AEROSPACE RECOMMENDED PRACTICE

ARP1833	REV. B
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(R) Sealing Techniques for Missile Applications

RATIONALE

This revision was necessary because the Tables were illegible, References needed to be made current, the drawing improved and materials which were no longer commercially available needed to be deleted. Since the document has been in use since 1986 with no reported technical issues, there were no changes to the gland dimensions other than the correction of typing errors.

FOREWORD

Missile hydraulic and pneumatic component designers have been handicapped by the absence of concise design criteria for two difficult sealing conditions usually existing in missile applications as follows:

- Static pressure condition - Low pressure for long periods in a cyclic temperature environment (i.e., long term storage requirements).
- Dynamic pressure condition - High pressures suddenly applied in an extreme temperature environment (i.e., operational firing requirement).

Each of the two conditions listed above are frequently required to be satisfied by a single seal in a missile hydraulic or pneumatic component with sealing requirements changing abruptly from the first to the second set of conditions.

This design standard is intended to facilitate more nearly optimum designs by presenting specific recommendations in the areas of materials, finishes, configurations and inspection criteria that past experiences show to be desirable and prudent.

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1. SCOPE

The purpose of this standard is to provide the missile hydraulic and pneumatic component designer with information learned, tested and substantiated in correction of problems and failures experienced with seals that are subject to the unique requirements of missile static storage and subsequent dynamic operational conditions.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS7379 Rubber: Fluorocarbon Elastomer (FKM) 70 to 80 Hardness, Low Temperature Sealing Tg -40 °F (-40 °C) For Elastomeric Seals in Aircraft Engine Oil, Fuel and Hydraulics Systems

AIR786 Elastomer Compatibility Considerations Relative to Elastomeric Sealant Selection

ARP1231 Gland Design, Elastomeric O-Ring Seals, General Considerations

ARP1234 Gland Design, Elastomeric O-Ring Seals, Static Axial, Without Back-Up Rings

AIR1412 Designing for Long Life With Elastomers

AS4716 Gland Design, O-ring and Other Elastomeric Seals

AS5857 Gland Design, O-ring and Other Elastomeric Seals, Static Applications

AS6235 Face Seal Gland Design, Static, O-ring and Other Seals for Aerospace Hydraulic and Pneumatic Applications

2.2 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada)), 001-800-514-1564 (Mexico) or +1-414-272-8575 (all other locations), www.asq.org.

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.3 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ISO 3601-2 Fluid power systems - O-rings - Part 2: Housing dimensions for general applications

ISO 3601-3 Fluid Power Systems - O-Rings - Part 3: Quality Acceptance Criteria

2.4 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME Y 14.5-2009 Dimensioning and tolerancing

3. ELASTOMERIC O-RING SEAL GUIDELINES

3.1 General Introduction

The O-ring is widely used as a seal element in a broad range of missile hydraulic and pneumatic component designs. It has been variably successful as attested by a continuing family of problems and failures associated with seal designs especially in low temperature and low pressure long term storage applications.

In some cases, the problem of failure has been directly attributed to inadequacies of the O-ring as a seal element choice (i.e., a simple misapplication). In other cases, the problem or failure cause was traced to improper choice of O-ring material properties and dimensions; inadequate design features interfacing with the O-ring; damage and abuse; quality controls; and insufficient testing of the design to detect and correct design deficiencies before committing the design to production.

It is essential that the missile hydraulic and pneumatic component designer have a working understanding of the O-ring as a candidate element for seal design; be aware of its functional limitations; and have some guidance for approaching design requirements which are not clearly “cut and dried” in the existing published “cook book” approaches to general O-ring usage.

This section of the standard is intended to supply information learned, tested and substantiated in the correction of problems and failures experienced with O-rings used in missile hydraulic and pneumatic components.

3.2 Seal Principle Discussion

The O-ring is made of highly elastic materials, performing its function in the deformed condition through its ability to reliably store elastic energy and use this energy to maintain sealing pressures against mating interfaces.

Mechanical deformation of the O-ring by surrounding structure or by the pressure of confined fluids, individually or in combination, is used to force the material into potential leak paths to provide a positive block to the flow of the confined fluid.

When the O-ring is deformed solely by the preloads applied by mating structure, and the resulting interface pressure is sufficient to provide the effective seal over the full range of functional and storage conditions without being assisted by the confined fluid pressure, it can be considered an ordinary gasket.

When the O-ring is primarily deformed by the pressure forces of the confined fluid, and secondarily by the structural and environmental effects, it must not be treated as a gasket.

The designer using the O-ring element must understand that the difference in deformation mode can be critical to successful sealing.

In low-pressure (below approximately 300 psig), low-temperature (dependent on material) design, the seal interface pressure must be achieved by maintaining adequate structurally applied preload compression in the O-ring, since fluid pressures in this range will usually not adequately deform O-rings made of known materials in the available hardness (durometer) ranges to form a seal.

In pressures ranging above 300 psig, and up to the extrusion pressure of the particular O-ring material choice, the fluid pressure is generally sufficient to deform the O-ring to provide effective interface pressures.

There are some special environmental conditions, such as low temperatures approaching the glass-transition of the material, the effect of which may best be determined by development testing as described herein.

In a robust static seal design, the sealing is obtained principally by the mechanical deformation of O-ring as described above. If lubricant is used in a static seal, its primary purpose should be help in installation (usually for static radial seals; face seals should generally not require lubrication). Lubricants generally provides minimal (if any) sealing for static seals. Hence, for static seals, use lubricant sparingly (see 3.5), especially since excess lubricant can migrate to undesirable areas, which can have negative consequences. For dynamic seals, if lubricant is used, then it should be sufficient (but not excessive) to reduce friction in the relative movement of the seal against the dynamic surface.

3.3 Common Failure Causes

Most failures of missile hydraulic and pneumatic component O-ring seals occur at low pressure and at low temperature extremes and can be attributed to any of the following causes:

a. Insufficient elastomeric force caused by a variety of factors such as:

- inadequate design squeeze ("Squeeze" means change in shape due to surrounding structures, whereas "deformation" may be caused by confined fluid pressures as well).
- excessive compressive set of seal materials
- inadequate durometer rating (i.e., too low)
- inadequate elastic compliance
- inadequate elastic temperature range
- reduction in volume due to migration of material additives

b. Spiraling of seals during operation in a reciprocating application or during assembly. This condition is generally associated with any of the following:

- inadequate stiffness of the O-ring cross-section
- excessive eccentricity
- inadequate lubrication
- inadequate assembly procedures or aids
- discontinuities and/or protrusions on the flash line
- incompatible surface finishes or conditions
- long stroke cylinders

c. Contamination lying across the seal contact surfaces

d. Handling or assembly damage

e. Molding or processing flaws in the seal

f. Extrusion of the seal during prior operation or environmental exposure due to either excessive design clearance or structural deformation under pressure or due to gland being undersized and/or O-ring being oversized

g. Excessive wear of dynamic seals due to microscopic pits and discontinuities in contacting surfaces such as anodized aluminum

h. Porosity or other defects in contacting surfaces

i.. Physical properties or dimensions that are not adequately controlled

j. Improper selection of seal materials and/or lubricants

k. Stretch too high; causing premature aging (see 3.7)

l. Ignoring the effect of eccentricity in radial seals, which can cause a leak at a specific location of the 360 degree circumference even if seal holds well at all other locations of the circumference (especially relevant for high pressure or vacuum seals).

m. Surface roughness too smooth for dynamic seals causing excessive wiping off of lubricant (similar to a "squeegee") leading to an increase in friction and possible abrasion and/or wear out of elastomeric seal. Surface roughness for dynamic seal glands sealing surface should range between 4 microinches to 16 microinches. Excessively rough gland surface can lead to abrasion and/or wear out of the elastomeric seal for dynamic seals. It can also lead to leakage in static seals even if the squeeze is within the desired range.

3.4 Development and Qualification Test Recommendations

Due to the time and cost constraints, development and qualification tests normally do not evaluate the effects of:

- long term storage and field service
- all possible variations in the material properties
- all possible dimensional and finish variations

Because of the factors above, development tests should selectively include conditions that exceed maximum specified environmental conditions. Marginal seal designs are prone to be revealed by exposure to temperatures that exceed specified extremes followed by leakage tests at:

- low temperature and low pressure
- high temperature and low pressure
- high temperature and high pressure applied suddenly
- low temperature and high pressure applied suddenly

The above tests are intended to encompass all extreme conditions. Usually, the most adverse combination of conditions is exposure to high temperature followed by leakage tests at low temperature (with high pressure applied suddenly).

Development test hardware should exceed design tolerances (i.e., margin excess involves consideration of critical nature of seal, machining capabilities, cost and time constraints) in each of the following areas:

- high diametral clearances
- high gland eccentricities
- rough finishes
- high and low preload "squeeze" conditions

Each vendor elastomeric compound for use should be qualified for specific seal applications. Specific material (i.e., physical characteristics) verification tests should be conducted on each vendor compound along with functional seal qualification tests.

Qualification by "similarity" should not be used to justify omission of functional qualification tests for critical seal applications.

Use of plastic models and leak path isolation fixtures as developmental test beds are important in evaluating sealing effectiveness, problems and failures.

Use of specialized leak detection and measurement equipment (i.e., excellent commercial detectors are available) is invaluable in understanding the margins of seal efficiency.

3.5 Design Guide for High Reliability

Efforts to achieve high reliability in an O-ring seal design will involve several of the following factors:

- Use of specific vendor elastomeric compounds that have demonstrated overstress margin of sealing qualities during and after exposure to fluids and specified environmental conditions. AIR786 provides initial guidance on establishing elastomer/fluid compatibility.

- Tightened inspection of critical O-rings for specific types of defects and mechanical properties, and of mating surfaces for dimensions and surface finish.

- Selective deviation from conventional gland dimensions, usually in the direction of increased squeeze and reduced gland volume. This provides increased interface pressure and is especially important in low pressure (or vacuum), low temperature applications. The volume of the gland must be at least equal to the volume of the seal under the worst case condition of seal swell and dimensional tolerance.

- Use of the largest standard O-ring cross-section and the highest standard durometer permitted by available space and by assembly damage considerations. In static low pressure applications, these features facilitate the achieving of higher interface pressures, in conjunction with nonstandard gland dimensions. In reciprocating seal applications, these features minimize the probability of spiraling.[1]

- The selective use of cap strips for reciprocating seal applications. Cap strips offer the advantage of improved wear resistance, reduced extrusion, and reduced friction. Cap strips made of appropriate materrials such as Virgin Polytetrafluoroethylene (PTFE) or UHMWPE (Ultra High Molecular Weight Polyethylene) can be particularly effective in reducing break out friction after long term storage. If a cap strip with a profile to approximately match the shape of the installed O-ring is used, the increased squeeze on the O-ring produces an increased load and may increase friction for low pressure applications. Care should therefore be taken to ensure appropriate performance of the application.

- However, cap strips have the disadvantage of reduced sealing reliability in certain low pressure, low temperature applications.

- The use of backup rings to prevent extrusion in high pressure, high clearance, high temperature applications. However, the use of backup rings may cause excessive break out friction in certain pneumatic applications.

- The selective and controlled use of lubrication. Lubrication is generally to be used only as an installation aid (see 3.2).

- Use of spring energized PTFE or UHMWPE U-cups to overcome environments hostile to O-rings especially if dynamic break out friction is a problem.

- AIR1412 contains helpful suggestion on designing for long life with elastomers.

[1] The statement regarding highest durometer rating is based upon extensive testing in 1976 on low pressure seals for the Phoenix missile. The statement may seem controversial but has been found to be consistent with O-ring seal theory.

3.6 Design Tips - Positive Considerations

- Consider creating source control drawings to define O-ring requirements as well as the necessary quality controls. Drawings should include the following:

  (a) Where practical, the specification of standard sizes and tolerances per AS568, and where necessary, the use of non-standard sizes and/or tolerances.

  (b) Reference to the appropriate material specification. Additional requirements should be stated where necessary.

  (c) Approved vendor compound numbers. The approved compounds should be strictly limited to those that have demonstrated suitability during qualification test programs.

  (d) Inspection for flaws in accordance with ISO 3601-3, Grade S or CS. The minimum inspection should be a 1.0 AQL, Level II, per ANSI/ASQ Z1.4. Consider 100% inspection for critical seal applications.

- Specify O-rings with the largest standard cross-section and highest durometer rating permitted by space, material and assembly considerations (for reasons given in 3.5).

- Control the gland total eccentricity to a practical minimum for dynamic radial seals. Lowering gland eccentricity may be limited by how tight the dimensional tolerances can be. Lowering dimensional tolerances will lower total gland eccentricity but tightening dimensional tolerances beyond a certain level may not be financially and/or technically viable.

- Control cylindrical sealing bore taper to a practical minimum for reciprocating dynamic seals.

- Consider designing gland widths as narrow as practical when not covered by existing standards. However, the gland should accommodate the volume of the seal under maximum material and swell conditions.

- Face seal designs should provide sufficient structural rigidity to minimize opening of extrusion gaps during high pressure exposures. When weight is important, high pressure face seals may be a bad design choice unless parts are inherently stiff for other reasons.

- Where pressure dictates, use backup rings designed on a case by case evaluation of compatible material, assembly and environmental factors, especially in high temperature high diametrical clearance applications. Select one piece over split ring backups if assembly, dynamic friction and environmental factors allow.

- Consider incorporation of design features and processes which give margin against assembly damage.

- Provide for the most practical edge relief possible in holes, slots and other discontinuities which cannot be avoided and which O-rings must pass over during assembly or functional operation. Putting a blend radius on a sharp corner is preferred over an edge break.

- Minimize the number of seals and the total linear length of seals in all component designs.

3.7 Design Tips - Negative Considerations

- Avoid specifying O-rings by only standard specifications (i.e., MS, AMS, AS, etc.) in critical seal applications.

- Avoid the use of nitrile (Buna N) material for external static seals for long term storage or service especially if the application includes either of the following conditions:

  (a) Sealing pressures from zero to approximately 300 psi while being subject to extreme cyclic changes in temperature (i.e. from below -25 °F to above +160 °F).

  (b) Functional operation at temperatures below -25 °F especially after long term cyclic temperature changes noted in condition (a) above.

- Avoid gland surface finishes greater than 32 Ra or less than 4 Ra. In critical dynamic applications, avoid surface finishes greater than 16 Ra. High pressure or vacuum applications may require a surface finish better than 16Ra.

- Avoid designs that require excessive O-ring stretch (i.e., greater than 50%) during assembly.

- Avoid installed stretch exceeding 5% based on nominal O-ring dimensions.

- Avoid if possible, entrance angles greater than 15 degree half-angle measurement and entrance cone diameters less than the free outside diameter of the O-ring.

- Avoid gland designs in which the O-ring is required to seal more than one circumferential gap.

- Avoid if possible, designs that require the O-ring to slide over holes, slots or other discontinuities with sharp edges. If not possible to avoid edges, then put a blend radius on all such edges; if not possible, then at least break the edges. (Use the numerical values for edge breaks listed in Tables 2 through 15 for guidance.)

- Avoid if possible, non-circular face seal gland designs.

- Multiple O-rings in the same groove may seem an attractive option when physical space is limited, as is often the case in missiles. For example, sometimes both an EMI and an environmental seal are necessary and the same seal may not be able to fulfill both the functions adequately. However, using multiple separate O-rings in the same groove is not recommended. If absolutely necessary to have dual seals in the same groove, then use co-extruded or co-molded seals.

3.8 Detail O-Ring Gland Design

3.8.1 General Description

Figure 1 and Tables 1 through 16 outline configuration and O-ring gland design information for various conditions encountered in missile hydraulic and pneumatic component designs. The information represents experience gained in the development of several missile systems; however, in certain areas, the information represents extrapolated data. It is anticipated that the information will facilitate more nearly optimum designs; however, design configurations should be proven by qualification testing as recommended in 3.4.

3.8.2 Gland Design Criteria

The information contained in the tables presented in this section is similar to that in AS4716, with the primary differences as follows:

a. The gland volumes are smaller. Some of the glands are as little as 7% greater than the O-ring volumes under maximum material conditions. If a volumetric swell greater than 7% is anticipated, the groove volume should be increased accordingly by increasing the width.

b. The gland edge breaks are sharper in the high pressure applications.

c. The squeeze is higher except in the dynamic pneumatic applications.

d. The diametral clearance is tighter in high pressure applications without backup rings.

e. The bore sizes for external seals generally conform to standard reamer sizes, for bores smaller than 1 inch.

f. The shaft sizes for internal seals are such that upon the addition of a diametral clearance, the resulting dimension generally corresponds to a standard reamer size for bores smaller than 1 inch.

g. The gland depth tolerances are generally tighter thru size 020.

h. The allowable eccentricities are smaller in high pressure and/or dynamic applications.

i. The sides of the grooves are perpendicular to the axis of the gland rather than being a maximum of 5 degrees from perpendicular.

NOTES:

1. Squeeze computations for the tables do not consider reduction in O-ring cross-section due to installed stretch. If stretch is kept below the recommended 5% per 3.7 then the error due to this is small but it will not be negligible if stretch is substantially greater than 5%.

2. There are other standards available for review and comparison. These include: AS5857, ARP1234, ARP1231, AS6235, and ISO 3601-2

3.8.3 Index of Figure and Tables

Figure 1 - Conventional glands design applications are show in Figure 1.

Table 1 - Recommended bore and shaft dimensions in inches.

Tables 2 Thru 15 - Recommended gland dimensions in inches, surface finishes, inspection levels and material hardnesses for various applications as follows:

Table 2: 0 - 300 psi - Dynamic hydraulic applications
Table 3: 300 - 1500 psi - Dynamic hydraulic applications
Table 4: 1500 - 3500 psi - Dynamic hydraulic applications
Table 5: 0 - 300 psi - Static hydraulic applications
Table 6: 300 - 1500 psi - Static hydraulic applications
Table 7: 1500 - 3500 psi - Static hydraulic applications
Table 8: 0 - 500 psi - Dynamic pneumatic applications
Table 9: 500 - 3000 psi - Dynamic pneumatic applications
Table 10: 3000 - 10 000 psi - Dynamic pneumatic applications
Table 11: 0 - 500 psi - Static pneumatic applications
Table 12: 500 - 3000 psi - Static pneumatic applications
Table 13: 3000 - 10 000 psi - Static pneumatic applications
Table 14: Face seals for hydraulic applications
Table 15: Face seals for pneumatic applications
Table 16: Recommended bore sizes for using standard reamers
Table 17: Summary of elastomeric materials

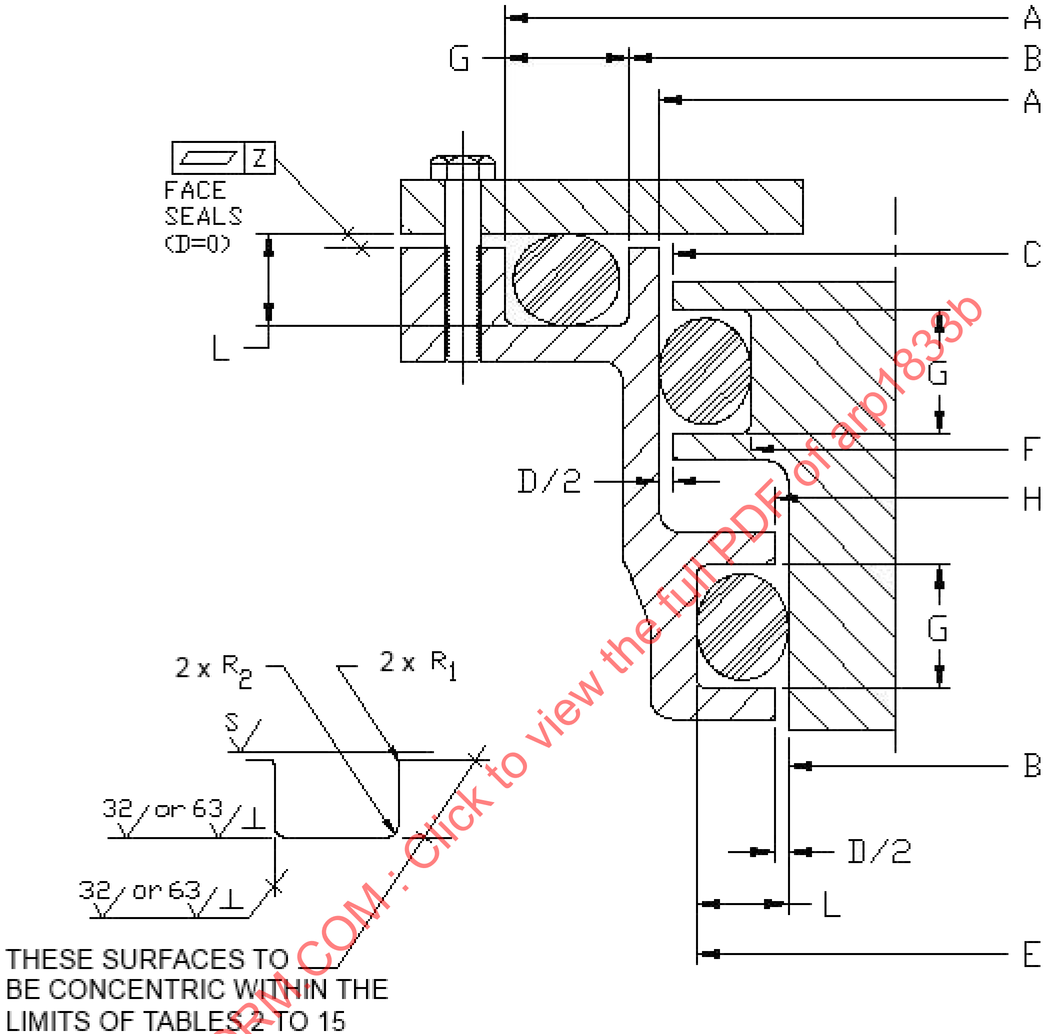
A decision as to which section of Tables 2 thru 15 is appropriate will at times require a choice if an application encompasses:

a. more than one set of conditions. In this case the designer should choose the smaller clearance and eccentricity, sharper corner break, smoother finish, and tighter inspection requirements.

b. both the static and dynamic conditions. In this case the better choice will probably be the lesser squeeze shown for dynamic applications to minimize the spiraling and friction potential especially in reciprocating applications.

3.8.4 Drawing Diameter Calculation

The gland depths and diametral clearances shown in Figure 1 will not appear on engineering drawings, but are used to calculate certain diameters that will appear on the drawings as follows:



NOTES AND DEFINITIONS:

A – Cylinder Bore I.D. per Table 1
B – Rod O.D. per Table 1
C – Piston O.D (= A-D)
D – Diametral Clearance per Tables 2 to 13
E – Internal Gland I.D. (= B+2L)
F – Piston Gland O.D. (= A-2L)
G – Gland Width per Tables 2 to 15
H – Rod Bore I.D (= B+D)
L – Gland Depth per Tables 2 to 15
R_1 – Corner Break Radius per Tables 2 to 15
R_2 – Fillet Radius per Tables 2 to 15
S√ – Finish of Adjacent Surface per Tables 2 to 15, As defined in ANSI B46.1-78
Z – Surface Flatness per Tables 14 and 15

Figure 1 - Gland design

a. For external seals:

- The rod/piston diameter C is calculated from dimension A per Table 1 and D per Tables 2 thru 15:

$$C = A + D \quad \text{(Eq. 1)}$$

The tolerance on C is the tolerance on D minus the tolerance on A. (See further for special cases.) As a check:

$$D = A - C \quad \text{(Eq. 2)}$$

where D must equal the value in Tables 2 thru 15, including the specified tolerances.

- The cylinder/bore diameter A is per Table 1.

- The gland root diameter F, is calculated from dimension A per Table 1 and L per Tables 2 thru 15:

$$F = A - 2L \quad \text{(Eq. 3)}$$

The tolerance on F is twice the tolerance on L, minus the tolerance on A. As a check:

$$L = (A - F)/2 \quad \text{(Eq. 4)}$$

where L must equal the value in Tables 2 thru 15, including the specified tolerances.

- The groove width and other parameters are per Tables 2 thru 15.

b. For internal seals:

- The rod/piston diameter B is per Table 1.

- The cylinder/bore diameter H, is calculated from dimension B per Table 1 and D per Tables 2 thru 15:

$$H = B + D \quad \text{(Eq. 5)}$$

The tolerance on H is the tolerance on D minus the tolerance on B. (See further for special cases.) As a check:

$$D = H - B \quad \text{(Eq. 6)}$$

where D must equal the value in Tables 2 thru 15, including the specified tolerances.

- The gland diameter E, is calculated from dimension B per Table 1 and L from Tables 2 thru 15:

$$E = B + 2L \quad \text{(Eq. 7)}$$

- The tolerance on E is twice the tolerance on L minus the tolerance on B. As a check:

$$L = (E - B)/2 \quad \text{(Eq. 8)}$$

where, L must equal the value in Tables 2 thru 15, including the specified tolerances.

- The groove width and other parameters are per Tables 2 thru 15.

c. For face seals, internally pressurized:

- The outside diameter is dimension A per Table 1:

$$O.\ D. = A. \tag{Eq. 9}$$

- The inside diameter is calculated from dimension A per Table 1 and G from Table 14 or 15:

$$I.\ D. = A - 2G. \tag{Eq. 10}$$

- The tolerance on the I. D. is twice the tolerance on G minus the tolerance on A. As a check:

$$G = (A - I.D.)/2 \tag{Eq. 11}$$

  where, G must equal the value in Tables 2 thru 15, including the specified tolerance.

- The groove depth and other parameters are per Table 14 or 15.

d. For face seals, externally pressurized:

- The inside diameter is dimension B per Table 1:

$$I.D. = B. \tag{Eq. 12}$$

- The outside diameter is calculated from dimension B per Table 1 and G from Table 14 or 15:

$$O.\ D. = B + 2G. \tag{Eq. 13}$$

- The tolerance on the O. D. is twice the tolerance on G minus the tolerance on B. As a check:

$$G = (O.\ D. - B)/2 \tag{Eq. 14}$$

  where, G must equal the value in Tables 2 thru 15, including the specified tolerance.

- The groove depth and other parameters are per Table 14 or 15.

In some cases, the tolerances that are specified for the diametral clearances D in Tables 2 thru 15 (i.e., for high pressure pneumatic applications, without backup rings) are equal to or tighter than the tolerances specified for the diameters A and B in Table 1. In these cases, the tolerances in Tables 2 thru 15 take precedence and, therefore, the tolerances for A or B must be reduced appropriately.

Example - Designing an internal seal of nominal size 013, for a low pressure dynamic hydraulic application would result in the following steps.

a. The applicable dimensions would be:

   $B = 0.435 \pm 0.0005$ per Table 1
   $L = 0.055 \pm 0.0005$ per Table 2
   $D = 0.004 \pm 0.003$ per Table 2

b. The internal gland diameter is calculated using Equation 7:

   $E = B + 2L$
   $= (0.435 \pm 0.0005) + 2(0.055 \pm 0.0005)$
   $= (0.435 \pm 0.0005) + (0.110 \pm 0.001)$

Adding the basic dimensions and subtracting the B bore tolerance from the gland depth tolerance:

E = 0.545 ± 0.0005 (ANSWER)

c. The gland depth check using Equation 8 is:

L = (E - B)/2
= [(0.545 ± 0.0005) - (0.435 ± 0.0005)]/2
= (0.110 ± 0.001)/2

= 0.055 ± 0.0005 (CHECK)

d. The rod bore using Equation 5 is:

H = (0.435 ± 0.0005) + (0.004 ± 0.003)

Adding the basic dimensions and subtracting the B bore tolerance from the diametral clearance tolerance:

= 0.439 ± 0.0025 (ANSWER)

e. The Diametral Clearance Check using Equation 6 is:

D = H - B
= (0.439 ± 0.0025) - (0.435 ± 0.0005)

= 0.004 ± 0.003 (CHECK)

3.8.5 Size and Stretch Considerations

Designs that require shaft or bore sizes different from those in the tables should consider the following factors:

a. Shaft Size. Excessive O-ring stretch in the installed state should be avoided. Specifically, the shaft diameter (diameter B or F per Figure 1) should be within the following limits:

Not more than 5% larger than the O-ring nominal I.D.

Not smaller than the O-ring maximum I.D.

NOTES:

1. These limits do not accommodate an infinite range of shaft sizes. Therefore, special O-rings and backup rings may be required.

2. Little information is available regarding the effects of O-ring stretch beyond 5%, except that it contributes to the aging of nitriles particularly at elevated temperatures.

3. If the designer employs stretch in excess of 5%, the following formula can be used to predict the resulting flattening of the O-ring:

$$y = 54 [1 - (6/\sqrt{+} x)] \qquad \text{(Eq. 15)}$$

where:

y = percent loss of compression diameter due to stretch (i.e., if y = 4, the reduction in the O-ring cross-section is 4%)
x = percent stretch on inside diameter (i.e., for 5% stretch, x = 5)

4. The formula is empirical and represents published data with a maximum error of 0.3% for x = 0 to x = 26.

b. Bore Size. To comply with good design practices, an effort should be made to use bore sizes that coincide with standard reamer sizes. This is sometimes awkward when designing internal seals where the bore diameter (H - per Figure 1) is determined by the rod diameter plus the clearance (B + D per Figure 1). The resulting dimension should be adjusted to coincide with a standard reamer size in the following cases:

The bore size is less than 1 inch.

The resulting O-ring stretch is compatible with the previously stated stretch limitations.

The resulting dimensions are compatible with other design requirements.

NOTE: Standard reamer sizes are shown in Table 16.

EXAMPLE: Consider the following rationale:

1. The bore diameter H of 0.439 ± 0.0025 derived in the previous example (i.e., 3.8.4) does not encompass one of the standard reamer sizes of Table 16.

2. Using the previously stated limits (i.e., 3.8.5), the rod diameter B can vary between 0.431 (the O-ring maximum I.D.) and 0.447 (5% greater than the nominal I.D.) or:

   B = 0.431/0.447
   = 0.439 ± 0.008

3. The bore diameter H, in this case is 0.004 ± 0.003 larger than B or:

   H = (0.439 ± 0.008) + (0.004 ± 0.003)
   = 0.443 ± 0.011

4. The calculated bore diameter H thus encompasses either the 7/16 (0.4375) or the 29/64 (0.4531) reamer size. Since either size is satisfactory, assume that the more common size 7/16 (0.4375) is selected.

5. The new size for the H bore diameter is 0.0015 smaller than the originally calculated diameter of 0.439. Therefore, each of the other two corresponding diameters are adjusted by the same amount and become:

   B = 0.4335 ± 0.0005
   (ANSWERS)
   E = 0.5434 ± 0.0005

4. NOTES

4.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications nor in documents that contain editorial changes only.

PREPARED BY SAE SUBCOMMITTEE A-6C2, SEALS OF
COMMITTEE A-6, AEROSPACE ACTUATION, CONTROL AND FLUID POWER SYSTEMS

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-004	0.070	0.005	0.070	0.003	0.185 (0.189)	0.0005	0.074	0.0005	(a)(b)(c)(d)
-005	0.101	0.005	0.070	0.003	0.213 (0.221)		0.105		(a)(b)(c)(d)
-006	0.114	0.005	0.070	0.003	0.228 (0.2344)		0.123		(b)(c)(e)
-007	0.145	0.005	0.070	0.003	0.261 (0.2656)		0.152		(b)(c)(e)
-008	0.176	0.005	0.070	0.003	0.295 (0.2969)		0.183		(b)(c)(e)
-009	0.208	0.005	0.070	0.003	0.323 (0.3281)		0.217		(b)(c)(e)
-010	0.239	0.005	0.070	0.003	0.358 (0.3594)		0.248		(b)(c)(e)
-011	0.301	0.005	0.070	0.003	0.4219		0.311		(b)(e)
-012	0.364	0.005	0.070	0.003	0.4844		0.373		(b)(e)
-013	0.426	0.005	0.070	0.003	0.552		0.435		(a)
-014	0.489	0.005	0.070	0.003	0.617		0.498		(a)
-015	0.551	0.007	0.070	0.003	0.6875		0.561		(a)
-016	0.614	0.009	0.070	0.003	0.750		0.623		(a)
-017	0.676	0.009	0.070	0.003	0.8125		0.686		(a)
-018	0.739	0.009	0.070	0.003	0.875		0.748		(a)
-019	0.801	0.009	0.070	0.003	0.9375		0.811		(a)
-020	0.864	0.009	0.070	0.003	1.000	0.0005	0.873	0.0005	(a)
-021	0.926	0.009	0.070	0.003	1.0625	0.001	0.935	0.001	(a)
-022	0.989	0.010	0.070	0.003	1.125		0.998		(a)
-023	1.051	0.010	0.070	0.003	1.1875		1.061		(a)
-024	1.114	0.010	0.070	0.003	1.250		1.123		(a)
-025	1.176	0.010	0.070	0.003	1.3125		1.186		(a)
-026	1.239	0.010	0.070	0.003	1.375		1.248		(a)
-027	1.301	0.010	0.070	0.003	1.4375		1.311		(a)
-028	1.364	0.013	0.070	0.003	1.500		1.373		(a)
-029	1.489	0.013	0.070	0.003	1.625		1.498		(a)
-030	1.614	0.013	0.070	0.003	1.750	0.001	1.623	0.001	(a)

NOTES:

(a) Not recommended for reciprocating applications.

(b) Sizes noted require considerable stretch when installed in standard external grooves and may require compounds with superior elongation, or two piece pistons.

(c) Use dimensions in parentheses for dynamic pneumatic applications.

(d) Not for use in face seal applications.

(e) Not for use in internal pressure face seal applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-031	1.739	0.015	0.070	0.003	1.875	0.001	1.748	0.001	(a)
-032	1.864	0.015	0.070	0.003	2.000		1.873		(a)
-033	1.989	0.018	0.070	0.003	2.125		2.000		(a)
-034	2.114	0.018	0.070	0.003	2.250		2.125		(a)
-035	2.239	0.018	0.070	0.003	2.375		2.250		(a)
-036	2.364	0.018	0.070	0.003	2.500		2.375		(a)
-037	2.489	0.018	0.070	0.003	2.625		2.500		(a)
-038	2.614	0.020	0.070	0.003	2.750		2.625		(a)
-039	2.739	0.020	0.070	0.003	2.875		2.750		(a)
-040	2.864	0.024	0.070	0.003	3.000		2.875		(a)
-041	2.989	0.024	0.070	0.003	3.125		3.000		(a)
-042	3.239	0.024	0.070	0.003	3.375		3.250		(a)
-043	3.489	0.024	0.070	0.003	3.625		3.500		(a)
-044	3.739	0.027	0.070	0.003	3.875		3.750		(a)
-045	3.989	0.027	0.070	0.003	4.125		4.000		(a)
-046	4.239	0.030	0.070	0.003	4.375		4.250		(a)
-047	4.489	0.030	0.070	0.003	4.625		4.500		(a)
-048	4.739	0.030	0.070	0.003	4.875		4.750		(a)
-049	4.989	0.037	0.070	0.003	5.125		5.000		(a)
-050	5.239	0.037	0.070	0.003	5.375	0.001	5.250	0.001	(a)
-102	0.049	0.005	0.103	0.003	0.228	0.001	0.061	0.001	(b)(e)
-103	0.081	0.005	0.103	0.003	0.257		0.092		(b)(e)
-104	0.112	0.005	0.103	0.003	0.290		0.123		(b)(e)
-105	0.143	0.005	0.103	0.003	0.323		0.155		(b)(e)
-106	0.174	0.005	0.103	0.003	0.358		0.186		(b)(e)
-107	0.206	0.005	0.103	0.003	0.3906		0.217		(b)(e)
-108	0.237	0.005	0.103	0.003	0.4219		0.248		(b)(e)
-109	0.299	0.005	0.103	0.003	0.4844		0.311		(b)(e)
-110	0.362	0.005	0.103	0.003	0.5625	0.001	0.373	0.001	(b)(e)

NOTES:

(a) Not recommended for reciprocating applications.

(b) Sizes noted require considerable stretch when installed in standard external grooves and may require compounds with superior elongation, or two piece pistons.

(e) Not for use in internal pressure face seal applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-111	0.424	0.005	0.103	0.003	0.625	0.001	0.436	0.001	(b)(e)
-112	0.487	0.005	0.103	0.003	0.6875		0.498		(b)(e)
-113	0.549	0.007	0.103	0.003	0.750		0.561		(b)(e)
-114	0.612	0.009	0.103	0.003	0.8125		0.623		(e)
-115	0.674	0.009	0.103	0.003	0.875		0.686		(e)
-116	0.737	0.009	0.103	0.003	0.9375		0.748		
-117	0.799	0.010	0.103	0.003	1.000		0.811		(a)
-118	0.862	0.010	0.103	0.003	1.0625		0.873		(a)
-119	0.924	0.010	0.103	0.003	1.125		0.936		(a)
-120	0.987	0.010	0.103	0.003	1.1875		0.998		(a)
-121	1.049	0.010	0.103	0.003	1.250		1.061		(a)
-122	1.112	0.010	0.103	0.003	1.3125		1.123		(a)
-123	1.174	0.012	0.103	0.003	1.375		1.186		(a)
-124	1.237	0.012	0.103	0.003	1.4375		1.248		(a)
-125	1.299	0.012	0.103	0.003	1.500		1.311		(a)
-126	1.362	0.012	0.103	0.003	1.5625		1.373		(a)
-127	1.424	0.012	0.103	0.003	1.625		1.436		(a)
-128	1.487	0.012	0.103	0.003	1.6875		1.498		(a)
-129	1.549	0.015	0.103	0.003	1.750		1.561		(a)
-130	1.612	0.015	0.103	0.003	1.8125		1.623		(a)
-131	1.674	0.015	0.103	0.003	1.875		1.686		(a)
-132	1.737	0.015	0.103	0.003	1.9375		1.748		(a)
-133	1.799	0.015	0.103	0.003	2.000		1.811		(a)
-134	1.862	0.015	0.103	0.003	2.0625		1.873		(a)
-135	1.925	0.017	0.103	0.003	2.125		1.936		(a)
-136	1.987	0.017	0.103	0.003	2.1875		2.000		(a)
-137	2.050	0.017	0.103	0.003	2.250		2.0625		(a)
-138	2.112	0.017	0.103	0.003	2.3125		2.125		(a)
-139	2.175	0.017	0.103	0.003	2.375		2.1875		(a)
-140	2.237	0.017	0.103	0.003	2.4375	0.001	2.250	0.001	(a)

NOTES:

(a) Not recommended for reciprocating applications.

(b) Sizes noted require considerable stretch when installed in standard external grooves and may require compounds with superior elongation, or two piece pistons.

(e) Not for use in internal pressure face seal applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-141	2.300	0.020	0.103	0.003	2.500	0.001	2.3125	0.001	(a)
-142	2.362	0.020	0.103	0.003	2.5625		2.375		(a)
-143	2.425	0.020	0.103	0.003	2.625		2.4375		(a)
-144	2.487	0.020	0.103	0.003	2.6875		2.500		(a)
-145	2.550	0.020	0.103	0.003	2.750		2.5625		(a)
-146	2.612	0.020	0.103	0.003	2.8125		2.625		(a)
-147	2.675	0.022	0.103	0.003	2.875		2.6875		(a)
-148	2.737	0.022	0.103	0.003	2.9375		2.750		(a)
-149	2.800	0.022	0.103	0.003	3.000		2.8125		(a)
-150	2.862	0.022	0.103	0.003	3.0625		2.875		(a)
-151	2.987	0.024	0.103	0.003	3.250		3.000		(a)
-152	3.237	0.024	0.103	0.003	3.500		3.250		(a)
-153	3.487	0.024	0.103	0.003	3.750		3.500		(a)
-154	3.737	0.028	0.103	0.003	4.000		3.750		(a)
-155	3.987	0.028	0.103	0.003	4.250		4.000		(a)
-156	4.237	0.030	0.103	0.003	4.500		4.250		(a)
-157	4.487	0.030	0.103	0.003	4.750		4.500		(a)
-158	4.737	0.030	0.103	0.003	5.000		4.750		(a)
-159	4.987	0.035	0.103	0.003	5.250		5.000		(a)
-160	5.237	0.035	0.103	0.003	5.500		5.250		(a)
-161	5.487	0.035	0.103	0.003	5.750		5.500		(a)
-162	5.737	0.035	0.103	0.003	6.000		5.750		(a)
-163	5.987	0.035	0.103	0.003	6.250		6.000		(a)
-164	6.237	0.040	0.103	0.003	6.500		6.250		(a)
-165	6.487	0.040	0.103	0.003	6.750		6.500		(a)
-166	6.737	0.040	0.103	0.003	7.000		6.750		(a)
-167	6.987	0.040	0.103	0.003	7.250		7.000		(a)
-168	7.237	0.045	0.103	0.003	7.500		7.250		(a)
-169	7.487	0.045	0.103	0.003	7.750		7.500		(a)
-170	7.737	0.045	0.103	0.003	8.000	0.001	7.750	0.001	(a)

NOTES:

(a) Not recommended for reciprocating applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-171	7.987	0.045	0.103	0.003	8.250	0.001	8.000	0.001	(a)
-172	8.237	0.050	0.103	0.003	8.500		8.250		(a)
-173	8.487	0.050	0.103	0.003	8.750		8.500		(a)
-174	8.737	0.050	0.103	0.003	9.000		8.750		(a)
-175	8.987	0.050	0.103	0.003	9.250		9.000		(a)
-176	9.237	0.055	0.103	0.003	9.500		9.250		(a)
-177	9.487	0.055	0.103	0.003	7.570		9.500		(a)
-178	9.737	0.055	0.103	0.003	10.000	0.001	9.750	0.001	(a)
-201	0.171	0.005	0.139	0.004	0.4375	0.001	0.182	0.001	(b)(e)
-202	0.234	0.005	0.139	0.004	0.500		0.248		(b)(e)
-203	0.296	0.005	0.139	0.004	0.5625		0.311		(b)(e)
-204	0.359	0.005	0.139	0.004	0.625		0.373		(e)
-205	0.421	0.005	0.139	0.004	0.6875		0.436		(e)
-206	0.484	0.005	0.139	0.004	0.750		0.498		(e)
-207	0.546	0.007	0.139	0.004	0.8125		0.561		(e)
-208	0.609	0.009	0.139	0.004	0.875		0.623		(e)
-209	0.671	0.009	0.139	0.004	0.9375		0.686		(e)
-210	0.734	0.010	0.139	0.004	1.000		0.748		(e)
-211	0.796	0.010	0.139	0.004	1.0625		0.811		(e)
-212	0.859	0.010	0.139	0.004	1.125		0.873		(e)
-213	0.921	0.010	0.139	0.004	1.1875		0.936		(e)
-214	0.984	0.010	0.139	0.004	1.250		0.998		(e)
-215	1.046	0.010	0.139	0.004	1.3125		1.061		(e)
-216	1.109	0.012	0.139	0.004	1.375		1.123		(e)
-217	1.171	0.012	0.139	0.004	1.4375		1.186		(e)
-218	1.234	0.012	0.139	0.004	1.500		1.248		(e)
-219	1.296	0.012	0.139	0.004	1.5625		1.311		
-220	1.359	0.012	0.139	0.004	1.625	0.001	1.373	0.001	

NOTES:

(a) Not recommended for reciprocating applications.

(b) Sizes noted require considerable stretch when installed in standard external grooves and may require compounds with superior elongation, or two piece pistons.

(e) Not for use in internal pressure face seal applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-221	1.421	0.012	0.139	0.004	1.6875	0.001	1.436	0.001	
-222	1.484	0.015	0.139	0.004	1.750		1.498		
-223	1.609	0.015	0.139	0.004	1.875		1.623		(a)
-224	1.734	0.015	0.139	0.004	2.000		1.748		(a)
-225	1.859	0.018	0.139	0.004	2.125		1.873		(a)
-226	1.984	0.018	0.139	0.004	2.250		2.000		(a)
-227	2.109	0.018	0.139	0.004	2.375		2.125		(a)
-228	2.234	0.020	0.139	0.004	2.500		2.250		(a)
-229	2.359	0.020	0.139	0.004	2.625		2.375		(a)
-230	2.484	0.020	0.139	0.004	2.750		2.500		(a)
-231	2.609	0.020	0.139	0.004	2.875		2.625		(a)
-232	2.734	0.024	0.139	0.004	3.000		2.750		(a)
-233	2.859	0.024	0.139	0.004	3.125		2.875		(a)
-234	2.984	0.024	0.139	0.004	3.250		3.000		(a)
-235	3.109	0.024	0.139	0.004	3.375		3.125		(a)
-236	3.234	0.024	0.139	0.004	3.500		3.250		(a)
-237	3.359	0.024	0.139	0.004	3.625		3.375		(a)
-238	3.484	0.024	0.139	0.004	3.750		3.500		(a)
-239	3.609	0.028	0.139	0.004	3.875		3.625		(a)
-240	3.734	0.028	0.139	0.004	4.000		3.750		(a)
-241	3.859	0.028	0.139	0.004	4.125		3.875		(a)
-242	3.984	0.028	0.139	0.004	4.350		4.000		(a)
-243	4.109	0.028	0.139	0.004	4.375		4.125		(a)
-244	4.234	0.030	0.139	0.004	4.500		4.250		(a)
-245	4.359	0.030	0.139	0.004	4.625		4.375		(a)
-246	4.484	0.030	0.139	0.004	4.750		4.500		(a)
-247	4.609	0.030	0.139	0.004	4.875		4.625		(a)
-248	4.734	0.030	0.139	0.004	5.000		4.750		(a)
-249	4.859	0.035	0.139	0.004	5.125		4.875		(a)
-250	4.984	0.035	0.139	0.004	5.250	0.001	5.000	0.001	(a)

NOTES:

(a) Not recommended for reciprocating applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-251	5.109	0.035	0.139	0.004	5.375	0.001	5.125	0.001	(a)
-252	5.234	0.035	0.139	0.004	5.500		5.250		(a)
-253	5.359	0.035	0.139	0.004	5.625		5.375		(a)
-254	5.484	0.035	0.139	0.004	5.750		5.500		(a)
-255	5.609	0.035	0.139	0.004	5.875		5.625		(a)
-256	5.734	0.035	0.139	0.004	6.000		5.750		(a)
-257	5.859	0.035	0.139	0.004	6.125		5.875		(a)
-258	5.984	0.035	0.139	0.004	6.250		6.000		(a)
-259	6.234	0.040	0.139	0.004	6.500		6.250		(a)
-260	6.484	0.040	0.139	0.004	6.750		6.500		(a)
-261	6.734	0.040	0.139	0.004	7.000		6.750		(a)
-262	6.984	0.040	0.139	0.004	7.250		7.000		(a)
-263	7.234	0.045	0.139	0.004	0.500		7.250		(a)
-264	7.484	0.045	0.139	0.004	7.750		7.500		(a)
-265	7.734	0.045	0.139	0.004	8.000		7.750		(a)
-266	7.984	0.045	0.139	0.004	8.250		8.000		(a)
-267	8.234	0.050	0.139	0.004	8.500		8.250		(a)
-268	8.484	0.050	0.139	0.004	8.750		8.500		(a)
-269	8.734	0.050	0.139	0.004	9.000		8.750		(a)
-270	8.984	0.050	0.139	0.004	9.250		9.000		(a)
-271	9.234	0.055	0.139	0.004	9.500		9.250		(a)
-272	9.484	0.055	0.139	0.004	9.750		9.500		(a)
-273	9.734	0.055	0.139	0.004	10.000		9.750		(a)
-274	9.984	0.055	0.139	0.004	10.250		10.000		(a)
-275	10.484	0.055	0.139	0.004	10.750		10.500		(a)
-276	10.984	0.065	0.139	0.004	11.250		11.000		(a)
-277	11.484	0.065	0.139	0.004	11.750		11.500		(a)
-278	11.984	0.065	0.139	0.004	12.250		12.000		(a)
-279	12.984	0.065	0.139	0.004	13.250		13.000		(a)
-280	13.984	0.065	0.139	0.004	14.250	0.001	14.000	0.001	(a)

NOTES:

(a) Not recommended for reciprocating applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-281	14.984	0.065	0.139	0.004	15.250	0.001	15.000	0.001	(a)
-282	15.955	0.075	0.139	0.004	16.250		16.000		(a)
-283	16.955	0.080	0.139	0.004	17.250	0.001	17.000		(a)
-284	17.955	0.085	0.139	0.004	18.250		18.000	0.001	(a)
-309	0.412	0.005	0.210	0.005	0.8125	0.001	0.436	0.001	(e)
-310	0.475	0.005	0.210	0.005	0.875		0.498		(e)
-311	0.537	0.007	0.210	0.005	0.9375		0.560		(e)
-312	0.600	0.009	0.210	0.005	1.000		0.623		(e)
-313	0.662	0.009	0.210	0.005	1.0625		0.686		(e)
-314	0.725	0.010	0.210	0.005	1.125		0.748		(e)
-315	0.787	0.010	0.210	0.005	1.1875		0.811		(e)
-316	0.850	0.010	0.210	0.005	1.250		0.873		(e)
-317	0.912	0.010	0.210	0.005	1.3125		0.936		(e)
-318	0.975	0.010	0.210	0.005	1.375		0.998		(e)
-319	1.037	0.010	0.210	0.005	1.4375		1.061		(e)
-320	1.100	0.012	0.210	0.005	1.500		1.123		(e)
-321	1.162	0.012	0.210	0.005	1.5625		1.186		
-322	1.225	0.012	0.210	0.005	1.625		1.248		
-323	1.287	0.012	0.210	0.005	1.6875		1.311		
-324	1.350	0.012	0.210	0.005	1.750		1.373		
-325	1.475	0.015	0.210	0.005	1.875		1.498		
-326	1.600	0.015	0.210	0.005	2.000		1.623		
-327	1.725	0.015	0.210	0.005	2.125		1.748		
-328	1.850	0.015	0.210	0.005	2.250		1.873		
-329	1.975	0.018	0.210	0.005	2.375		2.000		
-330	2.100	0.018	0.210	0.005	2.500		2.125		
-331	2.225	0.018	0.210	0.005	2.625		2.250		
-332	2.350	0.018	0.210	0.005	2.750		2.375		
-333	2.475	0.020	0.210	0.005	2.875		2.500		
-334	2.600	0.020	0.210	0.005	3.000		2.625		
-335	2.725	0.020	0.210	0.005	3.125	0.001	2.750	0.001	

NOTES:

(a) Not recommended for reciprocating applications.

(e) Not for use in internal pressure face seal applications.

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-336	2.850	0.020	0.210	0.005	3.250	0.001	2.875	0.001	
-337	2.975	0.024	0.210	0.005	3.375		3.000		
-338	3.100	0.024	0.210	0.005	3.500		3.125		
-339	3.225	0.024	0.210	0.005	3.625		3.250		
-340	3.350	0.024	0.210	0.005	3.750		3.375		
-341	3.475	0.024	0.210	0.005	3.875		3.500		
-342	3.600	0.028	0.210	0.005	4.000		3.625		
-343	3.725	0.028	0.210	0.005	4.125		3.750		
-344	3.850	0.028	0.210	0.005	4.250		3.875		
-345	3.975	0.028	0.210	0.005	4.357		4.000		
-346	4.100	0.028	0.210	0.005	4.500		4.125		
-347	4.225	0.030	0.210	0.005	4.625		4.250		
-348	4.350	0.030	0.210	0.005	4.750		4.375		
-349	4.475	0.030	0.210	0.005	4.875		4.500		
-350	4.600	0.030	0.210	0.005	5.000		4.625		
-351	4.725	0.030	0.210	0.005	5.125		4.750		
-352	4.850	0.030	0.210	0.005	5.250		4.875		
-353	4.975	0.037	0.210	0.005	5.375		5.000		
-354	5.100	0.037	0.210	0.005	5.500		5.125		
-355	5.225	0.037	0.210	0.005	5.625		5.250		
-356	5.350	0.037	0.210	0.005	5.750		5.375		
-357	5.475	0.037	0.210	0.005	5.875		5.500		
-358	5.600	0.037	0.210	0.005	6.000		5.625		
-359	5.725	0.037	0.210	0.005	6.125		5.750		
-360	5.850	0.037	0.210	0.005	6.250		5.875		
-361	5.975	0.037	0.210	0.005	6.375		6.000		
-362	6.225	0.040	0.210	0.005	6.625		6.250		
-363	6.475	0.040	0.210	0.005	6.875		6.500		
-364	6.725	0.040	0.210	0.005	7.125		6.750		
-365	6.975	0.040	0.210	0.005	7.375	0.001	7.000	0.001	

Table 1 - Bore and rod dimensions (inches) for O-ring gland seal design (continued)

AS568 Uniform Dash No.	Standard O-ring Size				Bore Dia. External Seals		Rod Dia. Internal Seals		Notes
	I.D.	+ TOL	W	+ TOL	A	+ TOL	B	+ TOL	
-366	7.225	0.045	0.210	0.005	7.625	0.001	7.250	0.001	
-367	7.475	0.045	0.210	0.005	7.875		7.500		
-368	7.725	0.045	0.210	0.005	8.125		7.750		
-369	7.975	0.045	0.210	0.005	8.375		8.000		
-370	8.225	0.050	0.210	0.005	8.625		8.250		
-371	8.475	0.050	0.210	0.005	8.875		8.500		
-372	8.725	0.050	0.210	0.005	9.125		8.750		
-373	8.975	0.050	0.210	0.005	9.375		9.000		
-374	9.225	0.055	0.210	0.005	9.625		9.250		
-375	9.475	0.055	0.210	0.005	9.875		9.500		
-376	9.725	0.055	0.210	0.005	10.125		9.750		
-377	9.975	0.055	0.210	0.005	10.375		10.000		
-378	10.475	0.060	0.210	0.005	10.875		10.500		
-379	10.975	0.060	0.210	0.005	11.375		11.000		
-380	11.475	0.065	0.210	0.005	11.875		11.500		
-381	11.975	0.065	0.210	0.005	12.375		12.000		
-382	12.975	0.065	0.210	0.005	13.375		13.000		
-383	13.975	0.070	0.210	0.005	14.375		14.000		
-384	14.975	0.070	0.210	0.005	15.375		15.000		
-385	15.955	0.075	0.210	0.005	16.375		16.000		
-386	16.955	0.080	0.210	0.005	17.375		17.000		
-387	17.955	0.085	0.210	0.005	18.375		18.000		
-388	18.953	0.090	0.210	0.005	19.375		19.000		
-389	19.953	0.095	0.210	0.005	20.375		20.000		
-390	20.953	0.095	0.210	0.005	21.375		21.000		
-391	21.953	0.100	0.210	0.005	22.375		22.000		
-392	22.940	0.105	0.210	0.005	23.375		23.000		
-393	23.940	0.110	0.210	0.005	24.375		24.000		
-394	24.940	0.115	0.210	0.005	25.375		25.000		
-395	25.940	0.120	0.210	0.005	26.375	0.001	26.000	0.001	

Table 2 - O-ring gland dimensions for low pressure, dynamic hydraulic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width			D Diam Clearance		Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze		Percent Squeeze		S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
			No Back-up ± TOL	One Back-up ± TOL	Two Back-ups ± TOL	No Back-up ± TOL	With Back-up ± TOL				Max.	Min.	Max.	Min.			
004 Thru 020	0.070 ±0.003	0.055 ±0.0005	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.006 +0.003	0.006 ±0.003	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.0185	0.0115	25.3	17.2	16	100%	70 ±5
021 Thru 050	0.070 ±0.003	0.055 ±0.001	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.006 ±0.003	0.006 ±0.003	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.019	0.011	26.0	16.4	16	100%	70 ±5
102 Thru 178	0.103 ±0.003	0.085 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.007 ±0.003	0.007 ±0.003	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.022	0.014	20.8	14.0	16	100%	70 ±5
201 Thru 284	0.139 ±0.004	0.118 ±0.001	0.160 ±0.005	0.210 ±0.005	0.260 ±0.005	0.008 ±0.004	0.008 ±0.004	0.003 Max	0.008 ±0.002	0.015 ±0.005	0.026	0.016	18.2	11.9	16	100%	70 ±5
309 Thru 395	0.210 ±0.005	0.185 ±0.001	0.230 ±0.005	0.280 ±0.005	0.330 ±0.005	0.009 ±0.005	0.009 ±0.005	0.004 Max	0.008 ±0.002	0.025 ±0.005	0.031	0.019	14.4	9.3	16	100%	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 3 - O-ring gland dimensions for medium pressure, dynamic hydraulic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width			D Diam Clearance		Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze		Percent Squeeze		Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
			No Back-up ± TOL	One Back-up ± TOL	Two Back-ups ± TOL	No Back-up ± TOL	With Back-up ± TOL				Max.	Min.	Max.	Min.			
004 Thru 020	0.070 ±0.003	0.055 ±0.0005	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.002 +0.001	0.004 ±0.002	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.0185	0.0115	25.3	17.2	32	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.055 ±0.001	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.002 ±0.001	0.004 ±0.002	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.019	0.011	26.0	16.4	32	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.086 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.003 ±0.002	0.005 ±0.002	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.021	0.013	19.8	13.0	32	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.120 ±0.001	0.160 ±0.005	0.210 ±0.005	0.260 ±0.005	0.004 ±0.003	0.006 ±0.003	0.003 Max	0.008 ±0.002	0.015 ±0.005	0.024	0.014	16.8	10.4	32	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.185 ±0.001	0.230 ±0.005	0.280 ±0.005	0.330 ±0.005	0.005 ±0.003	0.007 ±0.004	0.004 Max	0.008 ±0.002	0.025 ±0.005	0.030	0.018	14.0	8.8	32	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 4 - O-ring gland dimensions for high pressure, dynamic hydraulic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width: No Back-up ± TOL	G Gland Width: One Back-up ± TOL	G Gland Width: Two Back-ups ± TOL	D Diam Clearance: No Back-up ± TOL	D Diam Clearance: With Back-up ± TOL	Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze: Max.	Squeeze: Min.	Percent Squeeze: Max.	Percent Squeeze: Min.	S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
004 Thru 020	0.070 ±0.003	0.056 ±0.0005	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.0015 +0.001	0.002 ±0.001	0.001 Max	0.001 Max	0.010 ±0.005	0.0175	0.0105	24.0	15.7	32 √	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.056 ±0.001	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.0015 ±0.001	0.002 ±0.001	0.001 Max	0.001 Max	0.010 ±0.005	0.018	0.010	24.7	14.9	32 √	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.088 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.002 ±0.001	0.003 ±0.002	0.002 Max	0.002 Max	0.010 ±0.005	0.019	0.011	17.9	11.0	32 √	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.122 ±0.001	0.160 ±0.005	0.210 ±0.005	0.260 ±0.005	0.003 ±0.002	0.004 ±0.002	0.003 Max	0.003 Max	0.015 ±0.005	0.022	0.012	15.4	8.9	32 √	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.187 ±0.001	0.230 ±0.005	0.280 ±0.005	0.330 ±0.005	0.004 ±0.002	0.005 ±0.002	0.004 Max	0.005 Max	0.025 ±0.005	0.029	0.017	13.5	8.3	32 √	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 5 - O-ring gland dimensions for low pressure, static hydraulic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width			D Diam Clearance		Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze		Percent Squeeze		S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
			No Back-up ± TOL	One Back-up ± TOL	Two Back-ups ± TOL	No Back-up ± TOL	With Back-up ± TOL				Max.	Min.	Max.	Min.			
004 Thru 020	0.070 ±0.003	0.055 ±0.0005	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.004 +0.003	0.005 -0.003	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.0185	0.0115	25.3	17.2	16 √	1.5	70 ±5
021 Thru 050	0.070 ±0.003	0.055 ±0.001	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.004 ±0.003	0.005 0.003	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.019	0.011	26.0	16.4	16 √	1.5	70 ±5
102 Thru 178	0.103 ±0.003	0.084 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.005 ±0.003	0.006 ±0.003	0.004 Max	0.008 ±0.002	0.010 ±0.005	0.023	0.015	21.7	15.0	16 √	1.5	70 ±5
201 Thru 284	0.139 ±0.004	0.113 ±0.001	0.162 ±0.005	0.212 ±0.005	0.262 ±0.005	0.006 ±0.004	0.007 ±0.004	0.005 Max	0.008 ±0.002	0.015 ±0.005	0.031	0.021	21.7	15.6	16 √	1.5	70 ±5
309 Thru 395	0.210 ±0.005	0.171 ±0.001	0.240 ±0.005	0.290 ±0.005	0.340 ±0.005	0.007 ±0.005	0.008 ±0.005	0.006 Max	0.008 ±0.002	0.025 ±0.005	0.045	0.029	20.9	14.1	16 √	1.5	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 6 - O-ring gland dimensions for medium pressure, static hydraulic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width			D Diam Clearance		Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze		Percent Squeeze		S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
			No Back-up ± TOL	One Back-up ± TOL	Two Back-ups ± TOL	No Back-up ± TOL	With Back-up ± TOL				Max.	Min.	Max.	Min.			
004 Thru 020	0.070 ±0.003	0.055 ±0.0005	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.002 +0.001	0.004 -0.002	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.0185	0.0115	25.3	17.2	32 √	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.055 ±0.001	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.002 ±0.001	0.004 0.002	0.002 Max	0.008 ±0.002	0.010 ±0.005	0.019	0.011	26.0	16.4	32 √	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.084 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.003 ±0.002	0.005 ±0.002	0.004 Max	0.008 ±0.002	0.010 ±0.005	0.023	0.015	21.7	15.0	32 √	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.113 ±0.001	0.162 ±0.005	0.212 ±0.005	0.262 ±0.005	0.004 ±0.003	0.006 ±0.003	0.005 Max	0.008 ±0.002	0.015 ±0.005	0.031	0.021	21.7	15.6	32 √	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.171 ±0.001	0.240 ±0.005	0.290 ±0.005	0.340 ±0.005	0.005 ±0.003	0.007 ±0.004	0.006 Max	0.008 ±0.002	0.025 ±0.005	0.045	0.029	20.9	14.1	32 √	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 7 - O-ring gland dimensions for high pressure, static hydraulic applications

AS568Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width: No Back-up ± TOL	G Gland Width: One Back-up ± TOL	G Gland Width: Two Back-ups ± TOL	D Diam Clearance: No Back-up ± TOL	D Diam Clearance: With Back-up ± TOL	Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze: Max.	Squeeze: Min.	Percent Squeeze: Max.	Percent Squeeze: Min.	S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
004 Thru 020	0.070 ±0.003	0.055 ±0.0005	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.002 ±0.001	0.003 ±0.001	0.001 Max	0.001 Max	0.010 ±0.005	0.0185	0.0115	25.3	17.2	32	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.055 ±0.001	0.088 ±0.005	0.138 ±0.005	0.188 ±0.005	0.002 ±0.001	0.003 ±0.001	0.001 Max	0.001 Max	0.010 ±0.005	0.019	0.011	26.0	16.4	32	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.084 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.003 ±0.001	0.004 ±0.002	0.002 Max	0.002 Max	0.010 ±0.005	0.023	0.015	21.7	15.0	32	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.113 ±0.001	0.162 ±0.005	0.212 ±0.005	0.262 ±0.005	0.004 ±0.002	0.005 ±0.002	0.003 Max	0.003 Max	0.015 ±0.005	0.031	0.021	21.7	15.6	32	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.171 ±0.001	0.240 ±0.005	0.290 ±0.005	0.340 ±0.005	0.005 ±0.002	0.006 ±0.002	0.004 Max	0.005 Max	0.025 ±0.005	0.045	0.029	20.9	14.1	32	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

TABLE 8 - O-ring gland dimensions for low pressure, dynamic pneumatic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width: No Back-up ± TOL	G Gland Width: One Back-up ± TOL	G Gland Width: Two Back-ups ± TOL	D Diam Clearance: No Back-up ± TOL	D Diam Clearance: With Back-up ± TOL	Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze: Max.	Squeeze: Min.	Percent Squeeze: Max.	Percent Squeeze: Min.	S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
004 Thru 020	0.070 ±0.003	0.057 ±0.0005	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.0015 ±0.0005	0.004 ±0.002	0.0005 Max	0.008 ±0.002	0.010 ±0.005	0.0165	0.0095	22.6	14.2	32	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.057 ±0.001	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.0015 ±0.0005	0.004 ±0.002	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.017	0.009	23.3	13.4	32	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.086 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.002 ±0.001	0.005 ±0.003	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.021	0.013	19.8	13.0	32	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.119 ±0.001	0.160 ±0.005	0.210 ±0.005	0.260 ±0.005	0.004 ±0.002	0.006 ±0.004	0.002 Max	0.008 ±0.002	0.015 ±0.005	0.025	0.015	17.5	11.1	32	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.185 ±0.001	0.230 ±0.005	0.280 ±0.005	0.380 ±0.005	0.006 ±0.003	0.007 ±0.005	0.003 Max	0.008 ±0.002	0.025 ±0.005	0.031	0.019	14.4	9.3	32	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.

Table 9 - O-ring gland dimensions for medium pressure, dynamic pneumatic applications

AS568 Uniform Dash No.	W Cross Section ± TOL	L Gland Depth ± TOL	G Gland Width			D Diam Clearance		Eccentricity	R_1 Edge Break ± TOL	R_2 Fillet Radius ± TOL	Squeeze		Percent Squeeze		S Surface Finish	AQL Note (1) (2)	Hardness Shore A Durometer
			No Back-up ± TOL	One Back-up ± TOL	Two Back-ups ± TOL	No Back-up ± TOL	With Back-up ± TOL				Max.	Min.	Max.	Min.			
004 Thru 020	0.070 ±0.003	0.057 ±0.0005	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.001 ±0.0004	0.004 ±0.002	0.0004 Max	0.008 ±0.002	0.010 ±0.005	0.0165	0.0095	22.6	14.2	32	4.0	70 ±5
021 Thru 050	0.070 ±0.003	0.057 ±0.001	0.090 ±0.005	0.140 ±0.005	0.190 ±0.005	0.001 ±0.0004	0.004 ±0.002	0.0008 Max	0.008 ±0.002	0.010 ±0.005	0.017	0.009	23.3	13.4	32	4.0	70 ±5
102 Thru 178	0.103 ±0.003	0.086 ±0.001	0.120 ±0.005	0.170 ±0.005	0.220 ±0.005	0.002 ±0.001	0.005 ±0.002	0.001 Max	0.008 ±0.002	0.010 ±0.005	0.021	0.013	19.8	13.0	32	4.0	70 ±5
201 Thru 284	0.139 ±0.004	0.119 ±0.001	0.160 ±0.005	0.210 ±0.005	0.260 ±0.005	0.003 ±0.002	0.006 ±0.003	0.002 Max	0.008 ±0.002	0.015 ±0.005	0.025	0.015	17.5	11.1	32	4.0	70 ±5
309 Thru 395	0.210 ±0.005	0.185 ±0.001	0.230 ±0.005	0.280 ±0.005	0.380 ±0.005	0.004 ±0.002	0.007 ±0.004	0.003 Max	0.008 ±0.002	0.025 ±0.005	0.031	0.019	14.4	9.3	32	4.0	70 ±5

NOTES:

(1) Inspect for flaws per ISO 3601-3 Grade S or CS. Inspection level shall be the tabulated AQL, Level II, per ANSI Z1.4.

(2) 100% inspection is required for critical internal seals or for external seals where long-term sealing is required. For less critical applications, engineering judgment is required. Depending upon the critical nature of the application, an AQL of 1.5, 2.5 or 4.0 may be appropriate. An AQL of 1.0 is used for AMS7XXX standards and hence is recommended when 100% inspection is not feasible or necessary.