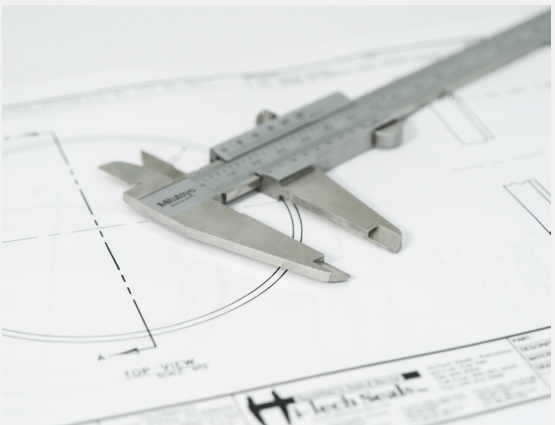
Hi-Tech Seals



O-Ring Design Guide







Our Vision

Provide superior value to our customers.



Our Mission

Supply quality products delivered on time, at a competitive cost, backed by a knowledgeable team of sealing professionals, so our customers may grow and prosper.

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Introduction

For over 34 years Hi-Tech Seals has been recognized as a leader in the distribution and manufacturing of industrial seals, gaskets, and rubber and plastic solutions. We continually invest in new and innovative products, materials, and services with the intention of helping our customers grow and prosper in an ever-changing world economy.

We offer a personal solution to the business world, tailoring our business relationship to reflect the needs of our clients. We work alongside a variety of industries, while maintaining a high standard for all our products and services. Our diverse supply chain allows our customers to be confident we will provide a solution that meets and exceeds their specifications.

Kit Creation Program

Whether needed for maintenance or manufacturing, our kits are an excellent system to help our customers stay organized, increase efficiency, and simplify the ordering process. Our knowledgeable team of seal professionals can assist with identifying the components and create your custom kit in our system. The kit labels can include company name, logos, part numbers, application information, and other applicable information. When placing an order, simply provide us with one part number and receive all components in one package.

ISO 9001 Registered QMS

At Hi-Tech Seals, we are committed to our Quality Management System (QMS). Our first branch registered under an ISO QMS in 1996. We are proud to state that our entire company is registered under the ISO 9001:2015 Quality Management System. The three main goals of our policy include:

- Hi-Tech Seals shall distribute and/or manufacture a quality product that will meet our customers' expectations and applicable requirements.
- Hi-Tech Seals shall commit to quality objectives agreed upon by senior management, identified through a holistic and collaborative approach involving all potential stakeholders.
- Hi-Tech Seals shall strive to continually improve the Quality Management System (QMS) effectiveness based on efficient processes, well-defined measurements, and best practices.

After Hours Service

If you experience a seal or gasket emergency our technical professionals are available 24 hours a day. Hi-Tech Seals offers after-hours service seven days a week to ensure our customers' businesses can continue operating. To assist our customers to the best of our ability we also offer after hours Rapid Seal machining and Rapid Gasket manufacturing services. *Charges may apply, provided we can assist you.*



O-Rings

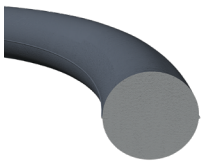
O-rings are the most widely used seal in history due to their simplicity, low cost, ease of installation, and small space requirements. The seals versatility enables them to be used in thousands of applications across a multitude of industries and markets. O-rings are designed for both static and dynamic applications and can be used as a double acting seal.

A properly designed O-ring groove allows the O-ring to be squeezed diametrically out of round, even before the application of pressure. The O-ring seals by distortion of its resilient elastic compound to fill the leakage path.

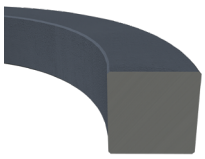
As the name suggests, the O-ring has a circular profile. They are also available in a square cut and quad profile. Square cut rings have the same ID as an O-ring but have different cross sections. Quad rings have the same diameters and cross sections as an O-ring, only their profile shape differs.

Our imperial O-rings are available in standard AS-568 and ISO 3601 sizes. Metric O-rings are available in standard DIN 3771, BS4518, ISO 3601, European sizes, and JIS sizes.





O-ring



Square Cut Ring



Quad Ring

O-Ring Prefixes

Prefix	Material	Duro.*
N70	Nitrile	70 ±5
N90	Nitrile	90 ±5
LTN	Low Temperature Nitrile	70 ±5
HS7	Hydrogenated Nitrile	70 ±5
HS8	Hydrogenated Nitrile	80 ±5
HS9	Hydrogenated Nitrile	90 ±5
FK7	Fluorocarbon	75 ±5
FK9	Fluorocarbon	90 ±5
V75	Viton™	75 ±5
V90	Viton™	90 ±5
LTV	Low Temperature Viton™/Fluorocarbon	75 ±5
PF7	Perfluoroelastomer	70 ±5
PF8	Perfluoroelastomer	80 ±5
PF9	Perfluoroelastomer	90 ±5

Prefix	Material	Duro.*
KAL	Kalrez®	**
A80	Aflas® FEPM	80 ±5
A90	Aflas® FEPM	90 ±5
NEO	Neoprene	70 ±5
E70	Ethylene-Propylene	70 ±5
E80	Ethylene-Propylene	80 ±5
E90	Ethylene-Propylene	90 ±5
S70	Silicone	70 ±5
FS7	Fluorosilicone	70 ±5
U90	Urethane	90 ±5
T	PTFE	***
TEV	FEP/PFA Encapsulated Viton™	****
TES	FEP/PFA Encapsulated Silicone	****

Quad Ring Prefixes

Prefix	Material	Duro.*
QN7	Nitrile	70 ±5
QN9	Nitrile	90 ±5
QV7	Viton™/Fluorocarbon	70 ±5
QE7	Ethylene-Propylene	70 ±5

Square Cut Ring Prefixes

Prefix	Material	Duro.*
TS7	Nitrile	70 ±5
TS9	Nitrile	90 ±5

Material general temperature range and descriptions are available on pg 50.

** Shore A Hardness*

ISO 3601 O-Ring Standards

At Hi-Tech Seals, we are fully compliant with ISO 3601-1 dimension and tolerance standards for all Class A standard series O-rings and Class B non-standard series O-rings. Our quality acceptance criteria for all O-rings is in accordance with ISO 3601-3 Grade N. This classifies surface imperfections of O-rings and specifies maximum acceptable limits for these imperfections.

ISO3601-1 Dimensional Tolerances

ISO 3601-1 defines two classifications of O-rings, Class A and Class B. Class A have equivalent tolerances to those identified in AS568 and have tighter tolerances than Class B. They are suitable for industrial and aerospace applications or when the housing requires tighter tolerances. Class B O-rings are suitable for general purpose applications and have slightly wider tolerances than Class A O-rings.

ISO 3601-3 Quality Acceptance Criteria

ISO 3601-3 defines and classifies O-ring surface imperfections into one of three grades N, S, and CS.

- Grade N (general purpose) - Identifies the acceptance criteria for O-rings that are intended for general use applications
- Grade S (special) - Identifies the acceptance criteria for O-rings intended for applications that require a higher level of quality and or precision with respect to dimensional tolerances of surface imperfections
- Grade CS (critical service) - Identifies critical applications where a much higher level of quality and precision is required and the O-ring's surface must be near perfect to perform in a satisfactory manner. For example, critical service aerospace or medial applications

The surface imperfections characterized by ISO 3601-3 include flash, excessive trimming, offset, non-fills, parting-line projection, back rind, flow marks, and indentations.



Standard O-Rings

Standard O-rings are a simple and economical sealing solution that is used in all types of applications, by an extesive range of industries. These seals are designed for both static and dynamic applcations. A properly designed O-ring groove allows the O-ring to be squeezed diametrically out-of-round even before the application pressure. The O-ring seals by distortion of its resilient elastic copound to fill the leakage path.

- Most widely used seal in the world
- Simple and effective
- Offers full rebound and compression characteristics of the material
- Straight forward installation

PTFE Colour Coated O-Rings

Colour-coated O-rings are covered in a thin layer of PTFE that adheres to the O-ring's material. They offer remarkable wear properties, which extend the O-ring's service life. We offer a wide selection of standard colour coated O-rings, and custom colours are available upon request.

Coating O-rings in contrasting colours can help distinguish between similar looking materials and sizes, ensuring the proper O-ring is installed. Customers also take advantage of their low coefficient of friction for easier installation.

- Excellent adhesion, wear, and friction properties
- Easier identification of parts by colour coding
- Eliminates the need for lubricants and grease
- Improves installation
- Increases chemical resistance
- Available in a wide range of colours

FEP/PFA Encapsulated O-Rings

Encapsulated O-rings consist of an elastomer inner ring surrounded by a seamless and uniform FEP/PFA casing. The inner ring provides resilience and sealing force of the elastomer, while the casing offers excellent chemical resistance. These O-rings are cost-effective and high-performance seals. They are suitable for critical applications that traditional materials would not withstand.

- Seals in hostile chemicals and temperature environments
- Offers excellent properties with the combination of elastomer flexibility plus the benefit of FEP/PFA chemical resistance
- Easier installation compared to many other highly chemical-resistant seal options







Machining Specifications

O-Ring Cross-Section

The I.D. and O.D. of an O-ring gland is primarily influenced by the diameter of the mating surface of the rod or piston and bore. Although the cross-section of the O-ring may seem arbitrary, there are some distinct advantages to either a larger or smaller cross-section O-ring.

Smaller Cross-Sections Advantages

- More compact
- Lighter weight
- Less expensive; especially for higher cost elastomers like fluorocarbon (FKM) or fluorosilicone (FVMQ, FMQ)
- Less machining required for machined grooves since grooves are smaller
- Increased resistance to explosive decompression

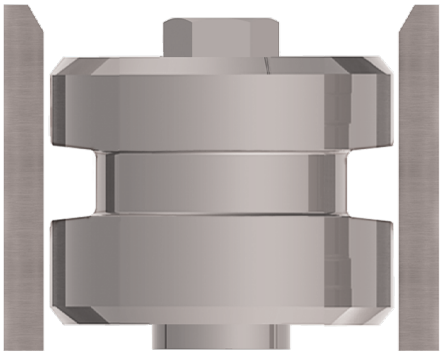
Larger Cross-Sections Advantages

- Less prone to compression set
- Less volume swell in liquid on a percentage basis
- Allows for larger tolerance while still maintaining acceptable compression squeeze and compression ratio over full stack-up range
- Less prone to leakage due to contamination; dirt, lint, scratches, etc.

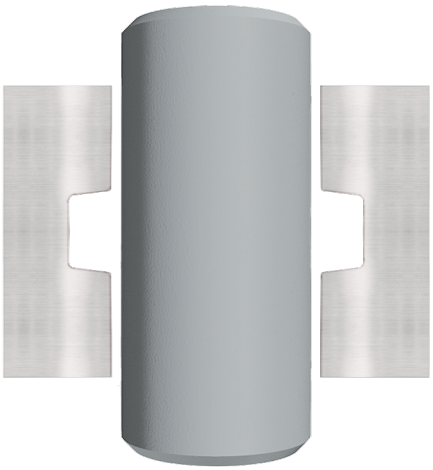
O-Ring Gland Types

O-rings are primarily used to prevent the loss of a fluid or gas. However, O-rings can be used as dust seals, drive belts, or on rotating shafts. Most O-ring seals can be classified into one of the three arrangements or configurations below.

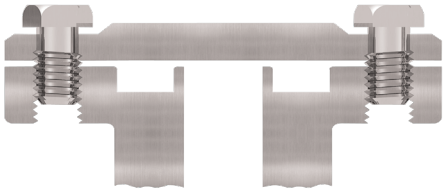
Piston Configuration



Rod Configuration

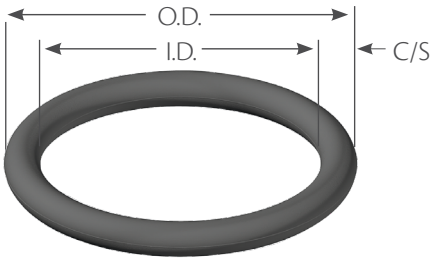


Face Type Configuration

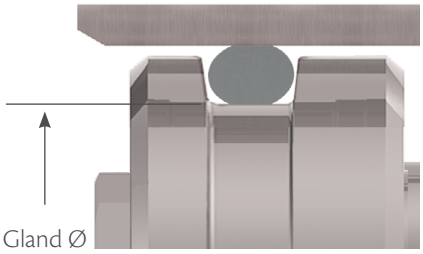


Machining Specifications

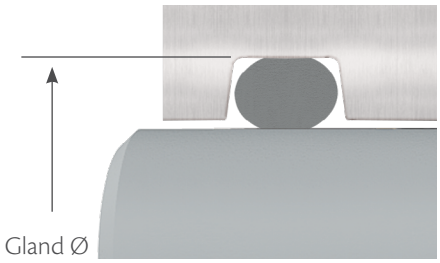
O-Ring



Piston



Rod



I.D. = Inner Diameter
O.D. = Outer Diameter

I.D. Stretch & O.D. Interference

For hydraulic and pneumatic piston sealing applications

The O-ring's I.D. should be stretched between 2% and 5% for dynamic applications and 2% and 8% for static applications. For O-rings with an I.D. smaller than 20 mm, this is not always possible which can result in a wider range of stretch. To minimize this range and the maximum stretch, it is necessary to minimize the tolerance of the piston gland diameter and have a less stringent requirement for the minimum O-ring stretch. In dynamic applications, it is important to keep the maximum stretch to 5% or less to avoid detrimental effects on sealing performance.

For hydraulic and pneumatic rod sealing applications

The O-ring's O.D. should be equal to or larger than the rod gland diameter to give interference on the O-ring O.D. The O-ring O.D. should not exceed 3% of the rod gland diameter for O-rings with an I.D. greater than 250 mm, or 5% for O-rings with an I.D. smaller than 250 mm. For O-rings with an I.D. smaller than 20 mm, this is not always possible due to tolerance issues, which can result in a greater O-ring O.D. interference.

Machining Specifications

Reduction in Cross-Section

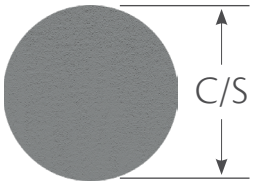
If the I.D. of the O-ring is stretched, the cross-section of the O-ring will decrease. The following table gives the O-ring cross-sections that result from various percentages of I.D. stretch.

O-Ring Series	O-Ring C/S		Reduced O-Ring C/S at % ID Stretch (Inch / mm)				
	Inch	mm	1%	2%	3%	4%	5%
000	0.070	1.78	0.069 / 1.76	0.069 / 1.74	0.068 / 1.73	0.068 / 1.71	0.068 / 1.69
100	0.103	2.62	0.102 / 2.59	0.101 / 2.57	0.100 / 2.54	0.100 / 2.52	0.100 / 2.49
200	0.139	3.53	0.138 / 3.49	0.137 / 3.46	0.136 / 3.42	0.135 / 3.39	0.134 / 3.35
300	0.210	5.33	0.208 / 5.28	0.206 / 5.22	0.205 / 5.17	0.204 / 5.12	0.203 / 5.06
400	0.275	6.99	0.272 / 6.92	0.270 / 6.85	0.268 / 6.78	0.267 / 6.71	0.266 / 6.64

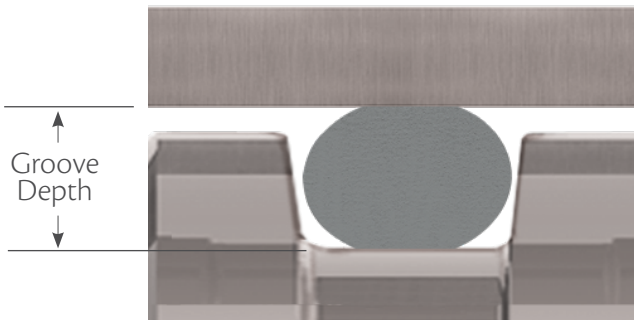
Compression

Compression squeeze is the difference between the original O-ring cross-section and the final O-ring cross-section once installed.

Compression Squeeze = C/S - Groove Depth



Compression Squeeze



This can usually be expressed as a percentage:

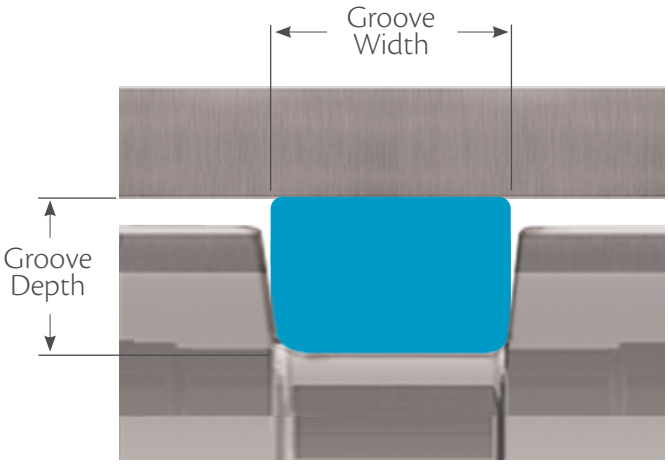
$$\text{O-ring C/S Squeeze (\%)} = \frac{\text{Compression Squeeze}}{\text{C/S}} \times 100$$

For recommended O-ring C/S squeeze (%) values please refer to page 15 and 16.

Machining Specifications

Gland Fill

The gland fill is the percentage of the gland that is occupied by the O-ring. It is calculated by dividing the cross-sectional area (CSA) of the O-ring by the cross-sectional area of the gland.



Area of a circle = πr^2 and $r = \frac{d}{2}$, where d = diameter (C/S)

Therefore, O-ring CSA = $\pi\left(\frac{C/S}{2}\right)^2$

Gland CSA = Groove Depth x Groove Width*

Gland Fill (%) = $\frac{\text{O-ring CSA}}{\text{Gland CSA}}$ x 100

** Effect of gland angle and extrusion gap not addressed.*

It is important to consider the groove fill or occupancy of the installed O-ring to avoid detrimental effects on radial sealing performance. The groove fill of the installed O-ring should not exceed 85 % to allow for possible O-ring thermal expansion, volume swell due to fluid exposure and effects of tolerances.

Volume change is the increase or decrease of the volume of an elastomer after it has been in contact with a fluid, measured in percent (%). For static O-ring applications volume swell up to 30 % can usually be tolerated. For dynamic applications, 10 or 15% swell is a reasonable maximum unless special provisions are made in the gland design itself. This is a general rule and there may occasionally be exceptions.

It is also important to note there are significant differences in the coefficients of thermal expansion between the O-ring material and the groove materials. Elastomers can have coefficients of thermal expansion 7 to 20 times higher than that of metal, such as steel.

Machining Specifications

Extrusion Gap

Extrusion is a concern for radial seals where there is a gap between the piston and the bore for a piston type seal or between the rod and throat diameter for a rod type seal. It is not typically a concern for face type seals where the metal parts to be sealed are in contact line-to-line. The issue is that at higher pressures and especially for softer O-ring elastomers, the O-ring can be forced by the pressure into the small gap between the piston (or rod) and the bore (throat diameter). Unless the bore (throat diameter) and the piston (or rod) are ensured to remain concentric by the hardware, we have to assume that entire possible gap can shift to one side (see diagram below).

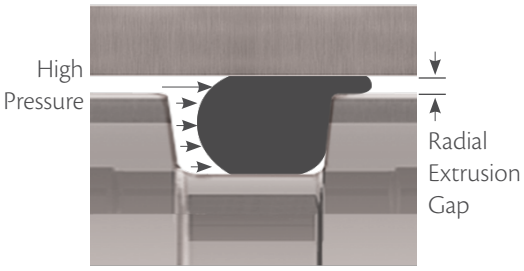
Piston Type Seal

$$\text{Radial Extrusion Gap} = \frac{\text{Bore Ø - Piston Ø}}{2}$$

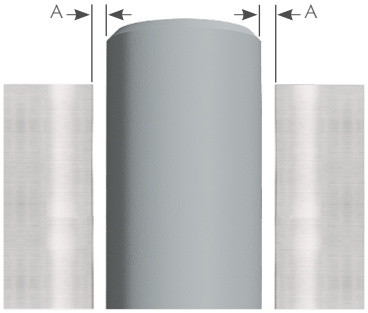
Ø = Diameter

Rod Type Seal

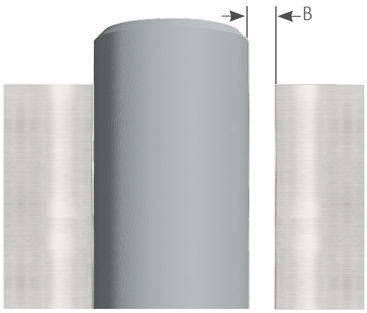
$$\text{Radial Extrusion Gap} = \frac{\text{Bore Ø - Rod Ø}}{2}$$



Extrusion



Radial Gap (A)



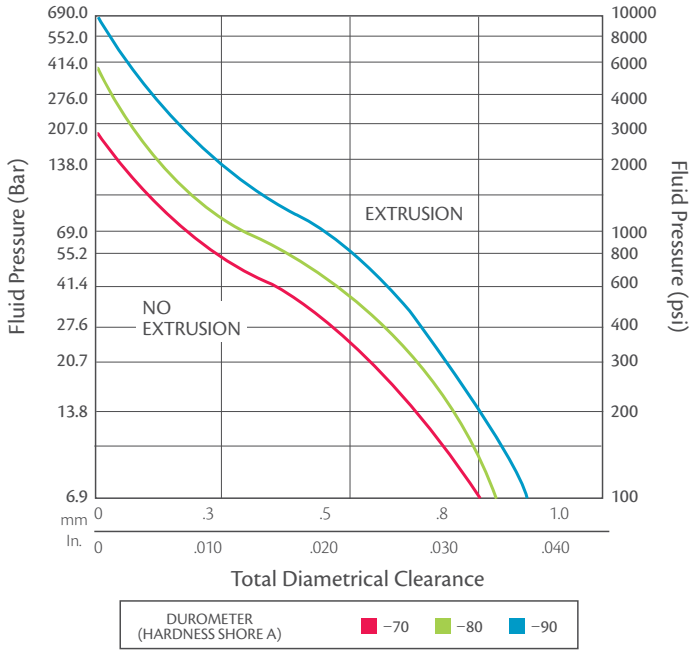
Diametrical Gap (B)

Maximum Possible Extrusion Gap

Limits for Extrusion

There are different methods to counter O-ring extrusion. One of these methods is to simply increase the durometer rating of the O-ring. However, as the durometer is increased, the O-ring can become less malleable. Another option would be to use anti-extrusion devices. These are thin rings made of hard plastic materials such as KasPex™ PEEK, PTFE, and nylon. Once in place these rings will provide essentially zero clearance.

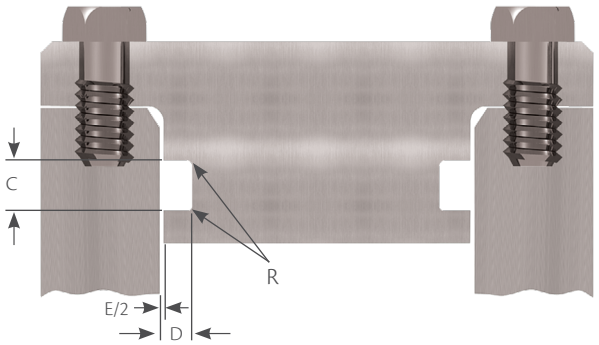
Reduce the clearance shown by 60% when using silicone or fluoro-silicone elastomers.



Machining Specifications

Groove Dimensions - ISO 3601

Static Radial Applications

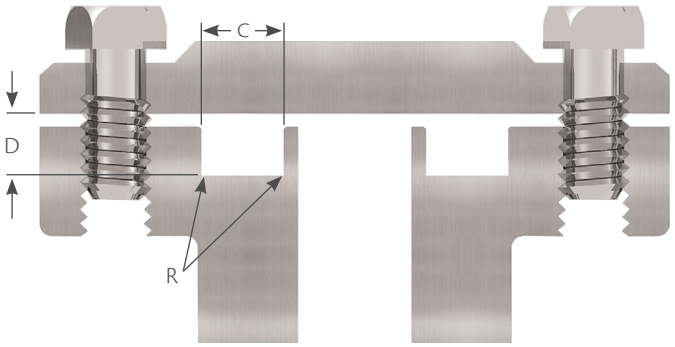


Information is based on ISO 3601
** Pneumatic applications typically do not use a Back-up ring.*

	D			E	C Groove Width +0.010/-0.000			R
		Squeeze						
O-Ring C/S	Groove Depth	Inches	%	Diametrical Clearance Max.	No Back-Up Ring	One Back-Up Ring	Two Back-Up Rings	Groove Radius
0.070	0.049 - 0.057	0.010 - 0.025	14 - 35	0.004	0.110	0.165	0.220	0.008 - 0.016
0.103	0.075 - 0.087	0.013 - 0.031	13 - 30	0.005	0.150	0.205	0.260	0.008 - 0.016
0.139	0.101 - 0.117	0.018 - 0.042	13 - 30	0.006	0.197	0.252	0.307	0.016 - 0.031
0.210	0.156 - 0.180	0.025 - 0.059	12 - 28	0.006	0.283	0.354	0.429	0.016 - 0.031
0.275	0.212 - 0.242	0.028 - 0.069	10 - 25	0.007	0.374	0.484	0.594	0.031 - 0.047

Static Axial (Face) Applications

Internal Pressure: O-ring OD = Gland OD
External Pressure: O-ring ID = Gland ID

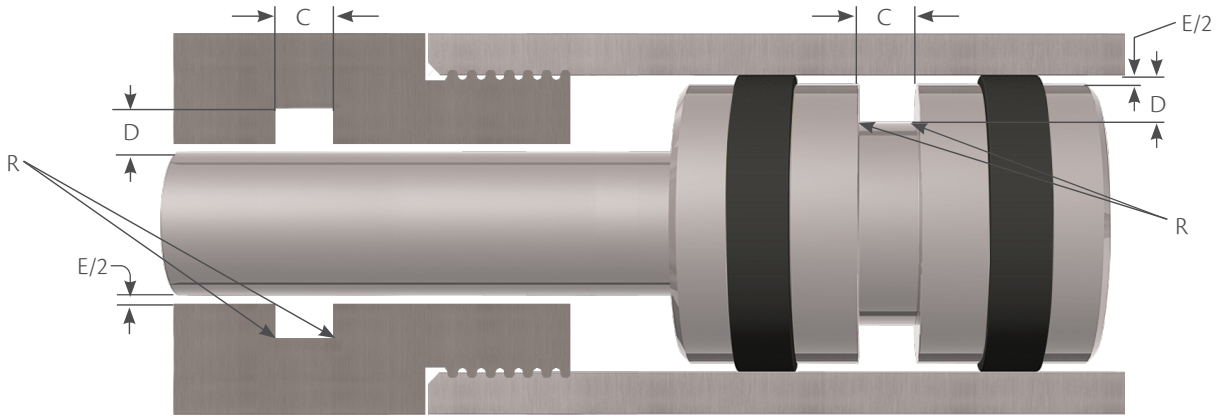


Information is based on ISO 3601

	D		C Groove Width +0.008/-0.000		R
	Groove Depth				
O-Ring C/S	+0.004/-0.000	Squeeze %	Hydraulic	Pneumatic	Groove Radius
0.070	0.051	21 - 36	0.126	0.114	0.008 - 0.016
0.103	0.079	19 - 30	0.157	0.142	0.008 - 0.016
0.139	0.106	17 - 26	0.209	0.189	0.016 - 0.031
0.210	0.165	15 - 23	0.299	0.276	0.016 - 0.031
0.275	0.224	13 - 20	0.354	0.335	0.031 - 0.047

Machining Specifications

Reciprocating Applications



Information is based on ISO 3601
** Pneumatic applications typically do not use a back-up ring.*

O-Ring C/S	D Groove depth		Squeeze Hydraulic		Squeeze Pneumatic		E	C Groove Width +0.010/-0.000			R
	Hydraulic	Pneumatic	Inches	%	Inches	%	Diametrical Clearance Max.	No Back- Up Ring	One Back- Up Ring	Two Back- Up Rings	Groove Radius
0.070	0.054 - 0.058	0.056 - 0.060	0.009 - 0.019	13 - 27	0.007 - 0.017	10 - 24	0.004	0.110	0.165	0.220	0.008 - 0.016
0.103	0.081 - 0.088	0.083 - 0.092	0.012 - 0.025	12 - 24	0.008 - 0.023	8 - 22	0.005	0.150	0.205	0.260	0.008 - 0.016
0.139	0.112 - 0.120	0.115 - 0.125	0.015 - 0.031	11 - 22	0.010 - 0.028	7 - 20	0.006	0.197	0.252	0.307	0.016 - 0.031
0.210	0.173 - 0.182	0.177 - 0.190	0.023 - 0.042	11 - 20	0.015 - 0.038	7 - 18	0.006	0.283	0.354	0.429	0.016 - 0.031
0.275	0.229 - 0.244	0.234 - 0.253	0.025 - 0.052	9 - 19	0.017 - 0.047	6 - 17	0.007	0.374	0.484	0.594	0.031 - 0.047

For piston applications groove width (w) values do not apply for 001-003 and 400-424 series O-rings.

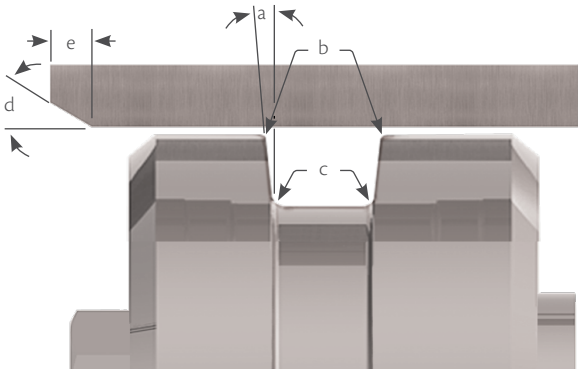
For rod applications groove width (w) values do not apply for 001-003, 028-050, 135-178, 232-284, 350-395, 400-424, and 430-475.

For rotary applications contact our engineering team at engineering@hitechseals.com

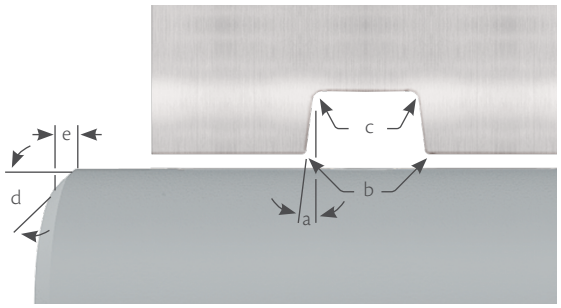
Machining Specifications

Groove Details

Piston & Rod Appliations



Piston Application



Rod Application

O-Ring Series	O-Ring C/S		Wall Angle	Break Edge	Radius c		Chamfer Length (e) d at 15°		Chamfer Length (e) d at 20°	
	Inch	mm	a	b	Inch	mm	Inch	mm	Inch	mm
000	0.070	1.78	0-5°	0.004 - 0.012 Inch 0.10 - 0.30 mm	0.008 - 0.016	0.20 - 0.40	0.043	1.10	0.035	0.90
100	0.103	2.62			0.008 - 0.016	0.20 - 0.40	0.059	1.50	0.043	1.10
200	0.139	3.53			0.016 - 0.031	0.40 - 0.80	0.071	1.80	0.055	1.40
300	0.210	5.33			0.016 - 0.031	0.40 - 0.80	0.106	2.70	0.083	2.10
400	0.275	6.99			0.031 - 0.047	0.80 - 1.20	0.142	3.60	0.110	2.80

Hardware Conditions

The metal hardware specifications of the O-ring gland and any mating part has a significant impact on the life and sealing perf-ormance of the O-ring. The following are general fluid sealing surface roughness values for glands using elastomeric O-Rings:

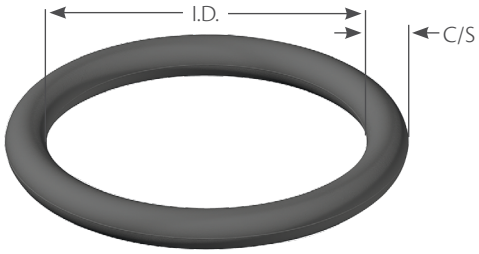
For a static mating surface: Ra 32 µinch maximum
For a dynamic mating surface: Ra 3-12 µinch

The recommended minimum shaft hardness is 50 HRC (Hard-ness Rockwell C).

For more detailed surface finish guidelines (gases, cryogenics, etc.), please contact our engineering team at engineering@hitechseals.com

Machining Specifications

O-Ring Tolerances



Information based on ISO 3601 Non-Standard Class A O-Rings.

C/S	Tolerance
0.80 < C/S ≤ 3.15	± 0.08
3.15 < C/S ≤ 4.50	± 0.10
4.50 < C/S ≤ 6.30	± 0.13
6.30 < C/S ≤ 8.40	± 0.15
*9.00 ≤ C/S ≤ 20.00	± 0.20

**Based on DIN 3771.*

Machining information and tolerances for various standards are available through Hi-Tech Seals.

Information provided in this catalogue is meant to aid with seal selection process. Contact us for assistance in designing an application.

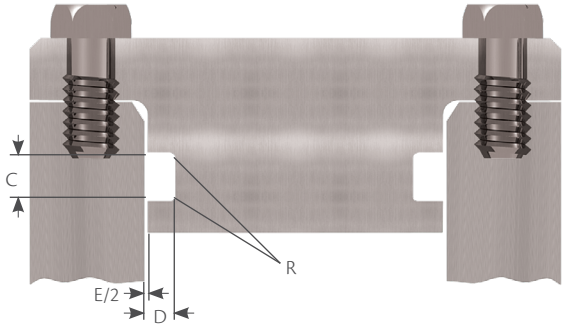
I.D. (mm)			Tolerance
0.68	to	1.53	± 0.10
1.54	to	11.69	± 0.13
11.70	to	13.46	± 0.15
13.47	to	17.53	± 0.18
17.54	to	20.57	± 0.20
20.58	to	23.88	± 0.23
23.89	to	28.70	± 0.25
28.71	to	35.56	± 0.30
35.57	to	43.18	± 0.36
43.19	to	50.80	± 0.41
50.81	to	58.42	± 0.46
58.43	to	66.55	± 0.51
66.56	to	74.93	± 0.56
74.94	to	83.57	± 0.61
83.58	to	92.20	± 0.66
92.21	to	101.60	± 0.71

I.D. (mm)			Tolerance
101.61	to	117.35	± 0.76
117.36	to	141.22	± 0.89
141.23	to	166.37	± 1.02
166.38	to	192.02	± 1.14
192.03	to	218.69	± 1.27
218.70	to	253.37	± 1.40
253.38	to	289.56	± 1.52
289.57	to	347.98	± 1.78
347.99	to	408.94	± 2.03
408.95	to	472.44	± 2.29
472.45	to	571.50	± 2.54
571.51	to	711.20	± 3.05
711.21	to	855.98	± 3.56
855.99	to	1005.84	± 4.06
1005.85	to	1163.32	± 4.57
1163.33	to	1320.80	± 5.08

Machining Specifications

Groove Dimensions - DIN 3771

Static Radial Applications



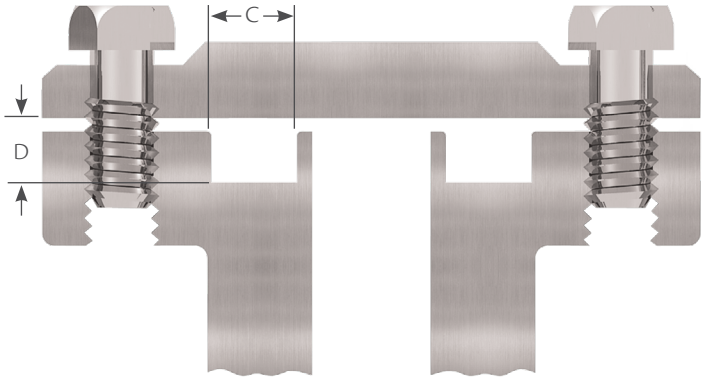
Information is based on DIN 3771.

O-ring C/S		D Gland Depth		E Diametrical Clearance	C Groove Width +0.13/-0.00	R Groove Radius	Max. Eccentricity
1.00	± 0.08	0.72	± 0.02	0.10	1.35	0.2	0.05
1.20	± 0.08	0.87	± 0.02	0.10	1.60	0.2	0.05
1.50	± 0.08	1.09	± 0.02	0.10	2.00	0.2	0.05
1.60	± 0.08	1.16	± 0.03	0.10	2.10	0.2	0.05
1.78 - 1.80	± 0.08	1.29	± 0.03	0.10	2.35	0.2	0.05
1.90	± 0.08	1.38	± 0.03	0.10	2.50	0.2	0.05
2.00	± 0.08	1.45	± 0.04	0.10	2.65	0.2	0.05
2.40	± 0.08	1.90	± 0.04	0.10	3.25	0.2	0.05
2.50	± 0.08	1.98	± 0.04	0.10	3.40	0.2	0.05
2.62	± 0.08	2.07	± 0.04	0.10	3.55	0.2	0.05
3.00	± 0.08	2.40	± 0.04	0.15	4.05	0.5	0.07
3.50 - 3.53	± 0.10	2.82	± 0.05	0.15	4.75	0.5	0.07
3.60	± 0.10	2.88	± 0.05	0.15	4.85	0.5	0.07
4.00	± 0.10	3.20	± 0.06	0.15	5.40	0.5	0.07
4.50	± 0.10	3.64	± 0.06	0.15	6.00	0.5	0.07
5.00	± 0.13	4.04	± 0.06	0.15	6.70	0.7	0.10
5.33- 5.34	± 0.13	4.31	± 0.08	0.15	7.15	0.7	0.10
5.50	± 0.13	4.45	± 0.08	0.15	7.35	0.7	0.10
5.70	± 0.13	4.61	± 0.08	0.15	7.65	0.7	0.10
6.00	± 0.13	4.91	± 0.08	0.18	8.15	0.7	0.13
6.99	± 0.15	5.72	± 0.10	0.18	9.50	0.7	0.13
7.00	± 0.15	5.73	± 0.10	0.18	9.55	0.7	0.13
7.50	± 0.15	6.14	± 0.10	0.18	10.20	1.0	0.13
8.00	± 0.18	6.55	± 0.10	0.18	10.90	1.0	0.13
8.40	± 0.18	6.87	± 0.15	0.18	11.45	1.0	0.13
9.00	± 0.2	7.65	± 0.15	0.18	11.85	1.0	0.13
10.0	± 0.2	8.50	± 0.15	0.18	13.20	1.0	0.13
11.0	± 0.2	9.35	± 0.15	0.18	14.50	1.0	0.13
12.0	± 0.2	10.20	± 0.15	0.18	15.85	1.5	0.13
13.0	± 0.2	11.05	± 0.15	0.18	17.15	1.5	0.13
14.0	± 0.2	11.90	± 0.3	0.18	18.45	1.5	0.13
16.0	± 0.2	13.60	± 0.3	0.18	21.10	1.5	0.13
18.0	± 0.2	15.30	± 0.3	0.18	23.75	1.5	0.13
20.0	± 0.2	17.00	± 0.3	0.18	26.40	1.5	0.13

Machining Specifications

Groove Dimensions

Static Axial (Face) Applications



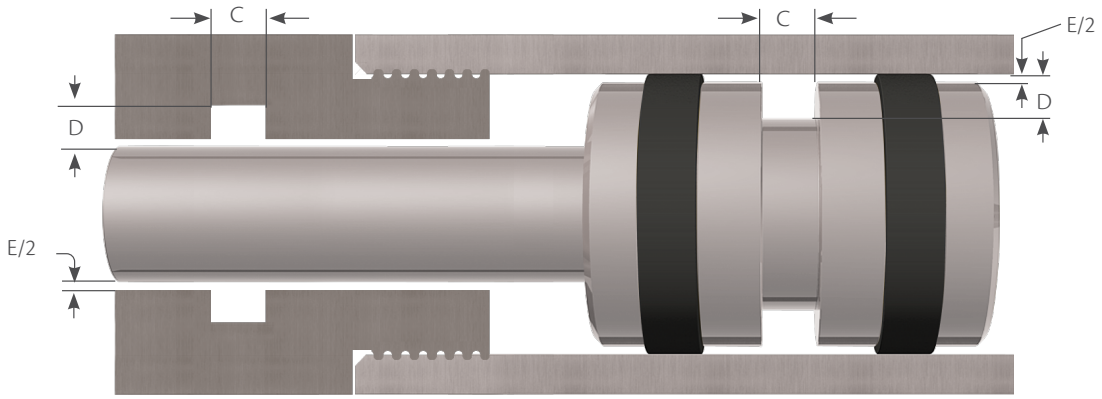
Information is based on DIN 3771.

O-Ring C/S		D Gland Depth		C Groove Width Hydraulic +0.13/-0.00	C Groove Width Pneumatic ± 0.13
1.00	± 0.08	0.75	± 0.02	1.45	1.20
1.20	± 0.08	0.90	± 0.02	1.75	1.45
1.50	± 0.08	1.13	± 0.02	2.20	1.80
1.60	± 0.08	1.20	± 0.03	2.35	1.90
1.78 - 1.80	± 0.08	1.34	± 0.03	2.60	2.15
1.90	± 0.08	1.43	± 0.03	2.75	2.30
2.00	± 0.08	1.51	± 0.04	2.90	2.40
2.40	± 0.08	1.82	± 0.04	3.20	2.80
2.50	± 0.08	1.90	± 0.04	3.30	2.90
2.62	± 0.08	1.99	± 0.04	3.50	3.05
3.00	± 0.08	2.27	± 0.04	3.90	3.45
3.50 - 3.53	± 0.10	2.67	± 0.05	4.60	4.05
3.60	± 0.10	2.72	± 0.05	4.70	4.10
4.00	± 0.10	3.03	± 0.06	5.25	4.60
4.50	± 0.10	3.60	± 0.06	6.10	5.10
5.00	± 0.13	4.00	± 0.06	6.80	5.70
5.33	± 0.13	4.26	± 0.08	7.25	6.05
5.50	± 0.13	4.40	± 0.08	7.45	6.25
5.70	± 0.13	4.56	± 0.08	7.75	6.50
6.00	± 0.13	4.98	± 0.08	8.00	6.75
6.99	± 0.15	5.80	± 0.10	9.05	7.85
7.00	± 0.15	5.81	± 0.10	9.05	7.90
7.50	± 0.15	6.23	± 0.10	9.70	8.40
8.00	± 0.15	6.64	± 0.10	10.35	9.00
8.40	± 0.15	6.97	± 0.15	10.90	9.45

Machining Specifications

Groove Dimensions

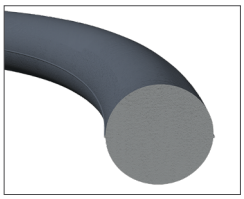
Reciprocating Applications



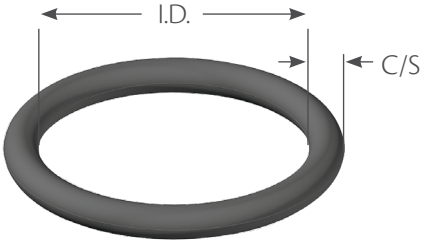
Information is based on DIN 3771.

O-Ring C/S		D Gland Depth		E Diametrical Clearance	C Groove Width +0.13/-0.00	Max. Eccentricity
1.00	± 0.08	0.80	± 0.02	0.10	1.35	0.05
1.20	± 0.08	0.96	± 0.02	0.10	1.60	0.05
1.50	± 0.08	1.20	± 0.02	0.10	2.00	0.05
1.60	± 0.08	1.28	± 0.03	0.10	2.10	0.05
1.78 - 1.80	± 0.08	1.42	± 0.03	0.10	2.40	0.05
1.90	± 0.08	1.52	± 0.03	0.10	2.50	0.05
2.00	± 0.08	1.60	± 0.04	0.10	2.65	0.05
2.40	± 0.08	2.06	± 0.04	0.10	3.25	0.05
2.50	± 0.08	2.15	± 0.04	0.10	3.40	0.05
2.62	± 0.08	2.25	± 0.04	0.10	3.55	0.05
3.00	± 0.08	2.61	± 0.04	0.15	4.05	0.07
3.50 - 3.53	± 0.10	3.07	± 0.05	0.15	4.75	0.07
3.60	± 0.10	3.13	± 0.05	0.15	4.85	0.07
4.00	± 0.10	3.48	± 0.05	0.15	5.40	0.07
4.50	± 0.10	3.99	± 0.05	0.15	6.00	0.07
5.00	± 0.13	4.44	± 0.05	0.15	6.70	0.10
5.33- 5.34	± 0.13	4.73	± 0.05	0.15	7.15	0.10
5.50	± 0.13	4.88	± 0.05	0.15	7.40	0.10
5.70	± 0.13	5.06	± 0.05	0.15	7.60	0.10
6.00	± 0.13	5.19	± 0.05	0.18	8.15	0.13
6.99	± 0.15	6.05	± 0.05	0.18	9.50	0.13
7.00	± 0.15	6.06	± 0.05	0.18	9.55	0.13
7.50	± 0.15	6.49	± 0.05	0.18	10.20	0.13
8.00	± 0.18	6.92	± 0.05	0.18	10.90	0.13
8.40	± 0.18	7.27	± 0.05	0.18	11.45	0.13
9.00	± 0.20	7.92	± 0.05	0.18	12.10	0.13
10.00	± 0.20	8.80	± 0.05	0.18	13.40	0.13

Imperial Size Chart



Square Cut Ring	Actual C/S
000 Series	0.066
100 Series	0.099
200 Series	0.134
300 Series	0.205
400 Series	0.266



	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D	C/S	I.D.		C/S		I.D.		C/S	
001	1/32	3/32	1/32	0.029	± 0.004	0.040	± 0.003	0.74	± 0.10	1.02	± 0.08
002	3/64	9/64	3/64	0.042	± 0.004	0.050	± 0.003	1.07	± 0.10	1.27	± 0.08
003	1/16	3/16	1/16	0.056	± 0.004	0.060	± 0.003	1.42	± 0.10	1.52	± 0.08
004	5/64	13/64	1/16	0.070	± 0.005	0.070	± 0.003	1.78	± 0.13	1.78	± 0.08
005	3/32	7/32	1/16	0.101	± 0.005	0.070	± 0.003	2.57	± 0.13	1.78	± 0.08
006	1/8	1/4	1/16	0.114	± 0.005	0.070	± 0.003	2.90	± 0.13	1.78	± 0.08
007	5/32	9/32	1/16	0.145	± 0.005	0.070	± 0.003	3.68	± 0.13	1.78	± 0.08
008	3/16	5/16	1/16	0.176	± 0.005	0.070	± 0.003	4.47	± 0.13	1.78	± 0.08
009	7/32	11/32	1/16	0.208	± 0.005	0.070	± 0.003	5.28	± 0.13	1.78	± 0.08
010	1/4	3/8	1/16	0.239	± 0.005	0.070	± 0.003	6.07	± 0.13	1.78	± 0.08
011	5/16	7/16	1/16	0.301	± 0.005	0.070	± 0.003	7.65	± 0.13	1.78	± 0.08
012	3/8	1/2	1/16	0.364	± 0.005	0.070	± 0.003	9.25	± 0.13	1.78	± 0.08
013	7/16	9/16	1/16	0.426	± 0.005	0.070	± 0.003	10.82	± 0.13	1.78	± 0.08
014	1/2	5/8	1/16	0.489	± 0.005	0.070	± 0.003	12.42	± 0.13	1.78	± 0.08
015	9/16	11/16	1/16	0.551	± 0.007	0.070	± 0.003	14.00	± 0.18	1.78	± 0.08
016	5/8	3/4	1/16	0.614	± 0.009	0.070	± 0.003	15.60	± 0.23	1.78	± 0.08
017	11/16	13/16	1/16	0.676	± 0.009	0.070	± 0.003	17.17	± 0.23	1.78	± 0.08
018	3/4	7/8	1/16	0.739	± 0.009	0.070	± 0.003	18.77	± 0.23	1.78	± 0.08
019	13/16	15/16	1/16	0.801	± 0.009	0.070	± 0.003	20.35	± 0.23	1.78	± 0.08
020	7/8	1	1/16	0.864	± 0.009	0.070	± 0.003	21.95	± 0.23	1.78	± 0.08
021	15/16	1 - 1/16	1/16	0.926	± 0.009	0.070	± 0.003	23.52	± 0.23	1.78	± 0.08
022	1	1 - 1/8	1/16	0.989	± 0.010	0.070	± 0.003	25.12	± 0.25	1.78	± 0.08
023	1 - 1/16	1 - 3/16	1/16	1.051	± 0.010	0.070	± 0.003	26.70	± 0.25	1.78	± 0.08
024	1 - 1/8	1 - 1/4	1/16	1.114	± 0.010	0.070	± 0.003	28.30	± 0.25	1.78	± 0.08
025	1 - 3/16	1 - 5/16	1/16	1.176	± 0.011	0.070	± 0.003	29.87	± 0.28	1.78	± 0.08
026	1 - 1/4	1 - 3/8	1/16	1.239	± 0.011	0.070	± 0.003	31.47	± 0.28	1.78	± 0.08
027	1 - 5/16	1 - 7/16	1/16	1.301	± 0.011	0.070	± 0.003	33.05	± 0.28	1.78	± 0.08
028	1 - 3/8	1 - 1/2	1/16	1.364	± 0.013	0.070	± 0.003	34.65	± 0.33	1.78	± 0.08
029	1 - 1/2	1 - 5/8	1/16	1.489	± 0.013	0.070	± 0.003	37.62	± 0.33	1.78	± 0.08
030	1 - 5/8	1 - 3/4	1/16	1.614	± 0.013	0.070	± 0.003	41.00	± 0.33	1.78	± 0.08
031	1 - 3/4	1 - 7/8	1/16	1.739	± 0.015	0.070	± 0.003	44.17	± 0.38	1.78	± 0.08
032	1 - 7/8	2	1/16	1.864	± 0.015	0.070	± 0.003	47.35	± 0.38	1.78	± 0.08
033	2	2 - 1/8	1/16	1.989	± 0.018	0.070	± 0.003	50.25	± 0.46	1.78	± 0.08
034	2 - 1/8	2 - 1/4	1/16	2.114	± 0.018	0.070	± 0.003	53.70	± 0.46	1.78	± 0.08
035	2 - 1/4	2 - 3/8	1/16	2.239	± 0.018	0.070	± 0.003	56.87	± 0.46	1.78	± 0.08
036	2 - 3/8	2 - 1/2	1/16	2.364	± 0.018	0.070	± 0.003	60.05	± 0.46	1.78	± 0.08
037	2 - 1/2	2 - 5/8	1/16	2.489	± 0.018	0.070	± 0.003	63.22	± 0.46	1.78	± 0.08
038	2 - 5/8	2 - 3/4	1/16	2.614	± 0.020	0.070	± 0.003	66.40	± 0.51	1.78	± 0.08
039	2 - 3/4	2 - 7/8	1/16	2.739	± 0.020	0.070	± 0.003	69.57	± 0.51	1.78	± 0.08
040	2 - 7/8	3	1/16	2.864	± 0.020	0.070	± 0.003	72.75	± 0.51	1.78	± 0.08
041	3	3 - 1/8	1/16	2.989	± 0.024	0.070	± 0.003	75.92	± 0.61	1.78	± 0.08

Imperial Size Chart

	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
042	3 - 1/4	3 - 3/8	1/16	3.239	± 0.024	0.070	± 0.003	82.27	± 0.61	1.78	± 0.08
043	3 - 1/2	3 - 5/8	1/16	3.489	± 0.024	0.070	± 0.003	88.62	± 0.61	1.78	± 0.08
044	3 - 3/4	3 - 7/8	1/16	3.739	± 0.027	0.070	± 0.003	94.97	± 0.69	1.78	± 0.08
045	4	4 - 1/8	1/16	3.989	± 0.027	0.070	± 0.003	101.32	± 0.69	1.78	± 0.08
046	4 - 1/4	4 - 3/8	1/16	4.239	± 0.030	0.070	± 0.003	107.67	± 0.76	1.78	± 0.08
047	4 - 1/2	4 - 5/8	1/16	4.489	± 0.030	0.070	± 0.003	114.02	± 0.76	1.78	± 0.08
048	4 - 3/4	4 - 7/8	1/16	4.739	± 0.030	0.070	± 0.003	120.37	± 0.76	1.78	± 0.08
049	5	5 - 1/8	1/16	4.989	± 0.037	0.070	± 0.003	126.72	± 0.94	1.78	± 0.08
050	5 - 1/4	5 - 3/8	1/16	5.239	± 0.037	0.070	± 0.003	133.07	± 0.94	1.78	± 0.08
102	1/16	1/4	3/32	0.049	± 0.005	0.103	± 0.003	1.24	± 0.13	2.62	± 0.08
103	3/32	9/32	3/32	0.081	± 0.005	0.103	± 0.003	2.06	± 0.13	2.62	± 0.08
104	1/8	5/16	3/32	0.112	± 0.005	0.103	± 0.003	2.84	± 0.13	2.62	± 0.08
105	5/32	11/32	3/32	0.143	± 0.005	0.103	± 0.003	3.63	± 0.13	2.62	± 0.08
106	3/16	3/8	3/32	0.174	± 0.005	0.103	± 0.003	4.42	± 0.13	2.62	± 0.08
107	7/32	13/32	3/32	0.206	± 0.005	0.103	± 0.003	5.23	± 0.13	2.62	± 0.08
108	1/4	7/16	3/32	0.237	± 0.005	0.103	± 0.003	6.02	± 0.13	2.62	± 0.08
109	5/16	1/2	3/32	0.299	± 0.005	0.103	± 0.003	7.59	± 0.13	2.62	± 0.08
110	3/8	9/16	3/32	0.362	± 0.005	0.103	± 0.003	9.19	± 0.13	2.62	± 0.08
111	7/16	5/8	3/32	0.424	± 0.005	0.103	± 0.003	10.77	± 0.13	2.62	± 0.08
112	1/2	11/16	3/32	0.487	± 0.005	0.103	± 0.003	12.37	± 0.13	2.62	± 0.08
113	9/16	3/4	3/32	0.549	± 0.007	0.103	± 0.003	13.94	± 0.18	2.62	± 0.08
114	5/8	13/16	3/32	0.612	± 0.009	0.103	± 0.003	15.54	± 0.23	2.62	± 0.08
115	11/16	7/8	3/32	0.674	± 0.009	0.103	± 0.003	17.12	± 0.23	2.62	± 0.08
116	3/4	15/16	3/32	0.737	± 0.009	0.103	± 0.003	18.72	± 0.23	2.62	± 0.08
117	13/16	1	3/32	0.799	± 0.010	0.103	± 0.003	20.29	± 0.25	2.62	± 0.08
118	7/8	1 - 1/16	3/32	0.862	± 0.010	0.103	± 0.003	21.89	± 0.25	2.62	± 0.08
119	15/16	1 - 1/8	3/32	0.924	± 0.010	0.103	± 0.003	23.47	± 0.25	2.62	± 0.08
120	1	1 - 3/16	3/32	0.987	± 0.010	0.103	± 0.003	25.07	± 0.25	2.62	± 0.08
121	1 - 1/16	1 - 1/4	3/32	1.049	± 0.010	0.103	± 0.003	26.64	± 0.25	2.62	± 0.08
122	1 - 1/8	1 - 5/16	3/32	1.112	± 0.010	0.103	± 0.003	28.24	± 0.25	2.62	± 0.08
123	1 - 3/16	1 - 3/8	3/32	1.174	± 0.012	0.103	± 0.003	29.82	± 0.30	2.62	± 0.08
124	1 - 1/4	1 - 7/16	3/32	1.237	± 0.012	0.103	± 0.003	31.42	± 0.30	2.62	± 0.08
125	1 - 5/16	1 - 1/2	3/32	1.299	± 0.012	0.103	± 0.003	32.99	± 0.30	2.62	± 0.08
126	1 - 3/8	1 - 9/16	3/32	1.362	± 0.012	0.103	± 0.003	34.59	± 0.30	2.62	± 0.08
127	1 - 7/16	1 - 5/8	3/32	1.424	± 0.012	0.103	± 0.003	36.17	± 0.30	2.62	± 0.08
128	1 - 1/2	1 - 11/16	3/32	1.487	± 0.012	0.103	± 0.003	37.77	± 0.30	2.62	± 0.08
129	1 - 9/16	1 - 3/4	3/32	1.549	± 0.015	0.103	± 0.003	39.34	± 0.38	2.62	± 0.08
130	1 - 5/8	1 - 13/16	3/32	1.612	± 0.015	0.103	± 0.003	40.94	± 0.38	2.62	± 0.08
131	1 - 11/16	1 - 7/8	3/32	1.674	± 0.015	0.103	± 0.003	42.52	± 0.38	2.62	± 0.08
132	1 - 3/4	1 - 15/16	3/32	1.737	± 0.015	0.103	± 0.003	44.12	± 0.38	2.62	± 0.08
133	1 - 13/16	2	3/32	1.799	± 0.015	0.103	± 0.003	45.69	± 0.38	2.62	± 0.08
134	1 - 7/8	2 - 1/16	3/32	1.862	± 0.015	0.103	± 0.003	47.29	± 0.38	2.62	± 0.08
135	1 - 15/16	2 - 1/8	3/32	1.925	± 0.017	0.103	± 0.003	48.90	± 0.43	2.62	± 0.08
136	2	2 - 3/16	3/32	1.987	± 0.017	0.103	± 0.003	50.47	± 0.43	2.62	± 0.08

Imperial Size Chart

	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
137	2 - 1/16	2 - 1/4	3/32	2.050	± 0.017	0.103	± 0.003	52.07	± 0.43	2.62	± 0.08
138	2 - 1/8	2 - 5/16	3/32	2.112	± 0.017	0.103	± 0.003	53.64	± 0.43	2.62	± 0.08
139	2 - 3/16	2 - 3/8	3/32	2.175	± 0.017	0.103	± 0.003	55.25	± 0.43	2.62	± 0.08
140	2 - 1/4	2 - 7/16	3/32	2.237	± 0.017	0.103	± 0.003	56.82	± 0.43	2.62	± 0.08
141	2 - 5/16	2 - 1/2	3/32	2.300	± 0.020	0.103	± 0.003	58.42	± 0.51	2.62	± 0.08
142	2 - 3/8	2 - 9/16	3/32	2.362	± 0.020	0.103	± 0.003	59.99	± 0.51	2.62	± 0.08
143	2 - 7/16	2 - 5/8	3/32	2.425	± 0.020	0.103	± 0.003	61.60	± 0.51	2.62	± 0.08
144	2 - 1/2	2 - 11/16	3/32	2.487	± 0.020	0.103	± 0.003	63.17	± 0.51	2.62	± 0.08
145	2 - 9/16	2 - 3/4	3/32	2.550	± 0.020	0.103	± 0.003	64.77	± 0.51	2.62	± 0.08
146	2 - 5/8	2 - 13/16	3/32	2.612	± 0.020	0.103	± 0.003	66.34	± 0.51	2.62	± 0.08
147	2 - 11/16	2 - 7/8	3/32	2.675	± 0.022	0.103	± 0.003	67.95	± 0.56	2.62	± 0.08
148	2 - 3/4	2 - 15/16	3/32	2.737	± 0.022	0.103	± 0.003	69.52	± 0.56	2.62	± 0.08
149	2 - 13/16	3	3/32	2.800	± 0.022	0.103	± 0.003	71.12	± 0.56	2.62	± 0.08
150	2 - 7/8	3 - 1/16	3/32	2.862	± 0.022	0.103	± 0.003	72.69	± 0.56	2.62	± 0.08
151	3	3 - 3/16	3/32	2.987	± 0.024	0.103	± 0.003	75.87	± 0.61	2.62	± 0.08
152	3 - 1/4	3 - 7/16	3/32	3.237	± 0.024	0.103	± 0.003	82.22	± 0.61	2.62	± 0.08
153	3 - 1/2	3 - 11/16	3/32	3.487	± 0.024	0.103	± 0.003	88.57	± 0.61	2.62	± 0.08
154	3 - 3/4	2 - 15/16	3/32	3.737	± 0.028	0.103	± 0.003	94.92	± 0.71	2.62	± 0.08
155	4	4 - 3/16	3/32	3.987	± 0.028	0.103	± 0.003	101.27	± 0.71	2.62	± 0.08
156	4 - 1/4	4 - 7/16	3/32	4.237	± 0.030	0.103	± 0.003	107.62	± 0.76	2.62	± 0.08
157	4 - 1/2	4 -11/16	3/32	4.487	± 0.030	0.103	± 0.003	113.97	± 0.76	2.62	± 0.08
158	4 - 3/4	4 - 15/16	3/32	4.737	± 0.030	0.103	± 0.003	120.32	± 0.76	2.62	± 0.08
159	5	5 - 3/16	3/32	4.987	± 0.035	0.103	± 0.003	126.67	± 0.89	2.62	± 0.08
160	5 - 1/4	5 - 7/16	3/32	5.237	± 0.035	0.103	± 0.003	133.02	± 0.89	2.62	± 0.08
161	5 - 1/2	5 - 11/16	3/32	5.487	± 0.035	0.103	± 0.003	139.37	± 0.89	2.62	± 0.08
162	5 - 3/4	5 - 15/16	3/32	5.737	± 0.035	0.103	± 0.003	145.72	± 0.89	2.62	± 0.08
163	6	6 - 3/16	3/32	5.987	± 0.035	0.103	± 0.003	152.07	± 0.89	2.62	± 0.08
164	6 - 1/4	6 - 7/16	3/32	6.237	± 0.040	0.103	± 0.003	158.42	± 1.02	2.62	± 0.08
165	6 - 1/2	6 - 11/16	3/32	6.487	± 0.040	0.103	± 0.003	164.77	± 1.02	2.62	± 0.08
166	6 - 3/4	6 - 15/16	3/32	6.737	± 0.040	0.103	± 0.003	171.12	± 1.02	2.62	± 0.08
167	7	7 - 3/16	3/32	6.987	± 0.040	0.103	± 0.003	177.47	± 1.02	2.62	± 0.08
168	7 - 1/4	7 - 7/16	3/32	7.237	± 0.045	0.103	± 0.003	183.82	± 1.14	2.62	± 0.08
169	7 - 1/2	7 - 11/16	3/32	7.487	± 0.045	0.103	± 0.003	190.17	± 1.14	2.62	± 0.08
170	7 - 3/4	7 - 15/16	3/32	7.737	± 0.045	0.103	± 0.003	196.52	± 1.14	2.62	± 0.08
171	8	8 - 3/16	3/32	7.987	± 0.045	0.103	± 0.003	202.87	± 1.14	2.62	± 0.08
172	8 - 1/4	8 - 7/16	3/32	8.237	± 0.050	0.103	± 0.003	209.22	± 1.27	2.62	± 0.08
173	8 - 1/2	8 - 11/16	3/32	8.487	± 0.050	0.103	± 0.003	215.57	± 1.27	2.62	± 0.08
174	8 - 3/4	8 - 15/16	3/32	8.737	± 0.050	0.103	± 0.003	221.92	± 1.27	2.62	± 0.08
175	9	9 - 3/16	3/32	8.987	± 0.050	0.103	± 0.003	228.27	± 1.27	2.62	± 0.08
176	9 - 1/4	9 - 7/16	3/32	9.237	± 0.055	0.103	± 0.003	234.62	± 1.40	2.62	± 0.08
177	9 - 1/2	9 - 11/16	3/32	9.487	± 0.055	0.103	± 0.003	240.97	± 1.40	2.62	± 0.08
178	9 - 3/4	9 - 15/16	3/32	9.737	± 0.055	0.103	± 0.003	247.32	± 1.40	2.62	± 0.08
201	3/16	7/16	1/8	0.171	± 0.005	0.139	± 0.004	4.34	± 0.13	3.53	± 0.10
202	1/4	1/2	1/8	0.234	± 0.005	0.139	± 0.004	5.94	± 0.13	3.53	± 0.10
203	5/16	9/16	1/8	0.296	± 0.005	0.139	± 0.004	7.52	± 0.13	3.53	± 0.10
204	3/8	5/8	1/8	0.359	± 0.005	0.139	± 0.004	9.12	± 0.13	3.53	± 0.10
205	7/16	11/16	1/8	0.421	± 0.005	0.139	± 0.004	10.69	± 0.13	3.53	± 0.10
206	1/2	3/4	1/8	0.484	± 0.005	0.139	± 0.004	12.29	± 0.13	3.53	± 0.10
207	9/16	13/16	1/8	0.546	± 0.007	0.139	± 0.004	13.87	± 0.18	3.53	± 0.10

Imperial Size Chart

	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
208	5/8	7/8	1/8	0.609	± 0.009	0.139	± 0.004	15.47	± 0.23	3.53	± 0.10
209	11/16	15/16	1/8	0.671	± 0.009	0.139	± 0.004	17.04	± 0.23	3.53	± 0.10
210	3/4	1	1/8	0.734	± 0.010	0.139	± 0.004	18.64	± 0.25	3.53	± 0.10
211	13/16	1 - 1/16	1/8	0.796	± 0.010	0.139	± 0.004	20.22	± 0.25	3.53	± 0.10
212	7/8	1 - 1/8	1/8	0.859	± 0.010	0.139	± 0.004	21.82	± 0.25	3.53	± 0.10
213	15/16	1 - 3/16	1/8	0.921	± 0.010	0.139	± 0.004	23.39	± 0.25	3.53	± 0.10
214	1	1 - 1/4	1/8	0.984	± 0.010	0.139	± 0.004	24.99	± 0.25	3.53	± 0.10
215	1 - 1/16	1 - 5/16	1/8	1.046	± 0.010	0.139	± 0.004	26.57	± 0.25	3.53	± 0.10
216	1 - 1/8	1 - 3/8	1/8	1.109	± 0.012	0.139	± 0.004	28.17	± 0.30	3.53	± 0.10
217	1 - 3/16	1 - 7/16	1/8	1.171	± 0.012	0.139	± 0.004	29.74	± 0.30	3.53	± 0.10
218	1 - 1/4	1 - 1/2	1/8	1.234	± 0.012	0.139	± 0.004	31.34	± 0.30	3.53	± 0.10
219	1 - 5/16	1 - 9/16	1/8	1.296	± 0.012	0.139	± 0.004	32.92	± 0.30	3.53	± 0.10
220	1 - 3/8	1 - 5/8	1/8	1.359	± 0.012	0.139	± 0.004	34.52	± 0.30	3.53	± 0.10
221	1 - 7/16	1 - 11/16	1/8	1.421	± 0.012	0.139	± 0.004	36.09	± 0.30	3.53	± 0.10
222	1 - 1/2	1 - 3/4	1/8	1.484	± 0.015	0.139	± 0.004	37.69	± 0.38	3.53	± 0.10
223	1 - 5/8	1 - 7/8	1/8	1.609	± 0.015	0.139	± 0.004	40.87	± 0.38	3.53	± 0.10
224	1 - 3/4	2	1/8	1.734	± 0.015	0.139	± 0.004	44.04	± 0.38	3.53	± 0.10
225	1 - 7/8	2 - 1/8	1/8	1.859	± 0.018	0.139	± 0.004	47.22	± 0.46	3.53	± 0.10
226	2	2 - 1/4	1/8	1.984	± 0.018	0.139	± 0.004	50.39	± 0.46	3.53	± 0.10
227	2 - 1/8	2 - 3/8	1/8	2.109	± 0.018	0.139	± 0.004	53.57	± 0.46	3.53	± 0.10
228	2 - 1/4	2 - 1/2	1/8	2.234	± 0.020	0.139	± 0.004	56.74	± 0.51	3.53	± 0.10
229	2 - 3/8	2 - 5/8	1/8	2.359	± 0.020	0.139	± 0.004	59.92	± 0.51	3.53	± 0.10
230	2 - 1/2	2 - 3/4	1/8	2.484	± 0.020	0.139	± 0.004	63.09	± 0.51	3.53	± 0.10
231	2 - 5/8	2 - 7/8	1/8	2.609	± 0.020	0.139	± 0.004	66.27	± 0.51	3.53	± 0.10
232	2 - 3/4	3	1/8	2.734	± 0.024	0.139	± 0.004	69.44	± 0.61	3.53	± 0.10
233	2 - 7/8	3 - 1/8	1/8	2.859	± 0.024	0.139	± 0.004	72.62	± 0.61	3.53	± 0.10
234	3	3 - 1/4	1/8	2.984	± 0.024	0.139	± 0.004	75.79	± 0.61	3.53	± 0.10
235	3 - 1/8	3 - 3/8	1/8	3.109	± 0.024	0.139	± 0.004	78.97	± 0.61	3.53	± 0.10
236	3 - 1/4	3 - 1/2	1/8	3.234	± 0.024	0.139	± 0.004	82.14	± 0.61	3.53	± 0.10
237	3 - 3/8	3 - 5/8	1/8	3.359	± 0.024	0.139	± 0.004	85.32	± 0.61	3.53	± 0.10
238	3 - 1/2	3 - 3/4	1/8	3.484	± 0.024	0.139	± 0.004	88.49	± 0.61	3.53	± 0.10
239	3 - 5/8	3 - 7/8	1/8	3.609	± 0.028	0.139	± 0.004	91.67	± 0.71	3.53	± 0.10
240	3 - 3/4	4	1/8	3.734	± 0.028	0.139	± 0.004	94.84	± 0.71	3.53	± 0.10
241	3 - 7/8	4 - 1/8	1/8	3.859	± 0.028	0.139	± 0.004	98.02	± 0.71	3.53	± 0.10
242	4	4 - 1/4	1/8	3.984	± 0.028	0.139	± 0.004	101.19	± 0.71	3.53	± 0.10
243	4 - 1/8	4 - 3/8	1/8	4.109	± 0.028	0.139	± 0.004	104.37	± 0.71	3.53	± 0.10
244	4 - 1/4	4 - 1/2	1/8	4.234	± 0.030	0.139	± 0.004	107.54	± 0.76	3.53	± 0.10
245	4 - 3/8	4 - 5/8	1/8	4.359	± 0.030	0.139	± 0.004	110.72	± 0.76	3.53	± 0.10
246	4 - 1/2	4 - 3/4	1/8	4.484	± 0.030	0.139	± 0.004	113.89	± 0.76	3.53	± 0.10
247	4 - 5/8	4 - 7/8	1/8	4.609	± 0.030	0.139	± 0.004	117.07	± 0.76	3.53	± 0.10
248	4 - 3/4	5	1/8	4.734	± 0.030	0.139	± 0.004	120.24	± 0.76	3.53	± 0.10
249	4 - 7/8	5 - 1/8	1/8	4.859	± 0.035	0.139	± 0.004	123.42	± 0.89	3.53	± 0.10
250	5	5 - 1/4	1/8	4.984	± 0.035	0.139	± 0.004	126.59	± 0.89	3.53	± 0.10
251	5 - 1/8	5 - 3/8	1/8	5.109	± 0.035	0.139	± 0.004	129.77	± 0.89	3.53	± 0.10
252	5 - 1/4	5 - 1/2	1/8	5.234	± 0.035	0.139	± 0.004	132.94	± 0.89	3.53	± 0.10
253	5 - 3/8	5 - 5/8	1/8	5.359	± 0.035	0.139	± 0.004	136.12	± 0.89	3.53	± 0.10
254	5 - 1/2	5 - 3/4	1/8	5.484	± 0.035	0.139	± 0.004	139.29	± 0.89	3.53	± 0.10
255	5 - 5/8	5 - 7/8	1/8	5.609	± 0.035	0.139	± 0.004	142.47	± 0.89	3.53	± 0.10
256	5 - 3/4	6	1/8	5.734	± 0.035	0.139	± 0.004	145.64	± 0.89	3.53	± 0.10
257	5 - 7/8	6 - 1/8	1/8	5.859	± 0.035	0.139	± 0.004	148.82	± 0.89	3.53	± 0.10

Imperial Size Chart

Dash #	Nominal I.D.	Nominal O.D.	Nominal C/S	Imperial Actual I.D.		Imperial Actual C/S		Metric Actual I.D.		Metric Actual C/S	
258	6	6 - 1/4	1/8	5.984	± 0.035	0.139	± 0.004	151.99	± 0.89	3.53	± 0.10
259	6 - 1/4	6 - 1/2	1/8	6.234	± 0.040	0.139	± 0.004	158.34	± 1.02	3.53	± 0.10
260	6 - 1/2	6 - 3/4	1/8	6.484	± 0.040	0.139	± 0.004	164.69	± 1.02	3.53	± 0.10
261	6 - 3/4	7	1/8	6.734	± 0.040	0.139	± 0.004	171.04	± 1.02	3.53	± 0.10
262	7	7 - 1/4	1/8	6.984	± 0.040	0.139	± 0.004	177.39	± 1.02	3.53	± 0.10
263	7 - 1/4	7 - 1/2	1/8	7.234	± 0.045	0.139	± 0.004	183.74	± 1.14	3.53	± 0.10
264	7 - 1/2	7 - 3/4	1/8	7.484	± 0.045	0.139	± 0.004	190.09	± 1.14	3.53	± 0.10
265	7 - 3/4	8	1/8	7.734	± 0.045	0.139	± 0.004	196.44	± 1.14	3.53	± 0.10
266	8	8 - 1/4	1/8	7.984	± 0.045	0.139	± 0.004	202.79	± 1.14	3.53	± 0.10
267	8 - 1/4	8 - 1/2	1/8	8.234	± 0.050	0.139	± 0.004	209.14	± 1.27	3.53	± 0.10
268	8 - 1/2	8 - 3/4	1/8	8.484	± 0.050	0.139	± 0.004	215.49	± 1.27	3.53	± 0.10
269	8 - 3/4	9	1/8	8.734	± 0.050	0.139	± 0.004	221.84	± 1.27	3.53	± 0.10
270	9	9 - 1/4	1/8	8.984	± 0.050	0.139	± 0.004	228.19	± 1.27	3.53	± 0.10
271	9 - 1/4	9 - 1/2	1/8	9.234	± 0.055	0.139	± 0.004	234.54	± 1.40	3.53	± 0.10
272	9 - 1/2	9 - 3/4	1/8	9.484	± 0.055	0.139	± 0.004	240.89	± 1.40	3.53	± 0.10
273	9 - 3/4	10	1/8	9.734	± 0.055	0.139	± 0.004	247.24	± 1.40	3.53	± 0.10
274	10	10 - 1/4	1/8	9.984	± 0.055	0.139	± 0.004	253.59	± 1.40	3.53	± 0.10
275	10 - 1/2	10 - 3/4	1/8	10.484	± 0.055	0.139	± 0.004	266.29	± 1.40	3.53	± 0.10
276	11	11 - 1/4	1/8	10.984	± 0.065	0.139	± 0.004	278.99	± 1.65	3.53	± 0.10
277	11 - 1/2	11 - 3/4	1/8	11.484	± 0.065	0.139	± 0.004	291.69	± 1.65	3.53	± 0.10
278	12	12 - 1/4	1/8	11.984	± 0.065	0.139	± 0.004	304.39	± 1.65	3.53	± 0.10
279	13	13 - 1/4	1/8	12.984	± 0.065	0.139	± 0.004	329.79	± 1.65	3.53	± 0.10
280	14	14 - 1/4	1/8	13.984	± 0.065	0.139	± 0.004	355.19	± 1.65	3.53	± 0.10
281	15	15 - 1/4	1/8	14.984	± 0.065	0.139	± 0.004	380.59	± 1.65	3.53	± 0.10
282	16	16 - 1/4	1/8	15.955	± 0.075	0.139	± 0.004	405.26	± 1.91	3.53	± 0.10
283	17	17 - 1/4	1/8	16.956	± 0.080	0.139	± 0.004	430.68	± 2.03	3.53	± 0.10
284	18	18 - 1/4	1/8	17.955	± 0.085	0.139	± 0.004	456.06	± 2.16	3.53	± 0.10
309	7/16	13/16	3/16	0.412	± 0.005	0.210	± 0.005	10.46	± 0.13	5.33	± 0.13
310	1/2	7/8	3/16	0.475	± 0.005	0.210	± 0.005	12.07	± 0.13	5.33	± 0.13
311	9/16	15/16	3/16	0.537	± 0.007	0.210	± 0.005	13.64	± 0.18	5.33	± 0.13
312	5/8	1	3/16	0.600	± 0.009	0.210	± 0.005	15.24	± 0.23	5.33	± 0.13
313	11/16	1 - 1/16	3/16	0.662	± 0.009	0.210	± 0.005	16.81	± 0.23	5.33	± 0.13
314	3/4	1 - 1/8	3/16	0.725	± 0.010	0.210	± 0.005	18.42	± 0.25	5.33	± 0.13
315	13/16	1 - 3/16	3/16	0.787	± 0.010	0.210	± 0.005	19.99	± 0.25	5.33	± 0.13
316	7/8	1 - 1/4	3/16	0.850	± 0.010	0.210	± 0.005	21.59	± 0.25	5.33	± 0.13
317	15/16	1 - 5/16	3/16	0.912	± 0.010	0.210	± 0.005	23.16	± 0.25	5.33	± 0.13
318	1	1 - 3/8	3/16	0.975	± 0.010	0.210	± 0.005	24.77	± 0.25	5.33	± 0.13
319	1 - 1/16	1 - 7/16	3/16	1.037	± 0.010	0.210	± 0.005	26.34	± 0.25	5.33	± 0.13
320	1 - 1/8	1 - 1/2	3/16	1.100	± 0.012	0.210	± 0.005	27.94	± 0.30	5.33	± 0.13
321	1 - 3/16	1 - 9/16	3/16	1.162	± 0.012	0.210	± 0.005	29.51	± 0.30	5.33	± 0.13
322	1 - 1/4	1 - 5/8	3/16	1.225	± 0.012	0.210	± 0.005	31.12	± 0.30	5.33	± 0.13
323	1 - 5/16	1 - 11/16	3/16	1.287	± 0.012	0.210	± 0.005	32.69	± 0.30	5.33	± 0.13
324	1 - 3/8	1 - 3/4	3/16	1.350	± 0.012	0.210	± 0.005	34.29	± 0.38	5.33	± 0.13
325	1 - 1/2	1 - 7/8	3/16	1.475	± 0.015	0.210	± 0.005	37.47	± 0.38	5.33	± 0.13
326	1 - 5/8	2	3/16	1.600	± 0.015	0.210	± 0.005	40.64	± 0.38	5.33	± 0.13
327	1 - 3/4	2 - 1/8	3/16	1.725	± 0.015	0.210	± 0.005	43.82	± 0.38	5.33	± 0.13
328	1 - 7/8	2 - 1/4	3/16	1.850	± 0.015	0.210	± 0.005	46.99	± 0.38	5.33	± 0.13
329	2	2 - 3/8	3/16	1.975	± 0.018	0.210	± 0.005	50.17	± 0.46	5.33	± 0.13
330	2 - 1/8	2 - 1/2	3/16	2.100	± 0.018	0.210	± 0.005	53.34	± 0.46	5.33	± 0.13

Imperial Size Chart

	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
331	2 - 1/4	2 - 5/8	3/16	2.225	± 0.018	0.210	± 0.005	56.52	± 0.46	5.33	± 0.13
332	2 - 3/8	2 - 3/4	3/16	2.350	± 0.018	0.210	± 0.005	59.69	± 0.46	5.33	± 0.13
333	2 - 1/2	2 - 7/8	3/16	2.475	± 0.020	0.210	± 0.005	62.87	± 0.51	5.33	± 0.13
334	2 - 5/8	3	3/16	2.600	± 0.020	0.210	± 0.005	66.04	± 0.51	5.33	± 0.13
335	2 - 3/4	3 - 1/8	3/16	2.725	± 0.020	0.210	± 0.005	69.22	± 0.51	5.33	± 0.13
336	2 - 7/8	3 - 1/4	3/16	2.850	± 0.020	0.210	± 0.005	72.39	± 0.51	5.33	± 0.13
337	3	3 - 3/8	3/16	2.975	± 0.024	0.210	± 0.005	75.57	± 0.61	5.33	± 0.13
338	3 - 1/8	3 - 1/2	3/16	3.100	± 0.024	0.210	± 0.005	78.74	± 0.61	5.33	± 0.13
339	3 - 1/4	3 - 5/8	3/16	3.225	± 0.024	0.210	± 0.005	81.92	± 0.61	5.33	± 0.13
340	3 - 3/8	3 - 3/4	3/16	3.350	± 0.024	0.210	± 0.005	85.09	± 0.61	5.33	± 0.13
341	3 - 1/2	3 - 7/8	3/16	3.475	± 0.024	0.210	± 0.005	88.27	± 0.61	5.33	± 0.13
342	3 - 5/8	4	3/16	3.600	± 0.028	0.210	± 0.005	91.44	± 0.71	5.33	± 0.13
343	3 - 3/4	4 - 1/8	3/16	3.725	± 0.028	0.210	± 0.005	94.62	± 0.71	5.33	± 0.13
344	3 - 7/8	4 - 1/4	3/16	3.850	± 0.028	0.210	± 0.005	97.79	± 0.71	5.33	± 0.13
345	4	4 - 3/8	3/16	3.975	± 0.028	0.210	± 0.005	100.97	± 0.71	5.33	± 0.13
346	4 - 1/8	4 - 1/2	3/16	4.100	± 0.028	0.210	± 0.005	104.14	± 0.71	5.33	± 0.13
347	4 - 1/4	4 - 5/8	3/16	4.225	± 0.030	0.210	± 0.005	107.32	± 0.76	5.33	± 0.13
348	4 - 3/8	4 - 3/4	3/16	4.350	± 0.030	0.210	± 0.005	110.49	± 0.76	5.33	± 0.13
349	4 - 1/2	4 - 7/8	3/16	4.475	± 0.030	0.210	± 0.005	113.67	± 0.76	5.33	± 0.13
350	4 - 5/8	5	3/16	4.600	± 0.030	0.210	± 0.005	116.84	± 0.76	5.33	± 0.13
351	4 - 3/4	5 - 1/8	3/16	4.725	± 0.030	0.210	± 0.005	120.02	± 0.76	5.33	± 0.13
352	4 - 7/8	5 - 1/4	3/16	4.850	± 0.030	0.210	± 0.005	123.19	± 0.76	5.33	± 0.13
353	5	5 - 3/8	3/16	4.975	± 0.037	0.210	± 0.005	126.37	± 0.94	5.33	± 0.13
354	5 - 1/8	5 - 1/2	3/16	5.100	± 0.037	0.210	± 0.005	129.54	± 0.94	5.33	± 0.13
355	5 - 1/4	5 - 5/8	3/16	5.225	± 0.037	0.210	± 0.005	132.72	± 0.94	5.33	± 0.13
356	5 - 3/8	5 - 3/4	3/16	5.350	± 0.037	0.210	± 0.005	135.89	± 0.94	5.33	± 0.13
357	5 - 1/2	5 - 7/8	3/16	5.475	± 0.037	0.210	± 0.005	139.07	± 0.94	5.33	± 0.13
358	5 - 5/8	6	3/16	5.600	± 0.037	0.210	± 0.005	142.24	± 0.94	5.33	± 0.13
359	5 - 3/4	6 - 1/8	3/16	5.725	± 0.037	0.210	± 0.005	145.42	± 0.94	5.33	± 0.13
360	5 - 7/8	6 - 1/4	3/16	5.850	± 0.037	0.210	± 0.005	148.59	± 0.94	5.33	± 0.13
361	6	6 - 3/8	3/16	5.975	± 0.037	0.210	± 0.005	151.77	± 0.94	5.33	± 0.13
362	6 - 1/4	6 - 5/8	3/16	6.225	± 0.040	0.210	± 0.005	158.12	± 1.02	5.33	± 0.13
363	6 - 1/2	6 - 7/8	3/16	6.475	± 0.040	0.210	± 0.005	164.47	± 1.02	5.33	± 0.13
364	6 - 3/4	7 - 1/8	3/16	6.725	± 0.040	0.210	± 0.005	170.82	± 1.02	5.33	± 0.13
365	7	7 - 3/8	3/16	6.975	± 0.040	0.210	± 0.005	177.17	± 1.02	5.33	± 0.13
366	7 - 1/4	7 - 5/8	3/16	7.225	± 0.045	0.210	± 0.005	183.52	± 1.14	5.33	± 0.13
367	7 - 1/2	7 - 7/8	3/16	7.475	± 0.045	0.210	± 0.005	189.87	± 1.14	5.33	± 0.13
368	7 - 3/4	8 - 1/8	3/16	7.725	± 0.045	0.210	± 0.005	196.22	± 1.14	5.33	± 0.13
369	8	8 - 3/8	3/16	7.975	± 0.045	0.210	± 0.005	202.57	± 1.14	5.33	± 0.13
370	8 - 1/4	8 - 5/8	3/16	8.225	± 0.050	0.210	± 0.005	208.92	± 1.27	5.33	± 0.13
371	8 - 1/2	8 - 7/8	3/16	8.475	± 0.050	0.210	± 0.005	215.27	± 1.27	5.33	± 0.13
372	8 - 3/4	9 - 1/8	3/16	8.725	± 0.050	0.210	± 0.005	221.62	± 1.27	5.33	± 0.13
373	9	9 - 3/8	3/16	8.975	± 0.050	0.210	± 0.005	227.97	± 1.27	5.33	± 0.13
374	9 - 1/4	9 - 5/8	3/16	9.225	± 0.055	0.210	± 0.005	234.32	± 1.40	5.33	± 0.13
375	9 - 1/2	9 - 7/8	3/16	9.475	± 0.055	0.210	± 0.005	240.67	± 1.40	5.33	± 0.13
376	9 - 3/4	10 - 1/8	3/16	9.725	± 0.055	0.210	± 0.005	247.02	± 1.40	5.33	± 0.13
377	10	10 - 3/8	3/16	9.975	± 0.055	0.210	± 0.005	253.37	± 1.40	5.33	± 0.13
378	10 - 1/2	10 - 7/8	3/16	10.475	± 0.060	0.210	± 0.005	266.07	± 1.52	5.33	± 0.13
379	11	11 - 3/8	3/16	10.975	± 0.060	0.210	± 0.005	278.77	± 1.52	5.33	± 0.13
380	11 - 1/2	11 - 7/8	3/16	11.475	± 0.065	0.210	± 0.005	291.47	± 1.65	5.33	± 0.13

Imperial Size Chart

	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
381	12	12 - 3/8	3/16	11.975	± 0.065	0.210	± 0.005	304.17	± 1.65	5.33	± 0.13
382	13	13 - 3/8	3/16	12.975	± 0.065	0.210	± 0.005	329.57	± 1.65	5.33	± 0.13
383	14	14 - 3/8	3/16	13.975	± 0.070	0.210	± 0.005	354.97	± 1.78	5.33	± 0.13
384	15	15 - 3/8	3/16	14.975	± 0.070	0.210	± 0.005	380.37	± 1.78	5.33	± 0.13
385	16	16 - 3/8	3/16	15.955	± 0.075	0.210	± 0.005	405.26	± 1.91	5.33	± 0.13
386	17	17 - 3/8	3/16	16.955	± 0.080	0.210	± 0.005	430.66	± 2.03	5.33	± 0.13
387	18	18 - 3/8	3/16	17.955	± 0.085	0.210	± 0.005	456.06	± 2.16	5.33	± 0.13
388	19	19 - 3/8	3/16	18.952	± 0.090	0.210	± 0.005	481.38	± 2.29	5.33	± 0.13
389	20	20 - 3/8	3/16	19.952	± 0.095	0.210	± 0.005	506.78	± 2.41	5.33	± 0.13
390	21	21 - 3/8	3/16	20.952	± 0.095	0.210	± 0.005	532.18	± 2.41	5.33	± 0.13
391	22	22 - 3/8	3/16	21.952	± 0.100	0.210	± 0.005	557.58	± 2.54	5.33	± 0.13
392	23	23 - 3/8	3/16	22.940	± 0.105	0.210	± 0.005	582.68	± 2.67	5.33	± 0.13
393	24	24 - 3/8	3/16	23.940	± 0.110	0.210	± 0.005	608.08	± 2.79	5.33	± 0.13
394	25	25 - 3/8	3/16	24.940	± 0.115	0.210	± 0.005	633.48	± 2.92	5.33	± 0.13
395	26	26 - 3/8	3/16	25.940	± 0.120	0.210	± 0.005	658.88	± 3.05	5.33	± 0.13
425	4 - 1/2	5	1/4	4.475	± 0.033	0.275	± 0.006	113.67	± 0.84	6.99	± 0.15
426	4 - 5/8	5 - 1/8	1/4	4.600	± 0.033	0.275	± 0.006	116.84	± 0.84	6.99	± 0.15
427	4 - 3/4	5 - 1/4	1/4	4.725	± 0.033	0.275	± 0.006	120.02	± 0.84	6.99	± 0.15
428	4 - 7/8	5 - 3/8	1/4	4.850	± 0.033	0.275	± 0.006	123.19	± 0.84	6.99	± 0.15
429	5	5 - 1/2	1/4	4.975	± 0.037	0.275	± 0.006	126.37	± 0.94	6.99	± 0.15
430	5 - 1/8	5 - 5/8	1/4	5.100	± 0.037	0.275	± 0.006	129.54	± 0.94	6.99	± 0.15
431	5 - 1/4	5 - 3/4	1/4	5.225	± 0.037	0.275	± 0.006	132.72	± 0.94	6.99	± 0.15
432	5 - 3/8	5 - 7/8	1/4	5.350	± 0.037	0.275	± 0.006	135.89	± 0.94	6.99	± 0.15
433	5 - 1/2	6	1/4	5.475	± 0.037	0.275	± 0.006	139.07	± 0.94	6.99	± 0.15
434	5 - 5/8	6 - 1/8	1/4	5.600	± 0.037	0.275	± 0.006	142.24	± 0.94	6.99	± 0.15
435	5 - 3/4	6 - 1/4	1/4	5.725	± 0.037	0.275	± 0.006	145.42	± 0.94	6.99	± 0.15
436	5 - 7/8	6 - 3/8	1/4	5.850	± 0.037	0.275	± 0.006	148.59	± 0.94	6.99	± 0.15
437	6	6 - 1/2	1/4	5.975	± 0.037	0.275	± 0.006	151.77	± 0.94	6.99	± 0.15
438	6 - 1/4	6 - 3/4	1/4	6.225	± 0.040	0.275	± 0.006	158.12	± 1.02	6.99	± 0.15
439	6 - 1/2	7	1/4	6.475	± 0.040	0.275	± 0.006	164.47	± 1.02	6.99	± 0.15
440	6 - 3/4	7 - 1/4	1/4	6.725	± 0.040	0.275	± 0.006	170.82	± 1.02	6.99	± 0.15
441	7	7 - 1/2	1/4	6.975	± 0.040	0.275	± 0.006	177.17	± 1.02	6.99	± 0.15
442	7 - 1/4	7 - 3/4	1/4	7.225	± 0.045	0.275	± 0.006	183.52	± 1.14	6.99	± 0.15
443	7 - 1/2	8	1/4	7.475	± 0.045	0.275	± 0.006	189.87	± 1.14	6.99	± 0.15
444	7 - 3/4	8 - 1/4	1/4	7.725	± 0.045	0.275	± 0.006	196.22	± 1.14	6.99	± 0.15
445	8	8 - 1/2	1/4	7.975	± 0.045	0.275	± 0.006	202.57	± 1.14	6.99	± 0.15
446	8 - 1/2	9	1/4	8.475	± 0.055	0.275	± 0.006	215.27	± 1.40	6.99	± 0.15
447	9	9 - 1/2	1/4	8.975	± 0.055	0.275	± 0.006	227.97	± 1.40	6.99	± 0.15
448	9 - 1/2	10	1/4	9.475	± 0.055	0.275	± 0.006	240.67	± 1.40	6.99	± 0.15
449	10	10 - 1/2	1/4	9.975	± 0.055	0.275	± 0.006	253.37	± 1.40	6.99	± 0.15
450	10 - 1/2	11	1/4	10.475	± 0.060	0.275	± 0.006	266.07	± 1.52	6.99	± 0.15
451	11	11 - 1/2	1/4	10.975	± 0.060	0.275	± 0.006	278.77	± 1.52	6.99	± 0.15
452	11 - 1/2	12	1/4	11.475	± 0.060	0.275	± 0.006	291.47	± 1.52	6.99	± 0.15
453	12	12 - 1/2	1/4	11.975	± 0.060	0.275	± 0.006	304.17	± 1.52	6.99	± 0.15
454	12 - 1/2	13	1/4	12.475	± 0.060	0.275	± 0.006	316.87	± 1.52	6.99	± 0.15
455	13	13 - 1/2	1/4	12.975	± 0.060	0.275	± 0.006	329.57	± 1.52	6.99	± 0.15
456	13 - 1/2	14	1/4	13.475	± 0.070	0.275	± 0.006	342.27	± 1.78	6.99	± 0.15
457	14	14 - 1/2	1/4	13.975	± 0.070	0.275	± 0.006	345.97	± 1.78	6.99	± 0.15
458	14 - 1/2	15	1/4	14.475	± 0.070	0.275	± 0.006	367.67	± 1.78	6.99	± 0.15

Imperial Size Chart

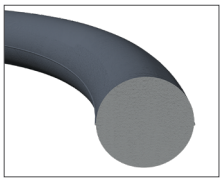
	Nominal			Imperial Actual				Metric Actual			
Dash #	I.D.	O.D.	C/S	I.D.		C/S		I.D.		C/S	
459	15	15 - 1/2	1/4	14.975	± 0.070	0.275	± 0.006	380.37	± 1.78	6.99	± 0.15
460	15 - 1/2	16	1/4	15.475	± 0.070	0.275	± 0.006	393.07	± 1.78	6.99	± 0.15
461	16	16 - 1/2	1/4	15.955	± 0.075	0.275	± 0.006	405.26	± 1.91	6.99	± 0.15
462	16 - 1/2	17	1/4	16.455	± 0.075	0.275	± 0.006	417.96	± 1.91	6.99	± 0.15
463	17	17 - 1/2	1/4	16.955	± 0.080	0.275	± 0.006	430.66	± 2.03	6.99	± 0.15
464	17 - 1/2	18	1/4	17.455	± 0.085	0.275	± 0.006	443.36	± 2.16	6.99	± 0.15
465	18	18 - 1/2	1/4	17.955	± 0.085	0.275	± 0.006	456.06	± 2.16	6.99	± 0.15
466	18 - 1/2	19	1/4	18.455	± 0.085	0.275	± 0.006	468.76	± 2.16	6.99	± 0.15
467	19	19 - 1/2	1/4	18.955	± 0.090	0.275	± 0.006	481.46	± 2.29	6.99	± 0.15
468	19 - 1/2	20	1/4	19.455	± 0.090	0.275	± 0.006	494.16	± 2.29	6.99	± 0.15
469	20	20 - 1/2	1/4	19.955	± 0.095	0.275	± 0.006	506.86	± 2.41	6.99	± 0.15
470	21	21 - 1/2	1/4	20.955	± 0.095	0.275	± 0.006	532.26	± 2.41	6.99	± 0.15
471	22	22 - 1/2	1/4	21.955	± 0.100	0.275	± 0.006	557.66	± 2.54	6.99	± 0.15
472	23	23 - 1/2	1/4	22.940	± 0.105	0.275	± 0.006	582.68	± 2.67	6.99	± 0.15
473	24	24 - 1/2	1/4	23.940	± 0.110	0.275	± 0.006	608.08	± 2.79	6.99	± 0.15
474	25	25 - 1/2	1/4	24.940	± 0.115	0.275	± 0.006	633.48	± 2.92	6.99	± 0.15
475	26	26 - 1/2	1/4	25.940	± 0.120	0.275	± 0.006	658.88	± 3.05	6.99	± 0.15

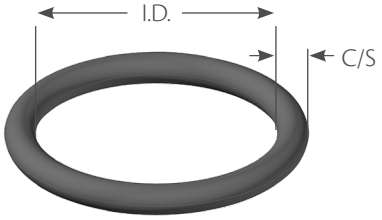
We offer O-rings in sizes ranging from 400-424. These O-ring size dimensions and tolerances are unassigned under ISO 3601. In addition, we stock specific non-standard C/S O-rings such as 3/8", 1/2", and 3/4".

O-Rings for Straight Thread Tube Fitting Bosses

		Hydraulic	Imperial Actual				Metric Actual			
	Tube Size	MIL-P-5570								
Dash #	OD Inch	MS28778	I.D.		C/S		I.D.		C/S	
901	3/32		0.185	± 0.005	0.056	± 0.003	4.70	± 0.13	1.42	± 0.08
902	1/8	2	0.239	± 0.005	0.064	± 0.003	6.07	± 0.13	1.63	± 0.08
903	3/16	3	0.301	± 0.005	0.064	± 0.003	7.65	± 0.13	1.63	± 0.08
904	1/4	4	0.351	± 0.005	0.072	± 0.003	8.92	± 0.13	1.83	± 0.08
905	5/16	5	0.414	± 0.005	0.072	± 0.003	10.52	± 0.13	1.83	± 0.08
906	3/8	6	0.468	± 0.005	0.078	± 0.003	11.89	± 0.13	1.98	± 0.08
907	7/16		0.530	± 0.005	0.082	± 0.003	13.46	± 0.13	2.08	± 0.08
908	1/2	8	0.644	± 0.009	0.087	± 0.003	16.36	± 0.23	2.21	± 0.08
909	9/16		0.706	± 0.009	0.097	± 0.003	17.93	± 0.23	2.46	± 0.08
910	5/8	10	0.755	± 0.009	0.097	± 0.003	19.18	± 0.23	2.46	± 0.08
911	11/16		0.863	± 0.009	0.116	± 0.004	21.92	± 0.23	2.95	± 0.10
912	3/4	12	0.924	± 0.009	0.116	± 0.004	23.47	± 0.23	2.95	± 0.10
913	13/16		0.986	± 0.010	0.116	± 0.004	25.04	± 0.25	2.95	± 0.10
914	7/8	14	1.048	± 0.010	0.116	± 0.004	26.62	± 0.25	2.95	± 0.10
916	1	16	1.171	± 0.010	0.116	± 0.004	29.74	± 0.25	2.95	± 0.10
918	1-1/8		1.355	± 0.012	0.116	± 0.004	34.42	± 0.30	2.95	± 0.10
920	1-1/4	20	1.475	± 0.014	0.118	± 0.004	37.47	± 0.36	3.00	± 0.10
924	1-1/2	24	1.720	± 0.014	0.118	± 0.004	43.69	± 0.36	3.00	± 0.10
928	1-3/4	28	2.090	± 0.018	0.118	± 0.004	53.09	± 0.36	3.00	± 0.10
932	2	32	2.337	± 0.018	0.118	± 0.004	59.36	± 0.36	3.00	± 0.10

Metric Size Chart





Part Number	C/S	I.D.	Cross Ref. #
1000115	1.00	1.15	
1000125	1.00	1.25	
100015	1.00	1.50	
100018	1.00	1.80	
10002	1.00	2.00	
100025	1.00	2.50	
100027	1.00	2.70	
10003	1.00	3.00	
100033	1.00	3.30	
100035	1.00	3.50	
10004	1.00	4.00	
100045	1.00	4.50	
10005	1.00	5.00	
100055	1.00	5.50	
10006	1.00	6.00	
100065	1.00	6.50	
10007	1.00	7.00	
100072	1.00	7.20	
100075	1.00	7.50	
10008	1.00	8.00	
100085	1.00	8.50	
10009	1.00	9.00	
100095	1.00	9.50	
10010	1.00	10.00	
100105	1.00	10.50	
10011	1.00	11.00	
100115	1.00	11.50	
10012	1.00	12.00	
100125	1.00	12.50	
10013	1.00	13.00	
100135	1.00	13.50	
10014	1.00	14.00	
100145	1.00	14.50	
10015	1.00	15.00	
100155	1.00	15.50	
10016	1.00	16.00	
100165	1.00	16.50	
10017	1.00	17.00	
10018	1.00	18.00	
100185	1.00	18.50	
10019	1.00	19.00	
100195	1.00	19.50	
10020	1.00	20.00	

Part Number	C/S	I.D.	Cross Ref. #
100205	1.00	20.50	
10021	1.00	21.00	
100215	1.00	21.50	
10022	1.00	22.00	
100225	1.00	22.50	
10023	1.00	23.00	
100235	1.00	23.50	
10024	1.00	24.00	
100245	1.00	24.50	
10025	1.00	25.00	
10028	1.00	28.00	
100294	1.00	29.40	
100299	1.00	29.90	
100305	1.00	30.50	
100318	1.00	31.80	
10032	1.00	32.00	
10039	1.00	39.00	
10042	1.00	42.00	
10060	1.00	60.00	
-001	1.02	0.74	-001
120025	1.20	2.50	
120026	1.20	2.60	
120035	1.20	3.50	
12005	1.20	5.00	
12024	1.20	24.00	
12026	1.20	26.00	
12028	1.20	28.00	
12035	1.20	35.00	
12040	1.20	40.00	
120535	1.20	53.50	
12098	1.20	98.00	
-002	1.27	1.07	-002
150018	1.50	1.80	
1500185	1.50	1.85	
15002	1.50	2.00	
150025	1.50	2.50	S 3
150028	1.50	2.80	
15003	1.50	3.00	
150035	1.50	3.50	S 4
15004	1.50	4.00	
150045	1.50	4.50	S 5
15005	1.50	5.00	
150055	1.50	5.50	S 6

Part Number	C/S	I.D.	Cross Ref. #
15006	1.50	6.00	
150065	1.50	6.50	S 7
15007	1.50	7.00	
150075	1.50	7.50	S 8
15008	1.50	8.00	
150085	1.50	8.50	S 9
15009	1.50	9.00	
150095	1.50	9.50	S 10
15010	1.50	10.00	
150105	1.50	10.50	
150107	1.50	10.70	S 11.2
15011	1.50	11.00	
150115	1.50	11.50	S 12
15012	1.50	12.00	S 12.5
150125	1.50	12.50	
15013	1.50	13.00	
1501325	1.50	13.25	
150135	1.50	13.50	S 14
15014	1.50	14.00	
15015	1.50	15.00	
150155	1.50	15.50	S 16
15016	1.50	16.00	
150165	1.50	16.50	
15017	1.50	17.00	
150175	1.50	17.50	S 18
15018	1.50	18.00	
150185	1.50	18.50	
15019	1.50	19.00	
150195	1.50	19.50	S 20
15020	1.50	20.00	
150205	1.50	20.50	
15021	1.50	21.00	
150215	1.50	21.5	S 22
15022	1.50	22.00	
150225	1.50	22.50	
15023	1.50	23.00	
150235	1.50	23.50	
15024	1.50	24.00	
150245	1.50	24.50	
15025	1.50	25.00	
150255	1.50	25.50	
15026	1.50	26.00	
150265	1.50	26.50	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
15027	1.50	27.00	
150275	1.50	27.50	
15028	1.50	28.00	
150285	1.50	28.50	
15029	1.50	29.00	
150295	1.50	29.50	
15030	1.50	30.00	
150305	1.50	30.50	
15031	1.50	31.00	
150315	1.50	31.50	
15032	1.50	32.00	
150325	1.50	32.50	
15033	1.50	33.00	
150335	1.50	33.50	
15034	1.50	34.00	
150345	1.50	34.50	
15035	1.50	35.00	
150355	1.50	35.50	
15036	1.50	36.00	
150365	1.50	36.50	
15037	1.50	37.00	
150375	1.50	37.50	
15038	1.50	38.00	
150385	1.50	38.50	
15039	1.50	39.00	
150395	1.50	39.50	
15040	1.50	40.00	
15041	1.50	41.00	
15042	1.50	42.00	
15043	1.50	43.00	
15044	1.50	44.00	
15045	1.50	45.00	
15046	1.50	46.00	
15047	1.50	47.00	
15048	1.50	48.00	
15049	1.50	49.00	
15050	1.50	50.00	
15051	1.50	51.00	
15052	1.50	52.00	
15053	1.50	53.00	
15054	1.50	54.00	
15055	1.50	55.00	
15056	1.50	56.00	
15057	1.50	57.00	
15058	1.50	58.00	
15059	1.50	59.00	
15060	1.50	60.00	
15061	1.50	61.00	
15062	1.50	62.00	
15063	1.50	63.00	
15064	1.50	64.00	

Part Number	C/S	I.D.	Cross Ref. #
15065	1.50	65.00	
15066	1.50	66.00	
15067	1.50	67.00	
15068	1.50	68.00	
15069	1.50	69.00	
15070	1.50	70.00	
15071	1.50	71.00	
15072	1.50	72.00	
15073	1.50	73.00	
15074	1.50	74.00	
15075	1.50	75.00	
15076	1.50	76.00	
15077	1.50	77.00	
15078	1.50	78.00	
15079	1.50	79.00	
15080	1.50	80.00	
15081	1.50	81.00	
15082	1.50	82.00	
15083	1.50	83.00	
15084	1.50	84.00	
15085	1.50	85.00	
15086	1.50	86.00	
15087	1.50	87.00	
15088	1.50	88.00	
15089	1.50	89.00	
15090	1.50	90.00	
15091	1.50	91.00	
15092	1.50	92.00	
15093	1.50	93.00	
15094	1.50	94.00	
15095	1.50	95.00	
15096	1.50	96.00	
15097	1.50	97.00	
15098	1.50	98.00	
15099	1.50	99.00	
15100	1.50	100.00	
15105	1.50	105.00	
15145	1.50	145.00	
-003	1.52	1.42	-003
160022	1.60	2.20	
1600275	1.60	2.75	
160028	1.60	2.80	
160031	1.60	3.10	
160032	1.60	3.20	
160037	1.60	3.70	
160041	1.60	4.10	
160047	1.60	4.70	
160050	1.60	5.00	
160051	1.60	5.10	
160061	1.60	6.10	
160068	1.60	6.80	

Part Number	C/S	I.D.	Cross Ref. #
160071	1.60	7.10	
160081	1.60	8.10	
160091	1.60	9.10	
160101	1.60	10.10	
160111	1.60	11.10	
160121	1.60	12.10	
160131	1.60	13.10	
160141	1.60	14.10	
160151	1.60	15.10	
160161	1.60	16.10	
160171	1.60	17.10	
160181	1.60	18.10	
160191	1.60	19.10	
160203	1.60	20.30	
160211	1.60	21.10	
160221	1.60	22.10	
160251	1.60	25.10	
160271	1.60	27.10	
160291	1.60	29.10	
160321	1.60	32.10	
160351	1.60	35.10	
160371	1.60	37.10	
160511	1.60	51.10	
160860	1.60	86.00	
160966	1.60	96.60	
16115	1.60	115.00	
-004	1.78	1.78	-004
-005	1.78	2.57	-005
-006	1.78	2.90	-006
-007	1.78	3.68	-007
-008	1.78	4.47	-008
-009	1.78	5.28	-009
-010	1.78	6.07	-010
-011	1.78	7.65	-011
-012	1.78	9.25	-012
-013	1.78	10.82	-013
-014	1.78	12.42	-014
-015	1.78	14.00	-015
-016	1.78	15.60	-016
-017	1.78	17.17	-017
-018	1.78	18.77	-018
-019	1.78	20.35	-019
-020	1.78	21.95	-020
-021	1.78	23.52	-021
-022	1.78	25.12	-022
-023	1.78	26.70	-023
-024	1.78	28.30	-024
-025	1.78	29.87	-025
-026	1.78	31.47	-026
-027	1.78	33.05	-027
-028	1.78	34.65	-028

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
-029	1.78	37.82	-029
-030	1.78	41.00	-030
-031	1.78	44.17	-031
-032	1.78	47.35	-032
-033	1.78	50.52	-033
-034	1.78	53.70	-034
-035	1.78	56.87	-035
-036	1.78	60.05	-036
-037	1.78	63.22	-037
-038	1.78	66.40	-038
-039	1.78	69.57	-039
-040	1.78	72.75	-040
-041	1.78	75.92	-041
-042	1.78	82.27	-042
-043	1.78	88.62	-043
-044	1.78	94.97	-044
-045	1.78	101.32	-045
-046	1.78	107.67	-046
-047	1.78	114.02	-047
-048	1.78	120.37	-048
-049	1.78	126.72	-049
-050	1.78	133.07	-050
180018	1.80	1.80	
18002	1.80	2.00	
1800224	1.80	2.24	
180025	1.80	2.50	
180028	1.80	2.80	
1800315	1.80	3.15	
1800355	1.80	3.55	
1800375	1.80	3.75	
18004	1.80	4.00	
180045	1.80	4.50	
1800487	1.80	4.87	
18005	1.80	5.00	
1800515	1.80	5.15	
180053	1.80	5.30	
180056	1.80	5.60	
18006	1.80	6.00	
180063	1.80	6.30	
180067	1.80	6.70	
180069	1.80	6.90	
180071	1.80	7.10	
180075	1.80	7.50	
18008	1.80	8.00	
180085	1.80	8.50	
1800876	1.80	8.76	
18009	1.80	9.00	
180095	1.80	9.50	
18010	1.80	10.00	
180106	1.80	10.60	
180112	1.80	11.20	

Part Number	C/S	I.D.	Cross Ref. #
180118	1.80	11.80	
180125	1.80	12.50	
180132	1.80	13.20	
18014	1.80	14.00	
18015	1.80	15.00	
18016	1.80	16.00	
18017	1.80	17.00	
190024	1.90	2.40	
190026	1.90	2.60	
190028	1.90	2.80	P 3
190034	1.90	3.40	
190037	1.90	3.70	
190038	1.90	3.80	P 4
190042	1.90	4.20	
190048	1.90	4.80	P 5
190049	1.90	4.90	
190057	1.90	5.70	
190058	1.90	5.80	P 6
190064	1.90	6.40	
190068	1.90	6.80	P 7
190072	1.90	7.20	
190078	1.90	7.80	P 8
19008	1.90	8.00	
190088	1.90	8.80	P 9
190089	1.90	8.90	
190098	1.90	9.80	P 10
20002	2.00	2.00	
200025	2.00	2.50	
200026	2.00	2.60	
20003	2.00	3.00	
200035	2.00	3.50	
20004	2.00	4.00	
200045	2.00	4.50	
200046	2.00	4.60	
20005	2.00	5.00	
200055	2.00	5.50	
20006	2.00	6.00	
200065	2.00	6.50	
20007	2.00	7.00	
200075	2.00	7.50	
20008	2.00	8.00	
200085	2.00	8.50	
20009	2.00	9.00	
200094	2.00	9.40	
20010	2.00	10.00	
200105	2.00	10.50	
20011	2.00	11.00	
200115	2.00	11.50	
20012	2.00	12.00	
200125	2.00	12.50	
20013	2.00	13.00	

Part Number	C/S	I.D.	Cross Ref. #
200135	2.00	13.50	
20014	2.00	14.00	
200145	2.00	14.50	
20015	2.00	15.00	
200155	2.00	15.50	
20016	2.00	16.00	
200165	2.00	16.50	
20017	2.00	17.00	
200175	2.00	17.50	
20018	2.00	18.00	
200185	2.00	18.50	
20019	2.00	19.00	
200195	2.00	19.50	
20020	2.00	20.00	
200205	2.00	20.50	
20021	2.00	21.00	
200215	2.00	21.50	
200219	2.00	21.90	S 22.4
20022	2.00	22.00	
200225	2.00	22.50	
20023	2.00	23.00	
200235	2.00	23.50	S 24
20024	2.00	24.00	
200245	2.00	24.50	S 25
20025	2.00	25.00	
200255	2.00	25.50	S 26
20026	2.00	26.00	
200265	2.00	26.50	
20027	2.00	27.00	
200275	2.00	27.50	S 28
20028	2.00	28.00	
200285	2.00	28.50	S 29
20029	2.00	29.00	
200295	2.00	29.50	S 30
20030	2.00	30.00	
200305	2.00	30.50	
20031	2.00	31.00	S 31.5
200315	2.00	31.50	S 32
20032	2.00	32.00	
200325	2.00	32.50	
20033	2.00	33.00	
200335	2.00	33.50	S 34
20034	2.00	34.00	
200345	2.00	34.50	S 35
20035	2.00	35.00	S 35.5
200355	2.00	35.50	S 36
20036	2.00	36.00	
200365	2.00	36.50	
20037	2.00	37.00	
200375	2.00	37.50	S 38
20038	2.00	38.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
20039	2.00	39.00	
200395	2.00	39.50	S 40
20040	2.00	40.00	
20041	2.00	41.00	
200415	2.00	41.50	S 42
20042	2.00	42.00	
20043	2.00	43.00	
200435	2.00	43.50	S 44
20044	2.00	44.00	
200445	2.00	44.50	S 45
20045	2.00	45.00	
200455	2.00	45.50	S 46
20046	2.00	46.00	
20047	2.00	47.00	
200475	2.00	47.50	S 48
20048	2.00	48.00	
20049	2.00	49.00	
200495	2.00	49.50	S 50
20050	2.00	50.00	
20051	2.00	51.00	
20052	2.00	52.00	
200525	2.00	52.50	S 53
20053	2.00	53.00	
20054	2.00	54.00	
200545	2.00	54.50	S 55
20055	2.00	55.00	
200555	2.00	55.50	S 56
20056	2.00	56.00	
20057	2.00	57.00	
20058	2.00	58.00	
20059	2.00	59.00	
200595	2.00	59.50	S 60
20060	2.00	60.00	
20061	2.00	61.00	
20062	2.00	62.00	
200625	2.00	62.50	S 63
20063	2.00	63.00	
20064	2.00	64.00	
200645	2.00	64.50	S 65
20065	2.00	65.00	
20066	2.00	66.00	
200665	2.00	66.50	S 67
20067	2.00	67.00	
20068	2.00	68.00	
20069	2.00	69.00	
200695	2.00	69.50	S 70
20070	2.00	70.00	
200705	2.00	70.50	S 71
20071	2.00	71.00	
20072	2.00	72.00	
20073	2.00	73.00	

Part Number	C/S	I.D.	Cross Ref. #
20074	2.00	74.00	
200745	2.00	74.50	S 75
20075	2.00	75.00	
20076	2.00	76.00	
20077	2.00	77.00	
20078	2.00	78.00	
20079	2.00	79.00	
200795	2.00	79.50	S 80
20080	2.00	80.00	
20081	2.00	81.00	
20082	2.00	82.00	
20083	2.00	83.00	
20084	2.00	84.00	
200845	2.00	84.50	S 85
20085	2.00	85.00	
20086	2.00	86.00	
20087	2.00	87.00	
20088	2.00	88.00	
20089	2.00	89.00	
200895	2.00	89.50	S 90
20090	2.00	90.00	
20091	2.00	91.00	
20092	2.00	92.00	
20093	2.00	93.00	
20094	2.00	94.00	
200945	2.00	94.50	S 95
20095	2.00	95.00	
20096	2.00	96.00	
20097	2.00	97.00	
20098	2.00	98.00	
20099	2.00	99.00	
200995	2.00	99.50	S 100
20100	2.00	100.00	
20102	2.00	102.00	
201045	2.00	104.50	S 105
20105	2.00	105.00	
20109	2.00	109.00	
201095	2.00	109.50	S 110
20110	2.00	110.00	
201115	2.00	111.50	S 112
201145	2.00	114.50	S 115
20115	2.00	115.00	
201195	2.00	119.50	S 120
20120	2.00	120.00	
201245	2.00	124.50	S 125
201256	2.00	125.60	
201295	2.00	129.50	S 130
20130	2.00	130.00	
201315	2.00	131.50	S 132
201345	2.00	134.50	S 135
201395	2.00	139.50	S 140

Part Number	C/S	I.D.	Cross Ref. #
20140	2.00	140.00	
201445	2.00	144.50	S 145
201495	2.00	149.50	S 150
20165	2.00	165.00	
20180	2.00	180.00	
20194	2.00	194.00	
240033	2.40	3.30	
240036	2.40	3.60	
240043	2.40	4.30	
240046	2.40	4.60	
240053	2.40	5.30	
240055	2.40	5.50	
240056	2.40	5.60	
240063	2.40	6.30	
240066	2.40	6.60	
240073	2.40	7.30	
240075	2.40	7.50	
240076	2.40	7.60	
24008	2.40	8.00	
240083	2.40	8.30	
240086	2.40	8.60	
240093	2.40	9.30	
240096	2.40	9.60	
240098	2.40	9.80	P 10A
240103	2.40	10.30	
240105	2.40	10.50	
240106	2.40	10.60	
240108	2.40	10.80	P 11
24011	2.40	11.00	P 11.2
240113	2.40	11.30	
240115	2.40	11.50	
240116	2.40	11.60	
240118	2.40	11.80	P 12
240123	2.40	12.30	P 12.5
240126	2.40	12.60	
240133	2.40	13.30	
240135	2.40	13.50	
240136	2.40	13.60	
240138	2.40	13.80	P 14
240143	2.40	14.30	
240145	2.40	14.50	
240146	2.40	14.60	
240148	2.40	14.80	P 15
240153	2.40	15.30	
240155	2.40	15.50	
240156	2.40	15.60	
240158	2.40	15.80	P 16
240159	2.40	15.90	
240163	2.40	16.30	
240166	2.40	16.60	
240173	2.40	17.30	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
240175	2.40	17.50	
240176	2.40	17.60	
240178	2.40	17.80	P 18
240183	2.40	18.30	
240186	2.40	18.60	
240193	2.40	19.30	
240196	2.40	19.60	
240198	2.40	19.80	P 20
240203	2.40	20.30	
240205	2.40	20.50	
240208	2.40	20.80	P 21
240213	2.40	21.30	
240215	2.40	21.50	
240216	2.40	21.60	
240218	2.40	21.80	P 22
240223	2.40	22.30	
240226	2.40	22.60	
240233	2.40	23.30	
240235	2.40	23.50	
240236	2.40	23.60	
240243	2.40	24.30	
240245	2.40	24.50	
240246	2.40	24.60	
24025	2.40	25.00	
240253	2.40	25.30	
240256	2.40	25.60	
240273	2.40	27.30	
240275	2.40	27.50	
240276	2.40	27.60	
240296	2.40	29.60	
240303	2.40	30.30	
240316	2.40	31.60	
240333	2.40	33.30	
240346	2.40	34.60	
240365	2.40	36.50	
240376	2.40	37.60	
240396	2.40	39.60	
240416	2.40	41.60	
240446	2.40	44.60	
240476	2.40	47.60	
240496	2.40	49.60	
240516	2.40	51.60	
240546	2.40	54.60	
240576	2.40	57.60	
240596	2.40	59.60	
240616	2.40	61.60	
240646	2.40	64.60	
240676	2.40	67.60	
240696	2.40	69.60	
25004	2.50	4.00	
250046	2.50	4.60	

Part Number	C/S	I.D.	Cross Ref. #
25005	2.50	5.00	
250055	2.50	5.50	
25006	2.50	6.00	
250065	2.50	6.50	
25007	2.50	7.00	
250075	2.50	7.50	
25008	2.50	8.00	
250085	2.50	8.50	
25009	2.50	9.00	
250095	2.50	9.50	
25010	2.50	10.00	
250105	2.50	10.50	
25011	2.50	11.00	
250115	2.50	11.50	
25012	2.50	12.00	
250125	2.50	12.50	
25013	2.50	13.00	
250135	2.50	13.50	
25014	2.50	14.00	
250145	2.50	14.50	
25015	2.50	15.00	
250155	2.50	15.50	
25016	2.50	16.00	
250165	2.50	16.50	
25017	2.50	17.00	
250175	2.50	17.50	
25018	2.50	18.00	
250185	2.50	18.50	
25019	2.50	19.00	
250195	2.50	19.50	
25020	2.50	20.00	
250205	2.50	20.50	
25021	2.50	21.00	
250215	2.50	21.50	
25022	2.50	22.00	
250225	2.50	22.50	
25023	2.50	23.00	
250235	2.50	23.50	
25024	2.50	24.00	
250245	2.50	24.50	
25025	2.50	25.00	
250255	2.50	25.50	
25026	2.50	26.00	
250265	2.50	26.50	
25027	2.50	27.00	
250275	2.50	27.50	
25028	2.50	28.00	
250285	2.50	28.50	
25029	2.50	29.00	
250295	2.50	29.50	
25030	2.50	30.00	

Part Number	C/S	I.D.	Cross Ref. #
250305	2.50	30.50	
25031	2.50	31.00	
250315	2.50	31.50	
25032	2.50	32.00	
250325	2.50	32.50	
25033	2.50	33.00	
250335	2.50	33.50	
25034	2.50	34.00	
250345	2.50	34.50	
25035	2.50	35.00	
250355	2.50	35.50	
25036	2.50	36.00	
250365	2.50	36.50	
25037	2.50	37.00	
250375	2.50	37.50	
25038	2.50	38.00	
250385	2.50	38.50	
25039	2.50	39.00	
250395	2.50	39.50	
25040	2.50	40.00	
25041	2.50	41.00	
25042	2.50	42.00	
25043	2.50	43.00	
25044	2.50	44.00	
25045	2.50	45.00	
25046	2.50	46.00	
25047	2.50	47.00	
25048	2.50	48.00	
25049	2.50	49.00	
25050	2.50	50.00	
25051	2.50	51.00	
25052	2.50	52.00	
25053	2.50	53.00	
25054	2.50	54.00	
25055	2.50	55.00	
25056	2.50	56.00	
25057	2.50	57.00	
25058	2.50	58.00	
25059	2.50	59.00	
25060	2.50	60.00	
25061	2.50	61.00	
25062	2.50	62.00	
25063	2.50	63.00	
25064	2.50	64.00	
25065	2.50	65.00	
25066	2.50	66.00	
25067	2.50	67.00	
25068	2.50	68.00	
25069	2.50	69.00	
25070	2.50	70.00	
25071	2.50	71.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
25072	2.50	72.00	
25073	2.50	73.00	
25074	2.50	74.00	
25075	2.50	75.00	
25076	2.50	76.00	
25077	2.50	77.00	
25078	2.50	78.00	
25079	2.50	79.00	
25080	2.50	80.00	
25081	2.50	81.00	
25082	2.50	82.00	
25083	2.50	83.00	
25084	2.50	84.00	
25085	2.50	85.00	
25086	2.50	86.00	
25087	2.50	87.00	
25088	2.50	88.00	
25089	2.50	89.00	
25090	2.50	90.00	
25091	2.50	91.00	
25092	2.50	92.00	
25093	2.50	93.00	
25094	2.50	94.00	
25095	2.50	95.00	
25096	2.50	96.00	
25097	2.50	97.00	
25098	2.50	98.00	
25099	2.50	99.00	
25100	2.50	100.00	
25101	2.50	101.00	
25102	2.50	102.00	
25103	2.50	103.00	
25104	2.50	104.00	
25105	2.50	105.00	
25106	2.50	106.00	
25107	2.50	107.00	
25108	2.50	108.00	
25109	2.50	109.00	
25110	2.50	110.00	
25111	2.50	111.00	
25112	2.50	112.00	
25113	2.50	113.00	
25114	2.50	114.00	
25115	2.50	115.00	
25116	2.50	116.00	
25117	2.50	117.00	
25118	2.50	118.00	
25119	2.50	119.00	
25120	2.50	120.00	
25121	2.50	121.00	
25122	2.50	122.00	

Part Number	C/S	I.D.	Cross Ref. #
25123	2.50	123.00	
25124	2.50	124.00	
25125	2.50	125.00	
25126	2.50	126.00	
25127	2.50	127.00	
25128	2.50	128.00	
25129	2.50	129.00	
25130	2.50	130.00	
25131	2.50	131.00	
25132	2.50	132.00	
25133	2.50	133.00	
25134	2.50	134.00	
25135	2.50	135.00	
25136	2.50	136.00	
25137	2.50	137.00	
25138	2.50	138.00	
25139	2.50	139.00	
25140	2.50	140.00	
25141	2.50	141.00	
25142	2.50	142.00	
25143	2.50	143.00	
25144	2.50	144.00	
25145	2.50	145.00	
25146	2.50	146.00	
25147	2.50	147.00	
25148	2.50	148.00	
25149	2.50	149.00	
25150	2.50	150.00	
-102	2.62	1.24	-102
-103	2.62	2.06	-103
-104	2.62	2.84	-104
-105	2.62	3.63	-105
-106	2.62	4.42	-106
-107	2.62	5.23	-107
-108	2.62	6.02	-108
-109	2.62	7.59	-109
-110	2.62	9.19	-110
-111	2.62	10.77	-111
-112	2.62	12.37	-112
-113	2.62	13.94	-113
-114	2.62	15.54	-114
-115	2.62	17.12	-115
-116	2.62	18.72	-116
-117	2.62	20.30	-117
-118	2.62	21.89	-118
-119	2.62	23.47	-119
-120	2.62	25.07	-120
-121	2.62	26.64	-121
-122	2.62	28.24	-122
-123	2.62	29.82	-123
-124	2.62	31.42	-124

Part Number	C/S	I.D.	Cross Ref. #
-125	2.62	32.99	-125
-126	2.62	34.59	-126
-127	2.62	36.17	-127
-128	2.62	37.77	-128
-129	2.62	39.34	-129
-130	2.62	40.94	-130
-131	2.62	42.52	-131
-132	2.62	44.12	-132
-133	2.62	45.69	-133
-134	2.62	47.29	-134
-135	2.62	48.90	-135
-136	2.62	50.47	-136
-137	2.62	52.07	-137
-138	2.62	53.64	-138
-139	2.62	55.25	-139
-140	2.62	56.82	-140
-141	2.62	58.42	-141
-142	2.62	59.99	-142
-143	2.62	61.60	-143
-144	2.62	63.17	-144
-145	2.62	64.77	-145
-146	2.62	66.34	-146
-147	2.62	67.95	-147
-148	2.62	69.52	-148
-149	2.62	71.12	-149
-150	2.62	72.69	-150
-151	2.62	75.87	-151
-152	2.62	82.22	-152
-153	2.62	88.57	-153
-154	2.62	94.92	-154
-155	2.62	101.27	-155
-156	2.62	107.62	-156
-157	2.62	113.97	-157
-158	2.62	120.32	-158
-159	2.62	126.67	-159
-160	2.62	133.02	-160
-161	2.62	139.37	-161
-162	2.62	145.72	-162
-163	2.62	152.07	-163
-164	2.62	158.42	-164
-165	2.62	164.77	-165
-166	2.62	171.12	-166
-167	2.62	177.47	-167
-168	2.62	183.82	-168
-169	2.62	190.17	-169
-170	2.62	196.52	-170
-171	2.62	202.87	-171
-172	2.62	209.22	-172
-173	2.62	215.57	-173
-174	2.62	221.92	-174
-175	2.62	228.27	-175

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
-176	2.62	234.62	-176
-177	2.62	240.97	-177
-178	2.62	247.32	-178
265014	2.65	14.00	
265015	2.65	15.00	
265016	2.65	16.00	
265017	2.65	17.00	
265018	2.65	18.00	
265019	2.65	19.00	
265020	2.65	20.00	
2650212	2.65	21.20	
2650224	2.65	22.40	
2650236	2.65	23.60	
265025	2.65	25.00	
2650258	2.65	25.80	
2650265	2.65	26.50	
265028	2.65	28.00	
265030	2.65	30.00	
2650315	2.65	31.50	
265032	2.65	32.00	
2650325	2.65	32.50	
2650335	2.65	33.50	
2650345	2.65	34.50	
2650355	2.65	35.50	
2650365	2.65	36.50	
2650375	2.65	37.50	
2650387	2.65	38.70	
300035	3.00	3.50	
30004	3.00	4.00	
300045	3.00	4.50	
30005	3.00	5.00	
300055	3.00	5.50	
30006	3.00	6.00	
300065	3.00	6.50	
30007	3.00	7.00	
300075	3.00	7.50	
30008	3.00	8.00	
300085	3.00	8.50	
30009	3.00	9.00	
300095	3.00	9.50	
30010	3.00	10.00	
300105	3.00	10.50	
30011	3.00	11.00	
300115	3.00	11.50	
30012	3.00	12.00	
300125	3.00	12.50	
30013	3.00	13.00	
300135	3.00	13.50	
30014	3.00	14.00	
300145	3.00	14.50	
30015	3.00	15.00	

Part Number	C/S	I.D.	Cross Ref. #
300155	3.00	15.50	
30016	3.00	16.00	
300165	3.00	16.50	
30017	3.00	17.00	
300175	3.00	17.50	
30018	3.00	18.00	
300182	3.00	18.20	
300185	3.00	18.50	
30019	3.00	19.00	
300192	3.00	19.20	
300195	3.00	19.50	
30020	3.00	20.00	
300205	3.00	20.50	
30021	3.00	21.00	
300215	3.00	21.50	
30022	3.00	22.00	
300222	3.00	22.20	
300225	3.00	22.50	
30023	3.00	23.00	
300235	3.00	23.50	
30024	3.00	24.00	
300242	3.00	24.20	
300245	3.00	24.50	
300246	3.00	24.60	
30025	3.00	25.00	
300252	3.00	25.20	
300255	3.00	25.50	
30026	3.00	26.00	
300262	3.00	26.20	
300265	3.00	26.50	
30027	3.00	27.00	
300275	3.00	27.50	
30028	3.00	28.00	
300285	3.00	28.50	
30029	3.00	29.00	
300292	3.00	29.20	
300295	3.00	29.50	
30030	3.00	30.00	
300302	3.00	30.20	
300305	3.00	30.50	
30031	3.00	31.00	
300315	3.00	31.50	
30032	3.00	32.00	
300322	3.00	32.20	
300325	3.00	32.50	
30033	3.00	33.00	
300335	3.00	33.50	
30034	3.00	34.00	
300342	3.00	34.20	
300345	3.00	34.50	
30035	3.00	35.00	

Part Number	C/S	I.D.	Cross Ref. #
300355	3.00	35.50	
30036	3.00	36.00	
300362	3.00	36.20	
300365	3.00	36.50	
30037	3.00	37.00	
300372	3.00	37.20	
300375	3.00	37.50	
30038	3.00	38.00	
300385	3.00	38.50	
30039	3.00	39.00	
300392	3.00	39.20	
300395	3.00	39.50	
30040	3.00	40.00	
300402	3.00	40.20	
30041	3.00	41.00	
300415	3.00	41.50	
30042	3.00	42.00	
300422	3.00	42.20	
300425	3.00	42.50	
30043	3.00	43.00	
30044	3.00	44.00	
300442	3.00	44.20	
300445	3.00	44.50	
30045	3.00	45.00	
30046	3.00	46.00	
30047	3.00	47.00	
30048	3.00	48.00	
30049	3.00	49.00	
300495	3.00	49.50	
30050	3.00	50.00	
300505	3.00	50.50	
30051	3.00	51.00	
30052	3.00	52.00	
30053	3.00	53.00	
30054	3.00	54.00	
300542	3.00	54.20	
300545	3.00	54.50	
30055	3.00	55.00	
30056	3.00	56.00	
300562	3.00	56.20	
30057	3.00	57.00	
30058	3.00	58.00	
30059	3.00	59.00	
300595	3.00	59.50	
30060	3.00	60.00	
30061	3.00	61.00	
30062	3.00	62.00	
300622	3.00	62.20	
30063	3.00	63.00	
30064	3.00	64.00	
300645	3.00	64.50	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
30065	3.00	65.00	
30066	3.00	66.00	
30067	3.00	67.00	
30068	3.00	68.00	
30069	3.00	69.00	
30070	3.00	70.00	
30071	3.00	71.00	
30072	3.00	72.00	
30073	3.00	73.00	
30074	3.00	74.00	
30075	3.00	75.00	
30076	3.00	76.00	
30077	3.00	77.00	
30078	3.00	78.00	
30079	3.00	79.00	
30080	3.00	80.00	
30081	3.00	81.00	
30082	3.00	82.00	
30083	3.00	83.00	
30084	3.00	84.00	
300845	3.00	84.50	
30085	3.00	85.00	
30086	3.00	86.00	
30087	3.00	87.00	
30088	3.00	88.00	
30089	3.00	89.00	
300895	3.00	89.50	
30090	3.00	90.00	
30091	3.00	91.00	
30092	3.00	92.00	
30093	3.00	93.00	
30094	3.00	94.00	
300945	3.00	94.50	
30095	3.00	95.00	
30096	3.00	96.00	
30097	3.00	97.00	
30098	3.00	98.00	
30099	3.00	99.00	
300995	3.00	99.50	
30100	3.00	100.00	
30101	3.00	101.00	
30102	3.00	102.00	
30103	3.00	103.00	
30104	3.00	104.00	
301045	3.00	104.50	
30105	3.00	105.00	
30106	3.00	106.00	
30107	3.00	107.00	
30108	3.00	108.00	
30109	3.00	109.00	
301095	3.00	109.50	

Part Number	C/S	I.D.	Cross Ref. #
30110	3.00	110.00	
30111	3.00	111.00	
30112	3.00	112.00	
30113	3.00	113.00	
30114	3.00	114.00	
301145	3.00	114.50	
30115	3.00	115.00	
30116	3.00	116.00	
30117	3.00	117.00	
30118	3.00	118.00	
30119	3.00	119.00	
301195	3.00	119.50	
30120	3.00	120.00	
30121	3.00	121.00	
30122	3.00	122.00	
30123	3.00	123.00	
30124	3.00	124.00	
301245	3.00	124.50	
30125	3.00	125.00	
30126	3.00	126.00	
301265	3.00	126.50	
30127	3.00	127.00	
30128	3.00	128.00	
30129	3.00	129.00	
301295	3.00	129.50	
30130	3.00	130.00	
30131	3.00	131.00	
30132	3.00	132.00	
30133	3.00	133.00	
30134	3.00	134.00	
301345	3.00	134.50	
30135	3.00	135.00	
30136	3.00	136.00	
30137	3.00	137.00	
30138	3.00	138.00	
30139	3.00	139.00	
301395	3.00	139.50	
30140	3.00	140.00	
30141	3.00	141.00	
30142	3.00	142.00	
30143	3.00	143.00	
30144	3.00	144.00	
301445	3.00	144.50	
30145	3.00	145.00	
30146	3.00	146.00	
30147	3.00	147.00	
30148	3.00	148.00	
30149	3.00	149.00	
301495	3.00	149.50	
30150	3.00	150.00	
30151	3.00	151.00	

Part Number	C/S	I.D.	Cross Ref. #
30152	3.00	152.00	
30153	3.00	153.00	
30154	3.00	154.00	
301545	3.00	154.50	
30155	3.00	155.00	
30156	3.00	156.00	
30157	3.00	157.00	
30158	3.00	158.00	
30159	3.00	159.00	
301595	3.00	159.50	
30160	3.00	160.00	
30161	3.00	161.00	
30162	3.00	162.00	
30163	3.00	163.00	
30164	3.00	164.00	
301645	3.00	164.50	
30165	3.00	165.00	
30166	3.00	166.00	
30167	3.00	167.00	
30168	3.00	168.00	
30169	3.00	169.00	
301695	3.00	169.50	
30170	3.00	170.00	
30171	3.00	171.00	
30172	3.00	172.00	
30173	3.00	173.00	
30174	3.00	174.00	
301745	3.00	174.50	
30175	3.00	175.00	
30176	3.00	176.00	
30177	3.00	177.00	
30178	3.00	178.00	
30179	3.00	179.00	
301795	3.00	179.50	
30180	3.00	180.00	
30181	3.00	181.00	
30182	3.00	182.00	
30183	3.00	183.00	
301835	3.00	183.50	
30184	3.00	184.00	
301845	3.00	184.50	
30185	3.00	185.00	
30186	3.00	186.00	
30187	3.00	187.00	
30188	3.00	188.00	
30189	3.00	189.00	
301895	3.00	189.50	
30190	3.00	190.00	
30191	3.00	191.00	
30192	3.00	192.00	
30193	3.00	193.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
30194	3.00	194.00	
301945	3.00	194.50	
30195	3.00	195.00	
30196	3.00	196.00	
30197	3.00	197.00	
30198	3.00	198.00	
30199	3.00	199.00	
301995	3.00	199.50	
30200	3.00	200.00	
310244	3.10	24.40	G 25
310294	3.10	29.40	G 30
310344	3.10	34.40	G 35
310394	3.10	39.40	G 40
310444	3.10	44.40	G 45
310494	3.10	49.40	G 50
310544	3.10	54.40	G 55
310594	3.10	59.40	G 60
310644	3.10	64.40	G 65
310694	3.10	69.40	G 70
310744	3.10	74.40	G 75
310794	3.10	79.40	G 80
310844	3.10	84.40	G 85
310894	3.10	89.40	G 90
310944	3.10	94.40	G 95
310994	3.10	99.40	G 100
311044	3.10	104.40	G 105
311094	3.10	109.40	G 110
311144	3.10	114.40	G 115
311194	3.10	119.40	G 120
311244	3.10	124.40	G 125
311294	3.10	129.40	G 130
311344	3.10	134.40	G 135
311394	3.10	139.40	G 140
311444	3.10	144.40	G 145
35005	3.50	5.00	
35008	3.50	8.00	
35009	3.50	9.00	
350092	3.50	9.20	
35010	3.50	10.00	
35011	3.50	11.00	
35012	3.50	12.00	
35013	3.50	13.00	
35014	3.50	14.00	
35015	3.50	15.00	
35016	3.50	16.00	
35017	3.50	17.00	
350175	3.50	17.50	
35018	3.50	18.00	
35019	3.50	19.00	
35020	3.50	20.00	
35021	3.50	21.00	

Part Number	C/S	I.D.	Cross Ref. #
350217	3.50	21.70	P 22A
35022	3.50	22.00	
350221	3.50	22.10	P 22.4
35023	3.50	23.00	
350237	3.50	23.70	P 24
35024	3.50	24.00	
350247	3.50	24.70	P 25
35025	3.50	25.00	
350252	3.50	25.20	P 25.5
350257	3.50	25.70	P 26
35026	3.50	26.00	
35027	3.50	27.00	
350277	3.50	27.70	P 28
35028	3.50	28.00	
350287	3.50	28.70	P 29
35029	3.50	29.00	
350292	3.50	29.20	P 29.5
350297	3.50	29.70	P 30
35030	3.50	30.00	
350305	3.50	30.50	
350307	3.50	30.70	P 31
35031	3.50	31.00	
350312	3.50	31.20	P 31.5
350317	3.50	31.70	P 32
35032	3.50	32.00	
35033	3.50	33.00	
350337	3.50	33.70	P 34
35034	3.50	34.00	
350347	3.50	34.70	P 35
35035	3.50	35.00	
350352	3.50	35.20	P 35.5
350357	3.50	35.70	P 36
35036	3.50	36.00	
35037	3.50	37.00	
350377	3.50	37.70	P 38
35038	3.50	38.00	
350387	3.50	38.70	P 39
35039	3.50	39.00	
350397	3.50	39.70	P 40
35040	3.50	40.00	
350407	3.50	40.70	P 41
35041	3.50	41.00	
350417	3.50	41.70	P 42
35042	3.50	42.00	
35043	3.50	43.00	
350437	3.50	43.70	P 44
35044	3.50	44.00	
350447	3.50	44.70	P 45
35045	3.50	45.00	
350457	3.50	45.70	P 46
35046	3.50	46.00	

Part Number	C/S	I.D.	Cross Ref. #
35047	3.50	47.00	
350477	3.50	47.70	P 48
35048	3.50	48.00	
350487	3.50	48.70	P 49
35049	3.50	49.00	
350497	3.50	49.70	P 50
35050	3.50	50.00	
35051	3.50	51.00	
35052	3.50	52.00	
35053	3.50	53.00	
35054	3.50	54.00	
35055	3.50	55.00	
35056	3.50	56.00	
35057	3.50	57.00	
35058	3.50	58.00	
35059	3.50	59.00	
35060	3.50	60.00	
35061	3.50	61.00	
35062	3.50	62.00	
35063	3.50	63.00	
35064	3.50	64.00	
35065	3.50	65.00	
35066	3.50	66.00	
35067	3.50	67.00	
35068	3.50	68.00	
35069	3.50	69.00	
35070	3.50	70.00	
35071	3.50	71.00	
35072	3.50	72.00	
35073	3.50	73.00	
35074	3.50	74.00	
35075	3.50	75.00	
35076	3.50	76.00	
35077	3.50	77.00	
35078	3.50	78.00	
35079	3.50	79.00	
35080	3.50	80.00	
35081	3.50	81.00	
35082	3.50	82.00	
35083	3.50	83.00	
35084	3.50	84.00	
35085	3.50	85.00	
35086	3.50	86.00	
35087	3.50	87.00	
35088	3.50	88.00	
35089	3.50	89.00	
35090	3.50	90.00	
35091	3.50	91.00	
35092	3.50	92.00	
35093	3.50	93.00	
35094	3.50	94.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
35095	3.50	95.00	
35096	3.50	96.00	
35097	3.50	97.00	
35098	3.50	98.00	
35099	3.50	99.00	
35100	3.50	100.00	
35101	3.50	101.00	
35102	3.50	102.00	
35103	3.50	103.00	
35104	3.50	104.00	
35105	3.50	105.00	
35106	3.50	106.00	
35107	3.50	107.00	
35108	3.50	108.00	
35109	3.50	109.00	
35110	3.50	110.00	
35111	3.50	111.00	
35112	3.50	112.00	
35113	3.50	113.00	
35114	3.50	114.00	
35115	3.50	115.00	
35116	3.50	116.00	
35117	3.50	117.00	
35118	3.50	118.00	
35119	3.50	119.00	
35120	3.50	120.00	
35121	3.50	121.00	
35122	3.50	122.00	
35123	3.50	123.00	
35124	3.50	124.00	
35125	3.50	125.00	
35126	3.50	126.00	
35127	3.50	127.00	
35128	3.50	128.00	
35129	3.50	129.00	
35130	3.50	130.00	
35131	3.50	131.00	
35132	3.50	132.00	
35133	3.50	133.00	
35134	3.50	134.00	
35135	3.50	135.00	
35136	3.50	136.00	
35137	3.50	137.00	
35138	3.50	138.00	
35139	3.50	139.00	
35140	3.50	140.00	
35141	3.50	141.00	
35142	3.50	142.00	
35143	3.50	143.00	
35144	3.50	144.00	
35145	3.50	145.00	

Part Number	C/S	I.D.	Cross Ref. #
35146	3.50	146.00	
35147	3.50	147.00	
35148	3.50	148.00	
35149	3.50	149.00	
35150	3.50	150.00	
35151	3.50	151.00	
35152	3.50	152.00	
35153	3.50	153.00	
35154	3.50	154.00	
35155	3.50	155.00	
35156	3.50	156.00	
35157	3.50	157.00	
35158	3.50	158.00	
35159	3.50	159.00	
35160	3.50	160.00	
35161	3.50	161.00	
35162	3.50	162.00	
35163	3.50	163.00	
35164	3.50	164.00	
35165	3.50	165.00	
35166	3.50	166.00	
35167	3.50	167.00	
35168	3.50	168.00	
35169	3.50	169.00	
35170	3.50	170.00	
35171	3.50	171.00	
35172	3.50	172.00	
35173	3.50	173.00	
35174	3.50	174.00	
35175	3.50	175.00	
35176	3.50	176.00	
35177	3.50	177.00	
35178	3.50	178.00	
35179	3.50	179.00	
35180	3.50	180.00	
35181	3.50	181.00	
35182	3.50	182.00	
35183	3.50	183.00	
35184	3.50	184.00	
35185	3.50	185.00	
35186	3.50	186.00	
35187	3.50	187.00	
35188	3.50	188.00	
35189	3.50	189.00	
35190	3.50	190.00	
35191	3.50	191.00	
35192	3.50	192.00	
35193	3.50	193.00	
35194	3.50	194.00	
35195	3.50	195.00	
35196	3.50	196.00	

Part Number	C/S	I.D.	Cross Ref. #
35197	3.50	197.00	
35198	3.50	198.00	
35199	3.50	199.00	
35200	3.50	200.00	
-201	3.53	4.34	-201
-202	3.53	5.94	-202
-203	3.53	7.52	-203
-204	3.53	9.12	-204
-205	3.53	10.69	-205
-206	3.53	12.29	-206
-207	3.53	13.87	-207
-208	3.53	15.47	-208
-209	3.53	17.04	-209
-210	3.53	18.64	-210
-211	3.53	20.22	-211
-212	3.53	21.82	-212
-213	3.53	23.39	-213
-214	3.53	24.99	-214
-215	3.53	26.57	-215
-216	3.53	28.17	-216
-217	3.53	29.74	-217
-218	3.53	31.34	-218
-219	3.53	32.92	-219
-220	3.53	34.52	-220
-221	3.53	36.09	-221
-222	3.53	37.69	-222
-223	3.53	40.87	-223
-224	3.53	44.04	-224
-225	3.53	47.22	-225
-226	3.53	50.39	-226
-227	3.53	53.57	-227
-228	3.53	56.74	-228
-229	3.53	59.92	-229
-230	3.53	63.09	-230
-231	3.53	66.27	-231
-232	3.53	69.44	-232
-233	3.53	72.62	-233
-234	3.53	75.79	-234
-235	3.53	78.97	-235
-236	3.53	82.14	-236
-237	3.53	85.32	-237
-238	3.53	88.49	-238
-239	3.53	91.67	-239
-240	3.53	94.84	-240
-241	3.53	98.02	-241
-242	3.53	101.19	-242
-243	3.53	104.37	-243
-244	3.53	107.54	-244
-245	3.53	110.72	-245
-246	3.53	113.89	-246
-247	3.53	117.07	-247

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
-248	3.53	120.24	-248
-249	3.53	123.42	-249
-250	3.53	126.59	-250
-251	3.53	129.77	-251
-252	3.53	132.94	-252
-253	3.53	136.12	-253
-254	3.53	139.29	-254
-255	3.53	142.47	-255
-256	3.53	145.64	-256
-257	3.53	148.82	-257
-258	3.53	151.99	-258
-259	3.53	158.34	-259
-260	3.53	164.69	-260
-261	3.53	171.04	-261
-262	3.53	177.39	-262
-263	3.53	183.74	-263
-264	3.53	190.09	-264
-265	3.53	196.44	-265
-266	3.53	202.79	-266
-267	3.53	209.14	-267
-268	3.53	215.49	-268
-269	3.53	221.84	-269
-270	3.53	228.19	-270
-271	3.53	234.54	-271
-272	3.53	240.89	-272
-273	3.53	247.24	-273
-274	3.53	253.59	-274
-275	3.53	266.29	-275
-276	3.53	278.99	-276
-277	3.53	291.69	-277
-278	3.53	304.39	-278
-279	3.53	329.79	-279
-280	3.53	355.19	-280
-281	3.53	380.59	-281
-282	3.53	405.26	-282
-283	3.53	430.68	-283
-284	3.53	456.06	-284
360183	3.60	18.30	
360198	3.60	19.80	
360213	3.60	21.30	
36023	3.60	23.00	
360246	3.60	24.60	
360262	3.60	26.20	
360278	3.60	27.80	
360293	3.60	29.30	
360308	3.60	30.80	
360325	3.60	32.50	
360341	3.60	34.10	
360356	3.60	35.60	
360373	3.60	37.30	
360434	3.60	43.40	

Part Number	C/S	I.D.	Cross Ref. #
40004	4.00	4.00	
40005	4.00	5.00	
40006	4.00	6.00	
40007	4.00	7.00	
40008	4.00	8.00	
40009	4.00	9.00	
40010	4.00	10.00	
40011	4.00	11.00	
40012	4.00	12.00	
40013	4.00	13.00	
40014	4.00	14.00	
400145	4.00	14.50	V 15
40015	4.00	15.00	
40016	4.00	16.00	
40017	4.00	17.00	
40018	4.00	18.00	
40019	4.00	19.00	
40020	4.00	20.00	
40021	4.00	21.00	
40022	4.00	22.00	
40023	4.00	23.00	
400235	4.00	23.50	V 24
40024	4.00	24.00	
40025	4.00	25.00	
40026	4.00	26.00	
40027	4.00	27.00	
40028	4.00	28.00	
40029	4.00	29.00	
40030	4.00	30.00	
40031	4.00	31.00	
40032	4.00	32.00	
40033	4.00	33.00	
400335	4.00	33.50	V 34
40034	4.00	34.00	
40035	4.00	35.00	
400355	4.00	35.50	V 36
40036	4.00	36.00	
40037	4.00	37.00	
40038	4.00	38.00	
40039	4.00	39.00	
400395	4.00	39.50	V 40
40040	4.00	40.00	
40041	4.00	41.00	
40042	4.00	42.00	
40043	4.00	43.00	
40044	4.00	44.00	
40045	4.00	45.00	
40046	4.00	46.00	
40047	4.00	47.00	
40048	4.00	48.00	
40049	4.00	49.00	

Part Number	C/S	I.D.	Cross Ref. #
40050	4.00	50.00	
40051	4.00	51.00	
40052	4.00	52.00	
40053	4.00	53.00	
40054	4.00	54.00	
400545	4.00	54.50	V 55
40055	4.00	55.00	
40056	4.00	56.00	
40057	4.00	57.00	
40058	4.00	58.00	
40059	4.00	59.00	
40060	4.00	60.00	
40061	4.00	61.00	
40062	4.00	62.00	
40063	4.00	63.00	
40064	4.00	64.00	
40065	4.00	65.00	
40066	4.00	66.00	
40067	4.00	67.00	
40068	4.00	68.00	
40069	4.00	69.00	V 70
40070	4.00	70.00	
40071	4.00	71.00	
40072	4.00	72.00	
40073	4.00	73.00	
40074	4.00	74.00	
40075	4.00	75.00	
40076	4.00	76.00	
40077	4.00	77.00	
40078	4.00	78.00	
40079	4.00	79.00	
40080	4.00	80.00	
40081	4.00	81.00	
40082	4.00	82.00	
40083	4.00	83.00	
40084	4.00	84.00	V 85
40085	4.00	85.00	
40086	4.00	86.00	
40087	4.00	87.00	
40088	4.00	88.00	
40089	4.00	89.00	
40090	4.00	90.00	
40091	4.00	91.00	
40092	4.00	92.00	
40093	4.00	93.00	
40094	4.00	94.00	
40109	4.00	109.00	
40110	4.00	110.00	
40111	4.00	111.00	
40112	4.00	112.00	
40113	4.00	113.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
40114	4.00	114.00	
40115	4.00	115.00	
40116	4.00	116.00	
40117	4.00	117.00	
40118	4.00	118.00	
40119	4.00	119.00	V 120
40120	4.00	120.00	
40121	4.00	121.00	
40122	4.00	122.00	
40123	4.00	123.00	
40124	4.00	124.00	
40125	4.00	125.00	
40126	4.00	126.00	
40127	4.00	127.00	
40128	4.00	128.00	
40129	4.00	129.00	
40130	4.00	130.00	
40131	4.00	131.00	
40132	4.00	132.00	
40133	4.00	133.00	
40134	4.00	134.00	
40135	4.00	135.00	
40136	4.00	136.00	
40137	4.00	137.00	
40138	4.00	138.00	
40139	4.00	139.00	
40140	4.00	140.00	
40141	4.00	141.00	
40142	4.00	142.00	
40143	4.00	143.00	
40144	4.00	144.00	
40145	4.00	145.00	
40146	4.00	146.00	
40147	4.00	147.00	
40148	4.00	148.00	
401485	4.00	148.50	V 150
40149	4.00	149.00	
40150	4.00	150.00	
40151	4.00	151.00	
40152	4.00	152.00	
40153	4.00	153.00	
40154	4.00	154.00	
40155	4.00	155.00	
40156	4.00	156.00	
40157	4.00	157.00	
40158	4.00	158.00	
40159	4.00	159.00	
40160	4.00	160.00	
40161	4.00	161.00	
40162	4.00	162.00	
40163	4.00	163.00	

Part Number	C/S	I.D.	Cross Ref. #
40164	4.00	164.00	
40165	4.00	165.00	
40166	4.00	166.00	
40167	4.00	167.00	
40168	4.00	168.00	
40169	4.00	169.00	
40170	4.00	170.00	
40171	4.00	171.00	
40172	4.00	172.00	
40173	4.00	173.00	V175
40174	4.00	174.00	
40175	4.00	175.00	
40176	4.00	176.00	
40177	4.00	177.00	
40178	4.00	178.00	
40179	4.00	179.00	
40180	4.00	180.00	
40181	4.00	181.00	
40182	4.00	182.00	
40183	4.00	183.00	
40184	4.00	184.00	
40185	4.00	185.00	
40186	4.00	186.00	
40187	4.00	187.00	
40188	4.00	188.00	
40189	4.00	189.00	
40190	4.00	190.00	
40191	4.00	191.00	
40192	4.00	192.00	
40193	4.00	193.00	
40194	4.00	194.00	
40195	4.00	195.00	
40196	4.00	196.00	
40197	4.00	197.00	
40198	4.00	198.00	
40199	4.00	199.00	
40200	4.00	200.00	
40201	4.00	201.00	
40202	4.00	202.00	
40203	4.00	203.00	
40204	4.00	204.00	
40205	4.00	205.00	
40206	4.00	206.00	
40207	4.00	207.00	
40208	4.00	208.00	
40209	4.00	209.00	
40210	4.00	210.00	
45006	4.50	6.00	
45008	4.50	8.00	
45009	4.50	9.00	
45010	4.50	10.00	

Part Number	C/S	I.D.	Cross Ref. #
45011	4.50	11.00	
45012	4.50	12.00	
45013	4.50	13.00	
45015	4.50	15.00	
45016	4.50	16.00	
45017	4.50	17.00	
45018	4.50	18.00	
45019	4.50	19.00	
45020	4.50	20.00	
45021	4.50	21.00	
45022	4.50	22.00	
45023	4.50	23.00	
45024	4.50	24.00	
45025	4.50	25.00	
45026	4.50	26.00	
45028	4.50	28.00	
45029	4.50	29.00	
45030	4.50	30.00	
45031	4.50	31.00	
45032	4.50	32.00	
45033	4.50	33.00	
45034	4.50	34.00	
45035	4.50	35.00	
45036	4.50	36.00	
45037	4.50	37.00	
45038	4.50	38.00	
45039	4.50	39.00	
45040	4.50	40.00	
45041	4.50	41.00	
45042	4.50	42.00	
45043	4.50	43.00	
45044	4.50	44.00	
45045	4.50	45.00	
45046	4.50	46.00	
45047	4.50	47.00	
45048	4.50	48.00	
45049	4.50	49.00	
45050	4.50	50.00	
45051	4.50	51.00	
45053	4.50	53.00	
45056	4.50	56.00	
45057	4.50	57.00	
45060	4.50	60.00	
45061	4.50	61.00	
45062	4.50	62.00	
45063	4.50	63.00	
45064	4.50	64.00	
45065	4.50	65.00	
45066	4.50	66.00	
45068	4.50	68.00	
45069	4.50	69.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
45070	4.50	70.00	
45071	4.50	71.00	
45073	4.50	73.00	
45074	4.50	74.00	
45075	4.50	75.00	
45076	4.50	76.00	
45080	4.50	80.00	
45081	4.50	81.00	
45083	4.50	83.00	
45085	4.50	85.00	
45086	4.50	86.00	
45089	4.50	89.00	
45090	4.50	90.00	
45092	4.50	92.00	
45095	4.50	95.00	
45098	4.50	98.00	
45100	4.50	100.00	
45101	4.50	101.00	
45105	4.50	105.00	
45106	4.50	106.00	
45110	4.50	110.00	
45115	4.50	115.00	
45118	4.50	118.00	
45120	4.50	120.00	
45122	4.50	122.00	
45124	4.50	124.00	
45126	4.50	126.00	
45128	4.50	128.00	
45130	4.50	130.00	
45137	4.50	137.00	
45140	4.50	140.00	
45150	4.50	150.00	
45153	4.50	153.00	
45155	4.50	155.00	
45157	4.50	157.00	
45160	4.50	160.00	
45165	4.50	165.00	
50004	5.00	4.00	
50005	5.00	5.00	
50006	5.00	6.00	
50007	5.00	7.00	
50008	5.00	8.00	
50009	5.00	9.00	
50010	5.00	10.00	
50011	5.00	11.00	
50012	5.00	12.00	
50013	5.00	13.00	
50014	5.00	14.00	
50015	5.00	15.00	
50016	5.00	16.00	
50017	5.00	17.00	

Part Number	C/S	I.D.	Cross Ref. #
50018	5.00	18.00	
50019	5.00	19.00	
50020	5.00	20.00	
50021	5.00	21.00	
50022	5.00	22.00	
50023	5.00	23.00	
50024	5.00	24.00	
50025	5.00	25.00	
50026	5.00	26.00	
50027	5.00	27.00	
50028	5.00	28.00	
50029	5.00	29.00	
50030	5.00	30.00	
50031	5.00	31.00	
50032	5.00	32.00	
50033	5.00	33.00	
50034	5.00	34.00	
50035	5.00	35.00	
50036	5.00	36.00	
50037	5.00	37.00	
50038	5.00	38.00	
50039	5.00	39.00	
50040	5.00	40.00	
50041	5.00	41.00	
50042	5.00	42.00	
50043	5.00	43.00	
50044	5.00	44.00	
50045	5.00	45.00	
50046	5.00	46.00	
50047	5.00	47.00	
50048	5.00	48.00	
50049	5.00	49.00	
50050	5.00	50.00	
50051	5.00	51.00	
50052	5.00	52.00	
50053	5.00	53.00	
50054	5.00	54.00	
50055	5.00	55.00	
50056	5.00	56.00	
50057	5.00	57.00	
50058	5.00	58.00	
50059	5.00	59.00	
50060	5.00	60.00	
50061	5.00	61.00	
50062	5.00	62.00	
50063	5.00	63.00	
50064	5.00	64.00	
50065	5.00	65.00	
50066	5.00	66.00	
50067	5.00	67.00	
50068	5.00	68.00	

Part Number	C/S	I.D.	Cross Ref. #
50069	5.00	69.00	
50070	5.00	70.00	
50071	5.00	71.00	
50072	5.00	72.00	
50073	5.00	73.00	
50074	5.00	74.00	
50075	5.00	75.00	
50076	5.00	76.00	
50077	5.00	77.00	
50078	5.00	78.00	
50079	5.00	79.00	
50080	5.00	80.00	
50081	5.00	81.00	
50082	5.00	82.00	
50083	5.00	83.00	
50084	5.00	84.00	
50085	5.00	85.00	
50086	5.00	86.00	
50087	5.00	87.00	
50088	5.00	88.00	
50089	5.00	89.00	
50090	5.00	90.00	
50091	5.00	91.00	
50092	5.00	92.00	
50093	5.00	93.00	
50094	5.00	94.00	
50095	5.00	95.00	
50096	5.00	96.00	
50097	5.00	97.00	
50098	5.00	98.00	
50099	5.00	99.00	
50100	5.00	100.00	
50101	5.00	101.00	
50102	5.00	102.00	
50103	5.00	103.00	
50104	5.00	104.00	
50105	5.00	105.00	
50106	5.00	106.00	
50107	5.00	107.00	
50108	5.00	108.00	
50109	5.00	109.00	
50110	5.00	110.00	
50111	5.00	111.00	
50112	5.00	112.00	
50113	5.00	113.00	
50114	5.00	114.00	
50115	5.00	115.00	
50116	5.00	116.00	
50117	5.00	117.00	
50118	5.00	118.00	
50119	5.00	119.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
50120	5.00	120.00	
50121	5.00	121.00	
50122	5.00	122.00	
50123	5.00	123.00	
50124	5.00	124.00	
50125	5.00	125.00	
50126	5.00	126.00	
50127	5.00	127.00	
50128	5.00	128.00	
50129	5.00	129.00	
50130	5.00	130.00	
50131	5.00	131.00	
50132	5.00	132.00	
50133	5.00	133.00	
50134	5.00	134.00	
50135	5.00	135.00	
50136	5.00	136.00	
50137	5.00	137.00	
50138	5.00	138.00	
50139	5.00	139.00	
50140	5.00	140.00	
50141	5.00	141.00	
50142	5.00	142.00	
50143	5.00	143.00	
50144	5.00	144.00	
50145	5.00	145.00	
50146	5.00	146.00	
50147	5.00	147.00	
50148	5.00	148.00	
50149	5.00	149.00	
50150	5.00	150.00	
50151	5.00	151.00	
50152	5.00	152.00	
50153	5.00	153.00	
50154	5.00	154.00	
50155	5.00	155.00	
50156	5.00	156.00	
50157	5.00	157.00	
50158	5.00	158.00	
50159	5.00	159.00	
50160	5.00	160.00	
50161	5.00	161.00	
50162	5.00	162.00	
50163	5.00	163.00	
50164	5.00	164.00	
50165	5.00	165.00	
50166	5.00	166.00	
50167	5.00	167.00	
50168	5.00	168.00	
50169	5.00	169.00	
50170	5.00	170.00	

Part Number	C/S	I.D.	Cross Ref. #
50171	5.00	171.00	
50172	5.00	172.00	
50173	5.00	173.00	
50174	5.00	174.00	
50175	5.00	175.00	
50176	5.00	176.00	
50177	5.00	177.00	
50178	5.00	178.00	
50179	5.00	179.00	
50180	5.00	180.00	
50181	5.00	181.00	
50182	5.00	182.00	
50183	5.00	183.00	
50184	5.00	184.00	
50185	5.00	185.00	
50186	5.00	186.00	
50187	5.00	187.00	
50188	5.00	188.00	
50189	5.00	189.00	
50190	5.00	190.00	
50191	5.00	191.00	
50192	5.00	192.00	
50193	5.00	193.00	
50194	5.00	194.00	
50195	5.00	195.00	
50196	5.00	196.00	
50197	5.00	197.00	
50198	5.00	198.00	
50199	5.00	199.00	
50200	5.00	200.00	
50201	5.00	201.00	
50202	5.00	202.00	
50203	5.00	203.00	
50204	5.00	204.00	
50205	5.00	205.00	
50206	5.00	206.00	
50207	5.00	207.00	
50208	5.00	208.00	
50209	5.00	209.00	
50210	5.00	210.00	
50211	5.00	211.00	
50212	5.00	212.00	
50213	5.00	213.00	
50214	5.00	214.00	
50215	5.00	215.00	
50216	5.00	216.00	
50217	5.00	217.00	
50218	5.00	218.00	
50219	5.00	219.00	
50220	5.00	220.00	
50221	5.00	221.00	

Part Number	C/S	I.D.	Cross Ref. #
50222	5.00	222.00	
50223	5.00	223.00	
50224	5.00	224.00	
50225	5.00	225.00	
50226	5.00	226.00	
50227	5.00	227.00	
50228	5.00	228.00	
50229	5.00	229.00	
50230	5.00	230.00	
50231	5.00	231.00	
50232	5.00	232.00	
50233	5.00	233.00	
50234	5.00	234.00	
50235	5.00	235.00	
50236	5.00	236.00	
50237	5.00	237.00	
50238	5.00	238.00	
50239	5.00	239.00	
50240	5.00	240.00	
50241	5.00	241.00	
50242	5.00	242.00	
50243	5.00	243.00	
50244	5.00	244.00	
50245	5.00	245.00	
50246	5.00	246.00	
50247	5.00	247.00	
50248	5.00	248.00	
50249	5.00	249.00	
50250	5.00	250.00	
53040	5.30	40.00	
530412	5.30	41.20	
530414	5.30	41.40	
530425	5.30	42.50	
530437	5.30	43.70	
53045	5.30	45.00	
530462	5.30	46.20	
530475	5.30	47.50	
530487	5.30	48.70	
53050	5.30	50.00	
530515	5.30	51.50	
53053	5.30	53.00	
530544	5.30	54.40	
530545	5.30	54.50	
53056	5.30	56.00	
53058	5.30	58.00	
53060	5.30	60.00	
530615	5.30	61.50	
53063	5.30	63.00	
53065	5.30	65.00	
53067	5.30	67.00	
53069	5.30	69.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
53071	5.30	71.00	
53073	5.30	73.00	
53075	5.30	75.00	
530775	5.30	77.50	
53080	5.30	80.00	
530825	5.30	82.50	
53085	5.30	85.00	
530875	5.30	87.50	
53090	5.30	90.00	
530925	5.30	92.50	
53095	5.30	95.00	
530975	5.30	97.50	
53100	5.30	100.00	
53103	5.30	103.00	
53106	5.30	106.00	
53109	5.30	109.00	
53112	5.30	112.00	
53115	5.30	115.00	
53118	5.30	118.00	
53122	5.30	122.00	
53125	5.30	125.00	
53128	5.30	128.00	
53132	5.30	132.00	
53136	5.30	136.00	
53140	5.30	140.00	
53145	5.30	145.00	
53150	5.30	150.00	
53155	5.30	155.00	
53160	5.30	160.00	
53165	5.30	165.00	
53170	5.30	170.00	
53175	5.30	175.00	
53180	5.30	180.00	
53185	5.30	185.00	
53190	5.30	190.00	
53195	5.30	195.00	
53200	5.30	200.00	
-309	5.33	10.46	-309
-310	5.33	12.07	-310
-311	5.33	13.64	-311
-312	5.33	15.24	-312
-313	5.33	16.81	-313
-314	5.33	18.42	-314
-315	5.33	19.99	-315
-316	5.33	21.59	-316
-317	5.33	23.16	-317
-318	5.33	24.77	-318
-319	5.33	26.34	-319
-320	5.33	27.94	-320
-321	5.33	29.51	-321
-322	5.33	31.12	-322

Part Number	C/S	I.D.	Cross Ref. #
-323	5.33	32.69	-323
-324	5.33	34.29	-324
-325	5.33	37.47	-325
-326	5.33	40.64	-326
-327	5.33	43.82	-327
-328	5.33	46.99	-328
-329	5.33	50.17	-329
-330	5.33	53.34	-330
-331	5.33	56.52	-331
-332	5.33	59.69	-332
-333	5.33	62.87	-333
-334	5.33	66.04	-334
-335	5.33	69.22	-335
-336	5.33	72.39	-336
-337	5.33	75.57	-337
-338	5.33	78.74	-338
-339	5.33	81.92	-339
-340	5.33	85.09	-340
-341	5.33	88.27	-341
-342	5.33	91.44	-342
-343	5.33	94.62	-343
-344	5.33	97.79	-344
-345	5.33	100.97	-345
-346	5.33	104.14	-346
-347	5.33	107.32	-347
-348	5.33	110.49	-348
-349	5.33	113.67	-349
-350	5.33	116.84	-350
-351	5.33	120.02	-351
-352	5.33	123.19	-352
-353	5.33	126.37	-353
-354	5.33	129.54	-354
-355	5.33	132.72	-355
-356	5.33	135.89	-356
-357	5.33	139.07	-357
-358	5.33	142.24	-358
-359	5.33	145.42	-359
-360	5.33	148.59	-360
-361	5.33	151.77	-361
-362	5.33	158.12	-362
-363	5.33	164.47	-363
-364	5.33	170.82	-364
-365	5.33	177.17	-365
-366	5.33	183.52	-366
-367	5.33	189.87	-367
-368	5.33	196.22	-368
-369	5.33	202.57	-369
-370	5.33	208.92	-370
-371	5.33	215.27	-371
-372	5.33	221.62	-372
-373	5.33	227.97	-373

Part Number	C/S	I.D.	Cross Ref. #
-374	5.33	234.32	-374
-375	5.33	240.67	-375
-376	5.33	2 47.02	-376
-377	5.33	253.37	-377
-378	5.33	266.07	-378
-379	5.33	278.77	-379
-380	5.33	291.47	-380
-381	5.33	304.17	-381
-382	5.33	329.57	-382
-383	5.33	354.97	-383
-384	5.33	380.37	-384
-385	5.33	405.26	-385
-386	5.33	430.66	-386
-387	5.33	456.06	-387
-388	5.33	481.38	-388
-389	5.33	506.78	-389
-390	5.33	532.18	-390
-391	5.33	557.58	-391
-392	5.33	582.68	-392
-393	5.33	608.08	-393
-394	5.33	633.48	-394
-395	5.33	658.88	-395
570242	5.70	24.20	
570352	5.70	35.20	
570362	5.70	36.20	
570372	5.70	37.20	
570392	5.70	39.20	
570412	5.70	41.20	
570442	5.70	44.20	
570443	5.70	44.30	
570452	5.70	45.20	
570453	5.70	45.30	
570472	5.70	47.20	
570476	5.70	47.60	P 48A
570492	5.70	49.20	
570493	5.70	49.30	
570496	5.70	49.60	P 50A
570512	5.70	51.20	
570516	5.70	51.60	P 52
570522	5.70	52.20	
570523	5.70	52.30	
570525	5.70	52.50	
570526	5.70	52.60	P 53
570530	5.70	53.00	
570542	5.70	54.20	
570543	5.70	54.30	
570546	5.70	54.60	P 55
570552	5.70	55.20	
570553	5.70	55.30	
570556	5.70	55.60	P 56
570572	5.70	57.20	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
570576	5.70	57.60	P 58
570592	5.70	59.20	
570593	5.70	59.30	
570596	5.70	59.60	P 60
570597	5.70	59.70	
570612	5.70	61.20	
570616	5.70	61.60	P 62
57062	5.70	62.00	
570622	5.70	62.20	
570623	5.70	62.30	
570626	5.70	62.60	P 63
57064	5.70	64.00	
570642	5.70	64.20	
570643	5.70	64.30	
570646	5.70	64.60	P 65
570666	5.70	66.60	P 67
570672	5.70	67.20	
57069	5.70	69.00	
570692	5.70	69.20	
570693	5.70	69.30	
570696	5.70	69.60	P 70
570702	5.70	70.20	
570706	5.70	70.60	P 71
570712	5.70	71.20	
570722	5.70	72.20	
570723	5.70	72.30	
57074	5.70	74.00	
570742	5.70	74.20	
570743	5.70	74.30	
570746	5.70	74.60	P 75
570772	5.70	77.20	
57079	5.70	79.00	
570792	5.70	79.20	
570793	5.70	79.30	
570796	5.70	79.60	P 80
570812	5.70	81.20	
570822	5.70	82.20	
570842	5.70	84.20	
570846	5.70	84.60	P 85
570872	5.70	87.20	
570891	5.70	89.10	
570892	5.70	89.20	
570893	5.70	89.30	
570896	5.70	89.60	P 90
570922	5.70	92.20	
570942	5.70	94.20	
570946	5.70	94.60	P 95
570966	5.70	96.60	
570992	5.70	99.20	
570996	5.70	99.60	P 100
571016	5.70	101.60	P 102
571046	5.70	104.60	P 105
571092	5.70	109.20	
571093	5.70	109.30	
571096	5.70	109.60	P 110
571116	5.70	111.60	P 112
571142	5.70	114.20	
571143	5.70	114.30	
571146	5.70	114.60	P 115
571192	5.70	119.20	
571196	5.70	119.60	P 120
571246	5.70	124.60	P 125
571292	5.70	129.20	
571296	5.70	129.60	P 130
571316	5.70	131.60	P 132
571342	5.70	134.20	
571346	5.70	134.60	P 135
571392	5.70	139.20	
571393	5.70	139.30	
571396	5.70	139.60	P 140
571442	5.70	144.20	
571446	5.70	144.60	P 145
571492	5.70	149.20	
571493	5.70	149.30	G 150
571496	5.70	149.60	P 150
571543	5.70	154.30	G 155
571593	5.70	159.30	G 160
571642	5.70	164.20	
571643	5.70	164.30	G 165
571693	5.70	169.30	G 170
571742	5.70	174.20	
571743	5.70	174.30	G 175
571793	5.70	179.30	G 180
571843	5.70	184.30	G 185
571892	5.70	189.20	
571893	5.70	189.30	G 190
571942	5.70	194.20	
571943	5.70	194.30	G 195
571992	5.70	199.20	
571993	5.70	199.30	G 200
572042	5.70	204.20	
572092	5.70	209.20	
572093	5.70	209.30	G 210
572193	5.70	219.30	G 220
572293	5.70	229.30	G 230
572343	5.70	234.30	
572393	5.70	239.30	G 240
572493	5.70	249.30	G 250
572593	5.70	259.30	G 260
572693	5.70	269.30	G 270
572793	5.70	279.30	G 280
572893	5.70	289.30	G 290
572993	5.70	299.30	G 300
573193	5.70	319.30	6320
573393	5.70	339.30	6340
573493	5.70	349.30	6350
573593	5.70	359.30	6360
573793	5.70	379.30	6380
573993	5.70	399.30	6400
60012	6.00	12.00	
60018	6.00	18.00	
60020	6.00	20.00	
60023	6.00	23.00	
60024	6.00	24.00	
60025	6.00	25.00	
60026	6.00	26.00	
60032	6.00	32.00	
60034	6.00	34.00	
60035	6.00	35.00	
60036	6.00	36.00	
60037	6.00	37.00	
60038	6.00	38.00	
60040	6.00	40.00	
60041	6.00	41.00	
60042	6.00	42.00	
60044	6.00	44.00	
60045	6.00	45.00	
60046	6.00	46.00	
60048	6.00	48.00	
60050	6.00	50.00	
60052	6.00	52.00	
60056	6.00	56.00	
60058	6.00	58.00	
60059	6.00	59.00	
60060	6.00	60.00	
60062	6.00	62.00	
60064	6.00	64.00	
60065	6.00	65.00	
60067	6.00	67.00	
60069	6.00	69.00	
60070	6.00	70.00	
60072	6.00	72.00	
60073	6.00	73.00	
60074	6.00	74.00	
60075	6.00	75.00	
60076	6.00	76.00	
60079	6.00	79.00	
60080	6.00	80.00	
60085	6.00	85.00	
60086	6.00	86.00	
60088	6.00	88.00	
60090	6.00	90.00	
60092	6.00	92.00	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
60095	6.00	95.00	
60098	6.00	98.00	
60100	6.00	100.00	
60103	6.00	103.00	
60105	6.00	105.00	
60110	6.00	110.00	
60112	6.00	112.00	
60114	6.00	114.00	
60115	6.00	115.00	
60118	6.00	118.00	
60120	6.00	120.00	
60122	6.00	122.00	
60124	6.00	124.00	
60125	6.00	125.00	
60128	6.00	128.00	
60130	6.00	130.00	
60134	6.00	134.00	
60135	6.00	135.00	
60138	6.00	138.00	
60140	6.00	140.00	
60142	6.00	142.00	
60145	6.00	145.00	
60146	6.00	146.00	
60148	6.00	148.00	
60150	6.00	150.00	
60160	6.00	160.00	
60165	6.00	165.00	
60166	6.00	166.00	
60169	6.00	169.00	
60170	6.00	170.00	
60172	6.00	172.00	
60175	6.00	175.00	
60180	6.00	180.00	
60185	6.00	185.00	
60190	6.00	190.00	
60195	6.00	195.00	
60200	6.00	200.00	
60208	6.00	208.00	
60210	6.00	210.00	
60215	6.00	215.00	
60220	6.00	220.00	
602225	6.00	222.50	V 225
60230	6.00	230.00	
60242	6.00	242.00	
60250	6.00	250.00	
60262	6.00	262.00	
60266	6.00	266.00	
60270	6.00	270.00	
60272	6.00	272.00	V 275
60290	6.00	290.00	
60295	6.00	295.00	

Part Number	C/S	I.D.	Cross Ref. #
60300	6.00	300.00	
60320	6.00	320.00	
603215	6.00	321.50	V 325
60330	6.00	330.00	
60355	6.00	355.00	
60365	6.00	365.00	
60370	6.00	370.00	
60376	6.00	376.00	
603765	6.00	376.50	V 380
60380	6.00	380.00	
60385	6.00	385.00	
60392	6.00	392.00	
60394	6.00	394.00	
604255	6.00	425.50	V 430
60429	6.00	429.00	
60445	6.00	445.00	
60478	6.00	478.00	
60480	6.00	480.00	
60500	6.00	500.00	
60504	6.00	504.00	
60525	6.00	525.00	
60575	6.00	575.00	
-425	6.99	113.67	-425
-426	6.99	116.84	-426
-427	6.99	120.02	-427
-428	6.99	123.19	-428
-429	6.99	126.37	-429
-430	6.99	129.54	-430
-431	6.99	132.72	-431
-432	6.99	135.89	-432
-433	6.99	139.07	-433
-434	6.99	142.24	-434
-435	6.99	145.42	-435
-436	6.99	148.59	-436
-437	6.99	151.77	-437
-438	6.99	158.12	-438
-439	6.99	164.47	-439
-440	6.99	170.82	-440
-441	6.99	177.17	-441
-442	6.99	183.52	-442
-443	6.99	189.87	-443
-444	6.99	196.22	-444
-445	6.99	202.57	-445
-446	6.99	215.27	-446
-447	6.99	227.97	-447
-448	6.99	240.67	-448
-449	6.99	253.37	-449
-450	6.99	266.07	-450
-451	6.99	278.77	-451
-452	6.99	291.47	-452
-453	6.99	304.17	-453

Part Number	C/S	I.D.	Cross Ref. #
-454	6.99	316.87	-454
-455	6.99	329.57	-455
-456	6.99	342.27	-456
-457	6.99	354.97	-457
-458	6.99	367.67	-458
-459	6.99	380.37	-459
-460	6.99	393.07	-460
-461	6.99	405.26	-461
-462	6.99	417.96	-462
-463	6.99	430.66	-463
-464	6.99	443.36	-464
-465	6.99	456.06	-465
-466	6.99	468.76	-466
-467	6.99	481.46	-467
-468	6.99	494.16	-468
-469	6.99	506.86	-469
-470	6.99	532.26	-470
-471	6.99	557.66	-471
-472	6.99	582.68	-472
-473	6.99	608.08	-473
-474	6.99	633.48	-474
-475	6.99	658.88	-475
70011	7.00	11.00	
70015	7.00	15.00	
70023	7.00	23.00	
70034	7.00	34.00	
70035	7.00	35.00	
70040	7.00	40.00	
70058	7.00	58.00	
70059	7.00	59.00	
70060	7.00	60.00	
70068	7.00	68.00	
70079	7.00	79.00	
70083	7.00	83.00	
70094	7.00	94.00	
70096	7.00	96.00	
70106	7.00	106.00	
70107	7.00	107.00	
70110	7.00	110.00	
70111	7.00	111.00	
701147	7.00	114.70	
70115	7.00	115.00	
70120	7.00	120.00	
70128	7.00	128.00	
70150	7.00	150.00	
701595	7.00	159.50	
70160	7.00	160.00	
701667	7.00	166.70	
701746	7.00	174.60	
70181	7.00	181.00	
701873	7.00	187.30	

Metric Size Chart

Part Number	C/S	I.D.	Cross Ref. #
70200	7.00	200.00	
702089	7.00	208.90	
70212	7.00	212.00	
70215	7.00	215.00	
70217	7.00	217.00	
70220	7.00	220.00	
70230	7.00	230.00	
70234	7.00	234.00	
702343	7.00	234.30	
70235	7.00	235.00	
70236	7.00	236.00	
70240	7.00	240.00	
70247	7.00	247.00	
70250	7.00	250.00	
702597	7.00	259.70	
70266	7.00	266.00	
702851	7.00	285.10	
702978	7.00	297.80	
70300	7.00	300.00	
70310	7.00	310.00	
70325	7.00	325.00	
70329	7.00	329.00	
70338	7.00	338.00	
70348	7.00	348.00	
70388	7.00	388.00	
70400	7.00	400.00	
70416	7.00	416.00	
70430	7.00	430.00	
70431	7.00	431.00	
70437	7.00	437.00	
70448	7.00	448.00	
70515	7.00	515.00	
70540	7.00	540.00	
70558	7.00	558.00	
70625	7.00	625.00	
80016	8.00	16.00	
80025	8.00	25.00	
80033	8.00	33.00	
80050	8.00	50.00	
80054	8.00	54.00	
80055	8.00	55.00	
80060	8.00	60.00	
80065	8.00	65.00	
80067	8.00	67.00	
80070	8.00	70.00	
80075	8.00	75.00	
80090	8.00	90.00	
80092	8.00	92.00	
80110	8.00	110.00	
80112	8.00	112.00	
80125	8.00	125.00	

Part Number	C/S	I.D.	Cross Ref. #
80140	8.00	140.00	
80144	8.00	144.00	
80145	8.00	145.00	
80160	8.00	160.00	
80175	8.00	175.00	
80184	8.00	184.00	
80185	8.00	185.00	
80188	8.00	188.00	
80200	8.00	200.00	
80205	8.00	205.00	
80210	8.00	210.00	
80230	8.00	230.00	
80235	8.00	235.00	
80245	8.00	245.00	
80278	8.00	278.00	
80290	8.00	290.00	
80300	8.00	300.00	
80308	8.00	308.00	
80320	8.00	320.00	
80326	8.00	326.00	
80330	8.00	330.00	
80425	8.00	425.00	
80440	8.00	440.00	
80470	8.00	470.00	
80475	8.00	475.00	
80480	8.00	480.00	
80490	8.00	490.00	
80500	8.00	500.00	
80565	8.00	565.00	
841441	8.40	144.10	
841495	8.40	149.50	P 150A
841541	8.40	154.10	
841545	8.40	154.50	P 155
841591	8.40	159.10	
841595	8.40	159.50	P 160
841641	8.40	164.10	
841645	8.40	164.50	P 165
841695	8.40	169.50	P 170
841741	8.40	174.10	
841745	8.40	174.50	P 175
841795	8.40	179.50	P 180
841845	8.40	184.50	P 185
841895	8.40	189.50	P 190
841941	8.40	194.10	
841945	8.40	194.50	P 195
841991	8.40	199.10	
841995	8.40	199.50	P 200
842041	8.40	204.10	
842045	8.40	204.50	P 205
842085	8.40	208.50	P 209
842091	8.40	209.10	

Part Number	C/S	I.D.	Cross Ref. #
842095	8.40	209.50	P 210
842145	8.40	214.50	P 215
842191	8.40	219.10	
842195	8.40	219.50	P 220
842245	8.40	224.50	P 225
842295	8.40	229.50	P 230
842345	8.40	234.50	P 235
842391	8.40	239.10	
842395	8.40	239.50	P 240
842445	8.40	244.50	P 245
842495	8.40	249.50	P 250
842545	8.40	254.50	P 255
842595	8.40	259.50	P 260
842645	8.40	264.50	P 265
842695	8.40	269.50	P 270
842745	8.40	274.50	P 275
84319	8.40	319.00	
843345	8.40	334.50	
844191	8.40	419.10	
10X475	10.00	475.00	V 480
10X5245	10.00	524.50	V 530
10X579	10.00	579.00	V 585
10X6335	10.00	633.50	V 640
10X683	10.00	683.00	V 690
10X7325	10.00	732.50	V 740
10X782	10.00	782.00	V 790
10X8365	10.00	836.50	V 845
10X1044	10.00	1044.00	V 1055

Common O-Ring Failures

Extrusion or Nibbling



When extrusion or nibbling occurs, the seal develops ragged edges, which can leave it looking tattered. This generally appears on the low-pressure side. In general, extrusion failures are caused by one of more of the following factors:

- Excessive clearances
- Excessive pressure
- Low modulus or hardness elastomer
- Excessive gland fill
- Irregular clearance gaps
- Sharp gland edges
- Improper sizing

Solutions to prevent extrusion include:

- Decreasing clearance
- Use a higher-modulus or harder elastomer
- Properly designing the gland
- Using polymer back-up rings

Over-Compression



Over-compression causes mating surfaces to appear flat. It may also cause the flattened surfaces of the seal to develop circumferential splits. In general, over-compression failures are caused by one of more of the following factors:

- Improper design (failure to account for thermal expansion)
- Chemical volume changes
- Excessive compression

One solution to prevent over-compression is to consider the material's response to chemical and thermal environments during the gland design process.

Abrasion



Abrasion generally happens in dynamic seals, subjected to reciprocating, oscillating or rotary motion. This failure causes laceration and breaking on the O-ring's surface that experience excessive wear. Abrasion is caused by one or more of the following:

- Rough sealing surfaces
- Excessive temperature
- Process environment containing abrasive particles
- Dynamic motion
- Poor elastomer surface finish

Solutions to prevent abrasion include:

- Use recommended gland surface finishes
- Consider internally lubed elastomers
- Eliminate abrasive components

Common O-Ring Failures

Compression Set



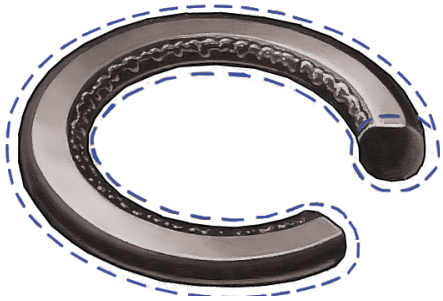
Compression set causes an O-ring's cross section to lose its circular or O-shape and resemble a flat sided oval. The flat side corresponds to the mating seal surfaces. Contributing factors may include one or more of the following:

- Excessive compression
- Excessive temperature
- Incompletely cured elastomer
- Elastomer with high compression set
- Excessive volume swell in chemical

Solutions to prevent compression set include:

- Low compression set elastomer
- Proper gland design for the specific elastomer
- Confirm material compatibility

Outgassing or Extraction



This failure is difficult to detect as the O-ring typically shows no visible change. In some instances, it may exhibit a decrease in cross-sectional size. In general, outgassing or extractions are caused by one of more of the following factors:

- Improper or improperly cured elastomer
- High vacuum levels
- Low hardness or plasticized elastomer

Solutions to prevent outgassing include:

- Avoid plasticized elastomers
- Ensure all seals are properly post-cured to minimize outgassing

Installation Damage



Damage that occurs to the O-ring during the installation process presents as small cuts, nicks, and gashes to the surface. Installation damage can be caused by one of more of the following factors:

- Sharp edges on the glands or components
- Improper sizing of elastomer
- Low-modulus or low-hardness elastomer
- Elastomer surface contamination

Solutions to prevent installation damage include:

- Remove all sharp edges
- Proper gland design
- Proper elastomer sizing
- Use a higher-modulus or harder elastomer

Common O-Ring Failures

Chemical Degradation



When chemical degradation occurs, the seal may exhibit signs including blisters, cracking, voids, or discoloration. In some cases, the degradation is observable only by measurement of physical properties. In general, chemical degradation is caused by:

- Incompatibility with the chemical and or thermal environment.

To prevent this failure from happening, use a more chemical-resistant elastomer.

Thermal Degradation



Thermal degradation may cause radial cracks to appear on the O-rings. They will be located on the highest temperature surfaces. In addition, certain elastomers may exhibit signs of softening or shiny surface as a result of excessive temperatures. In general, thermal degradation are caused by one of more of the following factors:

- Elastomer thermal properties
- Excessive temperature excursions or cycling

Solutions to prevent thermal degradation include:

- Selecting an elastomer with improved thermal stability
- Evaluation of the possibility of cooling sealing surfaces

Spiral Failure



When a spiral failure occurs, a spiral pattern or mark appears on the circumference of the O-ring. Spiral failures are typically caused by one or more of these factors:

- Difficult or tight installation (static)
- Slow reciprocating speed
- Low-modulus or durometer elastomer
- Irregular O-ring surface finish, including excessive parting line
- Excessive gland width
- Irregular or rough gland surface finish
- Inadequate lubrication

Solutions to prevent spiral failures include:

- Correct installation procedures
- Use a higher-modulus elastomers
- Internally lubed elastomers
- Proper gland design
- Gland surface finish of 8-16 micro-inch RMS
- Possibly use polymer back-up rings

Common O-Ring Failures

Plasma Degradation



When plasma degradation occurs, there is erosion on the O-ring where it was exposed to the plasma. This type of failure generally happens in electrical applications. In some cases, this appears as discolouration or powdered residue on the surface. Contribut -ing factors may include:

- Chemical reactivity of the plasma
- Ion bombardment (sputtering)
- Electron bombardment (heating)
- Improper gland design
- Incompatible seal material

Solutions to prevent plasma degradation include:

- Plasma-compatible elastomer and compound
- Minimize exposed area
- Examine gland design

Contamination



When this failure occurs, the foreign materials or contaminants are visible on the surface of the O-ring. In general, contamination is caused by:

- Process environment deposition
- Reactions or degradation of the elastomer
- Non-semiconductor-grade elastomer

To prevent this failure from happening specify contamination level including manufacturing and packaging of the seals.

Rapid Gas Decompression



O-rings that have undergone rapid gas decompression (RGD) exhibit blisters, pits, or pockets on their surface. RGD occurs when there is absorption of gas at high pressure and the subsequent rapid decrease in pressure. The absorbed gas blisters and ruptures the elastomer surface as the pressure is rapidly removed. In general, rapid gas decompression is caused:

- Rapid pressure changes
- Employing elastomer materials that are susceptible to gas permeation
- Low-modulus or low-hardness elastomer

Solutions to prevent rapid gas decompression include**:**

- Use RGD certified elastomer compounds, tested to industry standards
- Slow the release of the system pressure
- Increase the gland fill while being careful not to exceed 90%
- Choose a higher modulus or harder elastomer.

Material Summary Guide

Chloroprene (CR) (Neoprene - DuPont™)

-40°C to 121°C (-40°F to 250°F)

- Exceptional ozone and weather resistance
- Good chemical resistance, including to refrigerants (R12)
- Great mechanical properties are retained over a wide temperature range
- Commonly used with ammonia
- Poor resistance to aromatic hydrocarbons, polar solvents, and toluene

Ethylene Propylene (EPDM, EPM)

-54°C to 150°C (-65°F to 302°F)

- Excellent resistance to ozone, hot water, steam, and aging
- Commonly used with brake fluids and refrigerants
- Poor resistance to petroleum fluids and mineral oils

Fluorocarbon (FKM, FPM) (Viton™ Type A - Chemours)

-26°C to 204°C (-15°F to 400°F)

- Excellent resistance to higher temperatures, petroleum oils, and gasoline
- Wide range of chemical resistance
- Great ozone, weather, and aging resistance
- Poor compatibility with H_2S over 2%, amines, acetone, hot water, and steam
- Poor low temperature characteristics
- Low temperature compounds (Type 3 FKM) are available with a minimum temperature of -40°C (-40°F)

Fluorosilicone (FVMQ, FMQ)

-56°C to 204°C (-69°F to 400°F)

- Wide temperature range
- Excellent resistance to hydrocarbon fuels, petroleum oils, and silicone oils
- Relatively low tear strength, abrasion resistance, and tensile strength
- Generally, not suited for dynamic applications

Hydrogenated Nitrile (HNBR)

-40°C to 160°C (-40°F to 320°F)

- Nitrile based compound with improved chemical resistance
- Wider temperature range than standard nitrile
- High strength material that resists extrusion, abrasion, and wear
- Water and steam resistance to +149°C (+300°F)
- H_2S resistance up to 10%
- Commonly used with petroleum oils and CO_2
- Do not use with chlorinated hydrocarbons, polar solvents, or strong acids
- Low temperature compounds are available with a minimum temperature of -55°C (-67°F)

Nitrile (NBR)

-40°C to 120°C (-40°F to 248°F)

- Presently the most widely used rubber in the seal industry
- Exceptional balance of good mechanical properties, wear properties, and chemical resistance
- Resistant to most mineral oils and greases
- Do not use with glycol-based brake fluids and strong acids
- Low temperature nitrile compound available down to -55°C (-67°F)

Perfluoroelastomer (FFKM) (Kalrez® - DuPont™)

-32°C to 350°C (-25°F to 662°F)

- Broadest chemical resistance of any elastomeric material
- Combines the sealing integrity of elastomers with chemical resistance approaching that of PTFE
- Not suitable with liquid sodium and potassium, fluorinated solvents, and refrigerants
- Low temperature compounds available up to -42°C/-44°F
- Multiple grades available

Material Summary Guide

Polyetheretherketone (PEEK) (KasPex™ PEEK - Hi-Tech Seals Inc.)

-70°C to 260°C (-94°F to 500°F)

- Outstanding chemical resistance
- Excellent high temperature performance
- Exceptional wear and abrasion resistance
- High strength
- Maintains mechanical properties in high temperatures
- Commonly used for anti-extrusion purposes
- Do not use with hydrochloric, nitric, or sulphuric acids

Polytetrafluoroethylene (PTFE)

-260°C to 260°C (-436°F to 500°F)

- Virtually universal chemical resistance
- Very low coefficient of friction
- Reinforcements such as bronze, moly, glass, and carbon are commonly added to alter mechanical properties

Polyurethane (AU, EU) (BoKure™ Urethane - Hi-Tech Seals Inc.)

-54°C to 105°C (-65°F to 221°F)

- Thermoplastic elastomer with higher tensile strength, toughness, and wear resistance
- Great combination of hardness and elasticity
- Excellent low temperature flexibility
- Commonly used in high-pressure hydraulic systems where parts are subject to wear

Silicone (VMQ)

-65°C to 232°C (-85°F to 450°F)

- Excellent resistance to oxidation and ozone degradation
- Wide temperature range
- Commonly used in static applications due to its poor tensile strength and wear resistance
- Popular for food and medical applications

Tetrafluoroethylene-Propylene Copolymer (FEPM, TFE/P) (Aflas® FEPM - Asahi Glass Co.)

-9°C to 232°C (+16°F to 450°F)

- Good high temperature capability
- Resistant to strong acids and bases, amines, solvents, and hot water
- Found in numerous oilfield applications
- Poor low temperature performance and low resilience

Thermoplastic Elastomer (TPC- ET) (Hytrel® - DuPont)

-54°C to 149°C (-65°F to 300°F)

- Thrives in high temperatures and hostile fluids
- Excellent strength and toughness properties
- High resilience and flexibility which allows for easier installation than PTFE materials
- Not suitable with water and phosphate fluids above +80°C (+176°F)

Viton™ Extreme™ (FEPM) (Viton™ - Chemours)

-20°C to 204°C (-4°F to 400°F)

- Exhibits significantly improved performance over standard Viton™
- Provides excellent thermal resistance along with significantly advanced chemical resistance

** The material information provided is based on multiple industry accepted reference sources. It is intended to serve as a general guideline. Testing material in the application environment is highly recommended.*

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