



## Tire Pressure Special Study: Methodology

“Tire Pressure Special Study: Methodology” is the first in a series of research notes pertaining to the Tire Pressure Special Study (TPSS) conducted by the National Highway Traffic Safety Administration (NHTSA). Upcoming research notes will highlight driver profile data, interview data, vehicle profile data and tire data.

This research note describes the methodology NHTSA’s National Center for Statistics and Analysis used in the TPSS including sampling design, data collection methodology, and estimation procedures.

### Background

In 2000, Congress passed the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act. Section 12 of this act directed the Department of Transportation to complete a rulemaking within one year. This rulemaking requires implementation of a warning system in new motor vehicles indicating under-inflated tires.

In response to Section 12 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 the actual measured tire pressure differed from the manufacturer’s recommended tire pressure. The data collected will be used in support of various rulemaking actions. These include an upgrade to the placement and

contents of the vehicle placard and the development of an onboard tire pressure measuring sensor.

### Sample Design

Field data collection was conducted through the infrastructure of the National Automotive Sampling System Crashworthiness Data System (NASS CDS). The NASS CDS consists of teams of researchers located at 24 Primary Sampling Units (PSUs) throughout the United States. The PSUs are a probability sample selected from a frame of all geographic areas in the continental United States. The PSUs were selected based on the number of motor vehicle traffic crashes occurring within their regions.

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 1st through February 14th, 2001.

The sampling stages for the TPSS are as follows:

- NASS CDS PSUs, a sample of 24 PSUs selected from a total of 1,195 PSUs.
- Within each sampled PSU, eligible Zipcodes (at least 2 gas stations with more than one gas island) were listed

for the survey and a sample of seven Zipcodes was selected.

- Within each sampled Zipcode, eligible gas stations (more than one island) were listed and a sample of two gas stations was selected.
- The fourteen selected gas stations within a Zipcode were assigned to one of the 14 days of the data collection period. At each sampled gas station, the NASS CDS researchers were instructed to collect data from approximately 10 vehicles in each of the vehicle body types (passenger cars, sport utility vehicles, vans, and pickup trucks). In order to get an estimate of the total number of vehicles coming into the gas station, vehicle body type count tallies were collected for 15 minutes every two hours during data collection.

Based on experience with previous surveys, a response rate of over 90 percent was expected.

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

### Estimation

To simplify and unify estimating procedures, weights were produced for all sampled vehicles accounting for the sample design. The base weight, which is the reciprocal of the probability of the selection of the PSUs, the Zipcodes within the PSUs, and the gas stations within the Zipcodes reflected the sampling stages. Hence, the base weight for a selected gas station,  $BWT_G$ , is given by:

$$BWT_G = \frac{1}{P_{PSU} \times P_{Zip} \times P_G}$$

where

$P_{PSU}$  = Probability of selection of PSU;

$P_{Zip}$  = Probability of selection of the Zipcode within the PSU; and

$P_G$  = Probability of selection of the gas station within the Zipcode and PSU.

In order to get unbiased estimates for driver characteristics in the population, a base weight,  $BWT_{vi}$ , was defined for each vehicle sampled in each of the four vehicle categories and was given by:

$$BWT_{vi} = \frac{BWT_G \times E(N_i)}{n_i}$$

where

$E(N_i)$  = the expected number of vehicles in the  $i$ -th vehicle category coming to the gas station during the entire survey period (calculated using the vehicle tallies from the Daily Site Information Forms);

$n_i$  = the sample of vehicles selected; and

$i$  = represents each of the four vehicle body type categories.

### Data Collection Methodology

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 Daily Site Information Form

contained information regarding the number of vehicles by body type category coming into the gas station for refueling during each day. The vehicles were observed for fifteen-minute time periods every two hours. This

included a total count for each body type category as well as a total count of all vehicles. The Daily Site Information Form also contained information regarding the presence and operation of a site's air pressure pump available for customer use. Pump data collected included availability, use fee, functionality, air pressure gauge presence, and accuracy.

The **Driver Interview Form**, which was completed for each observation, contained information regarding the extent to which the driver was aware of the recommended air pressure for his/her vehicle's tires, if he/she monitors the air pressure in the tires, and how he/she monitors the air pressure. If the driver was neither the vehicle's primary driver nor responsible for the vehicle's maintenance, then none of the tire pressure knowledge or maintenance questions were asked. The form also contained driver profile data documented by the researcher.

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 air pressure, and the Gross Axle Weight Rating.

The **Tire Inspection Form**, which was also completed for each observation, contained tire size and measurement information. In addition, the form contained the ambient air temperature at the time of the observation.

### **Data Collection Process**

Cooperation of the owners of the gas stations at the different data collection sites was established prior to the commencement of the study. Each of the selected gas stations within a PSU was assigned to one of the 14 days over which the data were collected. Observations were collected between the hours of 8 am and 5 pm. Five fifteen-minute breaks were taken. The first was taken at 8 am, the other breaks were taken at 10 am, 12 pm, 2 pm, and 4 pm. During these breaks, researchers counted the vehicles coming into the gas station. The counts were broken up into four categories based upon

body type category (e.g. passenger cars, utility vehicles, vans, and pickup trucks). The counts were recorded on the the Daily Site Information Form. Only vehicles falling within the four body type categories were included in the study. In addition, of those body types, only vehicles entering the refueling stations for actual refueling were included in the study.

Each data collection team consisted of two to three researchers. This team size was chosen in order to expedite data collection and minimize the impact on the gas station. Each observation took approximately six to eight minutes. One researcher was tasked to garner cooperation with the participant, and to collect data on the Interview Form and the Vehicle Inspection Form. The second (and third if present) researcher collected data on the Tire Inspection Form. At the conclusion of each observation, the participant was given a Courtesy Card which contained the air 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 to measure tire pressure, and a tread depth indicator to measure tread depth. The only limitation to the equipment regarded the air pressure gauge. The gauge only measured pressures between 0 and 60 psi. Any pressures measuring 60 or above were coded as "60+."

The pyrometers used in the study were checked against each other prior to each data collection day. If the pyrometers did not measure the same ambient air temperature (within a tolerance of one degree), the researchers noted the discrepancy on the Daily Site Form.

The air pressure gauges used in the study were tested for calibration prior to each data collection day. The test was conducted using the two air pressure gauges assigned to each team. The tire pressure of a vehicle belonging to one of the researchers was checked with both gauges. If the pressures were not within a 1 psi tolerance they were to notify their Zone Center for immediate replacement. If the researcher could not determine which gauge was inaccurate, both gauges were replaced. No problems were noted with any of the equipment used in the study.

At the end of each day the research team documented the presence and function of any customer-use air pressure pump at the data collection site. The researchers checked the functioning status of the pump and whether there was any fee for use. In addition, the researchers checked the accuracy of any pressure gauges attached to the pump. This was accomplished by bleeding the air on the tires of one of the

researchers' vehicle to 10 psi. The researcher then inflated the tire until the vehicle manufacturer's recommended pressure was met. The researcher then checked the pressure with one of the supplied air pressure gauges. If the pressure was within  $\pm 1$  psi, the pressure gauge was deemed to be accurate.

The data collection forms, procedures, and methods were tested during an alpha and a beta test prior to study implementation.

### **Additional Analyses and Future Work**

Many other variables were collected during the tire pressure study, including driver profile data, vehicle general data, and the measurements of actual tire pressures taken by the researchers. Results from these analyses will be presented in an upcoming series of research notes.

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 Nancy Bondy [202-366-5353], Greg Radja [202-366-1757], Ramal Mooneshinghe [202-366-0689] or 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.nhtsa.dot.gov/people/nca>.

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