INTERNATIONAL STANDARD

ISO 6624-2

Second edition
2016-02-15

Internal combustion engines — Piston rings —

Part 2: Half keystone rings made of cast iron

Moteurs à combustion interne — Segments de piston —

Partie 2: Segments demi-trapézoïdaux fabriqués en fonte moulée

Reference number
ISO 6624-2:2016(E)

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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.

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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 34, *Propulsion, powertrain and powertrain fluids*.

This second edition cancels and replaces the first edition (ISO 6624-2:2003), 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,[2][3][4][5] ISO 6622,[6][7] ISO 6623,[8] ISO 6625,[9] ISO 6626,[10][11][12] and ISO 6627.[13]

Internal combustion engines — Piston rings —

Part 2:
Half keystone rings made of cast iron

1 Scope

This part of ISO 6624 specifies the essential dimensional features of half keystone rings made of cast iron, types HK, HKB and HKBA, having nominal diameters from 38 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.

ISO 6621-4, *Internal combustion engines — Piston rings — Part 4: General specifications*

3 Overview

The half keystone ring types are specified in Tables 1 and 2 and Figures 1 to 3. Their common features and the dimensions of those features are specified in Tables 3 and 4 and Figures 4 to 9. Tables 5 and 6 give the force factors for the different ring types, while Table 7 gives the dimensions and forces of half keystone rings.

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 shall 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 selection.

4 Ring types and designation examples

NOTE For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see ISO 6621-2).

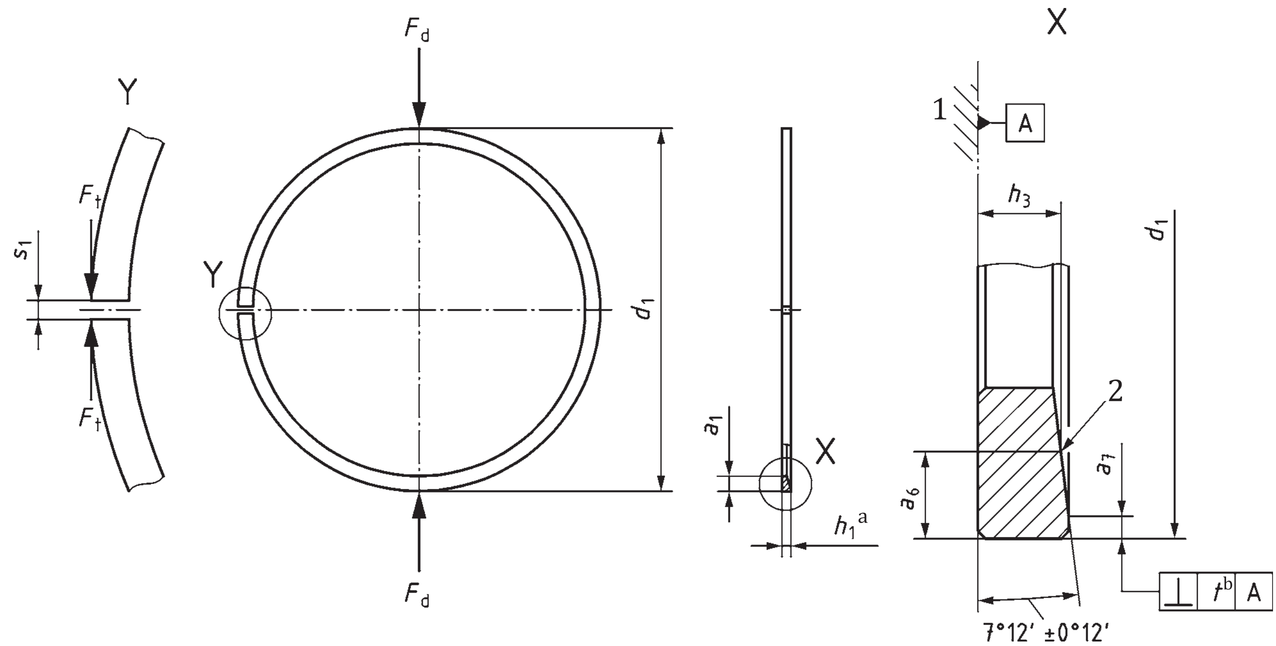
4.1 Type HK — Straight faced half keystone ring 7°

4.1.1 General features

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

See Table 7 for dimensions and forces.

h_3 values are calculated based on Annex A.



Key

1 reference plane (ring is positioned flat against datum A)

2 top side identification mark

a Nominal.

b $t = 0{,}006 \times h_1$.

Figure 1 — Type HK

4.1.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-2, being a 7° half keystone ring made of cast iron, with a straight-faced peripheral surface (HK), of d_1 = 90 mm (90), of nominal ring width h_1 = 1,5 mm (1,5), made of heat treated martensitic spheroidal graphite cast iron, subclass 53 (MC53), and having a chromium plated peripheral surface with a minimum thickness 0,1 mm (CR2). Parameters in parenthesis are used in the ISO ring designation:

Piston ring ISO 6624-2 HK - 90 × 1,5 - MC53/CR2

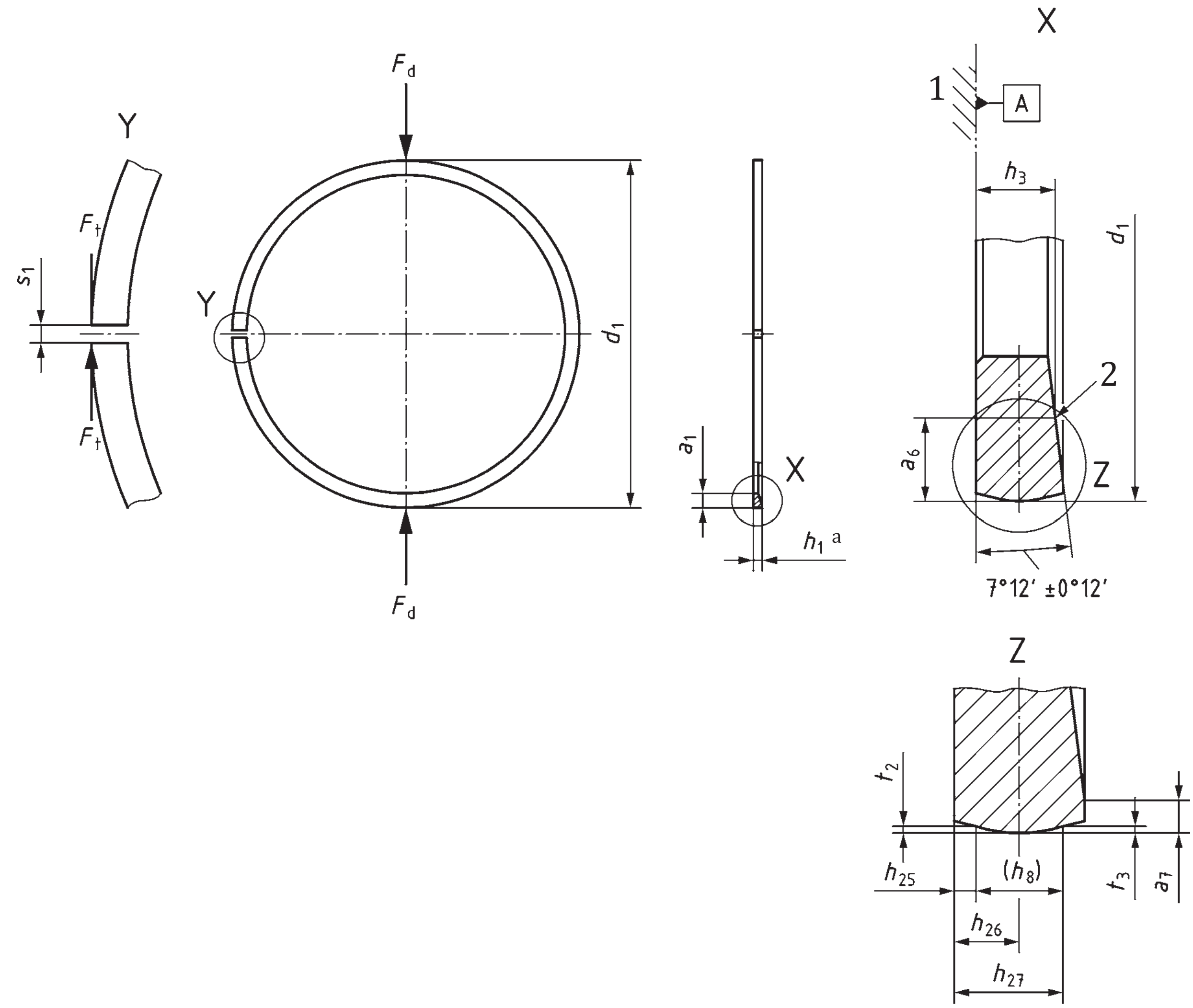
4.2 Type HKB — Barrel faced half keystone ring 7°

4.2.1 General features

Figure 2 shows the general features of piston ring type HKB.

See Table 7 for dimensions and forces.

h_3 values are calculated based on Annex A.



Key

1 reference plane (ring is positioned flat against datum A)

2 top side identification mark

a Nominal.

Figure 2 — Type HKB

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]
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 the manufacturer and the customer.

4.2.2 Designation

EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-2, being a 7° half keystone ring made of cast iron, with a barrel faced peripheral surface (HKB), of d_1 = 90 mm (90), of nominal ring width h_1 = 1,5 mm (1,5), made of non-heat-treated grey cast iron, subclass 12 (MC12), and having a chromium plated peripheral surface with a minimum thickness of 0,1 mm (CR2). Parameters in parenthesis are used in the ISO ring designation:

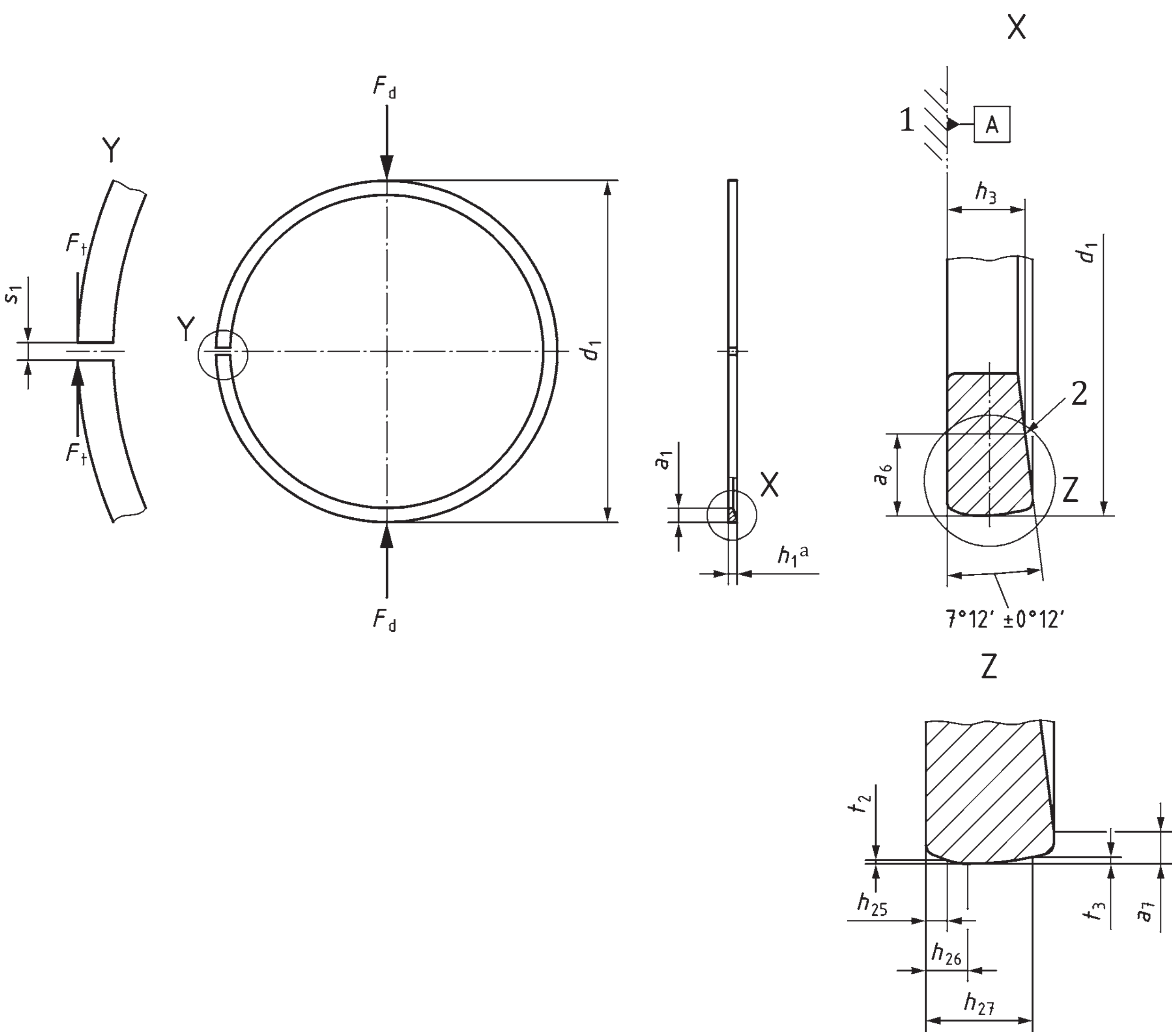
Piston ring ISO 6624-2 HKB - 90 × 1,5 - MC12/CR2

4.3 Type HKBA — Asymmetrical barrel faced half keystone ring 7°(h_1 ≥ 1,2 mm)

4.3.1 General features

See Table 7 for dimensions and forces.

h_3 values are calculated based on Annex A.



Key

1 reference plane (ring is positioned flat against datum A)

2 top side identification mark

a Nominal.

Figure 3 — Type HKBA

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	0,28	0,43	±0,15	0,90	0…0,005	0,005…0,016
1,5	0,35	0,50		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 the manufacturer and the customer.

4.3.2 Designation

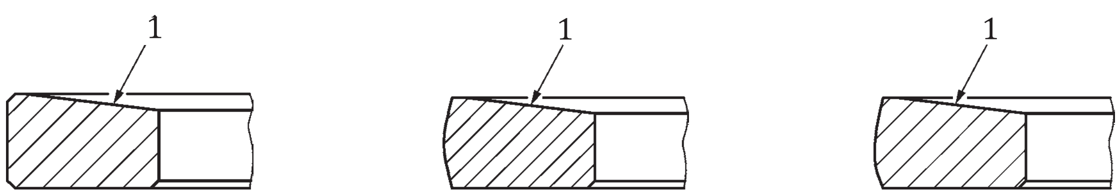
EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-2, being a 7° half keystone ring made of cast iron, with an asymmetrical barrel faced peripheral surface (HKBA), of d_1 = 90 mm (90), of nominal ring width h_1 = 1,5 mm (1,5), made of non-heat-treated grey cast iron, subclass 12 (MC12), and having a chromium plated peripheral surface with a minimum thickness of 0,1 mm (CR2). Parameters in parenthesis are used in the ISO ring designation:

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

5 Common features

5.1 Type HK, HKB and HKBA — Half keystone ring

5.1.1 Uncoated rings



a) Type HK **b) Type HKB** **c) Type HKBA**

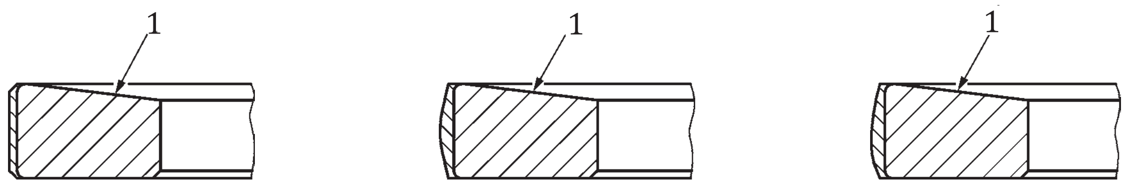
Key

1 top side identification mark

Figure 4 — Uncoated rings

5.1.2 Chromium plated or spray coated rings

5.1.2.1 Fully faced



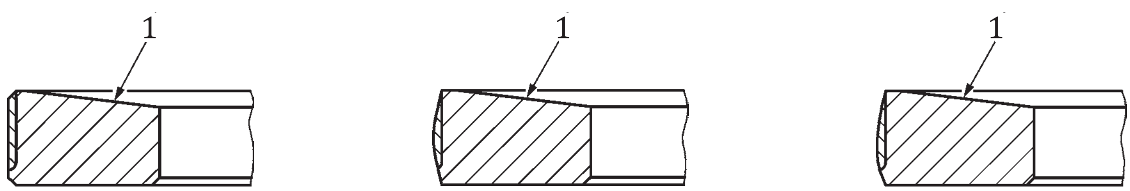
a) Type HK **b) Type HKB** **c) Type HKBA**

Key

1 top side identification mark

Figure 5 — Fully faced rings

5.1.2.2 Semi-inlaid



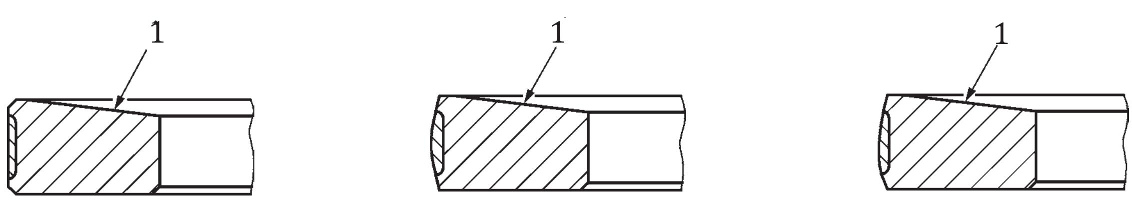
a) Type HK **b) Type HKB** **c) Type HKBA**

Key

1 top side identification mark

Figure 6 — Semi-inlaid rings

5.1.2.3 Inlaid (not recommended for chromium plated rings)



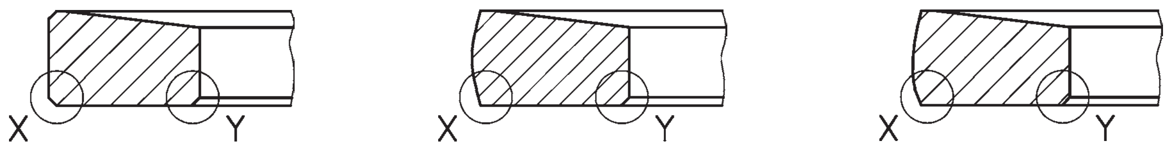
a) Type HK **b) Type HKB** **c) Type HKBA**

Key

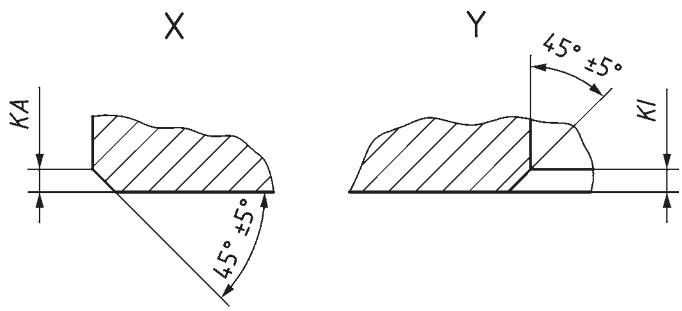
1 top side identification mark

Figure 7 — Inlaid rings

5.2 Chamfered edges — Type HK, HKB and HKBA rings — Outside and/or inside chamfered edges (KA, KI)



a) HK rings **b) HKB rings** **c) HKBA rings**



d) Chamfered edges

Key

1 top side identification mark

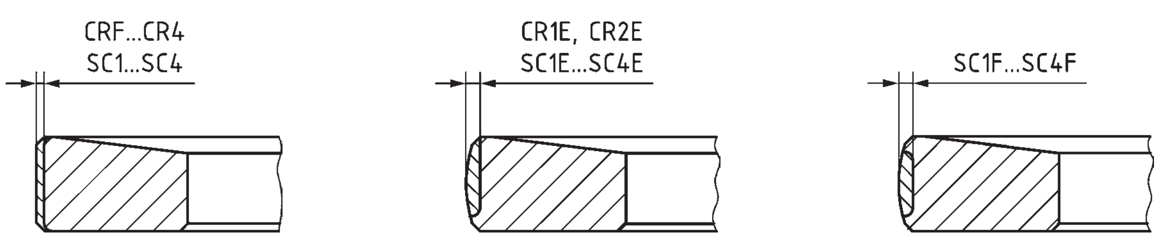
Figure 8 — Details of chamfered edges (KA, KI)

Table 3 — KA and KI dimensions

Dimensions in millimetres

d_1	**KA**	**KI**
$38 \le d_1 < 50$	0,2 max.	0,2 max.
$50 \le d_1 < 125$	0,3 ± 0,1	0,3 ± 0,15
$125 \le d_1 \le 160$	0,4 ± 0,1	0,4 ± 0,15

5.3 Type HK, HKB and HKBA rings (fully faced, semi-inlaid) — Plating/coating thickness



a) Fully faced **b) Semi-inlaid** **c) Inlaid**

Figure 9 — Plating/coating thickness

Table 4 — 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[a]	**SC3**[a]	0,15
CR4[a]	**SC4**[a]	0,20

[a] Not recommended for rings $h_1 \leq 1{,}5$.

6 Force factors

The tangential and diametral forces given in Table 7 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, multiplier correction factors given in Tables 5 and 6 and the force correction factors specified in ISO 6621-4 shall be used.

Table 5 — Force correction factors for HK, HKB and HKBA rings with features KA or KI

Factor	
KA	**KI**
0,98	0,98

Table 6 — Force correction factors for chromium plated and spray coated HK, HKB and HKBA rings (fully faced, semi-inlaid and inlaid type)

d_1 mm	Factor					
	CRF	**CR1**	**CR2/SC1**	**CR3/SC2**	**CR4/SC3**	**SC4**
$38 \leq d_1 < 50$	1	0,81	0,70	0,64	—	—
$50 \leq d_1 < 75$	1	0,90	0,85	0,81	0,75	0,71
$75 \leq d_1 < 100$	1	0,92	0,88	0,85	0,81	0,77
$100 \leq d_1 < 125$	1	0,94	0,91	0,88	0,86	0,83
$125 \leq d_1 \leq 160$	1	0,95	0,92	0,90	0,88	0,85

7 Dimensions and forces

See Table 7.

Table 7 — Dimensions and forces of HK, HKB and HKBA half keystone rings

Dimensions in millimetres

Nominal diameter d_1	Radial wall thickness a_1		Nominal value of ring width h_1					a_6	a_7	Method A: Measured value, h_3 [a b]						Method B: h_3 (ref.)					Method B: Measured value [b]	
			Column					Ref.		For h_1 shown in column						Column					a_6	
		Tolerance	1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5		Tolerance
38	1,6	±0,15 Within a ring: 0,15 max.	1,2	—	—	—	—	0,6	0,5 max.	1,169	—	—	—	—	$^{0}_{-0,024}$ For phos-phated PO surface: $^{+0,01}_{-0,024}$	1,16	—	—	—	—	0,69	$^{-0}_{0,19}$ For phos-phated PO surface: $^{+0,08}_{-0,19}$
39	1,65																					
40	1,65							0,8		1,143						1,13					0,90	
41	1,7																					
42	1,75																					
43	1,8																					
44	1,85																					
45	1,9																					
46	1,9																					
47	1,95																					
48	2																					
49	2,05																					
50	2,1			1,5				1,0		1,118	1,418					1,11	1,41				1,10	
51	2,15																					
52	2,15																					
53	2,2																					
54	2,25																					
55	2,3																					
56	2,35																					
57	2,4																					
58	2,4																					
59	2,45																					
60	2,5								0,6 max.	1,116	1,416					1,10	1,40				1,09	
61	2,55																					
62	2,6																					
63	2,65																					
64	2,65																					
65	2,7																					
66	2,75																					
67	2,8																					
68	2,85																					
69	2,9																					
70	2,9				1,75	2,0		1,5	0,7 max.	1,053	1,353	1,603	1,853			1,04	1,34	1,59	1,84		1,60	
71	2,95																					
72	3																					
73	3,05																					

Table 7 — (*continued*)

Closed gap		Tangential force F_t N						Diametral force F_d N						Nominal diameter
s_1	Tolerance	For h_1 shown in column					Tolerance	For h_1 shown in column					Tolerance	d_1
		1	2	3	4	5		1	2	3	4	5		
0,15	$^{+0,2}_{0}$	—	—	—	—	—	±30 % if F_t < 10 N ±20 % if F_t ≥ 10 N	7,3	—	—	—	—	±30 % if F_d < 21,5 N ±20 % if F_d ≥ 21,5 N	38
								7,7						39
		—	—					7,3	—					40
								7,5						41
								8,0						42
								8,4						43
								8,6						44
		—	—					8,8	—					45
								8,4						46
								8,6						47
								8,8						48
								9,2						49
		4,4	5,6					9,5	12,0					50
		4,5	5,8					9,7	12,5					51
		4,3	5,5					9,2	11,8					52
		4,5	5,8					9,7	12,5					53
		4,6	5,9					9,9	12,7					54
		4,7	6,1					10,1	13,1					55
		4,8	6,2					10,3	13,3					56
		5,0	6,4					10,8	13,8					57
		4,8	6,2					10,3	13,3					58
		4,9	6,3					10,5	13,5					59
0,2		5,0	6,5					10,8	14,0					60
		5,2	6,6					11,2	14,2					61
		5,3	6,8					11,4	14,6					62
		5,4	7,0					11,6	15,1					63
		5,2	6,7					11,2	14,4					64
		5,3	6,9					11,4	14,8					65
		5,4	7,0					11,6	15,1					66
		5,6	7,2					12,0	15,5					67
		5,7	7,4					12,3	15,9					68
		5,8	7,5					12,5	16,1					69
		5,6	7,3	8,6	10,0			12,0	15,7	18,5	21,5			70
		5,8	7,5	8,9	10,3			12,5	16,1	19,1	22,1			71
		5,9	7,6	9,1	10,5			12,7	16,3	19,6	22,6			72
		6,0	7,8	9,2	10,7			12,9	16,8	19,8	23,0			73

Table 7 — (*continued*)

Nominal diameter d_1	Radial wall thickness a_1		Nominal value of ring width h_1					a_6	a_7	Method A						Method B						
			Column					Ref.		Measured value, h_3 [a,b] For h_1 shown in column						h_3 (ref.) Column					Measured value[b] a_6	
		Tolerance	1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5		Tolerance
74	3,1																					
75	3,15																					
76	3,15																					
77	3,2																					
78	3,25																					
79	3,3																					
80	3,35																					
81	3,4		1,2				—	1,5		1,053	1,353	1,603	1,853	—		1,04	1,34	1,59	1,84	—	1,60	
82	3,4																					
83	3,45																					
84	3,5																					
85	3,55	± 0,15													-0 0,024							0 -0,19
86	3,6	Within a		1,5	1,75	2,0									For phos - phated PO surface:							For phos - phated PO surface:
87	3,65	ring:																				
88	3,65	0,15 max.													+0,01 -0,024							+0,08 -0,19
89	3,7																					
90	3,75																					
91	3,8																					
92	3,85								0,7 max.													
93	3,9																					
94	3,9		—				2,5			—	1,289	1,539	1,789	2,289		—	1,28	1,53	1,78	2,28		
95	3,95																					
96	4																					
97	4,05																					
98	4,1																					
99	4,15																					
100	4,15							2,0													2,07	
101	4,2																					
102	4,25																					
103	4,25	±0,20																				
104	4,3	Within a	1,75	2,0	2, 5	3,0	—			1,539	1,789	2,289	2,789	—		1,53	1,78	2,28	2,78	—		
105	4,35	ring:													0							0
106	4,4	0,20 max.													-0,029							-0,23
107	4,4														For phos - phated PO surface:							For phos - phated PO surface:
108	4,45														+ 0,01							+0,08
109	4,5														- 0,029							-0,23

Table 7 — (*continued*)

Closed gap		Tangential force F_t N						Diametral force F_d N						Nominal diameter
s_1	Tolerance	For h_1 shown in column					Tolerance	For h_1 shown in column					Tolerance	d_1
		1	2	3	4	5		1	2	3	4	5		
0,2	$^{+0,2}_{0}$	6,1	7,9	9,4	10,9			13,1	17,0	20,2	23,4			74
		6,2	8,0	9,5	11,1			13,3	17,2	20,4	23,9			75
		6,0	7,8	9,3	10,8			12,9	16,8	20,0	23,2			76
		6,2	8,0	9,5	11,1			13,3	17,2	20,4	23,9			77
		6,3	8,1	9,7	11,2			13,5	17,4	20,9	24,1			78
		6,4	8,3	9,8	11,4			13,8	17,8	21,1	24,5			79
		6,4	8,4	10,0	11,6			13,8	18,1	21,5	24,9			80
		6,6	8,6	10,3	11,9	—		14,2	18,5	22,1	25,6	—		81
0,25		6,4	8,4	10,0	11,6			13,8	18,1	21,5	24,9			82
		6,5	8,5	10,1	11,8			14,0	18,3	21,7	25,4			83
		6,6	8,6	10,3	12,0			14,2	18,5	22,7	25,8			84
		6,8	8,8	10,5	12,3			14,6	18,9	22,6	26,4			85
		6,8	8,9	10,7	12,4			14,6	19,1	23,0	26,7			86
		6,9	9,1	10,9	12,6			14,8	19,6	23,4	27,1			87
		6,8	8,9	10,6	12,3			14,6	19,1	22,8	26,4			88
		6,9	9,0	10,8	12,6			14,8	19,4	23,2	27,1			89
			9,1	10,9	12,7	16,3	±30 % if F_t < 10 N		19,6	23,4	27,3	35,0	±30 % if F_d < 21,5 N	90
			9,2	11,0	12,9	16,5			19,8	23,7	27,7	35,5		91
	$^{+0,25}_{0}$	—	9,4	11,2	13,1	16,8	±20 % if F_t ≥ 10 N	—	20,2	24,1	28,2	36,1	±20 % if F_d ≥ 21,5 N	92
			9,5	11,4	13,3	17,1			20,4	24,5	28,6	36,8		93
			9,3	11,1	13,0	16,7			20,0	23,9	28,0	35,9		94
			9,5	11,3	13,2	17,0			20,4	24,3	28,4	36,6		95
			9,6	11,5	13,5	17,3			20,6	24,7	29,0	37,2		96
		—	9,7	11,7	13,6	17,5		—	20,9	25,2	29,2	37,6		97
			9,9	11,9	13,9	17,8			21,3	25,6	29,9	38,3		98
			10,0	12,0	14,0	18,0			21,5	25,8	30,1	38,7		99
0,3		11,8	13,7	17,7	21,6			25,3	29,5	38,1	46,4			100
		11,9	13,9	17,9	21,9			25,6	29,9	38,5	47,1			101
		12,1	14,1	18,2	22,3			26,0	30,3	39,1	47,9			102
		12,2	14,3	18,4	22,5			26,3	30,7	39,6	48,4			103
		12,0	14,0	18,1	22,1	—		25,8	30,1	38,9	47,5	—		104
		12,1	14,2	18,3	22,3			26,0	30,5	39,3	47,9			105
		12,2	14,3	18,5	22,6			26,3	30,7	39,8	48,6			106
		12,0	14,0	18,1	22,2			25,8	30,1	38,9	47,7			107
		12,1	14,2	18,3	22,4			26,1	30,5	39,3	48,2			108
		12,2	14,3	18,5	22,7			26,3	30,7	39,8	48,8			109

Table 7 — (*continued*)

Nominal diameter	Radial wall thickness		Nominal value of ring width							Method A						Method B						
d_1	a_1		h_1					a_6	a_7	**Measured value**, h_3[a,b]						h_3 (ref.)					**Measured value**[b]	
			Column					Ref.		For h_1 shown in column						Column					a_6	
		Tolerance	1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5		Tolerance
110	4,55	±0,20 Within a ring: 0,20 max.	—	2,0	2,5	3,0	3,5	2,0	0,7 max.	—	1,789	2,289	2,789	3,289	0 -0,029 For phos-phated PO surface: + 0,01 - 0,029	—	1,78	2,28	2,78	3,28	2,07	0 -0,23 For phos-phated PO surface: +0,08 -0,23
111	4,55																					
112	4,6																					
113	4,65																					
114	4,7																					
115	4,7																					
116	4,75																					
117	4,8																					
118	4,85																					
119	4,85																					
120	4,9																					
121	4,95																					
122	4,95																					
123	5																					
124	5,05																					
125	5,05																					
126	5,1																					
127	5,15																					
128	5,2																					
129	5,2																					
130	5,25			—							—						—					
131	5,3																					
132	5,3																					
133	5,35																					
134	5,4																					
135	5,4																					
136	5,45																					
137	5,5																					
138	5,5																					
139	5,55																					
140	5,6																					
141	5,65																					
142	5,65																					
143	5,7																					
144	5,75																					
145	5,75																					
146	5,8																					
147	5,85																					

Table 7 — (*continued*)

Closed gap		Tangential force F_t N						Diametral force F_d N						Nominal diameter
s_1	Tolerance	For h_1 shown in column					Tolerance	For h_1 shown in column					Tolerance	d_1
		1	2	3	4	5		1	2	3	4	5		
			14,5	18,7	22,9	27,1			31,2	40,2	49,2	58,3		110
			14,2	18,4	22,5	26,6			30,5	39,6	48,4	57,2		111
		—	14,4	18,6	22,8	27,0		—	31,0	40,0	49,0	58,1		112
			14,6	18,8	23,1	27,3			31,4	40,4	49,7	58,7		113
			14,7	19,1	23,4	27,7			31,6	41,1	50,3	59,6		114
			14,5	18,7	23,0	27,2			31,2	40,2	49,5	58,5		115
			14,6	18,9	23,1	27,4			31,4	40,6	49,7	58,9		116
		—	14,8	19,1	23,4	27,8		—	31,8	41,1	50,3	59,8		117
			14,5	18,7	23,0	27,2			31,2	40,2	49,5	58,5		118
0,35			14,7	19,0	23,3	27,6			31,6	40,9	50,1	59,3		119
			14,8	19,2	23,6	28,0			31,8	41,3	50,7	60,2		120
			15,0	19,5	23,9	28,3			32,3	41,9	51,4	60,8		121
		—	14,7	19,1	23,5	27,8		—	31,6	41,1	50,5	59,8		122
			14,9	19,3	23,8	28,2			32,0	41,5	51,2	60,6		123
			15,0	19,5	23,9	28,4			32,3	41,9	51,4	61,1		124
			14,7	19,1	23,5	27,9			31,6	41,1	50,5	60,0		125
			14,9	19,4	23,8	28,2			32,0	41,7	51,2	60,6		126
		—	15,1	19,6	24,1	28,6	±30 % if F_t < 10 N	—	32,5	42,1	51,8	61,5	±30 % if F_d < 21,5 N	127
	$_{0}^{\pm 0,25}$		15,3	19,8	24,4	29,0			32,9	42,6	52,5	62,4		128
			15,0	19,5	24,0	28,4			32,3	41,9	51,6	61,1		129
				19,6	24,2	28,7	±20 % if F_t ≥ 10 N			42,2	51,9	61,7	±20 % if F_d ≥ 21,5 N	130
				19,9	24,4	29,0				42,7	52,6	62,4		131
		—	—	19,5	24,0	28,5		—	—	41,9	51,6	61,3		132
				19,7	24,2	28,7				42,3	52,0	61,7		133
				19,9	24,5	29,1				42,8	52,7	62,6		134
				19,5	24,1	28,6				42,0	51,7	61,5		135
				19,8	24,4	28,9				42,5	52,4	62,1		136
		—	—	20,0	24,6	29,3		—	—	43,0	53,0	63,0		137
0,4				19,6	24,2	28,8				42,2	52,1	61,9		138
				19,9	24,5	29,1				42,7	52,7	62,6		139
				20,1	24,7	29,4				43,1	53,2	63,2		140
				20,2	25,0	29,7				43,5	53,7	63,9		141
		—	—	19,9	24,5	29,2		—	—	42,8	52,7	62,8		142
				20,1	24,8	29,5				43,1	53,3	63,4		143
				20,3	25,1	29,8				43,7	53,9	64,1		144
				20,0	24,6	29,3				42,9	53,0	63,0		145
		—	—	20,1	24,9	29,6		—	—	43,3	53,5	63,6		146
				20,3	25,1	29,9				43,7	54,0	64,3		147

Table 7 — (*continued*)

Nominal diameter	Radial wall thickness		Nominal value of ring width							Method A						Method B						
d_1	a_1		h_1					a_6	a_7	**Measured value**, h_3[ab]						h_3 (ref.)					**Measured value**[b]	
			Column					Ref.		For h_1 shown in column						Column					a_6	
		Tolerance	1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5		Tolerance
148	5,85	±0,20 Within a ring: 0,20 max.	—	—	2,5	3,0	3,5	2,0	0,7 max.	—	—	2,289	2,789	3,289	0 −0,029 For phosphated PO surface: +0,01 -0,029	—	—	2,28	2,78	3,28	2,07	0 −0,23 For phosphated PO surface: +0,08 −0,23
149	5,9																					
150	5,95				—							—						—				
151	5,95																					
152	6																					
153	6																					
154	6,05																					
155	6,1																					
156	6,15																					
157	6,15																					
158	6,2																					
159	6,2																					
160	6,25																					

Table 7 — (*continued*)

Closed gap		Tangential force F_t N						Diametral force F_d N						Nominal diameter d_1
s_1	Tolerance	For h_1 shown in column					Tolerance	For h_1 shown in column					Tolerance	
		1	2	3	4	5		1	2	3	4	5		
0,4	$^{+0,25}_{0}$	—	—	20,0	24,8	29,5	±30 % if F_t < 10 N ±20 % if F_t ≥ 10 N	—	—	43,1	53,2	63,4	±30 % if F_d < 21,5 N ±20 % if F_d ≥ 21,5 N	148
				20,2	25,0	29,8				43,5	53,7	64,1		149
0,5	$^{+0,3}_{0}$	—	—	—	25,0	29,8		—	—	—	53,9	64,1		150
					25,0	29,8					53,9	64,1		151
					24,9	29,7					53,6	63,9		152
					24,9	29,7					53,6	63,9		153
					24,8	29,5					53,3	63,4		154
		—	—	—	25,0	29,8		—	—	—	53,8	64,1		155
					25,3	30,1					54,3	64,7		156
					25,3	30,1					54,3	64,7		157
					25,1	30,0					54,1	64,5		158
					25,1	30,0					54,1	64,5		159
		—	—	—	25,0	29,8		—	—	—	53,8	64,1		160

NOTE 1 For intermediate sizes (for example repair sizes), the radial wall thickness of the next smaller nominal diameter should be applied.

NOTE 2 The values for F_t and F_d, given in Table 6, 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 modulus of elasticity (E_n) are given in ISO 6621-4. Mean forces are calculated for nominal radial wall thickness (a_1) and mean ring width (h_1).

NOTE 3 For the sole purpose of this part of ISO 6624, the assumed average ratio F_d/F_t is 2,15. However, for rings up to 50 mm, the ratio F_d/F_t shall be determined between manufacturer and customer.

[a] h_3 values are calculated based on Annex A.

[b] These tolerances are based on single keystone machined rings.

Annex A
(normative)

Calculation of measurement width h$_3$ of half keystone rings

The measurement width, h_3, as defined in DIN is calculated according to Formula (A.1):

$$h_3 = (h_1 + 0{,}05) - a_6 \cdot \tan 7{,}2° \quad \text{(A.1)}$$

As the dimensioning of keystone rings in the ISO standard differs significantly from the dimensioning according to the old DIN standard and the tolerance values in the ISO standard have been increased, a correction value (h_{3k}) for the accurately calculated measurement width h$_3$ has been introduced to ensure continued compatibility of the rings according to the ISO standards. Therefore, the measurement width, h_3, as defined in ISO is calculated according to Formula (A.2):

$$h_3 = (h_1 + 0{,}05) - a_6 \cdot \tan 7{,}2° - h_{3k} \quad \text{(A.2)}$$

The correction value, h_{3k}, is dependent on the nominal diameter, d_1 (see Table A.1):

Table A.1 — Correction value

Nominal diameter d_1 [mm]	**Correction value** h_{3k}
$d_1 < 60$	0,005 5
$60 \le d_1 < 90$	0,007 5
$90 \le d_1 \le 160$	0,008 5

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1) To be published (revision of ISO 6626:1989).

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