

MicrOring[®] Seals

The leader in microminiature
sealing solutions.



What is a MicrOring® Seal?

As a general definition, a MicrOring® seal is any o-ring that measures less than 1 mm in either inside diameter or cross section. Apple Rubber offers MicrOring® seals in more than 2,000 sizes, ranging from the largest, with an inside diameter or cross section of .039 in. (1.0 mm), down to .008 in. (.20 mm) inside diameter and cross section – the smallest size o-ring in the world!

MicrOring® seals were developed by Apple Rubber to meet the ever-increasing demand for effective seals in a wide range of miniaturized applications, from precision instruments and medical devices to aerospace and fiber optics. Today's smaller designs can present some big challenges for the design engineer, particularly the tight tolerances required for microminiature sealing applications.

The Leader in Microminiature Sealing Solutions


Apple Rubber has earned a reputation for solving tough sealing problems associated with smaller designs. Even our competitors have recommended us for challenging microminiature applications that were beyond their capabilities.

With engineering expertise and advanced manufacturing technology, our capability to provide microminiature seals is unsurpassed. In addition, we can develop special compounds to meet the needs of your application.

Beyond O-Rings – The Benefits of Microminiature Composite Seals

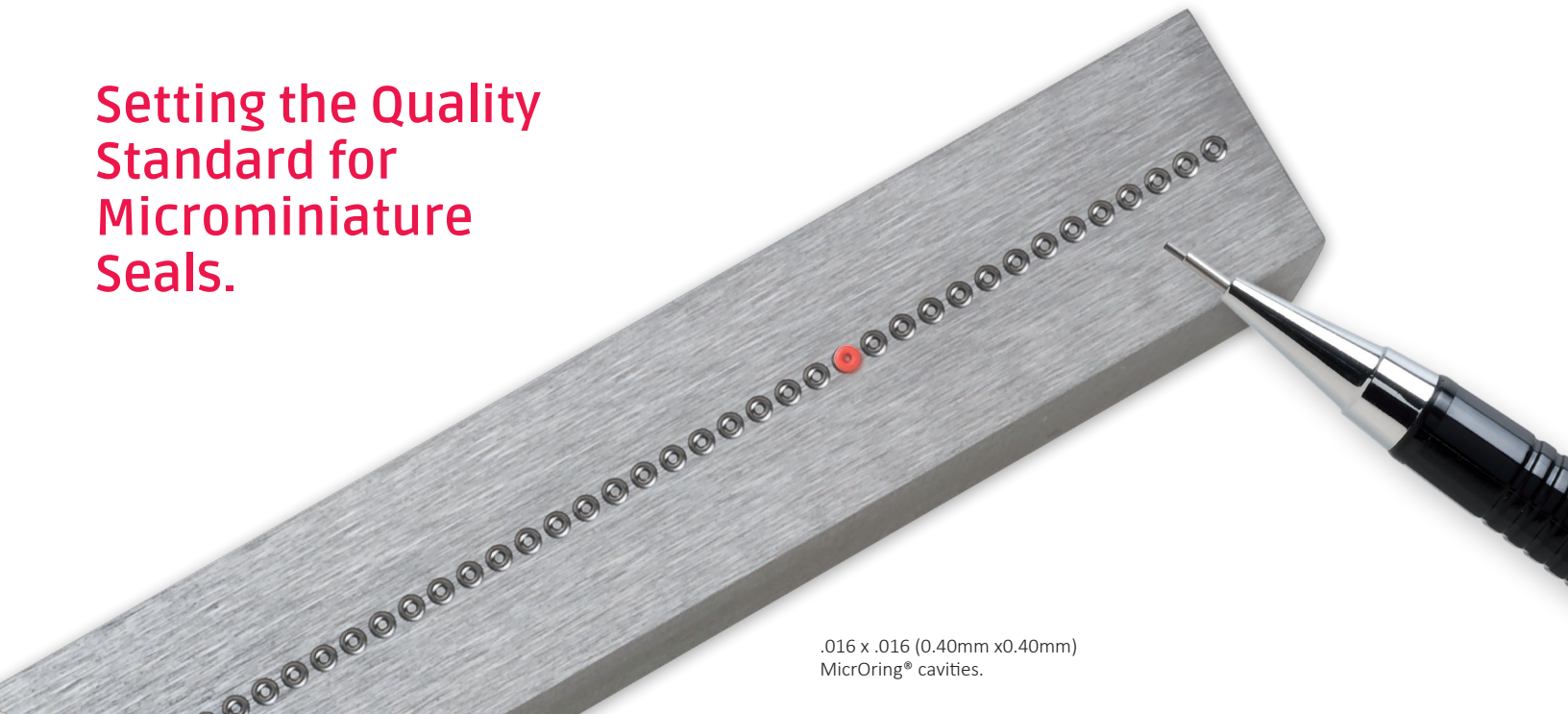
Apple Rubber can ease installation and reduce assembly costs with a composite MicrOring® seal custom-engineered for your specific application. Composite seals combine the structural advantages of metal or plastic with the sealing performance of elastomers. They can provide the tighter tolerances and added finesse required in today's microminiature designs.

We can develop microminiature composite seals — incorporating the seal and another component in one part instead of two — that may even simplify the design of your product.



This microminiature composite seal eases installation and saves assembly costs.

Setting the Quality Standard for Microminiature Seals.



.016 x .016 (0.40mm x0.40mm)
MicOring® cavities.

There is a Big Difference in the Quality of Apple's MicOring® Seals

By nature of their size, microminiature o-rings and seals present some manufacturing challenges. From mold manufacture through part molding and quality assurance, every step in the seal manufacturing process demands unique capabilities.

The first step in the creation of a seal is the manufacturing of a mold. Apple Rubber Products has developed a state of the art mold shop within our manufacturing facility that is particularly suited to micro-mold manufacture. This capability allows us to produce the highest quality micro-molds with the shortest lead times at the lowest cost. At the core of our mold shop are a number of specialized machining centers with high speed spindles capable of efficiently machining the cavity feature of the precision micro-mold. The high spindle speed allows efficient use of extremely small cutters without resorting to expensive EDM work.

This high precision micro-mold is then mated to a micro-molding press where seals are produced. We operate several micro presses both inside and outside our Class 7 (10,000) clean room. These presses provide extremely tight controls for precision part production.

The parts are then inspected. Because microminiature o-rings are difficult to visually inspect, potential problems such as non-fills may be overlooked. That is why we use sophisticated, non-contact measuring equipment when evaluating micro-miniature seals. We also use FTIR (Fourier Transform Infrared Spectrophotometer) and other equipment that requires only a small sample to offer both material and dimensional validation.

Applelab® features a wide variety of other specialized equipment to perform a range of tests on MicOrings® such as tensile strength, elongation and modulus of elasticity. We can provide standard and custom testing with full documentation, which may enable you to eliminate the need for costly incoming inspection.

Dimensional Inspection Criteria for MicOring® Seals

Cross section Range and Tolerance = +/- .003

I.D. Range (in.)	Tolerance (in.)
.000 to .056	+/- .004
.057 to .550	+/- .005
.551 to .605	+/- .007
.606 to .800	+/- .009
.801 to 1.090	+/- .010

Understanding Basic Sealing Concepts.

Important Considerations for Selecting Microminiature O-Rings

In sealing applications, correct o-ring selection is the result of a number of design considerations including dimensions, chemical compatibility, and the material physical properties to resist pressure and temperature extremes. With microminiature applications, the component dimensions and tolerances become more important as the o-ring size gets smaller.

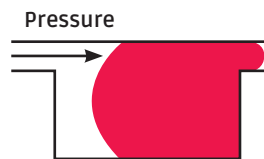
Microminiature designs leave less room for inaccuracies, requiring higher precision and tighter tolerances. It is helpful to pay particular attention to some basic sealing concepts when selecting a microminiature o-ring for your application. These include:

» Sealing Force

The initial sealing force is the normal force exerted by the resiliency of the elastomeric seal when squeezed between the mating surfaces of the gland geometry. The sealing force increases as the system pressure is transmitted through the seal geometry. A physical barrier is formed when the force from squeezing the seal and the system pressure causes the seal to fill the potential leak paths.

» Low Pressure Sealing

In a low pressure sealing application, the system pressure is too low to “activate” the seal. The design must rely solely on the resilience of the elastomer to retain the needed sealing force. Proper seal material selection and surface finish on both the seal and gland are critical to an effective seal.



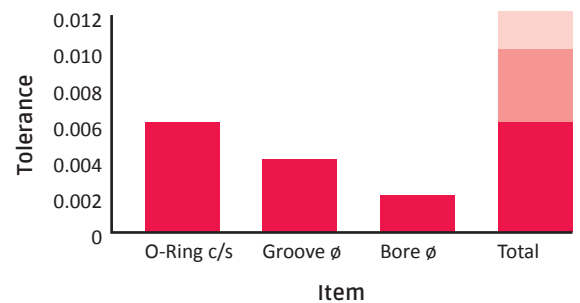
» High Pressure Sealing

In high pressure sealing applications, the system pressure does “activate” the seal to fill potential leak paths. Attention does need to be given to seal material hardness and hardware clearances to prevent potential seal extrusion.



» Understanding Tolerance Stack-up

Tolerance stack-up is an especially important factor in microminiature o-rings due to the fact that the tolerances account for a large percentage of the nominal o-ring size. In a sealing application, the tolerances of all the parts in contact with the o-ring must be considered in order to create an effective seal. The combination of these tolerances is the tolerance stack-up.

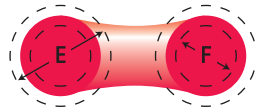
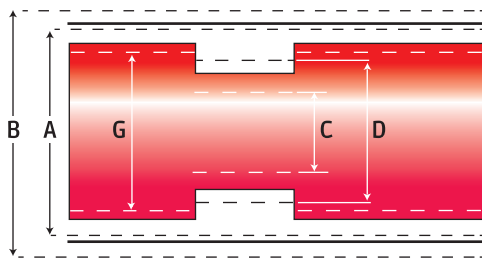


The graph above shows a piston application where the o-ring cross section tolerance is ± 0.003 ", the groove diameter tolerance is ± 0.004 ", and the bore diameter tolerance is ± 0.002 ". In this example, the gland height may vary up to 0.006", and the o-ring cross section up to 0.006". Therefore, the total tolerance stack-up is 0.012". This is under the assumption that the application is concentric. If the nominal o-ring size is 0.030", it is easy to see that the tolerance stack-up is close to half the size of the o-ring. This can result in too much or too little squeeze, which can cause the o-ring to fail.

O-Ring Compression Calculations for Piston and Bore

In an application utilizing a standard size o-ring, it is usually possible to compensate for tolerance stack-up in any number of ways including specification of a larger o-ring cross section. In microminiature applications, there is little room to accommodate this option.

The following formulas can act as a guide for calculating minimum and maximum o-ring compression for a male radial seal when designing for microminiature sealing applications. The formulas should be used as a guide only. Apple Rubber engineers can assist you in determining exact specifications for your particular microminiature application.

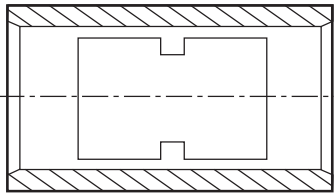


- A Min. Bore Diameter
- B Max. Bore Diameter
- C Min. Groove Diameter
- D Max. Groove Diameter
- E Max. O-Ring Cross Section
- F Min. O-Ring Cross Section
- G Min. Piston Diameter

Male Radial Seal

Be sure to reference the o-ring calculator tool on our website at www.applerubber.com/oring-gland-calculator/

Concentric

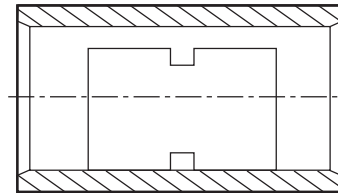


$$\text{Max. \% Compression} = \frac{\left[\frac{A - D}{2} \right] - E}{E} \cdot 100$$

$$\text{Min. \% Compression} = \frac{\left[\frac{B - C}{2} \right] - F}{F} \cdot 100$$

$$\text{Min. Groove Width}^* = \frac{\left[\frac{\pi E^2}{4} \right]}{\left[\frac{A - D}{2} \right]} \cdot 1.1$$

Eccentric



$$\text{Max. \% Compression} = \frac{\left[\frac{G - D}{2} \right] - E}{E} \cdot 100$$

$$\text{Min. \% Compression} = \frac{\left[\frac{B - C}{2} + \frac{B - G}{2} \right] - F}{F} \cdot 100$$

$$\text{Min. Groove Width}^* = \frac{\left[\frac{\pi E^2}{4} \right]}{\left[\frac{G - D}{2} \right]} \cdot 1.1$$

* Equations based on Maximum o-ring Cross Section, Minimum Groove Depth and filling 90% of the groove.

The Right Materials for Your Applications.

Apple Rubber is also an outstanding resource for special compounds to meet the unique needs of your application. We continually research and develop new materials and durometers to keep pace with rapidly changing needs in today's microminiature designs. Call us for more information on special materials.

The Largest Selection of Microminiature Seals Anywhere

With more than 2,000 microminiature sizes, Apple Rubber offers the largest selection of microminiature o-rings anywhere, many available for immediate delivery. The charts on the following pages provide all the information you need at a glance to order MicrOring® seals, quickly and easily.

In addition, Apple Rubber has an extensive tooling inventory with thousands of molds ready for processing upon your request. This saves time and money in tooling for prototype or high production quantities. Apple Rubber has the capabilities to create and produce tooling for virtually any size microminiature o-ring for fast response to your needs.

The most commonly used durometer is 70. Although other durometers are offered, availability may be limited due to processing or shrinkage factors.

Materials	Apple Material Designation	Durometers (Shore A)	Temperature Range* (Dry Heat Only)	Description
Buna-N/Nitrile (NBR)	BN	40 thru 90	-40 to +257° F -40 to +125° C	Presently the seal industry's most widely used elastometer. Nitrile combines excellent resistance to petroleum-based oils and fuels, silicone greases, hydraulic fluids, water and alcohols. It has a good balance of such desirable working properties as low compression set, high tensile strength and high abrasion resistance.
Ethylene-Propylene (EPM/EPDM)	EP	40 thru 90	-40 to +275° F -40 to +135° C	Features good resistance to such polar solvents as ketones (MEK & Acetone). EPM/EPDM is also highly recommended for effective resistance to steam (to 400°F), hot water, silicone oils and greases, dilute acids and alkalies, alcohols and automotive brake fluids. Properly compounded, Ethylene Propylene can provide extended temperature range of -76°F to +350°F.
Silicone (Mq; Pmq; Vmq; Pvmq)	SL	25 thru 80	-85 to +400° F -65 to +230° C	Especially resistant to high, dry heat in primarily static applications. Silicones are fungus resistant, odorless, tasteless, non-toxic elastomers and possess high-resistance to the aging effects of both sunlight and ozone attack.
Neoprene® (Chloroprene) (CR)	CR	40 thru 90	-40 to +250° F -40 to +121° C	An early developed, oil-resistant substitute for natural rubber, Neoprene features moderate resistance to petroleum oils, good resistance to ozone, sunlight and oxygen aging, relatively low compression set, good resilience, reasonable cost, and high resistance to attack by Freon® and Ammonia.
Fluorocarbon (Viton®) (Fluorel®) (FKM)	VT	55 thru 95	-13 to +446° F -25 to +230° C	Combines high-temperature toughness with wide chemical agent compatibility, Fluorocarbon compounds feature excellent resistance to petroleum products and solvents and good high-temperature compression set characteristics.
Fluorosilicone (Fvmq)	FS	40 thru 80	-75 to +400° F -60 to +200° C	Combines the good high and low temperature stability of Silicones with the fuel, oil and solvent resistance of fluorocarbons. FS compounds feature good compression set and resilience properties. FS compounds are suitable for exposure to air, sunlight, ozone, chlorinated and aromatic hydrocarbons.

Please check the latest standard for current version. *The temperatures listed are general operating range.

800.828.7745 (U.S. and Canada only) 716.684.6560 or visit applerubber.com

MicrOring® Seal Sizes

Inches		Millimeters		Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section
0.008	0.008	0.20	0.20	0.028	0.030	0.71	0.76	0.039	0.039	1.00	1.00	0.055	0.025	1.40	0.64
0.010	0.010	0.25	0.25	0.029	0.013	0.74	0.33	0.040	0.016	1.02	0.41	0.055	0.028	1.40	0.71
0.012	0.014	0.30	0.36	0.030	0.015	0.76	0.38	0.041	0.020	1.04	0.50	0.055	0.030	1.40	0.76
0.012	0.030	0.30	0.76	0.030	0.016	0.76	0.41	0.041	0.022	1.04	0.56	0.055	0.031	1.40	0.79
0.012	0.039	0.30	1.00	0.030	0.020	0.76	0.50	0.043	0.016	1.09	0.41	0.055	0.032	1.40	0.81
0.013	0.035	0.33	0.89	0.030	0.031	0.76	0.79	0.043	0.020	1.09	0.50	0.056	0.019	1.42	0.48
0.014	0.026	0.36	0.66	0.030	0.038	0.76	0.97	0.043	0.026	1.09	0.66	0.057	0.015	1.45	0.38
0.014	0.030	0.36	0.76	0.031	0.016	0.79	0.41	0.043	0.031	1.09	0.79	0.057	0.020	1.45	0.50
0.014	0.038	0.36	0.97	0.031	0.018	0.79	0.46	0.043	0.039	1.09	1.00	0.057	0.022	1.45	0.56
0.014	0.039	0.36	1.00	0.031	0.020	0.79	0.50	0.044	0.017	1.12	0.43	0.057	0.024	1.45	0.61
0.016	0.016	0.41	0.41	0.031	0.024	0.79	0.61	0.044	0.032	1.12	0.81	0.057	0.030	1.45	0.76
0.017	0.017	0.43	0.43	0.031	0.028	0.79	0.71	0.045	0.016	1.14	0.41	0.057	0.036	1.45	0.91
0.017	0.020	0.43	0.50	0.031	0.031	0.79	0.79	0.045	0.022	1.14	0.56	0.058	0.033	1.47	0.84
0.017	0.022	0.43	0.56	0.031	0.039	0.79	1.00	0.045	0.023	1.14	0.58	0.059	0.010	1.50	0.25
0.018	0.012	0.46	0.30	0.032	0.016	0.81	0.41	0.045	0.025	1.14	0.64	0.059	0.014	1.50	0.36
0.018	0.016	0.46	0.41	0.032	0.018	0.81	0.46	0.045	0.034	1.14	0.86	0.059	0.018	1.50	0.46
0.018	0.020	0.46	0.50	0.032	0.024	0.81	0.61	0.045	0.039	1.14	1.00	0.059	0.019	1.50	0.48
0.018	0.035	0.46	0.89	0.032	0.027	0.81	0.69	0.046	0.034	1.17	0.86	0.059	0.020	1.50	0.50
0.020	0.012	0.50	0.30	0.032	0.028	0.81	0.71	0.047	0.012	1.19	0.30	0.059	0.022	1.50	0.56
0.020	0.016	0.50	0.41	0.032	0.029	0.81	0.74	0.047	0.016	1.19	0.41	0.059	0.024	1.50	0.61
0.020	0.017	0.50	0.43	0.032	0.030	0.81	0.76	0.047	0.018	1.19	0.46	0.059	0.026	1.50	0.66
0.020	0.020	0.50	0.50	0.032	0.032	0.81	0.81	0.047	0.022	1.19	0.56	0.059	0.028	1.50	0.71
0.020	0.039	0.50	1.00	0.032	0.033	0.81	0.84	0.047	0.024	1.19	0.61	0.059	0.029	1.50	0.74
0.022	0.015	0.56	0.38	0.033	0.012	0.84	0.30	0.047	0.028	1.19	0.71	0.059	0.030	1.50	0.76
0.022	0.026	0.56	0.66	0.033	0.015	0.84	0.38	0.047	0.031	1.19	0.79	0.059	0.032	1.50	0.81
0.023	0.030	0.58	0.76	0.033	0.018	0.84	0.46	0.047	0.032	1.19	0.81	0.059	0.035	1.50	0.89
0.024	0.014	0.61	0.36	0.033	0.022	0.84	0.56	0.047	0.034	1.19	0.86	0.059	0.039	1.50	1.00
0.024	0.016	0.61	0.41	0.034	0.030	0.86	0.76	0.047	0.036	1.19	0.91	0.062	0.031	1.57	0.79
0.024	0.018	0.61	0.46	0.034	0.038	0.86	0.97	0.047	0.038	1.19	0.97	0.062	0.032	1.57	0.81
0.024	0.020	0.61	0.50	0.035	0.016	0.89	0.41	0.047	0.039	1.19	1.00	0.062	0.039	1.57	1.00
0.024	0.022	0.61	0.56	0.035	0.018	0.89	0.46	0.048	0.025	1.22	0.64	0.063	0.014	1.60	0.36
0.024	0.024	0.61	0.61	0.035	0.021	0.89	0.53	0.049	0.020	1.24	0.50	0.063	0.016	1.60	0.41
0.024	0.026	0.61	0.66	0.035	0.022	0.89	0.56	0.049	0.026	1.24	0.66	0.063	0.020	1.60	0.50
0.024	0.031	0.61	0.79	0.035	0.024	0.89	0.61	0.049	0.034	1.24	0.86	0.063	0.022	1.60	0.56
0.024	0.032	0.61	0.81	0.035	0.037	0.89	0.94	0.049	0.039	1.24	1.00	0.063	0.024	1.60	0.61
0.024	0.033	0.61	0.84	0.035	0.039	0.89	1.00	0.050	0.018	1.27	0.46	0.063	0.028	1.60	0.71
0.025	0.016	0.64	0.41	0.036	0.016	0.91	0.41	0.050	0.022	1.27	0.56	0.063	0.030	1.60	0.76
0.025	0.017	0.64	0.43	0.036	0.030	0.91	0.76	0.051	0.012	1.30	0.30	0.063	0.035	1.60	0.89
0.025	0.025	0.64	0.64	0.037	0.032	0.94	0.81	0.051	0.016	1.30	0.41	0.063	0.036	1.60	0.91
0.026	0.015	0.66	0.38	0.037	0.037	0.94	0.94	0.051	0.020	1.30	0.50	0.063	0.039	1.60	1.00
0.026	0.016	0.66	0.41	0.037	0.038	0.94	0.97	0.051	0.026	1.30	0.66	0.064	0.016	1.63	0.41
0.026	0.022	0.66	0.56	0.038	0.013	0.97	0.33	0.051	0.028	1.30	0.71	0.065	0.022	1.65	0.56
0.026	0.024	0.66	0.61	0.039	0.016	1.00	0.41	0.052	0.020	1.32	0.50	0.065	0.035	1.65	0.89
0.026	0.028	0.66	0.71	0.039	0.018	1.00	0.46	0.053	0.035	1.35	0.89	0.066	0.020	1.68	0.50
0.028	0.008	0.71	0.20	0.039	0.020	1.00	0.50	0.054	0.028	1.37	0.71	0.067	0.012	1.70	0.30
0.028	0.015	0.71	0.38	0.039	0.024	1.00	0.61	0.055	0.012	1.40	0.30	0.067	0.020	1.70	0.50
0.028	0.016	0.71	0.41	0.039	0.028	1.00	0.71	0.055	0.014	1.40	0.36	0.067	0.024	1.70	0.61
0.028	0.018	0.71	0.46	0.039	0.030	1.00	0.76	0.055	0.016	1.40	0.41	0.067	0.026	1.70	0.66
0.028	0.020	0.71	0.50	0.039	0.032	1.00	0.81	0.055	0.020	1.40	0.50	0.067	0.027	1.70	0.69
0.028	0.022	0.71	0.56	0.039	0.036	1.00	0.91	0.055	0.024	1.40	0.61	0.067	0.028	1.70	0.71

Inches		Millimeters		Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section
0.067	0.030	1.70	0.76	0.079	0.038	2.00	0.97	0.095	0.032	2.41	0.81	0.118	0.030	3.00	0.76
0.067	0.037	1.70	0.94	0.079	0.039	2.00	1.00	0.096	0.023	2.44	0.58	0.118	0.032	3.00	0.81
0.067	0.039	1.70	1.00	0.081	0.016	2.06	0.41	0.096	0.039	2.44	1.00	0.118	0.033	3.00	0.84
0.068	0.018	1.73	0.46	0.081	0.028	2.06	0.71	0.098	0.012	2.50	0.30	0.118	0.034	3.00	0.86
0.069	0.020	1.75	0.50	0.082	0.018	2.08	0.46	0.098	0.014	2.50	0.36	0.118	0.035	3.00	0.89
0.069	0.022	1.75	0.56	0.083	0.013	2.11	0.33	0.098	0.020	2.50	0.50	0.118	0.036	3.00	0.91
0.069	0.024	1.75	0.61	0.083	0.018	2.11	0.46	0.098	0.024	2.50	0.61	0.118	0.038	3.00	0.97
0.069	0.026	1.75	0.66	0.083	0.031	2.11	0.79	0.098	0.026	2.50	0.66	0.118	0.039	3.00	1.00
0.069	0.028	1.75	0.71	0.083	0.035	2.11	0.89	0.098	0.028	2.50	0.71	0.120	0.017	3.05	0.43
0.069	0.030	1.75	0.76	0.084	0.016	2.13	0.41	0.098	0.031	2.50	0.79	0.120	0.018	3.05	0.46
0.070	0.020	1.78	0.50	0.085	0.013	2.16	0.33	0.098	0.032	2.50	0.81	0.120	0.025	3.05	0.64
0.070	0.025	1.78	0.64	0.085	0.024	2.16	0.61	0.098	0.039	2.50	1.00	0.120	0.030	3.05	0.76
0.070	0.028	1.78	0.71	0.085	0.030	2.16	0.76	0.100	0.018	2.54	0.46	0.122	0.014	3.10	0.36
0.070	0.030	1.78	0.76	0.085	0.032	2.16	0.81	0.100	0.020	2.54	0.50	0.122	0.016	3.10	0.41
0.071	0.015	1.80	0.38	0.085	0.036	2.16	0.91	0.100	0.025	2.54	0.64	0.122	0.031	3.10	0.79
0.071	0.016	1.80	0.41	0.086	0.016	2.18	0.41	0.100	0.038	2.54	0.97	0.122	0.033	3.10	0.84
0.071	0.020	1.80	0.50	0.086	0.030	2.18	0.76	0.101	0.034	2.57	0.86	0.122	0.039	3.10	1.00
0.071	0.024	1.80	0.61	0.087	0.016	2.21	0.41	0.102	0.028	2.59	0.71	0.124	0.025	3.15	0.64
0.071	0.028	1.80	0.71	0.087	0.020	2.21	0.50	0.102	0.030	2.59	0.76	0.124	0.034	3.15	0.86
0.071	0.031	1.80	0.79	0.087	0.024	2.21	0.61	0.102	0.032	2.59	0.81	0.125	0.020	3.18	0.50
0.071	0.032	1.80	0.81	0.087	0.026	2.21	0.66	0.102	0.039	2.59	1.00	0.125	0.025	3.18	0.64
0.072	0.036	1.83	0.91	0.087	0.028	2.21	0.71	0.103	0.030	2.62	0.76	0.125	0.031	3.18	0.79
0.073	0.012	1.85	0.30	0.087	0.032	2.21	0.81	0.106	0.018	2.69	0.46	0.126	0.020	3.20	0.50
0.073	0.016	1.85	0.41	0.087	0.034	2.21	0.86	0.106	0.025	2.69	0.64	0.126	0.025	3.20	0.64
0.073	0.018	1.85	0.46	0.087	0.039	2.21	1.00	0.106	0.028	2.69	0.71	0.126	0.026	3.20	0.66
0.073	0.020	1.85	0.50	0.088	0.035	2.24	0.89	0.106	0.034	2.69	0.86	0.126	0.028	3.20	0.71
0.073	0.026	1.85	0.66	0.089	0.024	2.26	0.61	0.106	0.039	2.69	1.00	0.126	0.032	3.20	0.81
0.074	0.018	1.88	0.46	0.089	0.026	2.26	0.66	0.107	0.010	2.72	0.25	0.126	0.035	3.20	0.89
0.075	0.012	1.91	0.30	0.090	0.020	2.29	0.50	0.109	0.034	2.77	0.86	0.126	0.036	3.20	0.91
0.075	0.016	1.91	0.41	0.090	0.025	2.29	0.64	0.110	0.017	2.79	0.43	0.126	0.039	3.20	1.00
0.075	0.020	1.91	0.50	0.090	0.026	2.29	0.66	0.110	0.020	2.79	0.50	0.127	0.010	3.23	0.25
0.075	0.022	1.91	0.56	0.090	0.030	2.29	0.76	0.110	0.026	2.79	0.66	0.127	0.014	3.23	0.36
0.075	0.024	1.91	0.61	0.091	0.012	2.31	0.30	0.110	0.028	2.79	0.71	0.128	0.025	3.25	0.64
0.075	0.025	1.91	0.64	0.091	0.016	2.31	0.41	0.110	0.031	2.79	0.79	0.130	0.024	3.30	0.61
0.075	0.026	1.91	0.66	0.091	0.018	2.31	0.46	0.110	0.038	2.79	0.97	0.130	0.025	3.30	0.64
0.075	0.028	1.91	0.71	0.091	0.020	2.31	0.50	0.112	0.019	2.84	0.48	0.130	0.026	3.30	0.66
0.075	0.030	1.91	0.76	0.091	0.022	2.31	0.56	0.112	0.024	2.84	0.61	0.130	0.035	3.30	0.89
0.075	0.035	1.91	0.89	0.091	0.024	2.31	0.61	0.112	0.035	2.84	0.89	0.130	0.039	3.30	1.00
0.075	0.039	1.91	1.00	0.091	0.026	2.31	0.66	0.112	0.036	2.84	0.91	0.131	0.029	3.33	0.74
0.078	0.016	1.98	0.41	0.091	0.028	2.31	0.71	0.114	0.016	2.90	0.41	0.132	0.021	3.35	0.53
0.078	0.023	1.98	0.58	0.091	0.030	2.31	0.76	0.114	0.018	2.90	0.46	0.132	0.028	3.35	0.71
0.078	0.030	1.98	0.76	0.091	0.033	2.31	0.84	0.114	0.031	2.90	0.79	0.133	0.014	3.38	0.36
0.078	0.031	1.98	0.79	0.091	0.039	2.31	1.00	0.114	0.032	2.90	0.81	0.133	0.032	3.38	0.81
0.078	0.033	1.98	0.84	0.093	0.035	2.36	0.89	0.114	0.033	2.90	0.84	0.133	0.038	3.38	0.97
0.079	0.016	2.00	0.41	0.093	0.039	2.36	1.00	0.114	0.035	2.90	0.89	0.134	0.029	3.40	0.74
0.079	0.020	2.00	0.50	0.094	0.016	2.39	0.41	0.114	0.036	2.90	0.91	0.134	0.031	3.40	0.79
0.079	0.022	2.00	0.56	0.094	0.027	2.39	0.69	0.114	0.039	2.90	1.00	0.134	0.032	3.40	0.81
0.079	0.023	2.00	0.58	0.094	0.028	2.39	0.71	0.115	0.028	2.92	0.71	0.135	0.025	3.43	0.64
0.079	0.024	2.00	0.61	0.094	0.031	2.39	0.79	0.116	0.025	2.95	0.64	0.135	0.032	3.43	0.81
0.079	0.025	2.00	0.64	0.094	0.032	2.39	0.81	0.116	0.039	2.95	1.00	0.135	0.036	3.43	0.91
0.079	0.026	2.00	0.66	0.094	0.034	2.39	0.86	0.117	0.010	2.97	0.25	0.137	0.025	3.48	0.64
0.079	0.028	2.00	0.71	0.095	0.016	2.41	0.41	0.117	0.025	2.97	0.64	0.138	0.016	3.50	0.41
0.079	0.030	2.00	0.76	0.095	0.018	2.41	0.46	0.118	0.016	3.00	0.41	0.138	0.018	3.50	0.46
0.079	0.031	2.00	0.79	0.095	0.028	2.41	0.71	0.118	0.020	3.00	0.50	0.138	0.020	3.50	0.50
0.079	0.033	2.00	0.84	0.095	0.031	2.41	0.79	0.118	0.024	3.00	0.61	0.138	0.028	3.50	0.71

Inches		Millimeters		Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section
0.138	0.031	3.50	0.79	0.169	0.020	4.29	0.50	0.205	0.024	5.21	0.61	0.239	0.025	6.07	0.64
0.138	0.035	3.50	0.89	0.169	0.024	4.29	0.61	0.205	0.028	5.21	0.71	0.239	0.030	6.07	0.76
0.138	0.039	3.50	1.00	0.171	0.016	4.34	0.41	0.205	0.031	5.21	0.79	0.239	0.031	6.07	0.79
0.139	0.025	3.53	0.64	0.171	0.028	4.34	0.71	0.205	0.032	5.21	0.81	0.239	0.039	6.07	1.00
0.139	0.039	3.53	1.00	0.171	0.030	4.34	0.76	0.208	0.030	5.28	0.76	0.240	0.018	6.10	0.46
0.140	0.025	3.56	0.64	0.171	0.039	4.34	1.00	0.208	0.031	5.28	0.79	0.240	0.020	6.10	0.50
0.140	0.030	3.56	0.76	0.172	0.037	4.37	0.94	0.208	0.032	5.28	0.81	0.240	0.024	6.10	0.61
0.140	0.032	3.56	0.81	0.173	0.031	4.39	0.79	0.208	0.039	5.28	1.00	0.240	0.033	6.10	0.84
0.142	0.020	3.61	0.50	0.173	0.032	4.39	0.81	0.209	0.016	5.31	0.41	0.242	0.031	6.15	0.79
0.142	0.031	3.61	0.79	0.173	0.039	4.39	1.00	0.209	0.020	5.31	0.50	0.242	0.032	6.15	0.81
0.142	0.039	3.61	1.00	0.175	0.020	4.45	0.50	0.209	0.024	5.31	0.61	0.242	0.037	6.15	0.94
0.144	0.025	3.66	0.64	0.175	0.030	4.45	0.76	0.210	0.033	5.33	0.84	0.242	0.039	6.15	1.00
0.146	0.012	3.71	0.30	0.175	0.039	4.45	1.00	0.211	0.032	5.36	0.81	0.244	0.020	6.20	0.50
0.146	0.014	3.71	0.36	0.176	0.025	4.47	0.64	0.212	0.012	5.38	0.30	0.244	0.039	6.20	1.00
0.146	0.016	3.71	0.41	0.176	0.030	4.47	0.76	0.213	0.020	5.41	0.50	0.247	0.024	6.27	0.61
0.146	0.020	3.71	0.50	0.176	0.031	4.47	0.79	0.213	0.028	5.41	0.71	0.247	0.028	6.27	0.71
0.146	0.028	3.71	0.71	0.177	0.020	4.50	0.50	0.213	0.031	5.41	0.79	0.248	0.020	6.30	0.50
0.146	0.031	3.71	0.79	0.177	0.024	4.50	0.61	0.213	0.032	5.41	0.81	0.248	0.028	6.30	0.71
0.146	0.035	3.71	0.89	0.177	0.039	4.50	1.00	0.216	0.022	5.50	0.56	0.250	0.028	6.35	0.71
0.146	0.037	3.71	0.94	0.179	0.033	4.55	0.84	0.216	0.026	5.50	0.66	0.250	0.032	6.35	0.81
0.146	0.039	3.71	1.00	0.180	0.020	4.57	0.50	0.216	0.028	5.50	0.71	0.250	0.035	6.35	0.89
0.150	0.020	3.81	0.50	0.180	0.027	4.57	0.69	0.216	0.032	5.50	0.81	0.253	0.032	6.43	0.81
0.150	0.023	3.81	0.58	0.180	0.035	4.57	0.89	0.217	0.018	5.50	0.46	0.254	0.035	6.45	0.89
0.150	0.024	3.81	0.61	0.181	0.028	4.60	0.71	0.217	0.039	5.50	1.00	0.256	0.028	6.50	0.71
0.150	0.028	3.81	0.71	0.181	0.030	4.60	0.76	0.218	0.020	5.54	0.50	0.256	0.034	6.50	0.86
0.150	0.031	3.81	0.79	0.181	0.032	4.60	0.81	0.218	0.025	5.54	0.64	0.256	0.039	6.50	1.00
0.150	0.032	3.81	0.81	0.181	0.035	4.60	0.89	0.218	0.030	5.54	0.76	0.258	0.039	6.55	1.00
0.150	0.037	3.81	0.94	0.184	0.030	4.67	0.76	0.220	0.027	5.59	0.69	0.259	0.039	6.58	1.00
0.152	0.036	3.86	0.91	0.185	0.020	4.70	0.50	0.220	0.028	5.59	0.71	0.260	0.032	6.60	0.81
0.153	0.032	3.89	0.81	0.185	0.024	4.70	0.61	0.220	0.032	5.59	0.81	0.262	0.016	6.65	0.41
0.154	0.013	3.91	0.33	0.185	0.026	4.70	0.66	0.220	0.035	5.59	0.89	0.263	0.031	6.68	0.79
0.154	0.016	3.91	0.41	0.185	0.035	4.70	0.89	0.220	0.039	5.59	1.00	0.263	0.035	6.68	0.89
0.154	0.032	3.91	0.81	0.185	0.039	4.70	1.00	0.221	0.018	5.61	0.46	0.264	0.031	6.71	0.79
0.154	0.038	3.91	0.97	0.187	0.019	4.75	0.48	0.222	0.031	5.64	0.79	0.264	0.032	6.71	0.81
0.155	0.010	3.94	0.25	0.187	0.031	4.75	0.79	0.224	0.024	5.69	0.61	0.264	0.039	6.71	1.00
0.155	0.016	3.94	0.41	0.188	0.035	4.78	0.89	0.224	0.029	5.69	0.74	0.266	0.026	6.76	0.66
0.155	0.025	3.94	0.64	0.189	0.032	4.80	0.81	0.225	0.019	5.72	0.48	0.268	0.020	6.81	0.50
0.157	0.012	4.00	0.30	0.189	0.035	4.80	0.89	0.225	0.024	5.72	0.61	0.268	0.026	6.81	0.66
0.157	0.020	4.00	0.50	0.189	0.039	4.80	1.00	0.228	0.024	5.79	0.61	0.270	0.018	6.86	0.46
0.157	0.039	4.00	1.00	0.190	0.035	4.83	0.89	0.228	0.028	5.79	0.71	0.270	0.039	6.86	1.00
0.158	0.012	4.00	0.30	0.191	0.023	4.85	0.58	0.228	0.035	5.79	0.89	0.272	0.030	6.91	0.76
0.158	0.016	4.00	0.41	0.191	0.030	4.85	0.76	0.228	0.039	5.79	1.00	0.273	0.027	6.93	0.69
0.158	0.020	4.00	0.50	0.192	0.019	4.88	0.48	0.230	0.037	5.84	0.94	0.275	0.020	7.00	0.50
0.158	0.024	4.00	0.61	0.193	0.026	4.90	0.66	0.232	0.031	5.89	0.79	0.275	0.024	7.00	0.61
0.158	0.039	4.00	1.00	0.195	0.015	4.95	0.38	0.232	0.039	5.89	1.00	0.276	0.020	7.00	0.50
0.159	0.025	4.04	0.64	0.197	0.020	5.00	0.50	0.235	0.030	5.97	0.76	0.276	0.024	7.00	0.61
0.160	0.035	4.06	0.89	0.197	0.024	5.00	0.61	0.235	0.034	5.97	0.86	0.276	0.030	7.00	0.76
0.161	0.020	4.09	0.50	0.197	0.031	5.00	0.79	0.236	0.016	6.00	0.41	0.276	0.031	7.00	0.79
0.161	0.031	4.09	0.79	0.197	0.032	5.00	0.81	0.236	0.020	6.00	0.50	0.276	0.039	7.00	1.00
0.161	0.032	4.09	0.81	0.197	0.039	5.00	1.00	0.236	0.030	6.00	0.76	0.280	0.033	7.11	0.84
0.165	0.020	4.19	0.50	0.200	0.020	5.08	0.50	0.236	0.031	6.00	0.79	0.282	0.033	7.16	0.84
0.165	0.031	4.19	0.79	0.200	0.035	5.08	0.89	0.236	0.032	6.00	0.81	0.283	0.031	7.19	0.79
0.165	0.032	4.19	0.81	0.201	0.023	5.11	0.58	0.236	0.039	6.00	1.00	0.283	0.035	7.19	0.89
0.165	0.039	4.19	1.00	0.201	0.032	5.11	0.81	0.237	0.025	6.00	0.64	0.284	0.028	7.21	0.71
0.167	0.026	4.24	0.66	0.205	0.016	5.21	0.41	0.238	0.031	6.05	0.79	0.284	0.032	7.21	0.81

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Inches		Millimeters		Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section
0.285	0.025	7.24	0.64	0.335	0.039	8.50	1.00	0.416	0.020	10.57	0.50	0.504	0.024	12.80	0.61
0.285	0.032	7.24	0.81	0.337	0.039	8.56	1.00	0.421	0.031	10.69	0.79	0.504	0.026	12.80	0.66
0.285	0.033	7.24	0.84	0.343	0.031	8.71	0.79	0.421	0.039	10.69	1.00	0.512	0.016	13.00	0.41
0.287	0.039	7.29	1.00	0.346	0.028	8.79	0.71	0.425	0.016	10.80	0.41	0.512	0.020	13.00	0.50
0.289	0.031	7.34	0.79	0.351	0.028	8.92	0.71	0.425	0.024	10.80	0.61	0.512	0.024	13.00	0.61
0.290	0.024	7.37	0.61	0.353	0.035	8.97	0.89	0.425	0.039	10.80	1.00	0.512	0.026	13.00	0.66
0.293	0.039	7.44	1.00	0.354	0.020	9.00	0.50	0.426	0.035	10.82	0.89	0.512	0.034	13.00	0.86
0.295	0.020	7.50	0.50	0.354	0.030	9.00	0.76	0.432	0.034	10.97	0.86	0.512	0.035	13.00	0.89
0.295	0.024	7.50	0.61	0.354	0.032	9.00	0.81	0.432	0.035	10.97	0.89	0.512	0.039	13.00	1.00
0.295	0.026	7.50	0.66	0.354	0.039	9.00	1.00	0.433	0.020	11.00	0.50	0.516	0.039	13.11	1.00
0.295	0.032	7.50	0.81	0.356	0.020	9.04	0.50	0.433	0.024	11.00	0.61	0.525	0.020	13.34	0.50
0.295	0.039	7.50	1.00	0.356	0.031	9.04	0.79	0.433	0.026	11.00	0.66	0.526	0.031	13.36	0.79
0.297	0.039	7.54	1.00	0.359	0.025	9.12	0.64	0.433	0.028	11.00	0.71	0.528	0.039	13.41	1.00
0.300	0.025	7.62	0.64	0.361	0.035	9.17	0.89	0.433	0.039	11.00	1.00	0.531	0.020	13.50	0.50
0.300	0.035	7.62	0.89	0.362	0.024	9.19	0.61	0.435	0.025	11.05	0.64	0.531	0.039	13.50	1.00
0.301	0.025	7.65	0.64	0.362	0.035	9.19	0.89	0.435	0.031	11.05	0.79	0.534	0.019	13.56	0.48
0.301	0.035	7.65	0.89	0.362	0.039	9.19	1.00	0.440	0.024	11.18	0.61	0.535	0.039	13.59	1.00
0.301	0.038	7.65	0.97	0.363	0.031	9.22	0.79	0.440	0.026	11.18	0.66	0.537	0.020	13.64	0.50
0.302	0.028	7.67	0.71	0.364	0.035	9.25	0.89	0.440	0.028	11.18	0.71	0.539	0.026	13.69	0.66
0.303	0.031	7.70	0.79	0.365	0.026	9.27	0.66	0.445	0.012	11.30	0.30	0.539	0.031	13.69	0.79
0.305	0.020	7.75	0.50	0.368	0.030	9.35	0.76	0.445	0.024	11.30	0.61	0.543	0.020	13.79	0.50
0.306	0.034	7.77	0.86	0.372	0.035	9.45	0.89	0.445	0.026	11.30	0.66	0.543	0.039	13.79	1.00
0.307	0.020	7.80	0.50	0.374	0.020	9.50	0.50	0.449	0.022	11.40	0.56	0.550	0.034	13.97	0.86
0.307	0.024	7.80	0.61	0.374	0.030	9.50	0.76	0.450	0.035	11.43	0.89	0.551	0.016	14.00	0.41
0.310	0.015	7.87	0.38	0.374	0.031	9.50	0.79	0.453	0.024	11.50	0.61	0.551	0.022	14.00	0.56
0.311	0.016	7.90	0.41	0.374	0.032	9.50	0.81	0.453	0.039	11.50	1.00	0.551	0.026	14.00	0.66
0.311	0.020	7.90	0.50	0.374	0.034	9.50	0.86	0.457	0.028	11.61	0.71	0.551	0.028	14.00	0.71
0.311	0.024	7.90	0.61	0.374	0.039	9.50	1.00	0.460	0.029	11.68	0.74	0.551	0.031	14.00	0.79
0.311	0.031	7.90	0.79	0.378	0.028	9.60	0.71	0.460	0.031	11.68	0.79	0.551	0.032	14.00	0.81
0.312	0.018	7.92	0.46	0.386	0.031	9.80	0.79	0.462	0.020	11.73	0.50	0.551	0.039	14.00	1.00
0.312	0.028	7.92	0.71	0.386	0.035	9.80	0.89	0.465	0.036	11.81	0.91	0.559	0.030	14.20	0.76
0.312	0.031	7.92	0.79	0.386	0.039	9.80	1.00	0.469	0.020	11.91	0.50	0.559	0.039	14.20	1.00
0.312	0.035	7.92	0.89	0.393	0.035	9.98	0.89	0.469	0.032	11.91	0.81	0.562	0.032	14.27	0.81
0.312	0.036	7.92	0.91	0.394	0.016	10.00	0.41	0.472	0.016	12.00	0.41	0.571	0.012	14.50	0.30
0.313	0.031	7.95	0.79	0.394	0.022	10.00	0.56	0.472	0.020	12.00	0.50	0.571	0.024	14.50	0.61
0.313	0.033	7.95	0.84	0.394	0.024	10.00	0.61	0.472	0.024	12.00	0.61	0.571	0.031	14.50	0.79
0.315	0.020	8.00	0.50	0.394	0.030	10.00	0.76	0.472	0.026	12.00	0.66	0.571	0.039	14.50	1.00
0.315	0.024	8.00	0.61	0.394	0.031	10.00	0.79	0.472	0.039	12.00	1.00	0.575	0.024	14.61	0.61
0.315	0.028	8.00	0.71	0.394	0.039	10.00	1.00	0.480	0.022	12.19	0.56	0.577	0.030	14.66	0.76
0.315	0.031	8.00	0.79	0.395	0.035	10.03	0.89	0.480	0.039	12.19	1.00	0.577	0.031	14.66	0.79
0.315	0.039	8.00	1.00	0.395	0.037	10.03	0.94	0.482	0.030	12.24	0.76	0.583	0.020	14.81	0.50
0.319	0.018	8.10	0.46	0.398	0.020	10.11	0.50	0.482	0.038	12.24	0.97	0.587	0.020	14.91	0.50
0.319	0.028	8.10	0.71	0.400	0.030	10.16	0.76	0.484	0.039	12.29	1.00	0.587	0.025	14.91	0.64
0.319	0.039	8.10	1.00	0.405	0.028	10.29	0.71	0.488	0.020	12.40	0.50	0.591	0.020	15.00	0.50
0.322	0.035	8.18	0.89	0.405	0.031	10.29	0.79	0.490	0.030	12.45	0.76	0.591	0.022	15.00	0.56
0.323	0.025	8.20	0.64	0.406	0.030	10.31	0.76	0.492	0.020	12.50	0.50	0.591	0.024	15.00	0.61
0.324	0.028	8.23	0.71	0.408	0.039	10.36	1.00	0.492	0.026	12.50	0.66	0.591	0.031	15.00	0.79
0.325	0.029	8.26	0.74	0.409	0.031	10.39	0.79	0.492	0.030	12.50	0.76	0.591	0.039	15.00	1.00
0.325	0.034	8.26	0.86	0.409	0.032	10.39	0.81	0.492	0.039	12.50	1.00	0.595	0.020	15.11	0.50
0.325	0.035	8.26	0.89	0.409	0.039	10.39	1.00	0.494	0.035	12.55	0.89	0.595	0.039	15.11	1.00
0.327	0.038	8.31	0.97	0.410	0.031	10.41	0.79	0.496	0.016	12.60	0.41	0.599	0.035	15.21	0.89
0.327	0.039	8.31	1.00	0.410	0.032	10.41	0.81	0.496	0.030	12.60	0.76	0.600	0.030	15.24	0.76
0.331	0.030	8.41	0.76	0.413	0.031	10.50	0.79	0.500	0.016	12.70	0.41	0.605	0.036	15.37	0.91
0.332	0.031	8.43	0.79	0.413	0.032	10.50	0.81	0.500	0.032	12.70	0.81	0.606	0.039	15.39	1.00
0.335	0.020	8.50	0.50	0.413	0.035	10.50	0.89	0.500	0.034	12.70	0.86	0.610	0.020	15.50	0.50

Inches		Millimeters		Inches		Millimeters		Inches		Millimeters		Inches		Millimeters	
I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section	I.D.	Cross Section
0.610	0.024	15.50	0.61	0.707	0.028	17.96	0.71	0.787	0.031	20.00	0.79	0.906	0.030	23.00	0.76
0.610	0.030	15.50	0.76	0.709	0.028	18.00	0.71	0.787	0.032	20.00	0.81	0.906	0.031	23.00	0.79
0.610	0.031	15.50	0.79	0.709	0.031	18.00	0.79	0.787	0.035	20.00	0.89	0.906	0.032	23.00	0.81
0.611	0.031	15.52	0.79	0.709	0.032	18.00	0.81	0.787	0.036	20.00	0.91	0.906	0.039	23.00	1.00
0.613	0.039	15.57	1.00	0.709	0.039	18.00	1.00	0.787	0.039	20.00	1.00	0.913	0.031	23.19	0.79
0.618	0.039	15.70	1.00	0.717	0.016	18.21	0.41	0.791	0.021	20.09	0.53	0.913	0.032	23.19	0.81
0.622	0.030	15.80	0.76	0.717	0.030	18.21	0.76	0.795	0.028	20.19	0.71	0.913	0.034	23.19	0.86
0.622	0.031	15.80	0.79	0.717	0.031	18.21	0.79	0.801	0.032	20.35	0.81	0.919	0.030	23.34	0.76
0.622	0.032	15.80	0.81	0.719	0.031	18.26	0.79	0.807	0.020	20.50	0.50	0.924	0.024	23.47	0.61
0.625	0.022	15.88	0.56	0.722	0.024	18.34	0.61	0.807	0.028	20.50	0.71	0.925	0.026	23.50	0.66
0.625	0.029	15.88	0.74	0.724	0.022	18.39	0.56	0.807	0.039	20.50	1.00	0.925	0.030	23.50	0.76
0.625	0.031	15.88	0.79	0.724	0.029	18.39	0.74	0.811	0.028	20.60	0.71	0.925	0.032	23.50	0.81
0.625	0.034	15.88	0.86	0.724	0.030	18.39	0.76	0.811	0.035	20.60	0.89	0.925	0.039	23.50	1.00
0.627	0.039	15.93	1.00	0.728	0.020	18.50	0.50	0.811	0.036	20.60	0.91	0.937	0.028	23.80	0.71
0.630	0.016	16.00	0.41	0.728	0.031	18.50	0.79	0.815	0.020	20.70	0.50	0.937	0.031	23.80	0.79
0.630	0.020	16.00	0.50	0.728	0.032	18.50	0.81	0.815	0.028	20.70	0.71	0.937	0.036	23.80	0.91
0.630	0.028	16.00	0.71	0.728	0.036	18.50	0.91	0.815	0.030	20.70	0.76	0.940	0.031	23.88	0.79
0.630	0.030	16.00	0.76	0.732	0.036	18.59	0.91	0.815	0.035	20.70	0.89	0.940	0.039	23.88	1.00
0.630	0.039	16.00	1.00	0.732	0.039	18.59	1.00	0.819	0.024	20.80	0.61	0.945	0.020	24.00	0.50
0.638	0.032	16.21	0.81	0.736	0.020	18.69	0.50	0.819	0.032	20.80	0.81	0.945	0.024	24.00	0.61
0.642	0.031	16.31	0.79	0.736	0.024	18.69	0.61	0.823	0.039	20.90	1.00	0.945	0.028	24.00	0.71
0.643	0.031	16.33	0.79	0.736	0.031	18.69	0.79	0.827	0.020	21.00	0.50	0.945	0.031	24.00	0.79
0.650	0.020	16.50	0.50	0.740	0.024	18.80	0.61	0.827	0.024	21.00	0.61	0.945	0.039	24.00	1.00
0.650	0.024	16.50	0.61	0.748	0.012	19.00	0.30	0.827	0.032	21.00	0.81	0.948	0.027	24.08	0.69
0.650	0.026	16.50	0.66	0.748	0.020	19.00	0.50	0.827	0.039	21.00	1.00	0.950	0.035	24.13	0.89
0.650	0.028	16.50	0.71	0.748	0.022	19.00	0.56	0.839	0.028	21.31	0.71	0.957	0.036	24.31	0.91
0.650	0.032	16.50	0.81	0.748	0.024	19.00	0.61	0.839	0.031	21.31	0.79	0.959	0.035	24.36	0.89
0.654	0.024	16.61	0.61	0.748	0.028	19.00	0.71	0.839	0.035	21.31	0.89	0.961	0.030	24.41	0.76
0.654	0.028	16.61	0.71	0.748	0.030	19.00	0.76	0.839	0.039	21.31	1.00	0.961	0.039	24.41	1.00
0.654	0.030	16.61	0.76	0.748	0.031	19.00	0.79	0.840	0.030	21.34	0.76	0.965	0.020	24.50	0.50
0.656	0.037	16.66	0.94	0.748	0.035	19.00	0.89	0.846	0.020	21.50	0.50	0.965	0.024	24.50	0.61
0.659	0.032	16.74	0.81	0.748	0.037	19.00	0.94	0.846	0.028	21.50	0.71	0.965	0.031	24.50	0.79
0.661	0.039	16.79	1.00	0.748	0.039	19.00	1.00	0.846	0.039	21.50	1.00	0.972	0.028	24.69	0.71
0.662	0.030	16.81	0.76	0.750	0.020	19.05	0.50	0.847	0.032	21.50	0.81	0.975	0.030	24.77	0.76
0.669	0.022	17.00	0.56	0.750	0.032	19.05	0.81	0.850	0.030	21.59	0.76	0.975	0.031	24.77	0.79
0.669	0.024	17.00	0.61	0.750	0.035	19.05	0.89	0.852	0.024	21.64	0.61	0.980	0.032	24.89	0.81
0.669	0.026	17.00	0.66	0.752	0.039	19.10	1.00	0.853	0.028	21.67	0.71	0.984	0.020	25.00	0.50
0.669	0.030	17.00	0.76	0.756	0.020	19.20	0.50	0.860	0.032	21.84	0.81	0.984	0.024	25.00	0.61
0.669	0.031	17.00	0.79	0.756	0.035	19.20	0.89	0.862	0.020	21.89	0.50	0.984	0.028	25.00	0.71
0.669	0.039	17.00	1.00	0.756	0.036	19.20	0.91	0.866	0.020	22.00	0.50	0.984	0.030	25.00	0.76
0.675	0.029	17.15	0.74	0.762	0.030	19.35	0.76	0.866	0.028	22.00	0.71	0.984	0.039	25.00	1.00
0.683	0.030	17.35	0.76	0.766	0.039	19.46	1.00	0.866	0.032	22.00	0.81	0.985	0.020	25.00	0.50
0.685	0.020	17.40	0.50	0.768	0.024	19.50	0.61	0.866	0.036	22.00	0.91	0.987	0.031	25.07	0.79
0.685	0.021	17.40	0.53	0.768	0.039	19.50	1.00	0.866	0.039	22.00	1.00	0.987	0.039	25.07	1.00
0.685	0.026	17.40	0.66	0.775	0.031	19.69	0.79	0.870	0.024	22.10	0.61	0.988	0.035	25.10	0.89
0.685	0.028	17.40	0.71	0.776	0.031	19.71	0.79	0.874	0.035	22.20	0.89	0.988	0.036	25.10	0.91
0.685	0.039	17.40	1.00	0.776	0.032	19.71	0.81	0.874	0.036	22.20	0.91	0.989	0.030	25.12	0.76
0.687	0.025	17.45	0.64	0.776	0.039	19.71	1.00	0.886	0.016	22.50	0.41	0.996	0.024	25.30	0.61
0.689	0.020	17.50	0.50	0.779	0.031	19.79	0.79	0.886	0.028	22.50	0.71	1.000	0.030	25.40	0.76
0.689	0.031	17.50	0.79	0.780	0.024	19.81	0.61	0.886	0.031	22.50	0.79	1.000	0.031	25.40	0.79
0.689	0.032	17.50	0.81	0.780	0.031	19.81	0.79	0.898	0.031	22.81	0.79	1.000	0.032	25.40	0.81
0.689	0.036	17.50	0.91	0.780	0.039	19.81	1.00	0.898	0.032	22.81	0.81	1.000	0.035	25.40	0.89
0.694	0.034	17.63	0.86	0.785	0.039	19.94	1.00	0.898	0.035	22.81	0.89	1.000	0.039	25.40	1.00
0.697	0.016	17.70	0.41	0.787	0.024	20.00	0.61	0.906	0.016	23.00	0.41				
0.697	0.020	17.70	0.50	0.787	0.030	20.00	0.76	0.906	0.020	23.00	0.50				

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