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Passenger car tyres — Preparation method for an artificially worn state for wet grip testing

Pneus pour voitures particulières — Méthode de préparation d'une usure artificielle pour les essais d'adhérence sur revêtement mouillé

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Foreword

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This document was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 3, *Passenger car tyres and rims*.

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Passenger car tyres — Preparation method for an artificially worn state for wet grip testing

1 Scope

This document specifies the preparation of artificially worn tyres by tread rubber removal (e.g. cutter, buffing, grinding, etc.) for subsequent wet grip performance tests. This document applies to new passenger car tyres.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4000-1, *Passenger car tyres and rims — Part 1: Tyres (metric series)*

ISO 4223-1, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*

ISO 21920-2, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 2: Terms, definitions and surface texture parameters*

ASTM F421, *Standard Test Method for Measuring Groove and Void Depth in Passenger Car Tires*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4000-1, ISO 4223-1, ISO 21920-2, ASTM F421, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
tyre contour
geometrical shape of tyre shoulder and tread

Note 1 to entry: An example of tyre contour is shown in Figure 1.

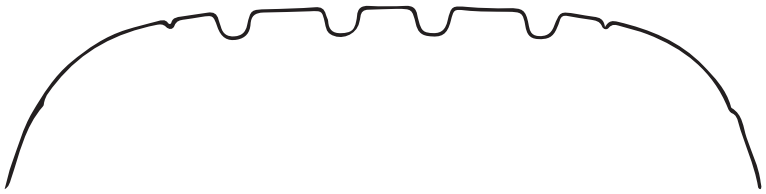

Figure 1 — Tyre contour

Note 2 to entry: Tyre contour should be obtained, e.g. by scan method.

3.2
groove
void volume between two adjacent ribs or blocks in the tread pattern

3.3
groove depth
vertical distance between the lowest point at bottom of tread pattern and tangent line of tyre surface

3.4
centre line
line dividing the overall width of the tyre in two equal parts

3.5
mould parting line
border circumference in which mould tread pattern segments connects with mould sidewall plates

Note 1 to entry: If no mould parting line is visible on the tyre, a virtual mould parting line shall be considered as the circumferential line in the equivalent position at the end of the shoulder grooves.

3.6
reference tread width
C
tyre tread width as calculated by:

$$C = (1{,}075 - 0{,}005\,ar)\,s^{1{,}001}$$

where:

ar is the nominal aspect ratio;

s is the nominal section width on measuring rim.

Note 1 to entry: Reference tread width is as shown in Figure 2.

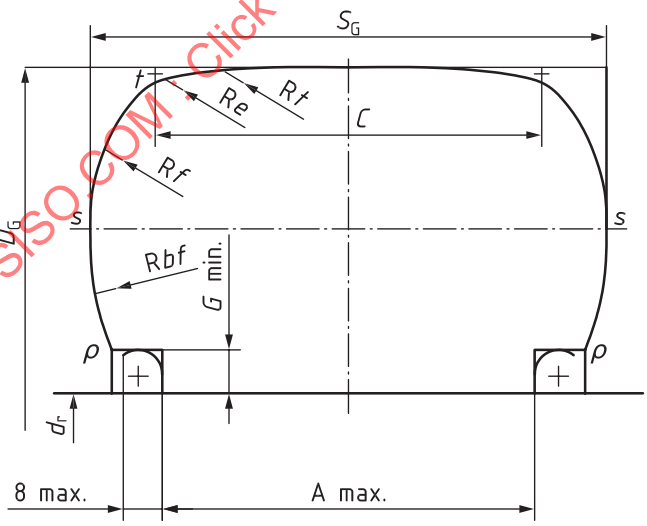

Figure 2 — Reference tread width (C)

3.7
central part of the tread
CP
75 % of reference tread width in the central tread, symmetrically measured from the centre line

3.8
tread pattern limit points
points in the tread which are 15 mm away from the mould parting line on the tread shoulder profile towards centre line

Note 1 to entry: The left limit point is marked with L_i, and the right is marked with L_e (see Figure 4).

3.9
shoulder control area of the tread
shoulder area between the edge of the central part of the tread and the tread pattern limit points

3.10
target groove depth
target vertical distance between the lowest point at bottom of tread pattern and tangent line of tread surface after artificially prepared

3.11
groove depth after buffing
actual vertical distance between the lowest point at bottom of tread pattern and tangent line of tread surface after artificially prepared

3.12
groove average depth
average of all tyre groove depth measurements in a single groove

3.13
operating inflation pressure
tyre inflation pressure during measurement and tread removal

4 Equipment and instrumentation

4.1 Tyre tread removal machine, with equipment to remove tread rubber in a predetermined manner.

4.2 Tread depth gauge, meeting the requirements of ASTM F421 is recommended.

However, any other mechanical, optical, or electronic device capable of measuring groove (void) depth can be used.

4.3 Test rims, which are rigid and made of steel or light alloy. The recommended tolerances are:

— maximum radial runout: 0,5 mm;

— maximum lateral runout: 0,5 mm.

4.4 Image recording equipment, with clear and storable image recording capability, to record the buffed tyre, is recommended.

4.5 Surface roughness, *Ra*, measurement meeting the requirements of ISO 21920-2. ISO 4287 may also be referred to regarding surface roughness measurements.

5 Preparation for buffing

The procedure steps shall be followed in the following sequence.

a) After the tyre is vulcanized, condition the tyre for more than 24 h.

b) Condition the tyre at the operating environment temperature of 5 °C to 40 °C for at least 3 h.

c) The reference tread width (C) and central part of the tread (CP) are calculated according to 3.6 and 3.7.

d) Mount the tyre on the rim and inflate it. The pressure should be between 180 kPa and 220 kPa.

e) When mounting the tyre, a suitable amount of lubricant may be used. Pay attention to observe whether the tyre and rim slip through trial buffing.

f) Avoid the tread wear indicator (TWI), select a section line and make a mark.

g) Place the tape measure on the tyre tread along the transversal direction, mark the location of the centre line (point O in Figure 3), and symmetrically mark two boundary points of the CP (the area between points O1 and O2 in Figure 3) with the central axis as the centre.

Figure 3 — Marking of tread central control area

h) With mould parting lines on both sides of the tyre, mark the tread pattern limit point on each side of the tyre (point L and L_e in Figure 4).

i) To mark the measuring points of tread groove depth on the tyre, the following suggestions should be followed:

1) The general principle of marking is to find the position where the groove of tread pattern is obvious and easy to measure, and to avoid tread wear indicators.

2) Mark the positions of groove depth measurement in the transversal direction of tyre.

Figure 4 — Mould parting line and tread pattern limit points

For the tyre with significant longitudinal groove pattern, in the transversal direction of the tyre, mark *n* marking points in CP where *n* is the number of longitudinal grooves (1 point in each longitudinal groove), mark 1 marking point in each shoulder control area of the tread (2 points in total). See Figure 5.

For tyres without significant longitudinal grooves, the circumferential line of tread wear indicators can be regarded as longitudinal groove. Mark 6 marks in the transversal direction of tyres. Four (n=4) of the points are respectively located in CP, two at shoulder control area of the tread. In case the tread pattern design prevents marking four points at central control area, mark as many points as possible.

Figure 5 — Marking point in transversal direction

The transversal marks shall be kept on the same section line as close as possible, and the deviation shall not be too far.

There shall be at least 4 circumference marks, which are approximately equidistant in the tyre circumference. An example is given in Figure 6 with 5 circumference marks.

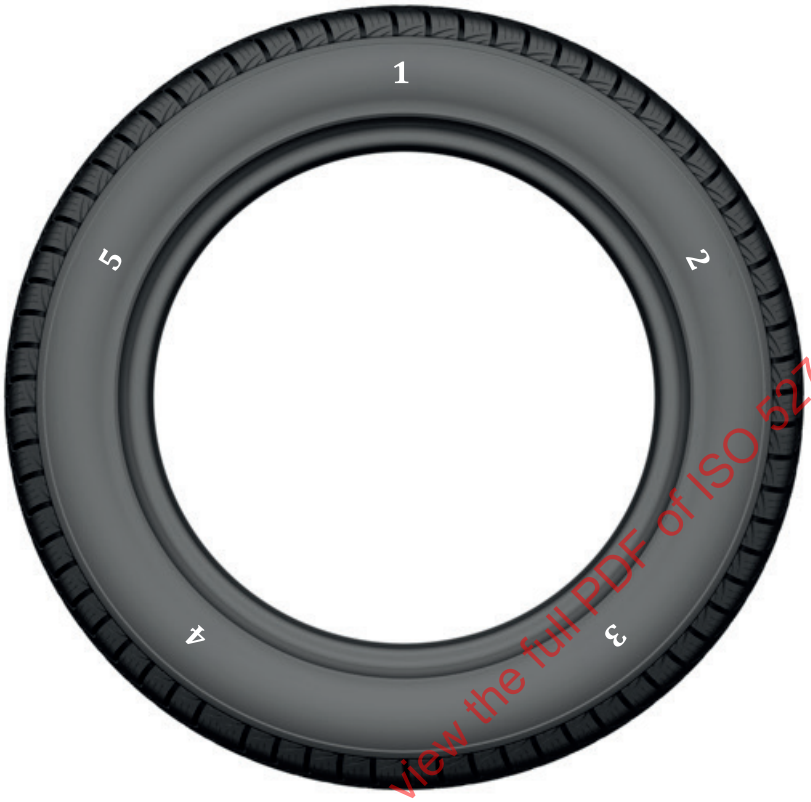

Figure 6 — Tyre circumference marks

j) Measure and record the marked points point by point using the tread depth gauge specified in Clause 4.2.

k) Set the grinding scheme according to the measured initial tyre contour, and the target groove depth of the tyre.

6 Buffing conditions

a) The working environment temperature for tyre buffing shall be 5 °C to 40 °C.

b) During buffing, the operating inflation pressure of the tyre should be between 180 kPa and 220 kPa.

c) During the buffing process, the surface temperature of the tyre shall be monitored. It shall not exceed 110 °C.

7 Buffing procedure

a) Inspect the tyre to determine that there are no tread defects that would affect the finished tyre. If such conditions are noted, do not use the tyre for this procedure.

b) Check the groove depth during buffing process. During the inspection, the tyre surface and groove shall be cleaned to remove the adhesive rubber powder and avoid the measurement error.

c) Adjust the feed speed and wear speed of grinding wheel grinding device carefully to make the groove depth of each mark point reach the target groove depth specified in Table 1.

d) Check the outer surface of the tyre carefully.

e) Use the tread depth gauge specified in 4.2 to measure and record the marked points point by point.

f) Using the surface roughness tester specified in 4.5, according to the circumferential marking points as defined in Clause 5, find the appropriate position in the middle of the central part of the tread and the shoulders on both sides. Measure and record the surface roughness of the tyre.

Table 1 — Tyre target tread pattern depth after buffing

Area	Target tread pattern depth mm
Central part of the tread	2,0
Shoulder control area of the tread	≤2,0

8 Buffing qualification determination rules

8.1 General

If the tyre meets the following requirements after buffing, it shall be regarded as a qualified worn tyre:

— there is no scorch, block fall, edge collapse, collapse (see Annex B), edge warping, abnormal deformation and cracking of pattern or any form of defect on the outer surface of tyre;

— the groove depth after buffing shall meet the requirements of Table 1 and 8.2;

— the surface roughness of tyres detected according to Clause 7 f) shall meet the requirement of 8.2 c).

8.2 Requirements

After buffing, the tread groove depth shall be treated according to Table 2, and meet all of the following requirements:

a) For all the measurement points defined in CP:

— the individual final tread depths shall be 2 mm ± 0,4 mm;

— the groove average depth shall be 2 mm ± 0,2 mm;

— the standard deviation of all tread depths is recommended to be below 0,3 mm to prevent uneven profile.

b) For all the measurement points defined in the shoulder zone, the final tread depth in the shoulder zone shall not be higher than 2 mm.

c) The tyre surface roughness measuring record shall be processed according to Table 3 and the average of the 3 arithmetical mean height of the absolute values of the roughness profile of the final surface shall not exceed 20 µm.

If one of the above conditions is not met, another candidate tyre shall be prepared.

Table 2 — Tread pattern depth record of worn tyre in millimetres

No.	X	A	B	C	D	Y
1	x_1	a_1	b_1	c_1	d_1	y_1
2	x_2	a_2	b_2	c_2	d_2	y_2
3	x_3	a_3	b_3	c_3	d_3	y_3
4	x_4	a_4	b_4	c_4	d_4	y_4
5 (optional)	x_5	a_5	b_5	c_5	d_5	y_5
Average value	$\bar{x}$	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{d}$	$\bar{y}$

Table 3 — Worn tyre surface roughness measuring record in micrometres

No.	Left	Middle	Right	Average value
1	Ra_{11}	Ra_{12}	Ra_{13}	Ra_1
2	Ra_{21}	Ra_{22}	Ra_{23}	Ra_2
3	Ra_{31}	Ra_{32}	Ra_{33}	Ra_3
4	Ra_{41}	Ra_{42}	Ra_{43}	Ra_4
5 (optional)	Ra_{51}	Ra_{52}	Ra_{53}	Ra_5

An example of a report on artificially worn tyre preparation is given in Annex A.

Annex A
(informative)

Example report of an artificially worn state for a passenger car tyre

A.1 Report

The first part of the report should be as follows.

a) Laboratory: [Name].

b) Report no.: [YYMMDD-xxxxx-xx].

c) Tyre manufacturer and brand name or trade description: [Name].

d) Tyre size.

e) Tyre service description.

f) Procedure: Preparation method according to ISO 5273.

Production week and year: [xxxx]

g) Signature: _____

[First name Last name]

A.2 Data

h) Date of report: [DD.MM.YYYY].

i) Ambient temperature;

Item Record.

Operating ambient temperature.

Remarks.

j) Removal machine: [Name].

k) Rim size.

l) Operating inflation pressure [kPa].

m) Groove depth [mm] measuring data as per Table A.1.

Table A.1

Groove depth of the artificially worn tyre mm						
Sampling location	X	A	B	C	D	Y
1						
2						
3						
4						
5 (optional)						
average						

n) Roughness measuring data as per Table A.2.

Table A.2

Roughness of the artificially worn tyre µm				
No.	**Left**	**Middle**	**Right**	**Average value**
1				
2				
3				
4				
5 (optional)				

o) Judgement as per Table A.3 and Table A.4.

Table A.3

Area	Target tread pattern depth in mm
central part of the tread	2,0
shoulder control area of the tread	≤2,0

Table A.4

Item	Measuring	Specification
Individual final tread depth of the artificially worn tyre for the central part		2 ± 0,4 mm
Shoulder control area of the tread		≤2 mm
Groove average depth for the central part		2 ± 0,2 mm
Roughness		≤20 µm
Remarks		
Judgement		