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BSI Standards Publication

Road vehicles and Tyre Pressure Gauges (TPG) — Interoperability between Tyre Information Systems (TIS) and TPG — Interfaces and Requirements

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National foreword

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Road vehicles and Tyre Pressure Gauges (TPG) - Interoperability between Tyre Information Systems (TIS) and TPG - Interfaces and Requirements

Véhicules routiers et manomètres de pneumatiques (TPG) - Interopérabilité entre systèmes d'information de pneumatiques (TIS) et TPG - Interfaces et exigences

Reifendruck Management Systeme (TPMS) und Reifendruck Anzeigen - Interoperabilität zwischen TPMS im Fahrzeug und Füllsystemen (TPG) - Schnittstellen und Anforderungen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 16661:2015) has been prepared by Technical Committee CEN/TC 301 “Road vehicles”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2015, and conflicting national standards shall be withdrawn at the latest by December 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under mandate M/457 given to CEN by the European Commission and the European Free Trade Association.

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Introduction

The general objective of this document is the capability of standardized interactivity between tyre pressure gauges (TPG) with tyre information systems (TIS), which provide all relevant data for tyre (re-)filling process for example placard information and/or the tyre pressure monitored via Tyre Pressure Monitoring System (TPMS).

EU regulation No 661/2009 is requiring TPMS on all newly homologated car types by November 2012 and on new cars by November 2014.

Increasing potential of TIS/TPMS and TPG, this document is part of the future European standards covering the interoperability of TPG with TIS, through standardized interfaces and data exchange formats, allowing advanced information management and exchange. The architecture is open and scalable to support from the most complex (full interoperability) to the simplest (fully manual) applications. Furthermore, the architecture considers relevant ways of communication. The communication standard allows the secure interfacing for data exchanges between the TPG and TIS.

1 Scope

This European Standard applies to the tyre pressure gauges (TPG) which operate using pressure equipment (devices used in fixed or mobile installations) to inflate the tyres of road using vehicles (M1 and M2 categories) and which may be capable of interacting with vehicles equipped with tyre pressure monitoring systems (TPMS) whereby the TPG may be steered by the TPMS/vehicle.

To set the correct tyre inflation, this European Standard defines requirements and processes for the interoperability of TPG with TPMS/vehicle, through standardized interfaces and data exchange formats allowing advanced information, management and control systems between TPG and TPMS/vehicle. The architecture is open and scalable to support the different levels of interoperability (from full interoperability to fully manual).

This European Standard does not define communication protocols (works specifically made under M/453 European mandate).

This European Standard may be applied to all TPG categories referenced in EN 12645.

The driver/operator is considered as being responsible for the validation of the parameters and tyre pressure.

This European Standard will be applicable upon development of Infrastructure solution (V2I-I2V communication solutions)

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ETSI DTS 101 556-2, *Intelligent Transport System (ITS) — Infrastructure to Vehicle (I2V) communication — Communication system specification to support application requirements for Tyre Pressure Monitoring System (TPMS)*

ISO 639-1, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

3 Conformance

In order to claim conformance with this European Standard, communication shall be established using accepted wireless communication standards (defined in ETSI DTS 101 556-2) and comply with the standards developed for the European mandate M/453 (Standardization mandate addressed to CEN, CENELEC and ETSI in the field of Information and Communication Technologies to support the interoperability of Co-operative systems for Intelligent Transport in the European Community).

It shall be able to demonstrate an open scalable architecture (from full interoperability to fully manual), depending on data availability defined herein.

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
tyre pressure gauge
TPG
tyre pressure measuring instrument comprising all the elements from the tyre valve connector up to and including the display device

Note 1 to entry: The elements may include connector, hose, control device, measurement components, display device, software, reservoir, etc.

4.2
Vehicle-to-Infrastructure interface
V2I interface
device mounted in the vehicle which exchanges data to the outside communication infrastructure

4.3
Infrastructure-to-Vehicle interface
I2V interface
device of the outside communication infrastructure which exchanges data with the vehicle

4.4
Vehicle-to-Infrastructure and Infrastructure-to-Vehicle communication
V2I/I2V communication
application of information and communication technologies that allows Vehicle-to-Infrastructure and Infrastructure-to-Vehicle communication

4.5
Tyre Information System
TIS
in-vehicle functional system that contains tyre relevant in-vehicle data from TPMS and/or other sources (e.g. HMI, other systems, placard table, measured/available tyre data, etc.)

Note 1 to entry: It provides these data to the vehicle ITS station for interoperability.

4.6
interoperability
standardized information exchange between the tyre pressure measuring instrument and TIS

4.7
level of interoperability
process automation level to complete data exchange between TIS and tyre pressure measuring system

4.8
placard table
table that contains the recommended inflation pressures made/calculated by vehicle manufacturer and/or tyre manufacturer for the intended service conditions

4.9
load configuration
vehicle load (partly/fully load) including the mass of the vehicle itself and supported loads

4.10
Tyre Pressure Monitoring System (TPMS)
any system fitted on a vehicle, able to evaluate the pressure of the tyres or the variation of the pressure over time and to transmit corresponding information to the user while the vehicle is running

Note 1 to entry: A TPMS is functionally composed of:

— sensing devices;

— information channel hardware;

— Central Processing Unit (CPU); and

— Human Machine Interface (HMI).

4.11
recommended cold tyre inflation pressure (p_{rec})
pressure recommended by the vehicle and/or the tyre manufacturer for each tyre position and for the intended service conditions of the vehicle

Note 1 to entry: p_{rec} is the same or higher than the minimum cold tyre inflation pressure.

Note 2 to entry: This data is usually defined on vehicle placard or on the owner's manual or stored into an available database (e.g. in an ECU in a vehicle, etc.)

4.12
proposed tyre pressure
$p_{proposed}$
inflation pressure proposed by the TPG

4.13
applied tyre pressure
$p_{applied}$
tyre pressure value indicated by TPG after the filling process is completed

4.14
cold tyre inflation pressure
p_{cold}
tyre pressure measured in absence of any pressure build-up due to tyre usage

4.15
warm tyre inflation pressure
p_{warm}
tyre pressure measured under the influence of pressure build-up due to tyre usage

4.16
intended vehicle service conditions
load, speed and camber of a vehicle corresponding to the intended usage

4.17
Wheel Fitted Component (WFC)
optional device that measures physical parameters and conveys information to (downlink) a central unit fitted in the vehicle body

Note 1 to entry: A WFC may also be equipped with an uplink channel which could carry the pressure on demand inputs or elsewhere.

4.18
under-inflation
tyre inflation pressure lower than recommended for the vehicle in service

4.19
diagnostic function
system process to verify the functionality of all involved components in terms of interoperability

4.20
TPG Intelligent Transport System (ITS) Station
TPG enabling the exchange of data: directly with a Vehicle ITS Station or indirectly with a Vehicle via a Central ITS Station

4.21
TPG Human Machine Interface (HMI)
Human Machine Interface as part of the TPG for data exchange and validation, and display required to perform the filling process

4.22
operator
human person in charge of inflating/verifying process can be driver or professional worker

4.23
vehicle ITS Station
establishes wireless communication between the vehicle to TPG ITS station and/or RSU ITS station

5 Symbols and abbreviations

DOT	US Department of Transportation
ECU	Electronic Control Unit
ENM	Enumerated
FL	Front Left
FR	Front Right
FS	Full Scale
HMI	Human Machine Interface
ITS	Intelligent Transport System
RF	Radio Frequency
RL	Rear Left
RR	Rear Right
RSU	Road Side Unit
TIN	Tyre Identification Number (often called DOT)
TIS	Tyre Information System
TPG	Tyre Pressure Gauge (see also new definition under 4.1)
TPMS	Tyre Pressure Monitoring System
V2I/I2V	Vehicle to Infrastructure/Infrastructure to Vehicle
WFC	Wheel Fitted Component

6 Requirements

6.1 Levels of interoperability

Depending on the level of equipped components and the availability of data, the following modes are possible:

1) Fully automatic mode: parameters from Table 1, Table 2 and Table 3 which are necessary for the correct determination of the $p_{proposed}$ are provided by TIS or TPG, and are confirmed by the operator.

2) Semi-automatic mode: part of the parameters from Table 1, Table 2 and Table 3 which are necessary for the correct determination of the $p_{proposed}$ are provided by TIS or TPG, and are confirmed by the operator.

3) Manual mode: operator identifies and applies the intended pressures (fully manual).

Independent which mode is utilized, a final confirmation by the operator of the $p_{proposed}$ related to the intended vehicle service condition is required prior to any filling process.

6.2 Required parameters provided by TIS, depending on level of interoperability

6.2.1 General

The requirements listed in the following clauses are associated to 1) and 2) defined in 6.1. All communication requirements for interoperability are covered in ETSI DTS 101 556-2.

Independent on level of interoperability as defined in 1) and 2) of 6.1, the following data shall be provided:

— basic parameter (see Table 1);

— placard table information (see Table 2).

The TPG provides a menu based on the data required to perform the filling process. The operator uses the TPG according to the intended vehicle service condition.

Details on the format and content of all parameters defined in the following clauses are described in Annex A and Annex B.

6.2.2 Basic parameters

The basic parameters defined in Table 1 contain information to be provided by TIS, transmitted by Vehicle ITS Station.

Table 1 — Basic parameter

Block No.	Name	Type	Length/ Unit	Description
1	Language	string	According to Table A.2: 5 Bit / letter (EN, DE, CY, … ; letter to comply with ISO 639-1)	Chosen language adjusted at HMI in the vehicle for synchronization of display language between vehicle and HMI TPG
2	Vehicle type	ENM	2 byte (e.g. M1)	Identification of passenger vehicle and truck (or any other vehicle)
3	Tyre temperature condition	ENM	1 Byte	In case the vehicle manufacturer considers a supplementary pressure value, i.e. concerning warm tyre condition, this parameter needs to be modified to all tyre set variant pressures. 00 = Pressure values given for cold tyres 01 = Pressure values given for warm tyres 10 = 'not available' 11 = reserved

6.2.3 Placard table information for vehicle platform

The following data defined in Table 2 contain information to be provided by TIS, transmitted by Vehicle ITS Station. In case of no tyre size dependency only block no. 4, 10, 11 are necessary to transmit.

Table 2 — Placard table information

Block No.	Name	Type	Length/ Unit	Description
4	Number of tyre sets	ENM	4 Bit	Number of tyre sets identifying the repetition amount of different tyre sets. It defines the length and content of the datagram. This Block number 4 defines the amount of repetition of block number 5 - 9. 0000 No tyre size dependency (no specific tyre data transmitted. Parameters under block number 5 – 9 are not considered / transmitted. Only block number 10 and associated variants defined below are considered). 0001 1 Tyre Set 0010 2 Tyre Sets 0011 3 Tyre Sets : 1111 15 Tyre Sets
5	Definition of tyre set variant	ENM	4 Bit * "Number	Identifier of the individual tyre sets determined in block number 4.

Block No.	Name	Type	Length/ Unit	Description
			of tyre sets" (block no.4)	0000 Not defined 0001 Tyre Set Variant1 0010 Tyre Set Variant2 0011 Tyre Set Variant3 : 1111 Tyre Set Variant15
6	Tyre dimension front axle		40 bit * "Number of tyre sets" (block no.4)	Contains description of tyre dimension at front axle. Data format and length of *DIMENSION*:7 x ASCII 4 Bit (according to Table A.1) Data format and length of *Load Index*: Binary 7 Bit Data format and length of *Speed Index*: ASCII 5 Bit (according to Table A.2) NOTE See Annex B for further information.
7	Tyre type front axle	ENM	1 Byte * "Number of tyre sets" (block no.4)	Contains description of tyre type at the front axle: 00xx xxxx Standard 01xx xxxx Reserved 10xx xxxx Run flat tyre 11xx xxxx Reserved xx0x xxxx no fixed rolling direction xx1x xxxx fixed rolling direction xxx0 xxxx symmetrical xxx1 xxxx asymmetrical xxxx 00xx All Season xxxx 01xx Summer xxxx 10xx Winter/Snow (M+S) xxxx 11xx 3 PMSF (3 Pics Mountain Snow Flake) xxxx xx0x Normal Load xxxx xx1x Extra Load (XL) xxxx xxx0 Default xxxx xxx1 Reserved (e.g. single or dual tyres) NOTE See Annex B for further information.
8	Tyre dimension rear axle		40 bit * "Number of tyre sets" (block no.4)	Contains description of tyre dimension at rear axle. Data format and length of *DIMENSION*: 7 x ASCII 4 Bit (according to Table A.1) Data Length and format of *Load Index*: Binary 7 Bit Data format and length of *Speed Index*: ASCII 5 Bit (according to Table A.2) NOTE See Annex B for further information.

Block No.	Name	Type	Length/ Unit	Description
9	Tyre type rear axle	ENM	1 Byte * "Number of tyre sets" (block no.4)	Contains description of tyre type at the rear axle: 00xx xxxx Standard 01xx xxxx Reserved 10xx xxxx Run flat tyre 11xx xxxx Reserved xx0x xxxx no fixed rolling direction xx1x xxxx fixed rolling direction xxx0 xxxx symmetrical xxx1 xxxx asymmetrical xxxx 00xx All Season xxxx 01xx Summer xxxx 10xx Winter/Snow (M+S) xxxx 11xx 3 PMSF (3 Pics Mountain Snow Flake) xxxx xx0x Normal Load xxxx xx1x Extra Load (XL) xxxx xxx0 Default xxxx xxx1 Reserved (e.g. single or dual tyres) NOTE See Annex B for further information.
10	Amount of pressure variants	ENM	4 Bit	For each tyre set variant several pressure configurations, based on certain conditions, may be available. This value indicates how many pressure configurations will be transmitted in the following configurations depending on tyre set variant: 0000 Not defined 0001 1 variant 0010 2 variants 1111 15 variants
11	Pressure Variant x		25 Bit * "Number of tyre sets" (block no.4) * "Amount of pressure variants" (block no.10)	Depending on the chosen pressure variant (see block number 10), this parameter block needs to be repeated accordingly. The following parameters are included: Variance (9 Bit) *Load configuration* xxxxxxx00 Not relevant xxxxxxx01 Partially load xxxxxxx10 Fully load xxxxxxx11 Reserved *Driving Type Configuration* xxx0000xx Not relevant xxx0001xx Sport xxx0010xx Eco xxx0011xx Comfort xxx0100xx - xxx1111xx Reserved

Block No.	Name	Type	Length/ Unit	Description
				Speed Type Configuration 000xxxxxx Not relevant 001xxxxxx Speed slot 1 010xxxxxx Speed slot 2 011xxxxxx Speed slot 3 100xxxxxx - 111xxxxxx Reserved Placard pressure values front axle (1 Byte) Resolution: 5 kPa Range 0 kPa to 1275 kPa Placard pressure values rear axle (1 Byte) Resolution: 5 kPa Range 0 kPa to 1275 kPa

6.2.4 Vehicle-specific data for increasing the level of interoperability

Vehicles equipped with TIS / TPMS may provide an increased level of interoperability (full or partial interoperability) with a TPG by sending additional data to the TPG. These data may be available (measured/programmed) in the vehicle and provided for communication between Vehicle ITS Station and TPG ITS Station.

Based on these data the partial or fully interoperability helps to prevent wrong usage and should increase the accuracy and efficiency of the filling process.

Table 3 provides all data for increased level of interoperability that may be applicable in the vehicle.

Table 3 — Vehicle-specific data for increasing the level of interoperability

Block No.	Name	Type	Length/ Unit	Description
12	Current vehicle configuration	ENM	9 Bit	The current vehicle configuration has an impact on the recommended pressures. *Load configuration* xxxxxxx00 Not relevant xxxxxxx01 Partially load xxxxxxx10 Fully load xxxxxxx11 Reserved *Driving Type Configuration* xxx0000xx Not relevant xxx0001xx Sport xxx0010xx Eco xxx0011xx Comfort xxx0100xx - xxx1111xx Reserved *Speed Type Configuration* 000xxxxxx Not relevant 001xxxxxx Speed slot 1 010xxxxxx Speed slot 2 011xxxxxx Speed slot 3 100xxxxxx - 111xxxxxx Reserved
13	Definition of content for wheel specific data (Block no. 14, 15, 16, 17, 18)		2Byte	1xxxxxxxxxxxxxxx *Current tyre pressure (8bit)* x1xxxxxxxxxxxxxx *Tyre side wall information (60bit)* xx1xxxxxxxxxxxxx *Tyre type (8bit)* xxx1xxxxxxxxxxxx *Current air temperature inside tyre (8bit)* xxxx1xxxxxxxxxxx *Recommended pressure (8bit)* xxxxx1xxxxxxxxxx *TIN (64bit)* xxxxxx1xxxxxxxxx *Sensor state (16bit)* xxxxxxx1xxxxxxx *Others (reserved for future use) (64bit)* 0 = Data not available 1 = Data available
14	Wheel location front left (FL)		236 bits (max)	Measured or permanent tyre data are transmitted via WFC to a vehicle body fixed antenna with receiver. The following data could be transferred for each tyre: *Current tyre pressure* (Length: 1 Byte) Data format: ENM Resolution: 2,5 kPa Pressure offset: 100 kPa Range: 100 kPa – 730 kPa (absolute pressure) 0x00: invalid / Error 0x01: Underflow (pressure < 100 kPa) 0x02 – 0xFE 100 kPa – 730 kPa (tyre inflation)

Block No.	Name	Type	Length/ Unit	Description
				0xFF Overflow (pressure > 730 kPa) *Tyre side wall information* (Length: 60 bits) Data format and length of *DIMENSION*: 7 x ASCII 4 Bit (according to Table A.1) Data Length and format of *Load Index*: Binary 7 Bit Data format and length of *Speed Index*: ASCII 5 Bit (according to Table A.2) Data format and length of *Reserved*: Binary 12bit *Tyre type* 00xx xxxx Standard 01xx xxxx Reserved 10xx xxxx Run flat tyre 11xx xxxx Reserved xx0x xxxx no fixed rolling direction xx1x xxxx fixed rolling direction xxx0 xxxx symmetrical xxx1 xxxx asymmetrical xxxx 00xx All Season xxxx 01xx Summer xxxx 10xx Winter (M+S) xxxx 11xx Severe Winter xxxx xx0x Normal Load xxxx xx1x Extra Load (XL) xxxx xxx0 Default xxxx xxx1 Reserved (Length: 1 Byte) Data format: ENM Resolution: 1 °C Temperature offset: −50 °C Range: −50 °C – 187 °C 0x00: invalid / Error 0x01: Underflow (temperature < −40 °C) 0x02 – 0xEF −50 °C – 187 °C (tyre air temperature) 0xFx Overflow (temperature > x °C) 0xF0 = Overflow threshold 1 > 85°C 0xF1 = Overflow threshold 2 > 90°C 0xF2 = Overflow threshold 3 > 95°C 0xF3 = Overflow threshold 4 > 100°C 0xF4 = Overflow threshold 5 > 105°C 0xF5 = Overflow threshold 6 > 110°C 0xF6 = Overflow threshold 7 > 115°C

Block No.	Name	Type	Length/ Unit	Description
				0xF7 = Overflow threshold 8 > 120°C 0xF8 = Overflow threshold 9 > 125°C 0xF9 = Overflow threshold 10 > 130°C 0xFA = Overflow threshold 11 > 135°C 0xFB = Overflow threshold 12 > 140°C 0xFC = Overflow threshold 13 > 145°C 0xFD = Overflow threshold 14 > 150°C 0xFE = Overflow threshold 15 > 155°C 0xFF = Overflow threshold 16 > 165°C *Recommended pressure (Pa) based on current vehicle configuration (block 13) and wheel specific data (blocks 14, 15, 16, 17, 18, 19)* *Note: Pa* (Length: 1 Byte) Resolution: 5 kPa Range: 0 kPa to 1 275 kPa (p_e) *TIN* (Length: 64 Bit) Data format ASCII, means 6 bit per character and 1 byte for week- and 1 byte for year of production. Example: *TIN:* CP5H AFRP 1209 Char: C P 5 H A F R P 12 09 Binary: 100011 110000 010101 101000 100001 100110 110010 110000 00001100 00001001 TIN MSB 0x8F TIN 2nd Byte 0x05 TIN 3rd Byte 0x68 TIN 4th Byte 0x86 TIN 5th Byte 0x6C TIN 6th Byte 0xB0 TIN 7th Byte 0x0C TIN LSB 0x09 *Sensor state* (Length: 16 Bit Bit 15 indicates Available / Unavailable Bit 14 indicates Working / Not working) WFC state reflects diagnosis information, provided by TIS. E.g. WFC functionality or battery life time. *Reserved for future use (e.g. energy status, profile code, run-flat mileage, tread depth, etc.)* (Length: app.64 Bit)
15	Wheel location front right (FR)		Max. 236 bits	Details of parameter definition refer to block number 14.
16	Wheel location rear left (RL)		Max. 236 bits	Details of parameter definition refer to block number 14.

Block No.	Name	Type	Length/ Unit	Description
17	Wheel location rear right (RR)		Max. 236 bits	Details of parameter definition refer to block number 14.
18	Spare tyre		Max. 236 bits	Details of parameter definition refer to block number 14.

6.2.5 Feedback information from the TPG to the TIS

The following optional parameters defined in Table 4 contain applied value information provided by the TPG, transmitted to the Vehicle ITS Station.

Table 4 — Feedback parameter

Block No.	Name	Type	Length/ Unit	Description
19	Final filling process status	ENM	1 bit	Failed/Completed
20	Number of applied tyre pressure values	ENM		{1,2,3,4,5} { > 5 = Invalid}
21	Applied tyre pressure[a] ($p_{applied}$)	ENM	1 Byte	*Applied tyre pressure* Resolution: 2,5 kPa Pressure offset: 100 kPa Range: 100 kPa – 730 kPa (absolute pressure) 0x00: invalid / Error 0x01: Underflow (pressure < 100 kPa) 0x02 – 0xFE 100 kPa – 730 kPa (tyre inflation) 0xFF Overflow (pressure > 730 kPa)
[a] Block No. 21 will be repeated depending on the number of applied tyre pressure values				

7 Process requirements

The following illustration outlines the filling process flow requirements defined in Clause 6.The filling process follows the pairing process defined in ETSI DTS 101 556-2, except in the case of fully manual mode.

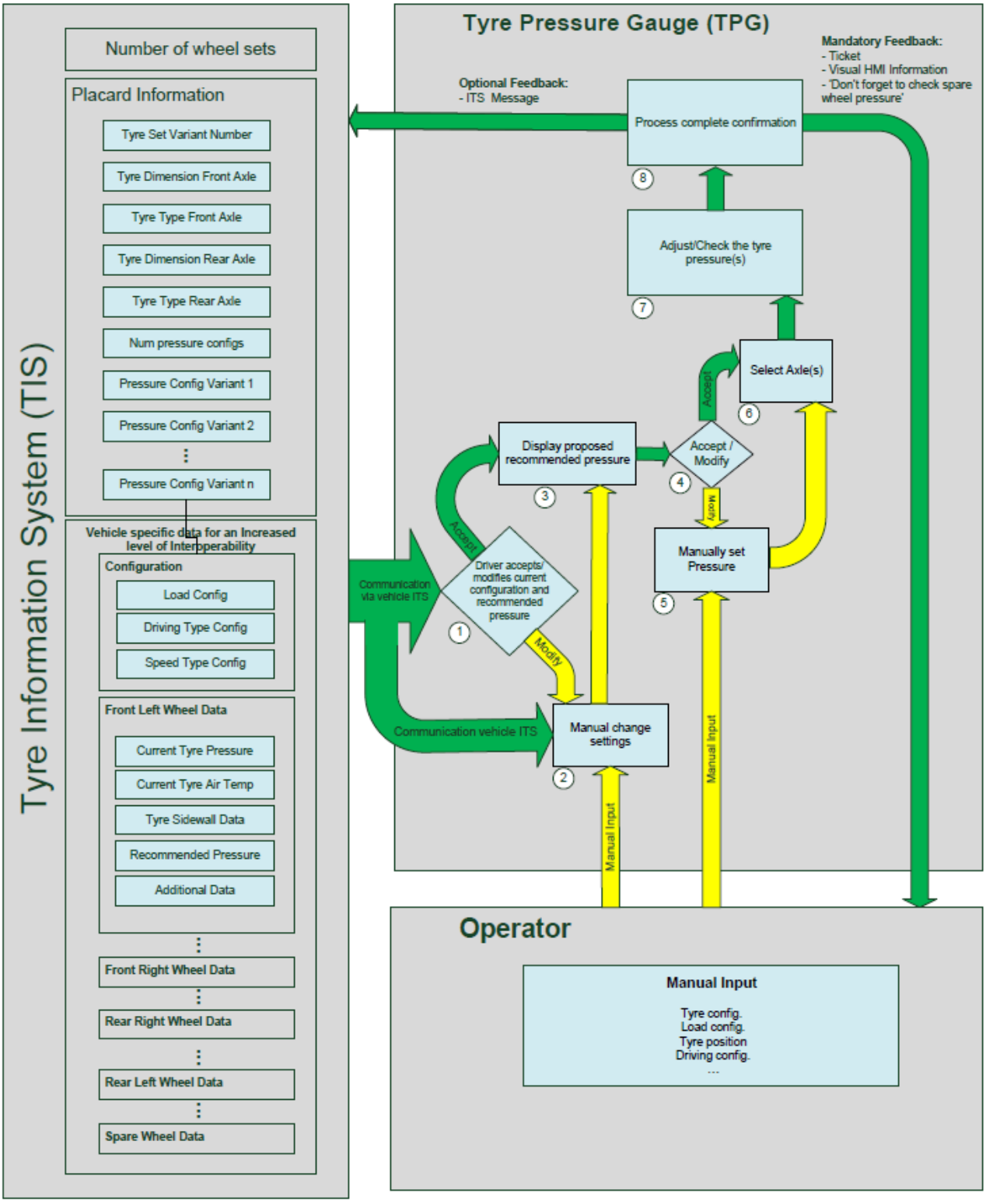

Figure 1 — Filling process flow

8 Test conditions

The tests shall be performed in the common operating range of the TIS and the TPG.

9 Test methods

This clause defines the minimum scope of tests that shall be performed in order to ensure interoperability between TIS and TPG.

— The following procedures shall be tested in accordance with ETSI DTS 101 556-2.

  — discovery process;

  — reservation process;

  — pairing;

  — tyre refilling process;

  — end of filling process.

— The TIS shall be able to send at least one of the profile data set as defined in Table 5.

Table 5 — TIS profiles

Data element	Profile 1	Profile 2	Profile 3
Language	M	M	M
Vehicle type	M	M	M
Tyre temperature condition	M	M	M
Number of tyre sets (No.)	M (2)	M (1)	M (1)
Definition of tyre set variant (No.)	M (2)	M (1)	M (1)
Tyre dimension front axle (No.)	M (2)	M (1)	M (1)
Tyre type front axle (No.)	M (2)	M (1)	M (1)
Tyre dimension rear axle (No.)	M (2)	M (1)	M (1)
Tyre type rear axle (No.)	M (2)	M (1)	M (1)
Amount of pressure variants (No.)	M (3)	M (2)	M (2)
Pressure Variants x (No.)	M (3) Variant 1 = Fully load, Sport, Speed type not relevant Placard pressure front axle Placard pressure rear axle Variant 2 = Partially load, Sport, Speed type not relevant Placard pressure front axle	M (2) Variant 1 = Fully load, Sport, Speed type not relevant Placard pressure front axle Placard pressure rear axle Variant 2 = Partially load, Sport, Speed type not relevant Placard pressure front axle	M (2) Variant 1 = Fully load, Sport, Speed type not relevant Placard pressure front axle Placard pressure rear axle Variant 2 = Partially load, Sport, Speed type not relevant Placard pressure front axle

Data element	Profile 1	Profile 2	Profile 3
	Placard pressure rear axle Variant 3 = Partially load, Comfort, speed limit not relevant. Placard pressure front axle Placard pressure rear axle	Placard pressure rear axle	Placard pressure rear axle
Current vehicle configuration	M Variant 1 = Fully load, Sport, Speed type not relevant	M Variant 1 = Fully load, Sport, Speed type not relevant	Optional
Definition of content for wheel specific data	M — Current tyre pressure — Tyre side wall information — Tyre type — Current air temperature inside tyre — Recommended pressure — TIN — Sensor state	M — Current tyre pressure — No Tyre side wall information — No Tyre type — Current air temperature inside tyre — No Recommended pressure — No TIN — Sensor state	Optional
Wheel location front left (FL)	— Current tyre pressure — Tyre side wall information — Tyre type — Current air temperature inside tyre — Recommended pressure — TIN — Sensor state	— Current tyre pressure — No Tyre side wall information — No Tyre type — Current air temperature inside tyre — No Recommended pressure — No TIN — Sensor state	Optional
Wheel location front right (FR)	— Current tyre pressure — Tyre side wall information — Tyre type — Current air temperature inside tyre — Recommended pressure — TIN — Sensor state	— Current tyre pressure — No Tyre side wall information — No Tyre type — Current air temperature inside tyre — No Recommended pressure — No TIN — Sensor state	Optional

Data element	Profile 1	Profile 2	Profile 3
Wheel location rear left (RL)	— Current tyre pressure — Tyre side wall information — Tyre type — Current air temperature inside tyre — Recommended pressure — TIN — Sensor state	— Current tyre pressure — No Tyre side wall information — No Tyre type — Current air temperature inside tyre — No Recommended pressure — No TIN — Sensor state	Optional
Wheel location rear right (RR)	— Current tyre pressure — Tyre side wall information — Tyre type — Current air temperature inside tyre — Recommended pressure — TIN — Sensor state	— Current tyre pressure — No Tyre side wall information — No Tyre type — Current air temperature inside tyre — No Recommended pressure — No TIN — Sensor state	Optional
Spare tyre	Optional	Optional	Optional
M = Mandatory			

— The TPG shall be able to receive and process all the data defined in Table 1, Table 2, and Table 3 (see Clause 6). For each of the profiles, the following filling decision shall be tested:

  — Profile 1 corresponds to the message flow: “1”, (“2” in case of manual change), “3”, “4”, “6”, “7” and “8” as shown in Figure 1.

  — Profile 2 and 3 correspond to the message flow: “1”, “2” (either in case of manual changes and/or input settings), “3”, “4”, “6”, “7” and “8” as shown in Figure 1.

  — The TPG shall perform message flow: “5”, “6”, “7” and “8” as shown in Figure 1 in order to fulfil the manual mode stated in 6.1.

These profiles should be supervised for transmission and reception on both TIS and TPG sides.

Annex A
(normative)

Parameter conversions

Table A.1 illustrates the conversion of characters in ASCII format in the size of 4 Bits.

Table A.1 — ASCII 4 Bit

Binary	Hex	Character
0000	0x00	*
0001	0x01	+
0010	0x02	,
0011	0x03	-
0100	0x04	.
0101	0x05	/
0110	0x06	0
0111	0x07	1
1000	0x08	2
1001	0x09	3
1010	0x0A	4
1011	0x0B	5
1100	0x0C	6
1101	0x0D	7
1110	0x0E	8
1111	0x0F	9

Table A.2 illustrates the conversion of characters in ASCII format in the size of 5 Bits.

Table A.2 — ASCII 5 Bit

Binary	Hex	Character
0 0000	0x00	@
0 0001	0x01	A
0 0010	0x02	B
0 0011	0x03	C
0 0100	0x04	D
0 0101	0x05	E
0 0110	0x06	F
0 0111	0x07	G
0 1000	0x08	H
0 1001	0x09	I
0 1010	0x0A	J
0 1011	0x0B	K
0 1100	0x0C	L
0 1101	0x0D	M
0 1110	0x0E	N
0 1111	0x0F	O
1 0000	0x10	P
1 0001	0x11	Q
1 0010	0x12	R
1 0011	0x13	S
1 0100	0x14	T
1 0101	0x15	U
1 0110	0x16	V
1 0111	0x17	W
1 1000	0x18	X
1 1001	0x19	Y
1 1010	0x1A	Z
1 1011	0x1B	[
1 1100	0x1C	\
1 1101	0x1D	]
1 1110	0x1E	^
1 1111	0x1F	_

Annex B
(normative)

Tyre dimension and type

Table B.1 defines tyre dimension and type utilized in Table 2

Table B.1 — Tyre dimension and type

Tyre dimension	48 Bit / 6 Byte
Data format and length of dimension	ASCII 4 Bit (See Annex A)
Data format and length of load index	Binary, 7 Bit
Data format and length of speed index	ASCII 5 Bit (See Annex A)
Data format and length of tyre type	Table, 8 Bit
Table of tyre type	
Binary	**Tyre type**
00xx xxxx	Standard
01xx xxxx	Reserved
10xx xxxx	Run flat tyre
11xx xxxx	Reserved
xx0x xxxx	No fixed rolling direction
xx1x xxxx	Fixed rolling direction
xxx0 xxxx	Symmetrical
xxx1 xxxx	Asymmetrical
xxxx 00xx	All seasons
xxxx 01xx	Summer
xxxx 10xx	Winter (M+S)
xxxx 11xx	3 PMSF (3 Pics Mountain Snow Flake)
xxxx xx0x	Normal load
xxxx xx1x	Extra load
xxxx xxx0	Default
xxxx xxx1	Reserved

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[1] EN 12645, *Tyre pressure measuring instruments - Devices for inspection of pressure and/or inflation / deflation of tyres for motor vehicles - Metrology, requirements and testing*

[2] ISO 21750:2006, *Road vehicles — Safety enhancement in conjunction with tyre inflation pressure monitoring*

[3] European mandate M/457 EN (December 2009), *Standardisation mandate to CEN, CENELEC and ETSI in the field of Tyre Pressure Gauges for motor vehicles and Tyre pressure Management Systems (measuring instruments)*

[4] European mandate M/453 EN (October 2009), *Standardisation mandate to CEN, CENELEC and ETSI in the field of Information and Communication Technologies to support the interoperability of Co-operative systems for Intelligent Transport in the European Community*

[5] Informal standard (protocol) on RF datagram for TPMS wheel unit, *written by German vehicle manufacturers with automotive suppliers*

[6] UN ECE R64, *Uniform provisions concerning the approval of vehicles equipped with temporary-use spare wheels/tyres and/or tyre pressure monitoring systems and/or run flat tyres*

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