

## REGULATION AND TYRE PRESSURE MONITORING SYSTEM

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### ABSTRACT

*Air pressure is required to allow tyre to support the weight of the vehicle. There is a minimum pressure for each vehicle based on tyre type and size and differing load in the vehicle. In some cases tyre pressure also need to be altered with speed. Tyre pressure monitoring systems (TPMS) are electronic systems designed to monitor the air pressure inside all the pneumatic tyres of a vehicle. Direct TPMS are more accurate than Indirect TPMS, showing tyre pressure measurements in almost real time. The effects of tyre under inflation on vehicle performance are adverse from a safety and environmental point of view.*

**Keywords:** regulation, tyre pressure monitoring systems, vehicle safety

### 1. INTRODUCTION

Tires are only part of the vehicle is in constant contact with the surface and tires are the only points of the vehicle and the road. Accordingly, the condition in which there except that significantly affects the security of traffic, it may be the cause of accidents with fatal outcome and the impact on the increased fuel consumption.

In addition, defective tires reduce vehicle performance, reduce braking efficiency, control, acceleration and ride comfort. Therefore, recently significant attention directed towards the control and management of the correctness of these systems. In this context, an important element of control systems and tire pressure monitoring levels in the tires, or obligations mounting of the TPMS – Tyre Pressure Monitoring Systems.

Japanese tire maker Bridgestone has spent a large study in 2009 year in 15 EU countries on the basis of which concluded that 81% of all used car with bad tires inflated.

Experts have reviewed even 52,400 cars, where they found that every eighth of road riding on tires that are due to low pressure prone to damage and even present a security risk. Nevertheless, this causes a higher annual fuel consumption of 4 billion liters.

The annual cost, therefore, reaches a value of 5.2 billion euros and further polluting the environment with 9.3 million tons of carbon dioxide (CO<sub>2</sub>). Until this information came months of free previews of tires on cars in the EU countries. Thus, there is a reason for legal regulation of this area and introducing obligations fitting a TPMS in all vehicles.

This was just part of the campaign which started in 2005 titled "Think Before You Drive" organized by the FIA Foundation (Fédération Internationale de l'Automobile), Bridgestone Corporation and national motoring clubs. [1]

## 2. STAGE OF REGULATION

If we talk about the TPMS in the aspect of wider application, special care for these systems was done in the United States, where it is already in 2008 year passed a law that defines the obligations of installation of monitoring tire pressure in all new passenger cars.

Of course, in the beginning of the implementation of this law was very complex because some systems indicate the tendency of displaying false warnings about too low air pressure in the tires due to changes in outside temperature, weather conditions and compatibility with a spare tire, and subsequently purchased a replacement wheel.

Table 1. Campaign "Think Before You Drive" 2005-2009

Year	Vehicles checked	Countries participant in campaign per year
2005	8,700	10
2006	20,300	19
2007	38,867	19
2008	31,178	14
2009	52,400	15
Total	151,445	

If we look at the EU space, also notice the signs of introducing similar legislation, in addition to the organization of tire manufacturers are increasingly implemented actions control the pressure in the tires, which are aimed at educating drivers about the importance of this often neglected element of security. New Legislation (Regulation), which was adopted in the European Parliament in early 2009 relate to the overall security of motor vehicles under the

designation COM(2008)316 – 2007/0243(COD).

This provision provides in 2012 been mandatory use of tires with low rolling resistance, in accordance with the achievement of savings in fuel consumption and CO2 emissions. These tires are also designed to reduce noise. Fuel consumption and CO2 emissions will be further reduced by the proposed introduction of a TPMS.

The European Commission's proposal can be summarized as follows [1]:

### - new requirements on tyres:

- Reduction in noise limits by an average of 4 dB(A). Requirements will apply to new tyre types from 2012 and all new tyres from 2016.
- New limits on rolling resistance (for reduction of CO2 emissions). (TLRR – Tyre Low Rolling Resistance). Limits to be applied in two stages: from 2012 and 2016. The proposal also applies to aftermarket tyres.
- Tyre Pressure Monitoring Systems to be mandatory (for CO2 emissions reductions and safety). TPMS will be required on new car types from 2012 and existing types from 2014.
- New wet grip requirements based on the requirements in UNECE Regulation 117. To be applied to new car tyre types from 2012 and existing type from 2014.

### - impact assesment conclusions:

- Mandatory measures can save around 5,000 lives and 35,000 serious injuries per year across EU25.
- Tyre measures can contribute around 7g/km towards CO2 reduction targets,
- Average vehicle purchase cost increase from all mandatory measures around 200€for cars and 2,500 €for heavy vehicles.
- Running costs for motorists likely to be reduced due to improved fuel economy.

At the same time, this proposal introduces a range of measures required by the accelerated adoption of several technologies researched a TPMS. In addition to the date of introduction, the technical specifications of the official regulations require that (the 9.2 of the adopted text): " M1 vehicles be equipped with a TPMS-om precision necessary to provide, when necessary, the driver inside the vehicle signal light when the level of pressure drops in any tire or the appearance of the same defect state, which is important in terms of fuel consumption and road security. Technical specifications of the range and limits of pressure should be determined after the directive is implemented, and will take into account technological - neutrality and cost efficiency of the approach to the development of

precision-a TPMS. Organizations involved in car tires safety estimated that about 80% of cars have tires that are improperly inflated.

Rules relating to regulations for pneumatic tires are also revised, not only in security but also for environmental impact. Rolling resistance of tires and their pressure affect the level of noise and CO2 emissions from vehicles. The new regulation establishes different standards for tires, which will reduce CO2 emissions and fuel consumption. The revised regulations also mentions the clear link between this proposal and CO2 packages, and special emphasis is placed on a reliable system of a TPMS in automobiles because they realize substantial savings on fuel and tires when they are under the prescribed pressure, and significant losses occur, but with minor differences in pressure (Table 2) [1]. It was not adopted these provisions extend to trucks, but given the emphasis on improving the effectiveness and reliability of these systems without favourities for any one specific technology. In addition, the rigid definition of tires, for example, limits the possibility of placing a professional off-road tires for 4x4 cars.

*Table 2. Some effects of under inflation on the performance of a motor vehicle*

Criterion	Effects of under-inflation	
Tread wear	↓	A tyre with 20% under-inflation reduces a 30% the total mileage
Rolling resistance	↓	Lowering by 0.5 bar results in 15% higher rolling resistance force
Rolling noise	↓	A deviation of 1 bar to standard inflation pressure rise noise emissions by 2 dB(A) (66%)
Fuel consumption	↓	Lowering by 0.5 results in a 2-5% increase in the fuel consumption
Directional stability at lane change	↓	Lowering by 0.5 bar results in a tendency towards a lateral skid, delayed transmission and spongy steering feel.

### 3. SYSTEMS OF A TYRE PRESSURE CONTROL

System for monitoring pressure in the tires (TPMS) informs the driver about the state of tire pressure and temperature in real time, whether the vehicle is in active or resting state. Generally, the system consists of sensors with radio frequency transmitters, fixed at each point and the receiver / display located on the instrumental panel of the vehicle. It shows the driver information display and alarm warnings about possible problems on tires.



*1-pressure sensor, 2-receiver, 3-electronic control unit, 4-display unit  
Picture 1. Tyre pressure monitoring system*



*Picture 2. TPMS sensors*

In practice, the present two systems control the pressure in the tires, which work in two different ways, namely:

- 1 – direct and
- 2 – indirect system of control.

Currently, the rubber industry gives priority to a direct system that raises the pressure sensor at each wheel individually and transferred to a computer in the car reliable information about measurement, based on which driver is immediately available information on the condition of tires.

Indirect system, favoured by some car manufacturers, which supports the International Organization of Automobile Designers (OICA), is the cheaper option. It measures the number of revolutions the tires on a single point and compare with other wheels. Other systems carry out the analysis of vibration characteristics using the ABS sensors. Board computer analyzes the data and determines whether there are changes in diameter of the point, what software is interpreted as a loss of pressure in the tire. Regardless of the number of indirect solution here is a significant delay until the information reaches the driver, which means that in case of fast pumping (cracking) tires would not be detected, and an accident would not have been prevented.

The first passenger car with the use of TPMS was a Porsche 959 from 1986. According to security vehicles and cost of maintaining this system of monitoring appeared widespread in the EU as an option (bid) for luxury passenger cars such as Audi A8, Mercedes-Benz S-Class and BMW series 7. However, the company PSA Peugeot Citroen in 1999 decided to set the TPMS system as standard options in the model Peugeot 607. A year later (2000) Renault is also in Laguna II set up this system as a standard option. The cost of these systems depends on the OEM (Original Equipment Manufacturers) and the manufacturer of the car and moves an average of €220, plus cost of shipping and installation.

### 3.1. The advantages of wide application of TPMS

Driving with tire pressure which is only 50 kPa (0.5 kb/cm<sup>2</sup>) less than the required, reduces fuel efficiency by 2% and even 4% in urban and suburban areas. Given that approximately 20% of the energy needed to drive the car used to overcome rolling resistance, it is important to have a prescribed tire pressure. The increase of the resistance directly affects the increase in fuel consumption. As one of the most important parts of a vehicle, the tires should be taken regularly. Given that drivers remember the control only when they notice that the tires ispuhale advantage of legal regulation and compulsory introduction of such systems is obvious. Condition regularity control the pressure in the tires in the EU is:

- |   |      |                          |      |
|---|------|--------------------------|------|
| - check every week                          | 5%,  | - check every two weeks  | 15%, |
| - check every month                         | 20%, | - check every two months | 25%, |
| - almost never check till something happens | 35%. |                          |      |

## 4. CONCLUSION

Maintaining proper tire pressure is necessary to achieve the optimal level of security, performance and fuel economy. Standard TPMS systems for monitoring the pressure consists of one sensor located at each wheel, and who oversees the current pressure in each point separately and warns the driver if the level of pressure in the tire pressure is low or too high. Whether you choose a model with base system (warning light is located on the dashboard) or premium system (the display to show status of each point) which is located on the Electronic Vehicle Information Center (EVIC), results in the control of pressure are noticeable

## 5. REFERENCES

- [1] IP/A/IMCO/IC/2008-112, Type approval requirements for the general safety of motor vehicles, European Parliament
- [2] <http://www.bridgestone.eu/press/press-releases/products/2010/8-out-of-10-motorists-in-europe-drive-on-under-inflated-tyres>