INTERNATIONAL STANDARD

ISO 6622-2

Second edition
2013-11-01

Internal combustion engines — Piston rings —

Part 2: Rectangular rings made of steel

Moteurs à combustion interne — Segments de piston —

Partie 2: Segments rectangulaires en acier

Reference number
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Contents

Page

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.

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 documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 6622-2:2003), which has been technically revised.

ISO 6622 consists of the following parts, under the general title *Internal combustion engines — Piston rings*:

— *Part 1: Rectangular rings made of cast iron*

— *Part 2: Regular rings made of steel*

Introduction

The ISO 6622 series is one of a number of series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6621,[2] [3] [4] [5] ISO 6623,[6] ISO 6624,[7] [8] [9] [10] ISO 6625, ISO 6626,[12] [13] [14] and ISO 6627[15] (see Bibliography for details).

The common features and dimensional tables presented in this part of ISO 6622 constitute a broad range of variables and, in selecting a particular ring type, the designer must bear in mind the conditions under which it will be required to operate.

It is also essential that the designer refer to the specifications and requirements of ISO 6621-3[4] and ISO 6621-4[16] before completing his selection.

Internal combustion engines — Piston rings —

Part 2: Rectangular rings made of steel

1 Scope

This part of ISO 6622 specifies the essential dimensional features of rectangular rings made of steel, types R, B, BA, and M having nominal diameters from 30 mm up to and including 160 mm, used in reciprocating internal combustion piston engines for road vehicles and other applications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

3 Overview

The rectangular ring types are specified in Tables 1 to 5 and Figures 1 to 6. Their common features and the dimensions of those features are specified in Tables 6 to 11 and Figures 7 to 22. Tables 12 and 13 give the force factors for the different ring types, while Table 13 gives the dimensions and forces of the rectangular rings.

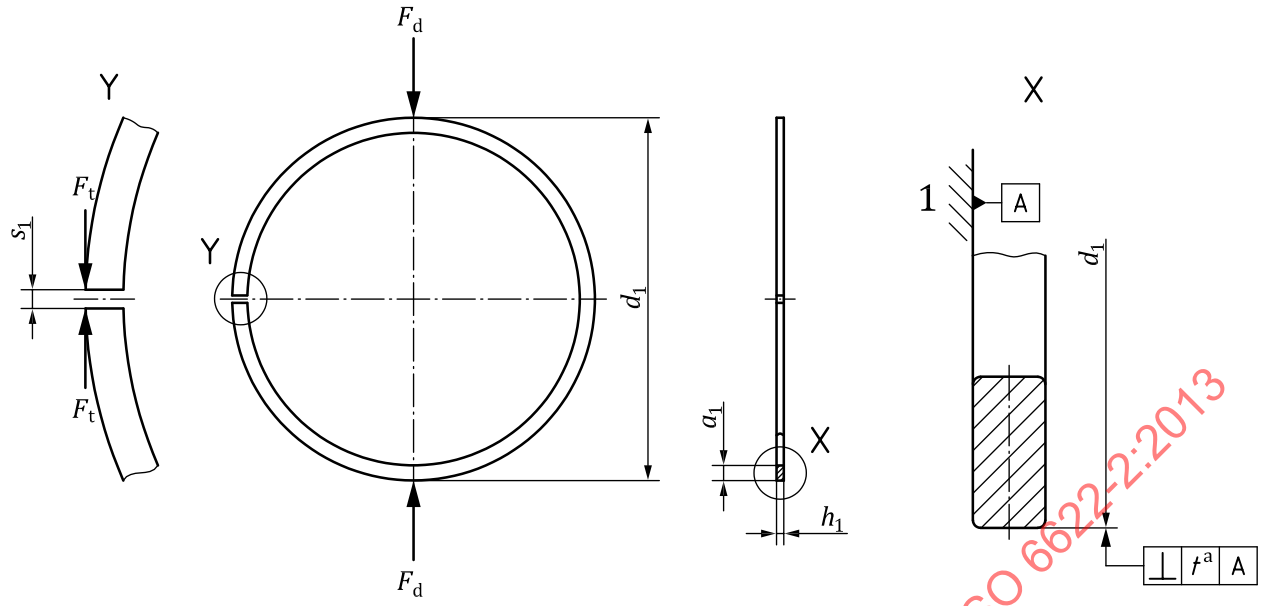
4 Ring types and designation examples

4.1 Type R — Straight-faced rectangular ring

4.1.1 General features

Figure 1 shows the general features of piston ring type R.

See Table 13 for dimensions and forces.



Key

1 reference plane

a $t = 0{,}005 \times h_1$.

Figure 1 — Type R

4.1.2 Designation

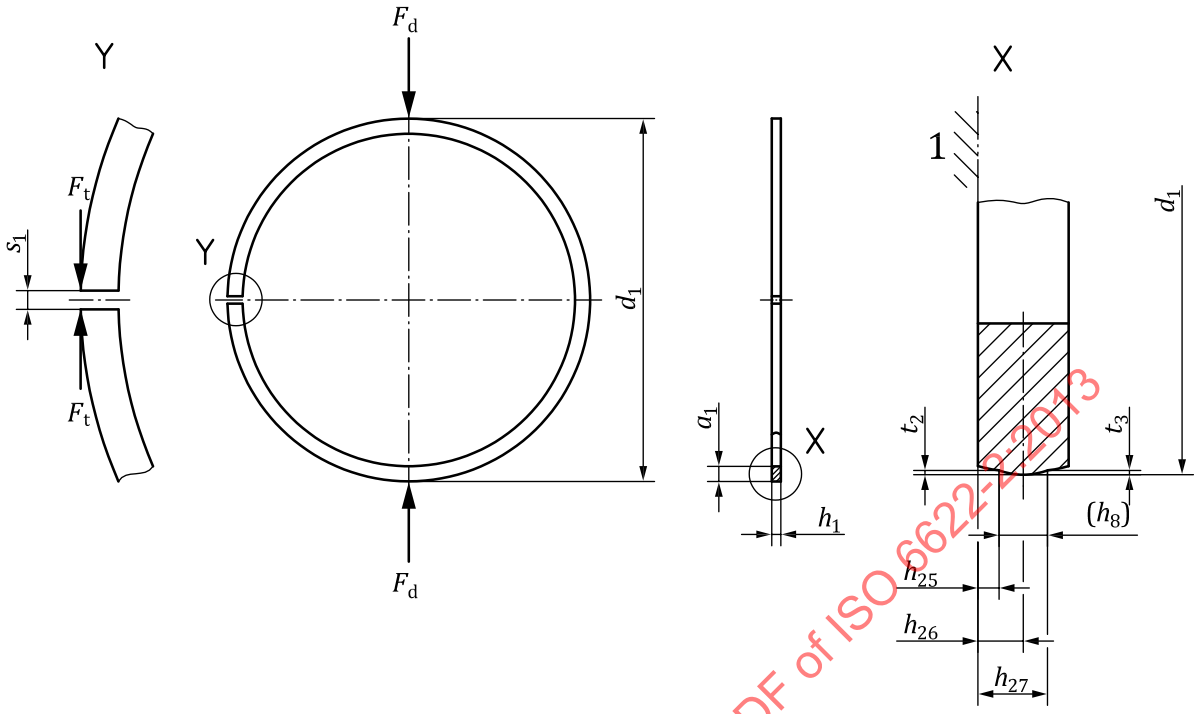
EXAMPLE Designation of a piston ring complying with the requirements of this part of ISO 6622 (i.e. ISO 6622-2) being a steel, rectangular ring with a straight-faced peripheral surface (R), of nominal diameter d_1 = 60 mm (60), of nominal ring width h_1 = 1,2 mm (1,2), made of CrSi alloyed steel, subclass 62 (MC62), and with a chromium-plated peripheral surface of a minimum thickness 0,1 mm (CR2). Parameters in parenthesis are used in the ISO ring designation:

Piston ring ISO 6622-2 R - 60 × 1,2 - MC62/CR2

4.2 Type B — Barrel-faced rectangular ring

4.2.1 General features

See Table 13 for dimensions and forces.



Key

1 reference plane

Figure 2 — Type B

Table 1 — Symmetrical barrel dimensions and gauge width (h_8)

Dimensions in millimetres

h_1	h_{25}	h_{26}	h_{26} tol.	h_{27}	t_2, t_3	h_8[a]
0,8	0,20	0,40	± 0,15	0,60	0,001...0,010	0,40
1,0	0,25	0,50	± 0,15	0,75	0,001...0,011	0,50
1,2	0,30	0,60	± 0,20	0,90	0,002...0,012	0,60
1,5	0,35	0,75	± 0,25	1,15	0,003...0,015	0,80
1,75	0,35	0,85	± 0,30	1,35		1,00
2,0	0,40	1,00	± 0,30	1,60		1,20
2,5	0,45	1,25	± 0,40	2,05		1,60
3,0	0,50	1,50	± 0,50	2,50	0,005...0,020	2,00
3,5	0,55	1,75	± 0,50	2,95		2,40

[a] Gauge width (h_8) only informative; may be used only if agreed between manufacturer and customer.

4.2.2 Designation

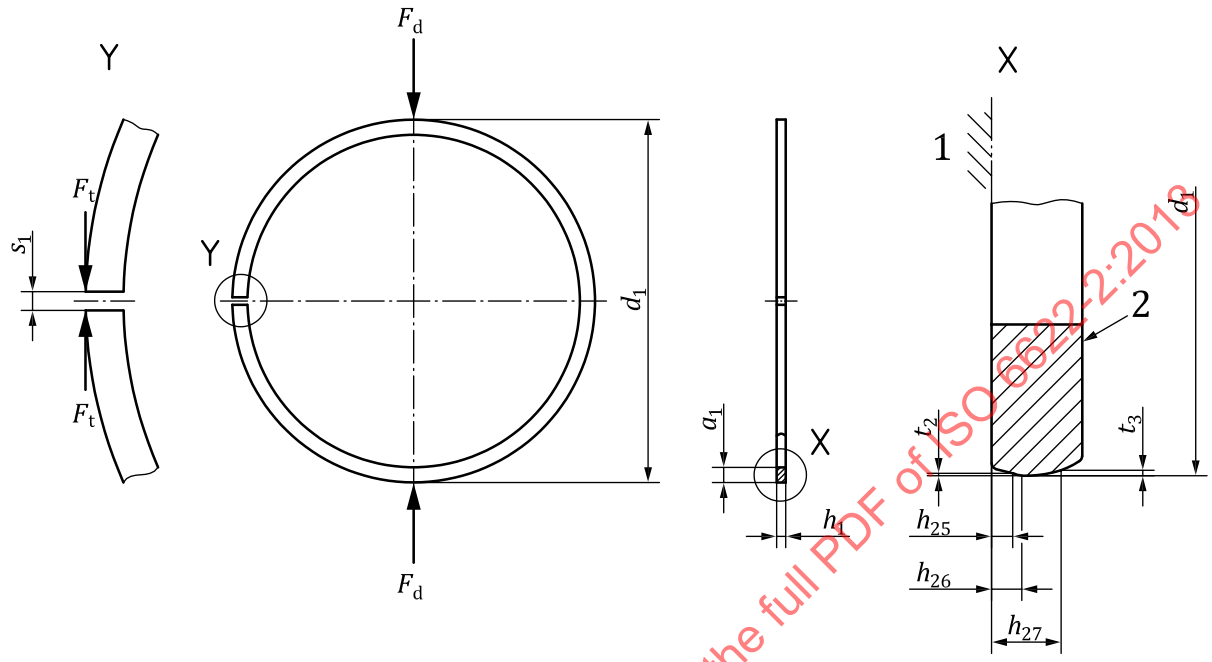
EXAMPLE Designation of a piston ring complying with the requirements of this part of ISO 6622 (i.e. ISO 6622-2) being a steel, rectangular ring with a barrel-faced peripheral surface (B), of nominal diameter d_1 = 60 mm (60), of nominal ring width h_1 = 1,5 mm (1,5), made of martensitic steel (17 % Cr), subclass 66 (MC66), nitrided on the peripheral surface and side faces (NT), to a depth of 0,03 mm min. on the peripheral surface (030), and with an associated side face depth of 0,010 mm min. Parameters in parenthesis are used in the ISO ring designation:

Piston ring ISO 6622-2 B - 60 × 1,5 - MC66/NT030

4.3 Type BA — Asymmetrical barrel-faced rectangular ring, h_1 ≥ 1,2mm

4.3.1 General features

See Table 13 for dimensions and forces.



Key

1 reference plane

2 top side identification mark

Figure 3 — Type BA

Table 2 — Asymmetrical barrel dimensions

Dimensions in millimetres

h_1	h_{25}[a]	h_{26}	h_{26} tol.	h_{27}	t_2[b]	t_3[b]
1,2	0,20 [c]	0,35 [c]	± 0,15	0,80 [c]	0...0,005	0,005...0,016
	0,28	0,43		0,90		
1,5	0,35	0,50	± 0,15	1,15	0...0,006	0,007...0,022
1,75	0,35	0,55	± 0,20	1,35	0...0,007	0,008...0,025
2,0	0,40	0,60		1,50		0,009...0,030
2,5	0,45	0,70	± 0,25	1,80	0...0,008	0,011...0,035
3,0	0,55	0,80		2,10		0,012...0,038
3,5	0,60	0,90	± 0,30	2,40	0...0,009	0,012...0,040

[a] h_{25} may be lowered for rings with reduced edge dimensions.

[b] t_2 and/or t_3 may be varied as agreed between manufacturer and customer.

[c] Recommended for bottom edge smaller than 0,2 mm.

4.3.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of this part of ISO 6622 (i.e. ISO 6622-2) being a steel, rectangular ring with an asymmetrical barrel-faced peripheral surface (BA), of nominal diameter d_1 = 80 mm (80), of nominal ring width h_1 = 1,5 mm (1,5), made of martensitic steel (17 % Cr), subclass 66 (MC66), nitrided on the peripheral surface and side faces (NT) to a depth of 0,05 mm min. on the peripheral surface (050), and with an associated side face depth of 0,015 mm min. Parameters in parenthesis are used in the ISO ring designation:

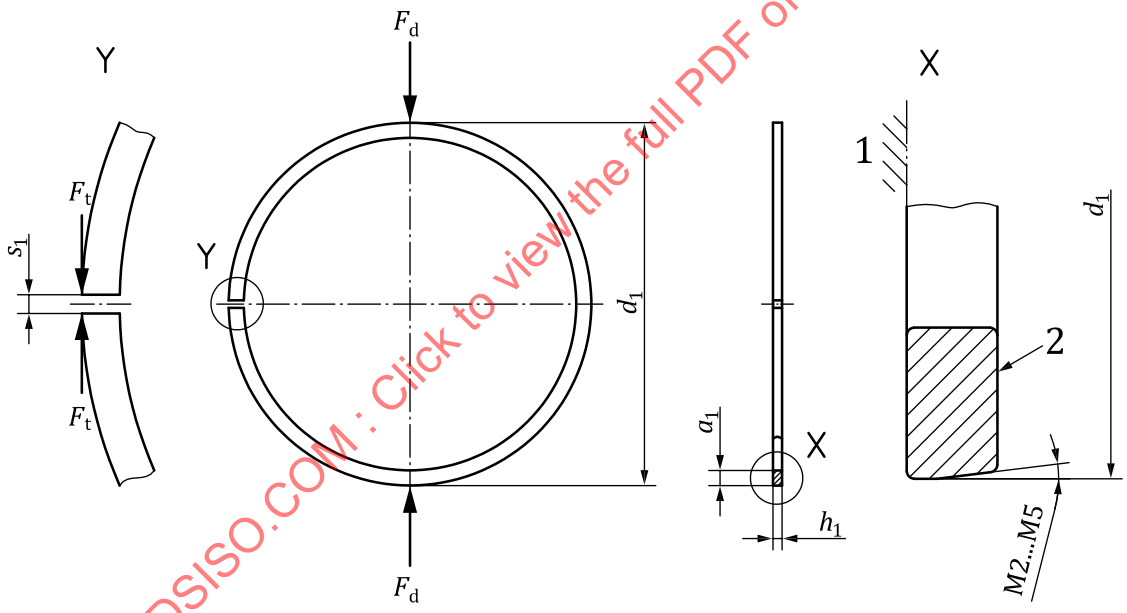
Piston ring ISO 6622-2 BA - 80 × 1,5 - MC66/NT050

4.4 Type M — Taper-faced rectangular ring

NOTE Taper M1 excluded.

4.4.1 General features

See Table 13 for dimensions and forces.



Key

1 reference plane

2 top side identification mark

Figure 4 — Type M

Table 3 — Taper

Dimensions in millimetres

Code	Nitrided rings and chromium-plated or spray-coated rings with peripheral surface ground[c]					
	Taper	Tolerance	with IF[a] (top side)		with IFU[a d] (bottom side)	
			Taper	Tolerance	Taper	Tolerance[b]
M2	30	$^{+60}_{0}$	30	$^{+60}_{0}$	—	—
M3	60		60		60	$^{+60}_{0}$
M4	90		90		90	
M5	120		120		120	

[a] IF and IFU are explained in Figures 24 and 25.

[b] For M rings (negative twist type) M3, M4, and M5, the twist angle should not exceed 90 % of the minimum taper angle.

[c] For chromium plated rings with tapered peripheral surface not ground, the tolerance shall be increased by 10 (e.g. M3 = 60: $^{+60}_{0}$ for M rings or $^{+70}_{0}$ for M rings with IF or IFU).

[d] IFU not recommended for rings with $h_1 \leq 1{,}2$ mm.

4.4.2 Designation

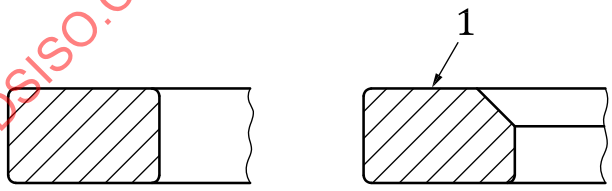
EXAMPLE Designation of a piston ring complying with the requirements of this part of ISO 6622 (i.e. ISO 6622-2) being a steel, rectangular ring with 60′ taper-faced peripheral surface (M3), of nominal diameter d_1 = 60 mm (60), of nominal ring width h_1 = 1,5 mm (1,5), made of alloyed steel (CrSi), subclass 62 (MC62), with a chromium-plated peripheral surface of a minimum thickness of 0,1 mm (CR2). Parameters in parenthesis are used in the ISO ring designation:

Piston ring ISO 6622-2 M3 - 60 × 1,5 - MC62/CR2

5 Common features

5.1 Type R — Straight-faced rectangular ring

5.1.1 Nitrided/PVD rings



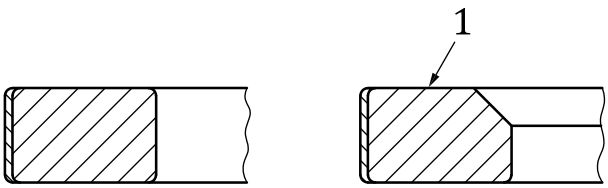
Key

1 top side identification mark

Figure 5 — Nitrided/PVD type R rings

5.1.2 Chromium-plated or spray-coated rings

5.1.2.1 Fully faced

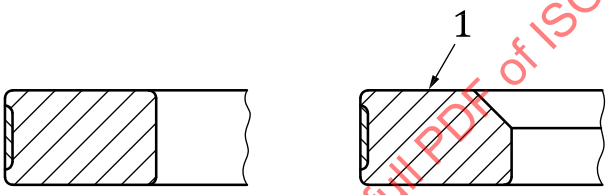


Key

1 top side identification mark

Figure 6 — Fully faced type R rings

5.1.2.2 Inlaid, h_1 ≥ 1,2 mm (not recommended for chromium-plated rings)



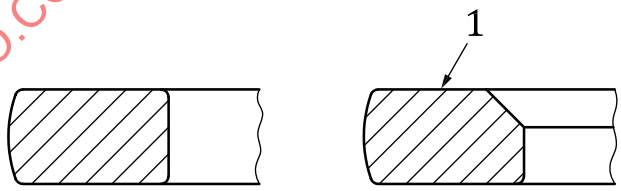
Key

1 top side identification mark

Figure 7 — Inlaid type R rings

5.2 Type B — Barrel-faced rectangular ring

5.2.1 Nitrided/PVD rings



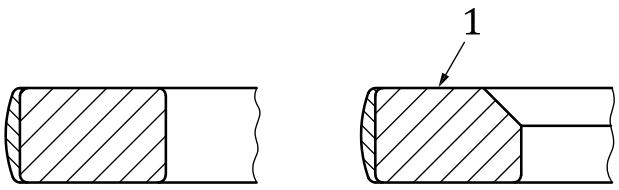
Key

1 top side identification mark

Figure 8 — Nitrided/PVD type B rings

5.2.2 Chromium-plated or spray-coated rings

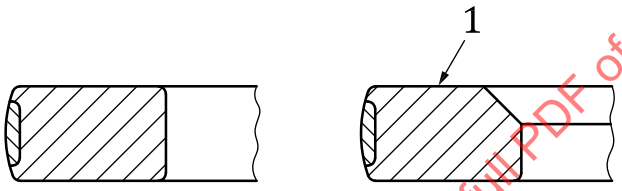
5.2.2.1 Fully faced



Key
1 top side identification mark

Figure 9 — Fully faced type B rings

5.2.2.2 Inlaid, h_1 ≥ 1,2 mm (not recommended for chromium-plated rings)

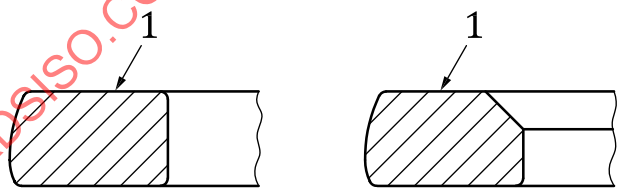


Key
1 top side identification mark

Figure 10 — Inlaid type B rings

5.3 Type BA — Asymmetrical barrel-faced rectangular ring, h_1 ≥ 1,2 mm

5.3.1 Nitrided/PVD rings

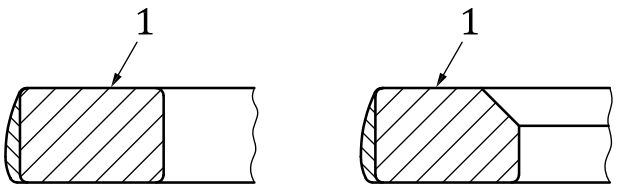


Key
1 top side identification mark

Figure 11 — Nitrided/PVD type BA rings

5.3.2 Chromium-plated or spray-coated rings

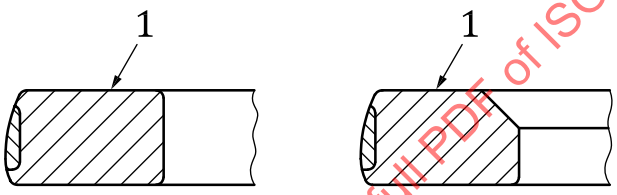
5.3.2.1 Fully faced



Key
1 top side identification mark

Figure 12 — Fully faced type BA rings

5.3.2.2 Inlaid, $h_1 \geq 1{,}2$ mm (not recommended for chromium-plated rings)



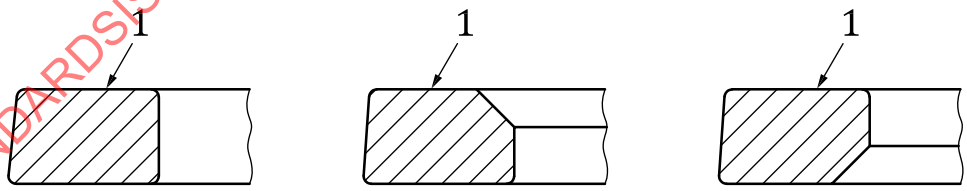
Key
1 top side identification mark

Figure 13 — Inlaid type BA rings

5.4 Type M — Taper-faced rectangular ring

5.4.1 Fully tapered

5.4.1.1 Uncoated/Nitrided/PVD rings

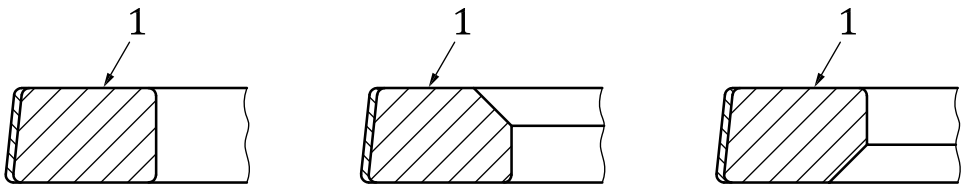


Key
1 top side identification mark

Figure 14 — Uncoated/Nitrided/PVD type M rings

5.4.1.2 Chromium-plated or spray-coated rings

5.4.1.2.1 Fully faced

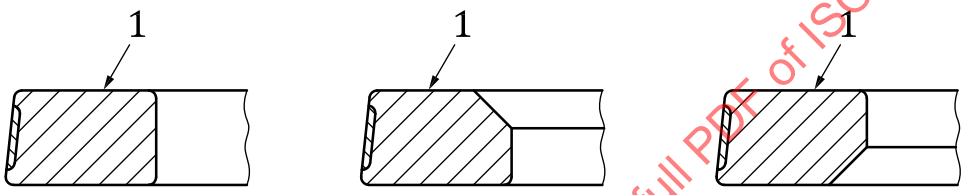


Key

1 top side identification mark

Figure 15 — Fully faced type M rings

5.4.1.2.2 Inlaid, $h_1 \geq 1{,}2$ mm (not recommended for chromium-plated rings)

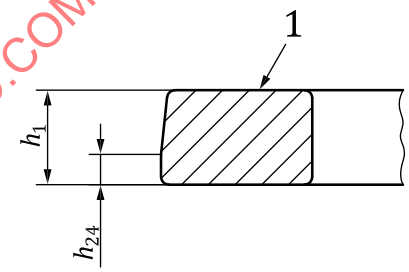


Key

1 top side identification mark

Figure 16 — Inlaid type M rings

5.4.2 Taper-faced rectangular ring with partly cylindrical machined (LM) or lapped (LP) peripheral surface



Key

1 top side identification mark

Figure 17 — Partly cylindrical or lapped type M rings

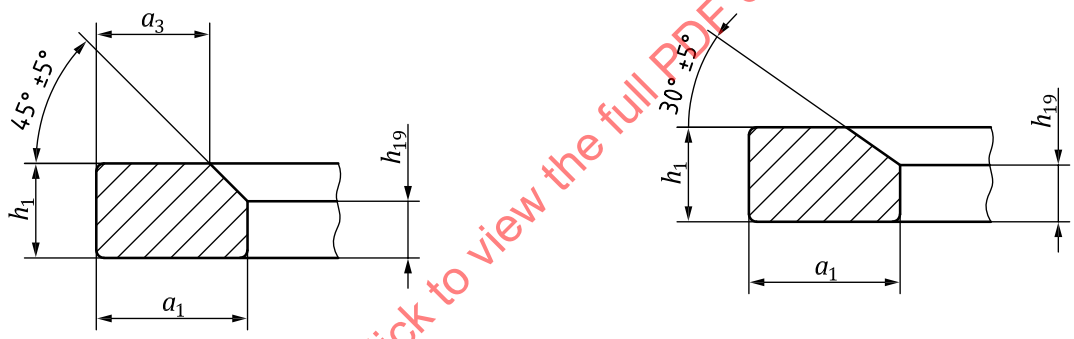
Table 4 — Axial dimensions of the cylindrical part of peripheral surface h_{24}

Dimensions in millimetres

h_1	h_{24}[a] **max.**	h_{24} **max. each side of gap up to 30°**
1,0	0,4	0,7
1,2	0,4	0,8
1,5	0,5	1,0
1,75	0,6	1,2
2,0	0,7	1,4
2,5	0,8	1,6
3,0	1,0	2,0
3,5	1,2	2,3

[a] Partly cylindrical peripheral surface shall be visible.

5.5 Type R, B, BA, and M rings (positive twist type) — Internal bevel top side



a) Commonly used in rings with $h_1 \geq 1{,}2$ mm **b) Commonly used in rings with $h_1 < 1{,}2$ mm**

Figure 18 — Internal bevel (IF)

5.6 Type M rings (negative twist type), taper M3 to M5 — Internal bevel bottom side

See Table 3.

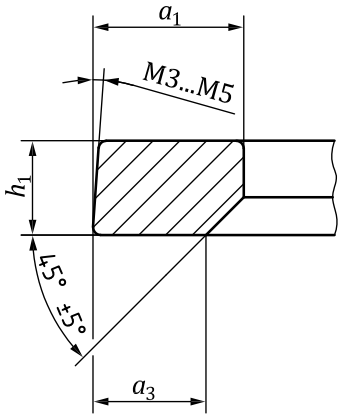


Figure 19 — Internal bevel bottom side (IFU)

Table 5 — h_{19} dimensions for rings h_1 < 1,5 mm

Dimensions in millimetres

d_1	h_{19}	
		Tolerance
$30 \le d_1 \le 100$	$0{,}6 \times h_1$	$^{0}_{-0{,}25}$

Table 6 — a_3 dimensions for rings h_1 ≥ 1,5 mm

Dimensions in millimetres

d_1	a_3	
		Tolerance
$30 \le d_1 < 80$	$0{,}8 \times a_1$	$^{0}_{-0{,}2}$
$80 \le d_1 \le 160$	$0{,}8 \times a_1$	$^{0}_{-0{,}3}$

5.7 Type R, B, BA, and M rings — Outside and inside rounded edges

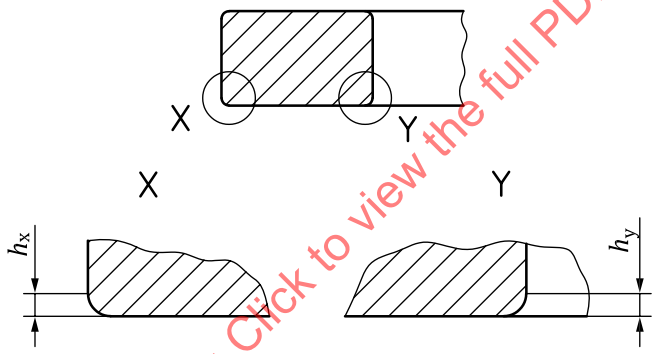


Figure 20 — Outside and inside rounded edges

Table 7 — h_x and h_y dimensions

Dimensions in millimetres

h_1	h_x **max.**	h_y **max.**
$0{,}8 \le h_1 < 1{,}5$	0,25	0,30
$h_1 \ge 1{,}5$	0,30	0,40

5.8 Type R, B, BA, and M rings (fully faced and inlaid) — Plating/coating thickness

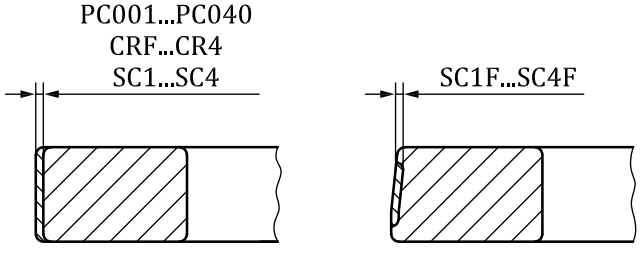


Figure 21 — Plating/coating thickness

Table 8 — Chromium plating/spray coating thickness

Dimensions in millimetres

Chromium plating code	Spray coating code	Thickness min.
CRF	—	0,005
CR1	**SC1**	0,050
CR2	**SC2**	0,100
CR3[a]	**SC3**[a]	0,150
CR4[a]	**SC4**[a]	0,200
[a] Not recommended for rings with $h_1 \leq 1{,}2$.		

Table 9 — PVD coating thickness

Dimensions in millimetres

Code	Peripheral surface min.
PC001	0,001
PC003	0,003
PC006 [a]	0,006
PC010 [a]	0,010
PC020 [a]	0,020
PC030 [a]	0,030
PC040 [a]	0,040
[a] Not applicable to diamond-like carbon (DLC) coatings.	

5.9 Type R, B, BA, and M rings — Nitrided case depth

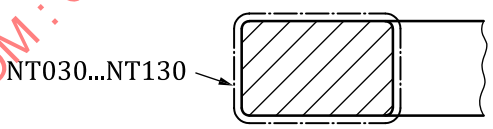


Figure 22 — Nitrided case depth

Table 10 — Nitrided case depth

Dimensions in millimetres

Code	Nitrided case depth min.	
	Peripheral surface	Side faces
NT030	0,03	0,010
NT050	0,05	0,015
NT070	0,07	0,020
NT090	0,09	0,020
NT110	0,11	0,030
NT130	0,13	0,030

6 Force factors

The tangential and diametral forces given in Table 13 shall be corrected when additional features are being used. For common features, the multiplier factors given in Tables 12 and 13 shall be used.

Table 11 — Force correction factors for R, B, BA, and M rings with features IF and taper

Factor		
M2 or M3	M4 or M5	IF
0,98	0,96	0,88

Table 12 — Force correction factors for chromium-plated, spray-coated, PVD–coated, and nitrided R, B, BA, and M rings (fully faced and inlaid type)

d_1 mm	Factor							
	CRF/PC001... PC030	CR1/ PC040	CR2/SC1	CR3	SC2	CR4/SC3	SC4	NT030...NT130
$30 \leq d_1 < 50$	1	0,80	0,71	—	0,63	—	—	1,03
$50 \leq d_1 < 75$	1	0,87	0,81	0,75	0,75	0,69	0,64	1,03
$75 \leq d_1 < 100$	1	0,91	0,86	0,82	0,82	0,78	0,74	1,03
$100 \leq d_1 < 125$	1	0,93	0,89	0,86	0,86	0,82	0,79	1,03
$125 \leq d_1 \leq 160$	1	0,94	0,91	0,89	0,89	0,86	0,83	1,03

7 Dimensions and forces

See Table 13.

Table 13 — Dimensions and forces of R, B, BA, and M rectangular rings made of steel

Dimensions in millimetres

Nominal diameter d_1	Radial wall thickness a_1	Tolerance	Ring width h_1							Tolerance	Closed gap s_1	Tolerance	Tangential force F_t [N] For h_1 shown in column							Tolerance	Diametral force F_d [N] For h_1 shown in column							Tolerance	Nominal diameter d_1
			1	2	3	4	5	6	7				1	2	3	4	5	6	7		1	2	3	4	5	6	7		
30	1,1	±0,15 Within a ring: 0,15 max.	0,8	1,0	1,2	—	—	—	—	−0,010 −0,025 For phosphated PO surface: −0,005 −0,025	0,15	+0,2 0	—	—	3,0					±30 % if F_t < 10 N ±20 % if F_t ≥ 10 N		4,3	5,4	6,5					±30 % if F_d < 21,5 N ±20 % if F_d ≥ 21,5 N	30
31															3,0						4,3	5,4	6,5						31
32															3,0						4,3	5,4	6,5						32
33															-						4,2	5,2	6,2						33
34	1,3														3,4						4,8	6,0	7,3						34
35														-	3,4						5,0	6,2	7,3						35
36														-	3,4						5,0	6,2	7,3						36
37													—	-	3,5						5,0	6,2	7,5						37
38														-	3,4						4,8	6,0	7,3						38
39	1,5					—								3,3	3,9						5,7	7,1	8,4						39
40														3,3	3,9						5,7	7,1	8,4						40
41														3,3	3,9						5,7	7,1	8,4						41
42													—	3,3	3,9						5,7	7,1	8,4						42
43														3,3	3,9						5,7	7,1	8,4						43
44														3,2	3,9	—	—	—	—		5,5	6,9	8,4	—	—	—	—		44
45	1,7												3,1	3,8	4,5						6,6	8,2	9,7						45
46													3,1	3,8	4,5						6,6	8,2	9,7						46
47													-	3,7	4,5						6,4	8,0	9,7						47
48													-	3,7	4,5						6,4	8,0	9,7						48
49													-	3,7	4,5						6,4	8,0	9,7						49
50	1,9					1,5							3,0	3,7	4,4	5,6					6,4	8,0	9,5	12,0					50
51													3,4	4,3	5,1	6,4					7,4	9,2	11,0	13,8					51

Table 13 — *(continued)*

Dimensions in millimetres

Nominal diameter d_1	Radial wall thickness a_1		Ring width h_1								Closed gap s_1		Tangential force F_t [N] For h_1 shown in column								Diametral force F_t [N] For h_1 shown in column								Nominal diameter d_1
		Tolerance	1	2	3	4	5	6	7	Tolerance		Tolerance	1	2	3	4	5	6	7	Tolerance	1	2	3	4	5	6	7	Tolerance	
52													3,4	4,2	5,1	6,4					7,2	9,0	11,0	13,8					52
53										−0,010 −0,025			3,4	4,2	5,1	6,4					7,2	9,0	11,0	13,8					53
54	1,9									For phosphated PO surface: 0 -0,025			3,4	4,2	5,0	6,3					7,2	9,0	10,8	13,5					54
55											0,15	+0,2 0	3,4	4,2	5,0	6,3					7,2	9,0	10,8	13,5					55
56													3,3	4,1	5,0	6,2					7,0	8,8	10,8	13,3					56
57													3,8	4,8	5,7	7,2					8,2	10,3	12,3	15,5					57
58													3,8	4,7	5,7	7,1					8,1	10,1	12,3	15,3					58
59	2,1						—	—	—				3,7	4,6	5,6	7,0	—	—	—		7,9	9,9	12,0	15,1	—	—	—		59
60													3,7	4,6	5,5	6,9					7,9	9,9	11,8	14,8					60
61		±0,15 Within a ring: 0,15 max.											3,6	4,5	5,4	6,8				± 30 % if F_t < 10 N	7,8	9,7	11,6	14,6				± 30 % if F_d < 21,5 N	61
62													4,2	5,2	6,2	7,8					9,0	11,2	13,3	16,8					62
63													4,1	5,1	6,2	7,7				± 20 % if F_t ≥ 10 N	8,8	11,0	13,3	16,6				± 20 % if F_d ≥ 21,5 N	63
64	2,3		0,8	1,0	1,2	1,5							4,1	5,1	6,1	7,7					8,8	11,0	13,1	16,6					64
65										−0,010 −0,030			4,0	5,0	6,1	7,6					8,6	10,8	13,1	16,3					65
66										For phosphated PO surface: 0 -0,030			4,0	5,0	6,0	7,5					8,6	10,8	12,9	16,1					66
67											0,2	+0,2 0	3,9	4,9	5,9	7,4					8,4	10,5	12,7	15,9					67
68													4,6	5,7	6,8	8,6					9,8	12,3	14,6	18,5					68
69													4,5	5,6	6,8	8,5					9,6	12,0	14,6	18,3					69
70	2,5												4,5	5,6	6,7	8,4	9,8	11,2	14,1		9,6	12,0	14,4	18,1	21,1	24,1	30,2		70
71													4,4	5,5	6,6	8,3	9,7	11,1	13,9		9,4	11,8	14,2	17,8	20,9	23,9	29,9		71
72							1,75	2,0	2,5				4,3	5,4	6,5	8,2	9,6	11,0	13,7		9,3	11,6	14,0	17,6	20,6	23,7	29,6		72
73													4,3	5,4	6,5	8,1	9,5	10,8	13,6		9,3	11,6	14,0	17,4	20,4	23,2	29,2		73