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AEROSPACE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

ARP674

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Rev. A

GROOVE DESIGN, METAL O-RING GASKET

1. SCOPE:

Groove designs presented herein are applicable for use with the following MS metal o-ring gaskets, or to dimensionally equivalent gaskets of other materials:

AMS 5570 or AMS 5576 Plain	AMS 5570 or AMS 5576 Silver Pl.
MS9141 - 0.035 tube x 0.006 wall	MS9371 - 0.035 tube x 0.006 wall
MS9142 - 0.062 tube x 0.006 wall	MS9372 - 0.062 tube x 0.006 wall
MS9202 - 0.062 tube x 0.010 wall	MS9373 - 0.062 tube x 0.010 wall
MS9203 - 0.094 tube x 0.006 wall	MS9374 - 0.094 tube x 0.006 wall
MS9204 - 0.094 tube x 0.010 wall	MS9375 - 0.094 tube x 0.010 wall
MS9205 - 0.125 tube x 0.010 wall	MS9376 - 0.125 tube x 0.010 wall

2. CLASSIFICATION:

Two groove designs are provided for each gasket size as follows:

Type 1. Two-plane contact with gasket, axially on both faces, groove bottom & flange face.

Type 2. Three-plane contact with gasket, axially on both faces and radially on the outside diameter, groove bottom and outer wall, and mating flange face.

3. APPLICATION:

Use Type 1 grooves for normal pressure where flange loads must be held to a minimum, and Type 2 grooves for high pressure where higher flange loads can be tolerated. Normal pressure versus high pressure for each gasket cross-section is defined in section 6, and load to compress the gasket in Type 1 and Type 2 grooves is given in section 5. Type 1 grooves are recommended for use with MS plain gaskets or with MS gaskets silver plated 0.0015 inch maximum thickness, except as noted in 3.1. Type 2 grooves are recommended for MS plain gaskets, and also, for MS plated gaskets after groove diameter H is adjusted for plating thickness as noted under Table I.

3.1 0.035 Tube Gaskets: The use of the 0.035 tube diameter gaskets is not recommended in Type 1 groove design because this size tubing deflects beyond the yield of the Type 321 material to the extent that it does not have enough springback to maintain a satisfactory seal. If design requires the use of the 0.035 tube diameter gasket, Type 2 groove design should be used to support the gasket outside diameter.

4. GASKET & GROOVE DATA:

Figs. 1 & 2, and Table I establish standard groove dimensions. Fig. 1 shows the Type 1 groove; Fig. 2 shows the Type 2 groove.

4.1 Surface Texture: All surfaces in contact with the seal (groove bottom & outside wall, and mating flange face) shall have a surface roughness of 32 microinches Ra; the bottom of the groove and the mating flange shall have circular lay (concentric with the gasket), and no flaws specified in accordance with ANSI Y14.36.

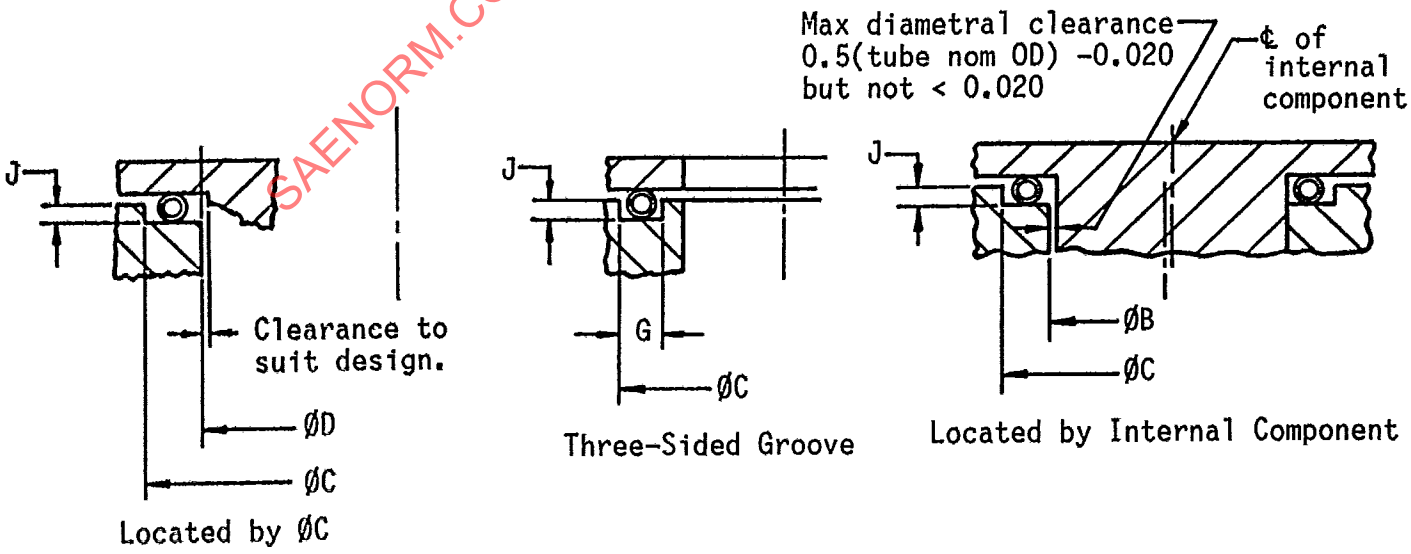

FIGURE 1 - Type 1, Two-Plane Contact Grooves

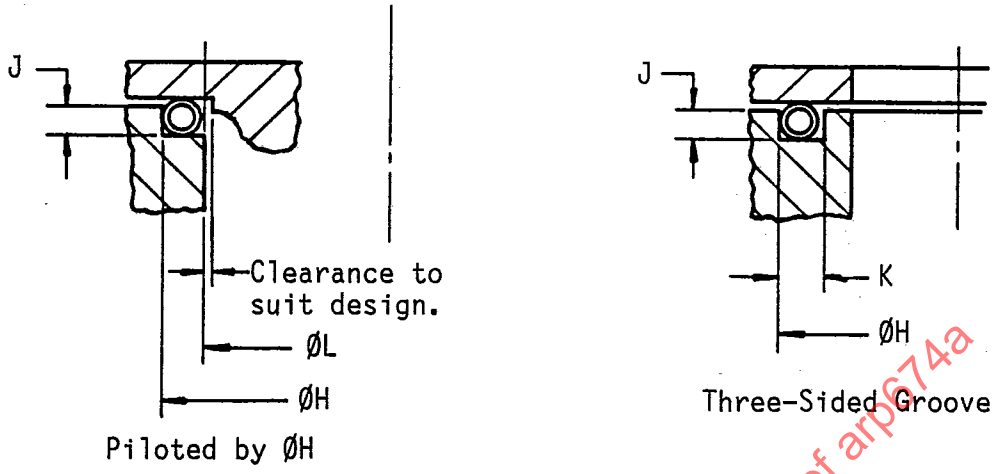

FIGURE 2 - Type 2, Three-Plane Contact Grooves

TABLE I - Dimensions for Grooves Shown in Figs. 1 and 2

Nom Tube Dia	ØB Max	ØC +0.010 -0.000	ØD Max	G Min	ØH +0.005 -0.000	J Groove Depth	K Min	ØL Max	Gasket Compression
0.035	-	-	-	-	A*+0.005	0.023 - 0.027	0.055	A*-0.090	0.007 - 0.015
0.062	A*-0.148	A*+0.027	A*0.159	0.093	A*+0.005	0.045 - 0.050	0.090	A*-0.150	0.011 - 0.020
0.094	A*-0.216	A*+0.027	A*0.227	0.127	A*+0.010	0.074 - 0.079	0.125	A*-0.220	0.014 - 0.023
0.125	A*-0.278	A*+0.027	A*0.289	0.158	A*+0.010	0.100 - 0.105	0.160	A*-0.290	0.019 - 0.028

* "A" dimension is minimum gasket OD per applicable MS drawing.

Note: Plated gaskets used in Type 2 groove design require ØH to be increased by 2X max plating thickness. For example: Silver plating thickness of 0.0010 - 0.0015 on a 0.094 tube dia gasket requires ØH min = A*+0.010 + 0.003, ØH max = ØH min +0.005.

Dimensions in inches. Fillets at bottom of groove = R 0.016 - 0.031. Break edges 0.003 - 0.015.

5. LOAD TO COMPRESS GASKET:

The load per inch of seal circumference required to axially seat the mating flanges under extreme tolerance conditions of maximum gasket free height and minimum groove depth (equals maximum compression) is given in Fig. 3 for Type 1 grooves and in Table II for Type 2 grooves.

TABLE II - Type 2 Groove, Load to Compress Gasket

Gasket	Nom Tube Dia	Nom Wall Thick	Deflection Max	Load, lb/in of Circumference
MS9141 MS9371	0.035	0.006	0.015	500
MS9142 MS9372	0.062	0.006	0.020	252
MS9202 MS9373	0.062	0.010	0.020	465
MS9203 MS9374	0.094	0.006	0.023	105
MS9204 MS9375	0.094	0.010	0.023	370
MS9205 MS9376	0.125	0.010	0.028	250

Dimensions in inches.

6. LIMITING PRESSURE, Type 1 Groove:

Limiting internal pressure for MS gaskets, or for gaskets of other materials but with the same cross-section as the MS gaskets, may be determined from the following relationships for gaskets installed in Type 1 grooves under minimum compression. For pressures that exceed these limits, use Type 2 grooves.

a) Internal pressure to overcome static friction due to compression load on gasket. Two surfaces are to be considered, that is, bottom of groove and mating flange. Hence, the following relationship:

$$P_1 \text{ max} = 2(Ff/J \text{ max})$$

where P_1 max = max internal pressure to overcome static friction, groove bottom and mating flange
F = clamp load at min pinch, lb/in of circumference
f = static coefficient of friction
J max = max groove depth, inch

b) Internal pressure to expand gasket to its tensile yield strength. Two cross-sectional areas of the gasket are to be considered. In the free state, the gasket is elliptical in shape; hence, the minimum cross-sectional area of the gasket, A_t, is as follows:

$$A_t = \frac{\pi}{4}[d_1 d_2 - (d_1 - 2t)(d_2 - 2t)]$$

where A_t = minimum cross-sectional area of gasket

d_1 = gasket minimum free height

d_2 = gasket minimum free radial width

t = gasket minimum wall thickness

Max internal pressure, P_2 maximum, to expand gasket to its tensile yield strength is as follows:

$$P_2 \text{ max} = \frac{2A_t S_{ty}}{J \text{ max } (A - 2d_2)}$$

where S_{ty} = tensile yield strength for gasket material

A = min gasket OD

The maximum limiting internal pressure for Type 1 grooves is the sum of P_1 max and P_2 max, that is,

$$P \text{ max} = P_1 \text{ max} + P_2 \text{ max}$$

where, P max = max limiting internal pressure

The above relationships reduces to the following equations for the MS gaskets used in Type 1 grooves:

MS9142 & MS9372, P max = $40Ff + \frac{0.0336Sty}{A - 0.112}$ (eq. 1)

MS9202 & MS9373, P max = $40Ff + \frac{0.0620Sty}{A - 0.112}$ (eq. 2)

MS9203 & MS9374, P max = $25.32Ff + \frac{0.0342Sty}{A - 0.178}$ (eq. 3)

MS9204 & MS9375, P max = $25.32Ff + \frac{0.0587Sty}{A - 0.178}$ (eq. 4)

MS9205 & MS9376, P max = $19.05Ff + \frac{0.0609Sty}{A - 0.240}$ (eq. 5)

6.1 Fig. 4 is a solution of the above equations for the MS gaskets using 0.1 for coefficient of friction and 24 000 lbf/in^2 for allowable tensile yield stress (800°F conditions) and values for F extracted from ARP674 (1st edition) and proportionally adjusted for the difference in minimum pinch.

7. LARGE DIAMETER GASKETS:

Use the Type 1 groove for MS seals 33.6 inches and larger in diameter and for gaskets dimensionally equivalent to MS gaskets made from AMS 5582 material which are 11.5 inches and larger in diameter. The diametral expansion for these gaskets at the room temperature limiting pressures (see eq. 1 thru 5) is sufficient to effect a three-plane contact. These diameters are determined by equation (6) below:

$$A = \frac{\Delta A \cdot E}{S_{ty}} \quad \text{(eq. 6)}$$

where A = min OD of gasket

ΔA = diametral growth of gasket at room temperature limiting pressure; that is, C max - A = 0.037. See Table I.

S_{ty} = allowable room temperature tensile yield strength for the material.

E = modulus of elasticity for the material.

For the MS seals:

$$A = \frac{0.037 \times 29 \times 10^6}{32000} = 33.53 \text{ inches (say 33.6 inches)}$$

For gaskets dimensionally equivalent to MS gaskets made from AMS 5582:

$$A = \frac{0.037 \times 31 \times 10^6}{100000} = 11.47 \text{ inches (say 11.5 inches)}$$