



Economic and Social Council

Distr.: General
Date: 17 December 2020

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

183rd session

Geneva, 9-11 March 2021

Item 4.6.9 of the provisional agenda

1958 Agreement:

Consideration of draft amendments to existing

UN Regulations submitted by GRBP

Proposal for a new 01 series of amendments to UN Regulation No. 141 (Tyre pressure monitoring system)

Submitted by the Working Party on Noise and Tyres*

The text reproduced below was adopted by the Working Party on Noise and Tyres (GRBP) at its seventy-second session (ECE/TRANS/WP.29/GRBP/70, para. 22). It is based on ECE/TRANS/WP.29/GRBP/2020/20 and Annex IX to the report. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration at their March 2021 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



UN Regulation No. 141, amend to read:

"Uniform provisions concerning the approval of vehicles with regard to their Tyre Pressure Monitoring Systems (TPMS)

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1. Scope

This Regulation applies to the approval of vehicles of category: M₁ up to a maximum mass of 3,500 kg, M₂, M₃, N₁, N₂, N₃, O₃ and O₄,¹ when equipped with a tyre pressure monitoring system.

2. Definitions

For the purposes of this Regulation:

- 2.1. "*Approval of a vehicle*" means the approval of a vehicle type with regard to its tyre pressure monitoring system.
- 2.2. "*Vehicle type*" means vehicles which do not differ significantly in such essential aspects as:
- (a) The manufacturer's trade name or mark;
 - (b) Vehicle features which significantly influence the performances of the tyre pressure monitoring system;
 - (c) The design of the tyre pressure monitoring system.
- 2.3. "*Wheel*" means a complete wheel consisting of a rim and a wheel disc;
- 2.4. "*Twin wheel*" means the fitment of a pair of wheels on one side of an axle, on the same hub;
- 2.5. "*Tyre*" means a pneumatic tyre, being a reinforced flexible envelope that is provided with, or forms in conjunction with the wheel on which it is mounted, a continuous, essentially toroidal, closed chamber containing a gas (usually air) or a gas and liquid, that is intended normally to be used at a pressure greater than atmospheric pressure;
- Tyres shall be classified as follows:
- (a) Class C1 tyres — Tyres conforming to UN Regulation No. 30;
 - (b) Class C2 tyres — Tyres conforming to UN Regulation No. 54 and identified by a load capacity index in single formation lower or equal to 121 and a speed category symbol higher or equal to 'N';
 - (c) Class C3 tyres: Tyres conforming to UN Regulation No. 54 and identified by:
 - (i) A load capacity index in single formation higher or equal to 122; or
 - (ii) A load capacity index in single formation lower or equal to 121 and a speed category symbol lower or equal to 'M'.
- 2.6. "*Maximum mass*" means the maximum value of the vehicle stated by the manufacturer to be technically permissible (this mass may be higher than the "permissible maximum mass" laid down by the national administration);
- 2.7. "*Maximum axle load*" means the maximum value, as indicated by the manufacturer, of the total vertical force between the contact surfaces of the tyres or tracks of one axle and the ground and resulting from the part of the vehicle mass supported by that axle; this load may be higher than the "authorized axle load" laid down by the national administration. The sum of the axle loads may be greater than the value corresponding to the total mass of the vehicle;

¹ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, para. 2 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

- 2.8. "Tyre Pressure Monitoring System (TPMS)" means a system fitted on a vehicle which can evaluate the pressure of the tyres or the variation of pressure over time and transmit corresponding information to the user while the vehicle is running;
- 2.9. "Cold tyre inflation pressure" means the tyre pressure at ambient temperature, in the absence of any pressure build-up due to tyre usage;
- 2.10. "Recommended cold inflation pressure (P_{rec})" means the pressure recommended for each tyre position by the vehicle manufacturer, for the intended service conditions (e.g. speed and load) of the given vehicle, as defined on the vehicle placard and/or the vehicle owner's manual;
- 2.11. "In service operating pressure (P_{warm})" means the inflation pressure for each tyre position elevated from the cold pressure (P_{rec}) by temperature effects during vehicle usage;
- 2.12. "Test Pressure (P_{test})" means the actual pressure of the tyre(s) selected for each tyre position after deflation during the test procedure.
- 2.13. "Cumulative driving time" means the total time elapsed
where the vehicle of category M_1 up to a maximum mass of 3,500 kg or N_1 is driven at speeds equal to or higher than 40 km/h and further deducted by 120 seconds for each event where the vehicle speed drops below 40 km/h
or
where the vehicle of other categories than M_1 up to a maximum mass of 3,500 kg and N_1 is driven at speeds equal to or higher than 30 km/h and further deducted by 120 seconds for each event where the vehicle speed drops below 30 km/h.
- 2.14. "Tyre Pressure Refill System (TPRS)" means a system fitted on a vehicle which refills underinflated tyres fitted to an axle of the vehicle with air pressure from a vehicle mounted reservoir (infrastructure) while the vehicle is running but not limited to.
- 2.15. "Central Tyre Inflation System (CTIS)" means a system fitted on a vehicle which controls the air pressure in each tyre fitted to an axle of the vehicle with air pressure from a vehicle mounted reservoir (infrastructure) while the vehicle is running but not limited to.

3. Application for approval

- 3.1. The application for approval of a vehicle type with regard to its tyre pressure monitoring system shall be submitted by the vehicle manufacturer or by his duly accredited representative;
- 3.2. It shall be accompanied, in triplicate, by a description of the vehicle type with regard to the items specified in Annex 1 to this Regulation:
- 3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the Type Approval Authority or the Technical Service responsible for conducting the approval tests.
- 3.4. The Type Approval Authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

4. Approval

- 4.1. If the vehicle submitted for approval pursuant to this Regulation meets all the requirements of paragraph 5. below, approval of that vehicle type shall be granted.
- 4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 01 for the Regulation as amended by the 01 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another type of vehicle.
- 4.3. Notice of approval or of extension or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.
- 4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:
- 4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which granted approval;²
- 4.4.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the markings prescribed in paragraph 4.4.1.
- 4.5. If the vehicle conforms to a vehicle type approved, under one or more regulations annexed to the Agreement, in the country which granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case, the regulation and approval numbers and the additional symbols for all the regulations under which approval has been granted in the country which granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.
- 4.6. The approval mark shall be clearly legible and be indelible.
- 4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.
- 4.8. Annex 2 to this Regulation gives examples of approval marks.

5. Specifications and tests

- 5.1. General
- 5.1.1. Any vehicle of categories M₁ up to a maximum mass of 3,500 kg, M₂, M₃, N₁, N₂, N₃, O₃ and O₄, in all cases fitted with a Tyre Pressure Monitoring System (TPMS) complying with the definition of paragraph 2.8, shall meet the performance requirements contained in paragraphs 5.1.2. to 5.6. of this Regulation over a wide range of road and environmental conditions encountered within the territory of the Contracting Parties.
- 5.1.1.1. A Tyre Pressure Refill System (TPRS) shall be deemed to be equivalent to a Tyre Pressure Monitoring System (TPMS) when the test criteria of Annex 4 to this Regulation are met. In this case TPMS is not required to be installed.

² The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6, Annex 3 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

- 5.1.1.2. A Central Tyre Inflation System (CTIS) shall be deemed to be equivalent to a Tyre Pressure Monitoring System (TPMS) when the test criteria of Annex 4 to this Regulation are met. In this case TPMS is not required to be installed.
- 5.1.1.3. If more than one system as defined in paragraphs 2.8., 2.14. or 2.15. has been installed, all systems shall be approved according to the requirements of this Regulation.
- 5.1.2. The effectiveness of the tyre pressure monitoring system fitted on a vehicle shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by fulfilling the technical requirements and respecting the transitional provisions of UN Regulation No. 10 by applying:
- (a) The 03 series of amendments for vehicles without a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries);
 - (b) The 06 series of amendments for vehicles with a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries).
- 5.1.3. For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, the system shall operate from a speed of 40 km/h or below, up to the vehicle's maximum design speed.
- For vehicles of categories M₂, M₃, N₂, N₃, O₃ and O₄, the system shall operate from a speed of 30 km/h or below, up to the vehicle's maximum design speed.
- 5.1.4. The vehicle shall fulfil the tests (puncture, diffusion and malfunction) as specified in Annex 3 to this Regulation.
- 5.1.5. If a variant of any vehicle submitted for approval is fitted with twin wheels, that variant shall be used for the tests defined in Annex 3 to this Regulation and one of the tyres on a twin wheel (the 'test tyre') must be deflated for the puncture test in 2.5 of Annex 3 to this Regulation.
- 5.1.6. For vehicles of categories M₁ up to a maximum mass of 3500 kg and N₁
- In case of a given warning and if the tyre pressure monitoring system is equipped with a reset function but does not detect a minimum pressure as defined in paragraphs 5.2. and 5.3. after executing the reset function, the reset control shall be designed and/or located inside the vehicle in such a way that the risk of an inadvertent reset by vehicle occupants or cargo is reduced.
- For vehicles where the tyre pressure monitoring system does not detect if the pressure is above a minimum pressure as defined in paragraphs 5.2. and 5.3. after executing the reset function, the tyre pressure monitoring system shall include at least measures avoiding a reset if the vehicle did not become stationary after a pressure warning was issued, and either
- (a) Measures avoiding inadvertent reset control operation (e.g. shortly touching on the reset control or continuous blocking of the reset control by vehicle occupants or cargo), or
 - (b) An activation by at least two deliberate actions (e.g. in a menu based system).
- The manufacturer shall provide in the vehicle owner's handbook, or by any other communication means in the vehicle, the necessary information.
- 5.2. Tyre pressure detection for incident-related pressure loss.
- 5.2.1. For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, fitted with tyres of the class C1, the TPMS shall illuminate the warning signal described in paragraph 5.5. within not more than ten minutes of cumulative driving time after the in service operating pressure in one of the vehicle's tyres has been reduced by twenty per cent or it is at a minimum pressure of 150 kPa, whichever is higher.

- 5.2.2. For vehicles of category M_1 up to a maximum mass of 3,500 kg and N_1 , fitted with tyres of the tyre class C2, the TPMS shall illuminate the warning signal described in paragraph 5.5. within ten minutes of cumulative driving time after the in service operating pressure in one of the vehicle's tyres has been reduced by 20 per cent or it is at a minimum pressure of 220 kPa, whichever is higher.
- 5.2.3. For vehicles of category M_2 , M_3 , N_2 , N_3 , O_3 and O_4 , fitted with tyres of the tyre class C2 or C3, the TPMS shall illuminate the warning signal described in paragraph 5.5. within not more than ten minutes of cumulative driving time after the in-service operating pressure in one of the vehicle's tyres has been reduced by 20 per cent.
- 5.2.4. The low tyre pressure warning signal described in paragraph 5.5. shall be illuminated whenever the towed vehicle TPMS provides low tyre pressure warning information via the communication interface described in paragraph 5.6
- 5.3. Detection for a tyre pressure level significantly below the recommended pressure for optimum performance including fuel consumption and safety.
- 5.3.1. For vehicles of category M_1 up to a maximum mass of 3,500kg and N_1 , fitted with tyres of the tyre class C1, the TPMS shall illuminate the warning signal described in paragraph 5.5. within not more than sixty minutes of cumulative driving time after the in service operating pressure in any of the vehicle's tyres, has been reduced by twenty per cent or it is at a minimum pressure of 150 kPa, whichever is higher.
- 5.3.2. For vehicle category of category M_1 up to a maximum mass of 3,500kg and N_1 , fitted with tyres of the tyre class C2, the TPMS shall illuminate the warning signal described in 5.5. within not more than 60 minutes of cumulative driving time after the in-service operating pressure in any of the vehicle's tyres has been reduced by 20 per cent or it is at a minimum pressure of 220 kPa, whichever is higher.
- 5.3.3. For vehicle categories M_2 , M_3 , N_2 and N_3 , fitted with tyres of the tyre class C2 or C3, the TPMS shall illuminate the warning signal within not more than 60 minutes of cumulative driving time after the in-service operating pressure in any of the vehicle's rolling tyres in contact with the ground has been reduced by 20 per cent.
- 5.3.4. For vehicle of categories O_3 and O_4 , fitted with tyres of the tyre class C2 or C3, the TPMS shall transmit an appropriate warning signal described in 5.5 within not more than 60 minutes of cumulative driving time after the in-service operating pressure in any of the vehicle's rolling tyres in contact with the ground has been reduced by 20 per cent.
- 5.3.5. The low tyre pressure warning signal described in paragraph 5.5. shall be illuminated whenever the towed vehicle TPMS provides low tyre pressure warning information via the communication interface described in paragraph 5.6.
- 5.4. Malfunction detection.
- 5.4.1. The TPMS shall illuminate the warning signal described in paragraph 5.5. not more than 10 minutes after the occurrence of a malfunction that affects the generation or transmission of control or response signals in the vehicle's tyre pressure monitoring system.
- 5.4.2. The malfunction indication warning signal described in paragraph 5.5. shall be illuminated whenever the towed vehicle TPMS provides a malfunction indication via the communication interface described in paragraph 5.6.
- 5.4.3. The malfunction indication warning signal described in paragraph 5.5. shall be illuminated whenever no valid TPMS information is available from a

connected towed vehicle, that is required to have TPMS, via any communication interface described in paragraph 5.6.

- 5.5. Warning indication.
 - 5.5.1. The warning indication shall be by means of an optical warning signal conforming to UN Regulation No. 121.
 - 5.5.2. In the case of a vehicle of category N₂ or N₃ towing at least one vehicle of category O₃ or O₄, the optical warning signal referred to in 5.5.1. must indicate whether any warning relates to the individual towing or to the towed vehicle(s).
 - 5.5.3. The warning signal shall be activated when the ignition (start) switch is in the "on" (run) position (bulb check). This requirement does not apply to tell-tales shown in a common space.
 - 5.5.4. The warning signal must be visible even by daylight; the satisfactory condition of the signal must be easily verifiable by the driver from the driver's seat.
 - 5.5.5. For vehicles of category O₃ and O₄, the optical warning signal referred to in 5.5.1 must be displayed to the driver of the towing vehicle of category N₂ or N₃, as specified in paragraph 5.5.4.
 - 5.5.6. The malfunction indication may be the same warning signal as the one used to indicate under-inflation. If the warning signal described in paragraph 5.5.1. is used to indicate both under-inflation and a malfunction of the TPMS, the following shall apply: with the ignition (start) switch in the "on" (run) position the warning signal shall flash to indicate a malfunction. After a short period of time the warning signal shall remain continuously illuminated as long as the malfunction exists and the ignition (start) switch is in the "on" (run) position. The flashing and illumination sequence shall be repeated each time the ignition (start) switch is in the "on" (run) position until the malfunction has been corrected.
 - 5.5.7. The tell-tale of the warning described in paragraph 5.5.1. may be used in a flashing mode in order to provide information about the reset status of the tyre pressure monitoring system in accordance with the owner's manual of the vehicle.
- 5.6. Communications interface between towing and towed vehicles
 - 5.6.1. In the case of a vehicle of category N₂ or N₃ towing at least one vehicle of category O₃ or O₄, the communications interface between these vehicles can be achieved via wired or wireless equipment, provided that the TPMS equipment in the towing vehicle and in the towed vehicle(s) are compatible.
 - 5.6.1.1. Wired equipment can be based on the braking electric control line which conforms to ISO 11992-1 and be a point-to-point type.

Different wired specifications may be used, provided that the TPMS equipment in the towing vehicle and in the towed vehicle(s) are compatible.
 - 5.6.1.2. In the case of a wireless equipment, the communication link must be an open standard specification. Provision must be made to ensure that the wireless link is set up between the physically connected vehicles (as opposed to other vehicles in the vicinity), and that information shared over this link is secure against outside interference.
 - 5.6.1.3. In the case of a point-to-point link between a towing vehicle ECU and a towed vehicle ECU, there shall be an open standard specification to allow a TPMS ECU, which does not constitute part of the point-to-point link, to connect, communicate and operate via the towed vehicle ECU which constitutes part of the point-to-point link, i.e. standardised gatewaying.

6. Supplementary information

- 6.1. The owner's manual, if any, of the vehicle shall contain at least the following information:
 - 6.1.1. A statement that the vehicle is equipped with such a system (and information how to reset the system, if the actual system includes such a feature).
 - 6.1.2. An image of the tell-tale symbol described in paragraph 5.5.1. (and an image of the malfunction tell-tale symbol, if a dedicated tell-tale is used for this function).
 - 6.1.3. Additional information about the significance of the low tyre pressure warning tell-tale illuminating and a description of the corrective action to be undertaken if this happens, including the reset procedure if the actual system includes such a feature.
- 6.2. If no owner's manual is supplied with the vehicle, the information required in paragraph 6.1. above shall be displayed in a prominent place on the vehicle.

7. Modifications and extension of approval of the vehicle type

- 7.1. Every modification of the vehicle type as defined in paragraph 2.2. of this Regulation shall be notified to the Type Approval Authority which approved the vehicle type. The Type Approval Authority may then either:
 - 7.1.1. Consider that the modifications made do not have an adverse effect on the conditions of the granting of the approval and grant an extension of approval;
 - 7.1.2. Consider that the modifications made affect the conditions of the granting of the approval and require further tests or additional checks before granting an extension of approval.
- 7.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.3. above to the Contracting Parties to the Agreement applying this Regulation.
- 7.3. The Type Approval Authority shall inform the other Contracting Parties of the extension by means of the communication form which appears in Annex 1 to this Regulation. It shall assign a serial number to each extension, to be known as the extension number.

8. Conformity of production

- 8.1. The conformity of production procedures shall comply with those set out in Schedule 1 to the Agreement (E/ECE/TRANS/505/Rev.3), with the following requirements:
- 8.2. The Type Approval Authority which has granted type approval, may at any time verify the conformity of production in each production facility. The normal frequency of these verifications shall be at least once per year.

9. Penalties for non-conformity of production

- 9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8 are not complied with.
- 9.2. If a Contracting Party to the Agreement, which applies this Regulation, withdraws an approval it has previously granted, it shall forthwith so notify the

other Contracting Parties applying this Regulation, by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "APPROVAL WITHDRAWN".

10. Production definitively discontinued

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication that authority shall inform thereof the other Contracting Parties to the Agreement applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "PRODUCTION DISCONTINUED".

11. Names and addresses of Technical Services responsible for conducting approval tests, and of Type Approval Authorities

The Contracting Parties to the Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

12. Transitional provisions

- 12.1. As from the official date of entry into force of the 01 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept type approvals under this Regulation as amended by the 01 series of amendments.
- 12.2. As from 6 July 2022, for vehicle types of category M₁ and as from 6 July 2024 for vehicle types of other categories than M₁, Contracting Parties applying this Regulation shall not be obliged to accept type approvals to the preceding series of amendments, first issued after 6 July 2022.
- 12.3. Until 6 July 2022, for vehicle types of category M₁ and until 6 July 2024 for vehicle types of other categories than M₁, Contracting Parties applying this Regulation shall accept type approvals to the preceding series of amendments, first issued before 6 July 2022.
- 12.4. As from 6 July 2022, for vehicle types of category M₁ and as from 6 July 2024 for vehicle types of other categories than M₁, Contracting Parties applying this Regulation shall not be obliged to accept type approvals issued to the preceding series of amendments to this Regulation.
- 12.5. Notwithstanding the transitional provisions above, Contracting Parties who start to apply this Regulation after the date of entry into force of the most recent series of amendments are not obliged to accept type approvals which were granted in accordance with any of the preceding series of amendments to this Regulation/are only obliged to accept type approval granted in accordance with the 01 series of amendments.
- 12.6. Notwithstanding paragraph 12.4., Contracting Parties applying this Regulation shall continue to accept type approvals issued according to the preceding series of amendments to this Regulation, for the vehicles/vehicle systems which are not affected by the changes introduced by the 01 series of amendments.

- 12.7. Contracting Parties applying this Regulation may grant type approvals according to any preceding series of amendments to this Regulation.³
- 12.8. Contracting Parties applying this Regulation shall continue to grant extensions of existing approvals to any preceding series of amendments to this Regulation.³

³ Note by the secretariat: the wording was adjusted in line with the decision of WP.29 at its November 2020 session (ECE/TRANS/WP.29/1155, paras. 92 and 93, and informal document WP.29-182-11).

Annex 1

Communication

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:



.....
.....
.....

- concerning:²
- Approval
 - Approval extended
 - Approval refused
 - Approval withdrawn
 - Production definitively discontinued

of a vehicle type with regard to its tyre pressure monitoring system pursuant to UN Regulation No. 141.

Approval No.:

Extension No.:

1. Trade name or mark of the vehicle:
.....
2. Vehicle type (if applicable, variants that are included):
3. Manufacturer's name and address:
4. If applicable, name and address of the manufacturer's representative:
.....
5. Vehicle submitted for approval on:
6. Technical Service responsible for conducting approval tests:
7. Date of test report:
8. Number of test report:
9. Brief description of the vehicle type:

¹ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the regulation).

² Strike out what does not apply.

- 9.1. Mass of the vehicle when tested:
 - Front axle:
 - Second axle:
 - Third axle:
 - Fourth axle:
 - Fifth axle:
 - Sixth axle:
 - etc.
 - Total:
- 9.2. Tyre Class, Marking and wheel size(s) of standard unit equipment:
- 9.3. Brief description of the tyre pressure monitoring system² / tyre pressure refill system² / central tyre inflation system² including implemented measures to avoid inadvertent reset control operation according to paragraph 5.1.6., if applicable.....

10. Result of the tests:

10.1. According to Annex 3 to this Regulation (TPMS), if applicable²:

	<i>Measured Time to warning (mm:ss)</i>
"Puncture test"	
"Diffusion test"	
"Malfunction test"	

10.2 According to Annex 4 to this Regulation (TPRS/ CTIS), if applicable²:

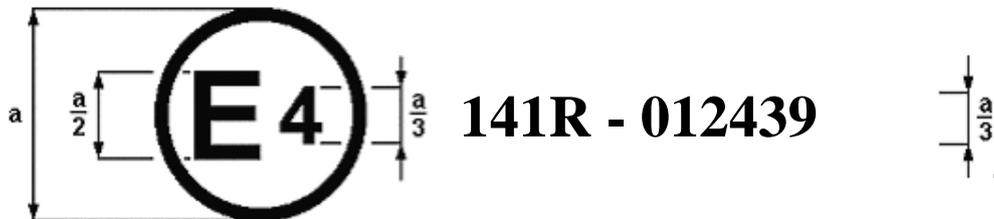
	<i>Start of refilling Time [s]</i>	<i>Refill Process completed Time [s]</i>	<i>Malfunction warning ON Time [s]</i>
"Refill functionality"			
"Malfunction warning"			

- 11. Position of approval mark:
- 12. Reason(s) of extension (if applicable):
- 13. Approval granted/refused/extended/withdrawn².....
- 14. Place:
- 15. Date:
- 16. Signature:
- 17. The list of documents deposited with the Type Approval Authority which has granted approval is annexed to this communication and can be obtained upon request.

Annex 2

Arrangements of approval marks

(See paragraph 4.4. of this Regulation)



$a = 8 \text{ mm min.}$

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to the equipment of a tyre pressure monitoring system, been approved in the Netherlands (E 4), pursuant to UN Regulation No. 141 under approval number 002439. The two digits of the approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. 141 as amended by the 01 series of amendments.

Annex 3

Tests requirements for Tyre Pressure Monitoring Systems (TPMS)

1. Test conditions
 - 1.1. General

In the case that both TPRS and TPMS are fitted to a vehicle, when TPMS is tested according to the tests outlined in this Annex, then TPRS shall be deactivated before commencing tests of TPMS. TPRS shall remain deactivated during tests of TPMS and can be reactivated after TPMS tests have been completed.

In the case that both CTIS and TPMS are fitted to a vehicle, when TPMS is tested according to the tests outlined in this Annex, then CTIS shall be deactivated before commencing tests of TPMS. CTIS shall remain deactivated during tests of TPMS and can be reactivated after TPMS tests have been completed.
 - 1.2. Ambient temperature.

The ambient temperature shall be between 0 °C and 40 °C.
 - 1.3. Road test surface.

The road shall have a surface affording good adhesion. The road surface shall be dry during testing.
 - 1.4. The tests shall be conducted in an environment free of interferences from radio wave.
 - 1.5. Vehicle conditions.
 - 1.5.1. Test weight.

The vehicle may be tested at any condition of load, the distribution of the mass among the axles being that stated by the vehicle manufacturer without exceeding any of the maximum permissible mass for each axle.

However, in the case where there is no possibility to set or reset the system, the vehicle shall be unladen. For vehicles of category M₁ up to a maximum mass of 3,500 kg, M₂, M₃, N₁, N₂, and N₃ there may be, in addition to the driver, a second person on the front seat (if fitted) who is responsible for noting the results of the tests.

The load condition shall not be modified during the test.
 - 1.5.2. Vehicle speed.

The TPMS shall be calibrated and tested for vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁:

 - (a) In a speed range from forty km/h and 120 km/h or the vehicle's maximum design speed if it is less than 120 km/h for the puncture test to verify the requirements of paragraph 5.2. to this Regulation; and
 - (b) In a speed range from forty km/h and 100 km/h or the vehicle's maximum design speed if it is less than 100 km/h for the diffusion test to verify the requirements of paragraph 5.3 to this Regulation and for the malfunction test to verify the requirements of paragraph 5.4. to this Regulation.

The TPMS shall be calibrated and tested for vehicles of categories M₂, M₃, N₂, N₃, O₃ and O₄:

- (c) In a speed range from 30 km/h and 90 km/h (or the vehicle's maximum design speed if it is less than 90 km/h) for the puncture test to verify the requirements of paragraph 5.2. to this Regulation; and
- (d) In a speed range from 30 km/h and 90 km/h (or the vehicle's maximum design speed if it is less than 90 km/h) for the diffusion test to verify the requirements of paragraph 5.3 to this Regulation and for the malfunction test to verify the requirements of paragraph 5.4. to this Regulation.

The whole speed range shall be covered during the test.

For vehicles equipped with cruise control, the cruise control shall not be engaged during testing.

1.5.3. Rim position.

The vehicle rims may be positioned at any wheel position, consistent with any related instructions or limitations from the vehicle's manufacturer.

1.5.4. Stationary location.

When the vehicle is parked, the vehicle's tyres shall be shaded from direct sun. The location shall be shielded from any wind that may affect the results.

1.5.5. Brake pedal application.

Driving time shall not accumulate during service brake application while the vehicle is moving.

1.5.6. Tyres.

The vehicle shall be tested with the tyres installed on the vehicle according to the vehicle manufacturer's recommendation. However, the spare tyre may be utilised for testing TPMS malfunction.

1.5.7. Lift axle(s)

If the vehicle is equipped with lift axle(s), the lift axle(s) shall be fully lowered such that the tyres shall have contact with the ground during testing.

1.6. Accuracy of pressure measurement equipment.

Pressure measurement equipment to be used for the tests contained in this annex shall be accurate to at least ± 3 kPa.

2. Test procedure

The test shall be performed at a test speed within the range in accordance with paragraph 1.5.2. to this annex, at least once for the test case according to paragraph 2.6.1. to this annex ("puncture test"), and at least once for each test case according to paragraph 2.6.2. to this annex ("diffusion test").

2.1. Before inflating the vehicle's tyres, leave the vehicle stationary outside at ambient temperature with the engine off shaded from direct sunlight and not exposed to wind or other heating or chilling influences for at least one hour for vehicles of category M₁ and N₁ and at least 4 hours for vehicles of category M₂, M₃, N₂, N₃, O₃ and O₄. Inflate the vehicle's tyres to the vehicle manufacturer's recommended cold inflation pressure (P_{rec}), in accordance with the vehicle manufacturer's recommendation for the speed and load conditions, and tyre positions. All pressure measurements shall be carried out using the same test equipment.

2.2. With the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "On" or "Run" position. The tyre pressure monitoring system shall perform a check of lamp function for the low tyre pressure tell-tale as specified in paragraph 5.5.2. of this Regulation. This last requirement does not apply to tell-tales shown in a common space.

- 2.3. If applicable, set or reset the tyre pressure monitoring system in accordance with the vehicle manufacturer's recommendations and verify in particular the measures avoiding inadvertent reset control operation according to paragraph 5.1.6.
- 2.4. Learning/ Tyre warming phase.
- 2.4.1. For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, drive the vehicle for a minimum of 20 minutes within the speed range in paragraph 1.5.2. to this annex, and with an average speed of 80 km/h (± 10 km/h). It is allowed to be outside the speed range for a maximum cumulative time of two minutes during this phase.
- For vehicles of category M₂, M₃, N₂, N₃, O₃ and O₄, drive the vehicle for a minimum of 120 minutes within the speed range in paragraph 1.5.2. to this annex, and with an average speed of 57 km/h (± 10 km/h). It is allowed to be outside the speed range for a maximum cumulative time of two minutes during this phase.
- 2.4.2. At the discretion of the Technical Service, where the driving test is undertaken on a track (circle/oval) with only turns in a single direction, then the driving test in paragraph 2.4.1. above should be equally split (± 2 minutes) in both directions.
- 2.4.3. Within the five minutes of completing the learning phase, measure the warm pressure of the tyre(s) to be deflated. The warm pressure shall be taken as the value P_{warm}. This value will be used for subsequent operations.
- 2.5. Deflation phase.
- 2.5.1. Procedure for the puncture test to verify the requirements of paragraph 5.2. to this Regulation.
- Following the requirements specified in 5.1.5, deflate one of the vehicle's tyres within five minutes of measuring the warm pressure as described in paragraph 2.4.3. above, until it is at P_{warm} - 20 per cent, or it is at a minimum pressure:
- (a) Of 150 kPa for vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, fitted with tyres of tyre class C1;
- or
- (b) Of 220 kPa for vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, fitted with tyres of tyre class C2,
- whichever is higher, namely P_{test}. Following a stabilisation period of between two and five minutes the pressure P_{test} shall be rechecked and adjusted if necessary.
- 2.5.2. Procedure for the diffusion test to verify the requirements of paragraph 5.3. to this Regulation.
- For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, fitted with tyres of tyre class C1 deflate all tyres within five minutes of measuring the warm pressure as described in paragraph 2.4.3. above, until the deflated tyres are at P_{warm} - 20 per cent plus a further deflation of 7 kPa, namely P_{test} or it is at a minimum pressure of 150 kPa. Following a stabilisation period of between two and five minutes the pressure P_{test} shall be rechecked and adjusted if necessary.
- For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁, fitted with tyres of tyre class C2 deflate all tyres within five minutes of measuring the warm pressure as described in paragraph 2.4.3. above, until the deflated tyres are at P_{warm} - 20 per cent plus a further deflation of 7 kPa, namely P_{test} or it is at a minimum pressure of 220 kPa. Following a stabilisation period of

between two and five minutes the pressure P_{test} shall be rechecked and adjusted if necessary.

For vehicles of category M_2 , M_3 , N_2 , N_3 , O_3 and O_4 deflate all tyres within 15 minutes of measuring the warm pressure as described in paragraph 2.4.3. above, until the deflated tyres are at $P_{\text{warm}} - 20$ per cent plus a further deflation of 7 kPa, namely P_{test} . Following a stabilisation period of between 5 and 10 minutes the pressure P_{test} shall be rechecked and adjusted if necessary.

- 2.6. Low tyre pressure detection phase.
 - 2.6.1. Procedure for the puncture test to verify the requirements of paragraph 5.2. to this Regulation.
 - 2.6.1.1. Drive the vehicle along any portion of the test course (not necessarily continuously). The sum of the total cumulative drive time shall be the lesser of 10 minutes or the time at which the low tyre pressure tell-tale illuminates.
 - 2.6.2. Procedure for the diffusion test to verify the requirements of paragraph 5.3. to this Regulation.
 - 2.6.2.1. Drive the vehicle along any portion of the test course. After not less than twenty (20) minutes and not more than forty (40) minutes bring the vehicle to a complete standstill with the engine switched off and the ignition key removed for not less than one (1) minute or more than three (3) minutes. Resume the test. The sum of the total cumulative drive time shall be the lesser of sixty (60) minutes of cumulative driving under the conditions set out in paragraph 1.4.2. above or the time at which the low tyre pressure tell-tale illuminates.
 - 2.6.3. If the low tyre pressure signal did not illuminate, discontinue the test.
- 2.7. Low pressure tell-tale illumination
 - 2.7.1. For vehicles of category M_1 up to a maximum mass of 3,500 kg and N_1

If the low tyre pressure tell-tale illuminated during the procedure in paragraph 2.6. above, deactivate the ignition locking system to the "Off" or "Lock" position. After a five minutes period, reactivate the vehicle's ignition locking system to the "On" ("Run") position. The tell-tale must illuminate and remain illuminated as long as the ignition locking system is in the "On" ("Run") position.
 - 2.7.2. For vehicles of category M_2 , M_3 , N_2 , N_3 , O_3 and O_4

If the low tyre pressure tell-tale illuminated during the procedure in paragraph 2.6. above, deactivate the ignition locking system to the "Off" or "Lock" position. After a five minutes period, reactivate the vehicle's ignition locking system to the "On" ("Run") position. The tell-tale must illuminate within ten minutes and remain illuminated as long as the ignition locking system is in the "On" ("Run") position.
- 2.8. Inflate all of the vehicle's tyres to the vehicle manufacturer's recommended cold inflation pressure. Reset the system in accordance with the instructions of the vehicle manufacturer. Determine whether the tell-tale has extinguished. If necessary, drive the vehicle until the tell-tale has been extinguished. If the tell-tale does not extinguish, discontinue the test.
- 2.9. Repetition of the deflation phase.

The test may be repeated, at the same or different loads, using the relevant test procedures in paragraphs 2.1. to 2.8. above, with the relevant tyre(s) on the vehicle under-inflated, in accordance with the provisions of paragraph 5.2. or 5.3. to this Regulation, whichever is relevant.

3. TPMS malfunction detection
 - 3.1. Simulate a TPMS malfunction, for example, by disconnecting the power source to any TPMS component, disconnecting any electrical connection between TPMS components, or installing a tyre or wheel on the vehicle that is incompatible with the TPMS. When simulating a TPMS malfunction, the electrical connections for the tell-tale lamps shall not be disconnected.
 - 3.2. Drive the vehicle for up to ten minutes of cumulative time (not necessarily continuously) along any portion of the test course.
 - 3.3. The sum of the total cumulative drive time under paragraph 3.2. shall be the lesser of ten minutes or the time at which the TPMS malfunction tell-tale illuminates.
 - 3.4. If the TPMS malfunction indicator did not illuminate in accordance with paragraph 5.4. to this Regulation, as required, discontinue the test.
 - 3.5. For vehicles of category M₁ up to a maximum mass of 3,500 kg and N₁

If the TPMS malfunction indicator is illuminated or illuminates during the procedure in paragraphs 3.1 to 3.3 above, deactivate the ignition locking system to the "Off" or "Lock" position. After five minutes, reactivate the vehicle's ignition locking system to the "On" ("Run") position. The TPMS malfunction indicator shall again signal a malfunction and remain illuminated as long as the ignition locking system is in the "On" ("Run") position.
 - 3.6. For vehicles of category M₂, M₃, N₂, N₃, O₃ and O₄

If the TPMS malfunction indicator is illuminated or illuminates during the procedure in paragraphs 3.1. to 3.3. above, deactivate the ignition locking system to the "Off" or "Lock" position. After five minutes, reactivate the vehicle's ignition locking system to the "On" ("Run") position. The TPMS malfunction indicator shall again signal a malfunction within ten minutes and remain illuminated as long as the ignition locking system is in the "On" ("Run") position.
 - 3.7. Restore the TPMS to normal operation. If necessary, drive the vehicle until the warning signal has extinguished. If the warning lamp has not extinguished, discontinue the test.
 - 3.8. The test may be repeated using the test procedures in paragraphs 3.1. to 3.6. above, with each such test limited to simulation of a single malfunction.

Annex 4

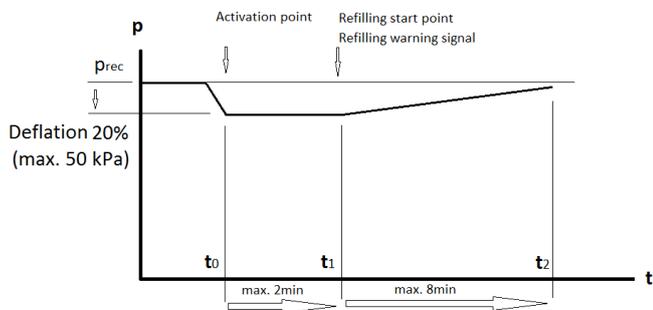
Test requirements for Tyre Pressure Refilling Systems (TPRS) and for Central Tyre Inflation System (CTIS)

1. Test conditions
 - 1.1. Ambient temperature.

The ambient temperature shall be between 0 °C and 40 °C.
 - 1.2. Road test surface
Testing shall be performed on even ground.
 - 1.3. Vehicle condition
 - 1.3.1. Testweight
Any weight condition the vehicle is legally approved for.
 - 1.3.2. Driving situation
Tests are performed with the vehicle in standstill.
In case of vehicles of category O₃ and O₄, electric and pneumatic supply shall be provided.
 - 1.3.3. Stationary location
When the vehicle is parked, the vehicle's tyres shall be shaded from direct sun.
 - 1.4. Tyres
The vehicle shall be tested with the tyres on the vehicle according to the vehicle manufacturer's recommendation.
 - 1.5. Accuracy of pressure measurement equipment
Pressure measurement equipment to be used for the tests contained in this Annex shall be accurate to at least +/-10 kPa.
All pressure measurements shall be carried out using the same test equipment.
2. Test procedure
 - 2.1. Vehicle conditioning
The pressure reservoir (mounted infrastructure) has to be filled according to UN Regulation No. 13, Series 11, Supplement 16, reservoir pressure limits. Prior to the testing, it has to be ensured that each vehicle wheel has rotated at least ten times. Leave the vehicle stationary outside at ambient temperature with the engine off shaded from direct sunlight and not exposed to wind or other heating or chilling influences for at least one hour.
 - 2.2. Check the systems refill functionality
Inflate the vehicle's tyres to the vehicle manufacturer's recommended cold inflation pressure (P_{rec}).
Deflate the tyre pressure of one tyre by 20% but not more than 50 kPa below the manufacturers recommended cold inflation pressure (Prec).
 - 2.2.1. Check refilling according to Figure 1
Check that within 2 minutes the TPRS / CTIS starts refilling and the optical signal for refilling as described by the manufacturer is ON.
Refill process shall be completed within 8 min after the refill process has started and the optical signal for refilling as described by the manufacturer shall be OFF as soon as the refilling process is completed.

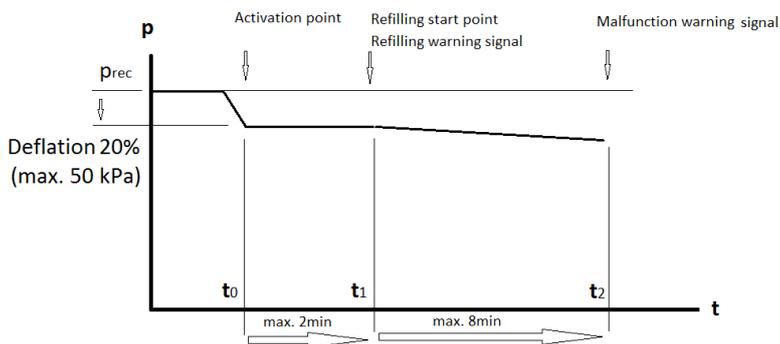
After the refilling process has been completed, check that the tyre pressure is in a range of +/- 5% of manufacturers recommended cold inflation pressure P_{rec} .

Figure 1
Refilling check



- 2.3. Check system malfunction warning functionality according to Figure 2
- Inflate the vehicle's tyres to the vehicle manufacturer's recommended cold inflation pressure (P_{rec}).
- Constantly deflate the system or the pressure of one tyre by 20% but not more than 50 kPa below the manufacturers recommended cold inflation pressure (P_{rec}).
- Within 2 minutes the system shall start refilling and the optical signal as described by the manufacturer for refilling is be ON
- Within 8 minutes after the start of the refilling the optical signal for malfunction as described by the manufacturer shall be ON.

Figure 2
Checking system malfunction warning functionality.



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