

TC31

INTERNATIONAL
STANDARD

ISO
4000-1

Fifth edition
1994-05-01

**Passenger car tyres and rims —
Part 1:
Tyres (metric series)**

*Pneumatiques et jantes pour voitures particulières —
Partie 1: Pneumatiques (série millimétrique)*



Reference number
ISO 4000-1:1994(E)

Foreword

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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.

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

This fifth edition cancels and replaces the fourth edition (ISO 4000-1:1989), of which it constitutes a technical revision.

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

- *Part 1: Tyres (metric series)*
- *Part 2: Rims (metric series)*

Annexes A and B form an integral part of this part of ISO 4000. Annexes C and D are for information only.

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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 the metric series of tyres primarily intended for passenger cars.

ISO 4000-2 deals with requirements for rims.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4000. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4000 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 31-0:1992, *Quantities and units — Part 0: General principles*.

ISO 3877-1:1978, *Tyres, valves and tubes — List of equivalent terms — Part 1: Tyres*.

ISO 4000-2:1987, *Passenger car tyres and rims — Part 2: Rims*.

ISO 4223-1:1989, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*.

3 Definitions

For definitions of terms relating to tyres, see ISO 4223-1; equivalent terms are given in ISO 3877-1.

4 Tyre designation

4.1 Size and construction

The characteristics shall be indicated as follows:

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

The nominal section width of the tyre shall be indicated in millimetres, ending either in 0 or 5, so that in any one series of tyres with the same nominal aspect ratio, the values shall all end with 0 or 5.

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

4.1.2 Nominal aspect ratio

The nominal aspect ratio shall be expressed as a percentage and shall be a multiple of 5.

4.1.3 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.

NOTE 1 Radial tyres designed for some existing vehicles with maximum speed capabilities in excess of 210 km/h or 240 km/h may be designated and marked differently. See annex C.

In the case of tyres designed for vehicles having a maximum speed capability in excess of 270 km/h, the code-letters "ZR" shall be indicated in the dimensions and constructional characteristics for radial ply construction in place of the tyre construction code R. (See also 4.2.)

In the case of tyres designed for vehicles having a maximum speed capability of 240 km/h to 270 km/h, the code-letters "ZR" may be indicated in the dimensional and constructional characteristics for radial ply construction in place of the tyre construction code R (See example 2 and annex C.)

NOTE 2 The use of another code letter (for example, in the case of a new construction type) should first be remitted to ISO for acceptance.

4.1.4 Nominal rim diameter code

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

For 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 of millimetres.

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

4.2 Service condition characteristics

The service condition characteristics or service description shall be indicated as follows:

Load index Speed symbol

For the special case of tyres designed for vehicles having a maximum speed capability in excess of 270 km/h, the indication of the service condition

characteristics is precluded. For the maximum speed capability and the load capacity of the tyres, the tyre manufacturer concerned shall be consulted.

4.2.1 Load index

The maximum tyre load capacity corresponding to the service conditions specified by the tyre manufacturer shall be indicated by a load index taken from table 2. This indication is understood to be per tyre for a single mounting.

4.2.2 Speed symbol

The speed category is assigned to a tyre to denote the maximum speed for which use of the tyre is rated.

The speed symbol shall be indicated by a letter taken from table 3 corresponding to the speed category.

4.3 Other service characteristics

4.3.1 The word "TUBELESS" shall appear on the tyre to characterize tyres that can be used without a tube.

4.3.2 The letter "T" immediately in front of the tyre size designation shall be used to characterize high-pressure special temporary-use spare tyres.

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

- the type of vehicle for which the tyre is primarily designed, using the symbol "P"¹⁾;
- the temporary use of certain spare tyres using indications such as "TEMPORARY USE ONLY";
- the bias-belted construction with the words "BIAS-BELTED";
- the radial ply construction with the word "RADIAL";
- the direction of mounting;
- the direction of rotation;
- the type of tread pattern;
- other characteristics.

1) This symbol may be used where there may be ambiguity regarding the tyre type. Where this optional marking is used, it should be so positioned 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		

NOTES

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

For speed symbol V tyres (between 210 km/h and 240 km/h), the maximum tyre load capacity is to be reduced to the following percentage:

100 % at 210 km/h;
97 % at 220 km/h;
94 % at 230 km/h;
91 % at 240 km/h.

Between these speeds, linear interpolation is permitted.

2 In the case of speed symbol W and ZR marked tyres, maximum load capacity corresponding to the load index applies for speeds up to and including 240 km/h.

For speed symbol W tyres (between 240 km/h and 270 km/h), the maximum tyre load capacity is to be reduced to the following percentage:

100 % at 240 km/h;
95 % at 250 km/h;
90 % at 260 km/h;
85 % at 270 km/h.

Between these speeds, linear interpolation is permitted.

For speeds over 270 km/h, consult the tyre manufacturer concerned for the maximum tyre load capacity permitted in relation to the maximum speed allowed for the tyre.

Table 3 — Correlation between speed symbol and speed category

Speed symbol	Speed 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 ¹⁾	270 ¹⁾

NOTE — This list is not restrictive; other categories may be added later.

1) Radial ply tyres designed for operations at speeds in excess of 270 km/h are to be identified by means of code-letters "ZR" in the "dimensional and constructional" characteristics in place of the tyre construction code. For these tyres, consult the tyre manufacturers concerned for the maximum speed capability.

5 Marking

The marking shall consist of:

- the designation of the size and construction;
- the designation of service condition characteristics;²⁾
- the designation of 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 tyre having

- a size and construction of:
 - nominal section width 165 mm,
 - nominal aspect ratio 80,
 - radial ply construction,
 - nominal rim diameter code 15;
- service condition characteristics of:
 - load index (LI) 87, corresponding to a tyre load-carrying capacity of 545 kg,
 - speed symbol H, corresponding to a speed category of 210 km/h;
- other service characteristics:
 - TUBELESS: tyre to be used without a tube;

shall be marked as follows:

165/80 R 15 87 H

TUBELESS

NOTE 3 See annex D for other existing size markings.

EXAMPLE 2

A tyre marked

225/45 ZR 16

has the following characteristics:

- nominal section width 225 mm;
- nominal aspect ratio 45;
- radial ply construction tyre designed for operations at speeds in excess of 270 km/h (code letters "ZR");
- nominal rim diameter code corresponding to 406 mm (code 16).

NOTE 4 See annex C for special cases of radial tyres designed for speeds in excess of 210 km/h.

2) See special cases in 4.1.3 and 4.2.

6 Tyre dimensions

Except for the cases in 6.1.1 and 6.1.2, the formula-derived values for tyre dimensions are to be rounded to the nearest millimetre. For rounding, see ISO 31-0.

NOTE 5 Dimensions are expressed in millimetres.

6.1 Calculation of "design tyre" dimensions

6.1.1 Theoretical rim width, R_{th}

The theoretical rim width, R_{th} , is equal to the product of the nominal section width, S_N , and the rim/section ratio, K_1 :

$$R_{th} = K_1 S_N$$

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

$K_1 = 0,7$ for tyres having nominal aspect ratio (H/S) from 50 to 95 inclusive;

$K_1 = 0,85$ for tyres having nominal aspect ratio (H/S) from 35 to 45 inclusive.

Other K_1 values will be defined later for other tyre and rim types.

6.1.2 Measuring rim width, R_m

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

$$R_m = K_2 S_N$$

rounded to the nearest standardized rim.

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 (H/S) 95 to 75 inclusive;

$K_2 = 0,75$ for nominal aspect ratios (H/S) 70 to 60 inclusive;

$K_2 = 0,8$ for nominal aspect ratios (H/S) 55 to 50 inclusive;

$K_2 = 0,85$ for nominal aspect ratio (H/S) 45;

$K_2 = 0,9$ for nominal aspect ratios (H/S) 40 to 35 inclusive.

Other values of K_2 will be defined later for other tyre and rim types.

6.1.3 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 :

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

where R_m and R_{th} are expressed in millimetres.

6.1.4 Design tyre section height, H

The design tyre section height, H , is equal to the product of the nominal section width, S_N , and the nominal aspect ratio, H/S , divided by 100:

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

6.1.5 Design tyre overall diameter, D_o

The design tyre overall diameter, D_o , is the sum of the nominal rim diameter, D_r , plus twice the design tyre section height, H :

$$D_o = D_r + 2H$$

For those tyres using a nominal rim diameter code, the corresponding value of D_r given in table 1 is to be used.

6.1.6 Guidelines

Guidelines for the "tyre design dimensions" for the metric series of passenger car tyres mounted on 5° rims (code-designated) are given in annex A. Table 5 presents a guide relating to the determination of the appropriate rim widths for a given tyre.

6.2 Calculation of "maximum overall (grown) tyre dimensions in service"

This calculation is for use by vehicle manufacturers in designing for tyre clearance.

These dimensions are to be calculated with the coefficients (see table 4) appropriate to the design tyre section width and design tyre section height.

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

The maximum overall (grown) width in service, W_{max} , is equal to the greater of the two following values:

Table 4 — Coefficients for calculation of tyre dimensions

Structure	Tyre construction code	Nominal aspect ratio <i>H/S</i>	Coefficients			
			<i>a</i> ¹⁾	<i>b</i>	<i>c</i>	<i>d</i>
Diagonal	D	All	1,1	1,08	—	—
Bias-belted	B				—	—
Radial ply	R	≤ 65	1,04 ²⁾	1,04	0,96	0,97
		70	1,04 ³⁾			
		≥ 75	1,06			

1) The maximum overall section width may be exceeded by the thickness of a special protective rib on one sidewall.
 2) Application as of January 1st, 1992.
 3) Application as of January 1st, 1995.

a) the product of the design tyre section width, *S*, and the appropriate coefficient, *a* (see table 4):

$$W_{\max} = Sa$$

b) the addition of 8 mm to the design tyre section width, *S*:

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

6.2.2 Maximum overall (grown) diameter in service, *D_{o,max}*

The maximum overall (grown) diameter in service, *D_{o,max}*, is equal to the nominal rim diameter, *D_r*, plus twice the product of the design tyre section height, *H*, and the appropriate coefficient, *b* (see table 4):

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

6.3 Calculation of minimum tyre dimensions for radial ply tyres

6.3.1 Minimum tyre section width, *S_{min}*

The minimum tyre section width, *S_{min}*, is equal to the product of the design tyre section width, *S*, and the coefficient *c* (see table 4):

$$S_{\min} = Sc$$

6.3.2 Minimum tyre overall diameter, *D_{o,min}*

The minimum tyre overall diameter, *D_{o,min}*, is equal to the nominal rim diameter, *D_r*, plus twice the product of the design tyre section height, *H*, and the coefficient *d* (see table 4):

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

6.4 Range of recommended rims

6.4.1 The range of recommended rim widths is calculated as the product of the nominal section width, *S_N*, and the coefficients shown in table 5. The values obtained shall be rounded to the nearest standardized rim width (see ISO 4000-2:1987, table 2, dimension A).

6.4.2 The design tyre section width, *S*, 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.

7 Tyre dimension presentation

Tyre dimensions shall be shown in tables. An example for tyres mounted on 5° rims (code-designated) and nominal rim diameter expressed by a two-figure code (see 4.1.4) is given in table 6.

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

Nominal aspect ratio, H/S	Coefficients for calculation of recommended rim width	
	min.	max.
$80 \leq H/S \leq 95$	0,65	0,85 ¹⁾
$50 \leq H/S \leq 75$	0,7	0,9 ¹⁾
$H/S = 45$	0,8	0,95 ¹⁾
$35 \leq H/S \leq 40$	0,85	1

1) For tyres with a speed category higher than 210 km/h or in special cases, the rim width is not limited to the maximum value recommended in this table.

Table 6 — Example of tyre dimension table

Tyre size designation ¹⁾	Measuring rim code ²⁾	Design dimensions		Maximum dimensions in service (grown)	
		Section width, S mm	Overall diameter, D_o mm	Overall width, W_{max} mm	Overall diameter, $D_{o,max}$ mm
.....
.....
.....

1) See 4.1.
2) The measuring rim width, R_m , is expressed by a code. See 6.1.2 for calculation of R_m and ISO 4000-2 for standardized rims.

8 Tyre dimension measurement method

8.1 Before being measured, the tyre shall be mounted on its measuring rim, inflated to the recommended pressure given in table 7, and allowed to stand for a minimum of 24 h at normal room temperature, after which the inflation pressure shall be readjusted to the original value.

8.2 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, respectively.

Table 7 — Recommended pressures for measurement of tyre dimensions

Tyre	Pressure kPa
standard load version	180
extra load/reinforced version	230
"T-type" temporary-use spare tyre	420

8.3 Determine tyre overall diameter by measuring the maximum circumference of the tyre and dividing this dimension by π (where $\pi = 3,141\ 6$).

9 Inflation pressures

Operating cold inflation pressures should be agreed between tyre and vehicle manufacturers taking into account not only the tyre load-carrying capacity, but also the operating conditions, the maximum speed, the position of the tyre on the vehicle, service conditions and the construction and characteristics of the vehicle.

NOTE 6 Cold inflation pressure means the pressure taken with the tyre at ambient temperature; it does not include any pressure build-up due to tyre usage.

10 Load capacities

Guidelines for load capacities for passenger car tyres are given in annex B.