INTERNATIONAL STANDARD

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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

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 4000 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4000-1 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 3, *Passenger car tyres and rims*.

This seventh edition cancels and replaces the sixth edition (ISO 4000-1:1995), which has been technically revised.

ISO 4000 consists of the following parts, under the general title *Passenger car tyres and rims*:

— *Part 1: Tyres (metric series)*

— *Part 2: Rims*

Annexes A to D form a normative part of this part of ISO 4000. Annex E is for information only.

Passenger car tyres and rims —

Part 1:
Tyres (metric series)

1 Scope

This part of ISO 4000 specifies the designation, dimensions and load ratings of metric-series tyres primarily intended for passenger cars.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 4000. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 4000 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 4000-2, *Passenger car tyres and rims — Part 2: Rims.*

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

3 Terms and definitions

For the purposes of this part of ISO 4000, the terms and definitions given in ISO 4223-1. For other terms used in this field, together with their equivalents in other languages, see ISO 3877-1.

4 Designation

4.1 Size and construction

4.1.1 Characteristics

The tyre characteristics shall be designated as follows:

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

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 they shall all end in 5.

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

4.1.3 Nominal aspect ratio

The nominal aspect ratio (H/S) 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 as follows:

— B for bias-belted construction;

— D for diagonal construction;

— R for radial ply construction.

Radial tyres designed for some existing vehicles with a maximum speed capability exceeding 240 km/h may be designated and marked differently (see annex D).

In the case of tyres designed for vehicles having a maximum speed capability exceeding 240 km/h, the code-letters ZR may be indicated with the dimensional and constructional characteristics for radial ply tyres instead of the tyre construction code R (see 4.2).

For speeds exceeding 300 km/h, see annex D.

Use of any other code letter (for example, 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

In the case of tyres requiring new-concept rims, for safety reasons, especially concerning mounting, the code number shall be equal to the nominal rim diameter (D_r) expressed as a whole number in millimetres.

4.2 Service description

4.2.1 General

The service description shall be as follows:

Load index Speed symbol

In the special case of tyres designed for vehicles having a maximum speed capability exceeding 300 km/h, the service description need not be indicated. However, the tyre manufacturer shall be consulted as to the maximum speed capability and load capacity of such tyres.

4.2.2 Load index

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

4.2.3 Speed categories

A speed category is assigned to a tyre according to the maximum speed for which its use is rated. The speed for each category shall be indicated by a letter-symbol, according to those given in Table 3.

4.3 Other service characteristics

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

4.3.2 The words “REINFORCED” or “EXTRA LOAD” shall appear on tyres designed for loads and inflation pressures higher than the standard version.

4.3.3 The letters “LL”, close to the tyre size designation, or the word “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 characterize high-pressure, special, temporary-use spare tyres.

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

— type of vehicle for which the tyre is primarily designed, using the symbol “P” (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 ply construction, with the word “RADIAL”,

— direction of mounting,

— direction of rotation,

— type of tread pattern,

and other characteristics.

4.3.6 The optional marking “P” may be used where there could be ambiguity regarding the tyre type. It should be positioned such that confusion cannot result from its proximity to any other service condition marking.

Table 2 — Correlation between load index (LI) and tyre-load-carrying capacity (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	1 285
58	236	78	425	98	750	118	1 320
59	243	79	437	99	775	119	1 360
60	250	80	450	100	800	120	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	—	—

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

For tyres in the speed category V (between 210 km/h and 240 km/h), the maximum load 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, and linear interpolation is permitted.

In the case of speed categories W and Y, the maximum load 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 in the speed category W (between 240 km/h and 270 km/h), the maximum load 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, and linear interpolation is permitted.

For tyres in the speed category Y (between 270 km/h and 300 km/h), the maximum load 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, and linear interpolation is permitted.

See 4.2.3 and Table 3 list speed categories and their symbols.

For speeds of over 300 km/h or ZR-marked tyres (see annex D) or both, consult the tyre manufacturer for the maximum tyre load 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 capacity corresponding to the load index may 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 category symbols

Symbol	Category 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 might be added later.	
[a] Radial ply tyres designed for speeds exceeding 300 km/h shall be identified by ZR with the dimensional and constructional characteristics in place of the tyre construction code. Consult the tyre manufacturer for the maximum speed capability.	

5 Marking

The marking shall include designations of:

a) size and construction;

b) service condition characteristics (see 4.1.4 and 4.2 for special cases);

c) any other service characteristics.

The location of the marking of the load and speed characteristics 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 1 A tubeless tyre having a nominal section width 165 mm, nominal aspect ratio 80, radial ply construction and nominal rim diameter code 15, whose service description consists of a load index (LI) of 87 corresponding to a tyre load-carrying capacity of 545 kg, and which falls into the speed category H (210 km/h) is marked:

165/80 R 15 87 H
TUBELESS

NOTE See annex E for other existing size markings.

EXAMPLE 2 A tyre having a nominal section width 225 mm, nominal aspect ratio 45, radial ply construction designed for operations at speeds exceeding 240 km/h (code ZR) and nominal rim diameter code corresponding to 406 mm (code 16) is marked:

225/45 ZR 16

NOTE See annex D for special cases of radial tyres designed for speeds exceeding 210 km/h.

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 31-0).

6.2 Calculation of design tyre dimensions

6.2.1 Theoretical rim width, R_{th}

$$R_{th} = K_1 \cdot S_N$$

where S_N is the nominal section width and K_1 is the rim/section width ratio.

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 are to be defined in a future revision.

6.2.2 Measuring rim width, R_m

$$R_m = K_2 \cdot S_N$$

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.

NOTE Other values of K_2 for other tyre and rim types are to 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, R_m, so that:

$$S = S_N + 0{,}4\left(R_m - R_{th}\right)$$

with R_m and R_{th} expressed in millimetres.

6.2.4 Design tyre section height, H

$$H = S_N \frac{H/S}{100}$$

6.2.5 Design tyre overall diameter, D_o

$$D_o = D_r + 2H$$

For those tyres having a nominal rim diameter code, use the corresponding value of D_r given in Table 1.

6.2.6 Guidelines

See annex A for general guidelines to 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 tyres mounted on their measuring rims

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

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

Table 4 — Coefficients for calculation of tyre dimensions

Dimensions in millimetres

Structure	Construction code	Nominal aspect ratio, H/S	Coefficient			
			a [a]	b	c	d
Diagonal	D	All	1,1	1,08	—	—
Bias-belted	B				—	—
Radial ply	R	⩽ 65	1,04 [b]	1,04	0,96	0,97
		70	1,04 [c]			
		⩾ 75	1,06			

[a] The maximum overall section width may be exceeded by the thickness of a special protective rib on one sidewall.

[b] As of 1992-01-01.

[c] As of 1995-01-01.

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

The maximum overall (grown) width in service, W_{max}, 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):

$$W_{max} = Sa$$

— the addition of 8 mm to the design tyre section width, S:

$$W_{max} = S + 8$$

6.3.2 Maximum overall (grown) diameter in service, $D_{o\,max}$

$$D_{o\,max} = D_r + 2Hb$$

See Table 4 for the value of coefficient b.

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

6.4.1 Minimum tyre section width, S_{min}

$$S_{min} = Sc$$

See Table 4 for the value of coefficient c.

6.4.2 Minimum tyre overall diameter, $D_{o\,min}$

$$D_{o\,min} = D_r + 2Hd$$

See Table 4 for the value of coefficient d.

6.5 Range of approved rims

The range of approved rim widths is calculated as the product of the nominal section width, S_N, and the coefficients is shown in Table 5. Round the values obtained to the nearest standardized rim width (see ISO 4000-2).

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, expressed in millimetres.

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

Dimensions in millimetres

Nominal aspect ratio H/S	Coefficients for calculation of approved rim width	
	min.	max.
$70 \leqslant H/S \leqslant 95$	0,65	0,85
$50 \leqslant H/S \leqslant 65$	0,7	0,9
$H/S = 45$	0,8	0,95
$35 \leqslant H/S \leqslant 40$	0,85	1
$H/S = 30$	0,9	1
$20 \leqslant H/S \leqslant 25$	0,92	0,98

7 Tyre dimension presentation

Tyre dimensions shall be shown in tables such as Table 6, which is an example for tyres mounted on 5° rims (code-designated) and nominal rim diameter expressed by a two-figure code (see 4.1.5).

Table 6 — Example of tyre dimension table

Tyre size designation [a]	Measuring rim code [b]	Design dimensions		Maximum dimensions in service (grown)	
		Section width S	Overall diameter D_o	Overall width W_{max}	Overall diameter $D_{o\,max}$ [c]
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

[a] See 4.1.

[b] The measuring rim width, R_m, is expressed by a code. See 6.2.2 for calculation of R_m and ISO 4000-2 for standardized rims.

[c] For special service tyres, the values given may be exceeded by 1 %.

8 Tyre dimension measurement procedure

a) Prior to measurement, mount the tyre on an approved rim, inflated to the recommended pressure given in Table 7, 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) Caliper 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 7 — Recommended pressures for measurement of tyre dimensions

Tyre	Pressure kPa
Standard load and P-type LIGHT LOAD version	180
Extra load/reinforced version	220
T-type temporary-use spare tyre	420

9 Inflation pressures

Operating cold inflation pressures should be agreed between tyre and vehicle manufacturers, taking into account not only tyre load-carrying capacity (see annex C), but operating conditions such as maximum speed, camber angle and the position of the tyre on the vehicle, as well as service conditions and the construction and characteristics of the vehicle.

Unless otherwise specified by the tyre manufacturer, it is recommended that the cold inflation pressure of radial ply tyres be limited in normal application to 350 kPa for all standard load version sizes on code designated rims, irrespective of the speed category (see Table 2).

For normal road applications, the specified inflation pressure may not be less than 140 kPa. For special applications, consult the tyre manufacturer.

NOTE Cold inflation pressure is the pressure of the tyre at ambient temperature, and does not include pressure build-up due to tyre usage.

10 Load capacities

Load capacities for passenger car tyres are given in annex B.

NOTE For sizes not included in annex B, consult the national standardization organization.

See annex C for tyre load-carrying capacity at various inflation pressures.

11 Choice of tyre sizes

In selecting tyres for a vehicle, the vehicle maximum load on the tyre shall not be greater than the applicable maximum load carrying capacity of the tyre. Vehicle maximum load on the tyre is the load on an individual tyre that is determined by distributing to each axle its share of the maximum loaded vehicle weight and dividing by two.

The vehicle normal load on the tyre shall not be greater than 88 % of the maximum load-carrying capacity of the tyre. Vehicle normal load on the tyre is the load on an individual tyre that is determined by distributing (in accordance with Table 8) to each axle its share of the curb weight, accessory weight and normal occupant weight and dividing by two. These, and other relevant weights, are defined below.