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Item 5 (f) of the provisional agenda
Tyres: UN Regulation No. 141 (Tyre pressure monitoring systems)

Proposal for Supplement 1 to the 01 series of amendments to UN Regulation No. 141

Submitted by the Task Force on Tyre Pressure Monitoring System and Tyre Installation*

The text below has been prepared by the experts on communication interfaces of the Task Force on Tyre Pressure Monitoring System and Tyre Installation (TF TPMSTI) in order to update the requirements on the communication interfaces between towing and towed vehicles. The changes compared to the 01 series of amendments to UN Regulation No. 141 (ECE/TRANS/WP.29/GRBP/2020/20 as amended by GRBP-72-19-Rev.2) are marked in bold for added text and strike through for deleted text.

* In accordance with the programme of work of the Inland Transport Committee for 2021 as outlined in proposed programme budget for 2021 (A/75/6 (Sect.20), para 20.51), 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.

I. Proposal

Table of content, Annexes, insert titles of new Annexes 5 and 6 to read:

"**5 Compatibility between towing vehicles and towed vehicles with respect to ISO 11992 data communication…… .....**

6 Test procedure to assess the functional compatibility of vehicles equipped with ISO 11992 communication interfaces ....."

Paragraph 5.6.1., amend to read:

"5.6.1. ~~In the case of a vehicle of category N_2 or N_3 towing at least one vehicle of category O_3 or O_4, the communications interface between these vehicles can be realised via wired or wireless equipment, provided that the TPMS equipment in the towing vehicle and in the towed vehicle(s) are compatible.~~

Vehicles of category N_2 or N_3 towing at least one vehicle of category O_3 or O_4 and vehicles of category O_3 and O_4 shall be equipped with a communication interface to exchange TPMS data information between towing and towed vehicles. This may be achieved as a wired or a wireless interface, provided that the TPMS equipment in the towing vehicle and in the towed vehicle(s) are compatible."

Paragraph 5.6.1.1., amend to read:

"5.6.1.1. ~~Wired~~ **The data communication with wired** equipment **shall** ~~can~~ be based on the braking electric control line **conforming** ~~which conforms~~ to ISO 11992-1**:2019 and ISO 11992-2:2014** and be a point-to-point **type using the seven pin connector according to ISO 7638-1:2018 or ISO 7638-2:2018 or an appropriate automated connector**.

~~Different~~ **Other** wired specifications may be used, provided that the TPMS equipment in the towing vehicle and in the towed vehicle(s) are compatible **and fulfil the same functional requirements**."

Insert new paragraphs 5.6.1.1.1. and 5.6.1.1.2. to read:

"5.6.1.1.1. The support of messages is specified within Part A of Annex 5 to this Regulation for the towing vehicle and the towed vehicle(s)."

5.6.1.1.2. The functional compatibility of towing and towed vehicles equipped with data communication lines as described in paragraph 5.6.1.1. above shall be assessed at the time of type approval by checking that the relevant provisions as specified in Part A of Annex 5 are fulfilled.

Annex 6 to this Regulation provides a procedure for tests that may be used to perform this assessment."

Paragraph 5.6.1.3., renumber to 5.6.1.2. and amend to read:

"5.6.1.~~3~~**2**. 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 **an ECU providing** ~~a~~ TPMS **functionality** ~~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. **This data communication interface is specified in Part B of Annex 5.**"

Paragraph 5.6.1.2. (former), renumber to 5.6.1.3. and amend to read:

"5.6.1.~~2~~**3**. In the case of **data communication with** ~~a~~ wireless equipment, the communication link **shall** ~~must~~ be an open standard specification. Provision **shall** ~~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.

The same functional requirements as required in paragraph 5.6.1.1. shall be fulfilled."

Insert a new Annex 5 to read:

"Annex 5

Compatibility between towing vehicles and towed vehicles with respect to ISO 11992 data communication

A. TPMS data communication between towing vehicle and towed vehicle(s)

1. General

1.1. The requirements of Part A of this annex shall only apply to towing vehicles and towed vehicles equipped with a communication interface as described in paragraph 5.6.1.1. of this Regulation.

1.2. This annex defines requirements applicable to the towing vehicle and towed vehicle with respect to the support of messages defined within ISO 11992-2:2014

2. The parameters defined within ISO 11992-2:2014 that are transmitted by the communication interface shall be supported as follows:

2.1. The following functions and associated messages are those that shall be supported by the towing vehicle or towed vehicle as appropriate:

2.1.1. Messages transmitted from the towing vehicle to the towed vehicle, if supported:

Function / Parameter	*ISO 11992-2: 2014 reference*
Reverse gear status	**EBS12 Byte 2 Bit 5-6**
Braking system wheel-based vehicle speed	**EBS12 Byte 7-8**
Time/Date – Seconds	**TD11 Byte 1**
Time/Date – Minutes	**TD11 Byte 2**
Time/Date – Hours	**TD11 Byte 3**
Time/Date – Months	**TD11 Byte 4**
Time/Date – Day	**TD11 Byte 5**
Time/Date – Year	**TD11 Byte 6**
Time/Date - Local minute offset	**TD11 Byte 7**
Time/Date - Local hour offset	**TD11 Byte 8**
Identification data index	**RGE12 Byte 5**
Identification data content	**RGE12 Byte 6**

Note: Regarding the definition of the parameters of the TD11 message, there is a known inconsistency between the SAE J1939 and ISO 11992 standards. For the purposes of compliance to this Regulation, the TD11 message definition provided in the ISO 11992-2:2014 shall be used.

2.1.2. Mandatory messages transmitted from the towed vehicle to the towing vehicle:

Function / Parameter	*ISO 11992-2:2014 reference*	*Reference to paragraphs in this UN Regulation*
Tyre Pressure Status	**EBS23 Byte 1 Bit 1-2**	**Paragraph 5.3.5**
Tyre/wheel identification (pressure)	**EBS23 Byte 2**	**Paragraph 5.3.5**

2.1.3. Messages transmitted from the towed vehicle to the towing vehicle, if supported:

Function / Parameter	*ISO 11992-2:2014 reference*
Tyre/wheel identification (for EBS23 pressure)	**EBS23 Byte 2**
Tyre pressure	**EBS23 Byte 5**
Tyre/wheel identification (for RGE23)	**RGE23 Byte 1**
Tyre temperature	**RGE23 Byte 2-3**
Air leakage detection	**RGE23 Byte 4-5**
Tyre pressure threshold detection	**RGE23 Byte 6 Bit 1-3**
Tyre module power supply status	**RGE23 Byte 6 Bit 4-5**
Identification data index	**RGE23 Byte 7**
Identification data content	**RGE23 Byte 8**

2.1.4. The towed vehicle ECU transmitting the EBS23 and RGE23 messages shall assemble the EBS23 and RGE23 messages from TPMS content received from the ECU providing TPMS functionality and data from other sources.

Signals, other than Tyre Pressure Status (EBS23 Byte 1 Bit 1-2), within messages EBS23 and RGE23 shall be transmitted with the indication "not available" in case the ECU providing TPMS functionality does not provide such data.

2.2. When the towed vehicle transmits the following messages, the towing vehicle shall provide a low tyre pressure warning to the driver:

Function / Parameter	*ISO 11992-2:2014 reference*	*Driver warning required*
Tyre Pressure Status ***(For Low Tyre Pressure Warning Indication)***	**EBS23 Byte 1** **Bit 1-2** **(002 — tyre pressure insufficient)**	**References to paragraph 5.2.3., 5.2.4., 5.3.3., 5.3.5. and 5.5.2. in this UN Regulation**
Tyre/wheel identification ***(corresponding to Tyre Pressure Status)***	**EBS23 Byte 2** **(XXXXXXXX$_b$ — actual Tyre/Wheel ID)** **OR** **(00000000$_b$ — Tyre/Wheel ID not defined)** **OR** **(11111111$_b$ — Tyre/Wheel ID not available)**	**References to paragraph 5.2.3., 5.2.4., 5.3.3., 5.3.5. and 5.5.2. in this UN Regulation**

2.3. When the towed vehicle transmits the following messages, the towing vehicle shall provide a TPMS malfunction indication to the driver:

Function / Parameter	*ISO 11992-2:2014 reference*	*Driver warning required*
Tyre Pressure Status ***(For TPMS Malfunction Indication)***	**EBS23 Byte 1** **Bit 1-2** **(102 — error indicator)**	**Reference to paragraph 5.4.1., 5.4.2. and 5.5.2. in this UN Regulation**
Tyre/wheel identification ***(corresponding to Tyre Pressure Status)***	**EBS23 Byte 2** **XXXXXXXX$_b$ — actual Tyre/Wheel ID)** **OR** **(00000000$_b$ — Tyre/Wheel ID not defined)** **OR** **(11111111$_b$ — Tyre/Wheel ID not available)**	**Reference to paragraph 5.4.1., 5.4.2. and 5.5.2. in this UN Regulation**

2.3.1. The towed vehicle shall transmit a Tyre Pressure Status value of "error indicator" within 10 minutes of cumulative driving (in accordance with paragraph 5.4.1. of this Regulation) for any scenario where a valid Tyre Pressure Status (i.e. tyre pressure sufficient or insufficient) cannot be transmitted.

Note that before towed vehicles needed to comply with this Regulation, some of them transmitted Tyre Pressure Status "not available" for some of these scenarios, including when the towed vehicle had no function to perform tyre pressure monitoring. Towed vehicles that are required to comply with this Regulation going forward shall instead transmit "error indicator" for these scenarios.

Note that the towing vehicle would not be required to display a towed vehicle TPMS malfunction indication in the case that valid towed vehicle TPMS information is available on an alternative communication interface.

2.4. **When a permanent failure is detected in the communication line, the towing vehicle shall illuminate the towed vehicle TPMS malfunction indication signal.**

Note that the towing vehicle would not be required to display a towed vehicle TPMS malfunction indication in the case that valid towed vehicle TPMS information is available on an alternative communication interface.

2.5. **When a valid Tyre Pressure Status is temporarily not available (i.e. unavailable for less than 10 minutes of cumulative drive time), the towed vehicle shall transmit the following messages:**

Function / Parameter	*ISO 11992-2:2014 reference*	*Driver warning required*
Tyre Pressure Status ***(TPMS data temporarily unavailable)***	**EBS23 Byte 1** **Bit 1-2** **(112 — not available)**	**Not applicable**
Tyre/wheel identification ***(corresponding to Tyre Pressure Status)***	**EBS23 Byte 2** **$XXXXXXXX_b$ — actual Tyre/Wheel ID)** **OR** **(00000000_b — Tyre/Wheel ID not defined)** **OR** **(11111111_b — Tyre/Wheel ID not available)**	**Not applicable**

Note: paragraph 2.3.1. of part A of this Annex specifies required transmitted values when valid Tyre Pressure Status is unavailable for any longer duration.

2.6. **The support of all other messages defined within ISO 11992-2:2014 is optional for the towing vehicle and towed vehicle, unless required by other Regulations.**

B. Data communication between (i) a towed vehicle ECU constituting part of a point-to-point link with the towing vehicle (towed vehicle gateway ECU) and (ii) a towed vehicle ECU providing TPMS functionality

1. **General**

1.1. **The requirements of Part B of this annex shall only apply to towed vehicles with a communication interface as described in paragraph 5.6.1.2. of this Regulation.**

1.2. **This annex defines requirements applicable to the towed vehicle gateway ECU and the ECU providing TPMS functionality with respect to the provision of a standard ISO 11898:2015 interface and the support of messages defined within ISO 11992-2:2014.**

2. **The towed vehicle gateway ECU that is part of the point-to-point link shall provide an interface with the ECU providing TPMS functionality complying with data link layer and physical layer in accordance with ISO 11898:2015.**

2.1. **The CAN bit-rate for the ISO 11898:2015 interface shall be 250 kbit/s.**

2.2. **The ISO 11898:2015 bus termination shall be configured on the vehicle in accordance with the guidelines of the vehicle manufacturer for the given installation.**

2.3. A power connection shall be made available to the towed vehicle ECU providing TPMS functionality in accordance with the vehicle manufacturer.

2.4. The towed vehicle gateway ECU shall transmit, towards the towed vehicle ECU providing TPMS functionality, all messages and signals required to realise a reliable TPMS function.

3. The parameters that are transmitted by the ISO 11898:2015 communication interface shall be as defined within ISO 11992-2:2014 and shall be supported as follows:

3.1. The following functions and associated messages are those that shall be supported by the towed vehicle gateway ECU or towed vehicle ECU providing TPMS functionality as appropriate:

3.1.1. Messages transmitted, if supported, from the towed vehicle gateway ECU to the towed vehicle ECU providing TPMS functionality:

Function / Parameter	*ISO 11992-2:2014 reference*	*Reference to paragraphs in this UN Regulation*
Reverse gear status (towing vehicle)	**EBS12 Byte 2 Bit 5-6**	**Paragraph 5.6.1.2.**
Braking system wheel-based vehicle speed (towing vehicle)	**EBS12 Byte 7-8**	**Paragraph 5.6.1.2.**
Identification data index (towing vehicle)	**RGE12 Byte 5**	**Paragraph 5.6.1.2.**
Identification data content (towing vehicle)	**RGE12 Byte 6**	**Paragraph 5.6.1.2.**
Time/Date – Seconds (towing vehicle)	**TD11 Byte 1**	**Paragraph 5.6.1.2.**
Time/Date – Minutes (towing vehicle)	**TD11 Byte 2**	**Paragraph 5.6.1.2.**
Time/Date – Hours (towing vehicle)	**TD11 Byte 3**	**Paragraph 5.6.1.2.**
Time/Date – Months (towing vehicle)	**TD11 Byte 4**	**Paragraph 5.6.1.2.**
Time/Date – Day (towing vehicle)	**TD11 Byte 5**	**Paragraph 5.6.1.2.**
Time/Date – Year (towing vehicle)	**TD11 Byte 6**	**Paragraph 5.6.1.2.**
Time/Date - Local minute offset (towing vehicle)	**TD11 Byte 7**	**Paragraph 5.6.1.2.**
Time/Date - Local hour offset (towing vehicle)	**TD11 Byte 8**	**Paragraph 5.6.1.2.**
Braking system wheel-based vehicle speed (towed vehicle)	**EBS21 Byte 3-4**	**Paragraph 5.6.1.2.**
Lift axle 1 position (towed vehicle)	**RGE21 Byte 2 Bit 1-2**	**Paragraph 5.6.1.2.**
Lift axle 2 position (towed vehicle)	**RGE21 Byte 2 Bit 3-4**	**Paragraph 5.6.1.2.**

Note: Regarding the definition of the parameters of the TD11 message, there is a known inconsistency between the SAE J1939 and ISO 11992 standards. For the purposes of compliance to this Regulation, the TD11 message definition provided in the ISO 11992-2:2014 shall be used.

3.1.2. Mandatory messages transmitted from the towed vehicle ECU providing TPMS functionality to the towed vehicle gateway ECU:

Function / Parameter	*ISO 11992-2:2014 reference*	*Reference to paragraphs in this UN Regulation*
Tyre Pressure Status	**EBS23 Byte 1 Bit 1-2**	**Paragraph 5.6.1.2.**
Tyre/wheel identification (pressure)	**EBS23 Byte 2**	**Paragraph 5.6.1.2.**

3.1.3. Messages transmitted from the towed vehicle ECU providing TPMS functionality to the towed vehicle gateway ECU, if supported:

Function / Parameter	*ISO 11992-2:2014 reference*	*Reference to paragraphs in this UN Regulation*
Tyre/wheel identification (for EBS23 pressure)	**EBS23 Byte 2**	**Paragraph 5.6.1.2.**
Tyre pressure	**EBS23 Byte 5**	**Paragraph 5.6.1.2.**
Tyre/wheel identification	**RGE23 Byte 1**	**Paragraph 5.6.1.2.**
Tyre temperature	**RGE23 Byte 2-3**	**Paragraph 5.6.1.2.**
Air leakage detection	**RGE23 Byte 4-5**	**Paragraph 5.6.1.2.**
Tyre pressure threshold detection	**RGE23 Byte 6 Bit 1-3**	**Paragraph 5.6.1.2.**
Tyre module power supply status	**RGE23 Byte 6 Bit 4-5**	**Paragraph 5.6.1.2.**
Identification data index	**RGE23 Byte 7**	**Paragraph 5.6.1.2.**
Identification data content	**RGE23 Byte 8**	**Paragraph 5.6.1.2.**

3.1.4. For messages defined in section 3.1. of Part B of this Annex, signals shall be transmitted with the indication "not available" in case the ECU does not provide such data.

3.2. The support of all other messages defined within ISO 11992-2:2014 is optional for the towed vehicle gateway ECU and the towed vehicle ECU providing TPMS functionality, unless required by other Regulations.

3.3. The towed vehicle gateway ECU and the towed vehicle ECU providing TPMS functionality shall support diagnostics as per ISO 11992-4:2014.

4. The towed vehicle ECU providing TPMS functionality shall use the source address of "Other Trailer Devices" with respect to its position in the road train as per SAE J1939-71 standard i.e. TPMS of the first towed vehicle shall use source address 207 for "Other Trailer #1 Devices".''

Insert new a new Annex 6 to read

"Annex 6

Test procedure to assess the functional compatibility of vehicles equipped with ISO 11992 data communication interface

1. General

1.1. This annex describes a procedure that may be used to check towing and towed vehicles equipped with a communication interface as described in paragraph 5.6.1.1. of this Regulation against the functional requirements referred to in paragraph 5.6.1.1.1. of this Regulation. Alternative procedures may be used at the discretion of the Technical Service if an equivalent level of checking integrity can be established.

1.2. The references to ISO 7638 within this Annex apply to ISO 7638-1:2018 for 24V applications and ISO 7638-2:2018 for 12V applications.

2. Towing vehicles

2.1. ISO 11992 towed vehicle simulator

The simulator shall:

2.1.1. Have a connector meeting ISO 7638 (7 pin) to connect to the vehicle under test. Pins 6 and 7 of the connector shall be used to transmit and receive messages complying with ISO 11992-2:2014;

2.1.2. Be capable of receiving all of the messages transmitted by the motor vehicle to be type approved and be capable of transmitting all towed vehicle messages defined within ISO 11992-2:2014;

2.1.3. Provide a direct or indirect readout of messages, with the parameters in the data field shown in the correct order relative to time

2.2. Checking procedure

2.2.1. Check the following, with the simulator connected to the motor vehicle via the ISO 7638 interface and whilst all towed vehicle messages relevant to the interface are being transmitted:

2.2.1.1. Low Tyre Pressure Warning:

2.2.1.1.1. Simulate a towed vehicle low tyre pressure warning and check that the low tyre pressure warning signal specified in paragraph 5.5 of this regulation is displayed.

The parameters defined in EBS 23 bytes 1 and 2 of ISO 11992-2:2014 shall be transmitted as follows:

Control line signalling	*EBS 23 Byte 1* *Bits 1 - 2*	*EBS 23 Byte 2*
Low Tyre Pressure Warning for tyre/wheel identification number 1,7 (Axle 1, left inner)	**00_b** **(tyre pressure insufficient)**	**00010111_b** **(Tyre/Wheel "1,7")**

2.2.1.1.2. Simulate a towed vehicle low tyre pressure warning (without known tyre/wheel ID) and check that the low tyre pressure warning signal specified in paragraphs 5.5 of this Regulation is displayed.

The parameters defined in EBS 23 bytes 1 and 2 of ISO 11992-2:2014 shall be transmitted as follows:

Control line signalling	*EBS 23 Byte 1* *Bits 1 - 2*	*EBS 23 Byte 2*
Low Tyre Pressure Warning (without known tyre/wheel ID)	**00_b** **(tyre pressure insufficient)**	**00000000_b** **(Tyre/Wheel ID not defined)** **OR** **11111111_b** **(Tyre/Wheel ID not available)**

2.2.1.2. TPMS Malfunction Warning:

2.2.1.2.1. Simulate a towed vehicle TPMS malfunction, signalled by the towed vehicle TPMS, and check that the towed vehicle TPMS malfunction indication warning signal specified in paragraph 5.5.6. of this Regulation is displayed.

The parameters defined in EBS 23 bytes 1 and 2 of ISO 11992-2:2014 shall be transmitted as follows:

Control line signalling	*EBS 23 Byte 1* *Bits 1 - 2*	*EBS 23 Byte 2*
TPMS Malfunction for tyre/wheel identification number 1,7 (Axle 1, left inner)	**10_b** **(Error indicator)**	**00010111_b** **(Tyre/Wheel "1,7")**

2.2.1.2.2. Simulate a towed vehicle TPMS malfunction (without known tyre/wheel ID) and check that the towed vehicle TPMS malfunction indication warning signal specified in paragraph 5.5.6. of this Regulation is displayed.

The parameters defined in EBS 23 bytes 1 and 2 of ISO 11992-2:2014 shall be transmitted as follows:

Control line signalling	*EBS 23 Byte 1* *Bits 1 - 2*	*EBS 23 Byte 2*
TPMS Malfunction (without known tyre/wheel ID)	**10_b** **(Error indicator)**	**00000000_b** **(Tyre/Wheel ID not defined)** **OR** **11111111_b** **(Tyre/Wheel ID not available)**

2.2.1.2.3. Simulate a permanent failure in the communication line and check that the towed vehicle TPMS malfunction indication warning signal specified in paragraph 5.5.6. of this Regulation is displayed.

2.2.1.2.4. **Note that the towed vehicle TPMS malfunction indication would not be displayed in the case that valid TPMS information is available on an alternative interface.**

3. **Towed vehicles**

3.1. **ISO 11992 towing vehicle simulator**

Figure 1
Arrangement of device under test and vehicle simulator where TPMS functionality is provided by ECU connected via ISO 11898-1:2015 and 11898-2:2016 interface

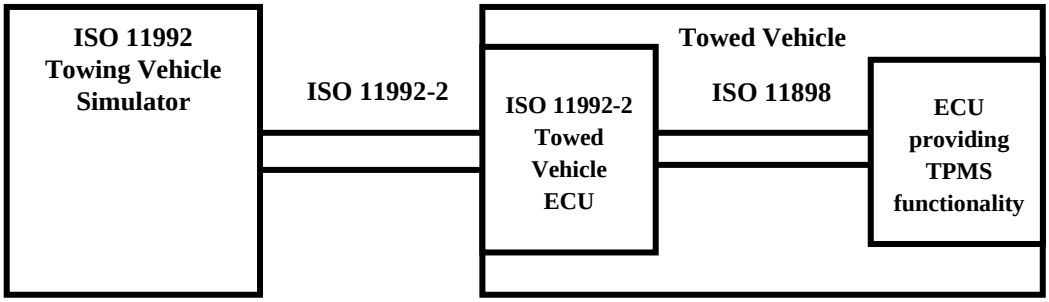
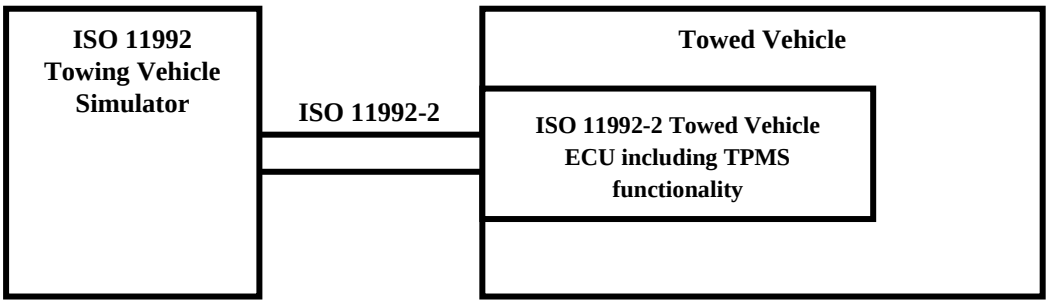


Figure 2
Arrangement of device under test and vehicle simulator where TPMS functionality is provided by ECU connected to towing vehicle



The simulator shall:

3.1.1. **Have a connector meeting ISO 7638 (7 pin) to connect to the vehicle under test. Pins 6 and 7 of the connector shall be used to transmit and receive messages complying with ISO 11992-2:2014;**

3.1.2 **Have a warning display and an electrical power supply for the towed vehicle;**

3.1.3. **Be capable of receiving all of the messages transmitted by the towed vehicle to be type approved and be capable of transmitting all motor vehicle messages defined within ISO 11992-2:2014;**

3.1.4. **Provide a direct or indirect readout of messages, with the parameters in the data field shown in the correct order relative to time.**

3.2. **Checking procedure**

3.2.1 **Configure the ISO 11992-2:2014 towed vehicle ECU to use either VIN "AABBCCDDEE1234567" or the actual VIN of the towed vehicle.**

3.2.2 **Check the following, with the simulator connected to the towed vehicle and whilst all towing vehicle messages relevant to the interface are being transmitted:**

3.2.2.1. The transmitted VIN shall be the one configured in paragraph 3.2.1. of this Annex

3.2.2.2. Follow the test procedure defined in Annex 3 of this Regulation and check that the TPMS warning and malfunction signals are transmitted as defined in paragraphs 2.2., 2.3. and 2.4. of Part A of Annex 5."

II. Justification

1. At its nineth meeting, TF TPMSTI agreed on the proposal submitted by an expert group, which was mandated by the Task Force, with the purpose to describe the communication interface protocol of TPMS between towing and towed vehicles of categories N_2, N_3 and O_3, O_4, respectively.

2. Paragraph 5.6. was revised to describe the requirements in a correct way.

3. The suitable communication requirements are described in Annex 5 on the basis of the International Organization for Standardization (ISO) bus requirements, in the same manner as described in UN Regulation No. 13 and the relevant ISO documents.

4. Testing requirements of the communication interface are also introduced in the additional Annex 6.