AMERICAN NATIONAL STANDARD

General Purpose Tapered and Reduced Cross Section Retaining Rings

METRIC

ANSI B27.7 - 1977

REAFFIRMED 1999

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

SECRETARIAT

SOCIETY OF AUTOMOTIVE ENGINEERS
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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FOREWORD

American National Standards Committee B27 for the standardization of plain and lock washers was organized in March 1926, as Sectional Committee B27 under the aegis of the American Standards Association (later the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute Inc.), with the Society of Automotive Engineers and The American Society of Mechanical Engineers as joint secretariats. In 1950, this Committee has been designated responsibility for standardization of washers and machine rings.

At a meeting of ANSI B27 Standards Committee held on February 4, 1971 it was recommended to the secretariats (ASME and SAE) that subcommittee 1, 2 and 4 on washers be merged into ANSI B18 Standards Committee and that Subcommittee 3 on retaining rings become a separate Standards Committee retaining the B27 designation. This change was subsequently approved by ANSI.

Formation of Subcommittee 1 on tapered and reduced section retaining rings was authorized by Standards Committee B27 at its meeting on October 15, 1974. At this meeting, it was decided that no further effort should be expended on inch dimensional products and Subcommittee 1 was assigned the responsibility of preparing American metric standards for tapered and reduced section retaining rings.

Subcommittee 1 prepared a draft proposal, General Purpose Tapered and Reduced Cross Section Retaining Rings which was balloted on June 16, 1975. At a subcommittee meeting held on February 17, 1976 results from the letter ballot was reviewed. The proposal was accepted by the subcommittee and presented to the B27 Standards Committee at its May 7, 1976 meeting. At that meeting a letter ballot of the entire committee was authorized. The Standard was duly approved by the committee and its sponsors and submitted to the American National Standards Institute for designation as an American Standard. This was granted on October 20, 1977.

AMERICAN NATIONAL STANDARDS COMMITTEE B27
Standardization of Retaining Rings, Retaining Clips and Similar Devices

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CONTENTS

ILLUSTRATIONS

TABLES

APPENDIX

AMERICAN NATIONAL STANDARD

TAPERED AND REDUCED CROSS SECTION RETAINING RINGS

(External Type—3AM1; Internal Type—3BM1; E-Ring Type—3CM1)

1. INTRODUCTORY NOTES

1.1 Scope

This standard is intended to cover complete general and dimensional data for three series of general purpose tapered and reduced cross section retaining rings which may be used with the nominal size shafts and housings listed and in grooves of the recommended dimensions listed. Also included are formulas and tolerances on which dimensional data are based. Three appendixes include guidance for assembly and recommended standard drawing formats.

The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. Consumers should consult with manufacturers concerning lists of stock production sizes.

1.2 Ring Types

1.2.1 External Rings. Dimensions of basic external retaining rings, and grooves for various shaft sizes are given in Table 4.

1.2.2 Internal Rings. Dimensions for basic internal retaining rings, and grooves for various housing sizes are given in Table 5.

1.2.3 External E-Rings. Dimensions of E-Type external retaining rings, and grooves for various shaft sizes are given in Table 6.

1.2.4 Designations. It is recommended that the preferred type designations be used to identify these rings on drawings, parts list, and other engineering documentation. The basic external rings in this standard are Type 3AM1. The basic internal rings in this standard are Type 3BM1. The E-Type external rings in this standard are Type 3CM1.

1.3 Applicability

The rings denoted in this standard are intended primarily for use with the shaft, housing, and groove sizes recommended; however, in certain cases these diameters may be altered somewhat to suit the requirements of a particular design. When such changes are made, care should be taken to not alter the shaft or housing size to such an extent that the ring will take enough permanent set to allow a loose fit after the ring has been assembled into the groove. Neither should the groove diameter be altered to the extent to permit the ring to fit loosely.

1.4 Dimensions

All dimensions in this standard are in millimetres unless otherwise stated.

1.5 Supplementary Information

Allowable loads, maximum radii and chamfers, clearance dimensions, gaging diameters and rpm limits for all 3 ring series are included in Appendix A, B and C.

2. GENERAL DATA

2.1 Basic Retaining Rings

Type 3AM1 retaining rings covered by this standard are spread over a shaft by means of a pliers or special tool and allowed to relax and seat in a circumferential groove, thereby providing an external protruding shoulder which can be used for locating and retaining a part on the shaft.

Type 3BM1 retaining rings covered by this standard are compressed into a housing by means of a pliers or special tool and allowed to relax and seat in a circumferential groove, thereby providing an internal protruding shoulder which can be used for locating and retaining a part contained inside of the housing.

In both cases, the rings have a tapered section to provide a more uniform distribution of stresses during expansion or compression.

2.2 E-Type Retaining Rings

Type 3CM1 retaining rings covered by this standard contain 3 prongs connected by a reduced section bridge to provide greater resilience during installation. The rings are installed radially, usually by means of an applicator, and provide a high shoulder for abutment by a retained part.

3. MATERIAL

Standard materials used in the manufacture of the retaining rings shall be carbon spring steel, corrosion resistant steel, or beryllium copper.

3.1 Carbon Spring Steel

Retaining rings made from carbon spring steel shall conform to the chemical composition of SAE 1060 to 1090 or AISI 1060 to 1090 or equivalent and have the following physical properties:

3.1.1 Heat Treatment. The retaining rings should be heat treated by austempering to the Rockwell C hardness values as specified in Table 1.

Table 1 Hardness Ranges for Tapered and Reduced Cross Section Retaining Rings

3AM1		3BM1	
Ring Size	Rockwell C	Ring Size	Rockwell C
7 through 12	51-55	8 through 13	51-55
13 through 26	49-53	14 through 20	50-54
27 through 85	48-52	21 through 26	49-53
88 through 100	47-51	27 through 250	48-52

3CM1	
Ring Size	*Rockwell C*
2 through 8	49-53
9 through 25	48-52

3.1.2 Surface Treatment. All retaining rings shall be available with the following protective finishes:

3.1.2.1 Phosphate Coating. Finish shall consist of basic phosphate treatment, and subsequent protective coating of any protective compound other than paint type. Parts furnished to this specification shall show no rust on significant surfaces when exposed to a salt spray resistance test for a period of 2 hours, minimum.

3.1.2.2 Cadmium or Zinc Plating. Basic requirements for plated finishes of either cadmium or zinc shall be a plated finish of 0.005 mm minimum thickness, treated to withstand 32 hours neutral salt spray test without evidence of white corrosion products. Basis metal corrosion should not exceed one spot per 645 square millimetres of significant surface, and such spots should be visible to the naked eye and should not exceed 1.5 millimetres in any dimension.

3.1.2.3 Black Oxide. Finish shall be essentially a black iron oxide of the magnetite type produced by conversion of the metal surface during immersion of the part in a hot alkaline salt solution or in a mixed salt fusion bath. The degree of pitting or metal loss shall be as specified by the purchaser, but in no case shall this be an amount detrimental to the performance of the part. The finish shall be black in color and lusterous in appearance.

3.1.2.4 Where plated or coated rings are subject to hydrogen embrittlement they shall be baked for three hours at 375° F (190° C), or other suitable times and temperatures, as soon as possible after the plating or coating operation to obviate such embrittlement.

3.2 Corrosion Resistant Steel

Retaining rings made from corrosion resistant steel shall conform to the chemical composition of PH 15-7Mo or equivalent (AISI 632-AMS 5520) and have the following physical properties:

3.2.1 Heat Treatment. The retaining rings should be heat treated to the Rockwell C hardness values within the range of 44-51.

3.2.2 Surface Treatment. Retaining rings shall be cleaned free of scale, grease, oil and other foreign material. Surfaces shall be finished completely before passivation and no operations shall be performed after passivating which will disturb the passivated surface film. The entire surface of the retaining rings shall be effectively passivated.

3.3 Beryllium Copper

Retaining rings made from beryllium copper shall conform to the chemical composition of Alloy 25, CDA 172 or equivalent (UNSC 17200) and have the following physical properties:

3.3.1 Heat Treatment. The retaining rings should be heat treated to the Rockwell C hardness values within the range of 37-43.

3.3.2 Surface Treatment. Retaining rings shall be cleaned to remove oxide formed as a result of the heat treating process. Since these rings have extremely

high resistance to most types of atmospheric corrosion, further protective finishes are usually not required.

4. HARDNESS TESTING PROCEDURE

The surfaces of both sides of each sample retaining ring shall be prepared for hardness testing by removal of all plating and other surface conditions which may affect the hardness reading. The load shall be applied perpendicular to the surface being tested within 7 degrees. Rockwell C Scale shall be used on prepared samples having a thickness of 1.3 mm or greater. Rockwell A Scale, or Rockwell superficial 45N, 30N, or 15N Scales shall be used on samples having lesser thickness and readings coverted to Rockwell C. Prepared samples shall be sufficiently wide to prevent bulging of the sides by the penetrator.

5. PERMANENT SET LIMITS

The following procedures should be used for determining if the permanent set of the ring is within the allowable limits:

5.1 Basic External (3AM1) Retaining Rings

1. Expand the ring with a plier until it just fits over a shaft 1% larger than the nominal shaft diameter. Repeat this procedure 4 more times with the same ring. The ring shall not crack during this procedure.

2. Measure the ring diameter (D) in the three places shown in Figure 1.

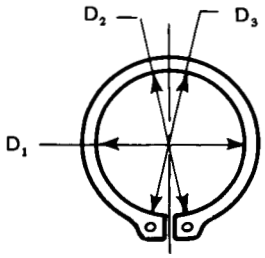


FIGURE 1 PERMANENT SET MEASUREMENTS FOR TYPE 3AM1 RINGS

3. Compute the average of the 3 diameters and compare it to the minimum groove diameter listed in the Data Chart for that ring. In all cases the average diameter after permanent set should be less than the groove diameter to insure that the ring will seat tightly.

5.2 Basic Internal (3BM1) Retaining Rings

1. Compress the ring with a plier until the lugs abut each other. Repeat this procedure 4 more times during this procedure.

2. Measure the ring diameter (D) in the three places shown in Figure 2.

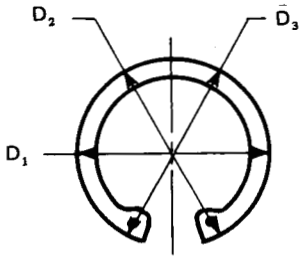


FIGURE 2 PERMANENT SET MEASUREMENTS FOR TYPE 3BM1 RINGS

3. Compute the average of the 3 diameters and compare it to the maximum groove diameter listed in the Data Chart for the ring. in all cases the average diameter after permanent set should be greater than the groove diameter to insure that the ring will seat tightly.

5.3 E-Type (3CM1) External Retaining Rings

The rings shall, upon being installed in the minimum groove diameter by an applicator or similar tool, grip the minimum groove diameter and shall have no less than 3 point contact.

6. IRREGULARITY LIMITATIONS

6.1 Dish

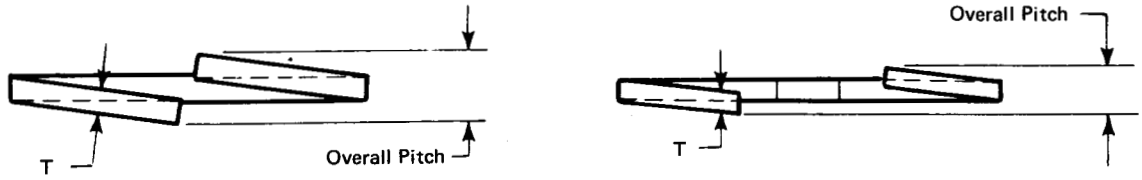
Dish limitations of tapered and reduced section retaining rings as shown in Figure 3 shall not exceed the dimensions specified in Table 2 for the applicable ring series thickness.

Table 2 Dish Limitations for Tapered and Reduced Section Retaining Rings

Types 3AM1 & 3BM1		Type 3CM1	
Ring Thickness	Permissible Dish	Ring Thickness	Permissible Dish
0.25-0.4	0.05	0.25-0.4	0.05
0.6 -0.9	0.08	0.6 -0.9	0.08
1.1 -2.4	0.13	1.1 -1.6	0.13
2.8 -3.2	0.25		
4.0 -4.8	0.40		

3AM1 and 3BM1 Rings 3CM1 Rings

FIGURE 3 DISH FOR TYPE 3AM1, TYPE 3BM1 AND TYPE 3CM1 RINGS



3AM1 and 3BM1 Rings 3CM1 Rings

FIGURE 4 PITCH FOR TYPE 3AM1, TYPE 3BM1 AND TYPE 3CM1 RINGS

6.2 Pitch

Pitch limitations of tapered and reduced section retaining rings as shown in Figure 4 shall not exceed the dimensions specified in Table 3 for the applicable ring series thickness.

Table 3 Pitch Limitations for Tapered and Reduced Section Retaining Rings

Types 3AM1 & 3BM1		Type 3CM1	
Ring Size mm	Overall Pitch Maximum	Ring Size mm	Overall Pitch Maximum
All sizes	3T	1 through 13	1.5T
		15 through 25	2T

Workmanship

Workmanship shall be in accordance with high grade commercial practice. Rings shall be free from rust, loose scale, hanging burrs, cracks and any other defects that might affect their functioning.

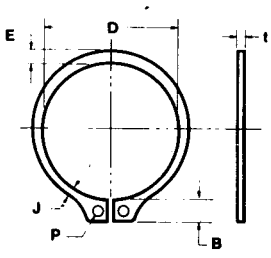
Additional Information

Consult with manufacturers for additional information not included in standard.

Dimensional Data

Dimensional data and performance information on rings and grooves for tapered and reduced cross section retaining rings are tabulated in Tables 4, 5 and 6.

BASIC external series
3AM1



MAX. BOTTOM RADII

Ring Sizes	R
-4 thru -6	none
-7 thru -18	0.1
-19 thru -30	0.2
-32 thru -50	0.3
-52 thru -100	0.4

F.I.M. (full indicator movement) is the maximum allowable deviation of concentricity between groove and shaft.

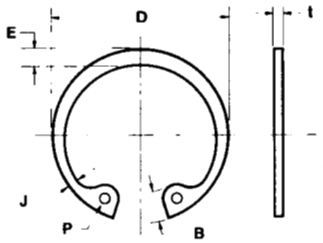
Table 4 Basic External

*Sizes -4, -5 and -6 are available in beryllium copper only.

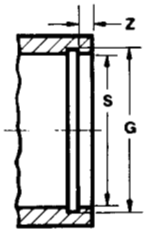
Shaft Dia.			Ring Dimensions (mm)										Groove Dimensions (mm)						
mm	Equiv. inch	Ring Series & Size No.	Free Diameter			Thickness All materials and finishes		Hole dia.	Lug	Large Section	Small Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3AM1	D	tol		t	tol	P min	B nom	E nom	J nom	kg	G	tol	FIM	W	tol	d ref	Z min
4	0.157	3AM1-4*	3.60	+0.05	-0.10	0.25	±0.05	0.6	1.35	0.65	0.40	0.017	3.80	-0.08	0.03	0.32	+0.05	0.1	0.3
5	0.197	-5*	4.55	+0.05	-0.10	0.4	±0.06	0.6	1.40	0.65	0.40	0.029	4.75	-0.08	0.03	0.5	+0.10	0.13	0.4
6	0.236	-6*	5.45	+0.05	-0.10	0.4	±0.06	0.6	1.40	0.75	0.50	0.040	5.70	-0.08	0.03	0.5	+0.10	0.15	0.5
7	0.275	-7	6.35	+0.05	-0.15	0.6	±0.06	1.0	2.05	0.90	0.60	0.10	6.60	-0.10	0.05	0.7	+0.15	0.20	0.6
8	0.315	-8	7.15	+0.05	-0.15	0.6	±0.06	1.0	2.20	1.00	0.65	0.12	7.50	-0.10	0.05	0.7	+0.15	0.25	0.8
9	0.354	-9	8.15	+0.05	-0.15	0.6	±0.06	1.0	2.20	1.15	0.75	0.15	8.45	-0.10	0.05	0.7	+0.15	0.28	0.8
10	0.393	-10	9.00	+0.05	-0.15	0.6	±0.06	1.0	2.20	1.30	0.80	0.19	9.40	-0.10	0.05	0.7	+0.15	0.30	0.9
11	0.433	-11	10.00	+0.05	-0.15	0.6	±0.06	1.0	2.20	1.40	0.85	0.23	10.35	-0.12	0.05	0.7	+0.15	0.33	1.0
12	0.472	-12	10.85	+0.05	-0.15	0.6	±0.06	1.0	2.20	1.50	0.90	0.24	11.35	-0.12	0.05	0.7	+0.15	0.33	1.0
13	0.512	-13	11.90	+0.15	-0.25	0.9	±0.06	1.2	2.80	1.60	0.95	0.44	12.30	-0.12	0.1	1.0	+0.15	0.35	1.0
14	0.551	-14	12.90	+0.15	-0.25	0.9	±0.06	1.2	2.80	1.70	1.00	0.49	13.25	-0.12	0.1	1.0	+0.15	0.38	1.2
15	0.591	-15	13.80	+0.15	-0.25	0.9	±0.06	1.2	2.80	1.80	1.05	0.54	14.15	-0.12	0.1	1.0	+0.15	0.43	1.3
16	0.630	-16	14.70	+0.15	-0.25	0.9	±0.06	1.2	2.80	2.05	1.15	0.59	15.10	-0.15	0.1	1.0	+0.15	0.45	1.4
17	0.669	-17	15.75	+0.15	-0.25	0.9	±0.06	1.2	2.80	2.10	1.15	0.64	16.10	-0.15	0.1	1.0	+0.15	0.45	1.4
18	0.708	-18	16.65	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.25	1.25	0.92	17.00	-0.15	0.1	1.2	+0.15	0.50	1.5
19	0.748	-19	17.60	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.35	1.30	0.95	17.95	-0.15	0.1	1.2	+0.15	0.53	1.6
20	0.787	-20	18.35	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.40	1.35	1.00	18.85	-0.15	0.1	1.2	+0.15	0.58	1.7
21	0.826	-21	19.40	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.50	1.40	1.1	19.80	-0.15	0.1	1.2	+0.15	0.60	1.8
22	0.866	-22	20.30	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.70	1.50	1.3	20.70	-0.15	0.1	1.2	+0.15	0.65	1.9
23	0.905	-23	21.25	+0.15	-0.25	1.1	±0.06	1.3	3.45	2.80	1.60	1.4	21.65	-0.15	0.1	1.2	+0.15	0.67	2.0
24	0.945	-24	22.20	+0.15	-0.25	1.1	±0.06	1.9	4.2	2.9	1.6	1.5	22.60	-0.15	0.1	1.2	+0.15	0.70	2.1
25	0.984	-25	23.10	+0.15	-0.25	1.1	±0.06	1.9	4.2	2.9	1.7	1.6	23.50	-0.15	0.1	1.2	+0.15	0.75	2.3
26	1.023	-26	24.05	+0.15	-0.25	1.1	±0.06	1.9	4.2	3.0	1.7	1.8	24.50	-0.15	0.1	1.2	+0.15	0.75	2.3
27	1.063	-27	24.95	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.1	1.8	2.2	25.45	-0.20	0.1	1.4	+0.15	0.78	2.3
28	1.102	-28	25.80	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.2	1.8	2.3	26.40	-0.20	0.1	1.4	+0.15	0.80	2.4
30	1.181	-30	27.90	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.3	1.8	2.5	28.35	-0.20	0.15	1.4	+0.15	0.83	2.5
32	1.260	-32	29.60	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.6	1.9	2.8	30.20	-0.20	0.15	1.4	+0.15	0.90	2.7
34	1.339	-34	31.40	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.8	2.0	3.1	32.00	-0.20	0.15	1.4	+0.15	1.00	3.0
35	1.378	-35	32.30	+0.25	-0.40	1.3	±0.06	1.9	4.6	3.9	2.1	3.3	32.90	-0.20	0.15	1.4	+0.15	1.05	3.1
36	1.417	-36	33.25	+0.25	-0.40	1.3	±0.06	1.9	5.4	4.1	2.2	3.6	33.85	-0.20	0.15	1.4	+0.15	1.06	3.2
38	1.496	-38	35.20	+0.25	-0.40	1.3	±0.06	3.1	5.4	4.3	2.3	4.0	35.8	-0.30	0.15	1.4	+0.15	1.10	3.3
40	1.575	-40	36.75	+0.35	-0.50	1.6	±0.08	3.1	6.0	4.4	2.3	5.6	37.7	-0.30	0.15	1.75	+0.20	1.15	3.4
42	1.654	-42	38.80	+0.35	-0.50	1.6	±0.08	3.1	6.0	4.6	2.4	6.3	39.6	-0.30	0.15	1.75	+0.20	1.20	3.6
43	1.683	-43	39.65	+0.35	-0.50	1.6	±0.08	3.1	6.0	4.7	2.5	6.7	40.5	-0.30	0.15	1.75	+0.20	1.25	3.8
45	1.772	-45	41.60	+0.35	-0.50	1.6	±0.08	3.1	6.0	4.8	2.6	7.0	42.4	-0.30	0.15	1.75	+0.20	1.30	3.9
46	1.811	-46	42.55	+0.35	-0.50	1.6	±0.08	3.1	6.0	4.9	2.6	7.3	43.3	-0.30	0.15	1.75	+0.20	1.35	4.0
48	1.890	-48	44.40	+0.35	-0.50	1.6	±0.08	3.1	6.2	5.0	2.6	7.7	45.2	-0.30	0.15	1.75	+0.20	1.40	4.2
50	1.969	-50	46.20	+0.35	-0.50	1.6	±0.08	3.1	6.2	5.1	2.7	8.2	47.2	-0.30	0.15	1.75	+0.20	1.40	4.2
52	2.047	-52	48.40	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.3	2.8	11.3	49.1	-0.30	0.15	2.15	+0.20	1.45	4.3
54	2.126	-54	49.9	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.4	2.9	11.8	51.0	-0.30	0.15	2.15	+0.20	1.50	4.5
55	2.165	-55	50.6	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.4	2.9	11.9	51.8	-0.30	0.15	2.15	+0.20	1.60	4.8
57	2.244	-57	52.9	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.6	3.0	12.5	53.8	-0.40	0.20	2.15	+0.20	1.60	4.8
58	2.283	-58	53.6	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.6	3.0	12.6	54.7	-0.40	0.20	2.15	+0.20	1.65	4.9
60	2.362	-60	55.8	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.7	3.0	13.2	56.7	-0.40	0.20	2.15	+0.20	1.65	4.9
62	2.441	-62	57.3	+0.35	-0.65	2.0	±0.08	3.1	6.8	5.8	3.0	13.4	58.6	-0.40	0.20	2.15	+0.20	1.70	5.1
65	2.559	-65	60.4	+0.50	-0.75	2.0	±0.08	3.1	6.8	6.0	3.1	15.4	61.6	-0.40	0.20	2.15	+0.20	1.70	5.1
68	2.677	-68	63.1	+0.50	-0.75	2.0	±0.08	3.1	6.8	6.2	3.3	16.3	64.5	-0.40	0.20	2.15	+0.20	1.75	5.3
70	2.756	-70	64.6	+0.50	-0.75	2.4	±0.08	3.1	7.8	6.3	3.3	19.3	66.4	-0.40	0.20	2.55	+0.20	1.80	5.4
72	2.835	-72	66.6	+0.50	-0.75	2.4	±0.08	3.1	7.8	6.4	3.3	20.6	68.3	-0.40	0.20	2.55	+0.20	1.85	5.5
75	2.953	-75	69.0	+0.50	-0.75	2.4	±0.08	3.1	7.8	6.6	3.4	22.6	71.2	-0.40	0.20	2.55	+0.20	1.90	5.7
78	3.071	-78	72.0	+0.50	-0.75	2.4	±0.08	3.1	7.8	6.6	3.4	21.5	74.0	-0.40	0.20	2.55	+0.20	2.00	6.0
80	3.150	-80	74.2	+0.50	-0.75	2.4	±0.08	3.1	7.8	7.0	3.6	26.8	75.9	-0.40	0.20	2.55	+0.20	2.05	6.1
82	3.228	-82	76.4	+0.50	-0.75	2.4	±0.08	3.1	7.8	7.1	3.7	28.1	77.8	-0.40	0.20	2.55	+0.20	2.10	6.3
85	3.346	-85	78.6	+0.50	-0.75	2.4	±0.08	3.1	7.8	7.3	3.8	29.0	80.6	-0.40	0.20	2.55	+0.20	2.20	6.6
88	3.464	-88	81.4	+0.50	-0.75	2.8	±0.08	3.1	8.4	7.5	3.9	32.2	83.5	-0.40	0.20	2.95	+0.20	2.25	6.7
90	3.543	-90	83.2	+0.50	-0.75	2.8	±0.08	3.1	8.4	7.5	3.9	33.1	85.4	-0.40	0.20	2.95	+0.20	2.30	6.9
95	3.740	-95	88.1	+0.50	-0.75	2.8	±0.08	3.1	8.4	7.9	4.1	37.6	90.2	-0.40	0.20	2.95	+0.20	2.40	7.2
100	3.937	3AM1-100	92.5	+0.50	-0.75	2.8	±0.08	3.1	8.7	8.0	4.1	43.1	95.0	-0.40	0.20	2.95	+0.20	2.50	7.5

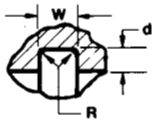
BASIC internal series

3BM1



Lug Configuration
for sizes -52 thru -250





Detail of Groove

MAX. BOTTOM RADII

Ring Sizes	R
-8 thru -17	0.1
-18 thru -30	0.2
-32 thru -55	0.3
-56 thru -250	0.4

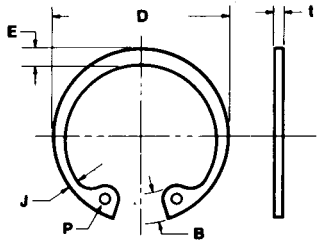
F.I.M. (full indicator movement) is the maximum allowable deviation of concentricity between groove and bore.

Table 5 Basic Internal

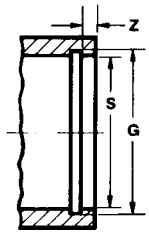
Bore Dia.			Ring Dimensions (mm)									Groove Dimensions (mm)						
mm	Equiv. inch	Ring Series & Size No.	Free Diameter		Thickness All materials and finishes		Hole dia.	Lug	Large Section	Small Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3BM1	D	tol	t	tol	P min	B nom	E nom	J nom	kg	G	tol	FIM	W	tol	d ref	Z min
8	0.315	3BM1-8	8.80	+0.25 -0.13	0.4	±0.06	0.8	1.7	0.85	0.45	0.05	8.40	+0.06	0.03	0.5	+0.10	0.2	0.6
9	0.354	-9	10.00	+0.25 -0.13	0.6	±0.06	1.0	2.1	1.25	0.65	0.11	9.45	+0.06	0.03	0.7	+0.15	0.23	0.7
10	0.393	-10	11.10	+0.25 -0.13	0.6	±0.06	1.0	2.1	1.30	0.70	0.14	10.50	+0.10	0.03	0.7	+0.15	0.25	0.8
11	0.433	-11	12.20	+0.25 -0.13	0.6	±0.06	1.0	2.5	1.30	0.70	0.17	11.60	+0.10	0.05	0.7	+0.15	0.3	0.9
12	0.472	-12	13.30	+0.25 -0.13	0.6	±0.06	1.0	2.5	1.35	0.75	0.19	12.65	+0.10	0.05	0.7	+0.15	0.33	1.0
13	0.512	-13	14.25	+0.25 -0.13	0.9	±0.06	1.2	2.9	1.35	0.90	0.35	13.70	+0.10	0.05	1.0	+0.15	0.35	1.1
14	0.551	-14	15.45	+0.25 -0.13	0.9	±0.06	1.2	3.3	1.60	0.90	0.39	14.80	+0.10	0.05	1.0	+0.15	0.40	1.2
15	0.591	-15	16.60	+0.25 -0.13	0.9	±0.06	1.5	3.3	1.65	0.95	0.42	15.85	+0.10	0.05	1.0	+0.15	0.43	1.3
16	0.630	-16	17.70	+0.25 -0.13	0.9	±0.06	1.5	3.4	1.70	0.95	0.47	16.90	+0.10	0.1	1.0	+0.15	0.45	1.4
17	0.669	-17	18.90	+0.25 -0.13	0.9	±0.06	1.5	3.4	1.70	0.95	0.52	18.00	+0.10	0.1	1.0	+0.15	0.50	1.5
18	0.708	-18	20.05	+0.25 -0.13	0.9	±0.06	1.5	3.6	1.8	1.0	0.58	19.05	+0.10	0.1	1.0	+0.15	0.53	1.6
19	0.748	-19	21.10	+0.25 -0.13	0.9	±0.06	1.5	3.6	1.8	1.0	0.59	20.10	+0.15	0.1	1.0	+0.15	0.55	1.7
20	0.787	-20	22.25	+0.25 -0.13	0.9	±0.06	1.5	4.0	2.0	1.1	0.70	21.15	+0.15	0.1	1.0	+0.15	0.57	1.7
21	0.826	-21	23.30	+0.40 -0.25	0.9	±0.06	1.5	4.0	2.1	1.2	0.82	22.20	+0.15	0.1	1.0	+0.15	0.60	1.8
22	0.866	-22	24.40	+0.40 -0.25	1.1	±0.06	1.5	4.0	2.1	1.2	0.90	23.30	+0.15	0.1	1.2	+0.15	0.65	1.9
23	0.905	-23	25.45	+0.40 -0.25	1.1	±0.06	1.5	4.0	2.2	1.2	1.00	24.35	+0.15	0.1	1.2	+0.15	0.67	2.0
24	0.945	-24	26.55	+0.40 -0.25	1.1	±0.06	1.5	4.0	2.3	1.3	1.09	25.4	+0.15	0.1	1.2	+0.15	0.70	2.1
25	0.984	-25	27.75	+0.40 -0.25	1.1	±0.06	1.5	4.0	2.6	1.3	1.26	26.6	+0.15	0.1	1.2	+0.15	0.80	2.4
26	1.023	-26	28.85	+0.40 -0.25	1.1	±0.06	1.5	4.0	2.7	1.4	1.3	27.7	+0.15	0.15	1.2	+0.15	0.85	2.6
27	1.063	-27	29.95	+0.65 -0.50	1.3	±0.06	1.9	4.6	2.8	1.4	1.7	28.8	+0.15	0.15	1.4	+0.15	0.90	2.7
28	1.102	-28	31.10	+0.65 -0.50	1.3	±0.06	1.9	4.6	2.9	1.5	1.8	29.8	+0.15	0.15	1.4	+0.15	0.90	2.7
30	1.181	-30	33.40	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.0	1.5	2.0	31.9	+0.20	0.15	1.4	+0.15	0.95	2.9
32	1.260	-32	35.35	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.1	1.6	2.2	33.9	+0.20	0.15	1.4	+0.15	0.95	2.9
34	1.339	-34	37.75	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.2	1.6	2.3	36.1	+0.20	0.15	1.4	+0.15	1.05	3.2
35	1.378	-35	38.75	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.3	1.6	2.3	37.2	+0.20	0.15	1.4	+0.15	1.10	3.3
36	1.417	-36	40.00	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.4	1.7	2.6	38.3	+0.20	0.15	1.4	+0.15	1.15	3.5
37	1.457	-37	41.05	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.4	1.7	2.9	39.3	+0.20	0.15	1.4	+0.15	1.15	3.5
38	1.496	-38	42.15	+0.65 -0.50	1.3	±0.06	1.9	4.6	3.4	1.7	3.0	40.4	+0.20	0.15	1.4	+0.15	1.20	3.6
40	1.575	-40	44.25	+0.90 -0.65	1.6	±0.08	1.9	5.1	4.0	2.0	4.0	42.4	+0.20	0.15	1.75	+0.20	1.20	3.6
42	1.654	-42	46.60	+0.90 -0.65	1.6	±0.08	1.9	5.8	4.2	2.1	4.7	44.5	+0.20	0.15	1.75	+0.20	1.25	3.7
45	1.772	-45	49.95	+0.90 -0.65	1.6	±0.08	1.9	6.0	4.3	2.1	5.1	47.6	+0.20	0.15	1.75	+0.20	1.30	3.9
46	1.811	-46	51.05	+0.90 -0.65	1.6	±0.08	2.3	6.0	4.3	2.1	5.2	48.7	+0.20	0.2	1.75	+0.20	1.35	4.0
47	1.850	-47	52.15	+0.90 -0.65	1.6	±0.08	2.3	6.0	4.3	2.2	5.8	49.8	+0.20	0.2	1.75	+0.20	1.40	4.2
48	1.890	-48	53.30	+0.90 -0.65	1.6	±0.08	2.3	6.0	4.5	2.3	6.1	50.9	+0.20	0.2	1.75	+0.20	1.45	4.3
50	1.969	-50	55.35	+0.90 -0.65	1.6	±0.08	2.3	6.0	4.6	2.3	6.2	53.1	+0.20	0.2	1.75	+0.20	1.55	4.6
52	2.047	-52	57.90	+1.00 -0.75	2.0	±0.08	2.3	6.4	4.7	2.3	8.1	55.3	+0.30	0.2	2.15	+0.20	1.65	5.0
55	2.165	-55	61.10	+1.00 -0.75	2.0	±0.08	2.3	6.7	5.1	2.5	8.9	58.4	+0.30	0.2	2.15	+0.20	1.70	5.1
57	2.244	-57	63.25	+1.00 -0.75	2.0	±0.08	2.3	6.9	5.2	2.5	9.9	60.5	+0.30	0.2	2.15	+0.20	1.75	5.3
58	2.283	-58	64.4	+1.00 -0.75	2.0	±0.08	2.3	6.9	5.3	2.6	10.1	61.6	+0.30	0.2	2.15	+0.20	1.80	5.4
60	2.362	-60	66.8	+1.00 -0.75	2.0	±0.08	2.3	6.9	5.3	2.6	10.5	63.8	+0.30	0.2	2.15	+0.20	1.90	5.7
62	2.441	-62	68.6	+1.00 -0.75	2.0	±0.08	2.7	7.1	5.3	2.6	11.5	65.8	+0.30	0.2	2.15	+0.20	1.90	5.7
63	2.480	-63	69.9	+1.00 -0.75	2.0	±0.08	2.7	7.1	5.4	2.7	11.6	66.9	+0.30	0.2	2.15	+0.20	1.95	5.9
65	2.559	3BM1-65	72.2	+1.00 -0.75	2.4	±0.08	2.7	7.4	5.6	2.8	15.4	69.0	+0.30	0.2	2.55	+0.20	2.00	6.0

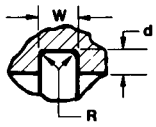
Additional sizes appear on page 7.

BASIC internal series
3BM1



Lug Configuration
for sizes -52 thru -250





Detail of Groove

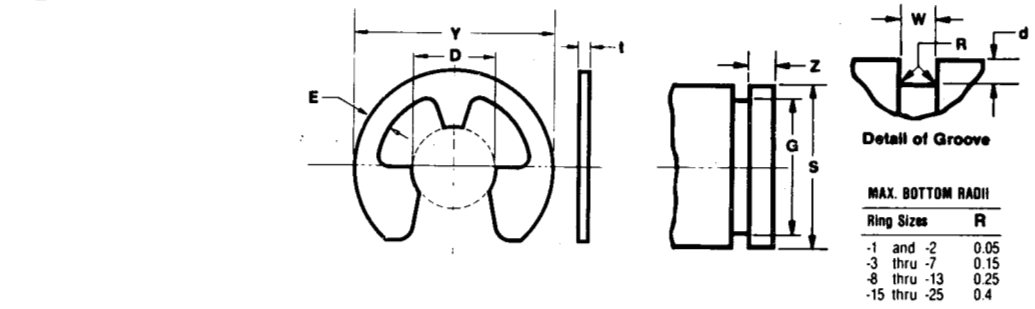
MAX. BOTTOM RADII	
Ring Sizes	R
-8 thru -17	0.1
-18 thru -30	0.2
-32 thru -55	0.3
-56 thru -250	0.4

F.I.M. (full indicator movement) is the maximum allowable deviation of concentricity between groove and bore.

Table 5 Basic Internal (Continued)

Bore Dia.			Ring Dimensions (mm)									Groove Dimensions (mm)						
mm	Equiv. inch	Ring Series & Size No.	Free Diameter		Thickness All materials and finishes		Hole dia.	Lug	Large Section	Small Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3BM1	D	tol	t	tol	P min	B nom	E nom	J nom	kg	G	tol	FIM	W	tol	d ref	Z min
68	2.677	3BM1-68	75.7	+1.00 -0.75	2.4	±0.08	2.7	7.6	5.8	2.9	15.9	72.2	+0.30	0.2	2.55	+0.20	2.10	6.3
70	2.756	-70	77.5	+1.00 -0.75	2.4	±0.08	2.7	7.6	5.8	2.9	16.1	74.4	+0.30	0.2	2.55	+0.20	2.20	6.6
72	2.835	-72	79.6	+1.00 -0.75	2.4	±0.08	2.7	7.6	5.8	2.9	16.3	76.5	+0.30	0.2	2.55	+0.20	2.25	6.7
75	2.953	-75	83.3	+1.00 -0.75	2.4	±0.08	2.7	7.9	6.2	3.1	19.3	79.7	+0.30	0.2	2.55	+0.20	2.35	7.1
78	3.071	-78	86.8	+1.40 -1.40	2.8	±0.08	3.1	7.9	6.5	3.2	24.0	82.8	+0.30	0.2	2.95	+0.20	2.40	7.2
80	3.150	-80	89.1	+1.40 -1.40	2.8	±0.08	3.1	7.9	6.7	3.3	25.9	85.0	+0.30	0.2	2.95	+0.20	2.50	7.5
82	3.228	-82	91.1	+1.40 -1.40	2.8	±0.08	3.1	8.7	6.9	3.4	27.2	87.2	+0.30	0.25	2.95	+0.20	2.60	7.8
85	3.346	-85	94.4	+1.40 -1.40	2.8	±0.08	3.1	8.7	7.0	3.6	29.5	90.4	+0.30	0.25	2.95	+0.20	2.70	8.1
88	3.464	-88	97.9	+1.40 -1.40	2.8	±0.08	3.1	8.7	7.3	3.6	31.3	93.6	+0.30	0.25	2.95	+0.20	2.80	8.4
90	3.543	-90	100.0	+1.40 -1.40	2.80	±0.08	3.1	8.7	7.4	3.6	32.6	95.7	+0.30	0.25	2.95	+0.20	2.85	8.6
92	3.622	-92	102.2	+1.40 -1.40	2.8	±0.08	3.1	8.7	7.6	3.8	33.1	97.8	+0.30	0.25	2.95	+0.20	2.90	8.7
95	3.740	-95	105.6	+1.65 -1.65	2.8	±0.08	3.1	8.7	7.8	3.9	35.4	101.0	+0.30	0.25	2.95	+0.20	3.00	9.0
98	3.858	-98	109.0	+1.65 -1.65	2.8	±0.08	3.1	9.4	8.1	4.1	39.4	104.2	+0.30	0.25	2.95	+0.20	3.10	9.3
100	3.937	-100	110.7	+1.65 -1.65	2.8	±0.08	3.1	9.4	8.2	4.1	39.9	106.3	+0.40	0.25	2.95	+0.20	3.15	9.5
102	4.016	-102	112.4	+1.65 -1.65	2.8	±0.08	3.1	9.4	8.4	4.2	42.2	108.4	+0.40	0.25	2.95	+0.20	3.20	9.6
105	4.134	-105	115.8	+1.65 -1.65	2.8	±0.08	3.1	9.4	8.4	4.3	44.0	111.5	+0.40	0.25	2.95	+0.20	3.25	9.8
108	4.252	-108	119.2	+1.65 -1.65	2.8	±0.08	3.1	9.4	8.5	4.6	45.8	114.6	+0.40	0.25	2.95	+0.20	3.30	9.9
110	4.331	-110	120.8	+1.65 -1.65	2.8	±0.08	3.8	10.3	8.7	4.6	47.6	116.7	+0.40	0.25	2.95	+0.20	3.35	10.1
115	4.528	-115	126.0	+1.65 -1.65	2.8	±0.08	3.8	10.3	8.9	4.6	50.3	121.9	+0.40	0.25	2.95	+0.20	3.45	10.4
120	4.724	-120	132.4	+1.65 -1.65	2.8	±0.08	3.8	10.3	9.4	4.6	56.2	127.0	+0.40	0.25	2.95	+0.20	3.50	10.5
125	4.921	-125	137.1	+1.65 -1.65	2.8	±0.08	3.8	10.3	9.5	4.7	60.0	132.1	+0.40	0.25	2.95	+0.20	3.55	10.7
130	5.118	-130	142.5	+1.65 -1.65	2.8	±0.08	3.8	10.3	9.8	4.9	63.5	137.2	+0.40	0.25	2.95	+0.20	3.60	10.8
135	5.315	-135	148.5	+1.65 -1.65	3.2	±0.10	3.8	11.6	10.4	5.0	79	142.3	+0.40	0.25	3.40	+0.25	3.65	11.0
140	5.512	-140	154.1	+1.65 -1.65	3.2	±0.10	3.8	11.6	10.4	5.0	83	147.4	+0.40	0.25	3.40	+0.25	3.70	11.1
145	5.709	-145	159.5	+1.65 -1.65	3.2	±0.10	3.8	11.6	10.6	5.3	87	152.5	+0.40	0.25	3.40	+0.25	3.75	11.3
150	5.906	-150	164.5	+1.65 -1.65	3.2	±0.10	3.8	11.6	10.8	5.4	89	157.6	+0.40	0.25	3.40	+0.25	3.80	11.4
155	6.102	-155	168.8	+1.65 -1.65	3.2	±0.10	3.8	11.6	10.8	5.4	91	162.7	+0.40	0.3	3.40	+0.25	3.85	11.6
160	6.299	-160	175.1	+2.05 -2.05	4.0	±0.12	4.6	12.3	10.9	5.4	121	167.8	+0.40	0.3	4.25	+0.25	3.90	11.7
165	6.496	-165	180.3	+2.05 -2.05	4.0	±0.12	4.6	12.3	11.1	5.6	127	172.9	+0.50	0.3	4.25	+0.25	3.95	11.9
170	6.693	-170	185.6	+2.05 -2.05	4.0	±0.12	4.6	12.3	11.4	5.6	138	178.0	+0.50	0.3	4.25	+0.25	4.00	12.0
175	6.890	-175	191.3	+2.05 -2.05	4.0	±0.12	4.6	13.5	11.6	5.7	147	183.2	+0.50	0.3	4.25	+0.25	4.10	12.3
180	7.087	-180	196.6	+2.05 -2.05	4.0	±0.12	4.6	13.5	12.0	5.9	156	188.4	+0.50	0.3	4.25	+0.25	4.20	12.6
185	7.283	-185	202.7	+2.30 -2.30	4.8	±0.12	4.6	14.2	12.4	6.0	194	193.6	+0.50	0.3	5.10	+0.25	4.30	12.9
190	7.480	-190	207.7	+2.30 -2.30	4.8	±0.12	4.6	14.2	12.9	6.3	220	198.8	+0.50	0.3	5.10	+0.25	4.40	13.2
200	7.874	-200	217.8	+2.30 -2.30	4.8	±0.12	4.6	14.2	13.3	6.5	235	209.0	+0.50	0.3	5.10	+0.25	4.50	13.5
210	8.268	-210	230.3	+2.30 -2.30	4.8	±0.12	4.6	15.2	14.2	6.9	275	219.4	+0.50	0.3	5.10	+0.25	4.70	14.1
220	8.661	-220	240.5	+2.30 -2.30	4.8	±0.12	4.6	16.8	15.0	7.3	285	230.0	+0.50	0.3	5.10	+0.25	5.00	15.0
230	9.055	-230	251.4	+2.30 -2.30	4.8	±0.12	4.6	16.8	15.5	7.5	330	240.6	+0.50	0.3	5.10	+0.25	5.30	15.9
240	9.449	-240	262.3	+2.30 -2.30	4.8	±0.12	4.6	18.7	16.3	7.7	365	251.0	+0.50	0.3	5.10	+0.25	5.50	16.5
250	9.843	3BM1-250	273.3	+2.30 -2.30	4.8	±0.12	4.6	18.7	16.7	7.8	375	261.4	+0.50	0.3	5.10	+0.25	5.70	17.1

E-RING external series
3CM1



MAX. BOTTOM RADII

Ring Sizes	R
-1 and -2	0.05
-3 thru -7	0.15
-8 thru -13	0.25
-15 thru -25	0.4

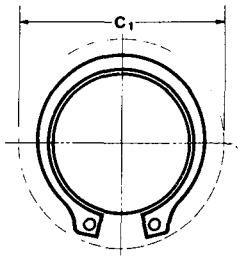
F.I.M. (full indicator movement) is the maximum allowable deviation of concentricity between groove and shaft.

Table 6 E-Ring External

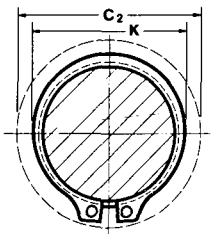
*Size -1 is available in beryllium copper only.

Shaft Dia.		Ring Dimensions (mm)								Groove Dimensions (mm)						
mm	Equiv. inch	Ring Series & Size No.	Free Diameter		Thickness All materials and finishes		Outer Dia.	Bridge	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3CM1	D	tol	t	tol	Y nom	E nom	kg	G	tol	FIM	W	tol	d ref	Z min
1	0.039	3CM-1*	0.64	+0.03 -0.08	0.25	±0.05	2.0	0.30	0.004	0.72	-0.05	0.04	0.32	+0.05	0.14	0.3
2	0.079	-2	1.30	+0.03 -0.08	0.25	±0.05	4.0	0.55	0.014	1.45	-0.05	0.04	0.32	+0.05	0.28	0.6
3	0.118	-3	2.10	+0.03 -0.08	0.4	±0.06	5.6	0.65	0.036	2.30	-0.08	0.04	0.5	+0.10	0.35	0.7
4	0.157	-4	2.90	+0.03 -0.08	0.6	±0.06	7.2	0.85	0.095	3.10	-0.08	0.05	0.7	+0.15	0.45	0.9
5	0.197	-5	3.70	+0.03 -0.08	0.6	±0.06	8.5	0.90	0.13	3.90	-0.08	0.05	0.7	+0.15	0.55	1.1
6	0.236	-6	4.70	+0.03 -0.08	0.6	±0.06	11.1	1.15	0.21	4.85	-0.08	0.05	0.7	+0.15	0.58	1.2
7	0.275	-7	5.25	+0.03 -0.08	0.6	±0.06	13.4	1.4	0.34	5.55	-0.10	0.08	0.7	+0.15	0.73	1.5
8	0.315	-8	6.15	+0.05 -0.10	0.6	±0.06	14.6	1.4	0.35	6.40	-0.10	0.08	0.7	+0.15	0.80	1.6
9	0.354	-9	6.80	+0.05 -0.10	0.9	±0.06	15.8	1.5	0.58	7.20	-0.10	0.08	1.0	+0.15	0.90	1.8
10	0.393	-10	7.60	+0.05 -0.10	0.9	±0.06	16.8	1.5	0.68	8.00	-0.10	0.08	1.0	+0.15	1.00	2.0
11	0.433	-11	8.55	+0.05 -0.10	0.9	±0.06	17.4	1.6	0.68	8.90	-0.10	0.10	1.0	+0.15	1.05	2.1
12	0.472	-12	9.20	+0.05 -0.10	1.1	±0.06	18.6	1.8	1.00	9.60	-0.15	0.10	1.2	+0.15	1.20	2.4
13	0.512	-13	9.95	+0.05 -0.10	1.1	±0.06	20.3	2.0	1.13	10.30	-0.15	0.10	1.2	+0.15	1.35	2.7
15	0.591	-15	11.40	+0.10 -0.15	1.1	±0.06	22.8	2.1	1.40	11.80	-0.15	0.10	1.2	+0.15	1.60	3.2
16	0.630	-16	12.15	+0.10 -0.15	1.1	±0.06	23.8	2.3	1.45	12.50	-0.15	0.10	1.2	+0.15	1.75	3.5
18	0.709	-18	13.90	+0.10 -0.15	1.3	±0.06	27.2	2.5	2.3	14.30	-0.15	0.10	1.4	+0.15	1.85	3.7
20	0.787	-20	15.60	+0.10 -0.15	1.3	±0.06	30.0	2.8	2.8	16.00	-0.20	0.10	1.4	+0.15	2.00	4.0
22	0.866	-22	17.00	+0.10 -0.15	1.3	±0.06	33.0	3.0	3.4	17.40	-0.20	0.10	1.4	+0.15	2.30	4.6
25	0.984	3CM1-25	19.50	+0.10 -0.15	1.3	±0.06	37.1	3.3	4.2	20.00	-0.20	0.10	1.4	+0.15	2.50	5.0

BASIC external series 3AM1



Ring Expanded over Shaft

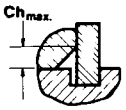


Ring Seated in Groove

P_r—The values listed below apply to rings made from SAE 1060–1090 and PH 15-7 Mo stainless steel except sizes –4, –5 and –6, which are supplied in beryllium copper only.* P_r values for other sizes made from beryllium copper can be calculated by multiplying listed values by 0.75.

Safety Factors—P_r and P_g
The allowable thrust load values listed include the following safety factors:
P_r: 4 P_g: 2

Max. Allowable Radius of Retained Part

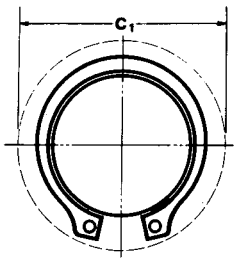


Max. Allowable Chamfer of Retained Part

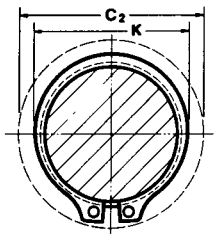
APPENDIX A

Ring Series and Size No.	Clearance Diameter: Ring expanded over shaft	Clearance Diameter: Ring seated in groove	Gaging Diameter: For checking ring when seated in groove	Allowable Thrust Loads Sharp corner abutment: SAE 1060–1090 and stainless steel rings used on hardened shafts Rc 50 min.	Allowable Thrust Loads Sharp corner abutment: All standard rings used on low carbon steel shafts	Maximum allowable corner radii and chamfers of retained parts		Maximum allowable assembly load with R_{max} or Ch_{max}	Calculated allowable assembly rpm (steel rings)
3AM1	C_1	C_2	K max	P_r (kN)	P_g (kN)	R_{max}	Ch_{max}	P'_r (kN)	rpm
3AM1–4*	7.0	6.8	4.90	0.6	0.2	0.35	0.25	0.2	70 000
–5*	8.2	7.9	5.85	1.1	0.3	0.35	0.25	0.5	70 000
–6*	9.1	8.8	6.95	1.4	0.4	0.35	0.25	0.5	70 000
–7	12.3	11.8	8.05	2.6	0.7	0.45	0.3	2.1	60 000
–8	13.6	13.0	9.15	3.1	1.0	0.5	0.35	2.1	55 000
–9	14.5	13.8	10.35	3.5	1.2	0.6	0.35	2.1	48 000
–10	15.5	14.7	11.50	3.9	1.5	0.7	0.4	2.1	42 000
–11	16.4	15.6	12.60	4.3	1.8	0.75	0.45	2.1	38 000
–12	17.4	16.6	13.80	4.7	2.0	0.8	0.45	2.1	34 000
–13	19.7	18.8	15.05	7.5	2.2	0.8	0.5	4.0	31 000
–14	20.7	19.7	15.60	8.1	2.6	0.9	0.5	4.0	28 000
–15	21.7	20.6	17.20	8.7	3.2	1.0	0.6	4.0	27 000
–16	22.7	21.6	18.35	9.3	3.5	1.1	0.6	4.0	25 000
–17	23.7	22.6	19.35	9.9	4.0	1.1	0.6	4.0	24 000
–18	26.2	25.0	20.60	16.0	4.4	1.2	0.7	6.0	23 000
–19	27.2	25.9	21.70	16.9	4.9	1.2	0.7	6.0	21 500
–20	28.2	26.8	22.65	17.8	5.7	1.2	0.7	6.0	20 000
–21	29.2	27.7	23.80	18.6	6.2	1.3	0.7	6.0	19 000
–22	30.3	28.7	24.90	19.6	7.0	1.3	0.8	6.0	18 500
–23	31.3	29.6	26.00	20.5	7.6	1.3	0.8	6.0	18 000
–24	34.1	32.4	27.15	21.4	8.2	1.4	0.8	6.0	17 500
–25	35.1	33.3	28.10	22.3	9.2	1.4	0.8	6.0	17 000
–26	36.0	34.2	29.25	23.2	9.6	1.5	0.9	6.0	16 500
–27	37.8	35.9	30.35	28.4	10.3	1.5	0.9	8.6	16 300
–28	38.8	36.9	31.45	28.4	11.0	1.6	1.0	8.6	15 800
–30	40.8	38.8	33.6	31.6	12.3	1.6	1.0	8.6	15 000
–32	42.8	40.7	35.9	33.6	14.1	1.7	1.0	8.6	14 800
–34	44.9	42.5	37.9	36	16.7	1.7	1.1	8.6	14 000
–35	45.9	43.4	39.0	37	18.1	1.8	1.1	8.6	13 500
–36	48.6	46.1	40.2	38	18.9	1.9	1.2	8.6	13 300
–38	50.6	48.0	42.5	40	20.5	2.0	1.2	8.6	12 700
–40	54.0	51.3	44.5	52	22.6	2.1	1.2	13.2	12 000
–42	56.0	53.2	46.9	54	24.8	2.2	1.3	13.2	11 000
–43	57.0	54.0	47.9	55	26.4	2.3	1.4	13.2	10 800
–45	59.0	55.9	50.0	58	28.8	2.3	1.4	13.2	10 000
–46	60.0	56.8	50.9	59	30.4	2.4	1.4	13.2	9 500

BASIC external series 3AM1



Ring Expanded over Shaft

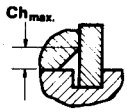


Ring Seated in Groove

P_r—The values listed below apply to rings made from SAE 1060–1090 and PH 15–7 Mo stainless steel except sizes –4, –5 and –6, which are supplied in beryllium copper only.* P_r values for other sizes made from beryllium copper can be calculated by multiplying listed values by 0.75.

Safety Factors—P_r and P_g
The allowable thrust load values listed include the following safety factors:
P_r: 4 P_g: 2

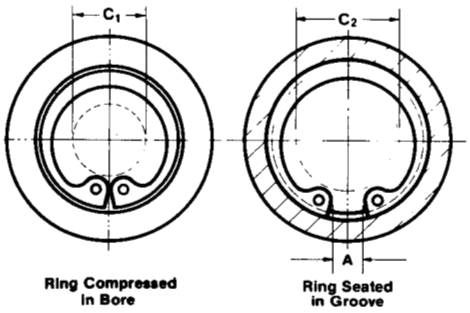
Max. Allowable Radius of Retained Part



Max. Allowable Chamfer of Retained Part

APPENDIX A (Continued)

Ring Series and Size No.	Clearance Diameter		Gaging Diameter	Allowable Thrust Loads Sharp corner abutment		Maximum allowable corner radii and chamfers of retained parts		Maximum allowable assembly load with R_{max} or Ch_{max}	Calculated allowable assembly rpm (steel rings)
	Ring expanded over shaft	Ring seated in groove	For checking ring when seated in groove	SAE 1060–1090 and stainless steel rings used on hardened shafts Rc 50 min.	All standard rings used on low carbon steel shafts				
3AM1	C_1	C_2	K max	P_r (kN)	P_g (kN)	R_{max}	Ch_{max}	P'_r (kN)	rpm
–48	62.4	59.1	53.0	62	33	2.4	1.4	13.2	8 800
–50	64.4	61.1	55.2	64	35	2.4	1.4	13.2	8 000
–52	67.6	64.1	57.4	84	37	2.5	1.5	22.0	7 700
–54	69.6	66.1	59.5	87	40	2.5	1.5	22.0	7 500
–55	70.6	66.9	60.4	89	44	2.5	1.5	22.0	7 400
–57	72.6	68.9	62.7	91	45	2.6	1.5	22.0	7 200
–58	73.6	69.8	63.6	93	46	2.6	1.6	22.0	7 100
–60	75.6	71.8	65.8	97	49	2.6	1.6	22.0	7 000
–62	77.6	73.6	67.9	100	52	2.7	1.6	22.0	6 900
–65	80.6	76.6	71.2	105	54	2.8	1.7	22.0	6 700
–68	83.6	79.5	74.5	110	58	2.9	1.7	22.0	6 500
–70	88.1	83.9	76.4	136	62	2.9	1.7	32	6 400
–72	90.1	85.8	78.5	140	65	2.9	1.7	32	6 200
–75	93.1	88.7	81.7	147	69	3.0	1.8	32	5 900
–78	95.4	92.1	84.6	151	76	3.0	1.8	32	5 600
–80	97.9	93.1	87.0	155	80	3.1	1.9	32	5 400
–82	100.0	95.1	89.0	159	84	3.2	1.9	32	5 200
–85	103.0	97.9	92.1	165	91	3.2	1.9	32	5 000
–88	107.0	100.8	95.1	199	97	3.2	1.9	47	4 800
–90	109.0	103.6	97.1	204	101	3.2	1.9	47	4 500
–95	114.0	108.6	102.7	215	112	3.4	2.1	47	4 350
3AM1–100	119.5	113.7	108.0	227	123	3.5	2.1	47	4 150



Ring Compressed in Bore

Ring Seated in Groove

BASIC internal series 3BM1

P_r—The values listed below apply to rings made from SAE 1060-1090 and PH 15-7 Mo stainless steel. P_r values for rings made from beryllium copper can be calculated by multiplying listed values by 0.75.

Safety Factors—P_r and P_g
The allowable thrust load values listed include the following safety factors:
P_r: 4 P_g: 2

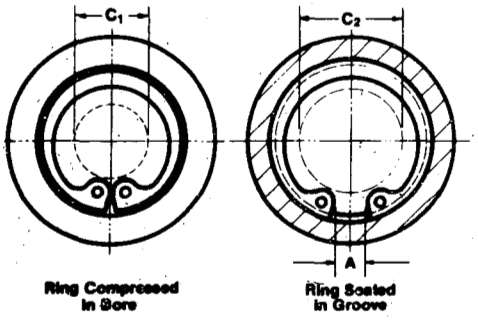
Max. Allowable Radius of Retained Part

Max. Allowable Chamfer of Retained Part

APPENDIX B

Ring Series and Size No.	Clearance Diameter		Gaging Diameter	Allowable Thrust Loads Sharp corner abutment		Maximum allowable corner radii and chamfers of retained parts		Maximum allowable assembly load with R_{max} or Ch_{max}
	Ring compressed in bore	Ring seated in groove	For checking ring when seated in groove	SAE 1060-1090 and stainless steel rings used in hardened bores Rc 50 min.	All standard rings used in low carbon steel bores			
3BM1	C_1	C_2	A min	P_r (kN)	P_g (kN)	R_{max}	Ch_{max}	P'_r (kN)
3MB1-8	4.4	4.8	1.40	2.4	1.0	0.4	0.3	0.8
-9	4.6	5.0	1.50	4.4	1.2	0.5	0.35	2.0
-10	5.5	6.0	1.85	4.9	1.5	0.5	0.35	2.0
-11	5.7	6.3	1.95	5.4	2.0	0.6	0.4	2.0
-12	6.7	7.3	2.25	5.8	2.4	0.6	0.4	2.0
-13	6.8	7.5	2.35	8.9	2.6	0.7	0.5	4.0
-14	6.9	7.7	2.65	9.7	3.2	0.7	0.5	4.0
-15	7.9	8.7	2.80	10.4	3.7	0.7	0.5	4.0
-16	8.8	9.7	2.80	11.0	4.2	0.7	0.5	4.0
-17	9.8	10.8	3.35	11.7	4.9	0.75	0.6	4.0
-18	10.3	11.3	3.40	12.3	5.5	0.75	0.6	4.0
-19	11.4	12.5	3.40	13.1	6.0	0.8	0.65	4.0
-20	11.6	12.7	3.8	13.7	6.6	0.9	0.7	4.0
-21	12.6	13.8	4.2	14.5	7.3	0.9	0.7	4.0
-22	13.5	14.8	4.3	22.5	8.3	0.9	0.7	7.4
-23	14.5	15.9	4.9	23.5	8.9	1.0	0.8	7.4
-24	15.5	16.9	5.2	24.8	9.7	1.0	0.8	7.4
-25	16.5	18.1	6.0	25.7	11.6	1.0	0.8	7.4
-26	17.5	19.2	5.7	26.8	12.7	1.2	1.0	7.4
-27	17.4	19.2	5.9	33	14.0	1.2	1.0	10.8
-28	18.2	20.0	6.0	34	14.6	1.2	1.0	10.8
-30	20.0	21.9	6.0	37	16.5	1.2	1.0	10.8
-32	22.0	23.9	7.3	39	17.6	1.2	1.0	10.8
-34	24.0	26.1	7.6	42	20.6	1.2	1.0	10.8
-35	25.0	27.2	8.0	43	22.3	1.2	1.0	10.8
-36	26.0	28.3	8.3	44	23.9	1.2	1.0	10.8
-37	27.0	29.3	8.4	45	24.6	1.2	1.0	10.8
-38	28.0	30.4	8.6	46	26.4	1.2	1.0	10.8
-40	29.2	31.6	9.7	62	27.7	1.7	1.3	17.4
-42	29.7	32.2	9.0	65	30.2	1.7	1.3	17.4
-45	32.3	34.9	9.6	69	33.8	1.7	1.3	17.4
-46	33.3	36.0	9.7	71	36	1.7	1.3	17.4
-47	34.3	37.1	10.0	72	38	1.7	1.3	17.4
-48	35.0	37.9	10.5	74	40	1.7	1.3	17.4
-50	36.9	40.0	12.1	77	45	1.7	1.3	17.4
-52	38.6	41.9	11.7	99	50	2.0	1.6	27.4
-55	40.8	44.2	11.9	105	54	2.0	1.6	27.4
-57	42.2	45.7	12.5	109	58	2.0	1.6	27.4
-58	43.2	46.8	13.0	111	60	2.0	1.6	27.4
-60	45.5	49.3	12.7	115	66	2.0	1.6	27.4
-62	47.0	50.8	14.0	119	68	2.0	1.6	27.4
-63	47.8	51.7	14.2	120	71	2.0	1.6	27.4
3BM1-65	49.4	53.4	14.2	149	75	2.0	1.6	42.0

BASIC internal series
3BM1



P_r—The values listed below apply to rings made from SAE 1060–1090 and PH 15–7 Mo stainless steel. P_r values for rings made from beryllium copper can be calculated by multiplying listed values by 0.75.

Safety Factors—P_r and P_g
The allowable thrust load values listed include the following safety factors:
P_r: 4 P_g: 2

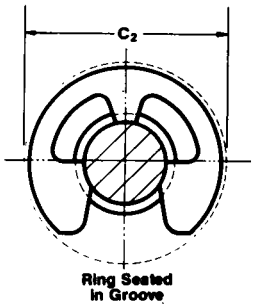
Max. Allowable Radius of Retained Part

Max. Allowable Chamfer of Retained Part

APPENDIX B (Continued)

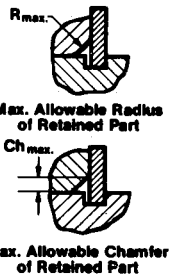
Ring Series and Size No.	Clearance Diameter		Gaging Diameter	Allowable Thrust Loads Sharp corner abutment		Maximum allowable corner radii and chamfers of retained parts		Maximum allowable assembly load with R_{max} or Ch_{max}
	Ring compressed in bore	Ring seated in groove	For checking ring when seated in groove	SAE 1060–1090 and stainless steel rings used in hardened bores Rc 50 min.	All standard rings used in low carbon steel bores			
3BM1	C_1	C_2	A min	P_r (kN)	P_g (kN)	R_{max}	Ch_{max}	P'_r (kN)
3BM1-68	52.0	56.2	14.4	156	82	2.3	1.8	39
-70	53.8	58.2	16.1	161	88	2.3	1.8	39
-72	55.9	60.4	17.4	166	93	2.3	1.8	39
-75	58.2	62.9	16.8	172	101	2.3	1.8	54
-78	61.2	66.0	17.6	209	108	2.5	2.0	54
-80	63.0	68.0	17.2	215	115	2.5	2.0	54
-82	63.5	68.7	18.8	220	122	2.6	2.1	54
-85	66.8	72.2	19.1	228	131	2.6	2.1	54
-88	69.6	75.2	20.4	236	141	2.8	2.2	54
-90	71.6	77.3	21.4	241	147	2.8	2.2	54
-92	73.6	79.4	22.2	247	153	2.9	2.4	54
-95	76.7	82.7	22.6	255	164	3.0	2.5	54
-98	78.3	84.5	22.6	263	174	3.0	2.5	54
-100	80.3	86.6	24.1	269	181	3.1	2.5	54
-102	82.2	88.6	25.5	273	187	3.2	2.6	54
-105	85.1	91.6	26.0	281	196	3.3	2.6	54
-108	88.1	94.7	26.4	290	205	3.5	2.7	54
-110	88.4	95.1	27.5	295	212	3.6	2.8	54
-115	93.2	100.1	29.4	309	227	3.7	2.9	54
-120	98.2	105.2	27.2	321	241	3.9	3.1	54
-125	103.1	110.2	30.3	335	255	4.0	3.2	54
-130	108.0	115.2	31.0	349	269	4.0	3.2	54
-135	110.4	117.7	30.4	415	283	4.3	3.4	67
-140	115.3	122.7	30.4	429	298	4.3	3.4	67
-145	120.4	127.9	31.6	444	313	4.3	3.4	67
-150	125.3	132.9	33.5	460	327	4.3	3.4	67
-155	130.4	138.1	37.0	475	343	4.3	3.4	67
-160	133.8	141.6	35.0	613	359	4.5	3.6	102
-165	138.7	146.6	33.1	632	374	4.6	3.7	102
-170	143.6	151.6	38.2	651	390	4.6	3.7	102
-175	146.0	154.2	37.7	670	403	4.8	3.8	102
-180	151.4	159.8	39.0	690	434	5.0	4.0	102
-185	154.7	163.3	37.3	851	457	5.1	4.1	151
-190	159.5	168.3	35.0	873	480	5.3	4.3	151
-200	169.2	178.2	43.9	919	517	5.4	4.3	151
-210	177.5	186.9	40.6	965	566	5.8	4.6	151
-220	184.1	194.1	38.3	1000	608	6.1	4.9	151
-230	194.0	204.6	49.0	1060	686	6.3	5.1	151
-240	200.4	211.4	45.4	1090	725	6.6	5.3	151
3BM1-250	210.0	221.4	53.0	1150	808	6.7	5.4	151

E-RING external series 3CM1



P_r—The values listed below apply to rings made from SAE 1060–1090 and PH 15–7 Mo stainless steel except size –1, which is supplied in beryllium copper only.* P_r values for other sizes made from beryllium copper can be calculated by multiplying listed values by 0.75.

Safety Factors—P_r and P_g
The allowable thrust load values listed include the following safety factors:
P_r: 3 P_g: 2



APPENDIX C

Ring Series and Size No.	Clearance Diameter	Allowable Thrust Loads Sharp corner abutment		Maximum allowable corner radii and chamfers of retained parts		Maximum allowable assembly load with R_{max} or Ch_{max}	Calculated allowable assembly rpm (steel rings)
	Ring seated in groove	SAE 1060–1090 and stainless steel rings used on hardened shafts Rc 50 min.	All standard rings used on low carbon steel shafts				
3CM1	C_2	P_r (kN)	P_g (kN)	R_{max}	Ch_{max}	P'_r (kN)	rpm
3CM1-1*	2.2	0.06	0.02	0.4	0.25	0.06	40 000
-2	4.3	0.13	0.09	0.8	0.5	0.13	40 000
-3	6.0	0.3	0.17	1.1	0.7	0.3	34 000
-4	7.6	0.7	0.3	1.6	1.2	0.7	31 000
-5	8.9	0.9	0.4	1.6	1.2	0.9	27 000
-6	11.5	1.1	0.6	1.6	1.2	1.1	25 000
-7	14.0	1.2	0.8	1.6	1.2	1.2	23 000
-8	15.1	1.4	1.0	1.7	1.3	1.4	21 500
-9	16.5	3.0	1.3	1.7	1.3	3.0	19 500
-10	17.5	3.4	1.6	1.7	1.3	3.4	18 000
-11	18.0	3.7	1.9	1.7	1.3	3.7	16 500
-12	19.3	4.9	2.3	1.9	1.4	4.9	15 000
-13	21.0	5.4	2.9	2.0	1.5	5.4	13 000
-15	23.5	6.2	4.0	2.0	1.5	6.2	11 500
-16	24.5	6.6	4.5	2.0	1.5	6.6	10 000
-18	27.9	8.7	5.4	2.1	1.6	8.7	9 000
-20	30.7	9.8	6.5	2.2	1.7	9.8	8 000
-22	33.7	10.8	8.1	2.2	1.7	10.8	7 000
3CM1-25	37.9	12.2	10.1	2.4	1.9	12.2	5 000