrained by a lap belt only and sustained injuries when her upper body struck the interior surfaces or when she contacted other unrestrained passengers during the accident sequence. A lap belt does not prevent movement of the upper body and acts as a fulcrum for flailing of the upper body and lower extremities.[9] However, the lap belt did prevent ejection, giving the passenger some protection as the van overturned and deformed. She did not experience the rapid deceleration into injury-causing surfaces inside or outside the vehicle that the ejected passengers did. Additionally, this passenger's injuries were not as severe as those of the unbelted passengers seated around her who also remained within the van, probably because she did not strike injury-causing surfaces within the vehicle or other passengers at as great a velocity. The simulation of lap-belted occupants within the van predicted a thorax injury for the simulated occupant in seat 15 during the first rollover sequence, further indicating that lap belts alone are not the most effective restraint. The accident simulation showed that during the first overturn, head, neck, and thorax injuries were not predicted for simulated occupants wearing lap/shoulder belts.

The Henrietta simulations showed that the amount of movement for unrestrained occupants was significantly greater than that of their restrained counterparts, resulting in far more serious predicted injuries and exposing them to the serious injuries associated with ejection. These predicted injuries occurred because the simulated occupants struck parts of the van during the accident sequence. Additionally, several simulated occupants in the unrestrained conditions were either partially or fully ejected, whereas neither of the restrained conditions resulted in predicted ejections during the first overturn. The Safety Board concludes that had the passengers in the accident vans been wearing lap/shoulder belts, their injuries may have been less severe because of fewer and less forceful impacts with nonoccupant-protected interior components and other occupants and because those who were ejected would have remained in the vehicle.

The Safety Board has advocated use of lap/shoulder belts for many years because they greatly reduce a passenger's risk of injury during a collision. Restrained by lap belts only, passengers sometimes sustain abdominal injuries as a result of pivoting about the lap belt or as the upper body flails about. NHTSA is developing a rulemaking to require that all center seats be equipped with lap/shoulder belts but has not disclosed whether the rulemaking will apply to 15-passenger vans. The Safety Board believes that NHTSA should include 12- and 15-passenger vans in its upcoming rulemaking that will require lap/shoulder belts at all center seats.

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[9] J.K. Mason, *The Pathology of Violent Injury* (London: Edward Arnold, 1978) 28.

One of the impact points between the Henrietta van and the ground during the rollover was the left front corner of the roof; the resulting roof crush at that location was so severe that it brought the roof in contact with the top of the driver's seatback. The driver was belted but sustained fatal head injuries as a result of the roof intrusion.

After the Henrietta accident, roof crush left 4 to 6 inches of space above each row of passenger seats; originally, the vehicle had 18 to 21 inches of space between the roof and the seats. Passengers probably sustained more serious injuries due to contact with the roof during the rollover and the resulting lack of interior space. The Safety Board concludes that roof crush to the Henrietta accident van contributed to the severity of the driver's injuries and diminished survivable space for the passengers. The roof in the Randleman accident did not sustain similar crush damage, probably due to the vehicle dynamics during the rollover sequence. The lack of roof crush damage may be one reason the injuries to those passengers who remained within the vehicle were less severe than in the case of the Henrietta accident. Other factors that may have contributed to the differing severity of injuries in these two accidents were the age of the occupants, the points of impact during the rolls, and the crash pulse experienced as the vehicles rolled over.

The Safety Board investigated another accident involving roof crush in a 15-passenger van that occurred on March 12, 2000, near San Antonio, Texas.[10] The driver, who had attempted to change lanes, left the roadway; when she tried to correct her path of travel, the vehicle rolled over, landed on a guardrail, and the rear of the vehicle straddled the guardrail on its roof. A lap/shoulder-belted 15-year-old female passenger was fatally injured; a lap/shoulder-belted 15-year-old male passenger and an unrestrained 15-year-old female passenger were seriously injured. All three were seated in the area of roof crush damage. The driver and the other 10 passengers, also belted, were outside the roof crush area and did not sustain serious injuries.

Studies have shown that the initial roof crush usually does not increase injuries to unrestrained occupants; passengers generally sustain serious injuries during contact with the roof and upper door window areas and when the head is adjacent to these areas during contact the ground.[11] However, the reduction in survivable space due to roof crush for those who remain within the vehicle can lead to injuries, particularly during subsequent rollovers. NHTSA, which evaluated 1988-1999 National Automotive Sampling System and Fatality Analysis Reporting System data, found that, on average, 26,376 occupants sustain serious or fatal injuries in light-vehicle rollovers annually. Roof crush intrusion is estimated to occur and possibly contribute to serious or fatal injury in about 26 percent of rollover crashes.[12] If the roof does not crush, belted occupants may benefit because they have less chance of contacting the roof and being subjected to the forces of roof-to-ground contact during the rollover sequence.[13]

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[10] Docket No. HWY-00-IH-032.

[11] K.F. Orlowski, R.T. Bundorf, and E.A. Moffatt, "Rollover Crash Tests—The Influence of Roof Strength on Injury Mechanics," SAE Paper 851734 (Warrendale, PA: Society of Automotive Engineers, 1985).

[12] National Highway Traffic Safety Administration, *Federal Motor Vehicle Safety Standards; Roof Crush Resistance*, NHTSA-1999-5572; Notice 2 (Washington, DC: NHTSA, October 2001).

[13] G.S. Bahling, R.T. Bundorf, G.S. Kaspzyk, E.A. Moffatt, K.O. Orlowski, and J.E. Stocke.

The purpose of FMVSS 216, "Roof Crush Resistance," which establishes strength requirements for passenger compartment roofs, is to reduce death and injury due to roof crush in rollover crashes. The standard applies only to passenger cars, multipurpose vehicles, and buses with a GVWR of 2,722 kg (6,000 pounds) or less. The GVWRs of 15-passenger vans exceed 8,500 pounds and, therefore, the vans are not required to meet FMVSS 216. Yet statistics show that 15-passenger vans are involved in a higher percentage of rollover accidents than are passenger cars and smaller vans. About 52 percent of the 15-passenger vans involved in fatal single-vehicle accidents experience a rollover, while 33 percent of passenger cars involved in such accidents do.[14]

NHTSA requested comments on its proposed amendments to FMVSS 216 on October 22, 2001. In the request, NHTSA stated that it is considering whether to extend FMVSS 216 to vehicles weighing up to 10,000 pounds, because the composition of the vehicle fleet has changed since the previous rulemaking was issued; in particular, the number of vehicles weighing more than 6,000 pounds has increased. The Safety Board believes that NHTSA should include 12- and 15-passenger vans in FMVSS 216, "Roof Crush Resistance," to minimize the extent to which survivable space is compromised in the event of a rollover accident.

None of the Henrietta or Randleman tires were inflated to the recommended pressure, even though the manufacturer-recommended pressures were specified on a label inside the driver's doorsill. The two front tires on the Henrietta van were inflated to 60 psi; the recommended pressure was 55 psi. The right rear tire on the Henrietta van was inflated to 58 psi; the preaccident pressure of the left rear tire could not be determined. However, given that three of the four tires on the Henrietta van were inflated to or near 60 psi and the words "reinflate to 60 psi" were written on the right front tire in yellow crayon, the left rear tire was also probably inflated to about 60 psi. Thus, the two rear tires were significantly under the manufacturer's recommended pressure of 80 psi. On the Randleman van, the left and right front tires were inflated to 62.5 psi and 60.5 psi, respectively, and the right rear tire was inflated to 60 psi. Again, the preaccident pressure on the left rear tire could not be determined but is likely to have been about 60 psi, as was true of the other three tires. The manufacturer-recommended tire pressures for the Randleman van were 50 psi for the front tires and 80 psi for the rear tires.

Overinflated tires can result in excessive tire wear to the center of the tread. Underinflation can shorten a tire's life and lead to premature tire failure. According to NHTSA, "When a tire is used while significantly underinflated, its sidewalls flex more and the air temperature inside the tire increases, increasing stress and the risk of failure. In addition, a significantly underinflated tire loses lateral traction, making handling more difficult."[15]

Underinflated tires are also able to carry less weight. In the case of the tires on the accident vehicles, when inflated to a pressure of 60 psi, each rear tire could carry almost 500 pounds less than it was designed to carry had it been inflated to the manufacturer's recommended pressure of 80 psi.

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[14] National Transportation Safety Board, *Evaluation of the Rollover Propensity of 15-passenger Vans*, Safety Report NTSB/SR-02/03 (Washington, DC: NTSB, 2002).

[15] Docket No. NHTSA 2000-8572.

Tires may be not be inflated to the proper pressure or an underrated tire may be placed on a vehicle because drivers are unaware of the proper pressure or load rating. As part of the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act of 2000, NHTSA issued a final rulemaking that requires manufacturers to place a prominent label stating the manufacturer-recommended tire pressures and tire load ratings on all vehicles weighing less than 10,000 pounds; the label is to be printed in yellow, red, black, and white and is to be affixed to the vehicle's B-pillar (the pillar behind the driver). By requiring placement of the label in a prominent location and providing consistent information, NHTSA seeks to ensure that consumers have the necessary information to maintain their tires.

As required by the TREAD Act, NHTSA also issued a rulemaking on June 5, 2002, directing that all vehicles be equipped with a tire pressure monitoring system that will alert the driver when a tire is significantly underinflated. During the period from November 1, 2003, through October 31, 2006, manufacturers must begin phasing in tire pressuring monitoring systems on their vehicles. To allow itself sufficient time to consider additional data on the effect and performance of tire pressure monitoring systems, NHTSA plans to defer a decision on long-term performance requirements for such systems on vehicles manufactured after October 31, 2006. It intends to publish these requirements by March 1, 2005, to give manufacturers sufficient lead time to comply with the final rule.

In its rulemaking, NHTSA requires manufacturers to employ a system that alerts drivers if the tire pressure of one or more tires is at least 25 or 30 percent[16] below the vehicle manufacturer's recommended cold inflation pressure for the tires. Based on this criterion, a tire pressure monitoring system on the accident vans would only have been required to warn the drivers when the pressure in the rear tires reached 25 or 30 percent of the recommended pressure of 80 psi, that is, 56 or 60 psi. At the time of the accidents, the rear tires of the vans were quite likely inflated to 58 or 60 psi and thus may not have been beyond the threshold that today's tire pressure monitoring systems were designed to detect. The Safety Board concludes that because low tire pressure in fully loaded 15-passenger vans contributes to vehicle instability, the current tire pressure monitoring standard of 25 or 30 percent below manufacturer's recommended pressure is insufficient to warn van drivers of potentially unsafe low pressures.

As was seen during the vehicle dynamics testing, the van became more unstable and difficult to control when the tire pressures were inflated to 58 psi for the rear tires. The test driver stated that in the lane change maneuver, the vehicle "wallowed" when the tire pressures were low. During the blowout testing, the driver reported that the van handled better when the tires were inflated to their recommended pressure and that tire pressure significantly affected in the handling of the van.

The Safety Board understands that tire pressure monitoring systems are a new technology and that detecting pressure differentials below 20 percent is currently difficult. However, as these accidents and the dynamic testing demonstrate, tire pressures that are 25 or 30 percent below the manufacturer's recommended pressure can have significant negative effects on the handling of 15-passenger vans. Therefore, the Safety Board recommends that NHTSA, in developing long-

[16] Manufacturers have two options, 25 percent or 30 percent, based on the capabilities of currently available technologies.

term performance requirements for tire pressure monitoring systems, adopt more stringent detection standards than 25 or 30 percent below manufacturer-recommended levels, since pressures at those levels can have an adverse effect on safe handling of vehicles, such as 12- and 15-passenger vans.

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

> In cooperation with the Federal Motor Carrier Safety Administration, revise its definitions of buses and commercial motor vehicles to apply consistently to 12- and 15-passenger vans, taking into account the unique operating characteristics and multiple functions of these vans. (H-03-12)
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> In cooperation with the American Driver and Traffic Safety Education Association, the National Safety Council, the American Automobile Association, General Motors Corporation, and Ford Motor Company, develop a training program that incorporates the skills required for safe operation of 12- and 15-passenger vans and addresses the consequences of unsafe operation, including, but not limited to, operating in a fully loaded condition, emergency braking, high-speed lane changes, tire blowouts, and tire pressure and maintenance. (H-03-13)
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> Include 12- and 15-passenger vans in Federal Motor Vehicle Safety Standard 201, Section 6, "Requirements for Upper Interior Component Protection." (H-03-14)
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> Include 12- and 15-passenger vans in your upcoming rulemaking that will require lap/shoulder belts at all center seats. (H-03-15)
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> Include 12- and 15-passenger vans in Federal Motor Vehicle Safety Standard 216, "Roof Crush Resistance," to minimize the extent to which survivable space is compromised in the event of a rollover accident. (H-03-16)
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> In developing long-term performance requirements for tire pressure monitoring systems, adopt more stringent detection standards than 25 or 30 percent below manufacturer-recommended levels, since pressures at those levels can have an adverse effect on the handling of vehicles, such as 12- and 15-passenger vans. (H-03-17)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, the 50 States and the District of Columbia, the American Driver and Traffic Safety Education Association, the American Automobile Association, the National Safety Council, the American Association of Motor Vehicle Administrators, Ford Motor Company, and General Motors Corporation.

Please refer to Safety Recommendations H-03-12 through -17 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman ENGLEMAN, Vice Chairman ROSENKER, and Members GOGLIA, CARMODY, and HEALING concurred in these recommendations.

Original Signed

By: Ellen G. Engleman
Chairman