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Introduction

In a project for the European Commission's DG CLIMA¹, TNO and TU Graz are performing a "study on Tyre Pressure Monitoring (TPMS) as a means to reduce Light-Commercial Vehicles (LCVs) and Heavy-Duty Vehicles (HDVs) fuel consumption and CO₂ emissions".

The **aim of this study** is to provide answers on TPMS related questions for LCVs & HDVs regarding:

1. Technology state-of-the-art
2. Current market penetration and uptake
3. Savings potential for fuel consumption & CO₂ emissions and
4. Potential for improving safety

In addition the study assesses possible policy measures that the European Commission could implement to promote the application of TPMS in LCVs & HDVs in the EU.

In order for this study to be as representative to the market as possible, this **questionnaire** is used to gather information on the above stated topics from the stakeholders, i.e. manufacturers of TPMS systems, tyres and vehicles. You are kindly asked to fill out the questionnaire.

- Please be as specific as possible.
- Please provide quantitative estimates where possible.
- If the information is not available, is confidential or needs to be explained via a telephone conversation please indicate this as well.
- Other comments, not specifically asked for in the questionnaire, are of course welcome and helpful.
- You should have received this questionnaire in DOCX-Format. The choice is yours to fill in the questionnaire on paper or in digital.

Results from this questionnaire, follow up interviews and the project will be presented in a stakeholder workshop which is planned in May 2013. We kindly request you to send your input via mail **before March 15th 2013**. You can send your file or scanned hardcopy to the following mail address:

Email: **stephan.vanzyl@tno.nl**
With the subject: **Questionnaire TPMS**

¹ Service Request No 0712/2012/635955/ETU/CLIMA.C.2 under the Framework Contract on ENTR/F1/2009/030 - Lot 5

TPMS – Questionnaire






This questionnaire is filled in by:

| | |
|---|--|
| Company | |
| Contact person | |
| Contact details (email, phone, address) | |
| Date | |

Definitions & Boundaries

In the questionnaire, the following **definitions and boundaries** are handled:

- TPMS (Tyre Pressure Monitoring System) as defined in Regulation 661/2009. This means that Central Tyre Inflation Systems are not included.
- EU, in specific EU-27. Throughout this study, the focus lies on the EU. Other markets around the world are not included.
- Vehicles: Throughout this study, when referring to vehicles, only LCVs & HDVs are considered. The following definitions are handled:
 - o LCVs (N1 vehicles and N2 and M2 with reference mass not exceeding 2610 kg),
 - o HDVs (vehicles of class N2 and M2 that are not LCVs and M3 and N3 vehicles).

| EU class | Example |
|----------|---|
| M2 |  |
| M3 |  |
| N1 |  |
| N2 |  |
| N3 |  |

TPMS – Questionnaire

1 Technology

1.1 Question 1.1 – Does your company apply TPMS?

In the configuration of tyres, does **your company** make use of TPMS technology? Please tick the box below.

- If the answer is No, you can skip the following questions and return the survey.

| Yes | No |
|-----|----|
| | |

TPMS – Questionnaire

1.2 Question 1.2 – Types of TPMS used in different vehicle classes

What kind of TPMS technology does **your company** use for LCVs & HDVs? In the following list, please provide product name and supplier of the technology.

- If you have a factsheet of your TPMS system(s) you can share with us, please provide a copy of it in your response.
- If different technologies are used for different vehicle models / variants within the same vehicle class, please feel free to add lines and indicate the various systems applied.

| | | TPMS technology | | | | | | | | |
|------|-------------|-----------------|--------------|------------------------------------|--|--|--|--|------------------------------------|----------------------------------|
| | EU class | Supplier | Product name | System type (direct / indirect) | Sensor type (pressure / temperature / both) | Sensor position (on rim / in tyre / on valve) | Display type (dashboard / handheld / on wheel / PC via satellite) | Display functions (bars & °C / % deviation from nominal values / only alerts) | Technical life time (in months) | Compatible with how many wheels? |
| LCVs | M2 (<2.61t) | | | | | | | | | |
| | N1 | | | | | | | | | |
| HDVs | M2 (>2.61t) | | | | | | | | | |
| | M3 | | | | | | | | | |
| | N2 | | | | | | | | | |
| | N3 | | | | | | | | | |

Other comments?

TPMS – Questionnaire

1.3 Question 1.3 – Suppliers & Technologies

Which suppliers does **your company** see as the main market players for TPMS systems (TOP 5)? What is the name of the product / technology?

| TOP 5 | Supplier | Product name |
|-------|----------|--------------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |

Other comments?

1.4 Question 1.4 – Current experience

What is your current experience with TPMS systems (e.g. largest benefits & shortcomings)?

1.5 Question 1.5 – Future developments

What does **your company** consider to be the next technological steps for improving TPMS system technology? Please specify:

TPMS – Questionnaire

1.6 Question 1.6 – Costs

What are the additional costs associated for a vehicle configuration with your TPMS system?

- Once again, if different technologies are used for different vehicle models / variants within the same vehicle class, please add lines and indicate the various systems applied.

| | | TPMS technology | |
|---------|-------------|----------------------|----------------------|
| | EU class | Additional costs [€] | Additional costs [%] |
| LCVs | M2 (<2.61t) | | |
| | N1 | | |
| HDVs | M2 (>2.61t) | | |
| | M3 | | |
| | N2 | | |
| | N3 | | |
| AVERAGE | | | |

Other comments?

TPMS – Questionnaire

2 Market

2.1 Question 2.1 – Share of TPMS: OEMs & retrofits

To your knowledge, considering the range of TPMS systems that are sold on a yearly basis in the EU ...

- a) what is the share of TPMS sold by OEM vehicle manufacturers [in %]?
- b) what is the share of TPMS sold by retailers [in %], for retrofit applications ?
- c) If applicable, what is the share of TPMS systems sold by other parties that do not fall under the categories above [in %]?

| | | TPMS market composition | | |
|----------|-------------|--------------------------|-------------------------------|----------------------------|
| EU class | | a) TPMS sold by OEMs [%] | b) TPMS sold by retailers [%] | c) TPMS sold by others [%] |
| LCVs | M2 (<2.61t) | | | |
| | N1 | | | |
| HDVs | M2 (>2.61t) | | | |
| | M3 | | | |
| | N2 | | | |
| | N3 | | | |
| AVERAGE | | | | |

TPMS – Questionnaire

Other comments?

2.2 Question 2.2 – Share of TPMS in your company’s sales

Considering the range of tyres that **your company** sells on a yearly basis in the EU, what is the share of tyres (for LCVs & HDVs) that are being equipped with TPMS [in %]?

| | | Share of tyres sold with TPMS by your company in the EU [%] | | |
|----------|-------------|---|------|------|
| EU class | | 2010 | 2011 | 2012 |
| LCVs | M2 (<2.61t) | | | |
| | N1 | | | |
| HDVs | M2 (>2.61t) | | | |
| | M3 | | | |
| | N2 | | | |
| | N3 | | | |
| AVERAGE | | | | |

Sales past 3 years

Other comments?

2.3 Question 2.3 – Expected share of TPMS retro-fits

To your knowledge, considering the range of vehicles that **your company** sells on a yearly basis in the EU, what is the share of tyres (originally not equipped with TPMS) that are retro-fitted with TPMS [in %]?

| | | Share of tyres sold without TPMS by your company & retrofitted with TPMS in the EU[%] | | |
|----------------|-------------|---|------|------|
| EU class | | 2010 | 2011 | 2012 |
| LCVs | M2 (<2.61t) | | | |
| | N1 | | | |
| HDVs | M2 (>2.61t) | | | |
| | M3 | | | |
| | N2 | | | |
| | N3 | | | |
| AVERAGE | | | | |

Sales past 3 years

Other comments?

2.4 Question 2.4 – Overall market share of TPMS

To your knowledge, considering the range of tyres that are sold **in TOTAL** on a yearly basis in the EU, what is the share of tyres that are equipped with TPMS [in %]?

| | | TOTAL share of tyres with TPMS sold in EU [%] | | |
|----------------|-------------|---|------|------|
| EU class | | 2010 | 2011 | 2012 |
| LCVs | M2 (<2.61t) | | | |
| | N1 | | | |
| HDVs | M2 (>2.61t) | | | |
| | M3 | | | |
| | N2 | | | |
| | N3 | | | |
| AVERAGE | | | | |

Sales past 3 years

Other comments?

2.5 Question 2.5 – Autonomous market trends in the absence of additional policy measures

Which trends, and associated threats or opportunities do you observe in the market for TPMS systems (TOP 5)? In the box below, please specify:

| TOP 5 | Trends | Threats / Opportunities |
|----------------|---|--|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| Example | TPMS prices are dropping. In the last ten years cost price dropped by 50% | Thread: price competition shifts production to lower wage countries. Opportunity: the system can earn itself back in a shorter amount of time |

Other comments?

2.6 Question 2.6 – Projections

How do you expect the trends specified above to influence the share of TPMS systems sold on tyres for LCVs & HDVs for **your company**? How is this projected in the expected sales of tyres with TPMS [in % of total tyres sold] on a short term basis (in 2 years) and on a long term basis (in 6 years)?

| | | Projected market share of tyres for LCVs & HDVs with TPMS sold by your company in EU [%] | | | | | |
|----------|-------------|--|------|------|------|------|------|
| EU class | | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| LCVs | M2 (<2.61t) | | | | | | |
| | N1 | | | | | | |
| HDVs | M2 (>2.61t) | | | | | | |
| | M3 | | | | | | |
| | N2 | | | | | | |
| | N3 | | | | | | |
| AVERAGE | | | | | | | |

...in 2 years

...in 6 years

Other comments?

3 Safety

3.1 Question 3.1 – Share of tyre failures attributed to incorrect tyre pressure

To your knowledge and for the specified vehicle categories, ...

- a) what is the share of accidents occurring due to tyre failures in general?
- b) what is the share of tyre failures due to incorrect tyre pressure?

| | EU class | a) Share of accidents attributed to tyre failures [%] | b) Share of tyre failures attributed to incorrect tyre pressure [%] |
|---------|-------------|---|---|
| LCVs | M2 (<2.61t) | | |
| | N1 | | |
| HDVs | M2 (>2.61t) | | |
| | M3 | | |
| | N2 | | |
| | N3 | | |
| AVERAGE | | | |

Other comments?

3.2 Question 3.2 – Types of accidents related to tyre failure

To your knowledge, what type of accidents result from tyre failure? Please fill in and indicate percentage:

- The table below is not complete. Room is left for further additions in types of tyre failures and accident type. If you perceive other types, please specify below.

| Accident type | Share of tyre failure related accident for different accidents types [%] | | | | |
|---------------------------|--|-------------------------------|--------------------------------|---------------------------|-----|
| | Share due to tyre blow out | Share due to too low pressure | Share due to too high pressure | If other, please specify. | ... |
| Rollover | | | | | |
| Spin out | | | | | |
| Collision | | | | | |
| Jack-knife | | | | | |
| If other, please specify. | | | | | |
| ... | | | | | |
| TOTAL (=100%) | | | | | |

Other comments?

3.3 Question 3.3 – Acceptable tyre pressure variation

What range of tyre pressure variation do you consider acceptable?

- Tyre pressure variation is here expressed as deviation from the defined nominal value for specific vehicle load conditions.

| | | Acceptable tyre pressure variation [%] | |
|---------|-------------|--|-------------|
| | EU class | Lower limit | Upper limit |
| LCVs | M2 (<2.61t) | | |
| | N1 | | |
| HDVs | M2 (>2.61t) | | |
| | M3 | | |
| | N2 | | |
| | N3 | | |
| AVERAGE | | | |

Other comments?

4 Potential for reduction in fuel consumption & CO₂ emissions

4.1 Question 4.1 – Share of kilometres driven with underinflated tyres

To assess the possible effect of TPMS on fuel consumption and CO₂ emissions, an assessment is needed on the actual share of LCVs & HDVs running on the road with under-inflated tyres. To your knowledge, what is the share of kilometres [% of vehicle-km] driven with underinflated tyres?

- If possible differentiate according to ranges of under-inflation [% under-inflation]. For example, in a certain EU class: 60 [% of vehicle-km] drive with 0 to 10 [% under-inflation], 20 [% of vehicle-km] drive with 10 to 20 [% under-inflation], 5 [% of vehicle-km] drive with 20 to 30 [% under-inflation] & 5 [% of vehicle-km] drive with >30 [% under-inflation].
- Here, it is assumed that the range of under-inflation is dictated by the tyre with the largest deviation from nominal pressure. For example, a vehicle with 4 wheels/tyres and one tyre at 25 [% under-inflation] is considered as a whole vehicle with 25 [% under-inflation]. If this differs from your assumptions, please specify.

| | | Share of kilometers driven with underinflated tyres [% of vehicle-km] | | | |
|----------|-------------|---|---------------------------------|---------------------------------|----------------------------|
| EU class | | 0 to 10 [% under-inflation] | 10 to 20 [% under-inflation] | 20 to 30 [% under-inflation] | >30 [% under-inflation] |
| LCVs | M2 (<2.61t) | | | | |
| | N1 | | | | |
| HDVs | M2 (>2.61t) | | | | |
| | M3 | | | | |
| | N2 | | | | |
| | N3 | | | | |
| AVERAGE | | | | | |

4.2 Question 4.2 – Impact of under-inflation on rolling resistance and fuel consumption

To assess the potential of TPMS for LCVs & HDVs, an assessment is needed on ...

- a) how under-inflation affects the rolling resistance coefficient (RRC) of the tyres.
- b) how under-inflation affects the fuel consumption or CO₂ emissions of the vehicle.

Please write your references below (% values preferred, if absolute reduction values are given, please provide the base value too):

- a) Suggestions for **literature or own equations** to calculate the reduction in RRC as function of under-inflation in tyres?

Example of estimation: % reduction of RRC = % under-inflation * x

- b) Suggestions for **literature or own estimations** to calculate the additional fuel consumption or CO₂ emissions as a function of under-inflation in tyres (% values preferred, if absolute reduction values are given, please provide the base value too):

Example of estimation: % reduction in fuel consumption or CO₂ emission = % under-inflation * x