
**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



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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6624-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

This first edition of ISO 6624-2 cancels and replaces ISO/TR 6624-2:1988, 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]} and ISO 6627^[12].

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 selection.

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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 and HKB, having diameters of from 38 mm up to and including 160 mm, used in reciprocating internal combustion piston engines.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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 Table 1 and Figures 1 and 2. Their common features and the dimensions of those features are specified in Tables 2 and 3 and Figures 3 to 8. Tables 4 and 5 give the force factors for the different ring types, while Table 6 gives the dimensions and forces of half keystone rings.

4 Ring types and designation examples

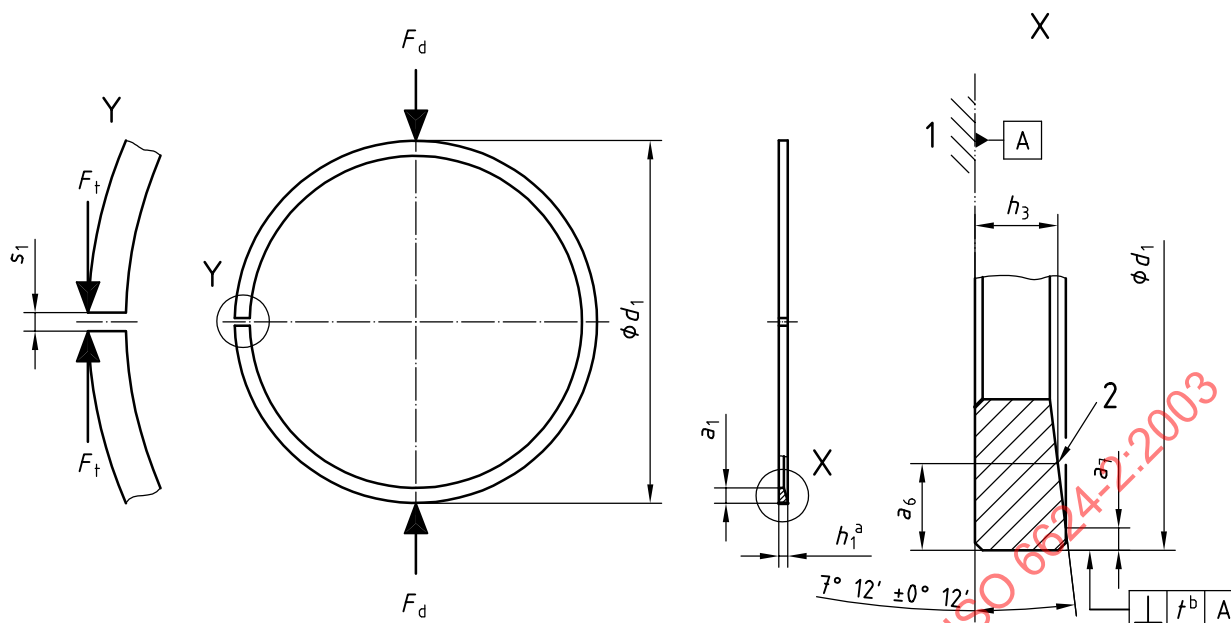
NOTE For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see ISO 6621-2).

4.1 Type HK — Straight faced half keystone ring 7°

4.1.1 General features

See Table 6 for dimensions and forces.

h_3 values are calculated based on $h_1 + 0,05$ mm.



Key

- 1 reference plane
- 2 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):

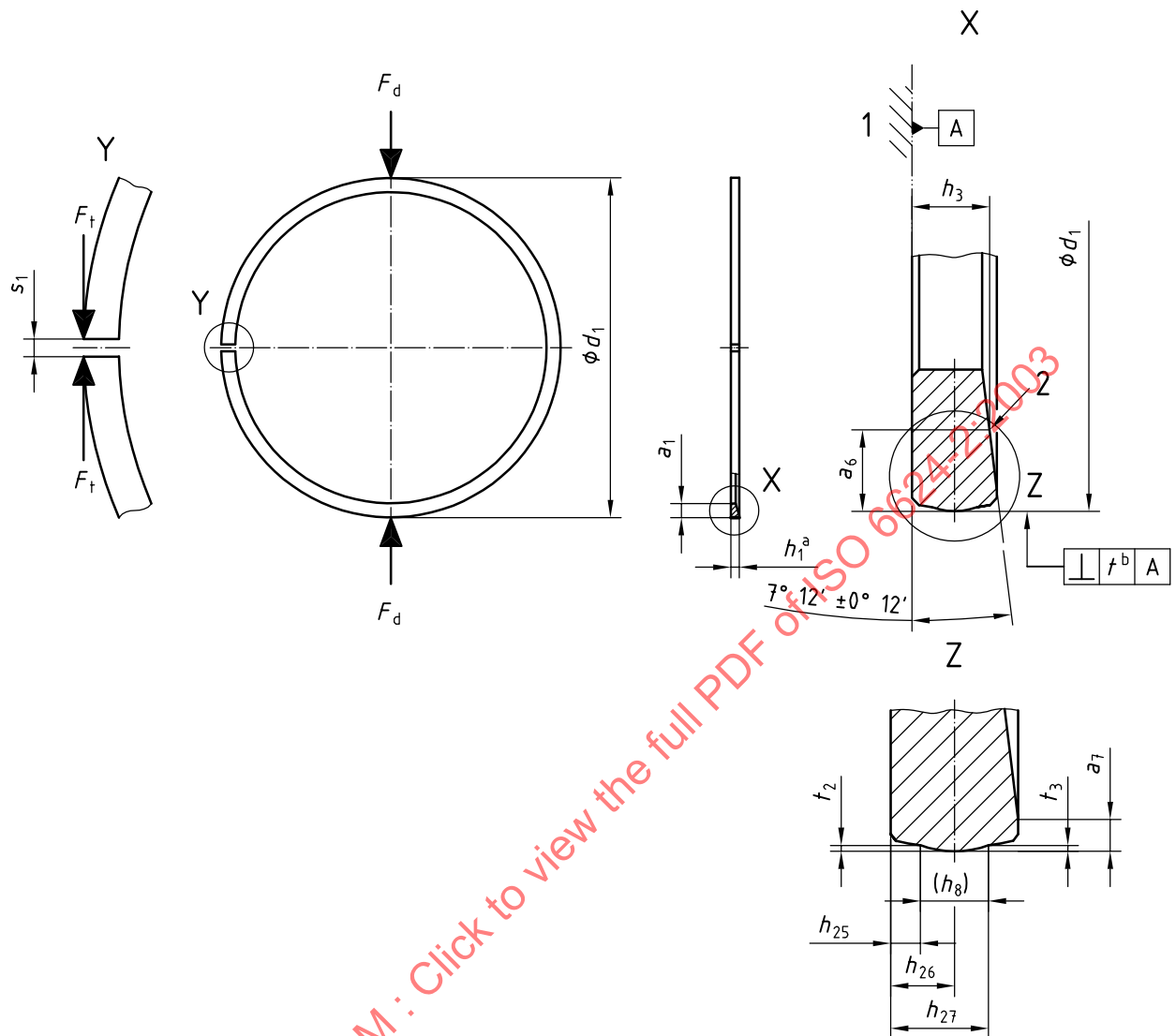
Piston ring ISO 6624-2 HK - 90 × 1,5 - MC53/CR2

4.2 Type HKB — Barrel faced half keystone ring 7°

4.2.1 General features

See Table 6 for dimensions and forces.

h_3 values are calculated based on $h_1 + 0,05$ mm.



Key

1 reference plane

2 mark

a Nominal.

b $t = 0,006 \times h_1$

Figure 2 — Type HKB

Table 1 — Gauge width (h_8) and barrel dimensions for symmetrical barrel faced compression rings

Dimensions in millimetres

h_1	h_{25}	h_{26}	h_{26} tol.	h_{27}	t_2, t_3	h_8^a
1,0	0,25	0,50	$\pm 0,15$	0,75	0,003...0,012	0,50
1,2	0,30	0,60	$\pm 0,20$	0,90		0,60
1,5	0,35	0,75	$\pm 0,25$	1,15	0,003...0,015	0,80
1,75	0,35	0,85	$\pm 0,30$	1,35		1,00
2,0	0,40	1,00	$\pm 0,30$	1,60		1,20
2,5	0,45	1,25	$\pm 0,40$	2,05		1,60
3,0	0,50	1,50	$\pm 0,50$	2,50	0,005...0,020	2,00
3,5	0,55	1,75	$\pm 0,50$	2,95		2,40

^a Gauge width (h_8) only informative; may be used only if agreed between manufacturer and client.

4.2.2 Designation

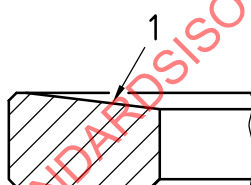
EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-2, being a 7° half keystone ring made of cast iron, with a barrel faced peripheral surface (HKB), of $d_1 = 90$ mm (90), of nominal ring width $h_1 = 1,5$ mm (1,5), made of non-heat-treated grey cast iron, subclass 12 (MC12),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

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

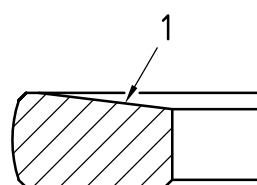
5 Common features

5.1 Type HK and HKB — Half keystone ring

5.1.1 Uncoated rings



a) Type HK



b) Type HKB

Key

1 mark

Figure 3 — Uncoated rings

5.1.2 Chromium plated or spray coated rings

5.1.2.1 Fully faced



Key

1 mark

Figure 4 — Fully faced rings

5.1.2.2 Semi-inlaid



Key

1 mark

Figure 5 — Semi-inlaid rings

5.1.2.3 Inlaid (not recommended for chromium plated rings)



Key

1 mark

Figure 6 — Inlaid rings

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



Key
1 mark

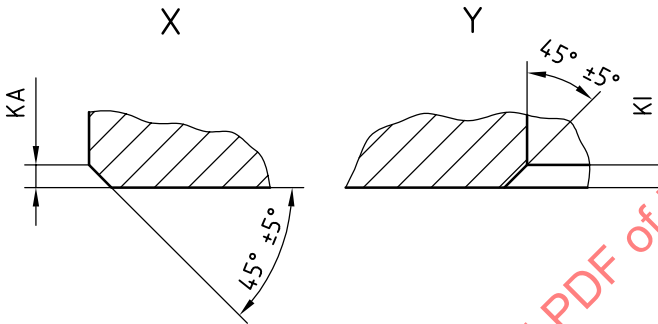


Figure 7 — Outside and inside chamfered edges (KA, KI)

Table 2 — KA and KI dimensions

Dimensions in millimetres

d_1	KA	KI
$38 \leq d_1 < 50$	0,2 max.	0,2 max.
$50 \leq d_1 < 125$	$0,3 \pm 0,1$	$0,3 \pm 0,15$
$125 \leq d_1 \leq 160$	$0,4 \pm 0,1$	$0,4 \pm 0,15$

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

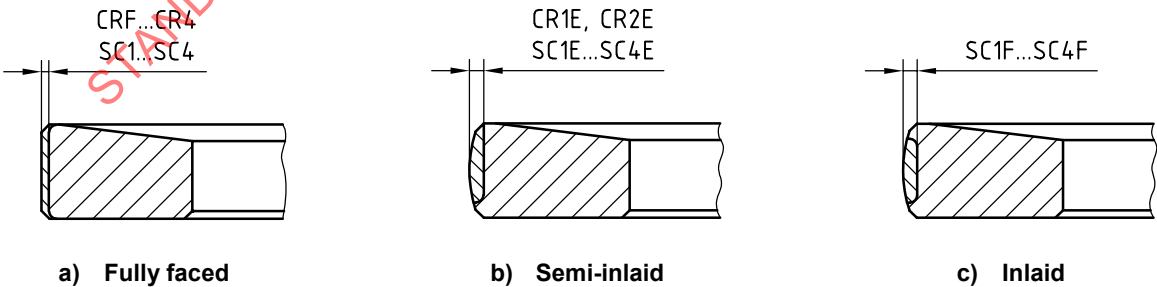


Figure 8 — Plating/coating thickness

Table 3 — 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 6 shall be corrected when additional features or materials other than grey cast iron with a modulus of elasticity, E_n , of 100 GN/m², or both, are used.

For common features, multiplier correction factors given in Tables 4 and 5 and the force correction factors given in ISO 6621-4 shall be used.

Table 4 — Force correction factors for HK and HKB rings with features KA or KI

Factor	
KA	KI
0,98	0,98

Table 5 — Force correction factors for chromium plated and spray coated HK and HKB 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

See Table 6.

Table 6 — Dimensions of HK and HKB half keystone rings

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

Table 6 (continued)

Dimensions in millimetres

Closed gap		Tangential force						Diametral force						Nominal diameter												
s_1	Tolerance	F_t N					Tolerance	F_d N					Tolerance	d_1												
		For h_1 shown in column						For h_1 shown in column																		
		1	2	3	4	5		1	2	3	4	5														
0,15	$+0,2$ 0	—	—	—	—	—	$\pm 30\%$ if $F_t < 10\text{ N}$	7,3	—	—	—	—	$\pm 30\%$ if $F_d < 21,5\text{ N}$	38												
																		39								
		—	—					—	—					—	$\pm 20\%$ if $F_t \geq 10\text{ N}$	7,3		—	—	—	$\pm 20\%$ if $F_d \geq 21,5\text{ N}$	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	—	—	—	$\pm 30\%$ if $F_t < 10\text{ N}$	9,5	12,0	—	—	—	$\pm 30\%$ if $F_d < 21,5\text{ N}$	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	—	—	—	$\pm 30\%$ if $F_t < 10\text{ N}$	10,8	14,0	—	—	—	$\pm 30\%$ if $F_d < 21,5\text{ N}$	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	—	$\pm 30\%$ if $F_t < 10\text{ N}$	12,0	15,7	18,5	21,5	—	$\pm 30\%$ if $F_d < 21,5\text{ N}$	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 6 (continued)

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

Table 6 (continued)

Dimensions in millimetres

Closed gap		Tangential force						Diametral force						Nominal diameter	
s_1	Tolerance	F_t N For h_1 shown in column					Tolerance	F_d N 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	
0,25		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	
		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	
0,3	$+0,25$ 0	—	9,1	10,9	12,7	16,3	$\pm 30\%$ if $F_t < 10\text{ N}$ $\pm 20\%$ if $F_t \geq 10\text{ N}$	—	19,6	23,4	27,3	35,0	$\pm 30\%$ if $F_d < 21,5\text{ N}$ $\pm 20\%$ if $F_d \geq 21,5\text{ N}$	90	
			9,2	11,0	12,9	16,5			19,8	23,7	27,7	35,5		91	
			9,4	11,2	13,1	16,8			20,2	24,1	28,2	36,1		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	
			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 6 (continued)

Nominal diameter d_1	Radial wall thickness a_1		Nominal value of ring width h_1					a_6 Ref.	a_7	Method A							Method B								
	Tolerance		Column							Measured value h_3^a For h_1 shown in column							h_3 (ref.) Column					Measured value			
			1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5	a_6	Tolerance			
110	4,55	$\pm 0,20$ Within a ring: 0,20 max.	—	2,0				2,0	0,7 max.	—		1,789						0 -0,024 For phosphated PO surface: +0,01 -0,024	—		2,28	2,78	3,28	2,07	For phosphated PC surface: +0,08 -0,19
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 6 (continued)

Dimensions in millimetres

Closed gap		Tangential force						Diametral force						Nominal diameter
s_1	Tolerance	F_t N For h_1 shown in column					Tolerance	F_d N For h_1 shown in column					Tolerance	d_1
		1	2	3	4	5		1	2	3	4	5		
0,35	$+0,25$ 0	—	14,5	18,7	22,9	27,1	$\pm 30\%$ if $F_t < 10\text{ N}$ $\pm 20\%$ if $F_t \geq 10\text{ N}$	—	31,2	40,2	49,2	58,3	$\pm 30\%$ if $F_d < 21,5\text{ N}$ $\pm 20\%$ if $F_d \geq 21,5\text{ N}$	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
			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			32,5	42,1	51,8	61,5		127
			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
0,4		—	19,6	24,2	28,7	$\pm 20\%$ if $F_t \geq 10\text{ N}$		—	—	42,2	51,9	61,7	$\pm 20\%$ if $F_d \geq 21,5\text{ N}$	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
			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