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Passenger car tyres and rims —

Part 1:
Tyres (metric series)

Pneumatiques et jantes pour voitures particulières —

Partie 1: Pneumatiques (série millimétrique)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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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*.

This thirteenth edition cancels and replaces the twelfth edition (ISO 4000-1:2021), which has been technically revised.

The main changes are as follows:

— high load capacity tyres have been added to facilitate their worldwide harmonized introduction;

— design section widths greater than 405 have been removed from load indices Tables B.1 and B.3;

— new internationally harmonized load indices have been added in Annex B.

A list of all parts in the ISO 4000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Passenger car tyres and rims —

Part 1:
Tyres (metric series)

1 Scope

This document specifies the designation, dimensions and load ratings of metric-series tyres primarily intended for passenger cars.

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 3877-1, *Tyres, valves and tubes — List of equivalent terms — Part 1: Tyres*

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

ISO 16992, *Passenger car tyres — Spare unit substitutive equipment (SUSE)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3877-1, ISO 4223-1 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
rim protector
feature incorporated into the lower sidewall area of the tyre which is intended to protect the rim flange from damage

EXAMPLE Protruding circumferential rubber rib.

3.2
high load capacity tyre
extra load tyre that is designed to carry a higher load at the same reference pressure

4 Designation

4.1 Size and construction

4.1.1 Characteristics

The tyre characteristics shall be designated:

Nominal section width / Nominal aspect ratio Tyre construction code Nominal rim diameter code

EXAMPLE 235/45 R 17.

4.1.2 Nominal section width

The nominal section width of the tyre shall be indicated in millimetres, and this part of the designation shall end in either the numeral of zero or five, so that in any single series of tyres with the same nominal aspect ratio, the values shall all end in 0 or all end in 5.

For sizes mounted on 5° tapered (code-designated) rims, the nominal section width shall end in 5.

4.1.3 Nominal aspect ratio

The nominal aspect ratio (H/S, where H is the design tyre section height and S is the design tyre section width) shall be expressed as a percentage and shall be a multiple of 5.

4.1.4 Tyre construction code

The tyre construction code shall be:

— B for bias-belted construction;

— D for diagonal construction;

— R for radial construction;

— RF for radial run-flat construction (only applicable to run-flat or self-supporting tyres as defined in ISO 16992; radial extended mobility tyres as defined in ISO 16992 shall have the construction code R).

In the case of tyres having a maximum speed capability exceeding 240 km/h, the tyre construction code R can be replaced by ZR and the tyre construction code RF can be replaced by ZRF.

In the case of tyres having a maximum speed capability exceeding 300 km/h, the tyre construction code R shall be replaced by ZR and the tyre construction code RF shall be replaced by ZRF.

Use of any other code-letter (e.g. in the case of a new construction type) should first be submitted to ISO for acceptance.

4.1.5 Nominal rim diameter code

For tyres mounted on 5° tapered (code-designated) rims, the code shall be as given in Table 1.

Table 1 — Nominal rim diameter code

Nominal rim diameter code	Nominal rim diameter D_r mm
10	254
12	305
13	330
14	356
15	381
16	406
17	432
18	457
19	483
20	508
21	533
22	559
23	584
24	610
25	635
26	660
28	711
30	762

In the case of tyres designed for new-concept rims, the code-number shall be equal to the nominal rim diameter (D_r) expressed as a whole number in millimetres to avoid mis-mounting.

4.2 Service description

4.2.1 General

The service description shall be:

Load index Speed symbol

In the case of tyres having a maximum speed capability exceeding 300 km/h, the load index and the speed symbol Y shall be both placed within parentheses, to identify performance up to 300 km/h.

EXAMPLE 235/45 ZR 17 (97Y).

For maximum speed capability and load carrying capacity of the tyre over 300 km/h, consult the manufacturer.

4.2.2 Load index

The maximum tyre load-carrying capacity (TLCC) corresponding to the service conditions specified by the tyre manufacturer shall be indicated by a load index (LI) taken from Table 2, per tyre for a single mounting.

4.2.3 Speed symbol

The speed symbol is an alpha or alpha-numeric code which indicates the speed category (4.2.4) of the tyre.

4.2.4 Speed category

A speed category is assigned to a tyre according to the maximum speed which the tyre can sustain. It is expressed by the speed symbol according to Table 3.

4.3 Other service characteristics

4.3.1 The word “TUBELESS” shall appear on the sidewalls of tyres without tubes.

4.3.2 The letters “XL”, close to the tyre size designation, or the words “REINFORCED” or “EXTRA LOAD” shall appear on the sidewalls of tyres designed for loads and inflation pressures higher than the standard version.

4.3.2.1 Additionally, the letters “HL”, immediately preceding the tyre size designation, shall be used to identify high load capacity tyres.

4.3.3 The letters “LL”, close to the tyre size designation, or the words “LIGHT LOAD” shall appear on the sidewalls of tyres designed for loads lower than the standard version.

4.3.4 The letter “T”, immediately preceding the tyre size designation, shall be used to identify T-type temporary-use spare tyres.

4.3.5 Specific indications, if required, can be added to indicate:

— the type of vehicle for which the tyre is primarily designed, using the symbol “P” for passenger cars (see 4.3.6);

— temporary use of certain spare tyres, using indications such as “TEMPORARY USE ONLY”;

— bias-belted construction, with the words “BIAS-BELTED”;

— radial construction, with the word “RADIAL”;

— intended inboard or outboard side for mounting;

— direction of rotation;

— type of tread pattern;

— other characteristics.

4.3.6 The optional marking “P”, immediately preceding the tyre size designation, can be used where there can be ambiguity regarding the tyre type.

EXAMPLE P295/45 R 17.

Table 2 — Equivalence between LI and TLCC

LI	TLCC kg	LI	TLCC kg	LI	TLCC kg	LI	TLCC kg
50	190	70	335	90	600	110	1 060
51	195	71	345	91	615	111	1 090
52	200	72	355	92	630	112	1 120
53	206	73	365	93	650	113	1 150
54	212	74	375	94	670	114	1 180
55	218	75	387	95	690	115	1 215
56	224	76	400	96	710	116	1 250
57	230	77	412	97	730	117[a]	1 285
58	236	78	425	98	750	118[a]	1 320
59	243	79	437	99	775	119[a]	1 360
60	250	80	450	100	800	120[a]	1 400
61	257	81	462	101	825	—	—
62	265	82	475	102	850	—	—
63	272	83	487	103	875	—	—
64	280	84	500	104	900	—	—
65	290	85	515	105	925	—	—
66	300	86	530	106	950	—	—
67	307	87	545	107	975	—	—
68	315	88	560	108	1 000	—	—
69	325	89	580	109	1 030	—	—

[a] ISO tyre loads according to this document have a 116 load index maximum: some existing tyres can have a higher load index number.

The maximum tyre load carrying capacity corresponding to the load index shall apply for speeds up to and including 210 km/h.

For tyres with the speed symbol V (between 210 km/h and 240 km/h), the maximum load carrying capacity per tyre shall be reduced to 100 % at 210 km/h, 97 % at 220 km/h, 94 % at 230 km/h and 91 % at 240 km/h; linear interpolation is permitted.

In the case of speed symbols W and Y, the maximum load carrying capacity per tyre corresponding to the load index shall apply for speeds up to and including 240 km/h for W and 270 km/h for Y.

For tyres with the speed symbol W (between 240 km/h and 270 km/h), the maximum load carrying capacity per tyre shall be reduced to 100 % at 240 km/h, 95 % at 250 km/h, 90 % at 260 km/h and 85 % at 270 km/h; linear interpolation is permitted.

For tyres with the speed symbol Y (between 270 km/h and 300 km/h), the maximum load carrying capacity per tyre shall be reduced to 100 % at 270 km/h, 95 % at 280 km/h, 90 % at 290 km/h and 85 % at 300 km/h; linear interpolation is permitted.

See 4.2.3, 4.2.4 and Table 3 for speed categories and their symbols.

For speeds of over 300 km/h or ZR-marked tyres or both, consult the tyre manufacturer for the maximum tyre load carrying capacity permitted in relation to the maximum speed allowed for the tyre.

For vehicles with a design maximum speed capability of up to 60 km/h, the maximum load carrying capacity corresponding to the load index can be exceeded, as shown below. However, an increase in the reference inflation pressure is necessary and should be determined in consultation with the tyre manufacturer. In the absence of such agreement, the following pressure increases are recommended:

— for 60 km/h, a 10 % load increase with a 10 kPa inflation pressure increase;

— for 50 km/h, a 15 % load increase with a 20 kPa inflation pressure increase;

— for 40 km/h, a 25 % load increase with a 30 kPa inflation pressure increase;

— for 30 km/h, a 35 % load increase with a 40 kPa inflation pressure increase;

— for 25 km/h, a 42 % load increase with a 50 kPa inflation pressure increase.

Table 3 — Speed symbols and corresponding speed

Speed symbol	Speed km/h
J	100
K	110
L	120
M	130
N	140
P	150
Q	160
R	170
S	180
T	190
U	200
H	210
V	240
W	270
Y[a]	300
NOTE This list is not exhaustive, and other categories and symbols can be added later.	
[a] For tyres designed for speeds exceeding 300 km/h, see 4.2.1.	

5 Marking

The marking shall include designations of the following:

a) size and construction;

b) service description (see 4.2.1);

c) any other service characteristics.

The location of the marking of the load index and speed category shall be distinct, but near the marking of the size and construction.

No location is specified for the markings related to other service characteristics (see 4.3).

EXAMPLE A tubeless tyre having a nominal section width of 165 mm, a nominal aspect ratio of 80, a radial construction and a nominal rim diameter code of 15, whose service description consists of a load index of 87, corresponding to a tyre load-carrying capacity of 545 kg, and a speed symbol H (210 km/h), is marked:

165/80 R 15 87 H TUBELESS

NOTE See Annex D for other existing size markings.

6 Tyre dimensions

6.1 Rounding values

Except in the cases given in 6.2.1 and 6.2.2, round the formula-derived values for tyre dimensions to the nearest millimetre (see ISO 80000-1:2022, B.3, rule B).

6.2 Calculation of design tyre dimensions

6.2.1 Theoretical rim width, R_{th}

For the theoretical rim width, see Formula (1):

$$R_{th} = K_1 \times S_N \quad (1)$$

where

R_{th} is the theoretical rim width, expressed in millimetres;

K_1 is the theoretical rim/section width ratio coefficient;

S_N is the nominal section width.

For tyres mounted on 5° rims (code-designated) with nominal rim diameter expressed by a two-figure code:

— K_1 = 0,7 where the tyres have a nominal aspect ratio of 50 to 95;

— K_1 = 0,85 where this ratio is 20 to 45.

NOTE K_1 values for other tyre and rim types will be defined in a future revision.

6.2.2 Measuring rim width code, R_{mc}

For the measuring rim width code, see Formula (2), where R_{mc} is rounded to the nearest 0,5:

$$R_{mc} = \frac{K_2 \times S_N}{25,4} \quad (2)$$

where K_2 is the measuring 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.

NOTE Other values of K_2 for other tyre and rim types will be defined in a future revision.

6.2.3 Design tyre section width, S

The design tyre section width, S, is the nominal section width, S_N, transferred from the theoretical rim, R_{th}, to the measuring rim width code, R_{mc}, as shown in Formula (3):

$$S = S_N + 0,4 \times (25,4 \times R_{mc} - R_{th}) \quad (3)$$

EXAMPLE 265/40 R17.

K_1 = 0,85 (see 6.2.1) and K_2 = 0,9 (see 6.2.2).

$R_{th} = K_1 \times S_N = 265 \times 0{,}85 = 225{,}25$ mm.

$R_{mc} = K_2 \times S_N/25{,}4 = 0{,}9 \times 265/25{,}4 = 9{,}39$, rounded to 9,5.

$25{,}4 \times R_{mc} = 25{,}4 \times 9{,}5 = 241{,}3$ mm.

$S = S_N + 0{,}4\ (25{,}4\ R_{mc} - R_{th}) = 265 + 0{,}4\ (241{,}3 - 225{,}25) = 271{,}42$ mm, rounded to 271 mm.

6.2.4 Design tyre section height, H

The design tyre section height, H, is calculated using Formula (4):

$$H = S_N \times \frac{H/S}{100} \tag{4}$$

where H/S is the nominal aspect ratio.

6.2.5 Design tyre overall diameter, D_0

The design tyre overall diameter, D_0, is calculated using Formula (5):

$$D_0 = D_r + 2 \times H \tag{5}$$

Use the corresponding value of D_r given in Table 1.

6.2.6 Guidelines

See Annex A for general guidelines on the tyre design dimensions for the metric series of passenger car tyres mounted on 5° rims (code-designated).

6.3 Calculation of maximum overall (grown) tyre dimensions in service tyre mounted on their measuring rims

6.3.1 General

The calculation of maximum overall (grown) tyre dimensions in service for tyres mounted on their measuring rims is for use by vehicle manufacturers in designing for tyre clearance.

Calculate these dimensions based on design section width and design section height with the coefficient appropriate to the construction (see Table 4).

Table 4 — Coefficients for calculation of tyre dimensions

Construction	Construction code	Coefficient			
		a	*b*	*c*	*d*
Diagonal	D	1,1	1,08	—	—
Bias-belted	B			—	—
Radial	R	1,04	1,04	0,96	0,97
Radial run-flat	RF				

6.3.2 Maximum overall (grown) width in service, W_{max}

The maximum overall (grown) width in service, W_{max}, includes elevation due to labelling, decorations, protective ribs or bands and rim protectors and is equal to the greater of the following values:

— the product of the design tyre section width, S, and the appropriate coefficient, a (see Table 4), see Formula (6):

$$W_{max} = S \times a \quad (6)$$

— the addition of 8 mm to the design tyre section width, S, see Formula (7):

$$W_{max} = S + 8 \quad (7)$$

If the overall (grown) width is measured at the rim protectors, an additional 8 mm is allowed. In this case, W_{max} equals to the greater of the following values ($S \times a + 8$) or ($S + 16$).

6.3.3 Maximum overall (grown) diameter in service, $D_{0,max}$

For the maximum overall (grown) diameter in service, see Formula (8):

$$D_{0,max} = D_r + 2 \times H \times b \quad (8)$$

See Table 4 for the value of coefficient b. $H \times b$ shall be first rounded to the nearest integer before calculating the maximum overall diameter in service.

6.4 Calculation of minimum tyre dimensions for radial tyres mounted on their measuring rims

6.4.1 Minimum tyre section width, S_{min}

For the minimum tyre section width, see Formula (9):

$$S_{min} = S \times c \quad (9)$$

See Table 4 for the value of coefficient c.

6.4.2 Minimum tyre overall diameter, $D_{0,min}$

For the minimum tyre overall diameter, see Formula (10):

$$D_{0,min} = D_r + 2 \times H \times d \quad (10)$$

See Table 4 for the value of coefficient d. $H \times d$ shall be first rounded to the nearest integer before calculating the minimum overall diameter.

6.5 Range of approved rims

The range of approved rim width codes for the nominal aspect ratio of 35 and above is calculated as the product of the nominal section width, S_N, and the coefficients shown in Table 5, divided by 25,4. Round the values obtained to the nearest 0,5 rim width code. For tyre sizes with a nominal aspect ratio of 30 and below, the range of approved rim width codes is the measuring rim width code ±0,5.

For high load capacity tyres, the minimum rim width and the maximum rim width shall be calculated according to Table 5 but, in any case, the minimum rim width shall be greater than or equal to the measuring rim width code minus 0,5, and the maximum rim width shall be less than or equal to the measuring rim width code plus 0,5, regardless of the nominal aspect ratio.

The maximum overall (grown) width in service, W_{max}, and the minimum tyre section width, S_{min}, will change by 40 % of the change in rim width code multiplied by 25,4, rounded to the nearest millimetre. However, this is not applicable to tyres whose overall width is measured at the rim protectors, in which case, the change will be greater than 40 %.

Table 5 — Approved rim width codes for passenger car tyres as a function of nominal aspect ratio

Nominal aspect ratio	Coefficients for calculation of approved rim width	
H/*S*	min.	max.
70 ≤ *H* / *S* ≤ 95	0,65	0,85
50 ≤ *H* / *S* ≤ 65	0,7	0,9
H / *S* = 45	0,8	0,95
35 ≤ *H* / *S* ≤ 40	0,85	1
H / *S* ≤ 30	measuring rim width code −0,5	measuring rim width code +0,5

7 Tyre dimension measurement procedure

The tyre dimension measurement procedure shall be as follows.

a) Prior to measurement, mount the tyre on an approved rim using a width code as defined in 6.5, inflated to the recommended pressure given in Table 6, and allow it to stand for a minimum of 24 h at normal room temperature.

b) Readjust the inflation pressure to the original value.

c) Measure the section width and the overall width of the tyre at six points approximately equally spaced around the tyre circumference. Record the average of these measurements as section width and overall width.

d) Determine the tyre overall diameter by measuring its maximum circumference and dividing this by π (where π = 3,141 6).

Table 6 — Recommended pressures for measurement of tyre dimensions

Tyre	Pressure kPa
Standard load and P-type light load (LL) version	180
Extra load/reinforced version, including high load capacity (HL) version	220
T-type temporary-use spare type	420

8 Inflation pressures

Correct inflation pressures are of the highest importance for driving safety.

Over-inflation causes the tyre to be more susceptible to impact damage.

Under-inflation causes over-heating and can greatly shorten the life of a tyre. It affects vehicle stability and can cause irregular wear, internal damage and, ultimately, even tyre disablement.

The effects of under-inflation are not necessarily immediate. It can be a considerable time before they occur. The pressures (cold) recommended by the tyre manufacturers in their technical documents should be regarded as minima.

The recommended cold tyre inflation pressure for each tyre position specified by the vehicle and/or the tyre manufacturer for the intended service condition of the given vehicle shall be equal or higher than the minimum cold tyre inflation pressure, given by the tyre manufacturer or the tyre standardization body for the given service conditions.

The recommended cold tyre inflation pressure should take into account not only the tyre load-carrying capacity (see Annex C) and the high speed capability, but also the operating conditions such as