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1958 Agreement:
Consideration of draft amendments to existing UN Regulations submitted by GRBP

Proposal for Supplement 14 to the 02 series of amendments to UN Regulation No. 117 (Tyre rolling resistance, rolling noise and wet grip)

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-fourth session (ECE/TRANS/WP.29/GRBP/72, para. 21). It is based on ECE/TRANS/WP.29/GRBP/2021/17 as amended by Informal document GRBP-74-31-Rev.1. 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 2022 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2022 as outlined in proposed programme budget for 2022 (A/76/6 (part V sect. 20) para 20.76), 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.

Table of contents, Annexes, amend to read:[**]

"Annexes

"

[**] Page numbers will be indicated at a later stage *(note by the secretariat)*.

Paragraph 1.1., amend to read:

"1.1. This Regulation applies to new pneumatic tyres* of classes C1, C2 and C3 with regard to their sound emissions, rolling resistance and to adhesion performance on wet surfaces (wet adhesion). It does not, however, apply to:

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* For the purpose of this Regulation "tyres" means "pneumatic tyres"

Paragraph 1.1.3., amend to read:

"1.1.3. Tyres designed for competition;"

Paragraph 1.1.6., amend to read:

"1.1.6. Tyres with a speed category less than 80 km/h (speed category symbol F);"

Paragraph 2.1., amend to read:

2.1. "*Type of tyre*" means tyres which do not differ in such essential characteristics as:

(a) The manufacturer's name;

(b) The tyre class (see paragraph 2.6. below);

(c) The tyre structure;

(d) The category of use: normal tyre, snow tyre and special use tyre;

(e) Whether snow tyre for use in severe snow conditions or not;

(f) For class C1 tyres, whether ice grip tyre or not;

(g) For classes C2 and C3 tyres, whether traction tyre or not;

(h) The tread pattern (see paragraph 3.2.1. of this Regulation)."

Paragraph 2.3., amend to read:

"2.3. "*Brand name/trademark*" means the identification of the brand or trademark as defined by the tyre manufacturer and marked on the sidewall(s) of the tyre. The brand name/trademark may be the same as that of the manufacturer."

Paragraphs 2.6.1. to 2.6.3., amend to read:

"2.6.1. *Class C1 tyres*: tyres conforming to UN Regulation No. 30;

2.6.2. *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";

2.6.3. *Class C3 tyres*: tyres conforming to UN Regulation No. 54 and identified by:

(a) A load capacity index in single formation higher or equal to 122; or

(b) A load capacity index in single formation lower or equal to 121 and a speed category symbol lower or equal to "M"."

Paragraph 2.7., amend to read:

"2.7. "*Representative tyre size*" means the tyre size which is submitted to the test described in Annex 3 to this Regulation with regard to rolling sound emissions, or Annex 5 for adhesion on wet surfaces or Annex 6 for rolling resistance to assess the conformity for the type approval of the type of tyre, or Annex 7 for measuring snow performance, or Annex 8 for measuring ice performance."

Paragraph 2.11., amend to read:

"2.11. "*Reinforced tyre*" or "*extra load tyre*" of class C1 means a tyre structure designed to carry more load at a higher inflation pressure than the load carried

by the corresponding standard version tyre at the standard inflation pressure as specified in ISO 4000-1:2010[2]"

Paragraph 2.12., amend to read:

"2.12. "*Traction tyre*" means a tyre in classes C2 or C3 bearing the inscription TRACTION and intended to be fitted primarily to the drive axle(s) of a vehicle to maximize force transmission in various circumstances."

Paragraph 2.13.1., amend to read:

"2.13.1. "*Snow tyre for use in severe snow conditions*" means a snow tyre whose tread pattern, tread compound or structure is specifically designed to be used in severe snow conditions and that fulfils the requirements of paragraphs 6.4. and 6.4.1. of this Regulation."

Insert a new paragraph 2.13.1.1., to read:

"2.13.1.1. "*Ice grip tyre*" means a class C1 snow tyre for use in severe snow conditions that is additionally designed to be used on road surfaces covered with ice and that fulfils the requirements of paragraph 6.4.2. of this Regulation."

Paragraph 2.18., amend to read:

"2.18. "*Standard Reference Test Tyre*" or "*SRTT*" means a tyre that is produced, controlled and stored in accordance with the standards of ASTM International:

(a) E1136 – 17 for the size P195/75R14 and referred to as "SRTT14",

(b) F2493 – 20 for the size P225/60R16 and referred to as "SRTT16",

(c) F2872 – 16 for the size 225/75R16C and referred to as "SRTT16C",

(d) F2871 – 16 for the size 245/70R19.5 and referred to as "SRTT19.5",

(e) F2870 – 16 for the size 315/70R22.5 and referred to as "SRTT22.5".

Paragraph 2.19., amend to read:

"2.19. Wet adhesion or snow performance or ice performance measurements – Specific definitions"

Paragraph 2.19.1., amend to read:

"2.19.1. "*Adhesion on wet surfaces*" or "*wet adhesion*" means the relative braking performance, on a wet surface, of a test vehicle equipped with the candidate tyre in comparison to that of the same test vehicle equipped with a Standard Reference Test Tyre (SRTT)."

Paragraph 2.19.2., amend to read:

"2.19.2. "*Candidate tyre*" or "*candidate tyre set*" means a tyre or a tyre set, representative of the type that is submitted for approval in accordance with this Regulation and whose performances are evaluated relative to that of a reference tyre or reference tyre set."

Insert a new paragraph 2.19.3., to read:

"2.19.3. "*Reference tyre*" or "*reference tyre set*" means a tyre or a tyre set of Standard Reference Test Tyres as defined in the respective annex."

Paragraph 2.19.3., renumber as 2.19.4. and amend to read:

"2.19.4."*Control tyre*" or "*control tyre set*" means a normal production tyre or a normal production tyre set that is used to establish the wet adhesion level or snow performance level or ice performance level of tyre sizes unable to be fitted to the same vehicle as the reference tyre or reference tyre set – see paragraph 2.2.2.8. of Annex 5, part (B), paragraph 3.4.3. of Annex 7 and paragraph 2.4.5.1.1. of Annex 8 to this Regulation."

Insert a new paragraph 2.19.5., to read:

"2.19.5. "*Test tyre*" means a candidate tyre, reference tyre or control tyre."

Paragraph 2.19.4., renumber as 2.19.6. and amend to read:

"2.19.6. "*Wet grip index*" *(G)* means the dimensionless unit for expressing the wet adhesion level of a candidate tyre relative to that of the applicable SRTT."

Paragraph 2.19.5., renumber as 2.19.7. and amend to read:

"2.19.7. "*Snow grip index*" *(SG)* means the dimensionless unit for expressing the snow performance level of a candidate tyre relative to the performance of the applicable SRTT."

Insert a new paragraph 2.19.8., to read:

"2.19.8. "*Ice grip index*" *(G_I)* means the dimensionless unit for expressing the ice performance level of a candidate tyre relative to the performance of the applicable SRTT."

Paragraphs 2.19.6. to 2.19.8., renumber as 2.19.9. to 2.19.11.

Insert new paragraphs 2.19.12. to 2.19.16., to read:

"2.19.12. "*Test run*" means a single pass of a loaded tyre over a given test surface.

2.19.13. "*Braking test*" means a series of a specified number of test runs of the same test tyre repeated within a short time frame.

2.19.14. "*Traction test*" means a series of a specified number of spin-traction test runs of the same tyre repeated within a short time frame.

2.19.15. "*Acceleration test*" means a series of specified number of traction controlled acceleration test runs of the same tyre repeated within a short timeframe.

2.19.16. "*Test cycle*" means a series of braking tests, traction tests or acceleration tests that consist of an initial test of the reference tyre or the control tyre, of tests of candidate tyres and/or control tyres and a final test of the same reference tyre or control tyre."

Paragraph 2.20.1., amend to read:

"2.20.1. "*Rolling resistance*" (F_r) means the loss of energy (or energy consumed) per unit of distance travelled.[3]"

Footnote 3, amend to read:

"[3] The International System of Units (SI) unit conventionally used for the rolling resistance is the newton-metre per metre, which is equivalent to a drag force in newton."

Paragraph 2.20.2., amend to read:

"2.20.2. "*Rolling resistance coefficient*" (C_r) means the ratio of the rolling resistance to the load on the tyre.[4]"

Paragraph 2.20.4., amend to read:

"2.20.4. "*Laboratory control tyre*" means a tyre used by an individual laboratory to control machine behaviour as a function of time.[7]"

Paragraph 2.20.5., amend to read:

"2.20.5. "*Capped inflation*" means the process of inflating the tyre to the required cold inflation pressure and allowing the inflation pressure to build up, as the tyre is warmed up while running."

Paragraph 2.20.6., amend to read:

"2.20.6. "*Parasitic loss*" means the loss of energy (or energy consumed) per unit distance excluding internal tyre losses, attributable to aerodynamic loss of the

different rotating elements of the test equipment, bearing friction and other sources of systematic loss which may be inherent in the measurement."

Paragraph 2.20.7., amend to read:

"2.20.7. "*Skim test reading*" means a type of parasitic loss measurement, in which the tyre is kept rolling without slippage, while reducing the tyre load to a level at which energy loss within the tyre itself is virtually zero."

Paragraph 2.20.8., amend to read:

"2.20.8. "*Inertia*" or "*moment of inertia*" means the ratio of the torque applied to a rotating body, such as a tyre assembly or machine drum, to the rotational acceleration of this body.[8]"

Paragraph 2.20.9., amend to read:

"2.20.9. "*Measurement reproducibility*" (σ_m) means the capability of a machine to measure rolling resistance.[9]"

Paragraph 3.1.1., amend to read:

"3.1.1. The performance characteristics to be assessed for the type of tyre; "rolling sound emissions level" and/or "adhesion performance level on wet surfaces" and/or "rolling resistance level"; "snow performance level" in case of "snow tyre for use in severe snow conditions" and additionally "ice performance level" in case of ice grip tyre;"

Paragraph 3.1.5.1., amend to read:

"3.1.5.1. Whether snow tyre for use in severe snow conditions or not;"

Paragraph 3.1.5.2., amend to read:

"3.1.5.2. For classes C2 and C3 tyres, whether traction tyre or not;"

Insert a new paragraph 3.1.5.3., to read:

"3.1.5.3. For class C1 tyres, whether ice grip tyre or not;"

Paragraph 3.1.8., amend to read:

"3.1.8. A list of tyre size designations covered by this application and specifying for each brand name/trademark and/or each trade description/commercial name the applicable tyre size designations and service descriptions, adding in case of class C1 tyres whether "reinforced" (or "extra load") or not."

Paragraph 3.2.1., amend to read:

"3.2.1. Details of the major features, with respect to the effects on the performance (i.e. rolling sound emission level, adhesion on wet surfaces, rolling resistance, snow performance and ice performance) of the tyres, including the tread pattern, included in the designated range of tyre sizes. This may be by means of descriptions supplemented by technical data, drawings, photographs or Computer Tomography (CT) scans, and must be sufficient to allow the Type Approval Authority or Technical Service to determine whether any subsequent changes to the major features will adversely affect the tyre performance. The effects of changes to minor details of tyre construction on tyre performances will be evident and determined during checks on conformity of production;"

Paragraph 3.2.2., amend to read:

"3.2.2. Drawings or photographs of the tyre sidewall, showing the approval marks referred to in paragraph 4., shall be submitted once the production has been established, but no later than one year after the date of granting of type approval;"

Paragraph 4.2.1., amend to read:

"4.2.1. The manufacturer's name or the brand name/trademark;"

Paragraph 4.2.2., amend to read:

"4.2.2. The trade description/commercial name (see paragraph 2.4. of this Regulation). However, the trade description is not required when it coincides with the brand name/trademark;"

Paragraph 4.2.6., amend to read:

"4.2.6. The "Alpine Symbol" ("3-peak-mountain with snowflake" conforming to the pictogram described in Annex 7, Appendix 1) if the snow tyre is classified as "snow tyre for use in severe snow conditions";"

Insert a new paragraph 4.2.6.1., to read:

"4.2.6.1. The "Ice Grip Symbol" (conforming to the pictogram described in Annex 8, Appendix 1) if the snow tyre for use in severe snow conditions is additionally classified as ice grip tyre;"

Paragraph 4.3.1., amend to read:

"4.3.1. In case the approval of a tyre pursuant to this Regulation has been granted by the same Type Approval Authority than that granting the approval pursuant to UN Regulations Nos. 30 or 54, the approval mark pursuant to UN Regulations Nos. 30 or 54 can be combined with an indication of the applicable series of amendments to which the tyre was approved pursuant to UN Regulation No. 117 on the form of 2 digits (example "02" indicating that the UN Regulation No.117 approval was granted following the 02 series of amendments) and the suffixes according to paragraph 5.2.2. using the addition sign "+", as described in Annex 2, Appendix 3 of this Regulation, for example "0236378 + 02S1WR2"."

Paragraph 5.2.1., amend to read:

"5.2.1. Instead of granting the original type approval number pursuant to UN Regulation No. 117, upon the request of the manufacturer, the Type Approval Authority may grant the type approval number, which had been granted before to that type of tyre pursuant to UN Regulations Nos. 30 or 54 with the subsequent extension number."

Paragraph 5.2.2., amend to read:

"5.2.2. The communication form mentioned in paragraph 5.3. below shall identify specific performance parameters of UN Regulation No. 117 by the following suffixes: …"

Paragraph 5.3.1., amend to read:

"5.3.1. With reference to paragraph 5.2.1. above, tyre manufacturers are entitled to submit an application for extension of type approval to the requirements of other Regulations relevant to the type of tyre. In that case, a copy of the relevant type approval communication(s), as issued by the relevant Type Approval Authority, shall be attached to the application for extension of approval. All applications for extension of approval(s) shall only be granted by the Type Approval Authority which issued the original approval for the tyre."

Paragraph 5.3.1.1., amend to read:

"5.3.1.1. When extension of approval is granted to incorporate into the communication form (see Annex 1 to this Regulation) certification(s) of conformity to other Regulations, (all) the specific type approval number(s) and the Regulation itself shall be added to item 9. of Annex 1 "Communication"."

Paragraph 5.3.1.2., amend to read:

"5.3.1.2. The suffix(es) mentioned in paragraph 5.2.2. above shall be preceded by the two digits identifying the series of amendments of the prescription on tyre performances for UN Regulation No. 117, e.g. "02S2" to identify the second series of amendments on tyre road rolling sound emissions at stage 2 or

"02S1WR1" to identify the second series of amendments on tyre road rolling sound emissions at stage 1, tyre adhesion on wet surfaces and rolling resistance at stage 1 (see paragraph 6.1. below for stage 1 and stage 2 definitions)."

Paragraph 5.4.3., amend to read:

"5.4.3. The suffix(es), and the identification to the relevant series of amendments, if any, as specified in the communication form.

One of the suffixes listed below or any combination of them can be used.

S1	Rolling sound emission level at stage 1
S2	Rolling sound emission level at stage 2
W	Wet adhesion level
R1	Rolling resistance level at stage 1
R2	Rolling resistance level at stage 2

These suffixes shall be placed to the right or below the approval number, if part of the original approval.

If the approval is extended subsequent to UN Regulations Nos. 30 or 54 approvals, the addition sign "+" and the series of amendment to UN Regulation No. 117 shall be placed in front of the suffix or any combination of suffixes to denote an extension to the approval.

If the approval is extended subsequent to the original approval under UN Regulation No. 117, the addition sign "+" shall be placed between the suffix or any combination of suffixes of the original approval and the suffix or any combination of suffixes added to denote an extension to the approval."

Paragraph 6.1.1., amend to read:

"6.1.1. For class C1 tyres, the rolling sound emission value shall not exceed the values pertinent to the applicable stage given below. These values refer to the nominal section width as defined in UN Regulation No. 30: …"

Paragraph 6.1.2., amend to read:

"6.1.2. For class C2 tyres, the rolling sound emission value with reference to its category of use (see paragraph 2.1., subparagraph (d) above) shall not exceed the values pertinent to the applicable stage given below: …"

Paragraph 6.1.3., amend to read:

"6.1.3. For class C3 tyres, the rolling sound emission value with reference to its category of use (see paragraph 2.1., subparagraph (d) above) shall not exceed the values pertinent to the applicable stage given below: …"

Paragraph 6.2., amend to read:

"6.2. The wet adhesion will be based on a procedure that compares either peak brake force coefficient ("pbfc") or mean fully developed deceleration ("mfdd") against values achieved by a Standard Reference Test Tyre (SRTT). The relative performance shall be indicated by a wet grip index (G)."

Paragraph 6.2.1., amend to read:

"6.2.1. For class C1 tyres, tested in accordance with either procedure given in Annex 5, Part (A), to this Regulation, the tyre shall meet the following requirements:

Category of use		*Wet grip index (G)*
Normal tyre		≥ 1.1

Category of use		*Wet grip index (G)*
Snow tyre		≥ 1.1
	"Snow tyre for use in severe snow conditions" and with a speed category symbol ("R" and above, including "H") indicating a maximum permissible speed greater than 160 km/h	≥ 1.0
	"Snow tyre for use in severe snow conditions" and with a speed category symbol ("Q" or below excluding "H") indicating a maximum permissible speed not greater than 160 km/h	≥ 0.9
Special use tyre		Not defined

"

Paragraph 6.2.2., amend to read:

"6.2.2. For class C2 tyres, tested in accordance with either procedure given in Annex 5, Part (B), to this Regulation, the tyre shall meet the following requirements: …"

Paragraph 6.2.3., amend to read:

"6.2.3. For class C3 tyres, tested in accordance with either procedure given in Annex 5, Part (B), to this Regulation, the tyre shall meet the following requirements: …"

Paragraphs 6.4.1. and 6.4.1.1., merge and amend to read:

"6.4.1. Snow performance requirements for classes C1, C2 and C3 tyres

The minimum snow grip index value, as calculated in the procedure described in Annex 7 and compared with the respective Standard Reference Test Tyre (SRTT) shall be as follows: …"

Insert a new paragraph 6.4.2., to read:

"6.4.2. Ice performance requirements for class C1 tyres classified as ice grip tyre

In order to be classified as ice grip tyre, a snow tyre for use in severe snow conditions shall meet the minimum ice grip index value, as calculated in the procedure described in Annex 8 and compared with the respective Standard Reference Test Tyre (SRTT) shall be as follows:

Class of tyre	*Ice grip index*
	Ref. = SRTT16
C1	1.18

"

Paragraph 6.5., amend to read:

"6.5. In order to be classified as a "traction tyre", a tyre is required to meet the condition of paragraph 6.5.1. below."

Paragraph 6.5.1., amend to read:

"6.5.1. The tyre shall have a tread pattern with minimum two circumferential ribs, each containing a minimum of 30 block-like elements, separated by grooves and/or sipe elements the depth of which has to be minimum of one half of the tread depth. The use of an alternative option of a physical test will only apply at a later stage following a further amendment to the Regulation including a reference to appropriate test methods and limit values."

Paragraph 6.6., amend to read:

"6.6. In order to be classified as a "special use tyre" a tyre shall have a block tread pattern in which the blocks are larger and more widely spaced than for normal tyres and have the following characteristics:

For class C1 tyres: a tread depth ≥ 11 mm and void to fill ratio ≥ 35 per cent;

For class C2 tyres: a tread depth ≥ 11 mm and void to fill ratio ≥ 35 per cent;

For class C3 tyres: a tread depth ≥ 16 mm and void to fill ratio ≥ 35 per cent."

Paragraph 6.7., amend to read:

"6.7. In order to be classified as a "professional off-road tyre", a tyre shall have all of the following characteristics:

(a) For classes C1 and C2 tyres:

(i) A tread depth ≥ 11 mm;

(ii) A void-to-fill ratio ≥ 35 per cent;

(iii) A maximum speed ~~rating~~ category symbol of ≤ Q.

(b) For class C3 tyres:

(i) A tread depth ≥ 16 mm;

(ii) A void-to-fill ratio ≥ 35 per cent;

(iii) A maximum speed category symbol of ≤ K."

Paragraph 8., amend to read:

"… The conformity of production procedures shall comply with those set out in the 1958 Agreement, Schedule 1 (E/ECE/324-E/ECE/TRANS/505/Rev.3) with the following requirements:"

Paragraph 8.2., amend to read:

"8.2. The authority which has granted type approval may at any time verify the conformity control methods applied by the manufacturer. In general, the conformity control methods should take into consideration the production volumes of the type of tyre at each manufacturing facility. The normal frequency of these verifications shall be at least once every two years."

Insert a new paragraph 8.3., to read:

"8.3. Verification tests shall be carried out on random samples of tyres bearing the approval mark required by this Regulation taken from the series production. Where the test procedure involves testing a number of tyres at the same time, for example a set of four tyres for the purpose of measuring wet adhesion in accordance with the standard vehicle procedure given in Annex 5 to this Regulation, then the set shall be considered as being one unit for the purposes of calculating the number of tyres to be tested. The Type Approval Authority shall satisfy itself that all tyres falling within an approved type comply with the approval requirement."

Paragraph 8.2.1., renumber as 8.3.1. and amend to read:

"8.3.1. In the case of verification tests with regard to approvals in accordance with paragraph 6.2. of this Regulation, these shall be carried out using the same testing method (see Annex 5 to this Regulation) as that adopted for original approval."

Insert a new paragraph 8.3.2., to read:

"8.3.2. In the case of verification tests with regard to approvals in accordance with paragraph 6.4. of this Regulation, these shall be carried out using the same

testing method (see Annex 7 to this Regulation) as that adopted for original approval."

Paragraphs 8.3. and 8.4., renumber as 8.4. and 8.5., respectively.

Paragraph 9.1., amend to read:

"9.1. The approval granted in respect of a type of tyre pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8. above are not complied with, or if any tyre of the type of tyre exceeds the limits given in paragraphs 8.4. or 8.5. above."

Paragraph 12.1., amend to read:

"12.1. As from the date of entry into force of the 02 series of amendments to this Regulation, Contracting Parties applying this Regulation shall not refuse to grant approval under this Regulation for a type of tyre if the tyre complies with the requirements of the 02 series of amendments, including the stage 1 or stage 2 rolling sound requirements set out in paragraphs 6.1.1. to 6.1.3. of this Regulation, the requirements for wet adhesion set out in paragraph 6.2.1. of this Regulation, and the stage 1 or stage 2 rolling resistance requirements set out in paragraph 6.3.1. or 6.3.2. of this Regulation."

Paragraph 12.2., amend to read:

"12.2. As from 1 November 2012, Contracting Parties applying this Regulation shall refuse to grant approval if the type of tyre to be approved does not meet the requirements of this Regulation as amended by the 02 series of amendments, and shall, in addition, refuse to grant approval if the stage 2 rolling sound requirements set out in paragraphs 6.1.1. to 6.1.3. of this Regulation, the requirements for wet adhesion set out in paragraph 6.2.1. of this Regulation, and the stage 1 rolling resistance requirements set out in paragraph 6.3.1. of this Regulation are not complied with."

Paragraph 12.3., amend to read:

"12.3. As from 1 November 2014, Contracting Parties applying this Regulation may refuse to allow the sale or entry into service of a tyre which does not meet the requirements of this Regulation as amended by the 02 series, and which does not meet the requirements of this Regulation as amended by the 02 series of amendments including the wet adhesion requirements set out in paragraph 6.2.1. of this Regulation."

Paragraph 12.4., amend to read:

"12.4. As from 1 November 2016, Contracting Parties applying this Regulation shall refuse to grant approvals if the type of tyre to be approved does not meet the requirements of this Regulation as amended by the 02 series of amendments including the stage 2 rolling resistance requirements set out in paragraph 6.3.2. of this Regulation and the wet adhesion requirements set out in paragraphs 6.2.2. and 6.2.3. of this Regulation."

Paragraph 12.7., amend to read:

"12.7. As from the dates given below, any Contracting Party applying this Regulation may refuse to allow the sale or entry into service of a tyre which does not meet the requirements of this Regulation as amended by the 02 series, and which does not meet the stage 2 rolling resistance requirements set out in paragraph 6.3.2. of this Regulation and the wet adhesion requirements set out in paragraphs 6.2.2. and 6.2.3. of this Regulation:

Tyre class	*Date*
C1 and C2	1 November 2018
C3	1 November 2020

"

Paragraph 12.12., amend to read:

"12.12. Until 1 September 2024, Contracting Parties applying this Regulation may continue to grant type approvals according to the 02 series of amendments to this Regulation, based on the test procedures for measuring wet adhesion described in Annex 5 of this Regulation, without taking into account the provisions of Supplement 13."

Insert a new paragraph 12.13., to read:

"12.13. Until 3 months after the date of entry into force of Supplement 14 to the 02 series of amendments to this Regulation, Contracting Parties applying this Regulation can continue to grant type approvals according to the 02 series of amendments to this Regulation, without taking into account the provisions of Supplement 14."

Annex 1,

Insert a new item 4.1.1., to read:

"4.1.1. Ice grip tyre (Yes/No)[2]"

Item 6., amend to read:

"6. Type of tyre designation:"

Item 6.2., amend to read:

"6.2. Trade description(s)/commercial name(s) of the type of tyre: "

Item 8.2., amend to read:

"8.2. Wet adhesion level of the representative tyre size, see paragraph 2.7. of this Regulation, as per the test report examples shown in the appendix to Annex 5: …… (G) using the vehicle or trailer method[2]"

Item 8.4., amend to read:

"8.4. Snow performance level of the representative tyre size, see paragraph 2.7. of Regulation No. 117, as per item 7. of the test report in the appendix[5] to Annex 7:…….. (snow grip index) using the brake on snow method[2], spin traction method[2] or acceleration method.[2]"

Insert a new item 8.4.1., to read:

"8.4.1. Ice performance level of the representative tyre size, see paragraph 2.7. of Regulation No. 117, as per item 7. of the test report in the appendix 2 to Annex 8:……..…(ice grip index) using the brake on ice method.[2]"

Footnote 5., amend to read:

"[5]Appendix 2 for classes C1 and C2 tyres.
Appendix 3 for class C3 tyres."

Item 16.2., amend to read:

"16.2. A list of tyre size designations: Specify for each brand name/trademark and/or each trade description/commercial name the list of tyre size designations and service descriptions, adding in case of class C1 tyres whether "reinforced" (or "extra load") or not."

Annex 2

Title, amend to read:

"**Annex 2**

Arrangements of approval marks"

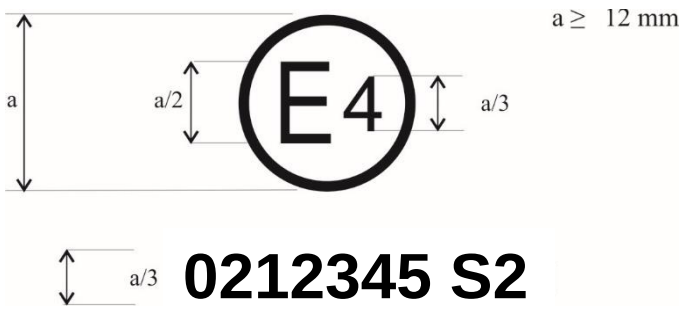
Annex 2 - Appendix 1, amend to read:

"**Annex 2 - Appendix 1**

Examples of separate UN Regulation No. 117 approval marks

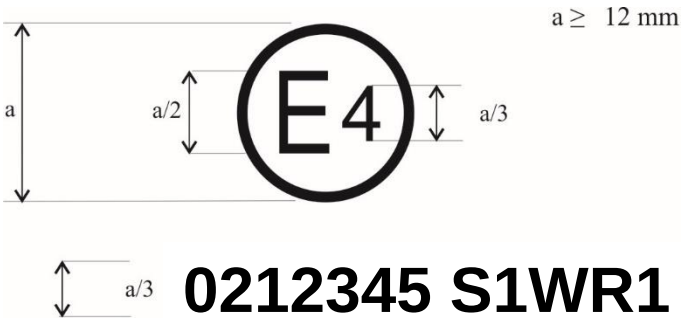
Approval according to UN Regulation No. 117 (see paragraph 5.4. of this Regulation)

Example 1



The above approval mark, affixed to a tyre shows that a tyre concerned has been approved in the Netherlands (E 4) pursuant to Regulation No. 117 (marked by "S2"), under approval number 0212345. This indicates that the approval is for rolling sound at stage 2 (S2). The first two digits of the approval number (02) indicate that the approval was granted in accordance with this Regulation which included 02 series of amendments.

Example 2



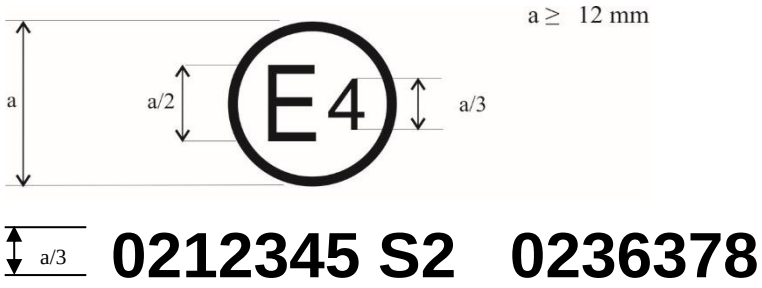
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to Regulation No. 117 (marked by "S1WR1") under approval number 0212345. This indicates that the approval is for rolling sound at stage 1 (S1), wet adhesion (W) and rolling resistance at stage 1 (R1). The first two digits of the approval number ("02") indicate that the approval was granted in accordance with this Regulation which included the 02 series of amendments."

Annex 2 - Appendix 2, delete footnote 1 and amend to read:

"**Annex 2 - Appendix 2**

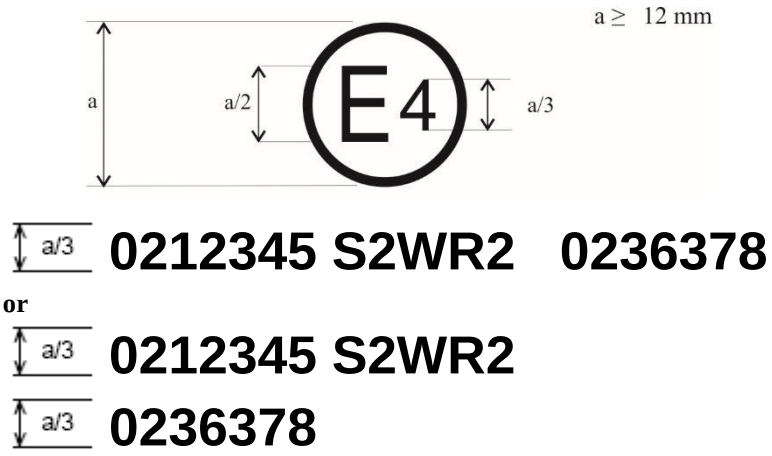
Approval according to UN Regulation No. 117 coincident with approval of UN Regulations Nos. 30 or 54

Example 1



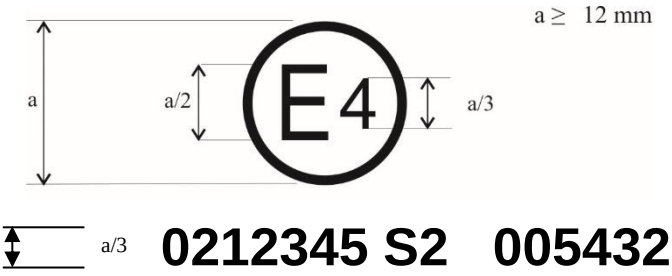
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 (marked by "S2"), under approval number 0212345 and UN Regulation No. 30, under approval number 0236378. This indicates that the approval is for rolling sound at stage 2 (S2). The first two digits of the approval number ("02") in conjunction with "S2" indicate that the approval was granted in accordance with UN Regulation No. 117 which included the 02 series of amendments. The first two digits of the UN Regulation No. 30 approval number ("02") indicate that this Regulation included the 02 series of amendments.

Example 2



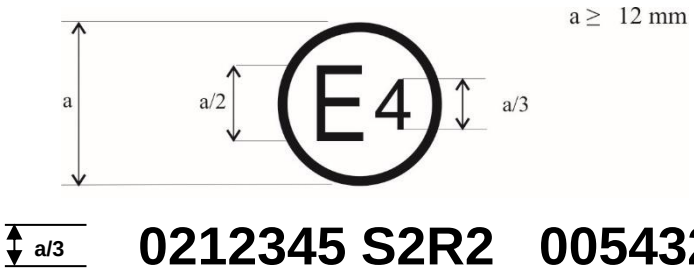
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 (marked by "S2WR2"), under approval number 0212345 and UN Regulation No. 30, under approval number 0236378. This indicates that the approval is for rolling sound at stage 2 (S2), wet adhesion (W) and rolling resistance at stage 2 (R2). The first two digits of the approval number ("02") in conjunction with "S2WR2" indicate that the first approval was granted in accordance with UN Regulation No. 117 which included the 02 series of amendments. The first two digits of the UN Regulation No. 30 approval number ("02") indicate that this Regulation included the 02 series of amendments.

Example 3



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 and the 02 series of amendments under approval number 0212345 (marked by "S2"), and UN Regulation No. 54, under approval number 0054321. This indicates that the approval is for rolling sound stage 2 (S2). The first two digits of the UN Regulation No. 117 approval number ("02") in conjunction with "S2" indicate that the first approval was granted in accordance with UN Regulation No. 117 which included the 02 series of amendments. The first two digits of the UN Regulation No. 54 approval number ("00") indicate that this Regulation was in its original form.

Example 4



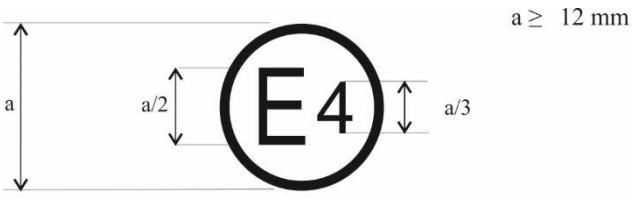
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 and the 02 series of amendments under approval number 0212345 (marked by "S2R2"), and UN Regulation No. 54, under approval number 0054321. This indicates that the approval is for rolling sound stage 2 (S2) and rolling resistance stage 2 (R2). The first two digits of the UN Regulation No. 117 approval number ("02") in conjunction with "S2R2" indicate that the first approval was granted in accordance with UN Regulation No. 117 which included the 02 series of amendments. The first two digits of the UN Regulation No. 54 approval number ("00") indicate that this Regulation was in its original form."

Annex 2 - Appendix 3, amend to read:

"Annex 2 - Appendix 3

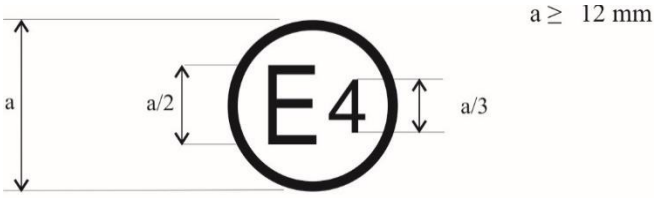
Combinations of markings of approvals issued in accordance with UN Regulations Nos. 117, 30 or 54

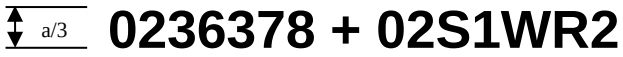
Example 1



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to UN Regulation No. 30 according to its 02 series of amendments (indicated by the first two digits of the approval number, "02") under approval number 0236378. It is also marked by "+ 02S1" which indicates that the tyre was also approved pursuant to UN Regulation No. 117 (02 series of amendments) for rolling sound at stage 1.

Example 2





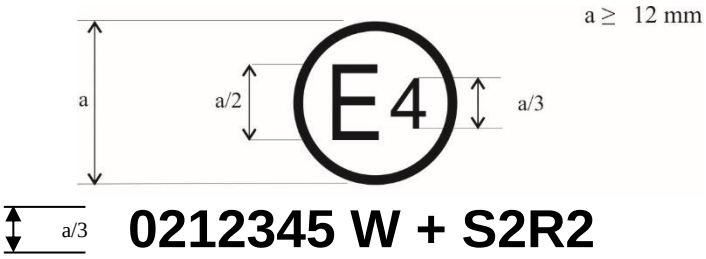
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E 4) pursuant to Regulation No. 30 according to its 02 series of amendments (indicated by the first two digits of the approval number, "02") under approval number 0236378. It is also marked by "+ 02S1WR2" which indicates that the tyre was also approved pursuant to UN Regulation No. 117 (02 series of amendments) for S1 (rolling sound at stage 1), W (wet adhesion) and R2 (rolling resistance at stage 2)."

Annex 2 - Appendix 4, delete footnote 1 amend to read:

"Annex 2 - Appendix 4

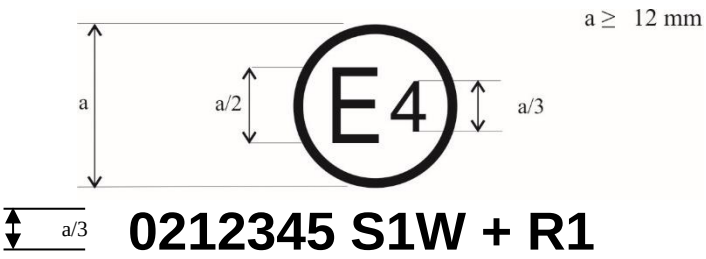
Extensions to combine approvals issued in accordance with Regulation No. 117

Example 1



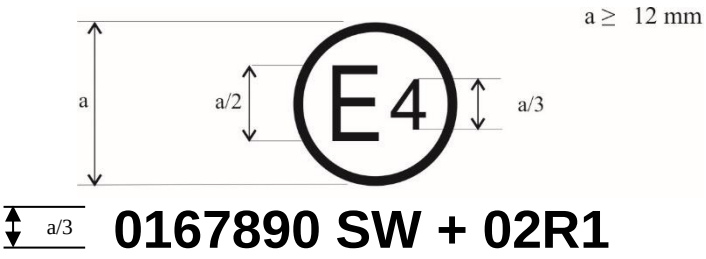
The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 according to its 02 series of amendments (indicated by the first two digits of the approval number, "02") under approval number 0212345 (marked by "W"). This indicates that the approval is for W (wet adhesion). The "S2R2" preceded by "+" indicates that its approval has been extended under UN Regulation No. 117 to rolling sound at stage 2 and rolling resistance at stage 2 based on separate certificate(s).

Example 2



The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 according to its 02 series of amendments (indicated by the first two digits of the approval number, "02") under approval number 0212345 (marked by "S1W"). This indicates that the approval is for S1 (rolling sound at stage 1) and W (wet adhesion). The "R1" preceded by "+" indicates that its approval has been extended under Regulation No. 117 to rolling resistance at stage 1 based on separate certificate(s).

Example 3



The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E 4) pursuant to UN Regulation No. 117 according to its 01 series of amendments (indicated by the first two digits of the approval number, "01") under approval

number 0167890 (marked by "SW"). This indicates that the approval is for S (rolling sound at stage 1) and W (wet adhesion). The "02R1" preceded by "+" indicates that-its approval has been extended under UN Regulation No. 117 according to its 02 series of amendments to rolling resistance at stage 1 based on separate certificate(s)."

Annex 3,

Paragraph 2.4.3., amend to read:

"2.4.3. Wheelbase

The wheelbase between the two axles fitted with the test tyres shall for class C1 be less than 3.50 m and for class C2 and class C3 tyres be less than 5 m."

Paragraph 2.5.1., amend to read:

"2.5.1. General

Four identical tyres shall be fitted on the test vehicle. In the case of class C3 tyres with a load capacity index in excess of 121 and without any dual fitting indication, two of these tyres of the same type and range shall be fitted to the rear axle of the test vehicle; the front axle shall be fitted with tyres of size suitable for the axle load and planed down to the minimum depth in order to minimize the influence of tyre/road contact noise while maintaining a sufficient level of safety.

In the case of class C2 tyres with a load capacity index lower or equal to 121, with a section width wider than 200 mm, an aspect ratio lower than 55, a rim diameter code lower than 15 and without any dual fitting indication, two of these tyres of the same type and range shall be fitted to the rear axle of the test vehicle; the front axle shall be fitted with tyres of a size suitable for the axle load and planed down to the minimum depth in order to minimize the influence of tyre/road contact noise while maintaining a sufficient level of safety.

Tyres with special fitting requirements shall be tested in accordance with these requirements (e.g. rotation direction). The tyres shall have full tread depth before being run-in.

Tyres are to be tested on rims permitted by the tyre manufacturer."

Paragraph 2.5.3., amend to read:

"2.5.3. Tyre inflation pressure

Each tyre fitted on the test vehicle shall have a test pressure P_t not higher than the reference pressure P_r and within the interval:

$$P_r \times \left(\frac{Q_t}{Q_r}\right)^{1.25} \leq P_t \leq 1.1\, P_r \times \left(\frac{Q_t}{Q_r}\right)^{1.25}$$

For class C2 and class C3 the reference pressure P_r is the inflation pressure corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

For class C1 the reference pressure is P_r = 250 kPa for "standard" tyres and 290 kPa for "reinforced" or "extra load" tyres; the minimum test pressure shall be P_t = 150 kPa."

Paragraph 3.3., amend to read:

"3.3. Test speed range

The test vehicle speeds shall be within the range:

(a) From 70 to 90 km/h for class C1 and class C2 tyres;

(b) From 60 to 80 km/h for class C3 tyres."

Paragraph 4., amend to read:

"4. Interpretation of results

The measurement shall be invalid if an abnormal discrepancy between the values is recorded (see paragraph 2.3.2. of this Annex)."

Paragraph 4.1., amend to read:

"4.1. Determination of test result

Reference speed V_{ref} used to determine the final result will be:

(a) 80 km/h for class C1 and class C2 tyres;

(b) 70 km/h for class C3 tyres."

Paragraph 4.2., amend to read:

"4.2. Temperature correction

For class C1 and class C2 tyres, the rolling sound levels $L_i(\vartheta_i)$ obtained at the test surface temperature ϑ_i (where i denotes the number of the single measurement) shall be normalized to a test surface reference temperature ϑ_{ref} by applying a temperature correction, according to the following formula:

$$L_i(\vartheta_{ref}) = L_i(\vartheta_i) + K(\vartheta_{ref} - \vartheta_i)$$

where:

ϑ_{ref} = 20 °C,

For class C1 tyres, the coefficient K is:

−0.03 dB(A)/°C when $\vartheta_i > \vartheta_{ref}$ and

−0.06 dB(A)/°C when $\vartheta_i < \vartheta_{ref}$.

For class C2 tyres, the coefficient K is − 0.02 dB(A)/°C.

Notwithstanding the above procedure, the temperature correction may be made only on the final reported tyre rolling sound level L_R, utilizing the arithmetic mean value of the measured temperatures, if the measured test surface temperature does not change more than 5 °C within all measurements necessary for the determination of the sound level of one set of tyres. In this case the regression analysis below shall be based on the uncorrected rolling sound levels $L_i(\vartheta_i)$.

There will be no temperature correction for class C3 tyres."

Annex 3 – Appendix 1

Part 1, item 6.1., amend to read:

"6.1. Snow tyre use in severe snow conditions (Yes/No)[1] ....."

Part 2, item 2., amend to read:

"2. Test vehicle (make, model, year, modifications, etc.): .....

....."

Part 2, item 5.2., amend to read:

"5.2. Sound level according to paragraph 4.3. of Annex 3:

.....dB(A)"

Footnote 2, amend to read:

"[2] for classes C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation"

Annex 4,

Paragraph 2.1., amend to read:

"2.1. Residual voids content

The residual Voids Content (VC) of the test track paving mixture shall not exceed 8 per cent. For the measurement procedure, see paragraph 4.1. of this Annex."

Paragraph 4.1., amend to read:

"4.1. Measurement of the residual voids content

For the purpose of this measurement, cores have to be taken from the track in at least four different positions, which are equally distributed in the test area between lines AA and BB (see Figure 1). In order to avoid in homogeneity and unevenness in the wheel tracks, cores should not be taken in wheel tracks themselves, but close to them. Two cores (minimum) should be taken close to the wheel tracks and one core (minimum) should be taken approximately midway between the wheel tracks and each microphone location.

If there is a suspicion that the condition of homogeneity is not met (see paragraph 2.4. above), cores shall be taken from more locations within the test area.

The residual voids content has to be determined for each core, then the average value from all cores shall be calculated and compared with the requirement of paragraph 2.1. of this Annex. In addition, no single core shall have a voids value, which is higher than 10 per cent.

The test surface constructor is reminded of the problem, which may arise when the test area is heated by pipes or electrical wires and cores shall be taken from this area. Such installations shall be carefully planned with respect to future core drilling locations. It is recommended to leave a few locations of size approximately 200 mm x 300 mm where there are no wires/pipes or where the latter are located deep enough in order not to be damaged by cores taken from the surface layer."

Annex 5

Title, amend to read:

"Annex 5

Test procedures for measuring the wet ~~grip index~~ adhesion of new tyres"

Part (A), title, amend to read:

"(A) — Class C1 tyres"

Paragraph 2., amend to read:

"2. Definitions

In addition to the definitions in paragraph 2. of the main body of this Regulation, for the purposes of measuring wet adhesion of class C1 tyres:"

Paragraphs 2.1. to 2.5, delete.

Paragraph 2.6., renumber as 2.1. and amend to read:

"2.1. "*Reference tyre*" or "*reference tyre set*" means a tyre or a tyre set of Standard Reference Test Tyres SRTT16."

Paragraph 2.7., renumber as 2.2.

Paragraph 2.8., renumber as 2.3. and amend to read:

"2.3. "*Average braking force coefficient*" (BFC) means, for the vehicle method, the ratio of the average deceleration in a braking test to the acceleration due to gravity (rounded to 9.81 $m \cdot s^{-2}$)."

Paragraphs 2.9. to 2.15., renumber as 2.4. to 2.10.

Paragraph 3.1.5., amend to read:

"3.1.5. The wetted frictional properties of the surface shall be measured using the SRTT16 either with the method described in paragraph 3.2.1. of this Annex in case the vehicle method (according to paragraph 4.1. below) is used, or with the method described in paragraph 3.2.2. in this Annex in case the trailer (or tyre test vehicle) method is used."

Paragraph 3.2.1., amend to read:

"3.2.1. Using the procedure described in paragraph 4.1. of this Annex, perform two braking tests of the reference tyre, each consisting of at least six (6) valid test runs in the same direction on aligned segments of the track. The braking tests shall cover the entire potential braking area, including where the texture depth was measured.

Evaluate the braking tests as described in paragraphs 4.1.6.1. and 4.1.6.2. of this Annex. If the coefficient of variation of one braking test CV_{BFC} exceeds 4 per cent, dismiss the results and repeat the braking tests.

For each braking test, the arithmetic mean $\overline{BFC_{\text{ave}}}$ of the average braking force coefficients shall be corrected for effects of temperature as follows:

$$BFC_{\text{ave,corr}} = \overline{BFC_{\text{ave}}} + a \cdot (\vartheta - \vartheta_0)$$

where

ϑ is the wetted surface temperature in degrees Celsius,

$a = 0.002\ ^{\circ}\text{C}^{-1}$ and $\vartheta_0 = 20\ ^{\circ}\text{C}$.

For each braking test, the temperature-corrected average braking force coefficient ($BFC_{\text{ave,corr}}$) shall be not less than 0.57 and not greater than 0.79.

The arithmetic means of the temperature-corrected average braking force coefficients of the two braking tests shall not differ by more than 10 per cent of the average of the two values:

$$CVal\left(BFC_{\text{ave,corr}}\right) = 2 \cdot \left|\frac{BFC_{\text{ave,corr},1} - BFC_{\text{ave,corr},2}}{BFC_{\text{ave,corr},1} + BFC_{\text{ave,corr},2}}\right| \leq 10\ \%$$

"

Paragraph 4., amend to read:

"4. Testing methods for measuring wet adhesion

For the calculation of the wet grip index (G) of a candidate tyre, the wet grip braking performance of the candidate tyre is compared to the wet grip braking performance of the reference tyre on a vehicle travelling straight ahead on a wet, paved surface. It is measured with one of the following methods:

(a) Vehicle method consisting of testing a set of tyres mounted on an instrumented passenger car;

(b) Testing method using a trailer towed by a vehicle or a tyre test vehicle, equipped with the test tyre(s)."

Paragraph 4.1.1., amend to read:

"4.1.1. Principle

The testing method covers a procedure for measuring the deceleration performance of class C1 tyres during braking, using an instrumented passenger car.

Starting with a defined initial speed, the brakes are applied hard enough on four wheels at the same time to activate the ABS. The average deceleration is calculated between two pre-defined speeds."

Paragraph 4.1.6.1., amend to read:

"4.1.6.1. Calculation of the average braking force coefficient

For each valid test run *j*, the average braking force coefficient $BFC_{ave,j}$ is calculated from the distance d_j covered between 80 km/h and 20 km/h as follows:

$$BFC_{ave,j} = \frac{v_i^2 - v_f^2}{2 \cdot d_j \cdot g}$$

where:

v_f is the final speed in m/s; v_f = 20 km/h = 5.556 m/s

v_i is the initial speed in m/s; v_i = 80 km/h = 22.222 m/s

d_j is the distance covered in test run *j* between v_i and v_f in metres;

g is the acceleration due to gravity = 9.81 $m \cdot s^{-2}$."

Paragraph 4.1.6.2., amend to read:

"4.1.6.2. Validation of results

The coefficient of variation CV_{BFC} is calculated as follows:

$$CV_{BFC} = 100\% \cdot \frac{\sigma_{BFC}}{\overline{BFC_{ave}}}$$

where

$\sigma_{BFC} = \sqrt{\frac{1}{N-1}\sum_{j=1}^{N}\left(BFC_{ave,j} - \overline{BFC_{ave}}\right)^2}$ denotes the corrected sample standard deviation and

$\overline{BFC_{ave}}$ the arithmetic mean of the average braking force coefficients $BFC_{ave,j}$ of *N* test runs.

For the reference tyre:

(a) The coefficient of variation CV_{BFC} of the initial and the final braking test of the reference tyre within one test cycle shall be less than or equal to 4 per cent.

(b) The arithmetic means of the average braking force coefficients of the initial and the final braking test shall not differ by more than 5 per cent of the average of the two values:

$$CVal(BFC_{ave}) = 100\% \cdot 2 \cdot \left|\frac{\overline{BFC_{ave}}(\mathrm{R_i}) - \overline{BFC_{ave}}(\mathrm{R_f})}{\overline{BFC_{ave}}(\mathrm{R_i}) + \overline{BFC_{ave}}(\mathrm{R_f})}\right| \leq 5\%$$

where

$\overline{BFC_{ave}}(\mathrm{R_i})$ / $\overline{BFC_{ave}}(\mathrm{R_f})$ is the arithmetic mean of the average braking force coefficients in the initial/final braking test of the reference tyre within a test cycle.

(c) The temperature-corrected average braking force coefficients ($BFC_{ave,corr}$, see paragraph 3.2.1. of this Annex) as calculated from the initial and from the final braking tests of the reference tyre within a test cycle shall be not less than 0.57 and not greater than 0.79.

If one or more of the above conditions is not met, the complete test cycle shall be performed again.

For the candidate tyres (T):

The coefficient of variation CV_{BFC} is calculated for each candidate tyre set. If one coefficient of variation is higher than 4 per cent, the data shall be discarded and the braking test repeated for that candidate tyre set."

Paragraph 4.1.6.3., amend to read:

"4.1.6.3. Calculation of adjusted average braking force coefficient

The average braking force coefficient of the reference tyre set used for the calculation of its braking force coefficient is adjusted according to the positioning of each candidate tyre set in a given test cycle.

This adjusted average braking force coefficient of the reference tyre $BFC_{adj}(R)$ is calculated in accordance with Table 1 where $\overline{BFC_{ave}}(R_i)$ is the arithmetic mean of the average braking force coefficients in the initial braking test of the reference tyre set (R_i) and $\overline{BFC_{ave}}(R_f)$ is the arithmetic mean of the average braking force coefficients in the final braking test of the same reference tyre set (R_f) within the test cycle.

Table 1

If the number and the sequence of candidate tyre sets within one test cycle is:	*and the candidate tyre set to be qualified within this test cycle is:*	*the corresponding adjusted average braking force coefficient of the reference tyre is calculated as follows:*
1 $R_i – T_1 – R_f$	T_1	$BFC_{adj}(R) = {}^1/_2 \cdot [\overline{BFC_{ave}}(R_i) + \overline{BFC_{ave}}(R_f)]$
2 $R_i – T_1 – T_2 – R_f$	T_1	$BFC_{adj}(R) = {}^2/_3 \cdot \overline{BFC_{ave}}(R_i) + {}^1/_3 \cdot \overline{BFC_{ave}}(R_f)$
	T_2	$BFC_{adj}(R) = {}^1/_3 \cdot \overline{BFC_{ave}}(R_i) + {}^2/_3 \cdot \overline{BFC_{ave}}(R_f)$
3 $R_i – T_1 – T_2 – T_3 – R_f$	T_1	$BFC_{adj}(R) = {}^3/_4 \cdot \overline{BFC_{ave}}(R_i) + {}^1/_4 \cdot \overline{BFC_{ave}}(R_f)$
	T_2	$BFC_{adj}(R) = {}^1/_2 \cdot [\overline{BFC_{ave}}(R_i) + \overline{BFC_{ave}}(R_f)]$
	T_3	$BFC_{adj}(R) = {}^1/_4 \cdot \overline{BFC_{ave}}(R_i) + {}^3/_4 \cdot \overline{BFC_{ave}}(R_f)$

"

Paragraph 4.1.6.4., amend to read:

"4.1.6.4. Calculation of the wet grip index of the candidate tyre

The wet grip index $G(T_n)$ of the candidate tyre T_n (n = 1, 2 or 3) is calculated as follows:

$$G(T_n) = K_{\text{vehicle}} \cdot \{\overline{BFC_{ave}}(T_n) - [a \cdot \Delta BFC(R) + b \cdot \Delta\vartheta + c \cdot (\Delta\vartheta)^2 + d \cdot \Delta MTD]\}$$

where:

$\overline{BFC_{ave}}(T_n)$ is the arithmetic mean of the average braking force coefficients of the candidate tyre T_n within a braking test;

$$\Delta BFC(R) = BFC_{adj}(R) - BFC(R_0)$$

$BFC_{adj}(R)$ is the adjusted average braking force coefficient in accordance with Table 1;

$BFC(R_0)$ = 0.68 is fixed as the braking force coefficient for the reference tyre in the reference conditions;

$$\Delta\vartheta = \vartheta - \vartheta_0$$

ϑ is the measured wet surface temperature in degrees Celsius when the candidate tyre T_n is tested;

ϑ_0 is the wetted surface reference temperature for the candidate tyre according to its category of use as listed in Table 2;

$$\Delta MTD = MTD - MTD_0$$

MTD is the measured macro texture depth in mm of the track (see paragraph 3.1.4. of this Annex);

MTD_0 = 0.8 mm is the macro texture depth of the reference track;

$K_{vehicle}$ = 1.87 is a factor to grant consistency between previous calculation of the wet grip index and this one, and to ensure convergence between vehicle and trailer method and

coefficients *a*, *b*, *c* and *d* are given in Table 2.

Table 2

Category of use		ϑ_0 *(°C)*	*a*	*b* $(°C^{-1})$	*c* $(°C^{-2})$	*d* (mm^{-1})
Normal tyre		20	+0.99382	+0.00269	−0.00028	−0.02472
Snow tyre		15	+0.92654	−0.00121	−0.00007	−0.04279
	Snow tyre for use in severe snow conditions	10	+0.72029	−0.00539	+0.00022	−0.03037
Special-use tyre		not defined				

"

Paragraph 4.2.4.2., amend to read:

"4.2.4.2. For "self-watering" systems, the tow vehicle and trailer or the tyre test vehicle may be optionally equipped with a pavement-wetting system, less the storage tank, which, in the case of the trailer, is mounted on the tow vehicle. The water being applied to the pavement ahead of the test tyres shall be supplied by a nozzle suitably designed to ensure that the water layer encountered by the test tyre has a uniform cross section at the test speed with a minimum splash and overspray.

The nozzle configuration and position shall ensure that the water jets are directed towards the test tyre and pointed towards the pavement at an angle of 20° to 30°.

The water shall strike the pavement 250 mm to 450 mm ahead of the centre of tyre contact. The nozzle shall be located 25 mm above the pavement or at the minimum height required to clear obstacles which the tester is expected to encounter, but in no case more than 100 mm above the pavement.

The water layer shall be at least 25 mm wider than the test tyre tread and applied so the tyre is centrally located between the edges. Water delivery rate shall ensure a water depth of (1.0 ± 0.5) mm and shall be consistent throughout the test to within ±10 per cent. The volume of water per unit of wetted width shall be directly proportional to the test speed. The quantity of water applied at 65 km/h shall be 18 l/s per metre of width of wetted surface in case of a water depth of 1.0 mm."

Paragraph 4.2.7.1.4., amend to read:

"4.2.7.1.4. The brakes shall be activated within an area of six (6) metres in the longitudinal direction and 0.5 metres in the transversal direction of a measurement point of the wetted frictional properties of the surface and sand depth in accordance with paragraphs 3.1.4. and 3.1.5. above. The test shall be run in the same direction as in paragraph 3.2.2. of this Annex. The rate of braking application shall be such that the time interval between initial application of force and peak longitudinal force is in the range 0.2 s to 0.5 s."

Paragraph 4.2.8.2., amend to read:

"4.2.8.2. Validation of results

The μ_{peak} coefficient of variation CV_{μ} is calculated as follows:

$$CV_{\mu} = 100\% \cdot \frac{\sigma_{\mu}}{\overline{\mu_{\text{peak}}}}$$

where

$\sigma_{\mu} = \sqrt{\frac{1}{N-1}\sum_{j=1}^{N}\left(\mu_{\text{peak},j} - \overline{\mu_{\text{peak}}}\right)^2}$ denotes the corrected sample standard deviation and

$\overline{\mu_{\text{peak}}}$ the arithmetic mean of the peak braking force coefficients ($\mu_{\text{peak},j}$) of N test runs.

For the reference tyre (R):

(a) The coefficients of variation CV_{μ} of the initial and the final braking tests of the reference tyre within one test cycle shall be less than or equal to 4 per cent;

(b) The arithmetic mean of the peak braking force coefficients of initial and the final braking test of the reference tyre within one test cycle shall not differ by more than 5 per cent of the average of the two values:

$$CVal\left(\mu_{peak}\right) = 100\% \cdot 2 \cdot \left|\frac{\overline{\mu_{peak}}(\mathrm{R_i}) - \overline{\mu_{peak}}(\mathrm{R_f})}{\overline{\mu_{peak}}(\mathrm{R_i}) + \overline{\mu_{peak}}(\mathrm{R_f})}\right| \leq 5\ \%$$

where

$\overline{\mu_{peak}}(\mathrm{R_i})$ and $\overline{\mu_{peak}}(\mathrm{R_f})$ are the arithmetic means of the peak braking force coefficients respectively in the initial and final braking tests of the reference tyre within a test cycle;

(c) The temperature-corrected average peak braking force coefficients ($\mu_{\text{peak,corr}}$, see paragraph 3.2.2. of this Annex) as calculated from the initial and from the final braking test of the reference tyre within a test cycle shall be not less than 0.65 and not greater than 0.90.

If one or more of the above conditions is not met, the complete test cycle shall be performed again.

For the candidate tyre(s) (T_n):

The coefficient of variation of the peak braking force coefficient CV_{μ} is calculated for each candidate tyre. If one coefficient of variation is greater than 4 per cent, the data shall be discarded and the braking test repeated for this candidate tyre."

Part (B), Heading, amend to read:

"(B) – Classes C2 and C3 tyres

Paragraph 1.1.1., amend to read:

"1.1.1. Standard Reference Test Tyre method

This method uses the SRTT16.

Using the procedure described in paragraph 4.2. of part (A) of this Annex, perform in the same area where the average macro texture depth was measured one braking test of the reference tyre, consisting of at least six (6) valid test runs in the same direction.

Evaluate the braking test as described in paragraphs 4.2.8.1. and 4.2.8.2. of part (A) of this Annex. If the coefficient of variation CV_{μ} exceeds 4 per cent, dismiss the results and repeat the braking test.

The arithmetic mean ($\overline{\mu_{\text{peak}}}$) of the measured peak braking force coefficients shall be corrected for the effects of temperature as follows:

$$\mu_{\text{peak,corr}} = \overline{\mu_{\text{peak}}} + a \cdot (\vartheta - \vartheta_0)$$

where

ϑ is the wetted track surface temperature in degrees Celsius,

$a = 0.002\ ℃^{-1}$ and $\vartheta_0 = 20\ ℃$.

The temperature corrected average peak braking force coefficient ($\mu_{\text{peak,corr}}$) shall be not less than 0.65 and not greater than 0.90.

The test shall be conducted using the lanes and length of the track to be used for the wet adhesion measurement.

For the trailer method, testing is run in such a way that braking occurs within 10 metres distance of where the surface was characterized."

Paragraph 1.4., amend to read:

"1.4. In order to cover the range of the tyre sizes fitting the commercial vehicles, the Standard Reference Test Tyres (SRTT) shall be used to measure the relative wet index as shown in the following table:

For class C3 tyres	
Narrow family $S_{\text{Nominal}} < 285$ mm	Wide family $S_{\text{Nominal}} \geq 285$ mm
SRTT19.5	SRTT22.5
For class C2 tyres SRTT16C	
S_{Nominal} = Tyre nominal section width	

"

Paragraph 2., amend to read:

"2. Test procedure

The comparative wet adhesion level shall be established using either:

(a) A trailer or special purpose tyre evaluation vehicle; or

(b) A standard production vehicle (M_2, M_3, N_1, N_2 or N_3, category) as defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.)."

Paragraph 2.1.1.4., amend to read:

"2.1.1.4. In the case a track wetting system is incorporated:

The system shall be able to deliver the water such that the tyre and track surface in front of the tyre are wetted before the start of braking and throughout the duration of the test. The apparatus may be optionally equipped with a pavement-wetting system, less the storage tank, which, in the case of the trailer, is mounted on the tow vehicle. The water being applied to the pavement ahead

of the test tyres shall be supplied by a nozzle suitably designed to ensure that the water layer encountered by the test tyre has a uniform cross section at the test speed with a minimum splash and overspray.

The nozzle configuration and position shall ensure that the water jets shall be directed toward the test tyre and pointed toward the pavement at an angle of 15 to 30°. The water shall strike the pavement 0.25 to 0.5 m ahead of the centre of tyre contact. The nozzle shall be located 100 mm above the pavement or the minimum height required to clear obstacles which the tester is expected to encounter, but in no case more than 200 mm above the pavement. The water layer shall be at least 25 mm wider than the test tyre tread and applied so the tyre is centrally located between the edges. The volume of water per unit of wetted width shall be directly proportional to the test speed. The quantity of water applied at 50 km/h shall be 14 l/s per metre of the width of the wetted surface. The nominal values of rate of water application shall be maintained within ±10 per cent."

Paragraph 2.1.2.14., amend to read:

"2.1.2.14. The wet grip index (G) shall be calculated as:

Wet grip index (G) = $\mu_{peak,ave}$ (T)/$\mu_{peak,ave}$ (R)

It represents the relative wet grip index for braking performance of the candidate tyre (T) compared to the reference tyre (R)."

Paragraph 2.2.2.2., amend to read:

"2.2.2.2. Vehicle equipment

The rear axle may be indifferently fitted with 2 or 4 tyres.

For the reference tyre testing, both axles are fitted with reference tyres. (A total of 4 or 6 reference tyres depending on the choice above mentioned).

For the candidate tyre testing, 3 fitting configurations are possible:

(a) "Configuration 1": candidate tyres on front and rear axles: it is the standard configuration that should be used every time it is possible.

(b) "Configuration 2": candidate on front axle and reference tyre or control tyre on rear axle: allowed in such cases where fitting the candidate tyre on the rear position is not possible.

(c) "Configuration 3": candidate on rear axle and reference tyre or control tyre on front axle: permitted in such cases where fitting the candidate tyre on the front position is not possible."

Paragraph 2.2.2.6.1., amend to read:

"2.2.2.6.1. First, mount the set of reference tyres on the vehicle.

The vehicle accelerates in the starting zone up to 65 ± 2 km/h.

Activation of the brakes on the track is made always at the same place with a tolerance of 5 metres in longitudinal and 0.5 metres in transverse."

Paragraph 2.2.2.7.4., amend to read:

"2.2.2.7.4. Calculation of braking force coefficient, BFC

BFC(R) and BFC(T) are calculated according to Table 6:

Table 6

Tested tyre	*Braking force coefficient is*
Reference tyre	BFC(R) = Ra/g
Candidate tyre	BFC(T) = Ta/g

g is the acceleration due to gravity (rounded to 9.81 $m \cdot s^{-2}$).

Ta (a = 1, 2, etc.) is the average of the AD values for a test of a candidate tyre."

Paragraph 2.2.2.7.5., amend to read:

"2.2.2.7.5. Calculation of the relative wet grip index of the tyre

The wet grip index represents the relative performance of the candidate tyre compared to the reference tyre. The way to obtain it depends on the test configuration as defined in paragraph 2.2.2.2. of this Annex. The wet grip index *G* of the tyre is calculated as reported into Table 7:

Table 7

Configuration C1: candidate tyres on both axles	$G = \frac{BFC(T)}{BFC(R)}$
Configuration C2: candidate tyres on front axle and reference tyres on rear axle	$G = \frac{BFC(T) \cdot [a + b + h \cdot BFC(R)] - a \cdot BFC(R)}{BFC(R) \cdot [b + h \cdot BFC(T)]}$
Configuration C3: reference tyres on front axle and candidate tyres on rear axle	$G = \frac{BFC(T) \cdot [-a - b + h \cdot BFC(R)] + b \cdot BFC(R)}{BFC(R) \cdot [-a + h \cdot BFC(T)]}$

Where (see also Figure 1):

cog: centre of gravity of the loaded vehicle

m: mass (in kilograms) of the loaded vehicle

a: horizontal distance between front axle and centre of gravity of the loaded vehicle (m)

b: horizontal distance between rear axle and centre of gravity of the loaded vehicle

h: vertical distance between ground level and centre of gravity of the loaded vehicle (m).

N.B. When *h* is not precisely known, these worst case values shall apply: 1.2 m for configuration C2, and 1.5 m for configuration C3

γ: loaded vehicle acceleration [$m \cdot s^{-2}$]

g: acceleration due to the gravity [$m \cdot s^{-2}$]

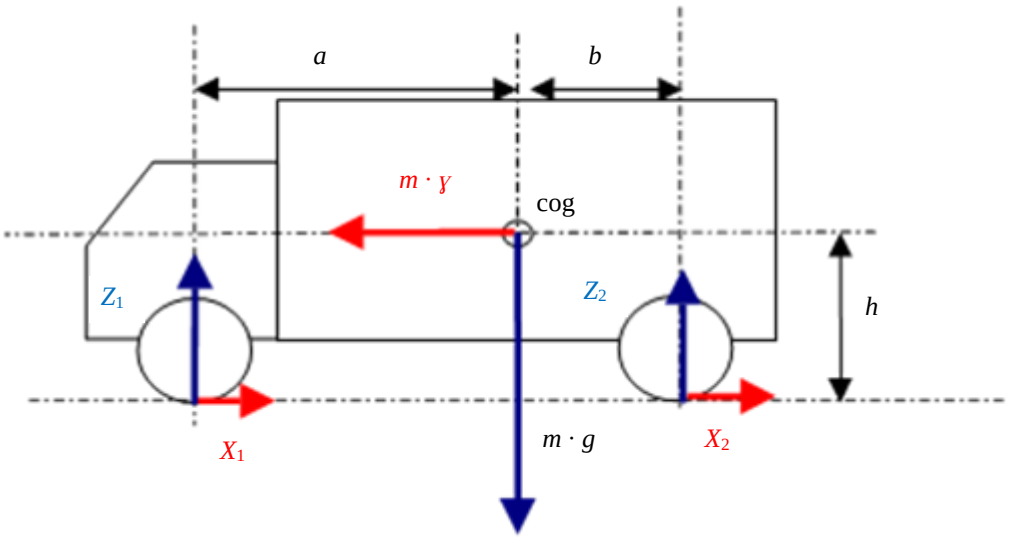
X_1: longitudinal (X-direction) reaction of the front tyre on the road

X_2: longitudinal (X-direction) reaction of the rear tyre on the road

Z_1: normal (Z-direction) reaction of the front tyre on the road

Z_2: normal (Z-direction) reaction of the rear tyre on the road

Figure 1
Nomenclature explanation related to grip index of the tyre



"

Paragraph 2.2.2.8., amend to read:

"2.2.2.8. Wet adhesion comparison between a candidate tyre and a reference tyre using a control tyre

When the candidate tyre size is significantly different from the reference tyre, a direct comparison on the same vehicle may be not possible. This approach uses an intermediate tyre, hereinafter called the control tyre."

Annex 5 – Appendix, Example 1, amend to read:

"…

No.		*1*	*2*	*3*	*4*	*5*
Brand						
Pattern/trade description		SRTT…				SRTT…
Size						
Service description						
Reference (test) inflation pressure(1) (kPa)						
Tyre identification						
M+S marking (Y/N)						
3PMSF marking (Y/N)						
Rim						
Load (kg)						
Pressure (kPa)						
μ_{peak}	1					
	2					
	3					
	4					
	5					

	6					
	7					
	8					
$\overline{\mu_{peak}}$						
Standard deviation, σ_μ						
$CV_\mu \leq 4$ % (2)						
$CVal(\mu_{peak}) \leq 5$ % (3)						
$\mu_{peak,corr}$(R)						
$\mu_{peak,adj}$(R)						
Wet grip index						
Wetted surface temp. (°C)						
Ambient temp. (°C)						
Remarks						

(1) for classes C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation

(2) For classes C2 and C3 tyres, the limit is 5 %.

(3) For classes C2 and C3 tyres, $CVal(\mu_{peak})$ is not defined nor applied."

Annex 5 – Appendix, Example 2, amend to read:

"*Example 2:* Test report of wet grip index using vehicle method

Test report number:		***Test date:***					
Track:			Minimum:	Maximum:	Vehicle		
Texture depth (mm):		Wetted surface temp. (°C):			Brand:		
$BFC_{ave,corr,1}$:		Ambient temp (°C):			Model:		
$BFC_{ave,corr,2}$:					Type:		
$CVal(BFC_{ave,corr})$:					Year of registration:		
Water depth (mm):					Maximum axle load:	Front	Rear
Initial speed (km/h):		Final speed (km/h):					

No.	*1*		*2*		*3*		*4*		*5*	
Brand										
Pattern/trade description	SRTT…								SRTT…	
Size										
Service description										
Reference (test) inflation pressure(1) (kPa)										
Tyre identification										
M+S marking (Y/N)										
3PMSF marking (Y/N)										
Rim										
Front axle pressure (kPa)	left:	right:	left:	right:	left:	right:	left:	right:	left:	right:
Rear axle pressure (kPa)	left:	right:	left:	right:	left:	right:	left:	right:	left:	right:
Front axle load (kg)	left:	right:	left:	right:	left:	right:	left:	right:	left:	right:
Rear axle load (kg)	left:	right:	left:	right:	left:	right:	left:	right:	left:	right:
	Braking distance (m)	*BFC_i*	*Braking distance (m)*	*BFC_i*	*Braking distance (m)*	*BFC_i*	*Braking distance (m)*	*BFC_i*	*Braking distance (m)*	*BFC_i*
Measurement 1										

	2										
	3										
	4										
	5										
	6										
	7										
	8										
	9										
	10										
$\overline{BFC_{ave}}$											
Standard deviation, σ_{BFC}											
$CV_{BFC} \leq 4$ % (2)											
$CVal(BFC_{ave}) \leq 5$ % (3)											
$BFC_{ave,corr}$(R)											
BFC_{adj}(R)											
Wet grip index											
Wetted surface temp. (°C)											
Ambient temp. (°C)											
Remarks											

(1) for classes C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

(2) For classes C2 and C3 tyres, the limit is 3 %.

(3) For classes C2 and C3 tyres, $CVal(BFC_{ave})$ is not defined nor applied."

Annex 6,

Paragraph 2.1.1., amend to read:

"2.1.1. Diameter

The test dynamometer shall have a cylindrical flywheel (drum) with a diameter of at least 1.7 m.

The F_r and C_r values shall be expressed relative to a drum diameter of 2.0 m. If drum diameter different than 2.0 m is used, a correlation adjustment shall be made following the method in paragraph 6.3. of this Annex."

Paragraph 2.2., amend to read:

"2.2. Measuring rim

The tyre shall be mounted on a steel or light alloy measuring rim, as follows:

(a) For class C1 tyres, the width of the rim shall be as defined in ISO 4000-1:2015,

(b) For classes C2 and C3 tyres, the width of the rim shall be as defined in ISO 4209 1:2001.

In cases where the width is not defined in the above-mentioned ISO Standards, the rim width as defined by one of the standards organizations as specified in Appendix 4 may be used."

Paragraph 2.4.2., amend to read:

"2.4.2. Alternative conditions

If the test ambient temperature is different from the reference ambient temperature, the rolling resistance measurement shall be corrected to the reference ambient temperature in accordance with paragraph 6.2. of this Annex."

Table 1., amend to read:

"Table 1
Test Speeds (in km/h)

Tyre class	*C1*	*C2 and C3*	*C3*	
Load index	All	LI ≤ 121	LI > 121	
Speed category symbol	All	All	J (100 km/h) and lower	K (110 km/h) and higher
Test speed (km/h)	80	80	60	80

"

Table 2, amend to read:

Table 2
Test loads and inflation pressures

Tyre class	*C1*		*C2, C3*
	Standard load	***Reinforced or extra load***	
Load - % of maximum load capacity as indicated by the load capacity index	80	80	85 (Refer to single application)
Inflation pressure kPa	210	250	Test inflation pressure corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

Note: The inflation pressure shall be capped with the accuracy specified in paragraph 4. of Appendix 1 to this Annex.

"

Paragraph 3.5., amend to read:

"3.5. Duration and speed.

When the deceleration method is selected, the following requirements apply:

(a) The deceleration j shall be determined in differential dω/dt or discrete Δω/Δt form, where ω is angular velocity, t – time;

If the differential form dω/dt is used, then the recommendations of Appendix 5 to this annex are to be applied;

(b) For duration Δt, the time increments shall not exceed 0.5 s;

(c) Any variation of the test drum speed shall not exceed 1 km/h within one time increment."

Paragraph 4.2., amend to read:

"4.2. Thermal conditioning

The inflated tyre shall be placed in the thermal environment of the test location for a minimum of:

(a) 3 hours for class C1 tyres;

(b) 6 hours for classes C2 and C3 tyres."

Table 3., amend to read:

"Table 3
Warm up durations

Tyre class	*C1*	*C2 and C3 LI ≤ 121*	*C3 LI > 121*	
Nominal rim diameter	All	All	< 22.5	≥ 22.5
Warm up duration	30 min.	50 min.	150 min.	180 min.

"

Paragraph 4.5.(j), amend to read:

"(j) Tyre size, manufacturer, type, identity number (if one exists), speed category symbol, load index, DOT number (Department of Transportation)."

Paragraph 4.6.1.(a)(ii), amend to read:

"(ii) Class C2 tyres: recommended value of 150 N; not to exceed 200 N for machines designed for class C1 tyre measurement or 500 N for machine designed for classes C2 and C3 tyres;"

Paragraph 4.7., amend to read:

"4.7. Allowance for machines exceeding σ_m criterion

The steps described in paragraphs 4.3. to 4.5. above shall be carried out once only, if the measurement standard deviation determined in accordance with paragraph 6.5. below is:

(a) Not greater than 0.075 N/kN for classes C1 and C2 tyres;

(b) Not greater than 0.06 N/kN for class C3 tyres.

If the measurement standard deviation exceeds this criterion, the measurement process will be repeated n times as described in paragraph 6.5. below. The rolling resistance value reported shall be the average of the n measurements."

Paragraph 5.1.2., amend to read:

"5.1.2. Force method at tyre spindle

Calculate: $F_{pl} = F_t (1 + r_L/R)$

Where:

F_t is the tyre spindle force in newton (see paragraph 4.6.1. above),

r_L is the distance from the tyre axis to the drum outer surface under steady state conditions, in metres,

R is the test drum radius, in metres."

Paragraph 5.1.3., amend to read:

"5.1.3. Torque method at drum axis

Calculate: $F_{pl} = T_t/R$

Where:

T_t is the input torque in newton metres, as determined in paragraph 4.6.1,

R is the test drum radius, in metres."

Paragraph 5.1.4., amend to read:

"5.1.4. Power method at drum axis

Calculate: $F_{pl} = \frac{3{,}6V \times A}{U_n}$

Where:

V is the electrical potential applied to the machine drive, in volts,

A is the electric current drawn by the machine drive, in amperes,

U_n is the test drum speed, in kilometres per hour."

Paragraph 5.1.5., amend to read:

"5.1.5. Deceleration method

Calculate the parasitic losses F_{pl}, in newtons.

$$F_{pl} = \frac{I_D}{R}\left(\frac{\Delta\omega_{D0}}{\Delta t_0}\right) + \frac{I_T}{R_r}\left(\frac{\Delta\omega_{T0}}{\Delta_0}\right)$$

Where:

I_D is the test drum inertia in rotation, in kilogram metres squared,

R is the test drum surface radius, in metres,

$\Delta\omega_{D0}$ is the test drum angular speed increment, drum without tyre, in radians per second,

Δt_0 is the time increment chosen for the measurement of the parasitic losses without tyre, in seconds,

I_T is the spindle, tyre and wheel inertia in rotation, in kilogram metres squared,

R_r is the tyre rolling radius, in metres,

$\Delta\omega_{T0}$ is the tyre angular speed increment, unloaded tyre, in radians per second.

or

$$F_{pl} = \frac{I_D}{R} j_{D0} + \frac{I_T}{R_r} j_{T0}$$

Where:

I_D is the test drum inertia in rotation, in kilogram metres squared,

R is the test drum surface radius, in metres,

j_{D0} is the deceleration of the test drum, without tyre, in radians per second squared,

I_T is the spindle, tyre and wheel inertia in rotation, in kilogram metres squared,

R_r is the tyre rolling radius, in metres,

j_{T0} is the deceleration of unloaded tyre, in radians per second squared."

Paragraph 5.2.2., amend to read:

"5.2.2. Force method at tyre spindle

The rolling resistance Fr, in newtons, is calculated using the equation

$F_r = F_t[1 + (r_L/R)] - F_{pl}$

Where:

F_t is the tyre spindle force in newtons,

F_{pl} represents the parasitic losses as calculated in paragraph 5.1.2. above,

r_L is the distance from the tyre axis to the drum outer surface under steady-state conditions, in metres,

R is the test drum radius, in metres."

Paragraph 5.2.3., amend to read:

"5.2.3. Torque method at drum axis

The rolling resistance F_r, in newtons, is calculated with the equation

$$F_r = \frac{T_t}{R} - F_{pl}$$

Where:

T_t is the input torque, in newton metres,

F_{pl} represents the parasitic losses as calculated in paragraph 5.1.3. above,

R is the test drum radius, in metres."

Paragraph 5.2.4., amend to read:

"5.2.4. Power method at drum axis

The rolling resistance F_r, in newtons, is calculated with the equation:

$$F_r = \frac{3{,}6V \times A}{U_n} - F_{pl}$$

Where:

V = is the electrical potential applied to the machine drive, in volts,

A = is the electric current drawn by the machine drive, in amperes,

U_n = is the test drum speed, in kilometres per hour,

F_{pl} = represents the parasitic losses as calculated in paragraph 5.1.4. above."

Paragraph 5.2.5., amend to read:

"5.2.5. Deceleration method

The rolling resistance Fr, in newtons, is calculated using the equation:

$$Fr = \frac{I_D}{R}\left(\frac{\Delta\omega_V}{\Delta t_V}\right) + \frac{R \times I_T}{R_r^2}\left(\frac{\Delta\omega_V}{\Delta t_V}\right) - F_{pl}$$

Where:

I_D is the test drum inertia in rotation, in kilogram metres squared,

R is the test drum surface radius, in metres,

F_{pl} represents the parasitic losses as calculated in paragraph 5.1.5. above,

Δt_v is the time increment chosen for measurement, in seconds,

$\Delta\omega_v$ is the test drum angular speed increment, without tyre, in radians per second,

I_T is the spindle, tyre and wheel inertia in rotation, in kilogram metres squared,

R_r is the tyre rolling radius, in metres,

F_r is the rolling resistance, in newtons.

or

$$Fr = \frac{I_D}{R} j_V + \frac{R \times I_T}{R_r^2} j_V - F_{pl}$$

Where:

I_D is the test drum inertia in rotation, in kilogram metres squared,

R is the test drum surface radius, in metres,

F_{pl} represents the parasitic losses as calculated in paragraph 5.1.5. above,

j_V is the deceleration of the test drum, in radians per second squared,

I_T is the spindle, tyre and wheel inertia in rotation, in kilogram metres squared,

R_r is the tyre rolling radius, in metres,

F_r is the rolling resistance, in newtons."

Paragraph 6.2., amend to read:

"6.2. Temperature correction

If measurements at temperatures other than 25 °C are unavoidable (only temperatures not less than 20 °C or more than 30 °C are acceptable), then a correction for temperature shall be made using the following equation, with:

F_{r25} is the rolling resistance at 25 °C, in newtons:

$$F_{r25} = F_r\left[1 + K\left(t_{amb} - 25\right)\right]$$

Where:

F_r is the rolling resistance, in newtons,

t_{amb} is the ambient temperature, in degrees Celsius,

K is equal to:

0.008 for class C1 tyres
0.010 for classes C2 and C3 tyres with a load index equal or lower than 121
0.006 for class C3 tyres with a load index greater than 121"

Paragraph 6.3., amend to read:

"6.3. Drum diameter correction

Test results obtained from different drum diameters shall be compared by using the following theoretical formula:

$$F_{r02} \cong KF_{r01}$$

With:

$$K = \sqrt{\frac{\left(R_1/R_2\right)\left(R_2 + r_T\right)}{\left(R_1 + r_T\right)}}$$

Where:

R_1 is the radius of drum 1, in metres,

R_2 is the radius of drum 2, in metres,

r_T is one-half of the nominal design tyre diameter, in metres,

F_{r01} is the rolling resistance value measured on drum 1, in newtons,

F_{r02} is the rolling resistance value measured on drum 2, in newtons."

Paragraph 6.5., amend to read:

"6.5. The laboratory shall ensure that, based on a minimum of three measurements, the machine maintains the following values of σ_m, as measured on a single tyre:

$\sigma_m \leq 0.075$ N/kN for tyres of classes C1 and C2

$\sigma_m \leq 0.06$ N/kN for tyres of class C3

If the above requirement for σ_m is not met, the following formula shall be applied to determine the minimum number of measurements n (rounded to the immediate superior integer value) that are required by the machine to qualify for conformance with this Regulation.

$n = (\sigma_m / x)^2$

Where:

x = 0.075 N/kN for tyres of classes C1 and C2

x = 0.06 N/kN for tyres of class C3

If a tyre needs to be measured several times, the tyre/wheel assembly shall be removed from the machine between the successive measurements.

If the removal/refitting operation duration is less than 10 minutes, the warm-up durations indicated in paragraph 4.3. above may be reduced to:

(a) 10 minutes for tyres of class C1;

(b) 20 minutes for tyres of class C2;

(c) 30 minutes for tyres of class C3."

Annex 6 - Appendix 1

Paragraph 2.1., amend to read:

"2.1. Width

For passenger car tyre rims (class C1 tyres), the test rim width shall be the same as the measuring rim determined in ISO 4000-1: 2010, clause 6.2.2.

For truck and bus tyres (classes C2 and C3), the rim width shall be the same as the measuring rim determined in ISO 4209-1:2001, clause 5.1.3.

In cases where the width is not defined in the above-mentioned ISO Standards, the rim width as defined by one of the standards organizations as specified in Appendix 4 to Annex 6 may be used."

Paragraph 2.2., amend to read:

"2.2. Run-out

In case vehicle rims are used, the run-out shall meet the following criteria:

(i) for class C1 tyres, class C2 tyres and for class C3 tyres with LI ≤ 121:

(a) Maximum radial run-out: 0.5 mm;

(b) Maximum lateral run-out: 0.5 mm;

(ii) for class C3 tyres with LI ≥ 122:

(a) Maximum radial run-out: 2.0 mm,

(b) Maximum lateral run-out: 2.0 mm."

Paragraph 4. (a), amend to read:

"(a) Tyre loading:

(i) For class C1 tyres, class C2 tyres and for class C3 tyres with LI ≤ 121: ±20 N or ±0.5 per cent, whichever is greater;

(ii) For class C3 tyres with LI ≥ 122: ±45 N or ±0.5 per cent whichever is greater;"

Paragraph 5., amend to read:

"5. Instrumentation accuracy

The instrumentation used for readout and recording of test data shall be accurate within the tolerances stated below:

Parameter	*class C1 tyres, class C2 tyres and class C3 tyres with LI ≤ 121*	*class C3 tyres with LI ≥ 122*
Tyre load	±10 N or ±0.5 % [(a)]	±30 N or ±0.5 % [(a)]
Inflation pressure	±1 kPa	±1.5 kPa
Spindle force	±0.5 N or ±0.5 % [(a)]	±1.0 N or ±0.5 % [(a)]
Torque input	±0.5 Nm or ±0.5 % [(a)]	±1.0 Nm or ±0.5 % [(a)]
Distance	±1 mm	±1 mm
Electrical power	±10 W	±20 W
Temperature	±0.2 °C	
Surface speed	±0.1 km/h	
Time	±0.01 s - ±0.1 % - ±10 s[(b)]	
Angular velocity	±0.1 %	

[(a)] Whichever is greater.

[(b)] ±0.01 s [for] the time increments specified in Annex 6, paragraph 3.5.(b) for the data acquisition in the deceleration method in $\Delta\omega/\Delta t$ form

±0.1 per cent for the time increments specified in Annex 6, paragraph 3.5.(a) for the data acquisition in the deceleration method in $d\omega/dt$ form

± 10 sec for the other time durations specified in Annex 6."

Paragraph 6., amend to read:

"6. Compensation for load/spindle force interaction and load misalignment for the force method only

Compensation of both load/spindle force interaction ("cross talk") and load misalignment may be achieved either by recording the spindle force for both forward and reverse tyre rotation or by dynamic machine calibration. If spindle force is recorded for forward and reverse directions (at each test condition), compensation is achieved by subtracting the "reverse" value from the "forward" value and dividing the result by two. If dynamic machine calibration is intended, the compensation terms may be easily incorporated in the data reduction.

In cases where reverse tyre rotation immediately follows the completion of the forward tyre rotation, a warm-up time for reverse tyre rotation shall be at least 10 minutes for class C1 tyres and 30 minutes for all other tyre types."

Annex 6 - Appendix 3

Part 1,

Item 6.1., amend to read:

"6.1. Snow tyre for use in severe snow conditions (Yes/No)[2] ....."

Footnotes (1) and (2), amend to read:

"(1) for classes C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation as indicated on the sidewall."

(2) strike out what does not apply."

Annex 7

Paragraphs 1. to 1.2., delete.

Paragraph 1.3., renumber as paragraph 1. and amend to read:

"1. The traction test shall be performed according to ASTM standard:

(a) F1805-06 in case SRTT14 is used as reference tyre or

(b) F1805-20 in case SRTT16 is used as reference tyre."

Paragraph 1.4., delete.

Paragraph 2., amend to read:

"2. Spin traction method for classes C1 and C2 tyres (traction force test per paragraph 6.4. (b) of this Regulation)

The test procedure of ASTM standard F1805-06 or F1805-20, as applicable according to paragraph 1.3., shall be used to assess snow performance through the traction performance index (TPI) on medium pack snow (The snow compaction index measured with a CTI penetrometer[1] shall be between 70 and 80)."

"[1] See appendix of ASTM standard F1805-06 for details. "

Paragraph 3., amend to read:

"3. Braking on snow method for classes C1 and C2 tyres"

Paragraph 3.1.1., amend to read:

"3.1.1. Test course

The braking tests shall be done on a flat test surface of sufficient length and width, with a maximum 2 per cent gradient, covered with packed snow.

The snow surface shall be composed of a hard packed snow base at least 3 cm thick and a surface layer of medium packed and prepared snow about 2 cm thick.

The air temperature, measured about one metre above the ground, shall be between −15 °C and −2 °C; the snow temperature, measured at a depth of about one centimetre, shall be between −15 °C and −4 °C.

It is recommended to avoid direct sunlight, large variations of sunlight or humidity, as well as wind.

The snow compaction index measured with a CTI penetrometer shall be between 75 and 85."

Paragraph 3.1.4.1., amend to read:

"3.1.4.1. For class C1 tyres, the vehicle load shall be such that the resulting loads on the tyres are between 60 per cent and 90 per cent of the load corresponding to the tyre load index.

The cold inflation pressure shall be 240 kPa."

Paragraph 3.1.4.2., amend to read:

"3.1.4.2. For class C2 tyres, the vehicle load shall be such that the resulting loads on the tyres are between 60 per cent and 100 per cent of the load corresponding to the tyre load index. …"

Paragraph 3.1.6., amend to read:

"3.1.6. In order to run this test, the Standard Reference Test Tyres ~~(SRTT)~~ as shown in the following table shall be used:

Class C1 tyres	*Class C2 tyres*
SRTT14 or SRTT16	SRTT16C

"

Paragraph 3.4.2., amend to read:

"3.4.2. Statistical validations

The sets of repeats of measured or computed mfdd for each tyre should be examined for normality, drift, eventual outliers.

The consistency of the arithmetic means $\bar{a}$ and corrected sample standard deviations σ_a of successive braking tests of SRTT should be examined.

In addition and in order to take in account possible test evolution, the coefficient of validation $CVal_a$(SRTT) is calculated on the basis of the average values of any two consecutive groups of the minimum 6 runs of the Standard Reference Test Tyre according to

$$CVal_a(\text{SRTT}) = 100\% \times \left|\frac{\overline{a_{R2}} - \overline{a_{R1}}}{\overline{a_{R1}}}\right|$$

The coefficient of validation $CVal_a$(SRTT) shall not differ by more than 5 per cent.

The coefficient of variation CV_a , as defined in paragraph 3.4.1.1. of this Annex, of any braking test shall be less than 6 per cent.

If those conditions are not met, tests shall be performed again after re-grooming the test course."

Paragraph 4., amend to read:

"4. Acceleration method for class C3 tyres"

Paragraph 4.3.2., amend to read:

"4.3.2. The following tolerances shall be respected:

(a) For speed measurements: ±1 per cent or 0.5 km/h whichever is greater.

(b) For distance measurements: ±1 x 10^{-1} m"

Paragraph 4.4.1.3., amend to read:

"4.4.1.3. The air temperature, measured about one metre above the ground, shall be between −15 °C and −2 °C; the snow temperature, measured at a depth of about one centimetre, shall be between −15 °C and −4 °C.

Air temperature shall not vary more than 10 °C during the test."

Paragraph 4.7., amend to read:

"4.7. Acceleration on snow test procedure for snow grip index of class C3"

Paragraph 4.7.2.1.1., amend to read:

"4.7.2.1.1. In the particular case where a standard commercial vehicle equipped with a traction control system is not available, a vehicle without Traction Control/ASR/TCS is permitted provided the vehicle is fitted with a system to

display the percentage slip as stated in paragraph 4.3.4. of this Annex and a mandatory differential lock on the driven axle used in accordance with operating procedure 4.7.5.2.1. below. If a differential lock is available it shall be used; if the differential lock, however, is not available, the average slip ratio should be measured on the left and right driven wheel."

Paragraph 4.7.5.2.1., amend to read:

"4.7.5.2.1. In the particular case of paragraph 4.7.2.1.1. of this Annex where a standard commercial vehicle equipped with a traction control system is not available, the driver shall manually maintain the average slip ratio between 10 and 40 per cent (controlled slip procedure in place of the full slip) within the prescribed range of speeds. If a differential lock is not available, the averaged slip ratio difference between the left and right driven wheel shall not be higher than 8 per cent for each run. All the tyres and runs in the test session are performed with controlled slip procedure."

Paragraph 4.7.5.5., amend to read:

"4.7.5.5. In case of traction control system equipped vehicle, the average slip ratio shall be in the range from 10 per cent to 40 per cent (calculated as per paragraph 4.3.4. of this Annex)."

Paragraph 4.8.5., amend to read:

"4.8.5. Calculation of the slip ratio

The slip ratio can be calculated as the average of slip ratio as mentioned in paragraph 4.3.4. of this Annex or by comparing the average distance referred to in paragraph 4.7.5.3. of this Annex of the minimum 6 runs to the distance of a run done without slip (very low acceleration)

$$\text{Slip Ratio } \% = \left[\frac{\text{Average distance} - \text{No slip distance}}{\text{No slip distance}} \right] \times 100$$

No slip distance means the wheel distance calculated on a run done with a constant speed or a continuous low acceleration."

Paragraph 4.9.2., amend to read:

"4.9.2. Principle of the approach

The principle lies upon the use of a control tyre and 2 different vehicles for the assessment of a candidate tyre in comparison with a reference tyre.

One vehicle can fit the reference tyre and the control tyre, the other the control tyre and the candidate tyre. All conditions are in conformity with paragraph 4.7. above.

The first assessment is a comparison between the control tyre and the reference tyre. The result (snow grip index SG1) is the relative efficiency of the control tyre compared to the reference tyre.

The second assessment is a comparison between the candidate tyre and the control tyre. The result (snow grip index SG2) is the relative efficiency of the candidate tyre compared to the control tyre.

The second assessment is done on the same track as the first one. The air temperature must be in the range of ±5 °C of the temperature of the first assessment. The control tyre set is the same set as the set used for the first assessment.

The snow grip index SG of the candidate tyre compared to the reference tyre is deduced by multiplying the relative efficiencies calculated above:

$SG = SG1 \cdot SG2$"

Annex 7 – Appendix 2,

Title, amend to read:

"Test reports and test data for classes C1 and C2 tyres"

Part 2., item 2.1., amend to read:

"2.1. Test track characteristics:

	At start of tests	*At end of tests*	*Specification*
Weather			
Ambient temperature			–15 °C to –2 °C
Snow temperature			–15 °C to –4 °C
CTI index			75 to 85
Other			

"

Part 2., item 5, amend to read:

"5. Test results: mean fully developed decelerations ($m \cdot s^{-2}$) / traction coefficient[3]

Run number	*Specification*	*SRTT (1st test)*	*Candidate 1*	*Candidate 2*	*SRTT (2nd test)*
1					
2					
3					
4					
5					
6					
Mean					
Standard deviation					
Coefficient of variation	$CV_a \leq 6$ %				
Coefficient of Validation	$CVal_a$(SRTT) ≤ 5 %				
SRTT weighted average					
Factor *f*					
Snow grip index		1.00			

[1] for class C2 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation

[2] for class C2 tyres, refer to single load

[3] Strike out what does not apply."

Annex 7 – Appendix 3,

Title, amend to read:

"Test reports and test data for class C3 tyres"

Part 2., item 2.1., amend to read:

"2.1. Test track characteristics:

	At start of tests	*At end of tests*	*Specification*
Weather			
Ambient temperature			–15 °C to –2 °C
Snow temperature			–15 °C to –4 °C
CTI index			80 to 90
Other			

"

Insert a new Annex 8, to read:

"Annex 8

Procedures for ice performance testing relative to ice grip tyre of class C1

1. Specific definitions for ice performance test when different from existing ones

1.1. "*Non-consecutive braking test cycles*" means test cycles of braking tests performed at least after minimum refreshing (or new preparation) of the ice surface, or on a different test lane, or in a different day.

1.2. "*Reference load*" (Q_{ref}) means the theoretical load capacity of a tyre at the test inflation pressure. It is expressed in kilograms. It may exceed the maximum load-carrying capacity of the test tyre as indicated by its load index.

1.3. "*Load-on-tyre rate*" (R_{LoT}) means the actual static tyre load on the test vehicle divided by the reference load.

1.4. "*Set of tyres*" means a set of four tyres.

2. Braking on ice method for class C1 tyres

The ice performance is determined by a testing method in which the mean fully developed deceleration of a candidate tyre in an ABS braking test on a flat surface made of ice is compared with that of a reference tyre.

For determination of the ice performance, braking tests of a candidate tyre shall be performed in three (3) non-consecutive braking test cycles.

The relative performance shall be indicated by an ice grip index (G_I).

2.1. General conditions

2.1.1. Test course

2.1.1.1. The braking tests shall be done on a flat test surface of sufficient length and width covered with smooth ice with a maximum of 2 per cent gradient.

2.1.1.2. The test course surface shall be flat, smooth, polished ice and watered around at least one hour before testing. The water used to make the ice shall be clean

and free of any solid inclusions. Before starting the test, the braking line should be conditioned by conducting braking runs with a set of tyres not involved in the test program until the friction level stabilizes. The exact same test line shall be used for all braking test repetitions.

2.1.1.3. The surface grip level shall be controlled by measurements with the reference tyre. The average mean fully developed deceleration of the reference tyre shall be not less than 0.9 m/s² and not greater than 1.6 m/s² in each braking test.

2.1.1.4. The air temperature, measured about one meter above the ground, shall be between −15 °C and +4 °C; the ice temperature, measured on the surface of the conditioned line, shall be between −15 °C and −5 °C. Both air and ice temperatures shall be reported for each tested tyre.

2.1.1.5. Test cannot be conducted during snow fall or rain fall or any atmospheric precipitation. It is recommended to avoid direct sunlight, large variations of sunlight or humidity, as well as wind.

2.1.1.6. Indoor as well as outdoor facilities for ice tracks are accepted as far as the above requirements are met.

2.1.2. Vehicle

2.1.2.1. The test shall be conducted with a commercialized-model passenger car equipped with an ABS system in mechanical condition according to car manufacturer recommendations. Permitted modifications are as follows: those allowing the number of tyres sizes that can be mounted on the vehicle to be increased, those permitting automatic activation of the braking device to be installed. Any other modification of the braking system is prohibited. Increasing load on tyre by adding weight into the vehicle is permitted. Rim adapters or "spacers" for mounting wheels on the vehicle shall not exceed 60 mm.

2.1.3. Tyres

2.1.3.1. Standard Reference Test Tyre

For the evaluation of the ice performance of class C1 tyres, the Standard Reference Test Tyre SRTT16 shall be used. The reference tyre shall not be older than 30 months starting from the production week and shall be stored in accordance with ASTM F2493 – 20. "

2.1.3.2. Tyres preparation

2.1.3.2.1. Fit each test tyres on an approved rim pursuant to ISO 4000-1 using conventional mounting methods. Subject to the foregoing, the rim width code shall not differ more than 0.5 from the measuring rim. If a commercialized rim is not available for the test vehicle, it will be acceptable to use a rim whose rim width code differs by 1.0 from the measuring rim width code. Ensure proper bead seating by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

2.1.3.2.2. The tyres should be "broken-in" prior to testing (at least 100 km on dry roads or with an equivalent method) to ensure stable performance and to remove spew, compound nodules or flash resulting from the moulding process. The tyre designed tread depth and designed tread block or rib integrity shall not change significantly with break-in, which means the pace and "severity" of the break-in run needs to be carefully controlled to avoid such changes.

2.1.3.2.3. It is acceptable to recondition a test tyre before the braking test to reach a stabilized performance level. [1]

2.1.3.2.4. The tyre surface in contact with ice shall be cleaned before performing the test, removing snow and dirt.

(1) It can be done, for example, by driving 5 km to 10 km on rough road surfaces or equivalent.

2.1.3.2.5. Tyre and wheel assemblies shall be conditioned at the ambient temperature (outdoor or indoor depending on the test facility) at least two hours before they are fitted on the vehicle for tests. Tyre pressures shall then be adjusted to the values specified for the test.

2.1.3.2.6. In case a vehicle cannot accommodate both the reference and candidate tyres, a third tyre ("control" tyre) may be used as an intermediate. First, test the control tyre versus the reference on a suitable vehicle, then test the candidate tyre versus the control tyre on the selected vehicle.

2.1.4. Tyre load and inflation pressure

2.1.4.1. Tyre load and inflation pressure shall be adjusted according to Table 1 (depending on a direct comparison of candidate and reference tyre on the same vehicle, or an indirect comparison by using a control tyre and another vehicle).

Table 1
Tyre load and inflation pressure

	Reference tyre	*Control tyre*	*Candidate tyre*
Direct comparison	Inflation pressure: 230 kPa ≤ p_{test} ≤ 260 kPa Load-on-tyre rate: 65 % ≤ R_{LoT} (R) ≤ 75 %		Inflation pressure: 190 kPa ≤ p_{test} ≤ 270 kPa Load-on-tyre rate: R_{LoT}(R) − 15% ≤ R_{LoT}(T) ≤ R_{LoT}(R) + 15%
Indirect comparison	Vehicle 1: Inflation pressure: 230 kPa ≤ p_{test} ≤ 260 kPa Load-on-tyre rate: 65 % ≤ $R_{LoT,1}$(R) ≤ 75 %	Vehicle 1: Inflation pressure: 190 kPa ≤ p_{test} ≤ 270 kPa Load-on-tyre rate: $R_{LoT,1}$(R) − 15% ≤ $R_{LoT,1}$(C) ≤ $R_{LoT,1}$(R) + 15%	
		Vehicle 2: Inflation pressure: 190 kPa ≤ p_{test} ≤ 270 kPa Load-on-tyre rate: $R_{LoT,1}$(C) − 15% ≤ $R_{LoT,2}$(C) ≤ $R_{LoT,1}$(C) + 15%	Vehicle 2: Inflation pressure: 190 kPa ≤ p_{test} ≤ 270 kPa Load-on-tyre rate: 60 % ≤ $R_{LoT,2}$(T) ≤ 90 %

Load-on-tyre rate R_{LoT} is given by

$$R_{\mathrm{LoT}} = 100\% \cdot \frac{Q_{\mathrm{tyre}}}{Q_{\mathrm{ref}}}$$

where

Q_{tyre} is the actual static tyre load on the test vehicle, and

Q_{ref} is the reference load at the test inflation pressure as determined below.

2.1.4.2. The reference load Q_{ref} at the test inflation pressure p_{test} is determined according to

$$Q_{\mathrm{ref}} = Q_{\mathrm{LI}} \cdot \left(\frac{p_{\mathrm{test}}}{p_{\mathrm{ref}}}\right)^{0.8}$$

where

Q_{LI} is the maximum tyre load-carrying capacity according to its load index, and

p_{ref} is the reference inflation pressure as defined in Table 2.

Table 2
Reference inflation pressures

Tyre	p_{ref} *(kPa)*
Reference tyre	250
Standard tyre	250
Reinforced tyre (or "extra load" tyre)	290

2.1.5. Instrumentation

2.1.5.1. The vehicle shall be fitted with calibrated sensors suitable for measurements in cold and icy conditions. There shall be a data acquisition system to store measurements.

2.1.5.2. The accuracy of measurement sensors and systems shall be such that would allow a relative uncertainty(2) of less than or equal to 1 per cent on the measured or computed mean fully developed deceleration. [3]

2.2. Testing order and braking test cycles

2.2.1. For each braking test of a test tyre, at least nine (9) valid test runs shall be performed.

2.2.2. Within one braking test cycle, up to two (2) candidate tyres may be tested. Several braking test cycles may be combined and the final braking test of the reference tyre of one braking test cycle may serve as the initial braking test of the subsequent braking test cycle.

(2) Suitable methods for determining the relative measurement uncertainty can be found, for example, in ISO/IEC Guide 98-3, Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995).

(3) For example, in case the mean fully developed deceleration is computed according to paragraph 2.4.1.1. of this Annex, the accuracy of the measurements sensors or systems for the measurements of the distance (s) and of the speeds (v_i and v_f) should be such that the composition of their relative uncertainties, based on 2.4.1.1. of this Annex would allow to determine the mean fully developed deceleration with a relative uncertainty of less than or equal to 1 per cent.

EXAMPLE 1

For a braking test cycle with two candidate tyres, the order of testing is

$R_i – T_1 – T_2 – R_f$

where

R_i/R_f is the initial/final braking test of the reference tyre and

T_1, T_2 are the braking tests of the two candidate tyres to be evaluated.

EXAMPLE 2

The run order for a series of braking test cycles with a total of four (4) candidate tyre sets (T_1 to T_4) would be the following:

$R_i – T_1 – T_2 – R_f/R_i – T_3 – T_4 – R_f$,

where the final braking test of the reference tyre set (R_f) of the first braking test cycle serves as initial braking test (R_i) of the second braking test cycle.

For any candidate tyre at least three (3) non-consecutive braking test cycles shall be performed.

2.3. Test procedure

2.3.1. The vehicle shall be fitted on all four positions with the same tyres.

2.3.2. Drive the vehicle in a straight line at a speed about 5 km/h higher than the upper speed of the evaluation interval.

2.3.3. When the measuring zone has been reached, set the vehicle gear into neutral, press the brake pedal sharply down with a force sufficient to cause operation of the ABS on all wheels of the vehicle and to result in a stable deceleration of the vehicle and hold it down until the speed is 0 km/h.

2.3.4. The mean fully developed deceleration dm shall be determined either between 15 km/h and 5 km/h or between 20 km/h and 5 km/h. It shall be computed from measurements of either time (expressed in s), distance (expressed in m), or deceleration (expressed in $m \cdot s^{-2}$). For each test run in the braking tests (3 or 4) of a braking test cycle and for all test tyres, the same evaluation speed interval shall be used.

2.4. Data evaluation and presentation of results

2.4.1. Data evaluation

2.4.1.1. For a distance measurement, the mean fully developed deceleration d_m in a test run is computed as:

$$d_{\mathrm{m}} = \frac{v_{\mathrm{i}}^2 - v_{\mathrm{f}}^2}{2s}$$

where

v_{i} is the initial speed expressed in $m \cdot s^{-1}$

v_{f} is the final speed expressed in $m \cdot s^{-1}$, and

s is the distance, expressed in metres, covered between the initial speed and the final speed.

2.4.1.2. The highest and the lowest values (in total two (2) runs) of the at least nine valid test runs shall be disregarded in the evaluation of each braking test.

2.4.1.3. For each braking test in a braking test cycle, the arithmetic mean $d_{\mathrm{m,ave}}$ and the standard deviation σ_d of the mean fully developed deceleration and the coefficient of variation CV_d shall be computed and reported:

$$\sigma_d = \sqrt{\frac{1}{N-1} \cdot \sum_{j=1}^{N} \left(d_{\mathrm{m},j} - d_{\mathrm{m,ave}}\right)^2}$$

and

$$CV_d = 100\% \cdot \frac{\sigma_d}{d_{\mathrm{m,ave}}}$$

2.4.2. Calculation of the braking test ice grip index

2.4.2.1. For the calculation of the ice grip index $G_{I,k}(T_n)$ for an individual braking test, the mean fully developed deceleration of the reference tyre is adjusted according to the positioning of each candidate tyre (T_n) within a braking test cycle.

2.4.2.2. This adjusted mean fully developed deceleration $d_{\mathrm{m,adj}}(R)$ of the reference tyre is calculated in accordance with Table 3, where $d_{\mathrm{m,ave}}(R_i)$ and $d_{\mathrm{m,ave}}(R_f)$ are the arithmetic means of the mean fully developed decelerations in the initial and in the final braking test of the reference tyre within a braking test cycle.

Table 3
Calculation of the adjusted mean fully developed deceleration $d_{m,adj}(R)$ of the reference tyre

If the number and the sequence of candidate tyres within one braking test cycle is	*and the candidate tyre to be qualified is*	*the corresponding adjusted mean fully developed deceleration $d_{m,adj}(R)$ of the reference tyre is calculated as follows*
1 R1 – T1 – R2	T1	$d_{\mathrm{m,adj}}(\mathrm{R}) = {}^{1}/_{2} \cdot \left[d_{\mathrm{m,ave}}(\mathrm{R_i}) + d_{\mathrm{m,ave}}(\mathrm{R_f})\right]$
2 R1 –T1 – T2 – R2	T1	$d_{\mathrm{m,adj}}(\mathrm{R}) = {}^{2}/_{3} \cdot d_{\mathrm{m,ave}}(\mathrm{R_i}) + {}^{1}/_{3} \cdot d_{\mathrm{m,ave}}(\mathrm{R_f})$
	T2	$d_{\mathrm{m,adj}}(\mathrm{R}) = {}^{1}/_{3} \cdot d_{\mathrm{m,ave}}(\mathrm{R_i}) + {}^{2}/_{3} \cdot d_{\mathrm{m,ave}}(\mathrm{R_f})$

2.4.2.2. For an individual braking test, the ice grip index $G_{I,k}(\mathrm{T}_n)$ of the candidate tyre T_n *(n = 1, 2)* relative to the reference tyre is calculated as:

$$G_{I,k}(\mathrm{T}_n) = \frac{d_{\mathrm{m,ave}}(\mathrm{T}_n)}{d_{\mathrm{m,adj}}(\mathrm{R})}$$

2.4.3. Ice grip index

The ice grip index $G_I(\mathrm{T}_n)$ of a candidate tyre shall be computed as the arithmetic mean of the ice grip indices $G_{I,k}(\mathrm{T}_n)$ for the individual braking tests in the three non-consecutive braking test cycles as :

$$G_I(\mathrm{T}_n) = \frac{1}{3} \cdot \left[G_{I,1}(\mathrm{T}_n) + G_{I,2}(\mathrm{T}_n) + G_{I,3}(\mathrm{T}_n)\right]$$

An example of a full test report is given in appendix 2.

2.4.4. Statistical validation

2.4.4.1. The sets of mean fully developed decelerations d_{m} within each braking test shall be examined for normality, drift, eventual outliers.

2.4.4.2. If the coefficient of variation CV_d of a braking test of a candidate tyre exceeds 6 per cent, this braking test shall be discarded.

2.4.4.3. In the case that

a) the coefficient of variation CV_d of the initial or the final braking test of a reference tyre within a braking test cycle exceeds 6 per cent, or

b) the arithmetic means of the mean fully developed decelerations of the initial and the final braking test of the reference tyre within a braking test cycle exceeds 5 per cent of the average of the two values:

$$CVal(d_{\mathrm{m}}) = 2 \cdot \left|\frac{d_{\mathrm{m,ave}}(\mathrm{R_i}) - d_{\mathrm{m,ave}}(\mathrm{R_f})}{d_{\mathrm{m,ave}}(\mathrm{R_i}) + d_{\mathrm{m,ave}}(\mathrm{R_f})}\right| \cdot 100\% \leq 5\ \%, \text{ or}$$

c) the mean fully developed deceleration of the reference tyre is less than 0.9 m · s^{-2} or greater than 1.6 m · s^{-2} in the initial or the final braking test within a braking test cycle

the complete braking test cycle shall be discarded.

2.4.4.4. For each candidate tyre $\mathrm{T_n}$, the coefficient of variation CV_G of the ice grip indices $G_{I,k}(\mathrm{T}_n)$ for the individual braking tests in the three (3) non-consecutive braking test cycles shall be calculated as:

$$CV_G = 100\% \cdot \frac{\sigma_G}{G_I(\mathrm{T}_n)}$$

where

$$\sigma_G = \sqrt{\frac{1}{2} \cdot \sum_{k=1}^{3} \left[G_{I,k}(\mathrm{T}_n) - G_I(\mathrm{T}_n)\right]^2}$$

and

$G_I(\mathrm{T}_n)$ is the ice grip index of candidate tyre T_n.

2.4.4.4. If the coefficient of variation CV_G exceeds 6%, for this candidate tyre T_n additional braking tests shall be performed in non-consecutive braking cycles, until the coefficient of variation CV_G calculated from any three braking tests of this candidate tyre meets the requirement.

2.4.4.5. The SRTT shall be discarded if it exhibits irregular wear or damage or when the performance appears to have been deteriorated.

2.4.5. Ice performance comparison between a candidate tyre and a reference tyre using a control tyre

2.4.5.1. General

2.4.5.1.1. In case the candidate tyre cannot be fitted on the same vehicle as the reference tyre, for example, due to tyre size, inability to achieve required load-on-tyre rate and required test inflation pressure, comparison shall be made using intermediate tyres, herein referred to as "control tyres", and two different vehicles.

2.4.5.1.2. The control tyre shall pass the ice grip index threshold defined in paragraph 6.4.2. of this Regulation.

2.4.5.1.3. One vehicle shall be capable of being fitted with the reference tyre and the control tyre, and the other vehicle shall be capable of being fitted with the control tyre and the candidate tyre.

2.4.5.2. Ice grip index calculation in case of a control tyre

2.4.5.2.1. In a first series of three non-consecutive braking test cycles, using the procedure described in paragraph 2.1.3.2. to 2.4.4.5. of this Annex in which the control tyre shall be treated as a candidate tyre, the ice grip index $G_{I,1}(\mathrm{C})$ of the control tyre relative to the reference tyre shall be established. In a second series of three non-consecutive braking test cycles, in which the control tyre serves as reference tyre, the ice grip index $G_{I,2}(\mathrm{T})$ of the candidate tyre relative to the control tyre shall be established.

2.4.5.2.2. The ice grip index $G_I(\mathrm{T})$ of the candidate tyre relative to the reference tyre shall be calculated as the product of the two ice grip indices:

$$G_I(\mathrm{T}) = G_{I,1}(\mathrm{C}) \cdot G_{I,2}(\mathrm{T})$$

2.4.5.3. Boundary conditions

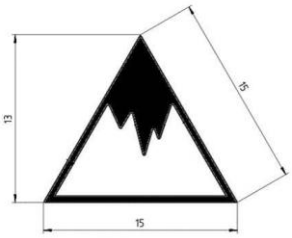
2.4.5.3.1. The same set of control tyres shall be used for comparison with the SRTT and with the candidate tyre and shall be fitted in the same wheel positions.

2.4.5.3.2. Control tyres that have been used for testing shall subsequently be stored under the same conditions as required for the SRTT.

2.4.5.3.3. The SRTT and control tyres shall be discarded if there is irregular wear or damage or when the performance appears to have been deteriorated.

Annex 8 - Appendix 1

Pictogram definition of "Ice Grip Symbol"



Minimum 15 mm base and 13 mm height.

Above drawing not to scale.

Annex 8 - Appendix 2

Test reports and test data for C1 tyres

Part 1 - Report

1. Type Approval Authority or Technical Service: .....
2. Name and address of manufacturer: .....
3. Test report No.: .....
4. Brand name and trade description: .....
5. Tyre class: .....
6. Category of use: .....
7. Ice grip index relative to SRTT
- 7.1. Test procedure and SRTT used .....
8. Comments (if any): .....
9. Date: .....
10. Signature: .....

Part 2 - Test data: 1st braking test cycle

1. Date of test: .....
2. Location of test track: .....
- 2.1. Test track characteristics:

	At start of test	*At end of test*	*Specification*
Weather			
Ambient temperature			−15 °C to +4 °C
Ice temperature			−15 °C to −5 °C
Other			

3. Test vehicle (make, model and type, year): .....
4. Test tyre details and data .....

	SRTT (Initial braking test)	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
Brand name				
Trade description/ commercial name				
Tyre size designation				
Service description				
Test rim width code				
Tyre load FL/FR/RL/RR (kg)				
Load-on-tyre rate (FL/FR/RL/RR) (%)				
Tyre pressure (kPa)				

5. Test results: mean fully developed decelerations ($m \cdot s^{-2}$)

Run number	*SRTT (Initial braking test)*	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
1				
2				
3				
4				
5				
6				
7				
8				
9				
$d_{m,ave}$				
σ_d				
CV_d (≤ 6 %)				
$CVal(d_m)$ (≤ 5%)				
$d_{m,adj}$(R)				
Ice grip index	1.00			

Part 2 - Test data: 2nd braking test cycle

1. Date of test: .....

2. Location of test track: .....

2.1. Test track characteristics:

	At start of test	*At end of test*	*Specification*
Weather			
Ambient temperature			−15 °C to +4 °C
Ice temperature			−15 °C to −5 °C

	At start of test	*At end of test*	*Specification*
Other			

3. Test vehicle (make, model and type, year): .....

4. Test tyre details and data .....

	SRTT (Initial braking test)	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
Brand name				
Trade description/ commercial name				
Tyre size designation				
Service description				
Test rim width code				
Tyre load FL/FR/RL/RR (kg)				
Load-on-tyre rate (FL/FR/RL/RR) (%)				
Tyre pressure (kPa)				

5. Test results: mean fully developed decelerations ($m \cdot s^{-2}$)

Run number	*SRTT (Initial braking test)*	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
1				
2				
3				
4				
5				
6				
7				
8				
9				
$d_{m,ave}$				
σ_d				
CV_d (≤ 6 %)				
$CVal(d_m)$ (≤ 5%)				
$d_{m,adj}$(R)				
Ice grip index	1.00			

Part 2 - Test data: 3rd braking test cycle

1. Date of test: .....

2. Location of test track: .....

2.1. Test track characteristics:

	At start of test	*At end of test*	*Specification*
Weather			
Ambient temperature			−15 °C to +4 °C
Ice temperature			−15 °C to −5 °C
Other			

3. Test vehicle (make, model and type, year): .....

4. Test tyre details and data .....

	SRTT (Initial braking test)	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
Brand name				
Trade description/ commercial name				
Tyre size designation				
Service description				
Test rim width code				
Tyre load FL/FR/RL/RR (kg)				
Load-on-tyre rate (FL/FR/RL/RR) (%)				
Tyre pressure (kPa)				

5. Test results: mean fully developed decelerations ($m \cdot s^{-2}$)

Run number	*SRTT (Initial braking test)*	*Candidate 1*	*Candidate 2*	*SRTT (final braking test)*
1				
2				
3				
4				
5				
6				
7				
8				
9				
$d_{m,ave}$				
σ_d				
CV_d (≤ 6 %)				
$CVal(d_m)$ (≤ 5%)				
$d_{m,adj}$(R)				
Ice grip index	1.00			

"