

Internal Combustion Engines—Piston Rings—Half Keystone Rings

This SAE Standard is equivalent to ISO Standard 6624/2 TR.

1. Scope—Differences, where they exist, are shown in Appendix A.

This SAE Standard specifies the essential dimensional features of HK- and HKB-half keystone rings with narrow ring width types.

Dimensional and allow for the use of cast iron (Table 6) or steel (Table 7). Since the modulus of elasticity of steel rings is higher than that of cast iron rings, the fluctuation in the surface pressure will become greater if the free gap is set as the reference for forces. Therefore, forces are set using the surface pressure as the reference in order to minimize the effect of the fluctuation.

The requirements of this document apply to half keystone rings of reciprocating internal combustion engines up to and including 70 mm diameter for cast iron rings and up to and including 100 mm diameter for steel rings.

1.1 Rationale—SAE J2001 is being discontinued because the content of this standard is also contained in ISO 6624-2. Therefore, to eliminate duplication and confusion in coordinating the standards between ISO and SAE, this document will be discontinued. The SAE Piston and Ring Standards Committee will now continue to support ISO in updating the standards as appropriate.

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SAE J2001 Cancelled JUN2008

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE DESIGNATION	ISO ¹ EQUIVALENT	
		INTERNAL COMBUSTION ENGINES—PISTON RINGS
J1588	6621/1	Vocabulary
J1589	6621/2	Measuring principles
J1590	6621/3	Material specifications
J1591	6621/4	General specifications
J1996	6621/5	Quality requirements
		INTERNAL COMBUSTION ENGINES—PISTON RINGS
J1997	6622/1	Rectangular rings
J1998	6622/2 TR	Rectangular rings with narrow ring width
		INTERNAL COMBUSTION ENGINES—PISTON RINGS
J2000	6624/1	Keystone rings
J2001	6624/2 TR	Half keystone rings
J2002	6625	INTERNAL COMBUSTION ENGINES—PISTON RINGS— OIL CONTROL RINGS
J2003	6626	INTERNAL COMBUSTION ENGINES—PISTON RINGS— COIL SPRING LOADED OIL CONTROL RINGS
J2004	6627 TR	INTERNAL COMBUSTION ENGINES—PISTON RINGS— EXPANDER/SEGMENT OIL CONTROL RINGS
J2226		INTERNAL COMBUSTION ENGINES—PISTON RINGS— STEEL RECTANGULAR RINGS
	1101	TECHNICAL DRAWINGS—GEOMETRICAL TOLERANCING— TOLERANCING OF FORM, ORIENTATION, LOCATION AND RUN-OUT—GENERALITIES, DEFINITIONS, SYMBOLS INDICATIONS ON DRAWINGS

1. TR refers to Technical Report

3. Ring Types and Designation Examples

NOTE—For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see SAE J1589).

3.1 Type HK—Straight Faced Half Keystone Ring 7 Degrees

3.1.1 GENERAL FEATURES

NOTE—See Table 6 or Table 7 for dimensions and forces.

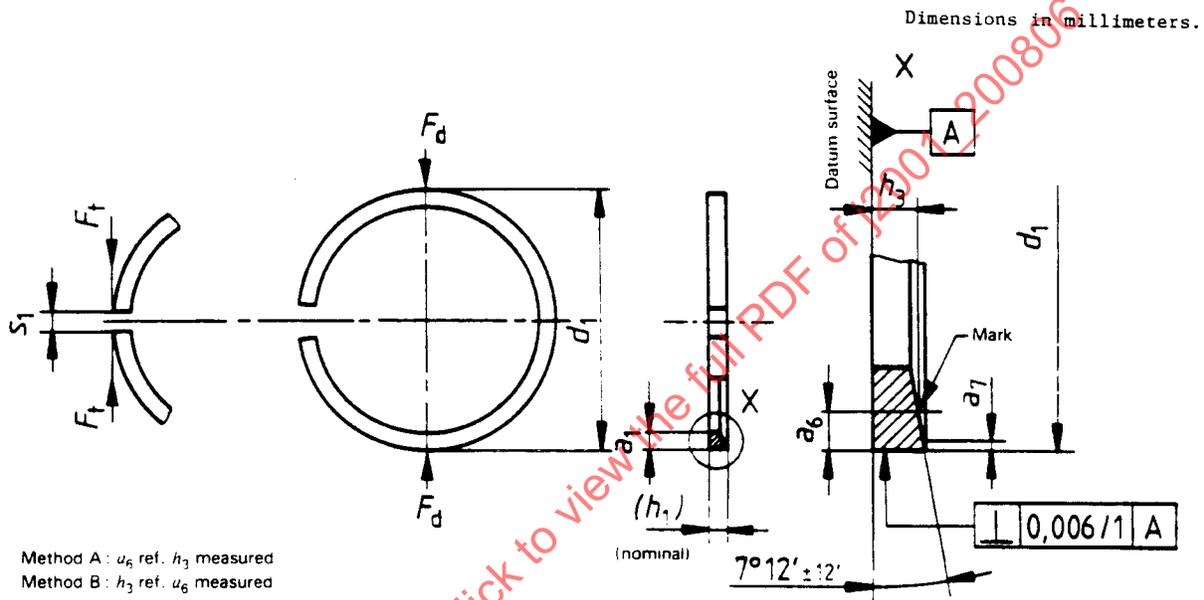


FIGURE 1—TYPE HK

3.1.2 DESIGNATION EXAMPLE—Designation of a straight faced half keystone ring 7 degrees of $d_1 = 60$ mm nominal diameter, $h_1 = 1.25$ mm ring width, made of steel (material subclass 62), general features as shown in Figure 1, and periphery chromium coated fully faced design 0.1 mm minimum thickness:

- a. Piston ring SAE J2001 HK-60 x 1.25-MC62/CR2

3.2 Type HKB—Barrel Faced Half Keystone Ring 7 Degrees

3.2.1 GENERAL FEATURES

NOTE—See Table 6 or Table 7 for dimensions and forces.

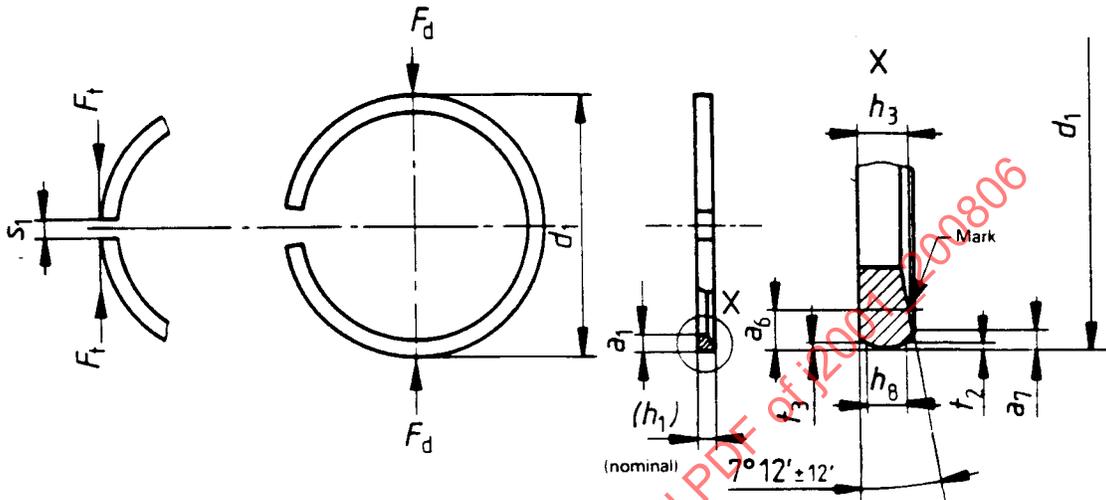


FIGURE 2—TYPE HKB

TABLE 1—GAUGE WIDTH (h_8) AND BARREL DIMENSIONS

Dimensions in millimeters				
h_1	h_8	t_2, t_3	t_2, t_3	Maximum Peak Off Center
1.25	0.6	0.001	0.013	0.2
1.55	0.8	0.02	0.016	0.25

3.2.2 DESIGNATION EXAMPLE—Designation of a barrel faced half keystone ring 7 degrees of $d_1 = 60\text{mm}$ nominal diameter, $h_1 = 1.25\text{ mm}$ ring width, made of steel (material subclass 62), general features as shown in Figure 2 and Table 1, and periphery molybdenum coated inlaid design 0.1 mm minimum thickness:

- a. Piston ring SAE J2001 HKB-60 x 1.25-MC62/MO2

4. Common Features

4.1 Types HK and HKB—Half Keystone Ring—(See Figures 3 to 6.)

4.1.1 UNCOATED RINGS

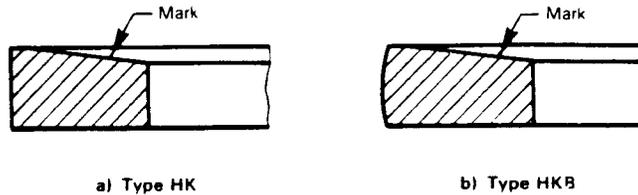


FIGURE 3—UNCOATED RINGS

4.1.2 COATED RINGS (CHROMIUM OR MOLYBDENUM)

4.1.2.1 Fully Faced

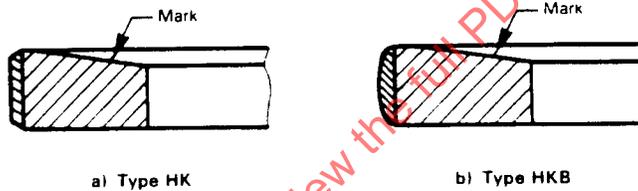


FIGURE 4—FULLY FACED COATED RINGS

4.1.2.2 Semi-Inlaid

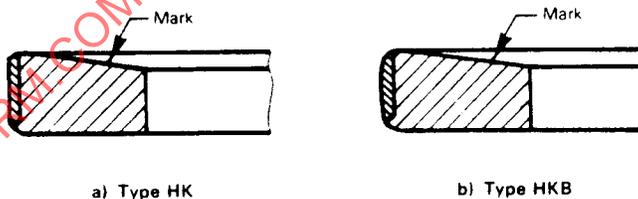


FIGURE 5—SEMI-INLAID COATED RINGS

4.1.2.3 Inlaid

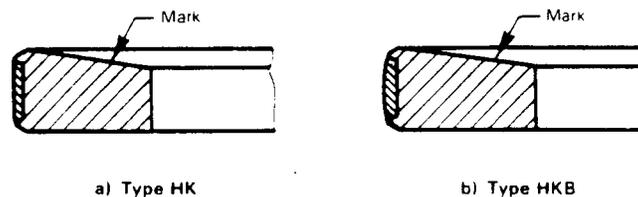


FIGURE 6—INLAID COATED RINGS

4.2 Chamfered Edges (Cast Iron Rings)

4.2.1 Hk AND HKB RINGS—OUTSIDE CHAMFERED EDGES (KA) (See Figures 7 to 9)—See Table 2 for dimensions.

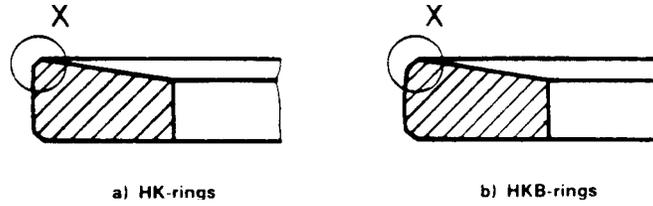


FIGURE 7—OUTSIDE CHAMFERED EDGES (KA)

4.2.2 Hk AND HKB RINGS—INSIDE CHAMFERED EDGES (KI)

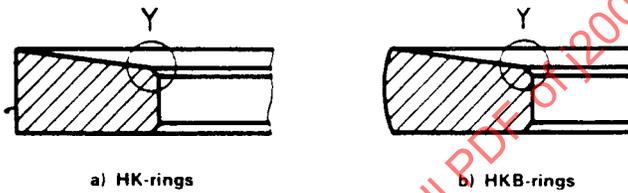


FIGURE 8—INSIDE CHAMFERED EDGES (KI)

4.2.3 Hk AND HKB RINGS—OUTSIDE AND INSIDE CHAMFERED EDGES (KA + KI)

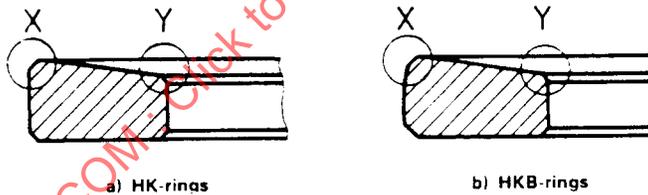


FIGURE 9—OUTSIDE AND INSIDE CHAMFERED EDGES (KA + KI)

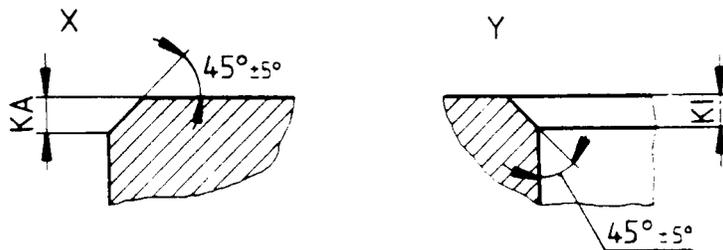


FIGURE 10—DETAILS OF FIGURES 7, 8, AND 9

TABLE 2—KA AND KI DIMENSIONS

Dimensions in millimeters	
KA	KI
0.15 ± 0.1	max 0.2

4.3 HK and HKB Steel Rings—Outside and Inside Rounded Edges—(See Figure 11.)

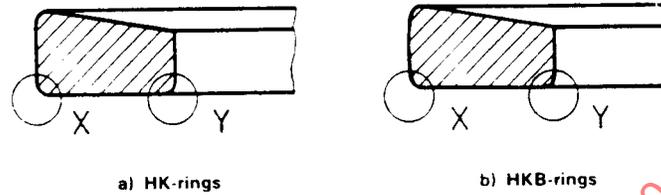


FIGURE 11—OUTSIDE AND INSIDE ROUNDED EDGES

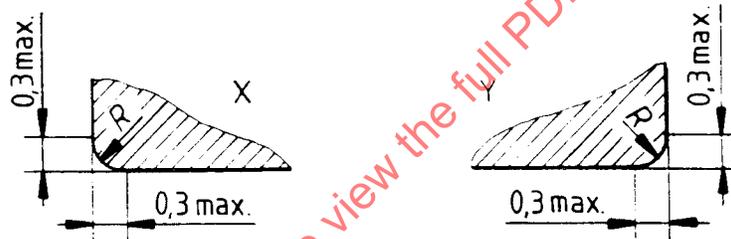


FIGURE 12—DETAILS OF FIGURE 11

4.4 HK and HKB Rings (Fully Faced, Semi-Inlaid, and Inlaid)—Layer Thickness (See Figure 13)—See Table 3 for dimensions.

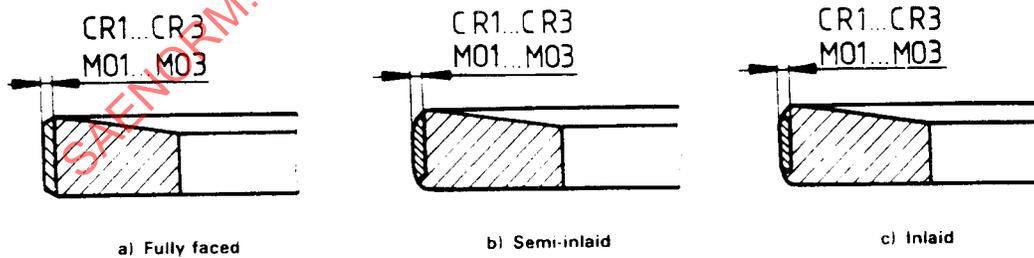


FIGURE 13—LAYER THICKNESS

TABLE 3—LAYER THICKNESS

		Dimensions in millimeters	
Chromium	Molybdenum	Thickness min	
CR1	MO1	0.05	
CR2	MO2	0.1	
CR3 ⁽¹⁾	MO3 ¹	0.15	

1. CR3 and MO3 apply to rings with nominal diameters of 50 mm or greater.

5. **Force Factors**—The tangential and diametral forces given in shall be corrected when additional features and/or materials other than grey cast iron with a modulus of elasticity of 100 000 MPa are being used.

For common features, multiplier correction factors given in Tables 4 and 5 the force correction factors given in SAE J1591 shall be used. Also, the tangential and diametral forces given in shall be corrected when additional features are being used.

TABLE 4—FORCE CORRECTION FACTORS FOR HK AND HKB RINGS WITH FEATURES KA AND KI

KA	Factor KI	KA and KI
0.98	0.98	0.96

TABLE 5—FORCE CORRECTION FACTORS FOR COATED HK AND HKB RINGS (FULLY FACED, SEMI-INLAID, AND INLAID TYPES)

d ₁ (Reference Coating) mm	Factor				
	CR1	CR2/MO1	CR3	MO2	MO3
38 ≤ d ₁ < 50	0.81	0.7	-	0.64	-
50 ≤ d ₁ ≤ 100	0.9	0.85	0.81	0.81	0.75

6. **Dimensions**—See Table 6 and Table 7.

TABLE 6—DIMENSIONS OF HK AND HKB HALF KEYSTONE RINGS WITH NARROW RING WIDTH MADE OF CAST IRON

Dimensions in millimeters.

Nominal diameter d_1	Radial wall thickness a_1	Ring width nominal value		Method A Measured value For h_3 shown in column				Method B Measured value a_6				Closed gap s_1	Tangential force F_t , N				Diametral force F_D , N				
		For h_1 shown in column		a_6 (ref.)	a_1	1		2		h_3 (ref.) Column	a_6		Tolerance	For h_1 shown in column		For h_1 shown in column		1		2	
		1	2			Tolerance	Tolerance	1	2					1	2	Tolerance	Tolerance	1	2	Tolerance	Tolerance
38	1,6			0,8		1,143		1,13	0,91									7,2			
39	1,65																	7,6			
40	1,65																	7,6			
41	1,7																	7,6			
42	1,75																	7,8			
43	1,8																	8,2			
44	1,85																	8,3		10,5	
45	1,9					1,118		1,11	1,06									8,5		11,2	
46	1,9																	8,3		10,6	
47	1,95																	8,5		10,9	
48	2																	8,9		11,4	
49	2,05				0,5 max.													9		11,8	
50	2,1																	9,4		12,1	
51	2,15																	9,6		12,5	
52	2,15																	9,2		11,9	
53	2,2																	9,6		12,3	
54	2,25					1,093		1,08	1,3									9,7		12,7	
55	2,3																	10,1		13	
56	2,35																	10,4		13,4	
57	2,4																	10,5		13,8	
58	2,4																	10,1		13,4	
59	2,45																	10,5		13,8	
60	2,5																	10,7		14	
61	2,55																	10,9		14,4	
62	2,6																	11,3		14,8	
63	2,65																	11,7		15	
64	2,65																	11,3		14,4	
65	2,7					1,09		1,08	1,28									11,5		14,8	
66	2,75																	11,7		15,3	
67	2,8																	11,9		15,6	
68	2,85																	12,3		16	
69	2,9																	12,4		16,2	
70	2,9					1,053		1,04	1,6									12		15,7	

NOTES

- For intermediate sizes (for example repair sizes), the radial wall thickness of the next smaller nominal diameter shall be applied.
- The values for F_t and F_D given in Table 6, apply to as cast grey cast iron with a typical modulus of elasticity (E_n) of 100 000 MPa. 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).
- For the sole purpose of this document, 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 the manufacturer and client.

This table is shown in ISO format. Commas represent decimal points.