INTERNATIONAL STANDARD

ISO 6624-2

First edition
2003-10-01

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
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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.

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

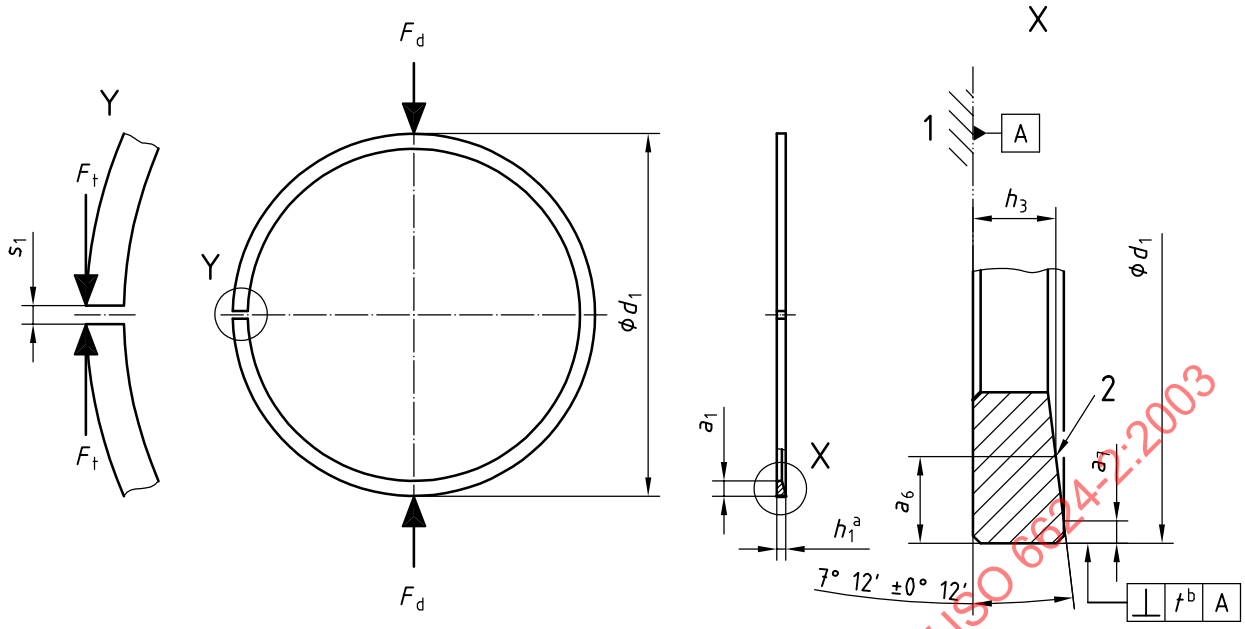
NOTE For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see ISO 6621-2).

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):

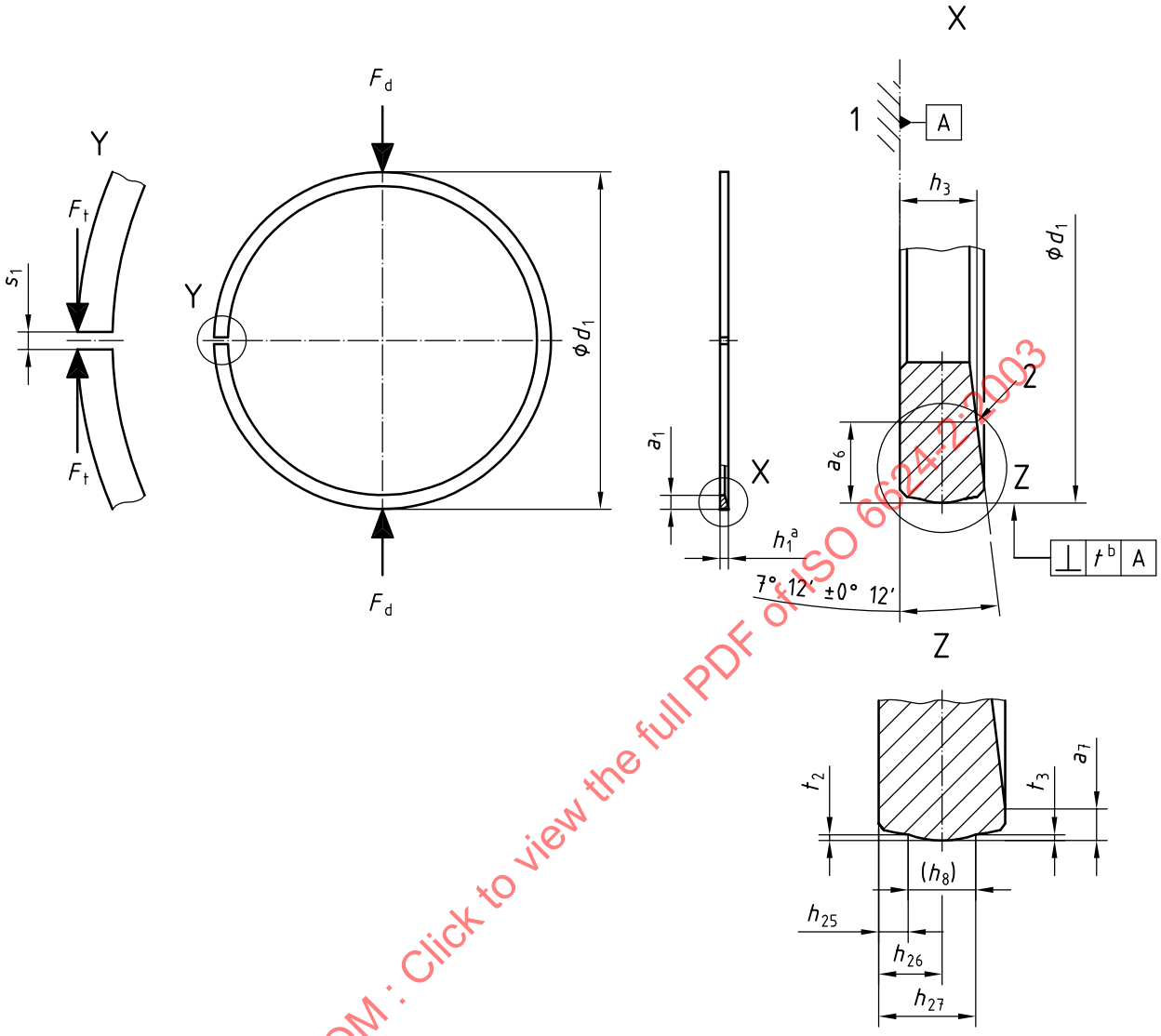
Piston ring ISO 6624-2 HK - 90 × 1,5 - MC53/CR2

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	± 0,15	0,75	0,003...0,012	0,50
1,2	0,30	0,60	± 0,20	0,90		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 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

a) Type HK b) Type HKB

Key

1 mark

Figure 4 — Fully faced rings

5.1.2.2 Semi-inlaid

a) Type HK b) Type HKB

Key

1 mark

Figure 5 — Semi-inlaid rings

5.1.2.3 **Inlaid** (not recommended for chromium plated rings)

a) Type HK b) Type HKB

Key

1 mark

Figure 6 — Inlaid rings

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

a) HK rings

b) HKB rings

Key

1 mark

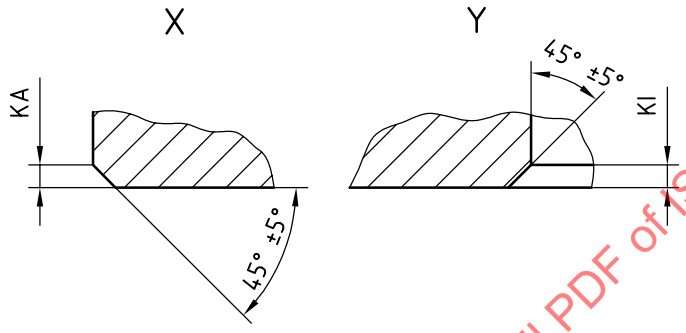


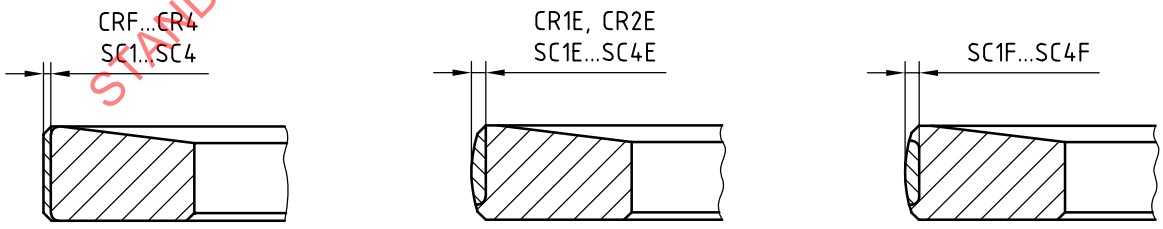
Figure 7 — Outside and inside chamfered edges (KA, KI)

Table 2 — KA and KI dimensions

Dimensions in millimetres

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

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



a) Fully faced

b) Semi-inlaid

c) Inlaid

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 $h_1 \leqslant 1{,}5$.

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/m^2, 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**
$38 \leqslant d_1 < 50$	1	0,81	0,70	0,64	—	—
$50 \leqslant d_1 < 75$	1	0,90	0,85	0,81	0,75	0,71
$75 \leqslant d_1 < 100$	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
$125 \leqslant d_1 \leqslant 160$	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 Column					a_6 Ref.	a_7	Method A: Measured value h_3[a] For h_1 shown in column						Method B: h_3 (ref.) Column					a_6	Measured value
		Tolerance	1	2	3	4	5			1	2	3	4	5	Tolerance	1	2	3	4	5		Tolerance
38	1,6							0,6		1,169						1,16					0,69	
39	1,65																					
40	1,65																					
41	1,7																					
42	1,75																					
43	1,8			—							—						—					
44	1,85							0,8		1,143						1,13					0,90	
45	1,9																					
46	1,9																					
47	1,95																					
48	2								0,5 max.													
49	2,05																					
50	2,1																					
51	2,15																					
52	2,15																					
53	2,2																					
54	2,25	± 0,15			—	—						—	—		0 −0,024			—	—			0 −0,19
55	2,3	Within a	1,2				—			1,118	1,418			—	For phos-phated PO surface: +0,01 −0,024	1,11	1,41			—	1,10	For phos-phated PO surface: +0,08 −0,19
56	2,35	ring:																				
57	2,4	0,15 max.																				
58	2,4																					
59	2,45							1,0														
60	2,5																					
61	2,55																					
62	2,6			1,5																		
63	2,65																					
64	2,65								0,6 max.	1,116	1,416					1,10	1,40				1,09	
65	2,7																					
66	2,75																					
67	2,8																					
68	2,85																					
69	2,9																					
70	2,9																					
71	2,95				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	
72	3																					
73	3,05																					

Table 6 (*continued*)

Dimensions in millimetres

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 $F_t \geqslant$ 10 N	7,3	—	—	—	—	± 30 % if F_d < 21,5 N ± 20 % if $F_d \geqslant$ 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 6 (*continued*)

Nominal diameter d_1	Radial wall thickness a_1		Nominal value of ring width h_1 Column					a_6 Ref.	a_7	Method A Measured value h_3[a] For h_1 shown in column						Method B h_3 (ref.) Column					Measured value 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																				
86	3,6	Within a		1,5	1,75	2,0																
87	3,65	ring:																				
88	3,65	0,15 max.																				
89	3,7																					
90	3,75														0 −0,024							0 −0,19
91	3,8																					
92	3,85								0,7 max.						For phos-phated PO surface:							For phos-phated PO surface:
93	3,9														+0,01 −0,024							+0,08 −0,19
94	3,9																					
95	3,95		—				2,5			—	1,289	1,539	1,789	2,289		—	1,28	1,53	1,78	2,28		
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:																				
106	4,4	0,20 max.																				
107	4,4																					
108	4,45																					
109	4,5																					

Table 6 (*continued*)

Dimensions in millimetres

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
0,25	$^{+0,25}_{0}$	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			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
		—	9,4	11,2	13,1	16,8	± 20 % if $F_t \geqslant 10$ N	—	20,2	24,1	28,2	36,1	± 20 % if $F_d \geqslant 21,5$ 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
		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	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]						h_3 (ref.)					Measured value	
			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																					
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			2,0							1,789						1,78					
120	4,9																					
121	4,95																					
122	4,95																					
123	5																					
124	5,05																					
125	5,05																					
126	5,1																					
127	5,15	± 0,20													$^{0}_{-0,024}$							$^{0}_{-0,19}$
128	5,2	Within a	—		2,5	3,0	3,5	2,0	0,7 max.	—		2,289	2,789	3,289	For phosphated PO surface:	—		2,28	2,78	3,28	2,07	For phosphated PO surface:
129	5,2	ring:																				
130	5,25	0,20 max.													$^{+0,01}_{-0,024}$							$^{+0,08}_{-0,19}$
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 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		
0,35	+0,25 0		14,5	18,7	22,9	27,1	± 30 % if F_t < 10 N		31,2	40,2	49,2	58,3	± 30 % if F_d < 21,5 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	± 20 % if $F_t \geqslant$ 10 N			42,2	51,9	61,7	± 20 % if $F_d \geqslant$ 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
				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