



Fastener and Fitting Seals

Catalog CSS-6431/USA





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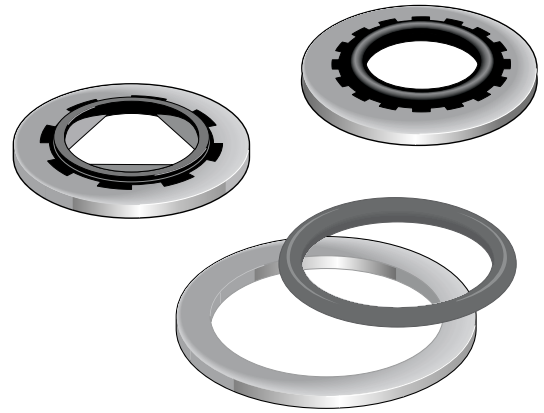
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Introduction

Most fluid systems have fasteners that must be sealed. Parker's fastener seal designs found in the Stat-O-Seals® and ThredSeals® feature an elastomeric sealing element molded in place within a metal retainer (washer). Although resembling a simple o-ring groove concept, the mold in place fastener seal offers numerous advantages. Ideal for sealing small and miniature sizes, the Parker Lock-O-Seal® is a two-piece combination seal comprising a separately molded o-ring fitted within a surrounding metal washer. Other speciality fastener seals are also available.



Stat-O-Seals

- Intended to seal the shank of a bolt immediately under the head
- 600 Series: Intended for sealing standard series fasteners
- NAS1523 Series: Applications that require conformance to NAS1523
- 610 Series: Intended for sealing metric fasteners from 5mm to 22mm

ThredSeals

- Intended for sealing directly on the fastener threads
- 750 Series: Intended for sealing most UNC and UNF threads

Lock-O-Seals

- 800 Series: Intended to seal the shank of a bolt immediately under the head
- Ideal for sealing small and miniature sizes
- Special material combinations not available as a 600 Series Stat-O-Seal

Specialty Products

- Fastener seal kits
- 250 Lock-O-Seals for sealing straight tube fittings and banjo style fittings
- Food, beverage and FDA related applications
- Custom designed fastener and fitting seals

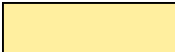
How to Use This Guide

Building a Part Number

This guide includes an intelligent part numbering system which allows users to build their own part number from a wide selection of available elastomers, retainer materials, and part sizes. Each material option and size is color coded to guide the user towards the most economical and readily available part number selections.

 = **Standard: General Application**

Whenever possible materials and sizes represented in white should be selected. These material combinations and sizes are the most economical and readily available, and will work for most general industrial applications.

 = **Non-Standard**

If there are specific application requirements such as sealing aggressive fluids, extreme temperatures, or certification requirements that are outside the recommended usage parameters for “white” coded materials, those that are color coded yellow should be evaluated next. Some part numbers built from “yellow” coded materials may have price premiums and/or slightly longer lead times due to raw material cost, manufacturability and economies of scale.

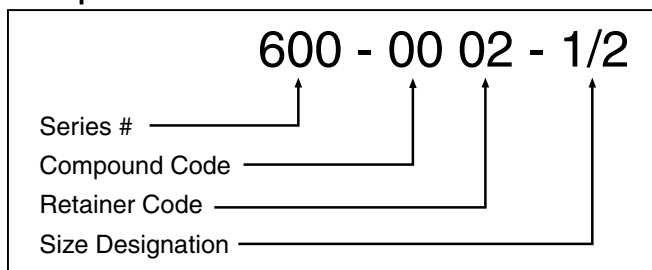
 = **Special: Consult Factory Prior to Ordering**

When none of the “white” and/or “yellow” coded material or size combinations meet your application requirements the options that are color coded “gray” should then be considered. Consult the Parker CSS Division prior to ordering part numbers which consist of “gray” coded material or size options. Special minimums, production preparation charges, and/or extended lead times may apply. Some material and size combinations are not feasible to manufacture and are thus not available.

NAS1523 Series

Material color codes do not apply to NAS1523 Series. Material selections are governed by NAS specifications.

Example Part Number

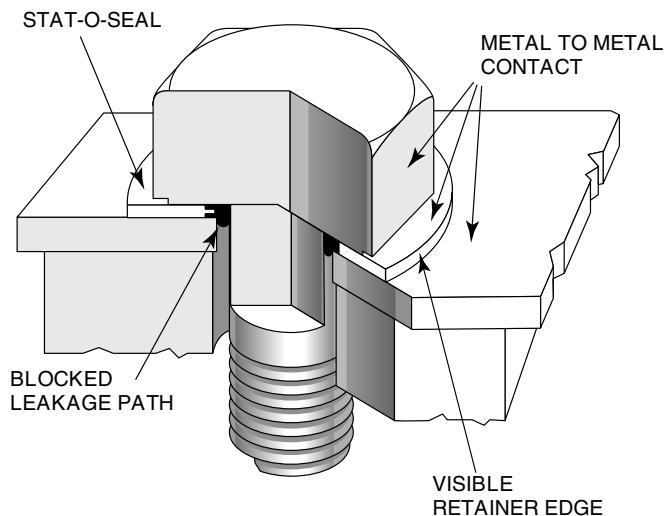


Stat-O-Seal

How the Stat-O-Seal Works

The Stat-O-Seal is designed with a pre-calculated interference factor built into the teardrop shaped elastomeric seal. The cross section free height of the rubber is greater than the metal retainer, providing the proper compression without squeezing the seal beyond its elastic limit.

As the fastener is installed into the mating hardware, the Stat-O-Seal is compressed down to the retainer thickness. The retainer provides a positive alternate load path for fastener torque and forms a protective gland area for the confinement of the seal in a controlled state. Since the elastomer seal cannot move outward, the mass of the seal is forced inward against the shank of the fastener and against the mating surfaces, creating a positive seal. This principle is known as **controlled confinement sealing**. The diameter of the fastener head should always exceed that of the maximum "E diameter" (see dimensional sketch on page 5) in order to preserve this principle.



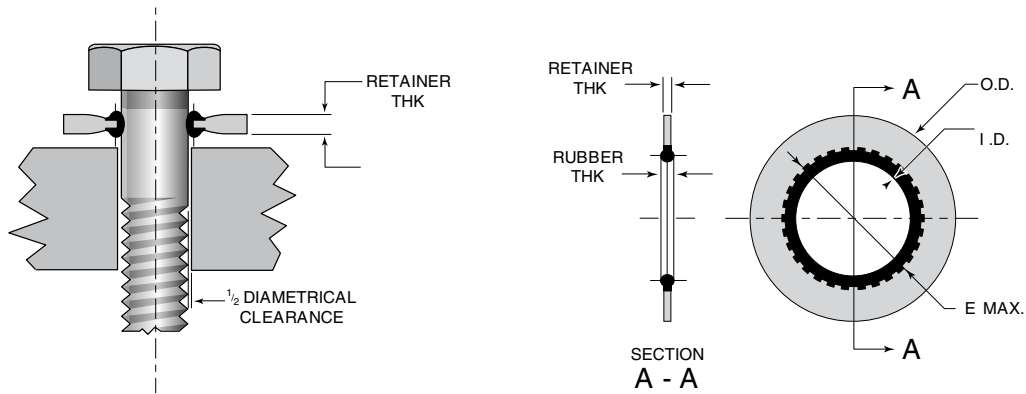
Stat-O-Seal Features

Parker Stat-O-Seals are one-piece, molded-in-place seals with the rubber sealing element mechanically and/or chemically bonded to the metal retainer. Parker's "Splined and Coined" mechanically bonding feature is used on many 600, NAS1523 and 610 series sizes. This feature ensures a positive attachment of the rubber to the retainer, eliminating missing or loose seal elements associated with bonded seals. Stat-O-Seals are designed to seal beneath the head of the fastener as shown for both internal and external pressure and vacuum systems.

Stat-O-Seals offer users long and reliable service, a high degree of reusability and easy assembly. The Stat-O-Seal's unique features provide many advantages and benefits as shown below:

- No machined O-ring grooves are required in the mating flange
- Precisely controlled optimum percent squeeze eliminates over compression
- The retainer edge is visible after installation allowing for easy visual inspection and reducing failures caused by missing seals
- The ridged self centering design provides easy and accurate placement of the seal
- The solid metal to metal contact improves joint stability and eliminates re-torquing
- Long reliable service and a high level of reusability
- Rubber/bolt interference provides for easy assembly

600 Series Stat-O-Seal – Designed for Standard Series Fasteners



600 Series Stat-O-Seal Dimensions							
Fastener Size (Ref.)	Thread Major Diameter (Ref.)	I.D. ± .010	E Diameter* Max.	O.D. ± .010	Retainer Thickness	Rubber Thickness	Diametrical Clearance** (Ref.)
#6	0.138	.130	.229	.385	.040 ± .004	.050 ± .003	1/64 Max.
#8	.164	.156	.255	.385	.040 ± .004	.050 ± .003	1/64 Max.
#10	.190	.180	.317	.443	.050 ± .005	.072 ± .005	1/64 Max.
#10 O/S	.190	.186	.365	.468			1/64 to 1/32
1/4	.250	.240	.381	.505			1/64 Max.
1/4 OS	.250	.245	.422	.531			1/64 to 1/32
5/16	.312	.301	.488	.603			
3/8	.375	.364	.546	.666			
7/16	.438	.427	.618	.760			
1/2	.500	.490	.696	.880			
9/16	.562	.552	.759	1.067			
5/8	.625	.615	.818	1.193	▼	▼	
11/16	.688	.674	.898	1.260	.050 ± .005	.072 ± .005	
3/4	.750	.740	.982	1.322	.064 ± .005	.096 ± .005	
13/16	.812	.798	1.048	1.416			
7/8	.875	.864	1.105	1.510			
15/16	.938	.921	1.172	1.635			
1	1.000	.988	1.234	1.760			
1 1/16	1.063	1.050	1.290	1.822			
1 1/8	1.125	1.106	1.351	1.885			
1 3/16	1.188	1.167	1.442	1.947			
1 1/4	1.250	1.229	1.474	2.010			
1 5/16	1.313	1.290	1.567	2.072			
1 3/8	1.375	1.352	1.631	2.135	▼	▼	
1 7/16	1.438	1.413	1.693	2.197	.064 ± .005	.096 ± .005	
1 1/2	1.500	1.475	1.817	2.260	.091 ± .005	.133 ± .005	
1 5/8	1.625	1.600	1.942	2.385			
1 3/4	1.750	1.725	2.067	2.510			
1 7/8	1.875	1.850	2.192	2.635	▼	▼	
2	2.000	1.975	2.317	2.760	.091 ± .005	.133 ± .005	▼
3	3.000	2.975	3.430	5.500	.120 ± .005	.175 ± .005	1/64 to 1/32

Notes:

* The fastener head diameter must be greater than the “E” diameter. A cover washer is recommended when the fastener head is near or below the “E” diameter.

** A chamfer with an outside diameter equal to that of the recommended diametrical clearance may be used.



600-XX XX - X

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temp.
00	Commercial Standard Nitrile	None General Purpose	General industrial environments, petroleum fluids and cold/room temperature water	-30°F to +225°F
01	N406-60 Nitrile	SAE AMS-R-6855, CL 1 or 2, Grade 60 (*1)	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
04	47-071 Nitrile	SAE AMS-R-7362, TYPE 1 or 2 Grade 60 (*1)	MIL-PRF-7808 Synthetic engine oil	-60°F to +180°F
06	S604-70 Silicone	SAE AMS 3304	Air, weathering and gases	-65°F to +400°F
07	C408-70 Neoprene	ASTM D2000 M3BC710 A14 B4 E034 F17 Z1	Refrigerant, Silicate ester fluids, weathering.	-35°F to +250°F
31	V720-75 Fluorocarbon	SAE AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F
50	E1267-80 Ethylene Propylene	NAS 1613	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-70°F to +250°F
60	L1830-60 Fluorosilicone	SAE AMS-R-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F
63	S355-75 Silicone	SAE AMS 7267	FDA conforming compound: Air, weathering and gases.	-60°F to +400°F
83	E515-80 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F
02	N304-75 Nitrile	SAE AMS-P-25732	Jet fuel, low temperature applications, petroleum fluids and cold/room temperature water	-65°F to +225°F
05	N602-70 Nitrile	SAE AMS-P-5315	General industrial environments, petroleum fluids and cold/room temperature water	-70°F to +180°F
82	B318-70 Butyl	SAE AMS 3238	Skydrol and other phosphate esters, water, steam and air	-65°F to +212°F
81	E529-60 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F



600-XX XX - X

Code	Retainer Material	Finish
02	Low-Carbon Steel, ASTM A 109/A 109M	Zinc Plated, Commercial Grade
00	Low-Carbon Steel, Commercial Grade	Cadmium Plated, Commercial Grade
01	Low-Carbon Steel, ASTM A 109/A 109M	Cadmium Plated Per SAE AMS-QQ-P-416
15	7075-T6 Aluminum SAE AMS-QQ-A-250/12	Anodize Per MIL-A-8625, Type II, Class I
30	302/304 Stainless Steel, SAE AMS 5513	Passivate Per SAE AMS-QQ-P-35
42	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 125,000 psi min tensile strength	Cadmium Plated Per SAE AMS-QQ-P-416 Type II, Dyed Black, Class 2
43	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 125,000 psi min tensile strength	Zinc Plated Per ASTM B 633 Type II, Dyed Black

Size (dash number)
6
8
10
10 O/S
1/4
1/4 OS
5/16
3/8
7/16
1/2
9/16
5/8
3/4
7/8
1
11/16
13/16
15/16
1 1/16
1 1/8
1 3/16
1 1/4
1 5/16
1 3/8
1 7/16
1 1/2
1 5/8
1 3/4
1 7/8
2
3

	= Standard: General application
	= Non-Standard
	= Special: Consult factory prior to ordering

Notes:

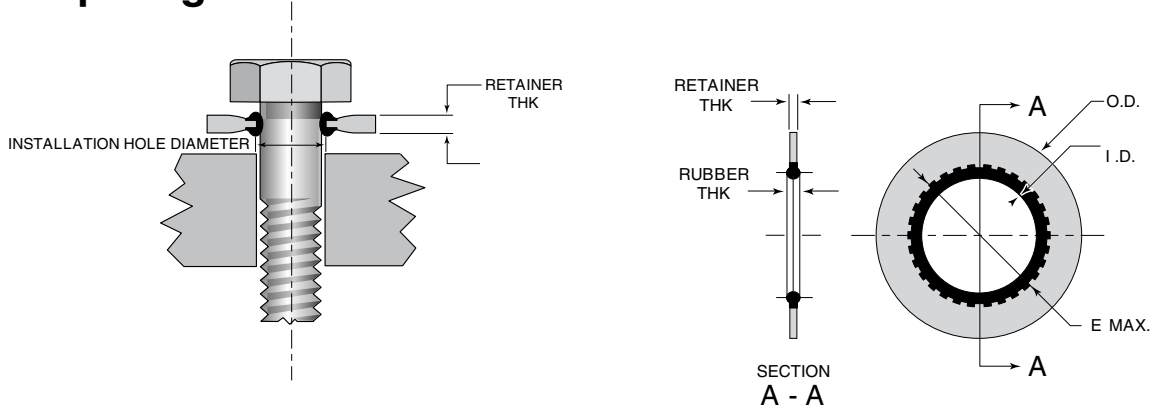
- *1: Compound meets both the Class 1 and Class 2 requirements. Certs will be issued to Class 1 unless Class 2 is specifically requested.
- 2: For more detailed compound information, see the Parker O-Ring Handbook (ORD 5700).

Example Part Number:

600-0002-1/2 = Commercial Standard Nitrile, Steel-Zinc Plated, Size 1/2



NAS1523 Series Stat-O-Seal – Designed for Applications Requiring NAS1523 Conformance



NAS1523 Stat-O-Seal Dimensions							
NAS Dash Number	Fastener Size (Ref.)	I.D. ± .010	E Diameter Max.	O.D. + .020 / - .005	Retainer Thickness	Rubber Thickness	Installation Hole Dia. (Ref.)
-06	#6	.130	.229	0.375	.040 ± .004	.050 ± .003	.137/.154
-08	#8	.156	.255	0.375	.040 ± .004	.050 ± .003	.165/.180
-3	#10	.180	.317	0.438	.050 ± .005	.072 ± .005	.191/.205
-4	1/4	.240	.445	0.500			.251/.265
-5	5/16	.301	.508	0.593			.327/.344
-6	3/8	.364	.571	0.656			.390/.405
-7	7/16	.427	.634	0.750			.453/.468
-8	1/2	.490	.696	0.875			.515/.531
-9	9/16	.552	.759	1.062			.577/.594
-10	5/8	.615	.818	1.188	▼	▼	.640/.656
-11	11/16	.674	.924	1.250	.050 ± .005	.072 ± .005	.703/.718
-12	3/4	.740	.982	1.312	.064 ± .005	.096 ± .005	.765/.781
-13	13/16	.798	1.048	1.406			.827/.843
-14	7/8	.864	1.105	1.500			.890/.906
-15	15/16	.921	1.172	1.625			.953/.968
-16	1	.988	1.234	1.750			1.015/1.032
-17	1 1/16	1.050	1.290	1.812			1.077/1.093
-18	1 1/8	1.106	1.351	1.875			1.140/1.156
-19	1 3/16	1.167	1.413	1.937			1.203/1.218
-20	1 1/4	1.229	1.474	2.000			1.265/1.281
-21	1 5/16	1.290	1.536	2.062			1.328/1.344
-22	1 3/8	1.352	1.597	2.125	▼	▼	1.390/1.406
-23	1 7/16	1.413	1.641	2.187	.064 ± .005	.096 ± .005	1.452/1.468
-24	1 1/2	1.475	1.820	2.250	.091 ± .005	.133 ± .005	1.515/1.531
-26	1 5/8	1.600	1.945	2.375			1.640/1.656
-28	1 3/4	1.725	2.070	2.500			1.765/1.781
-30	1 7/8	1.850	2.195	2.625	▼	▼	1.890/1.906
-32	2	1.975	2.320	2.750	.091 ± .005	.133 ± .005	2.015/2.031

NAS1523 **XX XX X**

Code	Retainer Material	Finish	Code	Size (dash number)	Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temp.	Color Code
AA	7075-T6 Aluminum SAE-AMS-QQ-A-250/12 (*1)	Anodize Per MIL-A-8625, Type II, Class I	06	6	B	N406-60 Nitrile	SAE AMS-R-6855, CL 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	Black
			08	8						
			3	10						
C	302/304 Stainless Steel, SAE AMS 5513	Passivate Per SAE AMS-QQ-P-35	4	1/4	E	V720-75 Fluorocarbon	SAE AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F	Gray
			5	5/16						
			6	3/8						
—	4130 Chrome Molybdenum Steel, SAE AMS 6350, Heat Treated to Rockwell C26 to C33	Cadmium Plated Per SAE AMS-QQ-P-416 Type II, Class 2, Dyed Black	7	7/16	F	N406-60 Nitrile	SAE AMS-R-6855, CL 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	None
			8	1/2						
			9	9/16						
			10	5/8						
			11	11/16						
			12	3/4						
			13	1 3/16						
			14	7/8						
			15	1 5/16						
			16	1						
			17	1 1/16						
			18	1 1/8						
			19	1 3/16						
			20	1 1/4						
			21	1 5/16						
			22	1 3/8						
			23	1 7/16						
24	1 1/2									
26	1 5/8									
28	1 3/4									
30	1 7/8									
32	2									
H	S355-75 Silicone	SAE AMS 7267	15	1 5/16	H	S355-75 Silicone	SAE AMS 7267	Air, weathering and gases. FDA conforming.	-60°F to +400°F	Brown
N	B318-70 Butyl	SAE AMS 3238	16	1	N	B318-70 Butyl	SAE AMS 3238	Skydrol and other phosphate esters, water, steam and air	-65°F to +212°F	Green
P	E1267-80 Ethylene Propylene	NAS 1613	18	1 1/8	P	E1267-80 Ethylene Propylene	NAS 1613	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-70°F to +250°F	Purple
R	L1830-60 Fluorosilicone	SAE AMS-R-25988, Type I, Class 1, Grade 60	20	1 1/4	R	L1830-60 Fluorosilicone	SAE AMS-R-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F	Red
W	S604-70 Silicone	SAE AMS 3304	22	1 3/8	W	S604-70 Silicone	SAE AMS 3304	Air, weathering and gases	-65°F to +400°F	White
Y	47-071 Nitrile	SAE AMS-R-7362, Type 1, Grade 60	24	1 1/2	Y	47-071 Nitrile	SAE AMS-R-7362, Type 1, Grade 60	MIL-L-7808 Synthetic engine oil	-60°F to +180°F	Yellow

Notes:

*1. Material specifications shown are prior to molding. The processing conditions for some elastomers may slightly anneal the retainer.

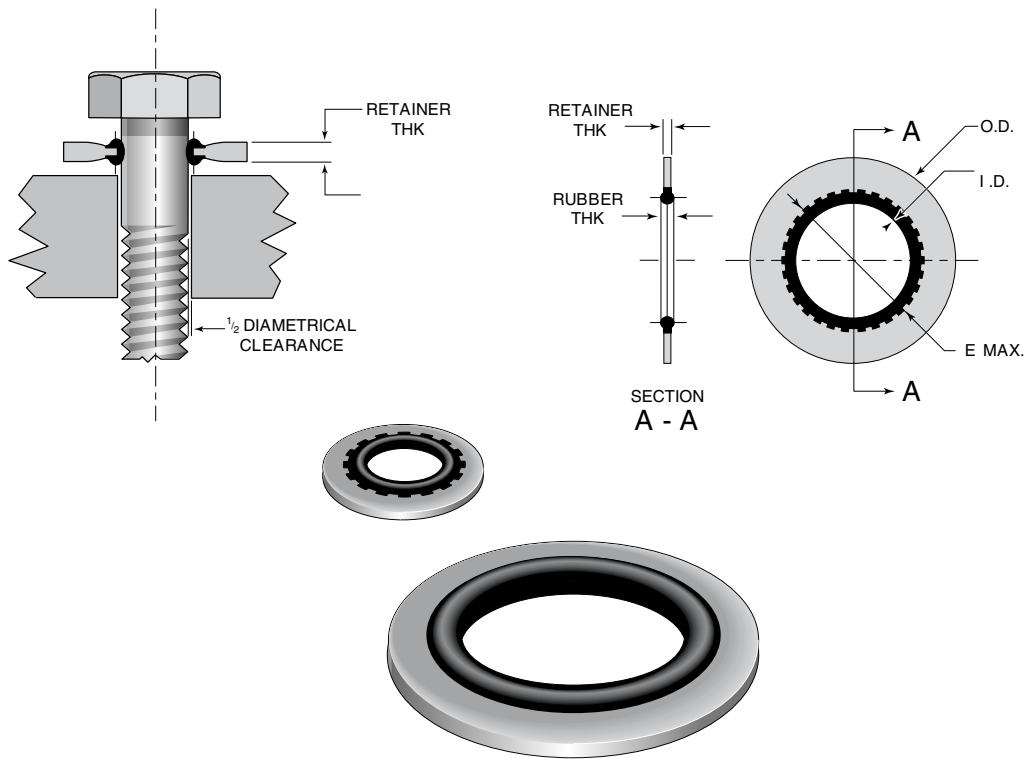
Example Part Numbers:

Material color codes do not apply. Material selections are governed by NAS specifications.

- NAS1523AA12R = 7075-T6 Aluminum – Anodized, L1830-60 Elastomer, 3/4 Size
- NAS1523C10B = 302/304 Stainless Steel – Passivated, N406-60 Elastomer, 5/8 Size
- NAS1523-10B = Chrome Moly Steel – Cad Plated, N406-60 Elastomer, 5/8 Size



610 Series Stat-O-Seal – Designed for Metric Fasteners



610 Series Stat-O-Seal Dimensions						
Fastener Size mm (Ref.)	I.D. ± 0.25 mm (± .010 in.)	E Diameter* ± 0.25 mm (± .010 in.)	O.D. ± 0.25 mm (± .010 in.)	Retainer Thickness ± 0.13 mm (± .005 in.)	Rubber Thickness ± 0.13 mm (± .005 in.)	Diametrical Clearance** Max. (Ref.) mm (in.)
5	4.83 (.190)	6.40 (.252)	9.78 (.385)	1.02 (.040)	1.32 (.052)	0.25 (.010)
6	5.79 (.228)	7.80 (.307)	11.25 (.443)	1.27 (.050)	1.68 (.066)	0.25 (.010)
8	7.77 (.306)	10.57 (.416)	13.49 (.531)	1.27 (.050)	1.68 (.066)	0.38 (.015)
10	9.73 (.383)	12.24 (.482)	15.32 (.603)	1.27 (.050)	1.68 (.066)	0.38 (.015)
12	11.71 (.461)	15.52 (.611)	19.30 (.760)	1.27 (.050)	1.68 (.066)	0.38 (.015)
14	13.67 (.538)	17.60 (.693)	22.35 (.880)	1.27 (.050)	1.68 (.066)	0.38 (.015)
16	15.67 (.617)	19.18 (.755)	27.10 (1.067)	1.27 (.050)	1.68 (.066)	0.38 (.015)
20	19.66 (.774)	24.21 (.953)	33.38 (1.314)	1.63 (.064)	2.44 (.096)	0.38 (.015)
22	21.62 (.851)	27.38 (1.080)	31.50 (1.240)	1.27 (.050)	1.68 (.066)	0.38 (.015)

Notes:

* The fastener head diameter must be greater than the “E” diameter. A cover washer is recommended when the fastener head is near or below the “E” diameter.

** A chamfer with an outside diameter equal to that of the recommended diametrical clearance may be used.



610-XX XX - X

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temperature
15	N1840-90 Nitrile	ASTM D2000 M3CH910 B34 E016 E036	General industrial environments, petroleum fluids and cold temperature water	-40°F to +225°F
31	V720-75 Fluorocarbon	ASTM D2000 M2HK710 A1-10 SAE-AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F

Code	Retainer Material	Finish
44	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 120,000 psi min tensile strength, HRc 25-30	Zinc Plated Per ASTM B 633 Type II, Dyed Clear
43	4130 Chrome Molybdenum Steel, SAE AMS 6350, Heat Treated to 175,000 psi min tensile strength	Zinc Plated Per ASTM B 633 Type II, Dyed Black
02	Low-Carbon Steel	Zinc Plated

Size (dash number)
5
6
8
10
12
14
16
20
22

- = Standard: General application
- = Non-Standard
- = Special: Consult factory prior to ordering

Example Part Number:

610-1543-10 = N1840-90 Elastomer, 4130 Chrome Moly HT to 175,000 psi tensile strength – Zinc plated, Size 10 mm



Stat-O-Seal High Pressure Considerations

Maximum Pressures Guidelines

The operating pressure of a Stat-O-Seal must be kept well below the pressure at which the retainer metal would rupture. The tables on this page give the maximum recommended internal operating pressure for 600 and 610 Series Stat-O-Seals as determined by hoop stress calculations. A safety factor of 3 was used along with the tensile yield strength for low carbon steel and chrome moly steel.

Although 7075-T6 is used for the aluminum retainers the actual material temper may vary on parts containing certain elastomers due to exposure to heat during processing. A safety factor of 4 was used when calculating the maximum safe operating pressure for aluminum to account for this variation. A safety factor of 2 was used for 304 stainless steel (annealed) due to the large differential between yield and ultimate strength.

All of the values assume adequate joint integrity to preclude flange separation and are based on static pressure. Metal fatigue should be factored in when necessary. Consult the factory for more information on sealing external pressures, vacuum service, or when sealing gaseous pressure greater than 200 psi.

Bolt Torque for High Pressure Applications

High pressure fluids acting under the head of a bolt tend to stretch it, lifting the bolt head off its seat. When this happens, the space exposed under the bolt head can permit the Stat-O-Seal elastomer to extrude and fail. It is, therefore, important in high pressure applications to torque the bolt well at assembly, providing enough pre-stress in the bolt to prevent stretching.

Clearance for Extra Rubber

Most Stat-O-Seals have some excess rubber (see recommended diametrical clearance), and clearance must be provided to receive it. In low pressure applications, this clearance may be either in the mounting surface or in a washer between the bolt head and the Stat-O-Seal. In high pressure applications, however, the normal clearance must be on the high pressure side of the Stat-O-Seal, with little or no clearance on the low pressure side. Otherwise, the fluid pressure will extrude too much rubber into the clearance gap, resulting in a leak.

600 Series – Maximum Recommended Safe Operating Pressure				
Fastener Size	7075-T6 Aluminum (psi)	Low Carbon Steel (psi)	304 Stainless Steel (psi)	Chrome Moly Steel (psi)
-6	10800	10800	9500	20000
-8	8000	8000	7000	14900
-10	6220	6200	5500	11500
-10 OS	4350	4300	3800	8000
1/4	5100	5000	4500	9500
1/4 OS	4000	4000	3500	7500
5/16	3650	3600	3200	6800
3/8	3400	3400	3000	6400
7/16	3650	3600	3200	6800
1/2	4250	4200	3750	7900
9/16	6675	6600	5900	12400
5/8	7600	7500	6700	14100
11/16	6700	6600	5900	12400
3/4	5700	5700	5000	10600
13/16	5800	5800	5100	10800
7/8	6075	6000	5350	11300
15/16	6575	6500	5800	12250
1	7100	7000	6275	13250
Above 1" Consult Factory				

610 Series – Maximum Recommended Safe Operating Pressure				
Size (mm)	Chrome Moly Steel HT to 175KSI Tensile		Chrome Moly Steel HT to 120KSI Tensile	
	PSI	Mpa	PSI	Mpa
5	22500	155	15250	105
6	18875	130	12850	89
8	11600	80	7900	54
10	10500	72	7200	50
12	10500	72	7100	49
14	11750	81	8000	55
16	18400	127	12500	86
20	17000	117	11500	79
22	6300	43	4350	30



Stat-O-Seal Recommended Fastening Torque

When fastening torques are discussed by engineers there is often controversy. There are many variables such as wrenching methods and thread friction (influenced by lubrication, plating, surface finishes, length of grip, class of thread, etc.) that may influence the load applied to a fastener.

Parker Stat-O-Seals provide a certain amount of latitude when it comes to torque requirements. Actually, Stat-O-Seals are capable of sealing low pressures when only finger tight.

When using a Stat-O-Seal the fastener should be torqued adequately to prevent joint separation when the system is pressurized and below the level at which the fastener or Stat-O-Seal retainer will yield. The tables on this page show a recommended range that will work for most Stat-O-Seal applications. The torque values displayed in the table may exceed the permissible torque values for many fastener materials. Contact your fastener supplier for the recommended torque limits of your fastener. Consult the factory for sizes not shown.

Lubricants are not required when installing Stat-O-Seals. If a lubricant is used, be sure it is compatible with the elastomer selected.

600 Series – Bolt Torque Recommendations								
Size	7075 Aluminum		Low Carbon Steel		Stainless Steel		Chrome Moly Steel	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
-6	25	5	33	5	33	5	45	5
-8	50	10	60	10	60	10	75	10
-10	70	13	60	13	60	13	90	13
-10 /S	80	13	60	13	60	13	95	13
-1/4	110	40	100	40	100	40	145	40
-1/4 S	110	40	100	40	100	40	145	40
-5/16	115	60	180	60	140	60	180	60
-3/8	216	80	220	80	220	80	230	80
-7/16	330	110	280	110	300	110	400	110
-1/2	360	130	540	130	420	130	600	130
-9/16	500	450	800	450	1000	450	1000	450
-5/8	1040	650	1100	650	1100	650	1700	650
-3/4	1550	550	2900	550	2900	550	3800	550
-7/8	1900	650	3900	650	3900	650	5400	650
1	2840	720	5900	720	5900	720	8000	720

610 Series – Bolt Torque Recommendations								
Fastener Size (mm)	Chrome Moly Steel HT to 175KSI Tensile				Chrome Moly Steel HT to 120KSI Tensile			
	lb.-in. (Min.)	N-m (Min.)	lb.-in. (Max.)	N-m (Max.)	lb.-in. (Min.)	N-m (Min.)	lb.-in. (Max.)	N-m (Max.)
5	13	1	106	12	13	1	74	8
6	40	5	177	20	40	5	125	14
8	60	7	399	45	60	7	275	31
10	80	9	798	90	80	9	550	62
12	130	15	1375	155	130	15	960	109
14	450	50	2217	250	450	50	1550	175
16	650	75	3326	375	650	75	2325	263

Note: The values in the tables above may exceed those recommended for some fasteners. Consult your fastener supplier for the recommended values.



ThredSeal

Applications

ThredSeals are safe and reliable seals for threaded devices. They are self-centering and non-directional, designed to seal directly against threads, without any special requirements.

ThredSeals can also offer considerable savings because they enable the use of low cost standard fasteners and full threaded fittings. They are easy to assemble and do not require special skills or tooling; simply push them on with a slight twisting motion and tighten the fastener.

ThredSeal Features

Unlike other cure-in-place thread sealing methods, ThredSeals are mechanical, not chemical in application. They can be easily assembled and removed, do not require set up cure time, and are easily parted from contacting surfaces without special tools or chemicals, providing easy access to the sealed areas.

ThredSeals seal at the recommended pressure and temperature levels by utilizing the bolt threads to form a contained elastomeric dam. If the elastomeric element is not damaged to the extent of tearing or rupturing, the seals are reusable. Close visual inspection after each removal is recommended, and the use of cover washers will reduce the possibility of tears or breaks in the rubber, as well as provide adequate seating surfaces for the nut.

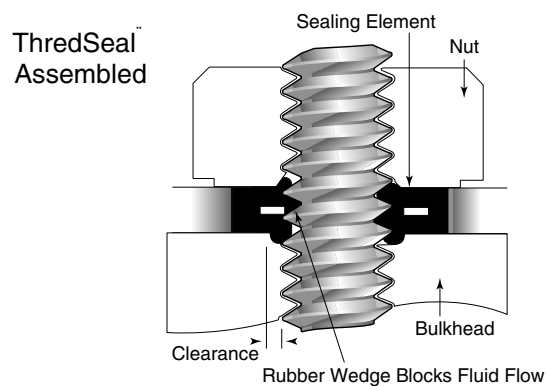
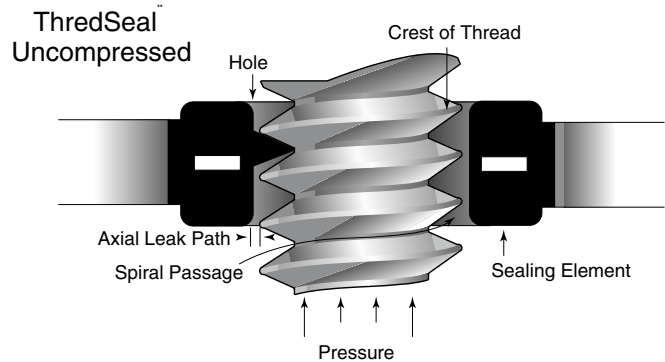
Key Benefits

- Effective sealing for standard fastener sizes
- Self-centering
- Non-directional
- Easy to assemble and disassemble
- Readily available in standard fastener sizes

Design Requirements

ThredSeals work by blocking all leak paths in a threaded fastener. They are used with standard bolts or screws and generally are seated on the nut side of the fastener. Unlike sealing directly underneath the bolt head, the nut side of the fastener has an additional spiral leak path, created by the threads, which will permit the fluid to wind its way through the helix.

ThredSeals have three wedge shaped protrusions on the inside of the seal. Since all standard screw threads have only a single V-shaped spiral channel, one of these wedges will always be in position to block the flow of fluid through this channel.



Maximum Pressure Recommendation

All standard ThredSeal sizes consisting of a low carbon steel retainer and commercial standard Nitrile have been static pressure tested to the limits shown in the following table. Many ThredSeal sizes are capable of sealing at pressures in excess of those shown in the table below, but it is recommended that customers test the part in their specific application when sealing higher pressures.

Maximum Recommended Pressure		
Fastener Size	Material Combination	
	Commercial Nitrile	Low Carbon Steel
#6 to #12	2000 psi	
1/4 to 1	5000 psi	
1 1/8 and Up	Consult Factory	

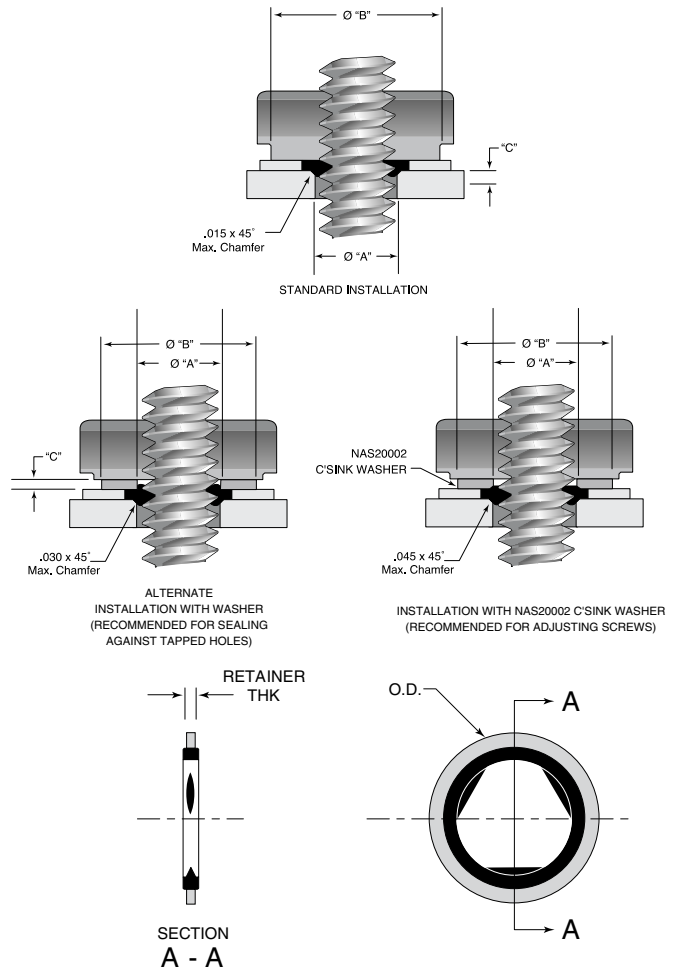
Installation Notes

In all ThredSeal applications, it is important that the rubber sealing element is completely covered by the adjacent metal parts to prevent extrusion of the rubber. To ensure proper coverage, the nut and/or washer that sits on the ThredSeal must have a minimum flat surface of diameter “B” in the table below.

Rubber is not a compressible material and thus must have a void into which it can flow while under load. ThredSeals are designed to seat against a clearance hole of diameter “A” in the table below. The required void can be provided through the clearance hole in the mounting surface, but in cases where the mounting hole is tapped, the same effect can be achieved with a washer or a counterbore of diameter “A” (clearance), either in the mounting surface or in the nut. In these cases, in order to provide adequate void space for the rubber, the washer thickness or counterbore depth is defined per dimension “C” in the table below. An NAS 20002 countersunk cover washer is recommended in adjusting screw applications.

Lubricants are not required to install ThredSeals. If a lubricant is used be sure it is compatible with the elastomer selected.

Note: For critical applications using UNF (Fine) threads, up to 20% additional void is recommended to avoid an overfill condition.



750 Series ThredSeal Dimensions							
Fastener Size (Ref.)	Threads Per Inch (Ref.)		O.D. ± .010	Retainer Thickness ± .005	A Clearance Diameter	B Min. Dia. of Mating Surface	C Min. Washer Thk. or C-Bore Depth
	UNC (Coarse)	UNF (Fine)					
#6	32	40	0.406	.050	.143/.149	3/8	3/64
#8	32	36	0.406	.050	.170/.177	3/8	3/64
#10	24	32	0.469	.050	.198/.206	3/8	1/16
#12	24	28	0.562	.050	.224/.234	7/16	1/16
1/4	20	28	0.562	.050	.260/.271	7/16	1/16
5/16	18	24	0.687	.064	.327/.339	1/2	1/16
3/8	16	24	0.750	.064	.392/.406	5/8	1/16
7/16	14	20	0.906	.078	.458/.474	11/16	1/16
1/2	13	20	1.000	.078	.523/.541	3/4	1/16
9/16	12	18	1.094	.094	.589/.609	7/8	1/16
5/8	11	18	1.187	.094	.654/.676	1	1/16
3/4	10	16	1.375	.109	.788/.812	1 1/8	3/32
7/8	9	14	1.562	.109	.921/.947	1 1/4	3/32
1	8	12	1.750	.120	1.054/1.082	1 7/16	3/32
1 1/8	8*	12	1.875	.120	1.187/1.217	1 9/16	3/16
1 1/4	8*	12	2.000	.120	1.321/1.353	1 11/16	3/16
1 3/8	8*	12	2.125	.120	1.454/1.488	1 13/16	3/16
1 1/2	8*	12	2.250	.120	1.587/1.623	1 15/16	3/16
1 3/4	5	N/A	3.375	.179	1.865/1.920	2 7/16	3/8

* Sizes 1 1/8, 1 1/4, 1 3/8, and 1 1/2 are not designed for standard coarse threads.

Special Considerations for Adjusting Screws

When sealing adjusting screws or other applications where the seal will be disturbed frequently, a cover washer should be provided to reduce the tearing action of repeated adjustments. A cover washer is especially important if the screw will be adjusted while hydraulic pressure is applied. Since adjusting screws generally fasten into tapped holes, this washer is the most convenient place to provide the needed extra void. A cone shaped void causes much less wear and tear than

a clearance hole. NAS 20002 countersunk washers have proved useful for this purpose. There are occasions when this countersink cannot be provided by a cover washer and may be machined into the mating boss or nut, although the cover washer is the preferred method. Such a countersunk type void is mandatory with adjusting screws subject to frequent adjustment and may be used in a permanent installation as well.

750- **XX** **XX** - **X**

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temp.	Code	Retainer Material	Finish	Size (dash number)
00	Commercial Standard Nitrile	None General Purpose	General industrial environments, petroleum fluids and cold/room temperature water	-30°F to +225°F	02	Low-Carbon Steel, ASTM A109/A109M	Zinc Plated, Commercial Grade	6
01	N406-60 Nitrile	SAE AMS-R-6855, CL 1 or 2, Grade 60 (*1)	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	00	Low-Carbon Steel, Commercial Grade	Cadmium Plated, Commercial Grade	8
31	V720-75 Fluorocarbon	SAE AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F	03	Low-Carbon Steel, Commercial Grade	Nickel Plated	10
30	V1854-75	ASTM D2000 M2HK710 A1-10 B37 EF31 E078	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F	15	7075-T6 Aluminum SAE AMS-QQ-A-250/12	Anodize Per MIL-A-8625, Type II, Class I	12
83	E515-80 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F	30	302/304 Stainless Steel, SAE AMS5513	Passivate Per SAE AMS-QQ-P-35	1/4
84	E1823-75 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F				5/16

Notes:

- *1: Compound meets both the Class 1 and Class 2 requirements. Certs will be issued to Class 1 unless Class 2 is specifically requested.
- 2: For more detailed compound information, see the Parker O-Ring Handbook (ORD 5700).

	= Standard: General application
	= Non-Standard
	= Special: Consult factory prior to ordering

Example Part Number:

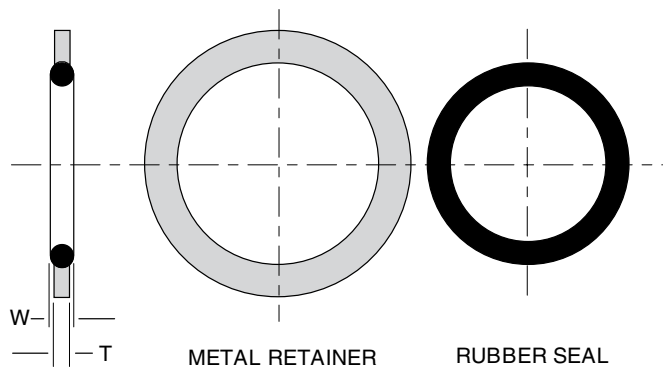
750-0002-1/2 = Commercial Standard Nitrile, Steel-Zinc Plated, Size 1/2



800 Series Lock-O-Seals

The 800 Series Lock-O-Seal is a two piece combination seal comprised of a separately molded O-ring fitted within a surrounding metal washer. These Lock-O-Seals are intended to seal beneath the head of a fastener. Lock-O-Seals are recommended for use instead of 600 series Stat-O-Seals under the following circumstances:

- (1) To seal bolts, studs, or other fasteners in the small and miniature sizes –specifically #2, #4 and #5
- (2) The elastomer, retainer material or combination of both is not offered as a 600 Series Stat-O-Seal



800 Series Lock-O-Seal Dimensions								
Fastener Size	Rubber Seal		Metal Retainer		Tolerance	T Thickness	Tolerance	Diametrical Clearance (Ref.)
	I.D.	W Thickness	I.D.	O.D.				
2	.078	.030	.136	.250	±.010	.024	±.003	1/64 Max.
4	.100	.038	.171	.312		.027		1/64 Max.
5	.116	.038	.187	.312		.027		1/64 Max.
6	.128	.050	.224	.375		.040		1/64 to 1/32
8	.154	.050	.250	.375		.040		1/64 Max.
10	.176	.050	.274	.438		.040		1/64 to 1/32
10 O/S	.176	.066	.312	.438		.050		
1/4	.239	.051	.333	.500		.040		
1/4 O/S	.239	.070	.375	.531		.050		
5/16	.301	.070	.437	.593		.050		
3/8	.364	.070	.500	.687		.050	±.003	
7/16	.425	.070	.562	.750		.050	±.004	
1/2	.489	.070	.625	.875		.050		
9/16	.550	.070	.687	1.062		.050		
5/8	.612	.070	.750	1.188		.050		
11/16	.676	.070	.812	1.250		.050		
3/4	.737	.103	.947	1.312		.075		
13/16	.799	.103	1.010	1.406		.075		
7/8	.862	.103	1.073	1.500		.075		
15/16	.924	.103	1.137	1.625		.075		
1	.987	.103	1.198	1.750		.075		
1 1/16	1.049	.103	1.260	1.812		.075		
1 1/8	1.112	.103	1.323	1.875		.075		
1 1/4	1.237	.103	1.443	2.000		.075		
1 5/16	1.299	.103	1.510	2.062		.075		
1 3/8	1.362	.103	1.572	2.125		.075		
1 7/16	1.424	.103	1.635	2.188	±.010	.075		
1 1/2	1.487	.103	1.699	2.250	±.015	.075		
1 5/8	1.612	.103	1.827	2.375		.075		
1 3/4	1.737	.103	1.947	2.500		.075		
1 7/8	1.862	.103	2.073	2.625	±.015	.075	±.004	1/64 to 1/32

Notes:

- Refer to the Parker O-Ring Handbook (ORD 5700) for O-ring shrinkage factors and tolerances.
- A chamfer with an outside diameter equal to that of the recommended diametrical clearance may be used.



800-XX XX - X

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temp.	Code	Retainer Material	Finish	Size (dash number)
00	Commercial Standard Nitrile	None General Purpose	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	02	Low-Carbon Steel, ASTM A109/A109M	Zinc Plated Per ASTM B633 Type I	2
01	N406-60 Nitrile	SAE AMS-R-6855, CL 1 or 2, Grade 60 (*1)	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	01	Low-Carbon Steel, ASTM A109	Cadmium Plated Per SAE AMS-QQ-P-416 Ty. II, CL.2, Gold	4
02	N304-75 Nitrile	SAE AMS-P-25732	Jet fuel, low temperature applications, petroleum fluids and cold/room temperature water	-65°F to +225°F	15	7075-T6 Aluminum SAE AMS-QQ-A-250/12	Anodize Per MIL-A-8625, Type II, Class I	5
04	47-071 Nitrile	SAE AMS-R-7362, Type 1 or 2 Grade 60 (*1)	MIL-PRF-7808 Synthetic engine oil	-60°F to +180°F	30	302/304 Stainless Steel, SAE AMS5513	Passivate Per SAE AMS-QQ-P-35	6
05	N602-70 Nitrile	SAE AMS-P-5315	General industrial environments, petroleum fluids and cold/room temperature water	-70°F to +180°F	42	4130 Chrome Molybdenum Steel, SAE-AMS6350, Heat Treated to 125,000 psi min tensile strength	Cadmium Plated Per SAE AMS-QQ-P-416 Type II, Dyed Black, Class 2	8
06	S604-70 Silicone	SAE AMS3304	Air, weathering and gases	-65°F to +400°F	43	4130 Chrome Molybdenum Steel, SAE-AMS6350, Heat Treated to 125,000 psi min tensile strength	Zinc Plated Per ASTM B633 Type II, Dyed Black	10
32	V747-75 Fluorocarbon	ASTM D2000 M2HK710 A1-10 (MIL-R-83248 Type I, CL I-Cancelled)	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-15°F to +400°F				10 O/S
35	V1164-75 Fluorocarbon	AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-15°F to +400°F				1/4
50	E1267-80	NAS 1613	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-70°F to +250°F				1/4 O/S
65	L1223-60 Fluorosilicone	SAE AMS-R-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F				5/16
83	E515-80 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F				3/8
09	Special Compound:	Add Parker Compound Number to end of part number to complete call out						

Notes:

*1: Compound meets both the Class 1 and Class 2 requirements. Certs will be issued to Class 1 unless Class 2 is specifically requested.

2: For more detailed compound information, see the Parker O-Ring Handbook (ORD 5700).

	= Standard: General application
	= Non-Standard
	= Special: Consult factory prior to ordering

Example Part Numbers:

800-0002-1/2 = Commercial Standard Nitrile, Steel-Zinc Plated, Size 1/2
 800-0902-1/2 V720-75 = Parker V720-75 Elastomer, Steel-Zinc Plated, Size 1/2



Part Number Conversion List

The part numbers for many of Parker fastener seals have changed since their implementation over 40 years ago. As a convenience to our customers the charts below can be used as a reference to convert obsolete part numbers, which may be specified on prints, part lists or other documentation, into the current part number. If you have an obsolete part number not listed, please contact the CSS Division for assistance in making the conversion.

600 Series Stat-O-Seals	
Alternative (Obsolete) Part Number	Current Fastener Seal Part Number
600-0101-()	600-0000-()
600-001-()	600-0101-()
600-015-()	600-0115-()
600-030-()	600-0130-()
600-042-()	600-0142-()
600-415-()	600-0415-()
600-430-()	600-0430-()
600-442-()	600-0442-()
600-701-()	600-0701-()
600-742-()	600-0742-()
600-6230-()	600-0630-()
600-6242-()	600-0642-()
600-501-()	600-0501-()
600-901-() XXXX	600-0901-() XXXX
600-915-() XXXX	600-0915-() XXXX
600-930-() XXXX	600-0930-() XXXX
600-942-() XXXX	600-0942-() XXXX

750 Series ThredSeals	
Alternative (Obsolete) Part Number	Current Fastener Seal Part Number
7500-()	750-0000-()

800 Series Lock-O-Seals	
Alternative (Obsolete) Part Number	Current Fastener Seal Part Number
800-001-()	800-0001-()
800-201-()	800-0201-()
800-401-()	800-0401-()
800-501-()	800-0501-()
800-601-()	800-0601-()
800-6001-()	800-6501-()
800-8101-()	800-8301-()
800-015-()	800-0015-()
800-215-()	800-0215-()
800-415-()	800-0415-()
800-515-()	800-0515-()
800-615-()	800-0615-()
800-6015-()	800-6515-()
800-8115-()	800-8315-()
800-030-()	800-0030-()
800-230-()	800-0230-()
800-430-()	800-0430-()
800-530-()	800-0530-()
800-630-()	800-0630-()
800-6030-()	800-6530-()
800-8130-()	800-8330-()
800-042-()	800-0042-()
800-242-()	800-0242-()
800-442-()	800-0442-()
800-542-()	800-0542-()
800-642-()	800-0642-()
800-6042-()	800-6542-()
800-8142-()	800-8342-()
800-901-() XXXX	800-0901-() XXXX
800-915-() XXXX	800-0915-() XXXX
800-930-() XXXX	800-0930-() XXXX
800-942-() XXXX	800-0942-() XXXX



Specialty Products

Fastener Seal Kit and Assemblies:

Bolts, nuts, fasteners and seals are often required to complete your assembly. Parker offers the value added services of providing design assistance and kitting for all of these components. Our convenient custom seal kits offer reduced inventory to OEMs and provides an easy one stop shop for aftermarket suppliers. Let us help you design your custom sealing solution and supply one easy to order fastener seal kit or assembly.

250 Series Lock-O-Seal

The 250 Series Lock-O-Seal is a two-piece combination seal comprised of a separately molded O-ring fitted within a surrounding metal washer. This series is designed for sealing two specific applications: (1) Straight tube fittings and bosses, and (2) NAS banjo style fittings and bosses. Contact your local Parker sales representative or the CSS Division for more information.

Food, Beverage and FDA Related Applications

Parker fasteners and fitting seals are available in FDA conforming materials. A complete list of Parker's FDA conforming elastomers can be found in the Parker O-Ring Handbook (ORD 5700). It is important to note that formal FDA approvals are not given to fasteners and fitting seals. It is ultimately up to the user to determine if the product meets the requirements of the particular application. Contact your local Parker sales representative or the CSS Division for more information or technical literature regarding the use of fastener seals in food, beverage or FDA related industries.

Custom Fastener and Fitting Seals

Parker designs and manufactures custom fastener and fitting seals for a wide range of industries and applications as listed below. Minimum order requirements and engineering charges may apply. Contact your local Parker sales representative or the CSS Division for more information.

- Automotive A/C connectors, drain plugs and more
- Aerospace fasteners and fittings with special material or quality requirements
- Special compounds for explosive decompression, chemical processing, and offshore drilling
- Banjo fittings, MS fittings, and custom fasteners
- Brass retainers for oxygen sealing applications
- Many more!



Offer of Sale

The items described in this document are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in this document, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. **Terms and Conditions of Sale:** All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute assent.
2. **Payment:** Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the rate of 1-1/2% for each month or a portion thereof that Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.
3. **Delivery:** Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for delays in delivery.
4. **Warranty:** Seller warrants that the items sold hereunder shall be free from defects in materials or workmanship for a period of 365 days from the date of shipment to Buyer, or 2,000 hours of use, whichever expires first. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATIONS OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**
NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY TO BUYER'S DESIGNS OR SPECIFICATIONS.
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6. **Changes, Reschedules and Cancellations:** Buyer may request to modify the designs or specifications for the item sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification of cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.
7. **Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges therefor by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer therefor. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.
8. **Buyer's Property:** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.
9. **Taxes:** Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller, or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefor upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.
10. **Indemnity For Infringement of Intellectual Property Rights:** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions, including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation.

Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgements resulting from any claim that such an item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.
11. **Force Majeure:** Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.
12. **Entire Agreement/Governing Law:** The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.



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