

EU drivers at risk of under-inflated tyres: new tests show failure of tyre pressure monitoring systems on the road

New fully independent field survey confirms that indirect TPMS fail to deliver the expected performance in real-world conditions and that reform is needed

August 2018

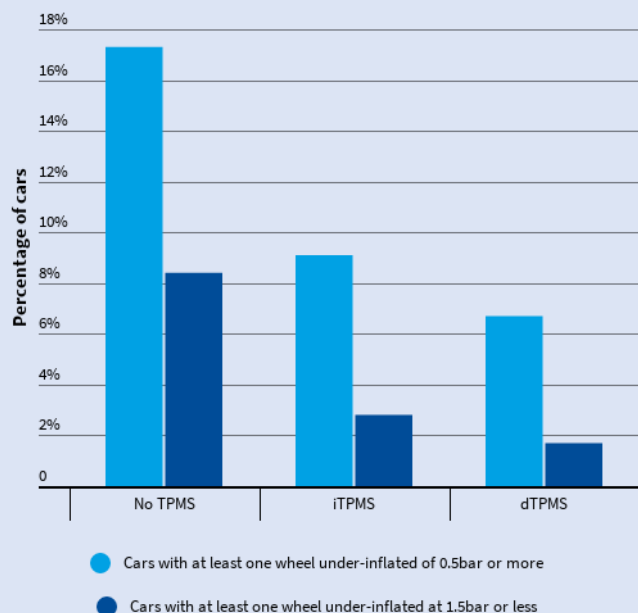
A briefing by  **TRANSPORT & ENVIRONMENT**

Summary

After having demonstrated in 2016 that indirect TPMS could be optimised to pass the regulatory test but fail to perform appropriately on the road, Transport & Environment (T&E) commissioned Dekra to carry out an independent on-road field survey to measure tyre pressure of about 1,000 cars in Italy and Portugal from random drivers.

First, Dekra's results show a clear safety benefit of having tyre pressure monitoring systems (TPMS) compared to the cars tested with no TPMS. The field survey also shows that direct TPMS, which relies on sensors to measure pressure, works better than indirect TPMS, where software is used to estimate pressure, in the most dangerous situations for the drivers: by 27% for under-inflation of 0.5bar or more and by 40% for tyres under-inflated at 1.5bar or less.

TPMS brings a strong safety benefit but still with room for improvement



Source: Transport & Environment from Dekra data

 **TRANSPORT & ENVIRONMENT**  @transenv  @transenv  transportenvironment.org

The field survey points to the following conclusions. First, fitting tyre pressure monitoring systems makes a difference as far as tyre pressure and therefore driver safety are concerned, so the recent General Safety Regulation (GSR) proposal from the Commission which extends TPMS beyond cars to all other vehicles (e.g. vans, trucks and buses) should be supported. Second, neither of the systems today works to its full potential and there is scope for improvement. In the most unsafe situations, represented by the dark blue bars in the graph on the left, the safety of drivers of about 330,000 brand new cars sold last year is put at risk because both TPMS technologies do not work at their best in real-life conditions. This is why the GSR must include provisions to make TPMS work effectively on all tyres, including the replacement ones, and to include a safety net to eliminate incorrect calibrations of tyre pressure by drivers.

1. Introduction

Tyre pressure monitoring systems (TPMS), designed to alert the driver when their tyres are deflating or at a dangerously low pressure, have been mandatory on passenger cars in Europe since 2014. There are two systems on the market today – direct and indirect TPMS; with carmakers often choosing to equip their vehicles with indirect systems due to their lower price. In November 2016, Transport & Environment (T&E) published a report underlining the failure of indirect TPMS to deliver the expected safety performance outside of the regulatory test. The test results showed how indirect systems fail to deliver warning signals in many real-world driving situations with dangerously under-inflated tyres that fall outside the narrow conditions of the type approval tests; those tests have since been strengthened at UNECE level¹ but not yet implemented into EU law. In May 2018, the Commission presented a proposal to review the General Safety Regulation (GSR). This is the law that mandates manufacturers to improve the safety performance of new vehicles in order for them to be permitted for sale on the EU market. Whereas TPMS has been a legal requirement only for passenger cars, Article 5 of the new GSR proposal extends the application of TPMS to all vehicles (i.e. vans, buses, and trucks). Moreover, the new testing methodology for TPMS developed at the United Nations is introduced into the EU law (UN Regulation n°141) from as soon as the new Regulation applies.

The new GSR proposal is the main law governing vehicles safety across Europe, and is a once in a decade opportunity to mandate the latest and effective technology to make road transport in Europe safer. To complement its earlier work on TPMS and feed into the GSR discussions, T&E has decided to undertake further tests on the real-world performance of direct and indirect tyre pressure systems in everyday operations. For this purpose, Dekra was commissioned to carry out a comprehensive, randomised and fully independent field survey to measure tyre pressure on a large sample of cars designed to compare the under-inflation events of direct and indirect TPMS, as well as cars with no TPMS. This briefing, accompanied by the test reports, summarises the findings.

2. Field survey shows safety benefit of TPMS but technology improvement is needed²

2.1. Methodology of the measurement campaign

T&E asked the testing and certification company Dekra to independently survey about 1,000 vehicles in Italy and Portugal (619 and 418 respectively), which is a large and representative sample of the current fleet. These two countries have been chosen in order not to have biased results caused by the regular change of winter/summer tyres that is compulsory or usual in Northern European countries.

During the survey, there was no targeting of specific brands or models. The only conditions so that a vehicle can be surveyed are the following:

- Cars equipped with a direct or indirect TPMS, firstly registered after November 1st 2014 (the mandatory implementation date for all new vehicles registered in the EU³);
- Cars that do not fit any TPMS or tyre puncture detection system, firstly registered between January 1st 2009 and December 31st 2013.

From the 1,037 vehicles surveyed in total, 486 cars did not have any fitted TPMS (47%), 299 cars were fitted with direct TPMS (29%), while 252 cars were equipped with indirect TPMS (24%).

¹ UNECE stands for the United Nations Economic Commission for Europe. This UN regional commission develops international regulations for motor vehicles on safety and emissions for instance that can be transposed, partly or entirely, into the EU law.

² Final reports from Dekra are published alongside this briefing on T&E's website

³ Official Journal of the EU, [Regulation n°523/2012](#)

The pressure of each tyre is measured and then normalised according to the measured ambient air temperature and the measured tyre temperature. Indeed, as temperatures and pressures are physically linked according to the ideal gas law, it is necessary to take into account the fact that tyre pressures were measured while tyres were hot and the differences with ambient air temperatures. A comparison is then made between these normalised tyre pressures and the tyre pressures recommended by the car manufacturer, which are defined for cold tyres. In order to strengthen the analysis, information regarding the TPMS fitted on the vehicle, the first date of registration and the recommended tyre pressures were checked for each vehicle thanks to its Vehicle Identification Number (VIN). Any VIN-checked vehicle that respects the criteria described above has been included in the results presented below. Due to legal restrictions, Dekra could not access information displayed on the dashboards of the surveyed cars in neither in Italy nor Portugal. This means that potential under-inflation or malfunction warning messages could not be accurately accessed.

2.2. Tyre under-inflation of 0.3/0.5bar or more

According to tyre manufacturers, an under-inflation of 0.3bar is considered to be moderate, while an under-inflation of 0.5bar is considered to be dangerous.⁴ Under-inflated tyres increase the rolling resistance of a vehicle, meaning that the fuel consumption and CO₂ emissions are getting more important. However, it is also a major safety concern as tyre under-inflation leads to poorer vehicle handling, increased stopping distances, aquaplaning, as well as premature tyre wear. With an under-inflation of 0.5bar or more, dangerous tyre blowouts can happen resulting in vehicle loss of control and possibly rollovers.

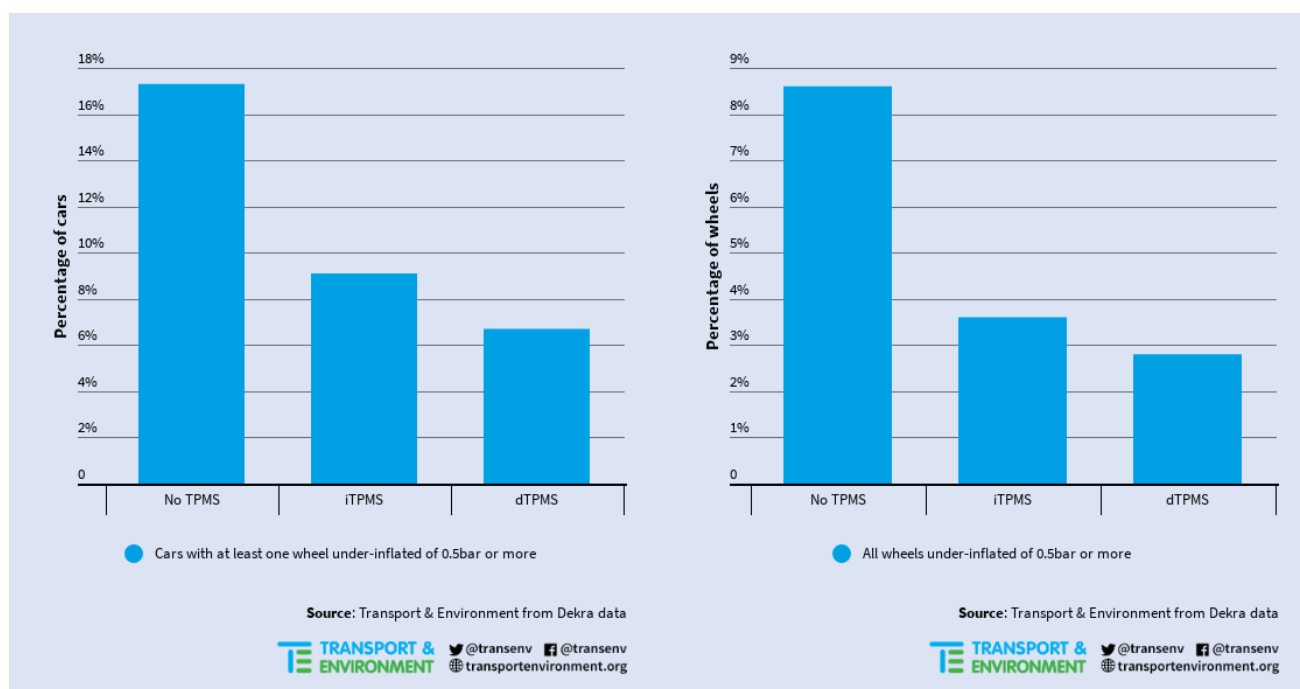


Figure 1 - Percentage of cars, per type of fitted TPMS technology, with at least one wheel under-inflated of 0.5bar or more

Figure 2 - Percentage of wheels, regardless of the car, per type of fitted TPMS technology, with an under-inflation of 0.5bar or more

The Figure 1 focuses on the percentage of surveyed cars having at least one wheel under-inflated of 0.5bar or more, while the Figure 2 focuses on the percentage of all wheels with the same under-inflation threshold for each fitted technology. The results clearly show that **to fit a TPMS system on cars bring a safety benefit** to drivers and other road users compared to cars without any system: indirect systems nearly halve the proportion of cars that have at least one wheel under-inflated of 0.5bar or more, while direct systems

⁴ TNO, [Study on some safety-related aspects of tyre use](#), TNO 2014 R11423-v2, 22/12/2016

bring the proportion down by 61% compared to cars without any of these technologies. These figures also mean that direct systems are more efficient by 27% compared to the indirect TPMS to prevent this situation.

The Figure 2 is similar regarding the technology comparison and the under-inflation threshold but in this case, all wheels for which the tyre pressure has been measured are mixed. The trends are similar about how beneficial for safety: indirect systems reduce down by 58% the number of under-inflated wheels of 0.5bar or more, while direct systems go a bit further with almost two-thirds less compared to cars without any TPMS. In that case, it means that direct systems are 20% more efficient than indirect TPMS.

Even though these results are encouraging, it also underlines that **direct systems bring a slightly better benefit than indirect systems** but also that **there is room for improvement regarding the performance of both technologies in real-life conditions**. Indeed, in the Figure 1, a weighted average of 8% of cars fitted with a TPMS (either direct or indirect) still have a dangerous tyre under-inflation. This proportion represents about 1.2 million brand new cars sold last year in the EU for which the drivers' safety is put at risk because TPMS systems not working at their full potential in real-life conditions.⁵

When the focus is made on the moderate tyre under-inflation level of 0.3bar or more, the same conclusions can be drawn from the results. The proportion of cars fitted with indirect systems is reduced by a quarter compared to older vehicles without such a system, while direct TPMS bring this proportion down by one third. Again, despite these systems, improvement should be made in order to reduce further the number of cars that still have this level of tyre under-inflation: 31% for cars with indirect TPMS, 28% for cars with direct TPMS – while the percentage goes up to 41% for cars without any fitted TPMS.

2.3. Tyre under-inflation at a level of 1.5bar or less

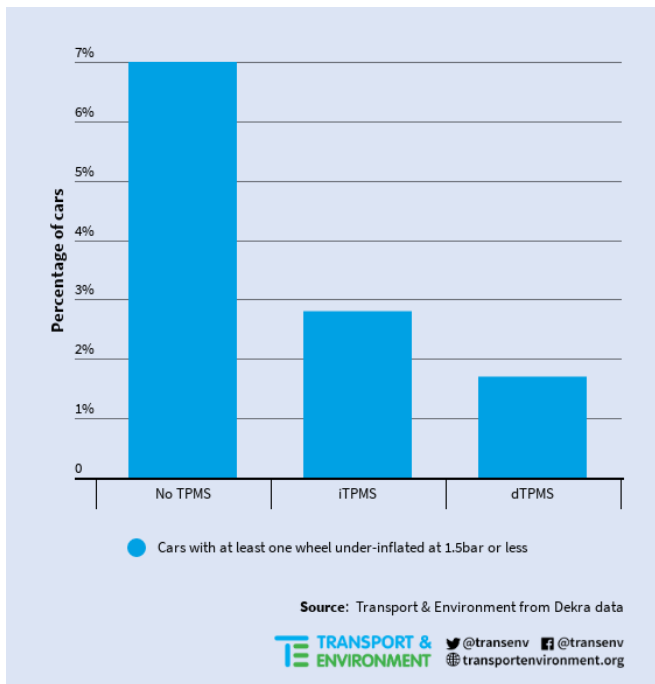


Figure 3 - Percentage of cars, per type of fitted TPMS technology, with at least one wheel under-inflated at 1.5bar or less

The second situation considered in the field survey is when the tyre pressure reaches an extremely low tyre pressure of 1.5bar or less. Such a low pressure level in a tyre is seriously unsafe for drivers and the other road users, with tyre starting to detach from its rim in certain conditions (when cornering, braking, etc.). This threshold is used in the current EU regulation as one of the conditions to trigger a warning signal on the dashboard of the vehicle.⁶

The Figure 3 makes a comparison of the percentages of cars that have such a low pressure between the different technologies. As underlined in the previous section, the current regulation brings a benefit for more safety, as indirect systems bring this proportion down by two thirds compared to cars without any system, while direct TPMS go further with a reduction of 80%. This means that direct TPMS are 40% more efficient to prevent this situation compared to indirect systems. This is a bigger efficiency gap compared to the previous chapter.

⁵ All brand news cars sold in the EU have to be fitted with a TPMS since November 2014. According to [ACEA](#), 15.1 million passenger cars were sold in the EU in 2017.

⁶ T&E, [Failure of indirect tyre pressure monitoring systems puts drivers and road users at risk](#), 07/11/2016

However, this still represents a major safety issue as, on average, 2% of the cars fitted with a TPMS system still have a low tyre pressure level of 1.5bar or less. In other words, about 330,000 of those cars sold in 2017, are being driven on Europe's roads in very unsafe conditions while this could have been avoided with a more stringent TPMS regulation.

3. Conclusions and recommendations

The results of the field survey show that **vehicles fitted with TPMS systems provide safer levels of tyre pressure compared with pre-2014 vehicles that are fitted with no TPMS**. This highlights the benefits of TPMS and shows why such technology should be mandatory for all vehicle categories so that all new trucks, vans, buses, and cars are fitted with some form of TPMS.

The field survey confirms that **vehicles equipped with indirect TPMS continue to fail to deliver the optimum road safety for which TPMS had been specifically mandated**.⁷ This is unfortunately not surprising as T&E's test programme in 2016 already exposed the failure of indirect TPMS to raise under-inflation and malfunction warnings, outside of the regulatory test, including when the tyre pressure was actually lower than 1.5bar.⁸ This situation is very unsafe as the driver – knowing the tyre safety systems are present in the car – is left to believe that their tyres are safe. This is unacceptable, especially when tyre pressure lower than 1.5bar is critical for safety, with a tyre starting to detach from its rim, for example when braking or cornering.

In summary, the field survey commissioned by T&E shows that **direct TPMS bring a slightly improved benefit** (also fuel consumption as a result of optimally pumped tyres) **in the most dangerous situations**. When tyres are under-inflated of 0.5bar or more, direct TPMS are 27% more efficient than indirect systems to prevent this situation. When tyres are under-inflated at 1.5bar, considered as seriously unsafe, this better efficiency of direct TPMS goes to 40% compared to indirect systems.

However, the most remarkable finding from the tests is that **neither of the TPMS systems fitted to cars today are fully effective at preventing dangerous tyre under-inflation** or work to their potential. In the most unsafe situation with tyres under-inflated at a level of 1.5bar or less, current TPMS technologies put at risk the safety of drivers of about 330,000 brand new cars sold last year in the EU. This calls for the improved regulation needed to make both systems more effective in the future. The need to tighten TPMS regulation has already been acknowledged in 2016 by UNECE,⁹ and its working group WP.29/GRRF, dealing with safety provisions amongst other issues. The UNECE adopted amendments, that are now part of the new ECE R.141 TPMS regulation,¹⁰ clarifying that TPMS must operate “over a wide range of road and environmental conditions” (instead of in accordance with the test procedure only), and that a malfunction warning time cannot be ignored due to “external influence” that manufacturers are currently allowed to use as a derogation (similar to the abuse of loopholes for switching off exhaust treatment systems to protect the engine).

T&E calls on the EU – in its current review of the General Safety Regulation (GSR) proposed by the Commission in May 2018 – to strengthen EU-wide TPMS provisions. Specifically, the below recommendations should be **swiftly implemented into the EU law with an ambitious timetable, 2020 for new types and 2021 for all new registered vehicles**:

1. Full transposition in to the EU of the new TPMS requirements agreed at UNECE (Regulation R.141);

⁷ Official Journal of the European Union, [Regulation n°661/2009](#), Article 9.2

⁸ T&E, [Failure of indirect tyre pressure monitoring systems puts drivers and road users at risk](#), 07/11/2016

⁹ UNECE, [Proposal for amendments to ECE/TRANS/WP.29/GRRF/2016/5 \(New Regulation on TPMS\) as amended by GRRF at its 81st session](#), 01-05/02/2016

¹⁰ UNECE, [Regulation No. 141 - Tyre Pressure Monitoring Systems \(TPMS\)](#), Addendum 140, January 2017

2. TPMS must be made **mandatory for all vehicle categories**, including vans, trucks and buses (all M and N categories), as well as for heavy trailers (O3 & O4);
3. An additional robust “**safety net**” performance requirement for all TPMS systems to **prevent any wrong TPMS calibrations** by the user setting the under-inflation warning threshold **below 1.5bar**;
4. Additional operational requirements for TPMS to remain fully compliant **for all tyres including after-market replacement ones**. Drivers will change tyres more than once in their vehicle’s lifetime and road safety must be guaranteed throughout. This includes the switch over to winter tyres.

This new independent field survey commissioned by T&E to Dekra has clearly showed that further extension and improvement of TPMS provisions is needed. Direct TPMS technology performs best today in real-life conditions, especially in the most dangerous situations for drivers; but clear TPMS benefits over cars without any tyre pressure systems were apparent in all tests. It is time for the European Commission to prioritise motorists’ safety in their GSR proposal and not allow the use of cheaper but less efficient systems that only work during the narrow type-approval tests. As with the Dieselgate emissions scandal resulting from decades-long manipulation of emissions tests, lives should not be put in danger for the sake of cost savings for carmakers.

Further information

Florent Grelier

Clean Vehicles Engineer

Transport & Environment

florent.grelier@transportenvironment.org

Tel: +32 (0)2 851 02 14