

**Internal Combustion Engines—Piston Rings—
Rectangular Rings With Narrow Ring Width**

This SAE Standard is equivalent to ISO Standard 6622/2 TR.

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

This SAE Standard specifies the essential dimensional features of R, B, and M rectangular piston ring types with narrow ring width.

Dimensional Tables 8 and 9 allow for the use of cast iron (Table 8) or steel (Table 9). 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 force. 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 rectangular rings for reciprocating internal combustion engines up to and including 90 mm diameter for cast iron rings and up to and including 100 mm diameter for steel. They may also be used for piston rings of compressors working under similar conditions.

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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
J1999	6623	INTERNAL COMBUSTION ENGINES—PISTON RINGS— SCRAPER RINGS
		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—Geometric tolerancing—Toler- ancing of form, orientation, location and run-out—Generali- ties, definitions, symbols indications on drawings

1. TR refers to Technical Report

3. Ring Types and Designation Examples

3.1 Type R—Straight Faced Rectangular Ring

3.1.1 GENERAL FEATURES

NOTE—See Table 8 or Table 9 for dimensions and forces.

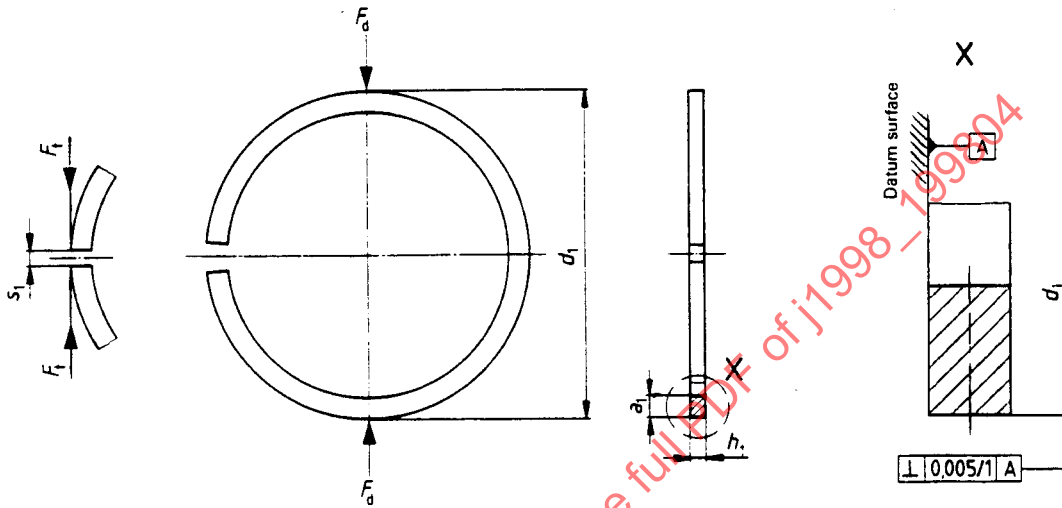


FIGURE 1 TYPE R

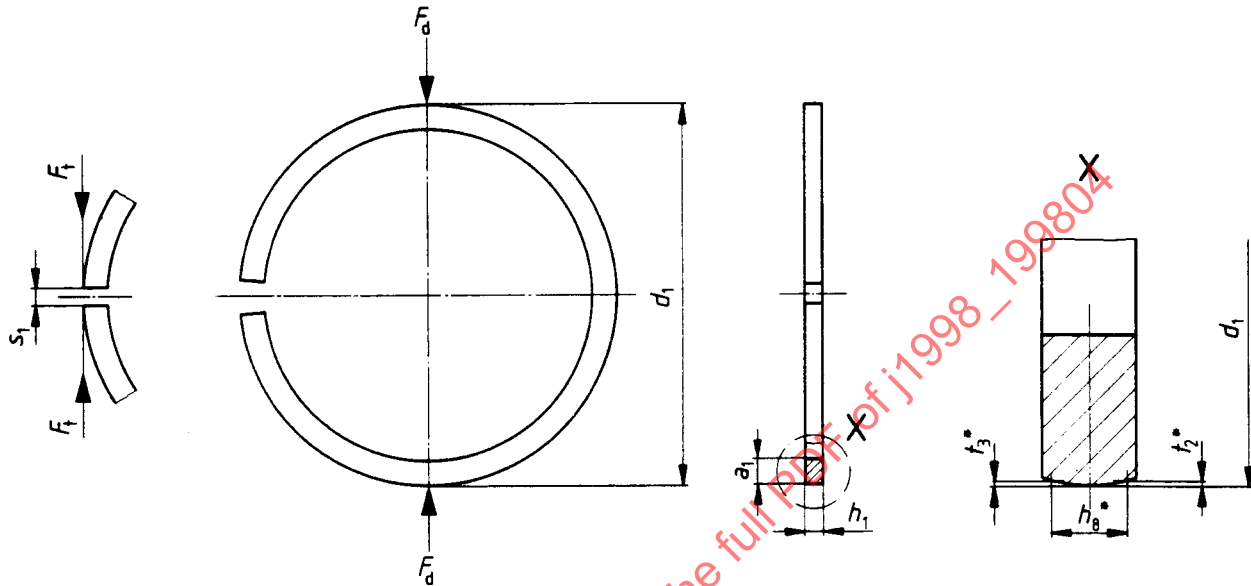
3.1.2 DESIGNATION EXAMPLE—Designation of a straight faced rectangular ring with narrow ring width of $d_1 = 60$ mm nominal diameter, $h_1 = 1.2$ mm ring width made of spheroidal graphite cast iron heat-treated (material subclass 51), general features as shown in Figure 1, and periphery chromium coated fully faced design 0.1 mm minimum thickness:

a. Piston ring SAE J1998 R-60 x 1.2-MC51/CR2

3.2 Type B—Barrel Faced Rectangular Ring

3.2.1 GENERAL FEATURES

NOTE—See Table 8 or 9 for dimensions and forces.



*See Table 1.

FIGURE 2—TYPE B

TABLE 1—GAUGE WIDTH (h_8) AND BARREL DIMENSIONS

Dimensions in millimeters				
h_1	h_s	t_2, t_s	t_2, t_s	Maximum Peak Off Center
1.2	0.6	0.001	0.013	0.2
1.5	0.8	0.002	0.016	0.25

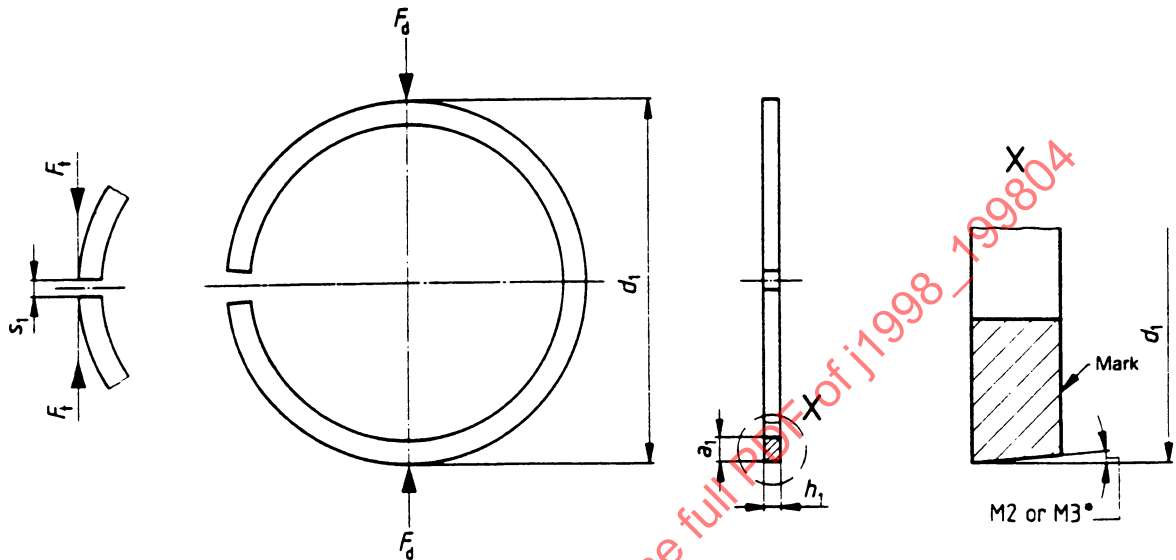
3.2.2 DESIGNATION EXAMPLE—Designation of a barrel faced rectangular ring with narrow ring width of $d_1 = 60$ mm nominal diameter, $h_1 = 1.2$ mm ring width made of steel (material subclass 62), general features as shown in Figure 2, and periphery chromium coated fully faced design 0.1 mm minimum thickness:

a. Piston ring SAE J1988 B-60 x 1.2-MC62/CR2

3.3 Type M—Taper Faced Rectangular Ring

3.3.1 GENERAL FEATURES

NOTE—See Table 8 or 9 for dimensions and forces.



*See Table 2.

FIGURE 3—TYPE M

TABLE 2—TAPER UNCOATED AND COATED RINGS (MOLYBDENUM OR CHROMIUM WITH TAPERED PERIPHERY GROUND)

Taper	Tolerance ⁽¹⁾	Tolerance ⁽¹⁾	With IF or IW ⁽²⁾ (Top Side) Tolerance ⁽¹⁾	With IF or IW ⁽²⁾ (Top Side) Tolerance ⁽¹⁾
M2	30'	+50'	30'	+60'
M3	60'	0	60'	0

1. For coated rings with tapered periphery not ground, the tolerance shall be increased by 10' (e.g., M3 = 60': +60' for M-rings or -70' for M-rings with IF or IW).

0 0

2. IF and IW are explained in Figures 16 and 17.

3.3.2 DESIGNATION EXAMPLE—Designation of a taper faced rectangular ring with narrow ring width of $d_1 = 60$ mm nominal diameter, $h_1 = 1.2$ mm ring width made of spheroidal graphite cast iron, heat-treated (material subclass 51) general features as shown in Figure 3 with taper M3 = 60' and periphery chromium coated fully faced design 0.1 mm minimum thickness:

- a. Piston ring SAE J1998 M3-60 x 1.2-MC51/CR2

4. Common Features

4.1 Type R—Straight Faced Rectangular Ring

4.1.1 UNCOATED RINGS

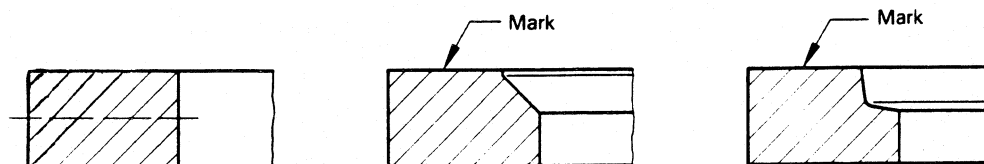


FIGURE 4—UNCOATED TYPE R RINGS

4.1.2 COATED RINGS (CHROMIUM OR MOLYBDENUM)

4.1.2.1 Fully Faced

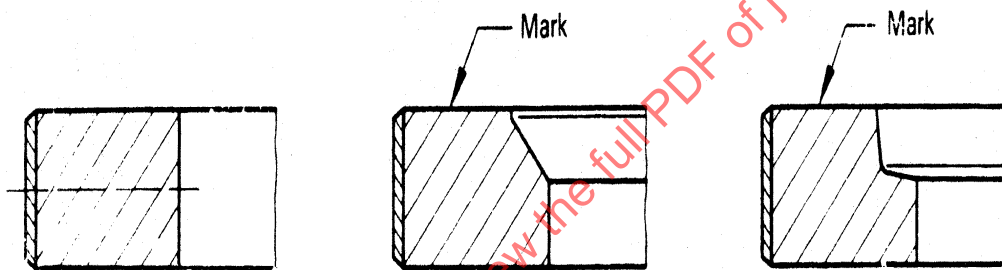


FIGURE 5—FULLY FACED COATED TYPE R RINGS

4.1.2.2 Semi-Inlaid

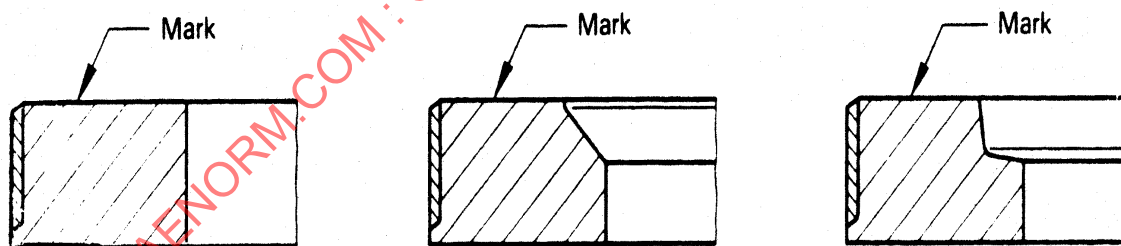


FIGURE 6—SEMI-INLAID COATED TYPE R RINGS

4.1.2.3 Inlaid

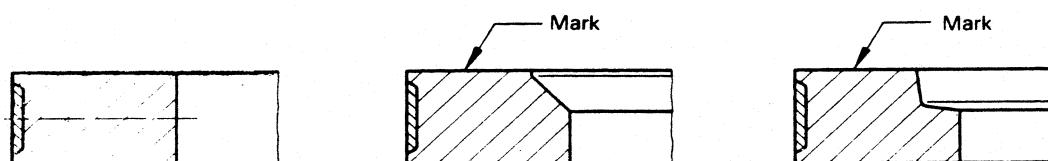


FIGURE 7—INLAID COATED TYPE R RINGS

4.2 Type B—Barrel Faced Rectangular Ring

4.2.1 UNCOATED RINGS

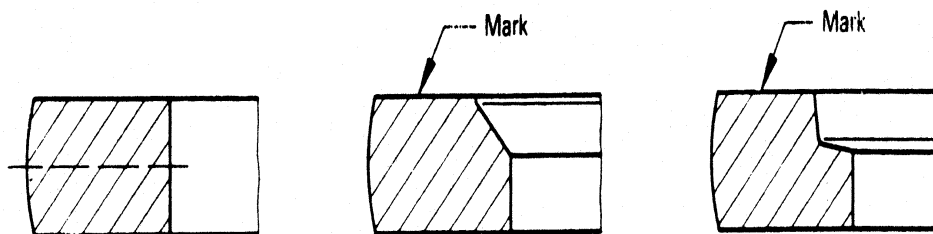


FIGURE 8—UNCOATED TYPE B RINGS

4.2.2 COATED RINGS (CHROMIUM OR MOLYBDENUM)

4.2.2.1 Fully Faced

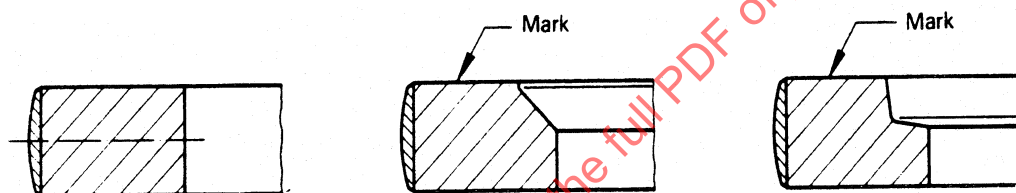


FIGURE 9—FULLY FACED COATED TYPE B RINGS

4.2.2.2 Semi-Inlaid

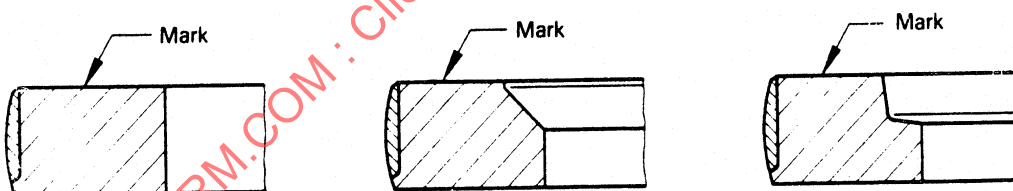


FIGURE 10—SEMI-INLAID COATED TYPE B RINGS

4.2.2.3 Inlaid

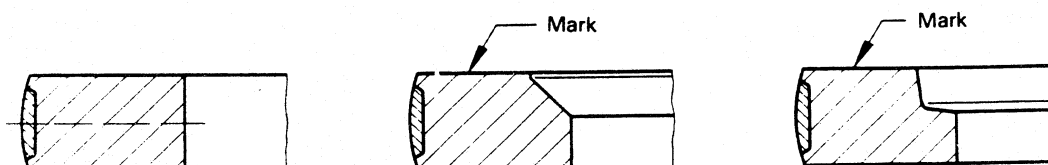


FIGURE 11—INLAID COATED TYPE B RINGS

4.3 Type M—Taper Faced Rectangular Rings

4.3.1 UNCOATED RINGS

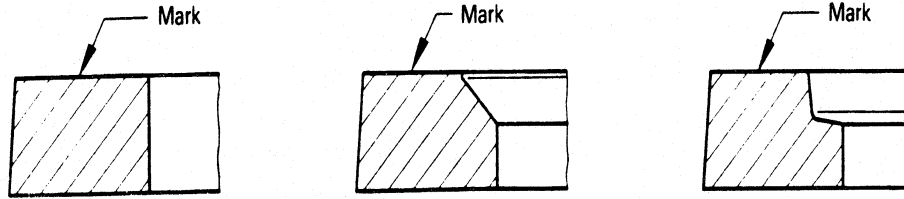


FIGURE 12—UNCOATED TYPE M RINGS

4.3.2 COATED RINGS (CHROMIUM OR MOLYBDENUM)

4.3.2.1 Fully Faced

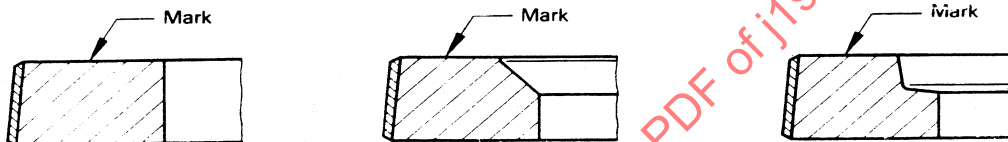


FIGURE 13—FULLY FACED COATED TYPE M RINGS

4.3.2.2 Semi-Inlaid

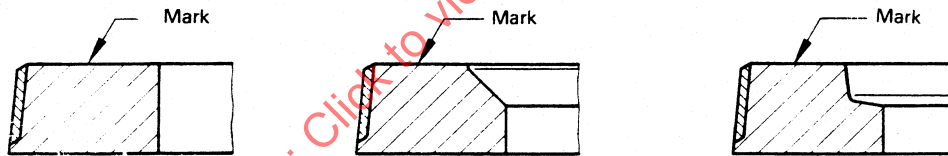


FIGURE 14—SEMI-INLAID COATED TYPE M RINGS

4.3.2.3 Inlaid

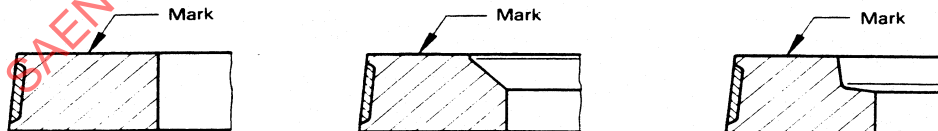


FIGURE 15—INLAID COATED TYPE M RINGS

4.4 R, B, and M Rings (Positive Twist Type)—Internal Bevel (Top Side) or Internal Step (Top Side)

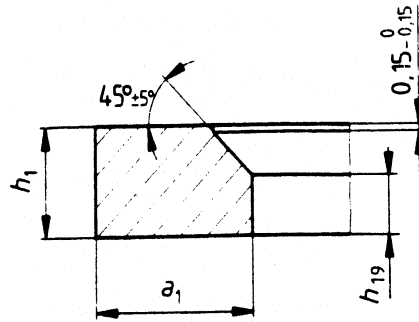


FIGURE 16—INTERNAL BEVEL (IF)

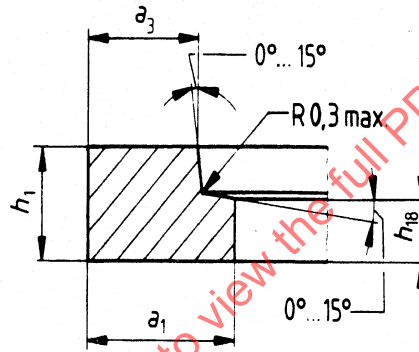


FIGURE 17—INTERNAL STEP (IW)

TABLE 3— h_{18} , h_{19} , AND a_3 DIMENSIONS

Dimensions in millimeters				
d_1	h_{18}, h_{19}	h_{18}, h_{19} Tolerance	a_3	a_3 Tolerance
$30 \leq d_1 < 60$	$0.6 \times h_1$	0 -0.25	$0.85 \times a_1$	0 -0.2
$60 \leq d_1 \leq 100$	$0.6 \times h_1$	0 -0.25	$0.9 \times a_1$	0 -0.3

4.5 Chamfered Edges (Cast Iron Rings)

4.5.1 R AND B RINGS—OUTSIDE CHAMFERED EDGES (KA)



FIGURE 18—OUTSIDE CHAMFERED EDGES (KA)

4.5.2 R, B, AND M RINGS—INSIDE CHAMFERED EDGES (KI)

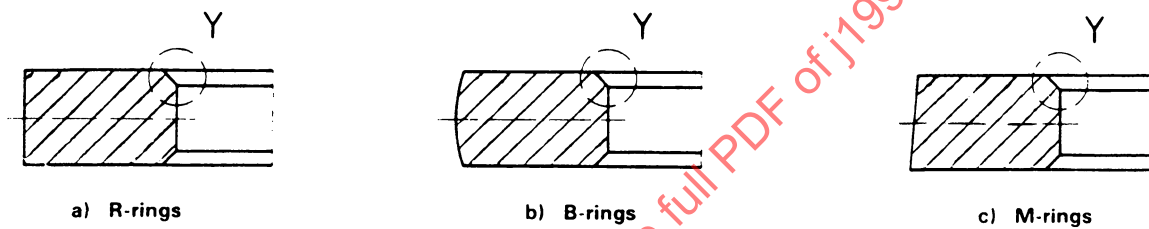


FIGURE 19—INSIDE CHAMFERED EDGES (KI)

4.5.3 R AND B RINGS—OUTSIDE AND INSIDE CHAMFERED EDGES (KA AND KI)

NOTE—See Table 4 for dimensions.



FIGURE 20—OUTSIDE AND INSIDE CHAMFERED EDGES (KA AND KI)

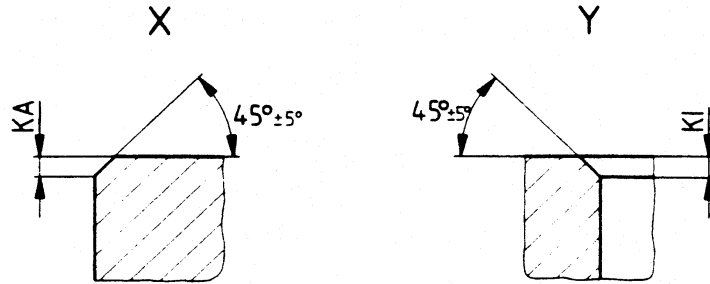


FIGURE 21—DETAILS OF FIGURES 18, 19, AND 20

TABLE 4—KA AND KI DIMENSIONS

KA	KI
0.15 ± 0.1	max 0.2

4.6 R and B Steel Rings—Outside and Inside Rounded Edges



FIGURE 22—OUTSIDE AND INSIDE ROUNDED EDGES

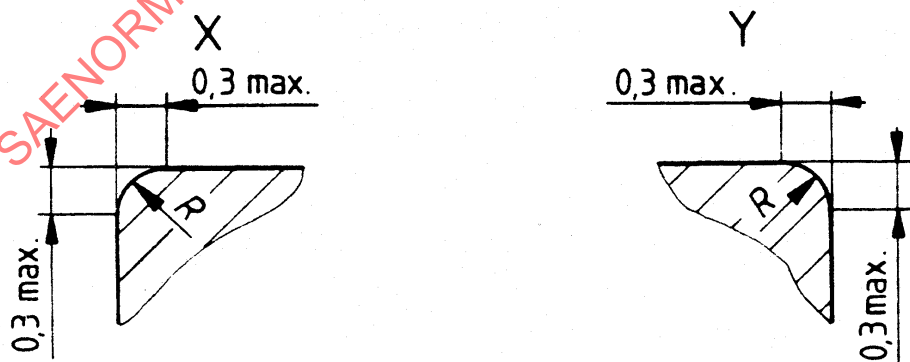


FIGURE 23—DETAILS OF FIGURE 22

4.7 R, B, and M Rings (Fully Faced, Semi-Inlaid, and Inlaid)—Layer Thickness

NOTE—See Table 5 for dimensions.

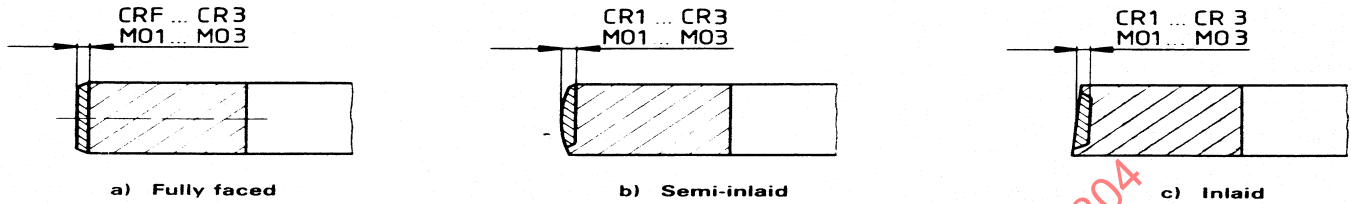


Figure 24—LAYER THICKNESS

TABLE 5—LAYER THICKNESS

Dimensions in millimeters		
Chromium	Molybdenum	Thickness min
CRF	—	0.005
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 Table 8 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 6 and 7 and the force correction factors given in SAE J1591 shall be used.

Also the tangential and diametral force given in Table 9 shall be corrected when additional features are being used.

**TABLE 6—FORCE CORRECTION FACTORS FOR R, B, AND M RINGS
WITH FEATURES KA, KI, IF, IW, AND TAPER**

Factor KA	Factor KI	Factor Taper M3	Factor IF	Factor IW $d < 60_1$	Factor IW $d > 60_1$	Factor KA and KI	Factor KA and Taper M3	Factor KA and IF	Factor KA and IW $d_1 < 60$	Factor KA and IW $d > 60_1$
0.98	0.98	0.98	0.87	0.77	0.82	0.96	0.96	0.85	0.75	0.8

**TABLE 7—FORCE CORRECTION FACTORS FOR COATED R, B, AND M RINGS
(FULLY FACED, SEMI-INLAID, AND INLAID TYPE)**

d_1 mm	Factor CRF	Factor CR1	Factor CR2/MO1	Factor CR3	Factor MO2	Factor MO3
$30 \leq d_1 < 50$	1	0.81	0.7	—	0.64	—
$50 \leq d_1 \leq 100$	1	0.9	0.85	0.81	0.81	0.75

6. Dimensions

TABLE 8—DIMENSIONS OF R, B, AND M RECTANGULAR RINGS
WITH NARROW RING WIDTH MADE OF CAST IRON

Nominal diameter d_1	Radial wall thickness		Ring width		Closed gap		Tangential force		Diametral force	
	a_1	Tolerance	h_1	Tolerance	s_1	Tolerance	F_t , N	Tolerance	F_{dt} , N	Tolerance
30	1,25	± 0,15 Within a ring: 0,15 max.	1,2	-0,01 -0,025 For phosphated PO surface: -0,005 -0,03	0,15	+0,2 0	—	—	6	± 30 %
31	1,3						6,2			
32	1,35						6,7			
33	1,4						6,9			
34	1,4						6,5			
35	1,45						—		6,9	
36	1,5						7,1			
37	1,55						7,5			
38	1,6						7,7			
39	1,65						8,2			
40	1,65						—		7,7	
41	1,7						8,2			
42	1,75						8,4			
43	1,8						8,8			
44	1,85						9			
45	1,9						—		9,2	
46	1,9						9			
47	1,95						9,2			
48	2						9,7			
49	2,05						9,9			
50	2,1						4,8	± 30 %	10,3	
51	2,15						4,9		10,5	
52	2,15						4,7		10,1	
53	2,2						4,9		10,5	
54	2,25						5		10,8	
55	2,3						5,2		11,2	
56	2,35						5,4		11,6	
57	2,4						5,5		11,8	
58	2,4						5,3		11,4	
59	2,45						5,5		11,8	
60	2,5						5,6		12	
61	2,55						5,7		12,3	
62	2,6						5,9		12,7	
63	2,65						6,1		13,1	
64	2,65						5,9		12,7	
65	2,7						6		12,9	
66	2,75						6,2		13,3	
67	2,8						6,3		13,3	
68	2,85						6,5		14	
69	2,9						6,6		14,2	
70	2,9						6,4		13,8	
71	2,95						6,6		14,2	
72	3						6,7		14,4	
73	3,05						6,9		14,8	
74	3,1						7,1		15,3	

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

**TABLE 8—DIMENSIONS OF R, B, AND M RECTANGULAR RINGS
WITH NARROW RING WIDTH MADE OF CAST IRON (CONTINUED)**

Nominal diameter d_1	Radial wall thickness a_1 Tolerance	Ring width h_1 Tolerance	Closed gap s_1 Tolerance	Tangential force F_t , N Tolerance	Diametral force F_d , N Tolerance
75	3,15	1,2	0,25	7,2	15,5
76	3,15			7	15,1
77	3,2			7,1	15,3
78	3,25			7,3	15,7
79	3,3			7,4	15,9
80	3,35			7,6	16,3
81	3,4			7,8	16,8
82	3,4			7,6	16,3
83	3,45			7,7	16,6
84	3,5			7,9	17,1
85	3,55		0,25	8	17,2
86	3,6			8,2	17,6
87	3,65			8,3	17,8
88	3,65			8,1	17,4
89	3,7			8,3	17,8
90	3,75			8,5	18,2

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 9, apply to steel with a typical modulus of elasticity (E_s) of 200 000 MPa.

Mean forces are calculated for nominal radial wall thickness (a_1), mean ring width (h_1), and no coating.

NOTE 3—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.

**TABLE 9—DIMENSIONS OF R, B, AND M RECTANGULAR RINGS
WITH NARROW RING WIDTH MADE OF STEEL**

Nominal diameter d_1	Radial wall thickness a_1	Ring width h_1		Closed gap s_1		Tangential force F_t , N		Diametral force F_d , N	
		Tolerance		Tolerance		Tolerance		Tolerance	
		Column 1	Column 2	Column 1	Column 2	Column 1	Column 2	Column 1	Column 2
30	1,1					—	—	6,8	8,5
31								7	8,8
32								7,3	9,1
33								7,5	9,4
34	1,3							8,2	10,5
35						—	—	8,4	10,8
36								8,6	11,1
37								8,9	11,4
38								9,2	11,8
39	1,5							9,5	12
40						—	—	9,7	12,3
41								9,9	12,5
42								10,1	12,9
43								10,3	13,1
44	1,7							10,5	13,3
45						—	—	11	13,5
46								11,2	14
47								11,4	14,2
48								11,6	14,6
49	1,9							11,8	14,8
50						5,6	7	12	15,1
51						5,7	7,2	12,3	15,5
52						5,8	7,3	12,5	15,7
53						6	7,5	12,9	16,1
54	2,1					6,1	7,6	13,1	16,3
55						6,2	7,7	13,3	16,6
56						6,3	7,9	13,5	17
57						6,4	8	13,8	17,2
58						6,5	8,2	14	17,6
59						6,6	8,3	14,2	17,8
60	2,3					6,7	8,5	14,4	18,3
61						6,9	8,6	14,8	18,5
62						7	8,7	15,1	18,7
63						7,1	8,9	15,3	19,1
64						7,2	9	15,5	19,4
65	2,5					7,3	9,2	15,7	19,8
66						7,4	9,3	15,9	20
67						7,5	9,4	16,1	20,2
68						7,6	9,6	16,3	20,6
69						7,8	9,7	16,8	20,9
70	2,7					7,9	9,9	17,2	21,5
71						8	10	17,4	21,7
72						8,1	10,1	17,6	22,1
73						8,2	10,3	17,8	22,4
74	2,9					8,3	10,4		

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