INTERNATIONAL STANDARD

ISO 6624-1

Second edition
2001-08-01

Internal combustion engines — Piston rings —

Part 1: Keystone rings made of cast iron

Moteurs à combustion interne — Segments de piston —

Partie 1: Segments trapézoïdaux en fonte

Reference number
ISO 6624-1:2001(E)

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Fax + 41 22 749 09 47
E-mail copyright@iso.ch
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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 6624 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6624-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

This second edition cancels and replaces the first edition (ISO 6624-1:1986), which has been technically revised.

ISO 6624 consists of the following parts, under the general title *Internal combustion engines — Piston rings*:

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

— *Part 2: Half keystone rings made of cast iron*

— *Part 3: Keystone rings made of steel*

— *Part 4: Half keystone rings made of steel*

Introduction

ISO 6624 is one of a number of series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6621, ISO 6622, ISO 6623, ISO 6625, ISO 6626 and ISO 6627 (see Bibliography for details).

The common features and dimensional tables presented in this part of ISO 6624 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 before completing a selection.

Internal combustion engines — Piston rings —

Part 1: Keystone rings made of cast iron

1 Scope

This part of ISO 6624 specifies the essential dimensional features of keystone rings made of cast iron, types T, TB, TBA, TM, K, KB, KBA and KM, having diameters of from 70 mm up to and including 200 mm, used in reciprocating internal combustion piston engines.

2 Normative reference

The following normative document contain provisions which, through reference in this text, constitute provisions of this part of ISO 6624. 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 6624 are encouraged to investigate the possibility of applying the most recent edition of the normative document 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 6621-4:—[1)], *Internal combustion engines — Piston rings — Part 4: General specifications*.

3 Overview

The keystone ring types are specified in Tables 1 to 3 and Figures 1 to 8. Their common features and the dimensions of those features are specified in Tables 4 to 7 and Figures 9 to 16. Tables 8 and 9 give the force factors for the different types of ring, while Table 10 and Table 11 give the dimensions and forces of keystone rings 6° and 15°, respectively.

1) To be published. (Revision of ISO 6621-4:1988)

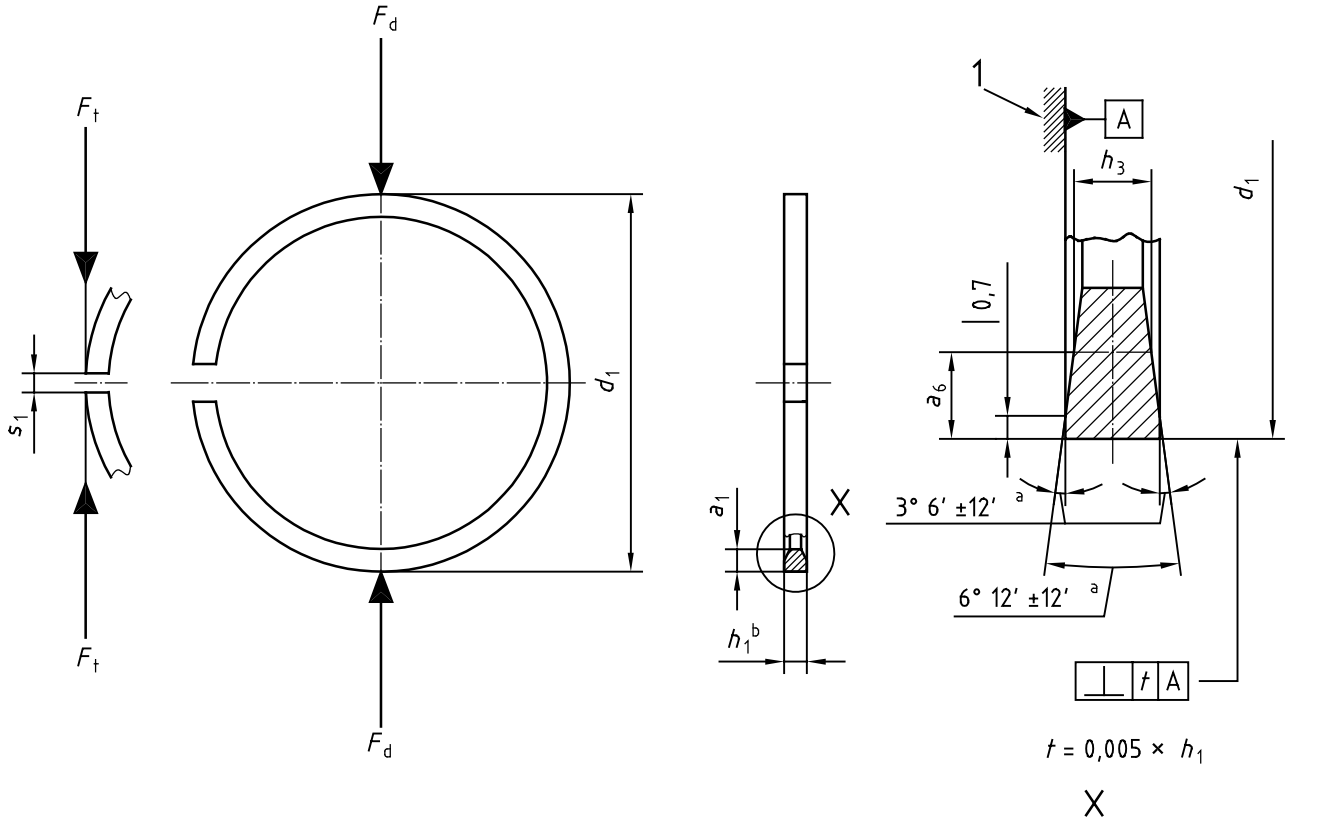
4 Ring types and designation examples

4.1 Type T — Straight faced keystone ring 6°

4.1.1 General features

See Table 10 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 1 — Type T

4.1.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 6° keystone ring with a straight faced peripheral surface (T), of nominal diameter d_1 = 90 mm (90) and nominal width h_1 = 2,5 mm (2,5), made of grey cast iron, subclass 12 (MC12), and having a chromium plated peripheral surface with a minimum thickness of 0,1 mm (CR2):

Piston ring ISO 6624-1 T- 90 × 2,5-MC12/CR2

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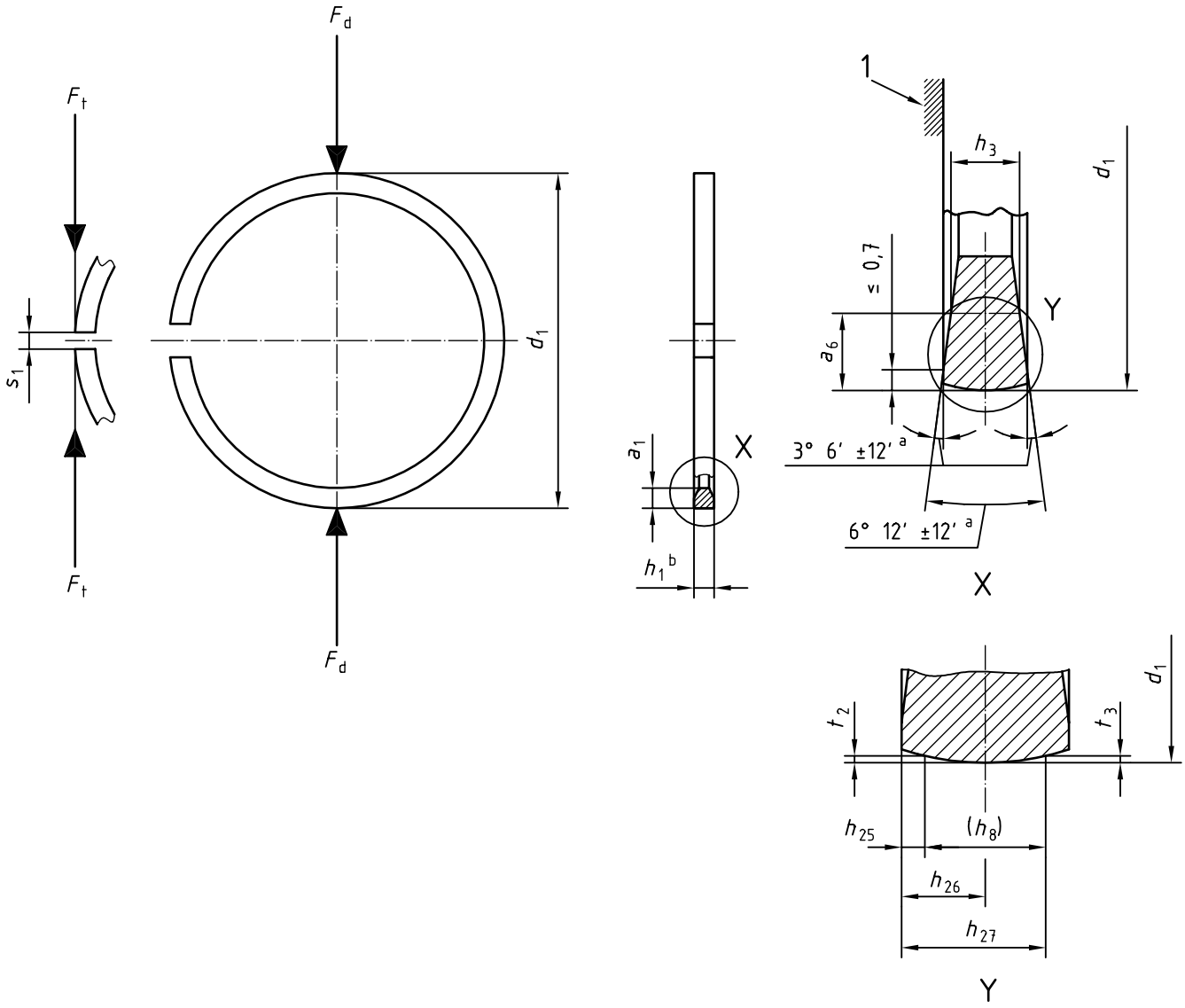
4.2 Type TB — Symmetrical barrel faced keystone ring 6°

4.2.1 General features

See Table 10 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 2 — Type TB

Table 1 — Symmetrical barrel dimensions

Dimensions in millimetres

h_1	h_{25}	h_{26}		h_{27}	t_2, t_3	h_8 [a]
			Tolerance			
2,0	0,40	1,00	± 0,30	1,60	0,003...0,015	1,2
2,5	0,45	1,25	± 0,40	2,05		1,6
3,0	0,50	1,50	± 0,50	2,50	0,005...0,020	2,0
3,5	0,55	1,75		2,95		2,4
4,0	0,60	2,00	± 0,60	3,40	0,005...0,023	2,8
4,5	0,65	2,25		3,85		3,2

[a] Gauge width h_8, informative only, shall be used only if agreed between manufacturer and client.

4.2.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 6° keystone ring with a symmetrical barrel faced peripheral surface (TB), of nominal diameter $d_1 = 90$ mm (90) and nominal ring width $h_1 = 2{,}5$ mm (2,5), made of heat-treated martensitic spheroidal graphite cast iron, subclass 53 (MC53), and having a semi-inlaid spray coating on the peripheral surface with a minimum thickness of 0,2 mm (SC4E):

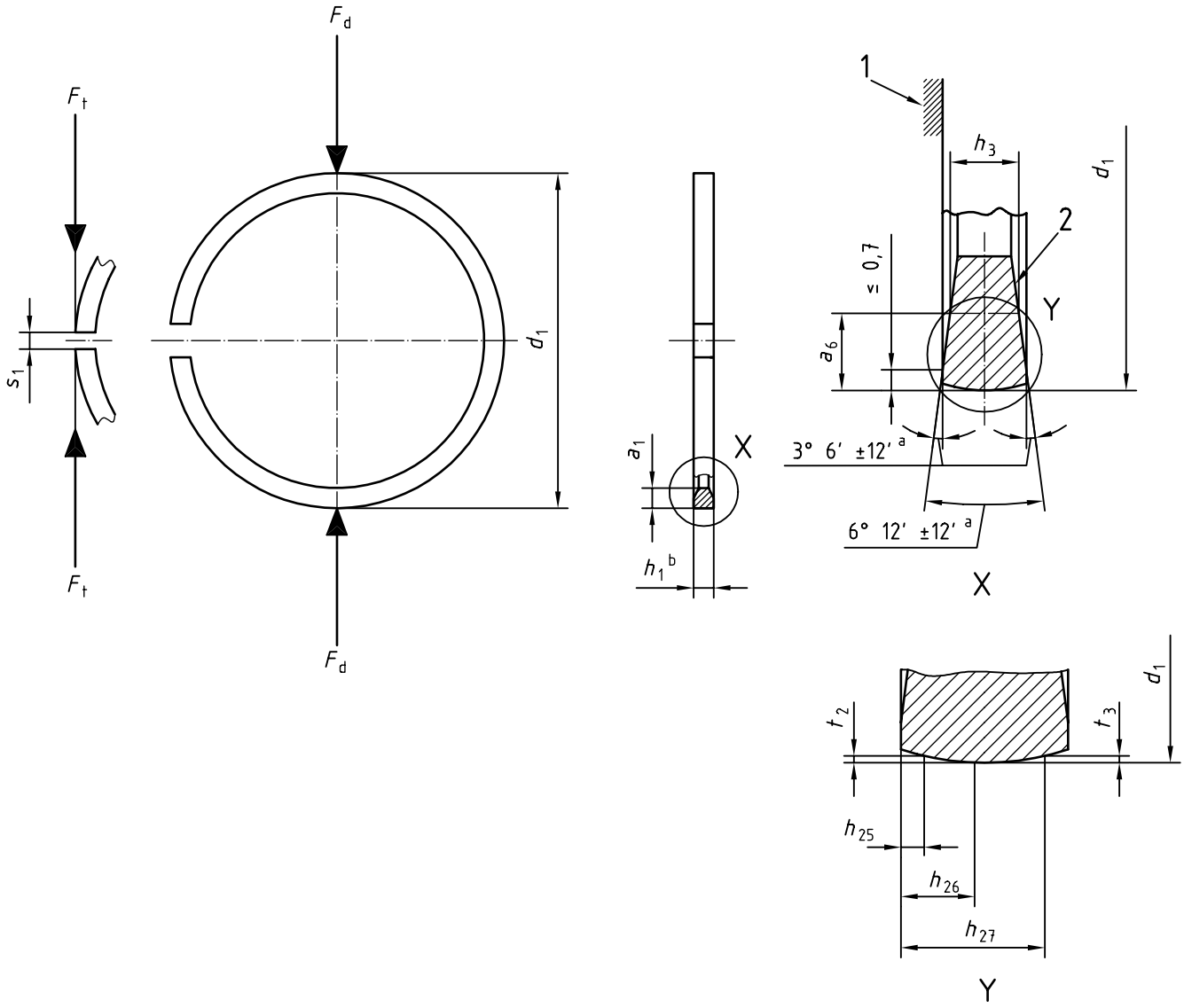
Piston ring ISO 6624-1 TB - 90 × 2,5-MC53/SC4E

4.3 Type TBA — Asymmetrical barrel faced keystone ring 6°

4.3.1 General features

See Table 10 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

2 Mark

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 3 — Type TBA

Table 2 — Asymmetrical barrel dimensions

Dimensions in millimetres

h_1	h_{25} [a]	h_{26}	Tolerance	h_{27}	t_2 [b]	t_3 [b]
2,00	0,40	0,60	± 0,20	1,50	0...0,007	0,009...0,030
2,50	0,45	0,70	± 0,25	1,80	0...0,008	0,011...0,035
3,00	0,55	0,80		2,10		0,012...0,038
3,50	0,60	0,90	± 0,30	2,40	0...0,009	0,012...0,040
4,00	0,65	0,95		2,80		0,013...0,045
4,50	0,70	1,05	± 0,35	3,20	0...0,010	0,015...0,050

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

[b] t_2 or t_3 or both may be varied as agreed between manufacturer and client.

4.3.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 6° keystone ring with an asymmetrical barrel faced peripheral surface (TBA), of nominal diameter $d_1 = 90$ mm (90) and nominal ring width $h_1 = 2{,}5$ mm (2,5), made of heat-treated martensitic spheroidal graphite cast iron, subclass 53 (MC53), and having a semi-inlaid spray coating on the peripheral surface with a minimum thickness of 0,2 mm (SC4E):

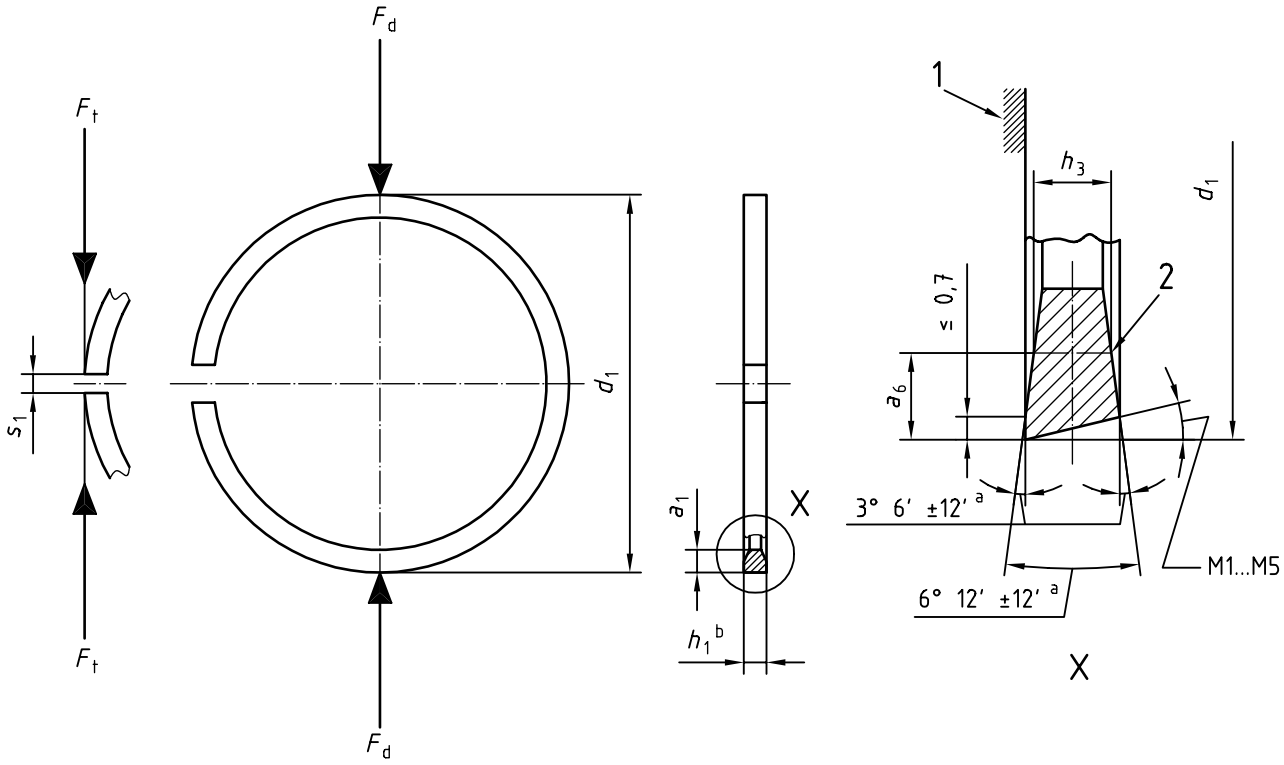
Piston ring ISO 6624-1 TBA - 90 × 2,5-MC53/SC4E

4.4 Type TM — Taper faced keystone ring 6°

4.4.1 General features

See Table 10 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

2 Mark

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 4 — Type TM

Table 3 — Taper

Dimensions in minutes

Code	Taper	Tolerance a	Internal twist feature designs Tolerance a
M1 b	10	$^{+50}_{0}$	$^{+60}_{0}$
M2 M3 M4 M5	30 60 90 120	$^{+60}_{0}$	$^{+70}_{0}$

a For chromium plated rings with a tapered peripheral surface that is not ground, the tolerance shall be increased by 10 (e.g. M3 = 60 tolerance: $^{+70}_{0}$; M3 with internal features = 60 tolerance: $^{+80}_{0}$).

b M1 not for rings with partly cylindrical peripheral surface.

4.4.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 6° keystone ring with a 10′ taper faced peripheral surface (TM1), of nominal diameter d_1 = 90 mm (90) and nominal ring width h_1 = 2,5 mm (2,5), made of heat-treated grey cast iron, subclass 22 (MC22), and phosphate-coated all over (PO):

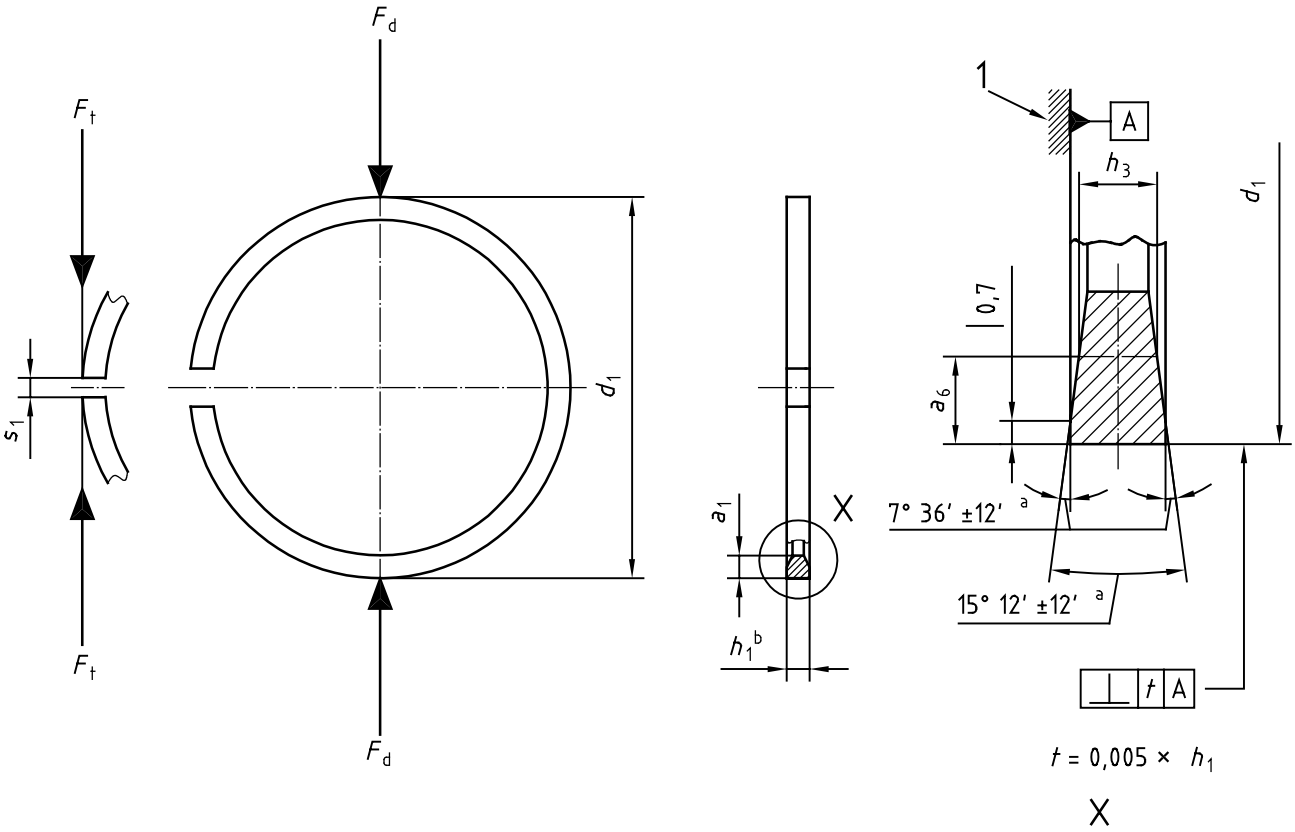
Piston ring ISO 6624-1 TM1 - 90 × 2,5-MC22/PO

4.5 Type K — Straight faced keystone ring 15°

4.5.1 General features

See Table 11 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 5 — Type K

4.5.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 15° keystone ring with a straight faced peripheral surface (K), of nominal diameter d_1 = 90 mm (90) and nominal ring width h_1 = 2,5 mm (2,5), made of carbidic cast iron, subclass 32 (MC32), and ferroxide coated all over (FE):

Piston ring ISO 6624-1 K - 90 × 2,5-MC32/FE

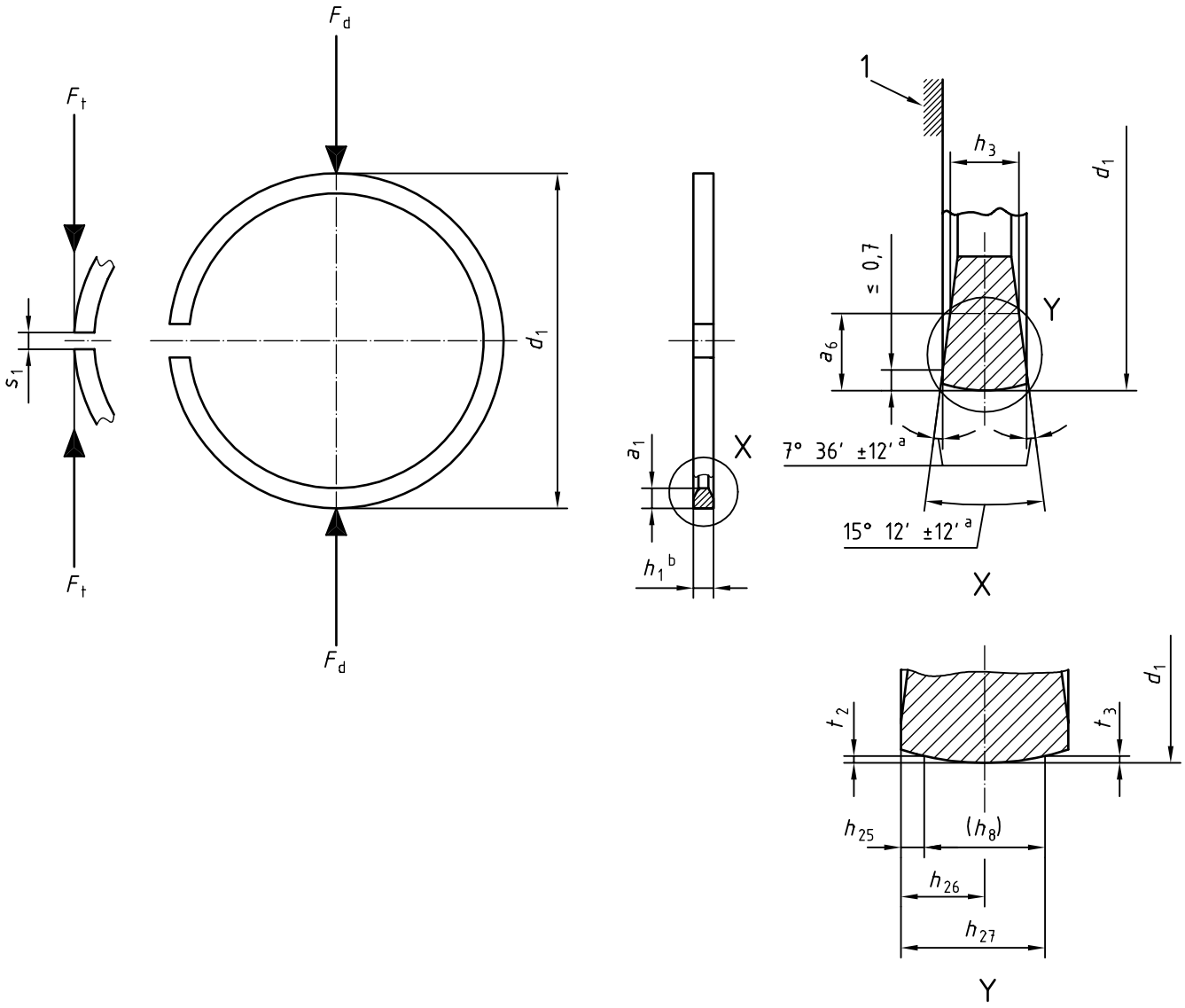
4.6 Type KB — Symmetrical barrel faced keystone ring 15°

4.6.1 General features

See Table 1 for symmetrical barrel dimensions.

See Table 11 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 6 — Type KB

4.6.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 15° keystone ring with a barrel faced peripheral surface (KB), of nominal diameter d_1 = 90 mm (90) and nominal ring width h_1 = 2,5 mm (2,5), made of malleable cast iron, subclass 4I (MC4I), and having an inlaid spray coating on the peripheral surface with a minimum thickness of 0,2 mm (SC4F):

Piston ring ISO 6624-1 KB - 90 × 2,5-MC41/SC4F

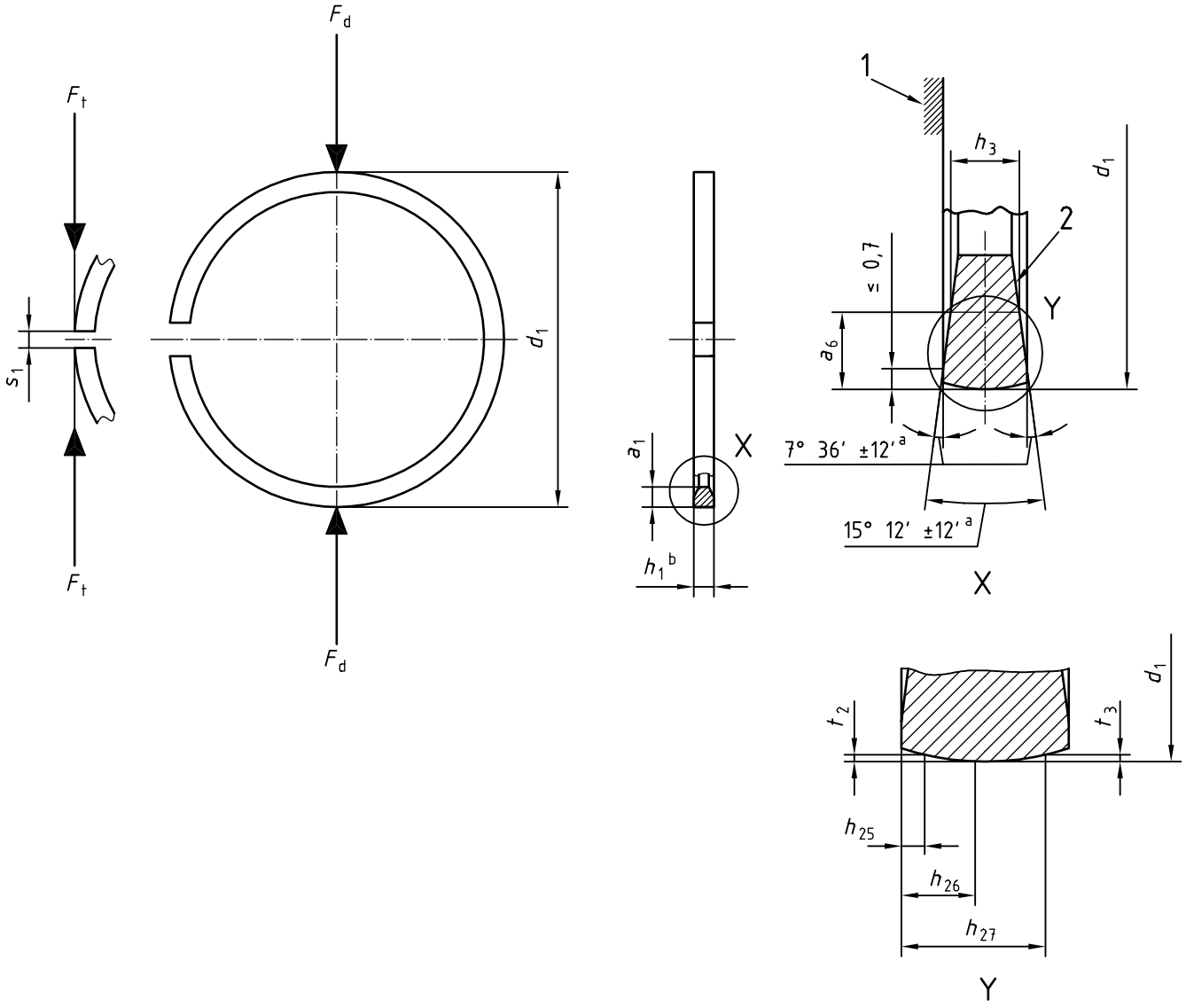
4.7 Type KBA — Asymmetrical barrel faced keystone ring 15°

4.7.1 General features

See Table 2 for asymmetrical barrel dimensions.

See Table 11 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane
2 Mark

a Due to manufacturing processing, side angle tolerances are not cumulative.
b Nominal.

Figure 7 — Type KBA

4.7.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron 15° keystone ring with an asymmetrical barrel faced peripheral surface (KBA) of nominal diameter d_1 = 90 mm (90) and nominal ring width h_1 = 2,5 mm (2,5), made of malleable cast iron, subclass 4I (MC4I), and having an inlaid spray coating on the peripheral surface with a minimum thickness of 0,2 mm (SC4F):

Piston ring ISO 6624-1 KBA - 90 × 2,5-MC41/SC4F

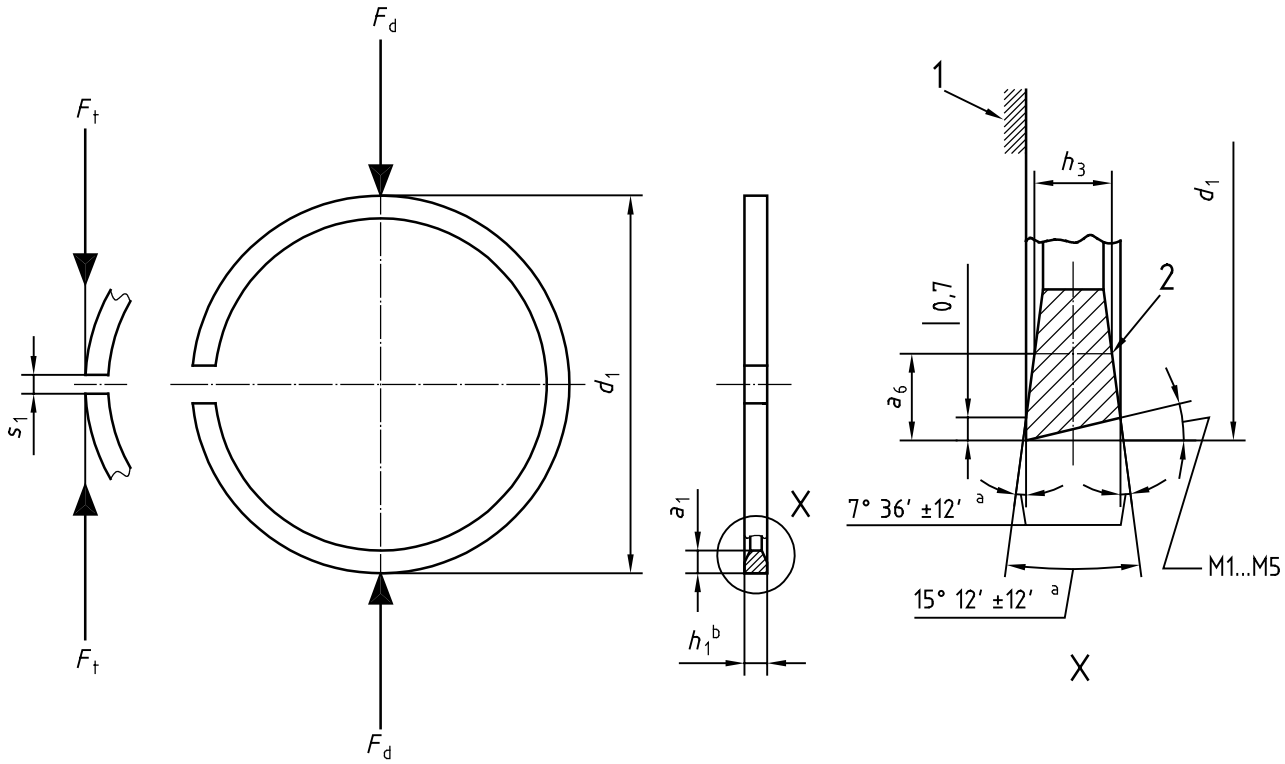
4.8 Type KM — Taper faced keystone ring 15°

4.8.1 General features

See Table 3 for taper.

See Table 11 for dimensions and forces.

Dimensions in millimetres



Key

1 Reference plane

2 Mark

a Due to manufacturing processing, side angle tolerances are not cumulative.

b Nominal.

Figure 8 — Type KM

4.8.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-1, being a cast iron, 15° keystone ring with a 10′ taper faced peripheral surface (KM1), of nominal diameter $d_1 = 90$ mm (90) and nominal ring width $h_1 = 2{,}5$ mm (2,5), made of grey cast iron, subclass 12 (MC12):

Piston ring ISO 6624-1 KM1 - 90 × 2,5-MC12

5 Common features

5.1 Type T, TB, TBA, TM, K, KB, KBA, KM rings — Inside chamfered edges (KI)

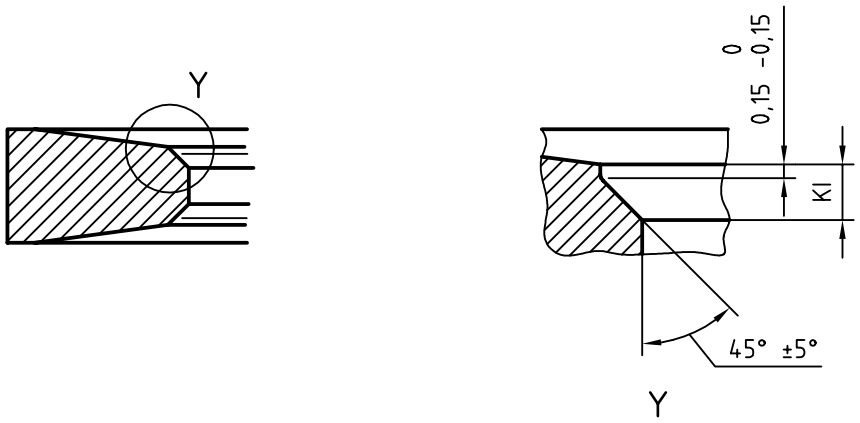


Figure 9 — Inside chamfered edges (KI)

Table 4 — KI dimensions

Dimensions in millimetres

d_1	KI
$70 \leqslant d_1 < 125$	0,3 ± 0,15
$125 \leqslant d_1 < 175$	0,4 ± 0,15
$175 \leqslant d_1 \leqslant 200$	0,6 ± 0,20

5.2 Type T, TB, TBA, TM, K, KB, KBA, KM rings (positive twist type) internal bevel or internal step top side

An internal bevel is not recommended for the 15° keystone rings with ring width h_1 given in the "nominal value of ring width" column 1 of Table 11.

Dimensions in millimetres

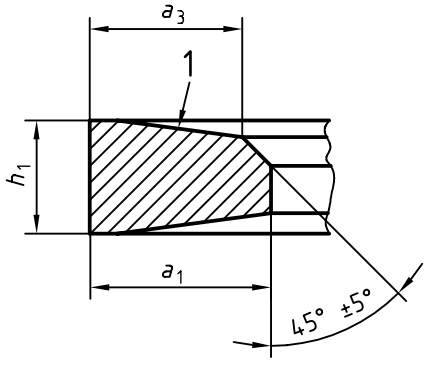


Figure 10 — Internal bevel top side (IF)

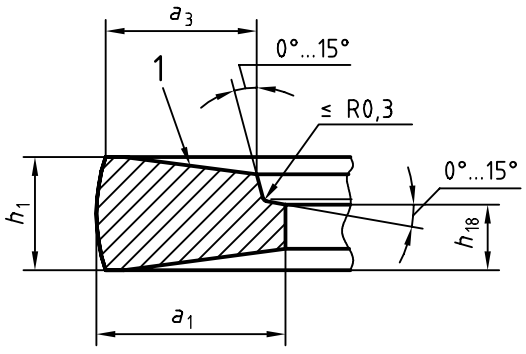


Figure 11 — Internal step top side (IW)

Key

1 Mark

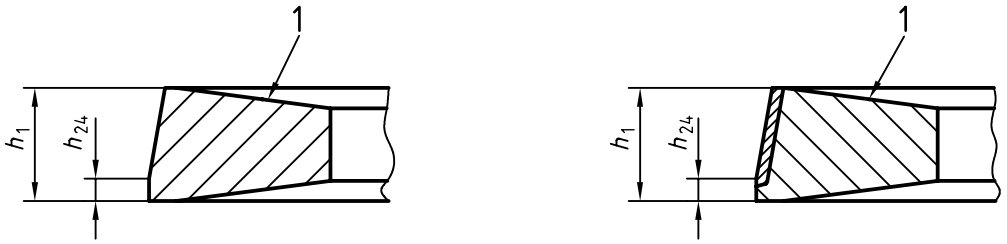
Table 5 — a_3 and h_{18} dimensions

Dimensions in millimetres

d_1	a_3		h_{18}	
		Tolerance		Tolerance
$70 \leqslant d_1 < 100$	$0{,}8 \times a_1$	$^{0}_{-0{,}3}$	$0{,}6 \times h_1$	$^{0}_{-0{,}25}$
$100 \leqslant d_1 < 160$	$0{,}8 \times a_1$	$^{0}_{-0{,}3}$	$0{,}6 \times h_1$	$^{0}_{-0{,}35}$
$160 \leqslant d_1 \leqslant 200$	$0{,}8 \times a_1$	$^{0}_{-0{,}4}$	$0{,}6 \times h_1$	$^{0}_{-0{,}45}$

5.3 Type TM or KM rings with partly cylindrical machined (LM) or lapped (LP) peripheral surface

Taper M1 is excluded.



Key

1 Mark

Figure 12 — Partly cylindrical peripheral surface

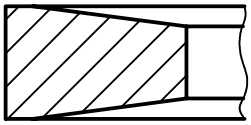
Table 6 — h_{24} dimensions

Dimensions in millimetres

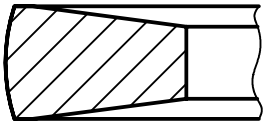
h_1	h_{24} max.	h_{24} max. each side of gap up to 30°
2,0	0,7	1,4
2,5	0,8	1,6
3,0	1,0	2,0
3,5	1,2	2,3
4,0	1,3	2,6
4,5	1,5	3,0
Partly cylindrical peripheral surfaces shall be visible.		

5.4 Type T, TB, TBA, TM, K, KB, KBA, KM rings — Plating/coating configuration

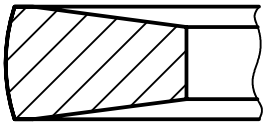
5.4.1 Uncoated rings



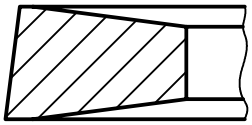
a) T or K rings



b) TB or KB rings



c) TBA or KBA rings

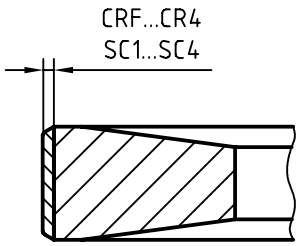


d) TM or KM rings

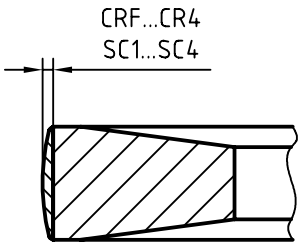
Figure 13 — Uncoated rings

5.4.2 Chromium plated or spray coated rings

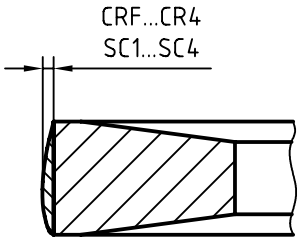
5.4.2.1 Fully faced



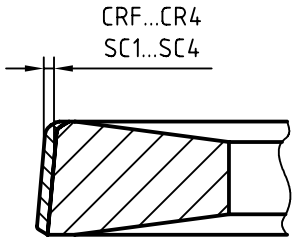
a) T or K rings



b) TB or KB rings



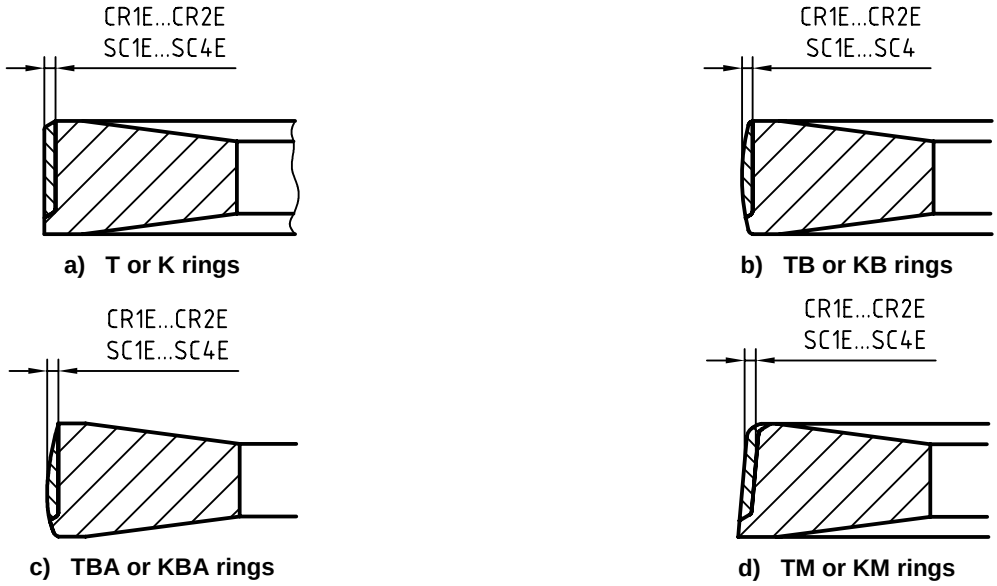
c) TBA or KBA rings



d) TM or KM rings

Figure 14 — Fully faced rings

5.4.2.2 Semi-inlaid



a) T or K rings

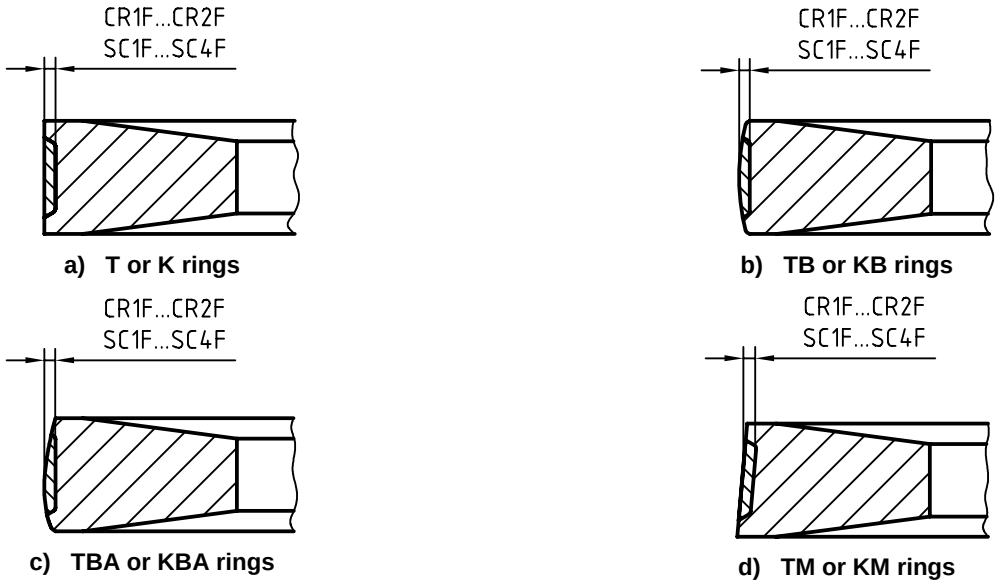
b) TB or KB rings

c) TBA or KBA rings

d) TM or KM rings

Figure 15 — Semi-inlaid rings

5.4.2.3 Inlaid



a) T or K rings

b) TB or KB rings

c) TBA or KBA rings

d) TM or KM rings

Figure 16 — Inlaid rings

Table 7 — Plating/coating thickness

Dimensions in millimetres

Chromium plating Code	**Spray coating** Code	**Thickness** min.
CRF	—	0,005
CR1	SC1	0,05
CR2	SC2	0,10
CR3	SC3	0,15
CR4	SC4	0,20

6 Force factors

The tangential and diametral forces given in Tables 10 and 11 shall be corrected when additional features or materials other than grey cast iron with a modulus of elasticity, E_n, of 100 GN/m^2, or both, are used.

For common features, the multiplier correction factors given in Tables 8 and 9, and the force correction factors given in ISO 6621-4:—[1)], shall be used.

Table 8 — Force correction factors for chromium plated or spray coated T, TB, TBA, TM, K, KB, KBA, KM rings with features KI, IF, IW and taper

Factor				
KI	M2 or M3	M4 or M5	IF	IW
0,96	0,98	0,96	0,88	0,78

Table 9 — Force correction factors for chromium plated or spray coated T, TB, TBA, TM, K, KB, KBA, KM rings (fully faced, semi-inlaid and inlaid types)

d_1	Factor					
mm	CRF	CR1	CR2/SC1	CR3/SC2	CR4/SC3	SC4
$70 \leqslant d_1 < 100$	1	0,92	0,88	0,85	0,81	0,77
$100 \leqslant d_1 < 125$	1	0,94	0,91	0,88	0,86	0,83
$125 \leqslant d_1 < 150$	1	0,95	0,92	0,90	0,88	0,85
$150 \leqslant d_1 \leqslant 200$	1	0,96	0,93	0,91	0,89	0,87

7 Dimensions

The dimensions and the tangential and diametral forces of keystone rings 6° and 15° are given in Tables 10 and 11.

Table 10 — Dimensions of T, TB, TBA, TM, keystone rings 6°

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
					Measured value					Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
70	2,90												9,9	12,6		21,3	27,1	
71	2,95												10,1	12,9		21,7	27,7	
72	3,00										0,20	$^{+0,20}_{0}$	10,3	13,2		22,1	28,4	
73	3,05												10,5	13,4		22,6	28,8	
74	3,10												10,7	13,7		23,0	29,5	
75	3,15					1,832	2,332			1,61			10,9	13,9		23,4	29,9	
76	3,15					0	0			0			10,6	13,6		22,8	29,2	
77	3,20					− 0,024	− 0,024			− 0,22			10,8	13,9		23,2	29,9	
78	3,25												11,0	14,1		23,7	30,3	
79	3,30		2,0	2,5	1,5	For phos-phated PO surface:	For phos-phated PO surface:	1,82	2,32	For phos-phated PO surface:			11,3	14,4		24,3	31,0	
80	3,35												11,5	14,7		24,7	31,6	
81	3,40												11,7	15,0		25,2	32,3	
82	3,40	± 0,15									0,25		11,4	14,6		24,5	31,4	
83	3,45	Within				+ 0,010	+ 0,010			+ 0,09			11,6	14,9		24,9	32,0	
84	3,50	a ring:				− 0,024	− 0,024			− 0,22			11,8	15,2		25,4	32,7	
85	3,55	$0,15_{\text{max.}}$											12,0	15,4		25,8	33,1	
86	3,60												12,2	15,7		26,2	33,8	
87	3,65											$^{+0,25}_{0}$	12,5	16,0		26,9	34,4	
88	3,65												12,2	15,6		26,2	33,5	
89	3,70												12,4	15,9		26,7	34,2	
90	3,75										0,30		16,1	19,6		34,6	42,1	
91	3,80					2,278	2,778			2,08			16,3	20,0		35,0	43,0	
92	3,85					0	0			0			16,6	20,3	± 30 % if	35,7	43,6	± 30 % if
93	3,90	± 0,2				− 0,024	− 0,024			− 0,22			16,9	20,6	F_t < 10 N	36,3	44,3	F_d < 21,5 N
94	3,90	Within				For phos-phated PO surface:	For phos-phated PO surface:			For phos-phated PO surface:			16,5	20,2		35,5	43,4	
95	3,95	a ring:	2,5	3,0	2,0			2,27	2,77				16,8	20,5	± 20 % if	36,1	44,1	± 20 % if
96	4,00	$0,2_{\text{max.}}$											17,1	20,9	$F_t \geqslant$ 10 N	36,8	44,9	$F_d \geqslant$ 21,5 N
97	4,05					+ 0,010	+ 0,010			+ 0,09			17,3	21,2		37,2	45,6	
98	4,10					− 0,024	− 0,024			− 0,22			17,6	21,5		37,8	46,2	
99	4,15												17,9	21,9		38,5	47,1	

Table 10 (*continued*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
100	4,15										0,30		17,5	21,4		37,6	46,0	
101	4,20					2,278	2,778			2,08			17,7	21,7		38,1	46,7	
102	4,25					0	0			0			18,0	22,0		38,7	47,3	
103	4,30					− 0,024	− 0,024			− 0,22			18,2	22,3		39,1	47,9	
104	4,30		2,5	3,0	2,0	For phos-	For phos-	2,27	2,77	For phos-			17,9	21,9		38,5	47,1	
105	4,35					phated PO	phated PO			phated PO			18,1	22,2		38,9	47,7	
106	4,40					surface:	surface:			surface:			18,3	22,5		39,3	48,4	
107	4,40					+ 0,010	+ 0,010			+ 0,09			18,0	22,0		38,7	47,3	
108	4,45	± 0,2				− 0,024	− 0,024			− 0,22			18,2	22,3		39,1	47,9	
109	4,50	Within											18,4	22,6		39,6	47,1	
110	4,55	a ring:											18,6	22,8		40,0	49,0	
111	4,55	0,2 max.											18,2	22,4		39,1	48,2	
112	4,60												18,5	22,7		39,8	48,8	
113	4,65												18,7	22,9		40,2	49,2	
114	4,70										0,35		18,9	23,2		40,6	49,9	
115	4,70												18,6	22,8		40,0	49,0	
116	4,75											$^{+0,25}_{0}$	18,8	23,1		40,4	49,7	
117	4,80												19,0	23,4		40,9	50,3	
118	4,80												18,7	22,9		40,2	49,2	
119	4,85												18,9	23,2		40,6	49,9	
120	4,90												19,1	23,5		41,1	50,5	
121	4,95												19,3	23,8		41,5	51,2	
122	4,95												19,0	23,3		40,9	50,1	
123	5,00												19,2	23,6		41,3	50,7	
124	5,05												19,4	23,9		41,7	51,4	
125	5,05												23,4	27,8		50,3	59,8	
126	5,10												23,7	28,1		51,0	60,4	
127	5,15												24,0	28,5		51,6	61,3	
128	5,20												24,2	28,8		52,0	61,9	
129	5,20												23,8	28,3		51,2	60,8	
130	5,25												24,0	28,5		51,6	61,3	
131	5,30												24,3	28,8		52,2	61,9	
132	5,30												23,9	29,1		51,4	62,6	

Table 10 (*continued*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width					Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B									
					Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1	h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6	Tolerance	1	2	Tolerance	1	2	Tolerance
133	5,35					2,724	3,224			2,63		24,1	28,7		51,8	61,7	
134	5,40					0	0			0		24,4	29,0		52,5	62,4	
135	5,40					− 0,024	− 0,024			− 0,22		24,0	28,5		51,6	6,3	
136	5,45					For phos-	For phos-			For phos-		24,3	28,8		52,2	61,9	
137	5,50					phated	phated			phated		24,5	29,1		52,7	62,6	
138	5,50					PO	PO			PO		24,1	28,7		51,8	61,7	
139	5,55					surface:	surface:			surface:	0,40	24,4	29,0		52,5	62,4	
140	5,60					+ 0,010	+ 0,010			+ 0,09		24,6	29,3		52,9	63,0	
141	5,65	0,2				− 0,024	− 0,024			− 0,22	$^{+0,25}_{0}$	24,9	29,6		53,5	63,6	
142	5,65	Within										24,5	29,1		52,7	62,6	
143	5,70	a ring:										24,7	29,4		53,1	63,2	
144	5,75	0,2 max.	3,0	3,5	2,5			2,71	3,21			25,0	29,7		53,8	63,9	
145	5,75											24,6	29,3		52,9	63,0	
146	5,80											24,9	29,6		53,5	63,6	
147	5,85											25,1	29,9		54,0	64,3	
148	5,85											24,7	29,4		53,1	63,2	
149	5,90											25,0	29,7		53,8	63,9	
150	5,95											25,0	29,8		53,8	64,1	
152	6,00					2,724	3,224			2,63		24,9	30,1		53,5	63,9	
154	6,05					0	0			0		24,8	29,5		53,3	63,4	
155	6,10					− 0,029	− 0,029			− 0,26		25,0	29,8		53,8	64,1	
156	6,15											25,2	30,1		54,2	64,7	
158	6,20					For phos-	For phos-			For phos-		25,1	29,9		54,0	64,3	
160	6,25					phated	phated			phated		25,0	29,8	± 30 % if	53,8	64,1	± 30 % if
162	6,35					PO surface:	PO surface:			PO surface:	$^{+0,30}_{0}$	25,4	30,3	$F_t < 10$ N	54,6	65,1	$F_d < 21,5$ N
164	6,40										0,50	25,3	30,2		54,4	64,9	
165	6,40					+ 0,010	+ 0,010			+ 0,09		25,0	29,8		53,8	64,1	
166	6,45					− 0,029	− 0,029			− 0,22		25,2	30,0		54,2	64,5	
168	6,50											25,1	29,9		54,0	64,3	
170	6,60											30,4	35,4	± 20 % if	65,4	76,1	± 20 % if
172	6,65											30,3	35,2	$F_t \geqslant 10$ N	65,1	75,7	$F_d \geqslant 21,5$ N
174	6,70											30,2	35,1		64,9	75,5	
175	6,75											30,3	35,2		65,1	75,7	

Table 10 (*concluded*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
176	6,80					3,172	3,672			3,20			30,5	35,5		65,6	76,3	
178	6,85					0	0			0			30,4	35,4		65,4	76,1	
180	6,90					− 0,029	− 0,029			− 0,27			30,3	35,2		65,1	75,7	
182	6,95					For phos-	For phos-			For phos-			30,1	35,1		64,7	75,5	
184	7,05					phated PO	phated PO			phated PO			30,6	35,7		65,8	76,8	
185	7,05					surface:	surface:			surface:			30,3	35,2		65,1	75,7	
186	7,10		3,5	4,0	3,0	+ 0,010	+ 0,010	3,15	3,65	+ 0,09	0,60	$^{+0,30}_{0}$	30,5	35,5		65,6	76,3	
188	7,15					− 0,029	− 0,029			− 0,27			30,4	35,4		65,4	76,1	
190	7,20												30,3	35,2		65,1	75,7	
192	7,25												30,1	35,1		64,7	75,5	
194	7,35												30,6	35,7		65,8	76,8	
195	7,35												30,2	35,2		64,9	75,7	
196	7,40												30,5	35,5		65,6	76,3	
198	7,45												30,4	35,4		65,4	76,1	
200	7,50												30,2	35,2		64,9	75,7	

For intermediate sizes (e.g. repair sizes), the radial wall thickness of the next smaller nominal diameter should be applied.

NOTE 1 The values for F_t and F_d given in Table 10 apply to grey cast iron with a typical modulus of elasticity, E_n, of 100 GN/m^2. Multiplying factors for materials having a different E_n are given in ISO 6621-4. Mean forces are calculated for nominal radial wall thickness (a_1) and mean trapezoidal ring width (h_3).

NOTE 2 For the sole purpose of this part of ISO 6624, the assumed average ratio F_d/F_t is 2,15.

NOTE 3 For measurement of keystone ring width, see ISO 6621-2.

NOTE 4 Columns 1 and 2 of nominal value of ring width, h_1, are the basis for the two columns for h_3 method A and B, for F_t and F_d.

Table 11 — Dimensions of K, KB, KBA, KM, keystone rings 15°

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
70	2,90												11,2	13,9		24,0	29,9	
71	2,95												11,4	14,2		24,5	30,5	
72	3,00										0,20	$^{+0,20}_{0}$	11,6	14,5		24,9	31,2	
73	3,05												11,9	14,8		25,6	31,8	
74	3,10												12,1	15,1		26,0	32,5	
75	3,15												12,2	15,3		26,2	32,9	
76	3,15												11,9	14,9		25,6	32,0	
77	3,20												12,1	15,1		26,0	32,5	
78	3,25					2,097	2,597			1,49			12,3	15,3		26,4	32,9	
79	3,30					0	0			0			12,5	15,7		26,9	33,8	
80	3,35					− 0,029	− 0,029			− 0,11			12,8	16,0		27,5	34,4	
81	3,40												13,0	16,3		28,0	35,0	
82	3,40					For phos-	For phos-			For phos-			12,7	15,9		27,3	34,2	
83	3,45				1,5	phated	phated	2,10	2,60	phated			12,9	16,2		27,7	34,8	
84	3,50					PO surface:	PO surface:			PO surface:	0,25		13,1	16,5		28,2	35,5	
85	3,55												13,3	16,7		28,6	35,9	
86	3,60					+ 0,010	+ 0,010			0,04			13,5	17,0		29,0	36,6	
87	3,65					− 0,029	− 0,029			− 0,11		$^{+0,25}_{0}$	13,7	17,3		29,5	37,2	
88	3,65	± 0,15											13,4	16,9		28,8	36,3	
89	3,70	Within											13,6	17,1		29,2	36,8	
90	3,75	a ring	2,5	3,0									13,7	17,3		29,5	37,2	
91	3,80	0,15 max.											13,9	17,6		29,9	37,8	
92	3,85												14,1	17,8		30,3	38,3	
93	3,90												14,3	18,1		30,7	38,9	
94	3,90												14,0	17,7		30,1	38,1	
95	3,95												14,1	17,9		30,3	38,5	
96	4,00												14,3	18,2		30,7	39,1	
97	4,05												14,5	18,5		31,2	39,8	
98	4,10												14,7	18,7		31,6	40,2	
99	4,15										0,30		14,9	19,0	± 30% if	32,0	40,9	± 30% if

Table 11 (*continued*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
100	4,15												18,5	22,5	$F_t < 10$ N	39,8	48,4	$F_d < 21,5$ N
101	4,20												18,8	22,8		40,4	49,0	
102	4,25												19,0	23,1	± 20 % if	40,9	49,7	± 20% if
103	4,30												19,2	23,3	$F_t \geqslant 10$ N	41,3	50,1	$F_d \geqslant 21,5$ N
104	4,30												18,8	22,9		40,4	49,2	
105	4,35												19,0	23,1		40,9	49,7	
106	4,40												19,2	23,4		41,3	50,3	
107	4,40												18,8	22,9		40,4	4,2	
108	4,45					2,463	2,963			2,05			19,0	23,2		40,9	49,9	
109	4,50					0	0			0			19,2	23,5		41,3	50,5	
110	4,55					− 0,034	− 0,034			− 0,13			19,4	23,6		41,7	50,7	
111	4,55												19,0	23,2		40,9	49,9	
112	4,60		3,0	3,5	2,0	For phos-	For phos-	2,45	2,95	For phos-			19,2	23,4		41,3	50,3	
113	4,65					phated	phated			phated			19,4	23,7		41,7	51,0	
114	4,70					PO surface:	PO surface:			PO surface:		+0,25 0	19,6	24,0		42,1	51,6	
115	4,70	± 0,20											19,2	23,5		41,3	50,5	
116	4,75	Within				+ 0,010	+ 0,010			0,04			19,4	23,7		41,7	51,0	
117	4,80	a ring:				− 0,034	− 0,034			− 0,13			19,6	24,0		42,1	51,6	
118	4,80	0,20 max.											19,2	23,5		41,3	50,5	
119	4,85										0,35		19,4	23,8		41,7	51,2	
120	4,90												19,6	24,0		42,1	51,6	
121	4,95												19,8	24,3		42,6	52,2	
122	4,95												19,4	23,8		41,7	51,2	
123	5,00												19,6	24,1		42,1	51,8	
124	5,05												19,8	24,3		42,6	52,2	
125	5,05												23,9	28,3		51,4	60,8	
126	5,10												24,1	28,6		51,8	61,5	
127	5,15												24,3	28,9		52,2	62,1	
128	5,20												24,6	29,2		52,9	62,8	
129	5,20												24,1	28,7		51,8	61,7	

Table 11 (*continued*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
130	5,25												24,3	28,9		52,2	62,1	
131	5,30												24,5	29,2		52,7	62,8	
132	5,30												24,1	28,7		51,8	61,7	
133	5,35												24,3	28,9		52,2	62,1	
134	5,40												24,5	29,2		52,7	62,8	
135	5,40					2,830	3,330			2,61			24,1	28,7		51,8	61,7	
136	5,45					0	0			0			24,4	29,0		52,5	62,4	
137	5,50					− 0,034	− 0,034			− 0,13			24,6	29,3		52,9	63,0	
138	5,50												24,2	28,8		52,0	61,9	
139	5,55					For phosphated PO surface:	For phosphated PO surface:	2,8	3,3	For phosphated PO surface:			24,4	29,1		52,5	62,6	
140	5,60											$^{+0,25}_{0}$	24,6	29,3		52,9	63,0	
141	5,65												24,8	29,6		53,3	63,6	
142	5,65		3,5	4,0	2,5						0,40		24,4	29,1		52,5	62,6	
143	5,70					+ 0,010	+ 0,010			+ 0,04			24,6	29,4		52,9	63,2	
144	5,75					− 0,034	− 0,034			− 0,13			24,8	29,6		53,3	63,6	
145	5,75												24,4	29,2	± 30 % if	52,5	62,8	± 30 % if
146	5,80												24,6	29,4	F_t < 10 N	52,9	63,2	F_d < 21,5 N
147	5,85												24,8	29,7		53,3	63,9	
148	5,85												24,4	29,2	± 20% if	52,5	62,8	± 20 % if
149	5,90												24,6	29,5	$F_t \geqslant$ 10 N	52,9	63,4	$F_d \geqslant$ 21,5 N
150	5,95												24,7	29,5		53,1	63,4	
152	6,00												24,5	29,3		52,7	63,0	
154	6,05												24,3	29,1		52,2	62,6	
155	6,10												24,5	29,4		52,7	63,2	
156	6,15												24,7	29,6		53,1	63,6	
158	6,20												24,5	29,4		52,7	63,2	
160	6,25	± 0,20										$^{+0,30}_{0}$	24,3	29,2		52,2	62,8	
162	6,35	Within											24,6	29,7		52,9	63,9	
164	6,40	a ring:									0,50		24,5	29,5		52,7	63,4	
165	6,40	$0,2_{\ max}$											24,1	29,1		51,8	62,6	
166	6,45												24,3	29,3		52,2	63	
168	6,50												24,1	29,1		51,8	62,6	

Table 11 (*concluded*)

Dimensions in millimetres

Nominal diameter	Radial wall thickness		Nominal value of ring width		Keystone ring width						Closed gap		Tangential force F_t [N]			Diametral force F_d [N]		
					Method A			Method B										
						Measured value				Measured value								
d_1	a_1		h_1		a_6	h_3		h_3			s_1		h_1			h_1		
		Tolerance	1	2		1	2	1	2	a_6		Tolerance	1	2	Tolerance	1	2	Tolerance
170	6,60												29,5	34,5		63,4	74,2	
172	6,65												29,3	34,3		63	73,7	
174	6,70												29,1	34,1		62,6	73,3	
175	6,75												29,2	34,2		62,8	73,5	
176	6,80												29,4	34,4		63,2	74,0	
178	6,85					3,191	3,691			2,98			29,2	34,2		62,8	73,5	
180	6,90					0	0			0			29,0	34,0		62,4	73,1	
182	6,95					− 0,039	− 0,039			− 0,15			28,8	33,9		61,9	72,9	
184	7,05												29,2	34,3		62,8	73,7	
185	7,05					For phos-	For phos-			For phos-		$^{+0,30}_{0}$	28,8	33,9		61,9	72,9	
186	7,10		4,0	4,5	3,0	phated	phated			phated			29,0	34,1		62,4	73,3	
188	7,15					PO surface:	PO surface:	3,2	3,7	PO surface:	0,60		28,8	33,9		61,9	72,9	
190	7,20												28,7	33,7		61,7	72,5	
192	7,25					+ 0,010	+ 0,010			0,04			28,5	33,6		61,3	72,2	
194	7,35					− 0,039	− 0,039			− 0,15			28,8	34		61,9	73,1	
195	7,35												28,5	33,6		61,3	72,2	
196	7,40												28,7	33,8		61,7	72,7	
198	7,45												28,5	33,6		61,3	72,2	
200	7,50												28,3	33,4		60,8	71,8	

For intermediate sizes (e.g. repair sizes), the radial wall thickness of the next smaller nominal diameter should be applied.

NOTE 1 The values for F_t and F_d given in Table 11 apply to grey cast iron with a typical modulus of elasticity (E_n) of 100 GN/m^2. Multiplying factors for materials having a different E_n are given in ISO 6621-4. Mean forces are calculated for nominal radial wall thickness (a_1) and mean trapezoidal ring width (h_3).

NOTE 2 For the sole purpose of this part of ISO 6624, the assumed average ratio F_d/F_t is 2,15.

NOTE 3 For measurement of keystone ring width, see ISO 6621-2.

NOTE 4 Columns 1 and 2 of nominal value of ring width, h_1, are the basis for the two columns for h_3 method A and B, for F_t and F_d.

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2) To be published. (Revision of ISO 6621-2:1984)

3) To be published. (Revision of ISO 6622-1:1986)

4) To be published. (Revision of ISO/TR 6622-2:1988)

5) To be published. (Revision of 6623:1986)

6) To be published.

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