

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 2401-1 : 2012

(JFPA/JSA)

O-rings — Part 1: O-rings

ICS 23.100.60;83.140.50

Reference number : JIS B 2401-1 : 2012 (E)

PROTECTED BY COPYRIGHT

Date of Establishment: 2012-03-21

Date of Public Notice in Official Gazette: 2012-03-21

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Machine Elements

JIS B 2401-1 : 2012, First English edition published in 2012-10

Translated and published by: Japanese Standards Association

4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Classification	2
4.1 Classification of O-rings	2
4.2 Classification of materials of O-rings and their discrimination symbols	2
5 Shape	3
6 Basic dimensions and size codes	4
7 Appearance	4
8 Material	5
9 Test methods	7
9.1 Dimensions of O-rings	7
9.2 Physical properties of materials of O-rings	7
9.3 Appearance	7
10 Inspection method	7
11 Designation codes of products	7
12 Marking	9
Annex JA (normative) Dimensions and tolerances of O-rings of Series F and non-standard O-rings	15
Annex JB (normative) Dimensions and tolerances of O-rings of Series S	26
Annex JC (normative) Test methods of physical properties for materials of O-rings	36
Annex JD (informative) Physical properties related to oil resistance, low-temperature resistance and corrosiveness of materials of O-rings and their test methods	38
Annex JE (informative) Physical properties and its test method of O-rings as products	44
Annex JF (informative) Comparison table between JIS and the corresponding International Standard	47

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by Japan Fluid Power Association (JFPA) /Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently **JIS B 2401:2005** is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or the utility model right.

JIS B 2401 series consists of the following 4 parts under the general title “*O-rings*”:

Part 1: O-rings

Part 2: Housing dimensions and sizes

Part 3: Quality acceptance criteria

Part 4: Anti-extrusion rings (back-up rings)

O-rings — Part 1 : O-rings

Introduction

This Japanese Industrial Standard has been prepared based on the fourth edition of **ISO 3601-1** published in 2008 with modifications of the technical contents which involve addition of types and materials of O-rings that are popularly used in Japan.

The portions given continuous sidelines or dotted underlines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex JF. Annex JA to Annex JE contain matters that are not given in the corresponding International Standard.

1 Scope

This Standard specifies the shapes, dimensions, appearance, material and other matters for O-rings used for general machinery applications, more specifically, O-rings for dynamic applications (P), O-rings for static applications (G), O-rings for vacuum flanges applications (V). O-ring specifications in **ISO 3601-1** are given in Annexes, as ISO O-rings for general industrial applications (Series F) in Annex JA and as ISO O-rings for precision instrument applications (Series S) in Annex JB.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 3601-1 : 2008 *Fluid power systems — O-rings — Part 1 : Inside diameters, cross-sections, tolerances and designation codes* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0142 *Fluid power systems and components — Vocabulary*

NOTE : Corresponding International Standard : **ISO 5598** : 2008 *Fluid power systems and components — Vocabulary* (MOD)

JIS B 2401-3 *O-rings — Part 3 : Quality acceptance criteria*

NOTE : Corresponding International Standard : **ISO 3601-3** : 2005 *Fluid power systems — O-rings — Part 3 : Quality acceptance criteria* (MOD)

JIS B 2410 *O-rings — Suitability of elastomeric materials for industrial applications*

JIS K 6250 *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

JIS K 6251 *Rubber, vulcanized or thermoplastics — Determination of tensile stress-strain properties*

JIS K 6253-3 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 3 : Durometer method*

NOTE : Corresponding International Standard : **ISO 7619-1** : 2010 *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1 : Durometer method (Shore hardness)* (MOD)

JIS K 6257 *Rubber, vulcanized or thermoplastic — Determination of heat ageing properties*

JIS K 6262 *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS B 0142** apply.

4 Classification

4.1 Classification of O-rings

O-rings are classified as shown in table 1.

Table 1 Classification of O-rings

Classification of O-ring	Symbol of classification
<u>O-rings for dynamic applications</u>	P
<u>O-rings for static applications</u>	G
<u>O-rings for vacuum flange applications</u>	V
ISO O-rings for general industrial applications	F
ISO O-rings for precision instrument applications	S

4.2 Classification of materials of O-rings and their discrimination symbols

Classification of materials of O-rings and their discrimination symbols are as shown in table 2.

Table 2 Classification of materials of O-rings and their discrimination symbols

Classification of material	Type A durometer hardness ^{b)}	Discrimination symbol of classification of material	Meaning of symbol	Conventional discrimination symbol (informative)
Nitrile rubber for general application [NBR ^{a)}]	70	NBR-70-1	Mineral oil resistant, Type A durometer hardness A70	Class A or 1A
	90	NBR-90	Mineral oil resistant, Type A durometer hardness A90	Class B or 1B
Nitrile rubber for fuel application [NBR ^{a)}]	70	NBR-70-2	Petroleum resistant, Type A durometer hardness A70	Class 2 or 2
Hydrogenated nitrile rubber [HNBR ^{a)}]	70	HNBR-70	Mineral oil resistant and heat resistant, Type A durometer hardness A70	—
	90	HNBR-90	Mineral oil resistant and heat resistant, Type A durometer hardness A90	—
Fluoro-rubber [FKM ^{a)}]	70	FKM-70	Heat resistant, Type A durometer hardness A70	Class 4D or 4D
	90	FKM-90	Heat resistant, Type A durometer hardness A 90	—
Ethylene propylene rubber [EPDM ^{a)}]	70	EPDM-70	Animal and vegetable oil resistant and brake oil resistant, Type A durometer hardness A70	Class 3 or 3
	90	EPDM-90	Animal and vegetable oil resistant and brake oil resistant, Type A durometer hardness A90	—
Silicone rubber [VMQ ^{a)}]	70	VMQ-70	Heat resistant and low temperature resistant, Type A durometer hardness A 70	Class 4C or 4C
Acrylic rubber [ACM ^{a)}]	70	ACM-70	Heat resistant and mineral oil resistant, Type A durometer hardness A70	—
Notes ^{a)} For the abbreviations in brackets, see JIS K 6397 . ^{b)} For Type A durometer hardness, see JIS K 6253-3 .				

5 Shape

The shape of O-ring shall be as shown in figure 1.

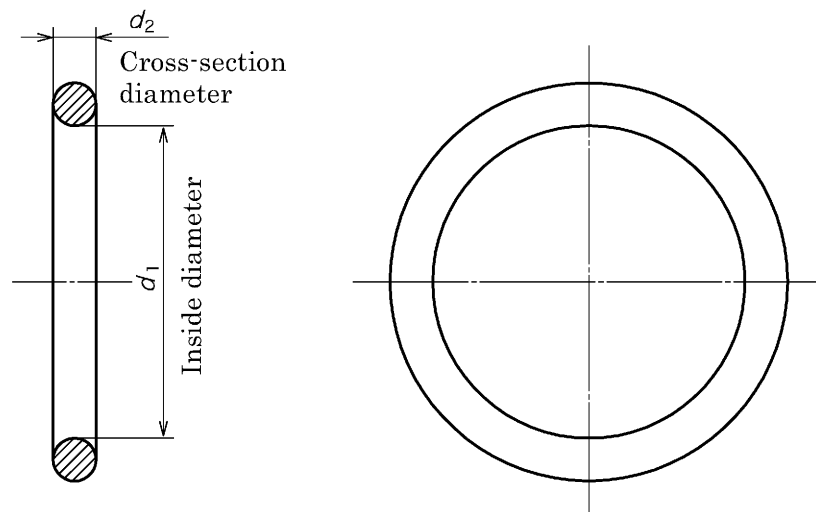


Figure 1 Shape of O-ring

6 Basic dimensions and size codes

Basic dimensions and size codes of O-rings are given in table 3. Dimensions and codes other than given in the table 3 shall be as agreed between the purchaser and the manufacturer.

Table 3 Basic dimensions and size codes of O-rings

Classification of O-rings	Basic dimension and size code
O-rings for dynamic applications	In accordance with table 5.
O-rings for static applications	In accordance with table 6.
O-rings for vacuum flange applications	In accordance with table 7.
ISO O-rings for general industrial applications ^{a)}	In accordance with Annex JA.
ISO O-rings for precision instrument applications	In accordance with Annex JB.
Note ^{a)} For ISO O-rings for general industrial applications, Class A tolerances, for precision applications, and Class B tolerances, for more general applications, are specified.	

7 Appearance

The appearance of the surface of the O-ring shall be in accordance with quality grades N, S, and CS of **JIS B 2401-3**.

For the appearance of the O-ring of size 10 mm ± 0.30 mm in table 7, which is not specified in **JIS B 2401-3**, the quality acceptance grade for cross-section diameter over 5.7 mm up to and including 8.4 mm given in **JIS B 2401-3** shall be applied.

8 Material

The material of O-rings, when tested in accordance with clause 9, shall satisfy the requirements in table 4, and shall be homogenous without foreign matter inclusions or abnormal dispersion. Further, the material of O-rings shall be sufficiently resistant to oil and low temperature, and shall not corrode or stick to the mating metal.

Physical properties not specified in table 4 shall be subject to agreement between the purchaser and the manufacturer, which may also be based on Annex JD. For physical properties of O-rings as products, Annex JE should be referred to.

Table 4 Physical properties of materials used for O-rings

Test items		Discrimination symbol indicating the classification of material											Test method
		NBR -70-1	NBR -90	NBR -70-2	HNBR -70	HNBR -90	FKM -70	FKM -90	EPDM -70	EPDM -90	VMQ -70	ACM -70	
Test under standard conditions	Type A durometer hardness	A70 ±5	A90 ±5	A70 ±5	A70 ±5	A90 ±5	A70 ±5	A90 ±5	A70 ±5	A90 ±5	A70 ±5	A70 ±5	To be in accordance with JC.2.2.
	Tensile strength MPa min.	10.0	14.0	10.0	16.0	16.0	10.0	10.0	10.0	10.0	3.5	6.0	
	Elongation % min.	250	100	200	180	100	170	80	150	80	60	100	
	Tensile stress MPa min. (at 100 % elongation)	2.5	—	2.5	2.5	—	2.0	—	—	—	—	—	
Heat aging test	Temperature and time	120 °C, 72 h	120 °C, 72 h	100 °C, 72 h	150 °C, 72 h	150 °C, 72 h	230 °C, 72 h	230 °C, 72 h	100 °C, 72 h	100 °C, 72 h	230 °C, 72 h	150 °C, 72 h	To be in accordance with JC.2.3.
	Type A durometer hardness max.	+10	+10	+10	+15	+15	+5	+5	+10	+10	+10	+10	
	Tensile strength variation ratio % max.	−15	−25	−15	−30	−30	−10	−10	−15	−15	−10	−30	
	Elongation variation ratio % max.	−45	−55	−40	−40	−40	−25	−25	−45	−45	−25	−40	
Compression set test	Temperature and time	120 °C, 72 h	120 °C, 72 h	100 °C, 72 h	150 °C, 72 h	150 °C, 72 h	200 °C, 72 h	200 °C, 72 h	100 °C, 72 h	100 °C, 72 h	175 °C, 72 h	150 °C, 72 h	To be in accordance with JC.2.4.
	Compression set % max.	40	40	25	40	40	40	40	25	30	30	60	

9 Test methods

9.1 Dimensions of O-rings

- a) **Cross-section diameter** The cross-section diameter shall be measured by means of a dial gauge, profile projector or the like.
- b) **Inside diameter** The inside diameter shall be measured by means of a conical gauge for inside diameter measurement, profile projector or the like.

9.2 Physical properties of materials of O-rings

The physical properties of materials of O-rings shall be tested in accordance with the method described in Annex JC.

9.3 Appearance

The appearance of the surface of the O-ring shall be tested as specified in clause 7.

10 Inspection method

The inspection shall be performed by the reasonable sampling plan, and when the tests as described in clause 9 are performed, the requirements in clauses 6, 7 and 8 shall be satisfied.

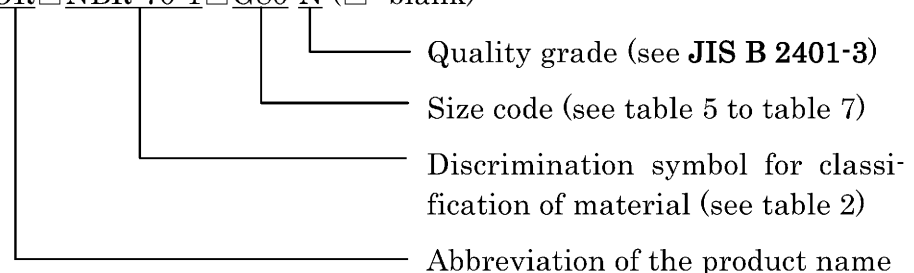
11 Designation codes of products

The products shall be designated by codes consisting of the elements specified in the following for each series, with the abbreviation “OR”, indicating the title of this Standard, O-ring, at the beginning.

- a) An example of designation code in which the dimensions and size code are as given in table 5, for O-rings for dynamic applications (P), in table 6, for O-rings for static applications (G), and in table 7, for O-rings for vacuum flange applications (V) is shown in example 1 below. If dimensions and size code other than those given in the said tables are used, the designation code for the O-ring for dynamic applications (P), O-ring for static applications (G), or the O-ring for vacuum flange applications (V) shall be as agreed between the purchaser and the manufacturer, in which case example 2 given below should be referred to.

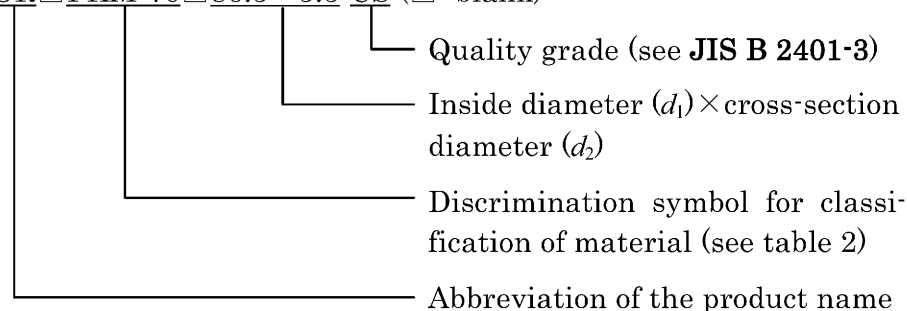
Example 1 Designation code in the case of material NBR-70-1, O-ring for static applications of size code G80, quality grade N :

OR □ NBR-70-1 □ G80-N (□ : blank)



Example 2 Designation code in the case of material FKM-70, inside diameter 86.5, cross-section diameter 5.5, quality grade CS :

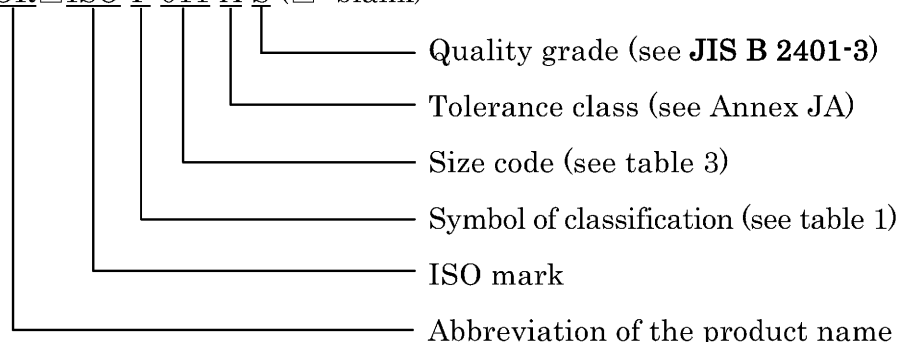
OR□ FKM-70□ 86.5×5.5-CS (□: blank)



- b) An example of designation code for O-rings of Series F in which the dimensions and size code are as shown in table JA.1 to table JA.6 is shown in example 1 below. If the dimensions and size code other than those given in the said tables are used, the designation code for the Series F O-ring should be decided referring to example 2 below.

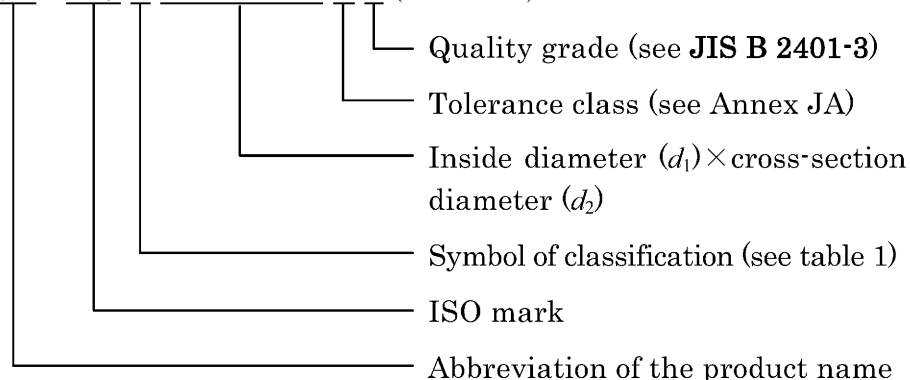
Example 1 Designation code in the case of ISO Series F, size code 011, class A tolerance, quality grade S :

OR□ ISO-F-011-A-S (□: blank)



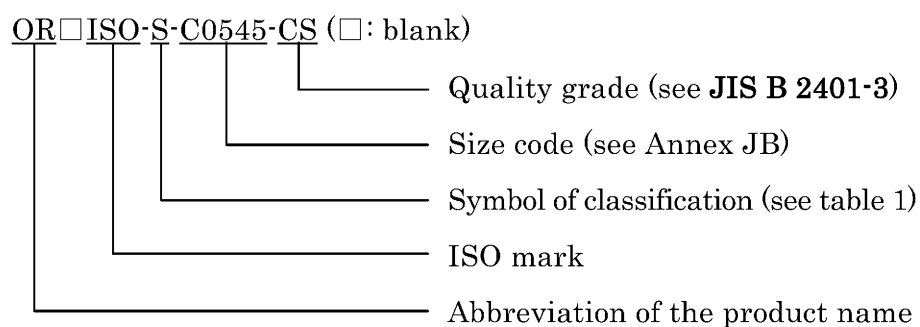
Example 2 Designation code in the case of O-rings of Series F not specified in ISO, inside diameter 68.50, cross-section diameter 2.62, class A tolerance, quality grade S :

OR□ ISO-F-68.50×2.62-A-S (□: blank)



- c) An example of designation code for O-rings of Series S in which the dimensions and size code are as shown in table JB.1 to table JB.5 is shown in the following.

Example An designation code in the case of ISO Series S, size code C0545, quality grade CS :



12 Marking

On the package of the product, the following shall be indicated.

- a) Title or number of this Standard
- b) Designation code of the product
- c) Discrimination symbol of the classification of the material
- d) Manufacturer's name or its abbreviation
- e) Date of manufacture or its abbreviation
- f) Use instructions (For marking of the compatibility with hydraulic fluid, see **JIS B 2410**.)

Table 5 Size code, inside diameter, and basic dimension of cross-section diameter and its tolerance for O-rings for dynamic applications (P)

Unit : mm

Inside diameter d_1		Basic dimension of cross-section diameter d_2 and its tolerance				
Basic dimension	Tolerance $\pm$	1.9 $\pm$ 0.08	2.4 $\pm$ 0.09	3.5 $\pm$ 0.10	5.7 $\pm$ 0.13	8.4 $\pm$ 0.15
		Size code				
2.8	0.14	P 3				
3.8	0.14	P 4				
4.8	0.15	P 5				
5.8	0.15	P 6				
6.8	0.16	P 7				
7.8	0.16	P 8				
8.8	0.17	P 9				
9.8	0.17	P10				
9.8	0.17		P10A			
10.8	0.18		P11			
11.0	0.18		P11.2			
11.8	0.19		P12			
12.3	0.19		P12.5			
13.8	0.19		P14			
14.8	0.20		P15			
15.8	0.20		P16			
17.8	0.21		P18			
19.8	0.22		P20			
20.8	0.23		P21			
21.8	0.24		P22			
21.7	0.24			P22A		
22.1	0.24			P22.4		
23.7	0.24			P24		
24.7	0.25			P25		
25.2	0.25			P25.5		
25.7	0.26			P26		
27.7	0.28			P28		
28.7	0.29			P29		
29.2	0.29			P29.5		
29.7	0.29			P30		
30.7	0.30			P31		
31.2	0.31			P31.5		
31.7	0.31			P32		
33.7	0.33			P34		
34.7	0.34			P35		
35.2	0.34			P35.5		
35.7	0.34			P36		
37.7	0.37			P38		
38.7	0.37			P39		
39.7	0.37			P40		
40.7	0.38			P41		
41.7	0.39			P42		
43.7	0.41			P44		

For tolerance on d_1 to be applied for classification of material FKM, VMQ, HNBR and ACM, the value given above shall be multiplied by 1.5 for VMQ and ACM, and 1.2, for FKM and HNBR.

Table 5 (continued)

Unit : mm

Inside diameter d_1		Basic dimension of cross-section diameter d_2 and its tolerance				
Basic dimension	Tolerance $\pm$	1.9 $\pm$ 0.08	2.4 $\pm$ 0.09	3.5 $\pm$ 0.10	5.7 $\pm$ 0.13	8.4 $\pm$ 0.15
		Size code				
44.7	0.41			P45		
45.7	0.42			P46		
47.7	0.44			P48		
48.7	0.45			P49		
49.7	0.45			P50		
47.6	0.44				P48A	
49.6	0.45				P50A	
51.6	0.47				P52	
52.6	0.48				P53	
54.6	0.49				P55	
55.6	0.50				P56	
57.6	0.52				P58	
59.6	0.53				P60	
61.6	0.55				P62	
62.6	0.56				P63	
64.6	0.57				P65	
66.6	0.59				P67	
69.6	0.61				P70	
70.6	0.62				P71	
74.6	0.65				P75	
79.6	0.69				P80	
84.6	0.73				P85	
89.6	0.77				P90	
94.6	0.81				P95	
99.6	0.84				P100	
101.6	0.85				P102	
104.6	0.87				P105	
109.6	0.91				P110	
111.6	0.92				P112	
114.6	0.94				P115	
119.6	0.98				P120	
124.6	1.01				P125	
129.6	1.05				P130	
131.6	1.06				P132	
134.6	1.09				P135	
139.6	1.12				P140	
144.6	1.16				P145	
149.6	1.19				P150	
149.5	1.19					P150A
154.5	1.23					P155
159.5	1.26					P160
164.5	1.30					P165
169.5	1.33					P170

For tolerance on d_1 to be applied for classification of material FKM, VMQ, HNBR and ACM, the value given above shall be multiplied by 1.5 for VMQ and ACM, and 1.2, for FKM and HNBR.

Table 5 (concluded)

Unit : mm

Inside diameter d_1		Basic dimension of cross-section diameter d_2 and its tolerance				
Basic dimension	Tolerance $\pm$	1.9 $\pm$ 0.08	2.4 $\pm$ 0.09	3.5 $\pm$ 0.10	5.7 $\pm$ 0.13	8.4 $\pm$ 0.15
		Size code				
174.5	1.37					P175
179.5	1.40					P180
184.5	1.44					P185
189.5	1.48					P190
194.5	1.51					P195
199.5	1.55					P200
204.5	1.58					P205
208.5	1.61					P209
209.5	1.62					P210
214.5	1.65					P215
219.5	1.68					P220
224.5	1.71					P225
229.5	1.75					P230
234.5	1.78					P235
239.5	1.81					P240
244.5	1.84					P245
249.5	1.88					P250
254.5	1.91					P255
259.5	1.94					P260
264.5	1.97					P265
269.5	2.01					P270
274.5	2.04					P275
279.5	2.07					P280
284.5	2.10					P285
289.5	2.14					P290
294.5	2.17					P295
299.5	2.20					P300
314.5	2.30					P315
319.5	2.33					P320
334.5	2.42					P335
339.5	2.45					P340
354.5	2.54					P355
359.5	2.57					P360
374.5	2.67					P375
384.5	2.73					P385
399.5	2.82					P400

For tolerance on d_1 to be applied for classification of material FKM, VMQ, HNBR and ACM, the value given above shall be multiplied by 1.5 for VMQ and ACM, and 1.2, for FKM and HNBR.

Table 6 Size code, inside diameter, and basic dimension of cross-section diameter and its tolerance for O-rings for static applications (G)

Unit : mm

Inside diameter d_1		Basic dimension of cross-section diameter d_2 and its tolerance	
Basic dimension	Tolerance $\pm$	3.1 $\pm$ 0.10	5.7 $\pm$ 0.13
		Size code	
24.4	0.25	G25	
29.4	0.29	G30	
34.4	0.33	G35	
39.4	0.37	G40	
44.4	0.41	G45	
49.4	0.45	G50	
54.4	0.49	G55	
59.4	0.53	G60	
64.4	0.57	G65	
69.4	0.61	G70	
74.4	0.65	G75	
79.4	0.69	G80	
84.4	0.73	G85	
89.4	0.77	G90	
94.4	0.81	G95	
99.4	0.85	G100	
104.4	0.87	G105	
109.4	0.91	G110	
114.4	0.94	G115	
119.4	0.98	G120	
124.4	1.01	G125	
129.4	1.05	G130	
134.4	1.08	G135	
139.4	1.12	G140	
144.4	1.16	G145	
149.3	1.19		G150
154.3	1.23		G155
159.3	1.26		G160
164.3	1.30		G165
169.3	1.33		G170
174.3	1.37		G175
179.3	1.40		G180
184.3	1.44		G185
189.3	1.47		G190
194.3	1.51		G195
199.3	1.55		G200
209.3	1.61		G210
219.3	1.68		G220
229.3	1.73		G230
239.3	1.81		G240
249.3	1.88		G250
259.3	1.94		G260
269.3	2.01		G270
279.3	2.07		G280
289.3	2.14		G290
299.3	2.20		G300
For tolerance on d_1 to be applied for classification of material FKM, VMQ, HNBR and ACM, the value given above shall be multiplied by 1.5 for VMQ and ACM, and 1.2, for FKM and HNBR.			