

Groove Design, Metal C-Ring Gasket, Face Type
Internal Pressure, Metric

FSC 5330

RATIONALE

MA2537 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE AND FIELD OF APPLICATION:

- 1.1 This standard provides the design criteria for static metal c-ring gasket applications, face type (axial compression) groove dimensions for aerospace metric c-ring sizes specified in MA2536.
- 1.2 Primarily for aerospace propulsion system applications where internally pressurized face type metal c-ring gaskets are required for sealing fluids at temperatures that precludes the use of elastomeric seals.
- 1.3 A table of c-ring groove dimensions are included based on the design criteria specified herein. Dimensions in this document are in millimeters, unless otherwise specified.

2. REFERENCES:

2.1 Applicable Documents:

MA2536	Gasket, Metal C-Ring, Internal Pressure, UNS N07750, Silver Plate, Metric
ANSI/ASME B46.1-1985	Surface Texture (Surface Roughness, Waviness, and Lay)
ANSI Y14.36-1978	Surface Texture Symbols

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2.2 Symbols:

Letter symbols used in this document are as follows:

- ϕA c-ring outside diameter
- ϕB c-ring inside diameter
- ϕC c-ring cross-section outside diameter
- ϕD groove outside diameter, internal pressure
- ϕE port inside diameter, open cavity
- F c-ring groove axial depth
- G c-ring groove width, closed cavity
- R corner radius, bottom of groove
- T c-ring wall thickness

3. TECHNICAL REQUIREMENTS:

3.1 C-Rings:

Figure 1 illustrates a c-ring; the outside diameter, inside diameter, and cross-section diameter are in accordance with MA2536.

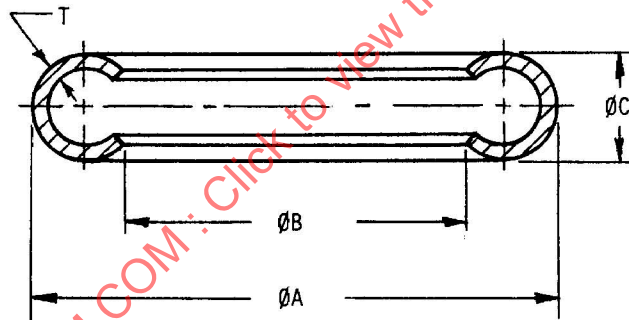


FIGURE 1 - C-Ring Dimensions

3.2 Face Type (Axial) C-Ring Groove, Internal Pressure:

Figure 2 specifies the letter symbol dimensions for face type c-ring groove, internal pressure, without inner groove wall. Figure 3 specifies the letter symbol dimensions for face type c-ring groove, internal pressure, with inner and outer groove walls.

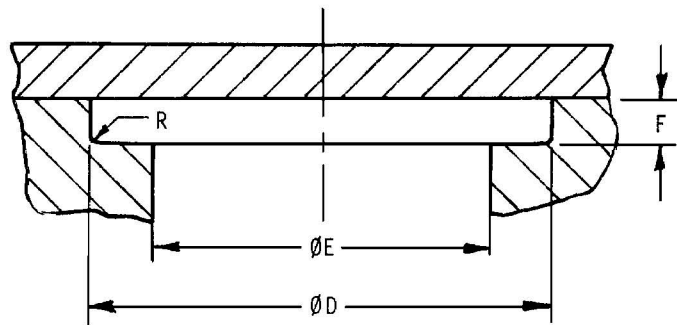


FIGURE 2 - Axial C-Ring Groove, Internal Pressure
Without Inner Groove Wall, Open Cavity

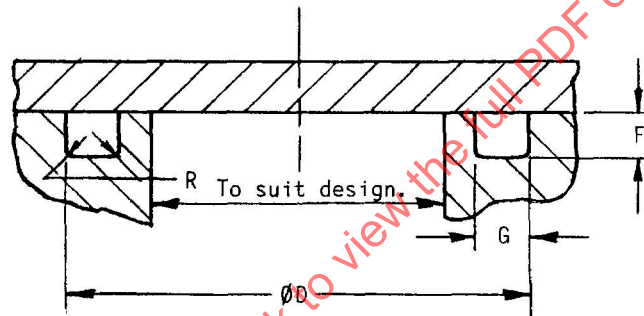


FIGURE 3 - Axial C-Ring Groove, Internal Pressure
With Inner and Outer Groove Walls

3.3 Surface Texture:

The surface roughness shall be $1.6 \mu\text{m Ra}$ on the groove side walls and $0.8 \mu\text{m Ra}$ with circular lay on bottom surface, and also, on the mating top surface in contact with the c-ring seal (see Figure 4). Surface roughness shall be determined in accordance with ANSI/ASME B46.1; symbols are in accordance with ANSI Y14.36.

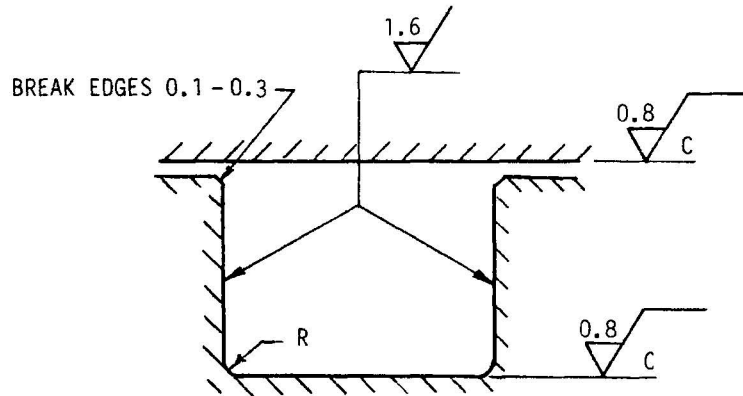


FIGURE 4 - Groove Surface Texture

3.4 Corner Radius and Edge Break:

The corner radius R (see Figures 2, 3, and 4) at bottom of groove shall be as specified in Table 1. The groove edges shall have 0.1 to 0.3 edge break.

TABLE 1 - Groove Corner Radius (R)

ϕC nom	Corner Radius R
1.60	0.3 - 0.5
2.50	0.5 - 0.8
3.20	0.8 - 1.2

3.5 Dimensions of Face Type Groove:

- 3.5.1 Groove Depth, F: The groove depths, F, are specified in Table 2 and are applicable for plated or unplated c-ring gaskets. The values were calculated to provide 20% squeeze on the nominal cross-sectional diameter of the c-ring; thus, the equation becomes:

$$F \text{ nom} = 0.8 \times \phi C \text{ nom} \quad (\text{Eq. 1})$$

3.5.1 (Continued):

The groove depth tolerances and resulting maximum and minimum percent squeeze based on the limits for ϕC , c-ring cross-section diameter, are given in Table 2 and calculated from the following equation:

$$\% \text{ Squeeze min} = [(\phi C \text{ min} - F \text{ max}) / \phi C \text{ min}] 100 \quad (\text{Eq. 2})$$

$$\% \text{ Squeeze max} = [(\phi C \text{ max} - F \text{ min}) / \phi C \text{ max}] 100 \quad (\text{Eq. 3})$$

TABLE 2 - Groove Depth F and Percent Squeeze

C-ring ϕC	Groove Depth F	% Squeeze
1.60 ± 0.05	1.28 ± 0.03	15.5 - 24.2
2.50 ± 0.05	2.00 ± 0.05	16.3 - 23.6
3.30 ± 0.08	2.56 ± 0.05	16.4 - 23.5

3.5.2 Groove Outside Diameter, Internal Pressure, ϕD : For internal pressure sealing, the groove outside diameter (ϕD) should be large enough to avoid interference (locking) with the c-ring outside diameter (ϕA) when the ring is compressed in the groove at assembly. Seal ring outside diameter (ϕA) grows approximately 50% of the amount of seal compression. The diameter (ϕB) on the open side of the c-ring seal does not change significantly. Sealing contact on the c-ring should only occur at the bottom of the groove and at the surface of the mating part. If the gasket makes contact with the groove outside diameter (ϕD), as well as the groove bottom surface and the surface of the mating part, a three line contact on the gasket is formed, which can cause leakage because the friction force generated between the gasket and the groove wall reduces the sealing contact force at the bottom of the groove. Therefore, the groove outer wall diameter is made larger than the c-ring outside diameter (ϕA) by 50% of the maximum squeeze, calculated from the following equations for unplated c-ring gaskets:

For $\phi C \text{ nom} = 1.60$:

$$\begin{aligned} \phi D \text{ min} &= \phi A \text{ max} + 0.20 \\ \phi D \text{ max} &= \phi D \text{ min} + \text{Tol H11} \end{aligned}$$

For $\phi C \text{ nom} = 2.50$:

$$\begin{aligned} \phi D \text{ min} &= \phi A \text{ max} + 0.30 \\ \phi D \text{ max} &= \phi D \text{ min} + \text{Tol H11} \end{aligned}$$

For $\phi C \text{ nom} = 3.20$:

$$\begin{aligned} \phi D \text{ min} &= \phi A \text{ max} + 0.40 \\ \phi D \text{ max} &= \phi D \text{ min} + \text{Tol H11} \end{aligned}$$

Tol H11	For ϕD	(Eq. 4)
0.11	> 10 to 18	
0.13	> 18 to 30	
0.16	> 30 to 50	
0.19	> 50 to 80	
0.22	> 80 to 120	(Eq. 5)
0.25	> 120 to 180	
0.29	> 180 to 250	

3.5.2 (Continued):

For plated c-ring gaskets, internal pressure seals, the groove outside diameter (ϕD) shall be increased by two times the maximum plating thickness.

- 3.5.3 Groove Width, G: The minimum groove width shall accommodate the maximum squeeze of the c-ring cross-section. The change in c-ring cross-section is approximately 25% of the maximum squeeze; therefore, the minimum groove width can be stated to be as follows:

$$G \text{ min} = 0.5(\phi A \text{ max} - \phi B \text{ min}) + 0.25(\phi C \text{ max} - F \text{ min}) + 0.08(\phi C \text{ nom}) \quad (\text{Eq. 7})$$

where

$0.08(\phi C \text{ nom})$ is minimum clearance

To simplify, Equation 7 can become:

$$\begin{aligned} G \text{ min} &= \phi C \text{ nom} + 0.05 \\ G \text{ max} &= G \text{ min} + 0.5(H11 \text{ Tol based on } \phi D \text{ min}) \end{aligned} \quad (\text{Eq. 8})$$

For plated c-ring gaskets, groove width G shall be increased by two times the maximum plating thickness.

- 3.5.4 Port Inside Diameter, ϕE , Open Cavity: The maximum port diameter, $\phi E \text{ max}$ for open cavity (without inner groove wall, see Figure 2), is calculated from the following equation:

$$\phi E \text{ max} = \phi B \text{ min} - 0.25 \quad (\text{Eq. 9})$$

For plated c-ring gaskets, internal pressure seals, the port inside diameter ($\phi E \text{ max}$) for the open cavity shall be decreased by two times the maximum plating thickness.

- 3.5.5 Groove Dimensions: Tables 3 through 5 provide groove dimensions for unplated c-ring gasket sizes shown in MA2536. For plated MA2536 gaskets, dimensions ϕD , ϕE and G min shall be revised as follows:

- ϕD increased by 2 x max plating thickness.
- ϕE decreased by 2 x max plating thickness.
- G min increased by 2 x max plating thickness.

TABLE 3 - C-Ring Gasket, Axial Squeeze, Groove Dimensions

for
 $\varnothing C$ nom = 1.60 (free height)
 Groove depth F = 1.25 - 1.31
 Groove width G min = 1.65 ^{3/}
 Corner radius R = 0.3 - 0.5
 Dimensions in mm and are for unplated gaskets.

C-Ring MA2536		Internal Pressure		C-Ring MA2536		Internal Pressure	
Size Code	$\varnothing A$ nom	$\varnothing D$ 1/	$\varnothing E$ max 2/	Size Code	$\varnothing A$ nom	$\varnothing D$ 1/	$\varnothing E$ max 2/
A010	10	10.20 - 10.31	6.80	A046	46	46.20 - 46.36	42.80
A011	11	11.20 - 11.31	7.80	A048	48	48.20 - 48.36	44.80
A012	12	12.20 - 12.31	8.80	A050	50	50.20 - 50.39	46.80
A013	13	13.20 - 13.31	9.80	A052	52	52.20 - 52.39	48.80
A014	14	14.20 - 14.31	10.80	A054	54	54.20 - 54.39	50.80
A015	15	15.20 - 15.31	11.80	A056	56	56.20 - 56.39	52.80
A016	16	16.20 - 16.31	12.80	A058	58	58.20 - 58.39	54.80
A017	17	17.20 - 17.31	13.80	A060	60	60.20 - 60.39	56.80
A018	18	18.20 - 18.33	14.80	A062	62	62.20 - 62.39	58.80
A019	19	19.20 - 19.33	15.80	A064	64	64.20 - 64.39	60.80
A020	20	20.20 - 20.33	16.80	A066	66	66.20 - 66.39	62.80
A021	21	21.20 - 21.33	17.80	A068	68	68.20 - 68.39	64.80
A022	22	22.20 - 22.33	18.80	A070	70	70.20 - 70.39	66.80
A023	23	23.20 - 23.33	19.80	A072	72	72.20 - 72.39	68.80
A024	24	24.20 - 24.33	20.80	A074	74	74.20 - 74.39	70.80
A025	25	25.20 - 25.33	21.80	A076	76	76.20 - 76.39	72.77
A026	26	26.20 - 26.33	22.80	A078	78	78.20 - 78.39	74.77
A027	27	27.20 - 27.33	23.80	A080	80	80.20 - 80.42	76.77
A028	28	28.20 - 28.33	24.80	A082	82	82.20 - 82.42	78.77
A029	29	29.20 - 29.33	25.80	A084	84	84.20 - 84.42	80.77
A030	30	30.20 - 30.36	26.80	A086	86	86.20 - 86.42	82.77
A032	32	32.20 - 32.36	28.80	A088	88	88.20 - 88.42	84.77
A034	34	34.20 - 34.36	30.80	A090	90	90.20 - 90.42	86.77
A036	36	36.20 - 36.36	32.80	A092	92	92.20 - 92.42	88.77
A038	38	38.20 - 38.36	34.80	A094	94	94.20 - 94.42	90.77
A040	40	40.20 - 40.36	36.80	A096	96	96.20 - 96.42	92.77
A042	42	42.20 - 42.36	38.80	A098	98	98.20 - 98.42	94.77
A044	44	44.20 - 44.36	40.80	A100	100	100.20 - 100.42	96.77

1/ For plated gaskets, increase $\varnothing D$ by 2 x max plating thickness

2/ For plated gaskets, decrease $\varnothing E$ by 2 x max plating thickness.

3/ For plated gaskets, increase G min by 2 x max plating thickness.