

SPRING NEWSLETTER

NHTSA Sets Standard for Tire Pressure Monitoring Devices

[Docket No. NHTSA 2000-8572, RIN 2127-AI33]

The Transportation Recall Enhancement, Accountability, and Documentation Act

Congress enacted the TREAD Act on November 1, 2000. ⁽⁴⁾ Section 13 of the TREAD Act mandated the completion of "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 requires the regulation to take effect within two years of the completion of the rulemaking.

Tire Pressure Monitoring Systems

There are currently two types of TPMSs: direct and indirect. Other types, including hybrid TPMSs that combine aspects of both direct and indirect systems, may be developed in the future. Direct TPMSs directly measure the pressure in a vehicle's tires, while indirect TPMSs estimate differences in pressure by comparing the rotational speed of the wheels. To varying degrees, both types can 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. At this time, NHTSA does not have any information indicating that a hybrid TPMS is being planned for production. However, the agency received comments from TRW, a TPMS manufacturer, stating its belief that such a system could be produced.

The VRTC evaluated six direct and four indirect TPMSs that are currently available. ⁽²⁷⁾ The VRTC found that the direct TPMSs were accurate to within an average of ± 1.0 psi. ⁽²⁸⁾ This leads the agency to believe that those 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 currently available types of TPMSs and their capabilities.

Indirect TPMSs

Current indirect TPMSs work with a vehicle's 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 current indirect TPMSs compare the sums of the wheel speeds on each diagonal (i.e., the sum of the speeds of the right front and left rear wheels as compared to the sum of the speeds of the left front and right rear wheels). Dividing the difference of the sums by the average of the four wheels speeds allows the indirect TPMS to have a ratio that is independent of vehicle speed. This ratio is best expressed by the following equation: $[(RF + LR) - (LF + RR)/Average Speed]$. If this ratio deviates from a set tolerance, one or more tires must be over- or under-inflated. A telltale then indicates to the driver that a tire is under-inflated. However, the telltale cannot identify which tire is under-inflated. Current vehicles that have indirect TPMSs include the Toyota Sienna, Ford Windstar, and Oldsmobile Alero.

Current indirect TPMSs must compare the average of the speeds of the diagonal wheels for several reasons. First, current indirect TPMSs cannot compare the speed of one wheel to the speeds of the other three wheels individually or to the average speed of the four wheels. During any degree of turning, the outside tires must rotate faster than the inside tires. Thus, all four wheel speeds deviate significantly when the vehicle is in a curve or turn. If a current indirect TPMS compared each individual wheel speed to the average of all four wheels speeds, the system would provide a false alarm each time the vehicle rounded a curve or made a turn. The same would be true if the indirect TPMS compared each individual wheel speed to the speed of the other three wheels individually. Since the outside wheels would rotate much faster than the inside wheels in a curve or turn, each outside tire would appear to be under-inflated when compared to an inside tire.

Current indirect TPMSs also cannot compare the speeds of the front wheels to the speeds of the rear wheels because in curves, the front and rear wheels (on both sides of the vehicle) rotate at different speeds. This is primarily due to the fact that the front axle is steerable and follows a different trajectory than the rear axle. As a result, current indirect TPMS must compare a tire from each side and a tire from the front and rear axles to factor out the speed difference caused by curves and turns. Thus, current indirect TPMSs must compare the average speed of the diagonal wheels.

The VRTC tested four current ABS-based indirect TPMSs. None met all the requirements of either alternative proposed in the NPRM. All but one did not illuminate the low tire pressure warning telltale when the pressure in the vehicle's tires decreased to 20 or 25 percent below the placard pressure.⁽²⁹⁾ The VRTC determined that since reductions in tire diameter with reductions in pressure are very slight in the 15-40 psi range, most current indirect TPMSs require a 20 to 30 percent drop in pressure before they are able to detect under-inflation. The VRTC also concluded that those thresholds were highly dependent on tire and loading factors.

The VRTC also found that none of the tested indirect TPMSs were able to detect significant under-inflation when all four of the vehicle's tires were equally under-inflated, or when two tires on the same axle or two tires on the same side of the vehicle were equally under-inflated. However, the VRTC did find that indirect TPMSs could detect when two tires located diagonally from each other (e.g., the front left and back right tires) became significantly under-inflated.

Direct TPMSs

Direct TPMSs use pressure sensors, located in each wheel, to directly measure the pressure in each tire. These sensors broadcast pressure data via a wireless radio frequency transmitter to a central receiver. The data are then analyzed and the results sent to a

display mounted inside the vehicle. The type of display varies from a simple telltale, which is how most vehicles are currently equipped, to a display showing the pressure 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.

Since direct TPMSs actually measure the pressure in each tire, they are able to detect when any tire or when each tire in any combination of tires is under-inflated, including when all four of the vehicle's tires are equally under-inflated. Direct TPMSs also can detect small pressure losses. Some systems can detect a drop in pressure as small as 1 psi.

Hybrid TPMSs

In their comments on the NPRM, TRW, a manufacturer of both direct and indirect TPMSs, stated that in order to meet the proposed requirements of the 3-tire, 25 percent alternative, current indirect TPMSs would need the equivalent of the addition of two tire pressure sensors and a radio frequency receiver. The tire pressure sensors would be installed on wheels located diagonally from each other.

For the following reasons, the agency believes that such a "hybrid" TPMS would be able to overcome the limitations of current indirect TPMSs, i.e., the inability to detect when all four tires, or two tires on the same axle or same side of the vehicle are under-inflated. First, a hybrid TPMS would be able to detect when two tires on the same axle or the same side of the vehicle were under-inflated because one of those tires necessarily would contain a direct pressure sensor. Second, a hybrid TPMS would be able to detect when the two tires without a direct pressure sensor were under-inflated because they would be located diagonally from each other, and, as the VRTC found in its review of current TPMSs, current indirect TPMSs are able to detect when two tires located diagonally from each other are under-inflated.

How often is tire pressure checked?	Drivers of passenger cars (%)	Drivers of pick-up trucks, SUVs, and vans (%)	
		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

Third, a hybrid TPMS would be able to detect when three or four tires were under-inflated because one of those tires necessarily would contain a direct pressure sensor.

However, since the agency does not have any information indicating that a hybrid TPMS is currently being planned for production, the agency does not know when such a system could be produced.

Part One -- Phase-in (November 2003 through October 2006)

NHTSA has decided to require vehicle manufacturers to equip their light vehicles (i.e., those with a gross vehicle weight rating (GVWR) of 10,000 lbs. or less) with TPMSs and to give them the option for complying with either of two sets of performance requirements during the period covered by the first part of the final rule, i.e., from November 1, 2003 to October 31, 2006. The options are the same as those in the preliminary determination about the final rule.

Under the first set or compliance option, the vehicle's TPMS will be required to warn the driver when the pressure in any single tire or in each tire in any combination of tires, up to a total of four tires, is 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the tires, or a minimum level of pressure specified in the standard, whichever pressure is higher. Under the second compliance option, the vehicle's TPMS will be required to warn the driver when the pressure in any single tire is 30 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the tires, or a minimum level of pressure specified in the standard, whichever pressure is higher.⁽²⁾

The two compliance options are outgrowths of the alternative sets of requirements proposed in the NPRM. In response to comments confirming that current indirect TPMSs cannot meet the proposed three-tire, 25 percent under-inflation requirements, and in order to allow those systems to be used during the phase-in, the agency is adopting requirements for detection of one-tire, 30 percent under-inflation as the first option. For the second option, the agency is adopting requirements for detection of 4-tire, 25 percent under-inflation. Adopting those requirements, instead of the proposed requirements for four-tire, 20 percent under-inflation, will permit manufacturers to use either direct TPMSs or hybrid TPMSs, i.e., TPMSs that combine direct and indirect TPMS technologies. One TPMS supplier indicated the potential for developing and producing hybrid systems, although it also indicated that it did not currently have plans for doing so. The agency believes that the difference in benefits between TPMSs meeting

four-tire, 20 percent requirements and TPMSs meeting four-tire, 25 percent requirements should not be substantial.

To facilitate compliance with the options, the rule phases them in by increasing percentages of production. Ten percent of a vehicle manufacturer's light vehicles will be required to comply with either compliance option during the first year (November 1, 2003 to October 31, 2004), 35 percent during the second year (November 1, 2004 to October 31, 2005), and 65 percent during the third year (November 1, 2005 to October 31, 2006). These percentages are the same as those in the preliminary determination about the final rule. The agency is allowing carry-forward credits for vehicles that are manufactured during the phase-in and are equipped with TPMSs that comply with the four-tire, 25 percent option. It is not allowing credits for TPMSs complying with the other option for the same reason that the agency is requiring manufacturers to provide consumers with information about the performance limitations of those systems.

2. Part Two -- November 2006 and Thereafter

Beginning November 1, 2006, all passenger cars and light trucks, multipurpose passenger vehicles, and buses under 10,000 pounds GVWR will be required to comply with the requirements in the second part of this final rule. The agency will publish the second part of this final rule by March 1, 2005, in order to give manufacturers sufficient lead time before vehicles must meet the requirements.

In anticipation of making the decision in part two of this final rule about the long-term requirements, the agency will leave the rulemaking docket open for the submission of new data and analyses. The agency also will conduct a study comparing the tire pressures of vehicles without any TPMS to the pressures of vehicles with TPMSs that do not comply with the four-tire, 25 percent compliance option. When completed, it will be placed in the docket for public examination. After consideration of the record compiled to this date, as supplemented by the results of the tire pressure study and any other new information submitted to the agency, NHTSA will issue the second part of this rule by March 1, 2005.

Based on the record now before the agency, NHTSA tentatively believes that the four-tire, 25 percent option would best meet the mandate in the TREAD Act. However, it is possible that the agency may obtain or receive new information that is sufficient to justify a continuation of the compliance options established by the first part of this final rule, or the adoption of some other alternative.

-----[Excerpted from NHTSA 3-03]-----

For this complete article and our new Useful Links page, visit our website:

WWW.PRTASSOC.COM

It explains our full range of products and services and provides a listing of our associates with their areas of expertise. You can subscribe to the Newsletter and assign files electronically.