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# AEROSPACE RECOMMENDED PRACTICE

ARP 674

## METAL RING SEAL GROOVE DESIGN

Issued 4-15-64
Revised

1. SCOPE: Groove designs presented herein are applicable for use with metal ring seals conforming to MS9142, MS9202, MS9203, MS9204, and MS9205, or modifications thereto as specified herein.

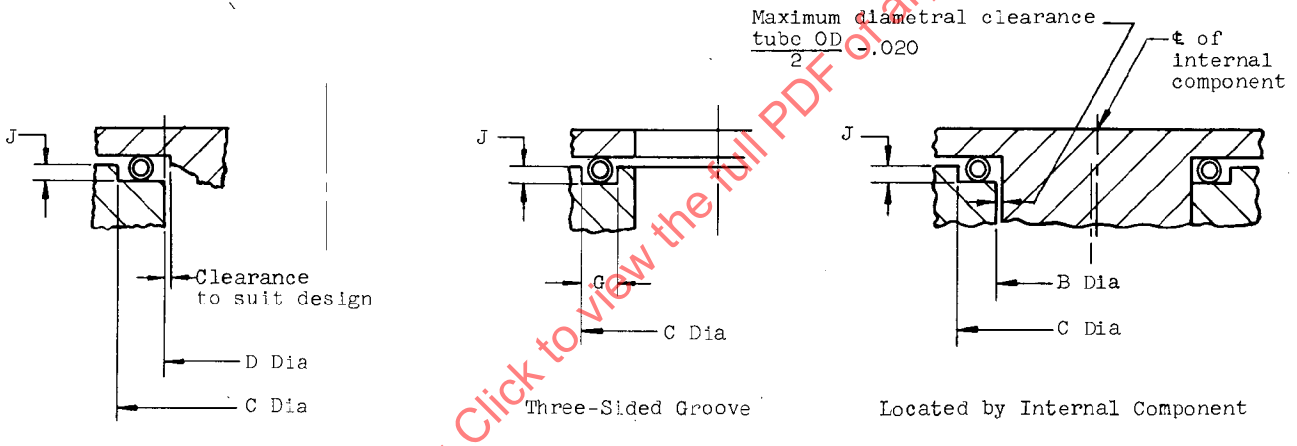
2. CLASSIFICATION: Two groove design configurations are provided for each seal size:

   Type 1--Two-plane contract with ring seal, axially on both faces.

   Type 2--Three-plane contact with ring seal, axially on both faces and radially on the outside diameter.

3. APPLICATION: Use Type 1 grooves for normal pressure, and Type 2 grooves for high pressures. Normal pressure versus high pressure for each seal cross-section is defined in paragraph 6. Type 1 grooves are recommended for use with MS seals referenced herein or with these seals silver plated plated up to and including .003 in. thick. Type 2 grooves are recommended only for seals without plating.

4. RING SEAL AND GROOVE DATA: Figures 1, 2, and Table I establish standard groove dimensions. Figure 1 shows the Type 1 groove; Figure 2 shows the Type 2 groove.



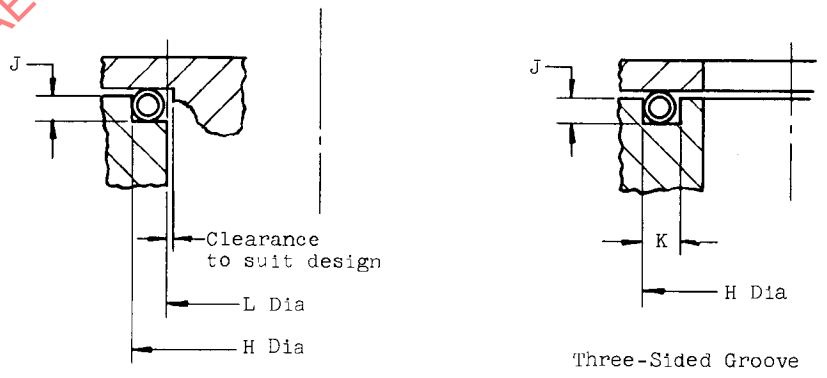

Located by C Dia

Three-Sided Groove

Located by Internal Component

Two Plane Contact Grooves

FIGURE 1




Piloted by H Dia

Three-Sided Groove

Three-Plane Contact Grooves

FIGURE 2

TABLE I

| Dimensions for Figures 1 and 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Seal (ref) | Tube dia nom | B max | C +.010 -.000 | D max | G min | H +.005 -.000 | J +.004 -.000 | K min | L max |
| MS9142 MS9202 | .062 | A*-.148 | A*+.027 | A*-.159 | .093 | A*+.005 | .042 | .080 | A*-.140 |
| MS9203 MS9204 | .094 | A*-.216 | A*+.027 | A*-.227 | .127 | A*+.005 | .074 | .114 | A*-.208 |
| MS9205 | .125 | A*-.278 | A*+.027 | A*-.289 | .158 | A*+.005 | .105 | .145 | A*-.270 |
| * "A" dimension is minimum seal OD per applicable MS standards. | | | | | | | | | |

All surfaces in contact with seal shall have a surface roughness callout of 32 microinches in accordance with AS 291. The lay shall be concentric with the ring and no flaws permitted.

Dimensions in inches. Corners to have fillets: .016-.031 R. Break sharp edges: .003-.015.

5. LOAD TO COMPRESS SEAL: The load per inch of seal circumference required to axially seat the mating flanges under the extreme tolerance conditions of maximum seal cross section and minimum groove depth (equals maximum pinch) is given in Figure 3 for Type I grooves and in Table II for Type 2 grooves.

TABLE II

| Load to Compress Seal--Type 2 Groove | | | | |
|---|---|---|---|---|
| Seal | Tube dia nom | Wall nom | Deflection maximum | Load, lb/in. of circumference |
| MS9142 | .062 | .006 | .023 | 290 |
| MS9202 | .062 | .010 | .023 | 535 |
| MS9203 | .094 | .006 | .024 | 110 |
| MS9204 | .094 | .010 | .024 | 385 |
| MS9205 | .125 | .010 | .023 | 205 |

Dimensions in inches.

6. LIMITING PRESSURES: Limiting pressure for MS seals, or for seals of other materials but with the same cross-section as the MS seals, can be determined from the following equations. The equations are based on seals installed in Type 1 grooves under minimum pinch. For pressures that exceed these limits use Type 2 grooves.

$$\text{MS9142 seal, } p_{max} = 43.48Ff + \frac{.0382\ S_{ty}}{A-.113} \quad (1)$$

$$\text{MS9202 seal, } p_{max} = 43.48Ff + \frac{.0639\ S_{ty}}{A-.113} \quad (2)$$

$$\text{MS9203 seal, } p_{max} = 25.64Ff + \frac{.0354\ S_{ty}}{A-.179} \quad (3)$$

$$\text{MS9204 seal, } p_{max} = 25.64Ff + \frac{.0609\ S_{ty}}{A-.179} \quad (4)$$

$$\text{MS9205 seal, } p_{max} = 18.35Ff + \frac{.0597\ S_{ty}}{A-.241} \quad (5)$$

Where $p_{max}$ = maximum internal pressure retained by seal, lb/in.$^2$

F = clamp load at minimum pinch. lb/in. of circumference, as determined by test.

f = coefficient of friction between seal and boss.

A = minimum seal diameter from MS.

$S_{ty}$ = allowable tensile yield strength for seal material.

6.1 Figure 4 is a solution of the above equations for the MS seals using 0.1 for coefficient of friction and 32,000 psi for allowable tensile yield stress (room temperature conditions) and values for F determined by test.

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

$$A = \frac{\Delta A\, E}{S_{ty}} \qquad (6)$$

where A = min. O.D. of seal.

$\Delta A$ = diametral growth of seal at limiting pressure; i.e. C(max)-A = .037. See Table I.

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

E = modulus of elasticity for the material.

For the MS seals:

$$A = \frac{.037 \times 29 \times 10^6}{32 \times 10^3} = 33.53 \text{ inches (say 33.6 inches)}$$

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

$$A = \frac{.037 \times 31 \times 10^6}{1 \times 10^5} = 11.47 \text{ inches (say 11.5 inches)}$$

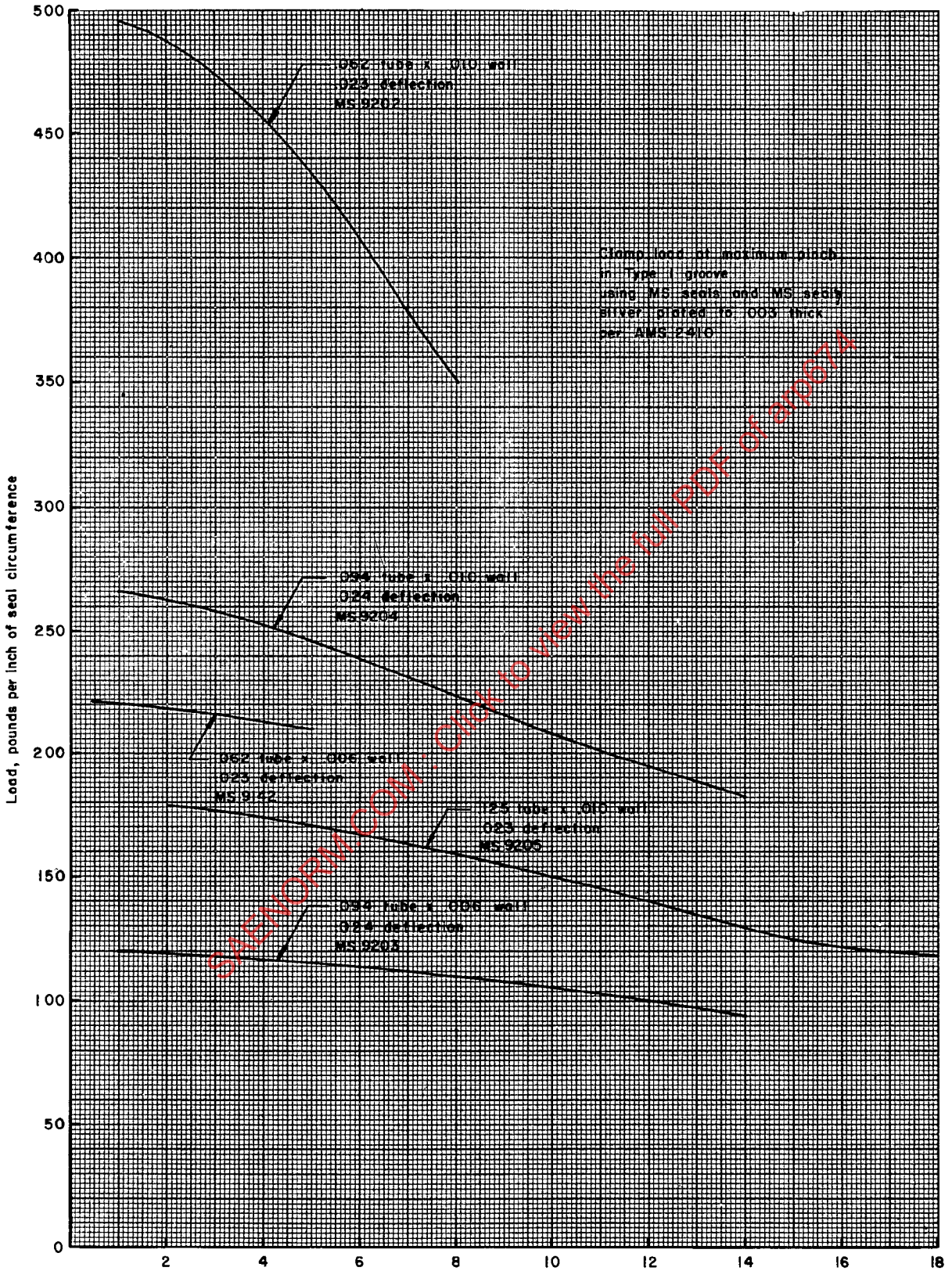



FIGURE 3