



AEROSPACE STANDARD

AS4716™**REV. D**Issued 1993-06
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Superseding AS4716C

Gland Design, O-Ring and Other Seals

RATIONALE

Revision D includes:

- Updated references.
- Corrected minor errors.
- Clarification of cylinder breathing under pressure (3.8).
- Corrected Equations B1 and B5. (Subsequently, Appendix B equations are re-numbered.)

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1. SCOPE

This SAE Aerospace Standard (AS) provides standardized gland (groove) design criteria and dimensions for O-ring seal glands for static and dynamic applications, and other seals.

1.1 Field of Application

The glands have been specifically designed for applications using AS568 size O-rings at pressures exceeding 1500 psi (10340 kPa) utilizing one or two anti-extrusion (backup) rings and applications at pressures below 1500 psi (10340 kPa) without backup rings. The glands have been sized to provide sufficient squeeze for effective sealing while at the same time limiting squeeze to allow satisfactory operation in dynamic applications.

While this specification covers the basic design criteria and recommendations for use with standard size O-rings, these glands may also be suitable for use with other elastomeric seals and elastomeric and mechanically energized plastic (non-elastomer) based seals.

NOTE: For static external applications, i.e., where the application is overboard and sealing to atmosphere, the glands should be per AS5857.

2. REFERENCES

2.1 Applicable Documents

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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2452	Superfinishing of HVOF Applied Tungsten Carbide Coatings
AIR6079	Selection of Metallic Spring Energized Seals for Aerospace
ARP4727	Gland Design, Computation of Seal Squeeze and Gland Volume
ARP5555	Recommendations for Installation of Seals in Standard Glands
ARP5935	Use of HVOF Thermal Spray Coatings for Hard Chrome Replacement in Landing Gear Applications
AS568	Aerospace Size Standard for O-Rings
AS5781	Retainers (Backup Rings), Hydraulic and Pneumatic, Polytetrafluoroethylene Resin, Single Turn, Scarf-Cut, For Use in AS4716 Glands
AS5782	Retainers (Backup Rings), Hydraulic and Pneumatic, Polytetrafluoroethylene Resin, Solid, Un-Cut, For Use in AS4716 Glands
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
AS8791	Hydraulic and Pneumatic Retainers (Backup Rings), Polytetrafluoroethylene (PTFE) Resin

2.1.2 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 B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

ASME Y14.5-1994 Dimensioning and Tolerancing

2.1.3 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 4287-1 Geometrical Product Specifications (GPS) — Surface Texture: Profile Method — Terms, Definitions and Surface Texture Parameters

2.1.4 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-G-5514 Gland Design; Packing, Hydraulic, General Requirements For (Inactive for New Design)

3. TECHNICAL REQUIREMENTS

3.1 Gland Configuration

3.1.1 General

As a general rule, O-rings and other elastomeric seals operating above 1500 psi (10340 kPa) should utilize backup rings or other devices of this nature to prevent seal extrusion. O-ring seal glands designed for backup ring use shall be increased in width. Therefore, this document depicts gland widths for applications using none, one and two backup rings. While these glands are sized based on standard O-rings, they may be used with other elastomeric seals, also referred to as “non-standard seals” and elastomeric and mechanically energized plastic (non-elastomer) seals. These other seals should be designed to perform in AS4716 standard size glands contained herein and should be qualified per the guidelines in ARP5555.

All the applicable recommendations in ARP5555 should be taken into consideration when fulfilling the requirements of this document.

3.1.2 Dimensions

The dimensions listed in Tables 1A, 1B, 2A, 2B, 7A and 7B are similar to the dimensions in MIL-G-5514 Revision G. Changes have been made to the Gland OD (F) and the Gland ID (E) to obtain the desired O-ring squeeze as stated in Tables 1A and 1B (also see Figures 1, 2, 4A, and 4B).

Changes have been made to the gland width dimensions to achieve a design goal of 85% maximum gland occupancy at ambient conditions. This was achieved except for dash numbers -004, -008, -010, -013, and -110 in which the gland occupancy slightly exceeds 85%. Also, the gland wall angle and the break edge dimensions (Figures 4A and 4B) have been included to permit these glands to be used at pressures up to 8000 psi (55160 kPa).

The maximum diametral clearances between the cylinder bore and piston, the rod and rod gland are listed in Tables 7A and 7B for the convenience of the user (see 3.3). The maximum run-outs are listed in Table 8 (see 3.4).

3.1.3 Limitations

The design criteria and standard glands outlined in this document are intended for use in static and dynamic applications with AS568 O-rings. Dash numbers -013 through -028, -117 through -149, and -223 through -247 are intended for static applications only due to the possibility of spiral failure occurring in these smaller cross-section/larger diameter O-ring sizes.

Also, glands conforming to the dimensions listed herein for dash numbers -001 through -004 do not meet the squeeze goal of an installed deflection of at least 0.005 inch (0.13 mm) on the O-ring cross-section using the most adverse accumulation of tolerances and O-ring stretch (see Appendix A). Therefore, dash numbers -001 through -004 may not be suitable for many applications.

Glands are designed so that they will not have more than 85% gland occupancy (15% free space) at 75 °F (24 °C) (see Appendix B). The standard glands defined herein are designed for up to 8000 psi (55160 kPa) applications and for use in seal applications where the free swell is limited to 20%.

The dash numbers highlighted in Tables 1A and 1B apply to glands where, if O-rings are used, they are to be static applications only and it is highly recommended that other seal types follow this rule. However, if other seals types are used dynamically within the static size range highlighted, then caution should be used to determine appropriate performance.

NOTE: The general use of 0.070 inch (1.78 mm) O-ring cross-sections and smaller is not recommended for applications subject to external leakage due to the increased possibility of leakage.

3.2 Gland and Groove Details

3.2.1 Gland Major Dimensions

The gland major dimensions are shown in Figure 1 and Tables 1A, 1B, 2A, and 2B.

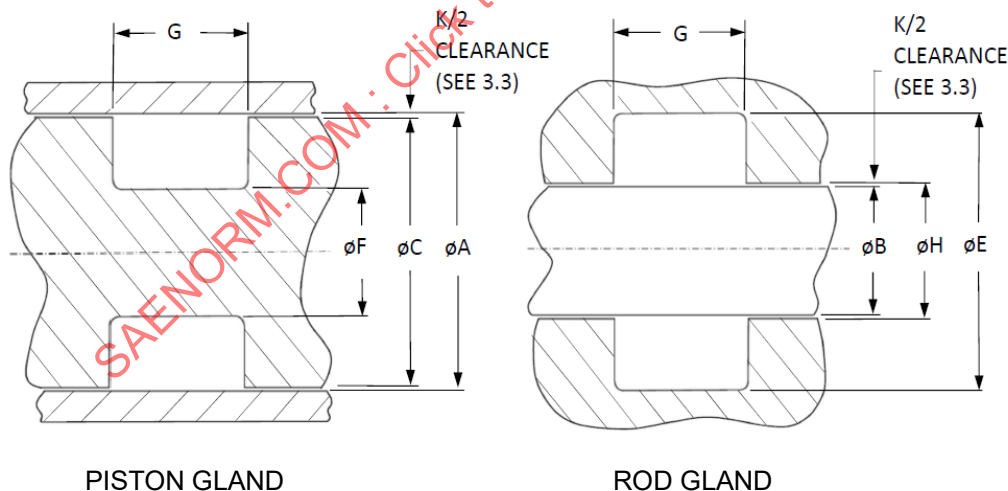


Figure 1 - Gland design

Examples of the gland configurations shown in Figure 1 are provided in Figure 2.

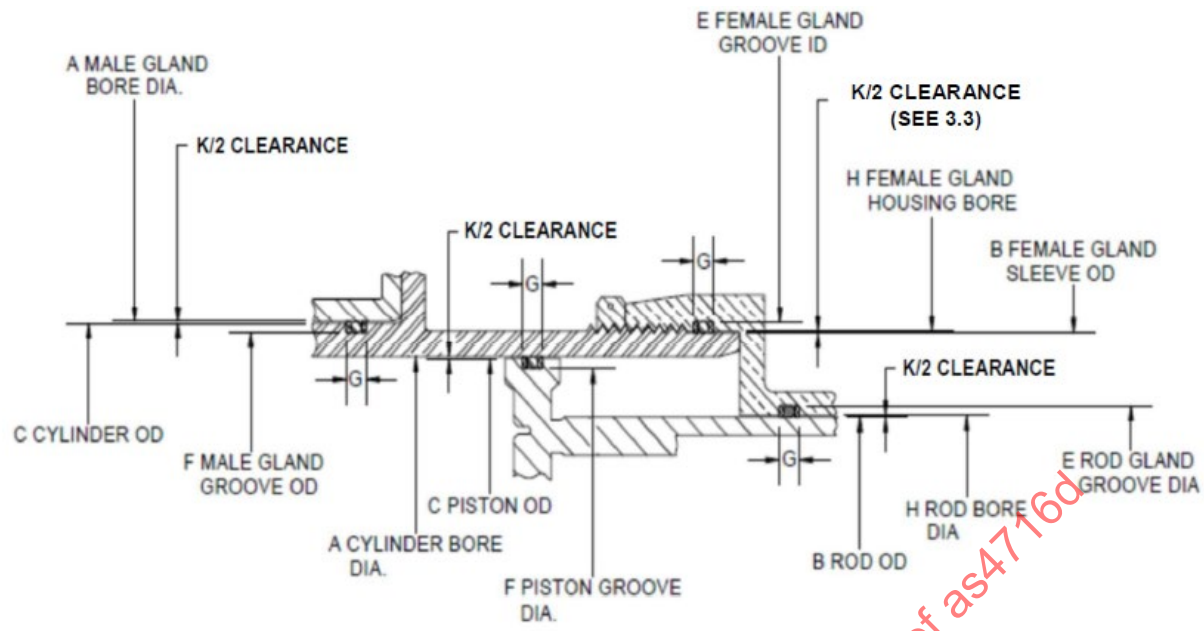


Figure 2 - Gland configuration examples

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Table 1A - Standard gland dimensions and O-ring squeeze in inches

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
001	0.093	0.095	0.033	0.033	0.035	0.095	0	0.0145
	0.092	0.096	0.032	0.032	0.036	0.096	0	0.0145
002	0.126	0.128	0.048	0.048	0.050	0.128	0	0.0147
	0.125	0.129	0.047	0.047	0.051	0.129	0	0.0147
003	0.157	0.159	0.063	0.063	0.065	0.159	0.0015	0.0164
	0.156	0.160	0.062	0.062	0.066	0.160	0.0015	0.0164
004	0.188	0.190	0.076	0.076	0.078	0.190	0.0026	0.0182
	0.187	0.191	0.075	0.075	0.079	0.191	0.0026	0.0182
005	0.219	0.221	0.115	0.108	0.110	0.217	0.0051	0.0200
	0.218	0.222	0.114	0.107	0.111	0.218	0.0054	0.0204
006	0.233	0.235	0.129	0.123	0.125	0.232	0.0052	0.0199
	0.232	0.236	0.128	0.122	0.126	0.233	0.0052	0.0199
007	0.264	0.266	0.158	0.154	0.156	0.264	0.0052	0.0197
	0.263	0.267	0.157	0.153	0.157	0.265	0.0051	0.0196
008	0.295	0.297	0.189	0.185	0.187	0.294	0.0057	0.0199
	0.294	0.298	0.188	0.184	0.188	0.295	0.0059	0.0202
009	0.327	0.329	0.220	0.217	0.219	0.327	0.0052	0.0192
	0.326	0.330	0.219	0.216	0.220	0.328	0.0052	0.0193
010	0.358	0.360	0.250	0.248	0.250	0.359	0.0052	0.0190
	0.357	0.361	0.249	0.247	0.251	0.360	0.0050	0.0189
011	0.420	0.422	0.312	0.310	0.312	0.421	0.0057	0.0193
	0.419	0.423	0.311	0.309	0.313	0.422	0.0054	0.0191
012	0.483	0.485	0.375	0.373	0.375	0.484	0.0060	0.0194
	0.482	0.486	0.374	0.372	0.376	0.485	0.0057	0.0192
013	0.548	0.550	0.441	0.435	0.437	0.545	0.0050	0.0196
	0.547	0.552	0.439	0.433	0.438	0.547	0.0050	0.0198
014	0.611	0.613	0.504	0.498	0.500	0.608	0.0052	0.0197
	0.610	0.615	0.502	0.496	0.501	0.610	0.0051	0.0199
015	0.673	0.675	0.566	0.560	0.562	0.670	0.0052	0.0200
	0.672	0.677	0.564	0.558	0.563	0.672	0.0051	0.0202
016	0.736	0.738	0.629	0.623	0.625	0.733	0.0052	0.0203
	0.735	0.740	0.627	0.621	0.626	0.735	0.0051	0.0205
017	0.798	0.800	0.691	0.685	0.687	0.795	0.0054	0.0204
	0.797	0.802	0.689	0.683	0.688	0.797	0.0052	0.0205
018	0.861	0.863	0.753	0.748	0.750	0.858	0.0050	0.0200
	0.860	0.865	0.751	0.746	0.751	0.860	0.0053	0.0205
019	0.923	0.925	0.815	0.810	0.812	0.920	0.0051	0.0200
	0.922	0.927	0.813	0.808	0.813	0.922	0.0053	0.0205
020	0.989	0.991	0.881	0.873	0.875	0.983	0.0050	0.0198
	0.988	0.993	0.879	0.871	0.876	0.985	0.0054	0.0205

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
021	1.051	1.053	0.943	0.935	0.937	1.045	0.0051	0.0199
	1.050	1.055	0.941	0.933	0.938	1.047	0.0055	0.0205
022	1.114	1.116	1.006	0.998	1.000	1.108	0.0051	0.0200
	1.113	1.118	1.004	0.996	1.001	1.110	0.0055	0.0205
023	1.176	1.178	1.068	1.060	1.062	1.170	0.0052	0.0200
	1.175	1.180	1.066	1.058	1.063	1.172	0.0055	0.0205
024	1.239	1.241	1.131	1.123	1.125	1.233	0.0052	0.0200
	1.238	1.243	1.129	1.121	1.126	1.235	0.0056	0.0205
025	1.301	1.303	1.193	1.185	1.187	1.295	0.0052	0.0201
	1.300	1.305	1.191	1.183	1.188	1.297	0.0056	0.0205
026	1.364	1.366	1.256	1.248	1.250	1.358	0.0053	0.0201
	1.363	1.368	1.254	1.246	1.251	1.360	0.0056	0.0205
027	1.426	1.428	1.318	1.310	1.312	1.420	0.0053	0.0202
	1.425	1.430	1.316	1.308	1.313	1.422	0.0056	0.0205
028	1.489	1.491	1.381	1.373	1.375	1.483	0.0053	0.0203
	1.488	1.493	1.379	1.371	1.376	1.485	0.0056	0.0205
104	0.295	0.297	0.128	0.123	0.125	0.295	0.0051	0.0204
	0.294	0.298	0.127	0.122	0.126	0.296	0.0051	0.0205
105	0.327	0.329	0.158	0.154	0.156	0.327	0.0052	0.0201
	0.326	0.330	0.157	0.153	0.157	0.328	0.0052	0.0203
106	0.358	0.360	0.187	0.185	0.187	0.359	0.0052	0.0199
	0.357	0.361	0.186	0.184	0.188	0.360	0.0052	0.0199
107	0.389	0.391	0.215	0.217	0.219	0.392	0.0050	0.0195
	0.388	0.392	0.214	0.216	0.220	0.393	0.0050	0.0196
108	0.420	0.422	0.246	0.248	0.250	0.423	0.0052	0.0196
	0.419	0.423	0.245	0.247	0.251	0.424	0.0053	0.0197
109	0.483	0.485	0.308	0.310	0.312	0.486	0.0051	0.0192
	0.482	0.486	0.307	0.309	0.313	0.487	0.0053	0.0194
110	0.548	0.550	0.379	0.373	0.375	0.546	0.0053	0.0204
	0.547	0.552	0.377	0.371	0.376	0.548	0.0052	0.0204
111	0.611	0.613	0.441	0.435	0.437	0.609	0.0052	0.0202
	0.610	0.615	0.439	0.433	0.438	0.611	0.0050	0.0201
112	0.673	0.675	0.502	0.498	0.500	0.672	0.0053	0.0201
	0.672	0.677	0.500	0.496	0.501	0.674	0.0053	0.0203
113	0.736	0.738	0.565	0.560	0.562	0.734	0.0052	0.0204
	0.735	0.740	0.563	0.558	0.563	0.736	0.0052	0.0207
114	0.798	0.800	0.627	0.623	0.625	0.797	0.0053	0.0210
	0.797	0.802	0.625	0.621	0.626	0.799	0.0052	0.0211
115	0.861	0.863	0.689	0.685	0.687	0.859	0.0050	0.0206
	0.860	0.865	0.687	0.683	0.688	0.861	0.0054	0.0212

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
116	0.923	0.925	0.751	0.748	0.750	0.923	0.0053	0.0208
	0.922	0.927	0.749	0.746	0.751	0.925	0.0050	0.0207
117	0.989	0.991	0.817	0.810	0.812	0.985	0.0050	0.0205
	0.988	0.993	0.815	0.808	0.813	0.987	0.0050	0.0209
118	1.051	1.053	0.879	0.873	0.875	1.048	0.0052	0.0207
	1.050	1.055	0.877	0.871	0.876	1.050	0.0051	0.0209
119	1.114	1.116	0.942	0.935	0.937	1.110	0.0053	0.0206
	1.113	1.118	0.940	0.933	0.938	1.112	0.0052	0.0209
120	1.176	1.178	1.003	0.998	1.000	1.173	0.0050	0.0204
	1.175	1.180	1.001	0.996	1.001	1.175	0.0053	0.0209
121	1.239	1.241	1.066	1.060	1.062	1.235	0.0050	0.0203
	1.238	1.243	1.064	1.058	1.063	1.237	0.0054	0.0209
122	1.301	1.303	1.128	1.123	1.125	1.298	0.0052	0.0204
	1.300	1.305	1.126	1.121	1.126	1.300	0.0055	0.0209
123	1.364	1.366	1.191	1.185	1.187	1.360	0.0051	0.0205
	1.363	1.368	1.189	1.183	1.188	1.362	0.0054	0.0210
124	1.426	1.428	1.253	1.248	1.250	1.423	0.0052	0.0206
	1.425	1.430	1.251	1.246	1.251	1.425	0.0055	0.0210
125	1.489	1.491	1.316	1.310	1.312	1.485	0.0052	0.0206
	1.488	1.493	1.314	1.308	1.313	1.487	0.0055	0.0210
126	1.551	1.553	1.378	1.373	1.375	1.548	0.0053	0.0207
	1.550	1.555	1.376	1.371	1.376	1.550	0.0056	0.0210
127	1.614	1.616	1.441	1.435	1.437	1.610	0.0053	0.0206
	1.613	1.618	1.439	1.433	1.439	1.612	0.0051	0.0215
128	1.676	1.678	1.503	1.498	1.500	1.673	0.0054	0.0207
	1.675	1.680	1.501	1.496	1.502	1.675	0.0052	0.0215
129	1.739	1.741	1.566	1.560	1.562	1.735	0.0053	0.0208
	1.738	1.743	1.564	1.558	1.564	1.737	0.0051	0.0215
130	1.802	1.805	1.631	1.623	1.625	1.798	0.0053	0.0217
	1.801	1.807	1.629	1.621	1.627	1.800	0.0051	0.0215
131	1.864	1.867	1.693	1.685	1.687	1.860	0.0053	0.0217
	1.863	1.869	1.691	1.683	1.689	1.862	0.0052	0.0215
132	1.927	1.930	1.756	1.748	1.750	1.923	0.0054	0.0217
	1.926	1.932	1.754	1.746	1.752	1.925	0.0052	0.0215
133	1.989	1.992	1.818	1.810	1.813	1.984	0.0054	0.0217
	1.988	1.994	1.816	1.808	1.815	1.986	0.0052	0.0225
134	2.052	2.055	1.881	1.873	1.876	2.047	0.0055	0.0218
	2.051	2.057	1.879	1.871	1.878	2.049	0.0053	0.0225
135	2.115	2.118	1.944	1.936	1.939	2.110	0.0054	0.0219
	2.114	2.120	1.942	1.934	1.941	2.112	0.0052	0.0225

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
136	2.177	2.180	2.006	1.998	2.001	2.172	0.0055	0.0219
	2.176	2.182	2.004	1.996	2.003	2.174	0.0053	0.0225
137	2.240	2.243	2.069	2.061	2.064	2.235	0.0055	0.0219
	2.239	2.245	2.067	2.059	2.066	2.237	0.0053	0.0225
138	2.302	2.305	2.131	2.123	2.126	2.297	0.0055	0.0219
	2.301	2.307	2.129	2.121	2.128	2.299	0.0053	0.0225
139	2.365	2.368	2.194	2.186	2.189	2.360	0.0056	0.0219
	2.364	2.370	2.192	2.184	2.191	2.362	0.0054	0.0225
140	2.427	2.430	2.256	2.248	2.251	2.422	0.0056	0.0219
	2.426	2.432	2.254	2.246	2.253	2.424	0.0054	0.0225
141	2.490	2.493	2.319	2.311	2.314	2.485	0.0050	0.0225
	2.488	2.495	2.317	2.309	2.316	2.487	0.0053	0.0225
142	2.552	2.555	2.381	2.373	2.376	2.547	0.0051	0.0225
	2.550	2.557	2.379	2.371	2.378	2.549	0.0053	0.0225
143	2.615	2.618	2.444	2.436	2.439	2.610	0.0051	0.0225
	2.613	2.620	2.442	2.434	2.441	2.612	0.0054	0.0225
144	2.677	2.680	2.506	2.498	2.501	2.672	0.0051	0.0225
	2.675	2.682	2.504	2.496	2.503	2.674	0.0054	0.0225
145	2.740	2.743	2.569	2.561	2.564	2.735	0.0052	0.0225
	2.738	2.745	2.567	2.559	2.566	2.737	0.0054	0.0225
146	2.802	2.805	2.631	2.623	2.626	2.797	0.0052	0.0225
	2.800	2.807	2.629	2.621	2.628	2.799	0.0054	0.0225
147	2.865	2.868	2.694	2.686	2.689	2.860	0.0051	0.0225
	2.863	2.870	2.692	2.684	2.691	2.862	0.0054	0.0225
148	2.927	2.930	2.756	2.748	2.751	2.922	0.0052	0.0225
	2.925	2.932	2.754	2.746	2.753	2.924	0.0054	0.0225
149	2.990	2.993	2.819	2.811	2.814	2.985	0.0052	0.0225
	2.988	2.995	2.817	2.809	2.816	2.987	0.0054	0.0225
210	0.989	0.991	0.750	0.748	0.750	0.989	0.0052	0.0244
	0.988	0.993	0.748	0.746	0.751	0.991	0.0054	0.0247
211	1.051	1.053	0.812	0.810	0.812	1.051	0.0054	0.0244
	1.050	1.055	0.810	0.808	0.813	1.053	0.0055	0.0248
212	1.114	1.116	0.874	0.873	0.875	1.115	0.0051	0.0242
	1.113	1.118	0.872	0.871	0.876	1.117	0.0052	0.0243
213	1.176	1.178	0.936	0.935	0.937	1.177	0.0052	0.0242
	1.175	1.180	0.934	0.933	0.938	1.179	0.0053	0.0244
214	1.239	1.241	0.999	0.998	1.000	1.240	0.0054	0.0243
	1.238	1.243	0.997	0.996	1.001	1.242	0.0054	0.0244
215	1.301	1.303	1.061	1.060	1.062	1.302	0.0055	0.0243
	1.300	1.305	1.059	1.058	1.063	1.304	0.0056	0.0244

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
216	1.364	1.366	1.124	1.123	1.125	1.365	0.0054	0.0246
	1.363	1.368	1.122	1.121	1.126	1.367	0.0055	0.0247
217	1.426	1.428	1.186	1.185	1.187	1.427	0.0055	0.0246
	1.425	1.430	1.184	1.183	1.188	1.429	0.0056	0.0247
218	1.489	1.491	1.249	1.248	1.250	1.490	0.0056	0.0246
	1.488	1.493	1.247	1.246	1.251	1.492	0.0057	0.0247
219	1.551	1.553	1.311	1.310	1.312	1.552	0.0057	0.0246
	1.550	1.555	1.309	1.308	1.313	1.554	0.0058	0.0248
220	1.614	1.616	1.374	1.373	1.375	1.615	0.0058	0.0247
	1.613	1.618	1.372	1.371	1.376	1.617	0.0059	0.0248
221	1.676	1.678	1.436	1.435	1.437	1.677	0.0059	0.0247
	1.675	1.680	1.434	1.433	1.438	1.679	0.0059	0.0248
222	1.739	1.741	1.499	1.498	1.500	1.740	0.0057	0.0250
	1.738	1.743	1.497	1.496	1.501	1.742	0.0058	0.0250
223	1.864	1.867	1.625	1.623	1.625	1.865	0.0053	0.0254
	1.863	1.869	1.623	1.621	1.627	1.867	0.0054	0.0255
224	1.989	1.992	1.750	1.748	1.750	1.990	0.0055	0.0254
	1.988	1.994	1.748	1.746	1.752	1.992	0.0056	0.0255
225	2.115	2.118	1.876	1.873	1.876	2.115	0.0054	0.0255
	2.114	2.120	1.874	1.871	1.878	2.117	0.0050	0.0260
226	2.240	2.243	2.001	1.998	2.001	2.240	0.0055	0.0255
	2.239	2.245	1.999	1.996	2.003	2.242	0.0051	0.0260
227	2.365	2.368	2.126	2.123	2.126	2.365	0.0056	0.0255
	2.364	2.370	2.124	2.121	2.128	2.367	0.0052	0.0260
228	2.490	2.493	2.251	2.248	2.251	2.490	0.0051	0.0260
	2.488	2.495	2.249	2.246	2.253	2.492	0.0052	0.0260
229	2.615	2.618	2.376	2.373	2.376	2.615	0.0051	0.0260
	2.613	2.620	2.374	2.371	2.378	2.617	0.0053	0.0260
230	2.740	2.743	2.501	2.498	2.501	2.740	0.0052	0.0260
	2.738	2.745	2.499	2.496	2.503	2.742	0.0054	0.0260
231	2.865	2.868	2.626	2.623	2.626	2.865	0.0053	0.0260
	2.863	2.870	2.624	2.621	2.628	2.867	0.0054	0.0260
232	2.990	2.993	2.751	2.748	2.751	2.990	0.0052	0.0260
	2.988	2.995	2.749	2.746	2.753	2.992	0.0053	0.0260
233	3.115	3.118	2.876	2.873	2.876	3.115	0.0053	0.0260
	3.113	3.120	2.874	2.871	2.878	3.117	0.0054	0.0260
234	3.240	3.243	3.001	2.997	3.000	3.239	0.0053	0.0260
	3.238	3.245	2.999	2.995	3.002	3.241	0.0055	0.0260
235	3.365	3.368	3.126	3.122	3.125	3.364	0.0054	0.0260
	3.363	3.370	3.124	3.120	3.127	3.366	0.0055	0.0260

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
236	3.490	3.493	3.251	3.247	3.250	3.489	0.0054	0.0260
	3.488	3.495	3.249	3.245	3.252	3.491	0.0056	0.0260
237	3.615	3.618	3.376	3.372	3.375	3.614	0.0055	0.0260
	3.613	3.620	3.374	3.370	3.377	3.616	0.0056	0.0260
238	3.740	3.743	3.501	3.497	3.500	3.739	0.0055	0.0260
	3.738	3.745	3.499	3.495	3.502	3.741	0.0057	0.0260
239	3.865	3.868	3.626	3.622	3.625	3.864	0.0055	0.0260
	3.863	3.870	3.624	3.620	3.627	3.866	0.0056	0.0260
240	3.990	3.993	3.751	3.747	3.750	3.989	0.0055	0.0260
	3.988	3.995	3.749	3.745	3.752	3.991	0.0056	0.0260
241	4.115	4.118	3.876	3.872	3.875	4.114	0.0056	0.0260
	4.113	4.120	3.874	3.870	3.877	4.116	0.0057	0.0260
242	4.240	4.243	4.001	3.997	4.000	4.239	0.0056	0.0260
	4.238	4.245	3.999	3.995	4.002	4.241	0.0057	0.0260
243	4.365	4.368	4.126	4.122	4.125	4.364	0.0056	0.0260
	4.363	4.370	4.124	4.120	4.127	4.366	0.0057	0.0260
244	4.489	4.493	4.251	4.247	4.250	4.489	0.0051	0.0265
	4.487	4.495	4.249	4.245	4.252	4.491	0.0057	0.0260
245	4.614	4.618	4.376	4.372	4.375	4.614	0.0051	0.0265
	4.612	4.620	4.374	4.370	4.377	4.616	0.0058	0.0260
246	4.739	4.743	4.501	4.497	4.501	4.739	0.0052	0.0265
	4.737	4.745	4.499	4.495	4.503	4.741	0.0053	0.0265
247	4.864	4.868	4.626	4.622	4.626	4.864	0.0052	0.0265
	4.862	4.870	4.624	4.620	4.628	4.866	0.0053	0.0265
325	1.864	1.867	1.495	1.498	1.500	1.870	0.0081	0.0322
	1.863	1.869	1.493	1.496	1.502	1.872	0.0079	0.0318
326	1.989	1.992	1.620	1.623	1.625	1.995	0.0083	0.0323
	1.988	1.994	1.618	1.621	1.627	1.997	0.0081	0.0319
327	2.115	2.118	1.746	1.748	1.750	2.120	0.0085	0.0322
	2.114	2.120	1.744	1.746	1.752	2.122	0.0083	0.0320
328	2.240	2.243	1.871	1.873	1.876	2.245	0.0087	0.0323
	2.239	2.245	1.869	1.871	1.878	2.247	0.0080	0.0325
329	2.365	2.368	1.996	1.998	2.001	2.370	0.0086	0.0326
	2.364	2.370	1.994	1.996	2.003	2.372	0.0080	0.0329
330	2.490	2.493	2.121	2.123	2.126	2.495	0.0083	0.0332
	2.488	2.495	2.119	2.121	2.128	2.497	0.0081	0.0330
331	2.615	2.618	2.246	2.248	2.251	2.620	0.0084	0.0332
	2.613	2.620	2.244	2.246	2.253	2.622	0.0083	0.0330
332	2.740	2.743	2.371	2.373	2.376	2.745	0.0085	0.0332
	2.738	2.745	2.369	2.371	2.378	2.747	0.0084	0.0330

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
333	2.865	2.868	2.496	2.498	2.501	2.870	0.0085	0.0334
	2.863	2.870	2.494	2.496	2.503	2.872	0.0084	0.0332
334	2.990	2.993	2.621	2.623	2.626	2.995	0.0087	0.0334
	2.988	2.995	2.619	2.621	2.628	2.997	0.0085	0.0332
335	3.115	3.118	2.746	2.748	2.751	3.120	0.0088	0.0334
	3.113	3.120	2.744	2.746	2.753	3.122	0.0087	0.0332
336	3.240	3.243	2.871	2.873	2.876	3.245	0.0089	0.0334
	3.238	3.245	2.869	2.871	2.878	3.247	0.0088	0.0332
337	3.365	3.368	2.996	2.997	3.000	3.369	0.0087	0.0335
	3.363	3.370	2.994	2.995	3.002	3.371	0.0087	0.0335
338	3.490	3.493	3.121	3.122	3.125	3.494	0.0088	0.0335
	3.488	3.495	3.119	3.120	3.127	3.496	0.0088	0.0335
339	3.615	3.618	3.246	3.247	3.250	3.619	0.0089	0.0335
	3.613	3.620	3.244	3.245	3.252	3.621	0.0089	0.0335
340	3.740	3.743	3.371	3.372	3.375	3.744	0.0090	0.0335
	3.738	3.745	3.369	3.370	3.377	3.746	0.0090	0.0335
341	3.865	3.868	3.496	3.497	3.500	3.869	0.0091	0.0335
	3.863	3.870	3.494	3.495	3.502	3.871	0.0090	0.0335
342	3.990	3.993	3.621	3.622	3.625	3.994	0.0090	0.0335
	3.988	3.995	3.619	3.620	3.627	3.996	0.0089	0.0335
343	4.115	4.118	3.746	3.747	3.750	4.119	0.0090	0.0335
	4.113	4.120	3.744	3.745	3.752	4.121	0.0090	0.0335
344	4.240	4.243	3.871	3.872	3.875	4.244	0.0091	0.0335
	4.238	4.245	3.869	3.870	3.877	4.246	0.0091	0.0335
345	4.365	4.368	3.996	3.997	4.000	4.369	0.0092	0.0335
	4.363	4.370	3.994	3.995	4.002	4.371	0.0091	0.0335
346	4.489	4.493	4.121	4.122	4.125	4.494	0.0087	0.0340
	4.487	4.495	4.119	4.120	4.127	4.496	0.0092	0.0335
347	4.614	4.618	4.246	4.247	4.250	4.619	0.0087	0.0340
	4.612	4.620	4.244	4.245	4.252	4.621	0.0092	0.0335
348	4.739	4.743	4.371	4.372	4.375	4.744	0.0088	0.0340
	4.737	4.745	4.369	4.370	4.377	4.746	0.0092	0.0335
349	4.864	4.868	4.496	4.497	4.500	4.869	0.0088	0.0340
	4.862	4.870	4.494	4.495	4.502	4.871	0.0093	0.0335
425	4.970	4.974	4.497	4.497	4.501	4.974	0.0175	0.0480
	4.968	4.977	4.494	4.494	4.503	4.977	0.0175	0.0480
426	5.095	5.099	4.622	4.622	4.626	5.099	0.0176	0.0480
	5.093	5.102	4.619	4.619	4.628	5.102	0.0176	0.0480
427	5.220	5.224	4.747	4.747	4.751	5.224	0.0176	0.0480
	5.218	5.227	4.744	4.744	4.753	5.227	0.0176	0.0480
428	5.345	5.349	4.872	4.872	4.876	5.349	0.0177	0.0480
	5.343	5.352	4.869	4.869	4.878	5.352	0.0177	0.0480

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
429	5.470	5.474	4.997	4.997	5.001	5.474	0.0176	0.0480
	5.468	5.477	4.994	4.994	5.003	5.477	0.0176	0.0480
430	5.595	5.599	5.122	5.122	5.126	5.599	0.0176	0.0480
	5.593	5.602	5.119	5.119	5.128	5.602	0.0176	0.0480
431	5.720	5.724	5.247	5.247	5.251	5.724	0.0177	0.0480
	5.718	5.727	5.244	5.244	5.253	5.727	0.0177	0.0480
432	5.845	5.849	5.372	5.372	5.376	5.849	0.0178	0.0480
	5.843	5.852	5.369	5.369	5.378	5.852	0.0178	0.0480
433	5.970	5.974	5.497	5.497	5.501	5.974	0.0178	0.0480
	5.968	5.977	5.494	5.494	5.503	5.977	0.0178	0.0480
434	6.095	6.099	5.622	5.622	5.626	6.099	0.0179	0.0480
	6.093	6.102	5.619	5.619	5.628	6.102	0.0179	0.0480
435	6.220	6.224	5.747	5.747	5.751	6.224	0.0179	0.0480
	6.218	6.227	5.744	5.744	5.753	6.227	0.0179	0.0480
436	6.345	6.349	5.872	5.872	5.876	6.349	0.0180	0.0480
	6.343	6.352	5.869	5.869	5.878	6.352	0.0180	0.0480
437	6.470	6.474	5.997	5.997	6.001	6.474	0.0180	0.0480
	6.468	6.477	5.994	5.994	6.003	6.477	0.0180	0.0480
438	6.720	6.724	6.247	6.247	6.251	6.724	0.0180	0.0480
	6.718	6.727	6.244	6.244	6.253	6.727	0.0180	0.0480
439	6.970	6.974	6.497	6.497	6.501	6.974	0.0181	0.0480
	6.968	6.977	6.494	6.494	6.504	6.977	0.0176	0.0485
440	7.220	7.224	6.747	6.747	6.751	7.224	0.0182	0.0480
	7.218	7.227	6.744	6.744	6.754	7.227	0.0177	0.0485
441	7.470	7.474	6.997	6.997	7.001	7.474	0.0182	0.0480
	7.468	7.477	6.994	6.994	7.004	7.477	0.0177	0.0485
442	7.720	7.724	7.247	7.247	7.251	7.724	0.0181	0.0480
	7.718	7.727	7.244	7.244	7.254	7.727	0.0176	0.0485
443	7.970	7.974	7.497	7.497	7.501	7.974	0.0182	0.0480
	7.968	7.977	7.494	7.494	7.504	7.977	0.0177	0.0485
444	8.220	8.224	7.747	7.747	7.751	8.224	0.0183	0.0480
	8.218	8.227	7.744	7.744	7.754	8.227	0.0178	0.0485
445	8.470	8.474	7.997	7.997	8.001	8.474	0.0183	0.0480
	8.468	8.477	7.994	7.994	8.004	8.477	0.0178	0.0485
446	8.970	8.974	8.497	8.497	8.501	8.974	0.0177	0.0485
	8.967	8.977	8.494	8.494	8.504	8.977	0.0177	0.0485
447	9.470	9.474	8.997	8.997	9.001	9.474	0.0168	0.0485
	9.467	9.478	8.994	8.994	9.004	9.478	0.0173	0.0485
448	9.970	9.974	9.497	9.497	9.501	9.974	0.0169	0.0485
	9.967	9.978	9.494	9.494	9.504	9.978	0.0174	0.0485
449	10.470	10.474	9.997	9.997	10.001	10.474	0.0170	0.0485
	10.467	10.478	9.994	9.994	10.004	10.478	0.0175	0.0485

Table 1A - Standard gland dimensions and O-ring squeeze in inches (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
450	10.970	10.974	10.497	10.497	10.501	10.974	0.0170	0.0485
	10.967	10.978	10.494	10.494	10.504	10.978	0.0175	0.0485
451	11.470	11.474	10.997	10.997	11.001	11.474	0.0171	0.0485
	11.467	11.478	10.994	10.994	11.004	11.478	0.0176	0.0485
452	11.970	11.974	11.497	11.497	11.501	11.974	0.0171	0.0485
	11.967	11.978	11.494	11.494	11.504	11.978	0.0176	0.0485
453	12.470	12.474	11.997	11.997	12.001	12.474	0.0172	0.0485
	12.467	12.478	11.994	11.994	12.004	12.478	0.0177	0.0485
454	12.970	12.974	12.497	12.497	12.501	12.974	0.0173	0.0485
	12.967	12.978	12.494	12.494	12.504	12.978	0.0178	0.0485
455	13.470	13.474	12.997	12.997	13.001	13.474	0.0173	0.0485
	13.467	13.478	12.994	12.994	13.004	13.478	0.0178	0.0485
456	13.970	13.974	13.497	13.497	13.501	13.974	0.0172	0.0485
	13.967	13.978	13.494	13.494	13.504	13.978	0.0177	0.0485
457	14.470	14.474	13.997	13.997	14.001	14.474	0.0173	0.0485
	14.467	14.478	13.994	13.994	14.004	14.478	0.0178	0.0485
458	14.970	14.974	14.497	14.497	14.501	14.974	0.0173	0.0485
	14.967	14.978	14.494	14.494	14.504	14.978	0.0178	0.0485
459	15.470	15.474	14.997	14.997	15.001	15.474	0.0174	0.0485
	15.467	15.478	14.994	14.994	15.004	15.478	0.0179	0.0485
460	15.970	15.974	15.497	15.497	15.501	15.974	0.0174	0.0485
	15.967	15.978	15.494	15.494	15.504	15.978	0.0179	0.0485

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
001	2.36	2.41	0.84	0.84	0.89	2.41	0	0.37
	2.34	2.44	0.81	0.81	0.91	2.44	0	0.37
002	3.20	3.25	1.22	1.22	1.27	3.25	0	0.37
	3.18	3.28	1.19	1.19	1.30	3.28	0	0.37
003	3.99	4.04	1.60	1.60	1.65	4.04	0.04	0.42
	3.96	4.06	1.58	1.58	1.68	4.06	0.04	0.42
004	4.78	4.83	1.93	1.93	1.98	4.83	0.07	0.46
	4.75	4.85	1.91	1.91	2.01	4.85	0.07	0.46
005	5.56	5.61	2.92	2.74	2.79	5.51	0.13	0.51
	5.54	5.64	2.90	2.72	2.82	5.54	0.14	0.52
006	5.92	5.97	3.28	3.12	3.18	5.89	0.13	0.51
	5.89	5.99	3.25	3.10	3.20	5.92	0.13	0.51
007	6.71	6.76	4.01	3.91	3.96	6.71	0.13	0.50
	6.68	6.78	3.99	3.89	3.99	6.73	0.13	0.50
008	7.49	7.54	4.80	4.70	4.75	7.47	0.15	0.51
	7.47	7.57	4.78	4.67	4.78	7.49	0.15	0.51
009	8.31	8.36	5.59	5.51	5.56	8.31	0.13	0.49
	8.28	8.38	5.56	5.49	5.59	8.33	0.13	0.49
010	9.09	9.14	6.35	6.30	6.35	9.12	0.13	0.48
	9.07	9.17	6.33	6.27	6.38	9.14	0.13	0.48
011	10.67	10.72	7.93	7.87	7.93	10.69	0.15	0.49
	10.64	10.74	7.90	7.85	7.95	10.72	0.14	0.49
012	12.27	12.32	9.53	9.47	9.53	12.29	0.15	0.49
	12.24	12.34	9.50	9.45	9.55	12.32	0.15	0.49
013	13.92	13.97	11.20	11.05	11.10	13.84	0.13	0.50
	13.89	14.02	11.15	11.00	11.13	13.89	0.13	0.50
014	15.52	15.57	12.80	12.65	12.70	15.44	0.13	0.50
	15.49	15.62	12.75	12.60	12.73	15.49	0.13	0.51
015	17.09	17.15	14.38	14.22	14.28	17.02	0.13	0.51
	17.07	17.20	14.33	14.17	14.30	17.07	0.13	0.51
016	18.69	18.75	15.98	15.82	15.88	18.62	0.13	0.52
	18.67	18.80	15.93	15.77	15.90	18.67	0.13	0.52
017	20.27	20.32	17.55	17.40	17.45	20.19	0.14	0.52
	20.24	20.37	17.50	17.35	17.48	20.24	0.13	0.52
018	21.87	21.92	19.13	19.00	19.05	21.79	0.13	0.51
	21.84	21.97	19.08	18.95	19.08	21.84	0.14	0.52
019	23.44	23.50	20.70	20.57	20.63	23.37	0.13	0.51
	23.42	23.55	20.65	20.52	20.65	23.42	0.14	0.52
020	25.12	25.17	22.38	22.17	22.23	24.97	0.13	0.50
	25.10	25.22	22.33	22.12	22.25	25.02	0.14	0.52

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
021	26.70	26.75	23.95	23.75	23.80	26.54	0.13	0.51
	26.67	26.80	23.90	23.70	23.83	26.59	0.14	0.52
022	28.30	28.35	25.55	25.35	25.40	28.14	0.13	0.51
	28.27	28.40	25.50	25.30	25.43	28.19	0.14	0.52
023	29.87	29.92	27.13	26.92	26.98	29.72	0.13	0.51
	29.85	29.97	27.08	26.87	27.00	29.77	0.14	0.52
024	31.47	31.52	28.73	28.52	28.58	31.32	0.13	0.51
	31.45	31.57	28.68	28.47	28.60	31.37	0.14	0.52
025	33.05	33.10	30.30	30.10	30.15	32.89	0.13	0.51
	33.02	33.15	30.25	30.05	30.18	32.94	0.14	0.52
026	34.65	34.70	31.90	31.70	31.75	34.49	0.14	0.51
	34.62	34.75	31.85	31.65	31.78	34.54	0.14	0.52
027	36.22	36.27	33.48	33.27	33.33	36.07	0.14	0.51
	36.20	36.32	33.43	33.22	33.35	36.12	0.14	0.52
028	37.82	37.87	35.08	34.87	34.93	37.67	0.14	0.52
	37.80	37.92	35.03	34.82	34.95	37.72	0.14	0.52
104	7.49	7.54	3.25	3.12	3.18	7.49	0.13	0.52
	7.47	7.57	3.23	3.10	3.20	7.52	0.13	0.52
105	8.31	8.36	4.01	3.91	3.96	8.31	0.13	0.51
	8.28	8.38	3.99	3.89	3.99	8.33	0.13	0.52
106	9.09	9.14	4.75	4.70	4.75	9.12	0.13	0.51
	9.07	9.17	4.72	4.67	4.78	9.14	0.13	0.51
107	9.88	9.93	5.46	5.51	5.56	9.96	0.13	0.50
	9.86	9.96	5.44	5.49	5.59	9.98	0.13	0.50
108	10.67	10.72	6.25	6.30	6.35	10.74	0.13	0.50
	10.64	10.74	6.22	6.27	6.38	10.77	0.14	0.50
109	12.27	12.32	7.82	7.87	7.93	12.34	0.13	0.49
	12.24	12.34	7.80	7.85	7.95	12.37	0.14	0.49
110	13.92	13.97	9.63	9.47	9.53	13.87	0.14	0.52
	13.89	14.02	9.58	9.42	9.55	13.92	0.13	0.52
111	15.52	15.57	11.20	11.05	11.10	15.47	0.13	0.51
	15.49	15.62	11.15	11.00	11.13	15.52	0.13	0.51
112	17.09	17.15	12.75	12.65	12.70	17.07	0.14	0.51
	17.07	17.20	12.70	12.60	12.73	17.12	0.14	0.52
113	18.69	18.75	14.35	14.22	14.28	18.64	0.13	0.52
	18.67	18.80	14.30	14.17	14.30	18.69	0.13	0.53
114	20.27	20.32	15.93	15.82	15.88	20.24	0.14	0.53
	20.24	20.37	15.88	15.77	15.90	20.30	0.13	0.54
115	21.87	21.92	17.50	17.40	17.45	21.82	0.13	0.52
	21.84	21.97	17.45	17.35	17.48	21.87	0.14	0.54

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
116	23.44	23.50	19.08	19.00	19.05	23.44	0.14	0.53
	23.42	23.55	19.03	18.95	19.08	23.50	0.13	0.53
117	25.12	25.17	20.75	20.57	20.63	25.02	0.13	0.52
	25.10	25.22	20.70	20.52	20.65	25.07	0.13	0.53
118	26.70	26.75	22.33	22.17	22.23	26.62	0.13	0.53
	26.67	26.80	22.28	22.12	22.25	26.67	0.13	0.53
119	28.30	28.35	23.93	23.75	23.80	28.19	0.14	0.52
	28.27	28.40	23.88	23.70	23.83	28.25	0.13	0.53
120	29.87	29.92	25.48	25.35	25.40	29.79	0.13	0.52
	29.85	29.97	25.43	25.30	25.43	29.85	0.14	0.53
121	31.47	31.52	27.08	26.92	26.98	31.37	0.13	0.52
	31.45	31.57	27.03	26.87	27.00	31.42	0.14	0.53
122	33.05	33.10	28.65	28.52	28.58	32.97	0.13	0.52
	33.02	33.15	28.60	28.47	28.60	33.02	0.14	0.53
123	34.65	34.70	30.25	30.10	30.15	34.54	0.13	0.52
	34.62	34.75	30.20	30.05	30.18	34.60	0.14	0.53
124	36.22	36.27	31.83	31.70	31.75	36.14	0.13	0.52
	36.20	36.32	31.78	31.65	31.78	36.20	0.14	0.53
125	37.82	37.87	33.43	33.27	33.33	37.72	0.13	0.52
	37.80	37.92	33.38	33.22	33.35	37.77	0.14	0.53
126	39.40	39.45	35.00	34.87	34.93	39.32	0.14	0.53
	39.37	39.50	34.95	34.82	34.95	39.37	0.14	0.53
127	41.00	41.05	36.60	36.45	36.50	40.89	0.14	0.52
	40.97	41.10	36.55	36.40	36.55	40.95	0.13	0.55
128	42.57	42.62	38.18	38.05	38.10	42.49	0.14	0.53
	42.55	42.67	38.13	38.00	38.15	42.55	0.13	0.55
129	44.17	44.22	39.78	39.62	39.68	44.07	0.14	0.53
	44.15	44.27	39.73	39.57	39.73	44.12	0.13	0.55
130	45.77	45.85	41.43	41.22	41.28	45.67	0.14	0.55
	45.75	45.90	41.38	41.17	41.33	45.72	0.13	0.55
131	47.35	47.42	43.00	42.80	42.85	47.24	0.14	0.55
	47.32	47.47	42.95	42.75	42.90	47.30	0.13	0.55
132	48.95	49.02	44.60	44.40	44.45	48.84	0.14	0.55
	48.92	49.07	44.55	44.35	44.50	48.90	0.13	0.55
133	50.52	50.60	46.18	45.97	46.05	50.39	0.14	0.55
	50.50	50.65	46.13	45.92	46.10	50.44	0.13	0.57
134	52.12	52.20	47.78	47.57	47.65	51.99	0.14	0.55
	52.10	52.25	47.73	47.52	47.70	52.05	0.14	0.57
135	53.72	53.80	49.38	49.17	49.25	53.59	0.14	0.56
	53.70	53.85	49.33	49.12	49.30	53.65	0.13	0.57

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
136	55.30	55.37	50.95	50.75	50.83	55.17	0.14	0.56
	55.27	55.42	50.90	50.70	50.88	55.22	0.14	0.57
137	56.90	56.97	52.55	52.35	52.43	56.77	0.14	0.56
	56.87	57.02	52.50	52.30	52.48	56.82	0.14	0.57
138	58.47	58.55	54.13	53.92	54.00	58.34	0.14	0.56
	58.45	58.60	54.08	53.87	54.05	58.40	0.14	0.57
139	60.07	60.15	55.73	55.52	55.60	59.94	0.14	0.56
	60.05	60.20	55.68	55.47	55.65	60.00	0.14	0.57
140	61.65	61.72	57.30	57.10	57.18	61.52	0.14	0.56
	61.62	61.77	57.25	57.05	57.23	61.57	0.14	0.57
141	63.25	63.32	58.90	58.70	58.78	63.12	0.13	0.57
	63.20	63.37	58.85	58.65	58.83	63.17	0.14	0.57
142	64.82	64.90	60.48	60.27	60.35	64.69	0.13	0.57
	64.77	64.95	60.43	60.22	60.40	64.75	0.14	0.57
143	66.42	66.50	62.08	61.87	61.95	66.29	0.13	0.57
	66.37	66.55	62.03	61.82	62.00	66.35	0.14	0.57
144	68.00	68.07	63.65	63.45	63.53	67.87	0.13	0.57
	67.95	68.12	63.60	63.40	63.58	67.92	0.14	0.57
145	69.60	69.67	65.25	65.05	65.13	69.47	0.13	0.57
	69.55	69.72	65.20	65.00	65.18	69.52	0.14	0.57
146	71.17	71.25	66.83	66.62	66.70	71.04	0.13	0.57
	71.12	71.30	66.78	66.57	66.75	71.10	0.14	0.57
147	72.77	72.85	68.43	68.22	68.30	72.64	0.13	0.57
	72.72	72.90	68.38	68.17	68.35	72.70	0.14	0.57
148	74.35	74.42	70.00	69.80	69.88	74.22	0.13	0.57
	74.30	74.47	69.95	69.75	69.93	74.27	0.14	0.57
149	75.95	76.02	71.60	71.40	71.48	75.82	0.13	0.57
	75.90	76.07	71.55	71.35	71.53	75.87	0.14	0.57
210	25.12	25.17	19.05	19.00	19.05	25.12	0.13	0.62
	25.10	25.22	19.00	18.95	19.08	25.17	0.14	0.63
211	26.70	26.75	20.63	20.57	20.63	26.70	0.14	0.62
	26.67	26.80	20.57	20.52	20.65	26.75	0.14	0.63
212	28.30	28.35	22.20	22.17	22.23	28.32	0.13	0.62
	28.27	28.40	22.15	22.12	22.25	28.37	0.13	0.62
213	29.87	29.92	23.77	23.75	23.80	29.90	0.13	0.62
	29.85	29.97	23.72	23.70	23.83	29.95	0.14	0.62
214	31.47	31.52	25.38	25.35	25.40	31.50	0.14	0.62
	31.45	31.57	25.32	25.30	25.43	31.55	0.14	0.62
215	33.05	33.10	26.95	26.92	26.98	33.07	0.14	0.62
	33.02	33.15	26.90	26.87	27.00	33.12	0.14	0.62

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
216	34.65	34.70	28.55	28.52	28.58	34.67	0.14	0.63
	34.62	34.75	28.50	28.47	28.60	34.72	0.14	0.63
217	36.22	36.27	30.12	30.10	30.15	36.25	0.14	0.63
	36.20	36.32	30.07	30.05	30.18	36.30	0.14	0.63
218	37.82	37.87	31.73	31.70	31.75	37.85	0.14	0.63
	37.80	37.92	31.67	31.65	31.78	37.90	0.15	0.63
219	39.40	39.45	33.30	33.27	33.33	39.42	0.15	0.63
	39.37	39.50	33.25	33.22	33.35	39.47	0.15	0.63
220	41.00	41.05	34.90	34.87	34.93	41.02	0.15	0.63
	40.97	41.10	34.85	34.82	34.95	41.07	0.15	0.63
221	42.57	42.62	36.47	36.45	36.50	42.60	0.15	0.63
	42.55	42.67	36.42	36.40	36.53	42.65	0.15	0.63
222	44.17	44.22	38.08	38.05	38.10	44.20	0.15	0.64
	44.15	44.27	38.02	38.00	38.13	44.25	0.15	0.64
223	47.35	47.42	41.28	41.22	41.28	47.37	0.14	0.65
	47.32	47.47	41.22	41.17	41.33	47.42	0.14	0.65
224	50.52	50.60	44.45	44.40	44.45	50.55	0.14	0.65
	50.50	50.65	44.40	44.35	44.50	50.60	0.14	0.65
225	53.72	53.80	47.65	47.57	47.65	53.72	0.14	0.65
	53.70	53.85	47.60	47.52	47.70	53.77	0.13	0.66
226	56.90	56.97	50.83	50.75	50.83	56.90	0.14	0.65
	56.87	57.02	50.78	50.70	50.88	56.95	0.13	0.66
227	60.07	60.15	54.00	53.92	54.00	60.07	0.14	0.65
	60.05	60.20	53.95	53.87	54.05	60.12	0.13	0.66
228	63.25	63.32	57.18	57.10	57.18	63.25	0.13	0.66
	63.20	63.37	57.13	57.05	57.23	63.30	0.13	0.66
229	66.42	66.50	60.35	60.27	60.35	66.42	0.13	0.66
	66.37	66.55	60.30	60.22	60.40	66.47	0.14	0.66
230	69.60	69.67	63.53	63.45	63.53	69.60	0.13	0.66
	69.55	69.72	63.48	63.40	63.58	69.65	0.14	0.66
231	72.77	72.85	66.70	66.62	66.70	72.77	0.14	0.66
	72.72	72.90	66.65	66.57	66.75	72.82	0.14	0.66
232	75.95	76.02	69.88	69.80	69.88	75.95	0.13	0.66
	75.90	76.07	69.83	69.75	69.93	76.00	0.14	0.66
233	79.12	79.20	73.05	72.97	73.05	79.12	0.14	0.66
	79.07	79.25	73.00	72.92	73.10	79.17	0.14	0.66
234	82.30	82.37	76.23	76.12	76.20	82.27	0.14	0.66
	82.25	82.42	76.18	76.07	76.25	82.32	0.14	0.66
235	85.47	85.55	79.40	79.30	79.38	85.45	0.14	0.66
	85.42	85.60	79.35	79.25	79.43	85.50	0.14	0.66

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
236	88.65	88.72	82.58	82.47	82.55	88.62	0.14	0.66
	88.60	88.77	82.53	82.42	82.60	88.67	0.14	0.66
237	91.82	91.90	85.75	85.65	85.73	91.80	0.14	0.66
	91.77	91.95	85.70	85.60	85.78	91.85	0.14	0.66
238	95.00	95.07	88.93	88.82	88.90	94.97	0.14	0.66
	94.95	95.12	88.88	88.77	88.95	95.02	0.15	0.66
239	98.17	98.25	92.10	92.00	92.08	98.15	0.14	0.66
	98.12	98.30	92.05	91.95	92.13	98.20	0.14	0.66
240	101.35	101.42	95.28	95.17	95.25	101.32	0.14	0.66
	101.30	101.47	95.23	95.12	95.30	101.37	0.14	0.66
241	104.52	104.60	98.45	98.35	98.43	104.50	0.14	0.66
	104.47	104.65	98.40	98.30	98.48	104.55	0.15	0.66
242	107.70	107.77	101.63	101.52	101.60	107.67	0.14	0.66
	107.65	107.82	101.58	101.47	101.65	107.72	0.15	0.66
243	110.87	110.95	104.80	104.70	104.78	110.85	0.14	0.66
	110.82	111.00	104.75	104.65	104.83	110.90	0.15	0.66
244	114.02	114.12	107.98	107.87	107.95	114.02	0.13	0.67
	113.97	114.17	107.93	107.82	108.00	114.07	0.15	0.66
245	117.20	117.30	111.15	111.05	111.13	117.20	0.13	0.67
	117.15	117.35	111.10	111.00	111.18	117.25	0.15	0.66
246	120.37	120.47	114.33	114.22	114.33	120.37	0.13	0.67
	120.32	120.52	114.28	114.17	114.38	120.42	0.14	0.67
247	123.55	123.65	117.50	117.40	117.50	123.55	0.13	0.67
	123.50	123.70	117.45	117.35	117.55	123.60	0.14	0.67
325	47.35	47.42	37.97	38.05	38.10	47.50	0.21	0.82
	47.32	47.47	37.92	38.00	38.15	47.55	0.20	0.81
326	50.52	50.60	41.15	41.22	41.28	50.67	0.21	0.82
	50.50	50.65	41.10	41.17	41.33	50.72	0.21	0.81
327	53.72	53.80	44.35	44.40	44.45	53.85	0.22	0.82
	53.70	53.85	44.30	44.35	44.50	53.90	0.21	0.81
328	56.90	56.97	47.52	47.57	47.65	57.02	0.22	0.82
	56.87	57.02	47.47	47.52	47.70	57.07	0.20	0.83
329	60.07	60.15	50.70	50.75	50.83	60.20	0.22	0.83
	60.05	60.20	50.65	50.70	50.88	60.25	0.20	0.84
330	63.25	63.32	53.87	53.92	54.00	63.37	0.21	0.84
	63.20	63.37	53.82	53.87	54.05	63.42	0.21	0.84
331	66.42	66.50	57.05	57.10	57.18	66.55	0.21	0.84
	66.37	66.55	57.00	57.05	57.23	66.60	0.21	0.84
332	69.60	69.67	60.22	60.27	60.35	69.72	0.22	0.84
	69.55	69.72	60.17	60.22	60.40	69.77	0.21	0.84

NOTE: For limitations applicable to the highlighted dash numbers, see 3.1.3.

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
333	72.77	72.85	63.40	63.45	63.53	72.90	0.22	0.85
	72.72	72.90	63.35	63.40	63.58	72.95	0.21	0.84
334	75.95	76.02	66.57	66.62	66.70	76.07	0.22	0.85
	75.90	76.07	66.52	66.57	66.75	76.12	0.22	0.84
335	79.12	79.20	69.75	69.80	69.88	79.25	0.22	0.85
	79.07	79.25	69.70	69.75	69.93	79.30	0.22	0.84
336	82.30	82.37	72.92	72.97	73.05	82.42	0.23	0.85
	82.25	82.42	72.87	72.92	73.10	82.47	0.22	0.84
337	85.47	85.55	76.10	76.12	76.20	85.57	0.22	0.85
	85.42	85.60	76.05	76.07	76.25	85.62	0.22	0.85
338	88.65	88.72	79.27	79.30	79.38	88.75	0.22	0.85
	88.60	88.77	79.22	79.25	79.43	88.80	0.22	0.85
339	91.82	91.90	82.45	82.47	82.55	91.92	0.23	0.85
	91.77	91.95	82.40	82.42	82.60	91.97	0.23	0.85
340	95.00	95.07	85.62	85.65	85.73	95.10	0.23	0.85
	94.95	95.12	85.57	85.60	85.78	95.15	0.23	0.85
341	98.17	98.25	88.80	88.82	88.90	98.27	0.23	0.85
	98.12	98.30	88.75	88.77	88.95	98.32	0.23	0.85
342	101.35	101.42	91.97	92.00	92.08	101.45	0.23	0.85
	101.30	101.47	91.92	91.95	92.13	101.50	0.23	0.85
343	104.52	104.60	95.15	95.17	95.25	104.62	0.23	0.85
	104.47	104.65	95.10	95.12	95.30	104.67	0.23	0.85
344	107.70	107.77	98.32	98.35	98.43	107.80	0.23	0.85
	107.65	107.82	98.27	98.30	98.48	107.85	0.23	0.85
345	110.87	110.95	101.50	101.52	101.60	110.97	0.23	0.85
	110.82	111.00	101.45	101.47	101.65	111.02	0.23	0.85
346	114.02	114.12	104.67	104.70	104.78	114.15	0.22	0.86
	113.97	114.17	104.62	104.65	104.83	114.20	0.23	0.85
347	117.20	117.30	107.85	107.87	107.95	117.32	0.22	0.86
	117.15	117.35	107.80	107.82	108.00	117.37	0.23	0.85
348	120.37	120.47	111.02	111.05	111.13	120.50	0.22	0.86
	120.32	120.52	110.97	111.00	111.18	120.55	0.23	0.85
349	123.55	123.65	114.20	114.22	114.30	123.67	0.22	0.86
	123.50	123.70	114.15	114.17	114.35	123.72	0.24	0.85
425	126.24	126.34	114.22	114.22	114.33	126.34	0.45	1.22
	126.19	126.42	114.15	114.15	114.38	126.42	0.45	1.22
426	129.41	129.52	117.40	117.40	117.50	129.52	0.45	1.22
	129.36	129.59	117.32	117.32	117.55	129.59	0.45	1.22
427	132.59	132.69	120.57	120.57	120.68	132.69	0.45	1.22
	132.54	132.77	120.50	120.50	120.73	132.77	0.45	1.22
428	135.76	135.87	123.75	123.75	123.85	135.87	0.45	1.22
	135.71	135.94	123.67	123.67	123.90	135.94	0.45	1.22

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

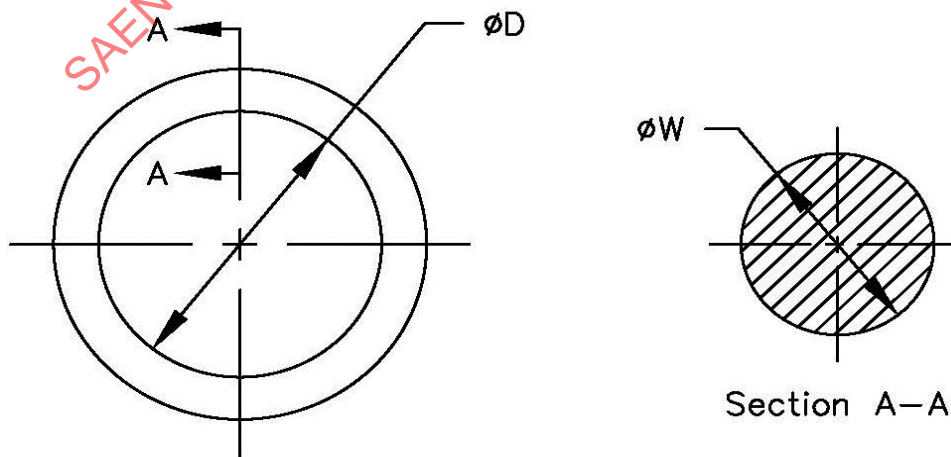
Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
429	138.94	139.04	126.92	126.92	127.03	139.04	0.45	1.22
	138.89	139.12	126.85	126.85	127.08	139.12	0.45	1.22
430	142.11	142.22	130.10	130.10	130.20	142.22	0.45	1.22
	142.06	142.29	130.02	130.02	130.25	142.29	0.45	1.22
431	145.29	145.39	133.27	133.27	133.38	145.39	0.45	1.22
	145.24	145.47	133.20	133.20	133.43	145.47	0.45	1.22
432	148.46	148.57	136.45	136.45	136.55	148.57	0.45	1.22
	148.41	148.64	136.37	136.37	136.60	148.64	0.45	1.22
433	151.64	151.74	139.62	139.62	139.73	151.74	0.45	1.22
	151.59	151.82	139.55	139.55	139.78	151.82	0.45	1.22
434	154.81	154.92	142.80	142.80	142.90	154.92	0.46	1.22
	154.76	154.99	142.72	142.72	142.95	154.99	0.46	1.22
435	157.99	158.09	145.97	145.97	146.08	158.09	0.46	1.22
	157.94	158.17	145.90	145.90	146.13	158.17	0.46	1.22
436	161.16	161.27	149.15	149.15	149.25	161.27	0.46	1.22
	161.11	161.34	149.07	149.07	149.30	161.34	0.46	1.22
437	164.34	164.44	152.32	152.32	152.43	164.44	0.46	1.22
	164.29	164.52	152.25	152.25	152.48	164.52	0.46	1.22
438	170.69	170.79	158.67	158.67	158.78	170.79	0.46	1.22
	170.64	170.87	158.60	158.60	158.83	170.87	0.46	1.22
439	177.04	177.14	165.02	165.02	165.13	177.14	0.46	1.22
	176.99	177.22	164.95	164.95	165.20	177.22	0.45	1.23
440	183.39	183.49	171.37	171.37	171.48	183.49	0.46	1.22
	183.34	183.57	171.30	171.30	171.55	183.57	0.45	1.23
441	189.74	189.84	177.72	177.72	177.83	189.84	0.46	1.22
	189.69	189.92	177.65	177.65	177.90	189.92	0.45	1.23
442	196.09	196.19	184.07	184.07	184.18	196.19	0.46	1.22
	196.04	196.27	184.00	184.00	184.25	196.27	0.45	1.23
443	202.44	202.54	190.42	190.42	190.53	202.54	0.46	1.22
	202.39	202.62	190.35	190.35	190.60	202.62	0.45	1.23
444	208.79	208.89	196.77	196.77	196.88	208.89	0.47	1.22
	208.74	208.97	196.70	196.70	196.95	208.97	0.45	1.23
445	215.14	215.24	203.12	203.12	203.23	215.24	0.47	1.22
	215.09	215.32	203.05	203.05	203.30	215.32	0.45	1.23
446	227.84	227.94	215.82	215.82	215.93	227.94	0.45	1.23
	227.76	228.02	215.75	215.75	216.00	228.02	0.45	1.23
447	240.54	240.64	228.52	228.52	228.63	240.64	0.43	1.23
	240.46	240.74	228.45	228.45	228.70	240.74	0.44	1.23
448	253.24	253.34	241.22	241.22	241.33	253.34	0.43	1.23
	253.16	253.44	241.15	241.15	241.40	253.44	0.44	1.23
449	265.94	266.04	253.92	253.92	254.03	266.04	0.43	1.23
	265.86	266.14	253.85	253.85	254.10	266.14	0.45	1.23

Table 1B - Standard gland dimensions and O-ring squeeze in millimeters (continued)

Gland and AS568 Dash No.	ØC	ØA	ØF	ØB	ØH	ØE	Actual Minimum Squeeze	Actual Maximum Squeeze
	Max Min	Min Max	Max Min	Max Min	Min Max	Min Max	Piston Rod	Piston Rod
450	278.64	278.74	266.62	266.62	266.73	278.74	0.43	1.23
	278.56	278.84	266.55	266.55	266.80	278.84	0.45	1.23
451	291.34	291.44	279.32	279.32	279.43	291.44	0.43	1.23
	291.26	291.54	279.25	279.25	279.50	291.54	0.45	1.23
452	304.04	304.14	292.02	292.02	292.13	304.14	0.43	1.23
	303.96	304.24	291.95	291.95	292.20	304.24	0.45	1.23
453	316.74	316.84	304.72	304.72	304.83	316.84	0.44	1.23
	316.66	316.94	304.65	304.65	304.90	316.94	0.45	1.23
454	329.44	329.54	317.42	317.42	317.53	329.54	0.44	1.23
	329.36	329.64	317.35	317.35	317.60	329.64	0.45	1.23
455	342.14	342.24	330.12	330.12	330.23	342.24	0.44	1.23
	342.06	342.34	330.05	330.05	330.30	342.34	0.45	1.23
456	354.84	354.94	342.82	342.82	342.93	354.94	0.44	1.23
	354.76	355.04	342.75	342.75	343.00	355.04	0.45	1.23
457	367.54	367.64	355.52	355.52	355.63	367.64	0.44	1.23
	367.46	367.74	355.45	355.45	355.70	367.74	0.45	1.23
458	380.24	380.34	368.22	368.22	368.33	380.34	0.44	1.23
	380.16	380.44	368.15	368.15	368.40	380.44	0.45	1.23
459	392.94	393.04	380.92	380.92	381.03	393.04	0.44	1.23
	392.86	393.14	380.85	380.85	381.10	393.14	0.46	1.23
460	405.64	405.74	393.62	393.62	393.73	405.74	0.44	1.23
	405.56	405.84	393.55	393.55	393.80	405.84	0.46	1.23

3.2.2 Groove Widths

Groove widths by dash number and requirement for zero backup, one backup or two backup widths are listed in Tables 2A and 2B. See Figures 1 and 3.



Dimensions and Tolerancing to ASME Y14.5-1994

Figure 3 - O-ring dimensions

Table 2A - Standard groove width for zero, one, and two backups in inches

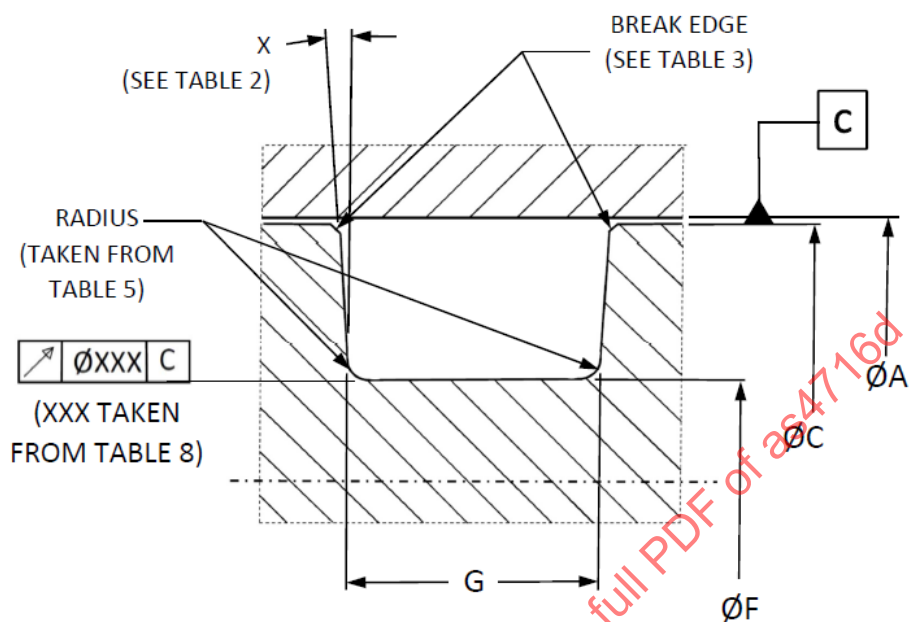
Gland and AS568 Dash No.	O-Ring Cross Section W Min	O-Ring Cross Section W Max	Groove Width G No Backup Ring Min	Groove Width G No Backup Ring Max	Groove Width G One Backup Ring Min	Groove Width G One Backup Ring Max	Groove Width G Two Backup Rings Min	Groove Width G Two Backup Rings Max
001	0.037	0.043	0.070	0.075	--	--	--	--
002	0.047	0.053	0.077	0.082	--	--	--	--
003	0.057	0.063	0.088	0.093	--	--	--	--
004 to 009	0.067	0.073	0.098	0.103	0.154	0.164	0.210	0.220
010 to 028	0.067	0.073	0.094	0.099	0.150	0.160	0.207	0.217
104 to 149	0.100	0.106	0.141	0.151	0.183	0.193	0.245	0.255
210 to 247	0.135	0.143	0.188	0.198	0.235	0.245	0.304	0.314
325 to 349	0.205	0.215	0.281	0.291	0.334	0.344	0.424	0.434
424 to 460	0.269	0.281	0.375	0.385	0.475	0.485	0.579	0.589

Table 2B - Standard groove width for zero, one, and two backups in millimeters

Gland and AS568 Dash No.	O-Ring Cross Section W Min	O-Ring Cross Section W Max	Groove Width G No Backup Ring Min	Groove Width G No Backup Ring Max	Groove Width G One Backup Ring Min	Groove Width G One Backup Ring Max	Groove Width G Two Backup Rings Min	Groove Width G Two Backup Rings Max
001	0.94	1.09	1.78	1.91	--	--	--	--
002	1.19	1.35	1.96	2.08	--	--	--	--
003	1.45	1.60	2.24	2.36	--	--	--	--
004 to 009	1.70	1.85	2.49	2.62	3.91	4.17	5.33	5.59
010 to 028	1.70	1.85	2.39	2.52	3.81	4.06	5.26	5.52
104 to 149	2.54	2.69	3.58	3.84	4.65	4.90	6.22	6.48
210 to 247	3.43	3.63	4.78	5.03	5.97	6.22	7.72	7.98
325 to 349	5.21	5.46	7.14	7.39	8.48	8.74	10.77	11.02
424 to 460	6.83	7.14	9.53	9.78	12.07	12.32	14.71	14.96

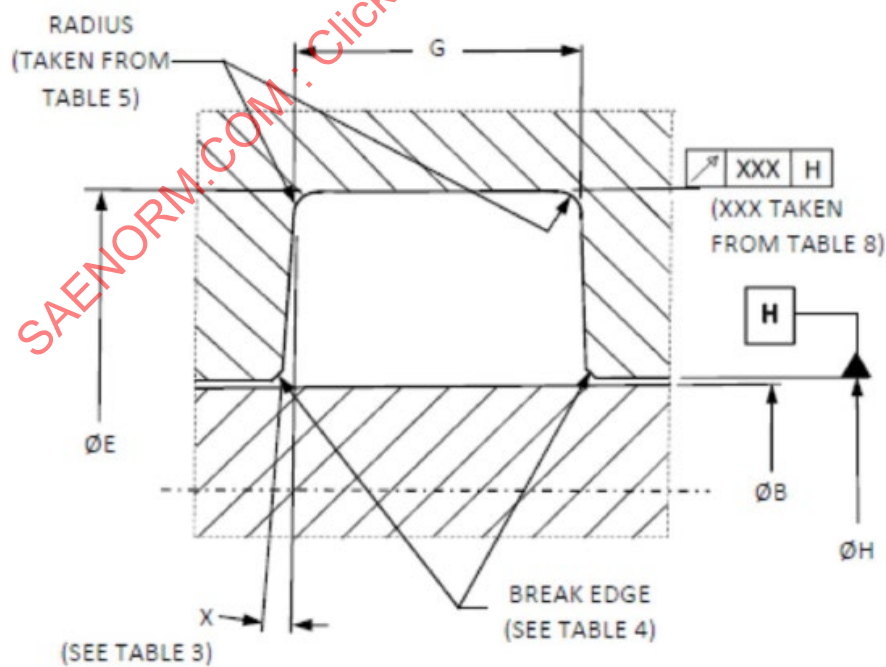
3.2.3 Standard Gland Design Details

Details for the standard gland design, including groove wall angle and groove edge break requirements, are depicted in Figures 4A and 4B and Tables 3 and 4.



DIMENSIONS & TOLERANCING PER ASME Y14.5-1994

Figure 4A - Groove details, piston gland



DIMENSIONS & TOLERANCING PER ASME Y14.5-1994

Figure 4B - Groove details, rod gland

Table 3 - Groove wall angle details

Groove Wall Angle (∠X)		
Pressure (psi)	Pressure (kPa)	∠X Degrees
≤4000	≤27580	0.0 + 5.0/-0.0
>4000 to 6000	>27580 to 41370	0.0 + 2.0/-0.0
>6000 to 8000	>41370 to 55160	0.0 ± 0.5

Table 4 - Groove break edge details in inches and millimeters

System Pressure		Break Edge Requirements	
Pressure (psi)	Pressure (kPa)	Groove Edge Break (inches)	Groove Edge Break (mm)
≤4000	≤27580	0.005 + 0.005/-0.000	0.13 + 0.13/-0.00
>4000	>27580	0.002 + 0.005/-0.000	0.05 + 0.13/-0.00

3.2.3.1 Groove Corner Radii

The groove corner radii shall be per Figures 4A and 4B and Table 5.

Table 5 - Standard groove corner radius dimensions in inches and millimeters

Gland and AS568 Dash No.	Inches		Millimeters	
	Corner Radius Maximum	Corner Radius Minimum	Corner Radius Maximum	Corner Radius Minimum
001 to 028	0.015	0.005	0.38	0.13
104 to 149	0.015	0.005	0.38	0.13
210 to 247	0.025	0.010	0.64	0.25
325 to 349	0.035	0.020	0.89	0.51
425 to 460	0.035	0.020	0.89	0.51

3.2.4 Surface Finishes of Glands

The surface finishes in Table 6 (indicated as surface roughness as defined in ASME B46.1 (ISO4287-1) shall be used in units containing O-rings and other elastomeric/plastic (non-elastomer) contact interface seals.

Table 6 - Surface roughness requirements

Part on Unit		Seal Material in Contact	Feature	Liquids (Hydraulic Oil, etc.)		Gases (Notes 5 and 6)	
				Value per ASME B46.1	Value per ISO 4287-1	Value per ASME B46.1	Value per ISO 4287-1
Cylinder bore ØA or piston rod ØB	On chrome, uncoated steel and hard anodized surfaces	Elastomer	Ra	8-12 (µin)	0.2-0.3 (µm)	4 (µin) (max)	0.1 (µm) (max)
		Plastic (Non-Elastomer)	Ra	4-8 (µin)	0.1-0.2 (µm)	-	-
	On HVOF surfaces (see Note 3 and 3.2.6)	Elastomer (Static Only)	Ra	4 (µin) (max)	0.1 (µm) (max)	4 (µin) (max)	0.1 (µm) (max)
		Plastic (Non-Elastomer)	Ra	2-4 (µin)	0.05-0.1 (µm)	-	-
			Rp	8 (µin) (max)	0.2 (µm) (max)	-	-
			Rz	40 (µin)	1.0 (µm)	-	-
			Rmr (Tp)	70-90%		-	
			Rsk	-0.5 to -1.5		-	
Part on Unit	Application	Seal Material in Contact & Seal Type	Feature	Value per ASME B46.1	Value per ISO 4287-1	Value per ASME B46.1	Value per ISO 4287-1
Groove Diameter	Static Seals	Elastomer	Ra	32 (µin) (max)	0.8 (µm) (max)	16 (µin) (max)	0.4 (µm) (max)
		Plastic (Non-Elastomer)	Ra	16 (µin) (max)	0.4 (µm) (max)	-	-
	Dynamic Seals	Elastomer	Ra	32 (µin) (max)	0.8 (µm) (max)	16 (µin) (max)	0.4 (µm) (max)
		Plastic (Non-Elastomer)	Ra	16 (µin) (max)	0.4 (µm) (max)	-	-
Groove Side Walls	Static Seals	Elastomer	Ra	63 (µin) (max)	1.6 (µm) (max)	63 (µin) (max)	1.6 (µm) (max)
		Plastic (Non-Elastomer)	Ra	63 (µin) (max)	1.6 (µm) (max)	-	-
	Dynamic Seals	Elastomer	Ra	32 (µin) (max)	0.8 (µm) (max)	32 (µin) (max)	0.8 (µm) (max)
		Plastic (Non-Elastomer)	Ra	63 (µin) (max)	1.6 (µm) (max)	-	-

NOTES:

1. The groove surfaces must be free from all machining irregularities exceeding the above values.
2. The groove edges shall be smooth and true and free of nicks, scratches, and burrs, etc.
3. The use of HVOF (high-velocity oxygenated fuel) coatings will require consideration to post-process 4. The highlighted cells indicate elastomer materials recommendation for static use only against HVOF surfaces.
5. Plastic (non-elastomer) contact seals are not recommended for use in gases unless leakage can be tolerated.
6. Applications include mixed gas/oil environments such as shock absorbers, accumulators, etc. Improved surface finishes for groove diameters (F and E) and dynamic surfaces (cylinder bore (A) or rod OD (B)) may be required depending on the application.
7. Surface finish of the piston OD (C) and rod gland bore (H) should be suitable for each specific application to prevent degradation of the cylinder bore (A) or rod diameter (B) to ensure seal performance.

3.2.5 Brief Descriptions of the Terms Used in Table 6

For more detailed information, refer to ASME B46.1 and ISO 4287-1.

- Ra Arithmetic mean deviation of the roughness profile. Roughness average is the arithmetic average of the absolute values of the measured profile height deviations as measured from the graphical mean line.
- Rp Maximum roughness profile peak height. The highest peak height over the sample length.
- Rz The maximum peak height to the lowest valley within a sampling length, averaged over five samples.
- Rmr The ratio of the material length at a specified depth for a surface finish profile (bearing ratio) (% at $C_0 = 5\%$ and $C_1 = 0.25 R_z$).
- Rsk The skewness of the assessed profile, i.e., the asymmetry of the height distribution, defined on the sampling length. Positive values correspond to high peaks spread on a regular surface (distribution skewed towards the bottom) while negative values are found on surfaces with pores and scratches (distribution skewed towards the top).

3.2.6 HVOF Application Process, Superfinishing and Surface Finish References

Refer to AIR6079, ARP5935, and AMS2452 for further recommendations on the application process of HVOF coatings, superfinishing. The skewness of the assessed profile, i.e., the asymmetry of the height distribution, is defined on the sampling length. Positive values correspond to high peaks spread on a regular surface (distribution skewed towards the bottom) while negative values are found on surfaces with pores and scratches (distribution skewed towards the top). and surface roughness for seals.

3.3 Diametral Clearances

The diametral clearance, (K) in Figures 1 and 2, is the total difference between the bore ID (A) and the piston OD (C) or the total difference between the rod OD (B) and the rod bore ID (H). The diametral clearance shall be as listed in Tables 7A and 7B.

Table 7A - Standard gland diametral clearance dimensions in inches

Gland and AS568 Dash No.	O-Ring Cross Section W Min	O-Ring Cross Section W Max	Diametral Clearance K Max Piston	Diametral Clearance K Max Rod
001	0.037	0.043	0.004	0.004
002	0.047	0.053	0.004	0.004
003	0.057	0.063	0.004	0.004
004 to 012	0.067	0.073	0.004	0.004
013 to 028	0.067	0.073	0.005	0.005
104 to 109	0.100	0.106	0.004	0.004
110 to 126	0.100	0.106	0.005	0.005
127 to 129	0.100	0.106	0.005	0.006
130 to 132	0.100	0.106	0.006	0.006
133 to 140	0.100	0.106	0.006	0.007
141 to 149	0.100	0.106	0.007	0.007
210 to 222	0.135	0.143	0.005	0.005
223 and 224	0.135	0.143	0.006	0.006
225 to 227	0.135	0.143	0.006	0.007
228 to 243	0.135	0.143	0.007	0.007
244 and 245	0.135	0.143	0.008	0.007
246 and 247	0.135	0.143	0.008	0.008
325 to 327	0.205	0.215	0.006	0.006
328 and 329	0.205	0.215	0.006	0.007
330 to 345	0.205	0.215	0.007	0.007
346 to 349	0.205	0.215	0.008	0.007
425 to 438	0.269	0.281	0.009	0.009
439 to 445	0.269	0.281	0.009	0.010
446	0.269	0.281	0.010	0.010
447 to 460	0.269	0.281	0.011	0.010

Table 7B - Standard gland diametral clearance dimensions in millimeters

Gland and AS568 Dash No.	O-Ring Cross Section W Min	O-Ring Cross Section W Max	Diametral Clearance K Max Piston	Diametral Clearance K Max Rod
001	0.94	1.09	0.10	0.10
002	1.19	1.35	0.10	0.10
003	1.45	1.60	0.10	0.10
004 to 012	1.70	1.85	0.10	0.10
013 to 028	1.70	1.85	0.13	0.13
104 to 109	2.54	2.69	0.10	0.10
110 to 126	2.54	2.69	0.13	0.13
127 to 129	2.54	2.69	0.13	0.15
130 to 132	2.54	2.69	0.15	0.15
133 to 140	2.54	2.69	0.15	0.18
141 to 149	2.54	2.69	0.18	0.18
210 to 222	3.43	3.63	0.13	0.13
223 and 224	3.43	3.63	0.15	0.15
225 to 227	3.43	3.63	0.15	0.18
228 to 243	3.43	3.63	0.18	0.18
244 and 245	3.43	3.63	0.20	0.18
246 and 247	3.43	3.63	0.20	0.20
325 to 327	5.21	5.46	0.15	0.15
328 and 329	5.21	5.46	0.15	0.18
330 to 345	5.21	5.46	0.18	0.18
346 to 349	5.21	5.46	0.20	0.18
425 to 438	6.83	7.14	0.23	0.23
439 to 445	6.83	7.14	0.23	0.25
446	6.83	7.41	0.25	0.25
447 to 460	6.83	7.14	0.23	0.25

3.4 Run Out

Maximum run-out δ as indicated in Figures 4A and 4B shall be as listed in Table 8.

Table 8 - Maximum groove diametral run-out for standard glands in inches and millimeters

Gland and AS568 Dash No.	Maximum Run Out δ (Inches)	Maximum Run Out δ (Millimeters)
001 to 028	0.002	0.05
104 to 149	0.002	0.05
210 to 247	0.003	0.08
325 to 349	0.004	0.10
425 to 460	0.005	0.13

3.5 O-Ring Seal Squeeze

Refer to ARP4727, Figures 1 and 3.

The minimum squeeze (see Tables 1A and 1B) is represented by the difference (interference) between the minimum cross-section W of the installed O-ring and the maximum permitted gland depth. The O-ring used to calculate minimum squeeze is one with the minimum free cross-section diameter and minimum inside diameter D .

The minimum cross-section diameter of the installed O-ring is obtained by subtracting the change in the minimum free cross-section diameter caused by the stretching of the O-ring when installed, from the minimum free cross-section diameter.

The maximum gland depth is that obtained using gland parts that provide the maximum possible diametral clearance, maximum run-out δ of gland parts and maximum possible radial displacement of the gland parts in the direction to cause maximum gland depth and minimum seal squeeze at the seal location that is 180 ° away from the direction of radial displacement.

The maximum O-ring squeeze in Tables 1A and 1B is represented by the difference between the maximum cross-section diameter of an installed O-ring and the minimum gland depth. The O-ring used to calculate maximum squeeze is an O-ring of maximum free cross-section diameter and maximum ID.

The maximum cross-section diameter of the installed O-ring is obtained by subtracting the change in the maximum free cross-section diameter caused by the stretching of the O-ring during installation, from the maximum free cross-section diameter.

The minimum gland depth for a piston-type gland is that obtained using the minimum bore diameter A , the minimum piston diameter C , maximum run-out δ of gland parts and maximum possible radial displacement of the minimum piston diameter for the minimum bore diameter.

The minimum gland depth for a rod-type gland is that obtained using maximum rod diameter B , maximum rod gland bore diameter H , maximum run-out δ of gland parts, and maximum possible radial displacement of the maximum rod diameter for the maximum rod gland bore diameter.

The equations used for calculating the reduced seal cross-section for piston and rod type glands under minimum and maximum squeeze conditions are listed in Appendix A. The equations used to calculate the minimum and maximum seal squeeze (listed in Tables 1A and 1B) for piston and rod-type glands are also listed in Appendix A.

3.6 Temperature Considerations in Gland Design

The calculations used in this standard have been based on a temperature of 75 °F (24 °C). The suitability of the glands should be verified for the temperature extremes expected in service. Differences in the coefficient of thermal expansion of different metals can result in differences in diametral clearance which may be a factor at temperature extremes. Even more important is the difference between the coefficient of thermal expansion of the seal material and the gland materials. Elastomers may have a linear coefficient of thermal expansion as much as ten times that of steel. Gland overfill at high temperatures must be avoided. Elastomer contraction at low temperatures may require some modification of the gland dimensions herein to assure adequate squeeze at low temperatures, particularly those lower than -40 °F (-40 °C).

A particularly severe application occurs when an unpressurized cylinder at low temperature is pressurized. Leakage is likely to occur until warmer fluid causes expansion of the elastomer. Leakage can be prevented in such cases by ensuring that adequate squeeze is provided by taking into account changes in gland and elastomer dimensions that occur at low temperature plus the radial expansion (i.e., gland “breathing”) that will occur with the application of pressure (see 3.8). Usually, satisfactory designs can be achieved within the dimensions of this standard by simply reducing the permitted tolerances on mating parts to achieve increased squeeze.

3.7 Installation of Anti-Extrusion (Backup) Rings

For pressures above 1500 psi (10342 kPa), the use of two backup rings in each gland, one on either side of the O-ring seal, is recommended to insure proper extrusion protection. Dimensions for gland widths to accommodate the use of two backup rings are shown in Tables 2A and 2B.

Where it is self-evident that pressure can be applied from one direction only and space requirements for two rings create a hardship, a single backup ring may be used. This ring is to be placed on the side of the O-ring away from the pressure. The groove width dimensions shown in Tables 2A and 2B for one backup ring may be used, as applicable. For applications where the pressure does not exceed 1500 psi (10342 kPa), backup rings are not required but may be used to provide greater extrusion protection.

Backup rings to AS5781 and AS5782 are specifically designed to fit AS4716 gland dimensions. Also, refer to ARP5555 for installation recommendations.

NOTES:

1. The AS4716 gland dimensions are different from the previous MIL-G-5514 for the -0XX, -1XX, and the -2XX series dash numbers and the application of AS8791 and "MS" backup rings may result in a compressive radial fit and are not recommended for use in AS4716 glands.
2. The optimum fit and limit conditions can be achieved with the use of backup rings per AS5781 and AS5782.

3.8 Cylinder Breathing

For operating pressures of 3000 psig (20690 kPa) and lower, diametral expansion of the cylinder bore (i.e., cylinder wall "breathing") shall be limited to 0.002 in/in (0.002 mm/mm) of the cylinder bore at the operating pressure. For operating pressures greater than 3000 psig (20690 kPa), diametral expansion of the cylinder bore shall be limited to 0.0015 in/in (0.0015 mm/mm) of the cylinder bore at the operating pressure.

3.9 Seal Installation

To facilitate seal installation, the edge where the piston and seal assembly enters a cylinder bore should be chamfered with a suitable blend radius to prevent pinching or other damage to the seal (see Figure 5).

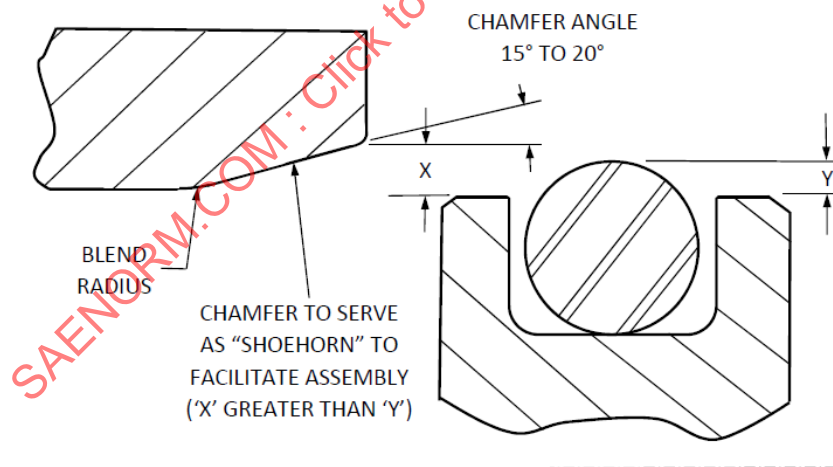


Figure 5 - O-ring installation

The seal shall be completely coated with hydraulic fluid or another compatible installation lubricant at the time of installation. After installing an O-ring in the groove, it should be checked to be sure it is not spiraled (twisted).

NOTES:

1. For seals other than O-rings, to prevent damage during installation, it is important to consult the seal manufacturer for the procedure(s) to install seals into piston or rod glands and recommendations regarding the lead-in chamfer requirements including angle and diameter.
2. Refer to ARP5555 for further recommendations.

4. NOTES

4.1 Revision Indicator

A change bar (I) 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.

4.2 Dimensions and Properties

Dimensions and properties in inch/pounds units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

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APPENDIX A - O-RING SQUEEZE CALCULATIONS AND DESIGN CONSIDERATIONS

A.1 SCOPE

This appendix provides the calculations and design considerations that were used to develop the minimum and maximum squeeze numbers listed in the last two columns of Tables 1A and 1B. All equations listed in Appendix A are in inches.

NOTE: This appendix is not a mandatory part of the specification.

A.2 CALCULATIONS

Throughout Appendix A, see Figure 1 for gland dimensions and see Figure 3 for O-ring dimensions.

A.2.1 Reduced O-Ring Cross Section

O-ring cross-sections are reduced slightly when installed in AS4716 glands due to stretch. The following calculations are used to determine the reduced cross-sections.

A.2.1.1 Reduced O-Ring Cross-Section for Piston Type Glands

A.2.1.2 For Minimum Squeeze Condition

A.2.1.2.1 For Minimum Squeeze Condition, Dash Sizes -009 and Larger, -110 and Larger

Where (O-ring inside diameter (D)/O-ring radial cross-section (W) of the nominal O-ring size) >2.95 (-009 and larger diameter 0.070 inch (1.78 mm)) cross-section O-rings, -110 and larger diameter 0.103 inch (2.62 mm) cross-section O-rings, and all other cross-section O-rings for use in glands listed in Tables 1A and 1B).

$$\text{REXMINP} = (\text{Min } W) - [(\text{Min } W) \times (\text{FACREDINCX})] \quad (\text{Eq. A1})$$

where:

REXMINP = reduced O-ring cross section for calculating min squeeze for piston type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \quad (\text{if } X < 0)$$

or

$$\text{FACREDINCX} = 0.0001 + 1.06X - 10X^2 \quad (\text{if } X < 0.03 \text{ and } > 0)$$

or

$$\text{FACREDINCX} = 0.0056 + 0.59X - 0.46X^2 \quad (\text{if } X > 0.03)$$

$$\text{WHERE } X = \frac{(\text{Min PGD} - \text{Min } D)}{(\text{Min } D)}$$

And where:

PGD = piston groove diameter F

D = O-ring inside diameter

A.2.1.2.2 For Minimum Squeeze Condition, Dash Sizes -008 and Smaller, -109 and Smaller

Where (O-ring inside diameter (D)/O-ring radial cross-section (W) of the nominal O-ring size) ≤ 2.95 (-008 and smaller diameter 0.070 inch (1.78 mm)) cross-section O-rings, -109 and smaller diameter 0.103 inch (2.62 mm) cross-section O-rings).

$$\text{REXMINP} = (\text{Min } W) - [(\text{Min } W) \times (\text{FACREDINCX})] \quad (\text{Eq. A2})$$

where:

REXMINP = reduced O-ring cross section for calculating min squeeze for piston type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \text{ (if } X \leq 0 \text{)}$$

or

$$\text{FACREDINCX} = 100X / (315e^{(-\text{MIN } S/\text{MIN } W)} + 165 + 100X) \text{ (if } X > 0 \text{)}$$

$$\text{WHERE } X = \frac{(\text{Min PGD} - \text{Min } D)}{(\text{Min } D)}$$

and where:

$$e = 2.71828$$

PGD = piston groove diameter F

D = O-ring inside diameter

A.2.1.3 For Maximum Squeeze Condition

A.2.1.3.1 For Maximum Squeeze Condition, Dash Sizes -009 and Larger, -110 and Larger

Where (O-ring inside diameter (D)/O-ring radial cross-section (W) of the nominal O-ring size) > 2.95 (-009 and larger diameter 0.070 inch (1.78 mm)) cross-section O-rings, -110 and larger diameter 0.103 inch (2.62 mm) cross-section O-rings, and all other cross-section O-rings for use in glands listed in Tables 1A and 1B).

$$\text{REXMAXP} = (\text{Max } W) - [(\text{Max } W) \times (\text{FACREDINCX})] \quad (\text{Eq. A3})$$

where:

REXMAXP = reduced O-ring cross section for calculating max squeeze for piston type glands

FACREDINCX is as defined in A.2.1.1.1, except that:

$$X = \frac{(\text{Max PGD} - \text{Max } D)}{(\text{Max } D)}$$

and where:

PGD = piston groove diameter F

D = O-ring inside diameter

A.2.1.3.2 For Maximum Squeeze Condition, Dash Sizes -008 and Smaller, -109 and Smaller

Where (O-ring inside diameter (D)/O-ring radial cross section (W) of the nominal O-ring size) ≤ 2.95 (-008 and smaller diameter 0.070 inch (1.78 mm) cross-section O-rings, -109 and smaller diameter 0.103 inch (2.62mm) cross-section O-rings).

$$\text{REXMAXP} = (\text{Max } W) - [(\text{Max } W) \times (\text{FACREDINCX})] \quad (\text{Eq. A4})$$

where:

REXMAXP = reduced O-ring cross section for calculating max squeeze for piston type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \text{ (if } X \leq 0 \text{)}$$

or

$$\text{FACREDINCX} = 100X / (315e^{(-\text{MAX } S/\text{MAX } W)} + 165 + 100X) \text{ (if } X > 0 \text{)}$$

$$\text{WHERE } X = \frac{(\text{Max PGD} - \text{Max } D)}{(\text{Max } D)}$$

and where:

$$e = 2.71828$$

PGD = piston groove diameter F

D = O-ring inside diameter

A.2.1.4 Reduced O-Ring Cross-Section for Rod Type Glands

A.2.1.5 For Minimum Squeeze Condition

A.2.1.5.1 For Minimum Squeeze Condition, Dash Sizes -009 and Larger, -110 and Larger

Where (O-ring inside diameter (D)/O-ring radial cross-section (W) of the nominal O-ring size) > 2.95 (-009 and larger diameter 0.070 inch (1.78 mm) cross-section O-rings, -110 and larger diameter 0.103 inch (2.62 mm) cross-section O-rings, and all other cross-section O-rings for use in glands listed in Tables 1A and 1B).

$$\text{REXMINR} = (\text{Min } W) - [(\text{Min } W) \times (\text{FACREDINCX})] \quad (\text{Eq. A5})$$

where:

REXMINR = reduced O-ring cross section for calculating min squeeze for rod type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \text{ (if } X < 0 \text{)}$$

or

$$\text{FACREDINCX} = 0.0001 + 1.06X - 10X^2 \text{ (if } X < 0.03 \text{ and } > 0 \text{)}$$

or

$$\text{FACREDINCX} = 0.0056 + 0.59X - 0.46X^2 \text{ (if } X > 0.03 \text{)}$$

$$\text{WHERE } X = \frac{(\text{Min DR} - \text{Min D})}{(\text{Min D})}$$

And where:

DR = rod diameter B

D = O-ring inside diameter

A.2.1.5.2 For Minimum Squeeze Condition, Dash Sizes -008 and Smaller, -109 and Smaller

Where the (O-ring inside diameter (D)/O-ring radial cross section (W) of the nominal O-ring size) ≤ 2.95 (-008 and smaller diameter 0.070 inch (1.78 mm) cross-section O-rings, -109 and smaller diameter 0.103 inch (2.62mm) cross-section O-rings).

$$\text{RECXMINR} = (\text{Min W}) - [(\text{Min W}) \times (\text{FACREDINCX})] \quad (\text{Eq. A6})$$

where:

RECXMINR = reduced O-ring cross section for calculating min squeeze for rod type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \text{ (if } X \leq 0 \text{)}$$

or

$$\text{FACREDINCX} = 100X + 315e^{(-\text{MIN S}/\text{MIN W})} + 165 + 100X \text{ (if } X > 0 \text{)}$$

$$\text{WHERE } X = \frac{(\text{Min DR} - \text{Min D})}{(\text{Min D})}$$

and where:

$$e = 2.71828$$

DR = rod diameter B

D = O-ring inside diameter

A.2.1.6 For Maximum Squeeze Condition

A.2.1.6.1 For Maximum Squeeze Condition, Dash Sizes -009 and Larger, -110 and Larger

Where (O-ring inside diameter (D)/O-ring radial cross-section (W) of the nominal O-ring size) >2.95 (-009 and larger diameter 0.070 inch (1.78 mm) cross-section O-rings, -110 and larger diameter 0.103 inch (2.62 mm) cross-section O-rings, and all other cross-section O-rings for use in glands listed in Tables 1A and 1B).

$$\text{RECXMAXR} = (\text{Max } W) - [(\text{Max } W) * (\text{FACREDINCX})] \quad (\text{Eq. A7})$$

where:

RECXMAXR = reduced O-ring cross section for calculating max squeeze for rod type glands

FACREDINCX is as defined above in A.2.2.1.1 except that

$$X = \frac{(\text{Max DR} - \text{Max D})}{(\text{Max D})}$$

and where:

DR = rod diameter B

D = O-ring inside diameter

A.2.1.6.2 For Maximum Squeeze Condition, -008 and Smaller, -109 and Smaller

Where (O-ring inside diameter (D)/O-ring radial cross section (W) of the nominal O-ring size) ≤ 2.95 (-008 and smaller diameter 0.070 inch (1.78 mm)) cross-section O-rings, -109 and smaller diameter 0.103 inch (2.62 mm) cross-section O-rings).

$$\text{RECXMAXR} = (\text{Max } W) - [(\text{Max } W) * (\text{FACREDINCX})] \quad (\text{Eq. A8})$$

where:

RECXMAXR = reduced O-ring cross section for calculating max squeeze for rod type glands

W = O-ring cross-section in the free condition

FACREDINCX (factor for reduction in O-ring cross-section) is defined below:

$$\text{FACREDINCX} = 0 \quad (\text{if } X \leq 0)$$

or

$$\text{FACREDINCX} = 100 * X / (315 * e^{(-\text{MAX } S / \text{MAX } W)} + 165 + 100 * X) \quad (\text{if } X > 0)$$

$$\text{WHERE } X = \frac{(\text{Max DR} - \text{Max D})}{(\text{Max D})}$$

and where:

$$e = 2.71828$$

DR = rod diameter B

D = O-ring inside diameter

A.2.2 Squeeze Calculations

The following calculations use the reduced O-ring cross-sections calculated in A2.1 to calculate the actual squeeze dimensions listed in Tables 1A and 1B.

Throughout the squeeze calculations below see Table 8 for run-out dimensions.

A.2.2.1 Minimum O-Ring Squeeze for Piston Type Glands

$$\text{MINSS} = \text{RECXMINP} - \left[\frac{(\text{Max CBD}) - (\text{Min PGD})}{2} + \frac{(\text{Max CBD}) - (\text{Min PD})}{2} + \frac{(\text{Max } \delta)}{2} \right] \quad (\text{Eq. A9})$$

where:

MINSS = minimum O-ring squeeze

RECXMINP = reduced O-ring cross section for calculating min squeeze for piston type glands (see Equations A1 or A2)

CBD = cylinder bore diameter A

PGD = piston groove diameter F

δ = run-out

PD = piston diameter C

A.2.2.2 Maximum O-Ring Squeeze for Piston Type Glands

$$\text{MAXSS} = \text{RECXMAXP} - \left[\frac{(\text{Min CBD}) - (\text{Max PGD})}{2} - \frac{(\text{Min CBD}) - (\text{Min PD})}{2} - \frac{(\text{Max } \delta)}{2} \right] \quad (\text{Eq. A10})$$

where:

MAXSS = maximum O-ring squeeze

RECXMAXP = reduced O-ring cross section for calculating max squeeze for piston type glands (see Equations A3 or A4)

A.2.2.3 Minimum O-Ring Squeeze for Rod Type Glands

$$\text{MINSS} = \text{RECXMINR} - \left[\frac{(\text{Max RGD}) - (\text{Min DR})}{2} + \frac{(\text{Max RB}) - (\text{Min DR})}{2} + \frac{(\text{Max } \delta)}{2} \right] \quad (\text{Eq. A11})$$

where:

MINSS = minimum O-ring squeeze

RECXMINR = reduced O-ring cross section for calculating min squeeze for rod type glands (see Equations A5 or A6)

RGD = rod groove diameter E

DR = rod diameter B

δ = run-out

RB = rod bore diameter H

A.2.2.4 Maximum O-Ring Squeeze for Rod Type Glands

$$\text{MAXSS} = \text{REXMAXR} - \left[\frac{(\text{Min RGD}) - (\text{Max DR})}{2} - \frac{(\text{Max RB}) - (\text{Max DR})}{2} - \frac{(\text{Max } \delta)}{2} \right] \quad (\text{Eq. A12})$$

where:

MAXSS = maximum O-ring squeeze

REXMAXR = reduced O-ring cross section for calculating max squeeze for rod type glands (see Equations A7 or A8)

RGD = rod groove diameter E

DR = rod diameter B

δ = run-out

RB = rod bore diameter H

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APPENDIX B - GLAND FILL AND O-RING OCCUPANCY CALCULATIONS AND DESIGN CONSIDERATIONS IGNORING SWELL AND AT AMBIENT TEMPERATURE

B.1 SCOPE

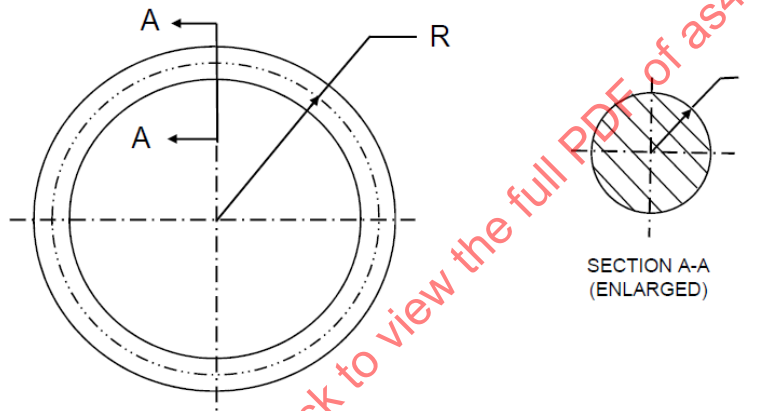
This appendix provides the calculations and design considerations that were used to ensure that all glands were designed so that they would not have more than 85% gland occupancy at 75 °F (24 °C). This appendix is not a mandatory part of the specification.

B.2 CALCULATIONS

Throughout Appendix B, see Figures 1, 4A, and 4B and Tables 1A, 2A, 3, and 5 for gland dimensions and Figure 3 for O-ring dimensions. Refer to AS5781 and AS5782 for backup ring dimensions.

B.2.1 O-Ring Volumes

See Figure B1.



Dimensions and tolerancing to ASME Y14.5-1994

Figure B1 - Torus dimensions

The recognized equation to calculate the volume of a Torus (O-ring):

$$= 2\pi^2 \times R \times r^2 \quad (\text{Eq. B1})$$

For an O-ring, see Figure 3.

We measure O-rings by inside diameter ($\varnothing D$) and cross-section ($\varnothing W$).

Substituting into Equation B1, O-ring volume = $2\pi^2 \times \left(\frac{D+W}{2}\right) \times \left(\frac{W}{2}\right)^2$ which, simplified, becomes:

$$\text{O-ring volume} = \frac{\pi^2}{4} \times (D + W) \times W^2 \quad (\text{Eq. B2})$$

B.2.2 Maximum Gland Occupancies

B.2.2.1 Maximum O-Ring Volume

$$\text{Maximum O-ring volume} = \frac{\pi^2}{4} \times (D_{\max} + W_{\max}) \times W_{\max}^2 \quad (\text{Eq. B3})$$

where:

$D_{\max}$ = max O-ring inside diameter, free condition

$W_{\max}$ = max O-ring cross-section diameter, free condition

B.2.2.2 Maximum Gland Fill for No Backup Ring Configuration

$$\text{Percent Maximum Gland Fill} = \frac{\text{Maximum O-ring Volume}}{\text{Minimum Gland Volume}} \times 100\% \quad (\text{Eq. B4})$$

Where max O-ring volume is as calculated in Equation B2 and minimum gland volume is based on the following:

For piston type:

- Min cylinder bore ID (A)
- Min gland width (G)
- Max gland OD (F)
- 0 degree gland wall angles
- Max corner radii

For rod type:

- Max Rod OD (B)
- Min gland width (G)
- Min gland ID (E)
- 0 degree gland wall angles
- Maximum corner radii

NOTE: See Tables 1A and 1B and Figures 1 and 2 for dimensions (A), (B), (E), and (F). For dimension (G), see Tables 2A and 2B and Figures 1, 2, 4A and 4B. For corner radii, see Table 5 and Figures 4A and 4B.

B.2.2.3 Maximum Gland Fill for One and Two Backup Ring Configurations

$$\text{Percent Maximum Gland Fill} = \frac{\text{Max O-ring Vol.} + \text{Max Backup Ring Vol.}}{\text{Minimum Gland Volume}} \times 100\% \quad (\text{Eq. B5})$$

Where max O-ring volume is as calculated in Equation B3 and minimum gland volume is based on the conditions listed above.

Maximum Gland volume occupancies by dash size for piston glands and rod glands are shown in Figures B2 and B3.

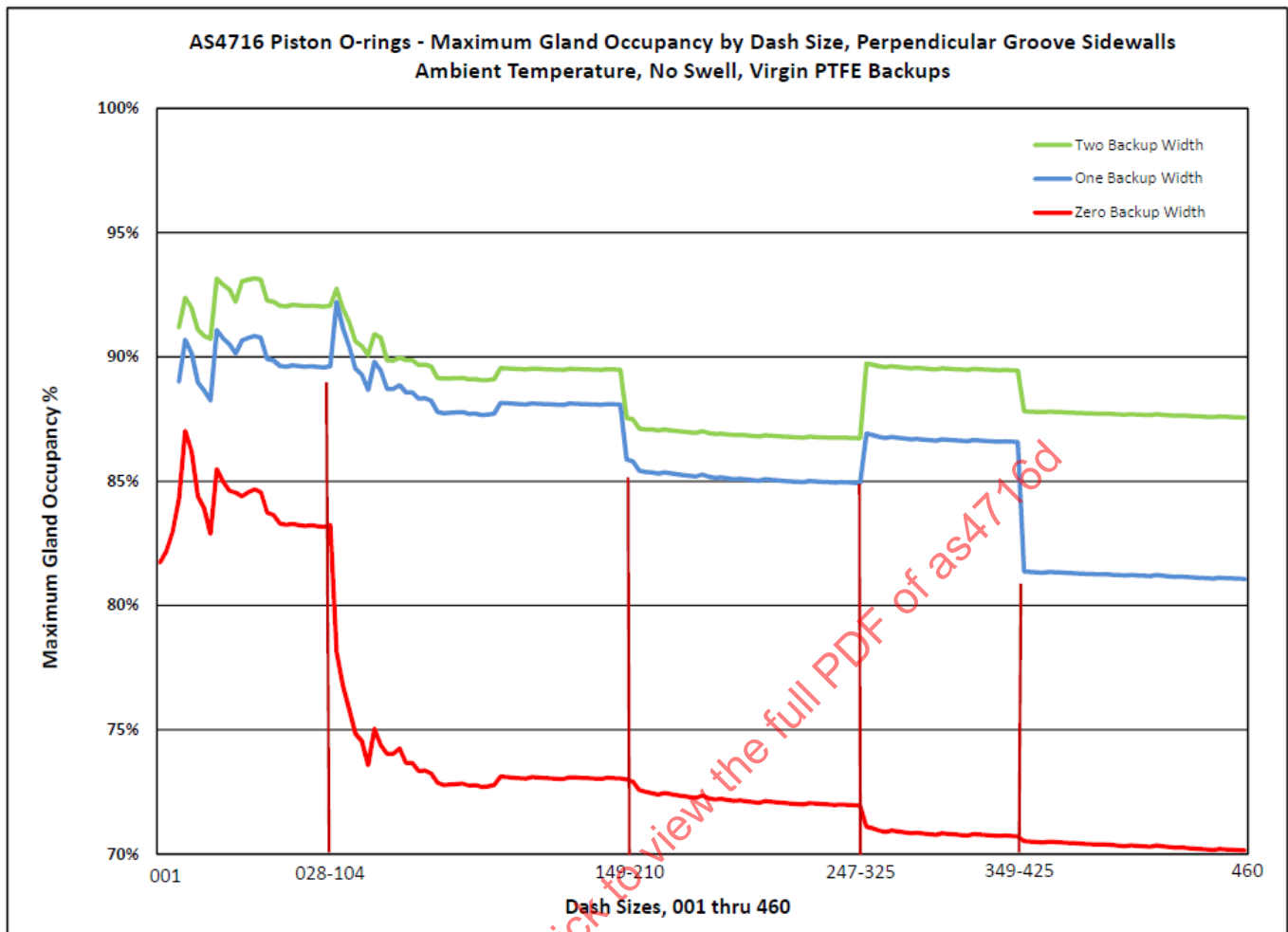


Figure B2 - O-ring gland maximum occupancies for piston seals at ambient temperature, no swell