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Research Note

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Tire Pressure Special Study
Tread Depth Analysis

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Nine percent of vehicles had at least one tire that was bald, with a measured tread depth of 2/32nds of an inch or less.

Along with other findings, this is presented in "Tire Pressure Special Study: Tread Depth Analysis", the fourth in a series of research notes containing results from the Tire Pressure Special Study (TPSS) conducted in 2001 by the National Center for Statistics and Analysis of the National Highway Traffic Safety Administration (NHTSA). The focus of this research note is on results from the tire measurements. Previous topics of TPSS research notes included the study methodology, the results from the driver interviews, and the vehicle observation data.

Background

In 2000, Congress passed the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act. Section 13 of this act directed the Department of Transportation to complete a rulemaking within one year, requiring implementation of a warning system in new motor vehicles indicating significantly under-inflated tires.

In response to Section 13 of the TREAD Act, NHTSA's National Center for Statistics and Analysis (NCSA) conducted the TPSS. 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 how significantly actual measured tire pressure differed from the manufacturer's recommended tire pressure. The data collected are being used to support various rulemaking actions including an upgrade to the placement and contents of the vehicle placard and the development of an onboard tire pressure monitoring system.

Data Collection Methodology

Field data collection was conducted by NCSA through the infrastructure of the National Automotive Sampling System Crashworthiness Data System (NASS CDS). The NASS CDS consists of teams of researchers located at Primary Sampling Units (PSUs) throughout the United States. The PSUs are located in urban, suburban, and rural settings with nationally representative populations.

The population surveyed by the researchers in the TPSS represents a sample frame consisting of drivers who used gas stations to fill up their vehicles between the hours of 8:00 am and 5:00 pm. Data collection was conducted from February 1, 2001, through February 14, 2001.

Vehicles surveyed included passenger cars and light trucks. NHTSA classifies light trucks as sport utility vehicles, pickup trucks and vans with a Gross Vehicle Weight Rating of less than 10,000 pounds. A total of 11,530 vehicles were included in the survey of which 6,442 were passenger cars, 1,874 were sport

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utility vehicles, 1,376 were vans, and 1,838 were pickup trucks. The distribution of vehicles was consistent with national estimates of vehicle registration.

Data collected during the TPSS included daily site information, driver interview and profile data, vehicle profile data, and tire data for all four tires on the vehicle. The vehicle information collected included vehicle profile data and the manufacturer's recommended tire pressures. Tire information collected included tire profile data as well as air pressure, sidewall temperature, and tread depth measurements.

The researchers were given forms on which to record the vehicle and tire measurements, as well as detailed instructions on how to proceed in order to promote consistency. The following was excerpted from the instruction document:

"The Measured Minimum Tire Tread Depth is to be measured using the supplied tire tread depth indicator. The measurement should be taken on the shallowest groove of the tread. Be careful not to measure on a wear bar indicator. The measurement is to be documented to the nearest thirty-second of an inch (X/32")."

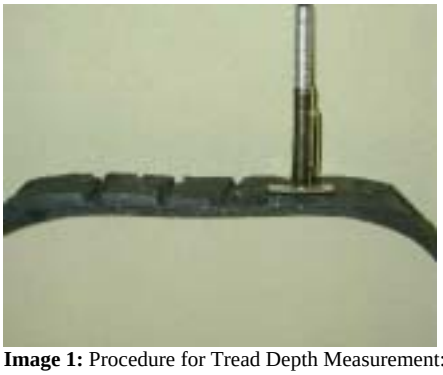


Image 1: Procedure for Tread Depth Measurement: "on the shallowest groove."

"The tire tread depth indicator is read by placing the indicator over the top of a groove and pressing down on the measurement rod until contact is made with the bottom of the groove. Read the indicator by rotating it until a line on the measuerment rod is flush with the base."

A complete description of the data collection process was presented in the previous research note "Tire Pressure Special Study: Methodology."

Analysis of the Vehicle Observations

Tread depth data were analyzed only for passenger cars with P-metric tires to reduce variation in initial tread depths. P-metric tires are regular passenger car tires and the labeling has the format "P205/75R14." Initial tread depths can vary from 8-11/32nds of an inch, while light truck tires have a much wider range.

Included in this analysis were the 6,240 vehicles that were passenger cars with P-metric tires and had a measured tread depth for each of the vehicle's four tires.

The data were analyzed by first creating a frequency distribution of the measured tread depths. Then, average tread depths were calculated for each tire and for each vehicle and those distributions graphed. Minimum tread depths were also determined for each vehicle and then for each axle and graphed.

For the purpose of this anaylsis, tires with 2/32nds of an inch or less tread depth were considered "bald" tires.

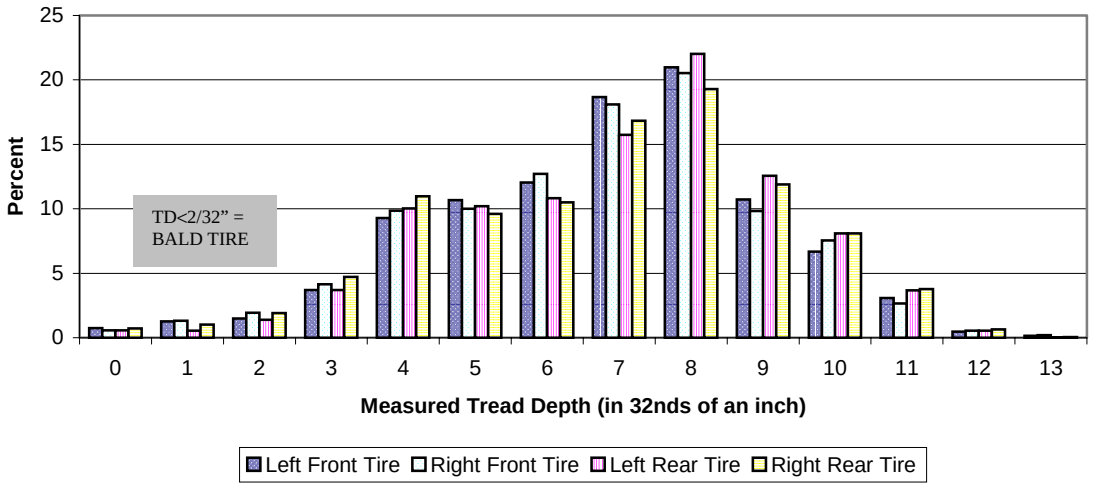
Estimates and Sampling Error

The observations were weighted to represent national estimates. Because estimates from the TPSS are based on a sample, they are statistically weighted according to the sample design and are subject to sampling error.

Results of the Tire Measurements

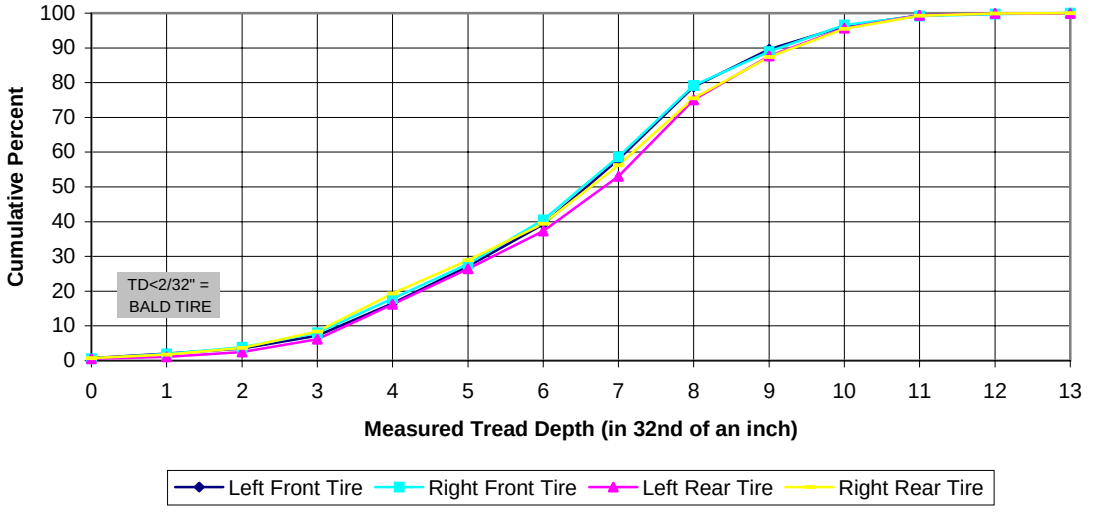
Figure 1 shows the frequency distribution of the measured tread depth for each tire. Figure 2 shows the cumulative percent of the measured pressure at each tire.

Figure 1
Percent Distribution of the Measured Tread Depth for Each Tire



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 2
Cumulative Percent of the Measured Tread Depth for Each Tire



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 1 shows that the average tread depth for each tire was around 7/32nds of an inch. As can be seen from Figure 2, above, and from Table 2, below, for each tire position except the left rear, almost 4% of vehicles had a bald tire at that position. Only 3% of vehicles had a bald tire in the left rear tire position.

Table 1
Average Tread Depth for Each Tire
(Estimates in Thirty-seconds of an Inch)

Tread	Left Front	Right Front	Left Rear	Right Rear
	6.8	6.8	7.0	6.8

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 2
Percent Distribution of the Measured Tread Depth for Each Tire

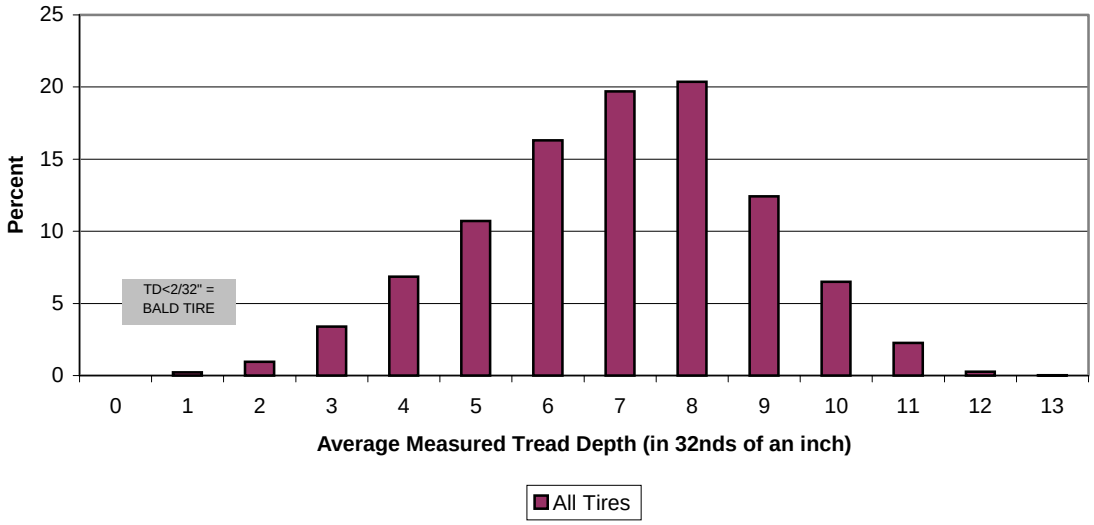
Tread (X/32")	Left Front		Right Front		Left Rear		Right Rear	
	%	Cum%	%	Cum%	%	Cum%	%	Cum%
0	0.8	0.8	0.6	0.6	0.6	0.6	0.7	0.7
1	1.3	2.0	1.3	1.9	0.6	1.1	1.0	1.7
2	1.5	3.5	1.9	3.8	1.4	2.5	1.9	3.7
3	3.7	7.2	4.1	8.0	3.7	6.2	4.7	8.4
4	9.3	16.5	9.9	17.8	10.0	16.3	11.0	19.3
5	10.7	27.2	10.0	27.8	10.2	26.4	9.6	28.9
6	12.0	39.2	12.7	40.5	10.8	37.3	10.5	39.4
7	18.7	57.9	18.1	58.7	15.7	53.0	16.8	56.3
8	21.0	78.9	20.5	79.2	22.0	75.0	19.3	75.5
9	10.7	89.6	9.8	89.0	12.6	87.6	11.9	87.4
10	6.7	96.3	7.6	96.5	8.1	95.7	8.1	95.5
11	3.1	99.3	2.7	99.2	3.7	99.4	3.8	99.3
12	0.5	99.8	0.6	99.8	0.5	99.9	0.6	99.9
13	0.2	100.0	0.2	100.0	0.0	99.9	0.0	100.0

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

The average tread depth for each vehicle was calculated. The results are shown in Figures 3 and 4. Figure 3 shows the frequency distribution of the average of the measured tread depths of the four tires for each vehicle.

Figure 4 shows the percent distribution of the average tread depth for each vehicle. Table 3 shows that less than 1.5% of vehicles had an average tread depth of 2/32nds of an inch or below.

Figure 3
Percent Distribution
of the Average Measured Tread Depth for Each Vehicle



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 4
Cumulative Percent
of the Average Measured Tread Depth for Each Vehicle

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

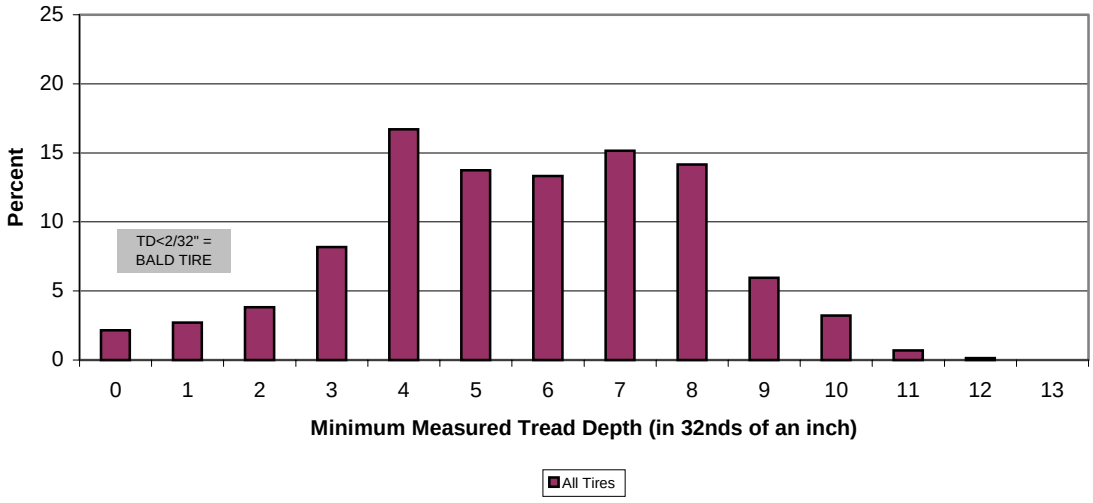
Table 3 Percent of the Average Measured Tread Depth for Each Vehicle		
Average Tread (X/32")	**Percent**	**Cumulative Percent**
0	0.0	0.0
1	0.2	0.2
2	0.9	1.2
3	3.4	4.6
4	6.9	11.4
5	10.7	22.1
6	16.3	38.4
7	19.7	58.1
8	20.3	78.5
9	12.4	90.9
10	6.5	97.4
11	2.3	99.7
12	0.3	100.0
13	0.0	100.0

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

For each vehicle, the tire with the lowest measured tread depth was determined.

Figure 5 shows the frequency distribution of the minimum measured tread depth for each vehicle.

Figure 5
Percent Distribution
of the Minimum Measured Tread Depth for Each Vehicle



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 6 and Table 4, below, show that almost **9% of vehicles had at least one tire that was bald**, with a measured tread depth of 2/32nds of an inch or less.

Figure 6
Cumulative Percent
of the Minimum Measured Tread Depth for Each Vehicle

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Table 4
Percent of the Minimum Measured Tread Depth for Each Vehicle

Minimum Tread	Both Axles%	Cum%	Front Axle%	Cum%	Rear Axle%	Cum%
0	2.2	2.2	1.1	1.1	1.0	1.0
1	2.7	4.9	1.9	3.0	1.4	2.4
2	3.8	8.7	2.3	5.3	2.4	4.9
3	8.2	16.9	5.4	10.7	6.0	10.8
4	16.7	33.6	12.3	23.0	13.0	23.9
5	13.7	47.3	11.7	34.7	11.0	34.9
6	13.3	60.7	13.4	48.1	11.7	46.6
7	15.2	75.8	17.5	65.6	16.3	62.8
8	14.2	90.0	18.3	83.9	18.2	81.1
9	5.9	95.9	8.8	92.7	10.0	91.1
10	3.2	99.1	5.3	98.0	6.6	97.7
11	0.7	99.8	1.6	99.6	1.9	99.6
12	0.1	100.0	0.2	99.8	0.4	100.0
13	0.0	100.0	0.2	100.0	0.0	100.0

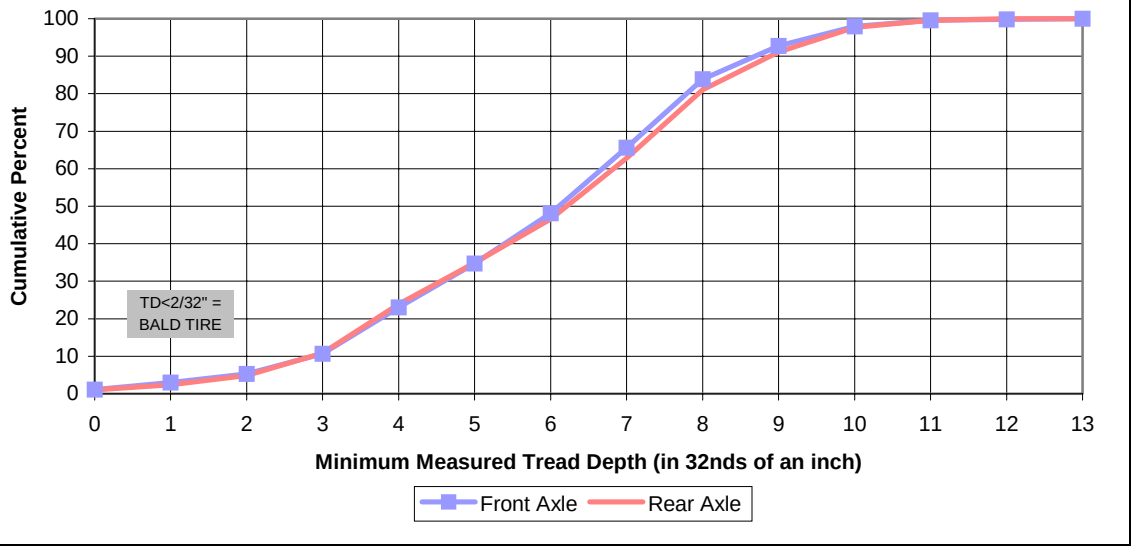
Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 7 shows the frequency distribution of the minimum measured tread depth for the front axle and the rear axle of each vehicle.

Figure 7
Percent Distribution of the Minimum Measured Tread Depth of Each Axle for Each Vehicle

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 8
Cumulative Percent of the Minimum Measured Tread Depth of Each Axle for Each Vehicle



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Analysis of Tire Pressure Relative to Tread Depth

Tread Depth was analyzed for its relationship with under-inflation. Unweighted data were used in this analysis; thus the percentages do not necessarily represent national estimates. The sample size of over 6,000 vehicles was sufficiently large to show a correlation between tread depth and under-inflation.

Table 5 shows the percentage of tires that deviated from the manufacturer's recommended cold tire inflation pressure (Delta P) by 8 psi or more by the tread depth of the tire. Categories were broken down by tread depth and extent of under-inflation. With under-inflation, there was a correlation between the tread depth of the tire and the amount of deviation in pressure, with balder tires being more likely to be under-inflated than tires with deeper tread. For example, bald left rear tires are 1.5 times more likely to be under-inflated than left rear tires with deeper tread. Bald right front tires are 1.8 times more likely to be under-inflated than right front tires with deeper tread. These calculations were made from the following table using the ratios of (TD ≤ 2 and DP ≥ 8) to (TD > 4 and DP ≥ 8).

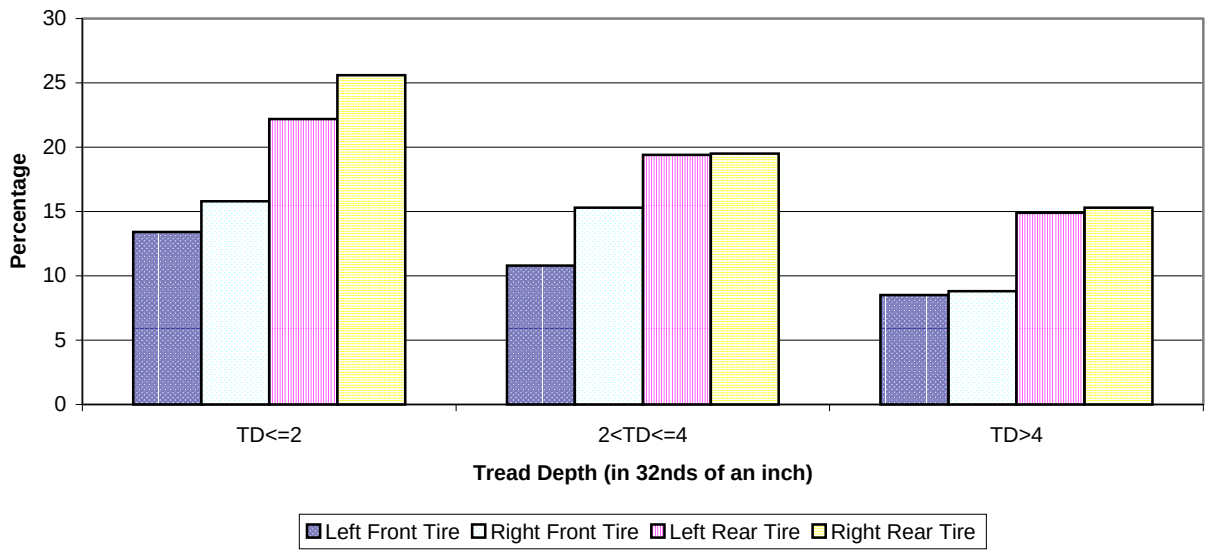
Table 5
Percentage of Tires Deviating from the Manufacturer's Recommended Pressure (Delta P) by Tire Position, Tread Depth and Delta P (Δ) (Under-inflation Only)

Tire Position	Tread Depth (X/32")					
	Tread Depth ≤ 2		2 < Tread Depth ≤ 4		Tread Depth > 4	
	Delta P in psi		Delta P in psi		Delta P in psi	
	Δ ≥ 8	Δ < 8	Δ ≥ 8	Δ < 8	Δ ≥ 8	Δ < 8
LF	13.4	86.6	10.8	89.2	8.5	91.5
RF	15.8	84.2	15.3	84.7	8.8	91.2
LR	22.2	77.8	19.4	80.6	14.9	85.1
RR	25.6	74.4	19.5	80.5	15.3	84.7

Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

Figure 9 is a graphical representation of Table 5 and shows that for vehicles that have tires with shallower tread depths, the percentage of those tires also being under-inflated by 8psi or more was higher than for vehicles that have tires with deeper tread depths. The figure also shows that rear tires with any kind of tread depth were more likely to be under-inflated than front tires.

Figure 9
For the Given Ranges of Tread Depth,
the Percentage of Tires Underinflated by 8psi or More (by Tire)



Source: National Center for Statistics and Analysis, NHTSA, NASS 2001 Tire Pressure Special Study.

For additional copies of this research note, please call (202)366-4198 or fax your request to (202)366-3189. For questions regarding the data reported in this research, contact Kristin Thiriez [202-366-2837] 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/.

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