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**World Forum for Harmonization of Vehicle Regulations**

**Working Party on Noise and Tyres**

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Item 7 (f) of the provisional agenda

**Tyres: Tyre abrasion**

**Proposal for Supplement 02 to the 04 series of amendments to UN Regulation No. 117**

**Submitted by the** **Task Force on Tyres Abrasion**[[1]](#footnote-2)\*

The text reproduced below was prepared by the expert from Task Force on Tyres Abrasion (TFTA). This document aims to introduce the test methods to measure tyre abrasion. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

**I. Proposal**

*Paragraph 1.1.,* amend to read:

“1.1. This Regulation applies to new pneumatic tyres \* of classes C1, C2 and C3 in new state with regard to their sound emissions, rolling resistance and to adhesion performance on wet surfaces (wet adhesion) and for class C1 tyres in worn state with regard to adhesion performance on wet surfaces (wet adhesion). **[It also applies to C1 tyres in new state with regards to their tyre abrasion.].** It does not, however, apply to:”

*Insert a new paragraph 1.3.,* to read:

“**1.3. In the case of class C1 tyres, except ice grip tyres and tyres having a nominal rim diameter code ≤ 13, approval shall be supplemented with information on the abrasion level according to paragraphs 5.7 to 5.9 of this Regulation.**”

*Paragraph 2.7.,* amend to read:

“2.7. "*Representative tyre size*" means the tyre size which is submitted to the test described in Annex 3 to this Regulation with regard to rolling sound emissions, or Annex 5 for adhesion on wet surfaces or Annex 6 for rolling resistance **or Annex 9 for adhesion on wet surfaces of tyres in worn state** to assess the conformity for the type approval of the type of tyre, or Annex 7 for measuring snow performance, or Annex 8 for measuring ice performance~~, or Annex 9 for adhesion on wet surfaces tyres in worn state~~.”

*Paragraph 2.18.,* amend to read:

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

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

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

(c) F3611-22 for the size P225/60R16 in worn state and referred to as "moulded SRTT16 worn",

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

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

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

**[(g) reserved,**

**(h) reserved,**

**(i) F3676 – 23 for the size 225/45R17 and referred to as "****SRTT17S",**

**(j) F3675 – 23 for the size 225/45R17 and referred to as "SRTT17W".]**”

*Insert a new paragraph 2.21. and its subparagraphs,* to read:

“**2.21. Abrasion performance - Specific definitions**

**2.21.1. "*Abrasion level*" means the ratio of mass of material lost from the tyre due to the abrasion process per distance travelled to the load on the tyre, and expressed in mg/km/t.**

**2.21.2. "*Abrasion rate*" means the ratio of mass of material lost from the tyre due to the abrasion process per distance travelled, and expressed in mg/km.**

**2.21.3. "*Abrasion index*" (AICT) of candidate tyre means the dimensionless unit for expressing the tyre abrasion level of a tyre relative to that of the applicable Standardized Reference Test Tyre (SRTT).**”

*Paragraph 3.1.1.*,amend to read:

“3.1.1. The performance characteristics to be assessed for the type of tyre; "rolling sound emissions level" and/or "adhesion performance level on wet surfaces of a tyre in new state" and/or "adhesion performance level on wet surfaces of a tyre in worn state" and/or "rolling resistance level"; "snow performance level" in case of tyre for use in severe snow conditions and additionally "ice performance level" in case of ice grip tyre **[and/or “tyre abrasion”];**”

*Insert a new paragraph 3.1.1.1.*,to read:

“**3.1.1.1. In case of class C1 tyres, the information on the abrasion level, if reported, shall be communicated in the format according to the test report sheet of Appendix 2 or Appendix 6 of Annex 10;**”

*Paragraph 3.2.1.*,amend to read:

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

*Insert new paragraph 5.7 to 5.9.,* to read:

“**5.7. Until [6 July 2025] and upon request of the applicant, during the approval of new type of class C1 tyres, it will be possible to determine the tyre abrasion level of the tyre type in accordance with Annex 10 to this Regulation. The test results shall be communicated to the Type Approval Authority in the format according to the test report sheet of Appendix 2 or Appendix 6 of Annex 10.**

**5.8. Starting from [7 July 2025], the manufacturer during the approval of new type of class C1 tyres, shall communicate the tyre abrasion level of the tyre type determined in accordance with Annex 10 to this Regulation. The test results shall be communicated to the Type Approval Authority in the format according to the test report sheet of Appendix 2 or Appendix 6 of Annex 10.**

**5.9. Abrasion tests are not required for extensions of existing type approvals according to this Regulation first granted before [6 July 2025].**”

*Annex 1*,

*Introductory part,* amend to read:

“…

Concerning:2 Approval granted

Approval extended

Approval refused

Approval withdrawn

Production definitively discontinued

of a type of tyre with regard to "rolling sound emission level" and/or "adhesion performance on wet surfaces" and/or "rolling resistance"**[and/or “tyre abrasion”]** pursuant to UN Regulation No. 117

Approval No.3....... Suffix(es)4

1. …”

*Insert a new item 8.6.*,to read:

“**8.6. Abrasion level available in the case of class C1 tyres (Yes/No)2**”

*Insert a new Annex 10,* to read:

“**Annex 10**

**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 compared to the abrasion level of a standard reference test tyre. It is measured with one of the followings test methods:**

**(a)** **vehicle test method on public open roads;**

**(b) indoor drum test method.**

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

**1.1. Scope**

**This method applies to C1 tyres in scope of this regulation except ice grip tyres and tyres having a nominal rim diameter code ≤ 13.**

**1.2. Definitions**

**In addition to relevant definitions set at point 2 of this Regulation the following apply.**

**1.2.1. *"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.**

**1.2.2. *"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.**

**1.2.3. *"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 ran 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 the internal combustion engine, or an electric machine.**

**1.2.7. *"Hybrid electric vehicle (HEV)"* is a Hybrid vehicle where one of the propulsion energy converters is an electric machine.**

**1.2.8. *"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.**

**1.2.9. *"Not off-vehicle charging hybrid electric vehicle (NOVC-HEV)"* is a hybrid electric vehicle that cannot be charged from an external source.**

**1.2.10. *"Off-vehicle charging hybrid electric vehicle (OVC-HEV)"* is a Hybrid electric vehicle that can be charged from an external source.**

**1.2.11. *"Pure electric vehicle (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 (ICE)"* is a vehicle where all propulsion energy converters are internal combustion engines.**

**1.2.13. *"Rechargeable electric energy storage system – REESS"* means an electric energy storage system that is rechargeable and that provides electric energy for electric propulsion.**

**1.2.14. *"FWD (Front Wheel Drive) vehicle"* means a vehicle where only the front axle delivers traction torque.**

**1.2.15. *"RWD (Rear Wheel Drive) vehicle"* means a vehicle where only the rear axle delivers traction torque.**

**1.2.16. *"4WD (4 Wheel Drive) vehicle"* means a vehicle where one of the axle traction torque can be switched off by the driver.**

**1.2.17. *"AWD (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 f2 coefficient"* (measured in N/(km/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/s2) 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/s2) 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. *"Test tyre"* indicates either candidate tyres or reference tyres.**

**1.2.24. *"Candidate tyre"* means a tyre whose abrasion performance is evaluated relative to that of a reference tyre.**

**1.2.25. *"Reference tyre"* means the tyre which will be used in each convoy as a reference for the evaluation of the abrasion performance of the candidate tyre, according to the following table:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | | ***Reference tyre*** | |
| ***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** |

**1.3. Symbols and abbreviated terms**

|  |  |  |
| --- | --- | --- |
| ***Symbol*** | ***Unit*** | ***Designation*** |
|  | **kg** | **Test load for each reference tyre** |
|  | **kg** | **Test load for each candidate tyre** |
|  | **g** | **Reference tyre initial mass of tyre i** |
|  | **g** | **Reference tyre final mass of tyre i** |
|  | **g** | **Candidate tyre initial mass of tyre i** |
|  | **g** | **Candidate tyre final mass of tyre i** |
| **SS** | **mg/km/t/oC** | **Sensitivity of *SRTT17S* to temperature variation** |
| **SW** | **mg/km/t/oC** | **Sensitivity of *SRTT17W* to temperature variation** |
| **S1** | **mg/km/t** | **Minimum abrasion rate @ 20℃ of SRTT17S during test** |
| **S2** | **mg/km/t** | **Maximum abrasion rate @ 20℃ of SRTT17S during test** |
| **W1** | **mg/km/t** | **Minimum abrasion rate @ 10℃of SRTT17W during test** |
| **W2** | **mg/km/t** | **Maximum abrasion rate @ 10℃ of SRTT17W during test** |
|  | **km** | **Total distance run by each test tyre during test** |
|  | **mg/km** | **Abrasion rate of reference tyre at test conditions** |
|  | **mg/km** | **Abrasion rate of candidate tyre at test conditions** |
|  | **mg/km/t** | **Abrasion rate of reference tyre, normalized to load in ton, at test conditions** |
|  | **mg/km/t** | **Abrasion rate of candidate tyre, normalized to load in ton, at test conditions** |
|  | **No dimension** | **Abrasion index of the candidate tyre** |

**1.4. Instrumentation.**

**Calibration and check for weight scales shall be carried out according to Annex 10 Appendix 1.**

**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.**

**The distance ran by the tyre shall equal the GNSS reported distance plus the distance ran without a GNSS signal, unless the latter is estimated by the GNSS system., 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 °C. A continuous measurement device recording the temperature is acceptable as well provided it fulfils the measurement accuracy described above.**

**Initial and final measurement 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 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 device or product not removing any rubber from the tyre (e.g. water based non-abrasive cleaner). Any visible stone shall be removed from the pattern before mass measurement. The measurement shall be repeated 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 device or product not removing any rubber from the tyre (e.g. water based non-abrasive cleaner). Any visible stone 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 full fuel tank (ICE vehicle), test ballast, equipped with the tyres to be tested, and wheels used for the test with drivers’ average weight. Load Q on each wheel shall be measured.**

**1.5.4. Vehicle alignment measurement procedure**

**The vehicle alignments shall be measured, with full fuel tank (ICE vehicle), test ballast, equipped with the tyres to be tested, and wheels used for the test with drivers’ average weight.**

**1.6. Vehicle requirements**

**1.6.1. General requirements**

**Alignments setting shall be performed as following:**

**(a) Measure and record the alignment values with vehicles in loaded conditions as explained in 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 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 shall take place maximum at 50 km of distance run before starting the test;**

**(d) Optionally at half distance;**

**(e) In case of an impact that may affect the alignment (e.g. curbstone contact, etc);**

**(f) At the end of the test. The alignment shall take place maximum at 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 initial measurement under the same condition.**

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

**1.6.2.1. Vehicles used for candidate tyres, loaded condition as described in paragraph 1.5.4.:**

**Toe IN/OUT angle per wheel on the front axle set to 0 ± 0.1 degrees;**

**Camber angle per wheel on the front axle set between -1.2 degrees to 0 degrees;**

**Toe IN/OUT angle per wheel on the rear axle between 0.05 degrees and 0.15 degrees;**

**Camber angle per wheel on the rear axle between -1.9 degrees and -0.6 degrees.**

**1.6.2.2. Vehicle used for reference tyres, loaded condition as described in paragraph 1.5.4:**

**Toe IN/OUT angle per wheel on the front axle set to 0 ± 0.05 degrees;**

**Camber angle per wheel on the front axle set between -1.2 degrees to 0 degree;**

**Toe IN/OUT angle per wheel on the rear axle between 0.05 degrees and 0.15 degrees;**

**Camber angle per wheel on the rear axle between -1.9 degrees and -0.6 degrees.**

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

**1.6.3.1. Vehicles used for candidate tyres, loaded condition as described in paragraph 1.5.4.:**

**(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. Vehicle used for reference tyres loaded condition as described in paragraph 1.5.4.:**

**(a) Toe IN/OUT angle per wheel on the front axle set 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.**

**In addition, for reference vehicle, toe IN/OUT in absolute value shall be lower than or equal to the values used for candidate vehicles for front axle.**

**1.6.4. Vehicle acceptable suspension and static tuning for 4WD vehicles**

**4WD vehicles may be used if only one axle is applied as 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**

**Vehicle with permanent 4WD shall respect the RWD vehicles settings described in paragraph 1.6.3. of this Annex.**

**1.6.6. In case no vehicle respecting conditions described in paragraph 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 vehicle if less than 4) able to fit the candidate tyres must demonstrated that the settings limits cannot be achieved. The vehicles shall be aged of less than two years, and made by 4 different carmakers.**

**(b) Select vehicles (both reference and candidate vehicles) respecting following criteria:**

**(i) Front Toe shall respect the previously given tolerances (0° +/- tolerance);**

**(ii) Front camber angle shall not differ by more than 0.5° between Reference and Candidate vehicle. Reference vehicle shall have a Front Camber lower than candidate vehicle, in absolute value;**

**(iii) Rear camber angle shall not differ by more than 0.6° between reference and candidate vehicle. Reference vehicle shall have a rear camber lower than candidate vehicle, in absolute value;**

**(iiii) Rear Toe angle shall not differ by more than 0.1° between reference and candidate vehicle. Reference vehicle shall have a rear toe lower than candidate vehicle, in absolute value;**

**(iiii) In addition, the following limit shall be respected for candidate vehicles with loaded condition as described in paragraph 1.5.3.:**

**(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 degree and 0.3 degrees;**

**(d) Camber angle on the rear axle set between -2.7 degree and 0.3 degrees.**

**(iiiii) In addition, the following limit shall be respected for candidate vehicles with loaded condition as described in paragraph 1.5.3.:**

**(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 and 0.3 degrees;**

**(d) Camber angle on the rear axle set between -2.7 degree and 0.3 degrees.**

**1.6.7. Vehicle acceptable propulsion energy convertor**

**All the propulsion energy convertor types are allowed, as long as they are homogeneous in the convoy. The convoy shall consist of vehicles that belong in the same vehicle type in terms of the vehicles’ electrification grade (i.e. ICE 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 be fitted on RWD vehicle.**

**If the tyre size can only be fitted on all wheels drive vehicles, an all wheels drive vehicle shall be used, and the reference tyre shall as well be fitted on all wheels drive vehicle. If available, 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 as it is defined by the vehicle manufacturer shall be selected.**

**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 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 f2 value of the vehicle with reference tyres shall be lower than or equal to 1.2 times the f2 value of the vehicles with candidate tyres.**

**The provision defined in this paragraph does not apply when the f2 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\*4 = 2680 kg.**

**The loaded vehicle mass shall then be 2680\*67 % = 1796 kg with a tolerance of 2680\*7 %, which corresponds to ± 188 kg.**

**Load distribution between front and rear axle 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 loads is authorized, as long as it does not exceed 85 per cent of the vehicle maximum payload. A minimum ballast of 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**

**Circuit shall be made of one or several closed loops. Vehicles shall return to the departure point. The minimum length shall be 300 km of different roads. Vehicle shall not be transported on a car carrier, except in case of vehicle/tyre failure.**

**When the circuit allows for running tests in both directions, the test shall be run to an equal distance for each direction when both directions are used.**

**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 driving style:**

**(i) more than 35 per cent of the total distance;**

**(ii) The longitudinal acceleration standard deviation shall be in range from 0.15 to 0.55 m/s2;**

**(iii) The lateral acceleration standard deviation shall be in range from 0.15 to 0.80 m/s2.**

**(b) Roads representative of regional driving style:**

**(i) more than 25 per cent of the total distance;**

**(ii) The longitudinal acceleration standard deviation shall be in range from 0.20 to 0.75 m/s2;**

**(iii) The lateral acceleration standard deviation shall be in range from 0.70 to 1.80 m/s2.**

**(c) Roads representative of urban driving style:**

**(i) more than 25 per cent of the total distance;**

**(ii) The longitudinal acceleration standard deviation shall be in range from 0.40 to 0.90 m/s2;**

**(iii) The lateral acceleration standard deviation shall be in range from 0.40 to 1.20 m/s2.**

**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**

**(a) Longitudinal acceleration: 0.45 m/s2 ± 10 per cent;**

**(b) Lateral acceleration: 0.93 m/s2 ± 10 per cent.**

**Longitudinal and lateral accelerations standard deviations during the test shall not deviate by more than 5 per cent from one vehicle to another vehicle of the same convoy.**

**1.6.13.3.2. Maximum acceleration**

**(a) Longitudinal acceleration: ± 5 m/s2 for a distance representing at least 99.98 per cent of the total distance;**

**(b) Lateral acceleration: ± 5 m/s2 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 test, the circuit shall respect the following abrasion level specifications for reference tyres:**

**(a) SRTT17S: the circuit abrasion level at 20 ℃ shall be in the range from [s1 to s2] mg/km/t;**

**(b) SRTT17W: the circuit abrasion level at 10 ℃ shall be in the range from [w1 to w2] 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, the one for the reference tyre which is used on the circuit.**

Abrasion rate mg/km/t

Temperature (test average)

20 oC

s1

s2

**Figure 1: The normalised to 20°C abrasion rate 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 reference tyres’ abrasion rate:**

**(a) At least one reference tyre (SRTT17S or SRTT17W) shall be selected. The reference tyre shall be measured at least at 3 different temperatures differing by more than 5 °C;**

**(b) A linear regression will give the value of abrasion rate for references tyres at 20 °C (SRTT17S) or 10°C (SRTT17W);**

**(c) For SRTT17S, at least one measurement shall be done between 15 and 25 ℃;**

**(d) For SRTT17W, at least one measurement shall be done between 5 and 15 ℃.**

**For each of the (at least) 3 sets of reference tyres tested, the *ARRTi* abrasion rate in mg/km/t at a temperature Ti is available.**

**The slope of the regression line of the reference tyre abrasion rate to the average test temperature during the test (*S*) is calculated by means of the following equation:**

**Where:**

**is the slope of the regression line of the reference tyre abrasion rate to the temperatures during the tests;**

**is the abrasion rate of reference tyre at test conditions in mg/kg/t;**

**is the average abrasion rate of the n reference tyres at three temperatures in mg/kg/t;**

**is the average temperature of the test in °C;**

**is the average temperature of the n tests in °C.**

**is the number of tests performed.**

**If the circuit is utilized to test tyres of category of use normal, tyres of category of use snow or special use not classified as tyres for use in severe snow conditions and tyres for use in severe snow conditions, the S calculation shall be done for each reference tyre, giving SS and SW values.**

**1.7. Weather and climate conditions requirements**

**1.7.1. Tyres tested against SRTT17S according to table in paragraph 1.2.25. of this Annex shall respect the following weather and climate conditions:**

**(a) The average temperature during the test shall be within the following range: from 7 °C to 35 °C;**

**(b) The minimum and maximum temperature during the test shall be within the following range: from 2 °C to 40 °C for at least 90 per cent of test distance;**

**(c) No driving under snow or ice conditions is allowed;**

**(d) The maximum allowed percentage of the total distance driven under wet conditions is 20 per cent.**

**1.7.2. Tyres tested against SRTT17W according to table in paragraph 1.2.25. of this Annex shall respect the following weather and climate conditions:**

**(a) The average temperature during the test shall be within the following range: from -3 °C to 20 °C;**

**(b) The minimum and maximum temperature during the test shall be within the following range: from -7 °C to 25 °C for at least 90 per cent of test distance;**

**(c) No driving under snow or ice conditions 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 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 temperature**

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

**The temperature measuring devices shall be accurate within ±1 °C. At least at starting and arrival point, the measurement shall be done with a fixed device respecting requested accuracy. 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 minutes after departure and after each driver’s break shall be discarded from the minimum, maximum, and average calculation. A time-based average for temperature is acceptable.**

**1.8. Standard Reference Test Tyre requirements**

**Reference tyres SRTT17S and SRTT17W shall be stored in condition recommended by [ASTM].**

**SRTT17S shall be used for evaluating candidate tyres** **of category of use normal and for tyres of category of use snow or special use not classified as tyres for use in severe snow condition.**

**SRTT17W shall be used for evaluating candidate tyres of category of use snow or special use classified as tyres for severe snow conditions.**

**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 for each test shall be fitted on a 7.5” rim width.**

**The rim width of 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 vehicle outside shall be positioned appropriately.**

**1.9.2. Tyre weight measurement (without rim)**

**The tyre weight 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 shall be measured:**

**(a) Before being fitted on the wheel, to get the initial tyre masses (*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 the following procedure described in paragraph 1.5.1. of this Annex.**

**Intermediate measurements of tyre and wheel mass assembly are optional.**

**1.9.4. Tyre inflation pressure**

**The reference inflation pressure of the tyres shall be 290 kPa.**

**Candidate tyres shall be inflated (cold) at their nominal pressure determined by the standard they belong to. More specifically:**

**(a) For standard load tyres the pressure shall be 250 kPa;**

**(b) For reinforced load tyres (XL) and high load capacity tyres (HL) the pressure shall be 290 kPa;**

**(c) The nominal pressure for nominal load as determined by the relevant standard 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 paragraph 1.6.**

**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 wheel load Q for reference and candidate vehicles are required.**

**1.10.2. Vehicle tuning**

**Vehicle alignments to 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 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 (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 temperature variation, but other varying parameters as well.**

**The measured performance shall be the mass losses of new tyres for a given distance and/or carried load. The overall mass loss shall be averaged among the 4 tyres of the tyre set and shall be reported in [mg/km and/or mg/km/ton], giving an index relative to reference tyre.**

**1.11.2. Test total distance**

**The total distance driven by each vehicle in the convoy shall be 8000 ± 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 only in the convoy;**

**(ii) RWD only in the convoy;**

**(iii) AWD (4 permanent driven wheels) only in the convoy.**

**(b) Propulsion energy converters (e.g. Pure internal combustion engine vehicle" (ICE), NOVC-HEVCs only, OVC-HEVs only, or PEVs only) in the same convoy. For hybrid vehicles, the provisions described in paragraph 1.6.9. 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 drivers;**

**(b) in all positions in the convoy.**

**Changes in drivers and vehicle positions may occur within a tolerance of 10 per cent of the predefined distance in 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 (both unloaded and loaded vehicle);**

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

**1.11.5.2. During the test**

**During the test, the following measurements shall be performed:**

**(a) Continuous measurement 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;**

**(e) Vehicle alignment, 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 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 assembly mass;**

**(g) Vehicle alignment, 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:**

**During each shift, temperature shall be measured and recorded at the beginning of test, at three intermediate points, and at the end of the test. At least one temperature measurement point shall be at the maximum altitude of the circuit. Additionally, one temperature measurement point shall be at the minimum altitude of the circuit. The average temperature of the circuit shall be calculated as the average of all the measured temperatures of all 5 points.**

**In case of continuous measurement, average temperature may be calculated either distance-based or time-based. Distance-based average for temperature is recommended.**

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

**During each shift, a continuous evaluation of speed, lateral, and longitudinal acceleration shall be carried out. A minimum sampling rate of 10 Hz is recommended. Most common technology is GNSS (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 the respect specifications defined in paragraph 1.6.13.3. of this Annex;**

**(c) If more than [1500 km] GNSS acceleration data are missing for the candidate tyre, the test for this candidate tyre is invalid;**

**(d) If more than [1500 km] GNSS acceleration data are missing for the reference tyre, the whole test is invalid;**

**(e) Vehicle alignments at the beginning and end of test shall respect the specifications defined in paragraph 6.1. of this Annex;**

**(f) For candidate tyres for use in severe snow conditions, the abrasion rate of the SRTT17W normalized at 10 °C (ARRT20) shall be in the range defined in paragraph 1.6.16. of this Annex;**

**(g) For other candidate tyres, the abrasion rate of the SRTT17S normalized at 20 °C (ARRT20) 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 losing more than 1 cm2 of tread chunking area, the tyre shall be considered as destroyed, and tyre destroyed process to be used.**

**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 8000 ± 300 km;**

**(c) The abrasion rate of reference tyre at 20°C 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 is considered valid and the distance considered for calculation has to be corrected accordingly.**

**Accidental deviation(s) are acceptable if representing less than 20 per cent of circuit distance or less than 100 km (whichever is lower) under the condition that the reference tyre abrasion rate at 20°C 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 be revalidated.**

**1.11.10. Vehicle trouble handling**

**The following provisions apply in case of vehicle damages 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 ran 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 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 7.5 per cent of the test. The mileage ran with the spare tyre shall be recorded and taken into account for the tyre abrasion rate;**

**(b) If a tyre used during the test is destroyed (or non-repairable puncture or ran without pressure), the mass loss of the other tyre tested on the same axle is 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 one shift failed for more than [5%] of the circuit distance (because of missing satellites signal 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 rate calculation.**

**1.11.13.1. Reference tyre abrasion rate normalized to distance and load at average test temperature (mg/km/t)**

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

**Where:**

**is the abrasion rate of the reference tyre at test average temperature in mg/kg/t;**

**is the mass of the reference tyre at the beginning of the test in mg;**

**is the mass of the reference tyre at the end of the test in mg;**

**is the total distance of the reference vehicle in km;**

**is the sum of the reference tyres load.**

**1.11.13.2. SRTT17S abrasion rate calculation at 20oC**

**Apply the temperature correction determined in paragraph 1.6.16.1. of this Annex to the normal reference tyre abrasion rate as follows:**

**where *Tm* is the average temperature of the test**

**1.11.13.3. SRTT17W abrasion rate calculation at 10oC**

**Apply the temperature correction determined in paragraph 1.6.16.1. of this Annex to the Winter reference tyre abrasion rate as follows:**

**where *Tm* is the average temperature of the test**

**1.11.13.4. Candidate tyre abrasion rate normalized to distance and load at average test temperature (mg/km/t)**

**The average abrasion rate at test average temperature of the candidate tyre during the test is calculated as following:**

**Where:**

**is the abrasion rate of the candidate tyre at test average temperature in mg/kg/t;**

**is the mass of the candidate tyre at the beginning of the test in mg;**

**is the mass of the candidate tyre at the end of the test in mg;**

**is the total distance of the candidate vehicle in km;**

**is he sum of the candidate tyres load….**

**1.11.13.5. The abrasion index of the candidate tyre shall be independent from the average test temperature and is calculated from the following equation:**

**Where:**

**is the abrasion index of the candidate tyre;**

**is the abrasion rate of the candidate tyre at test average temperature in mg/kg/t;**

**1.12. Test report**

**1.12.1. The test report shall include the following information:**

**(a) Average, minimum, and maximum 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 date of the test.**

**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 symbol, reference pressure, and serial number of the tyres;**

**(c) Vehicle tuning at the beginning of the test (Front axle TOE and camber, rear axle TOE and camber), in unloaded condition;**

**(d) Vehicle tuning at the beginning of the test (Front axle TOE and camber, rear axle TOE and camber), in loaded condition;**

**(e) Vehicle tuning at each intermediate measurement of the test (Front axle TOE and camber, rear axle TOE and camber), in loaded condition;**

**(f) Vehicle tuning at the end of the test (Front axle TOE and camber, rear axle TOE and camber), in loaded condition;**

**(g) Rim width (7.5”);**

**(h) Cold inflation pressure at the fitment;**

**(i) Cold inflation pressure at 50 per cent of the test;**

**(j) Cold inflation pressure at the end to the test;**

**(k) Balancing mass at the beginning of the test;**

**(l) Balancing mass at the end of the test;**

**(m) Initial tyre mass (*MRTSi*) for each reference tyre;**

**(n) Final tyre mass (*MRTFi*) for each reference tyre;**

**(o) Abrasion rate in mg/km/t normalized at 20oC**

**(p) Distance ran for each reference tyre;**

**(q) Standard deviation of longitudinal acceleration for the vehicle fitted with reference tyre;**

**(r) Standard deviation of lateral acceleration for the vehicle fitted with reference tyre;**

**(s) Percentage of distance covered over the maximum longitudinal acceleration for the vehicle fitted with reference tyre;**

**(t) Percentage of distance covered over the maximum lateral acceleration for the vehicle fitted with reference tyre;**

**(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 symbol, reference pressure, and serial number of the tyre;**

**(c) Vehicle tuning at the beginning of the test (Front axle TOE and camber, rear axle TOE and camber) in unloaded condition;**

**(d) Vehicle tuning at the beginning of the test (Front axle TOE and camber, rear axle TOE and camber) in loaded condition;**

**(e) Vehicle tuning at the end of the test (Front axle TOE and camber, rear axle TOE and camber) in loaded condition;**

**(f) Rim width;**

**(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 (*MCTSi*) for each candidate tyre;**

**(m) Final tyre mass (*MCTFi*) for each candidate tyre;**

**(n) Measured tyre load for each candidate tyre;**

**(o) Distance ran for each candidate tyre;**

**(p) Standard deviation of longitudinal acceleration for the vehicle fitted with candidate tyre;**

**(q) Standard deviation of lateral acceleration for the vehicle fitted with candidate tyre;**

**(r) Percentage of distance covered under the maximum longitudinal acceleration for the vehicle fitted with candidate tyre;**

**(s) Percentage of distance covered under the maximum lateral acceleration for the vehicle fitted with candidate tyre;**

**(t) Measured tyre load for each candidate tyre.**

**1.12.4. Final test results**

**(a) The measured result of abrasion rate ARRT 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 rate ARTT 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 rate index AITT as described in paragraph 11. of this Annex.**

**2. Test method (b) using indoor drum**

**2.1. Scope**

**2.1.1. This method applies to C1 tyres in scope of this regulation except ice grip tyres and tyres having a nominal rim diameter code ≤ 13.**

**2.2. Definitions and Terms**

**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 amount of the mass lost due to tyre abrasion  
Note 1 to entry: It is expressed in grams.**

**2.2.3. “Abrasion rate” means mass loss per unit distance travelled normalized by tyre load. It is expressed in mg/km/t.**

**2.2.4. “Abrasion index” means index that is calculated as the abrasion rate of a candidate tyre compared to the abrasion rate of a reference tyre under the same test method and conditions specified in this document.**

**2.2.5. “Test tyre” means tyre that is used for an evaluation programme, either candidate tyres or reference tyres**

**2.2.5.1. Candidate tyre**

**T test tyre that is part of an evaluation programme and that is evaluated with the reference tyre using the same test method**

**2.2.5.2. Reference tyre**

**R special test tyre that is used as a benchmark in an evaluation programme**

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

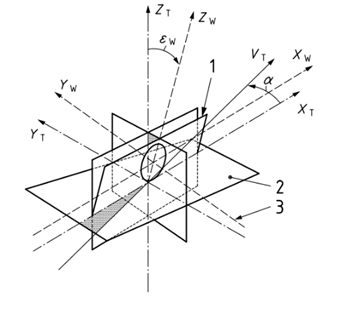
**(a) F3676 - 23 for the size 225/45R17 and referred to as "SRTT17S"**

**(b) F3675 - 23 for the size 225/45R17 and referred to as "SRTT17W"**

**Normal reference tyre (225/45R17 94 XL ASTM …) shall be used for testing candidate tyres not for severe snow condition, means normal, snow and special tyres.**

**Winter reference tyre (225/45R17 94 XL ASTM …) shall be used for testing candidate tyres for severe snow conditions (marked with 3PMSF symbol )**

**2.2.6. “Mean profile depth” is described in ISO13473-1.**

**2.2.7. “Tyre Coordination system” is tyre coordinate system specified in ISO 8855.  
**

**2.2.8. Vertical load**

**Fz tyre normal force of a tyre exerted on the road resulting from the mass supported by the tyre, as the Tyre normal force specified in ISO 8855.It is expressed in Newtons.**

**2.2.9. Lateral force**

**Fy force of a tyre generated in lateral direction during cornering , as the Tyre lateral force specified in ISO 8855**

**It is expressed in Newtons.**

**Positive sign turning left**

**Negative sign turning right**

**2.2.10. Longitudinal force**

**Fx force of a tyre generated in the longitudinal direction during acceleration or braking , as the Tyre longitudinal force specified in ISO 8855.**

**It is expressed in newtons.**

**positive sign for speed increase,**

**negative sign for speed decrease (e.g. braking)**

**2.2.11. Loaded radius**

**rL 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 section 2.5.2, in meter**

**2.2.12. Tyre torque**

**My Moment on tyre rotation axle**

**2.2.13. “Load index” means numerical code associated with the maximum load a tyre can carry at the speed indicated by its speed symbol under the service conditions specified by the tyre manufacturer.**

**2.3. Test method**

**2.3.1. General**

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

**In measuring tyre tread wear 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 tread wear test equipment with a cylindrical flywheel (drum) with external surface of drum.**

**2.3.2. Drum specification**

**2.3.2.1 Tyre Wear Test Equipment**

**Tread wear 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.**

**2.3.2.2.　 Diameter**

**The test dynamometer shall have a cylindrical flywheel (drum) with a diameter of at least [1,7 m].**

**2.3.2.3.　 Surface**

**The test surface shall be applied to external surface of the cylindrical drum. The test surface of drum shall:**

**(a) have MPD measured at the start of the drum test applied from 0,22 mm to 2,10 mm, according to ISO 13473-1 except for sampling interval, resampling, and low pass filter.**

**(b) The device for measurement of MPD must fulfil the specifications of ISO 13473-3. The sampling interval shall not be more than 0,033mm, and samples shall be taken at a fixed interval in the horizontal direction. Re-sample the signal to either 0,017 mm or 0,033 mm spacing; preferably 0,017 mm. For low-pass filtering, the filter shall be of the Butterworth type, 2nd order, and have a cut-off at 0,1 mm texture wavelength.**

**(c) 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.**

**(e) The test surface, including voids, shall be dry and clean for all measurements.**

**(f) The device for measurement of MPD must fulfil the specifications of ISO 13473-3 and provide a resolution of less than 0,1mm**

**The abrasion rate of the reference tyre for all surface shall be in the range.  
In case of SRTT17S, the range is 50 mg/km/t to 190 mg/km/t.  
In case of SRTT17W, the range is 35 mg/km/t to 165 mg/km/t  
(Abrasion Rate shall be calculated according to the method in paragraph 2.7).  
In case of sand paper used for surface it shall be replaced as specified in Appendix 5.**

**When the drum surface no longer satisfies the conditions of the previous period, the surface should be replaced.  
Intermediate inspection of the abrasion rate for the reference tyre is recommended.**

**2.3.2.4.　 Width**

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

**2.3.3. Tyre carriage and drive system**

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

**(a) 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**

**. Admitted deviation from the nominal value of load(Fz), lateral force(Fy), longitudinal force(Fx) and tyre torque(My) during the testing is:**

**Fz: ±50N or 1% whichever is greater**

**Fy: ± 100N or 5 % whichever is greater, for the difference between input peaks and actually generated peaks.**

**Fx: ± 100N or 5% whichever is greater, for the difference between input peaks and actually generated peaks.**

**My: ±40Nm or 5 % whichever is greater, for the difference between input peaks and actually generated peaks.**

**2.3.4. Adhesion prevention system**

**2.3.4.1. Powder distribution**

**Tread wear test equipment shall be equipped with the powder distribution system to spray a controlled volume of such material (e.g., talc) on the test surface near the test tyre contact patch so that abrasion fragments does not adhere to the tyre surface or the test drum surface. The material used for powder distribution shall be a mineral or clay, in the form of a powder. The powder particle size is generally around 0.1μm to 100μm. Powder distribution system and materials shall be identical for both reference tyre and candidate tyre during a test, and constant during the whole test.**

**2.3.4.2. Nozzle position**

**Nozzle position for powder distribution system shall be;**

**(a) Blow-in type**

**In case of only one nozzle, centre of the nozzle should be positioned in symmetrical plane. The distance between nozzles and centre of contact patch shall be at less/lower than 35 cm from centre of contact patch.**

**In case of multiple nozzles, they shall be placed parallel to Y axis and symmetrically distributed respective to X axis. The distance between nozzles and centre of contact patch shall be lower than 35 cm.**

**Nozzles should be oriented towards contact patch entrance.**

**Or**

**(b) Dispersion type**

**The tester is covered with the enclosure coverings, powder should be evenly dispersed within the enclosure. The nozzle/nozzles should be placed parallel to Y axis and symmetrically distributed respective to X axis.**

**2.3.5. Load, alignment, control and instrumental accuracies**

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

**2.3.6. Mass scale**

**Mass scale for test tyres shall have:**

**(a) Mass capacity being able to weigh test tyre**

**(b) The accuracy of the mass scale shall be within ±2 g.**

**Mass scale shall be duly calibrated.**

**2.4. Test Conditions**

**2.4.1. General**

**The test consists of a measurement of tyre mass loss in which the tyre is inflated to the cold pressure as specified in 2.4.3 and the inflation pressure shall be allowed to build up (i.e. “capped inflation”) and not be regulated by machine.**

**2.4.2. Test load**

**The standard test load Fz 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 and shall be kept within the tolerance specified in Appendix 4.**

**2.4.3. Tyre inflation pressure**

**The inflation pressure shall be set in accordance with that shown in Table 1 with the accuracy specified in Appendix 4 and shall be capped.**

**Table 1**

**Test loads and inflation pressures**

|  |  |  |
| --- | --- | --- |
| ***Tyre type*** | ***C1 a*** | |
| ***Standard load or light load*** | ***Reinforced or extra load*** |
| **Load -% of maximum load capacity** | **80** | **80** |
| **Inflation pressure b (kPa)** | **210** | **250** |
| **a For those C1 tyres belonging to categories which are not shown in ISO 4000-1:2015, 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 The inflation pressure shall be capped with the accuracy specified in Appendix 4.** | | |

**2.4.4. Testing condition (Longitudinal force, lateral force, speed, running distance)**

**Longitudinal force and lateral force shall be computed from the values shown in Appendix 3. Speed shall be in accordance with that shown in Appendix 4.**

**Running distance shall be 5,000 km.**

**The total distance of an actual test shall not differ more than ± 5% from the total input distance.**

**Reference tyre shall be mounted on 7.5” width rim. New candidate tyres shall be mounted on any rim requested and approved by the tyre manufacturer.**

**The rim width of candidate tyre shall be recorded. 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.**

**The test shall be performed at null camber (0°).**

**2.5. Test procedure**

**2.5.1. General**

**The test procedure steps described below are to be followed in the sequence given.**

**Both reference and candidate tyres shall be new when starting the test.**

**Test tyres with specified direction of rotation shall be rolling in the forward direction.**

**Direction of rolling shall be kept in the same direction throughout the test.**

**Abrasion rate calculation uses actual test run distance.**

**2.5.2. Thermal conditioning**

**Place the inflated tyre in the thermal environment of the test location for a minimum of 3 h.**

**2.5.3. Pressure adjustment**

**After thermal conditioning, the inflation pressure shall be adjusted to the test pressure.**

**2.5.4. Thermal environment**

**During the test, the ambient temperature, at a distance of not less than 0,15m and not more than 1 m from the tyre, shall be 25 °C ± 5 °C.**

**Average ambient temperature for reference and candidate tyre during test shall not differ by more than 2 degrees).**

**2.5.5. Mass measurement**

**The mass of tyre shall be measured before and after 5,000km of run set out in paragraph 2.5.6. for both reference and candidate tyres.**

**2.5.6. Test cycle**

**2.5.6.1. Input condition**

**Both reference tyre and candidate tyre shall be tested according to input condition of Appendix 4. The Appendix 4 test condition of 250 km is defined as one test cycle, and the test cycle shall be repeated 20 times until 5000 km is reached.**

**2.5.6.2. Basic test program(2position)**

**Both reference tyre and candidate tyre shall be mounted different position of one 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 2,500 km. Direction of rotation shall remain constant throughout the test.**

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

**2.5.6.3.** **Alternative test program (1postion drum)**

**In case test of reference tyre and candidate tyre is not possible at the same time, the alternative test program is available. As Reference tyre(R) and Candidate tyre(T), test order is following:**

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

**Repeat a set of Appendix 3 input conditions 4 times for 1000 km and 8 times for 2000 km.**

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

**2.5.6.4. Test starting phase**

**Tyre should touch the drum with speed equal to 0 km/h. Then the test load Fz should be applied at speed equal to 0km/h or at very low speed. After load application, 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 3.5km. During this starting phase should be free rolling conditions.**

**Distance run at starting phase shall not be counted.**

**2.5.7.** **Measurement and recording**

**The following shall be measured and recorded:**

|  |  |
| --- | --- |
| ***Item*** | ***Requirements*** |
| **(a) Test speed;** | **Sampling frequency ≥ 1Hz** |
| **(b) Tyre normal force to the drum surface;** | **Sampling frequency ≥ 1Hz** |
| **(c) Test inflation pressure: initial and end of the test, as defined in 2.5.3;** | **Shall measure at the timings of ：**   * **Before starting the test** * **3 or more hours after end of the test.**   **Interim measurement during test is optional** |
| **(d) Ambient temperature measured in degree ℃, tamb;** | **Sampling frequency ≥ 1Hz** |
| **(e) Lateral force applied to the test tyre during the test.** | **Sampling frequency ≥ 10 Hz** |
| **(f) Longitudinal force or torque applied to the test tyre during the test.** | **Sampling frequency ≥ 10 Hz** |
| **(g) Mass of tyre;** | **Shall measure at the timings of ：**   * **Before starting the test** * **3 or more hours after end of the test.** |
| **(h) MPD of the test surface;** | **Shall measure at the timings of ：**   * **Before starting the test** * **3 or more hours after end of the test.**   **Interim measurement during test is optional** |
| **(i) Photograph of tyres after test program** | **Photograph of tyres after test to record the surface as a proof of test completion in the right way.** |

**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.**

**2.6. Validation**

**When a tyre has been subjected to the test method specified in paragraph 2.4 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 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.**

**The following values measured from each parameter shall be with their tolerances as specified in Table 2. Otherwise, the test results shall be rejected.**

**Table 2**

**Validation of Fx, Fy, Fz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Measurement** | **Corresponding input step No. in each cycle (see Table A1)** | **Value to be verified** | **Tolerance** |
| **Fx** | **RMS (a) of G(x)** | **-** | **RMSGx = 0.059** | **±5%** |
| **Fy** | **RMS (a) of G(y)** | **-** | **RMSGy = 0.074** | **±5%** |
| **Fz** | **Average of all test cycles (total 20 cycles)** | **-** | **Average Fz** | **±50N or ±1%, whichever is greater** |
| **Note**  **(a) For the whole test of total 5000km, calculate the Root Mean Square (RMS) of G(x) and G(y) using the equations below:**      **where:**  **i is the number of data acquired at a sampling frequency of 10Hz.**  **N is the total number of data acquired.**  **Fx and Fy may be filtered by a low-pass filter to remove noise of the output.**  **Fz shall be filtered as the moving average per one tyre revolution.** | | | | |

**2.7. Processing of measurement results**

**Calculation method for Abrasion Index and Abrasion rate are following:**

**MlT = MTb – MTa**

**MlR = MRb - MRa**

**MlT is Mass loss of candidate tyre, in grams**

**MlR is Mass loss of reference tyre, in grams**

**MTb is Mass of candidate tyre before test cycle, in grams**

**MTa is Mass of candidate tyre after test cycle, in grams**

**MRb is Mass of reference tyre before test cycle, in grams**

**MRa is Mass of reference tyre after test cycle, in grams**

**Abrasion Index AICT：**

**AICT = Ar T (mg/km)/ ArR (mg/km)**

**Where,**

**ArT : Normalized abrasion rate(mg/km/t) of candidate tyre,　ArT = MlT (g)/DT(km) /Fz,T(t) x 1000(mg/kg)**

**ArR : Normalized abrasion rate(mg/km) of reference tyre,　ArR = MlR (g)/DR(km) /Fz,R(t) x 1000(mg/kg)**

**DT is Testing mileage of candidate tyre(km)**

**DR is Testing mileage of reference tyre(km)**

**Fz,T is Test load (t) of candidate tyre**

**Fz,R is Test load (t) of reference tyre**

**The reference tyre used to calculate the abrasion index shall be one of the tyres described in 2.2.5.2.**

**2.8. Test report**

**2.8.1. The test report shall include the following information:**

1. **Test machine identification**
2. **Drum circumference (m)**
3. **Test cycle (2 positions /1 position)**
4. **3rd body (Mineral / Clay)**
5. **MPD of test surface (mm): Beginning of test / End of test**
6. **Tyre class**
7. **Brand**
8. **Pattern/trade description**
9. **Tyre size designation**
10. **Service description**
11. **Test load (N)**
12. **Test inflation pressure (kPa)**
13. **Tyre identification**
14. **3PMSF marking (Y/N)**
15. **Rim**
16. **Inflation pressure (kPa): Beginning of test / End of test**
17. **Mass of tyre (g): Before test / After test**
18. **Test distance (km)**
19. **Abrasion rate (mg/km)**
20. **Normalized abrasion rate (mg/km/t)**
21. **Abrasion index (only applicable for candidate tyre)**
22. **Average ambient temp. (°C)**
23. **RMS of G(x)**
24. **RMS of G(y)**
25. **Average of Fz**

**Annex 10 – 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 (alongitudinal), [m/s²]**

**(c) The lateral acceleration (alateral), [m/s²]**

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

**Filter for measured Values**



**1.2. Speed jumps detection and correction**

**Before starting the filtering process, all measured values are checked concerning speed jumps. Speed jumps refer to measurements which are not plausible. For identifying speed jumps, the velocity is 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 ∙ tsampling is still plausible.**

**A speed jump will be detected if there is a speed difference of 2 ∙ Δspeedpossible. In 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 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.**

**[Matlab code:**

**fg = 1; % cut off frequency**

**order = 2; % filter order**

**fsample = 1/dt;  % sample rate of measurement**

**[b,a] = butter(order,fcutoff/(0.5\*fsample),'low');**

**out = filtfilt(b,a,double(datn)); % datn = relevant data ]**

**1.4. Filter for data range:**

**[Matlab code:**

**% define index based on data range**

**indx = find(speed > limits.vmin/3.6 & speed < limits.vmax/3.6 & abs(ax) < limits.ax & abs(ay) < limits.ay); % impossible accelerations are also eliminated**

**speed = speed(indx);**

**ax = ax(indx);**

**ay = ay(indx);]**

**1.5. Moving Average:**

**[Matlab code:**

**winAx = filter.ax\*fsample;**

**winOthers = filter.others\*fsample;**

**ax = smooth(ax,winAx,'moving');**

**ay = smooth(ay,winOthers,'moving');**

**speed = smooth(speed,winOthers,'moving');]**

**1.6. Distance-based Standard Deviation**

**Measured 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:**

**with**

**with**

**[Matlab code:**

**distance = cumsum(speed/fsample);**

**axDB = interp1(distance,ax,distance(1):1:distance(end)); % one value per 1m**

**ayDB = interp1(distance,ay,distance(1):1:distance(end));**

**stdax = round(std(axDB)\*1000)/1000;**

**stday = round(std(ayDB)\*1000)/1000;]**

**Annex 10 – Appendix 2**

**Test report example for vehicle method**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 driving distance:** | |  | | **Regional style distance:** | |  | |  |
| **Urban driving style distance:** | |  | | **Total deviation distance** | |  | |  |
| **Slope of reference tyre sensitivity to temperature:** | | | | | |  | |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Reference tyre/vehicle** | | | | **Candidate tyre/vehicle** | | | | |
|  | **Front Left** | **Front right** | **Rear left** | **Rear right** | **Front Left** | | **Front right** | **Rear left** | **Rear right** |
| **Vehicle information** |  | | | | | | | | |
| **Vehicle model** |  |  |  |  |  | |  |  |  |
| **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** |  |  |  |  | | **7.5"** | **7.5"** | **7.5"** | **7.5"** |
| **Initial tyre mass** |  |  |  |  | |  |  |  |  |
| **Final tyre mass** |  |  |  |  | |  |  |  |  |
| **Distance run by each tyre** |  |  |  |  | |  |  |  |  |
| **Reference tyre abrasion rate in mg/km/t normalized at 20°C (or 10)** | | | | | |  | | | |
| **Tyres visual inspection report** |  |  |  |  | |  |  |  |  |
| **Test results** |  | | | | | | | | |
| **Tyre Abrasion rate in mg/km/t** |  | | | | |  | | | |
| **Tyre Abrasion rate index** |  | | | | | **N/A** | | | |

Annex 10 – Appendix 3

Input of test cycle

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

**For torque control testing machine, tyre torque (My) is calculated with longitudinal force (Fx) and loaded radius (RL)**

**Fx　＝　Fz × G(x) or My = Test load(Fz) ×G(x) × RL**

**Fy　＝　Fz × G(y)**

**Fz is the test load defined in 2.2.8 and 2.4.2.**

**G(x) and G(y) represent the index compared to the standard acceleration due to earth gravity (g= 9.80665m/s2), alternatively the local earth gravity can be defined**

**Table A1 defines the time, G(x), G(y), and speed of test cycle, where:**

**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 Table A1;**

**G(x) and G(y) shall change linearly between two adjacent points.**

**Therefore, the values of Fx and Fy will also change linearly from one point to another. The following graphs show samples of linear change for Fx or Fy with respect to T.**

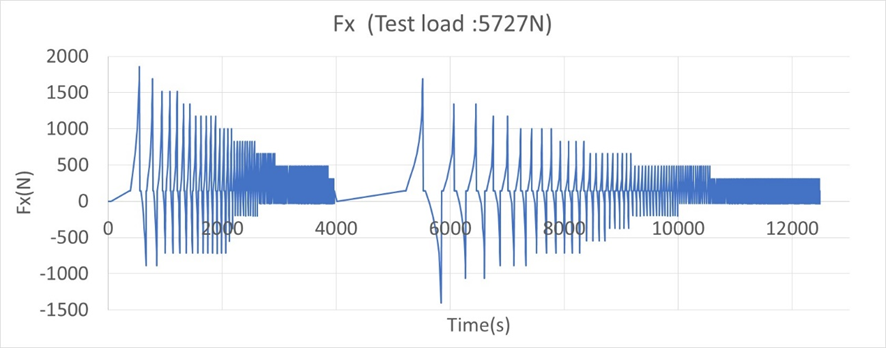
**T means the driving time from starting test.**

**The value of G(x) and G(y) at driving time T is mentioned in Table A1.**

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

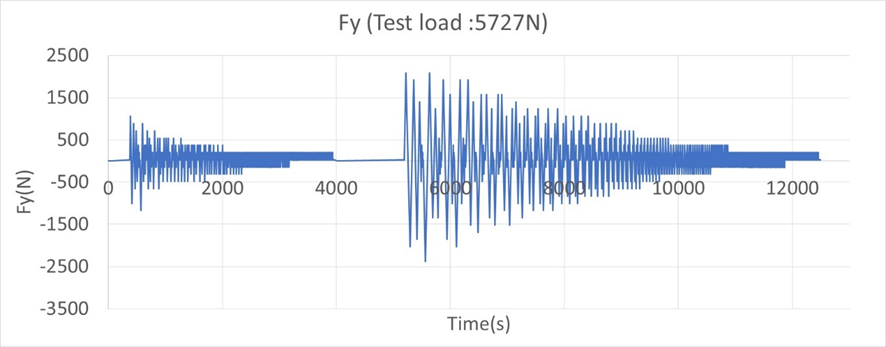
**Graph A.1**

**Example of Fx , with a test load of 5727N**

****

**Graph A.2**

**Example of Fy , 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** |
| **930.7** | **100** | **0.175** | **-0.025** |
| **935.8** | **100** | **0.205** | **0.035** |
| **940.8** | **100** | **0.235** | **0.005** |
| **945.9** | **100** | **0.265** | **0.035** |
| **953.5** | **100** | **0.025** | **0.005** |
| **961.0** | **100** | **0.025** | **-0.085** |
| **978.7** | **100** | **-0.005** | **0.095** |
| **986.3** | **100** | **-0.035** | **-0.025** |
| **991.3** | **100** | **-0.065** | **0.035** |
| **996.4** | **100** | **-0.095** | **0.005** |
| **1001.5** | **100** | **-0.125** | **0.035** |
| **1006.5** | **100** | **0.025** | **0.005** |
| **1014.1** | **100** | **0.025** | **0.095** |
| **1031.8** | **100** | **0.055** | **-0.085** |
| **1049.5** | **100** | **0.085** | **0.095** |
| **1059.6** | **100** | **0.115** | **-0.025** |
| **1067.1** | **100** | **0.145** | **0.035** |
| **1072.2** | **100** | **0.175** | **0.005** |
| **1077.2** | **100** | **0.205** | **0.035** |
| **1082.3** | **100** | **0.235** | **0.005** |
| **1084.8** | **100** | **0.265** | **0.005** |
| **1092.4** | **100** | **0.025** | **0.005** |
| **1100.0** | **100** | **0.025** | **-0.085** |
| **1112.6** | **100** | **-0.005** | **0.065** |
| **1120.2** | **100** | **-0.035** | **-0.025** |
| **1125.3** | **100** | **-0.065** | **0.035** |
| **1130.3** | **100** | **-0.095** | **0.005** |
| **1135.4** | **100** | **-0.125** | **0.035** |
| **1140.4** | **100** | **0.025** | **0.005** |
| **1148.0** | **100** | **0.025** | **0.095** |
| **1165.7** | **100** | **0.055** | **-0.085** |
| **1180.8** | **100** | **0.085** | **0.065** |
| **1188.4** | **100** | **0.115** | **-0.025** |
| **1193.5** | **100** | **0.145** | **0.035** |
| **1198.5** | **100** | **0.175** | **0.005** |
| **1203.6** | **100** | **0.205** | **0.035** |
| **1206.1** | **100** | **0.235** | **0.005** |
| **1208.6** | **100** | **0.265** | **0.005** |
| **1216.2** | **100** | **0.025** | **0.005** |
| **1223.8** | **100** | **0.025** | **-0.085** |
| **1236.4** | **100** | **-0.005** | **0.065** |
| **1241.5** | **100** | **-0.035** | **0.005** |
| **1246.5** | **100** | **-0.065** | **0.035** |
| **1251.6** | **100** | **-0.095** | **0.005** |
| **1256.6** | **100** | **-0.125** | **0.035** |
| **1261.7** | **100** | **0.025** | **0.005** |
| **1269.3** | **100** | **0.025** | **0.095** |
| **1284.4** | **100** | **0.055** | **-0.085** |
| **1299.6** | **100** | **0.085** | **0.065** |
| **1307.2** | **100** | **0.115** | **-0.025** |
| **1312.2** | **100** | **0.145** | **0.035** |
| **1317.3** | **100** | **0.175** | **0.005** |
| **1322.3** | **100** | **0.205** | **0.035** |
| **1324.8** | **100** | **0.235** | **0.005** |
| **1331.6** | **100** | **0.025** | **0.005** |
| **1339.2** | **100** | **0.025** | **-0.085** |
| **1351.8** | **100** | **-0.005** | **0.065** |
| **1356.8** | **100** | **-0.035** | **0.005** |
| **1361.9** | **100** | **-0.065** | **0.035** |
| **1366.9** | **100** | **-0.095** | **0.005** |
| **1372.0** | **100** | **-0.125** | **0.035** |
| **1377.1** | **100** | **0.025** | **0.005** |
| **1382.1** | **100** | **0.025** | **0.065** |
| **1397.3** | **100** | **0.055** | **-0.085** |
| **1409.9** | **100** | **0.085** | **0.065** |
| **1417.5** | **100** | **0.115** | **-0.025** |
| **1422.5** | **100** | **0.145** | **0.035** |
| **1427.6** | **100** | **0.175** | **0.005** |
| **1432.6** | **100** | **0.205** | **0.035** |
| **1435.2** | **100** | **0.235** | **0.005** |
| **1441.9** | **100** | **0.025** | **0.005** |
| **1447.0** | **100** | **0.025** | **-0.055** |
| **1457.1** | **100** | **-0.005** | **0.065** |
| **1462.1** | **100** | **-0.035** | **0.005** |
| **1467.2** | **100** | **-0.065** | **0.035** |
| **1472.2** | **100** | **-0.095** | **0.005** |
| **1477.3** | **100** | **-0.125** | **0.035** |
| **1482.3** | **100** | **0.025** | **0.005** |
| **1487.4** | **100** | **0.025** | **0.065** |
| **1502.5** | **100** | **0.055** | **-0.085** |
| **1515.2** | **100** | **0.085** | **0.065** |
| **1522.7** | **100** | **0.115** | **-0.025** |
| **1527.8** | **100** | **0.145** | **0.035** |
| **1532.9** | **100** | **0.175** | **0.005** |
| **1535.4** | **100** | **0.205** | **0.005** |
| **1541.3** | **100** | **0.025** | **0.005** |
| **1546.3** | **100** | **0.025** | **-0.055** |
| **1556.4** | **100** | **-0.005** | **0.065** |
| **1561.5** | **100** | **-0.035** | **0.005** |
| **1566.5** | **100** | **-0.065** | **0.035** |
| **1571.6** | **100** | **-0.095** | **0.005** |
| **1576.6** | **100** | **-0.125** | **0.035** |
| **1581.7** | **100** | **0.025** | **0.005** |
| **1586.8** | **100** | **0.025** | **0.065** |
| **1601.9** | **100** | **0.055** | **-0.085** |
| **1614.5** | **100** | **0.085** | **0.065** |
| **1619.6** | **100** | **0.115** | **0.005** |
| **1624.6** | **100** | **0.145** | **0.035** |
| **1629.7** | **100** | **0.175** | **0.005** |
| **1632.2** | **100** | **0.205** | **0.005** |
| **1638.1** | **100** | **0.025** | **0.005** |
| **1643.2** | **100** | **0.025** | **-0.055** |
| **1650.8** | **100** | **-0.005** | **0.035** |
| **1655.8** | **100** | **-0.035** | **0.005** |
| **1660.9** | **100** | **-0.065** | **0.035** |
| **1663.4** | **100** | **-0.095** | **0.005** |
| **1665.9** | **100** | **-0.125** | **0.005** |
| **1671.0** | **100** | **0.025** | **0.005** |
| **1676.0** | **100** | **0.025** | **0.065** |
| **1691.2** | **100** | **0.055** | **-0.085** |
| **1703.8** | **100** | **0.085** | **0.065** |
| **1708.9** | **100** | **0.115** | **0.005** |
| **1713.9** | **100** | **0.145** | **0.035** |
| **1719.0** | **100** | **0.175** | **0.005** |
| **1721.5** | **100** | **0.205** | **0.005** |
| **1727.4** | **100** | **0.025** | **0.005** |
| **1732.4** | **100** | **0.025** | **-0.055** |
| **1740.0** | **100** | **-0.005** | **0.035** |
| **1745.1** | **100** | **-0.035** | **0.005** |
| **1747.6** | **100** | **-0.065** | **0.005** |
| **1750.1** | **100** | **-0.095** | **0.005** |
| **1752.7** | **100** | **-0.125** | **0.005** |
| **1757.7** | **100** | **0.025** | **0.005** |
| **1762.8** | **100** | **0.025** | **0.065** |
| **1775.4** | **100** | **0.055** | **-0.055** |
| **1788.0** | **100** | **0.085** | **0.065** |
| **1793.1** | **100** | **0.115** | **0.005** |
| **1798.1** | **100** | **0.145** | **0.035** |
| **1800.7** | **100** | **0.175** | **0.005** |
| **1803.2** | **100** | **0.205** | **0.005** |
| **1809.1** | **100** | **0.025** | **0.005** |
| **1814.1** | **100** | **0.025** | **-0.055** |
| **1821.7** | **100** | **-0.005** | **0.035** |
| **1826.8** | **100** | **-0.035** | **0.005** |
| **1829.3** | **100** | **-0.065** | **0.005** |
| **1831.8** | **100** | **-0.095** | **0.005** |
| **1834.3** | **100** | **-0.125** | **0.005** |
| **1839.4** | **100** | **0.025** | **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** |
| **2526.6** | **100** | **0.145** | **0.005** |
| **2530.8** | **100** | **0.025** | **0.005** |
| **2533.3** | **100** | **0.025** | **-0.025** |
| **2538.4** | **100** | **-0.005** | **0.035** |
| **2540.9** | **100** | **-0.035** | **0.005** |
| **2543.4** | **100** | **0.025** | **0.005** |
| **2546.0** | **100** | **0.025** | **0.035** |
| **2553.5** | **100** | **0.055** | **-0.025** |
| **2561.1** | **100** | **0.085** | **0.035** |
| **2563.7** | **100** | **0.115** | **0.005** |
| **2566.2** | **100** | **0.145** | **0.005** |
| **2570.4** | **100** | **0.025** | **0.005** |
| **2572.9** | **100** | **0.025** | **-0.025** |
| **2578.0** | **100** | **-0.005** | **0.035** |
| **2580.5** | **100** | **-0.035** | **0.005** |
| **2583.0** | **100** | **0.025** | **0.005** |
| **2585.5** | **100** | **0.025** | **0.035** |
| **2593.1** | **100** | **0.055** | **-0.025** |
| **2600.7** | **100** | **0.085** | **0.035** |
| **2603.2** | **100** | **0.115** | **0.005** |
| **2606.6** | **100** | **0.025** | **0.005** |
| **2609.1** | **100** | **0.025** | **-0.025** |
| **2614.2** | **100** | **-0.005** | **0.035** |
| **2616.7** | **100** | **-0.035** | **0.005** |
| **2619.2** | **100** | **0.025** | **0.005** |
| **2621.8** | **100** | **0.025** | **0.035** |
| **2629.3** | **100** | **0.055** | **-0.025** |
| **2636.9** | **100** | **0.085** | **0.035** |
| **2639.4** | **100** | **0.115** | **0.005** |
| **2642.8** | **100** | **0.025** | **0.005** |
| **2645.3** | **100** | **0.025** | **-0.025** |
| **2650.4** | **100** | **-0.005** | **0.035** |
| **2652.1** | **100** | **0.025** | **0.005** |
| **2654.6** | **100** | **0.025** | **0.035** |
| **2662.2** | **100** | **0.055** | **-0.025** |
| **2669.8** | **100** | **0.085** | **0.035** |
| **2672.3** | **100** | **0.115** | **0.005** |
| **2675.7** | **100** | **0.025** | **0.005** |
| **2678.2** | **100** | **0.025** | **-0.025** |
| **2683.2** | **100** | **-0.005** | **0.035** |
| **2684.9** | **100** | **0.025** | **0.005** |
| **2687.4** | **100** | **0.025** | **0.035** |
| **2695.0** | **100** | **0.055** | **-0.025** |
| **2702.6** | **100** | **0.085** | **0.035** |
| **2705.1** | **100** | **0.115** | **0.005** |
| **2708.5** | **100** | **0.025** | **0.005** |
| **2711.0** | **100** | **0.025** | **-0.025** |
| **2716.1** | **100** | **-0.005** | **0.035** |
| **2717.8** | **100** | **0.025** | **0.005** |
| **2720.3** | **100** | **0.025** | **0.035** |
| **2727.9** | **100** | **0.055** | **-0.025** |
| **2735.5** | **100** | **0.085** | **0.035** |
| **2738.0** | **100** | **0.115** | **0.005** |
| **2741.3** | **100** | **0.025** | **0.005** |
| **2743.9** | **100** | **0.025** | **-0.025** |
| **2748.9** | **100** | **-0.005** | **0.035** |
| **2750.6** | **100** | **0.025** | **0.005** |
| **2753.1** | **100** | **0.025** | **0.035** |
| **2760.7** | **100** | **0.055** | **-0.025** |
| **2765.8** | **100** | **0.085** | **0.035** |
| **2768.3** | **100** | **0.115** | **0.005** |
| **2771.7** | **100** | **0.025** | **0.005** |
| **2774.2** | **100** | **0.025** | **-0.025** |
| **2779.2** | **100** | **-0.005** | **0.035** |
| **2780.9** | **100** | **0.025** | **0.005** |
| **2783.5** | **100** | **0.025** | **0.035** |
| **2791.0** | **100** | **0.055** | **-0.025** |
| **2796.1** | **100** | **0.085** | **0.035** |
| **2798.6** | **100** | **0.115** | **0.005** |
| **2802.0** | **100** | **0.025** | **0.005** |
| **2804.5** | **100** | **0.025** | **-0.025** |
| **2809.6** | **100** | **-0.005** | **0.035** |
| **2811.2** | **100** | **0.025** | **0.005** |
| **2813.8** | **100** | **0.025** | **0.035** |
| **2821.4** | **100** | **0.055** | **-0.025** |
| **2826.4** | **100** | **0.085** | **0.035** |
| **2828.9** | **100** | **0.115** | **0.005** |
| **2832.3** | **100** | **0.025** | **0.005** |
| **2834.8** | **100** | **0.025** | **-0.025** |
| **2839.9** | **100** | **-0.005** | **0.035** |
| **2841.6** | **100** | **0.025** | **0.005** |
| **2844.1** | **100** | **0.025** | **0.035** |
| **2851.7** | **100** | **0.055** | **-0.025** |
| **2856.7** | **100** | **0.085** | **0.035** |
| **2859.2** | **100** | **0.115** | **0.005** |
| **2862.6** | **100** | **0.025** | **0.005** |
| **2865.1** | **100** | **0.025** | **-0.025** |
| **2870.2** | **100** | **-0.005** | **0.035** |
| **2871.9** | **100** | **0.025** | **0.005** |
| **2874.4** | **100** | **0.025** | **0.035** |
| **2882.0** | **100** | **0.055** | **-0.025** |
| **2887.0** | **100** | **0.085** | **0.035** |
| **2889.6** | **100** | **0.115** | **0.005** |
| **2892.9** | **100** | **0.025** | **0.005** |
| **2895.5** | **100** | **0.025** | **-0.025** |
| **2900.5** | **100** | **-0.005** | **0.035** |
| **2902.2** | **100** | **0.025** | **0.005** |
| **2904.7** | **100** | **0.025** | **0.035** |
| **2912.3** | **100** | **0.055** | **-0.025** |
| **2917.4** | **100** | **0.085** | **0.035** |
| **2919.9** | **100** | **0.115** | **0.005** |
| **2923.3** | **100** | **0.025** | **0.005** |
| **2925.8** | **100** | **0.025** | **-0.025** |
| **2930.8** | **100** | **-0.005** | **0.035** |
| **2932.5** | **100** | **0.025** | **0.005** |
| **2935.0** | **100** | **0.025** | **0.035** |
| **2942.6** | **100** | **0.055** | **-0.025** |
| **2947.7** | **100** | **0.085** | **0.035** |
| **2950.2** | **100** | **0.025** | **0.005** |
| **2952.7** | **100** | **0.025** | **-0.025** |
| **2957.8** | **100** | **-0.005** | **0.035** |
| **2959.5** | **100** | **0.025** | **0.005** |
| **2962.0** | **100** | **0.025** | **0.035** |
| **2969.6** | **100** | **0.055** | **-0.025** |
| **2974.6** | **100** | **0.085** | **0.035** |
| **2977.2** | **100** | **0.025** | **0.005** |
| **2979.7** | **100** | **0.025** | **-0.025** |
| **2984.7** | **100** | **-0.005** | **0.035** |
| **2986.4** | **100** | **0.025** | **0.005** |
| **2988.9** | **100** | **0.025** | **0.035** |
| **2996.5** | **100** | **0.055** | **-0.025** |
| **3001.6** | **100** | **0.085** | **0.035** |
| **3004.1** | **100** | **0.025** | **0.005** |
| **3006.6** | **100** | **0.025** | **-0.025** |
| **3011.7** | **100** | **-0.005** | **0.035** |
| **3013.4** | **100** | **0.025** | **0.005** |
| **3015.9** | **100** | **0.025** | **0.035** |
| **3023.5** | **100** | **0.055** | **-0.025** |
| **3028.5** | **100** | **0.085** | **0.035** |
| **3031.0** | **100** | **0.025** | **0.005** |
| **3036.1** | **100** | **0.025** | **0.005** |
| **3041.2** | **100** | **-0.005** | **0.035** |
| **3042.8** | **100** | **0.025** | **0.005** |
| **3045.4** | **100** | **0.025** | **0.035** |
| **3052.9** | **100** | **0.055** | **-0.025** |
| **3058.0** | **100** | **0.085** | **0.035** |
| **3060.5** | **100** | **0.025** | **0.005** |
| **3065.6** | **100** | **0.025** | **0.005** |
| **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** |
| **3351.9** | **100** | **0.025** | **0.035** |
| **3357.0** | **100** | **0.055** | **0.005** |
| **3359.5** | **100** | **0.085** | **0.005** |
| **3362.0** | **100** | **0.025** | **0.005** |
| **3367.1** | **100** | **0.025** | **0.005** |
| **3372.1** | **100** | **-0.005** | **0.035** |
| **3373.8** | **100** | **0.025** | **0.005** |
| **3376.3** | **100** | **0.025** | **0.035** |
| **3381.4** | **100** | **0.055** | **0.005** |
| **3383.9** | **100** | **0.085** | **0.005** |
| **3386.4** | **100** | **0.025** | **0.005** |
| **3391.5** | **100** | **0.025** | **0.005** |
| **3394.0** | **100** | **-0.005** | **0.005** |
| **3395.7** | **100** | **0.025** | **0.005** |
| **3398.2** | **100** | **0.025** | **0.035** |
| **3403.3** | **100** | **0.055** | **0.005** |
| **3405.8** | **100** | **0.085** | **0.005** |
| **3408.3** | **100** | **0.025** | **0.005** |
| **3413.4** | **100** | **0.025** | **0.005** |
| **3415.9** | **100** | **-0.005** | **0.005** |
| **3417.6** | **100** | **0.025** | **0.005** |
| **3420.1** | **100** | **0.025** | **0.035** |
| **3425.2** | **100** | **0.055** | **0.005** |
| **3427.7** | **100** | **0.085** | **0.005** |
| **3430.2** | **100** | **0.025** | **0.005** |
| **3435.3** | **100** | **0.025** | **0.005** |
| **3437.8** | **100** | **-0.005** | **0.005** |
| **3439.5** | **100** | **0.025** | **0.005** |
| **3442.0** | **100** | **0.025** | **0.035** |
| **3447.1** | **100** | **0.055** | **0.005** |
| **3449.6** | **100** | **0.085** | **0.005** |
| **3452.1** | **100** | **0.025** | **0.005** |
| **3457.2** | **100** | **0.025** | **0.005** |
| **3459.7** | **100** | **-0.005** | **0.005** |
| **3461.4** | **100** | **0.025** | **0.005** |
| **3463.9** | **100** | **0.025** | **0.035** |
| **3469.0** | **100** | **0.055** | **0.005** |
| **3471.5** | **100** | **0.085** | **0.005** |
| **3474.0** | **100** | **0.025** | **0.005** |
| **3479.1** | **100** | **0.025** | **0.005** |
| **3481.6** | **100** | **-0.005** | **0.005** |
| **3483.3** | **100** | **0.025** | **0.005** |
| **3485.8** | **100** | **0.025** | **0.035** |
| **3490.9** | **100** | **0.055** | **0.005** |
| **3493.4** | **100** | **0.085** | **0.005** |
| **3495.9** | **100** | **0.025** | **0.005** |
| **3501.0** | **100** | **0.025** | **0.005** |
| **3503.5** | **100** | **-0.005** | **0.005** |
| **3505.2** | **100** | **0.025** | **0.005** |
| **3507.7** | **100** | **0.025** | **0.035** |
| **3512.8** | **100** | **0.055** | **0.005** |
| **3515.3** | **100** | **0.085** | **0.005** |
| **3517.8** | **100** | **0.025** | **0.005** |
| **3522.9** | **100** | **0.025** | **0.005** |
| **3525.4** | **100** | **-0.005** | **0.005** |
| **3527.1** | **100** | **0.025** | **0.005** |
| **3529.6** | **100** | **0.025** | **0.035** |
| **3534.7** | **100** | **0.055** | **0.005** |
| **3537.2** | **100** | **0.085** | **0.005** |
| **3539.7** | **100** | **0.025** | **0.005** |
| **3544.8** | **100** | **0.025** | **0.005** |
| **3547.3** | **100** | **-0.005** | **0.005** |
| **3549.0** | **100** | **0.025** | **0.005** |
| **3551.5** | **100** | **0.025** | **0.035** |
| **3556.6** | **100** | **0.055** | **0.005** |
| **3559.1** | **100** | **0.085** | **0.005** |
| **3561.6** | **100** | **0.025** | **0.005** |
| **3566.7** | **100** | **0.025** | **0.005** |
| **3569.2** | **100** | **-0.005** | **0.005** |
| **3570.9** | **100** | **0.025** | **0.005** |
| **3573.4** | **100** | **0.025** | **0.035** |
| **3578.5** | **100** | **0.055** | **0.005** |
| **3581.0** | **100** | **0.085** | **0.005** |
| **3583.5** | **100** | **0.025** | **0.005** |
| **3588.6** | **100** | **0.025** | **0.005** |
| **3591.1** | **100** | **-0.005** | **0.005** |
| **3592.8** | **100** | **0.025** | **0.005** |
| **3595.3** | **100** | **0.025** | **0.035** |
| **3600.3** | **100** | **0.055** | **0.005** |
| **3602.9** | **100** | **0.085** | **0.005** |
| **3605.4** | **100** | **0.025** | **0.005** |
| **3610.5** | **100** | **0.025** | **0.005** |
| **3613.0** | **100** | **-0.005** | **0.005** |
| **3614.7** | **100** | **0.025** | **0.005** |
| **3617.2** | **100** | **0.025** | **0.035** |
| **3619.7** | **100** | **0.055** | **0.005** |
| **3622.2** | **100** | **0.085** | **0.005** |
| **3624.8** | **100** | **0.025** | **0.005** |
| **3629.8** | **100** | **0.025** | **0.005** |
| **3632.3** | **100** | **-0.005** | **0.005** |
| **3634.0** | **100** | **0.025** | **0.005** |
| **3636.6** | **100** | **0.025** | **0.035** |
| **3639.1** | **100** | **0.055** | **0.005** |
| **3641.6** | **100** | **0.085** | **0.005** |
| **3644.1** | **100** | **0.025** | **0.005** |
| **3649.2** | **100** | **0.025** | **0.005** |
| **3651.7** | **100** | **-0.005** | **0.005** |
| **3653.4** | **100** | **0.025** | **0.005** |
| **3655.9** | **100** | **0.025** | **0.035** |
| **3658.5** | **100** | **0.055** | **0.005** |
| **3661.0** | **100** | **0.085** | **0.005** |
| **3663.5** | **100** | **0.025** | **0.005** |
| **3668.6** | **100** | **0.025** | **0.005** |
| **3671.1** | **100** | **-0.005** | **0.005** |
| **3672.8** | **100** | **0.025** | **0.005** |
| **3675.3** | **100** | **0.025** | **0.035** |
| **3677.8** | **100** | **0.055** | **0.005** |
| **3680.4** | **100** | **0.085** | **0.005** |
| **3682.9** | **100** | **0.025** | **0.005** |
| **3687.9** | **100** | **0.025** | **0.005** |
| **3690.5** | **100** | **-0.005** | **0.005** |
| **3692.1** | **100** | **0.025** | **0.005** |
| **3694.7** | **100** | **0.025** | **0.035** |
| **3697.2** | **100** | **0.055** | **0.005** |
| **3699.7** | **100** | **0.085** | **0.005** |
| **3702.2** | **100** | **0.025** | **0.005** |
| **3707.3** | **100** | **0.025** | **0.005** |
| **3709.8** | **100** | **-0.005** | **0.005** |
| **3711.5** | **100** | **0.025** | **0.005** |
| **3714.0** | **100** | **0.025** | **0.035** |
| **3716.6** | **100** | **0.055** | **0.005** |
| **3719.1** | **100** | **0.085** | **0.005** |
| **3721.6** | **100** | **0.025** | **0.005** |
| **3726.7** | **100** | **0.025** | **0.005** |
| **3729.2** | **100** | **-0.005** | **0.005** |
| **3730.9** | **100** | **0.025** | **0.005** |
| **3733.4** | **100** | **0.025** | **0.035** |
| **3735.9** | **100** | **0.055** | **0.005** |
| **3738.5** | **100** | **0.085** | **0.005** |
| **3741.0** | **100** | **0.025** | **0.005** |
| **3746.0** | **100** | **0.025** | **0.005** |
| **3748.6** | **100** | **-0.005** | **0.005** |
| **3750.3** | **100** | **0.025** | **0.005** |
| **3752.8** | **100** | **0.025** | **0.035** |
| **3755.3** | **100** | **0.055** | **0.005** |
| **3757.8** | **100** | **0.085** | **0.005** |
| **3760.4** | **100** | **0.025** | **0.005** |
| **3765.4** | **100** | **0.025** | **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** |
| **7774.1** | **60** | **0.145** | **0.005** |
| **7776.9** | **60** | **0.175** | **0.005** |
| **7782.4** | **60** | **0.025** | **0.005** |
| **7801.9** | **60** | **0.025** | **-0.205** |
| **7832.5** | **60** | **-0.005** | **0.155** |
| **7840.9** | **60** | **-0.035** | **-0.025** |
| **7846.4** | **60** | **-0.065** | **0.035** |
| **7849.2** | **60** | **-0.095** | **0.005** |
| **7852.0** | **60** | **-0.125** | **0.005** |
| **7857.6** | **60** | **0.025** | **0.005** |
| **7877.1** | **60** | **0.025** | **0.215** |
| **7910.5** | **60** | **0.055** | **-0.145** |
| **7924.4** | **60** | **0.085** | **0.065** |
| **7929.9** | **60** | **0.115** | **0.005** |
| **7932.7** | **60** | **0.145** | **0.005** |
| **7937.4** | **60** | **0.025** | **0.005** |
| **7954.1** | **60** | **0.025** | **-0.175** |
| **7984.7** | **60** | **-0.005** | **0.155** |
| **7993.0** | **60** | **-0.035** | **-0.025** |
| **7998.6** | **60** | **-0.065** | **0.035** |
| **8001.4** | **60** | **-0.095** | **0.005** |
| **8004.2** | **60** | **-0.125** | **0.005** |
| **8009.7** | **60** | **0.025** | **0.005** |
| **8026.4** | **60** | **0.025** | **0.185** |
| **8057.1** | **60** | **0.055** | **-0.145** |
| **8068.2** | **60** | **0.085** | **0.065** |
| **8073.8** | **60** | **0.115** | **0.005** |
| **8076.5** | **60** | **0.145** | **0.005** |
| **8081.2** | **60** | **0.025** | **0.005** |
| **8097.9** | **60** | **0.025** | **-0.175** |
| **8122.9** | **60** | **-0.005** | **0.125** |
| **8128.5** | **60** | **-0.035** | **0.005** |
| **8134.1** | **60** | **-0.065** | **0.035** |
| **8136.8** | **60** | **-0.095** | **0.005** |
| **8139.6** | **60** | **-0.125** | **0.005** |
| **8145.2** | **60** | **0.025** | **0.005** |
| **8161.9** | **60** | **0.025** | **0.185** |
| **8192.5** | **60** | **0.055** | **-0.145** |
| **8203.6** | **60** | **0.085** | **0.065** |
| **8209.2** | **60** | **0.115** | **0.005** |
| **8212.0** | **60** | **0.145** | **0.005** |
| **8216.6** | **60** | **0.025** | **0.005** |
| **8233.3** | **60** | **0.025** | **-0.175** |
| **8255.6** | **60** | **-0.005** | **0.125** |
| **8261.2** | **60** | **-0.035** | **0.005** |
| **8266.7** | **60** | **-0.065** | **0.035** |
| **8269.5** | **60** | **-0.095** | **0.005** |
| **8272.3** | **60** | **-0.125** | **0.005** |
| **8277.9** | **60** | **0.025** | **0.005** |
| **8294.6** | **60** | **0.025** | **0.185** |
| **8322.4** | **60** | **0.055** | **-0.115** |
| **8333.5** | **60** | **0.085** | **0.065** |
| **8339.1** | **60** | **0.115** | **0.005** |
| **8341.9** | **60** | **0.145** | **0.005** |
| **8346.5** | **60** | **0.025** | **0.005** |
| **8360.4** | **60** | **0.025** | **-0.145** |
| **8382.7** | **60** | **-0.005** | **0.125** |
| **8388.3** | **60** | **-0.035** | **0.005** |
| **8391.1** | **60** | **-0.065** | **0.005** |
| **8393.8** | **60** | **-0.095** | **0.005** |
| **8398.5** | **60** | **0.025** | **0.005** |
| **8415.2** | **60** | **0.025** | **0.185** |
| **8440.2** | **60** | **0.055** | **-0.115** |
| **8451.4** | **60** | **0.085** | **0.065** |
| **8456.9** | **60** | **0.115** | **0.005** |
| **8460.6** | **60** | **0.025** | **0.005** |
| **8474.6** | **60** | **0.025** | **-0.145** |
| **8494.0** | **60** | **-0.005** | **0.095** |
| **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** |
| **9122.1** | **60** | **-0.005** | **0.065** |
| **9124.9** | **60** | **-0.035** | **0.005** |
| **9127.7** | **60** | **-0.065** | **0.005** |
| **9131.4** | **60** | **0.025** | **0.005** |
| **9142.6** | **60** | **0.025** | **0.125** |
| **9162.0** | **60** | **0.055** | **-0.085** |
| **9167.6** | **60** | **0.085** | **0.035** |
| **9170.4** | **60** | **0.115** | **0.005** |
| **9174.1** | **60** | **0.025** | **0.005** |
| **9185.2** | **60** | **0.025** | **-0.115** |
| **9199.2** | **60** | **-0.005** | **0.065** |
| **9201.9** | **60** | **-0.035** | **0.005** |
| **9204.7** | **60** | **0.025** | **0.005** |
| **9215.9** | **60** | **0.025** | **0.125** |
| **9235.3** | **60** | **0.055** | **-0.085** |
| **9240.9** | **60** | **0.085** | **0.035** |
| **9243.7** | **60** | **0.025** | **0.005** |
| **9254.8** | **60** | **0.025** | **-0.115** |
| **9268.7** | **60** | **-0.005** | **0.065** |
| **9271.5** | **60** | **-0.035** | **0.005** |
| **9274.3** | **60** | **0.025** | **0.005** |
| **9282.7** | **60** | **0.025** | **0.095** |
| **9299.4** | **60** | **0.055** | **-0.055** |
| **9304.9** | **60** | **0.085** | **0.035** |
| **9307.7** | **60** | **0.025** | **0.005** |
| **9318.8** | **60** | **0.025** | **-0.115** |
| **9332.8** | **60** | **-0.005** | **0.065** |
| **9335.5** | **60** | **-0.035** | **0.005** |
| **9338.3** | **60** | **0.025** | **0.005** |
| **9346.7** | **60** | **0.025** | **0.095** |
| **9363.4** | **60** | **0.055** | **-0.055** |
| **9368.9** | **60** | **0.085** | **0.035** |
| **9371.7** | **60** | **0.025** | **0.005** |
| **9380.1** | **60** | **0.025** | **-0.085** |
| **9394.0** | **60** | **-0.005** | **0.065** |
| **9396.8** | **60** | **-0.035** | **0.005** |
| **9399.6** | **60** | **0.025** | **0.005** |
| **9407.9** | **60** | **0.025** | **0.095** |
| **9421.8** | **60** | **0.055** | **-0.055** |
| **9427.4** | **60** | **0.085** | **0.035** |
| **9430.2** | **60** | **0.025** | **0.005** |
| **9438.5** | **60** | **0.025** | **-0.085** |
| **9449.7** | **60** | **-0.005** | **0.065** |
| **9452.4** | **60** | **-0.035** | **0.005** |
| **9455.2** | **60** | **0.025** | **0.005** |
| **9463.6** | **60** | **0.025** | **0.095** |
| **9477.5** | **60** | **0.055** | **-0.055** |
| **9483.1** | **60** | **0.085** | **0.035** |
| **9485.8** | **60** | **0.025** | **0.005** |
| **9494.2** | **60** | **0.025** | **-0.085** |
| **9505.3** | **60** | **-0.005** | **0.065** |
| **9508.1** | **60** | **-0.035** | **0.005** |
| **9510.9** | **60** | **0.025** | **0.005** |
| **9519.2** | **60** | **0.025** | **0.095** |
| **9533.2** | **60** | **0.055** | **-0.055** |
| **9538.7** | **60** | **0.085** | **0.035** |
| **9541.5** | **60** | **0.025** | **0.005** |
| **9549.9** | **60** | **0.025** | **-0.085** |
| **9561.0** | **60** | **-0.005** | **0.065** |
| **9563.8** | **60** | **-0.035** | **0.005** |
| **9566.6** | **60** | **0.025** | **0.005** |
| **9574.9** | **60** | **0.025** | **0.095** |
| **9588.8** | **60** | **0.055** | **-0.055** |
| **9594.4** | **60** | **0.085** | **0.035** |
| **9597.2** | **60** | **0.025** | **0.005** |
| **9605.5** | **60** | **0.025** | **-0.085** |
| **9616.7** | **60** | **-0.005** | **0.065** |
| **9619.4** | **60** | **-0.035** | **0.005** |
| **9622.2** | **60** | **0.025** | **0.005** |
| **9630.6** | **60** | **0.025** | **0.095** |
| **9644.5** | **60** | **0.055** | **-0.055** |
| **9650.1** | **60** | **0.085** | **0.035** |
| **9652.8** | **60** | **0.025** | **0.005** |
| **9661.2** | **60** | **0.025** | **-0.085** |
| **9669.5** | **60** | **-0.005** | **0.035** |
| **9672.3** | **60** | **-0.035** | **0.005** |
| **9675.1** | **60** | **0.025** | **0.005** |
| **9683.5** | **60** | **0.025** | **0.095** |
| **9697.4** | **60** | **0.055** | **-0.055** |
| **9700.2** | **60** | **0.085** | **0.005** |
| **9702.9** | **60** | **0.025** | **0.005** |
| **9708.5** | **60** | **0.025** | **-0.055** |
| **9716.9** | **60** | **-0.005** | **0.035** |
| **9719.6** | **60** | **-0.035** | **0.005** |
| **9722.4** | **60** | **0.025** | **0.005** |
| **9730.8** | **60** | **0.025** | **0.095** |
| **9744.7** | **60** | **0.055** | **-0.055** |
| **9747.5** | **60** | **0.085** | **0.005** |
| **9750.3** | **60** | **0.025** | **0.005** |
| **9755.8** | **60** | **0.025** | **-0.055** |
| **9764.2** | **60** | **-0.005** | **0.035** |
| **9767.0** | **60** | **-0.035** | **0.005** |
| **9769.7** | **60** | **0.025** | **0.005** |
| **9778.1** | **60** | **0.025** | **0.095** |
| **9792.0** | **60** | **0.055** | **-0.055** |
| **9794.8** | **60** | **0.085** | **0.005** |
| **9797.6** | **60** | **0.025** | **0.005** |
| **9803.1** | **60** | **0.025** | **-0.055** |
| **9811.5** | **60** | **-0.005** | **0.035** |
| **9814.3** | **60** | **-0.035** | **0.005** |
| **9817.1** | **60** | **0.025** | **0.005** |
| **9825.4** | **60** | **0.025** | **0.095** |
| **9839.3** | **60** | **0.055** | **-0.055** |
| **9842.1** | **60** | **0.085** | **0.005** |
| **9844.9** | **60** | **0.025** | **0.005** |
| **9850.5** | **60** | **0.025** | **-0.055** |
| **9858.8** | **60** | **-0.005** | **0.035** |
| **9861.6** | **60** | **-0.035** | **0.005** |
| **9864.4** | **60** | **0.025** | **0.005** |
| **9869.9** | **60** | **0.025** | **0.065** |
| **9883.9** | **60** | **0.055** | **-0.055** |
| **9886.6** | **60** | **0.085** | **0.005** |
| **9889.4** | **60** | **0.025** | **0.005** |
| **9895.0** | **60** | **0.025** | **-0.055** |
| **9903.3** | **60** | **-0.005** | **0.035** |
| **9906.1** | **60** | **-0.035** | **0.005** |
| **9908.9** | **60** | **0.025** | **0.005** |
| **9914.5** | **60** | **0.025** | **0.065** |
| **9925.6** | **60** | **0.055** | **-0.025** |
| **9928.4** | **60** | **0.085** | **0.005** |
| **9931.2** | **60** | **0.025** | **0.005** |
| **9936.7** | **60** | **0.025** | **-0.055** |
| **9945.1** | **60** | **-0.005** | **0.035** |
| **9947.9** | **60** | **-0.035** | **0.005** |
| **9950.7** | **60** | **0.025** | **0.005** |
| **9956.2** | **60** | **0.025** | **0.065** |
| **9967.4** | **60** | **0.055** | **-0.025** |
| **9970.1** | **60** | **0.085** | **0.005** |
| **9972.9** | **60** | **0.025** | **0.005** |
| **9978.5** | **60** | **0.025** | **-0.055** |
| **9986.8** | **60** | **-0.005** | **0.035** |
| **9989.6** | **60** | **-0.035** | **0.005** |
| **9992.4** | **60** | **0.025** | **0.005** |
| **9998.0** | **60** | **0.025** | **0.065** |
| **10009.1** | **60** | **0.055** | **-0.025** |
| **10011.9** | **60** | **0.085** | **0.005** |
| **10014.7** | **60** | **0.025** | **0.005** |
| **10020.2** | **60** | **0.025** | **-0.055** |
| **10028.6** | **60** | **-0.005** | **0.035** |
| **10030.4** | **60** | **0.025** | **0.005** |
| **10036.0** | **60** | **0.025** | **0.065** |
| **10047.1** | **60** | **0.055** | **-0.025** |
| **10049.9** | **60** | **0.085** | **0.005** |
| **10052.7** | **60** | **0.025** | **0.005** |
| **10058.3** | **60** | **0.025** | **-0.055** |
| **10066.6** | **60** | **-0.005** | **0.035** |
| **10068.5** | **60** | **0.025** | **0.005** |
| **10074.1** | **60** | **0.025** | **0.065** |
| **10085.2** | **60** | **0.055** | **-0.025** |
| **10088.0** | **60** | **0.085** | **0.005** |
| **10090.8** | **60** | **0.025** | **0.005** |
| **10096.3** | **60** | **0.025** | **-0.055** |
| **10104.7** | **60** | **-0.005** | **0.035** |
| **10106.5** | **60** | **0.025** | **0.005** |
| **10112.1** | **60** | **0.025** | **0.065** |
| **10123.2** | **60** | **0.055** | **-0.025** |
| **10126.0** | **60** | **0.085** | **0.005** |
| **10128.8** | **60** | **0.025** | **0.005** |
| **10134.4** | **60** | **0.025** | **-0.055** |
| **10142.7** | **60** | **-0.005** | **0.035** |
| **10144.6** | **60** | **0.025** | **0.005** |
| **10150.1** | **60** | **0.025** | **0.065** |
| **10161.3** | **60** | **0.055** | **-0.025** |
| **10164.0** | **60** | **0.085** | **0.005** |
| **10166.8** | **60** | **0.025** | **0.005** |
| **10172.4** | **60** | **0.025** | **-0.055** |
| **10180.7** | **60** | **-0.005** | **0.035** |
| **10182.6** | **60** | **0.025** | **0.005** |
| **10188.2** | **60** | **0.025** | **0.065** |
| **10196.5** | **60** | **0.055** | **-0.025** |
| **10199.3** | **60** | **0.085** | **0.005** |
| **10202.1** | **60** | **0.025** | **0.005** |
| **10207.7** | **60** | **0.025** | **-0.055** |
| **10216.0** | **60** | **-0.005** | **0.035** |
| **10217.9** | **60** | **0.025** | **0.005** |
| **10223.4** | **60** | **0.025** | **0.065** |
| **10231.8** | **60** | **0.055** | **-0.025** |
| **10234.6** | **60** | **0.085** | **0.005** |
| **10237.3** | **60** | **0.025** | **0.005** |
| **10242.9** | **60** | **0.025** | **-0.055** |
| **10251.3** | **60** | **-0.005** | **0.035** |
| **10253.1** | **60** | **0.025** | **0.005** |
| **10258.7** | **60** | **0.025** | **0.065** |
| **10267.0** | **60** | **0.055** | **-0.025** |
| **10269.8** | **60** | **0.085** | **0.005** |
| **10272.6** | **60** | **0.025** | **0.005** |
| **10278.2** | **60** | **0.025** | **-0.055** |
| **10286.5** | **60** | **-0.005** | **0.035** |
| **10288.4** | **60** | **0.025** | **0.005** |
| **10293.9** | **60** | **0.025** | **0.065** |
| **10302.3** | **60** | **0.055** | **-0.025** |
| **10305.1** | **60** | **0.085** | **0.005** |
| **10307.9** | **60** | **0.025** | **0.005** |
| **10313.4** | **60** | **0.025** | **-0.055** |
| **10321.8** | **60** | **-0.005** | **0.035** |
| **10323.6** | **60** | **0.025** | **0.005** |
| **10329.2** | **60** | **0.025** | **0.065** |
| **10337.5** | **60** | **0.055** | **-0.025** |
| **10340.3** | **60** | **0.085** | **0.005** |
| **10343.1** | **60** | **0.025** | **0.005** |
| **10348.7** | **60** | **0.025** | **-0.055** |
| **10357.0** | **60** | **-0.005** | **0.035** |
| **10358.9** | **60** | **0.025** | **0.005** |
| **10364.4** | **60** | **0.025** | **0.065** |
| **10372.8** | **60** | **0.055** | **-0.025** |
| **10375.6** | **60** | **0.085** | **0.005** |
| **10378.4** | **60** | **0.025** | **0.005** |
| **10383.9** | **60** | **0.025** | **-0.055** |
| **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** |
| **11993.6** | **60** | **0.025** | **0.005** |
| **11996.4** | **60** | **0.025** | **0.035** |
| **11999.2** | **60** | **0.055** | **0.005** |
| **12001.1** | **60** | **0.025** | **0.005** |
| **12006.6** | **60** | **0.025** | **0.005** |
| **12009.4** | **60** | **-0.005** | **0.005** |
| **12011.3** | **60** | **0.025** | **0.005** |
| **12014.0** | **60** | **0.025** | **0.035** |
| **12016.8** | **60** | **0.055** | **0.005** |
| **12018.7** | **60** | **0.025** | **0.005** |
| **12024.3** | **60** | **0.025** | **0.005** |
| **12027.0** | **60** | **-0.005** | **0.005** |
| **12028.9** | **60** | **0.025** | **0.005** |
| **12031.7** | **60** | **0.025** | **0.035** |
| **12034.5** | **60** | **0.055** | **0.005** |
| **12036.3** | **60** | **0.025** | **0.005** |
| **12041.9** | **60** | **0.025** | **0.005** |
| **12044.7** | **60** | **-0.005** | **0.005** |
| **12046.5** | **60** | **0.025** | **0.005** |
| **12049.3** | **60** | **0.025** | **0.035** |
| **12052.1** | **60** | **0.055** | **0.005** |
| **12053.9** | **60** | **0.025** | **0.005** |
| **12059.5** | **60** | **0.025** | **0.005** |
| **12062.3** | **60** | **-0.005** | **0.005** |
| **12064.1** | **60** | **0.025** | **0.005** |
| **12066.9** | **60** | **0.025** | **0.035** |
| **12069.7** | **60** | **0.055** | **0.005** |
| **12071.6** | **60** | **0.025** | **0.005** |
| **12077.1** | **60** | **0.025** | **0.005** |
| **12079.9** | **60** | **-0.005** | **0.005** |
| **12081.8** | **60** | **0.025** | **0.005** |
| **12084.6** | **60** | **0.025** | **0.035** |
| **12087.3** | **60** | **0.055** | **0.005** |
| **12089.2** | **60** | **0.025** | **0.005** |
| **12094.8** | **60** | **0.025** | **0.005** |
| **12097.5** | **60** | **-0.005** | **0.005** |
| **12099.4** | **60** | **0.025** | **0.005** |
| **12102.2** | **60** | **0.025** | **0.035** |
| **12105.0** | **60** | **0.055** | **0.005** |
| **12106.8** | **60** | **0.025** | **0.005** |
| **12112.4** | **60** | **0.025** | **0.005** |
| **12115.2** | **60** | **-0.005** | **0.005** |
| **12117.0** | **60** | **0.025** | **0.005** |
| **12119.8** | **60** | **0.025** | **0.035** |
| **12122.6** | **60** | **0.055** | **0.005** |
| **12124.5** | **60** | **0.025** | **0.005** |
| **12130.0** | **60** | **0.025** | **0.005** |
| **12132.8** | **60** | **-0.005** | **0.005** |
| **12134.7** | **60** | **0.025** | **0.005** |
| **12137.4** | **60** | **0.025** | **0.035** |
| **12140.2** | **60** | **0.055** | **0.005** |
| **12142.1** | **60** | **0.025** | **0.005** |
| **12147.6** | **60** | **0.025** | **0.005** |
| **12150.4** | **60** | **-0.005** | **0.005** |
| **12152.3** | **60** | **0.025** | **0.005** |
| **12155.1** | **60** | **0.025** | **0.035** |
| **12157.9** | **60** | **0.055** | **0.005** |
| **12159.7** | **60** | **0.025** | **0.005** |
| **12165.3** | **60** | **0.025** | **0.005** |
| **12168.1** | **60** | **-0.005** | **0.005** |
| **12169.9** | **60** | **0.025** | **0.005** |
| **12172.7** | **60** | **0.025** | **0.035** |
| **12175.5** | **60** | **0.055** | **0.005** |
| **12177.3** | **60** | **0.025** | **0.005** |
| **12182.9** | **60** | **0.025** | **0.005** |
| **12185.7** | **60** | **-0.005** | **0.005** |
| **12187.5** | **60** | **0.025** | **0.005** |
| **12190.3** | **60** | **0.025** | **0.035** |
| **12193.1** | **60** | **0.055** | **0.005** |
| **12195.0** | **60** | **0.025** | **0.005** |
| **12200.5** | **60** | **0.025** | **0.005** |
| **12203.3** | **60** | **-0.005** | **0.005** |
| **12205.2** | **60** | **0.025** | **0.005** |
| **12208.0** | **60** | **0.025** | **0.035** |
| **12210.7** | **60** | **0.055** | **0.005** |
| **12212.6** | **60** | **0.025** | **0.005** |
| **12218.2** | **60** | **0.025** | **0.005** |
| **12220.9** | **60** | **-0.005** | **0.005** |
| **12222.8** | **60** | **0.025** | **0.005** |
| **12225.6** | **60** | **0.025** | **0.035** |
| **12228.4** | **60** | **0.055** | **0.005** |
| **12230.2** | **60** | **0.025** | **0.005** |
| **12235.8** | **60** | **0.025** | **0.005** |
| **12238.6** | **60** | **-0.005** | **0.005** |
| **12240.4** | **60** | **0.025** | **0.005** |
| **12243.2** | **60** | **0.025** | **0.035** |
| **12246.0** | **60** | **0.055** | **0.005** |
| **12247.8** | **60** | **0.025** | **0.005** |
| **12253.4** | **60** | **0.025** | **0.005** |
| **12256.2** | **60** | **-0.005** | **0.005** |
| **12258.1** | **60** | **0.025** | **0.005** |
| **12260.8** | **60** | **0.025** | **0.035** |
| **12263.6** | **60** | **0.055** | **0.005** |
| **12265.5** | **60** | **0.025** | **0.005** |
| **12271.0** | **60** | **0.025** | **0.005** |
| **12273.8** | **60** | **-0.005** | **0.005** |
| **12275.7** | **60** | **0.025** | **0.005** |
| **12278.5** | **60** | **0.025** | **0.035** |
| **12281.2** | **60** | **0.055** | **0.005** |
| **12283.1** | **60** | **0.025** | **0.005** |
| **12288.7** | **60** | **0.025** | **0.005** |
| **12291.5** | **60** | **-0.005** | **0.005** |
| **12293.3** | **60** | **0.025** | **0.005** |
| **12296.1** | **60** | **0.025** | **0.035** |
| **12298.9** | **60** | **0.055** | **0.005** |
| **12300.7** | **60** | **0.025** | **0.005** |
| **12306.3** | **60** | **0.025** | **0.005** |
| **12309.1** | **60** | **-0.005** | **0.005** |
| **12310.9** | **60** | **0.025** | **0.005** |
| **12313.7** | **60** | **0.025** | **0.035** |
| **12316.5** | **60** | **0.055** | **0.005** |
| **12318.4** | **60** | **0.025** | **0.005** |
| **12323.9** | **60** | **0.025** | **0.005** |
| **12326.7** | **60** | **-0.005** | **0.005** |
| **12328.6** | **60** | **0.025** | **0.005** |
| **12331.3** | **60** | **0.025** | **0.035** |
| **12334.1** | **60** | **0.055** | **0.005** |
| **12336.0** | **60** | **0.025** | **0.005** |
| **12341.6** | **60** | **0.025** | **0.005** |
| **12344.3** | **60** | **-0.005** | **0.005** |
| **12346.2** | **60** | **0.025** | **0.005** |
| **12349.0** | **60** | **0.025** | **0.035** |
| **12351.8** | **60** | **0.055** | **0.005** |
| **12353.6** | **60** | **0.025** | **0.005** |
| **12359.2** | **60** | **0.025** | **0.005** |
| **12362.0** | **60** | **-0.005** | **0.005** |
| **12363.8** | **60** | **0.025** | **0.005** |
| **12366.6** | **60** | **0.025** | **0.035** |
| **12369.4** | **60** | **0.055** | **0.005** |
| **12371.2** | **60** | **0.025** | **0.005** |
| **12376.8** | **60** | **0.025** | **0.005** |
| **12379.6** | **60** | **-0.005** | **0.005** |
| **12381.4** | **60** | **0.025** | **0.005** |
| **12384.2** | **60** | **0.025** | **0.035** |
| **12387.0** | **60** | **0.055** | **0.005** |
| **12388.9** | **60** | **0.025** | **0.005** |
| **12394.4** | **60** | **0.025** | **0.005** |
| **12397.2** | **60** | **-0.005** | **0.005** |
| **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 10 – Appendix 4

Test equipment tolerances

**Table B.1**

**Instrumentation accuracy**

|  |  |  |
| --- | --- | --- |
| ***Parameter*** | ***Control accuracy*** | ***Instrumentation accuracy at full scale*** |
| **Tyre forces and torque** | **Fz: ± 50 N or 1%**  **whichever is greater.**  **Fy: ± 100 N or 5%**  **whichever is greater, for the difference between input peaks and actually generated peaks.**  **Fx: ± 100 N or 5%**  **whichever is greater, for the difference between input peaks and actually generated peaks.**  **My: ± 40 Nm or 5% whichever is greater, for the difference between input peaks and actually generated peaks.** | **Fz: ± 1%**  **Fy: ± 1%**  **Fx: ± 1%**  **My: ± 1%** |
| **Inflation pressure** | **± 3 kPa** | **± 3 kPa** |
| **Mass scale** | **± 2 g** | **± 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, 68.83h (247,800s). The interval of measurement shall be minimum1Hz.** | **± 0.02 s for the time increments** |
| **Camber angle** | **0 +/- 0.1 degrees** | **0 +/-0.1 degrees** |
| **Thermometer** | **±5 °C** | **±0.5 °C** |
| **Speed** | **±2 km/h** | **± 0.1%** |

Annex 10 – Appendix 5

Replacement of sandpaper surface

**Sandpaper surface shall be replaced either when:**

* **It could not meet the specifications described in 2.3.2.3.; or**
* **Running distance reached 20,000 km for 2 positions drum in case of 3m, 40,000 km for 1 position drum in case of 3 m,**

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

**Road surface replacement distance (reference value) = 20000 km**

**Standard drum diameter = 3 m**

Annex 10 – Appendix 6

Example of a test report for indoor drum test method

**The test report shall include the following information.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test report number:** |  |  | **Test date:** | **~** | |
| **Test machine identification:** |  |  |  |  |  |
| **Drum circumference (m),** |  |  |  | **Beginning of test** | **End of test** |
| **Test cycle (2 positions /1 position)** |  |  | **MPD of test surface (mm):** |  |  |
| **3rd body** | **Mineral or Clay** |  |

|  |  |  |  |
| --- | --- | --- | --- |
| ***Type of test tyre*** | | ***Reference tyre*** | ***Candidate tyre*** |
| **Tyre class** | |  |  |
| **Brand** | |  |  |
| **Pattern/trade description** | | **SRTT…** |  |
| **Tyre size designation** | |  |  |
| **Service description** | |  |  |
| **Test load (N)** | |  |  |
| **Test inflation pressure (kPa)** | |  |  |
| **Tyre identification** | |  |  |
| **3PMSF marking (Y/N)** | |  |  |
| **Rim** | |  |  |
| **Inflation pressure (kPa)** | **Beginning of test** |  |  |
| **End of test** |  |  |
| **Mass of tyre (g)** | **Before test** |  |  |
| **After test** |  |  |
| **Test distance (km)** | |  |  |
| **Abrasion rate (mg/km)** | |  |  |
| **Normalized abrasion rate (mg/km/t)** | |  |  |
| **Abrasion index** | |  |  |
| **Average ambient temp. (°C)** | |  |  |
| **RMS of G(x)** | |  |  |
| **RMS of G(y)** | |  |  |
| **Average of Fz** | |  |  |
| **Remarks** | |  |  |

**II. Justification**

1. In line with the work ongoing in the Task Force on Tyre Abrasion (TFTA) as presented in document GRBP-78-26, TFTA is proposing to introduce a new methodology to measure tyre abrasion of C1 tyres in UN Regulation No. 117. For this reason, two methods are proposed: a vehicle test method on public open roads and an indoor drum test method. The investigation of a possible correlation between the two methods is still ongoing in TFTA, which explain the […] in some parts of the proposed amendment. No limit for tyre abrasion is proposed in the current text as a market assessment is required to define any performance level.
2. The scope is enlarged in paragraph 1.1. but the additions remain in […] as, on one hand, there is a requirement for measuring the tyre abrasion of C1 tyres; however, on the other hand, there is still no requirement for compliance with any threshold.
3. Nevertheless, paragraph 1.3. specify the applicable C1 tyres under the scope of tyre abrasion measurement: it covers all C1 tyres except for tyres with nominal rim > 13 and ice grip tyres. The latter are expected to have different use and behaviour and thus are not considered in the current proposal.
4. Paragraph 2.7. was missing, following the introduction of the previous amendments to the UN Regulation concerning adhesion on wet surfaces of tyres in worn state.
5. As tyre abrasion is expressed as an index of a candidate tyre compared to a reference tyre, dedicated to the abrasion, then the reference to the American Society for Testing and Materials (ASTM) standards needs to be included for both “summer” (SRTT17S) and “winter” (SRTT17W) reference tyres.
6. The abrasion performance is evaluated in three units: mass loss per distance normalised to the load index of the tyre (mg/km/t), mass loss per distance (mg/km), and index of abrasion of the candidate tyre compared to the reference tyre (-).
7. Several references to tyre abrasion shall be introduced in the Regulation in paragraph 3.2.1. and when limits will be defined in paragraphs 3.1.1. and 3.1.1.1.
8. As explained, the introduction of the tyre abrasion in the Regulation is a two steps approach: implementation of the test methods for C1 tyres to introduce, at a later stage, limits to comply with (ongoing work of TFTA). In any case, the proposal is to introduce the tyre abrasion measurement with a phase-in period in voluntary basis till [6 July 2025], and as mandatory from [7 July 2025] for new types of tyres approved according to this Regulation (paragraphs 5.7 to 5.9).
9. The abrasion results shall then be included in the certificate template.
10. Proposal to introduce new Annex 10 with description of the measurement (test conditions and methods and test report): for vehicle test method on public open roads method in appendices 1 and 2 and for indoor drum test method in appendices 3 to 6, as previously described in GRBP-78-26 with conclusions of open items except for remaining square brackets.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. \* In accordance with the programme of work of the Inland Transport Committee for 2024 as outlined in proposed programme budget for 2024 (A/78/6 (Sect. 20), table 20.5), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate. [↑](#footnote-ref-2)