



Fastener and Fitting Seals

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



ENGINEERING YOUR SUCCESS.



WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Fastener and Fitting Seals

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Fastener and Fitting Seals

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

ThredSeals

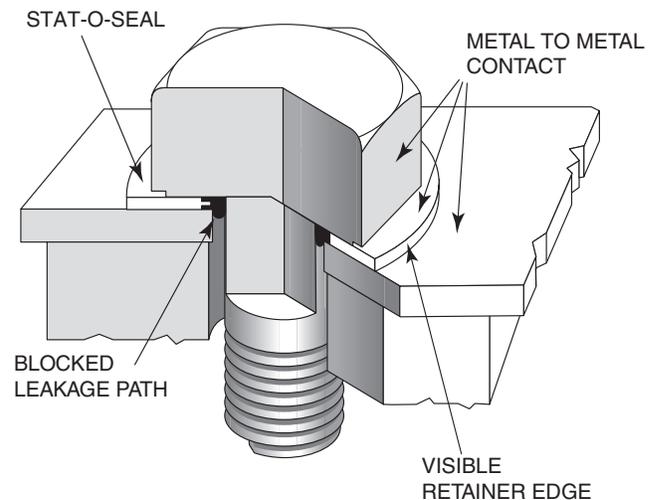
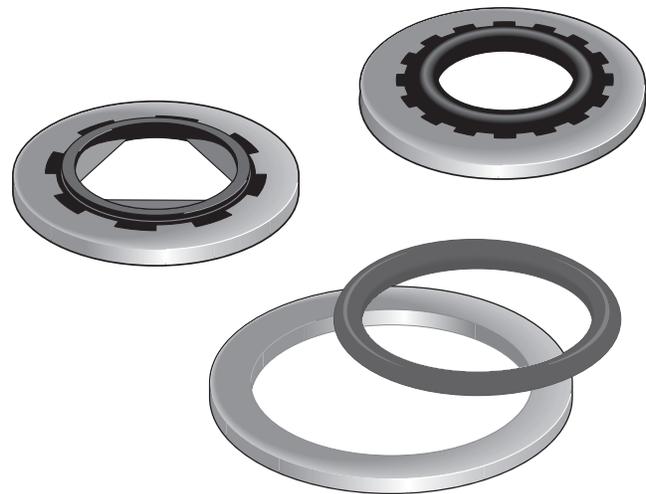
- Intended for sealing directly on the fastener threads
- 750 Series: Intended for sealing most UNC and UNF threads

Lock-O-Seals

- 800 Series: Intended to seal immediately under the head of a bolt
- 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.



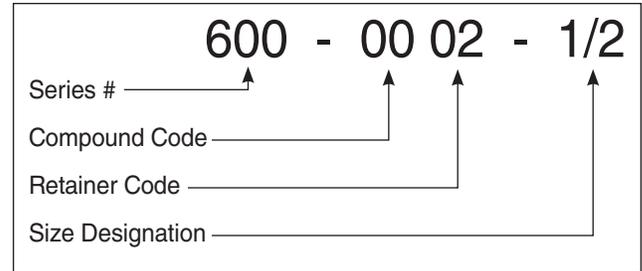
= **Special: Consult Factory Prior to Ordering**

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

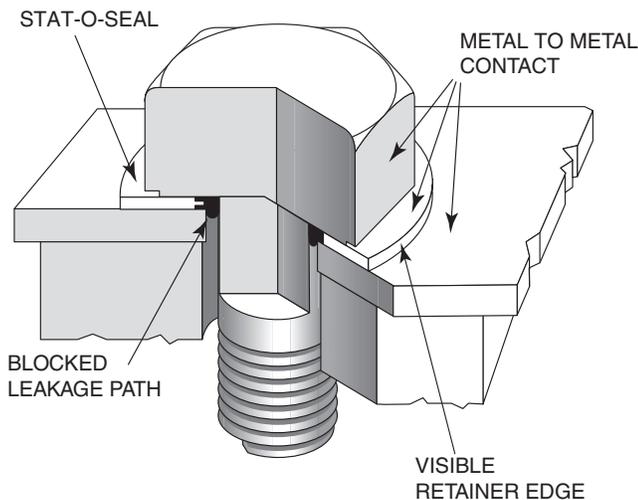


Stat-O-Seal

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

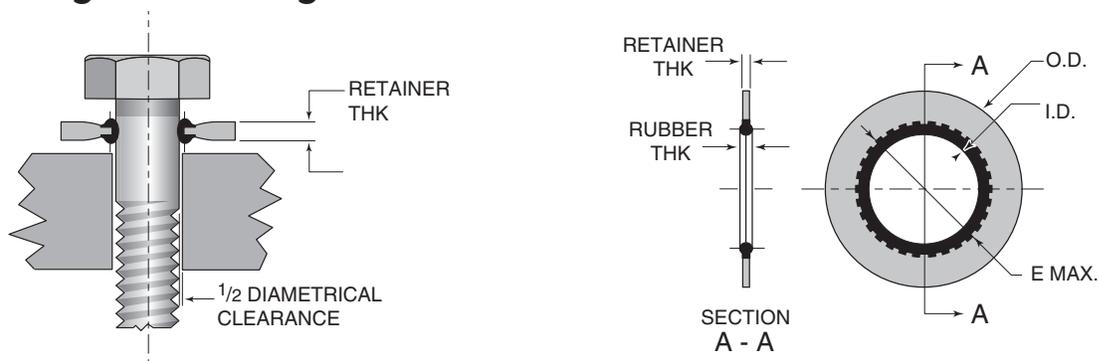
Parker Stat-O-Seals are one-piece, molded-in-place seals with the rubber sealing element mechanically and/or chemically bonded to the metal retainer. Parker's "Splined and Coined" mechanical bonding feature is used on many 600, NAS1523 and 610 series sizes. This feature ensures a positive attachment 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 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 English Unit Fasteners



600 Series Stat-O-Seal Dimensions							
Fastener Size	Thread Major Diameter	I.D. ± .010	E Diameter ¹ Max.	O.D. ± .010	Retainer Thickness	Rubber Thickness	Diametrical Clearance ²
#6	.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:

- 1) 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.
- 2) In place of a clearance diameter, a chamfer with an outside diameter equal to that of the recommended diametrical clearance may be used.

600 Series Stat-O-Seal

600 - XX XX - X

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temperature
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, Class 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
15	N1840-90 Nitrile	ASTM D2000 M3CH910 B34 EO16 EO36	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
02	NM304-75 Nitrile	MIL-P-25732	Jet fuel, low temperature applications, petroleum fluids and cold/room temperature water	-65°F to +225°F
04	47-071 Nitrile	SAE AMS-R-7362, Type 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 B14 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	MIL-DTL-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F
63	SM355-75 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
05	N602-70 Nitrile	SAE AMS-P-5315	General industrial environments, petroleum fluids and cold/room temperature water	-70°F to +180°F
09	Special Compound	Add Parker compound number to end of part number to complete call out		
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 Per ASTM B 633 Type I
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 AMS 2700
32	316 Stainless Steel Per SAE AMS 5524 Annealed	Passivate Per AMS 2700
42	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 120,000 psi min. tensile strength HR _C 26-30	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 120,000 psi min. tensile strength, HR _C 26-30	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:

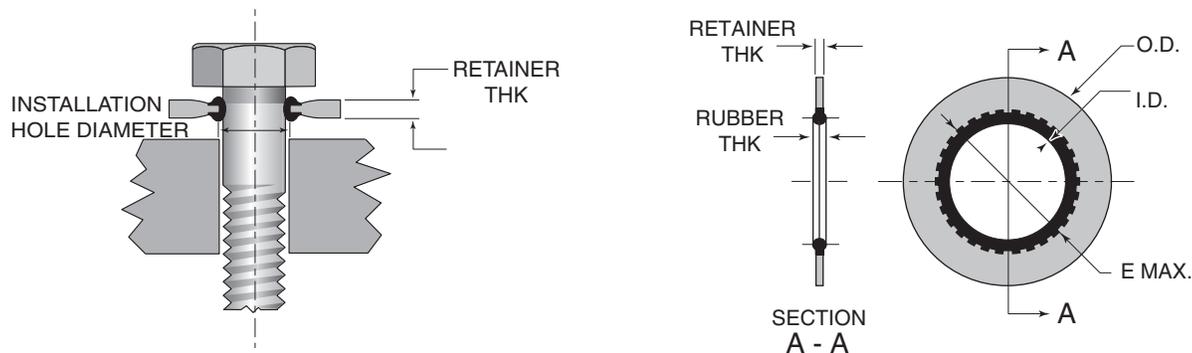
1) For more detailed compound information see the Parker O-Ring Handbook (ORD 5700).

Example P/N:

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

NAS 1523 Series Stat-O-Seal

Designed for Applications Requiring NAS1523 Conformance



NAS1523 Stat-O-Seal Dimensions

NAS Dash Number	Fastener Size	I.D. ± .010	E Diameter Max.	O.D. + .020 / - .005	Retainer Thickness	Rubber Thickness	Installation Hole Dia.
-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 Temperature	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, Class 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	Black
			08	8						
			3	10						
			4	1/4						
C	302/304 Stainless Steel, SAE AMS 5513	Passivate Per AMS 2700 Method 1, Class 4	5	5/16	E	V720-75 Fluorocarbon	SAE AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F	Gray
			6	3/8						
			7	7/16						
			8	1/2						
—	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	9	9/16	F	N406-60 Nitrile	SAE AMS-R-6855, Class 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F	None
			10	5/8						
			11	11/16						
			12	3/4						
			13	13/16						
			14	7/8						
			15	15/16						
			16	1						
			17	1-1/16						
			18	1-1/8						
			19	1-3/16						
			H	SM355-75 Silicone						
21	1-5/16									
22	1-3/8									
23	1-7/16									
N	B318-70 Butyl	SAE AMS 3238	24	1-1/2	N	B318-70 Butyl	SAE AMS 3238	Skydrol and other phosphate esters, water, steam and air	-65°F to +212°F	Green
			26	1-5/8						
			28	1-3/4						
			30	1-7/8						
P	E1267-80 Ethylene Propylene	NAS 1613	32	2	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
			24	1-1/2						
			26	1-5/8						
			28	1-3/4						
R	L1830-60 Fluorosilicone	MIL-DTL-25988, Type I, Class 1, Grade 60	32	2	R	L1830-60 Fluorosilicone	MIL-DTL-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F	Red
			26	1-5/8						
			28	1-3/4						
			30	1-7/8						
W	S604-70 Silicone	SAE AMS 3304	32	2	W	S604-70 Silicone	SAE AMS 3304	Air, weathering and gases	-65°F to +400°F	White
			32	2						
Y	47-071 Nitrile	SAE AMS-R-7362, Type 1, Grade 60	32	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
			32	2						

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.

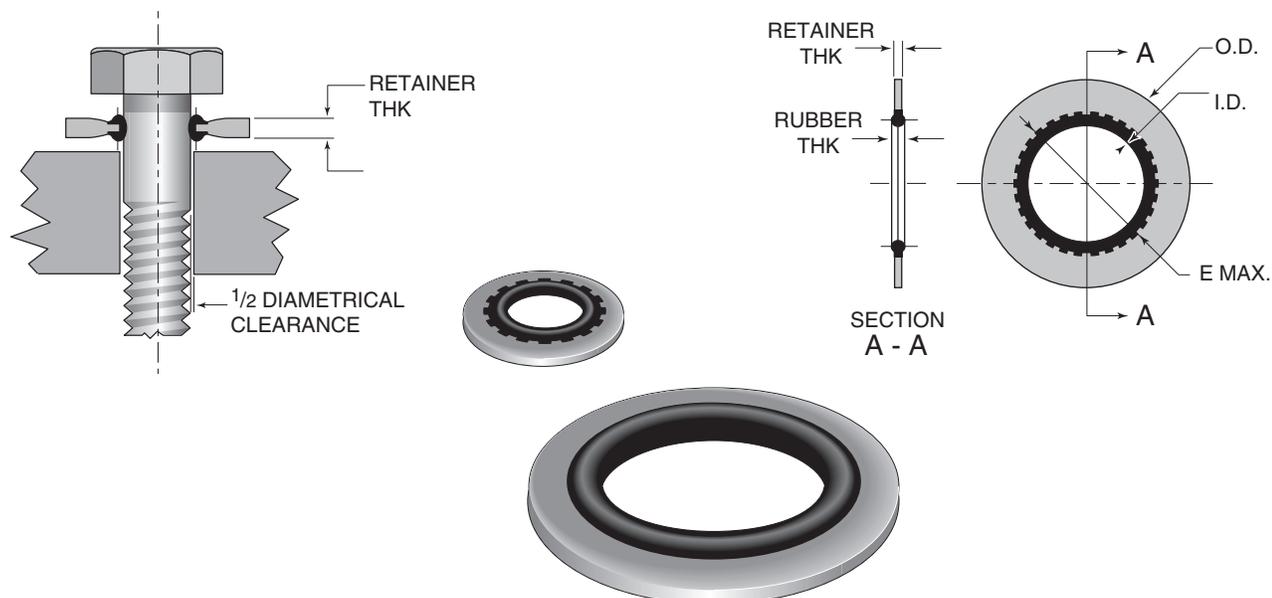
NAS1523AA12R = 7075-T6 Aluminum – Anodized, L1830-60 Elastomer, 3/4 Size

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	I.D. ± 0.25 mm (± .010 in.)	E Diameter ¹ ± 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 ² Max. 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:

- 1) 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.
- 2) In place of a clearance 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
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, Class 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
15	N1840-90 Nitrile	ASTM D2000 M3CH910 B34 EO16 EO36	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
02	NM304-75 Nitrile	MIL-P-25732	Jet fuel, low temperature applications, petroleum fluids and cold/room temperature water	-65°F to +225°F
04	47-071 Nitrile	SAE AMS-R-7362, Type 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 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	MIL-DTL-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F
63	SM355-75 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
05	N602-70 Nitrile	SAE AMS-P-5315	General industrial environments, petroleum fluids and cold/room temperature water	-70°F to +180°F
09	Special Compound	Add Parker compound number to end of part number to complete call out		
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

Code	Retainer Material	Finish	Size (dash number)
02	Low-Carbon Steel SAE 1020/1030 per ASTM A109/109M	Zinc Plated per ASTM B633, Type II, SC 3 Dyed Black, Trivalent Chromate	5
			6
			8
			10
			12
			14
30	Type 302/304 Stainless Steel Per SAE AMS 5513 Annealed	Passivate Per AMS 2700	16
			20
44	4130 Chrome Molybdenum Steel, SAE-AMS6350, Heat Treated to 120,000 psi min. tensile strength, HR _c 26-30	Zinc Plated Per ASTM B 633 Type III, Clear	22

	= Standard: General Application
	= Non Standard
	= Special: Consult Factory Prior to Ordering

Example Part Number:

610-1544-10 = N1840-90 Elastomer,
4120 Chrome Moly Steel
- Zinc Plated, N1840-90
Elastomer, 10mm Size

Stat-O-Seal

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 prestress 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	
	lb.-in. Max.	lb.-in. Min.	lb.-in. Max.	lb.-in. Min.	lb.-in. Max.	lb.-in. Min.	lb.-in. Max.	lb.-in. 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 O/S	80	13	60	13	60	13	95	13
-1/4	110	40	100	40	100	40	145	40
-1/4 OS	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

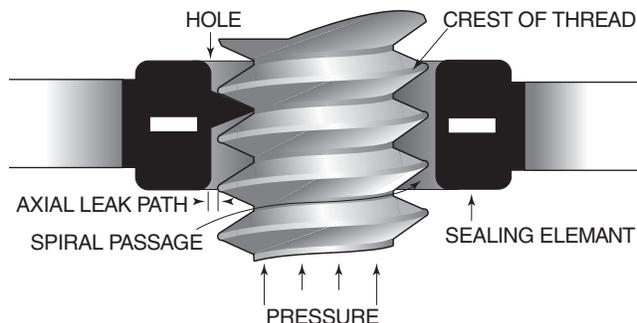
- Effective sealing for standard fastener sizes
- Self-centering
- Non-directional
- Easy to assemble and disassemble
- Readily available in standard fastener sizes

Design Requirements

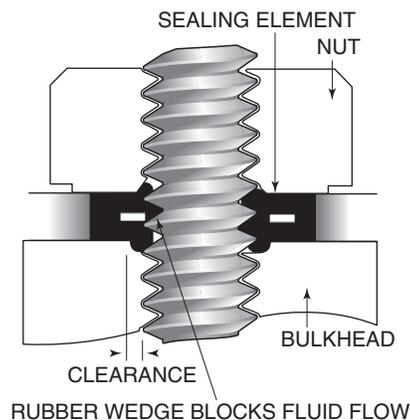
ThredSeals work by blocking all leak paths in a threaded fastener. They are used with standard bolts or screws and generally are seated on the nut side of the fastener. Unlike sealing directly underneath the bolt head, the nut side of the fastener has an additional spiral leak path, created by the threads,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

ThredSeal Uncompressed



ThredSeal Assembled



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	

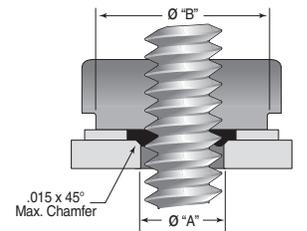
Installation Notes

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.

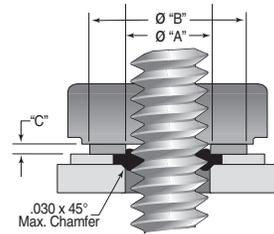
Rubber is not a compressible material and thus must have a void into which it can flow while under load. ThredSeals are designed to seat against a clearance hole of diameter "A" in the table below. The required void can be provided through the clearance hole in the mounting surface, but in cases where 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.

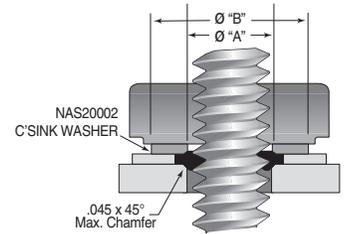
Note: For critical applications using UNF (Fine) threads, up to 20% additional void is recommended to avoid an overfill condition.



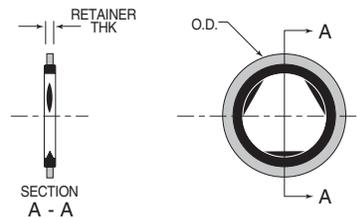
STANDARD INSTALLATION



ALTERNATE
INSTALLATION WITH WASHER
(RECOMMENDED FOR SEALING
AGAINST TAPPED HOLES)



INSTALLATION WITH
NAS20002 C'SINK WASHER
(RECOMMENDED FOR
ADJUSTING SCREWS)



750 Series ThredSeal Dimensions							
Fastener Size	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 ¹	12	1.875	.120	1.187/1.217	1-9/16	3/16
1-1/4	8 ¹	12	2.000	.120	1.321/1.353	1-11/16	3/16
1-3/8	8 ¹	12	2.125	.120	1.454/1.488	1-13/16	3/16
1-1/2	8 ¹	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

1) Sizes 1-1/8, 1-1/4, 1-3/8, & 1-1/2 are not designed for standard course threads. Testing is recommended prior to use.

ThredSeal

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 Temperature	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, Class 1, Grade 60	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
06	S604-70 Silicone	SAE AMS 3304	Air, weathering and gasses	-65°F to +180°F				10
31	V720-75 Fluorocarbon	SAE AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-20°F to +400°F				12
83	E515-80 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F	15	7075-T6 Aluminum SAE AMS-QQ-A-250/12	Anodize Per MIL-A-8625, Type II, Class I	1/4
09	Special Compound	Add Parker compound number to end of part number to complete call out						5/16
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	03	Low-Carbon Steel, Commercial Grade	Nickel Plated	3/8
84	E1823-75 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 2700	7/16
					32	316 Stainless Steel Per SAE AMS 5524 Annealed	Passivate Per SAE AMS 2700	1/2
								9/16
								5/8
								3/4
								7/8
								1
								1-1/8
								1-1/4
								1-3/8
								1-1/2
								1-3/4

Notes:

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

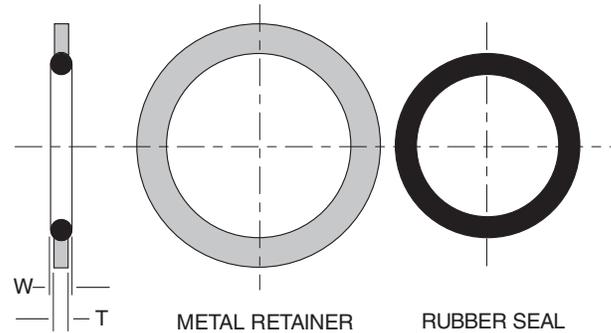
	= Standard: General Application
	= Non Standard
	= Special: Consult Factory Prior to Ordering

Example Part Number: 750-0002-1/2 = Commercial 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
	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:

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

800 Series Lock-O-Seals

800 - **XX** **XX** - **X**

Code	Seal Compound	Specification	Recommended Uses	Recommended Operating Temperature
00	Commercial Standard Nitrile	None General Purpose	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
01	N406-60 Nitrile	SAE AMS-R-6855, Class 1, Grade 60	General industrial environments, petroleum fluids and cold/room temperature water	-40°F to +225°F
02	NM304-75 Nitrile	MIL-P-25732	Jet fuel, low temperature applications, petroleum fluids and cold/room temperature water	-65°F to +225°F
04	47-071 Nitrile	SAE AMS-R-7362, Type 1	MIL-PRF-7808 Synthetic engine oil	-60°F to +180°F
05	N602-70 Nitrile	SAE AMS-P-5315	General industrial environments, petroleum fluids and cold/room temperature water	-70°F to +180°F
06	S604-70 Silicone	SAE AMS3304	Air, weathering and gases	-65°F to +400°F
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
35	V1164-75 Fluorocarbon	AMS 7276	Air, petroleum fluids, hydrocarbons, silicone fluids, many acids, and vacuum applications	-15°F to +400°F
50	E1267-80	NAS 1613	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-70°F to +250°F
65	L1223-60 Fluorosilicone	MIL-DTL-25988, Type I, Class 1, Grade 60	Petroleum fluids, silicone fluids, silicate esters	-85°F to +350°F
83	E515-80 Ethylene Propylene	Commercial	Water, steam, ozone and weather resistant, automotive brake fluid, Skydrol, phosphate esters	-65°F to +250°F
09	Special Compound	Add Parker compound number to end of part number to complete call out		

Code	Retainer Material	Finish	Size (dash number)
02	Low-Carbon Steel, ASTM A109/A109M	Zinc Plated Per ASTM B633 Type I	2
			4
			5
01	Low-Carbon Steel, ASTM A109	Cadmium Plated Per SAE AMS-QQ-P-416 Ty. II, CL.2, Gold	6
			8
			10
15	7075-T6 Aluminum SAE AMS-QQ-A-250/12	Anodize Per MIL-A-8625, Type II, Class I	10 O/S
			1/4
30	302/304 Stainless Steel, SAE AMS 5513	Passivate Per SAE AMS-QQ-P-35	1/4 O/S
			5/16
			3/8
42	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 120,000 psi min. tensile strength HR _c 26-30	Cadmium Plated Per SAE AMS-QQ-P-416 Type II, Dyed Black, Class 2	7/16
			1/2
			9/16
			5/8
44	4130 Chrome Molybdenum Steel, SAE-AMS 6350, Heat Treated to 120,000 psi min. tensile strength, HR _c 26-30	Zinc Plated Per ASTM B 633 Type II, Dyed Black	3/4
			7/8
			1
			11/16
			13/16
			15/16
			1-1/16
			1-1/8
1-1/4			
1-5/16			
1-3/8			
1-7/16			
1-1/2			
1-5/8			
1-3/4			
1-7/8			

Notes:

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

Example Part Number:

800-0002-1/2 = Commercial Nitrile, Steel-Zinc Plated, Size 1/2

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



= Standard: General Application

= Non Standard

= Special: Consult Factory Prior to Ordering

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 Composite Sealing Systems 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-()	800-0101-()
800-201-()	800-0201-()
800-401-()	800-0401-()
800-501-()	800-0501-()
800-601-()	800-0601-()
800-6001-()	800-6501-()
800-8101-()	800-8301-()
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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 Composite Sealing Systems 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 Composite Sealing Systems 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 and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. 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 its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. **Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is expressly conditioned on Buyer's assent to these Terms and Conditions and to the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional term or condition of Buyer's order or any other document issued by Buyer.

2. **Price Adjustments; Payments.** Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. **Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. **Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. This warranty is made only to Buyer and does not extend to anyone to whom Products are sold after purchased from Seller. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: Disclaimer of Warranty: This warranty comprises the sole and entire warranty pertaining to products provided hereunder. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. **Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

6. **LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

7. **Contingencies.** Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. **User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

9. **Loss to 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 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.

10. **Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. 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.

11. **Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. **Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

13. **Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

14. **Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

15. **Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. **Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

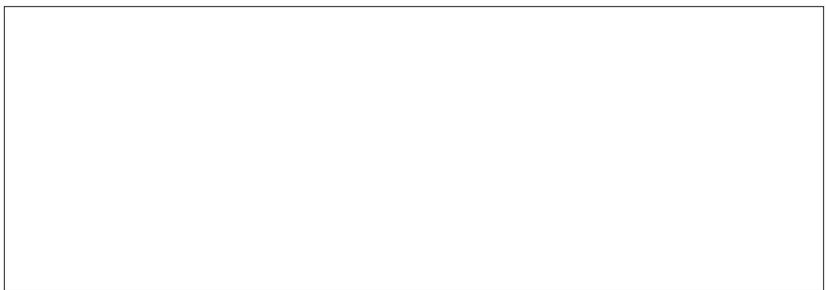
17. **Termination.** This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (b) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (c) an assignment for the benefit of creditors, or (d) the dissolution or liquidation of the Buyer.

18. **Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. **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 Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("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 a Product sold pursuant to this Agreement 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 a Product 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 the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product 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 Products 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 Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

20. **Taxes.** Unless otherwise indicated, 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 Products.

21. **Equal Opportunity Clause.** For the performance of government contracts and where dollar value of the Products exceed \$10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.



Your Local Authorized Parker Distributor



Parker Hannifin Corporation
Composite Sealing Systems Division
7664 Panasonic Way
San Diego, CA 92154
Phone: 619 661 7000
fax: 619 671 3202