Diaphragm Measurement Guide

DIA-COM CORPORATION

The Diaphragm Company

Online Diaphragm Measurement Guide: www.diacom.com

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AEROSPACE & DEFENSE

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About Measuring Diaphragms

Snap Gauge

The manufacturing of fabric reinforced diaphragms is a unique part of the rubber industry.

The rubber industry has been around for many years and has well-defined industry standards for rubber products that cover design and quality issues. These can be found in the Rubber Manufacturers Association ***RMA Handbook***, as well as many other industry publications. The rubber industry also has terminology that is commonly understood throughout the industry.

Fabric reinforced diaphragm manufacturing (in addition to those shared with the general rubber industry) has its own terminology, design concepts, quality standards, and expectations. The inherent flexibility of rubber, measuring techniques, measuring equipment used, fixtures, and other variables have an impact on the accuracy of measurements. Because rolling diaphragms are constructed with fabric reinforcement, and by design they have thin cross sections, the measurement techniques, equipment, and other variables become more critical in assuring the accuracy of any dimensional layouts.

Depending on the design of the diaphragm, DiaCom Corporation uses various measuring equipment such as optical comparators, vision system, specialized thickness gauges, tool maker's microscopes, double-sided tape, and mylar gauges. Measuring techniques used include fixturing, sectioning diaphragms for microscopic measurements, and other methods. (*Note: Calipers should never be used to measure the diameter of a diaphragm.*) It is important to note that standard temperature and pressure should be used when measuring diaphragms as well.

As rubber is a compressible material, a snap gauge will compress the rubber in a part affecting its measured thickness. Snap gauge compression is determined by the spring tension and the anvil/foot size of the gauge. The customer should work with DiaCom to establish a compression standard for the part being measured.

It is also important to remember two key factors in measuring diaphragms: First, all diaphragms are flexible. Second, fabric is manufactured in a two-dimensional matrix, length, and width. These two factors may seem self-evident, but they must be kept in mind when measuring diaphragms.

Comparator

The flexibility factor means that a diaphragm may deform slightly when placed on a measurement surface. Also, keep in mind that some measuring equipment can deform the part while the measurement is being taken, as diaphragms are typically flexible by design.

The second, or fabric factor, means that the diaphragm diameters, when unsupported, will have a slightly square condition as the fabric tries to revert to its original square condition. When measuring fabric-reinforced diaphragm diameters, it is a common practice to take two measurements 45° apart. The actual diameter is the average of these two measurements.

In all cases, it is important that the measurement techniques, equipment, and fixtures are duplicated at DiaCom Corporation and customer locations to avoid unnecessary confusion.

The Fabric Effect

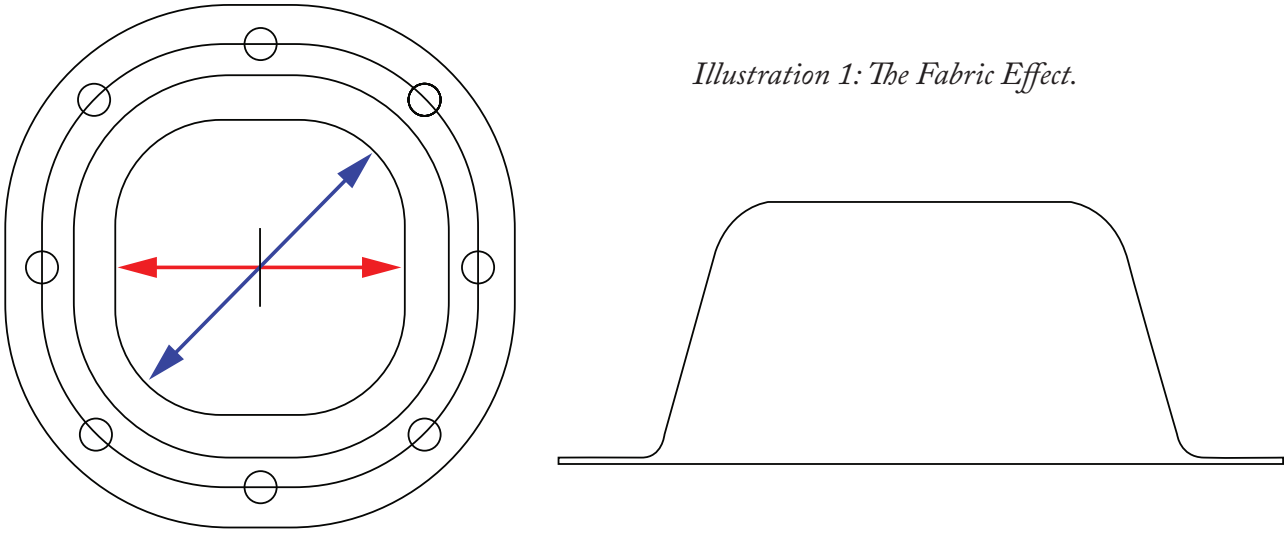


Illustration 1: The Fabric Effect.

The use of fabric reinforcement in rolling diaphragms is one of the key components that allows for the combination of high strength and great flexibility. Incorporating fabric reinforcement into rolling diaphragms has an impact on diaphragm dimensions when the diaphragm is in a relaxed state. This condition is commonly referred to as "*The Fabric Effect*".

The Fabric Effect is the result of forming a square-woven (or knitted) fabric into a round shape. After forming, the fabric will try to relax back to its square pattern shape. Shown above is an example of the result of *The Fabric Effect*. (Note: The effect has been exaggerated for this example.) As can be seen in the top view, there is a "squaring" effect that results in a short and long axis in the diaphragm. The difference in length of the two axes can run from less than 0.001" up to many thousandths of an inch depending on the size of the diaphragm. When using a measurement device, such as a comparator, several diameter measurements should be taken at different axes with the actual diameter reported as the average of the measurements. When using a Vision System, enough points (minimum: 8 preferred) should be taken on the circumference of the circle being measured.

The variation due to *The Fabric Effect* will be dependent on the materials used and the geometry of the diaphragm. It will also affect the location of any bolt holes or other trim features as the diaphragm is held in the correct shape while the trimming operation is performed. *The Fabric Effect* has no negative effect in the function or cycle-life capability of rolling diaphragms and is inherent in all rolling diaphragms. For consistent, repeatable measurements the use of the correct measurement technique is critical.

It should also be noted that rubber diaphragms are inherently non-rigid parts, which means that the measurement results can vary significantly based on the part size and shape, the materials used and the measurement technique. When setting part tolerances, care must be taken to allow for the rubber nature of the parts and the measurement techniques available, as well as the normal process variation associated with diaphragm manufacturing. We recommend that the customer's design personnel work closely with our engineering department at the start of the diaphragm program.

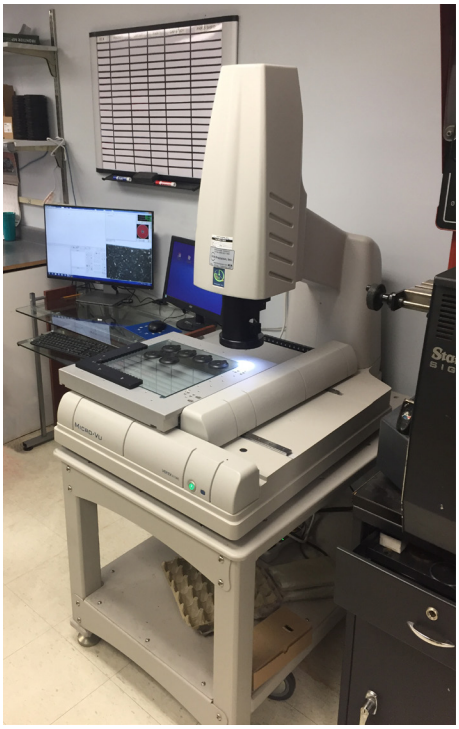
Rolling diaphragms are inherently soft and pliable, as they are intentionally manufactured with soft rubber and pliable fabrics in as thin a cross-section as possible. It is this flexibility, combined with the strength of the fabric reinforcement, that gives rolling diaphragms their unparalleled performance. This flexible nature of rolling diaphragms should be considered when setting up the dimensional tolerances for all diaphragms, especially trimmed hole dimensions.

Measurement Fixture

Unfortunately, this flexibility can have a detrimental impact on measurement accuracy. At best, it makes taking accurate measurements difficult. At worst, it can make measurement accuracy and repeatability extremely problematic.

Another aspect of rolling diaphragms that affects measurement accuracy, is the combination of rubber and fabric which come together during the compression molding process. Fabric and rubber react differently to the stresses developed during the molding process. Also, molded rubber will shrink after molding, while the fabric does not. The result of these differences in stress and shrinkage will cause the diaphragm to deform slightly from its molded shape. This slight deformation must be addressed when measuring the part, especially when the diaphragm design demands tight dimensional tolerances.

A third aspect of rolling diaphragms that affects measurement accuracy, is the overall general structural strength of most rolling diaphragm designs. Again, because the diaphragm is designed to be as thin as possible, and the rubber and fabric are as soft and pliable as possible, the very weight of the diaphragm may cause slight deformations if the diaphragm is unsupported as measurements are taken.



Vision System

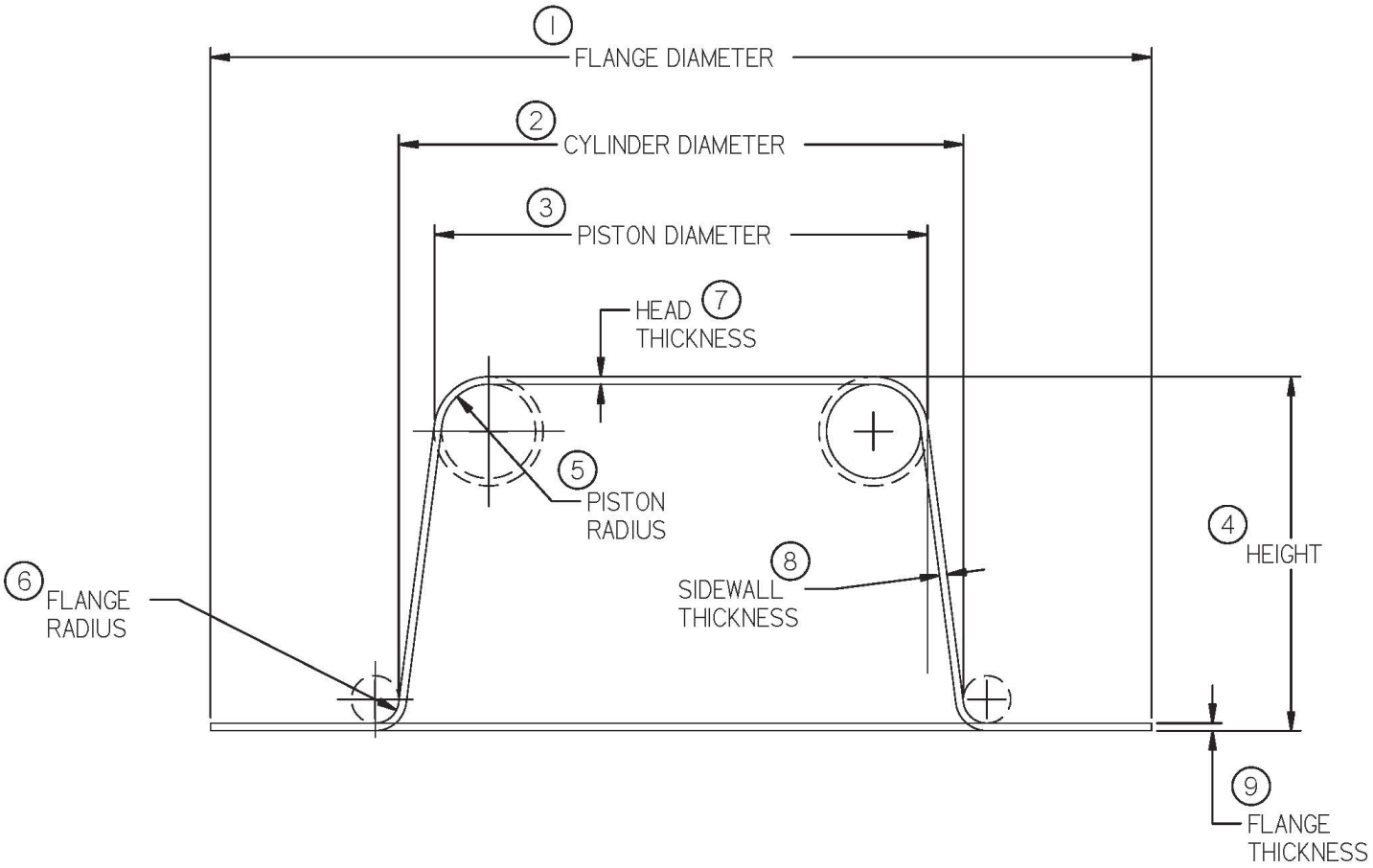
One of the ways to improve measurement accuracy and repeatability is to use measurement fixtures. In many cases, fixtures are very simple shapes used to hold the part in the molded shape, minimizing the distorting effects of the diaphragm flexibility, molding, stress, and part weight.

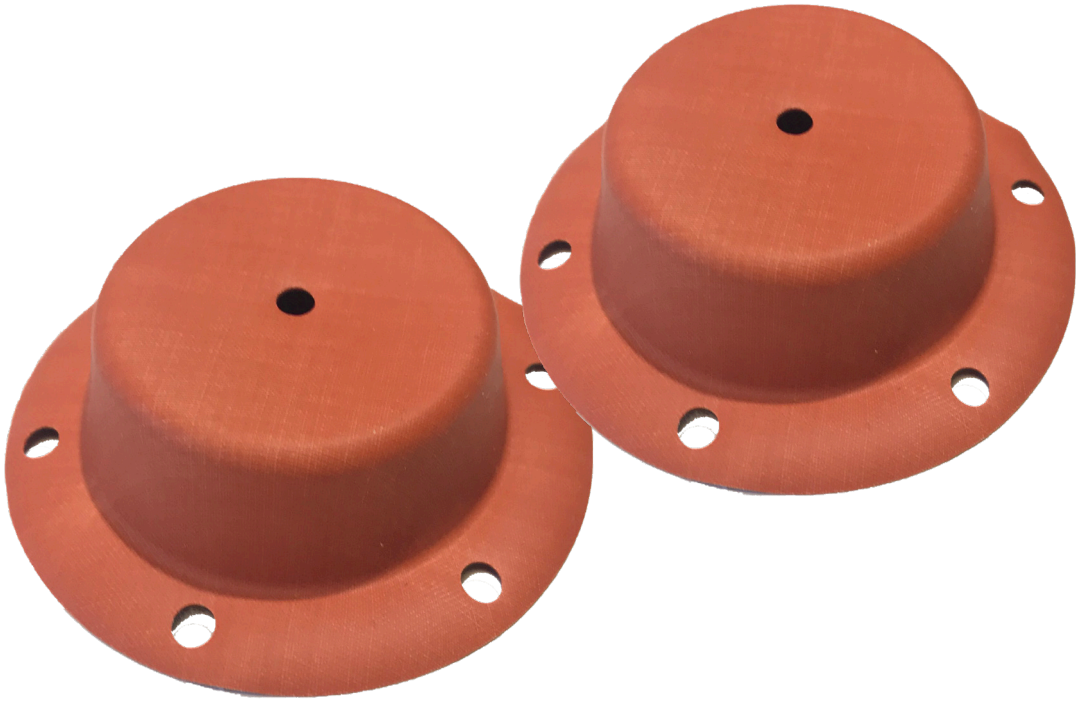
In some cases, a fixture must be made specifically for that part, especially when measuring a diaphragm with tight dimensional tolerances.

It is inherent in fixture design that some dimensions of the diaphragm are controlled by the fixture. Almost always, the flange and head of the diaphragm will be held flat by the fixture and set at the mean of the diaphragm height. While holding the head and flange flat (and at the proper height), the bolt holes are located by pins of the fixture, setting the holes in the proper location before taking the remaining measurements.

In all cases, as much as possible, Diacom and the customer must agree to use the same type of fixture, measurement equipment, (standard) temperature, pressure, and the same measurement techniques.

Type F Diaphragms





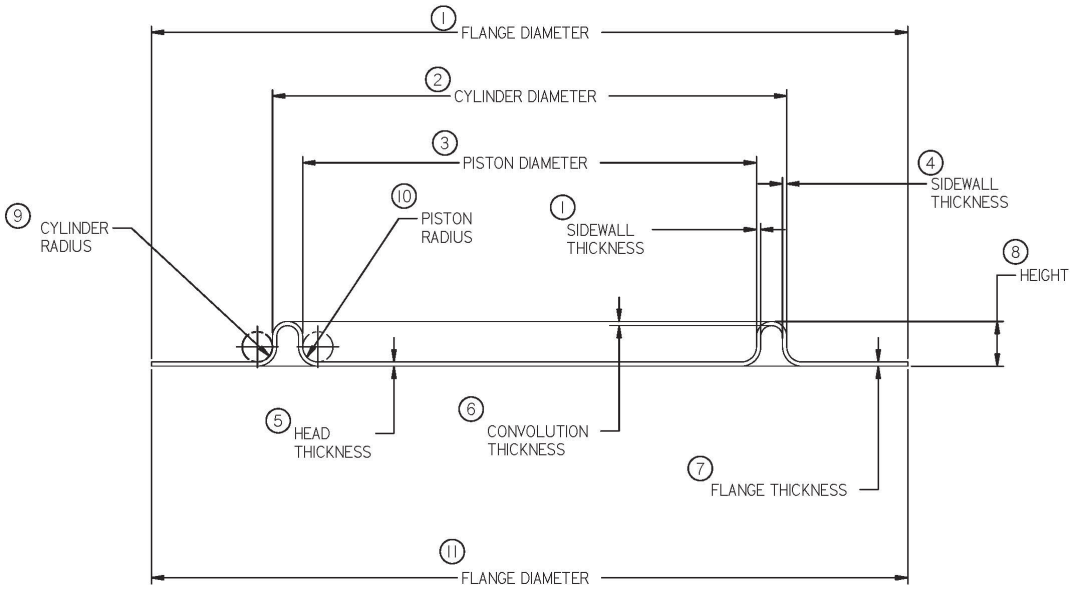
Dim. #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Flange Diameter	Vision System	Comparator up to 6"	_____	Vision System: At least eight (8) measurements must be taken. Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.
2	Cylinder Diameter	Vision System	Comparator up to 6"	_____	
3	Piston Diameter	Vision System	Comparator up to 6"	_____	
4	Height	Comparator up to 6"	Vision System	_____	The part is placed on a flat surface. The height is measured from that surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area.
5	Piston Radius	Vision System	Radius Gauge	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
6	Flange Radius	Vision System	Radius Gauge	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
7	Head Thickness	Snap Gauge	Measure Cross-Section		Measure a minimum of 2 points. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results. DiaCom and customer should agree on measurement device(s) used.)
8	Sidewall Thickness				
9	Flange Thickness				

Cylinder Diameter	25. to .99	6 to 25	1.00 to 2.50	25 to 64	2.51 to 4.00	64 to 102	4.01 to 8.00	102 to 205	8.01 & Up	205 & Up
Height	(See Available Sizes Table in DiaCom Diaphragm Design Guidebook page 15.)									
Cylinder Diameter	Tolerances on Cylinder Diameter and Piston Diameter are ± .-010" per inch of diameter, but the tolerance will be no less than ± .010" or greater than ± .060"									
Piston Diameter										
Head Thickness & Flange Thickness	.015 ± .003	0.38 ± 0.08	.017 ± .004	0.43 ± 0.10	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Wall Gauge	.015 ± .003	0.38 ± 0.08	.017 ± .004	0.43 ± 0.10	.024 ± .004	0.61 ± 0.10	.035 ± .005	.089 ± 0.13	.045 ± .007	1.14 ± 6.35
Head Radius	.094	2.39	.125	3.18	.156	3.96	.250	6.35	.250	6.35
Flange Radius	.031	0.79	.063	1.60	.094	2.39	.125	3.18	.125	3.18
Flange Diameter	Cyl. Diam +.750	Cyl. diam. +19.05	Cyl. Diam. + 1"	Cyl. Diam. +25.40	Cyl. Diam. + 1.50	Cyl. Diam. +38.10	Cyl. Diam. +2"	Cyl. Diam. +50.80	Cyl. Diam. +2"	Cyl. Diam. +50.80

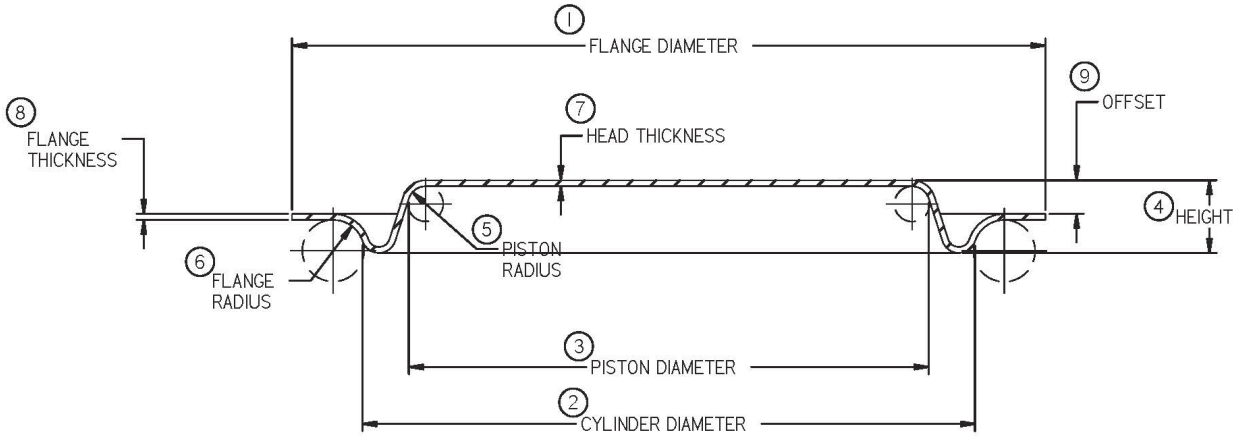
Diaphragm Flange Diameter and Hole Trim Tolerances:					
Diameter		Size		Position	
0 - 1.00"	0. - 25.40	± .010"	0.25	.010	0.25
1.01 - 3.00"	25.65 - 76.20	± .020"	0.51	.020	0.51
over 3.01"	76.45	± .030	0.76	.030	0.76
Angular relationship of holes: ± 1/2 degree.					

Type FC & FC Offset Diaphragms

FC



FC Offset

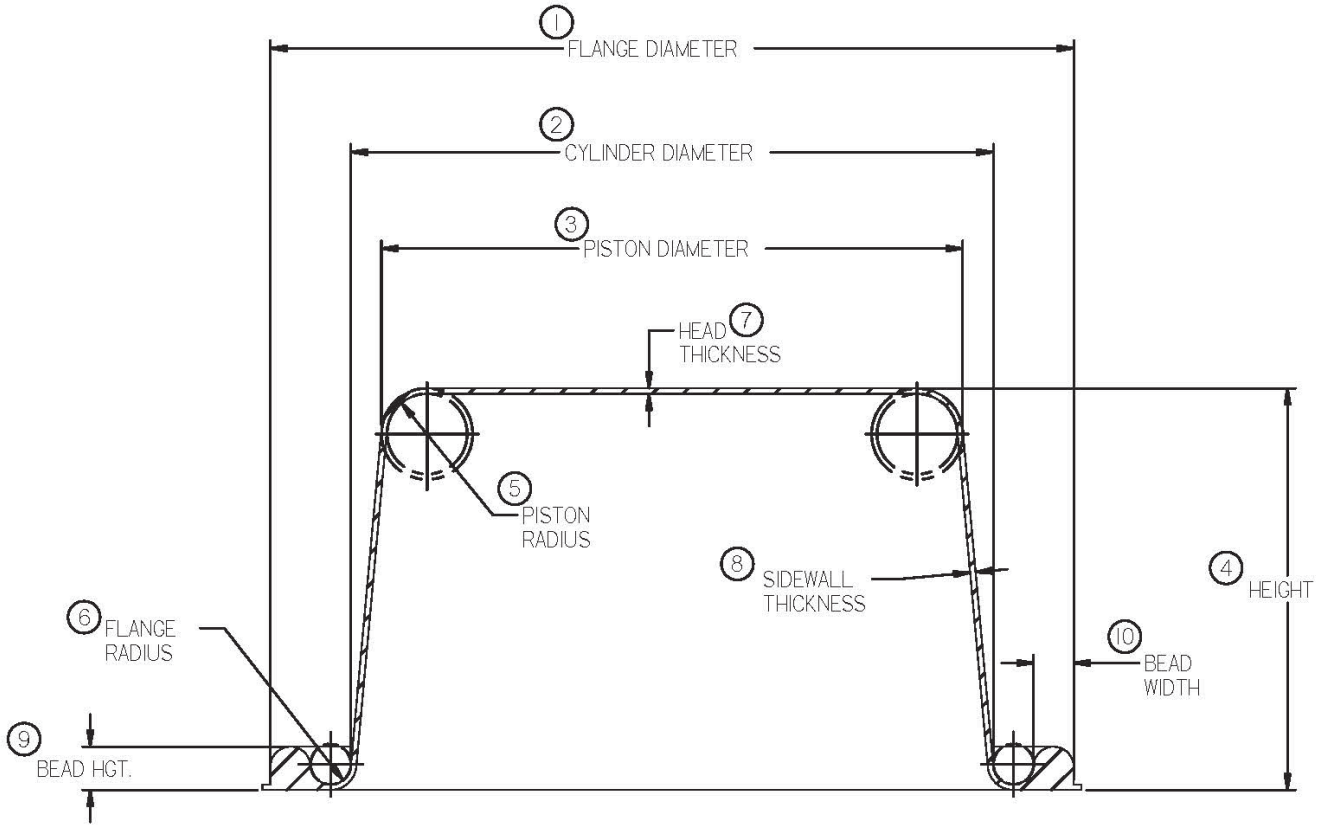


Dim. #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Flange Diameter	*Vision System*	*Comparator up to 6″*	_____	*Vision System: At least eight (8) measurements must be taken.* *Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.*
2	Cylinder Diameter	*Vision System*	*Comparator up to 6″*	_____	
3	Piston Diameter	Vision System	Comparator up to 6″	_____	
4	Height	*Comparator up to 6″*	Vision System	_____	*The part is placed on a flat surface. Note: It is important to ensure the part lays flat; it may be necessary to use a measurement fixture. The height is measured from the flat surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area.*
5	Piston Radius	Gauges	Vision System	_____	*In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.*
6	Cylinder Radius	Gauges	Vision System	_____	*In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.*
7	Head Thickness	Snap Gauge	Measure Cross-Section with Vision System	_____	*Measure a minimum of 3 points equally spaced around the part. Report the high and low measurements results* *(It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength - which may affect the measurement results.)*
8 & 9	Sidewall Thickness				
10	Convolution Thickness				
11	Flange Thickness				

Cylinder Diameter	*25. to .99*	*6 to 25*	*1.00 to 2.50*	*25 to 64*	*2.51 to 4.00*	*64 to 102*	*4.01 to 8.00*	*102 to 205*	*8.01 & Up*	*205 & Up*
Height	(See Available Sizes Table in DiaCom Diaphragm Design Guidebook page 17.)									
Cylinder Diameter	Tolerances on Cylinder Diameter and Piston Diameter are ± .-010″ per inch of diameter, but the tolerance will be no less than ± .010″ or greater than ± .060″									
Piston Diameter										
Head Thickness & Flange Thickness	*.015 ± .003*	*0.38 ± 0.08*	*.017 ± .004*	*0.43 ± 0.10*	*.024 ± .004*	*0.61 ± 0.10*	*.035 ± .005*	*0.89 ± 0.13*	*.045 ± .007*	*1.14 ± 0.18*
Wall Gauge	*.015 ± .003*	*0.38 ± 0.08*	*.017 ± .004*	*0.43 ± 0.10*	*.024 ± .004*	*0.61 ± 0.10*	*.035 ± .005*	*.089 ± 0.13*	*.045 ± .007*	*1.14 ± 0.18*
Piston Radius	*.031*	*0.79*	*.063*	*1.60*	*.094*	*2.39*	*.125*	*3.18*	*.125*	*3.18*
Flange Radius	*.031*	*0.79*	*.063*	*1.60*	*.094*	*2.39*	*.125*	*3.18*	*.125*	*3.18*
Flange Diameter	*Cyl. Diam +.750*	*Cyl. diam. +19.05*	*Cyl. Diam. + 1″*	*Cyl. Diam. +25.40*	*Cyl. Diam. + 1.50*	*Cyl. Diam. +38.10*	*Cyl. Diam. +2″*	*Cyl. Diam. +50.80*	*Cyl. Diam. +2″*	*Cyl. Diam. +50.80*

Diaphragm Flange Diameter and Hole Trim Tolerances:					
Diameter		*Size*		*Position*	
0 - 1.00″	*0. - 25.40*	*± .010″*	*0.254*	*.010*	*0.254*
1.01 - 3.00″	*25.65 - 76.20*	*± .020″*	*0.508*	*.020*	*0.508*
over 3.01″	*over 76.45*	*± .030*	*0.762*	*.030*	*0.762*
Angular relationship of holes: ± 1/2 degree.					

Type D Diaphragms

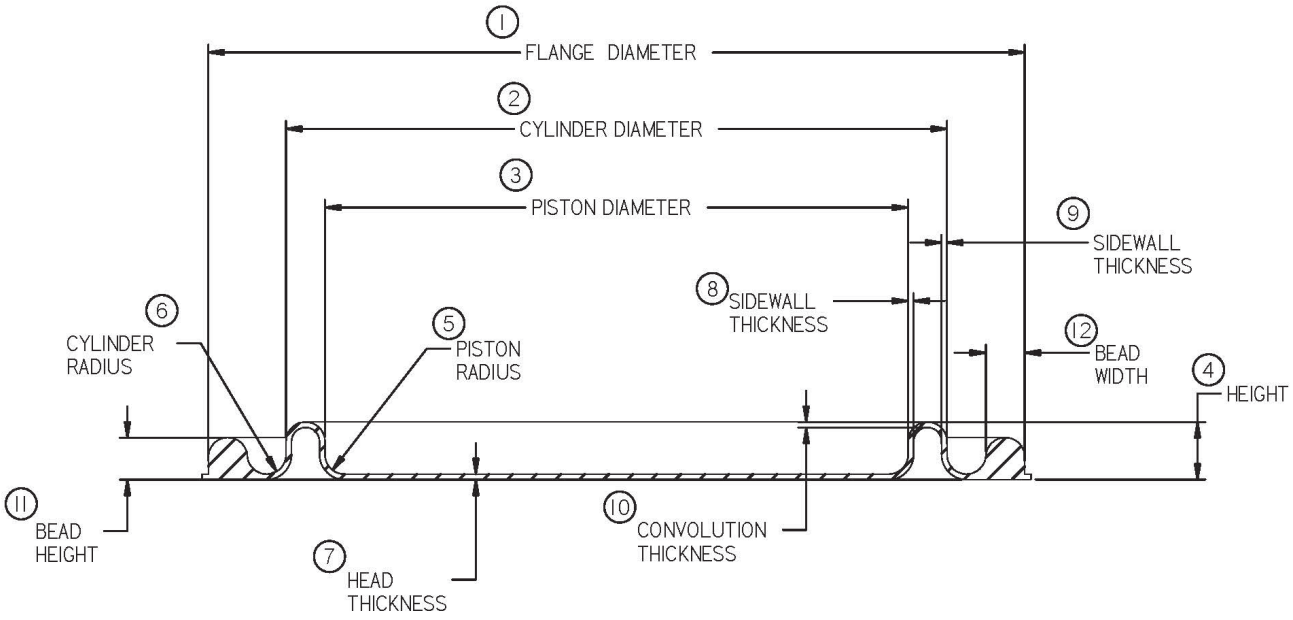


Diaphragm Flange Diameter and Hole Trim Tolerances					
Diameter		Size		Position	
.0 - 1.00″	± .0 - 25.40	± .010″	± 0.25	± .010″	0.25
1.01 - 3.00″	25.65 - 76.20	± .020″	± .051	± .020″	0.51
over 3.01″	over 76.45	± 0.30″	± 0.76	± .030	0.76

Dim #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Flange Diameter	*Vision System*	*Comparator up to 6"*	_____	*Vision System: At least eight (8) measurements must be taken.* *Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.*
2	Cylinder Diameter	*Vision System*	*Comparator up to 6"*	_____	
3	Piston Diameter	*Vision System*	*Comparator up to 6"*	_____	
4	Height	*Comparator up to 6"*	_____	_____	*Place part on a flat surface. The height is measured from that surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area.*
5	Piston Radius	*Vision System*	*Radius Gauge*	_____	*In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.*
6	Flange Radius	*Vision System*	*Radius Gauge*	*Calipers*	*In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.*
7	Head Thickness	*Snap Gauge*	*Measure Cross-Section with Comparator*	_____	*Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measuring device. When using Snap Gauges, for example, different models have different spring strength which may effect the measurement results.)*
8	Sidewall Thickness	*Snap Gauge*	*Measure Cross-Section with Comparator*	_____	*Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measuring device. When using Snap Gauges, for example, different models have different spring strength which may effect the measurement results.)*
9	Bead Height	*Snap Gauge*	*Measure Cross-Section with Vision System*	_____	*Note: The bead must be held flat when using contact gauges and the measurement gauge must not deflect the part while taking the measurements. If measuring a cross-sections, great care must be taken when cutting the cross-sections of a rubber part. The cut must be clean, smooth and precisely 90 Degrees to the axis of measurement. Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results.*
10	Bead Width	*Measure Cross-Section with Comparator*	*Calipers*	_____	*Note: Great care must be taken when cutting cross-sections of a rubber part. The cut must be clean, smooth, and precisely 90 degrees to the axis of measurement.*

Cylinder Diameter	.37 to .99	9 to 25	1.00 to 2.50	25 to 64	2.51 to 4.00	64 to 102	4.01 to 8.00	102 to 205	8.01 & Up	205 & Up
Height	(See Available Sizes Table in DiaCom Diaphragm Design Guidebook page 19.)									
Cylinder Diameter	Tolerances on Cylinder Diameter and Piston Diameter are ± .-010" per inch of diameter, but the tolerance will be no less than ± .010" or greater than ± .060"									
Piston Diameter										
Head & Flange Thickness	.15 ± .003	.038 ± 0.08	.017 ± .004	0.43 ± 0.10	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Wall Gauge	.015 ± .003	.038 ± 0.08	.017 ± .004	0.43 ± 0.10	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Flash Projection	.025 Max	0.64 Max	.025 Max	.064 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Flash Thickness	.025 Max	0.64 Max	.025 Max	.064 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Piston Radius	.094	2.39	.125	3.18	.156	3.96	.250	6.35	.250	6.35
Flange Radius	.031	0.79	.063	1.60	.094	2.39	.125	3.18	.125	3.18
Flange Diameter	Cyl. Diam. + .313	Cyl. Diam. + 7.95	Cyl. Diam. +.500	Cyl. Diam. +12.70	Cyl. Diam. +.750	Cyl. diam. +19.05	Cyl. diam. +1"	Cyl. diam. +25.40	Cyl. Diam. + 1"	Cyl. Diam. +25.40
Bead Width	.094 ± .003	2.39 ± 0.08	.125 ± .003	3.18 ± 0.08	.187 ± .003	4.75 ± 0.08	.250 ± .003	6.35 ± 0.08	.250 ± .004	6.35 ± 0.10
Bead Height	.095 ± .004	2.41 ± 0.10	.135 ± .004	3.43 ± 0.10	.200 ± .005	5.08 ± 0.13	.270 ± .007	6.86 ± 0.18	.270 ± .008	6.86 ± 0.20

Type DC Diaphragms

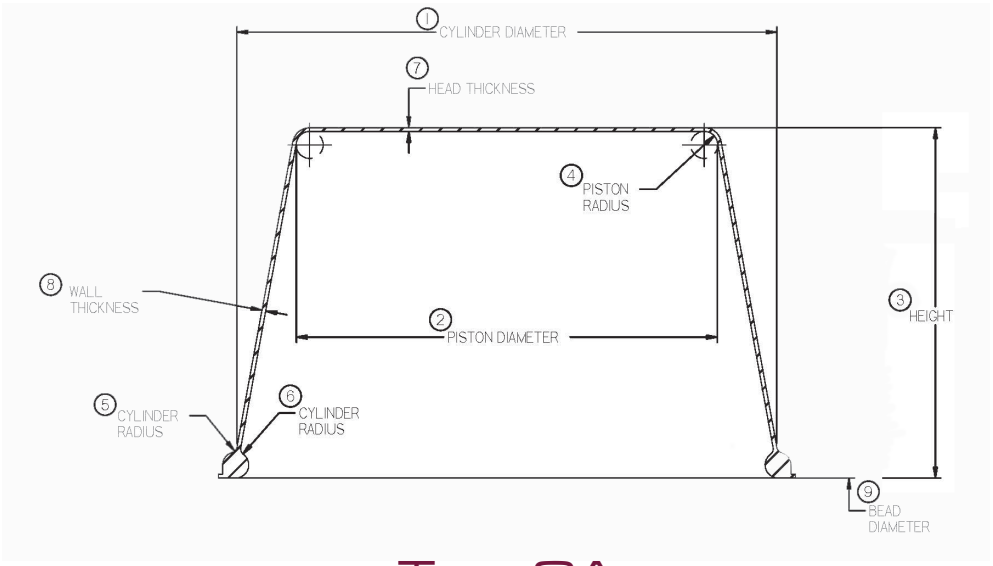


Diaphragm Flange Diameter and Hole Trim Tolerances:					
Diameter		Size		Position	
0 - 1.00"	0. - 25.40	± .010"	0.25	.010	0.25
1.01 - 3.00"	25.65 - 76.20	± .020"	0.51	.020	0.51
over 3.01"	Over 76.45	± .030	0.76	.030	0.76
Angular relationship of holes: ± 1/2 degree.					

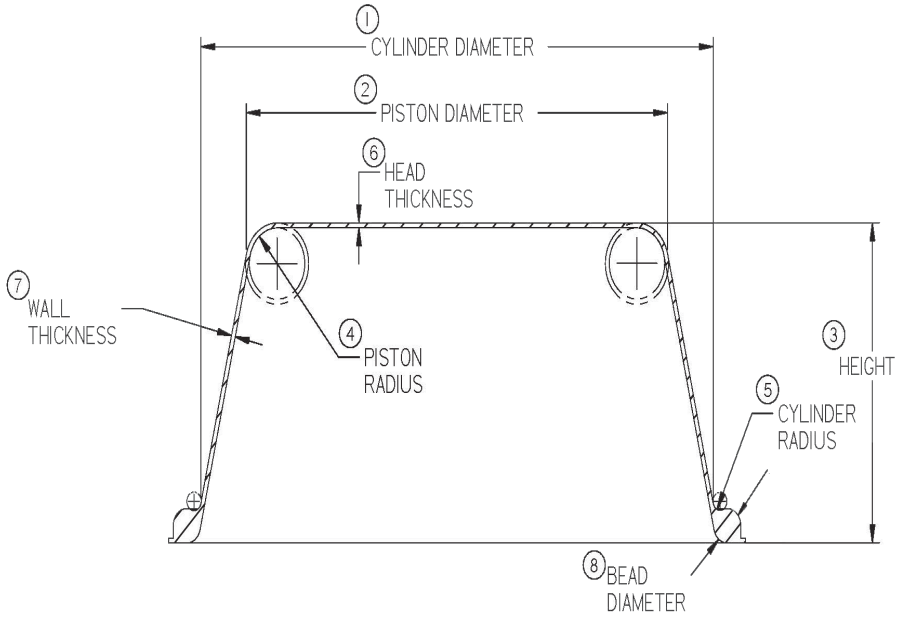
Dim. #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Flange Diameter	Vision System	Comparator up to 6"	Calipers	Vision System: At least eight (8) measurements must be taken. Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.
2	Cylinder Diameter	Vision System	Comparator up to 6"	_____	
3	Piston Diameter	Vision System	Comparator up to 6"	Calipers	
4	Height	Comparator up to 6"	Height Gauge	_____	The part is placed on a flat surface. (NOTE: It is important to ensure the part lays flat: it may be necessary to use a measurement fixture The height is measured from the flat surface to the top of the part.) The top of the part measurement is taken at a location approximately where the head radius transitions to the head area. Several measurements may be needed with the average of all readings reported.
5	Piston (Head Radius)	Radius Gauge	Measure Cross-Section with Vision System	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept or "Reject with no specific numerical value reported.
6	Cylinder (Flange) Radius	Radius Gauge	Measure Cross-Section with Vision System	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept or "Reject with no specific numerical value reported.
7	Head Thickness	Snap Gauge	Measure Cross Section with Vision System	_____	Measure a minimum of 2 points equally spaced around the part. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results.)
8	Sidewall Thickness				
9	Sidewall Thickness				
10	Convolution Thickness				
11	Bead Height	Snap Gauge	Measure Cross-Section with Vision System	_____	The bead must be held flat when using contact gauges and the measurement gauge must not deflect the part while taking the measurements. If measuring a cross-section, great care must be taken when cutting the cross-sections of a rubber part. The cut must be clean, smooth and precisely 90 degrees to the axis of measurement. Measure a minimum of 3 points equally spaced around the part. Report the high and low measurements.
12	Bead Width	Caliper	Measure Cross-Section with Vision System	_____	Great care must be taken when cutting cross-sections of a rubber part. The cut must be clean, smooth, and precisely 90 degrees to the axis of measurement. If the bead is large enough, the preferred method is to use calipers.

Cylinder Diameter	.37 to .99	9 to 25	1.00 to 2.50	25 to 64	2.51 to 4.0	64 to 102	4.01 to 8.0	102 to 205	8.01 & Up	205 & Up
Height	(See Available Sizes Table in DiaCom Diaphragm Design Guidebook page 20.)									
Cylinder Diameter	Tolerances on Cylinder Diameter and Piston Diameter are ± .-010" per inch of diameter, but the tolerance will be no less than ± .010" or greater than ± .060"									
Piston Diameter										
Head Thickness & Flange Thickness	.015 ± .003	0.38 ± 0.08	.017 ± .004	0.43 ± .0.10	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Wall Gauge	.015 ± .003	0.38 ± 0.08	.017 ± .004	0.43 ± .0.10	.024 ± .004	.061 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Flash Projection	.025 Max	0.64 Max	.025 Max	.64 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Flash Thickness	.025 Max	0.64 Max	.025 Max	.64 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Piston/Flange Radius	.031	.79	.063	1.60	.094	2.39	.125	3.18	.125	3.18
Flange Diameter	Cyl. Diam. + .313	Cyl. Diam. + 7.95	Cyl. Diam. + .500	Cyl. Diam. + 12.70	Cyl. Diam. +.750	Cyl. Diam. +19.05	Cyl. Diam. +1"	Cyl. Diam. +25.40	Cyl. Diam. +1"	Cyl. Diam. +25.40
Bead Width	.094 ± .003	2.39 ± 0.08	.125 ± .003	3.18 ± 0.08	.187 ± .003	4.75 ± 0.08	.250 ± .003	6.35 ± 0.08	.250 ± .004	6.35 ± 0.10
Bead Height	.095 ± .003	2.41 ± 0.10	.135 ± .004	3.43 ± 0.10	.200 ± .005	5.08 ± 0.13	.270 ± .006	6.86 ± 0.15	.270 ± .008	6.86 ± 0.20

Type O



Type OA



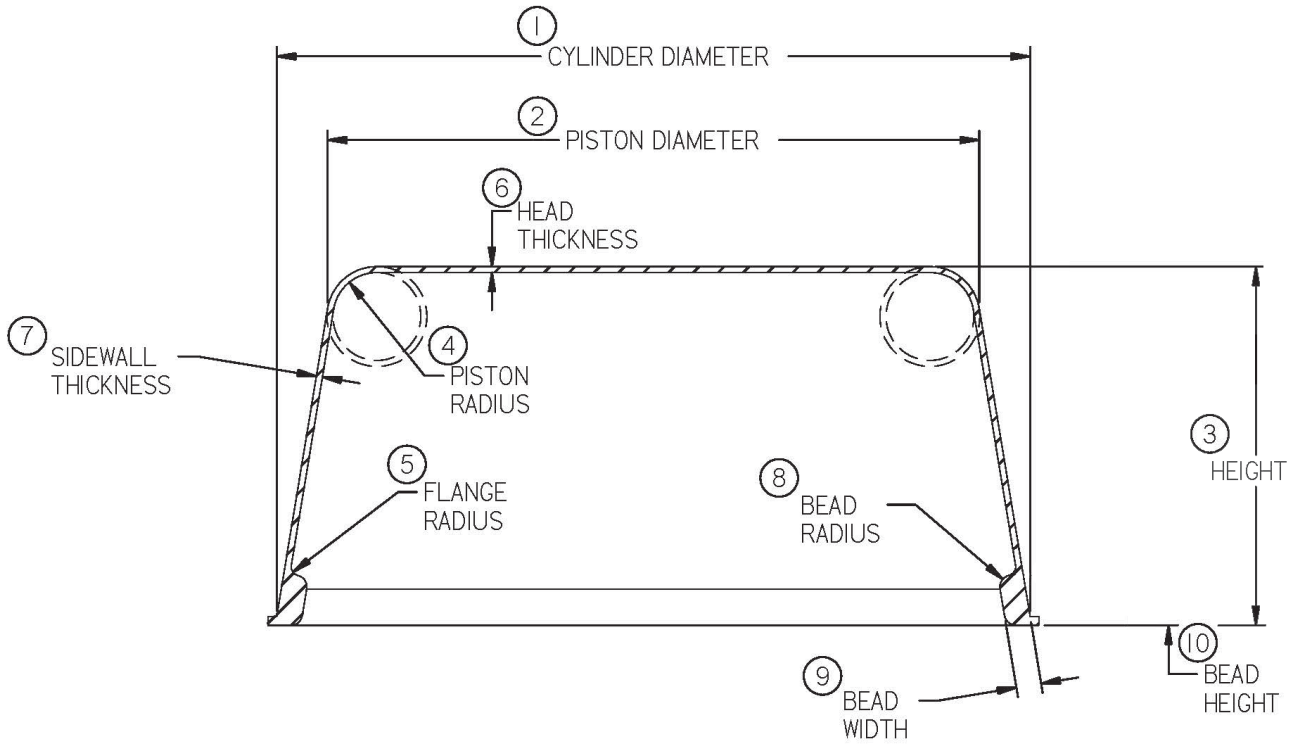
Dim. No	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Cylinder Diameter	Vision System	Comparator Up to 6"	_____	Vision System: At least eight (8) measurements must be taken. Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.
2	Piston Diameter	Vision System	Comparator Up to 6"	_____	
3	Height	Comparator	Height Gauge	_____	The part is placed on a flat surface. The height is measured from that surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area. Several measurements may be needed with the average of all readings recorded.
4	Piston or Head Radius	Radius Gauge	Vision System	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
5 & 6	Cylinder Radius	Radius Gauge	Vision System	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
7	Head Thickness	Snap Gauge	Measure Cross-Section with Vision System	_____	Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results.)
8	Sidewall Thickness	Snap Gauge	Measure Cross-Section with Vision System	_____	Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results. It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results.
9	Bead Diameter	Vision System	Measure Cross-Section with Vision System	_____	_____

(Note: If part is large, large calipers are used.)

Cylinder Diameter	1.00 to 2.50	25 to 64	2.51 to 4.00	64 to 102	4.01 to 8.00	102 & Up
Bead Diameter	.121	3.07	.151	3.84	.242	6.15
Convolution Width	.094	2.39	.156	3.96	.250	6.35
Flash Projection Flash Thickness	.020 Max .020 Max	0.51 Max 0.51 Max	0.030 Max 0.030 Max	0.076 Max 0.076 Max	0.040 Max 0.040 Max	1.02 Max 1.02 Max
Wall Gauge	.017	0.43	.024	0.61	.035	0.89
Piston Radius	.063	1.60	.094	2.39	.125	3.18
Piston Diameter	Cyl. Diam. less .188"	Cyl. Diam. less 4.78	Cyl. Diam. less .313"	Cyl. Diam. less 7.95	Cyl. Diam. less .500"	Cyl. Diam. less .12.70
Flange Radius	.032	0.81	.047	1.19	.063	1.60

Cylinder Diameter		Bead Groove Width = W		Bead Groove Height = H		Flange & Piston Corner Radii = R1 + R2		Lip Radius = R2		Lip Height = L	
1.00 - 2.50	25 to 64	.134	3.18	.96	.243	.063	1.60	.025	0.63	.100	2.54
2.51 - 4.00	64 - 102	.165	3.96	.122	.310	.094	2.39	.032	0.81	.130	3.30
4.01 - 8.0	102 - 205	.263	6.35	.196	4.98	.125	3.18	.045	1.14	.204	5.18
8.01 & Up	205 & Up	.263	6.35	.196	4.98	.125	3.18	.045	1.14	.190	4.83

Type OB Diaphragms

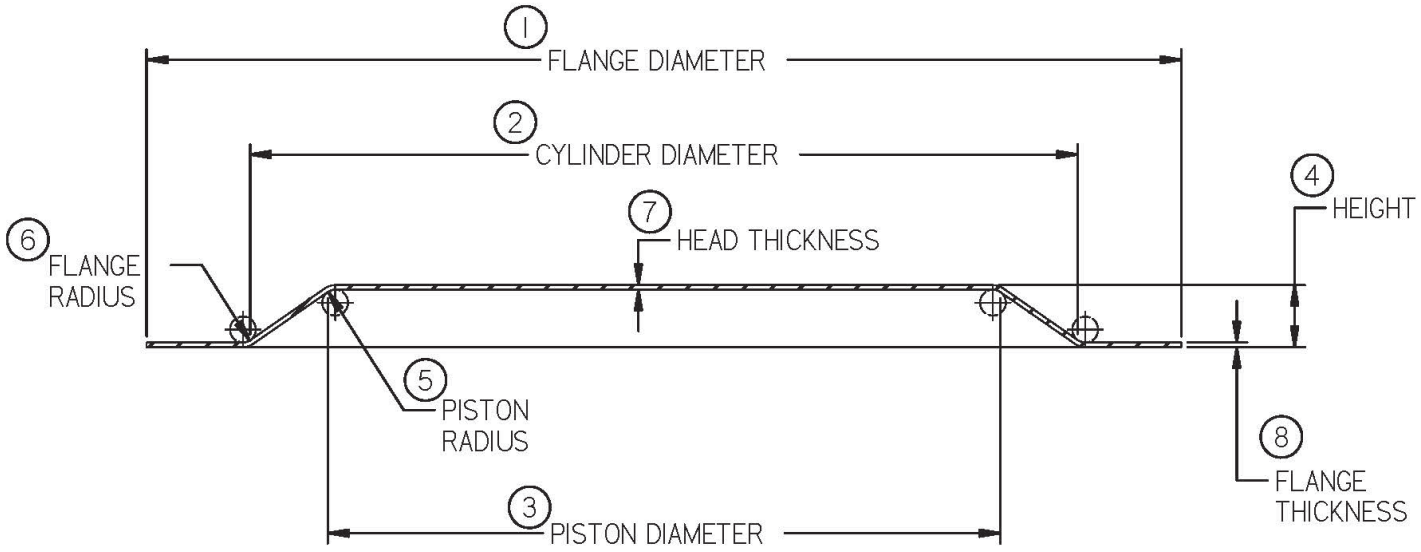


Dim. #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Cylinder Diameter	Vision System	Comparator Up to 6"	Measure Side Wall	Vision System: At least eight (8) measurements must be taken. Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.
2	Piston Diameter	Vision System	Comparator up to 6"	_____	
3	Height	Comparator up to 6"	Height Gauge	_____	The part is placed on a flat surface. The height is measured from that surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area.
4	Piston Radius	Vision System	Comparator up to 6"	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
5	Flange Radius	Vision System	Radius Gauge	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
6	Head Thickness	Snap Gauge	Measure Cross-Section with Vision System	_____	Measure a minimum of 2 points. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results. DiaCom and customer should agree on measurement device(s) used.)
7	Sidewall Thickness				
8	Bead Radius	Vision System	Radius Gauge	_____	Measure a minimum of 2 points. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results. DiaCom and customer should agree on measurement device(s) used.)
9	Bead Width	Vision System	Comparator	_____	
10	Bead Height	Vision System	Comparator	_____	

Cylinder Diameter	1.00 - 2.50	25 - 64	2.51 - 4.00	64 -102	4.01 - 8.00	102 - 205	8.01 & Up	205 & Up
Height Cylinder Diameter Piston Diameter	See Available Sizes Table (in the DiaCom Diaphragm Design Guidebook) Tolerances on Cylinder Diameter and Piston Diameter are ± .010" per inch of diameter, but the tolerance will be no less than ± .010 or greater than ± .060							
Piston Radius	.063	1.60	.094	2.39	.125	3.18	.125	3.18
Head Thickness	.017 ± .004	0.43 ± 0.13	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Wall Gauge	.017 ± .004	0.43 ± 0.13	.024 ± .004	0.61 ± 0.10	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Flash Projection	.25 Max	0.64 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Flash Thickness	.025 Max	0.64 Max	.035 Max	0.89 Max	.040 Max	1.02 Max	.056 Max	1.42 Max
Flange Radius	.031	.79	.047	1.19	.063	1.60	.063	1.60
Bead Width	.080 ± .003	2.03 ± 0.08	1.00 ± .003	2.54 ± 0.08	.120 ± .003	3.05 ± 0.08	.160 ± .003	4.06 ± 0.08
Bead Height	.150 ± .005	3.81 ± 0.13	.200 ± .005	5.08 ± 0.13	.260 ± .005	6.60 ± 0.13	.300 ± .007	7.62 ± 0.18

Cylinder Diameter		Bead Groove Width = W		Bead Groove Height = H		Lip Radius = R1		Piston Corner Radius = R2		Lip Clearance = C
1.00 -2.50	25 to 64	.080	2.03	.150	3.81	.030	0.76	.063	1.60	Sidewall Thickness ± .003
2.51 - 4.00	64 - 102	.100	2.54	2.00	5.08	.040	1.02	.094	2.39	
4.01 - 8.0	102 - 205	.120	3.05	.260	6.60	.050	1.27	.125	3.18	
8.01 & Up	205 & Up	.160	4.06	.300	7.62	.060	1.52	.188	4.78	

Type P Diaphragms



Dim. #	Dimension	Preferred Method	1st Alternative Method	2nd Alternative Method	Comments
1	Flange Diameter	Vision System	Comparator up to 6"	_____	Vision System: At least eight (8) measurements must be taken. Comparator: Place part on flat surface, measure from one side of the cylinder to the other. Turn part 90°, repeat measurement from one side of the cylinder to the other, add the results and divide by 2.
2	Cylinder Diameter	Vision System	Comparator up to 6"	Measure Sidewall Thickness	
3	Piston Diameter	Vision System	Comparator up to 6"	_____	
4	Height	Comparator up to 6"	Vision System	_____	The part is placed on a flat surface. The height is measured from that surface to the top of the part. The top of the part measurement is taken at a location approximately where the head radius transitions to the head area. Several measurements may be needed with the average of all readings reported.
5	Piston Radius	Comparator up to 6"	Radius Gauge	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
6	Flange Radius	Comparator	Radius Gauge	_____	In most instances, the part will deform to fit the gauge used. This dimension is reported as "Accept" or "Reject" with no specific numerical value reported.
7	Head Thickness	Snap Gauge	Measure Cross-Section		Measure a minimum of 3 points equally spaced around the part. Report the high and low measurement results. (It is important to remember that rubber parts may be deformed by the measurement device. When using Snap Gauges, for example, different models have different spring strength which may affect the measurement results. DiaCom and customer should agree on measurement device(s) used.)
8	Flange Thickness				

Cylinder Diameter	1.00 - 2.50	25 -64	2.51 - 4.00	64 to 102	4.01 to 8.00	102 to 205	8.00 & Up	102 to 205
Height	(See Available Sizes Table in DiaCom Diaphragm Design Guidebook.)							
Cylinder Diameter	Tolerances on Cylinder Diameter and Piston Diameter are ± .-010" per inch of diameter, but the tolerance will be no less than ± .010" or greater than ± .060"							
Piston Diameter								
Piston Radius	.063	1.60	.94	2.39	1.25	3.18	.125	3.18
Wall Gauge	.017 ± .005	0.43 ± 0.13	.024 ± .005	0.61 ± 0.13	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Head & Flange Thickness	.017 ± .005	0.43 ± 0.13	.024 ± .005	0.61 ± 0.13	.035 ± .005	0.89 ± 0.13	.045 ± .007	1.14 ± 0.18
Flange Radius	.031	0.79	.063	1.60	.094	2.39	.125	3.18
Flange Diameter	Cyl. Diam +.750	Cyl. Diam. +19.05	Cyl. Diam. + 1"	Cyl. Diam. +25.40	Cyl. Diam. + 1.50	Cyl. Diam. +38.10	Cyl. Diam. +2"	Cyl. Diam. +50.80

Diaphragm Flange Diameter and Hole Trim Tolerances:					
Diameter		Size		Position	
0 - 1.00"	0. - 25.40	± .010"	0.25	.010	0.25
1.01 - 3.00"	25.65 - 76.20	± .020"	0.51	.020	0.51
over 3.01"	76.45	± .030	0.76	.030	0.76

DIA·COM CORPORATION

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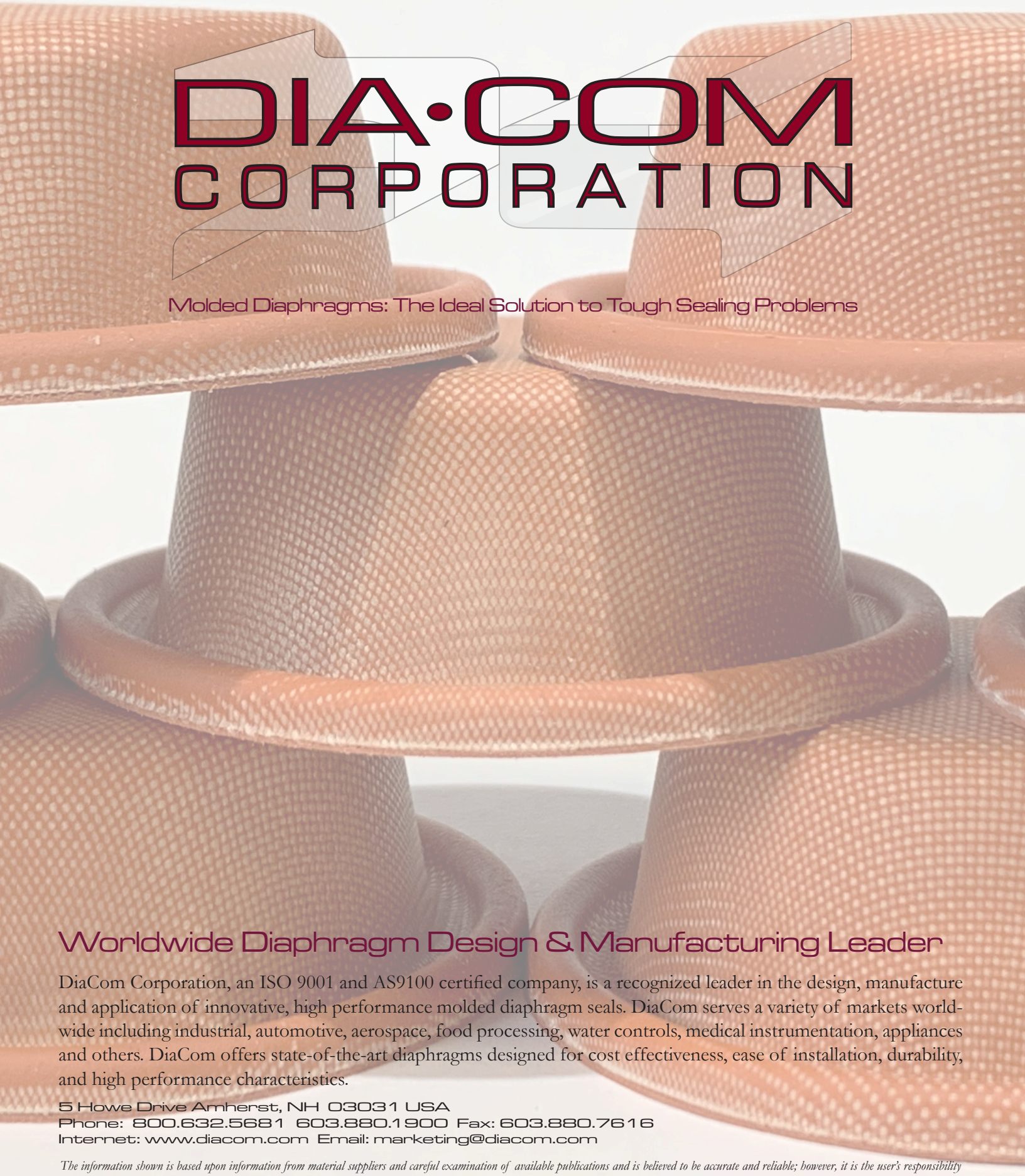

Worldwide Diaphragm Design & Manufacturing Leader

DiaCom Corporation, an ISO 9001 and AS9100 certified company, is a recognized leader in the design, manufacture and application of innovative, high performance molded diaphragm seals. DiaCom serves a variety of markets worldwide including industrial, automotive, aerospace, food processing, water controls, medical instrumentation, appliances and others. DiaCom offers state-of-the-art diaphragms designed for cost effectiveness, ease of installation, durability, and high performance characteristics.

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