SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J120

REV. JUN95

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Submitted for recognition as an American National Standard

RUBBER RINGS FOR AUTOMOTIVE APPLICATIONS

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board format.

1. Scope—This SAE Recommended Practice covers the dimensional and material requirements of rubber O-rings for automotive application and rectangular section rubber seal rings for automotive applications.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J200—Classification System for Rubber Materials

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 395—Test Methods for Rubber Property—Compression Set
ASTM D 412—Test Methods for Rubber Properties in Tension
ASTM D 471—Test Method for Rubber Property—Effect of Liquids
ASTM D 573—Test Method for Rubber—Deterioration in an Air Oven
ASTM D 676
ASTM D 746—Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 865—Test Method for Rubber—Deterioration by Heating in Air (Test Tube Enclosure)
ASTM D 1414—Test Methods for Rubber O-Rings

3. 120R1—Rubber O-Rings for Automotive Application

3.1 Scope

a. This SAE Recommended Practice covers the dimensional and material requirements of rubber O-rings for use in automotive sealing applications. Included are the recommended gland dimensions for standard size O-rings.

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b. The material and dimensional requirements established by this specification are based upon the following:

1. Static and dynamic applications.
2. Compounds of nominal 70 durometer hardness.
3. Fluid pressures of 1500 psi max (increased compound hardness, back-up rings, or reduced clearances, or both, promote sealing to much greater pressures).
4. Rotary seal applications are sometimes possible, but special design considerations are necessary and special compound recommendations can be obtained from seal suppliers.

3.2 Material Classifications—Two classes of material are covered by this specification. O-rings shall be classified in accordance with their intended use as follows:

a. Class I—Oil resistant service
b. Class II—Gasoline resistant service

Applications requiring resistance to special fluids can usually be satisfied by numerous compounds available. Suppliers should be contacted for their recommendations whenever possible. (See tables for compound designations in SAE J200.)

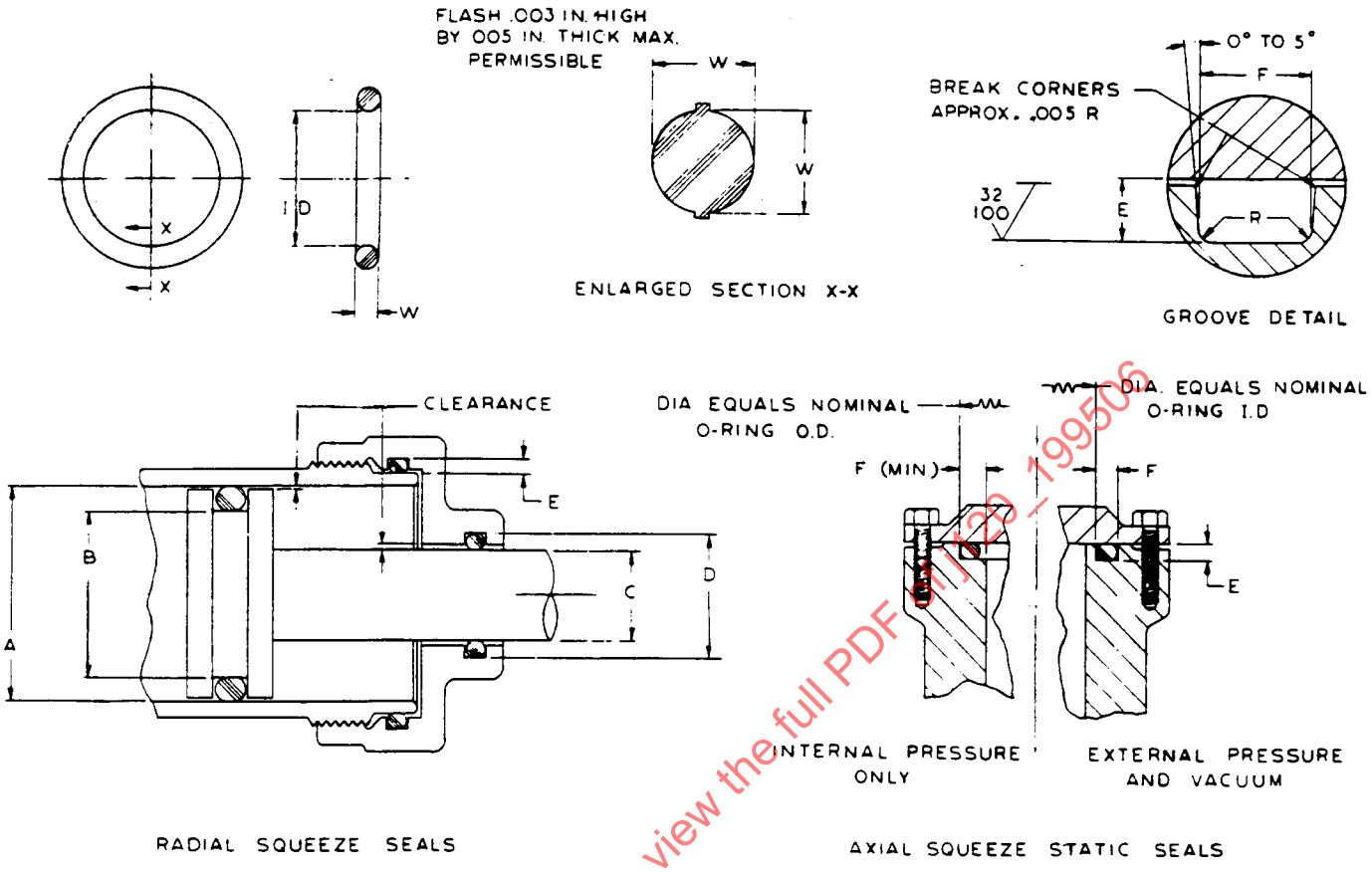
3.3 Basis of Purchase—Material and sizes required are specified by listing the SAE specification number, service classification, size number, and identification, when desired.

EXAMPLE—SAE Specification No..... 120R1
Class..... II
Size..... 128

3.4 Physical Requirements

a. Quality control and source approval tests shall be conducted on the actual seal ring when the section diameter is 0.100 in or larger, and the inside diameter is 1 in or larger. Smaller section parts do not provide reliable data. If, by necessity, smaller sizes are tested, then special specification limits and test procedures shall be based on actual part performance as agreed between the purchaser and the supplier.
b. Test specimens shall conform to the requirements specified in Table 1.

3.5 Dimensions and Tolerances—O-rings shall conform to the dimensions and tolerances prescribed in Table 2. For dimensional standardization purposes, O-rings shall be numbered as shown in Table 3.



MAXIMUM RECOMMENDED CLEARANCE, IN (INCLUDING PISTON OR ROD TO BORE CONCENTRICITY)

psi	70 Hardness	80 Hardness	90 Hardness	psi	70 Hardness	80 Hardness	90 Hardness
0	**0.010**	0.010	0.010	**1500**	**0.003**	0.005	0.008
250	**0.010**	0.010	0.010	**2000**	—	0.004	0.005
500	**0.008**	0.010	0.010	**3000**	—	0.003	0.004
1000	**0.005**	0.008	0.010	**5000**	—	—	0.003

NOTE—Data in bold face indicates basis for establishment of Table 2.

FIGURE 1—O-RING DESIGN EXAMPLES

TABLE 1—PHYSICAL REQUIREMENTS

	Class I Oil Service ASTM Specimen	Class I Oil Service Actual Part	Class II Fuel Service ASTM Specimen	Class II Fuel Service Actual Part
(a) Original Physical Properties				
Hardness points	70 ± 5	—	70 ± 5	—
Tensile strength, min, psi	1500	1200	1500	1200
Ultimate elongation, min, %	200	150	200	150
Ultimate elongation, max, %	400	400	400	400
Modulus at 100 elongation, min, psi	450	400	450	400
(b) Heat Aging, 70 h at __ °F	257	257	212	212
Hardness, points change	+10	—	+10	—
Tensile strength, max, % change	-15	-15	-15	-15
Elongation, max, % change	-50	-50	-50	-50
(c) Compression Set, 70 h at __ °F	257	257	212	212
ASTM specimen, max, %	35	—	25	—
0.200 to 0.300 in, max, %	—	45	—	35
0.100 to 0.200 in, max, %	—	65	—	55
(d) Fluid Aging, 70 h at __ °F	302	302	Room Temp	Room Temp
Type of ASTM Fluid	No. 1 Oil	No. 1 Oil	Fuel A	Fuel A
Hardness, points change	-5 to +8	—	0 to -8	—
Tensile strength, max, % change	-15	-15	-15	-15
Elongation, max, % change	-40	-40	-25	-25
Volume change, max, %	±5	±5	±3	±3
Dry-out volume change, max, % (4 h at 158 °F)	—	—	-6	-6
(e) Fluid Aging, 70 h at __ °F	302	302	Room Temp	Room Temp
Type of ASTM Fluid	No. 3 Oil	No. 3 Oil	Fuel B	Fuel B
Hardness, points change	0 to -15	—	-20	—
Tensile strength, max, % change	-30	-30	-50	-50
Elongation, max, % change	-40	-40	-50	-50
Volume change, max, %	+20	+20	+25	+25
Dry-out volume change, max, % (4 h at 158 °F)	—	—	-10	-10
(f) Fluid Aging, 70 h at __ °F			Room Temp	Room Temp
Type of ASTM Fluid			Fuel C	Fuel C
Volume change, max, %			+35	+35
(g) Low Temperature Aging				
Brittleness at -20 °F	No cracks	—	No cracks	—
Figure 8 bend, 5 h at -40 °F	—	No cracks	—	No cracks

NOTE—The limits in this table for actual parts are for parts 0.100 in cross section and larger. If smaller cross section parts are tested, special limits shall be agreed upon between the purchaser and the supplier.

TABLE 2—DIMENSIONS AND TOLERANCES, IN

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
Tolerance	**±0.005**	**—**	**+0.002 −0.000**	**+0.000 −0.002**	**+0.000 −0.002**	**+0.002 −0.000**
006	0.114	0.254	0.250	0.140	0.125	0.235
007	0.145	0.285	0.281	0.171	0.156	0.266
008	0.176	0.316	0.312	0.202	0.188	0.298
009	0.208	0.348	0.343	0.233	0.219	0.329
010	0.239	0.379	0.375	0.265	0.250	0.360
011	0.301	0.441	0.437	0.327	0.312	0.422
012	0.364	0.504	0.500	0.390	0.375	0.485
013	0.426	0.566	0.563	0.453	0.437	0.547
014	0.489	0.629	0.625	0.515	0.500	0.610
015	0.551	0.691	0.688	0.578	0.562	0.672
016	0.614	0.754	0.750	0.640	0.625	0.735
017	0.676	0.816	0.812	0.702	0.688	0.798
018	0.739	0.879	0.875	0.765	0.750	0.860
Tolerance	**±0.006**	**—**	**+0.002 −0.000**	**+0.000 −0.002**	**+0.000 −0.002**	**+0.002 −0.000**
019	0.801	0.941	0.937	0.827	0.812	0.922
020	0.864	1.004	1.000	0.890	0.875	0.985
021	0.926	1.066	1.062	0.952	0.937	1.047
022	0.989	1.129	1.125	1.015	1.000	1.110
023	1.051	1.191	1.188	1.078	1.062	1.172
024	1.114	1.254	1.250	1.140	1.125	1.235
025	1.176	1.316	1.312	1.202	1.188	1.298
026	1.239	1.379	1.375	1.265	1.250	1.360
027	1.301	1.441	1.437	1.327	1.312	1.422
028	1.364	1.504	1.500	1.390	1.375	1.485
Tolerance	**±0.010**	**—**	**+0.002 −0.000**	**+0.000 −0.002**	**+0.000 −0.002**	**+0.002 −0.000**
029	1.489	1.629	1.625	1.515	1.500	1.610
030	1.614	1.754	1.750	1.640	1.625	1.735
031	1.739	1.879	1.875	1.765	1.750	1.860
032	1.864	2.004	2.000	1.890	1.875	1.985
033	1.989	2.129	2.125	2.015	2.000	2.110
034	2.114	2.254	2.250	2.140	2.125	2.235
035	2.239	2.379	2.375	2.265	2.250	2.360
036	2.364	2.504	2.500	2.390	2.375	2.485
037	2.489	2.629	2.625	2.515	2.500	2.610
038	2.614	2.754	2.750	2.640	2.625	2.735
Tolerance	**±0.015**	—	**+0.002 −0.000**	**+0.000 −0.002**	**+0.000 −0.002**	**+0.002 −0.002**

W—Actual seal width
0.070 in ± 0.003 in

E—Groove width, in:
Dynamic—
0.055-0.057
Static:
Radial—
0.049-0.055
Axial—
0.045-0.050

F—Groove length, in—
0.090-0.100

R—Radius, in—
0.005-0.015

Cross-sectional squeeze, in, min:
Dynamic—0.010
Static:
Radial—0.012
Axial—0.017

Piston groove diameter shall be concentric with piston OD within 0.002 total indicator reading and rod gland groove diameter shall be concentric with rod bore diameter within 0.002 total indicator reading.

Note—Sizes 013 to 045 are not generally used for dynamic seals and are not ordinarily recommended for such service. In special cases where space or other factors dictate the desirability of small cross-sections, these sizes should be incorporated into a design only after a careful engineering analysis and thorough testing.

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
039	2.739	2.879	2.875	2.765	2.750	2.860
040	2.864	3.004	3.000	2.890	2.875	2.985
041	2.989	3.129	3.125	3.015	3.000	3.110
042	3.239	3.379	3.375	3.265	3.250	3.360
043	3.489	3.629	3.625	3.515	3.500	3.610
044	3.739	3.879	3.875	3.765	3.750	3.860
045	3.989	4.129	4.125	4.015	4.000	4.110
Tolerance	**±0.005 -0.000**	**— -0.003**	**+0.003 -0.003**	**+0.000 -0.000**	**+0.000**	**+0.003**
110	0.362	0.568	0.562	0.388	0.375	0.549
111	0.424	0.630	0.625	0.451	0.437	0.611
112	0.487	0.693	0.688	0.514	0.500	0.674
113	0.549	0.755	0.750	0.576	0.562	0.736
114	0.612	0.818	0.812	0.638	0.625	0.799
115	0.674	0.880	0.875	0.701	0.688	0.862
116	0.737	0.943	0.937	0.763	0.750	0.924
Tolerance	**±0.006**	—	**+0.003 -0.000**	**+0.000 -0.003**	**+0.000 -0.003**	**+0.003 -0.000**
117	0.799	1.005	1.000	0.826	0.812	0.986
118	0.862	1.068	1.062	0.888	0.875	1.049
119	0.924	1.130	1.125	0.951	0.937	1.111
120	0.987	1.193	1.188	1.014	1.000	1.174
121	1.049	1.255	1.250	1.076	1.062	1.236
122	1.112	1.318	1.312	1.138	1.125	1.299
123	1.174	1.380	1.375	1.201	1.188	1.362
124	1.237	1.443	1.437	1.263	1.250	1.424
125	1.299	1.505	1.500	1.326	1.312	1.486
126	1.362	1.568	1.562	1.389	1.375	1.549
127	1.424	1.630	1.625	1.451	1.437	1.611
128	1.487	1.693	1.688	1.514	1.500	1.674

W—Actual seal width
0.103 in ± 0.003 in
E—Groove width, in:
Dynamic—
0.087–0.090
Static:
Radial—
0.080–0.086
Axial—
0.072–0.080
F—Groove length, in—
0.140–0.150
R—Radius, in—
0.005–0.020
Cross-sectional squeeze, in, min:
Dynamic—0.010
Static:

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
Tolerance	**±0.010**	—	**+0.003 -0.000**	**+0.000 -0.003**	**+0.000 -0.003**	**+0.003 -0.000**
129	1.549	1.755	1.750	1.576	1.562	1.736
130	1.612	1.818	1.812	1.638	1.625	1.799
131	1.674	1.880	1.875	1.701	1.688	1.862
132	1.737	1.943	1.937	1.763	1.750	1.924
133	1.799	2.005	2.000	1.826	1.812	1.986
134	1.862	2.068	2.062	1.888	1.875	2.049
135	1.925	2.131	2.125	1.951	1.937	2.111
136	1.987	2.193	2.188	2.014	2.000	2.174
137	2.050	2.256	2.250	2.076	2.062	2.236
138	2.112	2.318	2.312	2.138	2.125	2.299
139	2.175	2.381	2.375	2.201	2.188	2.362
140	2.237	2.443	2.437	2.263	2.250	2.424
141	2.300	2.506	2.500	2.326	2.312	2.486
142	2.362	2.568	2.563	2.389	2.375	2.549
143	2.425	2.631	2.625	2.451	2.437	2.611
144	2.487	2.693	2.688	2.514	2.500	2.674
145	2.550	2.756	2.750	2.576	2.562	2.736
146	2.612	2.818	2.812	2.638	2.625	2.799
Tolerance	**±0.015**	—	**+0.003 −0.000**	**+0.000 −0.003**	**+0.000 −0.003**	**+0.003 −0.000**
147	2.675	2.881	2.875	2.701	2.688	2.862
148	2.737	2.943	2.937	2.763	2.750	2.924
149	2.800	3.006	3.000	2.826	2.812	2.986
150	2.862	3.068	3.062	2.888	2.875	3.049
151	2.987	3.193	3.188	3.014	3.000	3.174
152	3.237	3.442	3.437	3.263	3.250	3.424
153	3.487	3.693	3.688	3.514	3.500	3.674
154	3.737	3.943	3.937	3.763	3.750	3.924
155	3.987	4.193	4.188	4.014	4.000	4.174
156	4.237	4.443	4.437	4.263	4.250	4.424
157	4.487	4.693	4.687	4.514	4.500	4.674
158	4.737	4.943	4.937	4.763	4.750	4.924
159	4.987	5.193	5.188	5.014	5.000	5.174
Tolerance	**±0.023**	—	**+0.003 −0.000**	**+0.000 −0.003**	**+0.000 −0.003**	**+0.003 −0.000**
160	5.237	5.442	5.437	5.263	5.250	5.424
161	5.487	5.693	5.688	5.514	5.500	5.674
162	5.737	5.943	5.937	5.763	5.750	5.924
163	5.987	6.193	6.188	6.014	6.000	6.174

Radial—0.014
Axial—0.020

Piston groove diameter shall be concentric with piston OD within 0.003 total indicator reading and rod gland groove diameter shall be concentric with rod bore diameter within 0.003 total indicator reading.

Sizes 117 to 163 are not generally used for dynamic seals and are not ordinarily recommended for such service. In special cases where space or other factors dictate the desirability of small cross-sections, these sizes should be incorporated into a design only after a careful engineering analysis and thorough testing.

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
Tolerance	**±0.006**	—	**+0.004 −0.000**	**0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
210	0.734	1.012	1.000	0.762	0.750	0.988
211	0.796	1.074	1.062	0.824	0.812	1.050
212	0.859	1.137	1.125	0.887	0.870	1.113
213	0.921	1.199	1.188	0.950	0.937	1.175
214	0.984	1.262	1.250	1.012	1.000	1.238
215	1.046	1.324	1.312	1.075	1.062	1.300
216	1.109	1.387	1.375	1.137	1.125	1.363
217	1.171	1.449	1.437	1.199	1.188	1.426
218	1.234	1.512	1.500	1.262	1.250	1.488
219	1.296	1.574	1.562	1.324	1.312	1.550
220	1.359	1.637	1.625	1.387	1.375	1.613
221	1.421	1.699	1.688	1.450	1.437	1.675
222	1.484	1.762	1.750	1.512	1.500	1.738
Tolerance	**±0.010**	—	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
223	1.609	1.887	1.875	1.637	1.625	1.863
224	1.734	2.012	2.000	1.762	1.750	1.988
225	1.859	2.137	2.125	1.887	1.875	2.113
226	1.984	2.262	2.250	2.012	2.000	2.238
227	2.109	2.387	2.375	2.137	2.125	2.363
228	2.234	2.512	2.500	2.262	2.250	2.488
229	2.359	2.637	2.625	2.387	2.375	2.613
230	2.484	2.762	2.750	2.512	2.500	2.738
231	2.609	2.887	2.875	2.637	2.625	2.863
Tolerance	**±0.015**	—	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
232	2.734	3.012	3.000	2.762	2.750	2.988
233	2.859	3.137	3.125	2.887	2.875	3.113
234	2.984	3.262	3.250	3.012	3.000	3.238
235	3.109	3.387	3.375	3.137	3.125	3.363
236	3.234	3.512	3.500	3.262	3.250	3.488
237	3.359	3.637	3.625	3.387	3.375	3.613
238	3.484	3.762	3.750	3.512	3.500	3.738

W—Actual seal width
0.139 in ± 0.004 in

E—Groove width, in:
Dynamic—
0.119–0.123
Static:
Radial—
0.112–0.118
Axial—
0.100–0.110

F—Groove length, in—
0.180–0.190

R—Radius, in—
0.005–0.030

Cross-sectional squeeze, in, min:
Dynamic—0.012
Static:
Radial—0.017
Axial—0.025

Piston groove diameter shall be concentric with piston OD within 0.004 total indicator reading and rod gland groove diameter shall be concentric with rod bore diameter within 0.004 total indicator reading.

Sizes 223 to 281 are not generally used for dynamic seals and are not ordinarily recommended for such service. In special cases where space or other factors dictate the desirability of small cross-sections, these sizes should be incorporated into a design only after a careful engineering analysis and thorough testing.

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
Tolerance	**±0.015**	**—**	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
239	3.609	3.887	3.875	3.637	3.625	3.863
240	3.734	4.012	4.000	3.762	3.750	3.988
241	3.859	4.137	4.125	3.887	3.875	4.113
242	3.984	4.262	4.250	4.012	4.000	4.238
243	4.109	4.387	4.375	4.137	4.125	4.363
244	4.234	4.512	4.500	4.262	4.259	4.488
245	4.359	4.637	4.625	4.387	4.375	4.613
246	4.484	4.762	4.750	4.512	4.500	4.738
247	4.609	4.887	4.875	4.637	4.625	4.863
248	4.734	5.012	5.000	4.762	4.750	4.988
249	4.859	5.137	5.125	4.887	4.875	5.113
250	4.984	5.262	5.250	5.012	5.000	5.238
Tolerance	**±0.023**	**—**	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
251	5.109	5.387	5.375	5.137	5.125	5.363
252	5.234	5.512	5.500	5.262	5.250	5.488
253	5.359	5.637	5.625	5.385	5.375	5.613
254	5.484	5.762	5.750	5.512	5.500	5.730
255	5.609	5.887	5.875	5.637	5.625	5.863
256	5.734	6.012	6.000	5.762	5.750	5.988
257	5.859	6.137	6.125	5.887	5.875	6.113
258	5.984	6.262	6.250	6.012	6.000	6.238
259	6.234	6.512	6.500	6.262	6.250	6.488
260	6.484	6.762	6.750	6.512	6.500	6.738
261	6.734	7.012	7.000	6.762	6.750	6.988
262	6.984	7.262	7.250	7.012	7.000	7.238
Tolerance	**±0.030**	**—**	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
263	7.234	7.512	7.500	7.262	7.250	7.488
264	7.484	7.762	7.750	7.512	7.500	7.738
265	7.734	8.012	8.000	7.762	7.750	7.988
266	7.984	8.262	8.250	8.012	8.000	8.238
267	8.234	8.512	8.500	8.262	8.250	8.488
268	8.484	8.762	8.750	8.512	8.500	8.738
269	8.734	9.012	9.000	8.762	8.750	8.988
270	8.984	9.262	9.250	9.012	9.000	9.238
271	9.234	9.512	9.500	9.262	9.250	9.488
272	9.484	9.762	9.750	9.512	9.500	9.738
273	9.734	10.012	10.000	9.762	9.750	9.988
274	9.984	10.262	10.250	10.012	10.000	10.238

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia
Tolerance	**±0.040**	—	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
275	10.484	10.762	10.750	10.512	10.500	10.738
276	10.984	11.262	11.250	11.012	11.000	11.238
277	11.484	11.762	11.750	11.512	11.500	11.738
278	11.984	12.262	12.250	12.012	12.000	12.238
Tolerance	**±0.050**	—	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
279	12.984	13.262	13.250	13.012	13.000	13.238
280	13.984	14.262	14.250	14.012	14.000	14.238
Tolerance	**±0.060**	—	**+0.004 −0.000**	**+0.000 −0.004**	**+0.000 −0.004**	**+0.004 −0.000**
281	14.984	15.262	15.250	15.012	15.000	15.238
Tolerance	**±0.010**	—	**+0.005 −0.000**	**+0.000 −0.005**	**+0.000 −0.005**	**+0.005 −0.000**
325	1.475	1.895	1.875	1.509	1.500	1.866
326	1.600	2.020	2.000	1.634	1.625	1.991
327	1.725	2.145	2.125	1.759	1.750	2.116
328	1.850	2.270	2.250	1.884	1.875	2.241
329	1.975	2.395	2.375	2.009	2.000	2.366
330	2.100	2.520	2.500	2.134	2.125	2.491
331	2.225	2.645	2.625	2.259	2.250	2.616
332	2.350	2.770	2.750	2.384	2.375	2.741
333	2.475	2.895	2.875	2.509	2.500	2.866
334	2.600	3.020	3.000	2.634	2.625	2.991
335	2.725	3.145	3.125	2.759	2.750	3.116
336	2.850	3.270	3.250	2.884	2.875	3.241
337	2.975	3.395	3.375	3.009	3.000	3.366
338	3.100	3.520	3.500	3.134	3.125	3.491
339	3.225	3.645	3.625	3.259	3.250	3.616
340	3.350	3.770	3.750	3.384	3.375	3.741
341	3.475	3.985	3.875	3.509	3.500	3.866
342	3.600	4.020	4.000	3.634	3.625	3.991
343	3.725	4.145	4.125	3.759	3.750	4.116
344	3.850	4.270	4.250	3.884	3.875	4.241
345	3.975	4.395	4.375	4.009	4.000	4.366
346	4.100	4.520	4.500	4.134	4.125	4.491
347	4.225	4.645	4.625	4.259	4.250	4.616
348	4.350	4.770	4.750	4.384	4.375	4.741
349	4.475	4.895	4.875	4.509	4.500	4.866

W—Actual seal width
0.210 in ± 0.005 in
E—Groove width, in:
Dynamic—
0.183–0.188
Static:
Radial—
0.176–0.184
Axial—
0.165–0.175
F—Groove length, in—
0.280–0.290
R—Radius, in—
0.005–0.050
Cross-sectional squeeze, in, min:
Dynamic—0.017
Static:
Radial—0.021
Axial—0.030

Piston groove diameter shall be concentric with piston OD within 0.006 total indicator reading and rod gland groove diameter shall be concentric with rod bore diameter within 0.006 total indicator reading.

TABLE 2—DIMENSIONS AND TOLERANCES, IN (CONTINUED)

Size No.	Actual Size ID	Actual Size OD (Ref)	Dynamic Seals A Cylinder Bore Dia	Dynamic Seals B Piston Groove Dia	Dynamic Seals C Rod Dia	Dynamic Seals D Rod Gland Groove Dia	
Tolerance	**±0.015**	—	**+0.006 −0.000**	**−0.006**	**−0.006**	**−0.000**	
425	4.475	5.025	5.000	4.532	4.500	4.968	W—Actual seal width
426	4.600	5.150	5.125	4.657	4.625	5.093	0.275 in ± 0.006 in
427	4.725	5.275	5.250	4.782	4.750	5.218	E—Groove width, in:
428	4.850	5.400	5.375	4.907	4.875	5.343	Dynamic—
429	4.975	5.525	5.500	5.032	5.000	5.468	0.234–0.240
Tolerance	**±0.023**	—	**+0.006 −0.000**	**−0.006**	**−0.006**	**−0.000**	Static:
430	5.100	5.650	5.625	5.157	5.125	5.593	Radial—
431	5.225	5.775	5.750	5.282	5.250	5.718	0.225–0.235
432	5.350	5.900	5.875	5.407	5.375	5.843	Axial—
433	5.475	6.025	6.000	5.532	5.500	5.968	0.220–0.230
434	5.600	6.150	6.125	5.657	5.625	6.093	F—Groove length, in—
435	5.725	6.275	6.250	5.782	5.750	6.218	0.370–0.380
436	5.850	6.400	6.375	5.907	5.875	6.343	R—Radius, in—
437	5.975	6.525	6.500	6.032	6.000	6.468	0.005–0.060
438	6.225	6.775	6.750	6.282	6.250	6.718	Cross-sectional squeeze, in, min:
439	6.475	7.025	7.000	6.532	6.500	6.986	Dynamic—0.029
Tolerance	**±0.015**	—	**+0.006 −0.000**	**−0.006**	**−0.006**	**−0.000**	Static:
440	6.725	7.275	7.250	6.782	6.750	7.218	Radial—0.034
441	6.975	7.525	7.500	7.032	7.000	7.468	Axial—0.039
442	7.225	7.775	7.750	7.282	7.250	7.718	Piston groove diameter shall be concentric with piston OD within 0.008 total indicator reading and rod gland groove diameter shall be concentric with rod bore diameter within 0.008 total indicator reading.
443	7.475	8.025	8.000	7.532	7.500	7.968	
444	7.725	8.275	8.250	7.782	7.750	8.218	
445	7.975	8.525	8.500	8.032	8.000	8.468	
446	8.475	9.025	9.000	8.532	8.500	8.968	
Tolerance	**±0.015**		**+0.006 −0.000**	**−0.006**	**−0.006**	**−0.000**	
447	8.975	9.525	9.500	9.032	9.000	9.468	
448	9.475	10.025	10.000	9.532	9.500	9.968	
449	9.975	10.525	10.500	10.032	10.000	10.468	
450	10.475	11.025	11.000	10.532	10.500	10.968	
451	10.975	11.525	11.500	11.032	11.000	11.468	
452	11.475	12.025	12.000	11.532	11.500	11.968	
453	11.975	12.525	12.500	12.032	12.000	12.468	
454	12.475	13.025	13.000	12.532	12.500	12.968	
455	12.975	13.525	13.500	13.032	13.000	13.468	
456	13.475	14.025	14.000	13.532	13.500	13.968	
457	13.975	14.525	14.500	14.032	14.000	14.468	
458	14.475	15.025	15.000	14.532	14.500	14.968	
459	14.975	15.525	15.500	15.032	15.000	15.468	
460	15.475	16.025	16.000	15.532	15.500	15.968	

TABLE 3—O-RING NUMBERS

Number	Section Dia, in	Number	Section Dia, in
006 to 045	0.070 ± 0.003	325 to 349	0.210 ± 0.005
110 to 163	0.103 ± 0.003	425 to 460	0.275 ± 0.006
210 to 281	0.139 ± 0.004		

3.6 Methods of Test—The properties enumerated in these specifications shall be determined in accordance with the following methods of the American Society for Testing and Materials:

a. Hardness—The hardness reading shall be taken before and after aging by means of a durometer in accordance with ASTM D 676. Take hardness readings on sheet stock only.

b. Tensile Strength, Elongation, and Modulus—The tensile strength, elongation, and modulous of sheet stock shall be taken in accordance with ASTM D 412 and for seals in accordance with ASTM D 1414. For testing the molded parts, pull the entire ring, using ring spool tester attachments on the testing machine. An exception is made in paragraph (d) on Fluid Aging.

c. Heat Aging—Heat aging tests shall be conducted in accordance with ASTM D 573. If ASTM D 865 is used, it shall be referenced in the report.

d. Fluid Aging—The fluid immersion tests shall be conducted in accordance with ASTM D 471. When oil aging is to be performed on rings of a diameter greater than the width of the aging container, cut segments from the rings. This is to eliminate stress cracking which may occur where a large ring is bent, as in a test tube. When segments are used for aged data, use them for original property determinations. The dry-out volume after 4 h at 158 °F is based on the original unaged volume of the sample.

e. Compression Set—The compression set shall be conducted in accordance with Method B of ASTM D 395. Express compression set as a percentage of the original deflection. The specimen may be either in 1/2 in disc-molded or plied up from sheet stock, or O-rings 0.100 in in nominal cross section or larger, or both.

f. Low Temperature Aging—Low temperature evaluation shall be made on sheet stock by ASTM D 746. Molded parts shall be subjected to a 180 degree twist forming a figure eight while at the required temperature. This is to be accomplished by the use of suitable hooks or tongs, preconditioned at the testing temperature.

3.7 Identification—When requested by the purchaser, O-rings shall be marked with a nonpermanent colored stripe approximately 1/16 in wide and approximately 45 degrees of the seal circumference of 1/2 in, whichever is smaller. The color of the stripe shall be as follows:

a. Oil resistant service—yellow
b. Fuel resistant service—red

4. 120R2-Rectangular Section Rubber Seal Rings for Automotive Applications

4.1 Scope

a. This SAE Recommended Practice covers the dimensional and material requirements of rectangular section rubber seal rings for use in automotive sealing applications.
b. The materials and groove dimensions covered in these specifications are recommended for static applications only in which the fluid pressures do not exceed 1500 psi. For higher pressures, either extended service tests should be performed or the suppliers should be contacted for recommendations. Rectangular section seals should never be used in rotary or oscillating applications and are not generally intended for use as dynamic seals, although they have performed satisfactorily in some dynamic applications. It is advised that extensive service tests be conducted before rectangular section rings are released for dynamic uses.

4.2 Basis of Purchase—To specify the rectangular section seal desired, each engineering drawing shall list the SAE specification number, material classification, and size number covering the proper size ring. The letter "R" in the size number will designate a rectangular section seal ring.

EXAMPLE—SAE Specification 120R2M
Class I
Size R128

4.3 Detail Requirements

a. Refer to 120R1 of SAE J120 for material identification, physical properties, and test methods. It is intended that the same material shall be used for both O-rings and rectangular section seal rings for each material classification.
b. For applications requiring resistance to special fluids, numerous compounds are available. For these applications the suppliers should be contacted for their compound recommendations. (See tables in SAE J200 for designation.)

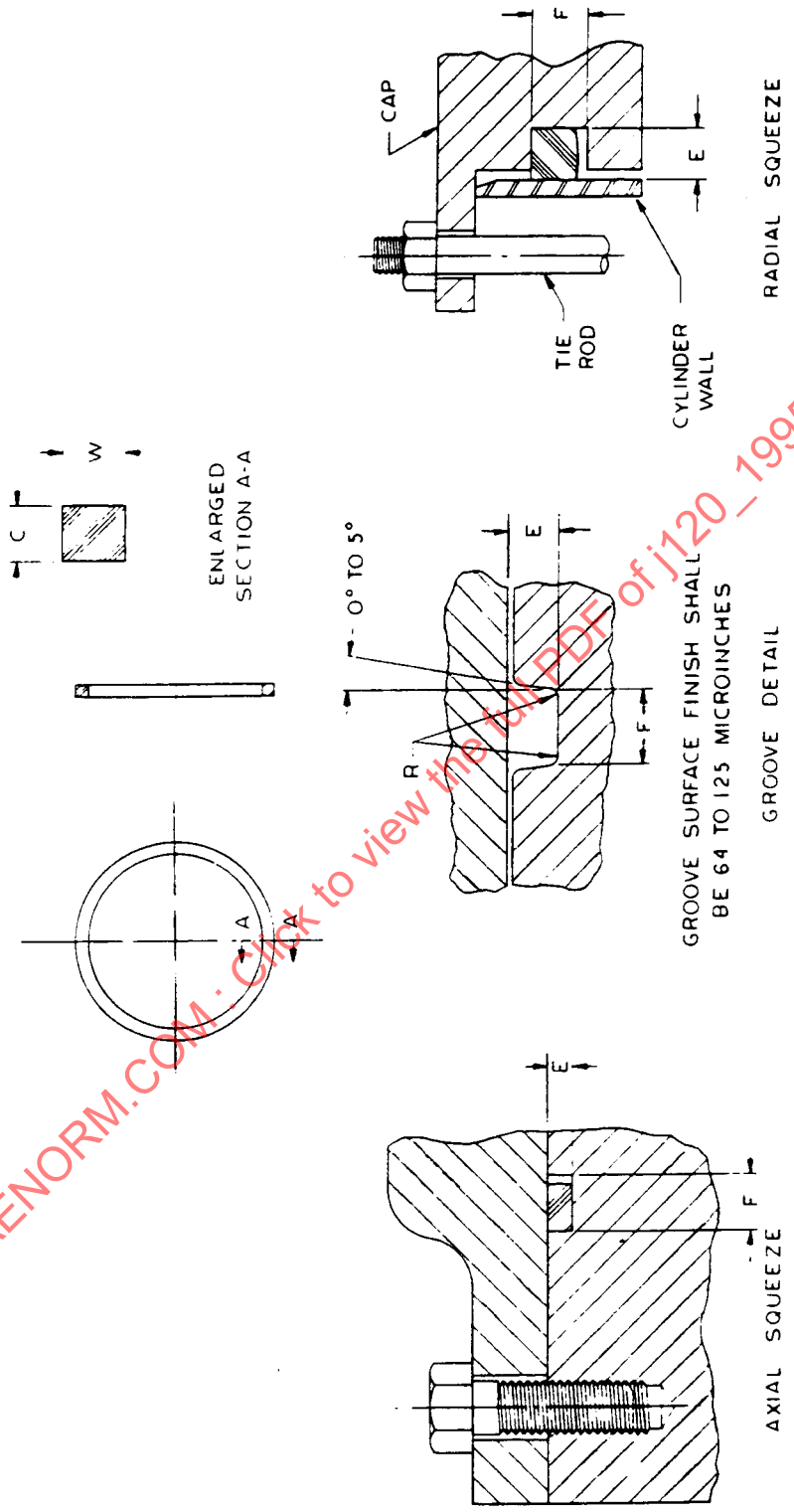


FIGURE 2—TYPICAL DESIGN EXAMPLES FOR RECTANGULAR SECTION SEAL RINGS

TABLE 4—GROOVES FOR RECTANGULAR SECTION SEAL RINGS

Size No.	Size, in Nominal ID	Size, in Nominal OD	Size, in Nominal W	Size, in Actual ID	Size, in Actual OD (Ref)	See Figure 2, for identification of dimensions W, C, E, F, and R
		Tolerance ±0.005				W—Actual seal width
R006	1/8	1/4	1/16	0.114	0.246	0.066 in ± 0.004 in
R007	5/32	9/32	1/16	0.145	0.277	C—Actual seal length
R008	3/16	5/16	1/16	0.176	0.308	0.066 in ± 0.003 in
R009	7/32	11/32	1/16	0.208	0.340	E—Groove width
R010	1/4	3/8	1/16	0.239	0.371	0.055 to 0.057 in
R011	5/16	7/16	1/16	0.301	0.433	F—Groove length
R012	3/8	1/2	1/16	0.364	0.496	0.090 to 0.100 in
R013	7/16	9/16	1/16	0.426	0.558	R—Radius 0.005 to 0.015 in
R014	1/2	5/8	1/16	0.489	0.621	Cross-sectional squeeze, 0.005 in, min
R015	9/16	11/16	1/16	0.551	0.683	
R016	5/8	3/4	1/16	0.614	0.746	
R017	11/16	13/16	1/16	0.676	0.808	
R018	3/4	7/8	1/16	0.739	0.871	
		Tolerance ±0.006				
R019	13/16	15/16	1/16	0.801	0.933	
R020	7/8	1	1/16	0.864	0.996	
R021	15/16	1-1/16	1/16	0.926	1.058	
R022	1	1-1/8	1/16	0.989	1.121	
R023	1-1/16	1-3/16	1/16	1.051	1.183	
R024	1-1/8	1-1/4	1/16	1.114	1.246	
R025	1-3/16	1-5/16	1/16	1.176	1.308	
R026	1-1/4	1-3/8	1/16	1.239	1.371	
R027	1-5/16	1-7/16	1/16	1.301	1.433	
R028	1-3/8	1-1/2	1/16	1.364	1.496	
		Tolerance ±0.010				
R029	1-1/4	1-5/8	1/16	1.489	1.621	
R030	1-5/8	1-3/4	1/16	1.614	1.746	
R031	1-3/4	1-7/8	1/16	1.739	1.871	
R032	1-7/8	2	1/16	1.864	1.996	
R033	2	2-1/8	1/16	1.989	2.121	
R034	2-1/8	2-1/4	1/16	2.114	2.246	
R035	2-1/4	2-3/8	1/16	2.239	2.371	
R036	2-3/8	2-1/2	1/16	2.364	2.496	
R037	2-1/2	2-5/8	1/16	2.489	2.621	
R038	2-5/8	2-3/4	1/16	2.614	2.746	
		Tolerance ±0.015				
R039	2-3/4	2-7/8	1/16	2.739	2.871	
R040	2-7/8	3	1/16	2.864	2.996	
R041	3	3-1/8	1/16	2.989	3.121	
R042	3-1/4	3-3/8	1/16	3.239	3.371	
R043	3-1/2	3-5/8	1/16	3.489	3.621	
R044	3-3/4	3-7/8	1/16	3.739	3.871	
R045	4	4-1/8	1/16	3.989	4.121	

TABLE 4—GROOVES FOR RECTANGULAR SECTION SEAL RINGS (CONTINUED)

Size No.	Size, in Nominal ID	Size, in Nominal OD	Size, in Nominal W	Size, in Actual ID	Size, in Actual OD (Ref)	See Figure 2, for identification of dimensions W, C, E, F, and R
		Tolerance ±0.005				W—Actual seal width
R110	3/8	9/16	3/32	0.362	0.560	0.099 in ± 0.004 in
R111	7/16	5/8	3/32	0.424	0.622	C—Actual seal length
R112	1/2	11/16	3/32	0.487	0.685	0.099 in ± 0.003 in
R113	9/16	3/4	3/32	0.549	0.747	E—Groove width
R114	5/8	13/16	3/32	0.612	0.810	0.087 to 0.090 in
R115	11/16	7/8	3/32	0.674	0.872	F—Groove length
R116	3/4	15/16	3/32	0.737	0.935	0.140 to 0.150 in
		Tolerance ±0.006				R—Radius 0.005 to 0.015 in
R117	13/16	1	3/32	0.799	0.997	Cross-sectional squeeze, 0.005 in, min
R118	7/8	1-1/16	3/32	0.862	1.060	
R119	15/16	1-1/8	3/32	0.924	1.122	
R120	1	1-3/16	3/32	0.987	1.185	
R121	1-1/16	1-1/4	3/32	1.049	1.247	
R122	1-1/8	1-5/16	3/32	1.112	1.310	
R123	1-3/16	1-3/8	3/32	1.174	1.372	
R124	1-1/4	1-7/16	3/32	1.237	1.435	
R125	1-5/16	1-1/2	3/32	1.299	1.497	
R126	1-3/8	1-9/16	3/32	1.362	1.560	
R127	1-7/16	1-5/8	3/32	1.424	1.622	
R128	1-1/2	1-11/16	3/32	1.487	1.685	
		Tolerance ±0.010				
R129	1-9/16	1-3/4	3/32	1.549	1.747	
R130	1-5/8	1-13/16	3/32	1.612	1.820	
R131	1-11/16	1-7/8	3/32	1.674	1.872	
R132	1-3/4	1-15/16	3/32	1.737	1.935	
R133	1-13/16	2	3/32	1.799	1.997	
R134	1-7/8	2-1/16	3/32	1.862	2.060	
R135	1-15/16	2-1/8	3/32	1.925	2.123	
R136	2	2-3/16	3/32	1.987	2.185	
R137	2-1/16	2-1/4	3/32	2.050	2.248	
R138	2-1/8	2-5/16	3/32	2.112	2.310	
R139	2-3/16	2-3/8	3/32	2.175	2.373	
R140	2-1/4	2-7/16	3/32	2.237	2.435	
R141	2-5/16	2-1/2	3/32	2.300	2.498	
R142	2-3/8	2-9/16	3/32	2.362	2.560	
R143	2-7/16	2-5/8	3/32	2.425	2.623	
R144	2-1/2	2-11/16	3/32	2.487	2.685	
R145	2-9/16	2-3/4	3/32	2.550	2.748	
R146	2-5/8	2-13/16	3/32	2.612	2.810	