



PRECIX[®]

DELIVERING SOLUTIONS THROUGH FOCUSED EXCELLENCE

**2014 O-RING AND
ELASTOMER GUIDE**

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INTRODUCTION

Precix® is a world-class manufacturer of O-Rings for the Automotive, Aerospace, Energy, Chemical Processing (CPI) and other industries. This O-Ring Design and Elastomer Guide will provide you with a mid-level view of what Precix can do for you and your customer.

Founded by a Massachusetts Institute of Technology graduate in 1910, Precix® has evolved into one of the top elastomeric solutions providers in North America, Europe and beyond. TS16949/ISO9001:2000/ISO14001/AS7115/AS9100/ISO 17025 Certified and a practitioner of Lean Manufacturing principles, Precix® is well positioned to be your elastomeric partner.

Seemingly simple in design, Precix® O-Rings perform complex and critical functions in endless applications for virtually all industries. These elastomer rings must counter the effects of chemical attack, friction, pressure and temperature while maintaining the integrity of the system of which they are components. Precix® is a proven leader in this realm, which is why Precix® O-Rings and specialty fuel seals are trusted by top companies/industries around the world.

- Complete AS568 Specification offering
- Custom molded seals and shapes available
- English and Metric sizes
- MIL/AMS, UL, FDA, NSF compounds available
- QuickRings® rapid prototyping (mold and parts in 10 working days or less)
- ISO 17025 Certified Lab
- Engineering Consultations
- Complete in-house tooling capabilities

Precix® manufactures a complete line of thermoset and injection molded elastomers. While we do the complete range our forte is clearly on higher-end elastomers including:

Perfluorocarbon (FFKM)
Fluorocarbon (FKM)
Low temperature Fluorocarbon (GFLT®, GLT®, TR-10 to - 40°C)
Low permeation FKM (GF® type)
Conductive/ESD FKM
Fluorosilicone (FVMQ)
Highly Saturated Nitrile (HNBR/HSN)
Other OEM-specific compounds

GF®, GLT®, GFLT®, Viton®, Viton® Extreme™, Kalrez® are registered trademarks of DuPont Dow Elastomers.
Vamac® is a registered trademark of DuPont.
Chemraz® is a registered trademark of Green Tweed.

EXAMPLES OF APPLICATION AREAS WE SERVICE INCLUDE:

AUTOMOTIVE

- Quick connects
- Fuel injectors
- Fuel rails
- Fuel tanks & pumps
- Rollover valves
- Fuel sensors
- Fuel filters
- Diesel/Biodiesel components
- Alternative fuel systems seals
- HVAC seals
- Transmission/Transfer case

AEROSPACE

- Engine
- Auxiliary Power Unit (APU)
- Hydraulic systems
- Landing gear

ENERGY

- Valve Seats
- Oil Field Pumps
- Explosive Decompression Apps
- Drill Bits
- Wind Turbines
- Solar Junction Boxes (UL 1703)

CHEMICAL PROCESSING

- Pumps
- Filter elements
- Mechanical seals
- Valves
- Sensors
- Quick connects

GENERAL PROPERTIES OF ELASTOMERS

Selection of the correct elastomeric material for O-Ring sealing is key for successful performance.

Primarily seal properties are determined by the broad chemical family of the elastomer selected. "Compounding" of the elastomer by Precix chemists results in secondary properties such as compression set and hardness.

To help with your elastomer selection, here is a "layman's" description of the common elastomers available in the marketplace. The associated table entitled "Capsule Summary of Typical Elastomer Properties" provides further detail in a comparative format.

While this information is meant to provide general guidelines, please consult your Precix representative for your specific needs.

NATURAL RUBBER (NR)

Natural rubber, the only nonman-made elastomer, is noteworthy for its high strength and outstanding resilience. However, the low heat resistance and limited fluid resistance make it a seldom used sealing material.

SBR (SBR)

SBR is a very cost-efficient material for general purpose applications. While heavily used in tires, its low heat resistance and limited fluid resistance limit sealing elastomer use.

BUTYL (IIR)

Butyl elastomers are characterized by their outstanding impermeability to gas penetration and high damping ability in dynamic applications. Butyl rubber also possesses corrosive chemical resistance. While this combination of properties is unique, the heat resistance of butyl rubber has limited its usage.

EPDM (EPDM)

EPDM elastomers are general purpose materials with excellent weathering characteristics for outdoor applications. As a family, EPDMs possess strong resistance to water and steam, as well as good resistance to most acids and alkalis. Their "polar" fluid resistance extends to materials such as automotive brake fluid and anti-freeze. These characteristics, along with moderate temperature resistance, make EPDM a niche player in the O-Ring sealing world.

NEOPRENE/CHLOROPRENE (CR)

Neoprene elastomers are middle of the road materials, with very moderate heat and fluid resistance. They are much more likely to be found in applications where their weathering or inherent flame resistances are needed. Other applications can include sealing of lubricating greases or non-aggressive oils.

NITRILE (NBR, BUNA-N)

Nitrile elastomers encompass a large family of materials that have been a work horse in the fluid sealing arena. While the temperature resistance is only moderate, the choice of the particular material, along with compounding, provides a wide range of properties. Most notable is their fuel and oil resistance, which ranges from moderate to excellent, depending on the particular nitrile chosen. Nitrile polymers remain a cost-efficient means of fuel and oil sealing, as long as the limited high heat resistance is not a hindrance to performance.

EPICHLOROHYDRIN (CO, ECO)

This small family of polymers, usually grouped into the specialty products area, are niche players. Their overall heat and oil resistance is very good, as is their low temperature capability. Impermeability to gases and excellent weathering resistance are other strong attributes. More seal applications would use epichlorohydrin materials if their processing behavior was less challenging.

POLYACRYLATE (ACRYLIC) (ACM)

Polyacrylate elastomers, another member of the specialty category, are known for their higher performance. Their combination of higher heat resistance, along with excellent compatibility with sulfur bearing oils and lubricants, makes them a mainstay in many automotive areas. These include transmission applications. A weakness can be their low temperature capability, as well as their sometimes challenging processing behavior.

VAMAC® (ETHYLENE/ACRYLIC) (AEM)

Vamac® materials, a relatively new elastomer family, is an up-and-coming specialty player. While the high temperature resistance is in the same league as other specialty elastomers, its unique combination of good oil resistance coupled with strong low temperature capability affords an unusual combination of properties. Also noteworthy is the damping capability in dynamic applications. The use of Vamac® has grown as the processing challenges have been minimized.

CAPSULE SUMMARY OF TYPICAL ELASTOMER PROPERTIES

URETHANE (AU, EU)

Urethane elastomers are an unusual category of elastomer materials, characterized by their high strength. Specifically, tensile strength properties are unmatched, as is their tear and abrasion resistance. Also noteworthy is their high load bearing capability. These attributes would be the main reasons for selecting urethane, rather than their moderate heat resistance or their good oil resistance.

HIGHLY SATURATED NITRILE (HSN/HNBR)

This relatively new family of elastomers is a step function improvement over the previously discussed nitrile family. On paper, the improvements in both high temperature capability and low temperature brittleness are moderate. However, the "hydrogenation process" also affords a more stable elastomer, for fluid additives. This higher cost material has seen strong growth in the automotive industry, for fuel, oil, and other applications.

SILICONE (VMQ)

Silicone elastomers represent a large family of higher performance, higher cost materials. They are characterized by their large operating temperature range, with the best low temperature capability of all elastomers, as well as strong high temperature performance. They also possess good oil resistance. Silicone elastomers are available in a variety of colors, as they do not require the traditional "carbon black" for strength building purposes. Besides the automotive industry, both health care and electrical applications are heavy silicone elastomer users. While not as "mechanically tough" as other elastomers, it is their wide temperature capability that cements their niche in the marketplace.

FLUOROSILICONE (FVMQ)

This specialty elastomer takes the strong properties of silicone rubber elastomers and adds fuel resistance to the mix. The resulting combination affords outstanding low temperature flexibility and extremely good fuel and oil resistance. Gasahol resistance is also noteworthy. While fluorosilicones were previously thought of as "fragile" elastomers, tougher versions are also now available. Their high performance also means higher cost.

FLUOROCARBONS (FKM)

The fluorocarbon elastomer family is the highest performance material available. Their high temperature performance is unmatched by any other polymer family, as is their versatile fluid resistance. Recent developments in fluorocarbon offerings have minimized the low temperature concerns. Additionally, by altering the fluorocarbon polymer chemistry, fluid resistance for both alkali materials and "polar" solvents has been added to the already strong repertoire of capabilities. While as a class of elastomers their cost is high, their properties are top notch. Precix specializes in fluorocarbons and possesses an unmatched product line offering.

PERFLUOROELASTOMERS (FFKM)

Perfluorinated polymers have been designed for very demanding sealing applications in aggressive chemical and high heat environments. They are resistant to attack by nearly all chemical reagents, including organic and inorganic acids, alkalines, ketones, esters, alcohols, fuels and hot waters.

The primary uses for these high performance materials are as O-rings, seals, diaphragms, packings and other molded parts used in the chemical processing, aerospace and semiconductor industries.

Terminology	Natural Rubber	SBR	Butyl	EPDM	Chloroprene	Nitrile	Epichlorohydrin	Polyacrylate	Vamac®	Urethane	HSN	Silicone	Fluorosilicone	Fluorocarbon	Perfluorocarbon
Typical ASTM D 1418 Designation	NR	SBR	IIR	EPDM	CR	NBR	CO,ECO	ACM	AEM	AU,EU	HNBR	VMQ	FVMQ	FKM	FFKM
Typical ASTM D 2000 Designation	AA	AA,BA	AA,BA	CA,DA	BC	BF,BG	CH	DH	EE	BG	CH, DH	FE,GE	FK	HK	KK
Physical Properties															
Tensile Strength	E	G	F-G	F-G	G-E	G	F-G	F	F-G	E	G	F	F	F-G	F-G
Compression Set	G	G	F	G	F-G	G	F-G	F-G	F-G	G	G	G-E	G	G-E	G
Resilience	E	G	F	F-G	G-E	G	F	F	F	G	G	F-G	F	F	F
Tear/Abrasion	E	G	F	F-G	G-E	G	F	F-G	F-G	E	G	P-F	P-F	F-G	F-G
Impermeability (Gas)	F	F	E	F	F	F-G	E	F-G	F-G	P-F	G	P-F	P-F	G-E	E
Temperature Range (Typical)															
High, Steady Use (°C)	70	100	100	150	100	125	125-150	150-175	175	100	150	225	200	250	300
Low Temperature	E	G	G	E	F	F-G	F-G	P-F	F-G	F-G	F-G	E	E	P-F	P
Typical Fluid Resistance															
Fuels	P	P	P	P	P	G-E	G-E	F	F	F-G	G-E	P-F	E	E	E
Oils	P	P	P	P	F	G-E	G-E	E	G	G-E	G-E	G	E	E	E
Acids	F-G	F	G-E	E	F-G	G	F	P-F	F	P-F	G	F	G	G-E	E
Ketones (oxygenated)	F-G	F	G	G-E	P-F	P	P	P	P	P	P	P-F	P	P-G	G-E
Water	G-E	G	G-E	E	G	F-G	G	P	G	P	F-G	G	G	G	G
Environmental Resistance															
Weathering	F	F	E	E	E	F	G-E	E	E	G-E	G	E	E	E	E
Ozone	P	P	G-E	E	G	P	G-E	E	E	E	F	E	E	E	E
Flame	P	P	P	P	G	P	P-F	P	P	G	P	F	G	G	G

Legend E- Excellent G- Good F- Fair P- Poor

Vamac® is a registered trademark of DuPont™.

This summary is intended as only a guideline for typical comparative purposes. Testing is required for specific applications.

Viton® General Use Grades

Precix® F40, F75, F90

Viton® A
Viton® A is a family of fluoroelastomer dipolymers, that is, they are polymerized from two monomers, vinylidene fluoride (VF2) and hexafluoropropylene (HFP). Viton® A fluoroelastomers are general purpose types that are suited for general molded goods such as O-Rings and V-rings, gaskets and other simple and complex shapes.

Precix® F10, F61, F95

Viton® B
Viton® B is a grade of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinylidene fluoride(VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® B fluoroelastomers offer better fluid resistance than A type fluoroelastomer.

Precix® F48, F56, F73, F86, F99

Viton® F/GF®
Viton® F/GF is a grade of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinylidene fluoride (VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® F/GF fluoroelastomers offer the best fluid resistance of all Viton® types. F/GF types are particularly useful in applications requiring resistance to fuel permeation.

Viton® Specialty Grades

Precix® F51

Viton® GB/GBL
Viton® GB and GBL are grades of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinyl fluoride (VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® GB and GBL use peroxide cure chemistry that result in superior resistance to steam, acid and aggressive engine oils.

Precix® F77, F78

Viton® GFLT®
Viton® GFLT is a fluoroelastomer designed to retain the high heat and the superior chemical resistance of the GF High Performance types, while improving the low temperature performance of the material. Viton® GFLT shows a 6 to 10°C lower Tg than general use Viton® grades.

Precix® F05, F19, F37, F85

Viton® GLT®
Viton® GLT is a fluoroelastomer designed to retain the high heat and the chemical resistance of general use grade of Viton® fluoroelastomer, while improving the low temperature flexibility of the material. Glass transition temperatures (Tg) of materials are indicative of low temperature performance in typical elastomer applications. Viton® GLT shows an 8 to 12°C lower Tg than general use Viton® grades.

Ultra Low Temp (TR-10 to -40c)

For applications requiring low temp performance below standard GLT types Precix offers -35 (F122) and a true -40 TR-10 (F103, F139).

Precix® F65

Viton® Extreme™(ETP)
Viton®Extreme™ combines the excellent thermal resistance of fluoroelastomers with unique resistance to chemicals and to environments that have historically exceeded the capabilities of conventional fluoroelastomers. This new class of fluoroelastomer, designated as FEPMs by ASTM D1418, is the choice for high pH environments.

FKM GRADE COMPARISON										
	GENERAL GRADES					SPECIALTY GRADES				
	A	B	F/GF	GB	GFLT	GLT	-30	-35	-40	ETP
Nominal Polymer Fluorine Content, wt%	66	68	70	66	67	64	67	65	65	67
Percent Volume Change in Fuel C 168 hr @ 23°C (73°F)	4	3	2	5	2	5	9	9	8	4
Percent Volume Change in E85 168 hr @ 40°C (104°F)	10	8	6	10	16	10	13	10	8	12
Percent Volume Change in Methanol 168 hr @ 23°C (73°F)	90	40	5	28	5	90	3	16	9	5
Vapor Permeation for CE10 at 40°C g-mm/m2/day	60	42	22	29	39	72	45	143	95	no data
Percent Volume Change in KOH 168 hr @ 70°C (158°F)	SAMPLES DEGRADED									14
Low Temperature Flexibility TR-10, °C	-17	-13	-5	-17	-24	-31	-30	-35	-40	-10
Relative Cost	1.0	1.5	1.5	3.0	4.0	4.0	4.0	5.0	8.5	20.0
Precix Material Code*	F75, F40	F95	F68, F86	F137	F78, F77	F19, F79	F119	F122	F103, F139	F65

KEY TO GRADES: **GF** Good for fuel **GB** Also good for fuel **GFLT** Good fuel, low temp **GLT** Good low temp **ETP** Viton Extreme

* Code are examples - other options exist
Viton, GF, GB, GFLT, GLT and ETP are registered trademarks or trademarks of E. I. du Pont de Nemours and Company or its affiliates.

ID	Precix Compound #	Duro	Color	Typical Temperature Range-deg C (F)	Specifications/Comments
Perfluorocarbons (FFKM) – commonly referred to as Kalrez® or Chemraz®					
P06	13852	60	Off-white	-15 to 300 (5 to 572)	Peroxide Cured
P04	13829	70	Off-white	-15 to 300 (5 to 572)	Peroxide Cured
P03	13789	75	Black	-15 to 300 (5 to 572)	AMS7257, Peroxide Cured, QPL Listed
P05	13847	90	Black	-15 to 300 (5 to 572)	Peroxide Cured
Fluorocarbons (FKM) – commonly referred to as Viton®					
F80	13710	60	Black	-25 to 250 (-13 to 482)	
F37	13737	60	Black	-40 to 250 (-40 to 482)	GLT® Type
F67	13767	60	Black	-32 to 250 (-25 to 482)	GFLT® Type
F18	13768	60	Brown	-25 to 250 (-13 to 482)	
F95	13795	65	Red	-22 to 250 (-8 to 482)	Volkswagen/Audi 2.8.1 – A/T 70
F99	13799	65	Green	-22 to 250 (-8 to 482)	GMN8423, GM6268M Type IV, GF® Type (HF - high fluorine)
F10	13759	70	Black	-25 to 250 (-13 to 482)	Honda (several fuel applications/specifications)
F57	13671	70	Green	-25 to 250 (-13 to 482)	Delphi/Saginaw 7846478
F56	13756	70	Black	-22 to 250 (-8 to 482)	GF® Type
F07	13723	70	Black	-32 to 250 (-25 to 482)	GFLT® Type
F40*	13740	75	Brown	-25 to 250 (-13 to 482)	
F75*	13664	75	Black	-25 to 250 (-13 to 482)	AMS 7276 (AS3208, AS3209), Formerly AMS7278, AMS7280 (M83248/1, MS9387, AS3084, AS3085), QPL Listed, UL Recognized
F05	13705	75	Blue	-40 to 250 (-40 to 482)	GLT® Type, Delphi M54453, BMW GS 93010 5516-FPM-70-M
F19*	13790	75	Black	-40 to 250 (-40 to 482)	AMS7287, AMS-R-83485 (M83485/1), GLT® Type, Pratt & Whitney approved, meets GE A5OTF327 CL-A (J1438) QPL Listed
F86	13728	75	Green	-22 to 250 (-8 to 482)	GF® Type (HF – high fluorine), Ford WSAM2D401A8, GM/Opel 6268 & 6269M Type III, BMW GS 93010 5505-FPM-75-M, ultra low permeation, UL Recognized
F78	13730	75	Black	-32 to 250 (-25 to 482)	GFLT® Type, Ford WSAM2D401A5, GM6269M Type I, UL Recognized
F79	13724	75	Black	-40 to 250 (-40 to 482)	GLT® Type
F77	13729	75	Gray	-32 to 250 (-25 to 482)	GFLT® Type, Ford WSAM2D401A5
F139	13845	75	Black	-40 to 250 (-40 to 482)	AMS7379, True -40 TR-10 FKM - QPL Listed
F125	13833	75	Brown	-25 to 250 (-13 to 482)	Caterpillar 1E0804
F127	13834	75	Black	-25 to 250 (-13 to 482)	Caterpillar 1E2865A
F48	13753	75	Black	-22 to 250 (-8 to 482)	Water, Base & Acid Resistance
F53	13663	75	Black	-22 to 250 (-8 to 482)	Transmission service - Dextron III and VI Testing
F38	13801	75	D.Blue	-40 to 250 (-40 to 482)	Low Temperature Fluorocarbon
F43	13742	75	Black	-22 to 250 (-8 to 482)	High Fluorine; Water, Base & Acid Resistance
F65	13678	75	Black	-22 to 250 (-8 to 482)	FKME: "Viton Extreme"- bridge b/w FKM and FFKM
F137	13843	80	Black	-22 to 250 (-8 to 482)	Dual Clutch Transmission
F98	13798	80	Black	-22 to 250 (-8 to 482)	Semi-conductive using Nanotube technology - volume resistivity (ohm-cm) 10^1 - 10^3; Bosch 0 580 P00 024, BMW GS 93010 5505 (fuel applications) & 5521 (diesel applications) -FPM-80-M
F126	13803	80	Black	-22 to 250 (-8 to 482)	Enhanced Semi-conductive using Nanotube technology - volume resistivity under 5 ohm-cm typical
F31	13731	80	Black	-32 to 250 (-25 to 482)	GLT® Type
F91	13791	80	Black	-25 to 250 (-13 to 482)	AS43003, AS43013 (DTD 5613A, Grade 80), SBAC Rolls Royce
F118	13825	85	Blue	-25 to 250 (-13 to 482)	Delphi M54427
F90*	13681	90	Black	-25 to 250 (-13 to 482)	AMS 7259 (AS3581), Formerly AMS7279 (M83248/2, MS9970) QPL Listed
F105	13810	90	Black	-25 to 250 (-13 to 482)	John Deere JDM H4R
F131	13837	90	Green	-25 to 250 (-13 to 482)	Caterpillar 1E0944
F133	13839	95	Black	-25 to 250 (-13 to 482)	Explosive Decompression (ED) Resistant

* = stock item

ID	Precix Compound #	Duro	Color	Typical Temperature Range-deg C (F)	Specifications/Comments
Fluorosilicones (FVMQ)					
G04	13344	60	Blue	-60 to 200 (-76 to 392)	AMS25988 Cl1 Gr 60, (M25988/3), Boeing Approved
G16*	13428	70	Blue	-60 to 200 (-76 to 392)	AMS25988 Cl1 Gr 70, (M25988/1), Boeing Approved
L61	113445	70	Green		Honda (several fuel applications/specifications)
G20*	13441	75	Blue	-60 to 200 (-76 to 392)	AMS7273 (AS9966, AS9967), Formerly (MS 9966, MS 9967) Boeing Approved
G17	13430	75	Yellow	-60 to 200 (-76 to 392)	GM6268 & 6269M Type II, BMW GS 93010, 5519-FMQ-75-M,Volkswagen/Audi 2.8.1.A, Ford WSA-M2D401-A6
G21	13504	75	Blue	-60 to 200 (-76 to 392)	AMS25988 Cl3 Gr75, (M25988/2)
G88	13488	80	Blue	-60 to 200 (-76 to 392)	AMS25988 Cl1 Gr 80, (M25988/4), Boeing Approved
Silicones (VMQ)					
L95	13510	50	Red-Orange	-65 to 250 (-85 to 482)	Hamilton HS701, Very high temp service
L85	13485	60	Red	-65 to 225 (-85 to 437)	AMS 3303
L35	13402	70	Red	-65 to 225 (-85 to 437)	AMS7267, AMS 3304, AMS 3357, AMS 3337 FDA Compliant. Boeing Approved
L70	13478	70	Red	-65 to 225 (-85 to 437)	AMS 3304
Fluorosilicone/Silicone (FVMQ/VMQ)					
L101	13516	60	Blue	-60 to 200 (-76 to 392)	
Highly Saturated Nitrile (HSN/HNBR)					
H76	14576	70	Black	-34 to 150 (-30 to 302)	
M27	14481	70	Black	-32 to 150 (-25 to 302)	Ford ESWM2D247 Type I
M30	14492	70	Black	-35 to 150 (-31 to 302)	
M29	14482	75	Black	-34 to 150 (-30 to 302)	Ford ESWM2D247 Type III, Internal Lube
H113	14610	75	Green	-32 to 150 (-25 to 302)	Bosch GW32-017
H95	14595	80	Black	-40 to 150 (-40 to 302)	BMW GS 93010 5518-HNBR-80-M
M98	14598	80	Black	-32 to 150 (-25 to 302)	Ford WSA-M2D451-A2
H94	14594	90	Black	-40 to 150 (-40 to 302)	
Ethylene Propylene (EPDM)					
E70	17401	60	Black	-46 to 150 (-50 to 302)	
E154	17554	70	Black	-55 to 150 (-67 to 302)	Internal Lube
E88	17456	70	Purple	-46 to 150 (-50 to 302)	Peroxide Cured
E150	17550	70	Black	-46 to 150 (-50 to 302)	TRW TS2-18-035
E61	17331	70	Black	-46 to 150 (-50 to 302)	NSF61 Approved
E34	17434	70	Black	-46 to 150 (-50 to 302)	UL Recognized. UL 1703: Flat-Plate Photovoltaic Modules and Panels
E86	17454	75	Red	-46 to 150 (-50 to 302)	Peroxide Cured
E152	17552	80	Black	-46 to 150 (-50 to 302)	
Nitrile (NBR)					
H73	14573	60	Black	-34 to 125 (-30 to 257)	
H112	14609	65	Black	-34 to 125 (-30 to 257)	Hamilton HS445
M31	14494	70	Black	-54 to 135 (-65 to 275)	MS28775 (MIL-P-25732), Formerly MS28775 (AMS-P-25732), QPL Listed
M07	14327	70	Black	-34 to 125 (-30 to 257)	UL Recognized
H77	14577	70	Black	-34 to 125 (-30 to 257)	DaimlerChrysler MSBZ105C, SAE 5120R1 Class 1
H102	14600	70	Black	-34 to 125 (-30 to 257)	HS163 Type A
H104	14602	70	Black	-50 to 125 (-70 to 257)	UL Recognized
H16	14126	75	Black	-29 to 125 (-20 to 257)	UL Recognized
H69	14571	70	Black	-25 to 125 (-13 to 257)	Daimler Chrysler MSBZ105G
H80	14575	80	Black	-34 to 125 (-30 to 257)	
Vamac (AEM)					
M95	07795	50	Black	-51 to 177 (-70 to 350)	
M94	07794	70	Black	-51 to 177 (-70 to 350)	Daimler Chrysler MSBZ623 Gr A; Ford WSD-M2D447-A
M86	07786	70	Black	-51 to 177 (-70 to 350)	
M96	07796	70	Black	-51 to 177 (-70 to 350)	

ID	Old Drawings	Old Specification	New Drawing	New Specification	Duro	Typical Temperature Range - deg C (F)	Notes
Perfluoroelastomer							
P03				AMS7257	75	-15 to 300 (5 to 572)	QPL Listed
Fluorocarbon							
F90 *	MS9970, M83248/2	AMS7279, AMS-R-83248 CL2, MIL-R-83248 CL2	AS3581	AMS7259	90	-25 to 250 (-13 to 482)	QPL Listed, Hamilton Sundstrand Approved
F75 *	M83248/1, MS9388, MS9387, AS3084 (900) AS3085	AMS7278, AMS7280, AMS-R-83248 CL1, MIL-R-83248 CL1	AS3208 (900) AS3209	AMS7276	75	-25 to 250 (-13 to 482)	QPL Listed, Hamilton Sundstrand Approved
F19 *	M83485/1	AMS-R-83485	AS83485	AMS7287	75	-40 to 250 (-40 to 482)	GLT® Type, Pratt & Whitney approved, meets GE A50TF327 CL-A (J1438), Hamilton Sundstrand, Boeing Approved; QPL Listed
F139			AMS7379	AMS7379	75	-40 to 250 (-40 to 482)	QPL Listed
F91			AS 43003 AS 43013	DTD 5613A Grade 80	80	-25 to 250 (-13 to 482)	SBAC Rolls Royce
Fluorosilicone							
G20	MS9966 MS9967	AMS 7273	AS9966 AS9967	AMS7273	75	-60 to 200 (-76 to 392)	Boeing Approved
G16 *	M25988/1	MIL-R-25988 CL1 G70	MIL-DTL-25988/1 AMS-R-25988/1 CL1 Gr70	MIL-DTL-25988C AMS-R-25988	70	-60 to 200 (-76 to 392)	Boeing Approved
G21	M25988/2	MIL-R-25988 Cl3 G75	MIL-DTL-25988/2 AMS-R-25988/2	MIL-DTL-25988C AMS-R-25988 Cl3 G75	75	-60 to 200 (-76 to 392)	
G04	M25988/3	MIL-R-25988 CL1 G60	MIL-DTL-25988/3 AMS-R-25988/3	MIL-DTL-25988C AMS-R-25988 AMS3325E	60	-60 to 200 (-76 to 392)	Boeing Approved
G88	M25988/4	MIL-R-25988 Cl1 G80	MIL-DTL-25988/4 AMS-R-25988/4	MIL-DTL-25988C AMS-R-25988 Cl1 G80	80	-60 to 200 (-76 to 392)	Boeing Approved
Silicone							
L35 *	MS9385 MS9386 MS9068	AMS7267 AMS3304 ZZ-R-765E Class 1A, 1B 2A, 2B Grade 70	AS9385 AS9386 AS3582	AMS7267, AMS3304 AMS3357 A-A-59588 Class 1A, 2B Grade 70, AMS3337	70	-65 to 225 (-85 to 437)	Boeing Approved
M31	MS28775	MIL-P-25732	MS28775	MIL-P-25732	70	-54 to 135 (-65 to 275)	QPL Listed
TBD	MS28778(900)	MIL-P-5510	MS28778 (900)	AMS-P-5510	90	-54 to 71 (-65 to 160)	Testing in process. QPL to follow

*Denotes a stock item

GF®, GLT®, GFLT®, Viton®, Viton® Extreme™, Kalrez® are registered trademarks of DuPont Dow Elastomers. Vamac® is a registered trademark of DuPont™.

ALPHA LIST OF OEM APPROVALS

OEM/Specification	Polymer	ID	Precix Compound #	Duro	Color	Typical Temperature Range - deg C (F)
Audi (refer to Volkswagen 2.8.1 – A/T 70)	FKM	F95	13795	65	Red	-22 to 250 (-8 to 482)
Audi (refer to Volkswagen 2.8.1 / TL52424)	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
BMW GS 93010 5516-FPM-70-M	FKM (GLT® Type)	F05	13705	75	Blue	-40 to 250 (-40 to 482)
BMW GS 93010 5505-FPM-75-M, GF® Type (HF – high fluorine)	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
BMW GS 93010 5519-FMQ-75-M	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
BMW GS 93010 5505-FPM-80-M fuel applications	FKM (Conductive)	F98	13798	80	Black	-22 to 250 (-8 to 482)
BMW GS 93010 5521-FPM-80-M diesel applications	FKM (Conductive)	F98	13798	80	Black	-22 to 250 (-8 to 482)
BMW GS 93010 5518-HNBR-80-M	HNBR	H95	14595	80	Black	-40 to 150 (-40 to 302)
Bosch 0 580 P00 024 (Conductive Material)	FKM	F98	13798	80	Black	-22 to 250 (-8 to 482)
Bosch GW32-017	HNBR	H113	14610	75	Green	-40 to 150 (-40 to 302)
Caterpillar 1E0804	FKM	F125	13833	75	Brown	-14 to 200C (+6 to 392)
Caterpillar 1E2865A	FKM	F127	13834	75	Black	-14 to 200C (+6 to 392)
Caterpillar 1E0944	FKM	F131	13837	90	Green	-14 to 200C (+6 to 392)
Chrysler MS-BZ105C, SAE 5120R1 Class 1	NBR	H77	14577	70	Black	-34 to 125 (-30 to 257)
Chrysler MS-BZ105G	NBR	H69	14571	70	Black	-25 to 125 (-13 to 257)
Chrysler MS-BZ623 Gr A	AEM (Vamac®)	M94	07794	80	Black	-60 to 200 (-76 to 392)
Chrysler MS-BZ832, Grade A1	FKM	F80	13710	60	Black	-25 to 250 (-13 to 482)
Chrysler MS-BZ832, Grade A3	FKM	F84	13717	75	Black	-25 to 250 (-13 to 482)
Chrysler MS-BZ832, Grade A4	FKM	F33	13743	80	Black	-22 to 250 (-8 to 482)
Chrysler MS-BZ832, Grade B2	FKM	F50	13750	75	Black	-40 to 250 (-40 to 482)
Chrysler MS-BZ832, Grade B2	FKM	F69	13688	70	Black	-40 to 250 (-40 to 482)
Chrysler MS-BZ832, Grade C2	FKM	F43	13742	70	Black	-22 to 250 (-8 to 482)
Chrysler MS-BZ832, Grade F3	FKM	F77	13729	75	Gray	-32 to 250 (-25 to 482)
Chrysler MS-BZ832, Grade F5	FKM	F31	13731	80	Black	-40 to 250 (-40 to 482)
Chrysler MS-BZ832, Grade G3	FKM	F05	13705	75	Blue	-40 to 250 (-40 to 482)
Chrysler MS-BZ832, Grade G4	FKM	F79	13724	75	Black	-40 to 250 (-40 to 482)
Chrysler MS-BZ832, Grade G5	FKM	F85	13727	85	Black	-40 to 250 (-40 to 482)
Chrysler BS-BB 40	FVMQ		13494	45	Red	-60 to 200 (-76 to 392)
Delphi 2HK715A1-10B37B38EF 31E078F15	FKM	F81	13711	75	Brown	-25 to 250 (-13 to 482)
Delphi 7HK915BLACK	FKM		13722	90	Black	-40 to 250 (-40 to 482)
Delphi 7HK915BROWN	FKM		13721	90	Brown	-22 to 250 (-8 to 482)
Delphi M54416	FKM	F84	13717	75	Black	-25 to 250 (-13 to 482)
Delphi M54427	FKM	F118	13731	80	Black	-40 to 250 (-40 to 482)
Delphi M54435	FKM		13704	75	Black	-22 to 250 (-8 to 482)
Delphi M54444	FKM	F04	13329	75	Black	-22 to 250 (-8 to 482)
Delphi M54444	FKM	F84	13717	75	Black	-25 to 250 (-13 to 482)
Delphi M54453	FKM	F05	13705	75	Blue	-40 to 250 (-40 to 482)
Delphi M54453	FKM	F79	13724	75	Black	-40 to 250 (-40 to 482)
Delphi M54472	FKM	F85	13727	85	Black	-40 to 250 (-40 to 482)
Delphi M54475	FKM		13706	75	Brown	-22 to 250 (-8 to 482)
Delphi M54481	FKM		13714	80	Red	-25 to 250 (-13 to 480)
Delphi M54489	FKM		13734	75	Brown	-25 to 250 (-13 to 480)
Delphi M54498	FKM	F07	13723	70	Black	-40 to 250 (-40 to 482)
Delphi M54498	FKM		13733	70	Green	-40 to 250 (-40 to 480)
Delphi/Saginaw 7846478	FKM	F57	13671	70	Green	-25 to 250 (-13 to 482)
Delphi M54106	NBR		14387	60	Black	-34 to 125 (-30 to 257)
Delphi MSP24100936 Rev002	FKM	F122	13830	80	Black	-40 to 250 (-40 to 482)
Ford ESA-M9P7-A, FKM/FVMQ Blend	FKM/FVMQ Blend	F52	13661	75	Brown	-32 to 200 (-25 to 392)
Ford ESW-M2D100-A	HNBR	H76	14576	70	Black	-32 to 150 (-25 to 302)
Ford ESWM2D247 Type 1	HNBR	M27	14481	70	Black	-32 to 150 (-25 to 302)
Ford ESWM2D247 Type 3, Internal Lube	HNBR	M29	14482	75	Black	-34 to 150 (-30 to 302)
Ford WSA-M2D451-A2	HNBR	M98	14598	80	Black	-32 to 150 (-25 to 302)

OEM/Specification	Polymer	ID	Precix Compound #	Duro	Color	Typical Temperature Range - deg C (F)
Ford WSA-M2D401-A5, GFLT® Type	FKM (GFLT® Type)	F77	13729	75	Gray	-32 to 250 (-25 to 482)
Ford WSA-M2D401-A5, GFLT Type	FKM (GFLT® Type)	F78	13730	75	Black	-32 to 250 (-25 to 482)
Ford WSA-M2D401-A6	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Ford WSA-M2D401-A6	FVMQ	L53	13446	70	Orange	-60 to 200 (-76 to 392)
Ford WSA-M2D401-A8, GF® Type (HF - high fluorine)	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
Ford WSD-M2D447-A	VAMAC	M94	07794	70	Black	-51 to 177 (-70 to 350)
GM/Opel 16163, Type B grade Bg (gas) and Bd (diesel)	FKM	F75	13664	75	Black	-25 to 250 (-13 to 482)
GM/Opel 6268 & 6269M Type II	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
GM/Opel 6268 & 6269M Type III, GF® Type (HF – high fluorine)	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
GM/Opel 6268M Type I, FKM/FVMQ Blend	FKM/FVMQ Blend	F52	13661	75	Brown	-32 to 200 (-25 to 392)
GM/Opel GM6268M Type II	FVMQ	L53	13446	70	Orange	-60 to 200 (-76 to 392)
GM/Opel GM6268M Type IV	FKM	F99	13799	65	Green	-22 to 250 (-8 to 482)
GM/Opel GM6269M Type I	FKM (GFLT® Type)	F78	13730	75	Black	-32 to 250 (-25 to 482)
GM/Opel GM6269M Type II	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
GM/Opel GMW16163	FKM	F75	13664	75	Black	-25 to 250 (-13 to 482)
Jaguar (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Jaguar (refer to Ford WSA-M2D401-A8, GF® Type (HF - high fluorine))	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
John Deere JDM H4R	FKM	F105	13810	90	Black	-25 to 250 (-13 to 482)
Land Rover (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Land Rover (refer to Ford WSA-M2D401-A8, GF® Type (HF - high fluorine))	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
Magneti Marelli FKM Type A1	FKM	F75	13664	75	Black	-25 to 250 (-13 to 482)
Magneti Marelli FKM Type A2	FKM	F54	13754	75	Black	-25 to 250 (-13 to 482)
Magneti Marelli FKM Type B	FKM	F47	13757	75	Black	-25 to 250 (-13 to 482)
Magneti Marelli FKM Type C	FKM	F51	13751	75	Black	-30 to 250 (-22 to 482)
Magneti Marelli FKM Type D	FKM	F79	13724	75	Black	-40 to 250 (-40 to 482)
Magneti Marelli FKM Type E	FKM (GFLT® Type)	F78	13730	75	Black	-32 to 250 (-25 to 482)
Magneti Marelli FKM Type F	FKM	F35	13755	80	Black	-22 to 250 (-8 to 482)
Magneti Marelli FVMQ	FVMQ	L54	13443	75	Yellow	-60 to 200 (-76 to 392)
Renault 03-10-100/--D / 34-04-815/--H	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)
Renault 03-10-100/--D / 34-04-815/--H	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Renault 03-10-100/--D / 34-04-815/--H	FKM	F95	13895	60	Red	-22 to 250 (-8 to 482)
Renault 03-50-000 Type 2	FKM	F75	13664	75	Black	-25 to 250 (-13 to 482)
TRW Automotive TS2-18-033	EPDM	E73	17074	70	Black	-46 to 150 (-50 to 302)
TRW Automotive TS2-18-034	EPDM	E70	17401	60	Black	-46 to 150 (-50 to 302)
TRW Automotive TS2-18-035	EPDM	E150	17550	70	Black	-46 to 150 (-50 to 302)
TRW Automotive TS2-18-036	EPDM	E82	17450	80	Black	-46 to 150 (-50 to 302)
TRW Automotive TS2-18-037	EPDM	E73	17074	70	Black	-46 to 150 (-50 to 302)
TRW Automotive TS2-18-037	EPDM	E82	17450	80	Black	-46 to 150 (-50 to 302)
Volkswagen 2.8.1 – A/T 70	FKM	F95	13795	60	Red	-22 to 250 (-8 to 482)
Volkswagen 2.8.1 A	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Volkswagen 2.8.1-A/T 75 (ESD - < 106Ω)	FKM	F98	13798	75	Black	-22 to 250 (-8 to 482)
Volkswagen 2.8.1 – A/T 85	FKM	F87	13787	85	Black	-22 to 250 (-8 to 482)
Volvo (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 to 200 (-76 to 392)
Volvo (refer to Ford WSA-M2D401-A8, GF® Type (HF - high fluorine))	FKM (GF® Type)	F86	13728	75	Green	-22 to 250 (-8 to 482)

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The information in the fluid compatibility chart is largely taken from “The Los Angeles Rubber Group, Inc. Chemical Resistance of Elastomers” database. Precix® has added supplemental data. We thank the Los Angeles Rubber Group, Inc. for access to this information.

The fluid compatibility data is intended as a typical guideline only, for comparative purposes. For actual applications, appropriate testing and validation is mandatory. While Precix believes the compatibility data is reliable, no representation, guarantees or warranties of any kind are made.

	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65%F	Higher Fluid Resistant Fluorocarbon Typical of 69-70%F	Perfluoroelastomers
Acetaldehyde	4	NA	4	2	4	4	3	1
Acetamide	1	1	4	2	1	2	1	1
Acetic Acid, Glacial	3	2	4	2	4	3	3	1
Acetic Acid, 30%	2	NA	4	1	2	2	1	1
Acetic Anhydride	3	4	4	3	4	4	4	1
Acetone	4	4	4	3	4	4	4	1
Acetophenone	4	4	4	4	4	4	4	1
Acetyl Chloride	4	4	4	3	1	1	1	1
Acetylene	1	NA	4	2	NA	1	1	1
Acrylonitrile	4	4	4	4	4	3	3	1
Adipic Acid	1	1	NA	NA	1	1	1	1
Alkazene (Dibromoethylbenzene)	4	NA	4	4	2	2	2	1
Alum-NH3-Cr-K (aq)	1	1	4	1	4	4	NA	1
Aluminum Acetate (aq)	2	NA	4	4	4	4	4	1
Aluminum Chloride (aq)	1	1	1	2	1	1	1	1
Aluminum Fluoride (aq)	1	1	NA	2	1	1	1	1
Aluminum Nitrate (aq)	1	1	NA	2	NA	1	1	1
Aluminum Phosphate (aq)	1	1	NA	1	NA	1	1	1
Aluminum Sulfate (aq)	1	1	4	1	1	1	1	1
Ammonia Anhydrous	2	2	4	3	4	4	4	1
Ammonia Gas (cold)	1	1	4	1	4	4	4	1
Ammonia Gas (hot)	4	4	4	1	4	4	4	1
Ammonium Carbonate (aq)	4	4	4	NA	NA	1	1	1
Ammonium Chloride (aq)	1	1	NA	NA	NA	1	1	1
Ammonium Hydroxide (conc.)	4	NA	4	1	2	2	1	1
Ammonium Nitrate (aq)	1	1	2	NA	NA	1	1	1
Ammonium Nitrite (aq)	1	1	NA	2	NA	1	1	1
Ammonium Persulfate (aq)	4	4	4	NA	NA	1	1	1
Ammonium Phosphate (aq)	1	NA	NA	1	NA	1	1	1
Ammonium Sulfate (aq)	1	1	4	NA	NA	2	1	1
Amyl Acetate (Banana Oil)	4	4	4	4	4	4	4	1
Amyl Alcohol	2	2	4	4	1	2	1	1
Amyl Borate	1	1	NA	NA	NA	1	1	1
Amyl Chloronapthalene	4	4	4	4	2	1	1	1
Amyl Napthalene	4	4	2	4	1	1	1	1

LEGEND
 1 - Little Effect
 2 - Moderate Effect - May Be Acceptable for Static Applications
 3 - Significant Effect- Caution Advised if Used
 4 - Do Not Use
 NA - Indicates Insufficient data

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Anderol L-774	2	2	2	4	2	1	1	1
Aniline	4	NA	4	4	3	3	1	1
Aniline Dyes	4	4	4	3	2	2	1	1
Aniline Hydrochloride	2	NA	4	4	2	2	1	1
Animal Fats	1	1	1	2	1	1	1	1
Ansul Ether (Anesthetics)	3	3	4	4	3	4	4	1
Anti-freeze	1	1	4	2	1	1	1	1
Aqua Regia	4	4	4	4	3	2	1	1
Aroclor, 1248	3	3	4	2	2	1	1	1
Aroclor, 1254	4	4	4	3	2	1	1	1
Aroclor, 1260	1	1	4	2	1	1	1	1
Arsenic Acid	1	1	3	1	1	1	1	1
Arsenic Trichloride (aq)	1	1	NA	NA	NA	4	4	1
Askarel	2	2	4	4	2	1	1	1
Asphalt	2	NA	2	4	2	1	1	1
ASTM Oil #1	1	1	1	1	1	1	1	1
ASTM Oil #3	1	1	1	3	1	1	1	1
ASTM Ref Fuel B	2	2	4	4	2	1	1	1
ASTM Ref. Fuel C	2	2	4	4	2	1	1	1
ASTM Ref. Fuel C/ Ethanol 85:15	2	2	4	4	2	2	1	1
ASTM Ref. Fuel C/ Methanol 85:15	2	2	4	4	2	3	1	1
Automatic Transmission Fluid	1	1	1	4	2	1	1	1
Banana Oil (Amyl Acetate)	4	4	4	4	4	4	4	1
Barium Chloride (aq)	1	1	1	1	1	1	1	1
Barium Hydroxide (aq)	1	1	4	1	1	1	1	1
Barium Sulfate (aq)	1	1	4	1	1	1	1	1
Barium Sulfide (aq)	1	1	4	1	1	1	1	1
Beer	1	1	4	1	1	1	1	1
Beet Sugar Liquors	1	1	4	1	1	1	1	1
Benzaldehyde	4	4	4	2	3	4	4	1
Benzene	4	4	4	4	3	1	1	1
Benzene Sulfonic Acid	4	NA	4	4	2	1	1	1
Benzine (Ligroin) (Pet Ether)	1	NA	1	4	1	1	1	1
Benzoic Acid	3	NA	3	3	2	1	1	1
Benzoyl Chloride	4	NA	4	NA	2	2	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Benzyl Alcohol	4	NA	4	2	2	1	1	1
Benzyl Benzoate	4	NA	4	NA	1	1	1	1
Benzyl Chloride	4	NA--	4	4	2	1	1	1
Biodiesel	2	2	2	4	1	1	1	1
Biphenyl (Diphenyl) (Phenylbenzene)	4	4	4	4	2	1	1	1
Blast Furnace Gas	4	4	4	1	2	1	1	1
Bleach Solutions	4	2	4	2	2	1	1	1
Borax	2	1	2	2	2	1	1	1
Bordeaux Mixture	2	NA	4	2	2	1	1	1
Boric Acid	1	1	4	1	1	1	1	1
Brake Fluid	4	NA	NA	3	4	4	3	1
Brine	1	1	4	1	1	1	1	1
Bromine-Anhydrous	4	NA	4	4	2	1	1	1
Bromine Trifluoride	4	4	4	4	4	4	4	1
Bromine Water	4	3	4	4	2	1	1	1
Bromobenzene	4	4	4	4	1	1	1	1
Bunker Oil	1	1	1	2	1	1	1	1
Butadiene	4	NA	4	4	2	1	1	1
Butane	1	1	1	4	1	1	1	1
Butter (Animal Fat)	1	1	1	2	1	1	1	1
Butyl Acetate	4	NA	4	4	4	4	4	1
Butyl Acetyl Ricinoleate	3	2	NA	NA	2	1	1	1
Butyl Acrylate	4	4	4	NA	4	4	4	1
Butyl Alcohol	1	1	4	2	2	1	1	1
Butyl Amine	3	3	4	4	4	4	4	1
Butyl Benzoate	4	NA	4	NA	1	1	1	1
Butyl Carbitol	4	4	4	4	4	3	2	1
Butyl Cellosolve	3	3	4	NA	4	4	4	1
Butyl Oleate	4	4	NA	NA	2	1	1	1
Butyl Stearate	2	2	NA	NA	2	1	1	1
Butylene	2	4	4	4	2	1	1	1
Butyraldehyde	4	NA	4	4	4	4	4	1
Calcium Acetate (aq)	2	2	4	4	4	4	4	1
Calcium Chloride (aq)	1	1	1	1	1	1	1	1
Calcium Hydroxide (aq)	1	1	4	1	1	1	1	1
Calcium Hypochlorite (aq)	2	2	4	2	2	1	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Calcium Nitrate (aq)	1	1	1	2	1	1	1	1
Calcium Sulfide (aq)	1	1	4	2	1	1	1	1
Cane Sugar Liquors	1	NA	4	1	1	1	1	1
Carbamate	3	NA	4	NA	1	1	1	1
Carbitol	2	NA	4	2	2	2	2	1
Carbolic Acid (Phenol)	4	4	4	4	1	1	1	1
Carbon Bisulfide	3	4	3	4	1	1	1	1
Carbon Dioxide	1	1	NA	2	1	1	1	1
Carbonic Acid	2	1	1	1	1	1	1	1
Carbon Monoxide	1	1	NA	1	2	1	1	1
Carbon Tetrachloride	3	2	4	4	3	1	1	1
Castor Oil	1	1	1	1	1	1	1	1
Cellosolve	4	NA	4	4	4	4	4	1
Cellosolve Acetate	4	4	4	4	4	4	4	1
Cellulube (Fryquel)	4	4	4	1	3	1	1	1
China Wood Oil (Tung Oil)	1	1	NA	4	2	1	1	1
Chlorine (Dry)	4	2	4	4	1	1	1	1
Chlorine (Wet)	4	3	4	4	2	2	1	1
Chlorine Dioxide	4	NA	4	NA	2	1	1	1
Chlorine Trifluoride	4	4	4	4	3	4	4	1
Chloroacetic Acid	4	4	4	NA	4	4	3	1
Chloroacetone	4	4	4	4	4	4	3	1
Chlorobenzene	4	4	4	4	2	1	1	1
Chlorobromomethane	4	4	4	4	2	1	1	1
Chlorobutadiene	4	4	4	4	2	1	1	1
Chlorododecane	4	4	4	4	1	1	1	1
Chloroform	4	4	4	4	4	1	1	1
O-Chloronaphthalene	4	NA	4	4	2	1	1	1
1-Chloro-1-Nitro Ethane	4	NA	4	4	4	4	4	1
Chlorosulfonic Acid	4	NA	4	4	4	4	4	1
Chlorotoluene	4	4	4	4	2	1	1	1
Chlorox (Sodium Hypochlorite NaOCl)	2	2	4	2	2	1	1	1
Chrome Plating Solutions	4	4	4	2	2	1	1	1
Chromic Acid	4	4	4	3	3	1	1	1
Citric Acid	1	1	NA	1	1	1	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Coal Tar (Creosote)	1	NA	1	4	1	1	1	1
Cobalt Chloride (aq)	1	1	4	2	1	1	1	1
Cocanut Oil	1	1	1	1	1	1	1	1
Cod Liver Oil	1	1	1	2	1	1	1	1
Coke Oven Gas	4	4	4	2	2	1	1	1
Copper Acetate (aq)	2	2	4	4	4	4	4	1
Copper Chloride (aq)	1	1	1	1	1	1	1	1
Copper Cyanide (aq)	1	1	1	1	1	1	1	1
Copper Sulfate (aq)	1	1	4	1	1	1	1	1
Corn Oil	1	1	1	1	1	1	1	1
Cottonseed Oil	1	1	1	1	1	1	1	1
Creosote (Coal Tar)	1	1	1	4	1	1	1	1
Cresol	4	NA	4	4	2	1	1	1
Cresylic Acid	4	1	4	4	2	1	1	1
Cumene	4	4	4	4	2	1	1	1
Cutting Oil	1	1	1	4	1	1	1	1
Cyclohexane	1	1	1	4	2	1	1	1
Cyclohexanol	3	1	NA	4	1	1	1	1
Cyclohexanone	4	4	4	4	4	4	4	1
P-Cymene	4	NA	4	4	2	1	1	1
Decalin	4	NA	NA	4	1	1	1	1
Decane	1	1	1	2	1	1	1	1
Denatured Alcohol	1	1	4	1	1	1	1	1
Detergent Solutions	1	1	4	1	1	1	1	1
Developing Fluids	1	1	NA	1	1	1	1	1
Diacetone	4	NA	4	4	4	4	3	1
Diacetone Alcohol	4	4	4	2	4	4	3	1
Dibenzyl Ether	4	4	NA	NA	NA	4	4	1
Dibenzyl Sebecate	4	4	4	3	3	2	1	1
Dibromoethylbenzene (Alkazene)	4	4	4	4	2	2	1	1
Dibutyl Amine	4	NA	4	3	4	4	4	1
Dibutyl Ether	4	4	3	4	3	3	3	1
Dibutyl Phthalate	4	4	4	2	3	3	2	1
Dibutyl Sebecate	4	4	4	2	2	2	1	1
O-Dichlorobenzene	4	NA	4	4	2	1	1	1

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Dichloro-Isopropyl Ether	4	4	3	4	3	3	3	1
Dicyclohexylamine	3	3	4	NA	4	4	4	1
Diesel Fuel	1	1	1	4	1	1	1	1
Diesel Oil	1	1	1	4	1	1	1	1
Diethylamine	2	NA	4	2	4	4	4	1
Diethyl Benzene	4	NA	NA	4	3	1	1	1
Diethyl Ether	4	4	3	4	3	4	4	1
Diethylene Glycol	1	NA	2	2	1	1	1	1
Diethyl Sebecate	2	3	4	2	2	2	1	1
Diisobutylene	2	1	4	4	3	1	1	1
Diisopropyl Benzene	4	NA	NA	NA	2	1	1	1
Diisopropyl Ketone	4	NA	4	4	4	4	4	1
Diisopropylidene Acetone (Phorone)	4	NA	4	4	4	4	4	1
Dimethyl Aniline (Xylidine)	3	NA	4	4	4	4	4	1
Dimethyl Ether (Methyl Ether) (Monomethyl Ether)	1	1	4	1	1	4	4	1
Dimethyl Formamide	2	NA	4	2	4	4	4	1
Dimethyl Phthalate	4	4	4	NA	2	2	1	1
Dinitrotoluene	4	4	4	4	4	4	4	1
Dioctyl Phthalate	3	NA	4	3	2	2	1	1
Dioctyl Sebecate	4	4	4	3	3	2	1	1
Dioxane	4	NA	4	4	3	4	4	1
Dioxolane	4	4	4	4	4	4	4	1
Dipentene	2	2	4	4	3	1	1	1
Diphenyl (Biphenyl) (Phenylbenzene)	4	4	4	4	2	1	1	1
Diphenyl Oxides	4	NA	4	3	2	1	1	1
Dow Corning 33, 200	1	1	1	3	2	1	1	1
Dow Corning 55	1	1	1	3	2	1	1	1
Dowtherm Oil	4	4	4	3	2	1	1	1
Dry Cleaning Fluids	3	3	4	4	2	1	1	1
Epichlorohydrin	4	4	4	4	4	4	4	1
Ethane	1	NA	1	4	2	1	1	1
Ethanolamine	2	NA	4	2	4	4	4	1
Ethyl Acetate	4	NA	4	2	4	4	4	1
Ethyl Acetoacetate	4	NA	4	2	4	4	4	1
Ethyl Acrylate	NA	4	2	4	4	4	1	1

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Ethyl Alcohol	1	4	1	1	2	1	1	1
Ethyl Benzene	NA	4	4	1	1	1	1	1
Ethyl Benzoate	NA	4	4	1	1	1	1	1
Ethyl Cellosolve	NA	4	4	4	4	4	1	1
Ethyl Cellulose	2	NA	4	3	4	4	4	1
Ethyl Chloride	1	NA	4	4	1	1	1	1
Ethyl Chloroformate	4	NA	4	4	2	1	1	1
Ethyl Chloroformate	4	NA	4	4	4	4	4	1
Ethyl Ether	3	NA	4	4	3	4	4	1
Ethyl Formate	4	NA	NA	NA	1	1	1	1
Ethyl Mercaptan	4	NA	NA	3	NA	2	1	1
Ethyl Oxalate	4	NA	4	4	2	1	1	1
Ethyl Pentachlorobenzene	4	NA	4	4	2	1	1	1
Ethyl Silicate	1	NA	NA	NA	1	1	1	1
Ethylene	1	NA	NA	NA	1	1	1	1
Ethylene Chloride	4	NA	4	4	3	2	1	1
Ethylene Chlorohydrin	4	NA	4	3	2	1	1	1
Ethylene Diamine	1	1	4	1	4	4	4	2
Ethylene Dichloride	4	NA	4	4	3	1	1	1
Ethylene Glycol	1	1	3	1	1	1	1	1
Ethylene Oxide	4	NA	4	4	4	4	4	1
Ethylene Trichloride	4	4	4	4	3	1	1	1
Fatty Acids	2	2	NA	3	NA	1	1	1
Ferric Chloride (aq)	1	1	1	2	1	1	1	1
Ferric Nitrate (aq)	1	1	1	3	1	1	1	1
Ferric Sulfate (aq)	1	1	1	2	1	1	1	1
Fish Oil	1	NA	NA	1	1	1	1	1
Fluorinated Cyclic Esters	NA	NA	NA	NA	NA	NA	NA	2
Fluorine (Liquid)	4	NA	4	4	NA	2	2	1
Fluorobenzene	4	NA	4	4	2	1	1	1
Fluoroboric Acid	1	NA	NA	NA	NA	NA	NA	NA
Fluorolube	1	1	NA	1	2	2	1	1
Fluorosilicic (Hydrofluosilicic) Acid	1	1	NA	4	4	1	1	1
Fluorosilicone Oil (DC 1265)	2	2	1	1	3	1	1	1

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Formaldehyde (RT)	3	2	4	2	4	4	4	1
Formic Acid	2	NA	NA	2	3	4	4	1
Freon 11	2	2	NA	4	2	2	2	2
Freon 12	1	1	1	4	3	2	2	2
Freon 13	1	NA	NA	4	4	1	2	2
Freon 21	4	NA	NA	4	NA	4	4	1
Freon 22	4	NA	2	4	4	4	4	2
Freon 31	4	NA	NA	NA	NA	4	4	2
Freon 32	1	NA	NA	NA	NA	4	4	2
Freon 112	2	2	NA	4	NA	1	2	2
Freon 113	1	1	NA	4	4	2	3	2
Freon 114	1	1	NA	4	2	2	2	2
Freon 115	1	NA	NA	NA	NA	2	2	2
Freon 134A	11	1	NA	NA	NA	3	3	2
Freon 142b	1	2	NA	NA	NA	4	4	2
Freon 152a	1	NA	NA	NA	NA	4	4	2
Freon 218	1	NA	NA	NA	NA	2	2	2
Freon C316	1	NA	NA	NA	NA	2	52	2
Freon C318	1	1	NA	NA	NA	2	2	2
Freon 13B1	1	NA	NA	4	NA	2	2	2
Freon 114B2	2	NA	NA	4	NA	2	2	2
Freon 502	2	NA	NA	NA	NA	4	4	2
Freon BF	2	2	NA	4	NA	2	2	2
Freon MF	1	2	NA	4	NA	2	2	2
Freon TA	1	NA	NA	3	NA	4	4	2
Freon TC	1	NA	NA	4	NA	2	2	2
Freon TF	1	1	NA	4	NA	2	2	2
Freon TMC	2	NA	NA	3	NA	2	2	2
Freon T-P35	1	NA	NA	1	NA		2	2
Freon T-WD602	2	NA	NA	4	NA	2	2	2
Fuel B	2	2	4	4	2	1	1	1
Fuel C	2	2	4	4	1	1	1	1

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Fuel Oil	1	1	1	4	1	1	1	1
Fumaric Acid	1	1	4	2	1	1	1	1
Furan, Furfuran	4	4	4	NA	NA	4	4	1
Furfural	4	4	4	4	NA	4	4	1
Fyrquel (Cellulube)	4	4	4	1	3	1	1	1
Gallic Acid	2	2	4	NA	1	1	1	1
Gasoline								
ASTM Ref Fuel B (87 Octane)	2	2	4	4	2	1	1	1
ASTM Ref. Fuel C	2	2	4	4	2	1	1	1
ASTM Ref. Fuel C/ Ethanol 85:15	2	2	4	4	2	2	1	1
ASTM Ref. Fuel C/ Methanol 85:15	2	2	4	4	2	3	1	1
Gear Lube	1	1	1	4	1	1	1	1
Gelatin	1	NA	4	1	1	1	1	1
Glauber's Salt (aq)	4	4	4	NA	1	1	1	1
Glucose	1	1	NA	1	1	1	1	1
Glue	1	NA	NA	1	1	1	1	1
Glycerin	1	NA	3	1	1	1	1	1
Glycols	1	1	4	1	1	1	1	1
Grease (Light)	1	1	1	4	1	1	1	NA
Green Sulfate Liquor	2	2	2	1	2	1	1	1
Halowax Oil	4	4	NA	4	1	1	1	1
Helium	1	1	1	1	1	1	1	1
N-Hexaldehyde	4	NA	NA	2	4	4	4	1
Hexane	1	1	1	4	1	1	1	1
N-Hexene-1	2	2	1	4	1	1	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Hexyl Alcohol	1	NA	4	2	2	1	1	1
Hydrazine	2	NA	NA	3	4	4	4	1
Hydraulic Oil (Petroleum)	1	1	3	1	1	1		
Hydrobromic Acid	4	4	4	4	3	1	1	1
Hydrobromic Acid 40%	4	NA	4	4	3	1	1	1
Hydrochloric Acid (Cold) 37%	3	NA	4	3	2	1	1	1
Hydrochloric Acid (Hot) 37%	4	NA	4	4	3	2	1	1
Hydrocyanic Acid	2	2	4	3	2	1	1	1
Hydrofluoric Acid (Conc.) Cold	4	NA	4	4	4	1	1	1
Hydrofluoric Acid (Conc.) Hot	4	NA	4	4	4	4	4	1
Hydrofluoric Acid-Anhydrous	4	NA	4	4	4	4	4	1
Hydrofluosilicic Acid (Fluosilicic Acid)	1	1	NA	4	4	1	1	1
Hydrogen Gas	1	NA	2	3	3	1	1	1
Hydrogen Peroxide (90%)	4	2	4	2	2	2	1	1
Hydrogen Sulfide (Wet) Cold	4	1	4	3	3	4	3	1
Hydrogen Sulfide (Wet) Hot	4	4	4	3	3	4	3	1
Hydroquinone	3	4	4	NA	2	2	1	1
Hypochlorous Acid	4	4	4	NA	NA	1	1	1
Iodine Pentafluoride	4	4	4	4	4	4	4	1
Iodoform	NA	NA	NA	NA	NA	3	2	1
IRM 901	1	1	1	1	1	1	1	1
IRM 903	1	1	1	3	1	1	1	1
Isobutyl Alcohol	2	2	4	1	2	1	1	1
Isooctane	1	1	1	4	1	1	1	1
Isophorone	4	4	4	4	4	4	4	1
Isopropyl Acetate	4	4	4	4	4	4	4	1
Isopropyl Alcohol	2	2	4	1	2	1	1	1
Isopropyl Chloride	4	4	4	4	2	1	1	1
Isopropyl Ether	2	2	3	4	3	4	4	1
JP4-JP6	1	1	2	4	2	1	1	1

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Kerosene	1	1	1	4	1	1	1	1
Lacquers	4	4	4	4	4	4	2	1
Lacquer Solvents	4	4	4	4	4	4	4	1
Lactic Acid (Cold)	1	NA	4	1	1	1	1	1
Lactic Acid (Hot)	4	NA	4	2	2	1	1	1
Lard	1	1	1	2	1	1	1	1
Lavender Oil	2	2	2	4	2	1	1	1
Lead Acetate (aq)	2	2	4	4	4	4	4	1
Lead Nitrate (aq)	1	1	NA	2	1	1	1	1
Lead Sulfamate (aq)	2	NA	4	2	1	1	1	1
Ligroin (Benzine) (Nitrobenzine)	1	1	1	4	1	1	1	1
Lime Bleach	1	1	4	2	1	1	1	1
Lime Sulfur	4	1	4	1	1	1	1	1
Lindol (Hydraulic Fluid)	4	NA	4	3	3	2	1	1
Linoleic Acid	2	2	NA	2	NA	2	1	1
Linseed Oil	1	1	1	1	1	1	1	1
Liquefied Petroleum Gas	1	1	3	3	3	1	1	1
Lubricating Oils (Petroleum)	1	1	1	4	1	1	1	1
Lye	2	2	4	2	1	2	1	1
Magnesium Chloride (aq)	1	1	NA	1	1	1	1	1
Magnesium Hydroxide (aq)	2	2	4	NA	NA	1	1	1
Magnesium Sulfate (aq)	1	NA	4	1	1	1	1	1
Maleic Acid	4	4	4	NA	NA	1	1	1
Maleic Anhydride	4	4	4	NA	NA	4	3	1
Malic Acid	1	1	4	2	1	1	1	1
Mercury Chloride (aq)	1	1	NA	NA	NA	1	1	1
Mercury	1	1	NA	NA	NA	1	1	1
Mesityl Oxide	4	4	4	4	4	4	4	1
Methane	1	1	1	4	2	1	1	1

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Methyl Acetate	4	4	4	4	4	4	4	1
Methyl Acrylate	4	NA	4	4	4	4	4	1
Methylacrylic Acid	4	NA	4	4	4	4	4	1
Methyl Alcohol (Methanol)	1	1	4	1	1	4	1	1
Methyl Bromide	2	2	3	NA	1	1	1	1
Methyl Butyl Ketone (Propyl Acetone)	4	4	4	3	4	4	4	1
Methyl Cellosolve	3	3	4	4	4	4	4	1
Methyl Chloride	4	4	4	4	2	2	1	1
Methyl Cyclopentane	4	4	4	4	2	1	1	1
Methylene Chloride	4	NA	4	4	2	2	2	1
Methyl Ether (Dimethyl Ether) (Monomethyl Ether)	1	1	4	1	1	4	4	1
Methyl Ethyl Ketone	4	NA	4	4	4	4	4	1
Methyl Formate	4	4	NA	NA	NA	4	4	1
Methyl Isobutyl Ketone	4	4	4	4	4	4	4	1
Methyl Methacrylate	4	4	4	4	4	4	4	1
Methyl Oleate	4	4	NA	NA	2	2	1	1
Methyl Salicylate	4	NA	NA	NA	NA	2	1	1
Methyl Tertiary Butyl Ether (MTBE)	3	NA	NA	NA	NA	4	3	1
Milk	1	1	4	1	1	1	1	1
Mineral Oil	1	1	1	2	1	1	1	1
Monochlorobenzene	4	4	4	4	2	1	1	1
Monomethyl Aniline	4	4	4	NA	NA	2	2	1
Monoethanol Amine	4	NA	4	2	4	4	4	1
Monomethyl Ether (Methyl Ether)	1	NA	4	1	1	4	4	1
Monovinyl Acetylene	1	NA	NA	2	NA	1	1	1
Mustard Gas	NA	NA	NA	1	NA	1	1	1
Naphtha	2	2	2	4	2	1	1	1
Naphthalene	4	4	NA	4	1	1	1	1
Naphthalenic Acid	2	NA	NA	4	1	1	1	1
Natural Gas	1	1	2	1	3	1	1	1
Neats Foot Oil	1	1	1	2	1	1	1	1

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Neville Acid	4	4	4	4	2	1	1	1
Nickel Acetate (aq)	2	2	4	4	4	4	4	1
Nickel Chloride (aq)	1	1	3	1	1	1	1	1
Nickel Sulfate (aq)	1	1	4	1	1	1	1	1
Niter Cake	1	1	4	1	1	1	1	1
Nitric Acid (Conc.)	4	4	4	4	3	2	1	1
Nitric Acid (Dilute)	4	NA	4	2	2	1	1	1
Nitric Acid-Red Fuming	4	4	4	4	4	3	2	1
Nitrobenzene	4	4	4	4	4	2	1	1
Nitrobenzene (Petroleum Ether)	1	1	1	4	1	1	1	1
Nitroethane	4	NA	4	4	4	4	4	1
Nitrogen	1	NA	1	1	1	1	1	1
Nitrogen Tetroxide	34	4	4	4	4	4	4	1
Nitromethane	4	4	4	4	4	4	4	1
Octachlorotoluene	4	NA	4	4	2	1	1	1
Octadecane	1	NA	2	4	1	1	1	1
N-Octane	2	NA	4	4	2	1	1	1
Octyl Alcohol	2	2	4	2	2	1	1	1
Oleic Acid	3	1	4	4	NA	2	2	1
Oleum Spirits	2	2	NA	4	2	1	1	1
Olive Oil	1	1	1	3	1	1	1	1
O-Dichlorobenzene	4	4	4	4	2	1	1	1
Oxalic Acid	2	2	NA	2	1	1	1	1
Oxygen-Cold	2	NA	2	1	1	1	1	1
Oxygen-(200-400°F)	4	4	4	2	4	2	1	1
Ozone	4	4	2	1	2	1	1	1
Paint Thinner, Duco	4	4	4	4	2	2	1	1
Palmitic Acid	1	1	NA	4	1	1	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Peanut Oil	1	NA	1	1	1	1	1	1
Perchloric Acid	4	NA	4	4	1	1	1	1
Perchloroethylene	2	NA	4	4	2	1	1	1
Petroleum-Below 250°F	1	NA	2	2	2	1	1	1
Petroleum-Above 250°F	4	NA	4	4	4	2	1	1
Phenol (Carbolic Acid)	4	4	4	4	1	1	1	1
Phenylbenzene (Biphenyl) (Diphenyl)	4	4	4	4	2	1	1	1
Phenyl Ethyl Ether	4	4	4	4	4	4	4	1
Phenyl Hydrazine	4	NA	4	NA	NA	2	1	1
Phorone (Diisopropylidene Acetone)	4	4	4	4	4	4	4	1
Phosphoric Acid-20%	2	NA	NA	2	2	1	1	1
Phosphoric Acid-45%	4	NA	NA	3	2	1	1	1
Phosphorus Trichloride	4	4	NA	NA	1	1	1	1
Pickling Solution	4	NA	4	4	4	2	1	1
Picric Acid	2	NA	NA	4	2	1	1	1
Pinene	2	NA	4	4	2	1	1	1
Pine Oil	4	NA	NA	4	1	1	1	1
Piperidine	4	NA	4	4	4	4	4	1
Plating Solution-Chrome	NA	4	NA	4	NA	1	1	1
Plating Solution-Others	1	1	NA	4	NA	1	1	1
Potassium Acetate (aq)	2	NA	4	4	4	4	4	1
Potassium Chloride (aq)	1	1	1	1	1	1	1	1
Potassium Cupro Cyanide (aq)	1	1	1	1	1	1	1	1
Potassium Cyanide (aq)	1	1	1	1	1	1	1	1
Potassium Dichromate (aq)	1	1	1	1	1	1	1	1
Potassium Hydroxide (aq)	2	2	4	3	3	4	4	1
Potassium Nitrate (aq)	1	1	1	1	1	1	1	1
Potassium Sulfate (aq)	1	1	4	1	1	1	1	1
Producer Gas	1	NA	2	2	2	1	1	1
Propane	1	1	1	4	2	1	1	1

LEGEND
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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
i-Propyl Acetate	4	NA	4	4	4	4	4	1
n-Propyl Acetate	4	NA	4	4	4	4	4	1
Propyl Acetone (Methyl Butyl Ketone)	4	4	4	3	4	4	4	1
Propyl Alcohol	1	1	4	1	1	1	1	1
Propyl Nitrate	4	1	4	4	4	4	4	1
Propylene	4	4	4	4	2	1	1	1
Propylene Oxide	4	4	4	4	4	4	4	1
Pydraul, 10E, 29 ELT	4	4	4	4	4	1	1	1
Pydraul, 30E, 50E, 65E, 90E	4	4	4	1	1	1	1	1
Pydraul, 115E	4	4	4	4	3	1	1	1
Pydraul, 230E, 312C, 540C	4	4	4	4	4	1	1	1
Pyranol, Transformer Oil	1	1	1	4	1	1	1	1
Pyridine	4	4	4	4	4	4	4	1
Pyroligneous Acid	4	4	4	NA	4	4	4	1
Pyrrole	4	NA	4	2	3	4	4	1
Radiation	3	3	3	3	4	3	3	1
Rapeseed Oil	2	2	2	4	1	1	1	1
Red Oil (MIL-H-5606)	1	1	1	4	1	1	1	1
RJ-1 (MIL-F-25558 B)	1	1	1	4	1	1	1	1
RP-1 (MIL-F-25576 C)	1	1	1	4	1	1	1	1
Sal Ammoniac	1	1	1	2	1	1	1	1
Salicylic Acid	2	2	NA	NA	1	1	1	1
Salt Water	1	1	4	1	1	1	1	1
Sewage	1	1	4	2	1	1	1	1
Silicate Esters	2	2	NA	4	1	1	1	1
Silicone Greases	1	1	1	3	1	1	1	1
Silicone Oils	1	1	1	3	1	1	1	1
Silver Nitrate	2	2	1	1	1	1	1	1
Skydrol 500	4	4	4	3	3	4	4	1
Skydrol 7000	4	4	4	3	3	2	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Soap Solutions	1	1	4	1	1	1	1	1
Soda Ash	1	1	NA	1	1	1	1	1
Sodium Acetate (aq)	2	2	4	4	4	4	4	1
Sodium Bicarbonate (aq) (Baking Soda)	1	1	NA	1	1	1	1	1
Sodium Bisulfite (aq)	1	1	4	1	1	1	1	1
Sodium Borate (aq)	1	1	NA	1	1	1	1	1
Sodium Chloride (aq)	1	1	NA	1	1	1	1	1
Sodium Cyanide (aq)	1	1	NA	1	1	1	1	1
Sodium Hydroxide (aq)	2	2	3	2	2	2	1	1
Sodium Hypochlorite (aq) (Chlorox)	2	2	4	2	2	1	1	1
Sodium Metaphosphate (aq)	1	1	NA	NA	1	1	1	1
Sodium Nitrate (aq)	2	NA	NA	4	NA	1	1	1
Sodium Perborate (aq)	2	2	NA	2	1	1	1	1
Sodium Peroxide (aq)	2	2	4	4	1	2	1	1
Sodium Phosphate (aq)	1	1	1	4	NA	1	1	1
Sodium Silicate (aq)	1	1	NA	NA	NA	1	1	1
Sodium Sulfate (aq)	1	NA	4	1	1	1	1	1
Sodium Thiosulfate (aq)	2	NA	4	1	1	1	1	1
Soybean Oil	1	1	1	1	1	1	1	1
Stannic Chloride (aq)	1	1	NA	2	1	1	1	1
Stannous Chloride (aq)	1	1	NA	2	1	1	1	1
Steam Under 300°F	4	4	4	3	4	2	2	1
Steam Over 300°F	4	4	4	4	4	4	3	1
Stearic Acid	2	2	NA	2	NA	1	1	1
Stoddard Solvent	1	1	1	4	1	1	1	1
Styrene	4	4	4	4	3	2	1	1
Sucrose Solution	1	2	4	1	1	1	1	1
Sulfite Liquors	2	NA	4	4	2	1	1	1
Sulfur	4	4	4	3	1	1	1	1
Sulfur Chloride (aq)	3	4	4	3	1	1	1	1
Sulfur Dioxide (Dry)	4	4	4	2	2	2	1	1
Sulfur Dioxide (Wet)	4	4	4	2	2	2	1	1
Sulfur Dioxide (Liquified)	4	4	4	2	2	2	1	1

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	Nitrile	Highly Saturated Nitrile	Vamac® Polyacrylate	Silicone	Fluorosilicone	Fluorocarbon Typical of 65°F	Higher Fluid Resistant Fluorocarbon Typical of 69-70°F	Perfluoroelastomers
Sulfur Trioxide	4	4	4	2	2	1	1	1
Sulfuric Acid (Dilute)	3	NA	2	4	3	1	1	1
Sulfuric Acid (Conc.)	4	NA	4	4	4	1	1	1
Sulfuric Acid (20% Oleum)	4	2	4	4	4	1	1	1
Sulfurous Acid	2	2	4	4	NA	3	2	1
Tannic Acid	1	1	4	2	NA	1	1	1
Tar, Bituminous	2	2	4	2	1	1	1	1
Tartaric Acid	1	1	NA	1	1	1	1	1
Terpineol	2	2	NA	NA	1	1	1	1
Tertiary Butyl Alcohol	2	NA	4	2	2	1	1	1
Tertiary Butyl Catechol	4	NA	4	NA	1	1	1	1
Tertiary Butyl Mercaptan	4	4	4	4	NA	1	1	1
Tetrabromoethane	4	4	4	4	2	1	1	1
Tetrabromomethane	4	NA	NA	4	2	1	1	1
Tetrabutyl Titanate	2	2	NA	NA	1	1	1	1
Tetrachloroethylene	4	4	4	4	2	1	1	1
Tetraethyl Lead	2	2	NA	NA	2	1	1	1
Tetrahydrofuran	4	4	4	4	4	4	4	1
Tetralin	4	4	NA	4	1	2	1	1
Thionyl Chloride	4	NA	4	NA	NA	2	1	1
Titanium Tetrachloride	2	2	4	4	2	1	1	1
Toluene	4	4	4	4	2	2	1	1
Toluene Diisocyanate	4	4	4	4	4	4	3	1
Transformer Oil	1	1	2	2	1	1	1	1
Transmission Fluid Type A	1	1	1	4	2	1	1	1
Triacetin	2	2	4	NA	4	4	3	1
Triaryl Phosphate	4	4	4	3	2	1	1	1
Tributoxy Ethyl Phosphate	4	4	4	NA	2	1	1	1
Tributyl Mercaptan	4	NA	4	4	3	1	1	1
Tributyl Phosphate	4	4	4	4	4	4	4	1
Trichloroacetic Acid	2	2	4	NA	4	4	3	1
Trichloroethane	4	4	4	4	2	1	1	1
Trichloroethylene	4	3	4	4	2	1	1	1
Tricresyl Phosphate	4	4	4	3	2	1	1	1
Triethanol Amine	2	3	4	NA	4	4	4	1

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Triethyl Aluminum	4	NA	4	NA	NA	2	1	1
Triethyl Borane	4	NA	4	NA	NA	1	1	1
Trinitrotoluene	4	4	4	NA	2	2	1	1
Trioctyl Phosphate	4	NA	4	3	2	2	1	1
Tung Oil (China Wood Oil)	1	1	NA	4	2	1	1	1
Turbine Oil	2	1	1	4	2	1	1	1
Turpentine	1	1	2	4	2	1	1	1
Ucon Lubricant LB 65	1	1	NA	1	1	1	1	1
Unsymmetrical Dimethyl Hydrazine (UDMH)	2	2	NA	4	4	4	4	1
Varnish	2	2	4	4	2	1	1	1
Vegetable Oils	1	1	1	2	1	1	1	1
Versilube F-50	1	1	1	3	1	1	1	1
Vinegar	2	2	4	1	3	1	1	1
Vinyl Chloride	4	NA	4	NA	NA	1	1	1
Wagner 21B Brake Fluid	3	NA	NA	3	4	4	3	1
Water	1	1	4	1	1	1	1	1
Whiskey, Wines	1	1	4	1	1	1	1	1
White Pine Oil	2	NA	NA	4	1	1	1	1
White Oil	1	1	1	4	1	1	1	1
Wood Oil	1	NA	1	4	2	1	1	1
Xylene	4	4	4	4	1	1	1	1
Xylidine (Di-methyl Aniline)	3	3	4	4	4	4	3	1
Zeolites	1	1	NA	NA	1	1	1	1
Zinc Acetate (aq)	2	2	4	4	4	4	4	1
Zinc Chloride (aq)	1	1	4	1	1	1	1	1
Zinc Sulfate (aq)	1	1	4	1	1	1	1	1
TT-T-656b	4	NA	4	4	3	4	NA	1
VV-B-680	2	NA	2	4	2	1	1	1
VV-G-632	1	NA	1	3	1	1	1	1
VV-G-671c	1	NA	1	3	1	1	1	1
VV-H-910	2	3	2	4	2	1	1	1

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VV-I-530a	1	NA	1	3	1	1	1	1
VV-K-211d	1	NA	NA	4	1	1	1	1
VV-K-220a	1	NA	2	4	1	1	1	1
VV-L-751b	2	NA	2	4	1	1	1	1
VV-L-800	1	NA	1	3	1	1	1	1
VV-L-820b	1	NA	1	3	1	1	1	1
VV-L-825a Type I	1	NA	1	3	1	1	1	1
VV-L-825a Type II	1	NA	1	3	1	1	1	1
VV-L-825a Type III	2	NA	2	4	1	1	1	1
VV-O-526	1	NA	1	3	1	1	1	1
VV-P-216a	1	NA	1	3	1	1	1	1
VV-P-236	2	NA	2	4	1	1	1	1
51-F-23	1	NA	1	3	1	1	1	1
MIL-L-644 B	1	NA	2	3	NA	NA	NA	NA
MIL-L-2104 B	1	NA	1	3	1	1	1	1
MIL-L-2105 B	1	NA	1	3	1	1	1	1
MIL-G-2108	1	NA	1	3	1	1	1	1
MIL-S-3136 B Type I	1	1	2	4	1	1	1	1
MIL-S-3136 B Type II	1	1	NA	4	1	1	1	1
MIL-S-3136 B Type III	1	1	NA	4	1	1	1	1
MIL-S-3136 B Type IV	1	1	1	3	1	1	1	1
MIL-S-3136 B Type V	1	1	1	3	1	1	1	1
MIL-S-3136 B Type VI	1	1	1	3	1	1	1	1
MIL-S-3136 B Type VII	1	1	NA	4	1	1	1	1
MIL-L-3150 A	1	NA	1	3	1	1	1	1
MIL-L-3503	1	NA	1	3	1	1	1	1
MIL-L-3545-B	2	NA	2	4	1	1	1	1
MIL-C-4339 C	1	NA	1	3	1	1	1	1
MIL-G-4343 B	2	NA	1	4	2	1	1	1
MIL-L-5020 A	1	NA	2	4	1	1	1	1

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MIL-J-5161 F	1	NA	NA	4	1	1	1	1
MIL-C-5545 A	2	NA	2	4	1	1	1	1
MIL-H-5559 A	1	NA	3	2	2	2	1	1
MIL-F-5566	1	NA	NA	1	1	1	1	1
MIL-F-5602	1	NA	1	3	1	1	1	1
MIL-H-5606 B (Red Oil)	1	1	1	4	1	1	1	1
MIL-J-5624 G JP-3, JP-4, JP-5	1	1	2	4	2	1	1	1
MIL-O-6081 C	1	NA	1	3	1	1	1	1
MIL-L-6082 C	1	NA	1	3	1	1	1	1
MIL-H-6083 C	1	NA	1	3	1	1	1	1
MIL-L-6085 A	1	2	3	3	1	1	1	1
MIL-L-6086 B	1	NA	1	3	1	1	1	1
MIL-L-6387 A	1	NA	NA	3	1	1	1	1
MIL-C-6529 C	2	NA	2	4	1	1	1	1
MIL-F-7024 A	1	NA	2	4	1	1	1	1
MIL-H-7083 A	1	NA	3	2	2	2	1	1
MIL-G-7118 A	1	NA	3	3	1	1	1	1
MIL-G-7187	1	NA	1	3	1	1	1	1
MIL-G-7421 A	1	NA	NA	3	1	1	1	1
MIL-H-7644	2	NA	2	4	2	1	1	1
MIL-L-7645	2	NA	2	4	1	1	1	1
MIL-G-7711 A	1	NA	1	3	1	1	1	1
MIL-L-7808 F	1	2	3	3	1	1	1	1
MIL-L-7870 A	1	NA	1	3	1	1	1	1
MIL-C-8188 C	1	NA	3	3	1	1	1	1
MIL-A-8243 B	1	NA	3	2	2	2	1	1
MIL-L-8383 B	1	NA	1	3	1	1	1	1

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MIL-H-8446 B (MLO-8515)	2	NA	3	4	1	1	1	1
MIL-I-8660 B	1	NA	NA	4	1	1	1	1
MIL-L-9000 F	1	NA	2	4	1	1	1	1
MIL-T-9188 B	4	NA	4	4	3	4	NA	1
MIL-L-9236 B	1	NA	3	4	1	1	1	1
MIL-L-10295 A	1	NA	1	3	1	1	1	1
MIL-L-10324 A	1	NA	1	3	1	1	1	1
MIL-G-10924 B	1	NA	1	3	1	1	1	1
MIL-L-11734 B	1	NA	3	3	1	1	1	1
MIL-O-11773	1	NA	3	3	1	1	1	1
MIL-P-12098	2	NA	2	4	2	1	1	1
MIL-H-13862	1	NA	1	3	1	1	1	1
MIL-H-13866 A	1	NA	1	3	1	1	1	1
MIL-H-13910 B	2	NA	2	4	2	1	1	1
MIL-H-13919 A	1	NA	1	3	1	1	1	1
MIL-L-14107 B	3	NA	NA	4	1	1	1	1
MIL-L-15017	1	NA	1	3	1	1	1	1
MIL-L-15018 B	1	NA	1	3	1	1	1	1
MIL-L-15019 C	1	NA	1	3	1	1	1	1
MIL-L-15719 A	2	NA	2	4	2	1	1	1
MIL-G-15793	1	NA	3	3	1	1	1	1
MIL-F-16929 A	1	NA	3	3	1	1	1	1
MIL-F-16958 A	1	NA	1	3	1	1	1	1
MIL-F-17111	1	NA	1	3	1	1	1	1
MIL-L-17331 D	1	NA	1	3	1	1	1	1
MIL-L-17353 A	1	NA	NA	3	1	1	1	1
MIL-L-17672 B	1	NA	1	3	1	1	1	1

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MIL-L-18486 A	1	NA	1	3	1	1	1	1
MIL-G-18709 A	1	NA	1	3	1	1	1	1
MIL-H-19457 B	4	NA	4	4	3	4	NA	1
MIL-F-19605	1	NA	NA	4	1	1	1	1
MIL-L-19701	1	NA	3	3	1	1	1	1
MIL-L-21260	1	NA	1	3	1	1	1	1
MIL-L-21568 A	1	NA	1	4	2	1	1	1
MIL-H-22072	1	NA	3	2	2	2	1	1
MIL-L-22396	1	NA	1	3	1	1	1	1
MIL-L-23699 A	1	NA	3	3	1	1	1	1
MIL-G-23827 A	1	NA	3	3	1	1	1	1
MIL-G-25013 D	1	NA	2	4	2	1	1	1
MIL-F-25172	1	NA	NA	4	1	1	1	1
MIL-L-25336 B	1	NA	3	3	1	1	1	1
MIL-F-25524 A	1	NA	NA	4	1	1	1	1
MIL-G-25537 A	1	NA	1	3	1	1	1	1
MIL-F-25558 B (RI-1)	1	1	1	3	1	1	1	1
MIL-F-25576 C (RP-1)	1	1	1	4	1	1	1	1
MIL-H-25598	1	NA	1	3	1	1	1	1
MIL-F-25656 B	1	1	2	4	2	1	1	1
MIL-L-25681 C	1	NA	2	4	2	1	1	1
MIL-G-25760 A	1	NA	3	4	1	1	1	1
MIL-L-25968	1	NA	3	3	1	1	1	1
MIL-L-26087 A	1	NA	1	3	1	1	1	1
MIL-G-27343	1	NA	NA	4	1	1	1	1
MIL-H-27601 A	2	NA	2	4	1	1	1	1

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MIL-G-27617	4	NA	NA	4	1	1	1	1
MIL-L-27686 D	1	NA	3	2	2	2	1	1
MIL-L-27694 A	1	NA	NA	4	1	1	1	1
MIL-L-46000 A	1	NA	3	3	1	1	1	1
MIL-H-46001 A	1	NA	1	3	1	1	1	1
MIL-L-46002	1	NA	NA	3	1	1	1	1
MIL-H-46004	1	NA	1	3	1	1	1	1
MIL-P-46046 A	2	NA	2	4	2	1	1	1
MIL-H-81019 B	1	NA	1	3	1	1	1	1
MIL-S-81087	1	NA	NA	4	2	1	1	1
O-A-548 b	1	NA	3	2	2	2	2	1
O-T-634 b	3	NA	4	4	2	1	1	1
P-S-661 b	1	NA	NA	4	1	1	1	1
P-D-680	1	1	NA	4	1	1	1	1
TT-N-95 a	1	1	NA	4	1	1	1	1
TT-N-97 B	1	1	3	4	2	1	1	1
TT-I-735 b	1	1	NA	1	1	1	1	11
TT-S-735 Type I	1	1	2	4	1	1	1	1
TT-S-735 Type II	1	1	NA	4	1	1	1	1
TT-S-735 Type III	1	1	NA	4	1	1	1	1
TT-S-735 Type IV	1	1	1	3	1	1	1	1
TT-S-735 Type V	1	1	1	3	1	1	1	1
TT-S-735 Type VI	1	1	1	3	1	1	1	1
TT-S-735 Type VII	1	1	NA	4	1	1	1	1

LEGEND
 1 - Little Effect
 2 - Moderate Effect - May Be Acceptable for Static Applications
 3 - Significant Effect- Caution Advised if Used
 4 - Do Not Use
 NA - Indicates Insufficient data

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O-RING DESIGN CRITERIA

The elastomeric O-Ring is our most common seal. It is used in products ranging from toys, appliances, and automobiles, to aircraft and space vehicles. The reasons are that it is extremely effective if properly selected, has a simple configuration is light in weight, and is easy to install.

An O-Ring functions as a seal through the mechanical deformation of the elastomeric material by the mating metal or plastic surfaces. This deformation, or shape change, starts approaching the configuration of the gland and effectively blocks the passage of liquids or gases.

Although the O-Ring configuration is simple, the design input must include many factors.

SERVICE CONDITIONS

- What fluids will the O-Ring be exposed to over its life?
- How much heat is involved? (continuous or spikes)
- What low temperatures will the O-Ring see?
- Will the part be exposed to ozone?
- Will the O-Ring be exposed to low or high pressure?
- Other considerations such as weathering, flame resistance, etc.

TYPE OF SERVICE

- Will the part be used in a static or dynamic environment?
- If used dynamically, will the movement be reciprocating or rotary?

TYPE AND SIZE OF SURFACES TO BE SEALED

- Small or large surface
- Piston or rod
- Flange, face, plug or cap seal

OTHER DESIGN INPUT CONSIDERATIONS

- Design Failure Mode and Effects Analysis (Design FMEA)
- Life expectancy
- Cost
- How much stretch or compression is required?
- What will be the shape of the gland and the gland dimensions?
- What surface finish should be used?
- Will back-up rings be required?
- Finite Element Analysis (FEA) results, if required

MANUFACTURING AND ASSEMBLY

- Design for Manufacturing considerations
- Design for Assembly considerations

SPECIFICATION REQUIREMENTS

- What customer specifications are required?
- What verification and validation criteria must be met?
- What governing body standards will be used?
- What government and/or environmental, health and safety standards must be considered?

STANDARD OR SPECIAL O-RINGS

- Will a standard AS568 size be acceptable, or is a custom size required?
- Will a standard Precix material be acceptable, or is a special formulation required?

DIMENSIONAL SYSTEM

- Will Metric, English or another dimensional system be used?

MARKING/COLOR

- Will color be required for inventory control or to prevent misapplication? *
- Will special marking on the O-Ring be required?

PACKAGING

- What specific packaging requirements are required?

While the above listing is detailed, it is not meant to be all inclusive. The design input stage is critical to be sure that all considerations have been appropriately studied.

*Most standard O-Ring materials are black in color.

O-RING SIZE CHARTS

SAE AS 568 Revision C

2. NOTES:

- 2.1 Only one Class of tolerances appears, conforming to the former Class I for O-Rings with inside diameters up to and including 0.50 inch (12.7 mm), and to the former Class II for O-Rings larger than 0.50 inch (12.7 mm).
- 2.2 In Table 1, the dash numbers are divided into groups of one hundred, and within each group are sequential and nonsignificant. Each hundred group, however, identifies the cross section size of the O-Rings within the group. For example, all 0.070 inch (1.78 mm) and smaller O-Ring cross sections fall into the group of -001 thru -099. The 0.103 inch (2.62 mm) cross section rings fall into the group of -100 thru -199, and so on.
- 2.3 Table 2, using the 900 series dash numbers, lists all of the presently standardized straight thread tube fitting boss gaskets. This series has traditionally utilized the significant dash numbering system, wherein the dash number designates the tube size in 16th's of an inch. This practice is also followed here, with the exception of the -901, which is intended for a 0.0938 inch (2.38 mm) nominal OD (outside diameter) tube, the 0.0625 inch (1.59 mm) OD tube not being in common aircraft use.
- 2.4 In the interest of standardization, it is requested that companies or agencies do not use the dash numbers in Table 1 to which sizes have not been assigned. Sizes not assigned are indicated by an asterisk (*). Anyone feeling that any special size not now shown is widely enough used to justify standardization should direct such a request to AMS Committee "CE" for coordination.

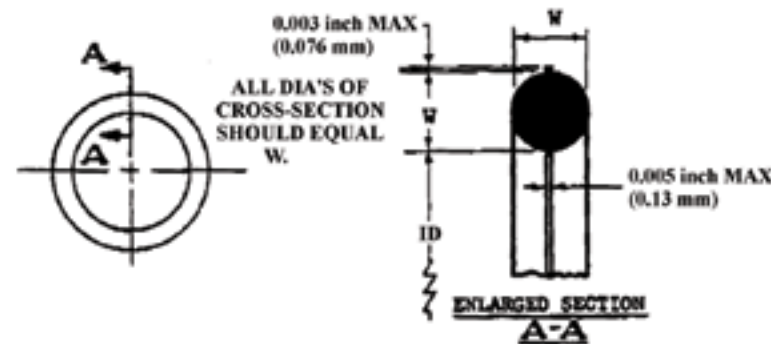


FIGURE 1 - Cross-Sectional Diameter "W"

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "CE"

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
0.070" (1.78mm) CROSS SECTION (±0.003"/±0.08mm)										
-001 (1)	0.029	0.004	0.040	0.003	0.0003	0.74	0.10	1.02	0.08	4.464
-002 (2)	0.042	0.004	0.050	0.003	0.0006	1.07	0.10	1.27	0.08	9.300
-003 (3)	0.056	0.004	0.060	0.003	0.0010	1.42	0.10	1.52	0.08	16.885
-004	0.070	0.005	0.070	0.003	0.0017	1.78	0.13	1.78	0.08	27.737
-005	0.101	0.005	0.070	0.003	0.0021	2.57	0.13	1.78	0.08	33.879
-006	0.114	0.005	0.070	0.003	0.0022	2.90	0.13	1.78	0.08	36.455
-007	0.145	0.005	0.070	0.003	0.0026	3.68	0.13	1.78	0.08	42.597
-008	0.176	0.005	0.070	0.003	0.0030	4.47	0.13	1.78	0.08	48.738
-009	0.208	0.005	0.070	0.003	0.0034	5.28	0.13	1.78	0.08	55.078
-010	0.239	0.005	0.070	0.003	0.0037	6.07	0.13	1.78	0.08	61.220
-011	0.301	0.005	0.070	0.003	0.0045	7.65	0.13	1.78	0.08	73.504
-012	0.364	0.005	0.070	0.003	0.0052	9.25	0.13	1.78	0.08	85.986
-013	0.426	0.005	0.070	0.003	0.0060	10.82	0.13	1.78	0.08	98.269
-014	0.489	0.005	0.070	0.003	0.0068	12.42	0.13	1.78	0.08	110.751
-015	0.551	0.007	0.070	0.003	0.0075	14.00	0.18	1.78	0.08	123.035
-016	0.614	0.009	0.070	0.003	0.0083	15.60	0.23	1.78	0.08	135.517
-017	0.676	0.009	0.070	0.003	0.0090	17.17	0.23	1.78	0.08	147.800
-018	0.739	0.009	0.070	0.003	0.0098	18.77	0.23	1.78	0.08	160.282
-019	0.801	0.009	0.070	0.003	0.0105	20.35	0.23	1.78	0.08	172.566
-020	0.864	0.009	0.070	0.003	0.0113	21.95	0.23	1.78	0.08	185.048
-021	0.926	0.009	0.070	0.003	0.0120	23.52	0.23	1.78	0.08	197.331
-022	0.989	0.010	0.070	0.003	0.0128	25.12	0.25	1.78	0.08	209.813
-023	1.051	0.010	0.070	0.003	0.0136	26.70	0.25	1.78	0.08	222.097
-024	1.114	0.010	0.070	0.003	0.0143	28.30	0.25	1.78	0.08	234.579
-025	1.176	0.011	0.070	0.003	0.0151	29.87	0.28	1.78	0.08	246.862
-026	1.239	0.011	0.070	0.003	0.0158	31.47	0.28	1.78	0.08	259.344
-027	1.301	0.011	0.070	0.003	0.0166	33.05	0.28	1.78	0.08	271.628
-028	1.364	0.013	0.070	0.003	0.0173	34.65	0.33	1.78	0.08	284.110
-029	1.489	0.013	0.070	0.003	0.0188	37.82	0.33	1.78	0.08	308.875
-030	1.614	0.013	0.070	0.003	0.0204	41.00	0.33	1.78	0.08	333.641
-031	1.739	0.015	0.070	0.003	0.0219	44.17	0.38	1.78	0.08	358.406
-032	1.864	0.015	0.070	0.003	0.0234	47.35	0.38	1.78	0.08	383.172
-033	1.989	0.018	0.070	0.003	0.0249	50.52	0.46	1.78	0.08	407.937
-034	2.114	0.018	0.070	0.003	0.0264	53.70	0.46	1.78	0.08	432.703
-035	2.239	0.018	0.070	0.003	0.0279	56.87	0.46	1.78	0.08	457.468
-036	2.364	0.018	0.070	0.003	0.0294	60.05	0.46	1.78	0.08	482.233
-037	2.489	0.018	0.070	0.003	0.0309	63.22	0.46	1.78	0.08	506.999
-038	2.614	0.020	0.070	0.003	0.0325	66.40	0.51	1.78	0.08	531.764
-039	2.739	0.020	0.070	0.003	0.0340	69.57	0.51	1.78	0.08	556.530
-040	2.864	0.020	0.070	0.003	0.0355	72.75	0.51	1.78	0.08	581.295
-041	2.989	0.024	0.070	0.003	0.0370	75.92	0.61	1.78	0.08	606.061
-042	3.239	0.024	0.070	0.003	0.0400	82.27	0.61	1.78	0.08	655.592
-043	3.489	0.024	0.070	0.003	0.0430	88.62	0.61	1.78	0.08	705.123
-044	3.739	0.027	0.070	0.003	0.0461	94.97	0.69	1.78	0.08	754.654
-045	3.989	0.027	0.070	0.003	0.0491	101.32	0.69	1.78	0.08	804.185
-046	4.239	0.030	0.070	0.003	0.0521	107.67	0.76	1.78	0.08	853.716

(1) .040" (1.02mm) Cross Section
 (2) .050" (1.27mm) Cross Section
 (3) .060" (1.52mm) Cross Section

O-RING SIZE CHARTS

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
0.070" (1.78mm) CROSS SECTION (±0.003"/±0.08mm)										
-047	4.489	0.030	0.070	0.003	0.0551	114.02	0.76	1.78	0.08	903.247
-048	4.739	0.030	0.070	0.003	0.0581	120.37	0.76	1.78	0.08	952.778
-049	4.989	0.037	0.070	0.003	0.0612	126.72	0.94	1.78	0.08	1002.309
-050	5.239	0.037	0.070	0.003	0.0642	133.07	0.94	1.78	0.08	1051.840
0.103" (2.62mm) CROSS SECTION (±0.003"/±0.08mm)										
-102	0.049	0.005	0.103	0.003	0.0040	1.24	0.13	2.62	0.08	65.202
-103	0.081	0.005	0.103	0.003	0.0048	2.06	0.13	2.62	0.08	78.928
-104	0.112	0.005	0.103	0.003	0.0056	2.84	0.13	2.62	0.08	92.226
-105	0.143	0.005	0.103	0.003	0.0064	3.63	0.13	2.62	0.08	105.524
-106	0.174	0.005	0.103	0.003	0.0073	4.42	0.13	2.62	0.08	118.821
-107	0.206	0.005	0.103	0.003	0.0081	5.23	0.13	2.62	0.08	132.548
-108	0.237	0.005	0.103	0.003	0.0089	6.02	0.13	2.62	0.08	145.846
-109	0.299	0.005	0.103	0.003	0.0105	7.59	0.13	2.62	0.08	172.441
-110	0.362	0.005	0.103	0.003	0.0122	9.19	0.13	2.62	0.08	199.466
-111	0.424	0.005	0.103	0.003	0.0138	10.77	0.13	2.62	0.08	226.061
-112	0.487	0.005	0.103	0.003	0.0154	12.37	0.13	2.62	0.08	253.085
-113	0.549	0.007	0.103	0.003	0.0171	13.94	0.18	2.62	0.08	279.681
-114	0.612	0.009	0.103	0.003	0.0187	15.54	0.23	2.62	0.08	306.705
-115	0.674	0.009	0.103	0.003	0.0203	17.12	0.23	2.62	0.08	333.301
-116	0.737	0.009	0.103	0.003	0.0220	18.72	0.23	2.62	0.08	360.325
-117	0.799	0.010	0.103	0.003	0.0236	20.29	0.25	2.62	0.08	386.920
-118	0.862	0.010	0.103	0.003	0.0253	21.89	0.25	2.62	0.08	413.945
-119	0.924	0.010	0.103	0.003	0.0269	23.47	0.25	2.62	0.08	440.540
-120	0.987	0.010	0.103	0.003	0.0285	25.07	0.25	2.62	0.08	467.565
-121	1.049	0.010	0.103	0.003	0.0302	26.64	0.25	2.62	0.08	494.160
-122	1.112	0.010	0.103	0.003	0.0318	28.24	0.25	2.62	0.08	521.184
-123	1.174	0.012	0.103	0.003	0.0334	29.82	0.30	2.62	0.08	547.780
-124	1.237	0.012	0.103	0.003	0.0351	31.42	0.30	2.62	0.08	574.804
-125	1.299	0.012	0.103	0.003	0.0367	32.99	0.30	2.62	0.08	601.400
-126	1.362	0.012	0.103	0.003	0.0383	34.59	0.30	2.62	0.08	628.424
-127	1.424	0.012	0.103	0.003	0.0400	36.17	0.30	2.62	0.08	655.019
-128	1.487	0.012	0.103	0.003	0.0416	37.77	0.30	2.62	0.08	682.044
-129	1.549	0.015	0.103	0.003	0.0432	39.34	0.38	2.62	0.08	708.639
-130	1.612	0.015	0.103	0.003	0.0449	40.94	0.38	2.62	0.08	735.664
-131	1.674	0.015	0.103	0.003	0.0465	42.52	0.38	2.62	0.08	762.259
-132	1.737	0.015	0.103	0.003	0.0482	44.12	0.38	2.62	0.08	789.283
-133	1.799	0.015	0.103	0.003	0.0498	45.69	0.38	2.62	0.08	815.879
-134	1.862	0.015	0.103	0.003	0.0514	47.29	0.38	2.62	0.08	842.903
-135	1.925	0.017	0.103	0.003	0.0531	48.90	0.43	2.62	0.08	869.928
-136	1.987	0.017	0.103	0.003	0.0547	50.47	0.43	2.62	0.08	896.523
-137	2.050	0.017	0.103	0.003	0.0564	52.07	0.43	2.62	0.08	923.547
-138	2.112	0.017	0.103	0.003	0.0580	53.64	0.43	2.62	0.08	950.143
-139	2.175	0.017	0.103	0.003	0.0596	55.25	0.43	2.62	0.08	977.167
-140	2.237	0.017	0.103	0.003	0.0613	56.82	0.43	2.62	0.08	1003.763
-141	2.300	0.020	0.103	0.003	0.0629	58.42	0.51	2.62	0.08	1030.787

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
0.103" (2.62mm) CROSS SECTION (±0.003"/±0.08mm)										
-142	2.362	0.020	0.103	0.003	0.0645	59.99	0.51	2.62	0.08	1057.382
-143	2.425	0.020	0.103	0.003	0.0662	61.60	0.51	2.62	0.08	1084.407
-144	2.487	0.020	0.103	0.003	0.0678	63.17	0.51	2.62	0.08	1111.002
-145	2.550	0.020	0.103	0.003	0.0694	64.77	0.51	2.62	0.08	1138.027
-146	2.612	0.020	0.103	0.003	0.0711	66.34	0.51	2.62	0.08	1164.622
-147	2.675	0.022	0.103	0.003	0.0727	67.95	0.56	2.62	0.08	1191.646
-148	2.737	0.022	0.103	0.003	0.0743	69.52	0.56	2.62	0.08	1218.242
-149	2.800	0.022	0.103	0.003	0.0760	71.12	0.56	2.62	0.08	1245.266
-150	2.862	0.022	0.103	0.003	0.0776	72.69	0.56	2.62	0.08	1271.862
-151	2.987	0.024	0.103	0.003	0.0809	75.87	0.61	2.62	0.08	1325.481
-152	3.237	0.024	0.103	0.003	0.0874	82.22	0.61	2.62	0.08	1432.721
-153	3.487	0.024	0.103	0.003	0.0940	88.57	0.61	2.62	0.08	1539.961
-154	3.737	0.028	0.103	0.003	0.1005	94.92	0.71	2.62	0.08	1647.200
-155	3.987	0.028	0.103	0.003	0.1071	101.27	0.71	2.62	0.08	1754.440
-156	4.237	0.030	0.103	0.003	0.1136	107.62	0.76	2.62	0.08	1861.679
-157	4.487	0.030	0.103	0.003	0.1202	113.97	0.76	2.62	0.08	1968.919
-158	4.737	0.030	0.103	0.003	0.1267	120.32	0.76	2.62	0.08	2076.159
-159	4.987	0.035	0.103	0.003	0.1332	126.67	0.89	2.62	0.08	2183.398
-160	5.237	0.035	0.103	0.003	0.1398	133.02	0.89	2.62	0.08	2290.638
-161	5.487	0.035	0.103	0.003	0.1463	139.37	0.89	2.62	0.08	2397.877
-162	5.737	0.035	0.103	0.003	0.1529	145.72	0.89	2.62	0.08	2505.117
-163	5.987	0.035	0.103	0.003	0.1594	152.07	0.89	2.62	0.08	2612.357
-164	6.237	0.040	0.103	0.003	0.1660	158.42	1.02	2.62	0.08	2719.596
-165	6.487	0.040	0.103	0.003	0.1725	164.77	1.02	2.62	0.08	2826.836
-166	6.737	0.040	0.103	0.003	0.1790	171.12	1.02	2.62	0.08	2934.075
-167	6.987	0.040	0.103	0.003	0.1856	177.47	1.02	2.62	0.08	3041.315
-168	7.237	0.045	0.103	0.003	0.1921	183.82	1.14	2.62	0.08	3148.555
-169	7.487	0.045	0.103	0.003	0.1987	190.17	1.14	2.62	0.08	3255.794
-170	7.737	0.045	0.103	0.003	0.2052	196.52	1.14	2.62	0.08	3363.034
-171	7.987	0.045	0.103	0.003	0.2118	202.87	1.14	2.62	0.08	3470.273
-172	8.237	0.050	0.103	0.003	0.2183	209.22	1.27	2.62	0.08	3577.513
-173	8.487	0.050	0.103	0.003	0.2249	215.57	1.27	2.62	0.08	3684.753
-174	8.737	0.050	0.103	0.003	0.2314	221.92	1.27	2.62	0.08	3791.992
-175	8.987	0.050	0.103	0.003	0.2379	228.27	1.27	2.62	0.08	3899.232
-176	9.237	0.055	0.103	0.003	0.2445	234.62	1.40	2.62	0.08	4006.471
-177	9.487	0.055	0.103	0.003	0.2510	240.97	1.40	2.62	0.08	4113.711
-178	9.737	0.055	0.103	0.003	0.2576	247.32	1.40	2.62	0.08	4220.950
0.139" (3.53mm) CROSS SECTION (±0.004"/±0.10mm)										
-201	0.171	0.005	0.139	0.004	0.0148	4.34	0.13	3.53	0.10	242.177
-202	0.234	0.005	0.139	0.004	0.0178	5.94	0.13	3.53	0.10	291.393
-203	0.296	0.005	0.139	0.004	0.0207	7.52	0.13	3.53	0.10	339.828
-204	0.359	0.005	0.139	0.004	0.0237	9.12	0.13	3.53	0.10	389.045
-205	0.421	0.005	0.139	0.004	0.0267	10.69	0.13	3.53	0.10	437.480
-206	0.484	0.005	0.139	0.004	0.0297	12.29	0.13	3.53	0.10	486.697
-207	0.546	0.007	0.139	0.004	0.0327	13.87	0.18	3.53	0.10	535.132
-208	0.609	0.009	0.139	0.004	0.0357	15.47	0.23	3.53	0.10	584.348
-209	0.671	0.009	0.139	0.004	0.0386	17.04	0.23	3.53	0.10	632.784

O-RING SIZE CHARTS

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
0.139" (3.53mm) CROSS SECTION (±0.004"/±0.10mm)										
-210	0.734	0.010	0.139	0.004	0.0416	18.64	0.25	3.53	0.10	682.000
-211	0.796	0.010	0.139	0.004	0.0446	20.22	0.25	3.53	0.10	730.436
-212	0.859	0.010	0.139	0.004	0.0476	21.82	0.25	3.53	0.10	779.652
-213	0.921	0.010	0.139	0.004	0.0505	23.39	0.25	3.53	0.10	828.087
-214	0.984	0.010	0.139	0.004	0.0535	24.99	0.25	3.53	0.10	877.304
-215	1.046	0.010	0.139	0.004	0.0565	26.57	0.25	3.53	0.10	925.739
-216	1.109	0.012	0.139	0.004	0.0595	28.17	0.30	3.53	0.10	974.956
-217	1.171	0.012	0.139	0.004	0.0625	29.74	0.30	3.53	0.10	1023.391
-218	1.234	0.012	0.139	0.004	0.0655	31.34	0.30	3.53	0.10	1072.608
-219	1.296	0.012	0.139	0.004	0.0684	32.92	0.30	3.53	0.10	1121.043
-220	1.359	0.012	0.139	0.004	0.0714	34.52	0.30	3.53	0.10	1170.259
-221	1.421	0.012	0.139	0.004	0.0744	36.09	0.30	3.53	0.10	1218.695
-222	1.484	0.015	0.139	0.004	0.0774	37.69	0.38	3.53	0.10	1267.911
-223	1.609	0.015	0.139	0.004	0.0833	40.87	0.38	3.53	0.10	1365.563
-224	1.734	0.015	0.139	0.004	0.0893	44.04	0.38	3.53	0.10	1463.215
-225	1.859	0.018	0.139	0.004	0.0952	47.22	0.46	3.53	0.10	1560.867
-226	1.984	0.018	0.139	0.004	0.1012	50.39	0.46	3.53	0.10	1658.518
-227	2.109	0.018	0.139	0.004	0.1072	53.57	0.46	3.53	0.10	1756.170
-228	2.234	0.020	0.139	0.004	0.1131	56.74	0.51	3.53	0.10	1853.822
-229	2.359	0.020	0.139	0.004	0.1191	59.92	0.51	3.53	0.10	1951.474
-230	2.484	0.020	0.139	0.004	0.1250	63.09	0.51	3.53	0.10	2049.126
-231	2.609	0.020	0.139	0.004	0.1310	66.27	0.51	3.53	0.10	2146.778
-232	2.734	0.024	0.139	0.004	0.1370	69.44	0.61	3.53	0.10	2244.429
-233	2.859	0.024	0.139	0.004	0.1429	72.62	0.61	3.53	0.10	2342.081
-234	2.984	0.024	0.139	0.004	0.1489	75.79	0.61	3.53	0.10	2439.733
-235	3.109	0.024	0.139	0.004	0.1548	78.97	0.61	3.53	0.10	2537.385
-236	3.234	0.024	0.139	0.004	0.1608	82.14	0.61	3.53	0.10	2635.037
-237	3.359	0.024	0.139	0.004	0.1668	85.32	0.61	3.53	0.10	2732.688
-238	3.484	0.024	0.139	0.004	0.1727	88.49	0.61	3.53	0.10	2830.340
-239	3.609	0.028	0.139	0.004	0.1787	91.67	0.71	3.53	0.10	2927.992
-240	3.734	0.028	0.139	0.004	0.1846	94.84	0.71	3.53	0.10	3025.644
-241	3.859	0.028	0.139	0.004	0.1906	98.02	0.71	3.53	0.10	3123.296
-242	3.984	0.028	0.139	0.004	0.1966	101.19	0.71	3.53	0.10	3220.947

Universal Dash	I.D.	I.D. ± Tolerance	C.S.	C.S. ± Tolerance	Volume (REF) Cubic	I.D.	I.D. ± Tolerance	C.S.	C.S. ± Tolerance	Volume (REF) Cubic
0.139" (3.53mm) CROSS SECTION (±0.004"/±0.10mm)										
-243	4.109	0.028	0.139	0.004	0.2025	104.37	0.71	3.53	0.10	3318.599
-244	4.234	0.030	0.139	0.004	0.2085	107.54	0.76	3.53	0.10	3416.251
-245	4.359	0.030	0.139	0.004	0.2144	110.72	0.76	3.53	0.10	3513.903
-246	4.484	0.030	0.139	0.004	0.2204	113.89	0.76	3.53	0.10	3611.555
-247	4.609	0.030	0.139	0.004	0.2263	117.07	0.76	3.53	0.10	3709.207
-248	4.734	0.030	0.139	0.004	0.2323	120.24	0.76	3.53	0.10	3806.858
-249	4.859	0.035	0.139	0.004	0.2383	123.42	0.89	3.53	0.10	3904.510
-250	4.984	0.035	0.139	0.004	0.2442	126.59	0.89	3.53	0.10	4002.162
-251	5.109	0.035	0.139	0.004	0.2502	129.77	0.89	3.53	0.10	4099.814
-252	5.234	0.035	0.139	0.004	0.2561	132.94	0.89	3.53	0.10	4197.466
-253	5.359	0.035	0.139	0.004	0.2621	136.12	0.89	3.53	0.10	4295.117
-254	5.484	0.035	0.139	0.004	0.2681	139.29	0.89	3.53	0.10	4392.769
-255	5.609	0.035	0.139	0.004	0.2740	142.47	0.89	3.53	0.10	4490.421
-256	5.734	0.035	0.139	0.004	0.2800	145.64	0.89	3.53	0.10	4588.073
-257	5.859	0.035	0.139	0.004	0.2859	148.82	0.89	3.53	0.10	4685.725
-258	5.984	0.035	0.139	0.004	0.2919	151.99	0.89	3.53	0.10	4783.377
-259	6.234	0.040	0.139	0.004	0.3038	158.34	1.02	3.53	0.10	4978.680
-260	6.484	0.040	0.139	0.004	0.3157	164.69	1.02	3.53	0.10	5173.984
-261	6.734	0.040	0.139	0.004	0.3277	171.04	1.02	3.53	0.10	5369.287
-262	6.984	0.040	0.139	0.004	0.3396	177.39	1.02	3.53	0.10	5564.591
-263	7.234	0.045	0.139	0.004	0.3515	183.74	1.14	3.53	0.10	5759.895
-264	7.484	0.045	0.139	0.004	0.3634	190.09	1.14	3.53	0.10	5955.198
-265	7.734	0.045	0.139	0.004	0.3753	196.44	1.14	3.53	0.10	6150.502
-266	7.984	0.045	0.139	0.004	0.3872	202.79	1.14	3.53	0.10	6345.806
-267	8.234	0.050	0.139	0.004	0.3992	209.14	1.27	3.53	0.10	6541.109
-268	8.484	0.050	0.139	0.004	0.4111	215.49	1.27	3.53	0.10	6736.413
-269	8.734	0.050	0.139	0.004	0.4230	221.84	1.27	3.53	0.10	6931.717
-270	8.984	0.050	0.139	0.004	0.4349	228.19	1.27	3.53	0.10	7127.020
-271	9.234	0.055	0.139	0.004	0.4468	234.54	1.40	3.53	0.10	7322.324
-272	9.484	0.055	0.139	0.004	0.4588	240.89	1.40	3.53	0.10	7517.627
-273	9.734	0.055	0.139	0.004	0.4707	247.24	1.40	3.53	0.10	7712.931

O-RING SIZE CHARTS

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
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0.139" (3.53mm) CROSS SECTION (±0.004"/±0.10mm)

-274	9.984	0.055	0.139	0.004	0.4826	253.59	1.40	3.53	0.10	7908.235
-275	10.484	0.055	0.139	0.004	0.5064	266.29	1.40	3.53	0.10	8298.842
-276	10.984	0.065	0.139	0.004	0.5303	278.99	1.65	3.53	0.10	8689.449
-277	11.484	0.065	0.139	0.004	0.5541	291.69	1.65	3.53	0.10	9080.056
-278	11.984	0.065	0.139	0.004	0.5779	304.39	1.65	3.53	0.10	9470.664
-279	12.984	0.065	0.139	0.004	0.6256	329.79	1.65	3.53	0.10	10251.878
-280	13.984	0.065	0.139	0.004	0.6733	355.19	1.65	3.53	0.10	11033.093
-281	14.984	0.065	0.139	0.004	0.7210	380.59	1.65	3.53	0.10	11814.307
-282	15.955	0.075	0.139	0.004	0.7672	405.26	1.91	3.53	0.10	12572.867
-283	16.955	0.080	0.139	0.004	0.8149	430.66	2.03	3.53	0.10	13354.081

0.210" (5.33mm) CROSS SECTION (±0.005"/±0.13mm)

-309	0.412	0.005	0.210	0.005	0.0677	10.46	0.13	5.33	0.13	1109.097
-310	0.475	0.005	0.210	0.005	0.0745	12.07	0.13	5.33	0.13	1221.434
-311	0.537	0.007	0.210	0.005	0.0813	13.64	0.18	5.33	0.13	1331.987
-312	0.600	0.009	0.210	0.005	0.0881	15.24	0.23	5.33	0.13	1444.323
-313	0.662	0.009	0.210	0.005	0.0949	16.81	0.23	5.33	0.13	1554.876
-314	0.725	0.010	0.210	0.005	0.1017	18.42	0.25	5.33	0.13	1667.212
-315	0.787	0.010	0.210	0.005	0.1085	19.99	0.25	5.33	0.13	1777.765
-316	0.850	0.010	0.210	0.005	0.1153	21.59	0.25	5.33	0.13	1890.102
-317	0.912	0.010	0.210	0.005	0.1221	23.16	0.25	5.33	0.13	2000.655
-318	0.975	0.010	0.210	0.005	0.1289	24.77	0.25	5.33	0.13	2112.991
-319	1.037	0.010	0.210	0.005	0.1357	26.34	0.25	5.33	0.13	2223.544
-320	1.100	0.012	0.210	0.005	0.1425	27.94	0.30	5.33	0.13	2335.880
-321	1.162	0.012	0.210	0.005	0.1493	29.51	0.30	5.33	0.13	2446.433
-322	1.225	0.012	0.210	0.005	0.1561	31.12	0.30	5.33	0.13	2558.770
-323	1.287	0.012	0.210	0.005	0.1629	32.69	0.30	5.33	0.13	2669.323
-324	1.350	0.012	0.210	0.005	0.1697	34.29	0.30	5.33	0.13	2781.659
-325	1.475	0.015	0.210	0.005	0.1833	37.47	0.38	5.33	0.13	3004.548
-326	1.600	0.015	0.210	0.005	0.1970	40.64	0.38	5.33	0.13	3227.438
-327	1.725	0.015	0.210	0.005	0.2106	43.82	0.38	5.33	0.13	3450.327
-328	1.850	0.015	0.210	0.005	0.2242	46.99	0.38	5.33	0.13	3673.216
-329	1.975	0.018	0.210	0.005	0.2378	50.17	0.46	5.33	0.13	3896.106
-330	2.100	0.018	0.210	0.005	0.2514	53.34	0.46	5.33	0.13	4118.995
-331	2.225	0.018	0.210	0.005	0.2650	56.52	0.46	5.33	0.13	4341.884
-332	2.350	0.018	0.210	0.005	0.2786	59.69	0.46	5.33	0.13	4564.774
-333	2.475	0.020	0.210	0.005	0.2922	62.87	0.51	5.33	0.13	4787.663

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
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0.210" (5.33mm) CROSS SECTION (±0.005"/±0.13mm)

-334	2.600	0.020	0.210	0.005	0.3058	66.04	0.51	5.33	0.13	5010.553
-335	2.725	0.020	0.210	0.005	0.3194	69.22	0.51	5.33	0.13	5233.442
-336	2.850	0.020	0.210	0.005	0.3330	72.39	0.51	5.33	0.13	5456.331
-337	2.975	0.024	0.210	0.005	0.3466	75.57	0.61	5.33	0.13	5679.221
-338	3.100	0.024	0.210	0.005	0.3602	78.74	0.61	5.33	0.13	5902.110
-339	3.225	0.024	0.210	0.005	0.3738	81.92	0.61	5.33	0.13	6124.999
-340	3.350	0.024	0.210	0.005	0.3874	85.09	0.61	5.33	0.13	6347.889
-341	3.475	0.024	0.210	0.005	0.4010	88.27	0.61	5.33	0.13	6570.778
-342	3.600	0.028	0.210	0.005	0.4146	91.44	0.71	5.33	0.13	6793.667
-343	3.725	0.028	0.210	0.005	0.4282	94.62	0.71	5.33	0.13	7016.557
-344	3.850	0.028	0.210	0.005	0.4418	97.79	0.71	5.33	0.13	7239.446
-345	3.975	0.028	0.210	0.005	0.4554	100.97	0.71	5.33	0.13	7462.335
-346	4.100	0.028	0.210	0.005	0.4690	104.14	0.71	5.33	0.13	7685.225
-347	4.225	0.030	0.210	0.005	0.4826	107.32	0.76	5.33	0.13	7908.114
-348	4.350	0.030	0.210	0.005	0.4962	110.49	0.76	5.33	0.13	8131.003
-349	4.475	0.030	0.210	0.005	0.5098	113.67	0.76	5.33	0.13	8353.893
-350	4.600	0.030	0.210	0.005	0.5234	116.84	0.76	5.33	0.13	8576.782
-351	4.725	0.030	0.210	0.005	0.5370	120.02	0.76	5.33	0.13	8799.671
-352	4.850	0.030	0.210	0.005	0.5506	123.19	0.76	5.33	0.13	9022.561
-353	4.975	0.037	0.210	0.005	0.5642	126.37	0.94	5.33	0.13	9245.450
-354	5.100	0.037	0.210	0.005	0.5778	129.54	0.94	5.33	0.13	9468.339
-355	5.225	0.037	0.210	0.005	0.5914	132.72	0.94	5.33	0.13	9691.229
-356	5.350	0.037	0.210	0.005	0.6050	135.89	0.94	5.33	0.13	9914.118
-357	5.475	0.037	0.210	0.005	0.6186	139.07	0.94	5.33	0.13	10137.008
-358	5.600	0.037	0.210	0.005	0.6322	142.24	0.94	5.33	0.13	10359.897
-359	5.725	0.037	0.210	0.005	0.6458	145.42	0.94	5.33	0.13	10582.78
-360	5.850	0.037	0.210	0.005	0.6594	148.59	0.94	5.33	0.13	10805.676
-361	5.975	0.037	0.210	0.005	0.6730	151.77	0.94	5.33	0.13	11028.565
-362	6.225	0.040	0.210	0.005	0.7002	158.12	1.02	5.33	0.13	11474.344
-363	6.475	0.040	0.210	0.005	0.7274	164.47	1.02	5.33	0.13	11920.122
-364	6.725	0.040	0.210	0.005	0.7546	170.82	1.02	5.33	0.13	12365.901
-365	6.975	0.040	0.210	0.005	0.7818	177.17	1.02	5.33	0.13	12811.680
-366	7.225	0.045	0.210	0.005	0.8090	183.52	1.14	5.33	0.13	13257.458
-367	7.475	0.045	0.210	0.005	0.8362	189.87	1.14	5.33	0.13	13703.237
-368	7.725	0.045	0.210	0.005	0.8634	196.22	1.14	5.33	0.13	14149.016
-369	7.975	0.045	0.210	0.005	0.8906	202.57	1.14	5.33	0.13	14594.794
-370	8.225	0.050	0.210	0.005	0.9178	208.92	1.27	5.33	0.13	15040.573
-371	8.475	0.050	0.210	0.005	0.9450	215.27	1.27	5.33	0.13	15486.352

O-RING SIZE CHARTS

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
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0.210" (5.33mm) CROSS SECTION (±0.005"/±0.13mm)

-372	8.725	0.050	0.210	0.005	0.9722	221.62	1.27	5.33	0.13	15932.131
-373	8.975	0.050	0.210	0.005	0.9994	227.97	1.27	5.33	0.13	16377.909
-374	9.225	0.055	0.210	0.005	1.0266	234.32	1.40	5.33	0.13	16823.688
-375	9.475	0.055	0.210	0.005	1.0538	240.67	1.40	5.33	0.13	17269.467
-376	9.725	0.055	0.210	0.005	1.0811	247.02	1.40	5.33	0.13	17715.245
-377	9.975	0.055	0.210	0.005	1.1083	253.37	1.40	5.33	0.13	18161.024
-378	10.475	0.060	0.210	0.005	1.1627	266.07	1.52	5.33	0.13	19052.581
-379	10.975	0.060	0.210	0.005	1.2171	278.77	1.52	5.33	0.13	19944.139
-380	11.475	0.065	0.210	0.005	1.2715	291.47	1.65	5.33	0.13	20835.696
-381	11.975	0.065	0.210	0.005	1.3259	304.17	1.65	5.33	0.13	21727.254
-382	12.475	0.065	0.210	0.005	1.4347	329.57	1.65	5.33	0.13	23510.368
-383	13.475	0.070	0.210	0.005	1.5435	354.97	1.78	5.33	0.13	25293.483
-384	14.475	0.070	0.210	0.005	1.6523	380.37	1.78	5.33	0.13	27076.598
-385	15.475	0.075	0.210	0.005	1.7590	405.26	1.91	5.33	0.13	28824.050
-386	16.475	0.080	0.210	0.005	1.8678	430.66	2.03	5.33	0.13	30607.165
-387	17.475	0.085	0.210	0.005	1.9766	456.06	2.16	5.33	0.13	32390.280
-388	18.475	0.090	0.210	0.005	2.0854	481.46	2.29	5.33	0.13	34173.395
-389	19.475	0.095	0.210	0.005	2.1942	506.86	2.41	5.33	0.13	35956.510
-390	20.475	0.095	0.210	0.005	2.3030	532.26	2.41	5.33	0.13	37739.624
-391	21.475	0.095	0.210	0.005	2.4118	557.66	2.41	5.33	0.13	39522.739
-392	22.475	0.105	0.210	0.005	2.5190	582.68	2.67	5.33	0.13	41279.107
-393	23.475	0.110	0.210	0.005	2.6278	608.08	2.79	5.33	0.13	43062.222
-394	24.475	0.115	0.210	0.005	2.7366	633.48	2.92	5.33	0.13	44845.337
-395	25.475	0.120	0.210	0.005	2.8454	658.88	3.05	5.33	0.13	46628.451

0.275" (6.99mm) CROSS SECTION (±0.006"/±0.15mm)

-425	4.475	0.033	0.275	0.006	0.8863	113.67	0.84	6.99	0.15	14524.450
-426	4.600	0.033	0.275	0.006	0.9097	116.84	0.84	6.99	0.15	14906.673
-427	4.725	0.033	0.275	0.006	0.9330	120.02	0.84	6.99	0.15	15288.895
-428	4.850	0.033	0.275	0.006	0.9563	123.19	0.84	6.99	0.15	15671.118
-429	4.975	0.037	0.275	0.006	0.9796	126.37	0.94	6.99	0.15	16053.340
-430	5.100	0.037	0.275	0.006	1.0030	129.54	0.94	6.99	0.15	16435.562
-431	5.225	0.037	0.275	0.006	1.0263	132.72	0.94	6.99	0.15	16817.785
-432	5.350	0.037	0.275	0.006	1.0496	135.89	0.94	6.99	0.15	17200.007
-433	5.475	0.037	0.275	0.006	1.0729	139.07	0.94	6.99	0.15	17582.229
-434	5.600	0.037	0.275	0.006	1.0963	142.24	0.94	6.99	0.15	17964.452
-435	5.725	0.037	0.275	0.006	1.1196	145.42	0.94	6.99	0.15	18346.674
-436	5.850	0.037	0.275	0.006	1.1429	148.59	0.94	6.99	0.15	18728.897
-437	5.975	0.037	0.275	0.006	1.1662	151.77	0.94	6.99	0.15	19111.119

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Volume (REF) Cubic Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Volume (REF) Cubic mm
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0.275" (6.99mm) CROSS SECTION (±0.006"/±0.15mm)

-438	6.225	0.040	0.275	0.006	1.2129	158.12	1.02	6.99	0.15	19875.564
-439	6.475	0.040	0.275	0.006	1.2595	164.47	1.02	6.99	0.15	20640.008
-440	6.725	0.040	0.275	0.006	1.3062	170.82	1.02	6.99	0.15	21404.453
-441	6.975	0.040	0.275	0.006	1.3528	177.17	1.02	6.99	0.15	22168.898
-442	7.225	0.045	0.275	0.006	1.3995	183.52	1.14	6.99	0.15	22933.343
-443	7.475	0.045	0.275	0.006	1.4461	189.87	1.14	6.99	0.15	23697.787
-444	7.725	0.045	0.275	0.006	1.4928	196.22	1.14	6.99	0.15	24462.232
-445	7.975	0.045	0.275	0.006	1.5394	202.57	1.14	6.99	0.15	25226.677
-446	8.475	0.055	0.275	0.006	1.6327	215.27	1.40	6.99	0.15	26755.567
-447	8.975	0.055	0.275	0.006	1.7260	227.97	1.40	6.99	0.15	28284.456
-448	9.475	0.055	0.275	0.006	1.8193	240.67	1.40	6.99	0.15	29813.346
-449	9.975	0.055	0.275	0.006	1.9126	253.37	1.40	6.99	0.15	31342.235
-450	10.475	0.060	0.275	0.006	2.0059	266.07	1.52	6.99	0.15	32871.125
-451	10.975	0.060	0.275	0.006	2.0992	278.77	1.52	6.99	0.15	34400.014
-452	11.475	0.060	0.275	0.006	2.1925	291.47	1.52	6.99	0.15	35928.904
-453	11.975	0.060	0.275	0.006	2.2858	304.17	1.52	6.99	0.15	37457.793
-454	12.475	0.060	0.275	0.006	2.3791	316.87	1.52	6.99	0.15	38986.683
-455	12.975	0.060	0.275	0.006	2.4724	329.57	1.52	6.99	0.15	40515.572
-456	13.475	0.070	0.275	0.006	2.5657	342.27	1.78	6.99	0.15	42044.462
-457	13.975	0.070	0.275	0.006	2.6590	354.97	1.78	6.99	0.15	43573.351
-458	14.475	0.070	0.275	0.006	2.7523	367.67	1.78	6.99	0.15	45102.241
-459	14.975	0.070	0.275	0.006	2.8456	380.37	1.78	6.99	0.15	46631.130
-460	15.475	0.070	0.275	0.006	2.9389	393.07	1.78	6.99	0.15	48160.020
-461	15.975	0.075	0.275	0.006	3.0285	405.26	1.91	6.99	0.15	49627.754
-462	16.455	0.075	0.275	0.006	3.1218	417.96	1.91	6.99	0.15	51156.643
-463	16.955	0.080	0.275	0.006	3.2151	430.66	2.03	6.99	0.15	52685.533
-464	17.455	0.085	0.275	0.006	3.3084	443.36	2.16	6.99	0.15	54214.422
-465	17.955	0.085	0.275	0.006	3.4017	456.06	2.16	6.99	0.15	55743.312
-466	18.455	0.085	0.275	0.006	3.4950	468.76	2.16	6.99	0.15	57272.201
-467	18.955	0.090	0.275	0.006	3.5883	481.46	2.29	6.99	0.15	58801.091
-468	19.455	0.090	0.275	0.006	3.6816	494.16	2.29	6.99	0.15	60329.980
-469	19.955	0.095	0.275	0.006	3.7749	506.86	2.41	6.99	0.15	61858.870
-470	20.455	0.095	0.275	0.006	3.8682	519.56	2.41	6.99	0.15	63387.760
-471	20.955	0.100	0.275	0.006	3.9615	532.26	2.41	6.99	0.15	64916.649
-472	21.455	0.105	0.275	0.006	4.0548	544.96	2.54	6.99	0.15	66445.539
-473	21.955	0.105	0.275	0.006	4.1481	557.66	2.54	6.99	0.15	67974.428
-474	22.455	0.110	0.275	0.006	4.2414	570.36	2.67	6.99	0.15	69503.318
-475	22.955	0.110	0.275	0.006	4.3347	583.06	2.67	6.99	0.15	71032.207
-476	23.455	0.115	0.275	0.006	4.4280	595.76	2.79	6.99	0.15	72561.097
-477	23.955	0.115	0.275	0.006	4.5213	608.46	2.79	6.99	0.15	74089.986
-478	24.455	0.120	0.275	0.006	4.6146	621.16	2.92	6.99	0.15	75618.876
-479	24.955	0.120	0.275	0.006	4.7079	633.86	2.92	6.99	0.15	77147.765
-480	25.455	0.120	0.275	0.006	4.8012	646.56	3.05	6.99	0.15	78676.655

O-RING SIZE CHARTS

O-RING DESIGN ENGINEERING SHEETS

Universal Dash Numbers	I.D. (Inches)	I.D. ± Tolerance (Inches)	C.S. (Inches)	C.S. ± Tolerance (Inches)	Tube Size O.D. Inches	I.D. (mm)	I.D. ± Tolerance (mm)	C.S. (mm)	C.S. ± Tolerance (mm)	Tube Size O.D. (mm)
O-RING BOSS GASKETS FOR STRAIGHT THREAD TUBE FITTINGS										
-901	0.185	0.005	0.056	0.003	3/32	4.70	0.13	1.42	0.08	2.38
-902	0.239	0.005	0.064	0.003	1/8	6.07	0.13	1.63	0.08	3.18
-903	0.301	0.005	0.064	0.003	3/16	7.65	0.13	1.63	0.08	4.76
-904	0.351	0.005	0.072	0.003	1/4	8.92	0.13	1.83	0.08	6.35
-905	0.414	0.005	0.072	0.003	5/16	10.52	0.13	1.83	0.08	7.94
-906	0.468	0.005	0.078	0.003	3/8	11.89	0.13	1.98	0.08	9.53
-907	0.530	0.007	0.082	0.003	7/16	13.46	0.18	2.08	0.08	11.11
-908	0.644	0.009	0.087	0.003	1/2	16.36	0.23	2.21	0.08	12.7
-909	0.706	0.009	0.097	0.003	9/16	17.93	0.23	2.46	0.08	14.29
-910	0.755	0.009	0.097	0.003	5/8	19.18	0.23	2.46	0.08	15.88
-911	0.863	0.009	0.116	0.004	11/16	21.92	0.23	2.95	0.10	17.46
-912	0.924	0.009	0.116	0.004	3/4	23.47	0.23	2.95	0.10	19.05
-913	0.986	0.010	0.116	0.004	13/16	25.04	0.25	2.95	0.10	20.64
-914	1.047	0.010	0.116	0.004	7/8	26.59	0.25	2.95	0.10	22.23
-916	1.171	0.010	0.116	0.004	1	29.74	0.25	2.95	0.10	25.4
-918	1.355	0.012	0.116	0.004	1-1/8	34.42	0.30	2.95	0.10	28.58
-920	1.475	0.014	0.118	0.004	1-1/4	37.47	0.36	3.00	0.10	31.75
-924	1.720	0.014	0.118	0.004	1-1/2	43.69	0.36	3.00	0.10	38.1
-928	2.090	0.018	0.118	0.004	1-3/4	53.09	0.46	3.00	0.10	44.45
-932	2.337	0.018	0.118	0.004	2	59.36	0.46	3.00	0.10	50.80

Seal function (check applicable motion and fill in all data)

- Static
- Reciprocating - Rate _____ Cycles per _____ Stroke _____ inches (mm)
- Rotating - Rate _____ RPM or FPM (MPM)
Surface conditions: _____
Maximum stretch at installation: _____ %
- Oscillating (fill in necessary reciprocating or rotating data)

Operating conditions

Temperature range: _____ °F (°C) to _____ °F (°C)
Normal temperature: _____ °F (°C)

Pressure range: _____ psi normal maximum pressure
_____ psi peak pressure

Fluid(s) to be sealed: _____

Oil analine point: _____

Seal data

Material specification: _____

Note: If you're using your own specification, please enclose a copy of it.

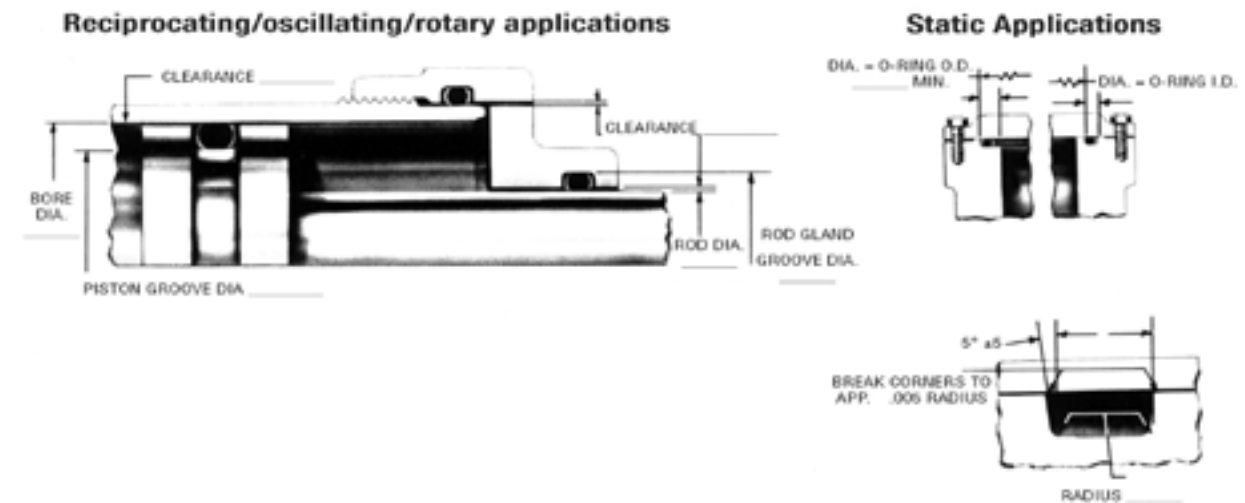
Hardness (durometer - Shore A): _____

Material presently used: _____
Compound

If this design is to replace an O-Ring that shows failure, please include a sample showing the failure for our analysis.

Mechanical data

Using the sketches below please fill in all known mechanical dimensions that apply to your design. If none of these apply, please furnish a sketch.



we're ready to help

- This is a hot job. Have a Precix O-Ring specialist call for an appointment
- I'm just beginning design work on this project. I'd appreciate hearing from Precix by _____

Name Title

Company

Address Phone

City State Zip

1. The percent stretch of the O-Ring ID should not exceed 5%, as it can lead to loss of seal compression.
2. The percent squeeze for optimum performance should be between 10 and 35% for static applications, and not more than 30% for dynamic applications.
3. The gland "fill" should not exceed 90%. Beyond 90% will not allow enough room for the O-Ring to compress properly, and may lead to premature failure. Excessive fill will not allow for expansion of material and extrusion may result.
4. To create seal compression, the groove depth must be less than the cross section of the O-Ring.
5. O-Ring seals operated at above 1,500 p.s.i. should utilize back-up rings or other devices, to prevent the O-Ring from extruding.
6. The maximum volume of an O-Ring should never be greater than the minimum gland volume.
7. Static applications are more forgiving, for both material and design tolerance, than dynamic applications.
8. Reciprocating seals should never be allowed to pass over ports, as nibbling and premature failure will occur.
9. The closer to ambient temperature that the seal is used, the longer the life expectancy.
10. Applications using stainless steel glands and bores should not use graphite-loaded O-ring materials. Graphite has a tendency to "pit" stainless steel.
11. Assembly of the O-Ring into the gland and bore is extremely critical. A compatible lubricant should be used to coat the ring before assembly. The lubricant should be compatible with both the O-Ring material and the fluids to be sealed.
12. A minimum 20° lead in angle, chamfer, or radius should be used on both the gland and bore to prevent pinching or skiving to the O-Ring during assembly.
13. Do not use lubricants that are composed of the same material as the O-Ring (For example – a silicone lubricant on a silicone O-Ring).
14. When only one back-up ring is used on applications greater than 1,500 psi, the back-up ring should be applied to the low pressure side of the O-Ring.
15. Before choosing the elastomer for an application, it is critical to determine which material is compatible with the fluids to be sealed. You should consult Precix, inc.TM for help if there are any doubts or questions.

The following pages provide standardized gland design criteria and dimensions for elastomeric O-Ring seals utilized for both static and dynamic applications. The glands have been specifically designed for applications using AS568 size O-Rings at pressures of less than 1,500 p.s.i. without back-up rings, and over 1,500 p.s.i. utilizing back-up rings. The glands have been sized to provide sufficient squeeze for effective sealing, while allowing satisfactory operation in dynamic applications. Although specifically designed for standard AS568 size O-Rings, these glands can also be used with other elastomeric seals.

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3. TECHNICAL REQUIREMENTS:

3.1 Gland Configuration:

3.1.1 General: As a general rule, O-rings and other elastomeric seals operating above 1500 psi should utilize backup rings or other devices of this nature to prevent seal extrusion. O-ring seal glands designed for backup ring use must be increased in width. Therefore, this document depicts gland widths for applications using none, one and two backup rings. While these glands are sized based on standard O-rings, they are to be used with other elastomeric seals. These seals should be designed to perform in these standard size glands.

3.1.2 Dimensions: The dimensions listed in Tables 1 through 5 are similar to the dimensions in MIL-G-5514 Revision F. Changes have been made to the Gland OD (F) and the Gland ID (E) to obtain the desired O-ring squeeze dimensions listed in Table 1 (Also see Figures 1 and 2). Changes have been made to the gland width dimensions to achieve a design goal of 85% maximum gland occupancy. (This was achieved except for sizes -004, -008, -010, -013 and -110 in which the gland occupancy slightly exceeds 85%.) Also, gland wall angle and break edge dimensions have been included to permit these glands to be used at pressures up to 8000 psi.

3.1.3 Limitations: The design criteria and standard glands set forth in this document are intended for use in static and dynamic applications with SAE AS568 O-rings (excluding dash numbers 013 through 028, 117 through 149 and 223 through 247 which are intended for static applications only due to the possibility of spiral failure occurring in these larger diameter sizes of the smaller cross section O-rings). Also, glands conforming to the dimensions listed herein for dash numbers 001 through 007 do not meet the squeeze goal of an installed deflection of at least 0.005 in on the O-ring cross-section using the most adverse accumulation of tolerances and O-ring stretch (see Appendix A). Therefore, the -001 through -007 sizes may not be suitable for many applications. Glands are designed so that they will not have more than 85% gland occupancy (15% free space) at 75 °F (24 °C). (See Appendix B). The standard glands described herein are designed for 1500 up to 8000 psig applications and for use in seal applications where the free swell is limited to 15 to 20%.

NOTE: Glands for sizes -102 through -109 are under development and will be added when available.

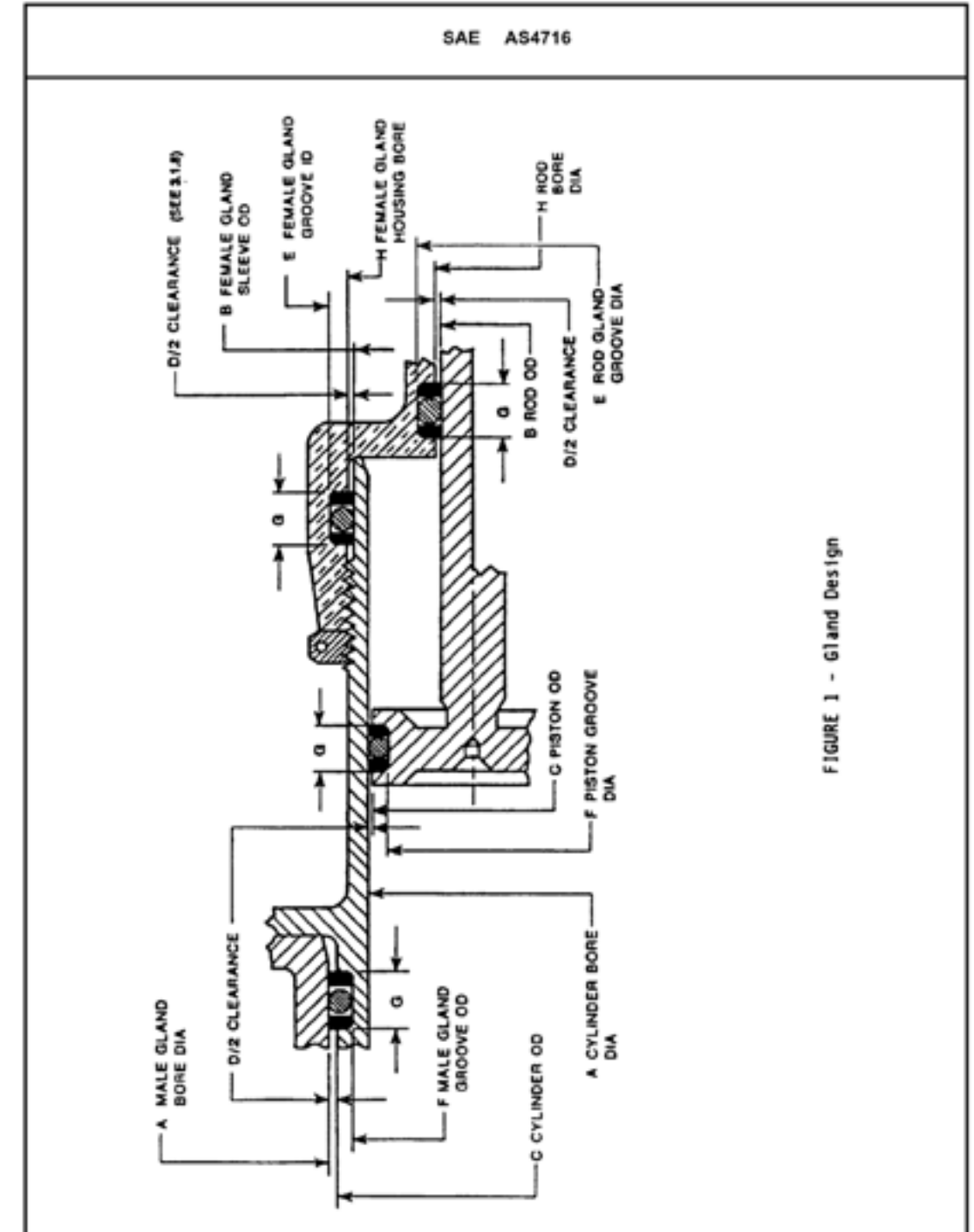


FIGURE 1 - Gland Design

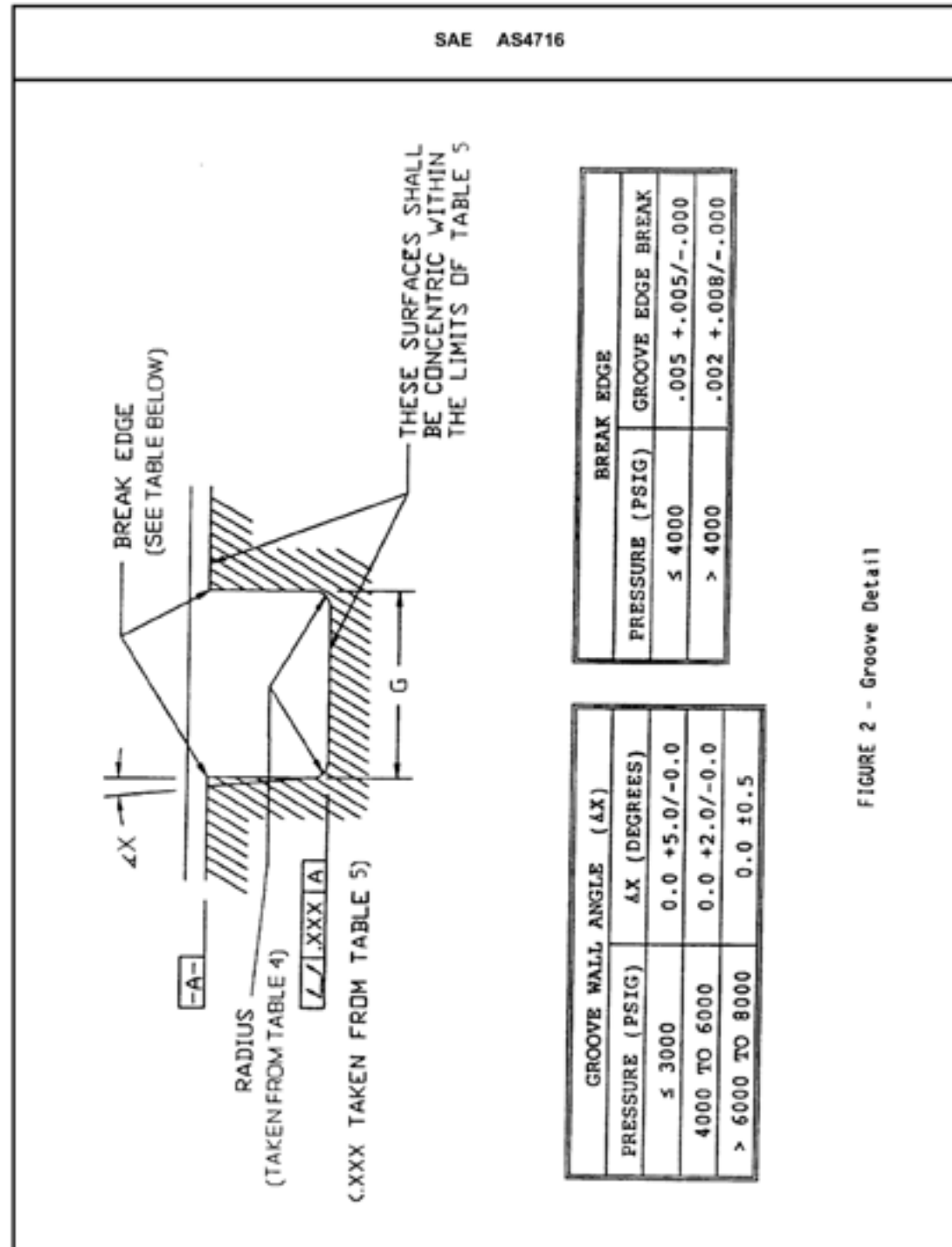


FIGURE 2 - Groove Detail

SAE AS4716

TABLE 1 - Standard Gland Dimensions and O-ring Squeeze in Inches

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Squeeze	
							Piston/Rod	Piston/Rod
001	.093 .092	.095 .096	.033 .032	.033 .032	.035 .036	.095 .096	.0000 .0000	.0145 .0145
002	.126 .125	.128 .129	.048 .047	.048 .047	.050 .051	.128 .129	.0000 .0000	.0139 .0139
003	.157 .156	.159 .160	.063 .062	.063 .062	.065 .066	.159 .160	.0000 .0000	.0154 .0154
004	.188 .187	.190 .191	.076 .075	.076 .075	.078 .079	.190 .191	.0003 .0003	.0176 .0176
005	.219 .218	.221 .222	.108 .107	.108 .107	.110 .111	.221 .222	.0020 .0020	.0178 .0178
006	.233 .232	.235 .236	.123 .122	.123 .122	.125 .126	.235 .236	.0023 .0023	.0177 .0177
007	.264 .263	.266 .267	.154 .153	.154 .153	.156 .157	.266 .267	.0032 .0032	.0179 .0179
008	.295 .294	.297 .298	.189 .188	.189 .188	.187 .188	.294 .295	.0050 .0053	.0193 .0196
009	.327 .326	.329 .330	.220 .219	.217 .216	.219 .220	.327 .328	.0052 .0052	.0192 .0193
010	.358 .357	.360 .361	.250 .249	.248 .247	.250 .251	.359 .360	.0052 .0050	.0190 .0189
011	.420 .419	.422 .423	.312 .311	.310 .309	.312 .313	.421 .422	.0057 .0054	.0193 .0191
012	.483 .482	.485 .486	.375 .374	.373 .372	.375 .376	.484 .485	.0060 .0057	.0194 .0192
013	.548 .547	.550 .552	.441 .439	.435 .433	.437 .438	.545 .547	.0060 .0050	.0196 .0198
014	.611 .610	.613 .615	.504 .502	.498 .496	.500 .501	.608 .610	.0052 .0051	.0197 .0199
015	.673 .672	.675 .677	.566 .564	.560 .558	.562 .563	.670 .672	.0052 .0051	.0200 .0202
016	.736 .735	.738 .740	.629 .627	.623 .621	.625 .626	.733 .735	.0052 .0051	.0203 .0205
017	.798 .797	.800 .802	.691 .689	.685 .683	.687 .688	.795 .797	.0054 .0052	.0204 .0205
018	.861 .860	.863 .865	.753 .751	.748 .746	.750 .751	.858 .860	.0050 .0053	.0200 .0205
019	.923 .922	.925 .927	.815 .813	.810 .808	.812 .813	.920 .922	.0051 .0053	.0200 .0205
020	.989 .988	.991 .993	.881 .879	.873 .871	.875 .876	.983 .985	.0050 .0054	.0198 .0205
021	1.051 1.050	1.053 1.055	.943 .941	.935 .933	.937 .938	1.045 1.047	.0051 .0055	.0199 .0205

O-RING GLAND DESIGN

SAE AS4716

TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze		Actual Maximum Squeeze	
							Piston/ Rod	Rod/ Rod	Piston/ Rod	Rod/ Rod
022	1.114	1.116	1.006	.998	1.000	1.108	.0051	.0200		
	1.113	1.118	1.004	.996	1.001	1.110	.0055	.0205		
023	1.176	1.178	1.068	1.060	1.062	1.170	.0052	.0200		
	1.175	1.180	1.066	1.058	1.063	1.172	.0055	.0205		
024	1.239	1.241	1.131	1.123	1.125	1.233	.0052	.0200		
	1.238	1.243	1.129	1.121	1.126	1.235	.0056	.0205		
025	1.301	1.303	1.193	1.185	1.187	1.295	.0052	.0201		
	1.300	1.305	1.191	1.183	1.188	1.297	.0056	.0205		
026	1.384	1.386	1.256	1.248	1.250	1.358	.0053	.0201		
	1.383	1.388	1.254	1.246	1.251	1.360	.0056	.0205		
027	1.426	1.428	1.318	1.310	1.312	1.420	.0053	.0202		
	1.425	1.430	1.316	1.308	1.313	1.422	.0056	.0205		
028	1.489	1.491	1.381	1.373	1.375	1.483	.0053	.0203		
	1.488	1.493	1.379	1.371	1.376	1.485	.0056	.0205		
110	.548	.550	.379	.373	.375	.546	.0053	.0204		
	.547	.552	.377	.371	.376	.548	.0052	.0204		
111	.611	.613	.441	.435	.437	.609	.0052	.0202		
	.610	.615	.439	.433	.438	.611	.0050	.0201		
112	.673	.675	.502	.498	.500	.672	.0053	.0201		
	.672	.677	.500	.496	.501	.674	.0053	.0203		
113	.736	.738	.565	.560	.562	.734	.0052	.0204		
	.735	.740	.563	.558	.563	.736	.0052	.0207		
114	.798	.800	.627	.623	.625	.797	.0053	.0210		
	.797	.802	.625	.621	.626	.799	.0052	.0211		
115	.861	.863	.689	.685	.687	.859	.0050	.0206		
	.860	.865	.687	.683	.688	.861	.0054	.0212		
116	.923	.925	.751	.748	.750	.923	.0053	.0208		
	.922	.927	.749	.746	.751	.925	.0050	.0207		
117	.989	.991	.817	.810	.812	.985	.0050	.0205		
	.988	.993	.815	.808	.813	.987	.0050	.0209		
118	1.051	1.053	.879	.873	.875	1.048	.0052	.0207		
	1.050	1.055	.877	.871	.876	1.050	.0051	.0209		
119	1.114	1.116	.942	.935	.937	1.110	.0053	.0206		
	1.113	1.118	.940	.933	.938	1.112	.0052	.0209		
120	1.176	1.178	1.003	.998	1.000	1.173	.0050	.0204		
	1.175	1.180	1.001	.996	1.001	1.175	.0053	.0209		
121	1.239	1.241	1.066	1.060	1.062	1.235	.0050	.0203		
	1.238	1.243	1.064	1.058	1.063	1.237	.0054	.0209		
122	1.301	1.303	1.128	1.123	1.125	1.298	.0052	.0204		
	1.300	1.305	1.126	1.121	1.126	1.300	.0055	.0209		
123	1.384	1.386	1.191	1.185	1.187	1.380	.0051	.0205		
	1.383	1.388	1.189	1.183	1.188	1.382	.0054	.0210		

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TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze		Actual Maximum Squeeze	
							Piston/ Rod	Rod/ Rod	Piston/ Rod	Rod/ Rod
124	1.426	1.428	1.253	1.248	1.250	1.423	.0052	.0206		
	1.425	1.430	1.251	1.246	1.251	1.425	.0055	.0210		
125	1.489	1.491	1.316	1.310	1.312	1.485	.0052	.0206		
	1.488	1.493	1.314	1.308	1.313	1.487	.0055	.0210		
126	1.551	1.553	1.378	1.373	1.375	1.548	.0053	.0207		
	1.550	1.555	1.376	1.371	1.376	1.550	.0056	.0210		
127	1.614	1.616	1.441	1.435	1.437	1.610	.0053	.0206		
	1.613	1.618	1.439	1.433	1.439	1.612	.0051	.0215		
128	1.676	1.678	1.503	1.498	1.500	1.673	.0054	.0207		
	1.675	1.680	1.501	1.496	1.502	1.675	.0052	.0215		
129	1.739	1.741	1.566	1.560	1.562	1.735	.0053	.0208		
	1.738	1.743	1.564	1.558	1.564	1.737	.0051	.0215		
130	1.802	1.805	1.631	1.623	1.625	1.798	.0053	.0217		
	1.801	1.807	1.629	1.621	1.627	1.800	.0051	.0215		
131	1.864	1.867	1.693	1.685	1.687	1.860	.0053	.0217		
	1.863	1.869	1.691	1.683	1.689	1.862	.0052	.0215		
132	1.927	1.930	1.756	1.748	1.750	1.923	.0054	.0217		
	1.926	1.932	1.754	1.746	1.752	1.925	.0052	.0215		
133	1.989	1.992	1.818	1.810	1.813	1.984	.0054	.0218		
	1.988	1.994	1.816	1.808	1.815	1.986	.0052	.0225		
134	2.052	2.055	1.881	1.873	1.876	2.047	.0055	.0218		
	2.051	2.057	1.879	1.871	1.878	2.049	.0053	.0225		
135	2.115	2.118	1.944	1.936	1.939	2.110	.0054	.0219		
	2.114	2.120	1.942	1.934	1.941	2.112	.0052	.0225		
136	2.177	2.180	2.006	1.998	2.001	2.172	.0055	.0219		
	2.176	2.182	2.004	1.996	2.003	2.174	.0053	.0225		
137	2.240	2.243	2.069	2.061	2.064	2.235	.0055	.0219		
	2.239	2.245	2.067	2.059	2.066	2.237	.0053	.0225		
138	2.302	2.305	2.131	2.123	2.126	2.297	.0055	.0219		
	2.301	2.307	2.129	2.121	2.128	2.299	.0053	.0225		
139	2.365	2.368	2.194	2.186	2.189	2.360	.0056	.0219		
	2.364	2.370	2.192	2.184	2.191	2.362	.0054	.0225		
140	2.427	2.430	2.256	2.248	2.251	2.422	.0056	.0219		
	2.426	2.432	2.254	2.246	2.253	2.424	.0054	.0225		
141	2.490	2.493	2.319	2.311	2.314	2.485	.0050	.0225		
	2.488	2.495	2.317	2.309	2.316	2.487	.0053	.0225		
142	2.552	2.555	2.381	2.373	2.376	2.547	.0051	.0225		
	2.550	2.557	2.379	2.371	2.378	2.549	.0053	.0225		
143	2.615	2.618	2.444	2.436	2.439	2.610	.0051	.0225		
	2.613	2.620	2.442	2.434	2.441	2.612	.0054	.0225		
144	2.677	2.680	2.506	2.498	2.501	2.672	.0051	.0225		
	2.675	2.682	2.504	2.496	2.503	2.674	.0054	.0225		

O-RING GLAND DESIGN

SAE AS4716

TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze ----- Piston/ Rod	Actual Maximum Squeeze ----- Piston/ Rod
145	2.740 2.738	2.743 2.745	2.569 2.567	2.561 2.559	2.564 2.566	2.735 2.737	.0052 .0054	.0225 .0225
146	2.802 2.800	2.805 2.807	2.631 2.629	2.623 2.621	2.626 2.628	2.797 2.799	.0052 .0054	.0225 .0225
147	2.865 2.863	2.868 2.870	2.694 2.692	2.686 2.684	2.689 2.691	2.860 2.862	.0051 .0054	.0225 .0225
148	2.927 2.925	2.930 2.932	2.756 2.754	2.748 2.746	2.751 2.753	2.922 2.924	.0052 .0054	.0225 .0225
149	2.990 2.988	2.993 2.995	2.819 2.817	2.811 2.809	2.814 2.816	2.985 2.987	.0052 .0054	.0225 .0225
210	.989 .988	.991 .993	.750 .748	.748 .746	.750 .751	.989 .991	.0052 .0054	.0244 .0247
211	1.051 1.050	1.053 1.055	.812 .810	.810 .808	.812 .813	1.051 1.053	.0054 .0055	.0244 .0248
212	1.114 1.113	1.116 1.118	.874 .872	.873 .871	.875 .876	1.115 1.117	.0051 .0052	.0242 .0243
213	1.176 1.175	1.178 1.180	.936 .934	.935 .933	.937 .938	1.177 1.179	.0052 .0053	.0242 .0244
214	1.239 1.238	1.241 1.243	.999 .997	.998 .996	1.000 1.001	1.240 1.242	.0054 .0054	.0243 .0244
215	1.301 1.300	1.303 1.305	1.064 1.062	1.060 1.058	1.062 1.063	1.302 1.304	.0067 .0056	.0254 .0244
216	1.364 1.363	1.366 1.368	1.124 1.122	1.123 1.121	1.125 1.126	1.365 1.367	.0054 .0055	.0246 .0247
217	1.426 1.425	1.428 1.430	1.186 1.184	1.185 1.183	1.187 1.188	1.427 1.429	.0055 .0056	.0246 .0247
218	1.489 1.488	1.491 1.493	1.249 1.247	1.248 1.246	1.250 1.251	1.490 1.492	.0056 .0057	.0246 .0247
219	1.551 1.550	1.553 1.555	1.311 1.309	1.310 1.308	1.312 1.313	1.552 1.554	.0057 .0058	.0246 .0248
220	1.614 1.613	1.616 1.618	1.374 1.372	1.373 1.371	1.375 1.376	1.615 1.617	.0058 .0059	.0247 .0248
221	1.676 1.675	1.678 1.680	1.436 1.434	1.435 1.433	1.437 1.438	1.677 1.679	.0059 .0059	.0247 .0248
222	1.739 1.738	1.741 1.743	1.499 1.497	1.498 1.496	1.500 1.501	1.740 1.742	.0057 .0058	.0250 .0250
223	1.864 1.863	1.867 1.869	1.625 1.623	1.623 1.621	1.625 1.627	1.865 1.867	.0053 .0054	.0254 .0255
224	1.989 1.988	1.992 1.994	1.750 1.748	1.748 1.746	1.750 1.752	1.990 1.992	.0055 .0056	.0254 .0255
225	2.115 2.114	2.118 2.120	1.876 1.874	1.873 1.871	1.876 1.878	2.115 2.117	.0054 .0050	.0255 .0260

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TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze ----- Piston/ Rod	Actual Maximum Squeeze ----- Piston/ Rod
226	2.240 2.239	2.243 2.245	2.001 1.999	1.998 1.996	2.001 2.003	2.240 2.242	.0055 .0051	.0255 .0260
227	2.365 2.364	2.368 2.370	2.126 2.124	2.123 2.121	2.126 2.128	2.365 2.367	.0056 .0052	.0255 .0260
228	2.490 2.488	2.493 2.495	2.251 2.249	2.248 2.246	2.251 2.253	2.490 2.492	.0051 .0052	.0260 .0260
229	2.615 2.613	2.618 2.620	2.376 2.374	2.373 2.371	2.376 2.378	2.615 2.617	.0051 .0053	.0260 .0260
230	2.740 2.738	2.743 2.745	2.501 2.499	2.498 2.496	2.501 2.503	2.740 2.742	.0052 .0054	.0260 .0260
231	2.865 2.863	2.868 2.870	2.626 2.624	2.623 2.621	2.626 2.628	2.865 2.867	.0053 .0054	.0260 .0260
232	2.990 2.988	2.993 2.995	2.751 2.749	2.748 2.746	2.751 2.753	2.990 2.992	.0052 .0053	.0260 .0260
233	3.115 3.113	3.118 3.120	2.876 2.874	2.873 2.871	2.876 2.878	3.115 3.117	.0053 .0054	.0260 .0260
234	3.240 3.238	3.243 3.245	3.001 2.999	2.997 2.995	3.000 3.002	3.239 3.241	.0053 .0055	.0260 .0260
235	3.365 3.363	3.368 3.370	3.126 3.124	3.122 3.120	3.125 3.127	3.364 3.366	.0054 .0055	.0260 .0260
236	3.490 3.488	3.493 3.495	3.251 3.249	3.247 3.245	3.250 3.252	3.489 3.491	.0054 .0056	.0260 .0260
237	3.615 3.613	3.618 3.620	3.376 3.374	3.372 3.370	3.375 3.377	3.614 3.616	.0055 .0056	.0260 .0260
238	3.740 3.738	3.743 3.745	3.501 3.499	3.497 3.495	3.500 3.502	3.739 3.741	.0055 .0057	.0260 .0260
239	3.865 3.863	3.868 3.870	3.626 3.624	3.622 3.620	3.625 3.627	3.864 3.866	.0055 .0056	.0260 .0260
240	3.990 3.988	3.993 3.995	3.751 2.749	3.747 3.745	3.750 3.752	3.989 3.991	.0055 .0056	.0260 .0260
241	4.115 4.113	4.118 4.120	3.876 3.874	3.872 3.870	3.875 3.877	4.114 4.116	.0056 .0057	.0260 .0260
242	4.240 4.238	4.243 4.245	4.001 3.999	3.997 3.995	4.000 4.002	4.239 4.241	.0056 .0057	.0260 .0260
243	4.365 4.363	4.368 4.370	4.126 4.124	4.122 4.120	4.125 4.127	4.364 4.366	.0056 .0057	.0260 .0260
244	4.489 4.487	4.493 4.495	4.251 4.249	4.247 4.245	4.250 4.252	4.489 4.491	.0051 .0057	.0265 .0260
245	4.614 4.612	4.618 4.620	4.376 4.374	4.372 4.370	4.375 4.377	4.614 4.616	.0051 .0058	.0265 .0260
246	4.739 4.737	4.743 4.745	4.501 4.499	4.497 4.495	4.501 4.503	4.739 4.741	.0052 .0053	.0265 .0265

SAE AS4716

TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze Piston/Rod	Actual Maximum Squeeze Piston/Rod
247	4.964 4.862	4.868 4.870	4.626 4.624	4.622 4.620	4.626 4.626	4.864 4.866	.0052 .0053	.0265 .0265
325	1.864 1.863	1.867 1.869	1.495 1.493	1.496 1.496	1.500 1.502	1.870 1.872	.0081 .0079	.0322 .0318
326	1.989 1.988	1.992 1.994	1.620 1.618	1.623 1.621	1.625 1.627	1.995 1.997	.0083 .0081	.0323 .0319
327	2.115 2.114	2.118 2.120	1.746 1.744	1.748 1.746	1.750 1.752	2.120 2.122	.0085 .0083	.0322 .0320
328	2.240 2.239	2.243 2.245	1.871 1.869	1.873 1.871	1.876 1.876	2.245 2.247	.0087 .0080	.0323 .0325
329	2.365 2.364	2.368 2.370	1.996 1.994	1.998 1.996	2.001 2.003	2.370 2.372	.0086 .0080	.0326 .0329
330	2.490 2.488	2.493 2.495	2.121 2.119	2.123 2.121	2.126 2.128	2.495 2.497	.0083 .0081	.0332 .0330
331	2.615 2.613	2.618 2.620	2.246 2.244	2.248 2.246	2.251 2.253	2.620 2.622	.0084 .0083	.0332 .0330
332	2.740 2.738	2.743 2.745	2.371 2.369	2.373 2.371	2.376 2.378	2.745 2.747	.0085 .0084	.0332 .0330
333	2.865 2.863	2.868 2.870	2.496 2.494	2.498 2.496	2.501 2.503	2.870 2.872	.0085 .0084	.0334 .0332
334	2.990 2.988	2.993 2.995	2.621 2.619	2.623 2.621	2.626 2.628	2.995 2.997	.0087 .0085	.0334 .0332
335	3.115 3.113	3.118 3.120	2.746 2.744	2.748 2.746	2.751 2.753	3.120 3.122	.0088 .0087	.0334 .0332
336	3.240 3.238	3.243 3.245	2.871 2.869	2.873 2.871	2.876 2.878	3.245 3.247	.0089 .0088	.0334 .0332
337	3.365 3.363	3.368 3.370	2.996 2.994	2.997 2.995	3.000 3.002	3.369 3.371	.0087 .0087	.0335 .0335
338	3.490 3.488	3.493 3.495	3.121 3.119	3.122 3.120	3.125 3.127	3.494 3.496	.0088 .0088	.0335 .0335
339	3.615 3.613	3.618 3.620	3.246 3.244	3.247 3.245	3.250 3.252	3.619 3.621	.0089 .0089	.0335 .0335
340	3.740 3.738	3.743 3.745	3.371 3.369	3.372 3.370	3.375 3.377	3.744 3.746	.0090 .0090	.0335 .0335
341	3.865 3.863	3.868 3.870	3.496 3.494	3.497 3.495	3.500 3.502	3.869 3.871	.0091 .0090	.0335 .0335
342	3.990 3.988	3.993 3.995	3.621 3.619	3.622 3.620	3.625 3.627	3.994 3.996	.0090 .0089	.0335 .0335
343	4.115 4.113	4.118 4.120	3.746 3.744	3.747 3.745	3.750 3.752	4.119 4.121	.0090 .0090	.0335 .0335
344	4.240 4.238	4.243 4.245	3.871 3.869	3.872 3.870	3.875 3.877	4.244 4.246	.0091 .0091	.0335 .0335

SAE AS4716

TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze Piston/Rod	Actual Maximum Squeeze Piston/Rod
345	4.365 4.363	4.368 4.370	3.996 3.994	3.997 3.995	4.000 4.002	4.369 4.371	.0092 .0091	.0335 .0335
346	4.489 4.487	4.493 4.495	4.121 4.119	4.122 4.120	4.125 4.127	4.494 4.496	.0087 .0092	.0340 .0335
347	4.614 4.612	4.618 4.620	4.246 4.244	4.247 4.245	4.250 4.252	4.619 4.621	.0087 .0092	.0340 .0335
348	4.739 4.737	4.743 4.745	4.371 4.369	4.372 4.370	4.375 4.377	4.744 4.746	.0088 .0092	.0340 .0335
349	4.864 4.862	4.868 4.870	4.496 4.494	4.497 4.495	4.500 4.502	4.869 4.871	.0088 .0093	.0340 .0335
425	4.970 4.968	4.974 4.977	4.497 4.494	4.497 4.494	4.501 4.503	4.974 4.977	.0175 .0175	.0480 .0480
426	5.095 5.093	5.099 5.102	4.622 4.619	4.622 4.619	4.626 4.628	5.099 5.102	.0176 .0176	.0480 .0480
427	5.220 5.218	5.224 5.227	4.747 4.744	4.747 4.744	4.751 4.753	5.224 5.227	.0176 .0176	.0480 .0480
428	5.345 5.343	5.349 5.352	4.872 4.869	4.872 4.869	4.876 4.878	5.349 5.352	.0177 .0177	.0480 .0480
429	5.470 5.468	5.474 5.477	4.997 4.994	4.997 4.994	5.001 5.003	5.474 5.477	.0176 .0176	.0480 .0480
430	5.595 5.593	5.599 5.602	5.122 5.119	5.122 5.119	5.126 5.128	5.599 5.602	.0176 .0176	.0480 .0480
431	5.720 5.718	5.724 5.727	5.247 5.244	5.247 5.244	5.251 5.253	5.724 5.727	.0177 .0177	.0480 .0480
432	5.845 5.843	5.849 5.852	5.372 5.369	5.372 5.369	5.376 5.378	5.849 5.852	.0178 .0178	.0480 .0480
433	5.970 5.968	5.974 5.977	5.497 5.494	5.497 5.494	5.501 5.503	5.974 5.977	.0178 .0178	.0480 .0480
434	6.095 6.093	6.099 6.102	5.622 5.619	5.622 5.619	5.626 5.628	6.099 6.102	.0179 .0179	.0480 .0480
435	6.220 6.218	6.224 6.227	5.747 5.744	5.747 5.744	5.751 5.753	6.224 6.227	.0179 .0179	.0480 .0480
436	6.345 6.343	6.349 6.352	5.872 5.869	5.872 5.869	5.876 5.878	6.349 6.352	.0180 .0180	.0480 .0480
437	6.470 6.468	6.474 6.477	5.997 5.994	5.997 5.994	6.001 6.003	6.474 6.477	.0180 .0180	.0480 .0480
438	6.720 6.718	6.724 6.727	6.247 6.244	6.247 6.244	6.251 6.253	6.724 6.727	.0180 .0180	.0480 .0480
439	6.970 6.968	6.974 6.977	6.497 6.494	6.497 6.494	6.501 6.504	6.974 6.977	.0181 .0176	.0480 .0485
440	7.220 7.218	7.224 7.227	6.747 6.744	6.747 6.744	6.751 6.754	7.224 7.227	.0182 .0177	.0480 .0485

O-RING GLAND DESIGN

SAE AS4716

TABLE 1 (Continued)

Gland and AS568 Dash No.	Piston or Cylinder OD C	Cylinder Bore ID A	Gland OD F	Rod or Gland Sleeve OD B	Rod Bore ID H	Gland ID E	Actual Minimum Squeeze Piston/ Rod	Actual Maximum Squeeze Piston/ Rod
441	7.470 7.468	7.474 7.477	6.997 6.994	6.997 6.994	7.001 7.004	7.474 7.477	.0182 .0177	.0480 .0485
442	7.720 7.718	7.724 7.727	7.247 7.244	7.247 7.244	7.251 7.254	7.724 7.727	.0181 .0176	.0480 .0485
443	7.970 7.968	7.974 7.977	7.497 7.494	7.497 7.494	7.501 7.504	7.974 7.977	.0182 .0177	.0480 .0485
444	8.220 8.218	8.224 8.227	7.747 7.744	7.747 7.744	7.751 7.754	8.224 8.227	.0183 .0178	.0480 .0485
445	8.470 8.468	8.474 8.477	7.997 7.994	7.997 7.994	8.001 8.004	8.474 8.477	.0183 .0178	.0480 .0485
446	8.970 8.967	8.974 8.977	8.497 8.494	8.497 8.494	8.501 8.504	8.974 8.977	.0177 .0177	.0485 .0485
447	9.470 9.467	9.474 9.478	8.997 8.994	8.997 8.994	9.001 9.004	9.474 9.478	.0168 .0173	.0485 .0485
448	9.970 9.967	9.974 9.978	9.497 9.494	9.497 9.494	9.501 9.504	9.974 9.978	.0169 .0174	.0485 .0485
449	10.470 10.467	10.474 10.478	9.997 9.994	9.997 9.994	10.001 10.004	10.474 10.478	.0170 .0175	.0485 .0485
450	10.970 10.967	10.974 10.978	10.497 10.494	10.497 10.494	10.501 10.504	10.974 10.978	.0170 .0175	.0485 .0485
451	11.470 11.467	11.474 11.478	10.997 10.994	10.997 10.994	11.001 11.004	11.474 11.478	.0170 .0176	.0485 .0485
452	11.970 11.967	11.974 11.978	11.497 11.494	11.497 11.494	11.501 11.504	11.974 11.978	.0171 .0176	.0485 .0485
453	12.470 12.467	12.474 12.478	11.997 11.994	11.997 11.994	12.001 12.004	12.474 12.478	.0172 .0177	.0485 .0485
454	12.970 12.967	12.974 12.978	12.497 12.494	12.497 12.494	12.501 12.504	12.974 12.978	.0173 .0178	.0485 .0485
455	13.470 13.467	13.474 13.478	12.997 12.994	12.997 12.994	13.001 13.004	13.474 13.478	.0173 .0178	.0485 .0485
456	13.970 13.967	13.974 13.978	13.497 13.494	13.497 13.494	13.501 13.504	13.974 13.978	.0172 .0177	.0485 .0485
457	14.470 14.467	14.474 14.478	13.997 13.994	13.997 13.994	14.001 14.004	14.474 14.478	.0173 .0178	.0485 .0485
458	14.970 14.967	14.974 14.978	14.497 14.494	14.497 14.494	14.501 14.504	14.974 14.978	.0173 .0178	.0485 .0485
459	15.470 15.467	15.474 15.478	14.997 14.994	14.997 14.994	15.001 15.004	15.474 15.478	.0174 .0179	.0485 .0485
460	15.970 15.967	15.974 15.978	15.497 15.494	15.497 15.494	15.501 15.504	15.974 15.978	.0174 .0179	.0485 .0485

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TABLE 2 - Standard Gland Width for Zero, One, and Two Backup

Gland and AS568 Dash No.	O-ring Cross Section W Min	O-ring Cross Section W Max	Gland Width G No Backup Ring Min	Gland Width G No Backup Ring Max	Gland Width G One Backup Ring Min	Gland Width G One Backup Ring Max	Gland Width G Two Backup Rings Min	Gland Width G Two Backup Rings Max
001	.037	.043	.070	.075	--	--	--	--
002	.047	.053	.077	.082	--	--	--	--
003	.057	.063	.088	.093	--	--	--	--
004 to 009	.067	.073	.098	.103	.154	.164	.210	.220
010 to 028	.067	.073	.094	.099	.150	.160	.207	.217
110 to 149	.100	.106	.141	.151	.183	.193	.245	.255
210 to 247	.135	.143	.188	.198	.235	.245	.304	.314
325 to 349	.205	.215	.281	.291	.334	.344	.424	.434
424 to 460	.269	.281	.375	.385	.475	.485	.579	.589

TABLE 3 - Standard Gland Diametral Clearance Dimensions

Gland and AS568 Dash No.	O-ring Cross Section W Min	O-ring Cross Section W Max	Diametral Clearance D Max Exterior	Diametral Clearance D Max Interior
001	.037	.043	.004	.004
002	.047	.053	.004	.004
003	.057	.063	.004	.004
004 to 012	.067	.073	.004	.004
013 to 028	.067	.073	.005	.005
110 to 126	.100	.106	.005	.005
127 to 129	.100	.106	.005	.006
130 to 132	.100	.106	.006	.006
133 to 140	.100	.106	.006	.007
141 to 149	.100	.106	.007	.007
210 to 222	.135	.143	.005	.005
223 and 224	.135	.143	.006	.006
225 to 227	.135	.143	.006	.007
228 to 243	.135	.143	.007	.007
244 and 245	.135	.143	.008	.007
246 and 247	.135	.143	.008	.008
325 to 327	.205	.215	.006	.006
328 and 329	.205	.215	.006	.007
330 to 345	.205	.215	.007	.007
346 to 349	.205	.215	.008	.007
425 to 438	.269	.281	.009	.009
439 to 445	.269	.281	.009	.010
446	.269	.281	.010	.010
447 to 460	.269	.281	.011	.010

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TABLE 4 - Standard Corner Radius Dimensions

Gland and AS568 Dash No.	Corner Radius Maximum	Corner Radius Minimum
001 to 028	.015	.005
110 to 149	.015	.005
210 to 247	.025	.010
325 to 349	.035	.020
425 to 460	.035	.020

TABLE 5 - Eccentricity for Standard Glands

Gland and AS568 Dash No.	Maximum Eccentricity
001 to 028	.002
110 to 149	.002
210 to 247	.003
325 to 349	.004
425 to 460	.005

3.1.4 Surface Finishes of Glands: The following surface finishes in Table 6 (indicated as surface roughness as defined in ANSI B46.1) shall be used in units containing O-ring seals:

TABLE 6

Part on Unit	Surface Roughness Ra (µin)
Cylinder bore or piston rod (diameter over which packaging must slide)	4 to 16 ¹
O-ring groove diameter:	
Dynamic Seals	32 (max)
Static Seals	63 (max)
O-ring groove sides when no backup ring is used:	
Dynamic Seals	32 (max)
Static Seals	63 (max)
O-ring groove sides when backup rings are used	63 (max)

¹Recommended range is 8 to 12.

The groove surfaces must be free from all machining irregularities exceeding the above values. Groove edges shall be smooth and true and free of nicks, scratches, and burrs, etc.

3.1.5 O-ring Seal Squeeze: The minimum squeeze (See Table 1) is represented by the difference (interference) between the minimum cross-section of the installed O-ring and the maximum permitted gland depth. The O-ring used to calculate minimum squeeze is one with the minimum free cross-section diameter and minimum ID. The minimum cross-section diameter of the installed O-ring is obtained by subtracting the change in the minimum free

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3.1.5 (Continued):

cross-section diameter, caused by the stretching of the O-ring during installation, from the minimum free cross-section diameter. The maximum gland depth is that obtained using gland parts that provide the maximum possible diametral clearance, maximum eccentricity of gland parts and maximum possible radial displacement of the gland parts in the direction to cause maximum gland depth and minimum seal squeeze at the seal location that is 180° away from the direction of radial displacement.

The maximum O-ring squeeze in Table 1 is represented by the difference between the maximum cross-section diameter of an installed O-ring and the minimum gland depth. The O-ring used to calculate maximum squeeze is an O-ring of maximum free cross-section diameter and maximum ID. The maximum cross-section diameter of the installed O-ring is obtained by subtracting the change in the maximum free cross-section diameter, caused by the stretching of the O-ring during installation, from the maximum free cross-section diameter. The minimum gland depth for a piston type gland is that obtained using MIN bore diameter, MIN piston diameter, maximum eccentricity of gland parts and maximum possible radial displacement of the MIN piston diameter with respect to the MIN bore diameter. The minimum gland depth for a rod type gland is that obtained using MAX rod diameter, MAX rod clearance diameter, maximum eccentricity of gland parts and maximum possible radial displacement of the MAX rod diameter with respect to the MAX rod clearance diameter.

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

3.1.6 Temperature Considerations in Gland Design: The calculations used in this standard have been based on a temperature of 75 °F (24 °C). The suitability of the glands should be verified for the temperature extremes expected in service. Differences in the coefficient of expansion of different metals can result in differences in diametral clearance which may be a factor at temperature extremes. Even more important is the difference in the coefficient of thermal expansion of the seal material and the gland materials. Elastomers may have a coefficient of expansion as much as 10 times that of steel. Gland overfill at high temperatures must be avoided. Elastomer contraction at low temperatures may require some modification of the gland dimensions herein to assure adequate squeeze at low temperatures, particularly those lower than -40 °F (-40 °C). A particularly severe application occurs when an unpressurized cylinder at low temperature is pressurized. Leakage is likely to occur until such time as warmer fluid causes expansion of the elastomer. Leakage can be prevented in such cases by ensuring that adequate squeeze is provided by taking into account changes in gland and elastomer dimensions that occur at low temperature plus the radial expansion (i.e., gland "breathing") that will occur with the application of pressure. Usually, satisfactory designs can be achieved within the dimensions of this standard by simply reducing the permitted tolerances on mating parts to achieve increased squeeze.

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3.1.7 Installation of Nonextrusion Rings: For pressures above 1500 psi, the use of two backup rings in each gland, one on either side of the O-ring seal, is recommended to insure proper backup ring installation, where space permits. Dimensions for gland widths to accommodate the use of two backup rings are shown in Table 2. Where it is self evident that pressure can be applied from one direction only and space requirements for two rings create a hardship, a single backup ring may be used. This ring is to be placed on the side of the O-ring away from the pressure. The groove width dimensions shown in Table 2 for one backup ring may be used, as applicable. For applications where the pressure does not exceed 1500 psi, backup rings are not required but may be used to provide greater extrusion protection.

Glands are designed to be compatible with Continuous Turn PTFE backup rings in accordance with MS27595, spiral PTFE backup rings in accordance with MS28782 and MS28783, and single-turn PTFE backup rings in accordance with MIL-R-8791/1.

3.1.8 Diametral Clearances: The diametral clearance, "D" in Figure 1, is the total difference between the bore ID (A) and the piston OD (C) or the total difference between the rod OD (B) and the rod bore ID (H). The diametral clearance shall be as listed in Table 3.

3.1.9 Groove Detail: Details for the standard groove design, including edge break and groove wall angle requirements, are depicted in Figure 2. Groove corner radius shall be in accordance with Table 4.

3.1.10 Eccentricity: The eccentricity, referred to in Table 5, is the total indicator reading, between the groove and the adjacent bearing surface (see Figure 2). As indicated in Figure 1, the designated surfaces shall be concentric within the limits of Table 5.

3.1.11 Cylinder Breathing: For operating pressures of 3000 psig and lower, radial expansion of the cylinder bore (i.e., cylinder wall "breathing") shall be limited to .002 in/in of cylinder bore at operating pressure. For operating pressures greater than 3000 psig, radial expansion of the cylinder bore shall be limited to .0015 in/in of cylinder bore at operating pressure.

3.1.12 O-ring Assembly: To facilitate O-ring assembly, the edge where the piston and O-ring assembly enters a cylinder bore should be chamfered to prevent pinching or other damage to the O-ring seal (see Figure 3).

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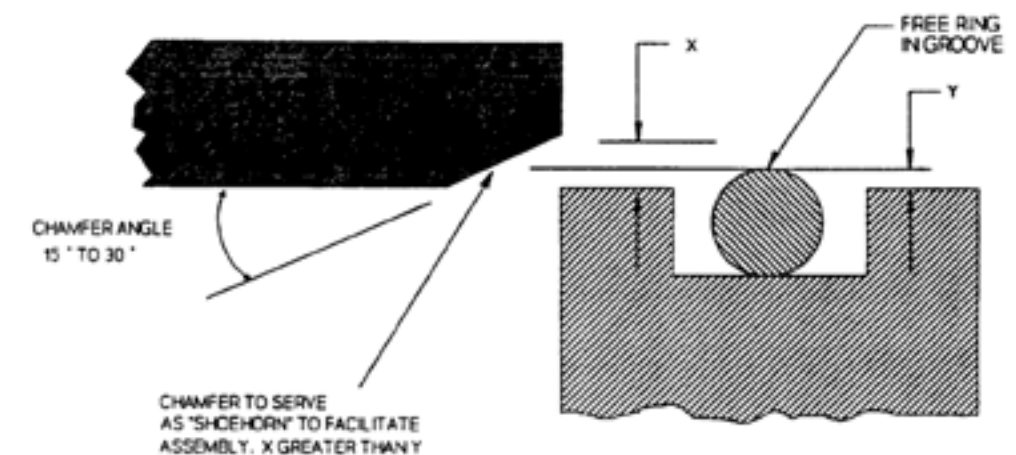


FIGURE 3 - O-ring Assembly