
**Internal combustion engines — Piston
rings —**

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

Moteurs à combustion interne — Segments de piston —

Partie 4: Segments semi-trapézoïdaux en acier



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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 6624-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

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 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.

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Internal combustion engines — Piston rings —

Part 4: Half keystone rings made of steel

1 Scope

This part of ISO 6624 specifies the essential dimensional features of half keystone rings made of steel, 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 to 5 and Figures 3 to 8. Table 6 gives the force factors for the different ring types, while Table 7 gives the dimensions and forces of half keystone rings.

4 Ring types and designation examples

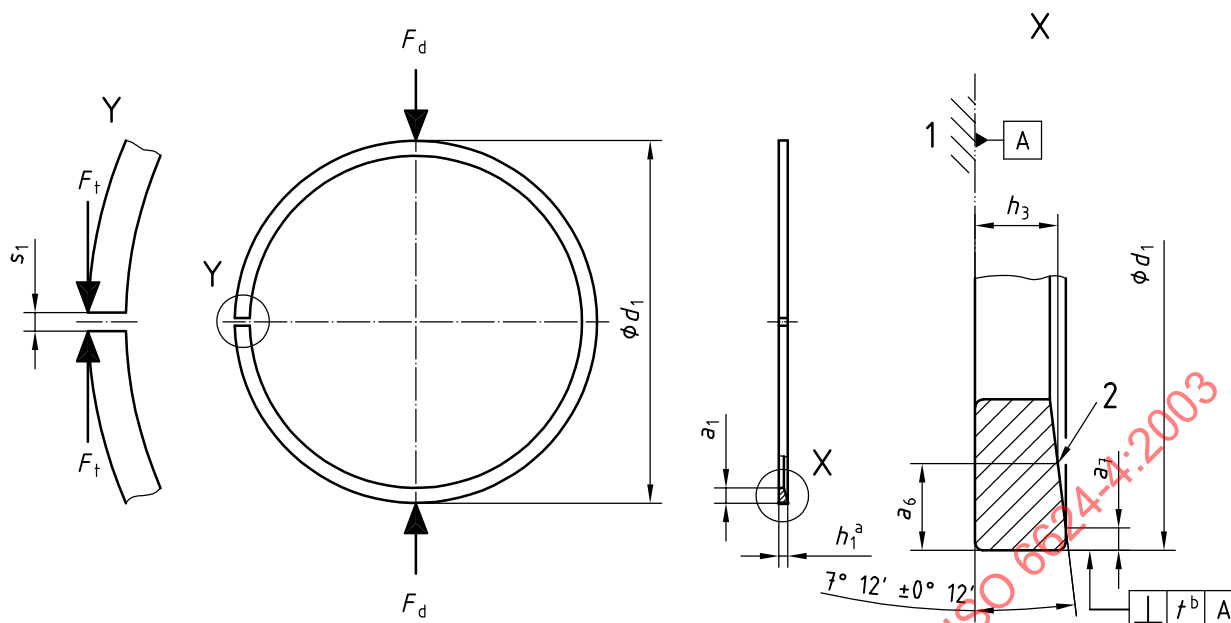
NOTE For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see ISO 6621-2).

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 6624-4, being a 7° half keystone ring made of steel with a straight faced peripheral surface (HK), of nominal diameter $d_1 = 60$ mm (60), of nominal ring width $h_1 = 1,2$ mm (1,2), made of CrSi alloyed steel subclass 62 (MC62), and having a chromium plated peripheral surface with a minimum thickness of 0,1 mm (CR2):

Piston ring ISO 6624-4 HK - 60 × 1,2 - MC62/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.

- b $t = 0,006 \times h_1$

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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
1,2	0,30	0,60	$\pm 0,20$	0,90	0,003...0,012	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

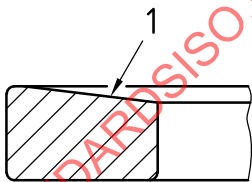
EXAMPLE Designation of a piston ring complying with the requirements of ISO 6624-4, being a half keystone ring made of steel with a barrel faced peripheral surface (HKB), of nominal diameter $d_1 = 60$ mm (60), of nominal ring width $h_1 = 1,5$ mm (1,5), made of martensitic steel 11%Cr (min.) subclass 65 (MC65), and nitrided on the peripheral surface and side faces (NT) to a depth of 0,050 mm min. on the peripheral surface (050), with an associated side face depth of 0,015 mm min.:

Piston ring ISO 6624-4 HKB - 60×1,5 - MC65/NT050

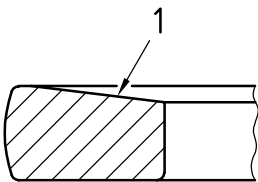
5 Common features

5.1 Type HK and HKB — Half keystone rings

5.1.1 Nitrided rings



a) Type HK



b) Type HKB

Key

1 mark

Figure 3 — Nitrided 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 Inlaid (not recommended for chromium plated rings)



Key

1 mark

Figure 5 — Inlaid rings

5.2 Type HK and HKB rings — Outside and inside rounded edges

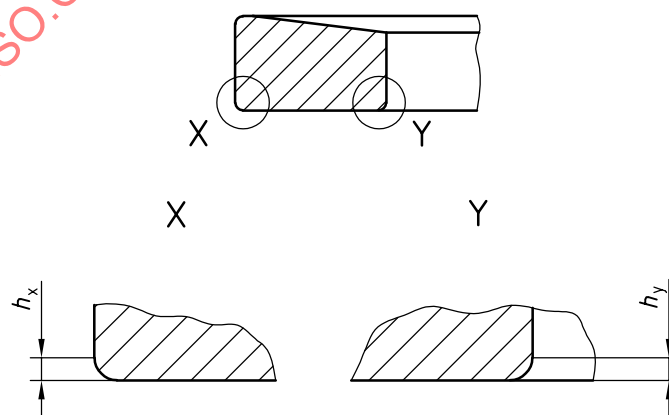


Figure 6 — Outside and inside rounded edges

Table 2 — h_x and h_y dimensions

Dimensions in millimetres

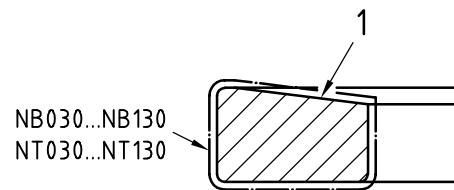
h_1	h_x max.	h_y max.
1,2	0,25	0,3
1,5	0,3	0,35
1,75		
2,0	0,3	0,4
2,5		
3,0		
3,5		

5.3 Type HK and HKB rings (fully faced and inlaid) — Plating/coating thickness**Figure 7 — 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 $h_1 \leq 1,5$.		

5.4 Type HK and HKB rings — Nitrided case depth



Key

1 mark

Figure 8 — Nitrided case depth

Table 4 — Nitrided case depth of peripheral surface and bottom side face

Dimensions in millimetres

Code	Nitrided case depth min.	
	Peripheral surface	Bottom side face
NB030	0,03	0,010
NB050	0,05	0,015
NB070	0,07	0,020
NB090	0,09	0,020
NB110	0,11	0,030
NB130	0,13	0,030
NOTE Nitrided case depth on top side face and on inside surface not specified.		

Table 5 — Nitrided case depth of peripheral surface and side faces

Dimensions in millimetres

Code	Nitrided case depth min.	
	Peripheral surface	Side faces
NT030	0,03	0,010
NT050	0,05	0,015
NT070	0,07	0,020
NT090	0,09	0,020
NT110	0,11	0,030
NT130	0,13	0,030
NOTE Nitrided case depth on inside surface not specified.		

6 Force factors

The tangential and diametral forces given in Table 7 shall be corrected when additional features are being used.

For common features, multiplier correction factors given in Table 6 shall be used. The force correction factors for the ratio $m/(d_1 - a_1)$, as given in ISO 6621-4, shall be used.

Table 6 — Force correction factors for chromium plated, spray coated and nitrided HK and HKB rings

d_1 mm	Factor							
	CRF	CR1	CR2/SC1	CR3	SC2	CR4/SC3	SC4	NB030...NB130 NT030...NT130
$38 \leq d_1 < 50$	1	0,80	0,71	—	0,63	—	—	1,03
$50 \leq d_1 < 75$	1	0,87	0,81	0,75	0,75	0,69	0,64	1,03
$75 \leq d_1 < 100$	1	0,91	0,86	0,82	0,82	0,78	0,74	1,03
$100 \leq d_1 < 125$	1	0,93	0,89	0,86	0,86	0,82	0,79	1,03
$125 \leq d_1 \leq 160$	1	0,94	0,91	0,89	0,89	0,86	0,83	1,03

7 Dimensions

See Table 7.

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Table 7 — Dimensions of HK and HKB half keystone rings

[illegible]

Table 7 (continued)

Dimensions in millimetres

Closed gap		Tangential force							Diametral force							Nominal diameter							
s ₁	Tolerance	F _t N							F _d N							d ₁							
		For h ₁ shown in column						Tolerance	For h ₁ shown in column						Tolerance								
		1	2	3	4	5	6		1	2	3	4	5	6									
0,15	+0,2 0	—	—						7,0	—						38							
									8,1							39							
									8,1							40							
									8,1							41							
									8,1							42							
									8,1							43							
									8,0							44							
									9,2							45							
									9,2							46							
									9,2							47							
									9,0							48							
									9,0							49							
		4,2	5,3	—	—	—	—	± 30 % if F _t < 10 N	9,0	11,4	—	—	—	± 30 % if F _d < 21,5 N	50								
		4,8	6,1						10,3	13,1					51								
		4,8	6,1						10,3	13,1					52								
		4,7	6,0						10,1	12,9					53								
		4,7	6,0						10,1	12,9					54								
		4,7	6,0						10,1	12,9					55								
		4,6	5,9						9,9	12,7					56								
		5,3	6,8						11,4	14,6					57								
5,2	6,7	11,2	14,4	58																			
5,2	6,6	11,2	14,2	59																			
0,2		5,1	6,5						11,0	14,0						60							
		5,0	6,4						10,8	13,8						61							
		5,7	7,3						12,3	15,7						62							
		5,6	7,2						12,0	15,5						63							
		5,6	7,2						12,0	15,5						64							
		5,5	7,1						11,8	15,3						65							
		5,5	7,0						11,8	15,1						66							
		5,4	6,9						11,6	14,8						67							
		6,2	7,9						13,3	17,0						68							
		6,1	7,8						13,1	16,8						69							
		6,0	7,7						9,2	10,6									12,9	16,6	19,8	22,8	70
		6,0	7,7						9,1	10,5									12,9	16,6	19,6	22,5	71
5,9	7,6	9,0	10,4	12,7	16,3	19,4	22,3	72															
5,8	7,5	8,9	10,2	12,5	16,1	19,1	22,0	73															

Table 7 (continued)

Nom- inal diam- eter	Radial wall thickness	Nominal value of ring width						a_6 Ref.	a_7	Method A								Method B						Measured value a_6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
		a_1	h_1							Measured value h_3^a								h_3 (ref.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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			Tolerance	1	2	3	4			5	6	1	2	3	4	5	6	Tolerance	1	2	3	4	5		6	Tolerance																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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Table 7 (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	6		1	2	3	4	5	6							
0,2	$^{+0,2}_0$	6,6	8,5	10,1	11,7	—	—	—	14,2	18,3	21,7	25,1	—	—	—	74					
0,25		6,5	8,4	9,9	11,5				14,0	18,1	21,3	24,7				75					
		6,4	8,2	9,8	11,3				13,8	17,6	21,1	24,2				76					
		6,3	8,1	9,6	11,1				13,5	17,4	20,6	23,8				77					
		6,1	7,9	9,4	10,9				13,1	17,0	20,2	23,3				78					
		7,0	9,0	10,7	12,4				15,1	19,4	23,0	26,6				79					
		6,9	8,9	10,6	12,2				14,8	19,1	22,8	26,2				80					
		6,8	8,8	10,4	12,1				14,6	18,9	22,4	26,0				81					
		6,7	8,7	10,3	11,9				14,4	18,7	22,1	25,6				82					
		6,6	8,6	10,2	11,8				14,2	18,5	21,9	25,4				83					
		6,5	8,4	10,0	11,6				14,0	18,1	21,5	24,9				84					
		7,4	9,6	11,4	13,2				15,9	20,6	24,5	28,4				85					
		7,3	9,5	11,3	13,0				15,7	20,4	24,3	28,0				86					
		7,2	9,3	11,1	12,9				15,5	20,0	23,9	27,7				87					
		7,1	9,2	11,0	12,7				15,3	19,8	23,7	27,3				88					
		7,0	9,1	10,8	12,5				15,1	19,6	23,2	26,9				89					
0,3	$^{+0,25}_0$	9,0	10,6	12,3	15,7				—	—	$\pm 30\%$ if $F_t < 10\text{ N}$ $\pm 20\%$ if $F_t \geq 10\text{ N}$	19,2				22,8	26,4	33,8	—	$\pm 30\%$ if $F_d < 21,5\text{ N}$ $\pm 20\%$ if $F_d \geq 21,5\text{ N}$	90
		10,1	12,1	14,0	17,9							21,8				26,0	30,1	38,5			91
		10,0	11,9	13,8	17,6							21,4				25,6	29,7	37,8			92
		9,8	11,6	13,5	17,2							21,0				24,9	29,0	37,0			93
		9,6	11,4	13,2	16,9	20,5	24,5	24,5				36,3	94								
		9,3	11,1	12,9	16,5	20,1	23,9	27,7				35,5	95								
		10,6	12,6	14,7	18,8	22,8	27,1	31,6				40,4	96								
		10,4	12,5	14,5	18,5	22,5	26,9	31,2				39,9	97								
		10,3	12,3	14,3	18,3	22,1	26,4	30,7				39,3	98								
		10,2	12,1	14,1	18,0	21,8	26,0	30,3				38,7	99								
		—	17,7	13,9	17,7	21,6	—	38,1				29,8	38,1	46,4	100						
			17,4	13,6	17,4	21,2		37,5				29,3	37,5	45,7	101						
			19,8	15,5	19,8	24,2		42,7				33,3	42,7	52,0	102						
			19,6	15,3	19,6	23,9		42,1				32,8	42,1	51,3	103						
			19,3	15,1	19,3	23,5		41,5				32,4	41,5	50,5	104						
19,0	14,8		19,0	23,1	40,8	31,9		40,8	49,8	105											
18,7	14,6		18,7	22,8	40,2	31,4		40,2	49,0	106											
18,4	14,3		18,4	22,4	39,5	30,8		39,5	48,1	107											
20,9	16,3		20,9	25,5	44,9	35,0		44,9	54,8	108											
20,5	15,9	20,5	25,0	44,0	34,3	44,0	53,7	109													

Table 7 (continued)

Nom- inal diam- eter	Radial wall thickness	Nominal value of ring width						a_6 Ref.	a_7	Method A							Method B						Measured value a_6		
		a_1	h_1							Measured value h_3^a							h_3 (ref.)								
			Column							For h_1 shown in column							Column								
			Tolerance	1	2	3	4			5	6	1	2	3	4	5	6	Tolerance	1	2	3	4		5	6
110	3,9	$\pm 0,20$ Within a ring: 0,20 max.																							
111																									
112																									
113																									
114																									
115	4,1																								
116																									
117																									
118																									
119					2,0							1,789							1,78						
120	4,3																								
121																									
122																									
123																									
124																									
125	4,5																0 -0,024								0 -0,19
126																For phos- phated PO surface: +0,01 -0,024							For phos- phated PO surface: +0,08 -0,19		
127		—	—		2,5	3,0	3,5	2,0	0,7 max.	—	—	2,289	2,789	3,289		—	—	2,28	2,78	3,28	2,07				
128																									
129																									
130	4,7																								
131																									
132																									
133																									
134																									
135	4,9																								
136																									
137																									
138																									
139																									
140	5,1																								
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142																									
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