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Research Note

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12 & 15 Passenger Vans Tire Pressure Study: Preliminary Results

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Summary

The National Highway Traffic Safety Administration's (NHTSA) National Center for Statistics and Analysis (NCSA) conducted a 15-passenger van tire pressure study. The purpose of the study was to determine the extent of underinflation and observe the tire condition in 12- and 15-passenger van (and vans with similar body styles) tires. The following topics are covered in this research note: sampling, data collection methodology, analysis and results.

Background

Crashes involving 12-and 15-passenger vans have raised concern about the safety of these vehicles among the public and NHTSA. In March 2003, Senator Olympia Snowe introduced the Passenger Van Safety Act of 2003, in the Senate. This bill, S.717, called on NHTSA to develop a dynamic test to assess the rollover risk of 15-passenger vans for a consumer information program; test 15-passenger vans at different load levels as part of the rollover resistance program of the NHTSA's New Car Assessment Program (NCAP); and test and evaluate the stability control and other technological systems that may assist drivers in controlling 15-passenger vans under conditions that may cause vehicle rollover. A similar bill was introduced by Representative Mark Udall in the House, H.R. 164[1].

The National Transportation Safety Board (NTSB) has also issued a series of recommendations related to 15-passenger van safety. NHTSA developed a 15-Passenger Van Action Plan that addresses these recommendations. As part of its 15-Passenger Van Action Plan, the agency decided to study the extent of underinflation in 12- and 15-passenger vans through the infrastructure of NCSA's National Automotive Sampling System (NASS).

In support of rulemaking activities mandated by Section 13 of the Transportation Recall Enhancement, Accountability, and Documentation Act, the NCSA conducted the Tire Pressure Special Study (TPSS) in February 2001 and the Tire Pressure Monitoring System Study (TPMSS) in 2003. The TPSS was designed to assess to what extent passenger vehicle operators are aware of the recommended tire pressures for their vehicles, the frequency and the means they use to measure their tire pressure, and whether and how significantly the actual measured tire pressure deviated from the manufacturer's recommended tire pressure. The TPMSS was designed to compare the extent of underinflation of vehicles equipped with TPMS to vehicles not equipped. The current Van Tire Pressure Study (VTPS) was designed to collect similar information to that collected in TPSS, but for 12- and 15-passenger vans (and vans with similar body styles).

Please refer to previous publications[2] for results from both of these studies and analyses of that data to estimate the effectiveness of indirect and direct TPMS.

The TPSS results showed that 27% of passenger cars in the United States had at least one significantly underinflated tire (for the purposes of this research note, "significant underinflation" is defined as 25% or more below placard). The data also showed that less than 25% of the study participants were aware of where to find the recommended tire pressure for their vehicles. NHTSA used this data in support of its rulemaking for Federal Motor Vehicle Safety Standard (FMVSS) No. 138, Tire Pressure Monitoring Systems.

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[1] NHTSA Action Plan for 15-Passenger Van Safety, November 2004 Update, http://www.nhtsa.dot.gov/cars/problems/studies/15PassVans/15passvan.html
[2] Research Notes and Reports from NCSA's Tire Pressure Special Study (DOT HS 809 315, DOT HS 809 316, DOT HS 809 317, DOT HS 809 359, and DOT HS 809 366) can be found at http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/AvailInf.html The analysis conducted on TPSS data to evaluate Tire Pressure Monitoring Systems was published at ESV 2003 (Paper Number 259) and can be found at http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/ESV2003.html

Sample Design

The VTPS was designed as a convenience sample to capture a good representation of multiple regions, climates, and demographics. Data was collected from 16 locations throughout the United States. These locations were distributed among urban, suburban, and rural locations and were located in the east, midwest, southwest, and western United States. Estimates of the number of registered vans in specific targeted states were found using RL Polk (a private company that provides automotive data and market information) registration data.

The VTPS sample was selected from several different types of organizations. The study targeted some locations with only one vehicle and some locations with a fleet of vehicles. Manufacturers of the vans included Ford, General Motors, and Dodge.

Table 1 - Distribution of Vehicle Organizations Sampled in the VTPS

Organization Type	Sample
Colleges and Universities	13%
Churches and Community Groups	24%
Camps and Daycares	11%
Subtotal	**48%**
Vanpools	11%
Transportation and Limo Services	13%
Subtotal	**24%**
Local Governments	7%
Military	1%
Subtotal	**8%**
Hotels	5%
Subtotal	**5%**
Other (individuals, etc.)	14%
Subtotal	**14%**
Total*	**99%**

*Total not 100% due to rounding.

Source: National Center for Statistics and Analysis, National Highway Traffic Safety Administration

The agency chose to focus on moderately to fully-loaded vehicles and those that are used to transport children and young adults. Church and community groups, universities and colleges, day care facilities, and camps made up 48% of the sample, see Table 1 (vans were not loaded when tire pressure measurements were taken). The distribution of vehicles shown in Table 1 is from a convenience sample and does not represent the true proportions of these vehicles in the United States. Extents of underinflation were analyzed and the results are shown in this research note. Data collection took place in spring and early summer of 2004. [Note: One would expect to find more underinflation during the cold winter months due to the temperature-related drop in tire pressure.]

The total number of vehicle inspections completed was 1,242, with 937 15-passenger vans.

Data Collection Methodology

Field data collection was conducted through the infrastructure of NCSA's National Automotive Sampling System (NASS).

Researchers visited organizations on weekdays during business hours. If a researcher contacted the owner of a vehicle by phone before an inspection, the researcher explained the study was related to van maintenance or "safety systems." In order to keep the study from being biased, "tire" and "tire pressure" were not mentioned in the phone contacts with the potential participants.

The pilot phase of the data collection was conducted from April 26, 2004 through May 14, 2004. Full-scale data collection was conducted from May 17, 2004 through June 25, 2004. The vans inspected in the pilot phase were included in the final VTPS data.Vehicles surveyed included 15-passenger vans, 12-passenger vans, 14-passenger vans, and cargo vans with similar Gross Vehicle Weight Ratings (GVWR) and body styles.

Nine anecdotal interviews were conducted to get an idea of the tire maintenance, driver training, and safety awareness of the managers of a subsample of our vehicles. The interviewees included vehicle fleet managers from 2 churches, 2 colleges, a community organization, a hotel, a daycare, a transportation company, and a vanpool company.

The **Vehicle Inspection Form**, which was completed for each observation, contained vehicle profile information such as make, model, and model year. It also contained information documented from the vehicle's placard regarding recommended tire size, recommended inflation pressure, and the Gross Axle Weight Ratings.

The **Tire Inspection Form**, which was also completed for each tire (except unmounted spare tires), contained tire size and measurement information, and a variable to document visible evidence of tire aging and/or damage (loose tread, sidewall rot, etc.).

At the conclusion of each observation, the participant was given a "courtesy card" which contained the inflation pressure measured on each tire, the vehicle manufacturer's recommended cold tire pressure, and several tire safety tips.

Special Equipment

Special equipment used for data collection included a pyrometer to measure tire sidewall temperature and ambient air temperature, an air pressure gauge, and a tread depth indicator to measure tread depth.

Analysis

Good tire care improves vehicle handling[3] as well as fuel efficiency and tire life. Proper tire maintenance can prevent such events as tread separations and tire blowouts which may cause loss of control of a vehicle, when not handled properly, and result in a rollover. Low tire pressure can also increase stopping distances and the chance of hydroplaning on wet surfaces.

[3] "Testing the Effects of TPMS Minimum Activation Pressure on the Handling and Rollover Resistance of a 15-Passenger Van", Garrott and Forkenbrock, DOT HS 809 701, June 2004

Data were collected on over 1,200 vehicles during the VTPS. An analysis was performed looking at the percentage of the vans that had at least one significantly underinflated (25% or more from placard pressure) tire.

The variables of interest in determining the underinflation are the recommended pressures for each vehicle and the measured pressures for each vehicle. These were compared to determine the extent of misinflation (misinflation is used to characterize the extent of underinflation and/or overinflation) for each tire and then for each vehicle as a whole. The data were used to determine both underinflation and misinflation (overinflation was included because indirect tire pressure monitoring systems do not distinguish between over and underinflation).

Results

For the purposes of this research note, underinflation was determined by comparing measured pressures to the vehicle manufacturer's recommended pressures. It should be noted that the vacated FMVSS No. 138, the regulation that required TPMS, listed minimum activation pressures (MAP) for the warning lamp to illuminate. For Load Range E rated tires, this MAP value was 46 psi (320 kPa). The VTPS found that 16% of the 15-passenger vans in the study had recommended pressures below this MAP value. Nonetheless, underinflation was determined relative to the recommended pressure.

VTPS found that 56% of all vans had at least one tire underinflated by 25% or more, see Table 2. That is more than double the percentage of passenger cars we found in the TPSS (TPSS is a national estimate, while VTPS is a convenience sample, so true comparisons are not possible).

Table 2 - Percent of Vehicles in the VTPS and TPSS with at Least One Tire Improperly Inflated

Vehicle	Misinflated by 25% or More	Underinflated by 25% or More
15-Passenger Vans	74%	57%
Other Vans	68%	54%
All Vans	72%	56%
Light Trucks from TPSS	39%	29%
Passenger Cars from TPSS	39%	27%

Source: National Center for Statistics and Analysis, National Highway Traffic Safety Administration

For all tables in this research note, "Other Vans" include 12-passenger, 14-passenger, and cargo vans. This study also compared the percentage of vans that had all four tires significantly underinflated to light trucks and passenger cars found in the TPSS. Table 3 shows that 6% of vans (a rate double that of passenger cars) had all four tires underinflated by 25% or more.

Average underinflation was calculated by finding the worst underinflated tire for each vehicle and then taking the average of all vehicles. The average underinflation of vans was 29% under the recommended pressure; vehicles with overinflated tires were included as vehicles with zero underinflation for this calculation. The average misinflation (also using the worst misinflated tire per vehicle) of vans was 35% from the placard pressure.

Table 3 - Percent of Vehicles in the VTPS and TPSS with All Four Tires Improperly Inflated

Vehicle	Misinflated by 25% or More	Underinflated by 25% or More
15-Passenger Vans	7%	4%
Other Vans	11%	9%
All Vans	8%	6%
Light Trucks from TPSS	7%	4%
Passenger Cars from TPSS	6%	3%

Source: National Center for Statistics and Analysis, National Highway Traffic Safety Administration

Because it was learned from all three of our tire studies that people use the pressure indicated on the tire sidewall as a guide when checking their tire pressure, the study also analyzed overinflation. It was found that 22% of vans had at least one tire overinflated by at least 25% of the recommended pressure. This can be explained by the large difference between the placard recommended front pressure (typically 45 or 55 psi) and the maximum pressure listed on the tire sidewall (80 psi). Two out of 9 interviewees said that they looked at the sidewall to determine inflation pressure. The rear recommended pressures were typically 80 psi, so overinflation due to referencing the tire sidewall was not seen here. See Table 4 for results.

Not only were vehicles overinflated when compared to recommended pressure, but many were inflated past the maximum pressure recommended on the tire sidewall. Seven percent of the vans had at least one tire inflated past the maximum pressure on the tire sidewall. 31 vehicles had at least one tire that was more than 5% over maximum pressure; 14 vehicles were more than 10% over maximum pressure, and 4 vehicles were more than 20% over the maximum pressure, which is more than 16 psi over the maximum pressure allowed.

Figure 1 - All Vans Percent Distribution of Misinflation

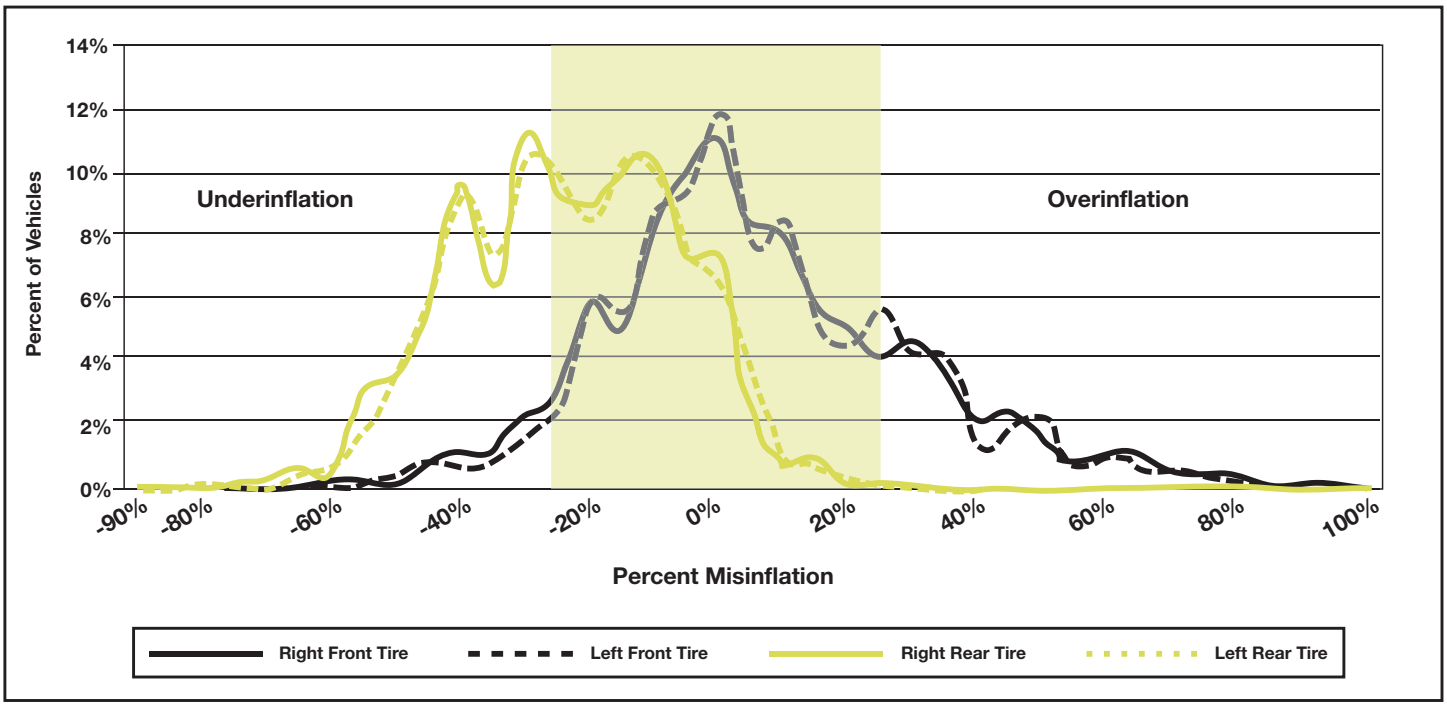


Table 4 - Percent of Vehicles in the VTPS with at Least One Tire Overinflated

Vehicle	Overinflated by 25% or More	Overinflated Past Max Pressure
15-Passenger Vans	23%	6%
Other Vans	18%	8%
All Vans	22%	7%

Source: National Center for Statistics and Analysis, National Highway Traffic Safety Administration

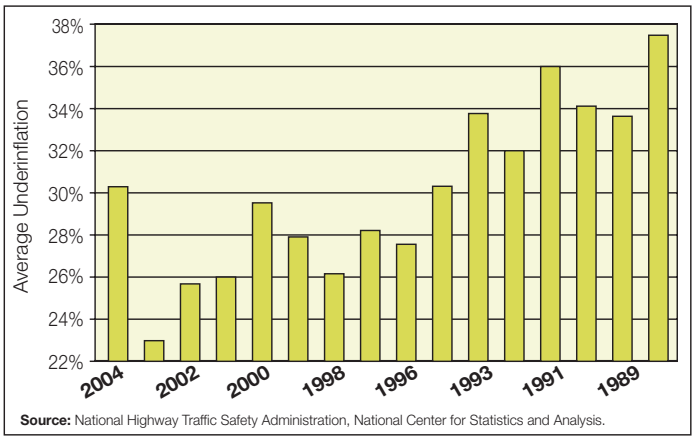
So far, the analysis has shown the percentage of vehicles with at least one underinflated tire, one overinflated tire, or one-misinflated tire. It is interesting to note that 6% of the vans had **both** significant underinflation and significant overinflation in the same vehicle.

Because vehicle handling characteristics differ depending not only on inflation pressures, but the location of misinflated tires, the figure shows the distribution of misinflation by tire location.

Figure 1 shows that underinflation is more of a problem with tires on the rear axle. 50% of rear tires were underinflated past the 25% threshold while between 8 and 9% of front tires were underinflated past the 25% threshold. Keep in mind that the typical recommended pressure for the rear tires is 80 psi, while for the front they are between 45 and 55 psi.

In addition to tire pressure, the age and wear of a tire also play a part in vehicle handling. In the TPSS, it was found that underinflation was more prevalent in older vehicles. This study produced a similar result.

Figure 2 - Average Underinflation by Model Year



The study found that 4% of vans had at least one tire with visible evidence of aging and/or damage. The study also examined the tires' tread depth and found that 6% of the 15-passenger vans had at least one bald tire (2/32nds of an inch or less). 18% of the 15-passenger vans had 4/32nds of an inch or less of tread. See Table 5 for these results. Worn tread has been linked with increasing underinflation[2].

Table 5 - Percent of Vehicles in the VTPS with at Least One Tire Below Certain Tread Depth

Vehicle	Tread Depth of 2/32nds of an inch or less (% of vehicles)	Tread Depth of 4/32nds of an inch or less (% of vehicles)
15-Passenger Vans	6%	18%
Other Vans	5%	17%
All Vans	5%	18%
Passenger Cars from TPSS	9%	34%

Source: National Center for Statistics and Analysis, National Highway Traffic Safety Administration

Conclusion

The data from this study show that a very high percentage of large vans have significantly underinflated tires, a much larger percentage than passenger cars. This poor tire maintenance in combination with the conditions under which these vehicles are driven (i.e. transporting groups of children, inexperienced drivers, etc.) suggest a need for better van tire safety awareness. Six of the 9 interviewees were familiar with the NHTSA advisories on 15-passenger vans. Research into potential countermeasures to improve van safety might include improving driver training, equipping vehicles with a tire gauge, requiring passengers to wear safety belts, and removing the last row of seats.

Other possible countermeasures to poor tire pressure might include the integration of tire pressure monitoring systems into 12- and 15-passenger vans. Regardless of the presence of TPMS, public awareness of proper tire maintenance is key to the improvement of tire condition. Each tire, including the spare, should be checked monthly when cold and set to the recommended inflation pressure as specified on the vehicle placard and in the owner's manual.

For additional copies of this research note, please call (202)934-8517 or fax your request to (202)366-3189. For questions regarding the data reported in this research, contact Eric Ferguson [202-366-9430] of the National Center for Statistics and Analysis. This research note and other general information on highway traffic safety may be accessed by internet users at: http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/.