

# Indirect Tire Pressure Monitoring Systems - Myths and Facts

The European Parliament made a decision in 2009 that all passenger cars must be equipped with tire pressure monitoring systems (TPMS). This applies to new vehicle models originating from as early as November 2012, and all vehicles which will be newly registered for road traffic from November 2014. This is the result of the goals that the EU has made to protect the climate, but also for the enhancement of road safety. There are still too many cars on the roads with too low tire pressure - they consume fuel unnecessarily and in extreme cases, present a safety risk. Lack of tire pressure is often regarded as at least partly responsible for a high proportion of accidents,.

Currently about 15% of all new cars are equipped with tire pressure monitoring systems, the trend is gratifying, however, continuing to rise.

Nevertheless, the majority of drivers are not yet familiar with these systems, and it is high time to learn about the facts and to dispel some myths.

First, there are two different types of tire pressure monitoring systems, the "direct" and "indirect". Both technologies have different strengths and weaknesses.

Direct systems or dTPMS are equipped with pressure sensors in the wheels, usually attached to the rim. They measure the pressure and often the temperature and send it by radio to a receiver in the car. One of the most obvious benefits is a pressure display for the driver but there are also disadvantages: the sensors require batteries and these are worn out after a few years and must be replaced. With a little luck, that falls in time with the already scheduled tire change, otherwise the tires must be removed separately for it. Furthermore, most sensors are designed so that the batteries are sealed and therefore cannot be changed at all. Thus, a set of new sensors is required, the same applies to the set of winter wheels.

With prices of well over 50 € per sensor that quickly becomes a costly inconvenience. Not to mention the problems with the disposal of toxic and electronic waste.

Indirect systems or iTPMS measure the pressure, however not with sensors in the wheels - they use existing signals as the wheel speeds of the ABS / ESP. The iTPMS technology links them with other signals such as the steering angle or the engine torque in an intelligent way so that the tire pressure can be monitored indirectly - hence the name. iTPMS are proven to be very reliable and easy to handle. After each check of the tire pressure or a change of wheels a reset of the system is required – often a simple push of a button. The system now knows what the nominal pressure is. This allows detecting both pressure losses on individual wheels caused by punctures as well as the gradual loss of air over long periods of time on all four wheels.

iTPMS are subject to many myths and prejudices most of them lacking a factual base or just simply being wrong.

Dunlop Tech in Hanau, Germany, and NIRA Dynamics from Linköping, Sweden, as two of the leading suppliers of iTPMS have therefore decided to have their products tested by TÜV SÜD together in order to give the discussion a factual base. Both companies supplied one vehicle each with summer and winter tires for the test campaign.

**NIRA Dynamics AB** from Linköping/Sweden is a company specialized in automotive software solutions. The main product is an iTPMS called TPI (Tire Pressure Indicator) which can be found mainly in Volkswagen group models.

**Dunlop Tech GmbH** from Hanau/Germany develops and distributes tire mobility systems like IMS (Instant Mobility System) and Warnair, an iTPMS. Vehicles from all around the world are equipped with Dunlop Tech products.

## **1) iTPMS not only detect pressure losses on individual wheels, the reliable monitoring of all four wheels of slow pressure losses has also become a standard feature.**

The modern 2<sup>nd</sup> generation iTPMS also use so-called spectrum analysis monitoring certain tire-pressure-dependent oscillations. This is done individually for each wheel, thus enabling a comprehensive monitoring for all four wheels. The new EU legislation already provides respective tests. Indirect systems can detect a pressure drop of 20% on all four wheels in about 15 min. driving time, see tests No. 3 & 6 conducted by TÜV SÜD. This is four times quicker than legally required.

## **2) iTPMS are accurate, reliable and warn already at moderate pressure losses.**

The temperature difference between a cool morning and the hot midday sun alone can cause differences of more than 0.3 bar in tire pressure. Warming and cooling effects through driving add another 0,2-0,3 bar. Nevertheless, there is no reason to force the driver to a gas station with a tire pressure warning on every cool morning. A finer resolution than 0,2 bar or 10% makes no sense in practice and would only have to be paid dearly by the drivers.

It is also necessary to distinguish between measurement accuracy and warning threshold. An iTPMS that was developed towards a warning threshold of 20% pressure drop as the current EU legislation prescribes will warn at a pressure drop of 20% at the latest, but in most cases earlier still.

The tests conducted by TÜV SÜD show this, see test no. 13.

A study carried out by TNS sifo among Swedish motorists has shown that more than half of the motorists regard warnings at pressure losses of 15% as too early and not justified, for 20% warning threshold it is still 25% of the motorists. The risk of warnings being ignored is high if thresholds are set too tight.

## **3) iTPMS systems work not only with all original tires and rims, they are also compatible with nearly all aftermarket tires and rims.**

The current indirect systems are tuned to work optimally with all the original tires. Furthermore, they are tested with a variety of popular aftermarket tires to make sure that the drivers do not run into trouble with them later on.

Therefore, it is rather the case that iTPMS work normally with almost any tire legally suitable for the vehicle. In contrast, direct TPMS with the sensors mounted on the rim do not always fit to aftermarket rims.

## **4) iTPMS work at high speeds as are common on German motorways.**

The constant comparison of each individual wheel speeds - one of the mainstays of iTPMS - works excellently even at speeds above 130 km/h. A reliable puncture detection even on the German Autobahn is therefore ensured as for example the test no. 14 by TÜV SÜD with vehicle 1 shows. The warning was issued at about 170 km/h.

## **5) iTPMS are robust against load changes.**

Modern indirect systems have sophisticated mechanisms for load compensation. The tests no. 11 & 12 by TÜV SÜD made with differences in load of 250 kg on the rear axle - equivalent to 2 adults in the back seat and about 100 kg of luggage - clearly indicate that loading is no problem for iTPMS.

## **6) iTPMS can reliably indicate which wheel has too low pressure.**

Modern iTPMS can reliably show whether one or more wheels are affected and those which are in doubt. The driver easily knows which tire to change and can therefore choose a safe stopping place accordingly.

## **7) iTPMS recognize a completely flat tire in time.**

It is not unusual that a nail punctures a tire and the driver does not notice but parks the car overnight. The next morning, the tire is flat and even then one does not notice the flat tire at once. In any case, to provide a warning as soon as possible is essential so that you do not turn on the road or even the highway with the flat tire.

Therefore, one of the tested indirect tire pressure monitoring systems has already now such a function, the other will soon follow. The test No. 15 by TÜV SÜD shows that the flat tire is detected in about 10 s.

## **8) TPMS should be tested from a customer perspective using continuous pressure losses, not pressure step tests. Pressure steps are very rare in customer practice.**

Real pressure losses are not sudden events. Even most punctures lead to gradual, steady losses over many minutes, often hours. Natural pressure loss due to diffusion or microscopic valve leaks take several months before significant losses are achieved.

The sudden leap in tire pressure by for example 20% is therefore not the rule but the rare exception. A real-world TPMS must therefore be particularly sensitive to continuous pressure losses. The so-called "step response" as required by law has little practical significance, despite the fact that the legal requirements are described as the "pressure step" test. But this has to do mainly with the fact that a so-called type approval test may not take six months. Furthermore, "pressure step" tests are more

easily defined and precisely repeatable. For simplicity's sake it is therefore assumed that TPMS which stand the "pressure step" test would also detect a real, steady pressure drop. For customer-focused, steady pressure loss, iTPMS show their full benefits because they can then follow the actual pressure profile continuously. "Pressure step" tests often make dTPMS look faster and more accurate in comparison with iTPMS than they really are in practice. The tests by TÜV SÜD with continuous pressure losses No. 13 show this clearly. The tested iTPMS detect a 20% pressure step on all four wheels after 15 minutes. The respective continuous test leads to a warning already at 16-18 %.

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