

Proposal to amend document GRBP/2025/27 (Proposal for a new UN Regulation on the uniform provisions concerning the approval of tyres with regard to abrasion performance)

Changes proposed by TF TA are marked in **bold blue** for added text and ~~strike through blue~~ for deleted text.

I. Proposal

UN Regulation No. [XXX] on uniform provisions concerning the approval of tyres with regard to abrasion performance

Contents

1.	Scope
2.	Definitions.....
3.	Application for approval
4.	Markings
5.	Approval.....
6.	Requirements.....
7.	Modifications of the type of tyre and extension of approval.....
8.	Conformity of production.....
9.	Penalties for non-conformity of production
10.	Production definitively discontinued.....
11.	Names and addresses of Technical Services responsible for conducting approval tests of Type Approval Authorities.....
12.	Introductory provisions

Annexes

1	Communication
2	Arrangements of approval marks
3	Procedure for determining the abrasion performance of tyres of class C1
	Appendix 1 - Test method (a) - Accelerations calculation.....
	Appendix 2 - Test method (a) - Test report example for the vehicle test method on public open roads
	Appendix 3 - Test method (b) - Input of test cycle
	Appendix 4 - Test method (b) - Test equipment tolerances

Appendix 5 - Test method (b) - Replacement of sandpaper surface
Appendix 6 - Test method (b) – Test report example for the indoor drum test method.....

1. Scope

- 1.1. This Regulation applies to new pneumatic tyres* of class C1 with regard to their abrasion performance.
- This Regulation applies only to tyres that conform to UN Regulation No. 117.
- 1.2. This Regulation does not apply (and approvals to this Regulation shall not be granted) to the following tyres:
- 1.2.1. Tyres designed as temporary-use spare tyres and marked "Temporary use only";
- 1.2.2. Tyres having a nominal rim diameter code ≤ 13 (or ≤ 330 mm) or ≥ 25 (or ≥ 635 mm);
- 1.2.3. Tyres designed for competition;
- 1.2.4. Tyres intended to be fitted to road vehicles of categories other than M, N and O;¹
- 1.2.5. Ice grip tyres;
- 1.2.6. Tyres fitted with additional devices to improve traction properties (e.g. studded tyres);
- 1.2.7. Tyres with a speed category less than 120 km/h (speed-category symbol L);
- 1.2.8. Tyres designed only to be fitted to vehicles registered for the first time before 1 October 2000;
- 1.2.9. Professional off-road tyres;
- 1.2.10. ~~[Road legal race tyres;]~~
- ~~1.2.11. [Tyres for use in severe snow conditions with a speed category less than or equal to 160 km/h (speed category symbol Q).]~~

2. Definitions

For the purpose of this Regulation, in addition to the definitions contained in UN Regulation No. 30, the following definitions shall apply:

- 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 2.5. below);
 - (c) The tyre structure;
 - (d) The category of use: normal tyre, snow tyre and special use tyre;
 - ~~[(e) Whether the tyre is a tyre for use in severe snow conditions or not;]~~
 - (f) The tread pattern (see paragraph 3.2.1. of this Regulation).

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

¹ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3).

-
- 2.2. "Manufacturer" means the person or body who is responsible to the Type Approval Authority (TAA) for all aspects of the type-approval and for ensuring the conformity of production.
- 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.
- 2.4. "Trade description/commercial name" means an identification of a range of tyres as given by the tyre manufacturer. It may coincide with the brand name/trademark.
- 2.5. "Tyre class" means one of the following groupings:
- 2.5.1. "Class C1 tyres" means tyres conforming to [UN](#) Regulation No. 30;
- 2.6. "Representative tyre size" means the tyre size which is submitted to the test described in Annex 3 to this Regulation to assess the conformity for the type approval of the type of tyre.
- 2.7. "Temporary-use spare tyre" means a tyre different from a tyre intended to be fitted to any vehicle for normal driving conditions; but intended only for temporary use under restricted driving conditions.
- 2.8. "Tyre designed for competition" means a tyre intended to be fitted to vehicles involved in motor sport competition and not intended for non-competitive on-road use.
- 2.9. [{"Road legal race tyre" means a tyre approved for use on public roads but primarily designed for track use and/or competition and fulfilling the requirements of paragraph 6.2. of this Regulation.}](#)
- 2.10. "Normal tyre" means a tyre intended for normal on-road use.
- 2.11. "Snow tyre" means a tyre whose tread pattern, tread compound or construction is primarily designed to achieve in mud and/or snow conditions a performance better than that of a normal tyre with regard to its ability to initiate and control vehicle motion.
- 2.11.1. "Tyre for use in severe snow conditions" means a snow tyre or a special use tyre whose tread pattern, tread compound or construction is specifically designed to be used in severe snow conditions and that conforms to [UN](#) Regulation No. 117.
- 2.11.1.1. "Ice grip tyre" means a class C1 snow tyre that is classified as [a](#) tyre for use in severe snow conditions, additionally designed to be used on road surfaces covered with ice and conforming to [UN](#) Regulation No. 117.
- 2.12. "Special use tyre" means a tyre intended for mixed use both on- and off-road or for other special duty. These tyres are primarily designed to initiate and maintain the vehicle in motion in off-road conditions.
- 2.12.1. "Professional off-road tyre" means a special use tyre primarily used for service in severe off-road conditions.
- 2.13. "Reinforced tyre" or "extra load tyre" of class C1 means a tyre 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 4000-1:2024.²
- 2.14. "Standard Reference Test Tyre" or "SRTT" means a tyre that is produced, controlled and stored in accordance with the standards of ASTM International:

² Class C1 tyres correspond to "passenger car tyres" in ISO 4000-1:2024.

-
- (a) F3676 – 24 for the size 225/45R17 94V and referred to as "SRTT17S";
- (b) F3675 – 24 for the size 225/45R17 94H and referred to as "SRTT17W".
- 2.15. "*Candidate tyre*" means a tyre, representative of the type that is submitted for approval in accordance with this Regulation and whose performance is evaluated relative to that of a reference tyre.
- 2.16. "*Reference tyre*" means a Standard Reference Test Tyre that is used as a reference in an evaluation programme.
- 2.17. "*Test tyre*" means a candidate tyre or a reference tyre.
- 2.18. "*Test cycle*" means a driving programme of a test tyre on the drum defined by the application of a series of longitudinal and lateral forces.
- 2.19. "*Abrasion rate*" means the mass of material lost from the tyre due to the abrasion process per distance travelled, and expressed in mg/km.
- 2.20. "*Abrasion level*" means the abrasion rate normalized to the load on the tyre, and expressed in mg/(km·t).
- 2.21. "*Abrasion index*" (*AICT*) means the dimensionless value for expressing the tyre abrasion level of a candidate tyre relative to that of the applicable Standardized Reference Test Tyre (SRTT).
- 2.22. "*Approval reference number*" means a six- to eight-digit number concatenating:
- the two digits (with a leading zero where applicable, "00" indicating that the approval was granted in accordance with original version of a regulation) that indicate the series of amendments applied to the approval pursuant to Schedule 4, paragraph 3, Section 2(a) of the 1958 Agreement and
 - the four to six-digit sequential number (with leading zeros in **the** case **that** the sequential number is less than 1000) pursuant to Schedule 4, paragraph 3, Section 3 of the 1958 Agreement, both as contained within the approval number assigned by the Contracting Party pursuant to paragraph 5.2.

3. Application for approval

- 3.1. The application for approval of a type of tyre with regard to this Regulation shall be submitted by the tyre manufacturer or by its duly accredited representative. It shall specify:
- 3.1.1. Manufacturer's name and address;
- 3.1.2. If applicable, name and address of manufacturer's representative;
- 3.1.3. Tyre class (see paragraph 2.5. of this Regulation);
- 3.1.4. Category of use (normal, snow, or special use);
- {3.1.4.1. Whether or not the tyre is **a tyre** for use in severe snow conditions.}
- 3.1.5. Tyre structure;
- 3.1.6. Brand name(s)/trademark(s), trade description(s)/commercial name(s);
- 3.1.7. 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 whether "reinforced" (or "extra load") or not, and whether or not the tyre is for use in severe snow conditions]~~.
- 3.2. The application for approval shall be accompanied by:

-
- 3.2.1. Details of the major features, with respect to the effects on the abrasion 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~~ shall 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;
- 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;
- 3.3. At the request of the Type Approval Authority, the applicant shall submit samples of tyres for test or copies of test reports from the Technical Services, communicated as given in paragraph 11. of this Regulation.
- 3.4. With regard to the application, testing may be confined to a representative tyre size of the type of tyre, at the discretion of the Type Approval Authority.

4. Markings

- 4.1. All tyres constituting the type of tyre shall be marked as prescribed by UN Regulations No. 30 and No. 117.
- 4.2. In particular, tyres shall bear:³
- 4.2.1. The manufacturer's name or the brand name/trademark;
- 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;
- 4.2.3. The tyre size designation;
- 4.2.4. The inscription "REINFORCED" (or alternatively "EXTRA LOAD") if the tyre is classified as reinforced;
- 4.2.5. The "Alpine Symbol" ("3-peak-mountain with snowflake" conforming to the pictogram described in Annex 7, Appendix 1 to UN Regulation No. 117 from now on referred to as "3PMSF") if the snow tyre or the special use tyre is classified as tyre for use in severe snow conditions;
- 4.2.6. The inscription "ET" and/or "POR" if the tyre is classified in the category of use "special". In addition, they may also bear the inscription "M+S" or "M.S" or "M&S".
- ET means Extra Tread, and POR means Professional Off-Road.
- [4.2.7. The inscription "{RLR}" if the tyre is classified as a road legal race tyre.]
- 4.3. Every tyre conforming to the type of tyre approved under this Regulation shall be marked on at least one of its sidewalls conspicuously with an international approval mark.
- 4.3.1. The approval mark shall be situated in the lower area of the tyre on at least one of its sidewalls. However, in the case of tyres identified by the tyre to rim fitment configuration symbol "A" or "U", the marking may be located anywhere on the outside sidewall of the tyre.

³ Some of these requirements may be specified separately in UN Regulation No. 30.

-
- 4.3.2. The international approval mark shall consist of the following:
- 4.3.2.1. A circle surrounding the letter "E" followed by the distinguishing number⁴ of the country which has granted approval and
- 4.3.2.2. The approval reference number and
- 4.3.2.3. One of the suffixes listed below:
- | | |
|----|---------|
| A1 | Stage 1 |
| A2 | Stage 2 |
- 4.3.3. The approval reference number and the suffix shall be placed close to the circle prescribed in paragraph 4.3.2.1. and with respect to the letter "E" either above or below or to the left or to the right of that circle and shall face in the same direction as the "E".
- 4.3.4. If the tyre conforms to type approvals under one or more other ~~Regulations-UN regulations~~ annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.3.2.1. does not need to be repeated. In such a case the additional numbers and symbols of all the ~~Regulations-UN regulations~~ under which approval has been granted in the country which has granted approval under this Regulation shall be placed adjacent to the symbol prescribed in paragraph 4.3.2.1.
- 4.3.5. Notwithstanding paragraph 4.3.2., in ~~the~~ case ~~that~~ the approval of a tyre pursuant to this Regulation has been granted by the same Type Approval Authority ~~than-as~~ that granting the approval pursuant to UN Regulation No. 30, the approval mark pursuant to UN Regulation No. 30 can be combined with an indication of the applicable series of amendments to which the tyre was approved pursuant to UN Regulation No. [XXX] in the form of 2 digits (for example "00" indicating that the UN Regulation No. [XXX] approval was granted following the original version) and the suffixes "A1" or "A2" using the addition sign "+", as described in ~~Example 1 of Model C in Annex 2 Annex 2~~ ~~Appendix 3~~ to this Regulation, for example "0236378 + 00A1".
- 4.3.6. Notwithstanding paragraph 4.3.2., in ~~the~~ case ~~that~~ the approval of a tyre pursuant to this Regulation has been granted by the same Type Approval Authority ~~than-as~~ that granting the approval pursuant to UN Regulation No. 117, the approval mark pursuant to UN Regulation No. 117 can be combined with an indication of the applicable series of amendments to which the tyre was approved pursuant to UN Regulation No. [XXX] in the form of 2 digits (for example "00" indicating that the UN Regulation No. [XXX] approval was granted following the original version) and the suffixes "A1" or "A2" using the addition sign "+", as described in ~~Example 2 of Model C in Annex 2 Annex 2~~ ~~Appendix 3~~ to this Regulation, for example "0401523 S2W2R3B + 00A2".
- 4.3.7. Annex 2 to this Regulation gives examples of arrangements of approval marks.
- 4.4. The markings specified in paragraph 4.2. and the approval mark specified in paragraph 4.3. of this Regulation shall be clearly legible, indelible and raised above or sunk below the tyre surface.

⁴ The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3).

5. Approval

- 5.1. If the candidate tyre submitted for approval pursuant to this Regulation meets the requirements of paragraphs 6. and 7. below, approval of that type of tyre shall be granted.
- 5.2. An approval number according to Schedule 4 to the Revision 3 of the 1958 Agreement shall be assigned to the type of tyre approved. The same Contracting Party may not assign the same number to another type of tyre.
- 5.3. Notice of approval or extension of approval or refusal of approval of a type of tyre pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to ~~the~~ **this** Regulation.
- 5.4. Contracting Parties applying this Regulation shall continue to accept test reports that were issued in accordance with Annex 10 to **UN** Regulation No. 117, before the entry into force of Supplement [4] to the 04 Series of Amendments to **UN** Regulation No. 117.

6. Requirements

- 6.1. Abrasion performance limits, as measured by [one of] the method[s] described in Annex 3 to this Regulation.
- 6.1.1. The abrasion index of the candidate tyre shall not exceed the values given below:

<i>Category of use</i>	<i>Abrasion index (AICT)</i>
Normal tyre	{1.00}
Snow tyre	{1.00}
Special use tyre	[Not defined]

Note: The limits shall be adjusted for the following specific tyre groups as follows

<i>Tyre group</i>	<i>Stage 1</i>	<i>Stage 2</i>
Standard load tyres	—	[-0.05/-0.10]
Reinforced or extra load tyres	+0.10	[-0.05/-0.10]
Tyres for use in severe snow conditions (3PMSF)	+0.10	[+0.10]
Tyres with a nominal aspect ratio ≤ 40 and a speed category ≥ 300 km/h (speed-category symbol Y)	+0.10	[—]
Tyres with low load index (LI < 77)	+0.10	[—]

The adjustments for specific tyre groups are cumulative, e.g., if a candidate tyre is a reinforced snow tyre for use in severe snow conditions, the limit shall be [1.20] for stage 1 and [1.05] for stage 2.

- 6.2. **[In order to be classified as road legal race tyre, a normal tyre shall meet the following requirements:**
- (a) **The void-to-fill ratio shall be less than or equal to 25 per cent and**

(b) The tread depth shall be less than or equal to 6 mm.]

7. Modifications of the type of tyre and extension of approval

- 7.1. Every modification of the type of tyre, which may influence the performance characteristics approved in accordance with this Regulation, shall be notified to the Type Approval Authority which approved the type of tyre. That Authority may either:
- 7.1.1. Consider that the modifications are unlikely to have any appreciable adverse effect on the performance characteristics approved and that the tyre will comply with the requirements of this Regulation; or
- 7.1.2. Require further samples to be submitted for test or further test reports from the designated Technical Service.
- 7.2. Confirmation or refusal of approval, specifying the modifications, shall be communicated by the procedure given in paragraph 5.3. of this Regulation to the Parties to the Agreement which apply this Regulation.
- 7.3. The Type Approval Authority granting the extension of approval shall assign a series number for such an extension which shall be shown on the communication form.

8. Conformity of production

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:

- 8.1. Any tyre approved under this Regulation shall be so manufactured as to conform to the performance characteristics of the type of tyre approved and satisfy the requirements of paragraph 6. above;
- 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.
- 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. Because the test procedure involves testing a number of tyres at the same time, 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.
- 8.3.1. The verification tests shall be carried out using the same testing method as that adopted for original approval.
- [8.3.2. Verification tests shall apply the same abrasion margin (A_{margin}) value as that applied for the original approval.]
- 8.4. Production shall be deemed to conform to the requirements of this Regulation if the abrasion index complies with the limits prescribed in paragraph 6.1. of this Regulation, with an additional allowance of [0.20] for considering possible mass production variations.

9. Penalties for non-conformity of production

- 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 paragraph 8.4.
- 9.2. If a Party to the Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith notify the other Contracting Parties applying this Regulation by means of a copy of the approval form conforming to the model in Annex 1 to this Regulation.

10. Production definitively discontinued

If the holder of an approval completely ceases to manufacture a type of tyre approved in accordance with this Regulation, it shall so inform the Type Approval Authority which granted the approval. Upon receiving the relevant communication that Authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

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

- 11.1. The Contracting Parties to the 1958 Agreement which apply this Regulation shall communicate to the United Nations Secretariat, the names and addresses of the Technical Services responsible for conducting approval tests and, where applicable, of the approved test laboratories and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension of approval or refusal of approval or withdrawal of approval, or production definitively discontinued, issued in other countries, are to be sent.
- 11.2. The Contracting Parties to the 1958 Agreement which apply this Regulation may designate laboratories of tyre manufacturers as approved test laboratories.
- 11.3. Where a Contracting Party to the 1958 Agreement applies paragraph 11.2. above, it may, if it so desires, be represented at the tests by one or more persons of its choice.

12. Introductory provisions

- 12.1. As from the official date of entry into force of this Regulation, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept type approvals pursuant to this Regulation.
- 12.2. As from [1 January 2033], Contracting Parties applying this Regulation shall not be obliged to accept type approvals of tyres, first issued after [31 December 2032], pursuant to this Regulation if the requirements Stage 2 are not complied with.
- 12.3. Until [31 December 2034], Contracting Parties applying this Regulation shall continue to grant extensions to type approvals, first issued before [1 January 2033], pursuant to this Regulation, if the requirements of Stage 2 are not complied with.

-
- 12.4. Until the dates given below, no Contracting Parties applying this Regulation shall mandatorily require the approval pursuant to this Regulation of new types of class C1 tyres.

Stage 1	{30 June 2028}
Stage 2	[31 December 2032]

- 12.5. Until the dates given below, no Contracting Parties applying this Regulation shall mandatorily require the approval pursuant to this Regulation of all types of class C1 tyres.

Stage 1	{30 June 2030}
Stage 2	[31 December 2034]

- ~~12.6. Until [30 June 2032], Contracting Parties applying this Regulation and mandatorily requiring the approval pursuant to this Regulation of all types of class C1 tyres shall continue to allow fitting on a vehicle in use of new class C1 tyres manufactured prior to [30 June 2030] and not type approved pursuant to this Regulation.~~

- [12.6. Notwithstanding paragraph 12.5, Contracting Parties applying this Regulation and mandatorily requiring the approval pursuant to stage 1 of this Regulation shall continue to allow for a period of 24 months from the date of requiring the approval for all types of class C1 tyres the fitting on a vehicle in use of new class C1 tyres that are manufactured prior to the date of requiring the approval pursuant to stage 1 for all types of class C1 tyres and that are not type approved pursuant to this Regulation.]**

- [12.7. Notwithstanding paragraph 12.5, Contracting Parties applying this Regulation and mandatorily requiring the approval pursuant to stage 2 of this Regulation shall continue to allow for a period of 24 months from the date of requiring the approval for all types of class C1 tyres the fitting on a vehicle in use of new class C1 tyres that are manufactured prior to the date of requiring the approval pursuant to stage 2 for all types of class C1 tyres and that are not type approved pursuant to stage 2 of this Regulation.]**

Annex 1

Communication

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



Issued by: Name of administration:

.....

Concerning:² Approval granted
 Approval extended
 Approval refused
 Approval withdrawn
 Production definitively discontinued

of a type of tyre pursuant to **UN** Regulation No. [XXX]

Approval No.³ Suffix⁴:

1. Manufacturer's name and address:
2. If applicable, name and address of manufacturer's representative:
3. "Tyre class" of the type of tyre:
4. "Category of use" of the type of tyre:
- [4.1. Tyre for use in severe snow conditions (Yes/No)²]**
5. Tyre structure:
6. Type of tyre designation:
 - 6.1. Brand name(s)/trademark(s) of the type of tyre
 - 6.2. Trade description(s)/commercial name(s) of the type of tyre:
7. Technical Service and, where applicable, test laboratory approved for purposes of approval or of verification of conformity tests:
8. Tyre abrasion index of the representative tyre size, paragraph 2.6. of this Regulation, as per the test report in Appendix 2 or 6 to Annex 3: using the vehicle test method on public open roads ² or the indoor drum method²
9. Number of report issued by the Technical Service:
10. Date of report issued by that Service:
11. Reason(s) of extension (if applicable):
12. Any remarks:
13. Place:

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

² Strike out what does not apply.

³ According to Schedule 4 to Revision 3 of the 1958 Agreement.

⁴ According to paragraph 4.3.2.3. of this Regulation

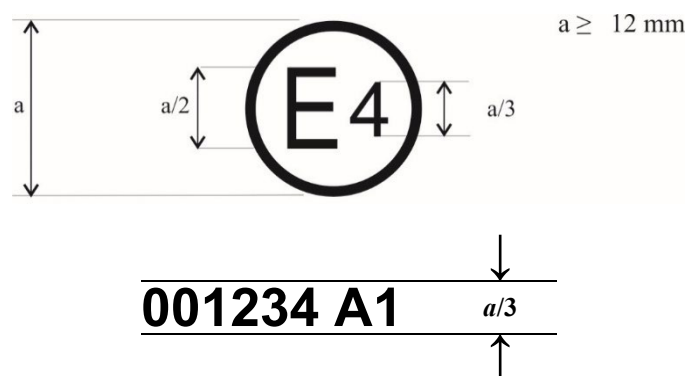
-
14. Date:
 15. Signature:
 16. Annexed to this communication are:
 - 16.1. A list of documents in the approval file deposited at the Type Approval Authorities having delivered the approval and which can be obtained upon request.
 - 16.2. A list of tyre size designations: Specify for each brand name/trademark and/or each trade description/commercial name the list of tyre size designations and service descriptions ~~], adding whether "reinforced" (or "extra load") or not,~~ ~~and whether or not tyre for use in severe snow conditions].~~

Annex 2

Arrangements of approval marks

Model A: ~~Example of a separate~~ Separate UN Regulation No. [XXX] approval mark

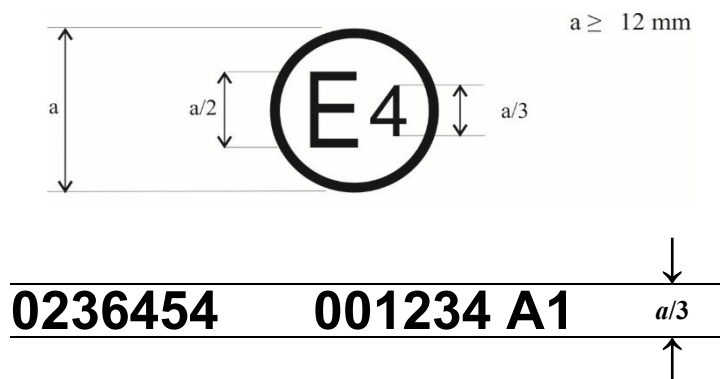
Example 1



The above approval mark, affixed to a tyre shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to UN Regulation No. [XXX] (marked by the suffix "A1" (abrasion at stage 1)), under the original version of this regulation (indicated by the first two digits "00") and the serial number 1234.

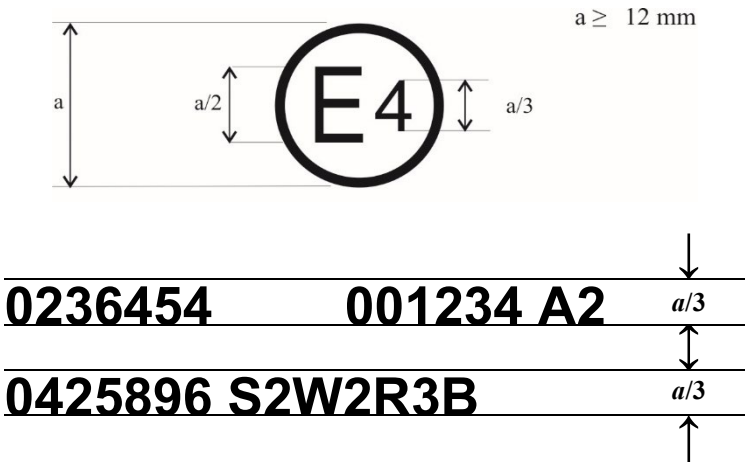
Model B: Approval pursuant to UN Regulation No. [XXX] coincident with approval pursuant to other regulations

Example 1



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to UN Regulation No. [XXX] (marked by the suffix "A1" (abrasion at stage 1)) with approval reference number 001234 and UN Regulation No. 30 with approval reference number 0236454. The first two digits of the approval numbers ("00" and "02") indicate that the approval pursuant to UN Regulation No. [XXX] was granted according to the original version and the approval pursuant to UN Regulation No. 30 according to the 02 series of amendments.

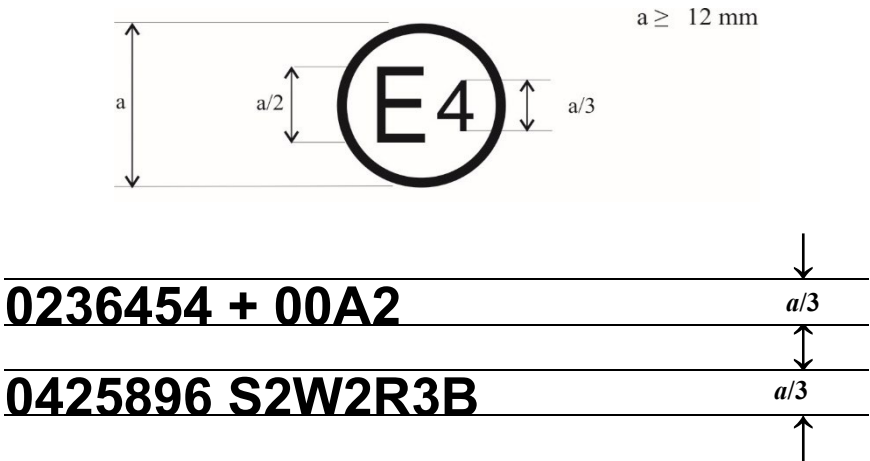
Example 2



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to [UN](#) Regulation No. [XXX] (marked by the suffix "A2" (abrasion at stage 2)) with approval reference number 001234, pursuant to [UN](#) Regulation No. 30 with approval reference number 0236454 and pursuant to [UN](#) Regulation No. 117 with approval reference number 0425896 for rolling sound emission at stage 2, wet adhesion of tyres in new state at stage 2, rolling resistance at stage 3 and wet adhesion of tyres in worn state (indicated by "S2W2R3B"). The first two digits of the approval numbers ("00", "02", and "04", respectively) indicate that the approval pursuant to UN Regulation No. [XXX] was granted according to the original version, the approval pursuant to UN Regulation No. 30 according to the 02 series of amendments, and the approval pursuant to UN Regulation No. 117 according to the 04 series of amendments.

Model C: Combinations of markings of approvals issued pursuant to [UN](#) Regulations Nos. [XXX], 30 and/or 117

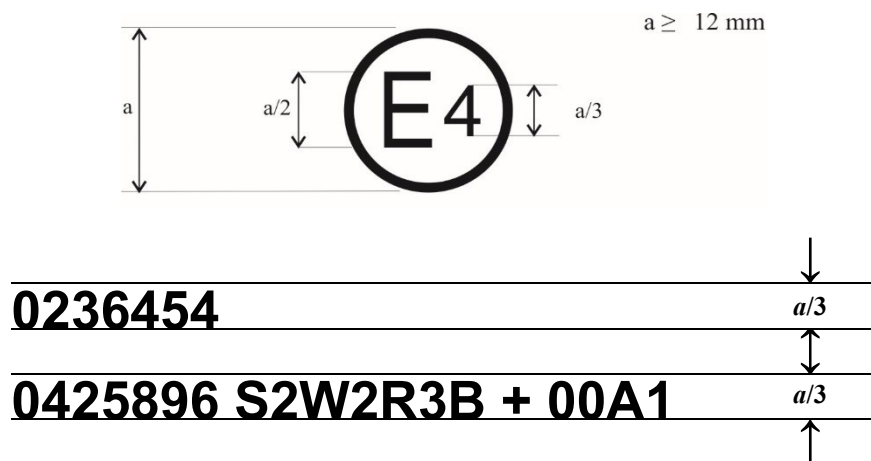
Example 1



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to [UN](#) Regulation No. [XXX] (marked by the "+ 00A2" (abrasion at stage 2)) according to the original version of this regulation, pursuant to [UN](#) Regulation No. 30 with approval reference number 0236454 and pursuant to [UN](#) Regulation No. 117 with approval reference number 0425896 for rolling sound emission at stage 2, wet adhesion of tyres in

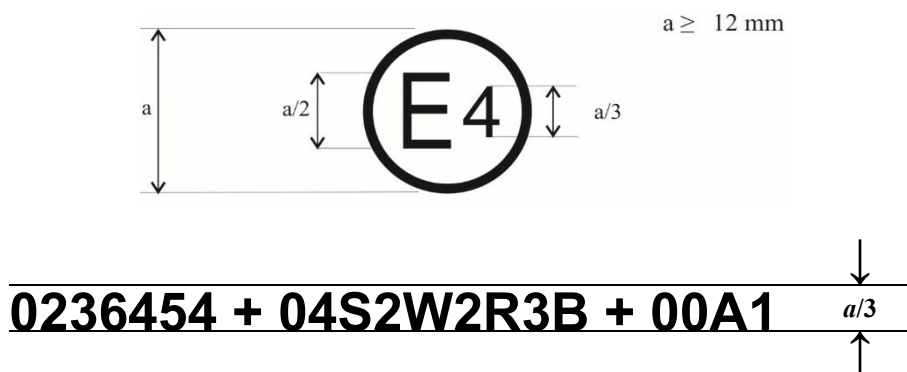
new state at stage 2, rolling resistance at stage 3 and wet adhesion of tyres in worn state (indicated by "S2W2R3B").

Example 2



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to UN Regulation No. [XXX] (marked by the "+ 00A1" (abrasion at stage 1)) according to the original version of this regulation, pursuant to UN Regulation No. 30 with approval reference number 0236454 and pursuant to UN Regulation No. 117 with approval reference number 0425896 for rolling sound emission at stage 2, wet adhesion of tyres in new state at stage 2, rolling resistance at stage 3 and wet adhesion of tyres in worn state (indicated by "S2W2R3B").

Example 3



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to UN Regulation No. [XXX] (marked by the "+ 00A1" (abrasion at stage 1)) according to the original version of this regulation, pursuant to UN Regulation No. 30 with approval reference number 0236454 and pursuant to UN Regulation No. 117 according to the 04 series of amendments for rolling sound emission at stage 2, wet adhesion of tyres in new state at stage 2, rolling resistance at stage 3 and wet adhesion of tyres in worn state (indicated by "+ 04S2W2R3B").

Annex 3

Procedure for determining the abrasion performance of tyres of class C1

Introduction

For the calculation of the tyre abrasion index of a candidate tyre, the abrasion level of the candidate tyre ~~is~~ **shall be** compared to the abrasion level of a standard reference test tyre. It ~~is~~ **shall be** measured with one of the following test methods:

- (a) vehicle test method on public open roads (**paragraph 1. of this Annex**);
- (b) indoor drum test method (**paragraph 2. of this Annex**).

1. Test method (a) using a vehicle on public open roads

1.1. This method applies to class C1 tyres in scope of this regulation.

1.2. Definitions

In addition to relevant definitions set out in paragraph 2 of this Regulation the following **definitions shall apply to the vehicle test method on public open roads**.

- 1.2.1. "*Circuit*" identifies the roads which will be used for the abrasion test. The circuit may consist of one or several loops, which can be run in any order.
- 1.2.2. "*Loop*" means the section of the circuit having the same starting and ending point. If the same loop is run clockwise and counterclockwise it shall be considered as 2 loops.
- 1.2.3. "*Shift*" means the period of time required to run the circuit (including break time, rotation time between vehicle in convoy or drive in vehicle).
- 1.2.4. "*Total distance*" is the total distance run by a tyre during the test.
- 1.2.5. "*Electric machine*" identifies the energy converter transforming between electrical and mechanical energy.
- 1.2.6. "*Category of propulsion energy converter*" means (i) an internal combustion engine, (ii) an electric machine or (iii) fuel cell.
- 1.2.7. "*Hybrid vehicle*" is a vehicle equipped with a powertrain containing at least two different categories of propulsion energy converters and at least two different categories of propulsion energy storage systems.
- 1.2.8. "*Hybrid electric vehicle*" **or** "~~{HEV}~~" is a hybrid vehicle where one of the propulsion energy converters is an electric machine.
- 1.2.9. "*Not off-vehicle charging hybrid electric vehicle*" **or** "~~{NOVC-HEV}~~" is a hybrid electric vehicle that cannot be charged from an external source.
- 1.2.10. "*Off-vehicle charging hybrid electric vehicle*" **or** "~~{OVC-HEV}~~" is a hybrid electric vehicle that can be charged from an external source.
- 1.2.11. "*Pure electric vehicle*" **or** "~~{PEV}~~" is a vehicle equipped with a powertrain containing exclusively electric machines as propulsion energy converters and exclusively rechargeable electric energy storage systems (REESS) as propulsion energy storage systems.

- 1.2.12. "Pure internal combustion engine **vehicle**" or "~~ICE~~ vehicle" is a vehicle where all propulsion energy converters are internal combustion engines.
- 1.2.13. "Traction REESS" means an electric energy storage system that is rechargeable and that provides electric energy for electric propulsion.
- 1.2.14. "FWD **vehicle**" or "~~Front Wheel Drive~~ vehicle" means a vehicle where only the front axle delivers traction torque.
- 1.2.15. "RWD **vehicle**" or "~~Rear Wheel Drive~~ vehicle" means a vehicle where only the rear axle delivers traction torque.
- 1.2.16. "4WD **vehicle**" or "~~4 Wheel Drive~~ vehicle" means a vehicle where the axle traction torque for one axle can be switched off by the driver.
- 1.2.17. "AWD **vehicle**" or "~~All Wheel Drive~~ vehicle" means a vehicle with permanent or vehicle controlled 4 wheels drive.
- 1.2.18. "Reference vehicle" identifies the vehicle that will be fitted with the reference tyres.
- 1.2.19. "Candidate vehicle" identifies the vehicle that will be fitted with the candidate tyres.
- 1.2.20. "Vehicle f_2 coefficient" (measured in $\text{N}/(\text{km}/\text{h})^2$) is the second-order road load coefficient according to UN Regulation No. 154. It is provided at reference conditions.
- 1.2.21. "Longitudinal acceleration" (measured in m/s^2) is the acceleration in the direction of vehicle movement. Longitudinal acceleration has a positive sign for speed increase and a negative sign for speed decrease (e.g. braking).
- 1.2.22. "Lateral acceleration" (measured in m/s^2) is the acceleration perpendicular to the direction of vehicle movement. Lateral acceleration has a positive sign when turning left in the direction of the vehicle movement. Lateral acceleration has a negative sign when turning right in the direction of the vehicle movement.
- 1.2.23. "Toe IN/OUT angle per wheel on the front (rear) axle" is the average of the measured toe angle of the right front (rear) wheel and the measured toe angle of the left front (rear) wheel.**

1.3. Symbols and abbreviated terms

<i>Symbol</i>	<i>Unit</i>	<i>Designation</i>
A_{ICT}	No dimension	Abrasion index of the candidate tyre
$ALCT$	$\frac{\text{mg}}{\text{km}\cdot\text{t}}$	Abrasion level of candidate tyre at test conditions
$ALRT$	$\frac{\text{mg}}{\text{km}\cdot\text{t}}$	Abrasion level of reference tyre at test conditions
A_{margin}	No dimension	Abrasion margin
D_{Ci}	km	Total distance run by candidate vehicle during the test
D_{Ri}	km	Total distance run by reference vehicle during the test
$MCTF_i$	g	Candidate tyre final mass of tyre i
$MCTS_i$	g	Candidate tyre initial mass of tyre i
$MRTF_i$	g	Reference tyre final mass of tyre i
$MRTS_i$	g	Reference tyre initial mass of tyre i

<i>Symbol</i>	<i>Unit</i>	<i>Designation</i>
O_S	$\frac{\text{mg}}{\text{km}\cdot\text{t}}$	Offset of the regression lines of the reference tyre abrasion level of SRTT17S
O_W	$\frac{\text{mg}}{\text{km}\cdot\text{t}}$	Offset of the regression lines of the reference tyre abrasion level of SRTT17W
Q_{Ci}	kg	Test load for each candidate tyre
Q_{Ri}	kg	Test load for each reference tyre
S_S	$\frac{\text{mg}}{\text{km}\cdot\text{t}\cdot^\circ\text{C}}$	Sensitivity of <i>SRTT17S</i> to temperature variation
S_W	$\frac{\text{mg}}{\text{km}\cdot\text{t}\cdot^\circ\text{C}}$	Sensitivity of <i>SRTT17W</i> to temperature variation
T_i	$^\circ\text{C}$	Average temperature of the test
\bar{T}	$^\circ\text{C}$	Average temperature of the n tests

1.4. Instrumentation

1.4.1. Instruments for tyre mass measurement

The weight scale shall be able to measure the tyre mass with an accuracy of ± 2 g.

1.4.2. Instruments for alignment and camber measurement on vehicle

The device shall have an accuracy of ± 0.033 degrees.

1.4.3. Instruments for vehicle mass measurement per position

The weight scale shall be able to measure the load on each tyre with an accuracy of ± 0.1 per cent.

1.4.4. Instruments for acceleration, distance, and speed measurements

During the test, a continuous evaluation of speed, lateral, and longitudinal acceleration shall be done, with a minimum and recommended sampling rate of 10 Hz. GNSS (Global Navigation Satellite System as defined by ISO 24245:2023) measurement associated with numerical treatment of the positions shall be used. See numerical treatment for GNSS (Global Navigation Satellite System) data in Appendix 1 of this [Regulation Annex](#).

The distance run by the tyre shall equal the GNSS reported distance plus the distance run without a GNSS signal, unless this distance is estimated by the GNSS itself.

Accelerometers shall not be used.

1.4.5. Tyre pressure measurement device

The device shall have an accuracy of ± 3 kPa.

1.4.6. Instruments for weather (rain, snow, ice) measurement

For rain, test drivers shall report mileage with wipers in function (actually wiping the windshield) for each shift.

For snow/ice, test drivers shall report mileage driven with snow or ice on the road for each shift.

1.4.7. Instruments for temperature measurement

The vehicle external thermometer may be used. Data shall be recorded with time and location on paper or file. Any thermometer positioned to measure external air temperature is acceptable ~~as well~~. The thermometer shall have a measurement accuracy of ± 1 $^\circ\text{C}$. ~~A-Alternatively, a~~ continuous measurement

-
- device recording the temperature ~~is acceptable~~ **may be used, as well** provided that it fulfils the measurement accuracy described above.
- Initial and final measurements shall be done using a calibrated thermometer.
- 1.4.8. Instruments for tyre and wheel assembly mass measurement
- The weight scale shall be able to measure the tyre and wheel assembly mass with an accuracy of ± 2 g.
- 1.5. Tyre, tyre and wheel assembly, and vehicle measurement procedure
- 1.5.1. Tyre mass measurement
- The tyre shall be cleaned and dried before the mass measurement, with **a** device or product not removing any rubber from the tyre (e.g. water based non-abrasive cleaner). Any visible ~~stone~~ **stones** shall be removed from the pattern before mass measurement. The measurement shall be ~~repeated~~ **performed** 3 times and averaged.
- 1.5.2. Tyre and wheel assembly mass measurement
- The tyre assembly shall be cleaned and dried before the mass measurement, with **a** device or product not removing any rubber from the tyre (e.g. water based non-abrasive cleaner). Any visible ~~stone~~ **stones** shall be removed from the pattern before mass measurement, without air pressure, and without valve core.
- The mass measurement shall be performed after checking that the balancing masses are all present on the assembly.
- 1.5.3. Vehicle mass measurement procedure
- The vehicle shall be cleaned and dried before measurement, with **a** full fuel tank (~~ICE vehicle if present~~), **with** test ballast as described in paragraph 1.6.12. of this Annex, equipped with the tyres to be tested, and wheels used for the test with drivers' average weight (i.e. 75 kg). Load Q on each wheel shall be measured.
- 1.5.4. Vehicle alignment measurement procedure
- The vehicle alignments shall be measured, with **a** full fuel tank (~~ICE vehicle if present~~), **with** test ballast as described in paragraph 1.6.12. of this Annex, equipped with the tyres to be tested, and wheels used for the test with drivers' average weight (i.e. 75 kg).
- 1.6. Vehicle and circuit requirements
- 1.6.1. General requirements
- A vehicle where the candidate tyres can be fitted on all 4 positions should be selected as a candidate vehicle. [In the case that it is not possible to find such a vehicle, a vehicle following the prescriptions of paragraph 1.6.6.2. shall be selected.]**
- Only a vehicle where the reference tyres can be fitted on all 4 positions shall be selected as a reference vehicle.**
- Alignments setting shall be performed as following:
- (a) Measure and record the alignment values with vehicles in loaded conditions as explained in **paragraph** 1.5.4.;
 - (b) The values measured with loaded conditions will be monitored during the test and will serve as the reference values to respect during the tests.
- Alignments (~~TOE~~ **toe** and camber) on both axles of reference vehicle and of each candidate vehicle shall be checked at least:

-
- (c) At the beginning of the test. The alignment **check** shall take place **at a** maximum ~~at of~~ 50 km of distance run before starting the test;
 - (d) Optionally at half distance;
 - (e)- In **the** case of an impact that may affect the alignment (e.g. ~~curbstone~~ **kerbstone** contact, etc);
 - (f) At the end of the test. The alignment **check** shall take place **at a** maximum ~~at of~~ 50 km of distance run after finishing the test;
 - (g) Any additional distance to reach the geometry measurement facility shall not be driven with reference or candidate tyres.

At the end of the test, the alignments shall not vary by more than ± 0.15 degrees for toe and ± 0.3 degrees for camber from **the** initial measurement under the same condition.

1.6.2. Vehicles' acceptable suspension and static tuning for FWD vehicles

1.6.2.1. **The alignment of the Vehicles used for candidate tyresvehicles, measured in loaded condition as described in paragraph 1.5.4., shall fulfil the following requirements:**

- (a) Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.1) degrees;
- (b) Camber angle per wheel on the front axle set between ~~+1.2~~ **-1.4** degrees to ~~0-0.2~~ degrees;
- (c) Toe IN/OUT angle per wheel on the rear axle between 0.05 degrees and 0.15 degrees;
- (d) Camber angle per wheel on the rear axle between -1.9 degrees and -0.6 degrees.

1.6.2.2. **The alignment of the Vehicle used for reference tyresvehicle, measured in loaded condition as described in paragraph 1.5.4., shall fulfil the following requirements:**

- (a) Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.05) degrees;
- (b) Camber angle per wheel on the front axle set between ~~+1.2~~ **-1.4** degrees to ~~-0.2 0~~ degrees;
- (c) Toe IN/OUT angle per wheel on the rear axle between 0.05 degrees and 0.15 degrees;
- (d) Camber angle per wheel on the rear axle between -1.9 degrees and -0.6 degrees;
- (e) In addition, the toe IN/OUT angle in absolute value shall be ~~lower~~ **less** than or equal to the values used in the candidate vehicles for the front axle.

1.6.3. Vehicles' acceptable suspension and static tuning for RWD vehicles

1.6.3.1. **The alignment of the Vehicles used for candidate tyresvehicles, measured in loaded condition as described in paragraph 1.5.4., shall fulfil the following requirements:**

- (a) Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.1) degrees;
- (b) Camber angle on the front axle set to (0 ± 0.1) degrees;
- (c) Toe IN/OUT angle per wheel on the rear axle set to (0 ± 0.1) degrees;
- (d) Camber angle on the rear axle set to (0 ± 0.1) degrees.

-
- 1.6.3.2. **The alignment of the vehicle used for reference tyres-vehicle, measured in loaded condition as described in paragraph 1.5.4., shall fulfil the following requirement:**
- (a) Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.05) degrees;
 - (b) Camber angle on the front axle set to (0 ± 0.1) degrees;
 - (c) Toe IN/OUT angle per wheel on the rear axle set to (0 ± 0.1) degrees;
 - (d) Camber angle on the rear axle set to (0 ± 0.1) degrees;
 - (e) In addition, toe IN/OUT in absolute value shall be **lower-less** than or equal to the values used for candidate vehicles for front axle.
- 1.6.4. Vehicles' acceptable suspension and static tuning for 4WD vehicles
 4WD vehicles may be used if only one axle is applied as **the** drive axle. In this case, they are considered as FWD or RWD, depending on the configuration.
- 1.6.5. Vehicles' acceptable suspension and static tuning for AWD vehicles
 Vehicles with permanent 4WD shall respect the RWD vehicles settings described in paragraph 1.6.3. ~~of this Annex.~~
- 1.6.6. **Special cases**
- 1.6.6.1.** In **the** case **that** no vehicle ~~respecting~~ **respects the** conditions described in paragraphs 1.6.2., 1.6.3., 1.6.4. or 1.6.5., the following process shall be used:
- (a) Measurement with at least 4 different vehicles (if 4 vehicles available or all the available vehicles if less than 4) able to fit the candidate tyres ~~shall~~ **must** demonstrate that the settings limits cannot be achieved. The vehicles shall be less than two years old and made by 4 different ~~earmakers~~ **vehicle manufacturers.**
 - (b) Select vehicles (both reference and candidate vehicles) respecting following criteria:
 - (i) Front ~~Toe-toe~~ IN/OUT angle shall respect the previously given tolerances (0° ~~degree~~ **degrees** +/- tolerance);
 - (ii) Front camber angle shall not differ by more than 0.5° ~~degrees~~ **degrees** between ~~Reference-reference~~ and ~~Candidate-candidate~~ vehicle. Reference vehicle shall have a Front Camber **lower-less** than or equal to the respective value of the candidate vehicle, in absolute value;
 - (iii) Rear camber angle shall not differ by more than 0.6° ~~degrees~~ **degrees** between reference and candidate vehicle. Reference vehicle shall have a rear camber **lower-less** than or equal to the respective value of the candidate vehicle, in absolute value;
 - (iv) Rear ~~Toe-toe~~ IN/OUT angle shall not differ by more than 0.1° ~~degrees~~ **degrees** between reference and candidate vehicle. Reference vehicle shall have a rear toe **lower-less** than or equal to the respective value of the candidate vehicle, in absolute value;
 - (v) In addition, the ~~following limits shall be respected for alignment of the~~ candidate vehicles, ~~measured in with~~ loaded condition as described in paragraph 1.5.4., **shall fulfil the following requirements:**
 - a. Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.1) degrees;

-
- b. Camber angle on the front axle set between -1.7 degrees and 0 degree;
 - c. Toe IN/OUT angle per wheel on the rear axle set between 0.05 degrees and 0.3 degrees;
 - d. Camber angle on the rear axle set between -2.7 degrees and 0.3 degrees.
- (vi) In addition, the following limits shall be respected for alignment of the reference vehicles, measured in with-loaded condition as described in paragraph 1.5.4., shall fulfil the following requirements:
- a. Toe IN/OUT angle per wheel on the front axle set to (0 ± 0.05) degrees;
 - b. Camber angle on the front axle set between -1.7 degrees and 0 degree;
 - c. Toe IN/OUT angle per wheel on the rear axle set between 0.05 degree-degrees and 0.3 degrees;
 - d. Camber angle on the rear axle set between -2.7 degrees and 0.3 degrees.

[1.6.6.2. In case no vehicle respecting the conditions described in paragraphs 1.6.1., 1.6.2., 1.6.3., 1.6.4., 1.6.5., or 1.6.6.1. the following process shall be used:

- (a) A vehicle where the candidate tyre can be fitted on one axle shall be selected.**
- (b) The candidate tyre shall be fitted on the appropriate axle, while the other axle shall be equipped with a tyre of the same brand and the same pattern, if available.**
- (c) L_C should not deviate by more than 5 per cent from L_R , where**
 - L_C is the ratio of the mass supported by the candidate vehicle's drive axle and the mass of the candidate vehicle;**
 - L_R is the ratio of the mass supported by the reference vehicle's drive axle and the mass of the reference vehicle.]**

1.6.7. Vehicle acceptable propulsion energy converter

All the propulsion energy converter types are allowed, as long as they are homogeneous in the convoy. The convoy shall consist of vehicles that belong ~~in to~~ the same vehicle type in terms of the vehicles' electrification grade (i.e. ICE ~~vehicle~~ or NOVC-HEV or OVC-HEV or PEV).

1.6.8. Vehicle acceptable transmission system

A FWD vehicle shall be used for the tyre size to be tested when available.

If the tyre size can only be fitted on RWD vehicles, a RWD vehicle shall be used, and the reference tyres shall ~~as well~~also be fitted on a RWD vehicle.

If the tyre size can only be fitted on ~~all wheels drive~~AWD vehicles, an ~~all wheels drive~~AWD vehicle shall be used, and the reference tyre shall ~~as well~~also be fitted on ~~all wheels drive~~an AWD vehicle. If available, a vehicle with similar torque distribution shall be used for both reference tyre and candidate tyre. If not available, the default mode shall be used for both reference vehicle and candidate vehicle.

Vehicles featuring automatic or manual transmission systems are allowed in the same convoy.

-
- 1.6.9. Vehicle driving mode
- If several driving modes are available, the default driving mode, if defined by the vehicle manufacturer, shall be selected.
- In the case that no default driving mode is defined by the vehicle manufacturer, the use of a representative driving mode shall be agreed with the responsible authority.
- 1.6.10. Regenerative braking
- The vehicles of the convoy shall have similar regenerative capabilities. This is fulfilled by selecting vehicles of the similar electrification grade (see [paragraph 1.6.7.](#)). If the regenerative braking function of a vehicle can be deactivated, the driver is allowed to do so only if all vehicles in the convoy run under the same regenerative braking conditions.
- 1.6.11. Vehicle acceptable aerodynamic performances
- Aerodynamic performance of the vehicle fitted with reference tyres shall respect the following condition:
- The f_2 value of the vehicle with reference tyres shall be ~~lower~~ less than or equal to 1.2 times the f_2 value of the vehicles with candidate tyres.
- The provision defined in this paragraph does not apply when the f_2 value of the vehicles is not available to the testing facility.
- 1.6.12. Vehicle acceptable mass (depending on the tyre size and tyre load index)
- The total vehicle mass shall allow to load the tyre with a total load of (67 ± 7) per cent of the total nominal tyre load capacity for 4 tyres.
- Example of calculation:
- Assuming that the reference tyres load index is 94, which corresponds to a maximum load of 670 kg.
- The total load nominal load of the 4 reference tyres would then be:
 $670 \times 4 = 2680$ kg.
- The loaded vehicle mass shall then be $2680 \times 67\% = 1796$ kg with a tolerance of $2680 \times 7\%$, which corresponds to ± 188 kg.
- Load distribution between front and rear axles shall be as following:
- (a) For FWD vehicles
- Front axle load: (56 ± 7) per cent of total vehicle load.
- Rear axle load: (44 ± 7) per cent of total vehicle load.
- (b) For AWD/RWD vehicles
- Front axle load: (50 ± 7) per cent of total vehicle load.
- Rear axle load: (50 ± 7) per cent of total vehicle load.
- Ballasting allowing to reach ~~above the~~ loads **specified above** is authorized, as long as it does not exceed 85 per cent of the vehicle maximum payload. A minimum ballast of **112.5 kg, representing** 1.5 passengers including driver, shall be included.
- 1.6.13. Circuit, acceleration, and speed requirements
- The circuit shall be a closed loop. Vehicles shall return to the departure point without being transported on a car carrier.
- 1.6.13.1. Circuit minimum length

The circuit shall be made of one or several closed loops. Vehicles shall return to the departure point. The minimum length shall be 30250 km of different roads. Vehicle shall not be transported on a car carrier, except in the case of vehicle/tyre failure.

1.6.13.2. Driving style distribution

The circuit shall respect the following distribution of acceleration/distance for each one of the represented driving styles:

- (a) Roads representative of highway-like driving style:
 - (i) more than 35 per cent of the total distance;
 - (ii) The longitudinal acceleration standard deviation shall be in range from 0.10 m/s^2 to 0.45 m/s^2 ;
 - (iii) The lateral acceleration standard deviation shall be in range from 0.15 m/s^2 to 1.00 m/s^2 .
- (b) Roads representative of urban-like driving style:
 - (i) more than 25 per cent of the total distance;
 - (ii) The longitudinal acceleration standard deviation shall be in range from 0.45 m/s^2 to 0.90 m/s^2 ;
 - (iii) The lateral acceleration standard deviation shall be in range from 0.40 m/s^2 to 1.20 m/s^2 .
- (c) Roads representative of regional-like driving style corresponds to the data points not lying in one of the clusters defined in (a) and (b) of this paragraph;
- (d) In addition, the speed distribution for the circuit shall respect the following conditions:
 - (i) The speed shall be lower-less than 60 km/h for at least 10 per cent of the global distance;
 - (ii) The speed shall be equal to or higher-greater than 60 km/h and lower-less than 90 km/h for at least 25 per cent of the global distance;
 - (iii) The speed shall be equal to or higher-greater than 90 km/h for at least 35 per cent of the global distance.

The calculation of the speed distribution shall be carried out using the 10 Hz data recorded on the global distance.

1.6.13.3. Global accelerations level

The following provisions regarding the deceleration standard deviation and maximum values shall apply:

1.6.13.3.1. Standard deviation

The standard deviation of longitudinal and lateral accelerations at the end of the test for the reference vehicle and for each candidate vehicle shall meet the following requirements:

- (a) Longitudinal acceleration: $0.45 \text{ m/s}^2 \pm 10$ per cent;
- (b) Lateral acceleration: $0.93 \text{ m/s}^2 \pm 10$ per cent.

In addition, the standard deviations of longitudinal and lateral accelerations at the end of the test shall not deviate by more than 5 per cent from those

~~for the reference vehicle from one vehicle to another vehicle~~ of the same convoy.

1.6.13.3.2. Maximum acceleration

The maximum longitudinal and lateral accelerations at the end of the test for the reference vehicle and for each candidate vehicle shall meet the following requirements:

- (a) Longitudinal acceleration: $\pm 5 \text{ m/s}^2$ for a distance representing at least 99.98 per cent of the total distance;
- (b) Lateral acceleration: $\pm 5 \text{ m/s}^2$ for a distance representing at least 99.9 per cent of the total distance.

1.6.14. Speed requirements

Speed, with a measurement tolerance of 10 km/h, shall not exceed the applicable legal limits applying in the respective country where the circuit is located. Additionally, the speed shall not exceed the value of 140 km/h. The maximum tolerance in distance travelled (including measuring tolerance of 10 km/h) is 0.5 per cent (40 km in total for 8000 km driving distance).

1.6.15. Acceleration and speed monitoring during the test

Acceleration and speed shall be constantly monitored during the test for each car in the convoy.

Details regarding acceleration and speed calculation are provided in Appendix 1 of this Annex.

1.6.16. Circuit abrasion level

To be usable for tests, the circuit shall respect the following abrasion level specifications for reference tyres:

- (a) SRTT17S: the circuit abrasion level at 20 °C shall be in the range from 25 to 75 mg/(km·t);
- (b) SRTT17W: the circuit abrasion level at 10 °C shall be in the range from 25 to 75 mg/(km·t).

If a circuit uses only one of the reference tyres (e.g. only the SRTT17S), only one of the conditions shall be respected, **this being** the one for the reference tyre which is used on the circuit.

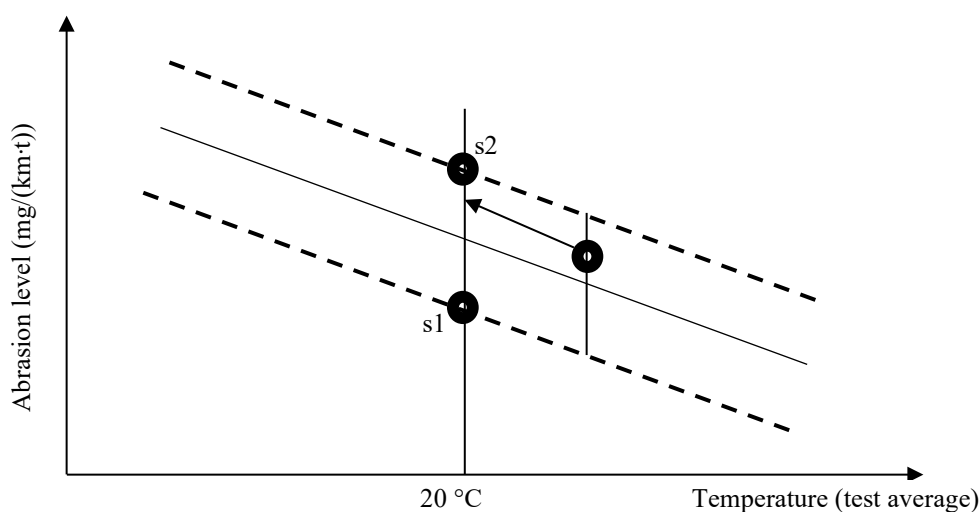


Figure 1: The normalised to 20°C abrasion level of the test shall be within s1 and s2.

- The calculation of the circuit abrasion level shall be made according to paragraph 1.6.16.1. ~~of this Annex.~~
- 1.6.16.1. The following provisions apply for the measurement of the abrasion level of the reference tyre:
- (a) At least one reference tyre (SRTT17S or SRTT17W) shall be selected.
 - (b) -The reference tyre shall be measured at least at 3 different temperatures differing from each other by more than 5 °C;
 - (bc) The value of abrasion level for reference tyres at 20 °C (SRTT17S) or 10°C (SRTT17W) shall be given by a linear regression;
 - (ed) For SRTT17S, at least one measurement shall be done between 15 and 25 °C;
 - (de) For SRTT17W, at least one measurement shall be done between 5 and 15 °C.

For each of the (at least) 3 sets of reference tyres tested, the $ALRT_i$ abrasion level in mg/(km·t) at a temperature T_i is available.

Calculation shall be updated each quarter using the results of all performed tests from the previous 4 quarters, starting one year after the circuit's initial accreditation. Update of slopes and offset at origin may only be performed if the range of temperature covers the provisions of this paragraph.

The sensitivity of SRTT17S and SRTT17W to temperature variation during the test (" S_S " and " S_W ") (i.e. the slope of the regression line of the reference tyre abrasion level to the average test temperature) ~~is~~ **shall be** calculated by means of the following equation:

$$S_S = \frac{\sum_{i=1}^n (ALRT_i - \overline{ALRT}) \times (T_i - \bar{T})}{\sum_{i=1}^n (T_i - \bar{T})^2} \quad \text{for SRTT17S}$$

$$S_W = \frac{\sum_{i=1}^n (ALRT_i - \overline{ALRT}) \times (T_i - \bar{T})}{\sum_{i=1}^n (T_i - \bar{T})^2} \quad \text{for SRTT17W}$$

The offsets of the regression lines of the reference tyre abrasion level to the average test temperature during the test ~~are~~ **shall be** calculated by means of the following equations:

$$O_S = \overline{ALRT} - S_S \cdot \bar{T} \quad \text{for SRTT17S}$$

$$O_W = \overline{ALRT} - S_W \cdot \bar{T} \quad \text{for SRTT17W}$$

The circuit abrasion levels at the relevant temperatures ~~are~~ **shall be** calculated by means of the following equations:

$$R_{ACS} = O_S + S_S \cdot 20 \quad \text{for SRTT17S}$$

$$R_{ACW} = O_W + S_W \cdot 10 \quad \text{for SRTT17W}$$

Where:

- S is the slope of the regression line of the reference tyre abrasion level to the temperatures during the tests;
- $ALRT_i$ is the abrasion level of reference tyre at test conditions in mg/(km·t);
- \overline{ALRT} is the average abrasion level of the n reference tyre tests at three temperatures in mg/(km·t);
- T_i is the average temperature of the test in °C;
- \bar{T} is the average temperature of the n tests in °C.
- n is the number of tests performed.

-
- If the circuit is utilized for both SRTT17S and SRTT17W, the S calculation shall be done for each reference tyre, giving S_S and S_W values.
- 1.7. Weather and climate conditions requirements
- 1.7.1. When testing tyres against SRTT17S according to the table in paragraph 1.8. of this Annex, the following weather and climate conditions shall be respected:
- (a) The average **ambient** temperature during the test shall be within the following range: from ~~107~~ °C to 35 °C. **However, for tyres designed for maximum speed greater than or equal to 300 km/h, the minimal average ambient temperature during the test shall be greater than or equal to 12 °C;**
 - (b) The minimum and maximum **ambient** temperature during the test shall be within the following range: from ~~52~~ °C to 40 °C for at least 90 per cent of ~~the~~ test distance. **However, for tyres designed for maximum speed greater than or equal to 300 km/h, the minimal ambient temperature for at least 90 per cent of test distance during the test shall be greater than or equal to 7 °C;**
 - (c) No driving under snow or ice conditions ~~is-shall be~~ allowed;
 - (d) The maximum allowed percentage of the total distance driven under wet conditions ~~is-shall be~~ 20 per cent.
- 1.7.2. When testing tyres against SRTT17W according to the table in paragraph 1.8. of this Annex, the following weather and climate conditions shall be respected:
- 1.7.2.1. Tyres for use in severe snow conditions
- (a) The average temperature during the test shall be within the following range: from -3 °C to ~~1720~~ °C;
 - (b) The minimum and maximum temperature during the test shall be within the following range: from -7 °C to ~~2225~~ °C for at least 90 per cent of ~~the~~ test distance;
 - (c) No driving under snow or ice conditions ~~is-shall be~~ allowed for more than 5 per cent of the total distance driven;
 - (d) The maximum allowed percentage of the total distance driven under wet conditions is 20 per cent.
- 1.7.2.2. Tyres not for use in severe snow conditions
- (a) The average temperature during the test shall be within the following range: from -3 °C to 35 °C;
 - (b) The minimum and maximum temperature during the test shall be within the following range: from -7 °C to 40 °C for at least 90 per cent of ~~the~~ test distance;
 - (c) No driving under snow or ice conditions ~~shall be is~~ allowed for more than 5 per cent of the total distance driven;
 - (d) The maximum allowed percentage of the total distance driven under wet conditions is 20 per cent.
- 1.7.3. Weather data recording
- 1.7.3.1. Wet distance measurement
- The wet distance, expressed as a per cent of the distance travelled, corresponds to the distance travelled with wipers on. ~~These~~ **This** can be manually collected on one vehicle of the convoy. Alternatively, data can be collected from vehicle

information (e.g. CAN bus -Controller Area Network- or OBD - On-Board Diagnostics-) when available.

1.7.3.2. Average **ambient** temperature

For the calculation of the average temperature, a minimum ~~5~~ of **5** measurements per shift on the circuit shall be carried out. The measurements shall include **the** starting and arrival points. Furthermore, the temperature at the highest altitude reached on the circuit shall be measured. Measurements shall be made ~~on~~ **from** at least one vehicle of the convoy.

The average temperature of the circuit shall be calculated as the average of all the measured temperatures of all 5 points **at the end of the test**.

At least at **the** starting and arrival points, the measurement shall be done with a fixed device respecting ~~requested~~ **the** accuracy **specified in paragraph 1.4.7**. The temperature sensor shall be positioned outside in an unobstructed location, exposed to the airflow, and protected from direct solar radiation. The latter may be achieved by any shading screen or similar device.

For measurements on the road, a weather station installed in the vehicle with external temperature sensor may be used. Continuous temperature measurement throughout the test is acceptable. In this case, average, minimum, and maximum measurement should be reported for the full test. The ~~10~~ first **10** minutes after departure and after each driver's break shall be discarded from the minimum, maximum, and average calculation. Both time-based and distance-based average for temperature are acceptable.

1.8. Standard Reference Test Tyre requirements

For the evaluation of the abrasion performance of the candidate tyre using the vehicle test method on public open roads, the reference tyre shall be selected according to the following table:

		<i>Reference tyre</i>	
<i>Category of use of the candidate tyre</i>		<i>SRTT17S</i>	<i>SRTT17W</i>
Normal tyre		X	
Snow tyre			X
	Snow tyre that is classified as tyre for use in severe snow conditions		X
Special use tyre		X	
	Marked with "M+S" or "M.S" or "M&S"		X
	Special use tyre that is classified as tyre for use in severe snow conditions		X

Reference tyres SRTT17S and SRTT17W shall be stored in condition recommended in ASTM F3676-23 and ASTM F3675-23 respectively.

1.9. Preparation and adjustments with respect to tyres

1.9.1. Tyre fitment on rim and vehicle

New candidate tyres shall be mounted and balanced on a rim permitted by the tyre manufacturer.

~~New Reference tyres~~ **Each new reference tyre** for each test shall be fitted on a **rim of rim width code 7.5** ~~7.5 Rim width code rim~~.

The rim width code of a candidate tyre shall be reported in the test report. Tyres with special fitment requirements, such as asymmetric or directional design, shall also be mounted in accordance with these requirements: the direction of

-
- rotation shall be respected and the side of the tyre intended to face **the outside of the** vehicle ~~outside~~ shall be positioned appropriately.
- 1.9.2. Tyre ~~weight~~**mass** measurement (without rim)
- The tyre ~~weight~~**mass** measurement shall be done following the procedure described in paragraph 1.5.1. of this Annex.
- No rubber (e.g. mould vents) shall be removed from any tyre (test or reference).
- Each tyre ~~weight~~**mass** shall be measured:
- (a) Before being fitted on the wheel, to get the initial tyre mass (*MRTSi*) for reference tyres and (*MCTSi*) for candidate tyres;
 - (b) After completing the test and dismounting the tyre from the tyre wheel assembly, to get the final tyre masses (*MRTFi*) for reference tyres and (*MCTFi*) for candidate tyres.
- 1.9.3. Tyre and wheel assembly mass measurement
- The tyre and wheel assembly mass measurement shall be done following the procedure described in paragraph 1.5.2. of this Annex.
- Intermediate measurements of tyre and wheel mass assembly are optional.
- 1.9.4. Tyre inflation pressure
- The inflation pressure of the reference tyres shall be 290 kPa.
- Candidate tyres shall be inflated (cold) at their nominal pressure determined by the standard they ~~belong~~**conform** to. More specifically:
- (a) For standard load tyres the pressure shall be 250 kPa;
 - (b) For reinforced tyres or extra load tyres the pressure shall be 290 kPa;
 - (c) The nominal pressure for nominal load as determined by the relevant standard **they conform to**, if different from (a) and (b).
- 1.10. Preparation and adjustments with respect to vehicles
- Vehicles for candidate and reference tyres shall be selected following the ~~constraints of requirements set out in~~ paragraph 1.6. **of this Annex**.
- 1.10.1. Vehicle mass measurement
- The vehicle mass measurement shall be done following the procedure described in paragraph 1.5.3. of this Annex. ~~The vehicle shall be ballasted following the specifications described in paragraph 1.6.12. of this Annex.~~
- Measurements of each tyre load Q for reference and candidate vehicles ~~are required~~**shall be performed**.
- 1.10.2. Vehicle tuning
- Vehicle alignments ~~to~~**shall** be tuned following the provisions specified in paragraphs 1.6.2. to 1.6.6. of this Annex.
- 1.11. Test method and measurements
- 1.11.1. General
- The tyre abrasion test shall be run on open roads. A maximum of 4 vehicles are allowed in a convoy. The vehicles shall drive approximately 8000 km along selected circuits with a given driving severity with the aim of exposing each candidate tyre to the same conditions (e.g. severity, drivers, position in convoy, weather).

The tyres are evaluated relatively to a reference tyre. The reference tyre shall be fitted on one convoy's vehicle in order to ~~absorb mainly~~ **minimize the influence of** temperature variation, ~~but as well as~~ other varying parameters ~~as well~~.

A candidate vehicle shall be fitted with the same candidate tyres.

The measured performance shall be calculated according to paragraph 1.11.13. of this Annex.

1.11.2. Test total distance

The total distance driven by each vehicle in the convoy shall be 8000 **km** ± 300 km. Any total distance outside these boundaries shall invalidate the test.

1.11.3. Convoy composition and management

The convoy shall be homogeneous regarding the following vehicle parameters:

- (a) Number and position of driven wheels (see paragraph 1.6. of this Annex)
 - (i) FWD **vehicles** only in the convoy;
 - (ii) RWD **vehicles** only in the convoy;
 - (iii) AWD **vehicles** ~~(4 permanent driven wheels)~~ only in the convoy.
- (b) Propulsion energy converters (e.g. ~~pure internal combustion engine vehicle (ICE)~~ **vehicles only**, NOVC-~~HEVCs~~ **HEVs** only, OVC-HEVs only, or PEVs only) ~~in the same convoy~~. For hybrid vehicles, the provisions described in paragraph 1.6.7. of this Annex shall apply.

The same model and same settings of vehicles shall be used for both reference tyre and candidate tyre provided that:

- (c) The candidate tyre size can be fitted on the same vehicle model as for the reference tyre;
- (d) Loading and alignment parameters are allowed for candidate tyre.

Regarding the maximal distance between vehicles in the convoy, each driver shall be able to have visual contact with the preceding and following vehicles.

Each vehicle shall drive on the right lane (or left lane for left driving countries) when free.

1.11.4. Vehicle rotation in the convoy and driver rotation on vehicles

Each candidate tyre, including tested and reference tyres, shall run equal parts of the test:

- (a) with ~~all each~~ drivers; **and**
- (b) in ~~all each~~ positions in the convoy.

Changes in drivers and vehicle positions may occur within a tolerance of 10 per cent of the predefined ~~distance in length of~~ the circuit.

1.11.5. Data measured before, during, and after the test

1.11.5.1. ~~Before and after the test:~~

Before and after the test, the following measurements shall be done:

- (a) Mass of each tyre;
- (b) Load on each tyre;
- (c) Vehicle alignments (loaded vehicle);

-
- (d) Tyre pressure after tyre fitment and before dismounting tyres.

1.11.5.2. ~~During the test~~

During the test, the following recordings shall be performed:

- (a) Continuous recordings of parameters needed for the calculation of longitudinal and lateral accelerations on each vehicle;
- (b) Continuous speed measurement on each vehicle;
- (c) Temperature measurement (as specified in paragraph 1.7.3. of this Annex.);
- (d) Tyre pressure each day under cold conditions. By cold conditions it is meant at least 30 minutes after the ~~last stop~~ **vehicle is at rest**. Tyres shall never be deflated;
- (e) Vehicle alignment **of reference vehicle**, in loaded condition, accompanied by correction to initial value if relevant ~~for vehicle used for reference tyres~~. The vehicle alignment measurement shall be carried out ~~4-3~~ times during the test, each at roughly a quarter of the test distance.

At intermediate stops, it is recommended but not compulsory to measure:

- (f) Tyre and ~~Wheel-wheel~~ assembly mass;
- (g) Vehicle alignment **of candidate vehicles**, in loaded condition, accompanied by correction to initial value if relevant ~~for vehicle used for candidate tyres~~.

1.11.6. Data processing for average temperature

Temperature measurement during the test:

Temperature shall be measured according to paragraph 1.7.3.

1.11.7. Data processing for test longitudinal and lateral accelerations standard deviation

During each shift, a continuous evaluation of speed, lateral, and longitudinal accelerations shall be carried out. A minimum sampling rate of 10 Hz is recommended. Most common technology is GNSS (~~global~~ **Global** Navigation Satellite System) measurement associated with numerical treatment of the positions.

Acceleration data processing is defined in Appendix 1 of this Annex.

1.11.8. Test validation

The test is considered valid when the following conditions are met:

- (a) Temperatures: minimum, maximum, and average temperatures as calculated in paragraph 1.11.6. of this Annex shall respect specifications defined in paragraph 1.7. of this Annex;
- (b) Accelerations: lateral and longitudinal acceleration shall respect maximum and standard deviation values as calculated in paragraph 1.11.7. of this Annex and shall respect the specifications defined in paragraph 1.6.13.3. of this Annex;
- (c) If more than ~~1500-600~~ km GNSS acceleration data are missing for the candidate tyre, the test for this candidate tyre ~~shall be~~ **is** invalid;
- (d) If more than ~~1500-600~~ km GNSS acceleration data are missing for the reference tyre, the whole test ~~shall be~~ **is** invalid;

-
- (e) Vehicle alignments at the beginning and end of test shall respect the specifications defined in paragraph 1.6. of this Annex;
 - (f) For candidate tyres of category of use snow tyres and special use tyres marked "M+S", ~~either-whether~~ or not classified as tyres for use in severe snow conditions, the abrasion level of the SRTT17W normalized at 10 °C (ALRT₁₀) shall be in the range defined in paragraph 1.6.16. of this Annex;
 - (g) For other candidate tyres, the abrasion level of the SRTT17S normalized at 20 °C (ALRT₂₀) shall be in the range defined in paragraph 1.6.16. of this Annex;
 - (h) A visual inspection of the reference tyres shall show no damage. The tyre sidewall marking shall still be readable. If a reference tyre ~~was losingloses~~ more than 1 cm² of tread chunking area, the tyre shall be considered as destroyed, and ~~the process for tyre-~~destroyed ~~tyresprocess~~ as described in paragraph 1.11.11. of this Annex shall apply.

1.11.9. Deviation from nominal circuit

The circuit is considered valid when the following provisions are met altogether:

- (a) The circuit is modified by less than 10 km for the full test or if it is modified by more than 10 km and less than 30 km, for less than 8 shifts;
- (b) The total driven distance remains ~~in the~~within (8000 ± 300) km;
- (c) The abrasion level of reference tyre at 20 °C or 10 °C as applicable is within the ranges specified in paragraph 1.6.16. of this Annex;
- (d) The acceleration limits are within the ranges specified in paragraphs 1.6.13.2. and 1.6.13.3. of this Annex.

When all provisions are met the circuit ~~shall be~~is considered valid and the distance considered for calculation ~~has to~~shall be corrected accordingly.

Accidental deviation(s) are acceptable if representing less than 20 per cent of ~~the~~ circuit distance or less than 100 km (whichever is lower), under the condition that the reference tyre abrasion level at 20 °C or 10 °C, as applicable, stays in authorized limits and acceleration standard deviations are respected.

In all other cases, the test is considered not valid and the circuit ~~has to~~shall be revalidated.

1.11.10. Vehicle trouble handling

The following provisions apply in ~~the~~ case of ~~vehicle~~-damages ~~to vehicles~~ in the convoy:

- (a) If a vehicle used in the convoy is damaged and cannot be used anymore (e.g. major mechanical failure or accident), it shall be replaced by an identical vehicle that shall be identically loaded and tuned. The replacement vehicle, equipped with the same tyres having started the test, shall run the distance lost due to vehicle failure on the lost segment of the circuit alone without the other vehicles of the convoy;
- (b) If a vehicle used in the convoy is broken down and can be repaired, the lost distance shall be run without other convoy vehicles on the lost segment of the test circuit;
- (c) If the failure occurs on a candidate vehicle and not on the reference vehicle, the convoy may continue the test and the failing vehicle/tyre

shall be withdrawn from the convoy. A new set of candidate tyres shall then be used for a new test, starting from scratch.

1.11.11. Tyre trouble handling

The following provisions apply in **the** case of tyre damages in the convoy:

- (a) If a tyre used during the test on the reference vehicle or one of the candidate vehicles is damaged by a reparable puncture and if the tyre can be repaired without running without pressure, the added repair mass shall be recorded and taken into account in the final calculation. The use of a spare tyre is permitted for a maximum distance of one loop or maximum **of** 7.5 per cent of the test distance. The mileage run with the spare tyre shall be recorded and taken into account for the tyre abrasion level;
- (b) If a tyre used during the test is destroyed (or **has a** non-reparable puncture or **is** run without pressure), the mass loss of the other tyre tested on the same axle **shall be** used twice to perform the final calculation. The spare tyre used to replace the destroyed tyre should have the same size and same pattern as the replaced tyre.

1.11.12. GNSS trouble handling

If the speed and acceleration recording for one vehicle ~~for during~~ one shift failed for more than 5 per cent of the circuit distance (because of missing ~~satellites signals~~ **satellite signals** or device failure), the missing data shall be replaced with one of the other vehicles (preferably the reference vehicle) of the same convoy of the same shift, if valid.

1.11.13. Data processing for abrasion level calculation.

1.11.13.1. Reference tyre abrasion level at average test temperature ($mg/(km \cdot t)$)

The average abrasion level at test average temperature of the reference tyre during the test is calculated as following:

$$ALRT = \frac{1000 * \sum_{i=1}^n (MRTS_i - MRTF_i) / D_{Ri}}{\sum_{i=1}^n Q_{Ri} / 1000}$$

Where:

$ALRT$ is the abrasion level of the reference tyre at test average temperature in $mg/(km \cdot t)$;

$MRTS_i$ is the mass of the reference tyre at the beginning of the test in g;

$MRTF_i$ is the mass of the reference tyre at the end of the test in g;

D_{Ri} is the total distance of the reference vehicle in km;

Q_{Ri} is the test load of the reference tyre in kg;

~~n~~ is the number of **reference** tyres.

1.11.13.2. SRTT17S abrasion level calculation at 20 °C

~~Apply to~~ The temperature correction determined in paragraph 1.6.16.1. of this Annex **shall be applied** to the normal reference tyre abrasion level as follows:

$$ALRT_{20} = ALRT + S_s \cdot (20 - \bar{T})$$

where \bar{T} is the average temperature of the test

1.11.13.3. SRTT17W abrasion level calculation at 10 °C

~~Apply to~~ The temperature correction determined in paragraph 1.6.16.1. of this Annex **shall be applied** to the Winter reference tyre abrasion level as follows:

$$ALRT_{10} = ALRT + S_W \cdot (10 - \bar{T})$$

where \bar{T} the average temperature of the test

1.11.13.4. Candidate tyre abrasion level at average test temperature in mg/(km·t)

The average abrasion level at test average temperature of the candidate tyre during the test shall be calculated as following:

$$ALCT = \frac{1000 * \sum_{i=1}^n (MCTS_i - MCTF_i) / D_{Ci}}{\sum_{i=1}^n Q_{Ci} / 1000}$$

Where:

$ALCT$ is the abrasion level of the candidate tyre at test average temperature in mg/(km·t);

$MCTS_i$ is the mass of the candidate tyre at the beginning of the test in g;

$MCTF_i$ is the mass of the candidate tyre at the end of the test in g;

D_{Ci} is the total distance of the candidate vehicle in km;

Q_{Ci} is the test load of the candidate tyre in kg;

n is the number of candidate tyres.

1.11.13.5. The abrasion index of the candidate tyre shall be calculated from the following equation:

$$AICT = \frac{ALCT}{ALRT} - A_{\text{margin}}$$

Where:

$AICT$ is the abrasion index of the candidate tyre;

$ALCT$ is the abrasion level of the candidate tyre, in mg/(km·t);

$ALRT$ is the abrasion level of the reference tyre, in mg/(km·t);

A_{margin} is the dimensionless abrasion margin, which accounts for the complexities of the abrasion level measurement methods, and is equal to [0.20]. the special abrasion characteristics of specific tyre groups as indicated below. A_{margin} is defined in two steps that account for the evolution of abrasion level measurement methods and tyre technology, as given in the following table:

	Stage 1	Stage 2
A_{margin} by tyre category of use		
Normal	[0.20]	[0.15]
Snow	[0.20]	[0.15]
Special use	[Not defined]	[Not defined]
A_{margin} allowances for specific tyre groups (to be incorporated into A_{margin})		
Tyre for use in severe snow conditions (3PMSF)	[+0.10]	[+0.10]
Reinforced or extra load tyre (XL)	[+0.10]	[+]
Tyres with a nominal aspect ratio ≤ 40 and suitable for speeds ≥ 300 km/h	[+0.10]	[+]
[Tyres with low load index (LI < 77)]	[+0.10]	[+]

~~Note: A_{margin} allowances for specific tyre groups are cumulative. E.g., if a candidate tyre is a reinforced snow tyre for use in severe snow conditions, the applicable A_{margin} shall be $0.2 + 0.1 + 0.1 = 0.4$.~~

- 1.12. Test report
- 1.12.1. The test report shall include the following information:
 - (a) Average, minimum, and maximum **ambient** temperature during the test;
 - (b) Percentage of distance covered on wet roads;
 - (c) Reference of the circuit used for the test, including the circuit length, driving style distribution, and location;
 - (d) Total deviation distance to the nominal distance in km;
 - (e) Start and end dates of the test;
 - (f) A_{margin} applied, with indication of any allowances incorporated therein.
- 1.12.2. For each reference tyre, the following information shall be reported:
 - (a) Model of vehicle used for reference tyre;
 - (b) Tyre data, including manufacturer, brand name, trade name, size, LI and load capacity, speed-**category** symbol, reference pressure, and serial number of the tyres;
 - (c) Vehicle tuning at the beginning of the test (Front axle ~~TOE-toe~~ and camber, rear axle ~~TOE-toe~~ and camber), in loaded condition;
 - (d) Vehicle tuning at each intermediate measurement of the test (Front axle ~~TOE-toe~~ and camber, rear axle ~~TOE-toe~~ and camber), in loaded condition;
 - (e) Vehicle tuning at the end of the test (Front axle ~~TOE-toe~~ and camber, rear axle ~~TOE-toe~~ and camber), in loaded condition;
 - (f) Rim width code (7.5);
 - (g) Cold inflation pressure at the fitment;
 - (h) Cold inflation pressure at 50 per cent of the test;
 - (i) Cold inflation pressure at the end to the test;
 - (j) Balancing mass at the beginning of the test;
 - (k) Balancing mass at the end of the test;
 - (l) Initial tyre mass (~~MRTS_i~~ **MRTS_i**) for each reference tyre;
 - (m) Final tyre mass (~~MRTF_i~~ **MRTF_i**) for each reference tyre;
 - (n) Abrasion level in mg/(km·t) normalized at 20 °C or 10 °C as applicable;
 - (o) Distance run for each reference tyre;
 - (p) Standard deviation of longitudinal acceleration for the vehicle fitted with reference tyre;
 - (q) Standard deviation of lateral acceleration for the vehicle fitted with reference tyre;
 - (r) Percentage of distance covered over the maximum longitudinal acceleration for the vehicle fitted with reference tyre;
 - (s) Percentage of distance covered over the maximum lateral acceleration for the vehicle fitted with reference tyre;

-
- (t) Percentage of time travelled over each speed range (i.e. urban-like, regional-like, and highway-like);
- (u) Measured tyre load for each reference tyre;
- (v) Reference tyres visual inspection report.
- 1.12.3. For each candidate tyre, the following information shall be reported:
- (a) Model of vehicle used for candidate tyre;
- (b) Tyre data, including manufacturer, brand name, trade name, size, LI and load capacity, speed-category symbol, reference pressure, and serial number of the tyre;
- (c) Vehicle tuning at the beginning of the test (Front axle ~~TOE~~-toe and camber, rear axle ~~TOE~~-toe and camber) in loaded condition;
- (d) Vehicle tuning at the end of the test (Front axle ~~TOE~~-toe and camber, rear axle ~~TOE~~-toe and camber) in loaded condition;
- (e) Rim width code;
- (f) Cold inflation pressure at the fitment;
- (g) Cold inflation pressure at 50 per cent of the test;
- (h) Cold inflation pressure at the end to the test;
- (i) Balancing mass at the beginning of the test;
- (j) Balancing mass at the end of the test;
- (k) Initial tyre mass (*MCTSi*) for each candidate tyre;
- (l) Final tyre mass (*MCTFi*) for each candidate tyre;
- (m) Measured tyre load for each candidate tyre;
- (n) Distance run for each candidate tyre;
- (o) Standard deviation of longitudinal acceleration for the vehicle fitted with candidate tyre;
- (p) Standard deviation of lateral acceleration for the vehicle fitted with candidate tyre;
- (q) Percentage of distance covered under the maximum longitudinal acceleration for the vehicle fitted with candidate tyre;
- (r) Percentage of distance covered under the maximum lateral acceleration for the vehicle fitted with candidate tyre;
- (s) Percentage of time travelled over each speed range (i.e. urban-like, regional-like, and highway-like).
- 1.12.4. Final test results
- (a) The measured result of abrasion level ALRT for the reference tyre during the test at average test temperature as described in paragraph 1.11. of this Annex;
- (b) The measured result of abrasion level ALCT for the candidate tyre during the test at average test temperature as described in paragraph 1.11. of this Annex;
- (c) The final result tyre abrasion index AICT as described in ~~paragraph 1.11.~~ paragraph 1.11. of this Annex.

2. Test method (b) using indoor drum

2.1. This method applies to class C1 tyres in scope of this regulation.

2.2. Definitions and Terms

In addition to relevant definitions provided in Paragraph 2 of this Regulation the following definitions **shall** apply to the indoor drum method.

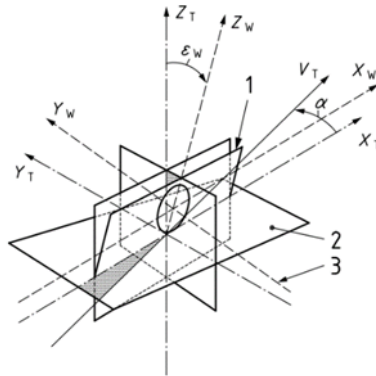
2.2.1. "Tyre abrasion" means tyre wear that is observed as the loss of tyre mass during usage.

2.2.2. "Mass loss" means the amount of the mass, expressed in grams, lost due to tyre abrasion.

2.2.3. "Mean profile depth" is used for the characterization of the surface roughness in macroscale and is described in ISO 13473-1.

2.2.4. "Micro-roughness" means the surface roughness characterized in microscale and is measured by altered filtering conditions as defined in ISO 13473-1.

~~2.2.5. "Tyre coordinate system" is tyre coordinate system specified in ISO 8855.~~



2.2.65. "Vertical load" means the tyre normal force of a tyre exerted on the road resulting from the mass supported by the tyre. Tyre normal force is specified in ISO 8855.

2.2.76. "Lateral force" means the force of a tyre generated in lateral direction during cornering. Tyre lateral force is specified in ISO 8855. It takes a positive sign when turning left and a negative sign when turning right.

2.2.87. "Longitudinal force" means the force of a tyre generated in the longitudinal direction during acceleration or braking. Tyre longitudinal force is specified in ISO 8855. It takes a positive sign for speed increase and a negative sign for speed decrease (e.g. braking).

2.2.98. "Loaded radius" means the distance from the tyre axis to the drum outer surface under steady-state conditions at 0 speed and 0 camber as well while the test load and inflation pressure is applied at room temperature and refer to the thermal conditioning of Paragraph 2.6.2. of this Annex.

2.2.109. "Tyre torque" means the moment ~~on~~ **applied to the** tyre rotation axle.

2.2.110. "Load index" means **a** numerical code associated with the maximum load **that** a tyre can carry at the speed indicated by its speed-**category** symbol under the service conditions specified by the tyre manufacturer.

2.3. Symbols and Abbreviated terms

In addition to relevant symbols and abbreviated terms provided in Paragraph 1.3. of ~~Annex 3 of this Regulation~~ **this Annex**, the following symbols and abbreviated terms apply to the indoor drum method.

<i>Symbol</i>	<i>Unit</i>	<i>Designation</i>
T	No dimension	Candidate tyre
R	No dimension	Reference tyre
Fz	N	Vertical load
Fy	N	Lateral force
Fx	N	Longitudinal force
r _L	m	Loaded radius
M _y	Nm	Tyre torque
LI	No dimension	Load Index
MPD	mm	Mean Profile Depth

2.4. Test Method

2.4.1. General

This test method evaluates the mass loss of the candidate tyre relative to the reference tyre.

In measuring tyre abrasion per distance travelled, it is necessary to control normal load, lateral force, and longitudinal force applied to a test tyre.

This test method uses a tyre abrasion test equipment with a cylindrical flywheel (drum) with an abrasive test surface on the external surface of the drum.

2.4.2. ~~Drum~~ Tyre Abrasion Test Machine Specifications

2.4.2.1. Tyre Abrasion Test Equipment

Tyre abrasion test equipment shall consist of a drum, a tyre carriage device, a loading device, and adhesion prevention system. There can be one or two carriage devices.

2.4.2.2. Drum ~~Diameter~~ Specification

The tyre abrasion test machine shall have a cylindrical flywheel (drum) built with a rigid and non-deformable material with an external diameter of at least 3-3 m. ~~[The drum circumference shall be measured over test surface segments.]~~

2.4.2.3. Test Surface

The test surface shall be applied to external surface of the cylindrical drum. The test surface of drum shall meet the following minimum requirements:

- The test surface of the drum shall have a MPD measured at the start and the end of the drum test not exceeding 2,0-2.0 mm, according to ISO 13473-1;
- The test surface of the drum shall have a micro-roughness measured at the start and end of the drum test within the range from 0.07 mm to 0.4 mm. The measuring method of MPD described in ISO 13473-1 shall apply to the measurement of micro-roughness, except for sampling interval, resampling, high-pass and low-pass filtering, and segment length. The sampling interval shall not be more than 0.033 mm, and samples shall be taken at a fixed interval in the horizontal direction. ~~Re-sample the~~ The signal shall be re-sampled to either 0.017 mm (preferably) or 0.033 mm spacing. For high-pass and low-pass filtering, the filters shall be of the Butterworth type, 2nd order, and shall have a

cut-off at 3.0 mm and 0.1 mm texture wavelength, respectively. The segment length shall be $3.33 \text{ mm} \pm 0.33 \text{ mm}$;

- (c) The test surface ~~of the drum~~ shall be textured with sands, stones, or an alternative material, e.g., aluminium oxide resin;

~~(d) The drum surface shall be built with rigid and not deformable material;~~

- (ed) The test surface, including voids, shall be dry and clean during the entire measurement procedure ~~and for all measurements~~;

- (fe) The device for measurement of the MPD ~~shall~~ must fulfil the specifications of ISO 13473-3. The device for measurement of micro-roughness ~~shall~~ must fulfil the specifications of ISO 13473-3, except for horizontal resolution, which shall not be more than 0.033 mm.

The abrasion level of the SRTT17S reference tyre for all types of surface shall be in the range between ~~50-45~~ mg/(km·t) and 190 mg/(km·t).

The abrasion level of the SRTT17W reference tyre for all types of surface shall be in the range between 35 mg/(km·t) and 165 mg/(km·t). The abrasion level shall be calculated according to the method in paragraph 2.8. of this Annex. In ~~the case of that~~ sandpaper ~~is~~ used for ~~the~~ surface it shall be replaced as specified in Appendix 5 ~~of this Annex~~.

When the drum surface no longer satisfies the conditions ~~of the previous period set out above~~, the surface shall be replaced. Intermediate inspection of the abrasion rate for the reference tyre is recommended.

2.4.2.4. Width

The width of the test surface shall always exceed the width of the test tyre contact patch throughout ~~the~~ entire test duration.

2.4.3. Tyre Carriage and Drive System

The tyre carriage and drive system shall be able to provide dynamic control of:

- (a) ~~tyre~~-Tyre lateral force developed by the drag force produced by tyre slip angle during running;
- (b) Longitudinal tyre force or torque developed by tractive force by the tyre during braking and accelerating.

The maximum allowed deviation from the nominal value of load (F_z), lateral force (F_y), longitudinal force (F_x), and tyre torque (M_y) during testing is defined as follows:

- (c) F_z : $\pm 50 \text{ N}$ or 1 per cent whichever is greater;
- (d) F_y : $\pm 100 \text{ N}$ or 5 per cent whichever is greater, for the difference between input peaks and actually generated peaks;
- (e) F_x : $\pm 100 \text{ N}$ or 5 per cent whichever is greater, for the difference between input peaks and actually generated peaks;
- (f) M_y : $\pm 40 \text{ Nm}$ or 5 per cent whichever is greater, for the difference between input peaks and actually generated peaks.

2.4.4. Adhesion Prevention System

2.4.4.1. Powder Distribution

The tread abrasion test equipment shall have a powder distribution system to spray a controlled volume of either talc or silica. Mixture of talc and silica is not allowed. The ~~typical~~ powder particle ~~typical~~ size can range from ~~0,10.1~~ μm to 100 μm .

The powder distribution system shall spray on the test surface near the test tyre contact patch so that abrasion fragments do not adhere to the tyre or test drum surface. ~~Powder~~ The powder distribution system and materials shall be identical for both reference tyre and candidate tyre during a test and shall remain constant during the entire test. The powder delivery rate (measured by mass per time) applied to the reference and candidate tyres shall be the same, with a maximum ± 2 per cent difference for each test and be in the range of 40 g/h to 200 g/h for each test tyre.

The powder delivery rate for each test cycle shall be controlled within ± 5 per cent of the average powder delivery rate for each test. This applies to both reference tyre and candidate tyre.

2.4.4.2. Nozzle Position

The nozzle position for the powder distribution system shall follow at least one of the following specifications:

- (a) Blow-in type: In a blow-in type system, powder is blown directly to the contact patch through nozzles. In the case of only one nozzle, the centre of the nozzle shall be positioned in symmetrical plane ($X = 0$). The distance from the nozzles to the centre of the contact patch shall not exceed 35 cm.

In the case of multiple nozzles, they shall be placed parallel to the Y axis and symmetrically distributed respective to the X axis. The distance from the centre of the nozzle array to the centre of the contact patch shall not exceed 35 cm. Nozzles shall be oriented towards contact patch entrance.

- (b) Dispersion type: In a dispersion-type system, powder is dispersed in the space around the tyre and the drum, but not blown directly onto the contact patch. The contact patch and the tyre are covered with the enclosure coverings, where powder should be evenly dispersed within the enclosure, so that the powder could be distributed to the contact patch. The nozzle(s) should be placed parallel to the Y axis and symmetrically distributed respective to the X axis.

2.4.5. Load, Alignment, Control and Instrumental Accuracies

Measurement of these parameters listed in Appendix 4 of this Annex shall be sufficiently accurate and precise to provide the required test data. The specific and respective values are provided in Appendix 4 of this Annex.

2.4.6. Mass Scale

The mass scale for test tyres shall have:

- (a) A mass capacity being able to weigh test tyres;
- (b) An accuracy within ± 2 g.

The mass scale shall be duly calibrated following the requirements defined by the manufacturer.

2.4.7. Reference tyre

For the evaluation of the abrasion performance of the candidate tyre using the indoor drum method, the reference tyre shall be selected according to the following table:

		Reference tyre	
Category of use of the candidate tyre		SRTT17S	SRTT17W
Normal tyre		X	
Snow tyre			X
	Snow tyre that is classified as tyre for use in severe snow conditions		X
Special use tyre		X	
	"M+S" or "M.S" or "M&S"		X
	Special use tyre that is classified as tyre for use in severe snow conditions		X

Reference tyres SRTT17S and SRTT17W shall be stored in conditions recommended in ASTM F3676-23 and ASTM F3675-23 respectively.

2.5. Test Conditions

2.5.1. General

The test consists of a measurement of tyre mass loss in which the tyre is inflated to the cold pressure as specified in ~~Paragraph~~ **paragraph 2.5.3.** of this Annex and the inflation pressure shall be allowed to build up (i.e. "capped inflation") and not be regulated by machine.

2.5.2. Test Load

The standard test load F_z on the tyre to be measured shall be calculated from its LI load, corresponding to the maximum mass associated with the LI of the tyre.

The standard test load shall be computed from the values shown in ~~Table 1~~ **the table in paragraph 2.5.3.** and shall be kept within the tolerance specified in Appendix 4 of this Annex.

2.5.3. Tyre Inflation Pressure

The inflation pressure shall be set in accordance with that shown in ~~Table 1~~ **the table below** with the accuracy specified in Appendix 4 of this Annex and shall be capped.

Table 1

Test loads and inflation pressures

Tyre type	Tyre of class C1 ^a	
	Standard load or light load	Reinforced or extra load
Load -% of maximum load capacity	80	80
Inflation pressure ^{b-a} (kPa)	210	250
^a For those class C1 tyres belonging to categories which are not shown in ISO 4000-1:2024, Annex B, the inflation pressure shall be the inflation pressure recommended by the tyre manufacturer, corresponding to the maximum tyre load capacity, reduced by 30 kPa. ^{b-a} The inflation pressure shall be capped with the accuracy specified in Appendix 4 of this Annex.		

2.5.4. Testing Conditions (Longitudinal force, lateral force, test speed, running distance)

The following testing conditions shall be met for a test to be considered valid:

-
- (a) Longitudinal force and lateral force shall be computed from the values shown in Appendix 3 of this Annex. Speed shall be in accordance with that shown in Appendix 3 of this Annex;
- (b) The total running distance of the test shall be 5044 km. The total distance of an actual test shall not differ more than ± 5 per cent from the total input distance;
- (c) The reference tyre shall be mounted on a **rim of rim width code 7.5** ~~Rim-width code rim~~. New candidate tyres shall be mounted on any rim requested and approved by the tyre manufacturer;
- (d) The rim width code of **the** candidate tyre shall be recorded.
- (e) Tyres with special fitment requirements, such as asymmetric or directional design, shall ~~also~~ be mounted in accordance with these requirements: direction of rotation shall be respected;
- (ef) The test shall be performed at ~~null-a~~ camber **angle of 0°**.
- 2.6. Test Procedure
- 2.6.1. General
- The test procedure steps described below shall be followed in the given sequence:
- (a) Both reference and candidate tyres shall be new when starting the test;
- (b) Test tyres with **a** specified direction of rotation shall be rolling in the forward direction;
- (c) The direction of rolling shall be kept the same throughout the test;
- (d) The abrasion level calculation shall use the actual test run distance.
- 2.6.2. Thermal Conditioning
- ~~Inflate~~ The tyre **shall be inflated** to not lower than the test pressure and ~~place~~ **placed** in the thermal environment of the test location ~~between 17 °C and 28 °C~~ for a minimum of 3 h.
- 2.6.3. Pressure Adjustment
- After thermal conditioning, the inflation pressure shall be adjusted to the test pressure.
- 2.6.4. Thermal Environment
- During the test, the ambient temperature shall be kept at ~~25-~~ °C \pm **3-3** °C for normal tyre and ~~20-20~~ °C \pm **3-3** °C for snow tyre. ~~The~~ The ambient temperature shall be measured at a distance of not less than 0.15 m and not more than 1 m from the tyre.
- The average ambient temperature for reference and candidate tyres during testing shall not differ by more than 2 °C.
- 2.6.5. Mass Measurement
- The mass of tyre shall be measured before and after 5044 km of run as defined in paragraph 2.6.6. of this Annex for both reference and candidate tyres.
- 2.6.6. Test Cycle
- 2.6.6.1. Input Condition
- Both reference tyre and candidate tyre shall be tested according to **the** input conditions of Appendix 3 of this Annex. The Appendix 3 test condition of **approximately** 250 km is defined as one test cycle, **including speed**

transitions, and the test cycle shall be ~~repeated~~**performed** 20 times until 5044 km is reached.

2.6.6.2. Default Test Program (2 positions drum)

Both **the** reference tyre and **the** candidate tyre shall be mounted at different positions ~~of one on the same~~ drum. Testing of both reference tyre and candidate tyre shall be conducted at the same time.

Tyres mounted at the two positions shall be exchanged once after the completion of 2500 km. The direction of rotation shall remain constant throughout the test.

A visual inspection of the tyres is recommended after the completion of 2500 km to ensure no tread chunking.

2.6.6.3. Alternative Test Program (1 position drum)

In **the** case ~~that~~ testing of reference tyre and candidate tyre is not possible at the same time, the alternative test program may be followed. The following test order for the Reference tyre (R) and Candidate tyre (T) shall be followed:

R (1000 km) – T (2000 km) – R (2000 km) – T (2000 km) – R (2000 km) – T (1000 km)

~~Repeat a~~**A** set of Appendix 3 **of this Annex** input conditions **shall be performed** 4 times for 1000 km and 8 times for 2000 km.

A visual inspection of **the** tyres is recommended around the completion of 2,500 km to ensure no tread chunking.

2.6.6.4. Test Starting Phase

- (a) The tyres shall touch the drum with **a** speed that equals 0 km/h.
- (b) ~~Then the~~**The** test load Fz shall **then** be applied at **a** speed equal to 0 km/h or at very low speed.
- (c) ~~After~~ load application, **the** speed can be increased to the initial test value 60 km/h with a maximum longitudinal acceleration of 0.125 m/s² or maximum travelled distance of 3.5 km.

~~This~~ starting phase shall be free rolling conditions. The distance run during the starting phase shall not be counted.

2.6.7. Measurement and Recording

~~Table 2 summarizes the items that shall be measured and recorded:~~

Table 2

~~Parameters to~~ **The following parameters shall** be measured and recorded over the drum test:

<i>Item</i>	<i>Requirements</i>
(a) Test speed	Sampling frequency \geq 1Hz
(b) Tyre normal force to the drum surface	Sampling frequency \geq 1Hz
(c) Test inflation pressure	Shall measure be measured : <ul style="list-style-type: none"> • Before starting the test; • 3 or more hours after end of the test. Interim measurement during test is optional
(d) Ambient temperature measured in °C, t_{amb}	Sampling frequency \geq 1Hz
(e) Lateral force applied to the test tyre during the test	Sampling frequency \geq 10 Hz

(f) Longitudinal force or torque applied to the test tyre during the test	Sampling frequency ≥ 10 Hz
(g) Mass of tyre	<p>Shall be measuredmeasure :</p> <ul style="list-style-type: none"> Before starting the test; afterAfter end of the test. <p>Interim measurement during test is optional</p>
(h) MPD and micro-roughness of the test surface;	<p>Shall be measuredmeasure at the timings of:</p> <ul style="list-style-type: none"> Before starting the test; afterAfter end of the test. <p>Interim measurement during test is optional</p>
(i) Photograph of tyres after test program	Photograph of tyres after test to record the surface as a proof of compliant test completion in the right way .
(j) Drum diameter	Shall be calculated as the drum circumference measured including the thickness of the test surface segments divided by 3.1416.

During the measurement of the force or torque applied to the test tyre, a moving average over one-wheel revolution may be used to eliminate first and/or second harmonic of the tyre.

During the measurement of the force or torque applied to the test tyre, a low pass filter may be used to eliminate first and/or second harmonic of the tyre.

2.7. Validation

After a tyre has been subjected to the test procedure specified in paragraph 2.6. ~~of this Annex~~ using a test rim and a valve that undergo no permanent deformation and allow no loss of air, there shall be no visual evidence of tread, sidewall, ply, cord, inner liner, belt or bead separation, chunking, open splices, cracking, broken cords, or rubber adhesion.

A visual inspection of reference tyres shall show no damage ~~on to~~ reference tyres. If a reference tyre loses more than a total of 1 cm² of tread area (due to chunking or other mechanism), the tyre shall be considered as destroyed and the test **shall be considered as** invalid.

The following values measured from each parameter shall be ~~with~~~~within~~ their tolerances as specified in ~~Table 3~~~~the table below~~. Otherwise, the test results shall be rejected.

Table 3

Validation of F_x, F_y, F_z

Parameter	Measurement	Value to be verified	Tolerance
F _x	RMS (a) of G(x)	RMS _{G_x} = 0.059	±5 %
F _y	RMS (a) of G(y)	RMS _{G_y} = 0.074	±5 %
F _x and F _y	RMS (a) of G(x, y)	RMS _{G_{xy}} = 0.095	±5 %
F _z	RMS of F _z	Prescribed test load R _{F_z}	±50 N or ±1 %, whichever is greater
<p>Note 1 to entry:</p> <p>(a) For the whole test of total 5044 km, calculate the Root Mean Square (RMS) of G(x), G(y) and F_z using the equations below:</p>			

$$RMS_{Gx} = \sqrt{\frac{1}{N} \times \sum_{i=1}^N \left(\frac{Fx_i}{Fz_i} \right)^2}$$

$$RMS_{Gy} = \sqrt{\frac{1}{N} \times \sum_{i=1}^N \left(\frac{Fy_i}{Fz_i} \right)^2}$$

$$RMS_{Gxy} = \sqrt{\frac{1}{N} \times \sum_{i=1}^N \frac{(Fx_i)^2 + (Fy_i)^2}{(Average\ of\ Fz)^2}}$$

$$RMS_{Fz} = \sqrt{\frac{1}{N} \times \sum_{i=1}^N (Fz_i)^2}$$

Where;

i is the number of data acquired at a sampling frequency of 10 Hz;

N is the total number of data acquired;

Fx , Fy and My may be filtered by a low pass filter to remove noise of the output;

Fz shall be filtered as the moving average per one second.

2.8. Processing of Measurement Results

The calculation method for the abrasion index and the abrasion level shall follow the equations:

$$MIT = MT_b - MT_a$$

$$MIR = MR_b - MR_a$$

Where:

MIT is the mass loss of the candidate tyre, in grams

MIR is the mass loss of the reference tyre, in grams

MT_b is the mass of the candidate tyre before test cycle, in grams

MT_a is the mass of the candidate tyre after test cycle, in grams

MR_b is the mass of the reference tyre before test cycle, in grams

MR_a is the mass of the reference tyre after test cycle, in grams

The abrasion index (AICT) shall be calculated according to the following equation:

$$AICT = \frac{ALCT}{ALRT} - A_{\text{margin}}$$

Where:

$ALCT$ is the abrasion level (mg/(km·t)) of the candidate tyre,

$$ALCT = 1000 \text{ (mg/kg)} \times \frac{MIT \text{ (g)}}{DT \text{ (km)} \times Fz \text{ (t)}}$$

$ALRT$ is the abrasion level (mg/(km·t)) of the reference tyre,

$$ALRT = 1000 \text{ (mg/kg)} \times \frac{MIR \text{ (g)}}{DR \text{ (km)} \times Fz \text{ (t)}}$$

DT is the testing mileage of candidate tyre (km)
 DR is the testing mileage of the reference tyre (km)
 Fz,T is the test load of the candidate tyre (t)
 Fz,R is the test load of the reference tyre (t)
 A_{margin} is the dimensionless abrasion margin, which accounts for the complexities of the abrasion level measurement methods, and **is equal to [0.20].the special abrasion characteristics of specific tyre groups as indicated below. A_{margin} is defined in two steps that account for the evolution of abrasion level measurement methods and tyre technology, as given in the following table:**

	Stage 1	Stage 2
<i>A_{margin} by tyre category of use</i>		
Normal	[0.20]	[0.10]
Snow	[0.20]	[0.10]
Special use	[Not defined]	[Not defined]
<i>A_{margin} allowances for specific tyre groups (to be incorporated into A_{margin})</i>		
Tyre for use in severe snow conditions (3PMSF)	[+0.10]	[+0.10]
Reinforced or extra load tyre (XL)	[+0.10]	[-]
Tyres with a nominal aspect ratio ≤ 40 and suitable for speeds ≥ 300 km/h	[+0.10]	[-]
Tyres with low load index (LI < 77)	[+0.10]	[-]

Note: ~~A_{margin} allowances for specific tyre groups are cumulative. E.g., if a candidate tyre is a reinforced snow tyre for use in severe snow conditions, the applicable A_{margin} shall be $0.2 + 0.1 + 0.1 = 0.4$.~~ The reference tyre used to calculate the abrasion index shall be one of the tyres described in **paragraph 2.4.7.** of this Annex.

2.9. Test report

2.9.1. The test report shall include the following information:

- Test machine identification;
- Drum diameter (m);
- Test cycle (2 positions / 1 position);
- 3rd body (talc / silica);
- MPD of test surface (mm): Beginning of test / End of test;
- Tyre class;
- Brand;
- Pattern/trade description;
- Tyre size designation;
- Service description;
- Test load (N);
- Test inflation pressure (kPa);

-
- (m) Tyre identification;
 - (n) 3PMSF marking (Y/N);
 - (o) M+S marking (Y/N);
 - (p) Rim width code;
 - (q) Inflation pressure (kPa): Beginning of test / End of test;
 - (r) Mass of tyre (g): Before test / After test;
 - (s) Test distance (km);
 - (t) Abrasion rate (mg/km);
 - (u) Abrasion level (mg/(km·t));
 - (v) Abrasion index (only applicable for candidate tyre);
 - (w) Average ambient temperature (°C);
 - (x) RMS of G(x);
 - (y) RMS of G(y);
 - (z) Average of Fz;
 - (aa) A_{margin} applied, with indication of any allowances incorporated therein.

Annex 3 – Appendix 1

Accelerations calculation

1. Input for calculation

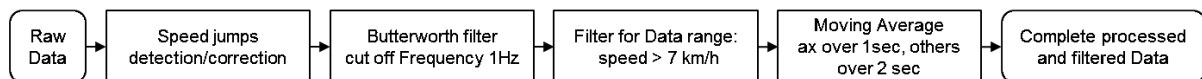
1.1. Required parameters

The following parameters are required for the calculation of longitudinal and lateral acceleration:

- (a) The vehicle velocity (v), [m/s]
- (b) The longitudinal acceleration ($a_{\text{longitudinal}}$), [m/s²]
- (c) The lateral acceleration (a_{lateral}), [m/s²]

The accelerations are derived by evaluation of GNSS (~~GLOBAL NAVIGATION SATELLITE SYSTEM~~ Global Navigation Satellite System as defined by ISO 24245:2023) signals. The ~~recommended~~ sampling rate is ~~shall be~~ 10 Hz or more. ~~Otherwise, the below described filtering process is not working.~~

Filter for measured ~~Values~~ values



1.2. Speed jumps detection and correction

Before starting the filtering process, all measured values ~~are~~ **shall be** checked concerning speed jumps. ~~Speed jumps refer to measurements which are not plausible.~~ For identifying speed jumps, ~~that refer to implausible measurements,~~ the velocity ~~is~~ **shall be** filtered by using a Butterworth filter with a cut-off frequency of 1 Hz. A threshold of 9 m/s² for the maximum longitudinal acceleration ~~is~~ defined. That means, that a speed change of maximum 9 m/s² · t_{sampling} is still plausible.

A speed jump **will be** detected if there is a speed difference of $2 \cdot \Delta \text{speed}_{\text{possible}}$. In ~~the~~ case of a detected speed jump, the relevant raw speed values **will be** replaced by a linear interpolated value.

1.3. Butterworth Filter:

For filtering the measurement, a Butterworth filter second order with a cut-off frequency of 1 Hz ~~is~~ **shall be** used. After this filter the values are smoothed with a "moving average" over 1 second for longitudinal acceleration, all other values over 2 seconds.

All accelerations measured for a velocity less than 7 km/h are excluded.

Python code:

```

from scipy.signal import butter, filtfilt
# Filter settings: n_order is the order of the filter,
# A scalar or length-2 sequence giving the critical frequencies
N = 2
Wn = 1 / (0.5 * round(data_inp['freq_sample'].mean()))
[b,a] = butter(N, Wn, 'lowpass')
data_filt = filtfilt(b, a, data_inp, padtype = 'odd')
data_inp = data_inp[(data_inp.speed_filt > speed_min)]
  
```

1.4. Moving Average:

Python code:

```
# averaging over 1 second window
# make sure window is odd
if round(data_inp['freq_sample'].mean()) % 2 != 0:
    win = int(round(data_inp['freq_sample'].mean()))
else:
    win = int(round(data_inp['freq_sample'].mean()) - 1)

data_inp['accx_filt_movg'] = data_inp['accx_filt'].rolling(window=win,
center=True, min_periods=1).mean()

# averaging over 2 second window
win = int(round(data_inp['freq_sample'].mean()) * 2 - 1)
data_inp['accy_filt_movg'] = data_inp['accy_filt'].rolling(window=win,
center=True, min_periods=1).mean()
data_inp['speed_filt_movg'] = data_inp['speed_filt'].rolling(window=win,
center=True, min_periods=1).mean()
```

1.5. Distance-based Standard Deviation

Calculated accelerations (sampled with a constant frequency) are transferred in distance-based values: one value per meter. For this, a simple interpolation is used. With these accelerations, the standard deviation can be calculated with following well-known formulas:

$$S_{\text{longitudinal}} = \sqrt{\frac{1}{N-1} \cdot \sum_{i=1}^N (a_{\text{longitudinal},i} - \mu_{\text{longitudinal}})^2}$$

$$\text{with } \mu_{\text{longitudinal}} = \frac{1}{N} \sum_{i=1}^N a_{\text{longitudinal},i}$$

$$S_{\text{lateral}} = \sqrt{\frac{1}{N-1} \cdot \sum_{i=1}^N (a_{\text{lateral},i} - \mu_{\text{lateral}})^2}$$

$$\text{with } \mu_{\text{lateral}} = \frac{1}{N} \sum_{i=1}^N a_{\text{lateral},i}$$

Python code:

```
from scipy import interpolate
import numpy as np

data_inp['distance'] = data_inp['speed']/data_inp['fsample']
data_inp['distance'] = data_inp['distance'].cumsum()

# interpolate function for acc
f_accx = interpolate.interp1d(data_inp['distance'], data_inp['accx'])
f_accy = interpolate.interp1d(data_inp['distance'], data_inp['accy'])

# generate array of distance every 1m
distance_1m = np.array(data_inp['distance'].iloc[0], data_inp['distance'].iloc[-1], 1)

# create an interpolation every 1m for the accelerations - numpy array result
# len of the array same as len of distance_1m
accx_DB = f_accx(distance_1m)
accy_DB = f_accy(distance_1m)

# compute the stadx with ceiling accx_DB and accy_DB
```

```
stdax = np.std(accx_DB)
```

```
stday = np.std(accy_DB)
```

2. Calculation of distribution of driving styles

The following steps shall be followed for the calculation of the distribution of driving styles:

- (a) Cumulate 8-000 km of acceleration data on a vehicle at the circuit. The accelerations data obtained while qualifying the circuit for abrasiveness may be used. The provisions defined for vehicle speed in paragraph 1.6.13.2. (d) of this Annex shall be respected in every single convoy test;
- (b) Split the data in segments of 20 km;
- (c) Compute the longitudinal and lateral acceleration standard deviations ($S_{\text{longitudinal}}$; S_{lateral}) for each segment, following the method described in paragraph 1. of this appendix;
- (d) For each segment with ($S_{\text{longitudinal}}$; S_{lateral}) data, count which road driving style (as defined in paragraph 1.6.13.2. of this Annex) it belongs to. This shall be done by attributing it to urban-like driving style if matching the corresponding criteria, to highway-like driving style if matching the corresponding criteria, or to regional-like driving style if not matching the urban-like or highway-like driving style;
- (e) The share of points in one road driving style equals to the number of points in the road driving style divided by the total number of segments. This share shall respect the shares defined in paragraph 1.6.13.2. of this Annex.

Annex 3 – Appendix 2

Test report example for vehicle test method on public open roads

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: C1
6. Category of use:
- 6.1. M+S marking in the case of special use tyres (Yes/No)⁸
- 6.2. 3PMSF marking (Yes/No)⁸
- 6.3. XL marking (Yes/No)⁸
- 6.4. Tyres with a nominal aspect ratio ≤ 40 and suitable for speeds ≥ 300 km/h (Yes/No)⁸
- 6.5. [Tyres with low load index (LI < 77) (Yes/No)⁸]
7. Comments (if any):
.....
8. Date:
9. Signature:

Tyre abrasion rate test report					
Test conditions:					
Test Starting date:		Test end date:			
Test temperatures: (degree C)					
Average:		Minimum:		Maximum:	
Percentage of distance covered on wet road:			(add snow)		
Circuit used for test:					
Reference:		Location:			
Nominal circuit length:		Total distance covered:			
Highway-like driving distance:		Regional-like style distance:			
Urban-like driving style distance:		Total deviation distance:			
Slope of reference tyre sensitivity to temperature:					

	Candidate tyre/vehicle				Reference tyre/vehicle			
	Front Left	Front right	Rear left	Rear right	Front Left	Front right	Rear left	Rear right
Vehicle information:								
Vehicle model:								

⁸ strike out what does not apply.

Standard deviation X acceleration:								
% of distance covered under the maximum longitudinal acceleration:								
Standard deviation Y acceleration:								
% of distance covered under the maximum lateral acceleration:								
Toe at test start:								
Camber at test start:								
Toe at test end:								
Camber at test end:								
Load per position:								
Tyre information:								
Tyre brand:								
Tyre pattern:								
Tyre size designation:								
Tyre load index:								
Tyre speed index:								
Serial number (if available):								
Cold inflation pressure (fitment):								
Cold inflation pressure 50% test:								
Cold inflation pressure (test end):								
Balancing mass (test beginning):								
Balancing mass (test end):								
Rim width code:					7.5	7.5	7.5	7.5
Initial tyre mass:								
Final tyre mass:								
Distance run by each tyre:								
Reference tyre abrasion level in mg/(km·t) normalized at 20°C (or 10°C):								
Tyres visual inspection report:								
Test results:								
Tyre Abrasion level in mg/(km·t):								
A_{margin} applied:								
Tyre Abrasion index (AICT):					N/A			

Annex 3 – Appendix 3

Input of test cycle

In order to calculate the input forces F_x and F_y , longitudinal and lateral acceleration indices, as $G(x)$ and $G(y)$ respectively, are introduced as below.

For torque control testing machine, tyre torque (M_y) is calculated with longitudinal force (F_x) and loaded radius (RL) following the equations provided below:

$$F_x = F_z \times G(x) \text{ or } M_y = \text{Test load}(F_z) \times G(x) \times RL$$

$$F_y = F_z \times G(y)$$

F_z is the test load defined in paragraphs 2.2.6-2.2.5. and 2.5.2. of this Annex.

$G(x)$ and $G(y)$ represent the index compared to the standard acceleration due to earth gravity ($g = 9.80665 \text{ m/s}^2$). Alternatively, the local earth gravity may be defined.

The table below ~~Table A1~~ defines the time, $G(x)$, $G(y)$, and speed of test cycle. In ~~Table T1~~ the table below, T represents the total test duration from the beginning of the test. At a point of test duration T, the values of $G(x)$ and $G(y)$ shall be equal to those listed in the table below ~~Table A1~~.

$G(x)$ and $G(y)$ shall change linearly between two adjacent points. Therefore, the values of F_x and F_y will also change linearly from one point to another. The following graphs show samples of linear change for F_x or F_y with respect to T.

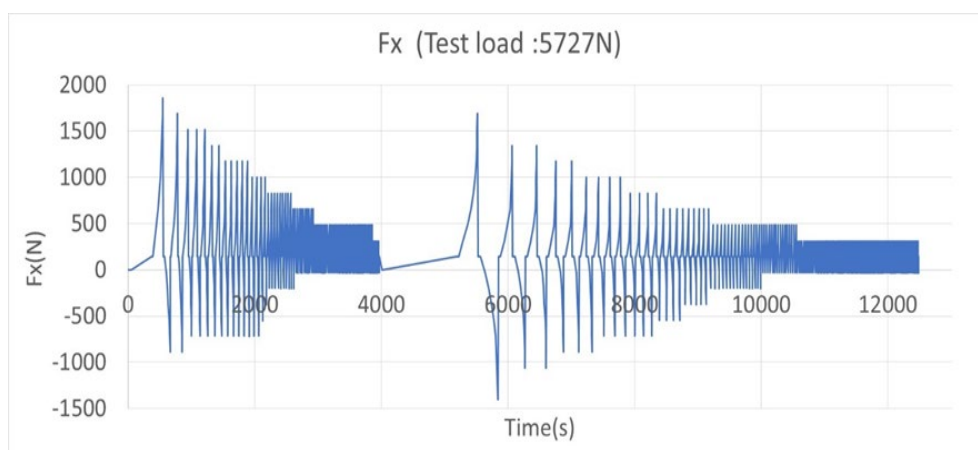
T means the driving time from starting test.

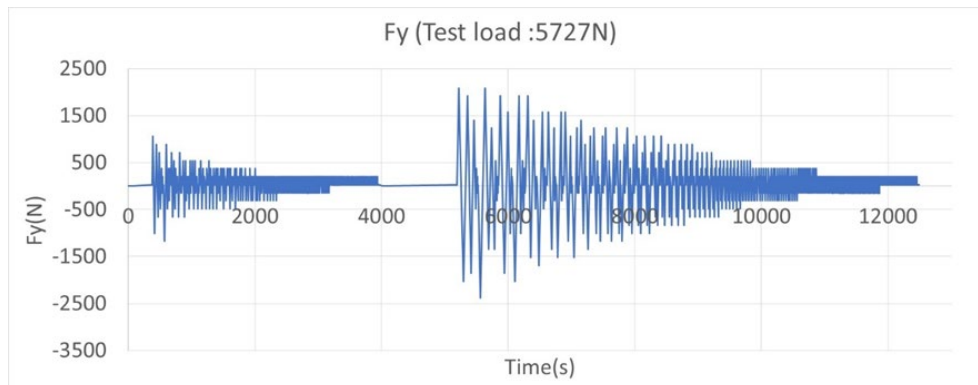
The value of $G(x)$ and $G(y)$ at driving time T is mentioned in the table below ~~Table A1~~.

$G(x)$ and $G(y)$ between each point changes linearly through those two points.

~~Graph A~~Figure :1

Example of F_x -, with a test load of 5727N



Graph A-figure 2Example of F_y , with a test load of 5727N**Table A1.**

Input of test cycle

T	v	$G(x)$	$G(y)$
(s)	(kph)		
0	60	0.000	0
50	100	0.000	0.000
373.2	100	0.025	0.005
388.4	100	0.025	0.185
418.7	100	0.055	-0.175
446.5	100	0.085	0.155
471.7	100	0.115	-0.115
491.9	100	0.145	0.125
509.6	100	0.175	-0.085
522.3	100	0.205	0.065
532.4	100	0.235	-0.025
540.0	100	0.265	0.035
545.0	100	0.295	0.005
547.5	100	0.325	0.005
556.8	100	0.025	0.005
574.5	100	0.025	-0.205
602.3	100	-0.005	0.155
620.0	100	-0.035	-0.085
632.6	100	-0.065	0.065
645.2	100	-0.095	-0.055
657.9	100	-0.125	0.065
662.9	100	-0.155	0.005

668.8	100	0.025	0.005
678.9	100	0.025	0.125
699.1	100	0.055	-0.115
719.3	100	0.085	0.095
737.0	100	0.115	-0.085
747.1	100	0.145	0.065
757.2	100	0.175	-0.025
764.8	100	0.205	0.035
769.9	100	0.235	0.005
774.9	100	0.265	0.035
777.4	100	0.295	0.005
785.9	100	0.025	0.005
796.0	100	0.025	-0.115
816.2	100	-0.005	0.125
826.3	100	-0.035	-0.025
833.9	100	-0.065	0.035
841.4	100	-0.095	-0.025
849.0	100	-0.125	0.035
851.6	100	-0.155	0.005
857.4	100	0.025	0.005
865.0	100	0.025	0.095
885.2	100	0.055	-0.115
902.9	100	0.085	0.095
915.6	100	0.115	-0.055

923.1	100	0.145	0.035		1198.5	100	0.175	0.005
930.7	100	0.175	-0.025		1203.6	100	0.205	0.035
935.8	100	0.205	0.035		1206.1	100	0.235	0.005
940.8	100	0.235	0.005		1208.6	100	0.265	0.005
945.9	100	0.265	0.035		1216.2	100	0.025	0.005
953.5	100	0.025	0.005		1223.8	100	0.025	-0.085
961.0	100	0.025	-0.085		1236.4	100	-0.005	0.065
978.7	100	-0.005	0.095		1241.5	100	-0.035	0.005
986.3	100	-0.035	-0.025		1246.5	100	-0.065	0.035
991.3	100	-0.065	0.035		1251.6	100	-0.095	0.005
996.4	100	-0.095	0.005		1256.6	100	-0.125	0.035
1001.5	100	-0.125	0.035		1261.7	100	0.025	0.005
1006.5	100	0.025	0.005		1269.3	100	0.025	0.095
1014.1	100	0.025	0.095		1284.4	100	0.055	-0.085
1031.8	100	0.055	-0.085		1299.6	100	0.085	0.065
1049.5	100	0.085	0.095		1307.2	100	0.115	-0.025
1059.6	100	0.115	-0.025		1312.2	100	0.145	0.035
1067.1	100	0.145	0.035		1317.3	100	0.175	0.005
1072.2	100	0.175	0.005		1322.3	100	0.205	0.035
1077.2	100	0.205	0.035		1324.8	100	0.235	0.005
1082.3	100	0.235	0.005		1331.6	100	0.025	0.005
1084.8	100	0.265	0.005		1339.2	100	0.025	-0.085
1092.4	100	0.025	0.005		1351.8	100	-0.005	0.065
1100.0	100	0.025	-0.085		1356.8	100	-0.035	0.005
1112.6	100	-0.005	0.065		1361.9	100	-0.065	0.035
1120.2	100	-0.035	-0.025		1366.9	100	-0.095	0.005
1125.3	100	-0.065	0.035		1372.0	100	-0.125	0.035
1130.3	100	-0.095	0.005		1377.1	100	0.025	0.005
1135.4	100	-0.125	0.035		1382.1	100	0.025	0.065
1140.4	100	0.025	0.005		1397.3	100	0.055	-0.085
1148.0	100	0.025	0.095		1409.9	100	0.085	0.065
1165.7	100	0.055	-0.085		1417.5	100	0.115	-0.025
1180.8	100	0.085	0.065		1422.5	100	0.145	0.035
1188.4	100	0.115	-0.025		1427.6	100	0.175	0.005
1193.5	100	0.145	0.035		1432.6	100	0.205	0.035

1435.2	100	0.235	0.005		1660.9	100	-0.065	0.035
1441.9	100	0.025	0.005		1663.4	100	-0.095	0.005
1447.0	100	0.025	-0.055		1665.9	100	-0.125	0.005
1457.1	100	-0.005	0.065		1671.0	100	0.025	0.005
1462.1	100	-0.035	0.005		1676.0	100	0.025	0.065
1467.2	100	-0.065	0.035		1691.2	100	0.055	-0.085
1472.2	100	-0.095	0.005		1703.8	100	0.085	0.065
1477.3	100	-0.125	0.035		1708.9	100	0.115	0.005
1482.3	100	0.025	0.005		1713.9	100	0.145	0.035
1487.4	100	0.025	0.065		1719.0	100	0.175	0.005
1502.5	100	0.055	-0.085		1721.5	100	0.205	0.005
1515.2	100	0.085	0.065		1727.4	100	0.025	0.005
1522.7	100	0.115	-0.025		1732.4	100	0.025	-0.055
1527.8	100	0.145	0.035		1740.0	100	-0.005	0.035
1532.9	100	0.175	0.005		1745.1	100	-0.035	0.005
1535.4	100	0.205	0.005		1747.6	100	-0.065	0.005
1541.3	100	0.025	0.005		1750.1	100	-0.095	0.005
1546.3	100	0.025	-0.055		1752.7	100	-0.125	0.005
1556.4	100	-0.005	0.065		1757.7	100	0.025	0.005
1561.5	100	-0.035	0.005		1762.8	100	0.025	0.065
1566.5	100	-0.065	0.035		1775.4	100	0.055	-0.055
1571.6	100	-0.095	0.005		1788.0	100	0.085	0.065
1576.6	100	-0.125	0.035		1793.1	100	0.115	0.005
1581.7	100	0.025	0.005		1798.1	100	0.145	0.035
1586.8	100	0.025	0.065		1800.7	100	0.175	0.005
1601.9	100	0.055	-0.085		1803.2	100	0.205	0.005
1614.5	100	0.085	0.065		1809.1	100	0.025	0.005
1619.6	100	0.115	0.005		1814.1	100	0.025	-0.055
1624.6	100	0.145	0.035		1821.7	100	-0.005	0.035
1629.7	100	0.175	0.005		1826.8	100	-0.035	0.005
1632.2	100	0.205	0.005		1829.3	100	-0.065	0.005
1638.1	100	0.025	0.005		1831.8	100	-0.095	0.005
1643.2	100	0.025	-0.055		1834.3	100	-0.125	0.005
1650.8	100	-0.005	0.035		1839.4	100	0.025	0.005
1655.8	100	-0.035	0.005		1844.5	100	0.025	0.065

1857.1	100	0.055	-0.055
1867.2	100	0.085	0.035
1872.2	100	0.115	0.005
1877.3	100	0.145	0.035
1879.8	100	0.175	0.005
1882.3	100	0.205	0.005
1888.2	100	0.025	0.005
1893.3	100	0.025	-0.055
1900.9	100	-0.005	0.035
1905.9	100	-0.035	0.005
1908.5	100	-0.065	0.005
1911.0	100	-0.095	0.005
1913.5	100	-0.125	0.005
1918.6	100	0.025	0.005
1923.6	100	0.025	0.065
1936.2	100	0.055	-0.055
1946.4	100	0.085	0.035
1951.4	100	0.115	0.005
1956.5	100	0.145	0.035
1959.0	100	0.175	0.005
1964.0	100	0.025	0.005
1969.1	100	0.025	-0.055
1976.7	100	-0.005	0.035
1981.7	100	-0.035	0.005
1984.2	100	-0.065	0.005
1986.8	100	-0.095	0.005
1989.3	100	-0.125	0.005
1994.4	100	0.025	0.005
1999.4	100	0.025	0.065
2009.5	100	0.055	-0.055
2019.6	100	0.085	0.035
2024.7	100	0.115	0.005
2029.7	100	0.145	0.035
2032.3	100	0.175	0.005
2037.3	100	0.025	0.005

2042.4	100	0.025	-0.055
2049.9	100	-0.005	0.035
2055.0	100	-0.035	0.005
2057.5	100	-0.065	0.005
2060.0	100	-0.095	0.005
2062.6	100	-0.125	0.005
2067.6	100	0.025	0.005
2070.1	100	0.025	0.035
2080.3	100	0.055	-0.055
2087.8	100	0.085	0.035
2092.9	100	0.115	0.005
2097.9	100	0.145	0.035
2100.5	100	0.175	0.005
2105.5	100	0.025	0.005
2108.0	100	0.025	-0.025
2115.6	100	-0.005	0.035
2120.7	100	-0.035	0.005
2123.2	100	-0.065	0.005
2125.7	100	-0.095	0.005
2129.9	100	0.025	0.005
2132.5	100	0.025	0.035
2142.6	100	0.055	-0.055
2150.2	100	0.085	0.035
2155.2	100	0.115	0.005
2160.3	100	0.145	0.035
2162.8	100	0.175	0.005
2167.8	100	0.025	0.005
2170.4	100	0.025	-0.025
2177.9	100	-0.005	0.035
2180.5	100	-0.035	0.005
2183.0	100	-0.065	0.005
2186.4	100	0.025	0.005
2188.9	100	0.025	0.035
2199.0	100	0.055	-0.055
2206.6	100	0.085	0.035

2211.6	100	0.115	0.005
2214.2	100	0.145	0.005
2218.4	100	0.025	0.005
2220.9	100	0.025	-0.025
2228.5	100	-0.005	0.035
2231.0	100	-0.035	0.005
2233.5	100	0.025	0.005
2236.1	100	0.025	0.035
2246.2	100	0.055	-0.055
2253.7	100	0.085	0.035
2258.8	100	0.115	0.005
2261.3	100	0.145	0.005
2265.5	100	0.025	0.005
2268.1	100	0.025	-0.025
2275.6	100	-0.005	0.035
2278.2	100	-0.035	0.005
2280.7	100	0.025	0.005
2283.2	100	0.025	0.035
2293.3	100	0.055	-0.055
2300.9	100	0.085	0.035
2306.0	100	0.115	0.005
2308.5	100	0.145	0.005
2312.7	100	0.025	0.005
2315.2	100	0.025	-0.025
2322.8	100	-0.005	0.035
2325.3	100	-0.035	0.005
2327.8	100	0.025	0.005
2330.4	100	0.025	0.035
2340.5	100	0.055	-0.055
2348.1	100	0.085	0.035
2353.1	100	0.115	0.005
2355.6	100	0.145	0.005
2359.9	100	0.025	0.005
2362.4	100	0.025	-0.025
2370.0	100	-0.005	0.035

2372.5	100	-0.035	0.005
2375.0	100	0.025	0.005
2377.5	100	0.025	0.035
2385.1	100	0.055	-0.025
2392.7	100	0.085	0.035
2397.7	100	0.115	0.005
2400.3	100	0.145	0.005
2404.5	100	0.025	0.005
2407.0	100	0.025	-0.025
2412.1	100	-0.005	0.035
2414.6	100	-0.035	0.005
2417.1	100	0.025	0.005
2419.6	100	0.025	0.035
2427.2	100	0.055	-0.025
2434.8	100	0.085	0.035
2439.9	100	0.115	0.005
2442.4	100	0.145	0.005
2446.6	100	0.025	0.005
2449.1	100	0.025	-0.025
2454.2	100	-0.005	0.035
2456.7	100	-0.035	0.005
2459.2	100	0.025	0.005
2461.8	100	0.025	0.035
2469.3	100	0.055	-0.025
2476.9	100	0.085	0.035
2482.0	100	0.115	0.005
2484.5	100	0.145	0.005
2488.7	100	0.025	0.005
2491.2	100	0.025	-0.025
2496.3	100	-0.005	0.035
2498.8	100	-0.035	0.005
2501.3	100	0.025	0.005
2503.9	100	0.025	0.035
2511.4	100	0.055	-0.025
2519.0	100	0.085	0.035

2524.1	100	0.115	0.005	2662.2	100	0.055	-0.025
2526.6	100	0.145	0.005	2669.8	100	0.085	0.035
2530.8	100	0.025	0.005	2672.3	100	0.115	0.005
2533.3	100	0.025	-0.025	2675.7	100	0.025	0.005
2538.4	100	-0.005	0.035	2678.2	100	0.025	-0.025
2540.9	100	-0.035	0.005	2683.2	100	-0.005	0.035
2543.4	100	0.025	0.005	2684.9	100	0.025	0.005
2546.0	100	0.025	0.035	2687.4	100	0.025	0.035
2553.5	100	0.055	-0.025	2695.0	100	0.055	-0.025
2561.1	100	0.085	0.035	2702.6	100	0.085	0.035
2563.7	100	0.115	0.005	2705.1	100	0.115	0.005
2566.2	100	0.145	0.005	2708.5	100	0.025	0.005
2570.4	100	0.025	0.005	2711.0	100	0.025	-0.025
2572.9	100	0.025	-0.025	2716.1	100	-0.005	0.035
2578.0	100	-0.005	0.035	2717.8	100	0.025	0.005
2580.5	100	-0.035	0.005	2720.3	100	0.025	0.035
2583.0	100	0.025	0.005	2727.9	100	0.055	-0.025
2585.5	100	0.025	0.035	2735.5	100	0.085	0.035
2593.1	100	0.055	-0.025	2738.0	100	0.115	0.005
2600.7	100	0.085	0.035	2741.3	100	0.025	0.005
2603.2	100	0.115	0.005	2743.9	100	0.025	-0.025
2606.6	100	0.025	0.005	2748.9	100	-0.005	0.035
2609.1	100	0.025	-0.025	2750.6	100	0.025	0.005
2614.2	100	-0.005	0.035	2753.1	100	0.025	0.035
2616.7	100	-0.035	0.005	2760.7	100	0.055	-0.025
2619.2	100	0.025	0.005	2765.8	100	0.085	0.035
2621.8	100	0.025	0.035	2768.3	100	0.115	0.005
2629.3	100	0.055	-0.025	2771.7	100	0.025	0.005
2636.9	100	0.085	0.035	2774.2	100	0.025	-0.025
2639.4	100	0.115	0.005	2779.2	100	-0.005	0.035
2642.8	100	0.025	0.005	2780.9	100	0.025	0.005
2645.3	100	0.025	-0.025	2783.5	100	0.025	0.035
2650.4	100	-0.005	0.035	2791.0	100	0.055	-0.025
2652.1	100	0.025	0.005	2796.1	100	0.085	0.035
2654.6	100	0.025	0.035	2798.6	100	0.115	0.005

2802.0	100	0.025	0.005		2932.5	100	0.025	0.005
2804.5	100	0.025	-0.025		2935.0	100	0.025	0.035
2809.6	100	-0.005	0.035		2942.6	100	0.055	-0.025
2811.2	100	0.025	0.005		2947.7	100	0.085	0.035
2813.8	100	0.025	0.035		2950.2	100	0.025	0.005
2821.4	100	0.055	-0.025		2952.7	100	0.025	-0.025
2826.4	100	0.085	0.035		2957.8	100	-0.005	0.035
2828.9	100	0.115	0.005		2959.5	100	0.025	0.005
2832.3	100	0.025	0.005		2962.0	100	0.025	0.035
2834.8	100	0.025	-0.025		2969.6	100	0.055	-0.025
2839.9	100	-0.005	0.035		2974.6	100	0.085	0.035
2841.6	100	0.025	0.005		2977.2	100	0.025	0.005
2844.1	100	0.025	0.035		2979.7	100	0.025	-0.025
2851.7	100	0.055	-0.025		2984.7	100	-0.005	0.035
2856.7	100	0.085	0.035		2986.4	100	0.025	0.005
2859.2	100	0.115	0.005		2988.9	100	0.025	0.035
2862.6	100	0.025	0.005		2996.5	100	0.055	-0.025
2865.1	100	0.025	-0.025		3001.6	100	0.085	0.035
2870.2	100	-0.005	0.035		3004.1	100	0.025	0.005
2871.9	100	0.025	0.005		3006.6	100	0.025	-0.025
2874.4	100	0.025	0.035		3011.7	100	-0.005	0.035
2882.0	100	0.055	-0.025		3013.4	100	0.025	0.005
2887.0	100	0.085	0.035		3015.9	100	0.025	0.035
2889.6	100	0.115	0.005		3023.5	100	0.055	-0.025
2892.9	100	0.025	0.005		3028.5	100	0.085	0.035
2895.5	100	0.025	-0.025		3031.0	100	0.025	0.005
2900.5	100	-0.005	0.035		3036.1	100	0.025	0.005
2902.2	100	0.025	0.005		3041.2	100	-0.005	0.035
2904.7	100	0.025	0.035		3042.8	100	0.025	0.005
2912.3	100	0.055	-0.025		3045.4	100	0.025	0.035
2917.4	100	0.085	0.035		3052.9	100	0.055	-0.025
2919.9	100	0.115	0.005		3058.0	100	0.085	0.035
2923.3	100	0.025	0.005		3060.5	100	0.025	0.005
2925.8	100	0.025	-0.025		3065.6	100	0.025	0.005
2930.8	100	-0.005	0.035		3070.6	100	-0.005	0.035

3072.3	100	0.025	0.005
3074.8	100	0.025	0.035
3082.4	100	0.055	-0.025
3087.5	100	0.085	0.035
3090.0	100	0.025	0.005
3095.1	100	0.025	0.005
3100.1	100	-0.005	0.035
3101.8	100	0.025	0.005
3104.3	100	0.025	0.035
3111.9	100	0.055	-0.025
3116.9	100	0.085	0.035
3119.5	100	0.025	0.005
3124.5	100	0.025	0.005
3129.6	100	-0.005	0.035
3131.3	100	0.025	0.005
3133.8	100	0.025	0.035
3141.4	100	0.055	-0.025
3146.4	100	0.085	0.035
3149.0	100	0.025	0.005
3154.0	100	0.025	0.005
3159.1	100	-0.005	0.035
3160.7	100	0.025	0.005
3163.3	100	0.025	0.035
3170.8	100	0.055	-0.025
3175.9	100	0.085	0.035
3178.4	100	0.025	0.005
3183.5	100	0.025	0.005
3188.5	100	-0.005	0.035
3190.2	100	0.025	0.005
3192.7	100	0.025	0.035
3197.8	100	0.055	0.005
3202.8	100	0.085	0.035
3205.4	100	0.025	0.005
3210.4	100	0.025	0.005
3215.5	100	-0.005	0.035

3217.2	100	0.025	0.005
3219.7	100	0.025	0.035
3224.7	100	0.055	0.005
3229.8	100	0.085	0.035
3232.3	100	0.025	0.005
3237.4	100	0.025	0.005
3242.4	100	-0.005	0.035
3244.1	100	0.025	0.005
3246.6	100	0.025	0.035
3251.7	100	0.055	0.005
3256.7	100	0.085	0.035
3259.3	100	0.025	0.005
3264.3	100	0.025	0.005
3269.4	100	-0.005	0.035
3271.1	100	0.025	0.005
3273.6	100	0.025	0.035
3278.6	100	0.055	0.005
3283.7	100	0.085	0.035
3286.2	100	0.025	0.005
3291.3	100	0.025	0.005
3296.3	100	-0.005	0.035
3298.0	100	0.025	0.005
3300.5	100	0.025	0.035
3305.6	100	0.055	0.005
3310.6	100	0.085	0.035
3313.2	100	0.025	0.005
3318.2	100	0.025	0.005
3323.3	100	-0.005	0.035
3325.0	100	0.025	0.005
3327.5	100	0.025	0.035
3332.5	100	0.055	0.005
3335.1	100	0.085	0.005
3337.6	100	0.025	0.005
3342.6	100	0.025	0.005
3347.7	100	-0.005	0.035

3349.4	100	0.025	0.005	3461.4	100	0.025	0.005
3351.9	100	0.025	0.035	3463.9	100	0.025	0.035
3357.0	100	0.055	0.005	3469.0	100	0.055	0.005
3359.5	100	0.085	0.005	3471.5	100	0.085	0.005
3362.0	100	0.025	0.005	3474.0	100	0.025	0.005
3367.1	100	0.025	0.005	3479.1	100	0.025	0.005
3372.1	100	-0.005	0.035	3481.6	100	-0.005	0.005
3373.8	100	0.025	0.005	3483.3	100	0.025	0.005
3376.3	100	0.025	0.035	3485.8	100	0.025	0.035
3381.4	100	0.055	0.005	3490.9	100	0.055	0.005
3383.9	100	0.085	0.005	3493.4	100	0.085	0.005
3386.4	100	0.025	0.005	3495.9	100	0.025	0.005
3391.5	100	0.025	0.005	3501.0	100	0.025	0.005
3394.0	100	-0.005	0.005	3503.5	100	-0.005	0.005
3395.7	100	0.025	0.005	3505.2	100	0.025	0.005
3398.2	100	0.025	0.035	3507.7	100	0.025	0.035
3403.3	100	0.055	0.005	3512.8	100	0.055	0.005
3405.8	100	0.085	0.005	3515.3	100	0.085	0.005
3408.3	100	0.025	0.005	3517.8	100	0.025	0.005
3413.4	100	0.025	0.005	3522.9	100	0.025	0.005
3415.9	100	-0.005	0.005	3525.4	100	-0.005	0.005
3417.6	100	0.025	0.005	3527.1	100	0.025	0.005
3420.1	100	0.025	0.035	3529.6	100	0.025	0.035
3425.2	100	0.055	0.005	3534.7	100	0.055	0.005
3427.7	100	0.085	0.005	3537.2	100	0.085	0.005
3430.2	100	0.025	0.005	3539.7	100	0.025	0.005
3435.3	100	0.025	0.005	3544.8	100	0.025	0.005
3437.8	100	-0.005	0.005	3547.3	100	-0.005	0.005
3439.5	100	0.025	0.005	3549.0	100	0.025	0.005
3442.0	100	0.025	0.035	3551.5	100	0.025	0.035
3447.1	100	0.055	0.005	3556.6	100	0.055	0.005
3449.6	100	0.085	0.005	3559.1	100	0.085	0.005
3452.1	100	0.025	0.005	3561.6	100	0.025	0.005
3457.2	100	0.025	0.005	3566.7	100	0.025	0.005
3459.7	100	-0.005	0.005	3569.2	100	-0.005	0.005

3570.9	100	0.025	0.005		3672.8	100	0.025	0.005
3573.4	100	0.025	0.035		3675.3	100	0.025	0.035
3578.5	100	0.055	0.005		3677.8	100	0.055	0.005
3581.0	100	0.085	0.005		3680.4	100	0.085	0.005
3583.5	100	0.025	0.005		3682.9	100	0.025	0.005
3588.6	100	0.025	0.005		3687.9	100	0.025	0.005
3591.1	100	-0.005	0.005		3690.5	100	-0.005	0.005
3592.8	100	0.025	0.005		3692.1	100	0.025	0.005
3595.3	100	0.025	0.035		3694.7	100	0.025	0.035
3600.3	100	0.055	0.005		3697.2	100	0.055	0.005
3602.9	100	0.085	0.005		3699.7	100	0.085	0.005
3605.4	100	0.025	0.005		3702.2	100	0.025	0.005
3610.5	100	0.025	0.005		3707.3	100	0.025	0.005
3613.0	100	-0.005	0.005		3709.8	100	-0.005	0.005
3614.7	100	0.025	0.005		3711.5	100	0.025	0.005
3617.2	100	0.025	0.035		3714.0	100	0.025	0.035
3619.7	100	0.055	0.005		3716.6	100	0.055	0.005
3622.2	100	0.085	0.005		3719.1	100	0.085	0.005
3624.8	100	0.025	0.005		3721.6	100	0.025	0.005
3629.8	100	0.025	0.005		3726.7	100	0.025	0.005
3632.3	100	-0.005	0.005		3729.2	100	-0.005	0.005
3634.0	100	0.025	0.005		3730.9	100	0.025	0.005
3636.6	100	0.025	0.035		3733.4	100	0.025	0.035
3639.1	100	0.055	0.005		3735.9	100	0.055	0.005
3641.6	100	0.085	0.005		3738.5	100	0.085	0.005
3644.1	100	0.025	0.005		3741.0	100	0.025	0.005
3649.2	100	0.025	0.005		3746.0	100	0.025	0.005
3651.7	100	-0.005	0.005		3748.6	100	-0.005	0.005
3653.4	100	0.025	0.005		3750.3	100	0.025	0.005
3655.9	100	0.025	0.035		3752.8	100	0.025	0.035
3658.5	100	0.055	0.005		3755.3	100	0.055	0.005
3661.0	100	0.085	0.005		3757.8	100	0.085	0.005
3663.5	100	0.025	0.005		3760.4	100	0.025	0.005
3668.6	100	0.025	0.005		3765.4	100	0.025	0.005
3671.1	100	-0.005	0.005		3767.9	100	-0.005	0.005

3769.6	100	0.025	0.005
3772.1	100	0.025	0.035
3774.7	100	0.055	0.005
3777.2	100	0.085	0.005
3779.7	100	0.025	0.005
3784.8	100	0.025	0.005
3787.3	100	-0.005	0.005
3789.0	100	0.025	0.005
3791.5	100	0.025	0.035
3794.0	100	0.055	0.005
3796.6	100	0.085	0.005
3799.1	100	0.025	0.005
3804.1	100	0.025	0.005
3806.7	100	-0.005	0.005
3808.4	100	0.025	0.005
3810.9	100	0.025	0.035
3813.4	100	0.055	0.005
3815.9	100	0.085	0.005
3818.5	100	0.025	0.005
3823.5	100	0.025	0.005
3826.0	100	-0.005	0.005
3827.7	100	0.025	0.005
3830.3	100	0.025	0.035
3832.8	100	0.055	0.005
3835.3	100	0.085	0.005
3837.8	100	0.025	0.005
3842.9	100	0.025	0.005
3845.4	100	-0.005	0.005
3847.1	100	0.025	0.005
3849.6	100	0.025	0.035
3852.2	100	0.055	0.005
3854.7	100	0.085	0.005
3857.2	100	0.025	0.005
3862.3	100	0.025	0.005
3864.8	100	-0.005	0.005

3866.5	100	0.025	0.005
3869.0	100	0.025	0.035
3871.5	100	0.055	0.005
3873.2	100	0.025	0.005
3878.3	100	0.025	0.005
3880.8	100	-0.005	0.005
3882.5	100	0.025	0.005
3885.0	100	0.025	0.035
3887.5	100	0.055	0.005
3889.2	100	0.025	0.005
3894.3	100	0.025	0.005
3896.8	100	-0.005	0.005
3898.5	100	0.025	0.005
3901.0	100	0.025	0.035
3903.5	100	0.055	0.005
3905.2	100	0.025	0.005
3910.3	100	0.025	0.005
3912.8	100	-0.005	0.005
3914.5	100	0.025	0.005
3917.0	100	0.025	0.035
3919.5	100	0.055	0.005
3921.2	100	0.025	0.005
3926.3	100	0.025	0.005
3928.8	100	-0.005	0.005
3930.5	100	0.025	0.005
3933.0	100	0.025	0.035
3935.5	100	0.055	0.005
3937.2	100	0.025	0.005
3942.3	100	0.025	0.005
3944.8	100	-0.005	0.005
3946.5	100	0.025	0.005
3951.5	100	0.025	0.005
3954.1	100	0.055	0.005
3955.7	100	0.025	0.005
3960.8	100	0.025	0.005

3963.3	100	-0.005	0.005
3965.0	100	0.025	0.005
4015.0	60	0.000	0.000
5188.3	60	0.025	0.005
5221.7	60	0.025	0.365
5291.3	60	0.055	-0.355
5358.1	60	0.085	0.335
5416.6	60	0.115	-0.325
5458.3	60	0.145	0.245
5486.2	60	0.175	-0.085
5497.3	60	0.205	0.065
5505.6	60	0.235	-0.025
5511.2	60	0.265	0.035
5514.0	60	0.295	0.005
5523.3	60	0.025	0.005
5562.2	60	0.025	-0.415
5637.4	60	-0.005	0.365
5693.1	60	-0.035	-0.235
5737.6	60	-0.065	0.215
5779.3	60	-0.095	-0.235
5801.6	60	-0.125	0.095
5818.3	60	-0.155	-0.055
5826.7	60	-0.185	0.035
5835.0	60	-0.215	-0.025
5837.8	60	-0.245	0.005
5847.1	60	0.025	0.005
5877.7	60	0.025	0.335
5941.7	60	0.055	-0.325
5991.8	60	0.085	0.275
6033.6	60	0.115	-0.175
6047.5	60	0.145	0.065
6055.8	60	0.175	-0.025
6061.4	60	0.205	0.035
6067.0	60	0.235	0.005
6074.4	60	0.025	0.005

6107.8	60	0.025	-0.355
6169.0	60	-0.005	0.335
6202.4	60	-0.035	-0.175
6227.5	60	-0.065	0.095
6246.9	60	-0.095	-0.085
6258.1	60	-0.125	0.065
6266.4	60	-0.155	-0.025
6269.2	60	-0.185	0.005
6276.6	60	0.025	0.005
6307.3	60	0.025	0.335
6360.1	60	0.055	-0.265
6404.7	60	0.085	0.245
6429.7	60	0.115	-0.085
6440.9	60	0.145	0.035
6446.4	60	0.175	0.005
6452.0	60	0.205	0.035
6454.8	60	0.235	0.005
6462.2	60	0.025	0.005
6490.0	60	0.025	-0.295
6542.9	60	-0.005	0.275
6562.4	60	-0.035	-0.085
6576.3	60	-0.065	0.065
6587.4	60	-0.095	-0.055
6595.8	60	-0.125	0.035
6601.4	60	-0.155	0.005
6604.1	60	-0.185	0.005
6611.6	60	0.025	0.005
6636.6	60	0.025	0.275
6686.7	60	0.055	-0.235
6725.7	60	0.085	0.215
6739.6	60	0.115	-0.055
6745.2	60	0.145	0.035
6750.7	60	0.175	0.005
6753.5	60	0.205	0.005
6760.0	60	0.025	0.005

6785.1	60	0.025	-0.265
6835.2	60	-0.005	0.275
6849.1	60	-0.035	-0.055
6857.4	60	-0.065	0.035
6865.8	60	-0.095	-0.025
6871.3	60	-0.125	0.035
6874.1	60	-0.155	0.005
6880.6	60	0.025	0.005
6905.7	60	0.025	0.275
6950.2	60	0.055	-0.205
6983.6	60	0.085	0.185
6994.7	60	0.115	-0.025
7000.3	60	0.145	0.035
7005.9	60	0.175	0.005
7008.7	60	0.205	0.005
7015.2	60	0.025	0.005
7040.2	60	0.025	-0.265
7082.0	60	-0.005	0.215
7093.1	60	-0.035	-0.025
7101.4	60	-0.065	0.035
7109.8	60	-0.095	-0.025
7115.4	60	-0.125	0.035
7118.1	60	-0.155	0.005
7124.6	60	0.025	0.005
7146.9	60	0.025	0.245
7185.9	60	0.055	-0.175
7213.7	60	0.085	0.155
7224.8	60	0.115	-0.025
7230.4	60	0.145	0.035
7233.2	60	0.175	0.005
7238.7	60	0.025	0.005
7261.0	60	0.025	-0.235
7297.2	60	-0.005	0.185
7305.5	60	-0.035	-0.025
7313.9	60	-0.065	0.035

7319.5	60	-0.095	0.005
7325.0	60	-0.125	0.035
7327.8	60	-0.155	0.005
7334.3	60	0.025	0.005
7353.8	60	0.025	0.215
7392.8	60	0.055	-0.175
7412.2	60	0.085	0.095
7420.6	60	0.115	-0.025
7426.2	60	0.145	0.035
7428.9	60	0.175	0.005
7434.5	60	0.025	0.005
7454.0	60	0.025	-0.205
7490.2	60	-0.005	0.185
7498.5	60	-0.035	-0.025
7506.9	60	-0.065	0.035
7512.4	60	-0.095	0.005
7515.2	60	-0.125	0.005
7520.8	60	0.025	0.005
7540.3	60	0.025	0.215
7576.5	60	0.055	-0.175
7595.9	60	0.085	0.095
7601.5	60	0.115	0.005
7607.1	60	0.145	0.035
7609.9	60	0.175	0.005
7615.4	60	0.025	0.005
7634.9	60	0.025	-0.205
7665.5	60	-0.005	0.155
7673.9	60	-0.035	-0.025
7679.4	60	-0.065	0.035
7685.0	60	-0.095	0.005
7687.8	60	-0.125	0.005
7693.4	60	0.025	0.005
7712.8	60	0.025	0.215
7749.0	60	0.055	-0.175
7765.7	60	0.085	0.095

7771.3	60	0.115	0.005		8139.6	60	-0.125	0.005
7774.1	60	0.145	0.005		8145.2	60	0.025	0.005
7776.9	60	0.175	0.005		8161.9	60	0.025	0.185
7782.4	60	0.025	0.005		8192.5	60	0.055	-0.145
7801.9	60	0.025	-0.205		8203.6	60	0.085	0.065
7832.5	60	-0.005	0.155		8209.2	60	0.115	0.005
7840.9	60	-0.035	-0.025		8212.0	60	0.145	0.005
7846.4	60	-0.065	0.035		8216.6	60	0.025	0.005
7849.2	60	-0.095	0.005		8233.3	60	0.025	-0.175
7852.0	60	-0.125	0.005		8255.6	60	-0.005	0.125
7857.6	60	0.025	0.005		8261.2	60	-0.035	0.005
7877.1	60	0.025	0.215		8266.7	60	-0.065	0.035
7910.5	60	0.055	-0.145		8269.5	60	-0.095	0.005
7924.4	60	0.085	0.065		8272.3	60	-0.125	0.005
7929.9	60	0.115	0.005		8277.9	60	0.025	0.005
7932.7	60	0.145	0.005		8294.6	60	0.025	0.185
7937.4	60	0.025	0.005		8322.4	60	0.055	-0.115
7954.1	60	0.025	-0.175		8333.5	60	0.085	0.065
7984.7	60	-0.005	0.155		8339.1	60	0.115	0.005
7993.0	60	-0.035	-0.025		8341.9	60	0.145	0.005
7998.6	60	-0.065	0.035		8346.5	60	0.025	0.005
8001.4	60	-0.095	0.005		8360.4	60	0.025	-0.145
8004.2	60	-0.125	0.005		8382.7	60	-0.005	0.125
8009.7	60	0.025	0.005		8388.3	60	-0.035	0.005
8026.4	60	0.025	0.185		8391.1	60	-0.065	0.005
8057.1	60	0.055	-0.145		8393.8	60	-0.095	0.005
8068.2	60	0.085	0.065		8398.5	60	0.025	0.005
8073.8	60	0.115	0.005		8415.2	60	0.025	0.185
8076.5	60	0.145	0.005		8440.2	60	0.055	-0.115
8081.2	60	0.025	0.005		8451.4	60	0.085	0.065
8097.9	60	0.025	-0.175		8456.9	60	0.115	0.005
8122.9	60	-0.005	0.125		8460.6	60	0.025	0.005
8128.5	60	-0.035	0.005		8474.6	60	0.025	-0.145
8134.1	60	-0.065	0.035		8494.0	60	-0.005	0.095
8136.8	60	-0.095	0.005		8499.6	60	-0.035	0.005

8502.4	60	-0.065	0.005
8505.2	60	-0.095	0.005
8509.8	60	0.025	0.005
8523.7	60	0.025	0.155
8548.8	60	0.055	-0.115
8557.1	60	0.085	0.035
8562.7	60	0.115	0.005
8566.4	60	0.025	0.005
8580.3	60	0.025	-0.145
8599.8	60	-0.005	0.095
8605.4	60	-0.035	0.005
8608.2	60	-0.065	0.005
8610.9	60	-0.095	0.005
8615.6	60	0.025	0.005
8629.5	60	0.025	0.155
8654.5	60	0.055	-0.115
8662.9	60	0.085	0.035
8665.7	60	0.115	0.005
8669.4	60	0.025	0.005
8683.3	60	0.025	-0.145
8702.8	60	-0.005	0.095
8708.4	60	-0.035	0.005
8711.1	60	-0.065	0.005
8713.9	60	-0.095	0.005
8718.6	60	0.025	0.005
8732.5	60	0.025	0.155
8752.0	60	0.055	-0.085
8760.3	60	0.085	0.035
8763.1	60	0.115	0.005
8766.8	60	0.025	0.005
8780.7	60	0.025	-0.145
8797.4	60	-0.005	0.095
8800.2	60	-0.035	0.005
8803.0	60	-0.065	0.005
8806.7	60	0.025	0.005

8820.6	60	0.025	0.155
8840.1	60	0.055	-0.085
8848.5	60	0.085	0.035
8851.2	60	0.115	0.005
8854.9	60	0.025	0.005
8866.1	60	0.025	-0.115
8882.8	60	-0.005	0.095
8885.6	60	-0.035	0.005
8888.3	60	-0.065	0.005
8892.1	60	0.025	0.005
8906.0	60	0.025	0.155
8925.5	60	0.055	-0.085
8933.8	60	0.085	0.035
8936.6	60	0.115	0.005
8940.3	60	0.025	0.005
8951.4	60	0.025	-0.115
8968.1	60	-0.005	0.095
8970.9	60	-0.035	0.005
8973.7	60	-0.065	0.005
8977.4	60	0.025	0.005
8988.5	60	0.025	0.125
9008.0	60	0.055	-0.085
9013.6	60	0.085	0.035
9016.4	60	0.115	0.005
9020.1	60	0.025	0.005
9031.2	60	0.025	-0.115
9045.1	60	-0.005	0.065
9047.9	60	-0.035	0.005
9050.7	60	-0.065	0.005
9054.4	60	0.025	0.005
9065.6	60	0.025	0.125
9085.0	60	0.055	-0.085
9090.6	60	0.085	0.035
9093.4	60	0.115	0.005
9097.1	60	0.025	0.005

9108.2	60	0.025	-0.115		9394.0	60	-0.005	0.065
9122.1	60	-0.005	0.065		9396.8	60	-0.035	0.005
9124.9	60	-0.035	0.005		9399.6	60	0.025	0.005
9127.7	60	-0.065	0.005		9407.9	60	0.025	0.095
9131.4	60	0.025	0.005		9421.8	60	0.055	-0.055
9142.6	60	0.025	0.125		9427.4	60	0.085	0.035
9162.0	60	0.055	-0.085		9430.2	60	0.025	0.005
9167.6	60	0.085	0.035		9438.5	60	0.025	-0.085
9170.4	60	0.115	0.005		9449.7	60	-0.005	0.065
9174.1	60	0.025	0.005		9452.4	60	-0.035	0.005
9185.2	60	0.025	-0.115		9455.2	60	0.025	0.005
9199.2	60	-0.005	0.065		9463.6	60	0.025	0.095
9201.9	60	-0.035	0.005		9477.5	60	0.055	-0.055
9204.7	60	0.025	0.005		9483.1	60	0.085	0.035
9215.9	60	0.025	0.125		9485.8	60	0.025	0.005
9235.3	60	0.055	-0.085		9494.2	60	0.025	-0.085
9240.9	60	0.085	0.035		9505.3	60	-0.005	0.065
9243.7	60	0.025	0.005		9508.1	60	-0.035	0.005
9254.8	60	0.025	-0.115		9510.9	60	0.025	0.005
9268.7	60	-0.005	0.065		9519.2	60	0.025	0.095
9271.5	60	-0.035	0.005		9533.2	60	0.055	-0.055
9274.3	60	0.025	0.005		9538.7	60	0.085	0.035
9282.7	60	0.025	0.095		9541.5	60	0.025	0.005
9299.4	60	0.055	-0.055		9549.9	60	0.025	-0.085
9304.9	60	0.085	0.035		9561.0	60	-0.005	0.065
9307.7	60	0.025	0.005		9563.8	60	-0.035	0.005
9318.8	60	0.025	-0.115		9566.6	60	0.025	0.005
9332.8	60	-0.005	0.065		9574.9	60	0.025	0.095
9335.5	60	-0.035	0.005		9588.8	60	0.055	-0.055
9338.3	60	0.025	0.005		9594.4	60	0.085	0.035
9346.7	60	0.025	0.095		9597.2	60	0.025	0.005
9363.4	60	0.055	-0.055		9605.5	60	0.025	-0.085
9368.9	60	0.085	0.035		9616.7	60	-0.005	0.065
9371.7	60	0.025	0.005		9619.4	60	-0.035	0.005
9380.1	60	0.025	-0.085		9622.2	60	0.025	0.005

9630.6	60	0.025	0.095		9844.9	60	0.025	0.005
9644.5	60	0.055	-0.055		9850.5	60	0.025	-0.055
9650.1	60	0.085	0.035		9858.8	60	-0.005	0.035
9652.8	60	0.025	0.005		9861.6	60	-0.035	0.005
9661.2	60	0.025	-0.085		9864.4	60	0.025	0.005
9669.5	60	-0.005	0.035		9869.9	60	0.025	0.065
9672.3	60	-0.035	0.005		9883.9	60	0.055	-0.055
9675.1	60	0.025	0.005		9886.6	60	0.085	0.005
9683.5	60	0.025	0.095		9889.4	60	0.025	0.005
9697.4	60	0.055	-0.055		9895.0	60	0.025	-0.055
9700.2	60	0.085	0.005		9903.3	60	-0.005	0.035
9702.9	60	0.025	0.005		9906.1	60	-0.035	0.005
9708.5	60	0.025	-0.055		9908.9	60	0.025	0.005
9716.9	60	-0.005	0.035		9914.5	60	0.025	0.065
9719.6	60	-0.035	0.005		9925.6	60	0.055	-0.025
9722.4	60	0.025	0.005		9928.4	60	0.085	0.005
9730.8	60	0.025	0.095		9931.2	60	0.025	0.005
9744.7	60	0.055	-0.055		9936.7	60	0.025	-0.055
9747.5	60	0.085	0.005		9945.1	60	-0.005	0.035
9750.3	60	0.025	0.005		9947.9	60	-0.035	0.005
9755.8	60	0.025	-0.055		9950.7	60	0.025	0.005
9764.2	60	-0.005	0.035		9956.2	60	0.025	0.065
9767.0	60	-0.035	0.005		9967.4	60	0.055	-0.025
9769.7	60	0.025	0.005		9970.1	60	0.085	0.005
9778.1	60	0.025	0.095		9972.9	60	0.025	0.005
9792.0	60	0.055	-0.055		9978.5	60	0.025	-0.055
9794.8	60	0.085	0.005		9986.8	60	-0.005	0.035
9797.6	60	0.025	0.005		9989.6	60	-0.035	0.005
9803.1	60	0.025	-0.055		9992.4	60	0.025	0.005
9811.5	60	-0.005	0.035		9998.0	60	0.025	0.065
9814.3	60	-0.035	0.005		10009.1	60	0.055	-0.025
9817.1	60	0.025	0.005		10011.9	60	0.085	0.005
9825.4	60	0.025	0.095		10014.7	60	0.025	0.005
9839.3	60	0.055	-0.055		10020.2	60	0.025	-0.055
9842.1	60	0.085	0.005		10028.6	60	-0.005	0.035

10030.4	60	0.025	0.005		10217.9	60	0.025	0.005
10036.0	60	0.025	0.065		10223.4	60	0.025	0.065
10047.1	60	0.055	-0.025		10231.8	60	0.055	-0.025
10049.9	60	0.085	0.005		10234.6	60	0.085	0.005
10052.7	60	0.025	0.005		10237.3	60	0.025	0.005
10058.3	60	0.025	-0.055		10242.9	60	0.025	-0.055
10066.6	60	-0.005	0.035		10251.3	60	-0.005	0.035
10068.5	60	0.025	0.005		10253.1	60	0.025	0.005
10074.1	60	0.025	0.065		10258.7	60	0.025	0.065
10085.2	60	0.055	-0.025		10267.0	60	0.055	-0.025
10088.0	60	0.085	0.005		10269.8	60	0.085	0.005
10090.8	60	0.025	0.005		10272.6	60	0.025	0.005
10096.3	60	0.025	-0.055		10278.2	60	0.025	-0.055
10104.7	60	-0.005	0.035		10286.5	60	-0.005	0.035
10106.5	60	0.025	0.005		10288.4	60	0.025	0.005
10112.1	60	0.025	0.065		10293.9	60	0.025	0.065
10123.2	60	0.055	-0.025		10302.3	60	0.055	-0.025
10126.0	60	0.085	0.005		10305.1	60	0.085	0.005
10128.8	60	0.025	0.005		10307.9	60	0.025	0.005
10134.4	60	0.025	-0.055		10313.4	60	0.025	-0.055
10142.7	60	-0.005	0.035		10321.8	60	-0.005	0.035
10144.6	60	0.025	0.005		10323.6	60	0.025	0.005
10150.1	60	0.025	0.065		10329.2	60	0.025	0.065
10161.3	60	0.055	-0.025		10337.5	60	0.055	-0.025
10164.0	60	0.085	0.005		10340.3	60	0.085	0.005
10166.8	60	0.025	0.005		10343.1	60	0.025	0.005
10172.4	60	0.025	-0.055		10348.7	60	0.025	-0.055
10180.7	60	-0.005	0.035		10357.0	60	-0.005	0.035
10182.6	60	0.025	0.005		10358.9	60	0.025	0.005
10188.2	60	0.025	0.065		10364.4	60	0.025	0.065
10196.5	60	0.055	-0.025		10372.8	60	0.055	-0.025
10199.3	60	0.085	0.005		10375.6	60	0.085	0.005
10202.1	60	0.025	0.005		10378.4	60	0.025	0.005
10207.7	60	0.025	-0.055		10383.9	60	0.025	-0.055
10216.0	60	-0.005	0.035		10392.3	60	-0.005	0.035

10394.1	60	0.025	0.005
10399.7	60	0.025	0.065
10408.1	60	0.055	-0.025
10410.8	60	0.085	0.005
10413.6	60	0.025	0.005
10419.2	60	0.025	-0.055
10427.5	60	-0.005	0.035
10429.4	60	0.025	0.005
10435.0	60	0.025	0.065
10443.3	60	0.055	-0.025
10446.1	60	0.085	0.005
10448.9	60	0.025	0.005
10454.4	60	0.025	-0.055
10462.8	60	-0.005	0.035
10464.6	60	0.025	0.005
10470.2	60	0.025	0.065
10478.6	60	0.055	-0.025
10481.3	60	0.085	0.005
10484.1	60	0.025	0.005
10489.7	60	0.025	-0.055
10498.0	60	-0.005	0.035
10499.9	60	0.025	0.005
10505.5	60	0.025	0.065
10513.8	60	0.055	-0.025
10516.6	60	0.085	0.005
10519.4	60	0.025	0.005
10525.0	60	0.025	-0.055
10533.3	60	-0.005	0.035
10535.2	60	0.025	0.005
10540.7	60	0.025	0.065
10549.1	60	0.055	-0.025
10551.9	60	0.085	0.005
10554.6	60	0.025	0.005
10560.2	60	0.025	-0.055
10568.6	60	-0.005	0.035

10570.4	60	0.025	0.005
10576.0	60	0.025	0.065
10584.3	60	0.055	-0.025
10586.2	60	0.025	0.005
10589.0	60	0.025	-0.025
10597.3	60	-0.005	0.035
10599.2	60	0.025	0.005
10604.7	60	0.025	0.065
10613.1	60	0.055	-0.025
10615.0	60	0.025	0.005
10617.7	60	0.025	-0.025
10626.1	60	-0.005	0.035
10627.9	60	0.025	0.005
10633.5	60	0.025	0.065
10641.9	60	0.055	-0.025
10643.7	60	0.025	0.005
10646.5	60	0.025	-0.025
10654.8	60	-0.005	0.035
10656.7	60	0.025	0.005
10662.3	60	0.025	0.065
10670.6	60	0.055	-0.025
10672.5	60	0.025	0.005
10675.3	60	0.025	-0.025
10683.6	60	-0.005	0.035
10685.5	60	0.025	0.005
10691.0	60	0.025	0.065
10699.4	60	0.055	-0.025
10701.2	60	0.025	0.005
10704.0	60	0.025	-0.025
10712.4	60	-0.005	0.035
10714.2	60	0.025	0.005
10719.8	60	0.025	0.065
10728.1	60	0.055	-0.025
10730.0	60	0.025	0.005
10732.8	60	0.025	-0.025

10741.1	60	-0.005	0.035
10743.0	60	0.025	0.005
10748.6	60	0.025	0.065
10756.9	60	0.055	-0.025
10758.8	60	0.025	0.005
10761.5	60	0.025	-0.025
10769.9	60	-0.005	0.035
10771.7	60	0.025	0.005
10777.3	60	0.025	0.065
10785.7	60	0.055	-0.025
10787.5	60	0.025	0.005
10790.3	60	0.025	-0.025
10798.7	60	-0.005	0.035
10800.5	60	0.025	0.005
10806.1	60	0.025	0.065
10814.4	60	0.055	-0.025
10816.3	60	0.025	0.005
10819.1	60	0.025	-0.025
10827.4	60	-0.005	0.035
10829.3	60	0.025	0.005
10834.8	60	0.025	0.065
10843.2	60	0.055	-0.025
10845.0	60	0.025	0.005
10847.8	60	0.025	-0.025
10856.2	60	-0.005	0.035
10858.0	60	0.025	0.005
10863.6	60	0.025	0.065
10871.9	60	0.055	-0.025
10873.8	60	0.025	0.005
10876.6	60	0.025	-0.025
10884.9	60	-0.005	0.035
10886.8	60	0.025	0.005
10889.6	60	0.025	0.035
10897.9	60	0.055	-0.025
10899.8	60	0.025	0.005

10902.6	60	0.025	-0.025
10908.1	60	-0.005	0.035
10910.0	60	0.025	0.005
10912.8	60	0.025	0.035
10921.1	60	0.055	-0.025
10923.0	60	0.025	0.005
10925.8	60	0.025	-0.025
10931.3	60	-0.005	0.035
10933.2	60	0.025	0.005
10936.0	60	0.025	0.035
10944.3	60	0.055	-0.025
10946.2	60	0.025	0.005
10949.0	60	0.025	-0.025
10954.5	60	-0.005	0.035
10956.4	60	0.025	0.005
10959.2	60	0.025	0.035
10967.5	60	0.055	-0.025
10969.4	60	0.025	0.005
10972.1	60	0.025	-0.025
10977.7	60	-0.005	0.035
10979.6	60	0.025	0.005
10982.4	60	0.025	0.035
10990.7	60	0.055	-0.025
10992.6	60	0.025	0.005
10995.3	60	0.025	-0.025
11000.9	60	-0.005	0.035
11002.8	60	0.025	0.005
11005.5	60	0.025	0.035
11013.9	60	0.055	-0.025
11015.8	60	0.025	0.005
11018.5	60	0.025	-0.025
11024.1	60	-0.005	0.035
11026.0	60	0.025	0.005
11028.7	60	0.025	0.035
11037.1	60	0.055	-0.025

11038.9	60	0.025	0.005
11041.7	60	0.025	-0.025
11047.3	60	-0.005	0.035
11049.2	60	0.025	0.005
11051.9	60	0.025	0.035
11057.5	60	0.055	0.005
11059.4	60	0.025	0.005
11062.1	60	0.025	-0.025
11067.7	60	-0.005	0.035
11069.6	60	0.025	0.005
11072.3	60	0.025	0.035
11077.9	60	0.055	0.005
11079.8	60	0.025	0.005
11082.6	60	0.025	-0.025
11088.1	60	-0.005	0.035
11090.0	60	0.025	0.005
11092.8	60	0.025	0.035
11098.3	60	0.055	0.005
11100.2	60	0.025	0.005
11103.0	60	0.025	-0.025
11108.5	60	-0.005	0.035
11110.4	60	0.025	0.005
11113.2	60	0.025	0.035
11118.7	60	0.055	0.005
11120.6	60	0.025	0.005
11123.4	60	0.025	-0.025
11128.9	60	-0.005	0.035
11130.8	60	0.025	0.005
11133.6	60	0.025	0.035
11139.1	60	0.055	0.005
11141.0	60	0.025	0.005
11143.8	60	0.025	-0.025
11149.4	60	-0.005	0.035
11151.2	60	0.025	0.005
11154.0	60	0.025	0.035

11159.6	60	0.055	0.005
11161.4	60	0.025	0.005
11164.2	60	0.025	-0.025
11169.8	60	-0.005	0.035
11171.6	60	0.025	0.005
11174.4	60	0.025	0.035
11180.0	60	0.055	0.005
11181.8	60	0.025	0.005
11184.6	60	0.025	-0.025
11187.4	60	-0.005	0.005
11189.2	60	0.025	0.005
11192.0	60	0.025	0.035
11197.6	60	0.055	0.005
11199.5	60	0.025	0.005
11202.2	60	0.025	-0.025
11205.0	60	-0.005	0.005
11206.9	60	0.025	0.005
11209.7	60	0.025	0.035
11215.2	60	0.055	0.005
11217.1	60	0.025	0.005
11219.9	60	0.025	-0.025
11222.6	60	-0.005	0.005
11224.5	60	0.025	0.005
11227.3	60	0.025	0.035
11232.9	60	0.055	0.005
11234.7	60	0.025	0.005
11237.5	60	0.025	-0.025
11240.3	60	-0.005	0.005
11242.1	60	0.025	0.005
11244.9	60	0.025	0.035
11250.5	60	0.055	0.005
11252.3	60	0.025	0.005
11255.1	60	0.025	-0.025
11257.9	60	-0.005	0.005
11259.8	60	0.025	0.005

11262.5	60	0.025	0.035
11268.1	60	0.055	0.005
11270.0	60	0.025	0.005
11272.7	60	0.025	-0.025
11275.5	60	-0.005	0.005
11277.4	60	0.025	0.005
11280.2	60	0.025	0.035
11285.7	60	0.055	0.005
11287.6	60	0.025	0.005
11290.4	60	0.025	-0.025
11293.2	60	-0.005	0.005
11295.0	60	0.025	0.005
11297.8	60	0.025	0.035
11303.4	60	0.055	0.005
11305.2	60	0.025	0.005
11308.0	60	0.025	-0.025
11310.8	60	-0.005	0.005
11312.6	60	0.025	0.005
11315.4	60	0.025	0.035
11321.0	60	0.055	0.005
11322.8	60	0.025	0.005
11325.6	60	0.025	-0.025
11328.4	60	-0.005	0.005
11330.3	60	0.025	0.005
11333.1	60	0.025	0.035
11338.6	60	0.055	0.005
11340.5	60	0.025	0.005
11343.3	60	0.025	-0.025
11346.0	60	-0.005	0.005
11347.9	60	0.025	0.005
11350.7	60	0.025	0.035
11356.2	60	0.055	0.005
11358.1	60	0.025	0.005
11360.9	60	0.025	-0.025
11363.7	60	-0.005	0.005

11365.5	60	0.025	0.005
11368.3	60	0.025	0.035
11371.1	60	0.055	0.005
11372.9	60	0.025	0.005
11375.7	60	0.025	-0.025
11378.5	60	-0.005	0.005
11380.4	60	0.025	0.005
11383.2	60	0.025	0.035
11385.9	60	0.055	0.005
11387.8	60	0.025	0.005
11390.6	60	0.025	-0.025
11393.4	60	-0.005	0.005
11395.2	60	0.025	0.005
11398.0	60	0.025	0.035
11400.8	60	0.055	0.005
11402.6	60	0.025	0.005
11405.4	60	0.025	-0.025
11408.2	60	-0.005	0.005
11410.1	60	0.025	0.005
11412.8	60	0.025	0.035
11415.6	60	0.055	0.005
11417.5	60	0.025	0.005
11420.3	60	0.025	-0.025
11423.0	60	-0.005	0.005
11424.9	60	0.025	0.005
11427.7	60	0.025	0.035
11430.5	60	0.055	0.005
11432.3	60	0.025	0.005
11435.1	60	0.025	-0.025
11437.9	60	-0.005	0.005
11439.7	60	0.025	0.005
11442.5	60	0.025	0.035
11445.3	60	0.055	0.005
11447.2	60	0.025	0.005
11450.0	60	0.025	-0.025

11452.7	60	-0.005	0.005
11454.6	60	0.025	0.005
11457.4	60	0.025	0.035
11460.2	60	0.055	0.005
11462.0	60	0.025	0.005
11464.8	60	0.025	-0.025
11467.6	60	-0.005	0.005
11469.4	60	0.025	0.005
11472.2	60	0.025	0.035
11475.0	60	0.055	0.005
11476.9	60	0.025	0.005
11479.6	60	0.025	-0.025
11482.4	60	-0.005	0.005
11484.3	60	0.025	0.005
11487.1	60	0.025	0.035
11489.8	60	0.055	0.005
11491.7	60	0.025	0.005
11494.5	60	0.025	-0.025
11497.3	60	-0.005	0.005
11499.1	60	0.025	0.005
11501.9	60	0.025	0.035
11504.7	60	0.055	0.005
11506.6	60	0.025	0.005
11509.3	60	0.025	-0.025
11512.1	60	-0.005	0.005
11514.0	60	0.025	0.005
11516.8	60	0.025	0.035
11519.5	60	0.055	0.005
11521.4	60	0.025	0.005
11524.2	60	0.025	-0.025
11527.0	60	-0.005	0.005
11528.8	60	0.025	0.005
11531.6	60	0.025	0.035
11534.4	60	0.055	0.005
11536.2	60	0.025	0.005

11539.0	60	0.025	-0.025
11541.8	60	-0.005	0.005
11543.7	60	0.025	0.005
11546.4	60	0.025	0.035
11549.2	60	0.055	0.005
11551.1	60	0.025	0.005
11553.9	60	0.025	-0.025
11556.7	60	-0.005	0.005
11558.5	60	0.025	0.005
11561.3	60	0.025	0.035
11564.1	60	0.055	0.005
11565.9	60	0.025	0.005
11568.7	60	0.025	-0.025
11571.5	60	-0.005	0.005
11573.4	60	0.025	0.005
11576.1	60	0.025	0.035
11578.9	60	0.055	0.005
11580.8	60	0.025	0.005
11583.6	60	0.025	-0.025
11586.3	60	-0.005	0.005
11588.2	60	0.025	0.005
11591.0	60	0.025	0.035
11593.8	60	0.055	0.005
11595.6	60	0.025	0.005
11598.4	60	0.025	-0.025
11601.2	60	-0.005	0.005
11603.0	60	0.025	0.005
11605.8	60	0.025	0.035
11608.6	60	0.055	0.005
11610.5	60	0.025	0.005
11613.2	60	0.025	-0.025
11616.0	60	-0.005	0.005
11617.9	60	0.025	0.005
11620.7	60	0.025	0.035
11623.5	60	0.055	0.005

11625.3	60	0.025	0.005
11628.1	60	0.025	-0.025
11630.9	60	-0.005	0.005
11632.7	60	0.025	0.005
11635.5	60	0.025	0.035
11638.3	60	0.055	0.005
11640.2	60	0.025	0.005
11642.9	60	0.025	-0.025
11645.7	60	-0.005	0.005
11647.6	60	0.025	0.005
11650.4	60	0.025	0.035
11653.1	60	0.055	0.005
11655.0	60	0.025	0.005
11657.8	60	0.025	-0.025
11660.6	60	-0.005	0.005
11662.4	60	0.025	0.005
11665.2	60	0.025	0.035
11668.0	60	0.055	0.005
11669.8	60	0.025	0.005
11672.6	60	0.025	-0.025
11675.4	60	-0.005	0.005
11677.3	60	0.025	0.005
11680.0	60	0.025	0.035
11682.8	60	0.055	0.005
11684.7	60	0.025	0.005
11687.5	60	0.025	-0.025
11690.3	60	-0.005	0.005
11692.1	60	0.025	0.005
11694.9	60	0.025	0.035
11697.7	60	0.055	0.005
11699.5	60	0.025	0.005
11702.3	60	0.025	-0.025
11705.1	60	-0.005	0.005
11707.0	60	0.025	0.005
11709.7	60	0.025	0.035

11712.5	60	0.055	0.005
11714.4	60	0.025	0.005
11717.2	60	0.025	-0.025
11719.9	60	-0.005	0.005
11721.8	60	0.025	0.005
11724.6	60	0.025	0.035
11727.4	60	0.055	0.005
11729.2	60	0.025	0.005
11732.0	60	0.025	-0.025
11734.8	60	-0.005	0.005
11736.6	60	0.025	0.005
11739.4	60	0.025	0.035
11742.2	60	0.055	0.005
11744.1	60	0.025	0.005
11746.8	60	0.025	-0.025
11749.6	60	-0.005	0.005
11751.5	60	0.025	0.005
11754.3	60	0.025	0.035
11757.1	60	0.055	0.005
11758.9	60	0.025	0.005
11761.7	60	0.025	-0.025
11764.5	60	-0.005	0.005
11766.3	60	0.025	0.005
11769.1	60	0.025	0.035
11771.9	60	0.055	0.005
11773.8	60	0.025	0.005
11776.5	60	0.025	-0.025
11779.3	60	-0.005	0.005
11781.2	60	0.025	0.005
11784.0	60	0.025	0.035
11786.7	60	0.055	0.005
11788.6	60	0.025	0.005
11791.4	60	0.025	-0.025
11794.2	60	-0.005	0.005
11796.0	60	0.025	0.005

11798.8	60	0.025	0.035
11801.6	60	0.055	0.005
11803.4	60	0.025	0.005
11806.2	60	0.025	-0.025
11809.0	60	-0.005	0.005
11810.9	60	0.025	0.005
11813.6	60	0.025	0.035
11816.4	60	0.055	0.005
11818.3	60	0.025	0.005
11821.1	60	0.025	-0.025
11823.9	60	-0.005	0.005
11825.7	60	0.025	0.005
11828.5	60	0.025	0.035
11831.3	60	0.055	0.005
11833.1	60	0.025	0.005
11835.9	60	0.025	-0.025
11838.7	60	-0.005	0.005
11840.6	60	0.025	0.005
11843.3	60	0.025	0.035
11846.1	60	0.055	0.005
11848.0	60	0.025	0.005
11850.8	60	0.025	-0.025
11853.5	60	-0.005	0.005
11855.4	60	0.025	0.005
11858.2	60	0.025	0.035
11861.0	60	0.055	0.005
11862.8	60	0.025	0.005
11865.6	60	0.025	-0.025
11868.4	60	-0.005	0.005
11870.2	60	0.025	0.005
11873.0	60	0.025	0.035
11875.8	60	0.055	0.005
11877.7	60	0.025	0.005
11883.2	60	0.025	0.005
11886.0	60	-0.005	0.005

11887.9	60	0.025	0.005
11890.7	60	0.025	0.035
11893.4	60	0.055	0.005
11895.3	60	0.025	0.005
11900.9	60	0.025	0.005
11903.6	60	-0.005	0.005
11905.5	60	0.025	0.005
11908.3	60	0.025	0.035
11911.1	60	0.055	0.005
11912.9	60	0.025	0.005
11918.5	60	0.025	0.005
11921.3	60	-0.005	0.005
11923.1	60	0.025	0.005
11925.9	60	0.025	0.035
11928.7	60	0.055	0.005
11930.5	60	0.025	0.005
11936.1	60	0.025	0.005
11938.9	60	-0.005	0.005
11940.8	60	0.025	0.005
11943.5	60	0.025	0.035
11946.3	60	0.055	0.005
11948.2	60	0.025	0.005
11953.7	60	0.025	0.005
11956.5	60	-0.005	0.005
11958.4	60	0.025	0.005
11961.2	60	0.025	0.035
11963.9	60	0.055	0.005
11965.8	60	0.025	0.005
11971.4	60	0.025	0.005
11974.2	60	-0.005	0.005
11976.0	60	0.025	0.005
11978.8	60	0.025	0.035
11981.6	60	0.055	0.005
11983.4	60	0.025	0.005
11989.0	60	0.025	0.005

11991.8	60	-0.005	0.005		12094.8	60	0.025	0.005
11993.6	60	0.025	0.005		12097.5	60	-0.005	0.005
11996.4	60	0.025	0.035		12099.4	60	0.025	0.005
11999.2	60	0.055	0.005		12102.2	60	0.025	0.035
12001.1	60	0.025	0.005		12105.0	60	0.055	0.005
12006.6	60	0.025	0.005		12106.8	60	0.025	0.005
12009.4	60	-0.005	0.005		12112.4	60	0.025	0.005
12011.3	60	0.025	0.005		12115.2	60	-0.005	0.005
12014.0	60	0.025	0.035		12117.0	60	0.025	0.005
12016.8	60	0.055	0.005		12119.8	60	0.025	0.035
12018.7	60	0.025	0.005		12122.6	60	0.055	0.005
12024.3	60	0.025	0.005		12124.5	60	0.025	0.005
12027.0	60	-0.005	0.005		12130.0	60	0.025	0.005
12028.9	60	0.025	0.005		12132.8	60	-0.005	0.005
12031.7	60	0.025	0.035		12134.7	60	0.025	0.005
12034.5	60	0.055	0.005		12137.4	60	0.025	0.035
12036.3	60	0.025	0.005		12140.2	60	0.055	0.005
12041.9	60	0.025	0.005		12142.1	60	0.025	0.005
12044.7	60	-0.005	0.005		12147.6	60	0.025	0.005
12046.5	60	0.025	0.005		12150.4	60	-0.005	0.005
12049.3	60	0.025	0.035		12152.3	60	0.025	0.005
12052.1	60	0.055	0.005		12155.1	60	0.025	0.035
12053.9	60	0.025	0.005		12157.9	60	0.055	0.005
12059.5	60	0.025	0.005		12159.7	60	0.025	0.005
12062.3	60	-0.005	0.005		12165.3	60	0.025	0.005
12064.1	60	0.025	0.005		12168.1	60	-0.005	0.005
12066.9	60	0.025	0.035		12169.9	60	0.025	0.005
12069.7	60	0.055	0.005		12172.7	60	0.025	0.035
12071.6	60	0.025	0.005		12175.5	60	0.055	0.005
12077.1	60	0.025	0.005		12177.3	60	0.025	0.005
12079.9	60	-0.005	0.005		12182.9	60	0.025	0.005
12081.8	60	0.025	0.005		12185.7	60	-0.005	0.005
12084.6	60	0.025	0.035		12187.5	60	0.025	0.005
12087.3	60	0.055	0.005		12190.3	60	0.025	0.035
12089.2	60	0.025	0.005		12193.1	60	0.055	0.005

12195.0	60	0.025	0.005		12298.9	60	0.055	0.005
12200.5	60	0.025	0.005		12300.7	60	0.025	0.005
12203.3	60	-0.005	0.005		12306.3	60	0.025	0.005
12205.2	60	0.025	0.005		12309.1	60	-0.005	0.005
12208.0	60	0.025	0.035		12310.9	60	0.025	0.005
12210.7	60	0.055	0.005		12313.7	60	0.025	0.035
12212.6	60	0.025	0.005		12316.5	60	0.055	0.005
12218.2	60	0.025	0.005		12318.4	60	0.025	0.005
12220.9	60	-0.005	0.005		12323.9	60	0.025	0.005
12222.8	60	0.025	0.005		12326.7	60	-0.005	0.005
12225.6	60	0.025	0.035		12328.6	60	0.025	0.005
12228.4	60	0.055	0.005		12331.3	60	0.025	0.035
12230.2	60	0.025	0.005		12334.1	60	0.055	0.005
12235.8	60	0.025	0.005		12336.0	60	0.025	0.005
12238.6	60	-0.005	0.005		12341.6	60	0.025	0.005
12240.4	60	0.025	0.005		12344.3	60	-0.005	0.005
12243.2	60	0.025	0.035		12346.2	60	0.025	0.005
12246.0	60	0.055	0.005		12349.0	60	0.025	0.035
12247.8	60	0.025	0.005		12351.8	60	0.055	0.005
12253.4	60	0.025	0.005		12353.6	60	0.025	0.005
12256.2	60	-0.005	0.005		12359.2	60	0.025	0.005
12258.1	60	0.025	0.005		12362.0	60	-0.005	0.005
12260.8	60	0.025	0.035		12363.8	60	0.025	0.005
12263.6	60	0.055	0.005		12366.6	60	0.025	0.035
12265.5	60	0.025	0.005		12369.4	60	0.055	0.005
12271.0	60	0.025	0.005		12371.2	60	0.025	0.005
12273.8	60	-0.005	0.005		12376.8	60	0.025	0.005
12275.7	60	0.025	0.005		12379.6	60	-0.005	0.005
12278.5	60	0.025	0.035		12381.4	60	0.025	0.005
12281.2	60	0.055	0.005		12384.2	60	0.025	0.035
12283.1	60	0.025	0.005		12387.0	60	0.055	0.005
12288.7	60	0.025	0.005		12388.9	60	0.025	0.005
12291.5	60	-0.005	0.005		12394.4	60	0.025	0.005
12293.3	60	0.025	0.005		12397.2	60	-0.005	0.005
12296.1	60	0.025	0.035		12399.1	60	0.025	0.005

12401.9	60	0.025	0.035
12404.6	60	0.055	0.005
12406.5	60	0.025	0.005
12412.1	60	0.025	0.005
12414.8	60	-0.005	0.005
12416.7	60	0.025	0.005
12419.5	60	0.025	0.035
12422.3	60	0.055	0.005
12424.1	60	0.025	0.005
12429.7	60	0.025	0.005
12432.5	60	-0.005	0.005
12434.3	60	0.025	0.005
12437.1	60	0.025	0.035
12439.9	60	0.055	0.005
12441.8	60	0.025	0.005
12447.3	60	0.025	0.005
12450.1	60	-0.005	0.005
12452.0	60	0.025	0.005
12454.7	60	0.025	0.035
12457.5	60	0.055	0.005
12459.4	60	0.025	0.005
12464.9	60	0.025	0.005
12467.7	60	-0.005	0.005
12469.6	60	0.025	0.005
12475.2	60	0.025	0.005
12477.9	60	0.055	0.005
12479.8	60	0.025	0.005
12485.4	60	0.025	0.005
12488.1	60	-0.005	0.005
12490.0	60	0.025	0.005

Annex 3 – Appendix 4

Test equipment tolerances

Table B.1
 Instrumentation accuracy

<i>Parameter</i>	<i>Control accuracy</i>	<i>Instrumentation accuracy</i>
Tyre forces (using filtered values)	Fz: ± 50 N or 1 % using filtered values whichever is greater.	at full scale: Fz: ± 1 %
	Fy: ± 100 N or 5 % using filtered values whichever is greater, for the difference between input peaks and actually generated peaks.	at full scale: Fy: ± 1 %
	Fx: ± 100 N or 5 % using filtered values whichever is greater, for the difference between input peaks and actually generated peaks.	at full scale: Fx: ± 1 %
Tyre torque	My: ± 40 Nm or 5 % using filtered values whichever is greater, for the difference between input peaks and actually generated peaks.	at full scale: My: ± 1 %
Inflation pressure	Not applicable	± 3 kPa
Mass scale	Not applicable	± 2 g
Test duration	For the test time durations, the total time of an actual test shall not differ more than ± 5 % from the total input time, 69.39h (249800s). The interval of measurement shall be more than 1Hz.	The accuracy of measuring one second is within ± 0.02 s
Camber angle	(0 ± 0.1) degrees	(0 ± 0.1) degrees
Temperature	± 3 °C	± 0.5 °C
Speed	± 2 km/h	± 0.1 % at full scale or ± 0.3 km/h, whichever is greater
Loaded radius	Not applicable	± 1 mm

Annex 3 – Appendix 5

Replacement of sandpaper surface

Sandpaper surface shall be replaced when it does not meet the specifications described in paragraph 2.4.2.3. of this Annex; **partial replacement is also allowed. In the case that the drum diameter is 3 m, Sandpaper-sandpaper** surface should be replaced ~~either~~ when **the running distance reaches:**

- (a) **20000 km for 2 positions drum** ~~Running distance reached 20000 km for 2 positions drum in case of 3 m,~~
- (b) ~~40000 km for 1 position drum in case of 3 m, [or partial replacement is also allowed]~~

~~In case of~~**In the case that the** drum diameter is not ~~3-3~~ m, the following formula applies:

Road surface replacement distance (km) = Road surface replacement distance (standard value) x Drum diameter owned by each testing institution (m) / Standard drum diameter (m)

Where:

Road surface replacement distance (standard value) = 20000 km;

Standard drum diameter = 3 m.

Annex 3 – Appendix 6

Example of a test report for indoor drum test method

The test report shall include the following information.

Test report number:	
Test machine identification:	
Drum circumference diameter (m):	
Test cycle (2 positions /1 position):	
Talc or Silica:	Talc or Silica

Test starting date:	–
Test end date:	

	Beginning of test	End of test
MPD of test surface (mm):		
Micro-roughness of test surface (mm)		

<i>Type of test tyre</i>	<i>Reference tyre</i>	<i>Candidate tyre</i>
Tyre class:		
Brand:		
Pattern/trade description:	SRTT...	
Tyre size designation:		
Service description:		
Test load (N):		
Test inflation pressure (kPa):		
Tyre identification:		
3PMSF marking (Yes/No) ⁷ :		
M+S marking (Yes/No) ⁷ :		
XL marking (Yes/No) ⁷ :		
Tyres with a nominal aspect ratio ≤ 40 and suitable for speeds ≥ 300 km/h (Yes/No) ⁷ :		
[Tyres with low load index (LI < 77) (Yes/No) ⁷ :]		
Rim width code:	7.5	
Inflation pressure (kPa)	Beginning of test:	
	End of test:	
Mass of tyre (g)	Before test:	
	After test:	
Test distance (km):		
Abrasion rate (mg/km):		
Abrasion level (mg/(km·t)):		
A_{margin} applied:		

Abrasion index (AICT):		
Average ambient temp. (°C):		
RMS of G(x):		
RMS of G(y):		
RMS of G(x,y):		
Average of Fz:		
Amount of powder sprayed relative to reference tyre:		
Remarks:		

II. Justification

- 1. The amendments proposed are the result of the work of the Task Force Tyre Abrasion done since the submission of document ECE/TRANS/WP.29/GRBP/2025/27.
