Working Paper N° : TYREGTR-09-03
(Proposal to amend Draft gtr with
respect to Rolling Resistance and
Rolling Sound)

# Proposal to amend the Draft gtr Text with respect to Tyre Rolling Resistance and Rolling Sound

**Submitted by the representative of the European Commission.**

The attached proposals are based on document TYREGTR-09-02 and are intended to introduce or amend requirements relating to tyre rolling sound or rolling resistance within the gtr, for the cases where such prescriptions are adopted by Contracting Parties.

**A. Proposed text modifications**

*In Paragraph 3, insert the following new definitions:*

*After the definition for "Brand name, Trade name or Trade mark" insert the following:*

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

*After the definition for "Flat tyre running mode" insert the following:*

'"Inertia" means the ratio of the torque applied to a rotating body to the rotational acceleration of this body. '

*After the definition for 'Intended outboard sidewall' insert the following:*

'"Laboratory Control Tyre" means a tyre used by an individual laboratory to control machine behaviour as a function of time.'

*After the definition for "Overall width", insert the following:*

'"Parasitic loss" means the loss of energy (or energy consumed) per unit distance excluding internal tyre losses, attributable to aerodynamic loss of the different rotating elements of the test equipment, bearing friction and other sources of systematic loss which may be inherent in the measurement.'

*After the definition for "rim protector", insert the following:*

'"Rolling resistance ($F_r$)" means the loss of energy (or energy consumed) per unit of distance traveled, measured in newton-meters per meter

"Rolling resistance coefficient ($C_r$)" means the ratio of the rolling resistance to the load on the tyre. '

*After the definition for "Sidewall separation" insert the following:*

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

*Replace paragraph 4.7.1 with the following:*

'4.7.1 Requirements

For passenger tyres which are included within the scope of this gtr, the rolling sound emission value shall not exceed the values given below for tyres of classes C1, C2 and C3, with reference to the categories of use and, where relevant, the nominal section widths, given in the definitions section in paragraph 3 of this gtr standard.

**Class C1 tyres**

| Nominal Section Width | Limit dB(A) |
|---|---|
| 185 and lower | 70 |
| Over 185 up to 245 | 71 |
| Over 245 up to 275 | 72 |
| Over 275 | 74 |
| The above limits shall be increased by 1 dB(A) for snow tyres for use in severe snow conditions[1], extra load tyres or reinforced tyres, or any combination of these classifications. | |

**Class C2 tyres**

| Category of use | Limit dB(A) |
|---|---|
| Normal | 72 |
| Snow* | 73 |
| Special | 74 |
| * Snow tyres for use in severe snow conditions | |

**Class C3 tyres**

| Category of use | Limit dB(A) |
|---|---|
| Normal | 73 |
| Snow* | 74 |
| Special | 75 |
| *snow tyres for use in severe snow conditions | |

[1] (editorial note) 'Snow tyre for use in severe snow conditions' is currently defined in the gtr text. However, this definition could be further refined, if desired, by adopting the new snow tyre definition in UNECE Regulation 117, including the test procedure contained in Annex 7 to that Regulation.

*Add a new section 4.9 (and renumber existing section 4.9 and subsequent sections accordingly*)

## '4.9 Requirements for Rolling Resistance

4.9.1 Requirements.

For passenger tyres which are included within the scope of this gtr,, the maximum values for the rolling resistance coefficient shall not exceed the following when measured by the method described in sections 4.9.2 to 4.9.10 to this Regulation.

| *Tyre class* | *Max value (N/kN)* |
|---|---|
| C1 | 10.5 |
| C2 | 9.0 |
| C3 | 6.5 |
| For snow tyres for use in severe snow conditions, the limits shall be increased by 1 N/kN. | |

4.9.2. Test Methods

The alternative measurement methods listed below are given in this Regulation. The choice of an individual method is left to the tester. For each method, the test measurements shall be converted to a force acting at the tyre/drum interface. The measured parameters are:

a) in the force method: the reaction force measured or converted at the tyre spindle;[2]

b) in the torque method: the torque input measured at the test drum;[3]

c) in the deceleration method: the measurement of deceleration of the test drum and tyre assembly;[2]

d) in the power method: the measurement of the power input to the test drum.[2]

---

[2] This measured value also includes the bearing and aerodynamic losses of the wheel and tyre which are also to be considered for further data interpretation.

[3] The measured value in the torque, deceleration and power methods also includes the bearing and aerodynamic losses of the wheel, the tyre, and the drum which are also to be considered for further data interpretation.

4.9.3. Test Equipment.

4.9.3.1. Drum specifications

4.9.3.1.1. Diameter

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

The Fr and Cr values shall be expressed relative to a drum diameter of 2.0 m. If drum diameter different than 2.0 m is used, a correlation adjustment shall be made following the method in paragraph 4.9.7.3.

4.9.3.1.2. Surface

The surface of the drum shall be smooth steel. Alternatively, in order to improve skim test reading accuracy, a textured surface may also be used, which should be kept clean.

The Fr and Cr values shall be expressed relative to the "smooth" drum surface. If a textured drum surface is used, see paragraph 4.9.8.7.

4.9.3.1.3. Width

The width of the drum test surface shall exceed the width of the test tyre contact patch.

4.9.3.2. Measuring rim

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

(a) for Class C1 and C2 tyres, the width of the rim shall be as defined in ISO 4000-1:2010,

(b) for Class C3 tyres, the width of the rim shall be as defined in ISO 4209 1:2001. No other rim width shall be allowed. See section 4.9.9.

4.9.3.3. Load, alignment, control and instrumentation 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 section 4.9.8.

4.9.3.4. Thermal environment

4.9.3.4.1. Reference conditions

The reference ambient temperature, measured at a distance not less than 0.15 m and not more than 1 m from the tyre sidewall, shall be 25 °C.

4.9.3.4.2. Alternative conditions

If the test ambient temperature is different from the reference ambient temperature, the rolling resistance measurement shall be corrected to the reference ambient temperature in accordance with paragraph 4.9.7.2.

4.9.3. 4.3. Drum surface temperature.

Care should be taken to ensure that the temperature of the test drum surface is the same as the ambient temperature at the beginning of the test.

4.9.4. Test Conditions

4.9.4.1. General

The test consists of a measurement of rolling resistance in which the tyre is inflated and the inflation pressure allowed to build up, i.e., “capped air”.

4.9.4.2. Test speeds

The value shall be obtained at the appropriate drum speed specified in Table 1.

## Table 1

**Test Speeds (in km/h)**

| *Tyre Class* | *C1* | *C2* | *C3* | |
|---|---|---|---|---|
| Load Index | All | LI ≤ 121 | LI > 121 | |
| Speed Symbol | All | All | J (100 km/h) and lower or tyres not marked with speed symbol | K (110 km/h) and higher |
| Speed | 80 | 80 | 60 | 80 |
| | | | | |

4.9.4.3 Test load

The standard test load shall be computed from the values shown in Table 2 and shall be kept within the tolerance specified in section 4.9.8.

4.9.4..4 Test inflation pressure

The inflation pressure shall be in accordance with that shown in Table 2 and shall be capped with the accuracy specified in section 4.9.8.4.

## Table 2

**Test Loads and Inflation Pressures**

| *Tyre Class* | *C1* [(a)] | | *C2, C3* |
|---|---|---|---|
| | Standard Load | Reinforced or Extra Load | |
| Load- % of maximum load capacity | 80 | 80 | 85 [(b)]<br>(% of single load) |
| Inflation pressure kPa | 210 | 250 | Corresponding to maximum load capacity for single application [(c)] |
| *Note*: The inflation pressure shall be capped with the accuracy specified in section 4.9.8.4. | | | |
| [(a)] For those passenger car tyres belonging to categories which are not shown in ISO 4000-1:2010, the inflation pressure shall be the inflation pressure recommended by the tyre manufacturer, corresponding to the maximum tyre load capacity, reduced by 30 kPa.<br>[(b)] As a percentage of single load, or 85 per cent of maximum load capacity for single application specified in applicable tyre standards manuals if not marked on tyre.<br>[(c)] Inflation pressure marked on sidewall, or if not marked on sidewall, as specified in applicable tyre standards manuals corresponding to maximum load capacity for single application. | | | |

4.9.4.5. Duration and speed

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

a) For duration $\Delta t$ , the time increments shall not exceed 0.5 s;

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

4.9.5. Test Procedure

4.9.5.1. General

The test procedure steps described below shall be followed in the sequence given.

4.9.5.2 Thermal conditioning

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

(a) 3 hours for Class C1 tyres;

(b) 6 hours for Class C2 and C3 tyres.

4.9.5.3. Pressure adjustment

After thermal conditioning, the inflation pressure shall be adjusted to the test pressure, and verified 10 minutes after the adjustment is made.

4.9.5.4. Warm-up

The warm-up durations shall be as specified in Table 3

## Table 3

Warm Up Durations

| *Tyre Class* | *C1* | *C2*<br>*LI ≤ 121* | *C3*<br>*LI > 121* | |
|---|---|---|---|---|
| Nominal Rim Diameter | All | All | < 22.5 | ≥ 22.5 |
| Warm up duration | 30 min. | 50 min. | 150 min. | 180 min. |

4.9.5.5. Measurement and recording

The following shall be measured and recorded (see figure 1):

(a) Test speed $U_n$.

(b) Load on the tyre normal to the drum surface $L_m$.

(c) The initial test inflation pressure as defined in paragraph 4.9.4.4.

(d) The coefficient of rolling resistance measured Cr, and its corrected value $Cr_c$, at 25 °C and for a drum diameter of 2 m.

(e) The distance from the tyre axis to the drum outer surface under steady state $r_{L,}$.

(f) Ambient temperature $t_{amb.}$

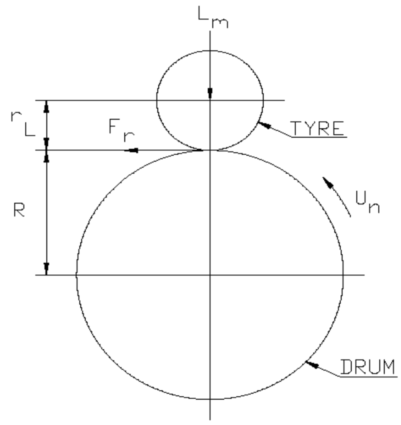
(g) Test drum radius R.

(h) Test method chosen.

i) Test rim (size and material).

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

## 1. FIGURE 1



All the mechanical quantities (forces, torques) will be orientated in accordance with the axis systems specified in ISO 8855:1991.

The directional tyres shall be run in their specified rotation sense.

4.9.5.6 Measurement of parasitic losses

The parasitic losses shall be determined by one of the following procedures given in paragraph 4.9.5.6.1. or 4.9.5.6.2.

4.9.5.6.1. Skim test reading

Skim test reading follows the procedure below:

(a) Reduce the load to maintain the tyre at the test speed without slippage.[4]

The load values should be as follows:

(i) Class C1 tyres: recommended value of 100 N; not to exceed 200 N;

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

(iii) Class C3 tyres: recommended value of 400 N; not to exceed 500 N.

(b) Record the spindle force $F_t$, input torque $T_t$, or the power, whichever applies.[3]

(c) Record the load on the tyre normal to the drum surface $L_m$.[3]

4.9.5. 6.2. Deceleration method

The deceleration method follows the procedure below:

a) Remove the tyre from the test surface;

b) Record the deceleration of the test drum $\Delta\omega Do/ \Delta t$ and that of the unloaded tyre $\Delta\omega_{T0}/ \Delta t$. [3]

4.9.5.7. Allowance for machines exceeding $\sigma_{m,i}$ criterion

---

[4] With the exception of the force method, the measured value includes the bearing and aerodynamic losses of the wheel, the tyre, and the drum losses which also need to be considered.

It is known that the spindle and drum bearing frictions depend on the applied load. Consequently, it is different for the loaded system measurement and the skim test reading. However, for practical reasons, this difference can be disregarded.

The steps described in paragraphs 4.9.5.3. to 4.9.5.5. shall be carried out once only, if the measurement standard deviation determined in accordance with paragraph 4.9.7.5. is:

(a) not greater than 0.075 N/kN for Class C1 and C2 tyres;

(b) not greater than 0.06 N/kN for Class C3 tyres.

If the measurement standard deviation exceeds this criterion, the measurement process will be repeated n times as described in paragraph 4.9.7.5. The rolling resistance value reported shall be the average of the n measurements.

4.9.6 Data Interpretation

4.9.6.1. Determination of parasitic losses

4.9.6.1.1. General

The laboratory shall perform the measurements described in paragraph 4.9.5.6.1. for the force, torque and power methods or those described in paragraph 4.9.5.6.2. for the deceleration method, in order to determine precisely in the test conditions (load, speed, temperature) the tyre spindle friction, the tyre and wheel aerodynamic losses, the drum (and as appropriate, engine and/or clutch) bearing friction, and the drum aerodynamic losses.

The parasitic losses related to the tyre/drum interface $F_{pl}$ expressed in newton shall be calculated from the force $F_t$ torque, power or the deceleration, as shown in paragraphs 4.9.6.1.2. to 4.9.6.1.5. below.

4.9.6.1.2. Force method at tyre spindle

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

where:

$F_t$ is the tyre spindle force in newton (see paragraph 4.9.5.6.1.);

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

R is the test drum radius, in meter.

4.9.6.1.3. Torque method at drum axis

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

where:

$T_t$ is the input torque in newton meter, as determined in paragraph 4.9.5.6.1.

R is the test drum radius, in meter.

4.9.6.1.4. Power method at drum axis

Calculate:

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

where:

V is the electrical potential applied to the machine drive, in volt;

A is the electric current drawn by the machine drive, in ampere;

$U_n$ is the test drum speed, in kilometer per hour.

4.9.6.1.5. Deceleration method

Calculate the parasitic losses $F_{pl}$, in newton.

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

where:

ID is the test drum inertia in rotation, in kilogram meter squared;

R is the test drum surface radius, in meter;

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

$\Delta t_0$ is the time increment chosen for the measurement of the parasitic losses without tyre, in second;

IT is the spindle, tyre and wheel inertia in rotation, in kilogram meter squared;

R is the tyre rolling radius, in metre;

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

4.9.6.2. Rolling resistance calculation

4.9.6.2.1. General

The rolling resistance $F_r$, expressed in newton, is calculated using the values obtained by testing the tyre to the conditions specified in this international standard and by subtracting the appropriate parasitic losses $F_{pl}$, obtained according to paragraph 4.9.6.1.

4.9.6.2.2. Force method at tyre spindle

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

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

where:

$F_t$ is the tyre spindle force in newton;

$F_{pl}$ represents the parasitic losses as calculated in paragraph 4.9.6.1.2.;

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

R is the test drum radius, in metre.

4.9.6.2.3. Torque method at drum axis

The rolling resistance $F_r$, in newton, is calculated with the equation

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

where:

$T_t$ is the input torque, in newton metre;

$F_{pl}$ represents the parasitic losses as calculated in paragraph 4.9.6.1.3.

R is the test drum radius, in metre.

4.9.6.2.4. Power method at drum axis

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

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

where:

V is the electrical potential applied to the machine drive, in volt;

A is the electric current drawn by the machine drive, in ampere;

$U_n$ is the test drum speed, in kilometre per hour;

$F_{pl}$ represents the parasitic losses as calculated in paragraph 4.9.6.1.4.

4.9.6.2.5. Deceleration method

The rolling resistance $F_r$, in newton, is calculated using the equation:

$$F_{\text{r}} = \frac{I_{\text{D}}}{R}\left(\frac{\Delta\omega_{\text{v}}}{\Delta t_{\text{v}}}\right) + \frac{RI_{\text{T}}}{R_{\text{r}}^{2}}\left(\frac{\Delta\omega_{\text{v}}}{\Delta t_{\text{v}}}\right) - F_{\text{pl}}$$

where:

ID is the test drum inertia in rotation, in kilogram metre squared;

R is the test drum surface radius, in meter;

$F_{pl}$ represents the parasitic losses as calculated in paragraph 4.9.6.1.5.;

$\Delta t_v$ is the time increment chosen for measurement, in second;

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

$I_T$ is the spindle, tyre and wheel inertia in rotation, in kilogram metre squared;

$R_r$ is the tyre rolling radius, in metre.

$F_r$ is the rolling resistance, in newton.

4.9.7. Data Analysis

4.9.7.1. Rolling resistance coefficient

The rolling resistance coefficient $C_r$ is calculated by dividing the rolling resistance by the load on the tyre:

$$C_r = \frac{F_r}{L_m}$$

where:

$F_r$ is the rolling resistance, in newton;

$L_m$ is the test load, in kN.

4.9.7.2. Temperature correction

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

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

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

where:

$F_r$ is the rolling resistance, in newton;

$t_{amb}$ is the ambient temperature, in degree Celsius;

$K$ is equal to:

0.008 for Class C1 tyres

0.01 for Class C2 tyres

0.006 for Class C3 tyres

4.9.7.3. Drum diameter correction

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

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

with:

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

where:

$R_1$ is the radius of drum 1, in meter;

$R_2$ is the radius of drum 2, in meter;

$r_T$ is one-half of the nominal design tyre diameter, in meter;

$F_{r01}$ is the rolling resistance value measured on drum 1, in newton;

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

4.9.7.4. Measurement result

Where n measurements are greater than 1, if required by paragraph 4.9.5.6., the measurement result shall be the average of the $C_r$ values obtained for the n measurements, after the corrections described in paragraphs 4.9.7.2. and 4.9.7.3. have been made.

4.9.7.5. The laboratory shall ensure that, based on a minimum of three measurements, the machine maintains the following values of $\sigma_{m,i}$, as measured on a single tyre:

$\sigma_{m,i} \leq 0.075$ N/kN for tyres of Classes C1 and C2

$\sigma_{m,i} \leq 0.06$ N/kN for tyres of Class C3

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

$$n = ( \sigma_{m,i} / x)^2$$

where:

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

x = 0.06 N/kN for tyres of Class C3

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

If the removal/refitting operation duration is less than 10 minutes, the warm-up durations indicated in paragraph 4.9.5.4. may be reduced to:

(a) 10 minutes for tyres of Class C1

(b) 20 minutes for tyres of Class C2

(c) 30 minutes for tyres of Class C3

4.9.7.6. Monitoring of the laboratory control tyre shall be carried out at intervals no greater than one month. Monitoring shall include a minimum of 3 separate measurements taken during this one month period. The average of the 3 measurements taken during a given one-month period shall be evaluated for drift from one monthly evaluation to another.

4.9.8. Test Equipment Tolerances

4.9.8.1 Purpose

The limits specified in this section are necessary in order to achieve suitable levels of repeatable test results, which can also be correlated among various test laboratories. These tolerances are not meant to represent a complete set of engineering specifications for test equipment; rather, they should serve as guidelines for achieving reliable test results.

4.9.8.2. Test rims

4.9.8.2.1. Width

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

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

4.9.8.2.2. Run-out

Run-out shall meet the following criteria:

(a) maximum radial run-out: 0.5 mm

(b) maximum lateral run-out: 0.5 mm

4.9.8.3. Drum / tyre alignment

General:

Angle deviations are critical to the test results.

4.9.8.3.1. Load application

The direction of tyre loading application shall be kept normal to the test surface and shall pass through the wheel centre within

(a) 1 mrad for the force and deceleration methods;

(b) 5 mrad for the torque and power methods.

4.9.8.3.2. Tyre alignment

4.9.8.3.2.1. Camber angle

The plane of the wheel shall be perpendicular to the test surface within 2 mrad for all methods.

4.9.8.3.2.2. Slip angle

The plane of the tyre shall be parallel to the direction of the test surface motion within 1 mrad for all methods.

4.9.8.4. Control accuracy

Test conditions shall be maintained at their specified values, independent of perturbations induced by the tyre and rim non-uniformity, such that the overall variability of the rolling resistance measurement is minimized. In order to meet this requirement, the average value of measurements taken during the rolling resistance data collection period shall be within the accuracies stated as follows:

(a) tyre loading:

(i) for LI ≤ 121: +/- 20 N or +/- 0.5 per cent, whichever is greater

(ii) for LI > 121: +/- 45 N or +/- 0.5 per cent whichever is greater

(b) cold inflation pressure: +/- 3 kPa

(c) surface speed:

(i) +/- 0.2 km/h for the power, torque and deceleration methods

(ii) +/- 0.5 km/h for the force method

(d) time: +/- 0.02 s

4.9.8.5. Instrumentation accuracy

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

| *Parameter* | *Load Index ≤ 121* | *Load Index > 121* |
|---|---|---|
| tyre load | +/- 10 N or +/- 0.5% [(a)] | +/- 30 N or +/- 0.5% [(a)] |
| inflation pressure | +/- 1 kPa | +/- 1.5 kPa |
| spindle force | +/- 0.5 N or + 0.5% [(a)] | +/- 1.0 N or + 0.5% [(a)] |
| torque input | +/- 0.5 Nm or + 0.5% [(a)] | +/- 1.0 Nm or + 0.5% [(a)] |
| distance | +/- 1 mm | +/- 1 mm |
| electrical power | +/- 10 W | +/- 20 W |
| temperature | +/- 0.2 °C | |
| surface speed | +/- 0.1 km/h | |
| time | +/- 0.01 s | |
| angular velocity | + /-0.1 % | |

[(a)] whichever is greater.

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

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

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

4.9.8.7. Test surface roughness

The roughness, measured laterally, of the smooth steel drum surface shall have a maximum centreline average height value of 6.3 µm.[1]

*Note:* In cases where a textured drum surface is used instead of a smooth steel surface, this fact is noted in the test report. The surface texture shall then be 180 µm deep (80 grit) and the laboratory is responsible for maintaining the surface roughness characteristics. No specific correction factor is recommended for cases where a textured drum surface is used.

---

[1] In cases where a textured drum surface is used instead of a smooth steel surface, this fact is noted in the test report. The surface texture shall then be 180 µm deep (80 grit) and the laboratory is responsible for maintaining the surface roughness characteristics. No specific correction factor is recommended for cases where a textured drum surface is used.

4.9.9 Measuring Rim Width

4.9.9.1. Class C1 tyres

The measuring rim width $R_m$ is equal to the product of the nominal section width $S_N$ and the coefficient $K_2$:

$R_m = K_2 \text{ x } S_N$

rounded to the nearest standardized rim, where $K_2$ is the rim/section width ratio coefficient. For tyres mounted on 5° drop-centre rims with a nominal diameter expressed by a two-figure code:

$K_2 = 0.7$ for nominal aspect ratios 95 to 75

$K_2 = 0.75$ for nominal aspect ratios 70 to 60

$K_2 = 0.8$ for nominal aspect ratios 55 and 50

$K_2 = 0.85$ for nominal aspect ratio 45

$K_2 = 0.9$ for nominal aspect ratios 40 to 30

$K_2 = 0.92$ for nominal aspect ratios 20 and 25

4.9.9.2. Class C2 and C3 tyres

The measuring rim width $R_m$ is equal to the product of the nominal section width $S_N$, and the coefficient $K_4$:

$R_m = K_4 \text{ x } S_N$ rounded to the nearest standardized rim width.

Table 4

Coefficients for determining measuring rim width

| *Tyre Structure Code* | *Type of rim* | *Nominal aspect ratio H/S* | *Measuring rim/ section ratio $K_4$* |
|---|---|---|---|
| B, D, R | 5º tapered | 100 to 75 | 0.70 |
| | | 70 and 65 | 0.75 |
| | | 60 | 0.75 |
| | | 55 | 0.80 |
| | | 50 | 0.80 |
| | | 45 | 0.85 |
| | | 40 | 0.90 |
| | 15º tapered (drop-centre) | 90 to 65 | 0.75 |
| | | 60 | 0.80 |
| | | 55 | 0.80 |
| | | 50 | 0.80 |
| | | 45 | 0.85 |
| | | 40 | 0.85 |
| *Note*: Other factors may be established for new tyre concepts (structures). | | | |

4.9.10 Test Report and Test Data (Rolling Resistance)

*Part 1: Report*

1. Approval authority or Technical Service: ....................................................................

2. Name and address of applicant: ..................................................................................

3. Test report No.: ...............................................................................................................

4. Manufacturer and brand name or trade description: ...................................................

5. Tyre class (C1, C2 or C3): ............................................................................................

6. Category of use: ..........................................................................................................

7. Rolling resistance coefficient (temperature and drum diameter corrected): .........................................................................................

8. Comments (if any): .........................................................................................

9. Date: ................................................................................................................

10. Signature: ..........................................................................................................

*Part 2: Test data*

1. Date of test: ........................................................................................................

2. Test machine identification and drum diameter / surface: ..........................................

3. Test tyre details: ..................................................................................................

3.1. Tyre size designation and service description: ..............................................................

3.2. Tyre brand and trade description: .................................................................................

3.3. Reference inflation pressure kPa: ..................................................................................

4. Test data: ..............................................................................................................

4.1. Measurement method: ..................................................................................................

4.2. Test speed km/h: .........................................................................................................

4.3. Load N: .......................................................................................................................

4.4. Test inflation pressure, initial: .....................................................................................

4.5. Distance from the tyre axis to the drum outer surface under steady state conditions, in meters, rL: ..........................................................................

4.6. Test rim width and material: ........................................................................................

4.7. Ambient temperature °C: .............................................................................................

4.8. Skim test load (except deceleration method) N: ..........................................................

5. Rolling resistance coefficient: .......................................................................................

5.1. Initial value (or average in the case of more than 1) N/kN: .......................................

5.2. Temperature corrected N/kN: .......................................................................................

5.3. Temperature and drum diameter corrected N/kN: ........................................................'

## B Justification

This document proposes or changes prescriptions relating to tyre rolling sound or rolling resistance within the gtr, for the cases where such prescriptions are adopted by Contracting parties. It is intended to align, as far as possible, with the recently agreed amendments to Regulation 117.

**Rolling Sound.**

The rolling sound limit values in the current gtr draft are in line with the limit values contained in the 01 series of amendments to Regulation 117. By the time this gtr comes into force, it is envisaged that most contracting parties will be applying the limit values contained in the 02 series of amendments to Regulation 117. The document proposes to amend the draft to include these new values. For reasons of simplification, not all the categories of tyre included in Regulation 117 are included in these requirements. However, these categories can be added if required.

**Rolling Resistance.**

As indicated during the 5th. informal group meeting in September 2008 , and more recently during the AC3 meetings in March and June 2010, the European Commission proposes to introduce Rolling Resistance into the tyre gtr at least as an option.

This document introduces test procedures for rolling resistance which are in line with those which were agreed for UNECE Regulation 117.02, at the 151st session of WP.29 in June 2010. (document WP.29/2010/63).

With regard to limit values for rolling resistance, Regulation 117.02 comprises two stages of rolling resistance limit values; the first can apply from November 2012, the second from November 2016. It is proposed that the gtr should adopt the stage 2 rolling resistance requirements, which are already technically feasible in 2010.

As is the case with the rolling sound requirements, not all the categories of tyre included in Regulation 117 are included in these requirements. However, these categories can be added if required.

Definitions relevant to the section on rolling resistance have also been added in paragraph 3.