AMERICAN NATIONAL STANDARD

General Purpose Metric Tapered and Reduced Cross Section Retaining Rings

TYPE 3DM1 – HEAVY DUTY EXTERNAL RINGS
TYPE 3EM1 – REINFORCED "E" RINGS
TYPE 3FM1 – "C" TYPE RINGS

ANSI B27.8M-1978

REAFFIRMED 1999

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

SECRETARIAT

SOCIETY OF AUTOMOTIVE ENGINEERS
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 had 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 I was assigned the responsibility of preparing American metric standards for tapered and reduced section retaining rings.

This Standard was approved as an American National Standard on November 28. 1978.

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Standardization of Retaining Rings, Retaining Clips and Similar Devices)

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AMERICAN NATIONAL STANDARD

GENERAL PURPOSE METRIC TAPERED AND REDUCED CROSS SECTION RETAINING RINGS

Type 3DM1 — Heavy Duty External Rings
Type 3EM1 — Reinforced "E" Rings
Type 3FM1 — "C" Type Rings

1. INTRODUCTORY NOTES

1.1 Scope

This standard is intended to cover complete general and dimensional data for three series of general purpose metric tapered and reduced cross section retaining rings which may be used with the nominal size shafts 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 dimension 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 Heavy Duty External Rings. Dimensions of retaining rings, and grooves for various shaft sizes are given in Table 4.

1.2.2 Reinforced "E" Rings. Dimensions for retaining rings, and grooves for various shaft sizes are given in Table 5.

1.2.3 External "C" Rings. Dimensions of "C" 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 heavy duty external rings in this standard are Type 3DM1. The reinforced "E" rings in this standard are Type 3EM1. The "C" Type external rings in this standard are Type 3FM1.

1.3 Applicability

The rings denoted in this standard are intended primarily for use with the shaft 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 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 millimeters 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 Heavy Duty External Retaining Rings

The 3DM1 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.

By virtue of their greater thickness and larger section height, these rings are resistant to shearing and coming out of their grooves than Type 3AM1 rings.

2.2 Type 3EM1 retaining rings covered by this standard contain 3 prongs connected by a reduced tapered 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.

These rings, by virtue of their design, are substantially stiffer and more resistant to coming out of their grooves under centrifugal forces than do Type 3CM1 rings.

2.3 "C" Type Retaining Rings

Type 3FM1 retaining rings covered by this standard has a tapered section with the taper on the inner surface of the ring facing the groove. The rings are installed radially, usually by means of an applicator, and provide a narrow, uniform 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 (UNS G10600 to G10900) 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

3MD1		3EM1	
Ring Size	Rockwell C	Ring Size	Rockwell C
10 through 16	50-54	4 through 8	49-53
17 through 50	48-52	9 through 15	48-52

3FM1	
Ring Size	Rockwell C
3 through 55	47-51

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 millimeters of significant surface, and such spots should be visible to the naked eye and should not exceed 1.5 millmeters 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 552 or UNS S15700) 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 ring 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 (UNS C17200) 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 Heavy Duty External (3DM1) 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.

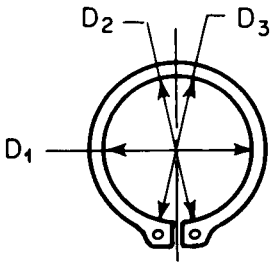


FIGURE 1 PERMANENT SET MEASUREMENTS FOR TYPE 3DM1 RINGS

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 Reinforced "E" Type (3EM1) and "C" Type (3FM1) 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 2 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

Type 3DM1	
Ring Thickness	Permissible Dish
0.9	0.08
1.1-2.4	0.13
2.8-3.2	0.25

Type 3EM1	
Ring Thickness	Permissible Dish
0.6-0.9	0.08
1.1	0.13

Type 3FM1	
Ring Thickness	Permissible Dish
0.4	0.05
0.6-0.9	0.08
1.1-2.0	0.13

FIGURE 2 DISH TYPE 3DM1, TYPE 3EM1 AND TYPE 3FM1

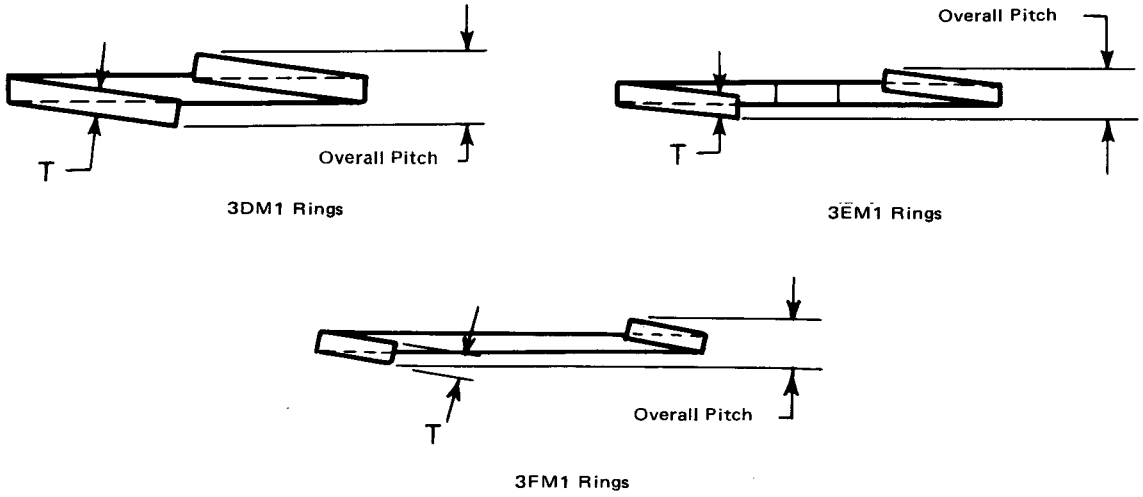


FIGURE 3 PITCH FOR TYPE 3DM1, TYPE 3EM1 AND TYPE 3FM1 RINGS

6.2 Pitch

Pitch limitations of tapered and reduced section retaining rings as shown in Figure 3 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

Type 3DM1		Type 3EM1	
Ring Size mm	Overall Pitch Maximum	Ring Size mm	Overall Pitch Maximum
All sizes	3T	4 through 12	1.5T
		13 through 15	2T

Type 3FM1	
Ring Size mm	Overall Pitch Maximum
3 through 12	1.5T
13 through 55	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

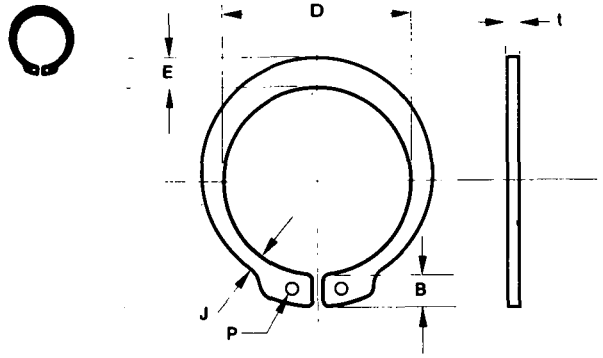
Consult with manufacturers for additional information not included in standard.

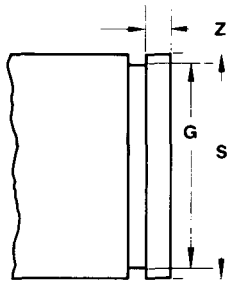
Dimensional Data

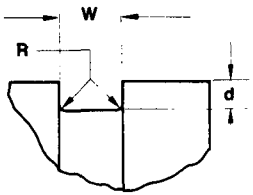
Dimensional data and performance information on rings and grooves for tapered and reduced cross section retaining rings are tabulated in Tables 4, 5 and 6.

HEAVY-DUTY—external
3DM1

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







Detail of Groove

MAX BOTTOM RADII

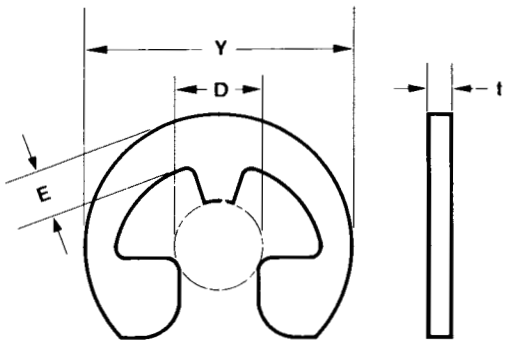
Ring Sizes	R
10 thru 15	0.1
16 thru 20	0.15
22 thru 30	0.2
32 thru 50	0.3

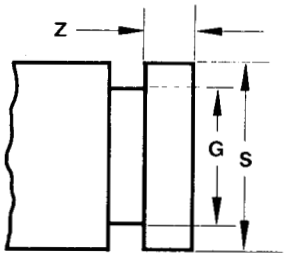
Table 4 Heavy-Duty—External

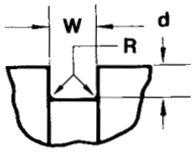
Shaft Dia.		Ring Series and Size No.	Ring Dimensions (mm)									Groove Dimensions (mm)						
			Free Diameter		Standard Thickness All materials and finishes		Hole Dia.	Lug	Large Section	Small Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
mm	Equiv. Inch																	
S	S	3DM1	D	tol	t	tol	P min	B nom	E nom	J nom	kg	G	tol	F.I.M.	W	tol	d ref	Z min
10	0.393	3DM1-10	9.20	+0.08 -0.20	0.9	±0.06	1.0	2.6	1.7	1.0	0.32	9.40	-0.08	0.05	1.0	+0.15	0.30	0.9
11	0.433	-11	10.00	+0.08 -0.20	0.9	±0.06	1.0	2.6	1.9	1.1	0.39	10.30	-0.08	0.05	1.0	+0.15	0.35	1.0
12	0.472	-12	11.05	+0.13 -0.25	1.1	±0.06	1.0	2.6	2.2	1.3	0.63	11.30	-0.08	0.05	1.2	+0.15	0.35	1.0
13	0.512	-13	11.80	+0.13 -0.25	1.3	±0.06	1.2	3.0	2.3	1.3	0.72	12.20	-0.10	0.05	1.4	+0.15	0.40	1.2
14	0.551	-14	12.80	+0.13 -0.25	1.3	±0.06	1.2	3.0	2.4	1.4	0.80	13.15	-0.10	0.05	1.4	+0.15	0.43	1.3
15	0.591	-15	13.80	+0.13 -0.25	1.3	±0.06	1.2	3.3	2.6	1.4	1.00	14.10	-0.10	0.05	1.4	+0.15	0.45	1.3
16	0.630	-16	14.70	+0.13 -0.25	1.3	±0.06	1.2	3.3	2.7	1.5	1.04	15.00	-0.10	0.08	1.4	+0.15	0.50	1.5
17	0.669	-17	15.65	+0.13 -0.25	1.3	±0.06	1.2	3.3	2.8	1.6	1.2	15.95	-0.10	0.08	1.4	+0.15	0.53	1.6
18	0.708	-18	16.55	+0.13 -0.25	1.6	±0.08	1.9	4.1	3.0	1.8	1.9	16.85	-0.10	0.08	1.75	+0.15	0.58	1.7
19	0.748	-19	17.50	+0.13 -0.25	2.0	±0.08	1.9	4.6	3.2	2.0	2.5	17.80	-0.10	0.08	2.15	+0.20	0.60	1.8
20	0.787	-20	18.45	+0.13 -0.25	2.0	±0.08	1.9	4.6	3.4	2.0	2.8	18.75	-0.10	0.08	2.15	+0.20	0.63	1.9
22	0.866	-22	20.40	+0.13 -0.25	2.0	±0.08	1.9	4.6	3.8	2.1	3.4	20.70	-0.10	0.08	2.15	+0.20	0.65	2.0
25	0.984	-25	23.10	+0.13 -0.25	2.0	±0.08	1.9	4.6	3.8	2.1	3.5	23.50	-0.10	0.08	2.15	+0.20	0.75	2.2
27	1.063	-27	24.85	+0.13 -0.25	2.4	±0.08	2.3	5.6	4.1	2.3	5.2	25.40	-0.15	0.10	2.55	+0.20	0.80	2.4
28	1.102	-28	25.70	+0.25 -0.40	2.4	±0.08	2.3	5.6	4.3	2.4	5.6	26.30	-0.15	0.10	2.55	+0.20	0.85	2.5
30	1.181	-30	27.60	+0.25 -0.40	2.4	±0.08	2.3	5.6	4.5	2.5	6.1	28.20	-0.15	0.10	2.55	+0.20	0.90	2.7
32	1.260	-32	29.35	+0.25 -0.40	2.4	±0.08	2.3	5.6	4.7	2.6	6.8	30.00	-0.15	0.10	2.55	+0.20	1.00	3.0
35	1.378	-35	32.20	+0.25 -0.40	2.4	±0.08	2.3	5.6	5.1	2.8	8.1	32.80	-0.15	0.10	2.55	+0.20	1.10	3.3
38	1.496	-38	35.05	+0.25 -0.40	2.8	±0.08	2.7	7.1	5.5	3.1	12.2	35.60	-0.15	0.10	2.95	+0.20	1.20	3.6
40	1.575	-40	36.70	+0.35 -0.50	2.8	±0.08	2.7	7.1	5.8	3.2	14.1	37.50	-0.20	0.15	2.95	+0.20	1.25	3.7
45	1.772	-45	41.10	+0.35 -0.50	2.8	±0.08	2.7	7.4	6.5	3.6	15.1	42.20	-0.20	0.15	2.95	+0.20	1.40	4.2
50	1.969	3DM1-50	45.50	+0.35 -0.50	3.2	±0.10	3.1	8.0	7.1	3.9	21.8	47.00	-0.20	0.15	3.40	+0.25	1.50	4.5

REINFORCED E-RING—external
3EM1

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







Detail of Groove

MAX BOTTOM RADII

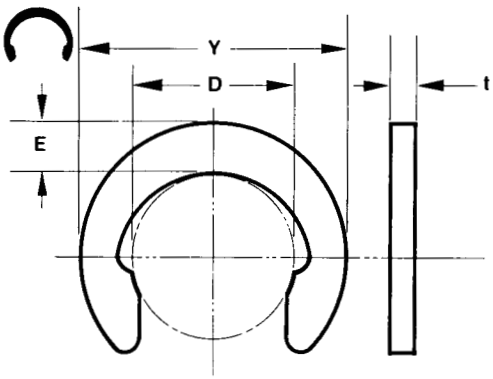
Ring Sizes	R
4	0.1
5 thru 9	0.15
10 thru 15	0.25

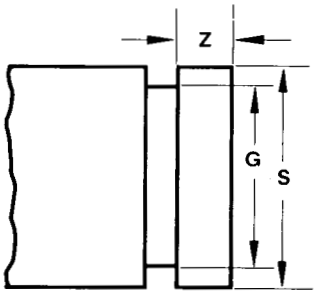
Table 5 Reinforced E-Ring — External

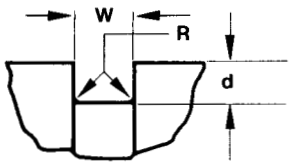
Shaft Dia.			Ring Dimensions (mm)							Groove Dimensions (mm)						
mm	Equiv. Inch	Ring Series and Size No.	Free Diameter		Standard Thickness All materials and finishes		Outer Dia.	Large Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3EM1	D	tol	t	tol	Y nom	E nom	kg	G	tol	F.I.M.	W	tol	d ref	Z min
4	0.157	3EM1 -4	2.90	+0.05 -0.08	0.6	±0.06	8.50	1.5	0.14	3.00	-0.05	0.05	0.7	+0.15	0.50	1.0
5	0.197	-5	3.65	+0.08 -0.08	0.6	±0.06	9.50	1.9	0.18	3.85	-0.05	0.05	0.7	+0.15	0.57	1.1
6	0.236	-6	4.65	+0.08 -0.08	0.6	±0.06	11.35	2.2	0.24	4.85	-0.10	0.05	0.7	+0.15	0.57	1.1
7	0.276	-7	5.20	+0.08 -0.08	0.6	±0.06	13.10	2.5	0.32	5.40	-0.10	0.08	0.7	+0.15	0.80	1.6
8	0.315	-8	6.15	+0.08 -0.08	0.6	±0.06	14.95	2.7	0.36	6.40	-0.15	0.08	0.7	+0.15	0.80	1.6
9	0.354	-9	6.75	+0.10 -0.10	0.9	±0.06	15.70	2.8	0.60	7.10	-0.15	0.10	1.0	+0.15	0.95	1.9
10	0.394	-10	7.45	+0.10 -0.10	0.9	±0.06	16.75	3.0	0.68	7.80	-0.15	0.10	1.0	+0.15	1.10	2.2
11	0.433	-11	8.45	+0.10 -0.10	0.9	±0.06	18.95	3.4	0.86	8.80	-0.15	0.10	1.0	+0.15	1.10	2.2
12	0.472	-12	9.10	+0.10 -0.10	1.1	±0.06	19.60	3.5	1.20	9.50	-0.15	0.10	1.2	+0.15	1.25	2.5
13	0.512	-13	9.80	+0.10 -0.10	1.1	±0.06	20.55	3.6	1.45	10.20	-0.15	0.10	1.2	+0.15	1.40	2.8
14	0.551	-14	10.90	+0.10 -0.10	1.1	±0.06	22.10	3.8	1.60	11.20	-0.15	0.10	1.2	+0.15	1.40	2.8
15	0.591	3EM1-15	11.50	+0.10 -0.10	1.1	±0.06	23.20	3.9	1.75	11.80	-0.15	0.10	1.2	+0.15	1.60	3.2

C-Ring—external
3FM1

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







Detail of Groove

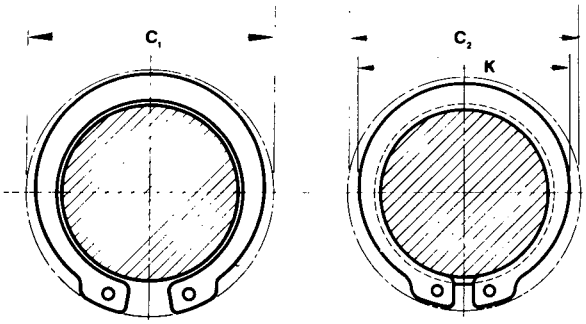
MAX BOTTOM RADII

Ring Sizes	R
3 thru 4	0.1
5 thru 16	0.2
17 thru 30	0.3
32 thru 55	0.4

Table 6 C-Ring — External

Shaft Dia.			Ring Dimensions (mm)							Groove Dimensions (mm)						
mm	Equiv. Inch	Ring Series and Size No.	Free Diameter		Standard Thickness All materials and finishes		Outer Dia.	Large Section	Approx. mass per 1000 Pcs.	Groove Diameter			Groove Width		Groove Depth	Edge Margin
S	S	3FM1	D	tol	t	tol	Y nom	E nom	kg	G	tol	F.I.M.	W	tol	d ref	Z min
3	0.118	3FM1 -3	2.18	±0.06	0.4	+0.06	3.98	0.90	0.019	2.3	-0.05	0.04	0.5	+0.10	0.35	1.0
4	0.157	-4	3.00	±0.06	0.4	+0.06	5.00	1.00	0.025	3.2	-0.07	0.04	0.5	+0.10	0.40	1.2
5	0.197	-5	3.80	±0.08	0.6	+0.06	6.20	1.20	0.055	4.0	-0.07	0.06	0.7	+0.15	0.50	1.5
6	0.236	-6	4.80	±0.08	0.6	+0.06	7.40	1.30	0.072	5.0	-0.07	0.06	0.7	+0.15	0.50	1.5
7	0.276	-7	5.80	±0.08	0.6	+0.06	8.60	1.40	0.09	6.0	-0.10	0.06	0.7	+0.15	0.50	1.5
8	0.315	-8	6.80	±0.09	0.6	+0.06	10.00	1.60	0.12	7.0	-0.10	0.06	0.7	+0.15	0.50	1.5
9	0.354	-9	7.80	±0.09	0.6	+0.06	11.20	1.70	0.13	8.0	-0.10	0.06	0.7	+0.15	0.50	1.5
10	0.393	-10	8.75	±0.09	0.6	±0.06	12.15	1.70	0.15	9.0	-0.10	0.06	0.7	+0.15	0.50	1.5
11	0.433	-11	9.65	±0.18	0.6	±0.06	13.20	1.80	0.17	10.0	-0.10	0.10	0.7	+0.15	0.50	1.5
12	0.472	-12	10.55	±0.18	0.6	+0.06	14.35	1.90	0.20	10.9	-0.10	0.10	0.7	+0.15	0.55	1.7
13	0.512	-13	11.40	±0.18	1.0	±0.06	15.40	2.00	0.39	11.8	-0.10	0.10	1.1	+0.15	0.60	1.8
14	0.551	-14	12.30	±0.18	1.0	+0.06	16.30	2.00	0.42	12.7	-0.10	0.10	1.1	+0.15	0.65	2.0
15	0.591	-15	13.20	±0.18	1.0	+0.06	17.40	2.10	0.50	13.6	-0.10	0.10	1.1	+0.15	0.70	2.1
16	0.630	-16	14.10	±0.18	1.0	±0.06	18.50	2.20	0.51	14.5	-0.10	0.10	1.1	+0.15	0.75	2.3
17	0.669	-17	14.90	±0.18	1.0	+0.06	19.40	2.25	0.55	15.4	-0.10	0.10	1.1	+0.15	0.80	2.4
18	0.708	-18	15.80	+0.18	1.2	+0.06	20.40	2.30	0.67	16.3	-0.10	0.10	1.3	+0.15	0.85	2.6
19	0.748	-19	16.70	±0.18	1.2	+0.06	21.50	2.40	0.85	17.2	-0.10	0.15	1.3	+0.15	0.90	2.7
20	0.787	-20	17.55	±0.18	1.2	+0.06	22.65	2.55	0.85	18.1	-0.20	0.15	1.3	+0.15	0.95	2.9
22	0.866	-22	19.40	±0.21	1.2	+0.06	25.00	2.80	1.07	19.9	-0.20	0.15	1.3	+0.15	1.05	3.2
23	0.905	-23	20.20	+0.21	1.2	+0.06	26.0	2.90	1.15	20.8	-0.20	0.15	1.3	+0.15	1.10	3.3
24	0.945	-24	21.10	±0.21	1.2	+0.06	27.1	3.00	1.2	21.7	-0.20	0.15	1.3	+0.15	1.15	3.5
25	0.984	-25	22.00	+0.21	1.2	+0.06	28.3	3.15	1.4	22.6	-0.20	0.15	1.3	+0.15	1.20	3.6
26	1.023	-26	22.90	±0.21	1.2	+0.06	29.4	3.25	1.5	23.5	-0.20	0.15	1.3	+0.15	1.25	3.8
28	1.062	-28	24.60	±0.21	1.6	+0.08	31.6	3.50	2.5	25.2	-0.20	0.15	1.75	+0.20	1.40	4.2
30	1.181	-30	26.30	+0.21	1.6	+0.08	33.7	3.70	2.6	27.0	-0.20	0.15	1.75	+0.20	1.50	4.5
32	1.260	-32	28.10	±0.21	1.6	+0.08	36.1	4.00	3.2	28.8	-0.20	0.15	1.75	+0.20	1.60	4.8
35	1.378	-35	30.80	±0.25	1.6	+0.08	39.4	4.30	3.5	31.5	-0.25	0.15	1.75	+0.20	1.75	5.3
36	1.417	-36	31.70	±0.25	1.6	+0.08	40.5	4.40	4.1	32.4	-0.25	0.20	1.75	+0.20	1.80	5.4
38	1.496	-38	33.40	±0.25	1.6	+0.08	42.6	4.60	4.3	34.2	-0.25	0.20	1.75	+0.20	1.90	5.7
40	1.575	-40	35.20	+0.39	1.6	+0.08	45.0	4.90	4.7	36.0	-0.25	0.20	1.75	+0.20	2.00	6.0
42	1.654	-42	37.00	+0.39	1.6	+0.08	47.2	5.10	5.0	37.8	-0.25	0.20	1.75	+0.20	2.10	6.3
45	1.772	-45	39.60	±0.39	1.6	+0.08	50.6	5.50	5.4	40.5	-0.25	0.20	1.75	+0.20	2.25	6.8
48	1.890	-48	42.30	+0.39	1.6	+0.08	54.1	5.90	7.1	43.2	-0.25	0.20	1.75	+0.20	2.40	7.2
50	1.969	-50	44.00	+0.39	2.0	+0.08	56.4	6.20	8.9	45.0	-0.25	0.20	2.15	+0.20	2.50	7.5
52	2.047	-52	46.00	±0.39	2.0	+0.08	58.6	6.30	9.3	47.0	-0.25	0.20	2.15	+0.20	2.50	7.5
55	2.165	3FM1-55	48.50	+0.39	2.0	+0.08	61.5	6.50	10.4	50.0	-0.25	0.20	2.15	+0.20	2.50	7.5

HEAVY-DUTY — external
3DM1



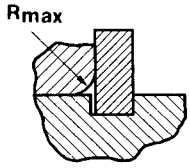
Ring Expanded over Shaft

Ring Seated in Groove

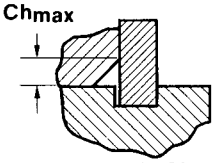
P_r — The values listed below apply to rings made from SAE 1060–1090 and PH 15-7 Mo stainless steel. P_r values can be calculated by multiplying listed values by 0.75.

P_g — The values listed apply to material with a tensile strength of 315 MPa.

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

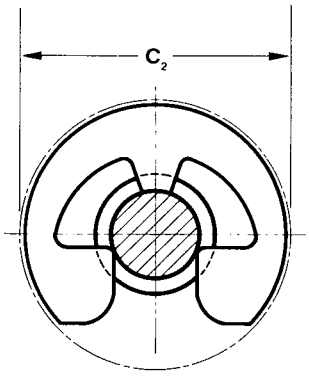


Max. Allowable Chamfer of Retained Part

APPENDIX A

	Application Data								
	Clearance Diameter		Gaging Dia.	Allow. Thrust Loads Sharp corner abutment		Maximum allowable corner radii and chamfers of retained parts		Allowable assembly load with R_{max} or Ch_{max}	Calculated allowable assembly rpm (steel rings)
Ring Series and Size No.	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				
3DM1	C_1	C_2	K max	P_r (kN)	P_g (kN)	R max	Ch max	P'_r (kN)	rpm
3DM1-10	15.6	14.8	12.15	9.3	2.9	1.0	0.8	2.7	66 000
-11	16.6	15.8	13.40	10.8	3.8	1.0	0.8	3.0	60 000
-12	17.6	16.8	14.95	13.7	4.0	1.6	1.3	3.2	55 000
-13	19.5	18.5	15.80	17.6	5.0	1.6	1.3	4.6	52 000
-14	20.5	19.5	16.90	18.9	5.8	1.6	1.3	4.8	47 000
-15	22.1	21.1	18.20	20.3	6.5	1.6	1.3	5.2	42 000
-16	23.2	22.0	19.20	21.6	7.7	1.6	1.3	5.4	39 000
-17	24.2	22.9	20.45	23.0	8.7	1.6	1.3	5.7	36 000
-18	26.8	25.5	21.75	30.0	10.0	1.8	1.5	8.0	35 000
-19	28.8	27.4	23.05	40	11.0	1.8	1.5	13.2	30 000
-20	29.8	28.4	24.30	42	13.1	2.0	1.6	13.2	29 000
-22	31.9	30.4	26.60	46	13.7	2.0	1.6	14.7	27 000
-25	34.9	33.1	29.45	52	18.0	2.0	1.6	14.7	24 000
-27	39.0	37.1	32.00	67	20.8	2.0	1.6	22.9	22 000
-28	40.0	38.0	33.20	69	22.8	2.0	1.6	24	20 000
-30	42.0	40.0	35.40	74	26.0	2.0	1.6	25	19 000
-32	44.1	41.8	37.30	79	30.8	2.5	2.1	19	18 000
-35	47.1	44.6	40.80	87	38	2.5	2.1	22	16 000
-38	53.2	50.5	44.40	111	44	2.5	2.1	32	15 000
-40	55.2	52.4	46.70	116	48	2.5	2.1	34	13 500
-45	60.9	57.7	52.20	130	61	2.5	2.1	38	12 500
3DM1-50	67.1	63.8	58.40	165	72	3.5	2.9	39	11 000

REINFORCED E-RING — external
3EM1

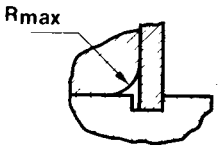


Ring Seated in Groove

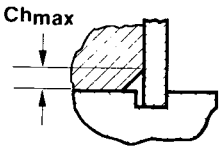
P_r — The values listed below apply to rings made from SAE 1060-1090 and PH 15-7 Mo stainless steel. P_r values for other sizes made from beryllium copper can be calculated by multiplying listed values by 0.75.

P_g — The values listed apply to material with a tensile strength of 315 MPa.

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



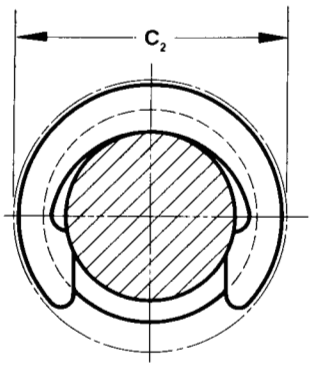
Max. Allowable Radius of Retained Part



Max. Allowable Chamfer of Retained Part

APPENDIX B

Ring Series and Size No.	Clearance Diameter Ring seated in groove	Application Data: Allow. Thrust Loads Sharp corner abutment — SAE 1060-1090 and stainless steel rings used on hardened shafts Rc 50 min.	Application Data: Allow. Thrust Loads Sharp corner abutment — All standard rings used on low carbon steel shafts	Application Data: Maximum allowable corner radii and chamfers of retained parts		Application Data: Allowable assembly load with R_{max} or Ch_{max}	Application Data: Calculated allowable assembly rpm (steel rings)
3EM1	C_2	P_r (kN)	P_g (kN)	R max	Ch max	P'_r (kN)	rpm
3EM1 -4	8.9	0.6	0.18	1.6	1.3	0.6	50 000
-5	9.9	0.8	0.27	1.6	1.3	0.8	43 000
-6	11.8	1.0	0.34	1.6	1.3	1.0	38 000
-7	13.7	1.1	0.54	1.6	1.3	1.1	33 000
-8	15.6	1.3	0.63	1.6	1.3	1.3	28 000
-9	16.4	2.2	0.8	1.8	1.4	2.2	27 000
-10	17.5	2.4	1.1	1.8	1.4	2.4	25 000
-11	19.7	2.7	1.2	1.8	1.4	2.7	21 500
-12	20.4	3.5	1.5	2.0	1.5	3.5	19 500
-13	21.3	3.9	1.7	2.0	1.5	3.9	17 500
-14	22.8	4.2	1.9	2.0	1.5	4.2	15 500
3EM1-15	23.9	4.5	2.3	2.0	1.5	4.5	14 000

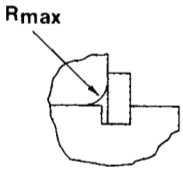


Ring Seated in Groove

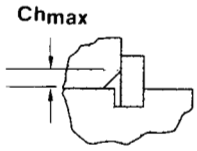
P_r: The values listed below apply to rings made from SAE 1060-1090 and PH 15-7 Mo stainless steel. P_r values for rings made from beryllium copper can be calculated by multiplying listed values by 0.75

P_g: The values listed apply to material with a tensile yield strength of 315 MPa. For other materials, refer to Item 2, Pg. 4.

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

C-Ring — external
3FM1

APPENDIX C

Ring Series and Size No.	Application Data: Clearance Diameter Ring seated in groove	Allow. Thrust Loads Sharp corner abutment: SAE 1060-1090 and stainless steel rings used on hardened shafts Rc 50 min.	Allow. Thrust Loads Sharp corner abutment: All standard rings used on low carbon steel shafts	Maximum allowable corner radii and chamfers of retained parts		Allowable assembly load with R_{max} or Ch_{max}	Calculated allowable assembly rpm (steel rings)
3FM1	C_2	P_r (kN)	P_g (kN)	R max	Ch max	P'_r (kN)	rpm
3FM1 -3	4.3	0.4	0.2	0.4	0.3	0.4	80 000
-4	5.4	0.5	0.4	0.4	0.3	0.4	80 000
-5	6.6	0.9	0.6	0.6	0.45	0.7	80 000
-6	7.8	1.1	0.7	0.6	0.45	0.7	80 000
-7	9.0	1.3	0.8	0.6	0.45	0.7	69 000
-8	10.4	1.5	1.0	0.6	0.45	0.7	67 000
-9	11.6	2.2	1.1	0.6	0.45	0.7	58 000
-10	12.6	2.3	1.2	0.6	0.45	0.7	50 000
-11	13.8	2.6	1.3	0.6	0.45	0.7	40 000
-12	15.0	2.8	1.6	0.6	0.45	0.7	35 000
-13	16.1	4.9	1.9	1.0	0.8	2.0	30 000
-14	17.0	5.5	2.1	1.0	0.8	2.0	27 000
-15	18.1	6.0	2.5	1.0	0.8	2.0	25 000
-16	19.2	6.3	2.9	1.0	0.8	2.0	24 000
-17	20.2	6.7	3.3	1.0	0.8	2.0	23 000
-18	21.3	8.5	3.6	1.2	0.9	2.8	21 000
-19	22.4	9.0	4.2	1.2	0.9	2.8	20 500
-20	23.6	9.5	4.6	1.2	0.9	3.0	20 000
-22	25.9	10.4	5.6	1.2	0.9	3.0	16 500
-23	27.0	10.9	6.1	1.2	0.9	3.2	15 200
-24	28.1	11.3	6.7	1.2	0.9	3.2	15 100
-25	29.3	11.8	7.4	1.2	0.9	3.2	15 000
-26	30.4	12.2	7.8	1.2	0.9	3.2	14 500
-28	32.6	17.6	9.5	1.5	1.15	6.3	13 200
-30	34.9	19.2	10.8	1.5	1.15	6.4	13 000
-32	37.3	20.5	12.2	1.5	1.15	6.6	12 900
-35	40.6	22.4	14.7	1.5	1.15	6.8	11 000
-36	41.7	23.1	15.7	1.5	1.15	6.8	10 200
-38	43.9	23.8	17.2	1.5	1.15	7.1	9 600
-40	46.3	25.6	19.6	1.5	1.15	7.2	9 200
-42	48.5	27.5	21.0	1.5	1.15	7.4	8 600
-45	52.1	28.4	24.5	1.5	1.15	7.6	8 300
-48	55.6	29.9	27.5	1.5	1.15	7.9	7 500
-50	58.0	40.0	30.4	2.0	1.5	12.0	6 800
-52	60.3	41.0	31.3	2.0	1.5	12.0	6 600
3FM1-55	63.7	43.0	33.3	2.0	1.5	12.0	6 500