(4) *Changes in Operating Conditions:* If GROWS significantly changes the treatment process or the chemicals used in the treatment process, GROWS may not manage the treatment sludge filter cake generated from the new process under this exclusion until it has met the following conditions: (a) GROWS must demonstrate that the waste meets the delisting levels set forth in Paragraph 3; (b) it must demonstrate that no new hazardous constituents listed in Appendix VIII of Part 261 have been introduced into the manufacturing or treatment process: and (c) it must obtain prior written approval from EPA and the Pennsylvania Department of Environmental Protection to manage the waste under this exclusion.

(5) *Reopener:*

(a) If GROWS discovers that a condition at the facility or an assumption related to the disposal of the excluded waste that was modeled or predicted in the petition does not occur as modeled or predicted, then GROWS must report any information relevant to that condition, in writing, to the Regional Administrator or his delegate and to the Pennsylvania Department of Environmental Protection within 10 days of discovering that condition.

(b) Upon receiving information described in paragraph (a) of this section, regardless of its source, the Regional Administrator or his delegate and the Pennsylvania Department of Environmental Protection will determine whether the reported condition requires further action. Further action may include repealing the exclusion, modifying the exclusion, or other appropriate response necessary to protect human health and the environment.

[FR Doc. 01–18533 Filed 7–25–01; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA 2000–8572]

RIN 2127–AI33

Federal Motor Vehicle Safety Standards: Tire Pressure Monitoring Systems; Controls and Displays

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking.

SUMMARY: The Transportation Recall Enhancement, Accountability, and Documentation Act of 2000 mandates a rulemaking proceeding to require motor vehicles to be equipped with a tire pressure monitoring system that warns the driver a tire is significantly under-inflated. In response, this document proposes to establish a new Federal Motor Vehicle Safety Standard No. 138 that would require tire pressure monitoring systems to be installed in new passenger cars and in new light trucks and multipurpose passenger vehicles.

This document seeks comment on two alternative versions of the new standard. One alternative would require that the driver be warned when the tire pressure in one or more tires, up to a total of 4 tires, has fallen to 20 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever is higher. The other alternative would require that the driver be warned when tire pressure in one or more tires, up to a total of 3 tires, has fallen to 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever is higher.

DATES: Comments must be received on or before September 6, 2001.

ADDRESSES: You may submit your comments in writing to: Docket Section, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. Alternatively, you may submit your comments electronically by logging onto the Docket Management System (DMS) website at *http://dms.dot.gov.* Click on ''Help & Information'' or ''Help/Info'' to view instructions for filing your comments electronically. Regardless of how you submit your comments, you should mention the docket number of this document. You can find the number at the beginning of this document.

FOR FURTHER INFORMATION CONTACT: For non-legal issues, you may call Mr. George Soodoo or Mr. Joseph Scott, Office of Crash Avoidance Standards (Telephone: 202–366–2720) (Fax: 202–366–4329).

For legal issues, you may call Mr. Dion Casey, Office of Chief Counsel (Telephone: 202–366–2992) (Fax: 202–366–3820).

You may send mail to these officials at National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590.

You may call Docket Management at 202–366–9324. You may visit the Docket from 10 a.m. to 5 p.m., Monday through Friday.

SUPPLEMENTARY INFORMATION:

Table of Contents

I. Executive Summary

This document proposes to establish a new Federal Motor Vehicle Safety Standard that would require tire pressure monitoring systems (TPMSs) to be installed in new passenger cars and in new light trucks and multipurpose passenger vehicles. Each vehicle's system would include a warning telltale that illuminates to inform the driver when the vehicle has a significantly under-inflated tire.

This document seeks comment on two alternative versions of the new standard. One alternative would require that the driver be warned when the tire pressure in one or more tires, up to a total of 4 tires, has fallen to 20 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever pressure is higher. The other alternative would require that the driver be warned when tire pressure in one or more tires, up to a total of 3 tires, has fallen to 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever pressure is higher.

To meet the first alternative, vehicle manufacturers would likely need to install direct TPMSs. Direct TPMSs have a tire pressure sensor in each tire.

To meet the second alternative, vehicle manufacturers could install either direct or indirect TPMSs. Indirect TPMSs do not have tire pressure sensors. Current indirect TPMSs rely on the presence of an anti-lock braking system (ABS) to detect and compare differences in the rotational speed of a vehicle's wheels. Wheel speed correlates to tire pressure since the diameter of a tire decreases slightly as tire pressure decreases. The second alternative would require only warnings about pressure loss in up to three tires since most indirect TPMSs cannot detect when all four tires lose pressure at roughly the same rate and become significantly under-inflated.

NHTSA anticipates that vehicle manufacturers would minimize their costs of complying with the second alternative by installing indirect TPMSs in vehicles currently equipped with ABSs and direct TPMSs in vehicles currently not so equipped. For vehicles already equipped with an ABS, the cost of modifying that system to serve the additional purpose of indirectly monitoring tire pressure would be significantly less than the cost of adding a direct TPMS to those vehicles. For vehicles not so equipped, adding a direct TPMS would be the less expensive way of monitoring tire pressure.

NHTSA has two sets of data, one from Goodyear and another from the agency's Vehicle Research and Testing Center (VRTC), on the effect of under-inflated tires on a vehicle's stopping distance. The Goodyear data indicate that a vehicle's stopping distance on wet surfaces is significantly reduced when its tires are properly inflated, as compared to when its tires are significantly under-inflated. The VRTC data indicate little or no effect on a vehicle's stopping distance. For purposes of this rulemaking, NHTSA is using the Goodyear data to establish an upper bound of benefits and the VRTC data to establish a lower bound. The estimates below are the mid-points between those upper and lower bounds.

NHTSA estimates that the first alternative would prevent 10,635 injuries and 79 deaths at an average cost of $66.33 per vehicle.[1] Since approximately 16 million vehicles are produced for sale in the United States each year, the total annual cost of the first alternative would be about $1.06 billion. However, if the average per vehicle fuel and tread life savings ($32.22 and $11.03, respectively) over the lifetime of the vehicle are factored in, the average net cost of the first alternative drops to $23.08 per vehicle, and the total annual cost drops to about $369 million ($1.06 billion − ($516 million + $176 million)) . The second alternative would prevent 6,585 injuries and 49 deaths at an average cost of $30.54 per vehicle.[2] Since approximately 16 million vehicles are produced for sale in the United States each year, the total annual cost of the second alternative would be about $489 million. However, if the average per vehicle fuel and tread wear savings ($16.40 and $5.51, respectively) over the lifetime of the vehicle are factored in, the average net cost of the second alternative drops to $8.63 per vehicle, and the total annual cost drops to about $138 million ($489 million − ($263 million + 88 million). The net cost per equivalent life saved would be $1.9 million for the first alternative and $1.1 million for the second.

The agency believes the proposals would also result in other benefits, such as fewer crashes resulting from tire blowouts, adverse effects on vehicle handling due to inflation pressure loss and hydroplaning, from fewer crashes involving vehicles that had been stopped by the side of the road because of a flat tire, and the prevention of the property damage that results from these crashes. NHTSA has not attempted to quantify those benefits. Those unquantified benefits would be greater for the first alternative than the second alternative.

The agency believes the proposals may also result in additional costs, such as the cost of replacing worn or damaged TPMS equipment and the cost of the time it would take for a driver to react to a low tire pressure warning by pulling over to a gas station to check and inflate the vehicle's tires. NHTSA has not attempted to quantify those costs.

II. Background

A. The Transportation Recall Enhancement, Accountability, and Documentation Act

Congress enacted the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act on November 1, 2000.[3] Section 13 of the TREAD Act mandates ''a rulemaking for a regulation to require a warning system in new motor vehicles to indicate to the operator when a tire is significantly under inflated'' within one year of the TREAD Act's enactment. Section 13 also provides that the regulation must take effect within two years of the completion of the rulemaking.

B. Previous Rulemaking on Tire Pressure Monitoring Systems

NHTSA first considered requiring a ''low tire pressure warning device'' in 1970. However, the agency determined that only warning device then available was an in-vehicle indicator, and that its cost was too high.

During the 1970s, several manufacturers developed inexpensive on-tire warning devices. In addition, the price of in-vehicle warning devices dropped significantly.

On January 26, 1981, NHTSA published an Advanced Notice of Proposed Rulemaking (ANPRM)

[1] The range of injuries prevented would be 0 to 21,270, an the range of deaths prevented would be 0 to 158.

[2] The range of injuries prevented would be 0 to 13,170, an the range of deaths prevented would be 0 to 97.

[3] Public Law 106–414.

soliciting public comment on whether the agency should propose a new Federal motor vehicle safety standard requiring each new motor vehicle to have a low tire pressure warning device which would ''warn the driver when the tire pressure in any of the vehicle's tires was significantly below the recommended operating levels.'' (46 FR 8062).

NHTSA noted in the ANPRM that under-inflated tires increase the rolling resistance of vehicles and, correspondingly, decrease their fuel economy. Research data at the time indicated that radial tires under-inflated by 10 pounds per square inch (psi) reduced the fuel economy of the vehicle on which they were mounted by 3 percent. Because of the worldwide oil shortages in the late 1970s and early 1980s, NHTSA was interested in finding ways to increase the fuel economy of passenger vehicles (i.e., passenger cars and multipurpose passenger vehicles). Since surveys conducted by the agency showed that about 50 percent of passenger car tires and 13 percent of truck tires were operated at pressures below the vehicle manufacturers' recommended inflation levels, the agency believed that low tire pressure warning devices would encourage drivers to maintain their tires at the proper inflation level, thus maximizing their vehicles' fuel economy.

Moreover, a 1973 study by Indiana University concluded that under-inflated tires were a probable cause of 1.4 percent of all motor vehicle crashes.[4] Based on that figure, and the approximately 18.3 million motor vehicle crashes then occurring annually in the U.S., the agency suggested that under-inflated tires were probably responsible for 260,000 crashes each year (1.4 percent × 18.3 million crashes).

In the ANPRM, the agency sought answers from the public to several questions, including:

(1) What tire pressure level should trigger the warning device?

(2) Should the agency specify the type of warning device (i.e., on-tire, in-vehicle) to be used?

(3) What would it cost to produce and install an on-tire or in-vehicle warning device?

(4) What is the fuel saving potential of low tire pressure warning devices?

(5) What studies have been performed which would show cause and effect relationships between low tire pressure and auto crashes?

(6) What would be the costs and benefits of a program to educate the public on the benefits of maintaining proper tire pressure?

NHTSA terminated the rulemaking on August 31, 1981. (46 FR 43721, August 31, 1981). The agency did so because public comments on the ANPRM indicated that the low tire pressure warning devices available at the time either had not been proven to be accurate and reliable or were too expensive. The comments indicated that in-vehicle warning devices had been proven to be accurate and reliable, but would have had a retail cost of $200 (in 1981 dollars) per vehicle. NHTSA stated, ''Such a cost increase cannot be justified by the potential benefits, although those benefits might be significant.'' (46 FR 43721). The comments also indicated that on-tire warning devices cost only about $5 (in 1981 dollars) per vehicle, but they had not been developed to the point where they were accurate and reliable enough to be required. The comments also suggested that on-tire warning devices were subject to road hazards, such as scuffing at curbs, ice, mud, etc. However, NHTSA said that it still believed that ''[m]aintaining proper tire inflation pressure results in direct savings to drivers in terms of better gas mileage and longer tire life, as well as offering increased safety.'' (46 FR 43721).

III. Problem Description

Drivers' infrequent monitoring of their vehicles' tire pressure, combined with the difficulty of visually detecting when a tire is several psi below the recommended inflation pressure and with typical tire pressure losses due to natural leakage and seasonal climatic changes, contribute to many vehicles' having under-inflated tires.

A. Infrequent Consumer Monitoring of Tire Pressure

Surveys have shown that most drivers infrequently check the inflation pressure in their vehicles' tires. One such survey was the omnibus survey conducted by the Bureau of Transportation Statistics (BTS) in September 2000 for NHTSA. The BTS conducted 1,017 household interviews. One of the questions posed was: ''How often do you, or the person who checks your tires, check the air pressure in your tires?'' The answers indicated that 29 percent of the respondents stated that they check the air pressure in their tires monthly; 29 percent stated that they check the air pressure only when one or more of their vehicle's tires appears under-inflated; 19 percent stated that they only have the air pressure checked when the vehicle is serviced; 5 percent stated that they only check the air pressure before taking their vehicle on a long trip; and 17 percent stated that they check the air pressure on some other occasion. Thus, 71 percent of drivers stated that they check the air pressure in their vehicles' tires less than once a month.[5]

In addition, NHTSA's National Center for Statistics and Analysis (NCSA) conducted a survey in February 2001. The survey was designed to assess the extent to which passenger vehicle drivers are aware of the recommended air pressure for their tires, if they monitor air pressure, and to what extent actual tire pressure differs from that recommended by the vehicle manufacturer.

Data was collected through the infrastructure of the National Accident Sampling System—Crashworthiness Data System (NASS–CDS). The NASS–CDS consists of 24 Primary Sampling Units (PSUs) located across the country. Within each PSU, a random selection of zip codes was obtained from a list of eligible zip codes. Within each zip code, a random selection of two gas stations was obtained.

A total of 11,530 vehicles were inspected at these gas stations. This total comprised 6,442 passenger cars, 1,874 SUVs, 1,376 vans, and 1,838 pick-up trucks. For analytical purposes, the data were divided into three categories: (1) passenger cars with P-metric tires; (2) pick-up trucks, SUVs, and vans with P-metric tires; and (3) pick-up trucks, SUVs, and vans with either light truck (LT) or flotation tires.

Drivers were asked how often they normally check their tires to determine if they are properly inflated. Their answers are in the following table:

[4] Indiana Tri-Level Study of the Causes of Traffic Accidents, 1973.

[5] The agency notes that it seems likely that the respondents overstated the frequency with which they check tire pressure, particularly given the fact that this survey was conducted during the height of publicity in the fall of 2000 about tire failures on sport utility vehicles.

How often is tire pressure checked?	Drivers of passenger cars (%)	Drivers of pick-up trucks, SUVs and vans (%)	
	P-metric tires	P-metric tires	LT or flotation tires
Weekly	8.76	8.69	8.16
Monthly	21.42	25.19	39.88
When they seem low	25.63	23.58	15.59
When serviced	30.18	27.72	25.54
For long trip	0.99	2.39	2.17
Other	6.46	8.27	6.97
Do not check	6.56	4.16	1.69

These data indicate that only about 30 percent of drivers of passenger cars, 34 percent of drivers of pick-up trucks, SUVs, and vans with P-metric tires, and 48 percent of drivers of pick-up trucks, SUVs, and vans with either LT or flotation tires claim that they check the inflation level in their tires at least once a month.

B. Loss of Tire Pressure Due to Natural and Other Causes

According to data from the tire industry, 85 percent of all tire air pressure losses are the result of slow leaks that occur over a period of hours, days, or months. Only 15 percent of tire air pressure losses are rapid air losses caused by contact with a road hazard, e.g., when a tire is punctured by a large nail that does not end up stuck in the tire. Slow leaks may be caused by many factors. Tires typically lose air pressure through natural leakage and permeation at a rate of 1 pound per square inch (psi) per month. In addition, seasonal climatic changes result in air pressure losses on the order of 1 psi for every 10°F decrease in the ambient temperature. Slow leaks also may be caused by slight damage to a tire, such as a road hazard that punctures a small hole in the tire or a nail that sticks in the tire. The agency has no data indicating how often any of these causes results in a slow leak.

C. Percentage of Motor Vehicles With Under-Inflated Tires

During the tire pressure survey, NASS–CDS crash investigators measured tire pressure on each vehicle coming into the gas station and compared the measured pressures to the vehicle manufacturer's recommended tire pressure. They found that about 36 percent of passenger cars and about 40 percent of light trucks had at least one tire that was at least 20 percent below the vehicle manufacturer's recommended cold inflation pressure. About 26 percent of passenger cars and 29 percent of light trucks had at least one tire that was at least 25 percent below the vehicle manufacturer's recommended cold inflation pressure. The agency notes those levels of under-inflation because they are the threshold levels at which the low tire pressure warning telltale would have to be illuminated in the two alternatives proposed in this NPRM.

D. Consequences of Under-Inflation of Tires

1. Reduced Vehicle Safety

When a tire is used while significantly under-inflated, its sidewalls flex more and the air temperature inside it increases, making the tire more prone to failure. In addition, a significantly under-inflated tire loses lateral traction, making handling more difficult. The agency also has received data from Goodyear indicating that significantly under-inflated tires increase a vehicle's stopping distance on wet surfaces.

NHTSA's crash files do not contain any direct evidence that points to low tire pressure as the cause of any particular crash. However, this lack of data does not imply that low tire pressure does not cause or contribute to any crashes. It simply reflects the fact that measurements of tire pressure are not among the vehicle information included in the crash reports received by the agency and placed in its crash data bases.[6]

The only tire-related data element in the agency's data bases is "flat tire or blowout." Even in crashes for which a flat tire or blowout is reported, crash investigators cannot tell whether low tire pressure contributed to the tire failure.

The agency examined its crash files to gather information on tire-related problems that resulted in crashes. The National Automotive Sampling System—Crashworthiness Data System (NASS–CDS) has trained investigators who collect data on a sample of tow-away crashes around the United States. These data can be weighted to generate national estimates.

The NASS–CDS General Vehicle Form contains a value indicating vehicle loss of control due to a blow out or flat tire. This value is used only when a vehicle's tire went flat, causing a loss of control of the vehicle and a crash. The value is not used for cases in which one or more of a vehicle's tires was under-inflated, preventing the vehicle from performing as well as it could have in an emergency situation.

NHTSA examined NASS–CDS data for 1995 through 1998 and estimated that 23,464 tow-away crashes, or one-half of one percent of all crashes, are caused by blowouts or flat tires each year. This is significantly fewer crashes than estimated by the 1973 Indiana Tri-Level study. However, the 260,000 crashes estimated in that study represented all crashes in which under-inflation was a probable or possible cause. The 23,464 crashes estimated from the NASS–CDS data are tow-away crashes caused by tire failure only. Further, in 1977, only 12 percent of vehicles were equipped with radial tires, while today over 90 percent of vehicles are equipped with radial tires. Radial tires are much more structurally sound than the bias-ply tires that were widely used in 1977. Thus, the current estimate of 23,464 crashes and the 1977 estimate of 260,000 crashes are not comparable.

[6] These crash data bases are the National Automotive Sampling System—Crashworthiness Data System (NASS–CDS) and the Fatality Analysis Reporting System (FARS).

The agency placed the tow-away crashes from the NASS–CDS files into two categories: Passenger car crashes and light truck crashes. Passenger cars were involved in 10,170 of the tow-away crashes caused by blowouts or flat tires, and light trucks were involved in the other 13,294.

NHTSA also examined data from the Fatality Analysis Reporting System (FARS) for evidence of tire problems involved in fatal crashes. In FARS, if tire problems are noted after the crash, the simple fact of their existence is all that is noted. No attempt is made to ascribe a role in the crash to those problems. Thus, the agency does not know whether the noted tire problem caused the crash, influenced the severity of the crash, or simply occurred during the crash. For example, a tire may have blown out and caused the crash, or a tire may have blown out during the crash when the vehicle struck some object such as a curb.

Thus, while an indication of a tire problem in the FARS file gives some clue as to the potential magnitude of tire problems in fatal crashes, the FARS data cannot give a precise measure of the causal role played by those problems. The very existence of tire problems are sometimes difficult to detect and to code accurately. Further, coding practices vary from State to State. Nevertheless, the agency notes that, from 1995 to 1998, 1.10% of all light vehicles involved in fatal crashes were coded as having tire problems. Over 535 fatal crashes involved vehicles coded with tire problems.

Under-inflated tires can contribute to other types of crashes than those resulting from blow outs or tire failure, including crashes which result from: an increase in stopping distance; skidding and/or a loss of control of the vehicle in a curve or in a lane change maneuver; or hydroplaning on a wet surface. However, the agency does not have any data on how often under-inflated tires cause crashes or contribute to their occurrence.

Tires are designed to perform at a specific inflation pressure. When a tire is under-inflated, the shape of its footprint and the pressure it exerts on the road surface are both altered. One consequence of this alteration can be a reduction in the tire's ability to transmit (or generate) braking force to the road surface, at least on wet surfaces.[7] Thus, under-inflated tires may increase a vehicle's stopping distance on wet surfaces. This is discussed more fully in the Benefits section below.

2. Reduced Tread Life

Unpublished data submitted by Goodyear indicate that when a tire is under-inflated, more pressure is placed on the shoulders of the tire, causing the tread to wear incorrectly. The Goodyear data also indicated that the tread on an under-inflated tire wears more rapidly than it would if the tire were inflated to the proper pressure. The agency requests comment on this issue.

The Goodyear data indicate that the average tread life of a tire is 45,000 miles, and the average cost of a tire is $61 (in 2000 dollars). Goodyear also estimated that a tire's average tread life would drop to 68 percent of the expected tread life if tire pressure dropped from 35 psi to 17 psi and remained there. Goodyear also assumed that this relationship was linear. Thus, for every 1 psi drop in tire pressure, tread life would decrease by 1.78 percent (32 percent/18). This loss of tread life would take place over the lifetime of the tire. Thus, according to Goodyear's data, if the tire remained under-inflated by 1 psi over its lifetime, its tread life would decrease by about 800 miles (1.78 percent of 45,000 miles).

As noted above, data from the NCSA tire pressure survey show that 36 percent of passenger cars had at least one tire that was under-inflated by at least 20 percent. The average level of under-inflation of the four tires on these cars was 6.1 psi. Thus, on average, passenger cars could lose about 4,880 miles (6.1 psi $\times$ 800 miles) of tire life due to under-inflation, if their tires were under-inflated to that extent throughout the life of the tires.

As also noted above, data from the NCSA tire pressure survey also show that about 40 percent of light trucks had at least one tire that was under-inflated by at least 20 percent. The average level of under-inflation of the four tires on these light trucks was 7.7 psi. Thus, on average, those light trucks could lose about 6,160 miles (7.7 psi $\times$ 800 miles) of tire life due to under-inflation, if their tires were under-inflated to that extent throughout the life of the tires.

3. Reduced Fuel Economy

Under-inflated tires increase the rolling resistance of vehicles and, correspondingly, decrease their fuel economy. According to a 1978 report,[8] fuel efficiency is reduced by one percent for every 3.3 psi of under-inflation. More recent data provided by Goodyear indicate that fuel efficiency is reduced by one percent for every 2.96 psi of under-inflation.

NHTSA notes that there is an apparent conflict between the Goodyear data indicating under-inflated tires increase a vehicle's stopping distance and the data indicating under-inflated tires increase a vehicle's rolling resistance. Since an under-inflated tire typically has a larger tread surface area (i.e., tire footprint) in contact with the road, the vehicle should have more traction, and its stopping distance should be reduced.

The larger footprint does result in an increase in rolling resistance on dry road surfaces due to increased friction between the tire and the road surface. However, the larger tire footprint also reduces the tire load per unit area. On dry road surfaces, the countervailing effects of a larger footprint and reduced load per unit of area nearly offset each other, with the result that the vehicle's stopping distance performance is only mildly affected by under-inflation.

On wet surfaces, however, under-inflation typically increases stopping distance for several reasons. First, as noted above, the larger tire footprint provides less tire load per area than a smaller footprint. Second, since the limits of adhesion are lower and achieved earlier on a wet surface than on a dry surface, a tire with a larger footprint, given the same load, is likely to slide earlier than the same tire with a smaller footprint because of the lower load per footprint area. The rolling resistance of an under-inflated tire on a wet surface is greater than the rolling resistance of the same tire properly-inflated on the same wet surface. This is because the slightly larger tire footprint on the under-inflated tire results in more rubber on the road and hence more friction to overcome. However, the rolling resistance of an under-inflated tire on a wet surface is less than the rolling resistance of the same under-inflated tire on a dry surface because of the reduced friction caused by the thin film of water between the tire and the road surface. The less tire load per area and lower limits of adhesion of an under-inflated tire on a wet surface are enough to overcome the increased friction caused by the larger footprint of the under-inflated tire. Hence, under-inflated tires cause longer stopping distance on wet surfaces than properly-inflated tires.

IV. Tire Pressure Monitoring Systems

There are two types of tire pressure monitoring systems (TPMSs). Direct systems directly measure the pressure in

[7] On dry surfaces, stopping distance seems to be only mildly affected by inflation pressure. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers, 1992, p. 57.

[8] The Aerospace Corporation, Evaluation of Techniques for Reducing In-use Automotive Fuel Consumption, June 1978.

a vehicle's tires, while indirect ones estimate the pressure. Both types inform the driver when the pressure in one or more tires falls below a pre-determined level. Unless the TPMS is connected to an automatic inflation system, the driver must stop the vehicle and inflate the under-inflated tire(s), preferably to the pressure recommended by the vehicle manufacturer. Currently, TPMSs are available as original equipment on a few vehicle models. They are available also as after-market equipment, but few are sold.

NHTSA's Vehicle Research and Test Center (VRTC) evaluated six direct and four indirect TPMSs that are currently available.[9] The VRTC found that the direct TPMSs were accurate to within an average of ± 1.0 psi, and indirect systems were accurate to within an average of ± 1.1 psi.[10] This leads the agency to believe that current TPMSs are more accurate than the systems that were available at the time of the agency's 1981 rulemaking on TPMSs.

Following is a description of the two types of TPMSs and their advantages and disadvantages.

A. Indirect TPMSs

Indirect TPMSs typically work with the vehicle's anti-lock brake system (ABS). The ABS employs wheel speed sensors to measure the rotational speed of each of the four wheels. As a tire's pressure decreases, the rolling radius decreases, and the rotational speed of that wheel increases correspondingly. Most indirect TPMSs compare each wheel's rotational speed with the rotational speed of the other wheels. If one tire becomes significantly under-inflated while the others remain at the proper pressure, the indirect TPMS can detect it because that wheel's rotational speed is higher than the rotational speed of the other wheels. This information is conveyed to the driver by a simple telltale. The telltale indicates that a tire is under-inflated, but cannot identify which tire is under-inflated. Current vehicles that have indirect systems include the Toyota Sienna, Ford Windstar, and Oldsmobile Alero.

B. Direct TPMSs

Direct TPMSs use pressure sensors, located in each wheel, to directly measure the pressure in each tire. These sensors broadcast data via a wireless radio frequency transmitter to a central receiver which analyzes the data. The central receiver is connected to a display mounted inside the vehicle. The type of display varies from a simple, single telltale to a display showing the pressure and temperature in each tire, sometimes including the spare tire. Thus, direct TPMSs can be linked to a display that tells the driver which tire is under-inflated. An example of a vehicle equipped with a direct system is the Chevrolet Corvette.

C. Advantages and Disadvantages

1. Indirect TPMSs

Indirect TPMSs have several advantages. First, they are less expensive than direct TPMSs for vehicles already equipped with an ABS. If a vehicle is already equipped with an ABS, the vehicle's manufacturer will only have to add the capability to monitor the wheel speed sensors, a low tire pressure warning telltale, and a reset button, and make some software changes. Making these additions and changes in a way that produces indirect systems like those currently on motor vehicles would cost about $12.90 per vehicle. However, as explained below, the agency is uncertain whether such an indirect TPMS would comply with either of the alternatives proposed in this NPRM.

NHTSA tested four current ABS-based indirect TPMSs. None of the four met the proposed requirements for either alternative. These TPMSs had problems detecting two significantly under-inflated tires on the same axle and on the same side of the vehicle. They also did not illuminate the low tire pressure warning telltale when the pressure in the vehicle's tires decreased to 20 percent, or even 25 percent, below the vehicle manufacturer's recommended cold inflation pressure. NHTSA does not know whether improving current indirect TPMSs to meet the requirements of either alternative would result in additional costs. The agency requests comments on this issue.

Pickup trucks comprise about 40 percent of light truck sales. Some percentage of pickup trucks that have ABS have only one wheel speed sensor for the rear axle. In order to meet the requirements of either proposed alternative, NHTSA believes vehicle manufacturers would have to add a fourth wheel speed sensor to these trucks at an estimated cost of $20 per vehicle. The agency assumes for this analysis that about 10 percent of all light trucks, or 7.5 percent of all light vehicles with ABS, would be in this category. However, the agency requests comment on the percentage of pickup trucks that would need this modification.

For vehicles currently without ABS, there are two indirect measurement choices. First, the vehicle manufacturer could add ABS and the necessary TPMS features to the vehicle. NHTSA estimates that this would cost about $240 per vehicle. The agency does not expect manufacturers to make this choice unless they are already planning for other reasons to add ABS. Second, the vehicle manufacturer could add wheel speed sensors and the necessary TPMS features to the vehicle. NHTSA estimates that this approach would cost about $130 per vehicle.

Second, the wheel components of indirect TPMSs are more robust and less likely to sustain damage than the wheel components of direct TPMSs. The wheel speed sensors of indirect TPMSs are located behind the brakes and often are integrated into the wheel hub assembly. This generally shields them from road damage. In addition, the entire brake/hub assembly would rarely be removed. In contrast, the pressure sensors of direct TPMSs are located inside the tire/wheel cavity, potentially subjecting them to road damage. These sensors also may be subject to damage during tire maintenance, i.e., rotating or changing the tires.

Finally, indirect TPMSs do not need an independent power source. They are powered by the car's battery.

Indirect TPMSs also have several disadvantages. First, since most indirect TPMSs calculate tire pressure by comparing the wheel speeds, they cannot detect the loss of pressure if all four tires lose pressure at similar rates. In its evaluation of four indirect TPMSs, the VRTC found that none of them were able to detect when all four of the vehicle's tires were equally under-inflated. The VRTC also found that none of the indirect TPMSs were able to detect when two tires on the same axle or two tires on the same side of the vehicle were equally under-inflated.

Second, most indirect TPMSs cannot detect small pressure losses. The VRTC found that since reductions in tire diameter with reductions in pressure are very slight in the 15–40 psi range, most indirect TPMSs require a 20 to 30 percent drop in pressure before they are able to detect under-inflation. The VRTC also found that those thresholds were highly dependent on tire and loading factors.

Third, vehicles must be moving for indirect TPMSs to detect an under-inflated tire. Thus, if a vehicle's tire is already under-inflated when a person gets in and begins to drive that vehicle, an indirect TPMS will not be able to

[9] An Evaluation of Existing Tire Pressure Monitoring Systems, May 2001. A copy of this report is available in the docket.

[10] This is not to say that the systems were able to detect a 1.0 psi drop in pressure. The systems were accurate within ±1.0 to 1.1 psi once tire pressure had fallen by a certain percentage.

alert the driver until after the vehicle begins moving.

Fourth, most indirect TPMSs need substantial time to calibrate the system, i.e., to ''learn'' the variables associated with distinct tire types under varying driving conditions. The VRTC found that the four indirect TPMSs it evaluated took anywhere from several minutes to several hours to calibrate. Calibration is necessary when a vehicle is first driven. Recalibration is necessary when the pressure in a tire is changed and when the tires are rotated or replaced. Indirect TPMSs do not indicate that the system is in calibration mode. During the calibration mode, the system is not monitoring tire pressure. Thus, if one or more tires becomes significantly under-inflated while the system is calibrating, the driver would not be alerted. Moreover, the agency notes that the calibration process is prone to human error. For example, a driver may accidentally press the reset button when one or more of the vehicle's tires is under-inflated, but not under-inflated enough to illuminate the low tire pressure warning telltale. This would re-calibrate the system so that it accepts the under-inflated condition as normal. The indirect TPMS then would not be able to detect an under-inflated tire until one or more tires was even more under-inflated than it already was. The agency requests comments specifically addressing the issue of human error that may occur with indirect TPMSs.

Fifth, apart from the time needed to calibrate, indirect TPMSs also need several minutes to detect an under-inflated tire. The VRTC found that the four indirect TPMSs it evaluated took one to ten minutes to detect an under-inflated tire.

Sixth, indirect TPMSs cannot tell the driver which tire is under-inflated.

Seventh, indirect TPMSs sometimes incorrectly indicate that a vehicle has an under-inflated tire when the vehicle is being driven on gravel or bumpy roads, is being driven at high speeds, e.g., over 70 mph, or has mismatched tires or a tire that is out of balance or out of alignment.

2. Direct TPMSs

Direct TPMSs have several advantages. First, since direct TPMSs actually measure the pressure in each tire, they are able to detect when any tire or combination of tires is under-inflated, including when all four of the vehicle's tires are equally under-inflated.

Second, since most direct TPMSs are battery-operated, they can operate while the vehicle is stationary. Thus, if a vehicle's tire becomes significantly under-inflated while the vehicle is parked, a direct TPMS can alert the driver as soon as he or she starts the vehicle.

Third, direct TPMSs can detect small pressure losses. Some systems can detect a drop in pressure as small as 1 psi.

Fourth, direct TPMSs can be linked to a display that tells the driver which tire is under-inflated and the actual pressure in each tire.

Fifth, direct TPMSs will not give false positives if the vehicle is being driven on gravel or bumpy roads, or has mismatched tires or a tire that is out of balance or out of alignment.

Direct TPMSs also have disadvantages. First, they are more expensive than indirect TPMSs for vehicles already equipped with ABS. There are two main costs associated with direct TPMSs: sensors and a receiver. There is a wide disparity in costs for sensors, depending on what type of information is sensed.[11] Providing only pressure sensors, as proposed to be required by both alternatives proposed in this NPRM, would cost from $5 to $10 per wheel, or $20 to $40 per vehicle.

The costs associated with a receiver depend upon whether the vehicle already has a receiver capable of receiving and processing the information coming from the sensors. NHTSA estimates that about 60 percent of vehicles currently have such a receiver. Making some software changes and adding a display showing the pressure for each tire would cost about $25 per vehicle. The 40 percent of vehicles without such a receiver would have to be equipped with a receiver incorporating the necessary software and with the display. The agency estimates that this would cost about $40 to $50 per vehicle.

The agency estimates that the total cost of adding a direct TPMS to a vehicle that is already equipped with a receiver would be $49 to $69.[12] For a vehicle that is not already equipped with a receiver, the cost would be $64 to $94. This is more than the cost of adding an indirect TPMS to a vehicle already equipped with an ABS, but less than the cost of adding wheel speed sensors or an ABS and an indirect TPMS to a vehicle not already equipped with an ABS.

Second, the wheel components of direct TPMSs are less robust and more likely to sustain damage than the wheel components of indirect TPMSs, especially when tires are taken off the rim. This issue is discussed above in the section on the advantages of indirect TPMSs. The agency notes, however, that it has not received any information indicating that direct TPMSs have sustained damage during driving or tire maintenance. The agency requests comments on the likelihood of such damage.

Third, most direct TPMSs need an independent power source. Those that do are powered by batteries, which generally have a life span of five to ten years. This also means that unless a direct TPMS is equipped with a low battery warning indicator, the driver might not know when the batteries for a direct TPMS have expired.

Finally, most direct TPMSs must be reset after a vehicle's tires are replaced. When a vehicle's tires are rotated, most direct TPMSs require that the sensor locations be reassigned in the receiver.

3. Tabular Summary of Advantages and Disadvantages of Indirect and Direct TPMSs

ADVANTAGES AND DISADVANTAGES OF INDIRECT AND DIRECT TPMSS

	Indirect TPMSs	Direct TPMSs
Cost of adding to vehicle with ABS, but without receiver	$12.90	$79.
Cost of adding to vehicle with ABS and receiver	$12.90	59.
Cost of adding to vehicle without ABS or receiver	$130 for wheel speed sensors; $240 for ABS	79.

[11] For example, some sensors sense temperature in addition to pressure.

[12] These figures include about $4 per vehicle for the cost of actually installing the direct TPMS.

ADVANTAGES AND DISADVANTAGES OF INDIRECT AND DIRECT TPMSS—Continued

	Indirect TPMSs	Direct TPMSs
Cost of adding to vehicle without ABS, but with receiver	$130 for wheel speed sensors; $240 for ABS	59.
Susceptibility of wheel components to damage during tire installation and removal.	Less likely	More likely.
Need for an independent power source	No	Yes.
Need to reset after a vehicle's tires are replaced or rotated	Yes, system must be re-calibrated	Yes.
Ability to detect loss of air pressure if all four tires lose pressure.	No	Yes.
Ability to detect small pressure losses	No	Yes.
Ability to detect under-inflated tire while vehicle is stationary	No, vehicle must be moving	Yes.
Ability to identify which tire is under-inflated	No	Yes.
Susceptible to giving false indications of a significantly under-inflated tire.	Yes, if the vehicle is being driven on gravel or bumpy roads or at high speeds (≥70 mph) or if it has mismatched tires or a tire out of balance or a out of alignment.	No.

V. Agency Proposal

A. Summary of Proposal

The agency is proposing two alternative versions of the TPMS standard. Both alternatives would require passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less, manufactured on or after November 1, 2003, to be equipped with a TPMS and a low tire pressure warning telltale (yellow) to alert the driver that one or more of the vehicle's tires is significantly under-inflated. Both alternatives would require the TPMS in each vehicle to be compatible with all replacement or optional tire sizes/rims recommended for that vehicle by the vehicle manufacturer. Both alternatives would require vehicle manufacturers to provide written instructions, in the owner's manual if one is provided, explaining the purpose of the low tire pressure warning telltale, the potential consequences of significantly under-inflated tires, and what actions drivers should take when the low tire pressure warning telltale is illuminated.

The first alternative would define ''significantly under-inflated'' as the tire pressure 20 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or an absolute level of pressure to be specified in the new standard, whichever pressure is higher. It would require the low tire pressure warning telltale to illuminate within 10 minutes of driving after any tire or combination of tires on the vehicle becomes significantly under-inflated. It would require the low tire pressure warning telltale to remain illuminated as long as any of the vehicle's tires remains significantly under-inflated, and the ignition switch is in the ''on'' (''run'') position. It would require that the telltale be deactivatable, manually or automatically, only when the vehicle no longer has a tire that is significantly under-inflated.

The second alternative would define ''significantly under-inflated'' as the tire pressure 25 percent below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or an absolute level of pressure to be specified in the new standard, whichever pressure is higher. The absolute pressure levels would be the same for both proposals. The second alternative would require the low tire pressure warning telltale to illuminate within 10 minutes of driving after any tire or combination of tires, up to a total of three tires, becomes significantly under-inflated. Like the first alternative, the second alternative would require the low tire pressure warning telltale to remain illuminated as long as any of the vehicle's tires remains significantly under-inflated, and the ignition switch is in the ''on'' (''run'') position. The second alternative also would require that the telltale be deactivatable, manually or automatically, only when the vehicle no longer has a tire that is significantly under-inflated.

The agency believes that only direct TPMSs will be able to meet the requirements of the first alternative. Current indirect TPMSs typically cannot detect significant under-inflation until the pressure in one of the vehicle's tires is about 30 percent below the pressure in at least some of the other tires. Further, they cannot detect when all four tires lose pressure at the same time.

NHTSA believes that direct TPMSs and upgraded indirect TPMSs will be able to meet the requirements of the second alternative. The agency requests comments on whether this goal is practicable.

B. Vehicles Covered by This Proposal

NHTSA is proposing to require TPMSs on passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less.

NHTSA is not proposing to require TPMSs on motorcycles because, unlike the types of vehicles that would be subject to the proposed standard on TPMS, motorcycles use tubed tires. In order for a direct TPMS to work with tubed tires, the pressure sensor would not only have to be inside the tire, but also inside the tube itself. The agency is not aware of any TPMSs that are made to work with tubed tires.

NHTSA is also not proposing to require TPMSs on medium (10,001–26,000 lbs. GVWR) and heavy (greater than 26,001 lbs. GVWR) vehicles for several reasons. First, this rulemaking is required by the TREAD Act, which was passed in response to the Firestone recall.[13] Since that recall was limited to light vehicles, the agency has limited its study of under-inflation to light vehicles.

[13] On August 9, 2000, Firestone announced that it was recalling 14.4 million ATX, ATX II, and Wilderness tires after receiving scores of complaints alleging that the tread on these tires was separating. NHTSA is investigating these tires and has attributed 203 deaths and more than 700 injuries to crashes involving tread separations on these tires.

Second, the issues associated with under-inflated tires on medium and heavy vehicles are different from and more complex than the issues associated with under-inflated tires on light vehicles. For example, medium and heavy vehicles are equipped with tires that are much larger and have much higher pressure levels than the tires used on light vehicles. In addition, medium and heavy vehicles are generally equipped with more axles and tires than light vehicles. Since the TREAD Act imposed a one-year deadline on this rulemaking, the agency did not have the time to study and analyze those issues sufficiently.

Third, the Federal Motor Carrier Safety Administration (FMCSA) has a program that is addressing tire maintenance issues on heavy, but not medium, vehicles. The FMCSA plans to conduct a comprehensive study, including possible fleet evaluations of different systems, of all the issues related to improvement of heavy vehicle tire maintenance.

NHTSA plans to coordinate with the FMCSA to address the issues associated with heavy vehicle tire maintenance. NHTSA will work with the FMCSA in examining the desirability of proposing a TPMS standard for heavy vehicles. The agency will also consider the implications of those results of that examination for medium vehicles.

C. Definition of ''Significantly Under-Inflated''

Before issuing this notice of proposed rulemaking, NHTSA employees attended numerous meetings with both tire and vehicle manufacturers to discuss TPMSs and how the term ''significantly under-inflated'' should be defined. The agency notes that there is a fundamental disagreement between vehicle and tire manufacturers as to what constitutes significant under-inflation.

In general, the tire manufacturers believe that ''significantly under-inflated'' should be defined as any pressure below the minimum pressure specified by the tire industry's standard-setting bodies for a vehicle's gross vehicle weight rating (GVWR) or gross axle weight rating (GAWR). They argue that any tire with an inflation pressure below the pressure specified by those bodies as necessary to carry the vehicle's GVWR or GAWR creates a potential safety problem. They are concerned that tires with a pressure even 1 psi below this level will experience increased temperatures and be more likely to fail.

The vehicle manufacturers would like the agency to leave the definition of ''significant under-inflation'' to them. They argue that there are too many vehicle-tire-load combinations for the agency to set one standard, and that the vehicle manufacturers can best determine at what inflation pressure a particular tire on a particular vehicle is significantly under-inflated. They suggest that the agency give them the flexibility to determine the level of significant under-inflation for the tires on each vehicle.

NHTSA believes that the tire manufacturers' definition is overly strict. Most manufacturers of light vehicles incorporate some reserve when determining a tire's recommended cold inflation pressure. Thus, the pressure in a tire may fall below that recommended pressure without significantly affecting the safety of the tire.

In addition, the pressures assigned by the tire industry's standard-setting bodies are simply the result of a mathematical calculation that a tire enclosing a given volume of air should be able to carry a certain load. The formula underlying the calculation is decades old. It remains unchanged even though tire technology and construction have changed significantly. A given size of today's tires is more able than the same size of tires 50 or even 25 years ago to carry a load safely. Thus, the tire industry's calculation is a very conservative estimate of the load-carrying capability of today's tires.

NHTSA also does not agree with the vehicle manufacturers' definition. The agency believes that it must set a minimum level to ensure that tires are not operated at pressures the agency believes are too low. The agency is proposing a minimum performance standard. Either proposed alternative would give vehicle manufacturers the freedom to raise the bar. In this case, either alternative would allow them to design TPMSs so that they provide a warning before any tire experiences the amount of pressure loss permitted under the agency proposal. The agency also believes that a minimum performance standard specifying a quantified requirement can work for the various vehicle-tire-load combinations.

NHTSA is proposing two alternative definitions of ''significantly under-inflated.'' The first would define ''significantly under-inflated'' as a tire pressure in one, two, three or four tires that is 20 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever pressure is higher. The second would define ''significantly under-inflated'' as a tire pressure in one, two, or three tires that is 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or a minimum level of pressure to be specified in the new standard, whichever pressure is higher.

In selecting these figures, NHTSA considered several factors. First, there is no bright line at the loss of air pressure definitely becomes a safety issue. Second, we did not wish to select a level of pressure loss so low that the warning telltale illuminates so often that it becomes a nuisance. Drivers could end up ignoring such a telltale altogether. Accordingly, we did not want to select a level as low as 10 percent below the manufacturer's recommended pressure. Our assessment of current TPMSs leads us to conclude that detecting 20 percent under-inflation is feasible for direct TPMSs, but may not be feasible for indirect ones. Most current indirect TPMSs are not able to detect differences in inflation pressure among a vehicle's tires that are less than 30 percent. However, we believe that indirect TPMSs can be improved sufficiently to enable them to detect 25 percent differentials. We are asking for comments on these figures. To aid the agency in selecting a figure for the final rule, NHTSA requests any data or analysis relating to the safety implications of under-inflation within the range of under-inflation discussed in this paragraph. It also requests information regarding the practicability of designing and manufacturing such systems.

The agency has data indicating that, as the amount of under-inflation increases, so does the negative effect on the vehicle's braking performance, fuel economy, and tire life. For example, according to data from Goodyear, a vehicle traveling at 62 mph on a wet surface (0.05 inch of water on the road) takes about 442 feet to stop if all of its tires are properly inflated. If all of its tires are under-inflated by 20 percent, the vehicle takes about 462 feet to stop. If all of its tires are under-inflated by 25 percent, the vehicle takes almost 470 feet to stop. The effects of 20 percent and 25 percent under-inflation on a vehicle's fuel economy and tire life are detailed in the Benefits section below.

The agency notes that, in some cases, sole reliance on the 20 percent or 25 percent figure would yield inflation pressures below 140 kPa (20 psi), a pressure at which the agency believes safety may become an issue. For example, the lowest vehicle manufacturer's recommended cold inflation pressure known to the agency is 26 psi. Under the second alternative, the low tire pressure warning telltale would not have to illuminate until one, two or three tires reaches 19.5 psi because 25 percent below 26 psi is 19.5 psi.

To prevent that from occurring, the agency is proposing to establish a floor. Both the 20 percent figure and the 25 percent figure are coupled with absolute minimum inflation pressures for the different types of tires. The warning telltale would have to be illuminated when the pressure falls to either 20 percent (first alternative) or 25 percent (second alternative) below the vehicle manufacturer's recommended cold inflation pressure, or the specified absolute minimum inflation pressure, whichever pressure is higher. These absolute minimum inflation pressures are specified in the 3rd column of Table 1 (below). (Note: The practical consequences of this floor under the second alternative is that manufacturers may not be able to use indirect TPMSs on vehicles for which the manufacturer's recommended pressure is 27 psi or less. This is because those systems may not be able to detect pressure differentials of less than 25 percent.)

Most passenger cars, minivans and SUVs are equipped with Standard Load P-metric tires. NHTSA chose 140 kPa (20 psi) as the minimum inflation pressure for such tires based on recent testing the agency conducted. The agency ran a variety of Standard Load P-metric tires at 20 psi with a load for 90 minutes on a dynamometer. None of these tires failed. This leads the agency to believe that warnings provided above that level will allow consumers to re-inflate their tires before the tire fails.

140 kPa is about 58 percent of the maximum inflation pressure for Standard Load P-metric tires of 240 kPa. The agency calculated the minimum inflation pressures for the other listed tire types by multiplying their maximum inflation pressures by 58 percent.

The proposed absolute minimum pressure levels for each type of tire are set forth in the following table:

TABLE 1.—LOW TIRE PRESSURE WARNING TELLTALE—MINIMUM ACTIVATION PRESSURE

Tire type	Maximum inflation pressure		Minimum activation pressure	
	(kPa)	(psi)	(kPa)	(psi)
P-metric—Standard Load	240, 300, or 350	35, 44, or 51	140 140 140	20 20 20
P-metric—Extra Load	280 or 340	41 or 49	160 160	23 23
Load Range C	350	51	200	29
Load Range D	450	65	260	38
Load Range E	600	87	350	51

D. Low Tire Pressure Warning Telltale

1. Color

NHTSA is proposing to amend Standard No. 101, Controls and Displays, 49 CFR § 571.101, to require that the warning telltale be yellow. The agency believes that yellow is appropriate because it conveys the message that the driver can continue driving, but should have the tire pressure checked at the earliest opportunity. Red represents a high level of urgency. It is used for a warning that a vehicle system needs immediate attention, and that it is unsafe to drive the vehicle farther. The agency believes that a driver needs to attend to a significantly under-inflated tire, but does not need to stop driving immediately.

2. Symbol

NHTSA is proposing that the warning telltale be identified by one of the symbols shown below. The first symbol was developed by the International Organization for Standardization (ISO), and is currently used in some TPMSs. However, during its May 2001 evaluation of existing TPMSs, NHTSA received some negative comments from evaluators regarding the recognizability of this symbol.[14] As a result, the agency conducted comprehension tests to determine which symbol best conveyed a tire pressure problem to drivers. The agency asked 120 people to look at a picture of 15 symbols, including the ISO symbol, and fill in the blank in the following statement: ''This image has just appeared on your vehicle's dashboard. It is a warning for ______.''

Results of this test showed that the ISO symbol was the least understood among the 15 symbols, with a comprehension rate of only 38%. However, the agency is proposing it as a possible choice because that symbol is currently used in most vehicles equipped with a TPMS. Several of the alternative symbols were recognized 100% of the time. The second proposed symbol below is one of those. Based on comments on this NPRM, the agency will select one of those two symbols and require its use with the telltale.

The third is a symbol that must be used if a vehicle manufacturer provides a display that identifies which tire is significantly under-inflated. The agency notes that many vehicles already have an image of the vehicle built into the dashboard, with lamps located around the image that illuminate when there is a problem (e.g., an incompletely closed door) in that area. Thus, the agency is proposing this symbol in addition to the first two symbols.

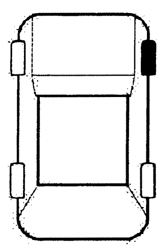
The three proposed symbols are below:

BILLING CODE 4910–59–P

[14] An Evaluation of Existing Tire Pressure Monitoring Systems, May 2001. A copy of this report is available in the docket.

ISO Flat Tire Symbol

Alternative Flat Tire Symbol



Vehicle Symbol Indicating Which Tire Is Significantly Under-inflated

BILLING CODE 4910–59–C

3. Time Frame for Telltale Illumination

As noted above, according to data from the tire industry and consumer surveys, 85 percent of tire pressure losses are slow pressure losses. These are losses in which it takes anywhere from several minutes to several weeks for the tire to become significantly under-inflated. The other 15 percent of tire pressure losses are rapid pressure losses. These losses typically result from a tire's being punctured (without the puncturing object's becoming embedded in the tire) or ruptured. TPMSs are designed to alert the driver to slow pressure losses. They are not intended to alert the driver to a rapid pressure loss.

The agency has received data from TPMS manufacturers indicating that direct TPMSs can alert the driver in less than one minute after a tire becomes significantly under-inflated, while indirect TPMSs can take up to ten minutes to do so. Since TPMSs are designed to alert the driver to slow pressure losses only, the agency believes that ten minutes is ample time. The agency believes that a TPMS that alerts the driver within ten minutes after a tire reaches the significant under-inflation threshold pressure would provide the driver sufficient time to take corrective action and avoid serious tire degradation. Thus, the agency is proposing that the warning telltale must become illuminated not more than ten minutes after a tire becomes significantly under-inflated.

4. Duration of Warning

NHTSA believes that the TPMS warning telltale should be illuminated as long as any of the vehicle's tires remains significantly under-inflated. The agency believes that a driver is more likely to take corrective action if the warning provided is continuous. Thus, in both alternatives, the agency is proposing that the warning telltale remain illuminated as long as any of the vehicle's tires remains significantly under-inflated, and the ignition switch is in the ''on'' (''run'') position, whether or not the engine is running.

The agency would like to receive comments specifically addressing this proposed requirement. Would both direct and indirect TPMSs be able to meet this?

5. Self-Check

During vehicle start-up, many vehicle systems provide a system readiness self-check or a bulb-check to provide an initial indication to the driver that the system is operational. NHTSA is aware that it is necessary to drive vehicles with indirect TPMSs for some distance so that the system can calibrate. As a result, these systems may not be capable of completing a full system self-check before the vehicle is driven. The agency also has no data indicating how often bulbs burn out. As a result, the agency is not proposing a system self-check or a bulb-check requirement. The agency requests comments on whether the standard should require a complete system check, a bulb-check, or no check.

E. System Calibration and Reset

NHTSA notes that most indirect TPMSs need substantial time to calibrate the system, i.e., to ''learn'' the variables associated with distinct tire types under varying driving conditions. The VRTC found that the four indirect TPMSs it evaluated took anywhere from several minutes to several hours to calibrate. This calibration is necessary when a vehicle is first driven, when the pressure in a tire is changed, and when the tires are rotated or replaced.

Indirect TPMSs do not indicate that the system is in calibration mode. During the calibration mode, the system is not monitoring tire pressure. Thus, if one or more tires becomes significantly under-inflated while the system is calibrating, the driver would not be alerted.

The agency is not proposing in either alternative that the TPMS indicate to the driver that the system is in calibration mode. The value of such an indication would likely be negligible since the system would only rarely be in that mode. Recalibration by the driver would typically occur only after replacing, rotating or reinflating tires. Nevertheless, the agency requests comment on this. Should this requirement be included?

NHTSA also notes that some TPMSs automatically extinguish the warning telltale when the inflation pressure in a tire rises above the threshold level for warning indication. These systems thus require no action on the part of the driver.

Other TPMSs make it necessary for the driver to reset the system by means of a reset button after taking action to resolve the low tire pressure problem. This may invite human error or abuse. For example, a driver may accidentally press the reset button when one or more of the vehicle's tires is under-inflated, but not under-inflated enough to illuminate the low tire pressure warning telltale. This would re-calibrate the system so that the under-inflated condition would be accepted as a normal variable. The indirect TPMS then would not be able to detect a significantly under-inflated tire until one or more tires was 20 percent or more lower than it already was. This could also occur if the driver simply pressed the reset button when the low tire pressure warning telltale illuminated. The indirect TPMS would re-calibrate the system so that the under-inflated condition would be accepted as a normal variable, and the system would not be able to detect a significantly under-inflated tire until it was 20 percent or more lower than it already was.

The agency is proposing that the warning telltale deactivate, manually or automatically, only when all of the vehicle's tires cease to be significantly under-inflated. The agency requests comment on this potential problem.

F. System Failure

NHTSA is not proposing that the TPMS must alert the driver in the event of a system malfunction, e.g., by adding a separate system failure telltale. The agency believes that such a requirement might be too costly. However, NHTSA solicits comments on this issue. How difficult would it be to add a system malfunction feature to TPMSs? What are the possible safety benefits of such a feature?

G. Number of Tires Monitored

In the first alternative, the agency is proposing that the TPMS be able to detect when one to four tires becomes significantly under-inflated. In the second alternative, the agency is proposing that the TPMS be able to detect when one to three tires becomes significantly under-inflated. The reason for this difference is that direct TPMSs can detect when all four tires become significantly under-inflated, but most indirect TPMSs cannot.

The agency is requesting comments on whether the second alternative should require that the TPMS be able to detect when all four tires become significantly under-inflated. Under both alternatives, indirect TPMSs would require some improvements in their performance. Current indirect TPMSs that can detect under-inflation only when a tire is 30 percent or more below would have to be improved so they could meet the 25 percent under-inflation requirement for one to three tires. Would requiring that indirect TPMSs be able to detect when all four tires become significantly under-inflated be a reasonable goal? What would the additional benefits and costs of such a requirement be?

H. Replacement Tires/Rims

NHTSA believes that it is important that a TPMS be able to function properly when the vehicle's original tires are replaced. Thus, the agency is proposing to require that each TPMS be able to meet the requirements of the new standard when any of the vehicle's original tires or rims are replaced with any optional or replacement tire/rim size(s) recommended for use on the vehicle by the vehicle manufacturer.

I. Monitoring of Spare Tire

The Federal motor vehicle safety standards do not require vehicles to be equipped with a spare tire. Thus, the agency is not proposing that the TPMS monitor the pressure in the spare tire while it is stowed.

J. Written Instructions

NHTSA is proposing that the vehicle's owner's manual provide an image of the TPMS symbol with the following information, in English: ''When the TPMS warning light is lit, one of your tires is significantly under-inflated. You should stop and check your tires as soon as possible, and inflate them to the proper pressure as indicated on the vehicle's tire inflation placard. Driving on an under-inflated tire causes the tire to overheat and can eventually lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.'' Each vehicle manufacturer may, at its discretion, provide additional information about the significance of the low tire pressure warning telltale illuminating and description of corrective action to be undertaken.

The agency believes that drivers would need this information so that they would know what to do if the low tire pressure warning telltale illuminates. The agency also believes that more drivers will inflate their tires, and thus experience the benefits associated with properly inflated tires, if they understand the potential consequences of significantly under-inflated tires. The agency requests comments addressing this issue. Is this information sufficient, or should the agency require additional information in the owner's manual?

K. Temperature Compensation

During the driving of a motor vehicle, the temperature in its tires increases. The increased temperature causes increases in the inflation pressure in the tire.[15] This phenomenon could impact the ability of a TPMS to measure or calculate the actual pressure in a tire accurately. A temperature compensation feature in a TPMS compensates for the increased inflation due to temperature increases. Some direct TPMSs employ pressure and temperature sensors located in the wheel. The agency is aware of no indirect TPMSs that are capable of compensating for temperature increases in tires.

It is possible that, without temperature compensation, the illumination of the low tire pressure warning telltale could be delayed due to the increased pressure caused by increased temperature. The telltale also could be extinguished due to the increased tire pressure experienced during normal operation. In addition, large fluctuations in the ambient temperature could result in the low tire pressure warning telltale's being activated on vehicles during ignition, and then de-activated after the vehicle has been driven for awhile and the temperature (and thus the pressure) in a tire increases.

NHTSA is not proposing to require a temperature compensation feature in either proposed alternative. The agency believes such a requirement would have limited value and add slightly to the cost of the proposed standard. The agency also believes that indirect TPMSs would not be able to meet such a requirement. However, the agency is concerned that TPMSs without a temperature compensation feature could allow the cold tire pressure to fall below the absolute minimum inflation pressure proposed in Table 1 without warning the driver. The agency requests comments on whether the standard should include a temperature compensation requirement, and what the safety benefits and costs of such a requirement would be. Also, if NHTSA did require a temperature compensation feature, how would the agency test/regulate it?

Alternatively, the agency could amend the test procedures to specify a cool-down period for tires after a vehicle's TPMS has been tested. This may make the tests more repeatable and accurate. The agency requests comments on this issue.

L. Test Conditions

Under both alternatives, NHTSA is proposing that each vehicle be tested at its gross vehicle weight rating (GVWR) and its lightly loaded vehicle weight (LLVW), defined as unloaded vehicle weight plus up to 400 pounds (including test driver and instrumentation). The ambient temperature would be between 0°C (32°F) and 40°C (104°F). The test road surface would be dry and smooth. The vehicle would be tested at a speed between 50 km/h (31.1 mph) and 100 km/h (62.2 mph).

The agency requests comments on these test conditions. For example, some indirect TPMSs require the vehicle to be driven at a variety of speeds, including stops and starts, to calibrate. The agency is proposing that vehicles be tested at a speed between 50 km/h and 100 km/h. This would exclude the stops and starts necessary for some indirect TPMSs to calibrate. It also would necessitate the use of nonpublic test courses, as opposed to public roads, for testing purposes. At what speeds should vehicles be tested? Are there any other driving conditions under which vehicles should be tested?

M. Test Procedures

In both alternatives, NHTSA is proposing that the vehicle's tires be inflated to the vehicle manufacturer's recommended cold inflation pressure. Then the vehicle would be driven between 50 km/h and 100 km/h for up to 20 minutes.

Under the first alternative, while driving at that speed, any combination of tires (from one to all four) is deflated until it is significantly under-inflated. Then the elapsed time between the time the vehicle's tire or combination of tires becomes significantly under-inflated and the time the low tire pressure warning telltale is illuminated is recorded. After the warning telltale illuminates, pressure is added to the tire or combination of tires that was deflated such that the tire or each of those tires is one psi below the level of significant under-inflation. Then the warning telltale is checked to see if it remains illuminated. If the warning telltale remains illuminated, a manual reset is attempted.

Under the second alternative, the procedures are the same, except any combination of tires (from one to three) is deflated until it is significantly under-inflated.

Under both alternatives, the agency is proposing that the test procedures be repeated for each tire and rim combination recommended by the vehicle manufacture for that vehicle. The agency requests comments on whether there are any steps that should be taken between testing different tire and rim combinations and that should be added to the test procedures.

The agency requests comment on all aspects of these test procedures. Should

[15] The actual tire pressure increase due to heat appears to depend on several factors, including whether the tire is under-inflated to start with, the load on the tire, and how much braking has occurred recently. The agency believes that the maximum increase in tire pressure due to increased temperature is 4 psi.

the agency specify more or less than 20 minutes for the system to calibrate? As noted above in the section on Temperature Compensation, the inflation pressure in tires increases as they heat up during normal operation. This may cause variations in testing. To ensure repeatability, should the agency specify that tires be tested cold? Are there any other procedures the agency should specify?

N. Human Factors

There are two human factors issues involved with TPMSs. The first is what information is displayed to the driver and how that information is displayed. The second is whether the driver responds to the information by checking and inflating the vehicle's tires.

Regarding the information displayed to the driver, NHTSA is proposing only a warning telltale that would illuminate when one or more of the vehicle's tires becomes significantly under-inflated. The agency is not proposing that the pressure in each tire be displayed. However, in NHTSA's analysis of the benefits, both in the PEA and below, the agency assumes that manufacturers who install direct TPMSs will display the pressure in each tire because it will be helpful to drivers in terms of safety, fuel economy, and tread life. Most indirect TPMSs are not capable of displaying the pressure in each tire.

The agency anticipates that drivers would react differently to the different information they receive from TPMSs. Some drivers of vehicles equipped with a direct TPMS would keep track of the pressure in each tire and add pressure to their tires whenever necessary, even before the warning telltale becomes illuminated. These drivers would accrue more benefits in terms of increased safety, fuel efficiency, and tread life than drivers who wait until the warning telltale becomes illuminated.

On the other hand, some drivers who currently check and inflate their own tires frequently enough to avoid significant under-inflation may start to rely on the TPMS warning telltale to indicate under-inflation. The agency believes that this would happen more often with drivers of vehicles equipped with an indirect TPMS, which only illuminate a warning telltale when one or more tires becomes significantly under-inflated, than with drivers of vehicles equipped with a direct TPMS, which display the pressure in each tire. These drivers would accrue fewer benefits in terms of safety, fuel efficiency, and tread life.

NHTSA does not have any information on which to base an estimate of the percentage of drivers who would use the information from a display of the pressure in each tire to inflate their tires more frequently than they currently do, or the percentage of drivers who would rely on the TPMS warning telltale to indicate under-inflation and inflate their tires less frequently than they currently do. The agency requests comment on this issue.

VI. Benefits

Following is a summary of the benefits associated with the two proposed alternatives. For a more detailed analysis, see the agency's Preliminary Economic Assessment (PEA). A copy of the PEA has been placed in the docket.

For purposes of this analysis, the agency assumed that vehicles with a direct TPMS will display a continuous readout of the pressure in each tire and have a warning telltale that illuminates when the vehicle's tires become significantly under-inflated. The agency assumed that 80 percent of drivers would react to this tire-specific information and re-inflate the significantly under-inflated tire(s). For indirect TPMSs, the agency assumed that only 60 percent of drivers would react to a low tire pressure warning telltale and re-inflate their significantly under-inflated tire(s). The agency requests comments on these assumptions.

The safety benefits that the agency has quantified come from calculations of a reduction in stopping distance for vehicles with properly inflated tires. NHTSA notes that the relationship of tire inflation to stopping distance is influenced by road conditions (i.e., wet versus dry), as well as by the road surface composition.

In tests conducted by Goodyear, significant increases were found in the stopping distance of tires that were under-inflated. By contrast, tests conducted by NHTSA at the VRTC testing ground found only minor differences in stopping distance. In some cases, these distances actually decreased with lower inflation pressure. The VRTC tests also found only minor differences between wet and dry road surface stopping distance.

It is likely that some of these differences are due to test track surface characteristics. The VRTC track surface is considered to be extremely aggressive in that it allows for maximum friction with tire surfaces. It is more representative of a new road surface than the worn surfaces on the vast majority of roads.

The Goodyear tests may be biased in other ways. Their basic wet surface tests were conducted on surfaces with .05 inch of standing water. This more than typically would be encountered under normal wet road driving conditions, and thus may exaggerate the stopping distances experienced under most circumstances. On the other hand, crashes are more likely to occur under more hazardous conditions, which may mean that the Goodyear data are less biased when applied to the actual crash-involved population.

Generally speaking, the Goodyear test results imply a significant impact on stopping distance from properly inflated tires, while the VRTC test results imply these impacts would be minor or nonexistent. The analysis below and in the PEA estimates stopping distance impacts using the Goodyear data to establish an upper range of potential benefits. A lower range of no benefit is implied by the current VRTC test results. The estimates detailed below are the mid-points between the upper and lower range of potential benefits.

The benefits from preventable crashes were assumed to occur over all crash types and severities. This assumption recognizes that there are a variety of crash circumstances for which marginal reductions in stopping distance may prevent the crash from occurring. Crash prevention may be more likely under some circumstances than others. For example, it is possible that a larger portion of side impact crashes than head-on crashes might be prevented. In side impact crashes where vehicles are moving perpendicular to each other, reduced stopping distance by one vehicle reduces the speed at which it enters the crash zone and potentially allows the second vehicle to move through the crash zone, thus avoiding the impact. In a head-on collision, both vehicles are moving toward the crash and a reduction in stopping distance for one vehicle may not improve the chances of avoiding the crash as much as in a side impact situation. Moreover, if a separate analysis were conducted for different crash types and severities, the portion of crashes prevented would be greater for crashes at higher speeds. However, NHTSA does not have sufficient information to conduct a separate analysis of each crash circumstance. Instead, the agency has used an overall estimate across all crash types. The agency requests comment on this issue.

A. First Alternative

The first alternative would require the TPMS to illuminate the low tire pressure warning telltale when pressure in any tire or combination of tires decreases to 20 percent below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires or the absolute value specified in proposed Table 1, whichever is higher. Thus, the TPMS would have to provide warning when any number of tires, from one to four tires, is significantly under-inflated.

When a vehicle's tires are under-inflated, and it is traveling on a wet surface, the vehicle takes longer to stop than when its tires are properly inflated. For example, according to data from Goodyear, a vehicle traveling at 62 mph on a wet surface takes about 442 feet to stop if its tires are properly inflated. If its tires are under-inflated by 20 percent, the vehicle takes about 462 feet to stop.

The Goodyear data indicates that, under the first alternative, the average stopping distance of passenger cars across all speeds and driving conditions would be reduced from 137 feet (the average stopping distance for a vehicle with tires 20 percent under-inflated) to 132.1 feet (the average stopping distance for a vehicle with properly inflated tires). The average stopping distance of light trucks would be reduced from 131.5 feet to 127.3 feet. This would reduce the number of crashes involving braking passenger cars by 3.6 percent and braking light trucks by 3.2 percent. The other 96.4 percent of crashes involving braking passenger cars and 96.8 percent of crashes involving braking light trucks would still occur, but at a reduced impact speed. The agency estimates that this would result in 79 fewer fatalities and would prevent or reduce in severity 10,635 nonfatal injuries.[16]

Correct tire pressure also improves a vehicle's fuel economy. Recent data from Goodyear indicate that a vehicle's fuel efficiency is reduced by one percent for every 2.96 psi that its tires are below the vehicle manufacturer's recommended cold inflation pressure. NHTSA estimates that, under the first alternative, the average vehicle would get a little over 2 percent higher fuel economy. This translates into an average discounted value of $32.22 (in 2001 dollars) over the lifetime of the vehicle for passenger cars and light trucks.

Correct tire pressure also increases a tire's life. Data from Goodyear indicate that for every 1 psi drop in tire pressure, tread life decreases by 1.78 percent. NHTSA estimates that under the first alternative, the average tire life would increase by 1,404 miles for passenger cars and 1,972 miles for light trucks. This would delay new tire purchases. The agency estimates that the average discounted value of these delayed tire purchases is $5.26 for passenger cars and $16.80 for light trucks.

B. Second Alternative

The second alternative requires the TPMS to illuminate the low tire pressure warning telltale when pressure in any tire or combination of tires, up to a total of three tires, decreases to 25 percent below the vehicle manufacturer's recommended cold inflation pressure for the vehicle's tires, or the absolute value specified in proposed Table 1, whichever is higher.

NHTSA estimates that the second alternative would also reduce a vehicle's stopping distance. However, since the pressure level at which the driver is warned is lower in the second alternative (25 percent versus 20 percent), fewer drivers would receive a low tire pressure warning. Thus, fewer drivers would inflate their tires to the proper pressure, and fewer vehicles would experience the reduced stopping distance. Consequently, the agency estimates that under the second alternative, the reduction in stopping distance would result in 49 fewer fatalities and would prevent or reduce in severity 6,585 nonfatal injuries.[17]

NHTSA estimates that under the second alternative, vehicles' fuel economy would be improved. However, fewer vehicles would experience this improvement for the reasons stated in the previous paragraph. Consequently, the agency estimates that under the second alternative, improved fuel economy would translate into an average discounted value of $16.40 (in 2001 dollars) over the lifetime of the vehicle for passenger cars and light trucks.

NHTSA estimates that under the second alternative, tire life would be increased by 1,131 miles for passenger cars and 1,615 miles for light trucks if they are equipped with a direct TPMS. If they are equipped with an indirect TPMS, the agency estimates that tire life would be increased by 635 miles for passenger cars and 615 miles for light trucks. This would delay new tire purchases. The agency estimates that the average discounted value of these delayed tire purchases is $4.24 for passenger cars and $13.84 for light trucks if they are equipped with a direct TPMS, and $2.39 for passenger cars and $5.17 for light trucks if they are equipped with an indirect TPMS.

NHTSA notes that longer tire life is an economic benefit rather than a safety benefit. The agency is concerned that tires' tread may last longer than other parts of the tire, e.g., the sidewall. Most drivers change their tires when the tread is low. If the tread outlasts the rest of the tire, the tire may fail. The agency believes that part of the cause of the Firestone problem was that the tread lasted longer than expected, allowing other failures to occur. The agency requests comment on this issue.

C. Unquantified Benefits

The agency believes the proposals would also result in other benefits, such as fewer crashes resulting from tire blowouts, adverse effects on vehicle handling due to inflation pressure loss and hydroplaning, from fewer crashes involving vehicles that had been stopped by the side of the road because of a flat tire, and the prevention of the property damage that results from these crashes. For more information on these unquantified benefits, see the PEA. NHTSA has not attempted to quantify those benefits. The agency requests comment on these unquantified benefits.

VII. Costs

A. Indirect TPMSs

The costs of incorporating an indirect TPMS into a vehicle would vary depending on the way in which the incorporation is accomplished. In order to add a current ABS-based indirect TPMS to a motor vehicle that already has an ABS, the agency assumes that the vehicle's manufacturer would only have to add the capability to monitor the wheel speed sensors, a low tire pressure warning telltale, and a reset button, and make some software changes. NHTSA estimates that the cost of adding these features would be about $12.90 per vehicle. However, as explained below, the agency is uncertain whether the resulting ABS-based indirect TPMS would comply with either alternative.

NHTSA tested four current ABS-based indirect TPMSs. None of the four met the proposed requirements for either alternative. These TPMSs had problems detecting two significantly under-inflated tires on the same axle and on the same side of the vehicle. They also did not illuminate the low tire pressure warning telltale when the pressure in the vehicle's tires decreased to 20 percent, or even 25 percent, below the vehicle manufacturer's recommended cold inflation pressure. NHTSA does not know whether improving current indirect TPMSs to meet the requirements of either alternative would

[16] The range of injuries prevented would be 0 to 21,270, and the range of deaths prevented would be 0 to 158.

[17] The range of injuries prevented would be 0 to 13,170, and the range of deaths prevented would be 0 to 97.

result in additional costs. The agency requests comments on this issue.

Pickup trucks comprise about 40 percent of light truck sales. Some percentage of pickup trucks that have ABS have only one wheel speed sensor for the rear axle. In order to meet the requirements of either proposed alternative, NHTSA believes vehicle manufacturers would have to add a fourth wheel speed sensor to these trucks at an estimated cost of $20 per vehicle. The agency assumes for this analysis that about 10 percent of all light trucks, or 7.5 percent of all light vehicles with ABS, would be in this category. However, the agency requests comment on the percentage of pickup trucks that would require this modification.

For vehicles currently without ABS, there are two indirect measurement choices. First, the vehicle manufacturer could add ABS and the necessary TPMS features to the vehicle. NHTSA estimates that this would cost about $240 per vehicle. The agency does not expect manufacturers that make this choice unless they are already planning for other reasons to add ABS. Second, the vehicle manufacturer could add wheel speed sensors and the necessary TPMS features to the vehicle. NHTSA estimates that this approach would cost about $130 per vehicle.

B. Direct TPMSs

There are two main costs associated with direct TPMSs: sensors and a receiver. There is a wide disparity in costs for sensors, depending on what type of information is sensed. Providing pressure sensors would cost from $5 to $10 per wheel, or $20 to $40 per vehicle.

The cost of the receiver depends upon whether the vehicle already has a receiver capable of receiving and processing the information coming from the sensors. NHTSA estimates that about 60 percent of vehicles currently have such a receiver. Making some software changes and adding a display showing the pressure for each tire would cost about $25 per vehicle. The 40 percent of vehicles without such a receiver would have to be equipped with a receiver, a display, and the necessary software. The agency estimates that this would cost about $40 to $50 per vehicle.

The agency estimates that installation costs for a direct TPMS would be about $4 per vehicle.

Thus, the agency estimates that the cost of adding a direct TPMS to a vehicle that is already equipped with a receiver would be $49 to $69. For a vehicle that is not already equipped with a receiver, the cost would be $64 to $94. The agency used the midpoints of $59 and $79 to determine the cost per vehicle of the first alternative

NHTSA determined the current use of TPMSs in new vehicles by using the calendar year 2000 sales, a model year 2001 list of the makes and models with each type of system, and an estimate that 2 percent of sales were purchased as an option on those models that offered a TPMS as an option. As a result, the agency estimates that 4 percent of the model year 2001 light vehicle fleet has an indirect TPMS, and 1 percent of the fleet has a direct TPMS.

NHTSA conducted tear down studies of two currently available direct TPMSs, one produced by Beru and the other produced by Johnson Controls. The agency chose the Beru TPMS because it is considered top-of-the-line. It also was the most expensive direct TPMS the agency found on the market, at a cost of $200. The Johnson Controls direct TPMS, on the other hand, is typical of most direct TPMSs. It cost only $69, similar to the costs estimated by the agency.

C. Testing and Maintenance Costs

There are some costs that would be associated with both direct and indirect TPMSs. For example, both systems would have to be tested for compliance with the proposed requirements. The agency estimates that the man-hours required to complete the testing would be 6 hours for a manager, 30 hours for a test engineer, and 30 hours for a test technician/driver. The agency estimates labor costs would be $75 per hour for a manager, $53 per hour for a test engineer, and $31 per hour for a test technician/driver. Thus, the agency estimates total testing costs would be $2,970 per vehicle model.

D. Unquantified Costs

The agency believes the proposals may also result in additional costs, such as the cost of replacing worn or damaged TPMS equipment, the cost of replacing batteries in a direct TPMS, and the cost of the time it would take for a driver to react to a low tire pressure warning by pulling over to a gas station to check and inflate the vehicle's tires. NHTSA has not attempted to quantify those costs. The agency requests comment on these unquantified costs.

E. First Alternative

Assuming that installation of a direct TPMS would be necessary to achieve compliance, the agency estimates that the average incremental cost would be $66.33 per vehicle. This would result in an average net cost of $23.08 per vehicle ($66.33 − $32.22 (fuel savings) − $11.03 (tread wear savings)), and a net cost per equivalent life saved of $1.9 million. The total annual cost would be about $1.06 billion, or $369 million when the fuel and tread wear savings are factored in.

F. Second Alternative

An indirect TPMS for all passenger cars and light trucks that are already equipped with an ABS would cost an average of $12.90 per ABS-equipped vehicle. The agency assumes that vehicle manufacturers would choose to equip vehicles that are not equipped with an ABS with a direct TPMS because it is cheaper than adding wheel speed sensors or an ABS. The average cost of adding a direct TPMS would be $66.33 per vehicle. The agency estimates that the overall cost of the second alternative would be $30.54 per vehicle, since 67 percent of vehicles are equipped with an ABS, while 33 percent are not. This would result in an average net cost of $8.63 ($30.54 − $16.40 (fuel savings) − $5.51 (tread wear savings)) per vehicle, and a net cost per equivalent life saved of $1.1 million. The total annual cost would be about $489 million, or $138 million when the fuel and tread wear savings are factored in.

VIII. Lead-Time

The TREAD Act requires that this rule take effect two years after the final rule is issued. Since the final rule must be issued by November 1, 2001, the rule must take effect not later than November 1, 2003.

NHTSA requests comment on whether vehicle manufacturers will be able to meet the statutory deadline, and whether TPMS manufacturers will be able to supply enough TPMSs to meet the demand under either of the alternatives proposed in this NPRM.

The agency requests comments also on whether a phase-in beginning on November 1, 2003, would be appropriate. Such a phase-in might provide for the compliance of 35 percent of production in the first year (2003), 65 percent in the second year (2004), and 100 percent in the third year (2005). If a phase-in were adopted, should carry forward credit be given for early compliance?

IX. Rulemaking Analyses and Notices

A. Executive Order 12866 and DOT Regulatory Policies and Procedures

Executive Order 12866, ''Regulatory Planning and Review'' (58 FR 51735, October 4, 1993), provides for making determinations whether a regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and to the requirements of the Executive Order. The Order defines a ''significant regulatory action'' as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or Tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

This proposal is economically significant. Accordingly, it was reviewed under Executive Order 12866. The rule is also significant within the meaning of the Department of Transportation's Regulatory Policies and Procedures. The agency has estimated that compliance with this proposed rule would cost from $30.54 to $66.33 per vehicle per year. Since approximately 16 million vehicles are produced for the United States market each year, this proposal would have greater than a $100 million effect.

Because this proposed rule is significant, the agency has prepared a Preliminary Economic Analysis (PEA). This analysis is summarized above in the sections on Benefits and Costs. The PEA is available in the docket and has been placed on the agency's website along with the proposal itself.

B. Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions). The Small Business Administration's regulations at 13 CFR part 121 define a small business, in part, as a business entity ''which operates primarily within the United States.'' (13 CFR 121.105(a)). No regulatory flexibility analysis is required if the head of an agency certifies the rule will not have a significant economic impact on a substantial number of small entities. SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities.

NHTSA has considered the effects of this proposed rule under the Regulatory Flexibility Act. I certify that this proposed rule would not have a significant economic impact on a substantial number of small entities. The rationale for this certification is that currently there are only four small motor vehicle manufacturers in the United States that would have to comply with this proposed rule. These manufacturers would have to rely on suppliers to provide the TPMS hardware, and then they would have to integrate the TPMS into their vehicles.

There are a few small manufacturers that manufacture recreational vehicles which would have to comply with this proposed rule. However, most of these manufacturers use van chassis supplied by the larger manufacturers, e.g., General Motors, Ford, or DaimlerChrysler, and could use the TPMSs supplied with the chassis. These manufacturers also would not have to test the TPMS for compliance with this proposed rule since they would be able to rely upon the chassis manufacturer's incomplete vehicle documentation.

C. National Environmental Policy Act

NHTSA has analyzed this rulemaking action for the purposes of the National Environmental Policy Act. The agency has determined that implementation of this proposed rule would not have any significant impact on the quality of the human environment.

D. Executive Order 13132 (Federalism)

Executive Order 13132 requires NHTSA to develop an accountable process to ensure ''meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.'' ''Policies that have federalism implications'' is defined in the Executive Order to include regulations that have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.'' Under Executive Order 13132, the agency may not issue a regulation with Federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, the agency consults with State and local governments, or the agency consults with State and local officials early in the process of developing the proposed regulation. NHTSA also may not issue a regulation with Federalism implications and that preempts State law unless the agency consults with State and local officials early in the process of developing the proposed regulation.

The agency has analyzed this proposed rule in accordance with the principles and criteria set forth in Executive Order 13132 and has determined that it would not have sufficient federalism implications to warrant consultation with State and local officials or the preparation of a federalism summary impact statement. The proposal would not have any substantial effects on the States, or on the current Federal-State relationship, or on the current distribution of power and responsibilities among the various local officials.

E. Civil Justice Reform

This proposed amendment would not have any retroactive effect. Under 49 U.S.C. 30103, whenever a Federal motor vehicle safety standard is in effect, a State may not adopt or maintain a safety standard applicable to the same aspect of performance which is not identical to the Federal standard, except to the extent that the state requirement imposes a higher level of performance and applies only to vehicles procured for the State's use. 49 U.S.C. 30161 sets forth a procedure for judicial review of final rules establishing, amending, or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court.

F. Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995, a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. This proposed rule would not require any collections of information as defined by the OMB in 5 CFR Part 1320.

G. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement

Act of 1995 (NTTAA), Public Law 104–113, section 12(d) (15 U.S.C. 272) directs us to use voluntary consensus standards in our regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies, such as the Society of Automotive Engineers (SAE). The NTTAA directs us to provide Congress, through OMB, explanations when we decide not to use available and applicable voluntary consensus standards.

There are no voluntary consensus standards available at this time. However, NHTSA will consider any such standards when they become available.

H. Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of more than $100 million in any one year (adjusted for inflation with base year of 1995). Before promulgating a rule for which a written statement is needed, section 205 of the UMRA generally requires NHTSA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows NHTSA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the agency publishes with the final rule an explanation why that alternative was not adopted.

This proposed rule would not result in the expenditure by State, local, or tribal governments, in the aggregate, of more than $100 million annually, but it would result in the expenditure of that magnitude by vehicle manufacturers and/or their suppliers. This document seeks comments on two alternatives for achieving the purposes of the TREAD Act mandate.

I. Plain Language

Executive Order 12866 requires each agency to write all rules in plain language. Application of the principles of plain language includes consideration of the following questions:

—Have we organized the material to suit the public's needs?
—Are the requirements in the rule clearly stated?
—Does the rule contain technical language or jargon that is not clear?
—Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand?
—Would more (but shorter) sections be better?
—Could we improve clarity by adding tables, lists, or diagrams?
—What else could we do to make this rulemaking easier to understand?

If you have any responses to these questions, please include them in your comments on this NPRM.

J. Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

Comments

How Do I Prepare and Submit Comments?

Your comments must be written and in English. To ensure that your comments are correctly filed in the Docket, please include the docket number of this document in your comments.

Your comments must not be more than 15 pages long. (49 CFR 553.21). We established this limit to encourage you to write your primary comments in a concise fashion. However, you may attach necessary additional documents to your comments. There is no limit on the length of the attachments.

Please submit two copies of your comments, including the attachments, to Docket Management at the address given above under **ADDRESSES.**

In addition, given the statutory deadline of November 1, 2001, for issuance of the final rule, for those comments of 4 or more pages in length, we request that you send 10 additional copies, as well as one copy on computer disc, to: Mr. George Soodoo, Office of Crash Avoidance Standards, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. We emphasize that this is not a requirement. However, we ask that you do this to aid us in expediting our review of all comments. The copy on computer disc may be in any format, although we would prefer that it be in WordPerfect 8 or Word 2000.

You may also submit your comments to the docket electronically by logging onto the Dockets Management System website at *http://dms.dot.gov.* Click on ''Help & Information'' or ''Help/Info'' to obtain instructions for filing the document electronically.

How Can I Be Sure That My Comments Were Received?

If you wish Docket Management to notify you upon its receipt of your comments, enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

How Do I Submit Confidential Business Information?

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under **FOR FURTHER INFORMATION CONTACT.** In addition, you should submit two copies, from which you have deleted the claimed confidential business information, to Docket Management at the address given above under **ADDRESSES.** When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR part 512.)

Will the Agency Consider Late Comments?

We will consider all comments that Docket Management receives before the close of business on the comment closing date indicated above under **DATES.** To the extent possible, we will also consider comments that Docket Management receives after that date. If Docket Management receives a comment too late for us to consider it in developing a final rule (assuming that one is issued), we will consider that comment as an informal suggestion for future rulemaking action.

How Can I Read the Comments Submitted by Other People?

You may read the comments received by Docket Management at the address given above under **ADDRESSES.** The hours of the Docket are indicated above in the same location.

You may also see the comments on the Internet. To read the comments on the Internet, take the following steps:

1. Go to the Docket Management System (DMS) Web page of the Department of Transportation (*http://dms.dot.gov/).*

2. On that page, click on ''search.''

3. On the next page (http://dms.dot.gov/search/), type in the four-digit docket number shown at the beginning of this document. Example: If the docket number were ''NHTSA–1998–1234,'' you would type ''1234.'' After typing the docket number, click on ''search.''

4. On the next page, which contains docket summary information for the docket you selected, click on the desired comments. You may download the comments. Although the comments are imaged documents, instead of word processing documents, the ''pdf'' versions of the documents are word searchable.

Please note that even after the comment closing date, we will continue to file relevant information in the Docket as it becomes available. Further, some people may submit late comments. Accordingly, we recommend that you periodically check the Docket for new material.

List of Subjects in 49 CFR Part 571

Imports, Motor vehicle safety, Reporting and recordkeeping requirements, Tires.

In consideration of the foregoing, NHTSA proposes to amend 49 CFR part 571 as follows:

PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

1. The authority citation for part 571 would continue to read as follows:

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.50.

2. In section 571.101, in Table 2, two new entries would be added at the end of the table to read as follows:

§ 571.101 Standard No. 101; controls and displays.

* * * * *

TABLE 2.—IDENTIFICATION AND ILLUSTRATION OF DISPLAYS

Column 1	Column 2	Column 3	Column 4	Column 5
Display	Telltale Color	Identifying Words or Abbreviation.	Identifying Symbol	Illumination.

* * * * *

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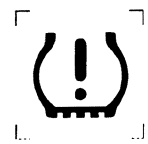
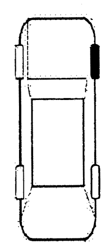
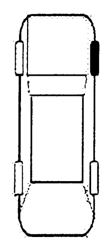
[ALTERNATIVE 1 FOR NEW ENTRIES]

Low Tire Pressure Telltale (that does not identify which tire has low pressure)	Yellow	Tire Pressure Monitoring System or Low Tire Pressure. Also see FMVSS 138		Yes
Low Tire Pressure Telltale (that identifies which tire has low pressure)	Yellow			Yes

[ALTERNATIVE 2 FOR NEW ENTRIES]

Low Tire Pressure Telltale (that does not identify which tire has low pressure)	Yellow	Tire Pressure Monitoring System or Low Tire Pressure. Also see FMVSS 138		Yes
Low Tire Pressure Telltale (that identifies which tire has low pressure)	Yellow			Yes

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3. Section 571.138 would be added to read as follows:

§ 571.138 Standard No. 138; tire pressure monitoring systems.

[FIRST ALTERNATIVE FOR S1 THROUGH S6]

S1. *Purpose and scope.* This standard specifies performance requirements for tire pressure monitoring systems to prevent significant under-inflation of tires and the resulting safety problems.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses that have a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less, and that are manufactured on or after [The date that is two years after date of publication of final rule.].

S3. *Definitions.* The following definitions apply to this standard:

Lightly loaded vehicle weight means unloaded vehicle weight, plus up to 400 pounds (including test driver and instrumentation).

Significantly under-inflated means any inflation pressure that is equal to or less than either the pressure 20 percent below the vehicle manufacturer's recommended cold inflation pressure, or the pressure specified in the 3rd column of Table 1 of this standard for the corresponding type of tire, whichever is higher.

Tire pressure monitoring system means a system that detects when one or more of a vehicle's tires is significantly under-inflated and illuminates the low tire pressure warning telltale.

S4. *Requirements.*

S4.1 *General.* Each vehicle must be equipped with a tire pressure monitoring system that meets the requirements of S4.2 and S4.3 of this standard under the test conditions of S5 and the test procedures of S6.

S4.2 *Low tire pressure warning telltale.*

S4.2.1 Each tire pressure monitoring system must include a low tire pressure warning telltale that:

(a) Is mounted inside the occupant compartment in clear view of the driver;

(b) Is identified by the symbol or words shown for the ''Low Tire Pressure Telltale'' in Table 2 of Standard No. 101 (§ 571.101);

(c) Becomes illuminated not more than 10 minutes after any of the vehicle's tires becomes significantly under-inflated;

(d) Remains illuminated as long as any of the vehicle's tires remains significantly under-inflated, and the ignition switch is in the ''on'' (''run'') position, whether or not the engine is running; and

(e) Can be deactivated, manually or automatically, only when all of the vehicle's tires cease to be significantly under-inflated.

S4.2.2 In the case of a telltale that identifies which tires are significantly under-inflated, each tire in the symbol for that telltale must illuminate when the tire it represents is significantly under-inflated.

S4.3 *Replacement tires/rims.* Each tire pressure monitoring system must continue to meet the requirements of this standard when the vehicle's original tires or rims are replaced with any optional or replacement tire/rim size(s) recommended for the vehicle by the vehicle manufacturer.

S4.4 *Written instructions.* The owner's manual in each vehicle must provide an image of the TPMS symbol with the following information, in English: ''When the TPMS warning light is lit, one of your tires is significantly under-inflated. You should stop and check your tires as soon as possible, and inflate them to the proper pressure as indicated on the vehicle's tire inflation placard. Driving on an under-inflated tire causes the tire to overheat and can eventually lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.'' Each vehicle manufacturer may, at its discretion, provide additional information about the significance of the low tire pressure warning telltale illuminating and description of corrective action to be undertaken.

S5. *Test conditions.*

S5.1 *Ambient temperature.* The ambient temperature is between 0°C (32°F) and 40°C (104°F).

S5.2 *Road test surface.* Road tests are conducted on a dry, smooth roadway.

S5.3 *Vehicle conditions.*

S5.3.1 *Test weight.* The vehicle is tested at its lightly loaded vehicle weight and at its gross vehicle weight rating without exceeding any of its gross axle weight ratings.

S5.3.2 *Vehicle speed.* The vehicle is tested at a speed between 50 km/h (31.1 mph) and 100 km/h (62.2 mph).

S6. *Test procedures.*

(a) Inflate the vehicle's tires to the vehicle manufacturer's recommended cold inflation pressure.

(b) Drive the vehicle between 50 km/h and 100 km/h for up to 20 minute.

(c) While driving within the speed range specified in paragraph S6(b) of this standard, deflate any tire or combination of the vehicle's tires until that tire or each of those tires is significantly under-inflated.

(d) Continue to drive within the speed range specified in paragraph S6(b) of this standard. Record the elapsed time between the time when the vehicle's tire or combination of tires becomes significantly under-inflated to the time the low tire pressure warning telltale is illuminated.

(e) After the warning telltale illuminates, add pressure (if necessary) to the tire or combination of tires that was deflated such that that tire or each of those tires is one psi below the level of significant under-inflation. Check to see if the warning telltale remains illuminated. If the warning telltale remains on, attempt to manually reset the system in accordance with the written instructions provided by the vehicle manufacturer.

(f) Repeat the test procedures in paragraphs 6(a) through (e) for each tire and rim combination recommended for the vehicle by the vehicle manufacturer.

Tables to § 571.138

TABLE 1.—LOW TIRE PRESSURE WARNING TELLTALE—MINIMUM ACTIVATION PRESSURE

Tire type	Maximum inflation minimum		Pressure activation pressure	
	(kPa)	(psi)	(kPa)	(psi)
P-metric—Standard Load	240,	35,	140	20
	300, or	44, or	140	20
	350	51	140	20
P-metric—Extra Load	280 or	41 or	160	23
	340	49	160	23
Load Range C	350	51	200	29
Load Range D	450	65	260	38
Load Range E	600	87	350	51

[SECOND ALTERNATIVE FOR S1 THROUGH S6]

S1. *Purpose and scope.* This standard specifies performance requirements for tire pressure monitoring systems to prevent significant under-inflation of tires and the resulting safety problems.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses that have a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less, and that are manufactured on or after [The date that is two years after date of publication of final rule.].

S3. *Definitions.* The following definitions apply to this standard:

Lightly loaded vehicle weight means unloaded vehicle weight plus up to 400 pounds (including test driver and instrumentation).

Significantly under-inflated means any inflation pressure that is equal to or less than either the pressure 25 percent below the vehicle manufacturer's recommended cold inflation pressure, or the pressure specified in the 3rd column of Table 1 of this standard for the corresponding type of tire, whichever is higher.

Tire pressure monitoring system means a system that detects when one or more of a vehicle's tires is significantly under-inflated and illuminates the low tire pressure warning telltale.

S4. *Requirements.*

S4.1 *General.* Each vehicle must be equipped with a tire pressure monitoring system that meets the requirements of S4.2 and S4.3 of this standard under the test conditions of S5 and the test procedures of S6.

S4.2 *Low tire pressure warning telltale.*

S4.2.1 Each tire pressure monitoring system must include a low tire pressure warning telltale that:

(a) Is mounted inside the occupant compartment in clear view of the driver;

(b) Is identified by the symbol or words shown for the ''Low Tire Pressure Telltale'' in Table 2 of Standard No. 101 (§ 571.101);

(c) Becomes illuminated not more than 10 minutes after any of the vehicle's tires becomes significantly under-inflated;

(d) Remains illuminated as long as any of the vehicle's tires remains significantly under-inflated, and the ignition switch is in the ''on'' (''run'') position, whether or not the engine is running; and

(e) Can be deactivated, manually or automatically, only when all of the vehicle's tires cease to be significantly under-inflated.

S4.2.2 In the case of a telltale that identifies which tires are significantly under-inflated, each tire in the symbol for that telltale must illuminate when the tire it represents is significantly under-inflated.

S4.3 *Replacement tires/rims.* Each tire pressure monitoring system must continue to meet the requirements of this standard when the vehicle's original tires or rims are replaced with any optional or replacement tire/rim size(s) recommended for the vehicle by the vehicle manufacturer.

S4.4 *Written instructions.* The owner's manual in each vehicle must provide an image of the TPMS symbol with the following information, in English: ''When the TPMS warning light is lit, one of your tires is significantly under-inflated. You should stop and check your tires as soon as possible, and inflate them to the proper pressure as indicated on the vehicle's tire inflation placard. Driving on an under-inflated tire causes the tire to overheat and can eventually lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.'' Each vehicle manufacturer may, at its discretion, provide additional information about the significance of the low tire pressure warning telltale illuminating and description of corrective action to be undertaken.

S5. *Test conditions.*

S5.1 *Ambient temperature.* The ambient temperature is between 0°C (32°F) and 40°C (104°F).

S5.2 Road test surface. Road tests are conducted on a dry, smooth roadway.

S5.3 *Vehicle conditions.*

S5.3.1 *Test weight.* The vehicle is tested at its lightly loaded vehicle weight and at its gross vehicle weight rating without exceeding any of its gross axle weight ratings.

S5.3.2 *Vehicle speed.* The vehicle is tested at a speed between 50 km/h (31.1 mph) and 100 km/h (62.2 mph).

S6. *Test procedures.*

(a) Inflate the vehicle's tires to the vehicle manufacturer's recommended cold inflation pressure.

(b) Drive the vehicle between 50 km/h and 100 km/h for up to 20 minutes.

(c) While driving within the speed range specified in paragraph S6(b) of this standard, deflate any tire or combination of the vehicle's tires, up to a total of three tires, until that tire or each of those tires is significantly under-inflated.

(d) Continue to drive within the speed range specified in paragraph S6(b) of this standard. Record the elapsed time between the time when the vehicle's tire or combination of tires becomes significantly under-inflated to the time the low tire pressure warning telltale is illuminated.

(e) After the warning telltale illuminates, add pressure (if necessary) to the tire or combination of tires that was deflated such that that tire or each of those tires is one psi below the level of significant under-inflation. Check to see if the warning telltale remains illuminated. If the warning telltale remains on, attempt to manually reset the system in accordance with the written instructions provided by the vehicle manufacturer.

(f) Repeat the test procedures in paragraphs 6(a) through (e) for each tire and rim combination recommended for the vehicle by the vehicle manufacturer.

Tables to § 571.138

TABLE 1.—LOW TIRE PRESSURE WARNING TELLTALE—MINIMUM ACTIVATION PRESSURE

Tire type	Maximum inflation pressure		Minimum activation pressure	
	(kPa)	(psi)	(kPa)	(psi)
P-metric—Standard Load	240,	35,	140	20
	300, or	44, or	140	20
	350	51	140	20
P-metric—Extra Load	280 or	41 or	160	23
	340	49	160	23
Load Range C	350	51	200	29
Load Range D	450	65	260	38
Load Range E	600	87	350	51

Issued: July 23, 2001.

Stephen R. Kratzke,

Associate Administrator for Safety Performance Standards.

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