Firestone

World's Number 1 Air Spring.

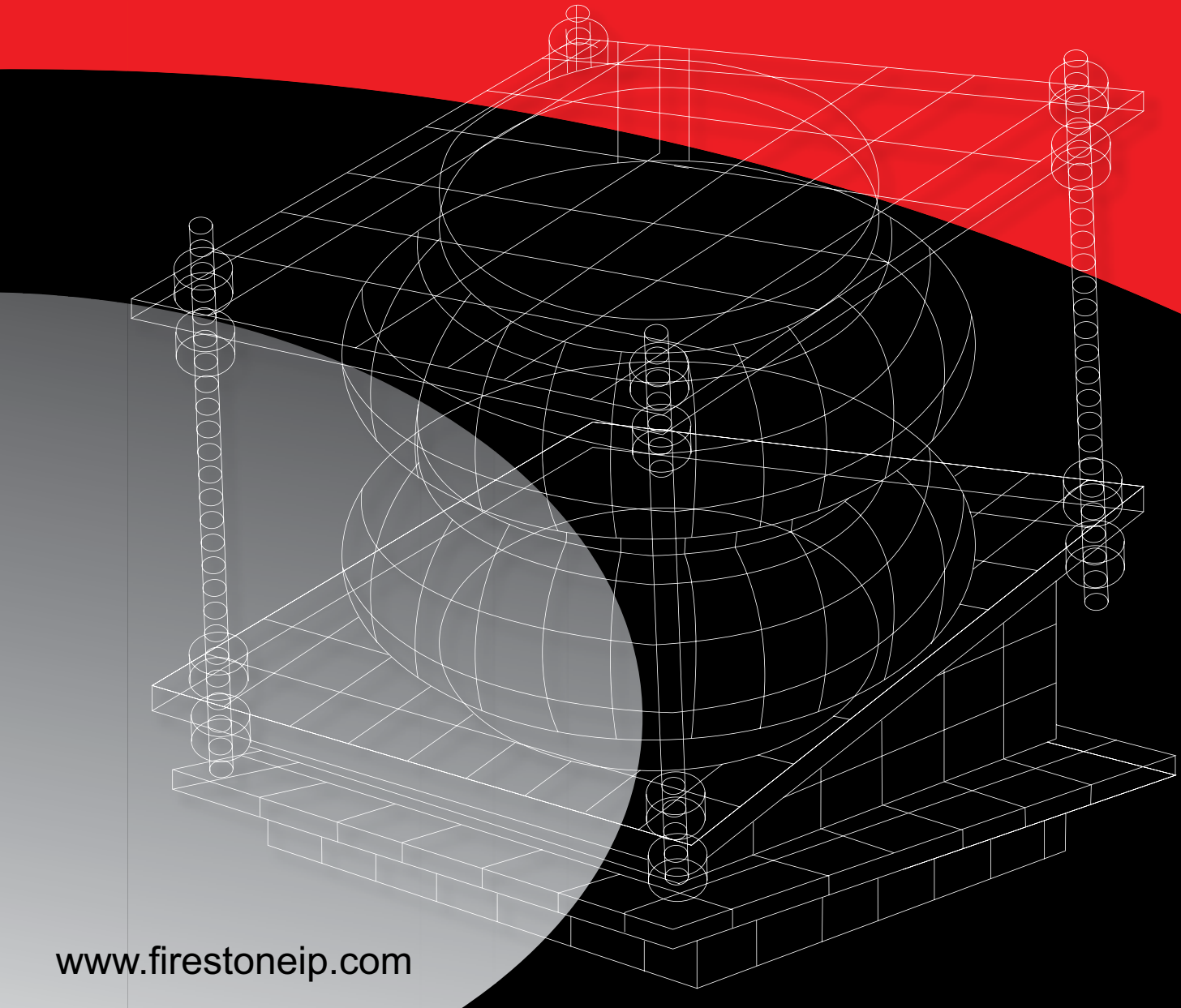
FIRESTONE INDUSTRIAL PRODUCTS COMPANY

AIRSTROKE™ ACTUATORS

AIRMOUNT™ ISOLATORS

Engineering Manual & Design Guide

METRIC



www.firestoneip.com

MEMDG0414

TABLE OF CONTENTS

INTRODUCTION

Firestone developed the air spring in the late 1930's as a more efficient spring (vibration isolator) for use in vehicle suspensions. Airide™ springs, as they were named, provided the means for a suspension to reduce the amount of road shock and vibration transmitted into the vehicle. Millions of kilometers of actual use have proven the dependability and effectiveness of the air suspension concept using Airide™ springs by Firestone.

Airstroke™ actuators, Airmount™ isolators, and Airide™ springs are Firestone registered trademark names FOR ONE PRODUCT: the air spring. The use of the air spring (actuator, industrial isolator and vehicular isolator, respectively) determines which name is applied to it. All of the parts in this catalogue may be used as Airstroke actuators (except the 1X84D-1) or Airmount isolators, with two exceptions: Triple convoluted and reversible sleeve type air springs (except the 1M1A) should not be used as Airmount isolators without consulting Firestone.

Individual Airstroke actuators and Airmount isolators are capable of generating a force or supporting a load of up to 450 kN and a stroke capability of up to 355 mm is possible. Included in this engineering manual are detailed operating characteristics for many of the standard Firestone air springs, along with technical details and procedures for using these products.

PLEASE NOTE:

The information contained in this publication is intended to provide a general guide to the characteristics and applications of these products. The material, herein, was developed through engineering design and development, testing and actual applications and is believed to be reliable and accurate. Firestone, however, makes no warranty, expressed or implied, of this information. Anyone making use of this material does so at his own risk and assumes all liability resulting from such use. It is suggested that competent professional assistance be employed for specific applications.

ADVANTAGES OF FIRESTONE AIRSTROKE™ ACTUATORS

Why use an Airstroke™ actuator (rather than air or hydraulic cylinder) for actuation?

LOW COST

Generally, initial cost is one-half or less than that of conventional pneumatic or hydraulic cylinders of the same force capabilities. This initial cost advantage is many times greater in the larger sizes.

WIDE SIZE RANGE

Airstroke actuators are available in sizes ranging from 58 mm to 950 mm in diameter. The force capability is up to 450 kN. Strokes of up to 355 mm are possible.

DURABLE FOR LONG LIFE

Airstroke actuators are a further application of Firestone's time proven Airide™ springs for truck and bus suspensions. The long life and durability necessary for millions of kilometers of heavy duty suspension use under adverse environmental conditions are also important factors in machine design.

NO MAINTENANCE OR LUBRICATION REQUIRED

NO INTERNAL ROD OR PISTON

Airstroke actuators have no internal rod, piston, or sliding seals as do conventional cylinders. This allows for the design of Airstroke actuators into applications where dirt or grit would destroy the seals on conventional cylinders.

FRICTION FREE FOR IMMEDIATE RESPONSE

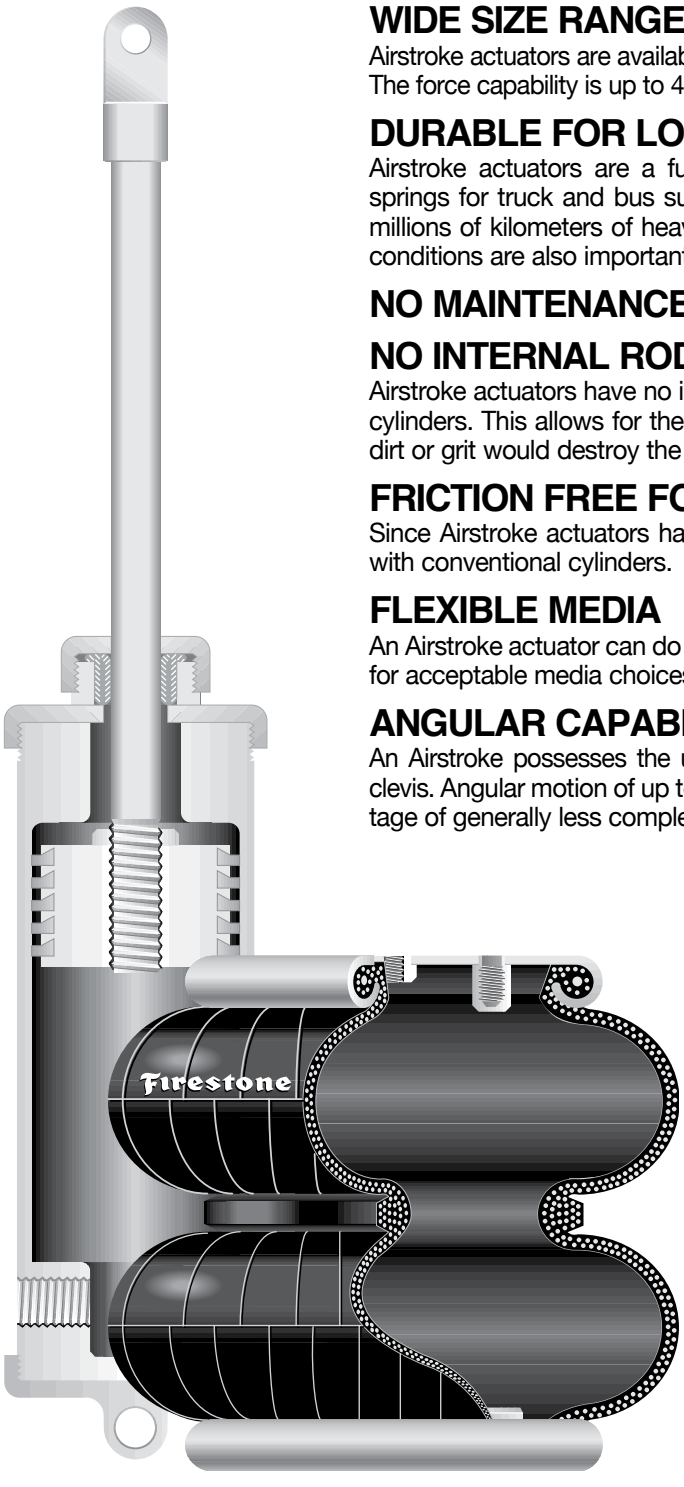
Since Airstroke actuators have no sliding seals, there is no breakaway friction as with conventional cylinders.

FLEXIBLE MEDIA

An Airstroke actuator can do its work with either a liquid or gas (Please see page 14 for acceptable media choices.)

ANGULAR CAPABILITY

An Airstroke possesses the unique capability of stroking through an arc without a clevis. Angular motion of up to 30 degrees is possible, along with the design advantage of generally less complex linkages.



SIDE LOADING CAPABILITY

Airstroke actuators, within certain limits, are not affected by side loads as are conventional cylinders. This misalignment capability eliminates potential rod bending, scoring, and excessive seal wear common to conventional cylinders.

COMPACT STARTING HEIGHT

Airstroke actuators have a low profile compared to conventional cylinders. Our smallest Airstroke actuator (58 mm dia.) collapses to just 30 mm in height, while our largest triple convoluted Airstroke (950 mm dia.) will collapse to a very compact 140 mm.

FACTORY SEALED AND TESTED

Most Airstroke actuators feature Firestone's proven concept of crimped end plates. The crimped design allows for preshipment testing and quicker installation on equipment.

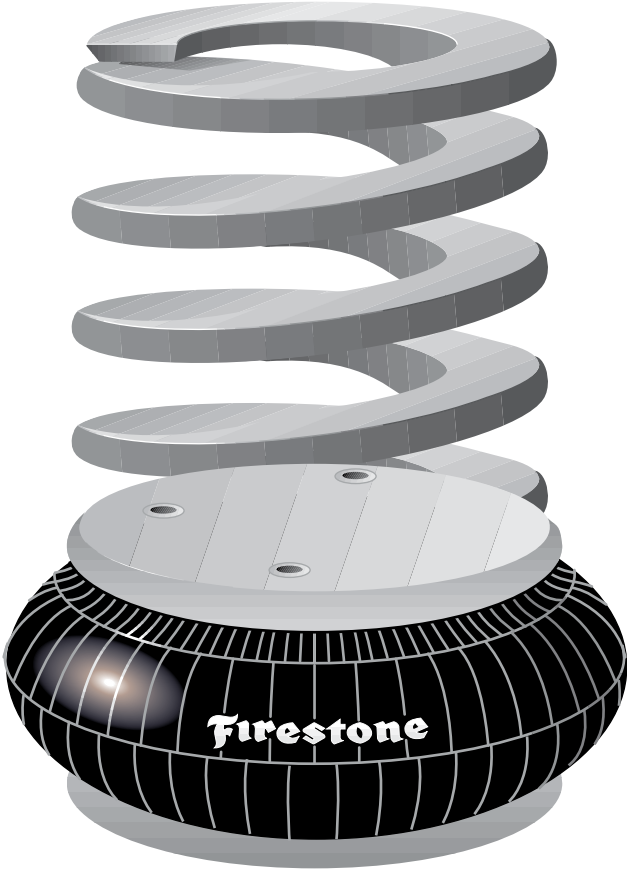
PLEASE REFER TO PAGE 15 FOR A THOROUGH DISCUSSION OF ACTUATION.

ADVANTAGES OF FIRESTONE AIRMOUNT™ ISOLATORS

Why use an Airmount™ isolator, rather than a coil spring or other type of isolator?

UNSURPASSED ISOLATION CAPABILITY

Airmount isolators can provide the highest degree of isolation of any type vibration isolator. System natural frequencies as low as 1 hertz are available. The addition of an auxiliary reservoir can provide even lower system frequencies. In order to achieve similar results from a conventional coil spring isolator, a real deflection of 230 mm would be required.



CONSTANT ISOLATION EFFICIENCY

Airmount isolators are unique in that the system's natural frequency does not change significantly with changes in load. This unique feature, combined with accurate height control, will allow the use of the same Airmount isolator at each mounting point of an unevenly loaded machine.

ACCURATE HEIGHT CONTROL

Airmount isolators provide accurate height control through regulation of internal air pressure. This feature eliminates the fatigue and permanent set found in the use of other types of vibration isolators.

WIDE SIZE RANGE

Airmount isolators are capable of isolating loads of 0.44 kN per mounting point to over 577 kN per mounting point.

COMPACT INSTALLED HEIGHT

Airmount isolators can carry the loads and provide the isolation described above at installed heights as low as 30 mm. Coil springs providing equal isolation would require a free height of 125 mm to 635 mm.

EXTENDED EQUIPMENT LIFE

Airmount isolators extend equipment life through their superior isolation capabilities.

EFFECTIVE NOISE REDUCTION

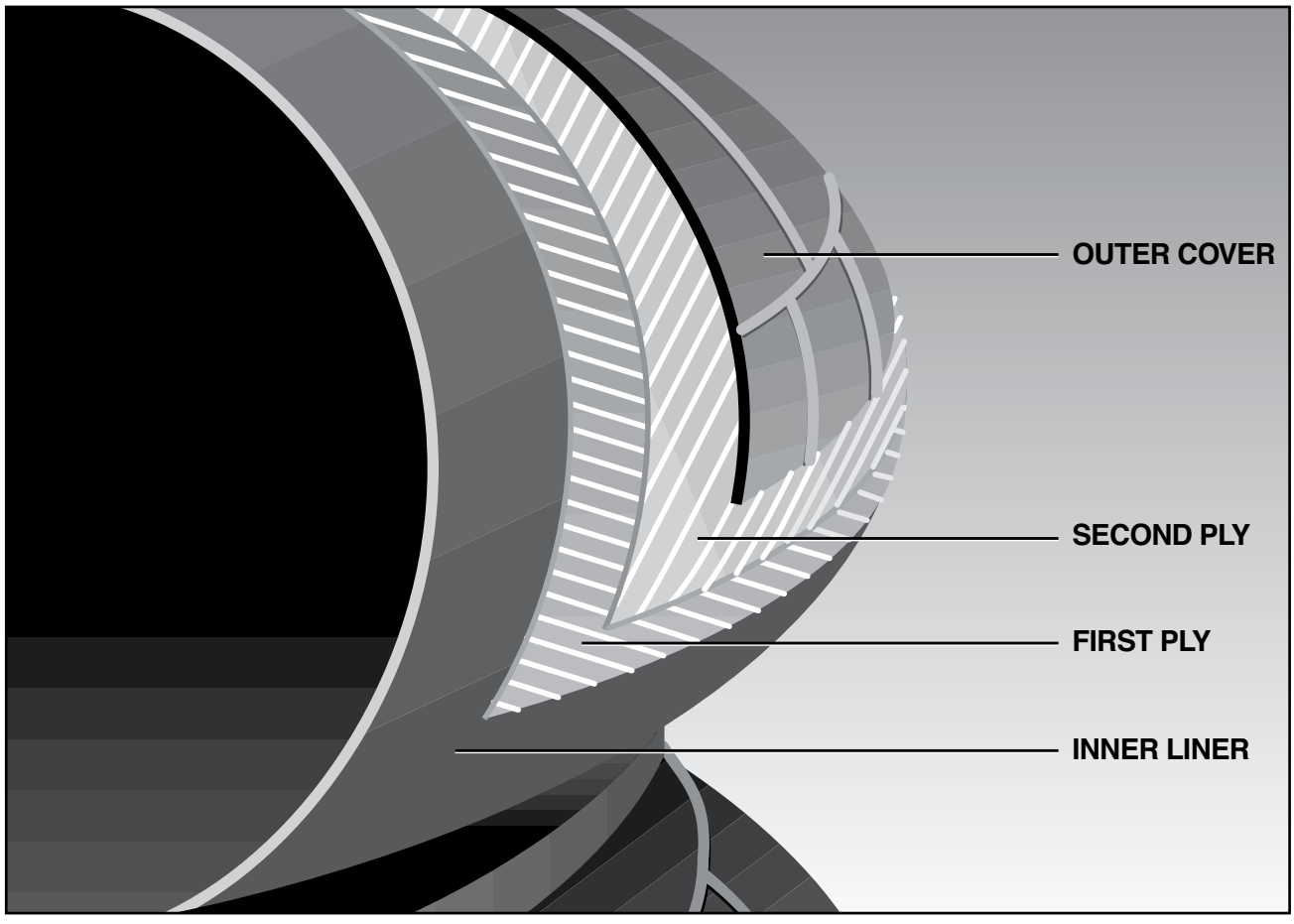
Airmount isolators reduce structurally transmitted noise. Airmount isolators are also quiet in themselves, since there is no spring chatter as found in conventional coil springs.

VERSATILE

Airmount isolators can be used not only to protect structural members from vibrating machinery, but are also widely used to protect delicate equipment from structurally transmitted vibration.

PLEASE REFER TO PAGE 21 FOR A THOROUGH DISCUSSION OF VIBRATION ISOLATION.

AIR SPRING BELLOWS CONSTRUCTION



An air spring is a carefully designed rubber/fabric bellows which contains a column of compressed air. The rubber bellows itself does not provide force or support load. This is done by the column of air.

Firestone air springs are highly engineered elastomeric bellows with specially designed metal end closures. Our standard two ply air spring bellows is actually made up of four layers:

- **a.** An inner liner of calendered rubber.
- **b.** One ply of fabric reinforced rubber.
- **c.** A second ply of fabric-reinforced rubber (with the cords at a specific bias angle to the first ply).
- **d.** An outer cover of calendered rubber.

Many of our air springs are also available in high strength construction for higher pressures (see page 14 for more detailed information). In this case, there are either four plies of fabric-reinforced rubber or two plies of special high strength cord, with an inner liner and outer cover.

The two ply air spring is standard. WHERE HIGH STRENGTH CONSTRUCTION IS AVAILABLE, IT IS SO NOTED IN THE SELECTION GUIDE (PAGE 32), ON THE INDIVIDUAL DATA SHEETS, AND IN THE INDEX (PAGE 100). If the high strength style number is omitted, then it is not currently available in that particular part. Call Firestone if you have any questions on the availability of any specific assemblies.

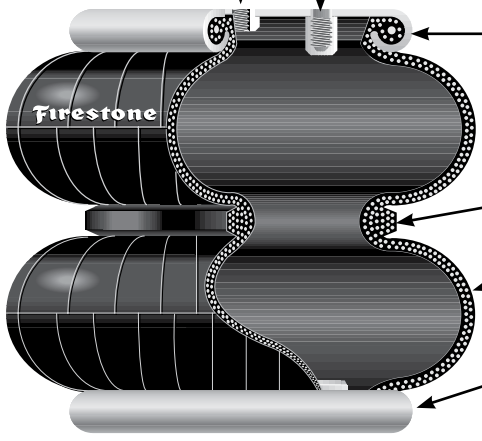
Each air spring bellows is identified by a style number. This style number is molded into the bellows during the curing (or vulcanization) process. Examples would be 16, 22, 313, 1T15M-6, etc... This identifies ONLY the rubber/fabric bellows and NOT THE COMPLETE ASSEMBLY. There are several different end closure options available for most air springs; therefore, please always specify both the style number and the complete **assembly order number (AON)**. An example would be: Style #22, assembly order number W01-M58-6381. Both numbers are given on the individual data sheets.

END CLOSURE OPTIONS

Each individual air spring data sheet shows a cross sectional view of the most popular end closure option for that part. For convoluted air springs 400 mm in diameter and less, and for the reversible sleeve air springs, THE CRIMPED BEAD PLATE ATTACHMENT IS SHOWN. For convoluted air springs 460 mm in diameter and larger, A BEAD RING ATTACHMENT IS SHOWN. An air spring of each variety, with proper terminology for each, is shown on the following pages.

CRIMPED BEAD PLATES

CONVOLUTED AIR SPRINGS
(#22 is shown)



AIR INLET
1/4 BSP parallel is standard. 3/4 BSP parallel is also available for most parts. (See the data sheet order block on each specific part).

BLIND NUT
M8 x 1.25 — 6H x 15 mm deep (two or four per each plate depending on part size). Used for mounting the part.

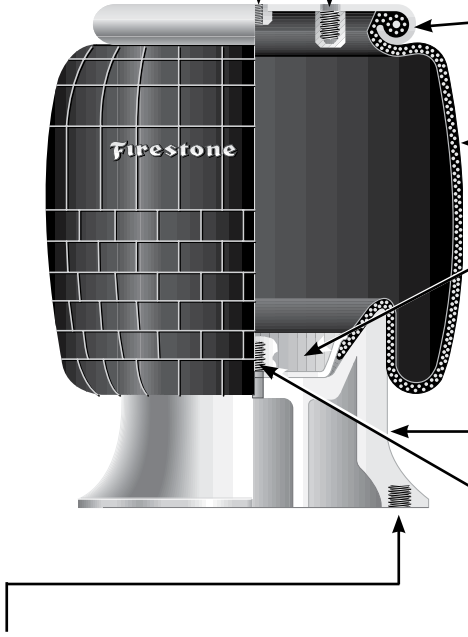
UPPER BEAD PLATE
(9 gauge carbon steel, 4 mm approx). Permanently crimped to bellows to form an airtight assembly which allows for leak testing before the unit leaves the factory. Zinc/chromate plated for rust protection.

GIRDLE HOOP
Wire wound type shown, molded into the bellows.

BELLOWS
Wall gauge is approximately 6 mm. See page 5 for detailed information.

LOWER BEAD PLATE
Usually the same as upper bead plate, except without air inlet.

REVERSIBLE SLEEVE AIR SPRINGS
(1T15M-6 is shown)



AIR INLET 1/4 BSP parallel is standard. 3/4 BSP parallel is also available for most parts. (See the data sheet order block on each specific part).

BLIND NUT M8 x 1.25 — 6H x 15 mm deep (two or four per each plate depending on part size). Used for mounting the part.

BEAD PLATE (9 gauge carbon steel, 4 mm approx). Permanently crimped to bellows to form an airtight assembly which allows for leak testing before the unit leaves the factory. Zinc/chromate plated for rust protection.

BELLOWS Wall gauge is approximately 6 mm. See page 5 for detailed information.

BELLOWS END CLOSURE — (steel) Permanently molded into the bellows (Except for styles 1T19L-7, 1T19L-11).

PISTON May be made of aluminum, steel, plastic or hard rubber. Held to the bellows by a bolt which screws into the bumper stud. For mounting, a long bolt may be used coming up through the mounting surface. Or, a short bolt may be used to attach the piston to the lower end closure and then use the threaded holes in the piston to secure the assembly to the mounting surface. (A piston long bolt is usually not included).

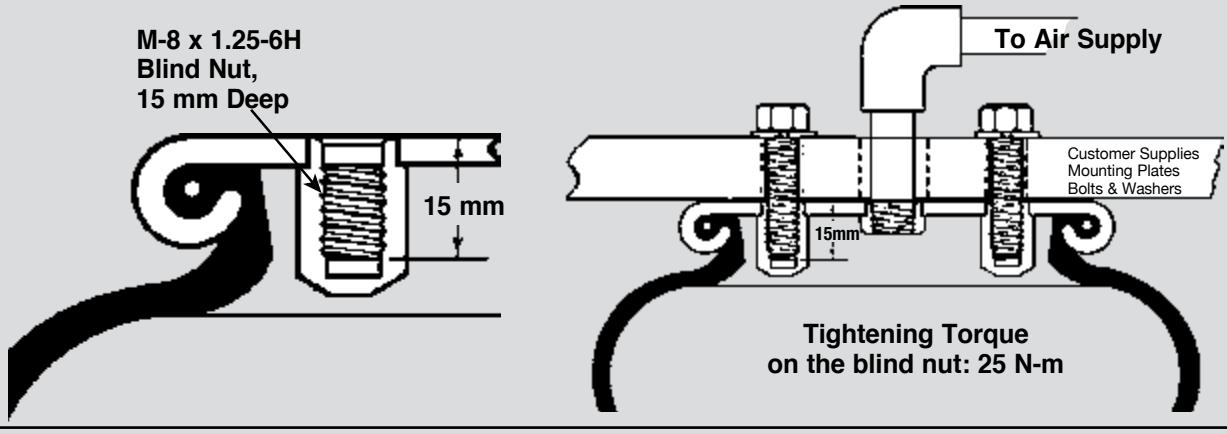
BUMPER STUD A permanent part of the bellows end closure (and bellows). It has two functions:

1. The optional rubber bumper snaps over the outside.
2. The inside is a threaded hole (see data sheets for thread dimension and depth) used to secure the piston to the bellows.

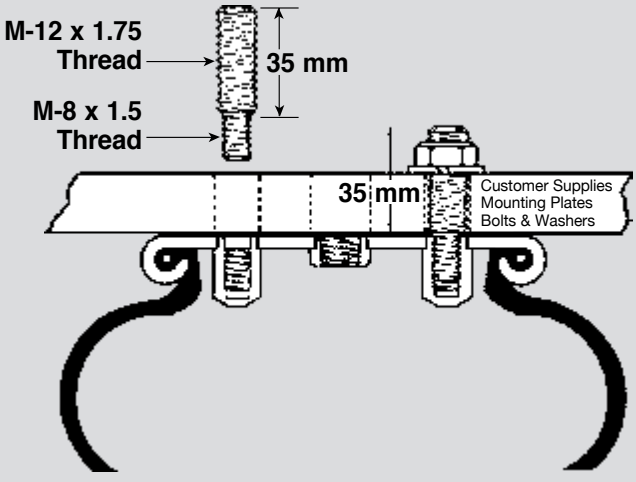
THREADED HOLE May be used for attachment to mounting surface. Not included in some pistons (See individual data sheets for specific part configuration.)

CRIMPED BEAD PLATE MOUNTING HARDWARE

CRIMPED BEAD PLATE AIR SPRINGS Use the blind nuts for attachment. This is accomplished by bringing bolts (two or four depending upon air spring size) through the customer supplied mountlng plate and tightening into the blind nut. If this bolt is too long, it may fracture the bottom out of the blind nut.



STUD ADAPTER

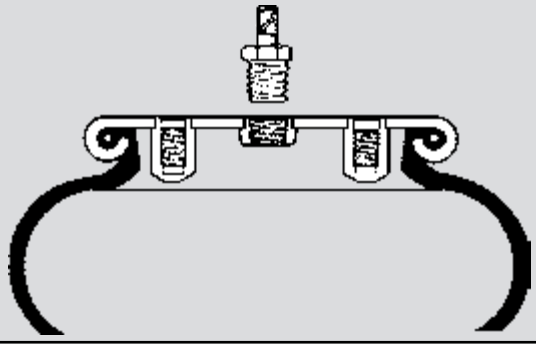


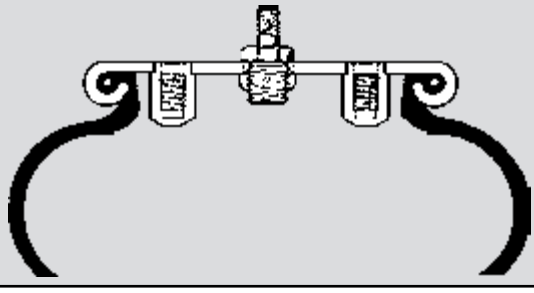
If a protruding bolt, rather than a blind nut is preferred to attach the air spring, a STUD ADAPTER is available from Firestone:

Description	Order No.
Imperial Stud Adapter	WC1-358-0361
Metric Stud Adapter	WC1-358-0369

TANK VALVE One method for inflating air springs (primarily used in Airmount isolator applications) is with a tank valve. An air hose chuck is used (as inflating a tire with an air line). Care must be taken to periodically check the pressure within the air spring, because air will slowly permeate through the rubber/fabric bellows (See page 25).

Description	Order No.
Tank Valve	WC1-358-0009
Metric Tank Valve	WC1-M58-3889



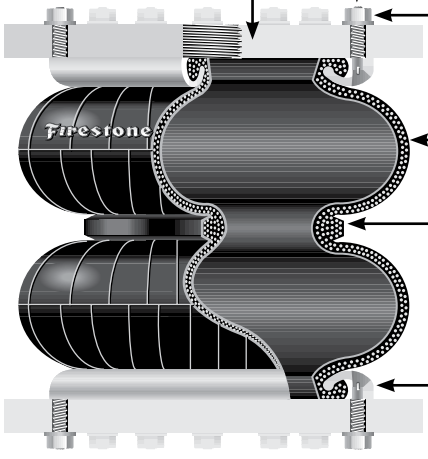


END CLOSURE OPTIONS

STEEL BEAD RINGS

CONVOLUTED AIR SPRINGS

(#22 is shown, with bead rings instead of crimped bead plates)



MOUNTING PLATE is not included. See page 10 for material, machining recommendations, and installation instructions.

BEAD RING BOLT May be one of four varieties. See page 10. Also refer to the data sheet order block on each individual part for bolt lengths.

NUTS AND LOCKWASHERS are included with the part. (Except for socket head type bead rings).

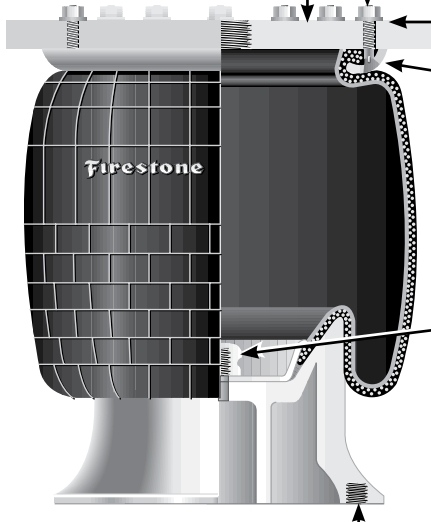
BELLOWS Wall gauge is approximately 6 mm. See page 5 for detailed information.

GIRDLE HOOP Wire wound type shown, molded into the bellows.

BEAD RING, upper and lower. Countersunk steel type shown. May also be of a second stamped steel variety or made of aluminum. See page 10. Also refer to the data sheet order block on each part for type and material. See the selection guide on page 32 for bolt circle diameter and number of bolts (each ring).

REVERSIBLE SLEEVE AIR SPRINGS

(1T15M-6 is shown, with a bead ring instead of a crimped bead plate)



MOUNTING PLATE is not included. See page 10 for material, machining recommendations, and installation instructions.

BEAD RING BOLT May be one of four varieties. See page 10. Also refer to the data sheet order block on each individual part for bolt lengths.

NUTS AND LOCKWASHERS are included with the part. (Except for socket head type bead rings).

BEAD RING Countersunk steel type shown. See the selection guide on page 32 for bolt circle diameter and number of bolts (each ring).

BUMPER STUD A permanent part of the bellows end closure (and bellows). It has two functions:

1. The optional rubber bumper snaps over the outside (of it).
2. The inside is a threaded hole (see data sheets for thread dimension and depth) used to secure the piston to the bellows.

THREADED HOLE May be used for attachment to mounting surface. Not included in some pistons (See individual data sheets for specific part configuration.)

END CLOSURE OPTIONS

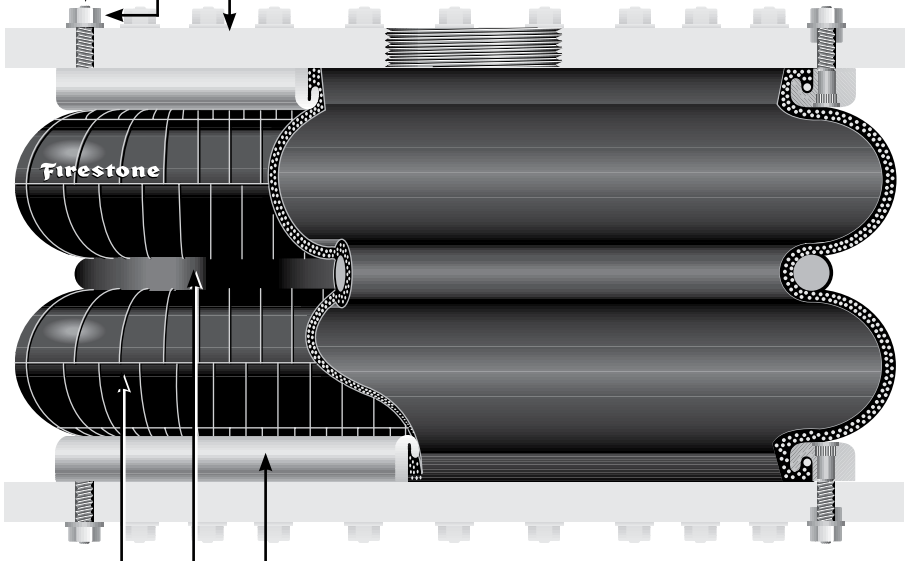
LARGE PARTS WITH ALUMINUM BEAD RINGS

All of the parts that are shown with crimped bead plates are also available with bead rings. (Bead plates are not suitable for some applications.) Typical examples of where bead rings are often used follow:

1. Where parts are stacked to increase stroke (See page 16).
2. Where the air spring is being used as a boot or flexible connector (See page 29).
3. When used as an Airmount™ isolator with an auxiliary reservoir (See page 24).
4. When air must move in or out of the unit at an extremely fast rate (and a 3/4 BSP air inlet is too small).
5. When used with an internal shaft, to either guide the part or to pull (rather than push) a load.

CONVOLUTED AIR SPRINGS

(#203 is shown)



BEAD RING BOLT May be one of four varieties. See page 10. Also refer to the data sheet order block on each individual part for bolt lengths.

NUTS AND LOCKWASHERS are included with the part. (Except for socket head type bead rings).

MOUNTING PLATE is not included. See page 10 for material, machining recommendations, and installation instructions.

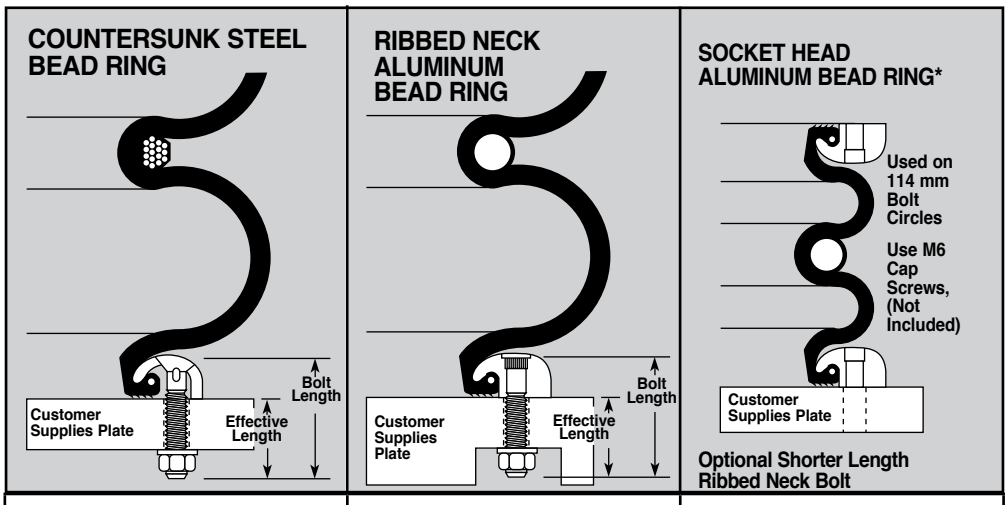
BEAD RING, upper and lower. (Aluminum)

GIRDLE HOOP Solid steel type shown, molded into the bellows.

BELLOWS Wall gauge is approximately 6 mm. See page 5 for detailed information.

END CLOSURE OPTIONS

THE THREE TYPES OF BEAD RINGS



Standard Bolt Length 40 mm	**Standard Bolt Length** 45 mm	
Standard Effective Length 28 mm	**Standard Effective Length** 30 mm	
Standard Order Number (bolt only) WC1-M58-3630	**Standard Order Number (bolt only)** WC1-M58-3635	
Thread M8 x 1.0	**Thread** M10 x 1.5	
Tightening Torque Nm 23 to 30	**Tightening Torque Nm** 38 to 44	

More bolt sizes available. Ask your Firestone Rep for availability.

BEAD RINGS CONTINUED

PLATE MACHINING REQUIREMENTS

When using bead rings, THE CUSTOMER WILL NEED TO FABRICATE HIS OWN MOUNTING PLATES. Hot or cold rolled steel provides satisfactory mounting surfaces, with specific finishes of 32 microns, if machined in a circular fashion, and 250 microns when ground (side to side). The thickness of mounting plates depends upon the application. The plates must be strong enough and backed by structural members to prevent bowing (of the plates) when subjected to the forces or loads involved. The rubber bellows provides its own seal; therefore, 'O' rings or other sealants are not needed when installing the part.

INSTALLATION

Follow this technique for assembling a bead ring style bellows to the mounting plate:

a. Insert the bolts into the bead ring (the bead rings have been previously attached to the bellows at the factory). The bolts will be pulled into place by the action of tightening the nuts.

b. Slip all of the bolts (which are protruding through the bead ring) into the mating holes of the mounting plate and attach the lockwashers and nuts. FINGER TIGHTEN all nuts to produce a uniform gap between the bead ring and mounting plate all the way around.

c. At this point, make certain that the bellows bead is properly seated under the bead ring.

PLEASE NOTE THAT UNIFORM SUCCESSIVE TIGHTENING OF THE NUTS IS IMPORTANT TO SEAT THE RUBBER BEAD PROPERLY TO THE MOUNTING PLATE FOR ITS FULL CIRCUMFERENCE.

Continue with the following sequence:

d. Tighten all nuts one turn each, moving around the circle until continuous contact is made between the bead ring and mounting plate.

e. Torque all nuts to the torque specifications shown on the page, going at least two complete turns around the bolt circle.

MATERIAL

Bead rings are supplied in either steel or aluminum. Steel bead rings can be of two different types. Both the bead ring material and type of ring are called out in the description section of the order block on each individual data page. Also, the bolt length (for the bolts supplied with that particular order number) is given.

WHERE A BEAD PLATE PART IS SHOWN AND THE BEAD RING ATTACHMENT IS PREFERRED, PLEASE REFER TO THE SELECTION GUIDE ON PAGE 32 FOR BOLT CIRCLE DIAMETERS AND NUMBER OF BOLTS (EACH RING).

*Available only on style #16, #268, and #267-1.5

END CLOSURE OPTIONS

LARGE PARTS WITH ROLLED PLATES

LARGE CONVOLUTED AIR SPRINGS

(#203 is shown, with rolled plates instead of bead rings)

The convoluted parts, with 442 to 569 mm max. diameter, are shown with bead rings as standard. We have developed a method for permanently attaching plates to these larger sized Airstroke™ actuators (called rolled plate assembly). These parts may be an advantage over the bead ring parts in some cases, because installation is much easier (they attach the same way as the bead plate parts). When installing the rolled plate parts, a backup plate as large in diameter as the bead plate must be used. This plate should be a minimum of 13 mm thick.

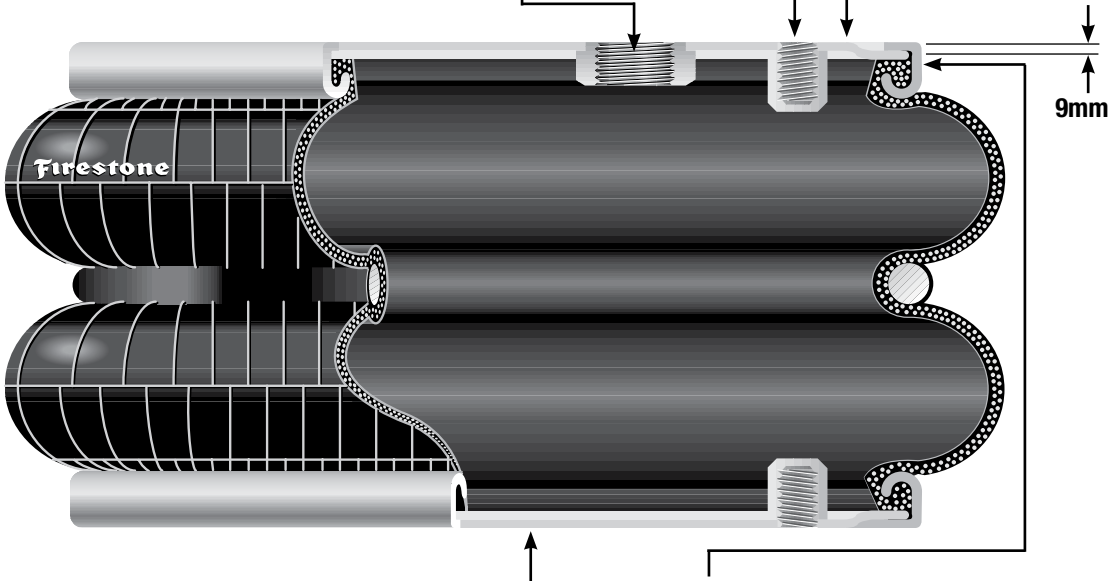
Again, for the blind nut and air entrance locations of rolled plate parts (bead rings are shown as standard on the data pages), please refer to the selection guide on page 32. The static data chart on each individual part may be used for the rolled plate version; but, two modifications must be made:

1. Increase the minimum height by 18 mm.
2. Add 18 mm to the height (bottom axis) before reading loads.

AIR INLET 3/4 NPT is standard. See the selection guide on page 32 for location (type 5). A centered 2" NPT air inlet is also available for some rolled plate parts. (Consult Firestone).

BLIND NUT M12 x 1.75 - 6H x 19 mm deep (four each plate). Used for mounting the part. A stud adapter for this size blind nut is not available.

UPPER BEAD PLATE (6 gauge carbon steel, 5 mm approx). Permanently crimped to bellows to form an airtight assembly. Allows for leak testing before the unit leaves the factory. Zinc/chromate plated for rust protection.



CLAMP RING This ring is crimped up under the bellows bead to permanently attach the bead plate to the bellows. It is also zinc/chromate plated for rust protection.

LOWER BEAD PLATE Usually the same as upper bead plate, except without air inlet. See the selection guide on page 32 for diameter (type 5).

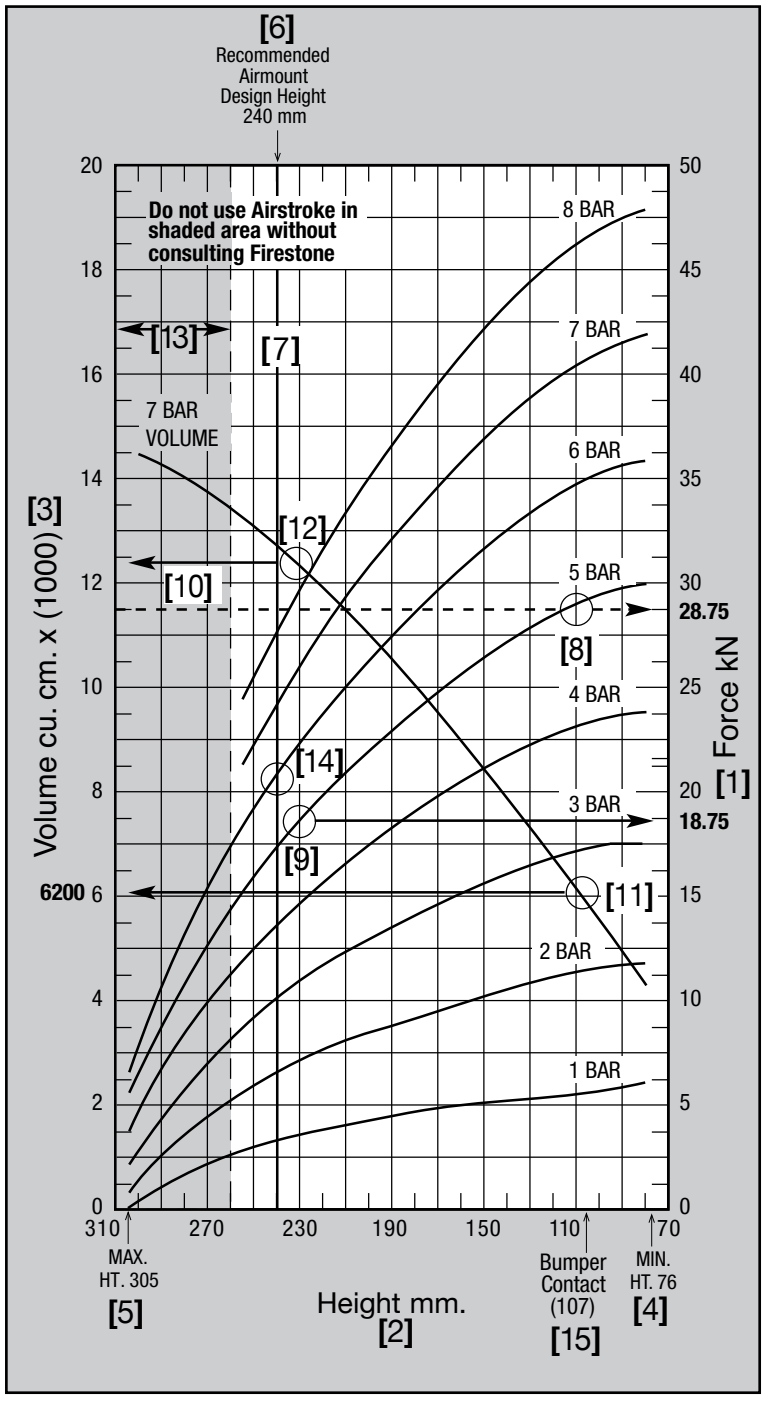
HOW TO USE THE STATIC DATA CHART

We also refer to this chart as the load/deflection (L/D) curve for an air spring. The force **[1]** is given on the right hand axis vs. the air spring height **[2]** as shown along the bottom axis; thus, load vs. deflection. The internal volume **[3]** is given along the left hand axis, again vs. height **[2]**. It is called static data because the air spring is in a static, or non-moving, constant pressure condition. In almost all cases the static curves were run using a two ply bellows; however, WHERE A HIGH STRENGTH BELLOWS IS AVAILABLE, USE THE TWO PLY CHART FOR IT ALSO.

AIRSTROKE™ ACTUATION

The important considerations are minimum height **[4]** (76 mm) and maximum recommended height **[5]** (260 mm). Subtracting one from the other gives the stroke potential for this part (260 – 76 = 184 mm). As an actuator, the entire stroke may be used, OR ANY PORTION THEREOF. IGNORE RECOMMENDED AIRMOUNT™ DESIGN HEIGHT [6] AND THE CORRESPONDING DARKENED LINE [7]. This height is important in using the air spring as an isolator (Airmount). It has nothing to do with the concern here of actuation. To determine the force at any given height, simply move up the height line to where it intersects any of the static pressure curves. Then move to the right and read from the force scale **[1]**.

EXAMPLE: At 5 BAR, what is the force using a #22 from 110 to 230 mm, or 230 – 110 = 120 mm stroke? See **[8]** for force at 110 mm (28.75 kN) and **[9]** for force at 230 mm (18.75 kN). This example illustrates the primary difference between Firestone Airstroke actuators and conventional air cylinders. Air cylinders have a constant area for the pressure to work against, or constant effective area. THE EFFECTIVE AREA AND FORCE OF AN AIR SPRING CHANGES AS THE HEIGHT CHANGES. (There is one exception: notice the plateau section of reversible sleeve 1T type curves).



In the example, the effective area of a #22, at 110 mm using the 5 bar curve, is:

$$\frac{28.75 \text{ kN} \times 100}{5 \text{ BAR}} = 575 \text{ cm}^2$$

at 230 mm in height, it is:

$$\frac{18.75 \text{ kN} \times 100}{5 \text{ BAR}} = 375 \text{ cm}^2$$

An air cylinder with 575 cm^2 of area would have a 5 bar force curve as shown by dotted line **[**10**]**.

The volume curve **[**3**]** may also be of importance:

a. If one needs to know the amount of free air to perform a desired operation.

b. If the actuation must be completed quickly and calculations of flow through the air inlet (orifice) are required.

In each case above, the change in internal volume is required. Read up from the two heights involved to the intersecting point with the volume curve. Then move to the left and read from the volume scale. In the example, at 110 mm, #22 (notice most volume curves are at 7 bar) has an internal volume of 6200 cm^3 **[**11**]** and at 230 mm the volume is 12400 cm^3 **[**12**]**. The change in volume is then 12400 – 6200 or 6200 cm^3. The volume at minimum height (6200 cm^3) would not be subtracted if exhausting the air spring to atmospheric pressure.

Notice the shaded area **[**13**]**. We do not recommend that an air spring be used at heights extending into this section. The "beginning of the shaded area" for a #22 is at 260 mm **[**5**]**.

SEE PAGE 15 FOR A MORE DETAILED DISCUSSION OF ACTUATION.

AIRMOUNT™ ISOLATION

Because of lateral stability considerations (see page 23 for more details) we recommend that each air spring be used at a SPECIFIC HEIGHT when used as an ISOLATOR. This specific height is called the "Airmount™ design height" **[**6**]**. The vertical line running through this height **[**7**]** is darkened so that it is easy to see where it intersects the static curves for load readings.

EXAMPLE: Support a 20 kN load (2000 kg) with an air spring. Would a #22 be appropriate, and if so, at what height? The height isn't much of a problem, as this part SHOULD BE USED AT 240 mm.

Simply move up the darkened line to where it intersects 20 kN **[**14**]**. That point falls between the 6 and 5 bar curves. Exactly what pressure would be required? Use the formula:

$$\text{Effective Area} = \frac{\text{(Load) kN} \times 100}{\text{Pressure (BAR)}}$$

Determine the effective area at 240 mm (using the 6 bar curve, since 6 bar would be closer to our exact pressure than 5 bar), or:

$$\text{Effective Area} = \frac{20.4 \times 100 \text{ [15]}}{6} = 340 \text{ cm}^2$$

Then divide the actual load by the effective area:

$$\frac{20 \text{ kN} \times 100}{340 \text{ cm}^2} = 5.8 \text{ bar}$$

The pressure required to support 20 kN. with a #22 at a design height of 240 mm is therefore 5.8 bar.

Please note that the static data can be converted to dynamic data (the air spring is in motion) by applying the formulas that are presented in the Airmount isolation section on page 22.

SEE PAGE 21 FOR A MORE DETAILED DISCUSSION OF VIBRATION ISOLATION.

INTERNAL RUBBER BUMPERS

Some parts are available with internal rubber bumpers. Where a bumper is available, it is shown as a dotted line in the cross sectional view of the air spring. Additionally, when bumpers are used, please note that:

1. the minimum height is increased to the "bumper contact" point **[**15**]** (this reduces the total available stroke somewhat, by 107 – 76 = 31 mm in our #22 example), and

2. the order block contains the proper ordering numbers for parts with bumpers.

BASIC PARAMETERS APPLICABLE TO BOTH AIRSTROKE™ ACTUATORS AND AIRMOUNT™ ISOLATORS

MEDIA

Air springs are designed for use with compressed air. Nitrogen is also acceptable. Air springs may be filled with water or water-glycol solutions. If water is to be used, rust inhibitors should be added to protect the end closures. Two reasons for liquid filling an air spring are:

1. To reduce the internal volume of air (and therefore, INCREASE the natural frequency of the air spring) and,
2. To use a media which is incompressible. Accurate positioning would be one reason to do this.

Petroleum base fluids (most hydraulic oils fall into this category) are NOT RECOMMENDED. Moderately lubricated air will not harm the bellows.

PRESSURE

Our "rule of thumb" is:

1. 7 bar maximum for 2 ply.
2. 12 bar maximum for high strength.

We recommend that there be a minimum THREE TIMES safety factor between maximum internal air pressure and burst pressure. So, as an example, if 7 bar is required, the burst should be 21 bar or greater. For convoluted air springs, the burst pressure DECREASES as HEIGHT INCREASES. Therefore, the determining factors are two-fold: What is the maximum height into extension and what is the internal pressure at that point? Please see the AIRSTROKE INFLATION PRESSURE CHART (for single, double, and triple convoluted air springs) on page 17 for specific bar vs. height information.

For AIRMOUNT™ applications (where the part is used at a height very close to the shaded area), it is best to stay within 7 bar maximum for a two ply, and 12 bar maximum for a high strength air spring.

STORAGE

The best storage environment is a dark, dry area at normal room temperature.

TEMPERATURE

1. **STANDARD ALL NATURAL RUBBER (LOW TEMPERATURE COMPOUND).** Our standard industrial air springs should be limited to use in the range:

   -53°C to 57°C

2. **EPICHLOROHYDRIN (HIGH TEMPERATURE COMPOUND).** Most convoluted parts are available in this material. The operating temperature range for it is:

   –17°C to 107°C

   Additionally, Epichlorohydrin has very good oil resistance. ALL EPICHLOROHYDRIN APPLICATIONS MUST BE APPROVED BY FIRESTONE. For more information on Epichlorohydrin please contact Firestone.

3. **NEOPRENE (HIGH TEMPERATURE COMPOUND).** Neoprene is more resistant to damage from oil. For this reason, Firestone Neoprene has been used as the inside layer in two configurations to reduce the hazard of having oil in the pneumatic plumbing system. The third configuration includes an outer layer of Firestone Neoprene for applications that expose the exterior of the air spring to an oil environment. In addition, Firestone Neoprene is able to withstand higher temperatures than natural rubber:

   -37°C to 74°C

CONTAMINATES

Shielding should be used to protect the bellows from exposure to hot metal, sand, petroleum base fluids, acids, etc. Please consult Firestone if you wish to know how the bellows will withstand a specific contaminant (For liquids such as acids, it is important to know both the concentration and temperature).

WARNING

DO NOT INFLATE ASSEMBLY WHEN IT IS UNRESTRICTED. ASSEMBLY MUST BE RESTRICTED BY SUSPENSION OR OTHER ADEQUATE STRUCTURE. DO NOT INFLATE BEYOND PRESSURES RECOMMENDED IN DESIGN LITERATURE (CONTACT FIRESTONE FOR INFORMATION). IMPROPER USE OR OVERINFLATION MAY CAUSE ASSEMBLY TO BURST CAUSING PROPERTY DAMAGE OR SEVERE PERSONAL INJURY.

AIRSTROKE™ ACTUATION

SELECTION

1. Refer to the selection guide on page 32 for Airstroke™ force and stroke capabilities. After your list of possibilities has been reduced to one or two air springs, then turn to the individual data page for more detailed information on those parts.

2. STROKE: The maximum STROKE CAPABILITY is the difference between the height corresponding to the "start of the shaded area" minus the minimum height. This entire stroke, OR ANY PORTION THEREOF, may be used. If an internal rubber bumper is required, please note that the minimum height is increased, and therefore, the total stroke is decreased.

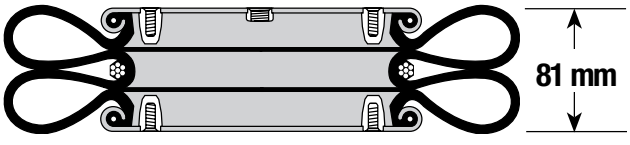
3. FORCE: Read the forces directly from the static data chart, or, use the force table located under the chart. Notice that the force generally decreases as height increases. This feature is discussed in detail on page 12 in the section entitled "How to Use the Static Data Chart."

4. SELECT THE END CLOSURES AND AIR INLET SIZE: Most Airstroke actuators are available with permanently attached plates or bead ring attachments. If an alternate end closure option is available, it is so stated under the cross sectional view of the part. Please refer to page 6 for a detailed discussion of end closure options.

DOWN AND UP STOPS

Positive stops in both directions (compression *and* extension) should always be used with Airstroke actuators.

1. In COMPRESSION, the minimum height shown for each air spring is at, or slightly above the PINCH POINT of the bellows. Here is a #22 shown in the collapsed or "pinch point" condition:



The bellows can be damaged if allowed to constantly bottom-out as shown above; therefore, a downstop is required to prevent this. An external downstop can be something as simple as a steel block and should be sized at or slightly greater than the minimum height of the Airstroke. In our #22 example, the block would need to be at least 85 mm high. If an external downstop cannot be used, many parts are available with internal rubber bumpers (shown as a dotted line in the cross-sectional view of the air spring where available).

2. In EXTENSION, an upstop is required to prevent the air spring from overextending at heights into the shaded area of the graph. The reasons for this are twofold: **a)** the life of the bellows may be reduced and **b)** the crimp may open up, allowing the bellows bead to blow out of the metal end closure. There are many ways to design-in an upstop, including

- **a.** a chain,
- **b.** a cable,
- **c.** contacting a metal stop, etc.

RETURN

An Airstroke actuator is a SINGLE ACTING device. To return the Airstroke to its minimum height (for another cycle or stroke), some return force must be used. Gravity acting on the load may be all that's required. The force to collapse the convoluted type Airstroke actuators to minimum height is given in the order block section for each part. If the load is not sufficient, then a second Airstroke or coil spring may be required.

GUIDING

AN AIRSTROKE FOLLOWS THE PATH OF LEAST RESISTANCE; therefore, the actuator should be guided in most instances. This is often easily accomplished in the mounting geometry.

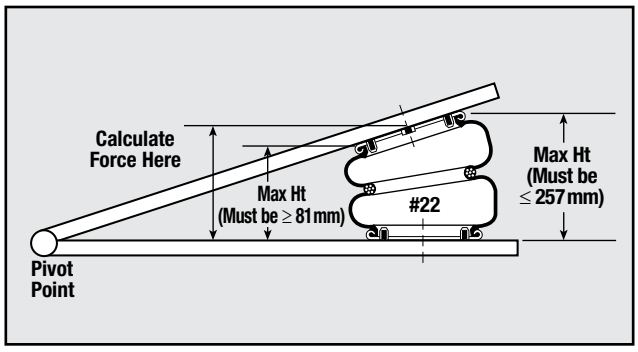
ANGULAR CAPABILITY

An Airstroke actuator can stroke through an arc (without a clevis). Angular motion of up to 30 degrees is possible. When using an actuator with the mounting plates at an angle to each other, observe the following:

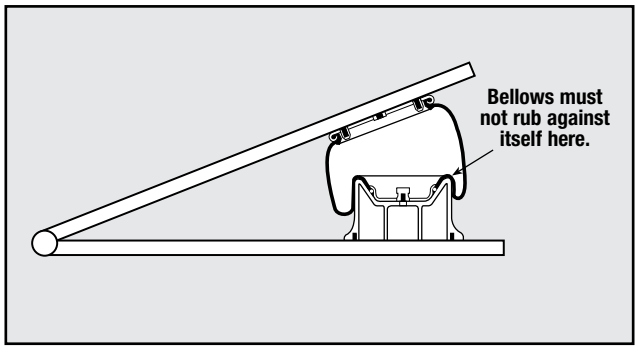
- **a.** Measure force at the height between the plate centers.
- **b.** Measure maximum height at the side separated the furthest.
- **c.** Measure minimum height at the side collapsed the most.
- **d.** Limit the horizontal misalignment between the two plates. We recommend 25 mm misalignment for each convolution.

Angular Capability continued

These measurements must fall within the guide lines for that particular part. Consider style #22 in the following pivot arrangement:



Reversible sleeve Type 1T parts may also stroke through an arc. In this case, care must be taken to prevent the bellows from rubbing (internally) against itself where it rolls over the piston:



HORIZONTAL MISALIGNMENT

The upper and lower bead plate centers (or mounting plate centers in the case of a bead ring type attachment) may be out of line somewhat without injury to the bellows. Our "rule of thumb" for convoluted type Airstroke actuators is 25 mm misalignment allowed per convolution. So, a single convoluted air spring may be out of line by as much as 25 mm, a double by 50 mm, and a triple convoluted air spring by 75 mm.

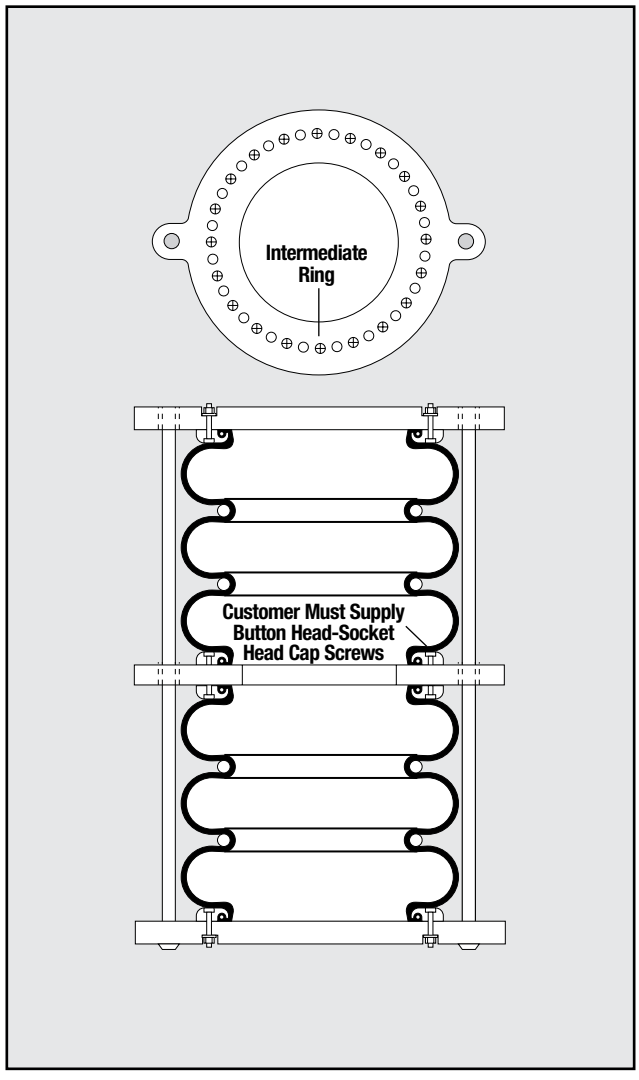
DESIGN ENVELOPE

Adequate clearance should be provided around the Airstroke to prevent puncturing or rubbing of the bellows. The maximum diameter @ 7 bar for each Airstroke (bellows) is located just above the cross-sectional view of the air spring on the individual parts pages.

STACKING

It is permissible to stack Airstroke actuators (one on top of another) to increase stroke; however, the intermediate plate (or plates) connecting the two or more Airstrokes MUST BE GUIDED.

Please note that the air spring forces are NOT additive in this configuration. A method for guiding, which also illustrates one center ring concept for mounting the two parts together at the middle, is illustrated below:



FAIL-SAFE DEVICES

Some applications require the use of fail-safe mechanisms (such as a mechanical lock-out on a scissors lift) to prevent damage or injury in the event of an air system failure.

VACUUM

An Airstroke can withstand a small amount of vacuum without injury to the bellows. The maximum amount of acceptable vacuum is dependent upon the bellow's size, the height in use, and whether it is a two ply or high strength (fabric) air spring. (A high strength Airstroke bellows has a "stiffer" wall than a two ply; therefore, it is less susceptible to dimpling and deformation inward). It is generally best to use only single convoluted air springs under vacuum.

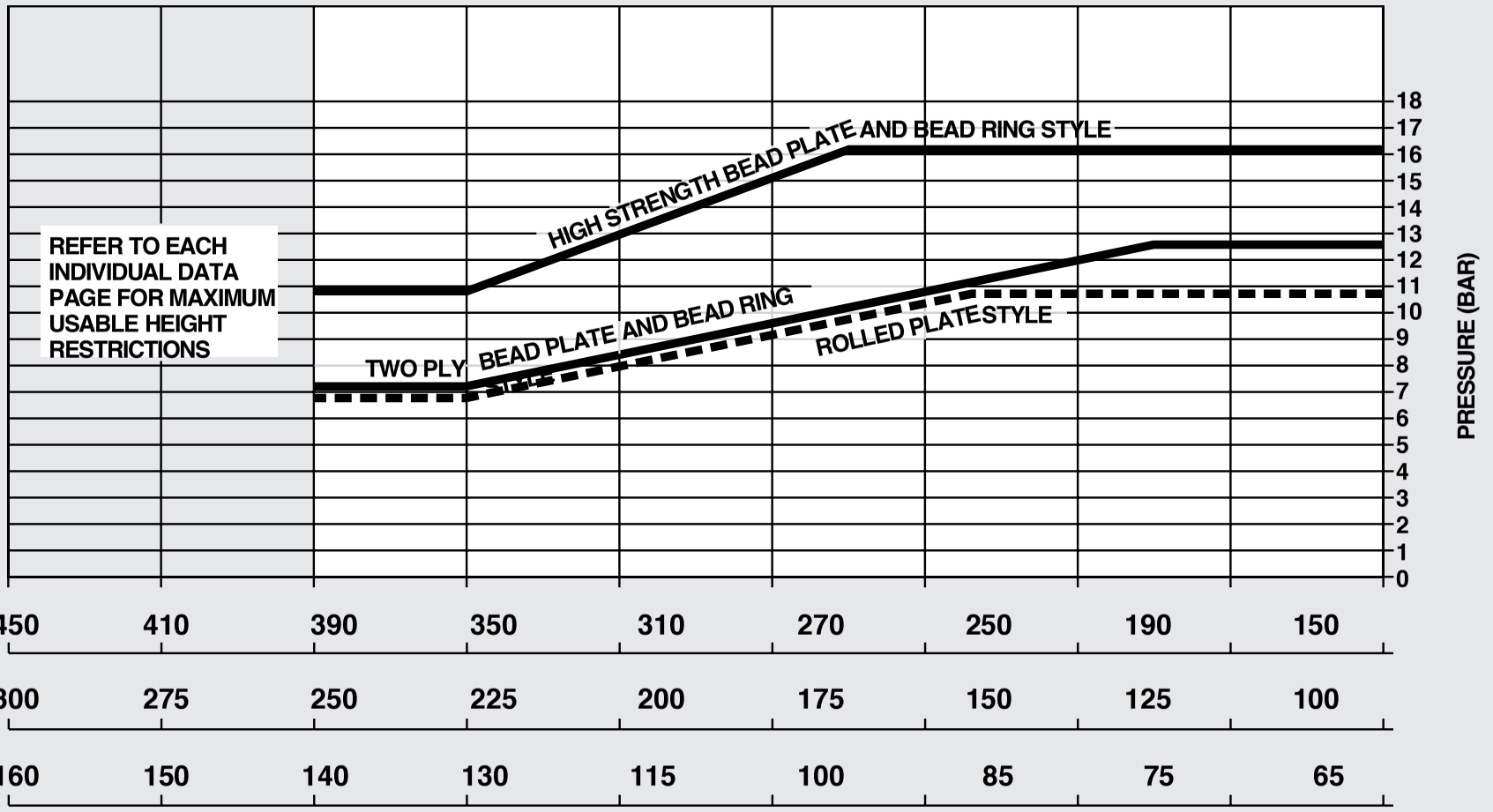
AN AIRSTROKE DESIGN PARAMETER WORKSHEET CAN BE FOUND ON PAGE 103.

INFLATION PRESSURE CHART

MAXIMUM RECOMMENDED INTERNAL PRESSURES FOR CONVOLUTED TYPE AIRSTROKE™ ACTUATOR APPLICATIONS

BASED ON APPROXIMATELY 1/3 NORMAL BURST VALUES

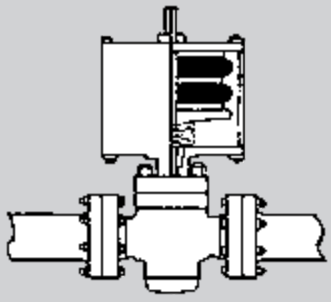
APPLICATIONS WHICH EXCEED THESE LIMITS SHOULD BE REVIEWED WITH FIRESTONE.



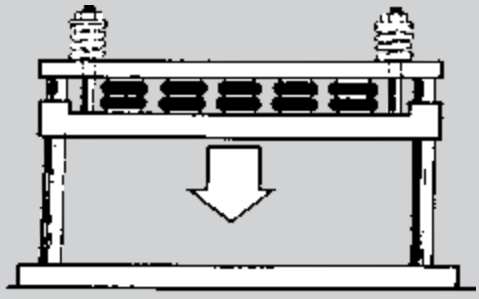
AIRSTROKE™

AIRSTROKE™ ACTUATOR PROBLEM SOLVERS

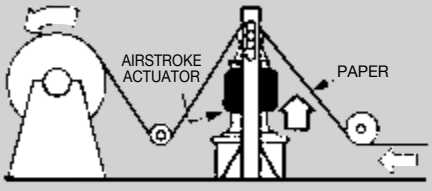
GATE VALVE OPERATOR



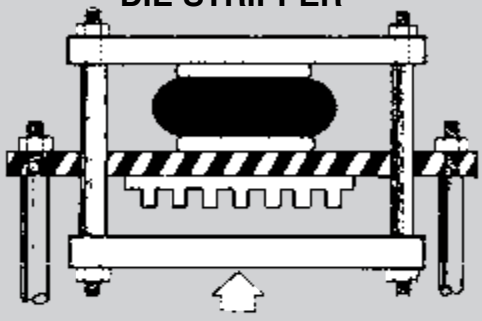
GLUING PRESS



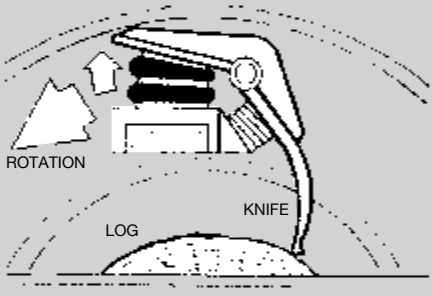
WEB TENSIONING DEVICE



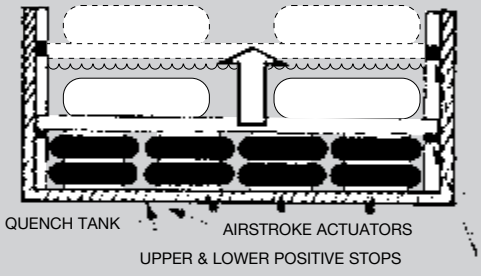
DIE STRIPPER



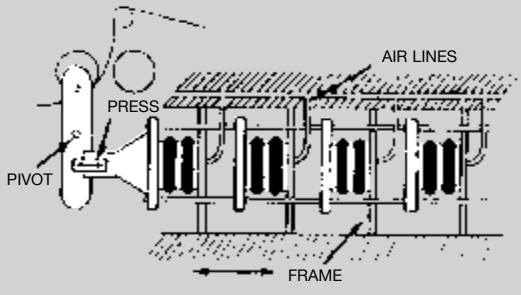
KNIFE SPRING ACTUATOR



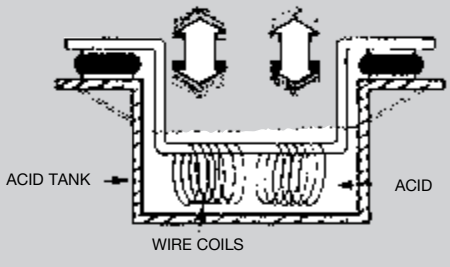
QUENCH TANK ACTUATOR



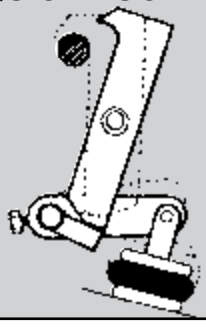
PAPER SIZING PRESS



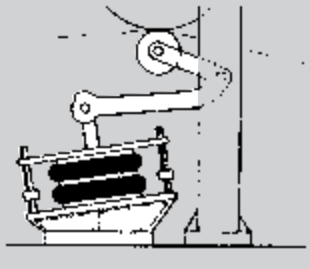
PICKLING TANK ACTUATOR



QUICK LOCK DEVICE

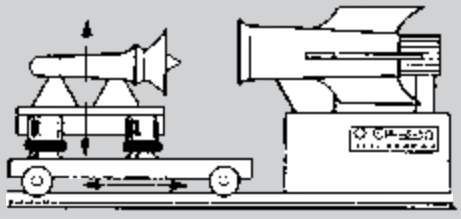


PRESSURE ROLL FOR CALENDER

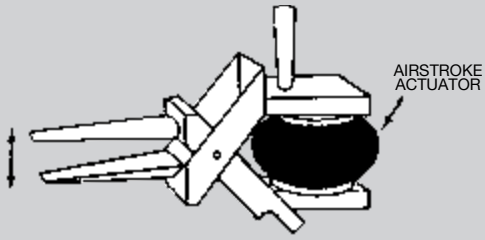


AIRSTROKE™ ACTUATOR PROBLEM SOLVERS

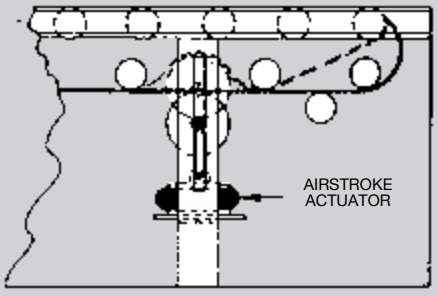
MISSILE ASSEMBLY FIXTURE



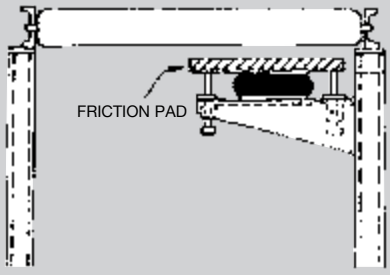
CORE STRAIGHTENER



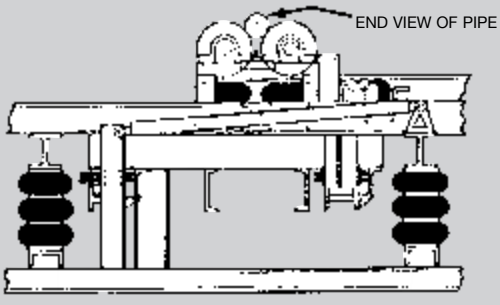
BELT TAKE-UP



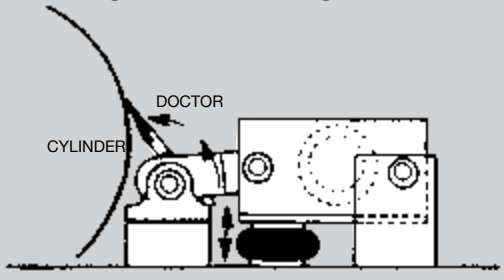
ROLLER FRICTION BRAKE



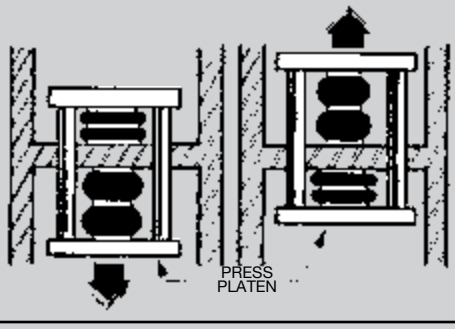
PIPE INDEXING THREADING



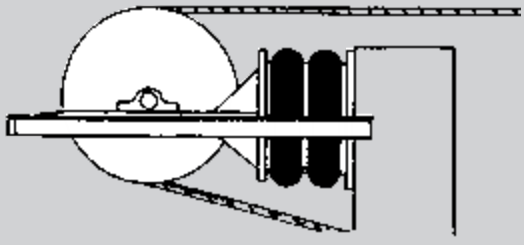
OSCILLATING DOCTOR FOR PAPER CALENDER ROLL



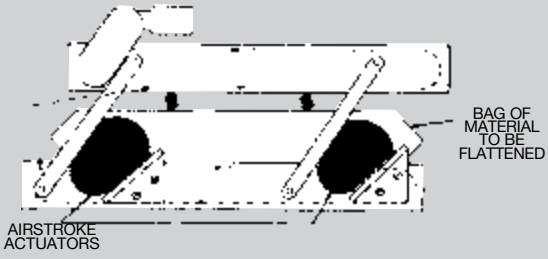
FORMING PRESS



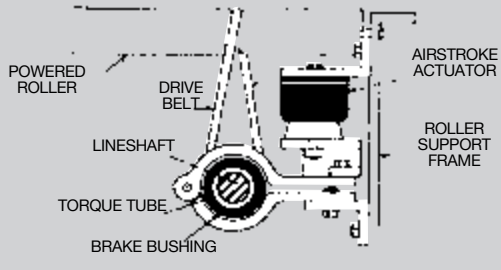
CABLE TENSIONING DEVICE



BAG FLATTENER

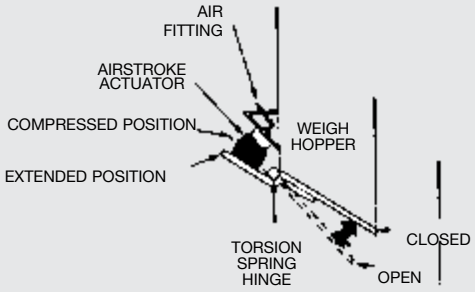


TORSIONAL FRICTION BRAKE

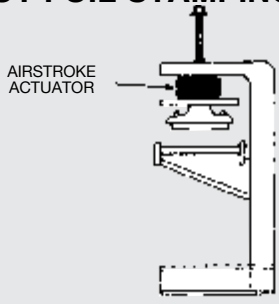


AIRSTROKE™ ACTUATOR PROBLEM SOLVERS

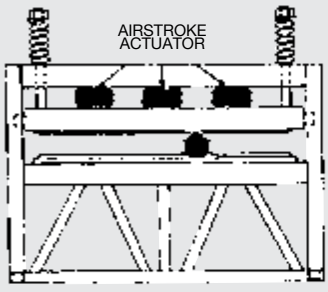
HINGED GATE



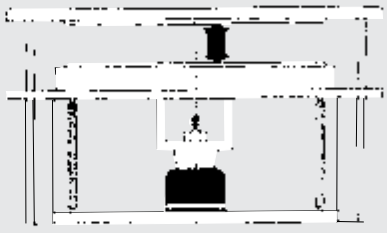
HOT FOIL STAMPING PRESS



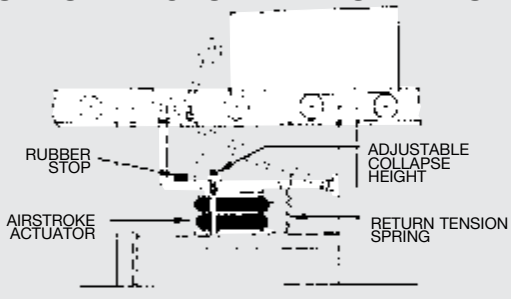
ACTUATED HEAVY DUTY SEALER



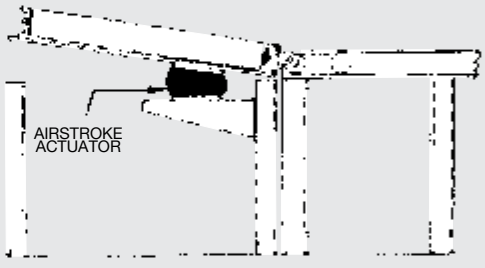
PIVOTED CLAMPING DEVICE



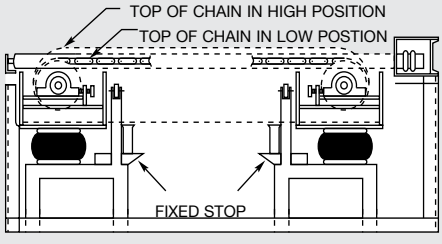
AIRSTROKE ACTUATED ROLLER STOP



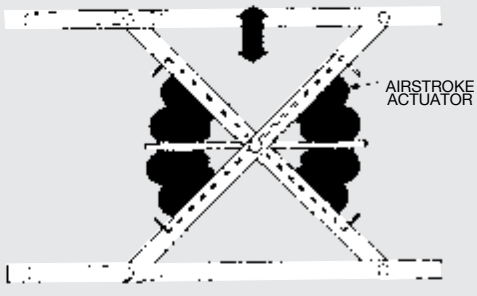
HINGED ACTUATED GRAVITY GATE



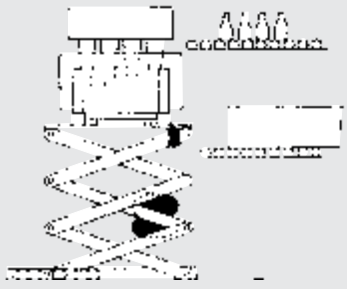
VERTICAL ACTUATED DRIVE TABLE



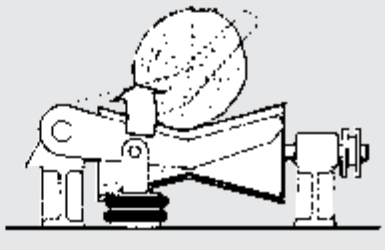
SCISSOR LIFT



CASE PACKER



CONVEYOR TRANSFER ACTUATOR



AIRMOUNT™ VIBRATION ISOLATION

SELECTION AND ISOLATION FORMULA

Refer to the selection guide on page 33 for Airmount™ load and isolation capabilities. Follow this procedure:

1. LOAD CAPACITY

Select one or two Airmount isolators that can support the load at each mounting point. It is normally best to design for pressures in the 4 to 6 bar range. Consider only the 1M1A and the single and double convoluted types at first. Please notice that in the range of 1 to 285 kN you will, in most cases, find both a single and double convoluted style part which will support the load.

2. DETERMINE ISOLATION EFFECTIVENESS

Select the disturbing frequency that is closest to the actual forced frequency 7, 13, or 25 Hz. Then check the percentage of isolation for the parts that were selected in 1 above.

3. DETERMINE DESIGN HEIGHT

THE AIR SPRING SHOULD BE USED AT THE DESIGN HEIGHT GIVEN. The double convoluted part is used at a design height somewhat higher than its single convolution equivalent. Make sure that the design height falls within the height restrictions. Also, the double convoluted part will show a higher percentage of isolation (less transmitted vibration) than the single convoluted air spring. The reason for this is that the double convoluted part has a greater internal volume of air than the single convoluted version of the same size. At disturbing frequencies in the 7 to 13 Hz range, the double convoluted part is a significantly better vibration isolator than the single convoluted part. At disturbing frequencies of 13 to 25 Hz, the gap closes considerably. At frequencies of 25 Hz and above, the difference is negligible.

4. DETERMINE EXACT INTERNAL PRESSURE AND ISOLATION EFFECTIVENESS

The chances are that your specific vibration problem does not fall neatly into the load and disturbing frequency criteria as presented in the selection guide.

Therefore, once a preliminary part selection has been made, turn to the individual data page for that part in order to determine the specific internal pressure required and the percentage of isolation attainable.

CONSIDER THIS EXAMPLE:

Isolate a vibrating screen which weighs a total of 6000 kg, preferably with ONE isolator at each corner. The vibrating mechanism is rotating at a speed of 14.2 Hz with a total stroke of 8 mm.

a. Determine the Load at Each Mounting Point:

$$\frac{6000}{4} = 1500 \text{ kg or } 14.7 \text{ kN force}$$

Scan down the 5 bar load column in the selection guide. It appears that either a #19 or a #22 will support the load at a pressure between 4 and 5 bar.

b. Determine Isolation Effectiveness.

Read the % of Isolation at 13 Hz for the #19 and #22 (since 13 Hz is closest to our machine speed of 14.2 Hz). A #19 is at 96.0% and a #22 is at 98.2%. Looking at isolation effectiveness in terms of % TRANSMISSION, the #19 will transmit 100 – 96.0, or 4.0% of the vibrations. A #22 will transmit 100 – 98.2, or 1.8% of the vibrations. So, even though there does not seem to be much difference between 96.0% and 98.2% isolation, the #22 is in fact a better isolator by approximately a factor of two when comparing transmitted vibration.

c. Determine Design Height.

Let's say we have chosen the #22 because 96.0% isolation for a #19 is considered to be too low. A #22 SHOULD BE USED AT 240 mm as shown in the second column on page 33.

d. Determine Exact Internal Pressure and Isolation Percentage.

Turn to page 61 for detailed information on the #22. **a)** What exact pressure will be required to support the load of 15 kN? Refer to the information in the block entitled "Dynamic Characteristics at 240 mm Design Height."

$$\frac{16.6 \text{ kN} \times (100)}{5 \text{ bar}} = 331 \text{ cm}^2 = \text{effective area @ 240 mm @ 5 bar}$$

Divide the actual load by the effective area:

$$\frac{14.7 \text{ kN} \times (100)}{331 \text{ cm}^2} = \frac{4.5}{} \text{ bar required to support 14.7 kN at 240 mm}$$

b) What exact isolation will be attained?

Use the formula:

$$\% \text{ Transmission} = \frac{100}{\left(\frac{f_f}{f_n}\right)^2 - 1}$$

Where: f_f = Forced Frequency (Hz)
f_n = Natural Frequency (Hz)

The forced frequency is 14.2 Hz. Read the natural frequency from the line at the load and pressure closest to the actual situation, or 1.80 (@ 5 bar and 16.56 kN): Design Ht. 240 mm

$$\% \text{ Transmission} = \frac{100}{\left(\frac{14.2}{1.80}\right)^2 - 1}$$

% Transmission = 1.63%
% Isolation = 100 – % Transmission
% Isolation = 100 – 1.63
% Isolation = 98.4%

Notice that the natural frequency of an Airmount changes only slightly with variations in pressure and load. Therefore, when working at pressures other than 4, 5, 6, or 7 bar, % isolation can be calculated quite accurately using the "closest" natural frequency and the formula above.

DYNAMIC SPRING RATE FORMULA

Spring rate is a different matter. Unlike most conventional springs, the rate of an Airmount is not constant. It is a function of the change in effective area, volume, and pressure from design height. To determine the rate of an Airmount, use the following formula:

$$K = \frac{[(P_g + 1.01) \times 100]\left[\frac{A_c}{10{,}000}\left(\frac{V_1}{V_c}\right)^{1.38} - \frac{A_e}{10{,}000}\left(\frac{V_1}{V_e}\right)^{1.38}\right] - \left[101 \times \left(\frac{A_c - A_e}{10{,}000}\right)\right]}{.02 \text{ m}}$$

WHERE:

K = Vertical Spring Rate in kN/m

P_g = Gauge Pressure at design height (bar)

A_c = Effective Area at 10mm below design height (cm^2)

A_e = Effective Area at 10mm above design height (cm^2)

V_1 = Internal Volume at design height (cm^3)

V_c = Internal Volume at 10mm below design height (cm^3)

V_e = Internal Volume at 10mm above design height (cm^3)

Consider the same #22 example: What is the vertical spring rate with a load of 15kN at a design height of 240 mm? Refer to the static data chart on page 61. Again, our "closest" pressure is 5 bar, so we'll need to read the appropriate data from the 5 bar curve.

The 5 bar information at +10 mm above design height would fall at the 250 mm height line, and –10 mm below design height would fall at the 230 mm height line. (In this example, we can read loads from the force table). The information at design height is located in the "Dynamic Characteristics Block." So,

K = Unknown

P_g = 4.5 bar

$$A_c = \frac{\text{(Load) kN x (100)}}{\text{Pressure (bar)}} \quad \frac{16.05 \text{ kN x (100)}}{4.5} = 357 \text{ cm}^2$$

$$A_e = \frac{\text{(Load) kN x (100)}}{\text{Pressure (bar)}} \quad \frac{13.55 \text{ kN x (100)}}{4.5} = 301 \text{ cm}^2$$

V_1 = 12,800 cm^3

V_c = 12,400 cm^3

V_e = 13,100 cm^3

$$K = \frac{[(P_g + 1.01) \times 100]\left[\frac{A_c}{10{,}000}\left(\frac{V_1}{V_c}\right)^{1.38} - \frac{A_e}{10{,}000}\left(\frac{V_1}{V_e}\right)^{1.38}\right] - \left[101 \times \left(\frac{A_c - A_e}{10{,}000}\right)\right]}{.02 \text{ m}}$$

$$K = \frac{[(4.5 + 1.01) \times 100]\left[\frac{357}{10{,}000}\left(\frac{12{,}800}{12{,}400}\right)^{1.38} - \frac{301}{10{,}000}\left(\frac{12{,}800}{13{,}100}\right)^{1.38}\right] - \left[101 \times \left(\frac{357 - 301}{10{,}000}\right)\right]}{.02 \text{ m}}$$

K= 195 kN/m

NATURAL FREQUENCY FORMULA

Once the spring rate is determined, calculate the Airmount natural frequency (for an UNDAMPED system) as follows:

$$f_n = .50\sqrt{\frac{K}{L}}$$

Where:

f_n = Natural Frequency in Hz

K = Rate (kN/m)

L = Load (kN)

in our example:

$$f_n = .50\sqrt{\frac{195}{15}}$$

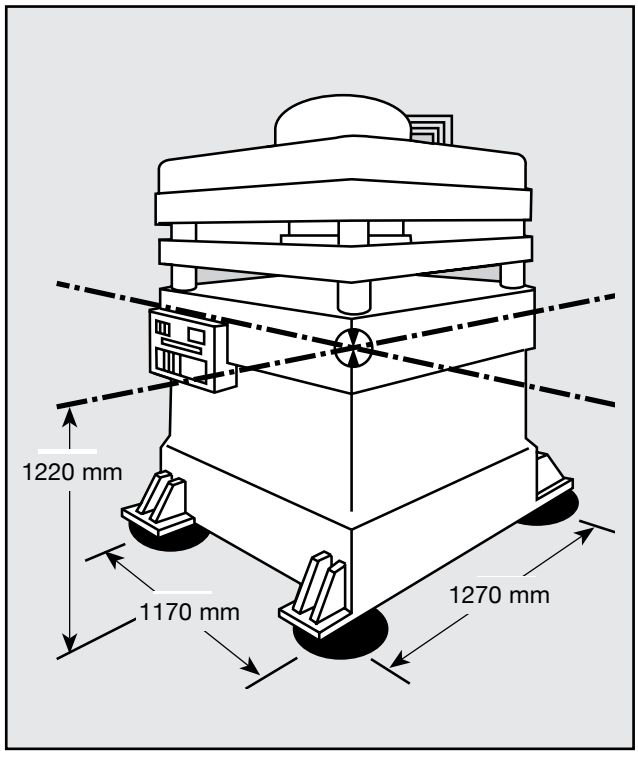
f_n = 1.80 Hz

AIRMOUNT™ VIBRATION ISOLATION

Up to this point, only the weight and disturbing frequency have been discussed. THERE ARE MANY OTHER IMPORTANT CONSIDERATIONS:

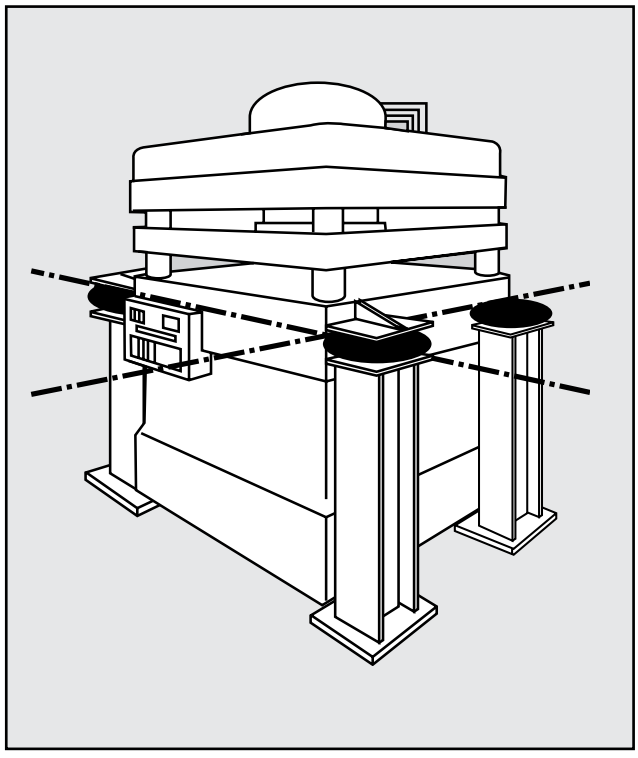
CENTER OF GRAVITY

An Airmount™ isolation system is inherently soft (easily deflected); therefore, precautions must be taken to insure that the system is stable. First, consider the location of the center of gravity (c.g.). Ideally, the Airmount isolators should be located on the same plane (parallel to the ground) as the center of gravity. Where this is not possible, follow this guideline: The distance between the most narrow mounting points should be at least twice the height of the center of gravity.



In the above example, the most narrow distance between two Airmount isolators is 1170 mm. The height to the c.g. is 1220 mm; therefore, this system does not meet our guideline. Two possible solutions would be:

1. Increase the base dimensions to meet our guideline by increasing both the width and length to at least 1220 x 2 or 2440 mm.
2. Locate the Airmount isolators at the c.g. as shown above (in the next column).



LATERAL RATES AND STABILITY

A single or double convoluted air spring SHOULD BE USED AT THE DESIGN HEIGHT GIVEN, because that is the point of maximum lateral rate or stability. The lateral rate DECREASES as the Airmount height DECREASES. Consider a #22 again at 6 bar:

Height	Lateral Rate	Vertical Rate
240 mm (design height)	51.0 kN/m	255.0 kN/m
215 mm	33.0 kN/m	140.0 kN/m
190 mm	Unstable	–

Notice that the #22 becomes unstable in the horizontal or lateral direction when moving down only 50 mm from design height.

AIRMOUNT™ VIBRATION ISOLATION

At design height and without an auxiliary reservoir, the single and double convoluted parts follow this pattern: i.e., the lateral rate varies from 1/5 to 1/2 of the vertical rate (only the larger high strength parts get as high as 1/2). Notice the #22 is approximately 1/4($\frac{51}{215}$). Going back to the original example of a vibrating screen which weighs 6000 kg mounted on four #22's (@ 240 mm), a side load of 2.04 kN ($\frac{51.0 \times 4}{100}$) would deflect the entire suspended mass by 10 mm.

TRIPLE CONVOLUTED AND REVERSIBLE SLEEVE TYPE PARTS

Both of these types are unstable laterally (except for the 1M1A). Due to low natural frequencies, both can be excellent isolators; however, do not use these two types as Airmount isolators without consulting Firestone.

DESIGN ENVELOPE

Adequate clearance should be provided around the Airmount to prevent puncturing or rubbing of the bellows. The maximum diameter @ 7 bar for each Airmount (bellows) is shown just above the cross sectional view of the air spring.

SAFETY STOPS

It is normally recommended that positive stops be installed IN ALL DIRECTIONS; i.e., into compression, extension, and laterally. Positioning of the vertical stops depends upon the amplitude of movement, both during normal operation and during startup and shutdown. A good "rule of thumb" is ± 15 mm from design height for vertical stops and also ± 15 mm (horizontally) for lateral stops.

INITIAL INSTALLATION

NEVER use Airmount™ isolators to lift the equipment into place, due to the lateral instability at lower air spring heights as discussed previously. The equipment should be rested on stops set slightly below design height and raised into position for isolation.

STARTUP AND SHUTDOWN RESONANCE AND AMPLIFICATION

Resonance is the condition where the forced frequency of the vibrating system is at the natural frequency of the suspension. When this happens, AMPLIFICATION of movement occurs. Going back to our vibrating screen example again, if the normal stroke is 8 mm, during startup and shutdown (as the machine goes through resonance), the amplitude of movement will be multiplied somewhat. So, while the machine is building up to speed and slowing down, the stroke may be amplified in the range of 10 to 35 mm if undamped. The longer the machine takes to go through resonance (to build up to, or slow down from full operating speed), the larger the amplitude of movement.

ISOLATING AN UNBALANCED MASS

The primary concern in this case is the amplitude of movement. It is dependent on:

1) The ratio of the unbalanced moving mass to the total suspended mass and,

2) The ratio of the speed of the unbalanced moving mass (forced frequency) to the natural frequency of the Airmounts.

The addition of damping to the isolation system (shock absorbers) will reduce the large amplitude of movement experienced during resonance.

If the amplitude of movement is too great, one possible solution would be to add an inertia base in order to increase the ratio of the total suspended mass to the moving unbalanced mass. A good "rule of thumb" is 10:1, respectively.

LOW PRESSURE OPERATION

The lateral rate of a single and double convoluted style Airmount DECREASES with decreasing internal air pressure (becomes less stable). Consult Firestone if you plan on operating an Airmount at less than 3 bar.

EFFECT OF AN AUXILIARY RESERVOIR

There is a direct relationship between natural frequency and isolation effectiveness. Generally, the lower the natural frequency, the better the isolator (or higher percentage of isolation). As previously mentioned, a double convoluted Airmount has a lower natural frequency than a single convoluted type (of the same size) because it has more internal air volume. We can use this principle to lower the natural frequency of an air spring by adding an auxiliary reservoir (pressure vessel) externally to the Airmount. This effectively increases the air spring volume and reduces its natural frequency.

In order for the reservoir to work properly, there must be a free flow of air between the Airmount and reservoir. Therefore, it should be mounted as close as possible to the Airmount. Additionally, a bead ring attachment is the best end closure choice as the hole in the upper mounting plate can be sized as large as the inside diameter of the bellows (at the top). A 3/4 BSP air inlet will restrict the flow of air somewhat, but can be used as long as it is understood that there is some throttling effect.

Going back to the #22 example, an auxiliary reservoir of three times the internal volume of the air spring at design height (approximately 38 liters) will reduce the natural frequency from 1.8 Hz to 1.5 Hz.

AIRMOUNT™ VIBRATION ISOLATION

DAMPING

Damping is defined as the ratio: $\frac{C}{C_c}$

WHERE: C = System Damping

C_c = Critical Damping

The damping ratio inherent in an Airmount™ is in the order of .03. This damping number is so small that the formulas presented in this section assume it to be zero.

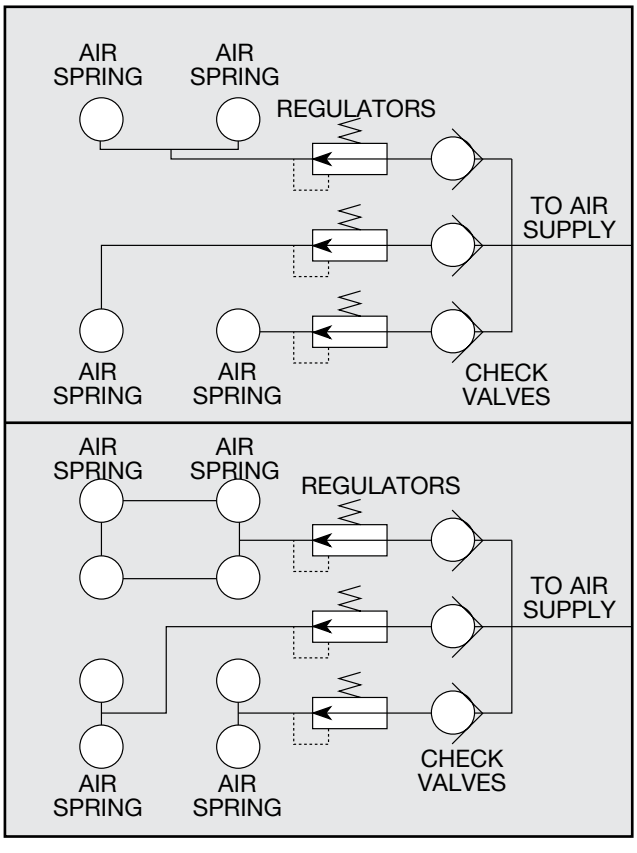
PLUMBING SYSTEMS

There are three basic ways of controlling an air suspended isolation system:

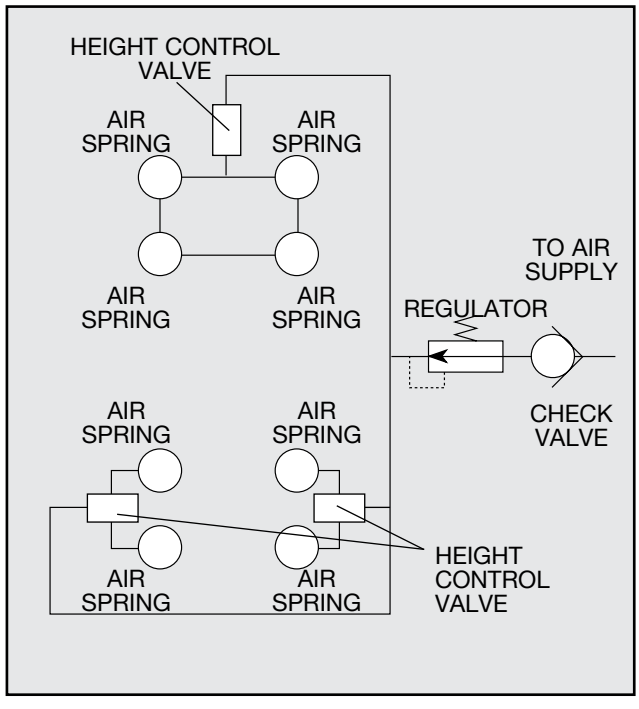
1. With a TANK VALVE in each Airmount. Each air spring is then inflated individually. The pressure in each must be checked periodically, because air will permeate through the bellows.

For an idea of the permeation rate, a #116 will lose approximately 2 bar over a period of one year (from 7 bar to 5 bar). Please see page 7 for a picture of a 1/4 BSP tank valve.

2. **Three Point Regulated System** The Airmount isolators can be connected directly to the factory compressed air system using pressure regulating valves. This eliminates the need for periodic inspections. The air springs should always be connected in clusters so the mass is supported with only THREE REGULATORS. This is illustrated below (in the previous column) for both a four and eight Airmount system:



3. **Three Point Leveled System** Height control can be provided by adding height control valves to the system. Again, there should be only THREE POINTS OF CONTROL, or in this case, three height control valves. Attempting to use more than three control points often results in the valves hunting or fighting one another. There are sensing systems available to control heights within .03 mm. Truck type leveling valves can provide accuracy to 1.6 mm. A three point, eight air spring, leveled system is illustrated below:



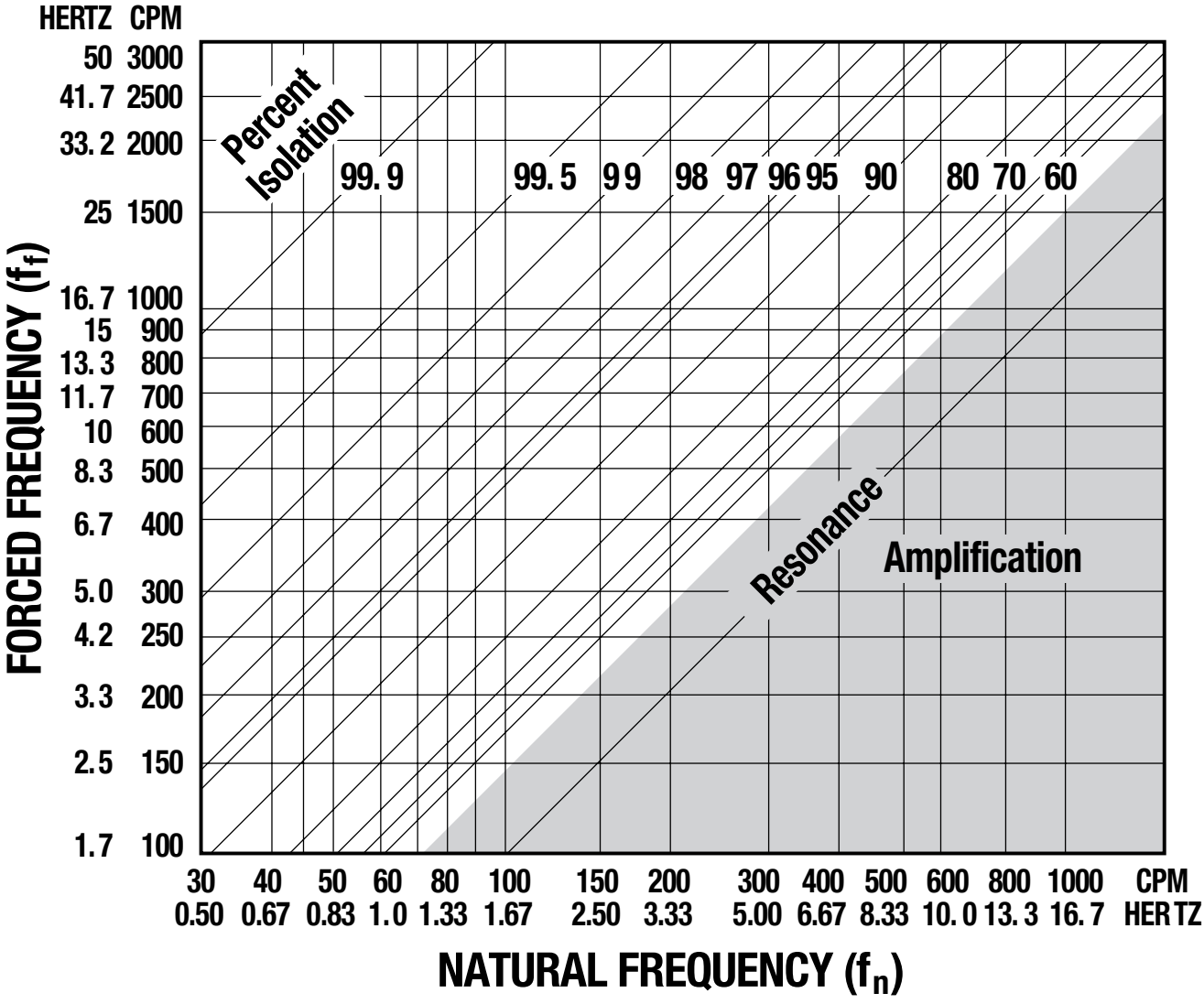
Description	Order No.
Height Control Valve	WC1-358-3592

An Airmount Design Parameter Worksheet can be found on page 105.

For More information ask your Firestone Rep for Technigram 107.

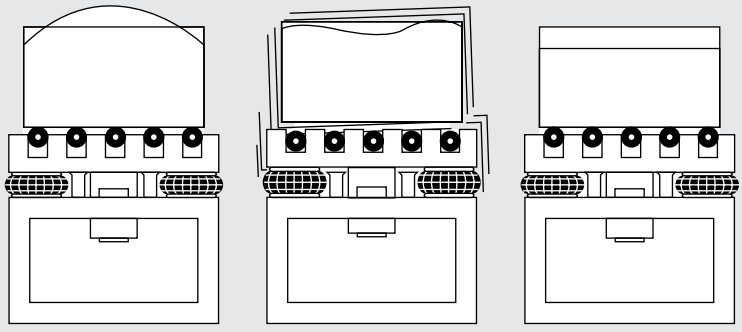
AIRMOUNT™ VIBRATION ISOLATION

ISOLATION CHART

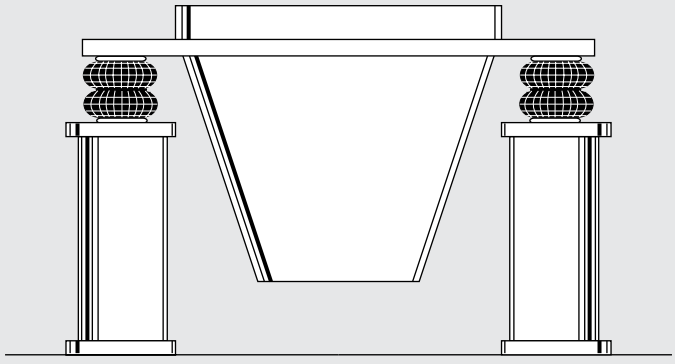


AIRMOUNT™ ISOLATION PROBLEM SOLVERS

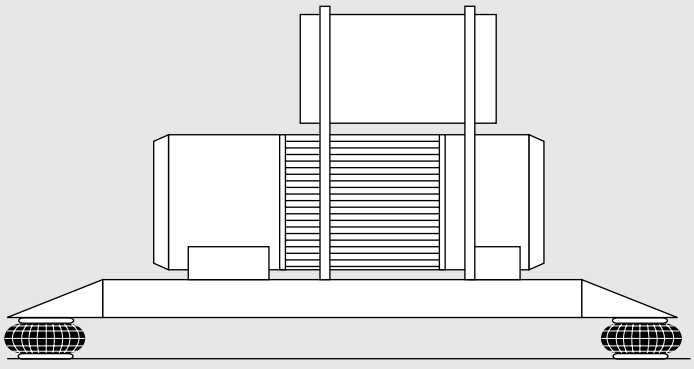
VIBRATING PACKER



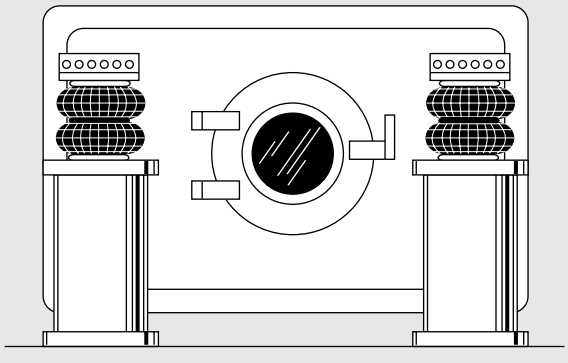
BIN HOPPER



COMPRESSOR

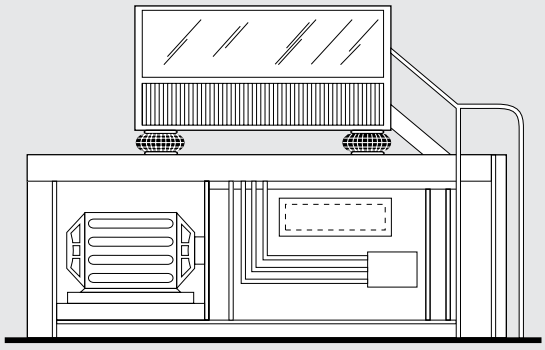


COMMERCIAL LAUNDRY MACHINE

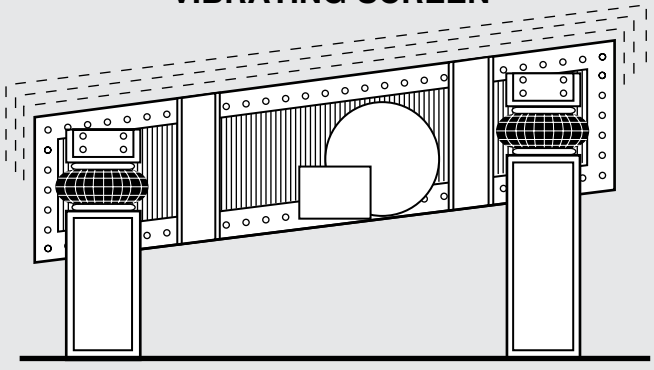


AIRMOUNT™ ISOLATION PROBLEM SOLVERS

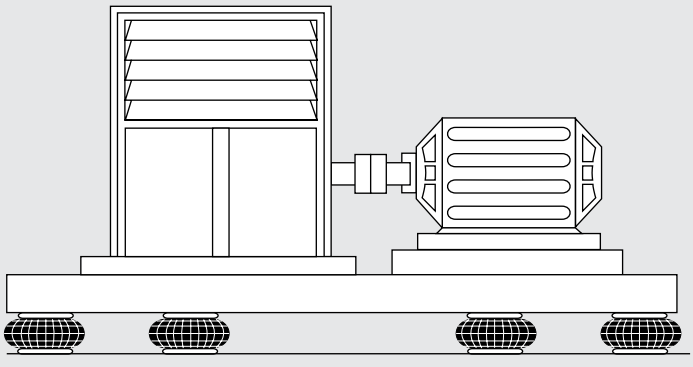
CONTROL BOOTH



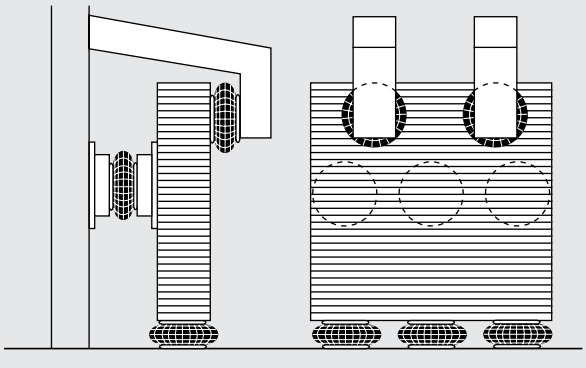
VIBRATING SCREEN



BLOWER AND MOTOR



CONTROL PANEL

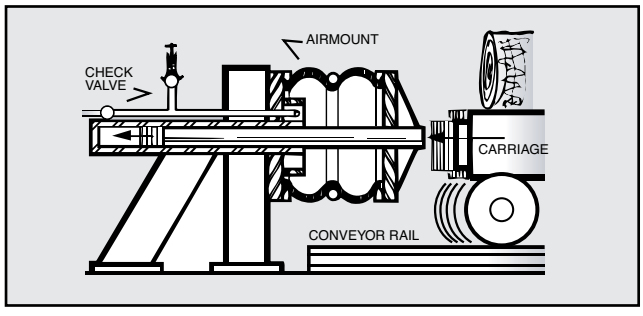


MISCELLANEOUS APPLICATIONS

The air spring provides a unique solution for many actuation and isolation applications the world over. Besides the common applications, there are many that are not readily recognized because of the air spring's unique construction. Listed below are some miscellaneous applications.

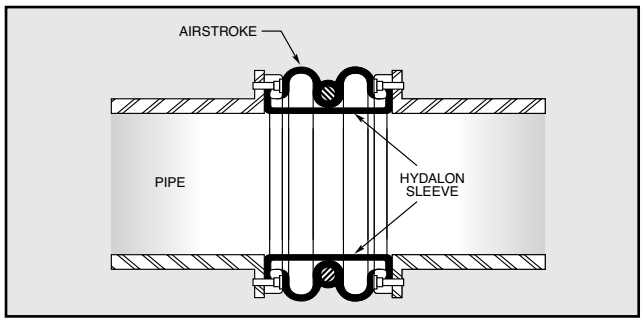
SHOCK IMPACT ISOLATION:

The air spring is frequently used in shock impact isolation applications. This air spring application is commonly found in saw mills as the means to both absorb the shock of a falling log, and then by actuating the air spring, to lift and transfer a log onto a conveyor. Because of the properties of both air and rubber, the air spring is an ideal solution to this problem. Without it, the mechanism and surrounding structure would suffer fatigue and fail prematurely due to the intensity of the shock from the falling log. Refer to the problem solver section on the following pages for miscellaneous applications.



PROTECTIVE BOOT AND FLEXIBLE CONNECTOR

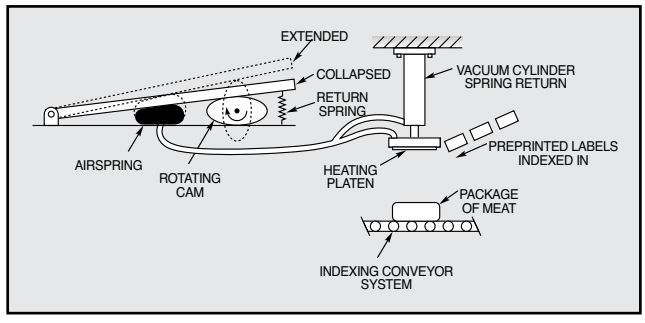
An air spring bellows, with a bead ring type attachment, can be used as a protective boot or flexible connector. Due to the flexible construction of the air spring and the ability to handle both misalignment and angular movement, the air spring is a suitable solution to this problem. To protect the inner surface from the flow of material, an inner sleeve may be required. Refer to the problem solver section on the following pages for miscellaneous applications.



For more information, call your local stocking distributor or the Firestone applications engineer at the phone number on the back cover of this design guide.

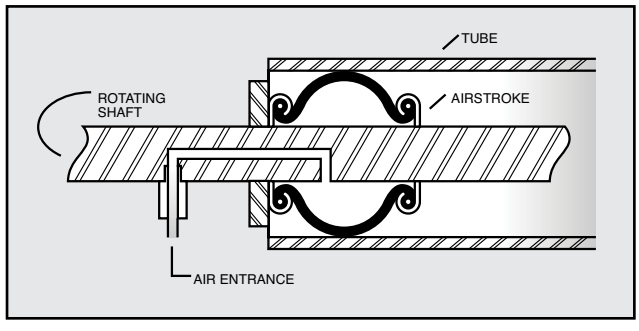
VACUUM PUMP

It is possible to drive an air spring mechanically in order to create a vacuum. The air spring can withstand a small amount of acceptable vacuum without injury to the bellows. The maximum amount of tolerable vacuum is dependent upon the bellows' size, height and whether it is a 2 or 4 ply air spring. It is generally best to use only the single convoluted air spring for this purpose. Refer to the problem solver section on the following pages for miscellaneous applications.



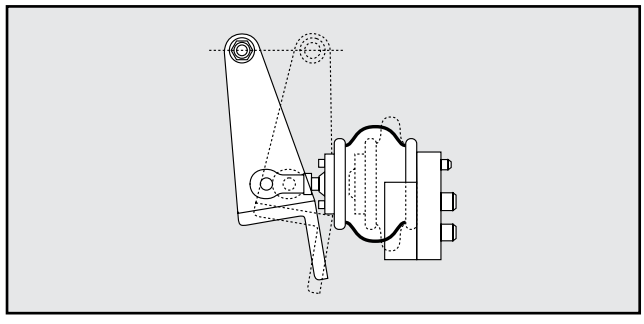
INFLATABLE CHUCK

By restricting the height internally of a bead ring style air spring, the rubber walls will extend in an outward fashion. In this arrangement the air spring can be used as an inflatable chuck. The air will need to be introduced via the same mechanism that restrains the air spring's height. Refer to the problem solver section on the following pages for miscellaneous applications.



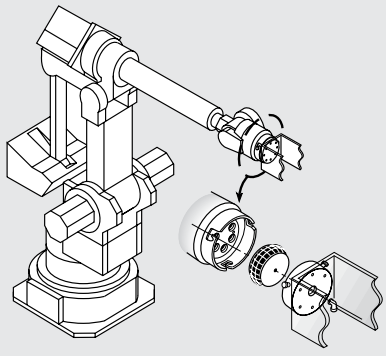
CAM FOLLOWER

The introduction of an air spring as the cam follower can extend the life of the cam greatly. Surface wear is reduced by removing the rigidity and friction of typical cam followers. With this reduction of wear comes continually smooth operations and overall minimization of fatigue. Refer to the problem solver section on the following pages for miscellaneous applications.

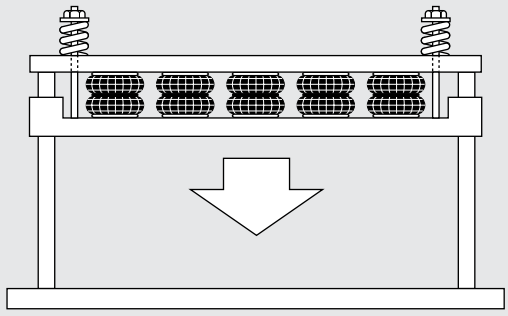


MISCELLANEOUS PROBLEM SOLVERS

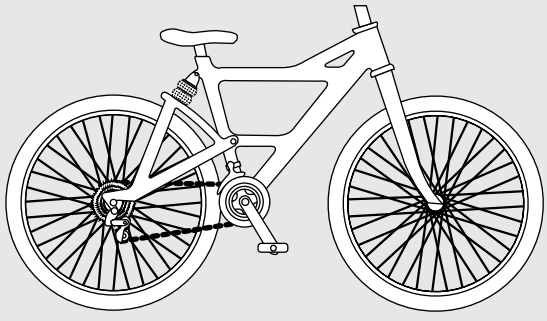
ROBOTIC COUPLING



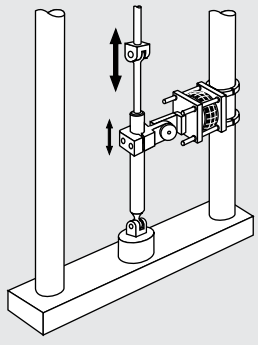
CONVEYOR END STOP



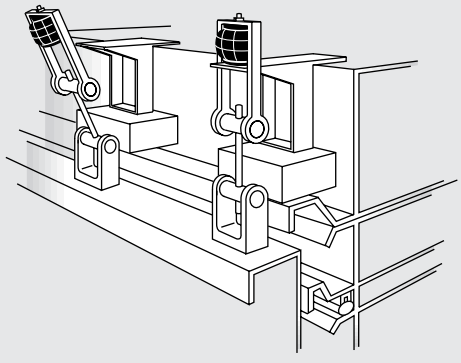
MOUNTAIN/TRAIL BIKE



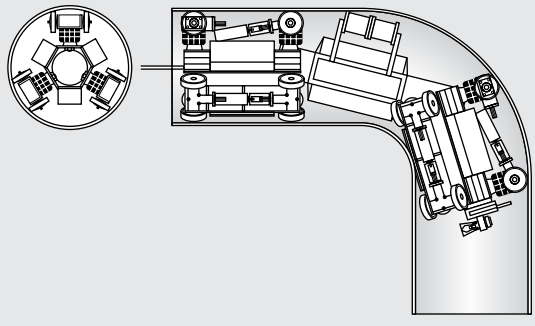
SHOCK ABSORBER TEST SYSTEM



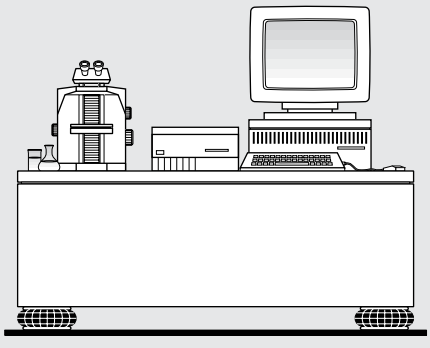
SCREENING MACHINE COVER CLAMP



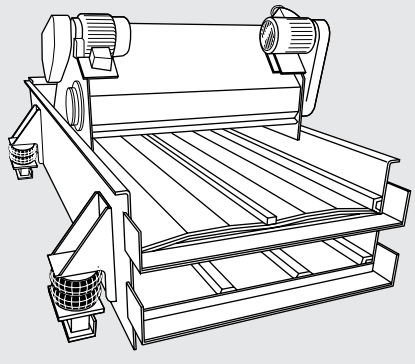
PIPE CRAWLER



DELICATE ELECTRONIC EQUIPMENT

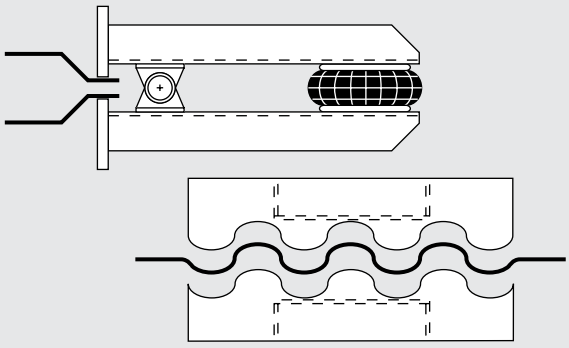


VIBRATING SCREEN

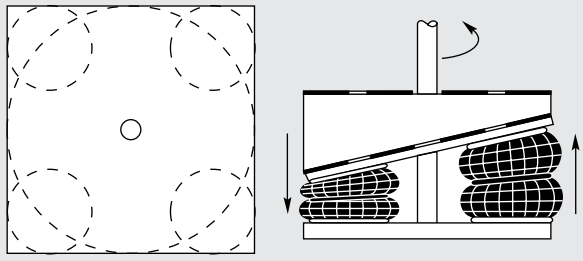


MISCELLANEOUS PROBLEM SOLVERS

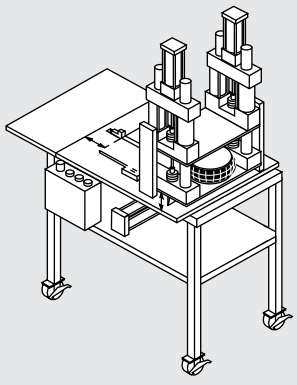
SHEET WELDING CLAMP



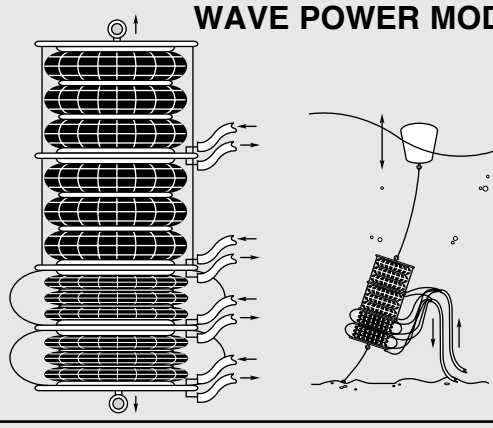
SWASH PLATE MOTOR



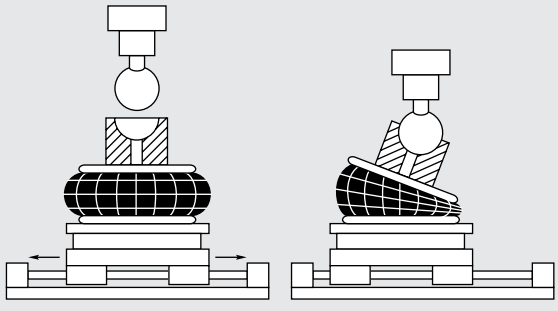
PERFECT BOUND MAGAZINE CUTTER



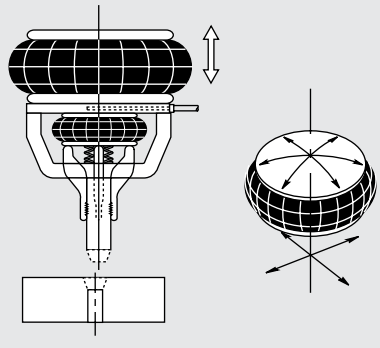
WAVE POWER MODULE



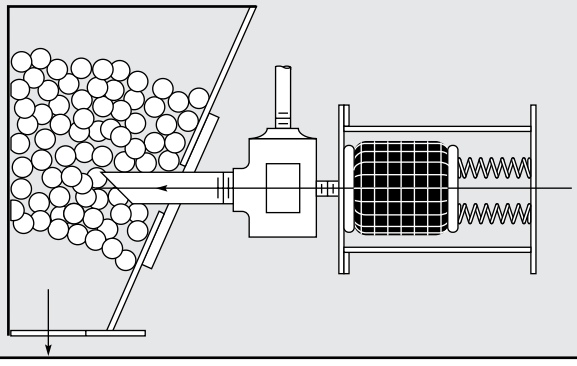
CHECK VALVE LAPPING



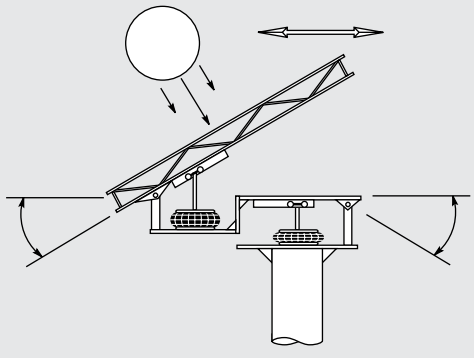
SELF ALIGNING DEVICE



AIR BLAST GENERATOR



SOLAR TRACKER



Firestone AIRSTROKE™ ACTUATORS

END CLOSURE OPTIONS

Style Number	Maximum Diameter at 7 BAR (mm)	Minimum Height (mm)	Maximum Stroke (mm)	Maximum Usable Height (mm)	7* BAR Force† at Stroke of			4 Ply Style Number	Pg. No.	Bead Plate Type	Dim. A (blind nut centers) (mm)	Dim. B (mm)	Bead Ring Type	Dim. C (bolt circle diameter) (mm)	Number of Bolts (each ring)
					25 mm (kN)	50% of Maximum Stroke	Maximum Stroke (kN)								
POLYACTUATOR															
50-P-10	50	11	10	22			37.4		34	SEE INDIVIDUAL DATA PAGE					
70-P-13	70	14	13	27			115.0		35						
SHAPED SLEEVE															
1M1A-0	86	38	36	74	2.5	0.0	2.2		36						
1M1A-1	86	38	60	98	2.8	0.0	2.1		37						
2M1A	88	64	86	150	2.7	2.7	2.1		38						
2M2A	59	30	26	56	0.8	0.0	0.7		39						
SINGLE CONVOLUTION															
16	152	48	36	84	5.0		2.5		40	1	45		4	114	6
131	165	51	53	104	7.6		3.5		41	1	45		4	114	6
160	183	53	109	162	10.6		2.6		42	1	45		4	114	6
110	211	53	79	132	11.8	7.7	3.8		43	1	70		4	135	6
116	231	51	79	130	15.1	10.3	5.2	117	44	1	70		4	135	6
116-1	244	51	107	158	16.8	24.8	13.7		45	3	89	45•	4	160	8
115	257	56	79	135	20.0	25.9	12.7		46	3	158	73	4	229	12
19	328	51	89	140	37.9	48.6	26.9		47	3	158	73	4	229	12
19-.75	343	56	99	155	39.8	50.4	25.7		48	2	159		4	287	12
113	386	51	97	148	55.9	71.7	36.7	128	49	2	159		4	287	12
113-1	404	53	117	170	61.3	72.7	43.5	128-1	50	2	159		N/A	N/A	N/A
153-2	460	64	120	184	73.6	90.4	62.9		51	5	229	350	4	351	18
119§	442	51	107	158	79.2	103.7	62.1		52	5	305	419	4	419	24
121§	516	53	91	144	110.6	143.5	89.8		53	5	381	483	4	483	24
126§	569	51	112	163	146.7	191.3	179.3	138-1.5	54				4	597	32
138-1.5	709	53	125	178	245.1	315.4	179.3		55				4	597	32
148-1	950	64	122	186	442.0	563.5	414.9	148-1 is 4-Ply	56				4	830	40
DOUBLE CONVOLUTION															
268	163	76	79	155	7.8	9.6	5.3		57	1	45		4	114	6
267-1.5	165	76	102	178	8.1	11.4	7.1		58	1	45		4	114	6
224	203	71	119	190	13.3	15.5	8.2	202	59	1	70		4	135	6
26	218	71	145	216	15.3	17.8	11.2		60						
274	251	79	152	231	21.4	25.5	13.9		61						
20-2	264	76	203	279	22.5	24.3	17.4		62	3	89	73	4	160	8
22	328	81	175	256	40.6	49.2	29.2	210	63	3	158	73	4	229	12
22-1.5	348	76	206	282	43.4	51.7	30.2		64	3	158		4	229	12
21	384	81	175	256	58.1	71.9	44.9	205	65	2	159		4	287	12
21-2	406	76	221	297	64.0	76.8	46.3		66	2	159		4	287	12
233-2	394	76	264	340	61.9	78.0	46.6		67	2	159		4	287	12
28§	442	86	170	256	84.7	99.8	67.4	201	68	5	229	350	4	351	18
203§	508	89	178	267	120.8	147.2	102.1	218	69	5	305	419	4	419	24
29§	577	84	191	275	151.9	188.6	136.2	207	70	5	381	483	4	483	24
200	660	89	180	269	201.6	255.4	191.7		71				4	559	24
215	709	89	218	307	240.0	300.5	222.5	215	72				4	597	32
248-2	950	107	231	338	441.4	559.6	426.7	248-2 is 4-Ply	73				4	830	40
TRIPLE CONVOLUTION															
352	333	122	277	399	45.1	51.4	34.5		74	3	157	73	4	229	12
313	384	114	272	386	58.7	70.0	43.1	39	75	2	159		4	287	12
333	386	114	305	419	61.6	70.6	45.9		76	2	159		4	287	12
312§	462	114	264	378	88.6	102.7	69.0	314	77	5	229	350	4	351	18
323§	521	117	274	391	119.7	143.5	98.2	324	78	5	305	419	4	419	24
320§	569	114	300	414	162.0	192.3	137.4	328	79	5	381	483	4	483	24
321	709	114	343	457	244.4	294.0	208.7	321	80				4	597	32
348-3	950	140	351	490	434.7	560.2	423.6	348-3 is 4-Ply	81				4	830	40
REVERSIBLE SLEEVE															
4004	79	91	91	183	1.5	1.6	1.7		82	SEE INDIVIDUAL DATA PAGE					
7002	107	89	64	152	4.1	5.1	5.3		83						
7010	102	146	108	254	3.2	4.9	5.1		84						
7012	127	127	114	241	3.9	6.3	6.1		85						
100/70	145	114	124	239	5.3	4.4	4.2		86	1	45	4	114	6	
1T14C-1	231	127	196	323	16.0	20.6	13.5		87						
1T14C-3	229	147	208	356	16.5	20.6	14.1		88	3	89	45•	4	160	8
1T14C-7	229	203	239	442	17.2	20.6	12.9	1T28C-7	89	3	89	45•	4	160	8
1T15T-1	284	102	170	272	28.3	34.7	22.9		90	3	89	45•	4	160	8
1T15LP-3	282	152	254	406	28.6	33.9	22.3		91	3	158	73	4	229	12
1T15L-4	297	152	251	404	32.1	43.9	29.0		92	3	158	73	4	229	12
1T15M-0	325	109	178	287	32.2	44.1	30.4		93	3	158	73	4	229	12
1T15M-2	320	127	211	338	34.3	47.4	32.1		94	3	158	73	4	229	12
1T15M-4	320	152	267	419	35.4	45.5	31.8		95	3	158	73	4	229	12
1T15M-6	320	178	310	488	35.4	44.3	31.2		96	3	158	73	4	229	12
1T15M-9	323	216	384	599	36.4	45.1	33.3		97	3	158	73	4	229	12
1T19L-7	361	165	325	490	45.5	56.8	41.2		98	3	158	73	4	229	12
1T19L-11	361	203	391	594	48.6	55.1	40.4		99	2	159		4	287	12

*Values for the Polyactuators are based out of the 3.5 BAR curve. Do not use polyactuator at more than 3.5 BAR.

† To determine Airstroke force at other pressures, divide force shown by 7 bar and multiply result by new pressure.

§ This is offered with a rolled plate. When using the rolled plate end closure option, add 17.5 mm to heights shown.

•On plates with a 3/4 BSP air inlet, B dimension is 38 mm.

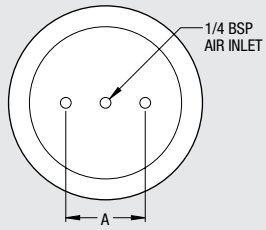
Firestone AIRMOUNT™ ISOLATORS

Style Number	Design Height (mm)	Load (at Design Height) at:			Natural Frequency (@ 7 BAR) f_n(Hz)	% of Isolation at Forced Frequency		
		••3 BAR (kN)	5 BAR (kN)	7 BAR (kN)		7 Hz	13 Hz	25 Hz
POLYACTUATOR								
50-P-10	DO NOT USE 50-P-10 AS AN AIRMOUNT ISOLATOR							
70-P-13	DO NOT USE 70-P-13 AS AN AIRMOUNT ISOLATOR							
SHAPED SLEEVE								
1M1A-0	65	1.0	1.8	2.5	3.4		92.8	98.1
1M1A-1	75	1.2	2.0	2.8	2.71		95.1	98.7
2M1A	DO NOT USE 2M1A AS AN AIRMOUNT ISOLATOR							
2M2A	45	0.42	0.68	0.95	3.2		93.3	98.3
SINGLE CONVOLUTION								
16	76	2.0	3.4	5.0	3.9		90.6	97.5
131	89	2.7	4.6	6.6	3.8	74.6	94.7	98.5
160	115	3.7	6	8.3	2.0	90.3	97.7	99.9
110	114	3.1	5.4	7.8	2.6	82.6	96.2	98.9
116	114	4.1	7.2	10.3	2.6	83.1	96.6	98.9
116-1	140	4.5	7.6	10.9	2.3	86.9	97.0	99.1
115	114	5.7	9.4	13.3	2.6	82.6	96.2	98.9
19	127	10.3	17.8	25.4	2.5	85.6	96.8	99.1
19-.75	140	9.1	15.9	23.0	2.5	85.6	96.8	99.1
113	127	15.6	27.1	38.9	2.3	86.9	97.0	99.2
113-1	140	18.5	31.8	45.1	2.2	87.4	97.1	99.2
153-2	150	22.4	39.0	56.6	2.0	90.3	97.7	99.4
119**	127	26.6	45.5	64.6	2.2	90.1	97.3	99.3
121**	127	31.2	55.4	81.6	2.3	87.2	97.1	99.2
126**	127	53.4	89.9	126.8	2.2	87.4	97.1	99.2
138-1.5	152	76.8	131.8	158.7	1.9	91.3	98.0	99.4
148-1	140	159	270	382.1	2.0	91.3	98.0	99.4
DOUBLE CONVOLUTION								
268	140	2.1	3.6	5.1	2.5	83.1	96.3	98.9
267-1.5	165	3.2	5.3	7.5	2.1	90.1	97.3	98.3
224	165	3.5	6.1	8.6	2.1	90.1	97.3	99.3
26	203	3.8	6.6	9.4	1.8	92.1	98.2	99.5
274	216	5.6	9.3	13.1	1.9	91.3	98.0	99.4
20-2	254	6.2	10.9	15.6	1.6	93.9	98.5	99.6
22	241	10.0	17.1	24.2	1.8	92.1	98.2	99.5
22-1.5	268	9.3	16.3	23.3	1.7	92.8	98.3	99.5
21	241	14.7	35.2	36.9	1.7	92.8	98.3	99.5
21-2	267	16.7	39.2	41.1	1.5	95.6	98.8	99.7
233-2	286	16.5	41.4	43.4	1.4	95.2	98.8	99.7
28**	241	22.2	51.6	54.1	1.7	92.8	98.3	99.5
203**	241	34.9	80.6	84.5	1.6	93.9	98.5	99.6
29**	241	47.3	108.0	113.2	1.5	95.6	98.8	99.7
200	241	64.3	147.1	154.3	1.5	95.6	98.8	99.7
215	267	76.6	175.2	183.7	1.4	95.2	98.8	99.7
248-2	279	149.2	343.9	360.7	1.4	95.2	98.8	99.7
TRIPLE CONVOLUTION								
352	343	11.3	20.0	29.1	1.3	95.9	99.0	99.7
313	330	16.0	27.6	39.6	1.4	95.2	98.8	99.7
333	373	15.9	27.8	39.5	1.2	96.8	99.2	99.8
312**	330	24.7	42.7	60.6	1.3	95.9	99.0	99.7
323**	330	35.7	62.0	87.8	1.3	95.9	99.0	99.7
320**	356	50.0	83.9	119.0	1.2	96.8	99.2	99.8
321	381	78.5	132.9	187.9	1.1	97.0	99.3	99.8
348-3	381	152.3	257.6	366.2	1.1	97.0	99.3	99.8
REVERSIBLE SLEEVE								
4004	140	0.7	1.1	1.6	1.6	93.9	98.5	99.6
7002	114	1.5	2.6	3.7	1.6	93.9	98.5	99.6
7010	203	1.4	2.4	3.4	1.1	97.0	99.3	99.8
7012	216	1.7	3.2	4.5	1.6	93.9	98.5	99.6
100/70	185	2.3	3.3	4.5	1.5	95.6	98.8	99.7
1T14C-1	254	5.9	10.1	14.3	1.4	95.2	98.8	99.7
1T14C-3	279	6.0	10.2	14.5	1.2	96.8	99.2	99.8
1T14C-7	343	6.0	10.3	14.7	1.1	97.0	99.3	99.8
1T15T-1	178	10.2	17.3	24.7	2.0	91.3	98.0	99.4
1T15LP-3	305	9.9	16.9	23.8	1.2	96.8	99.2	99.8
1T15L-4	279	12.8	22.0	31.1	1.4	95.2	98.8	99.7
1T15M-0	191	12.9	22.2	31.3	1.6	93.9	98.5	99.6
1T15M-2	241	13.8	23.5	33.3	1.4	95.2	98.8	99.7
1T15M-4	318	13.4	22.6	32.0	1.2	96.8	99.2	99.8
1T15M-6	381	13.2	22.1	31.4	1.1	97.1	99.3	99.8
1T15M-9	470	13.5	22.9	32.1	1.0	97.7	99.4	99.8
1T19L-7	380	16.8	28.4	40.2	1.2	96.8	99.2	99.8
1T19L-11	455	16.2	27.8	39.6	1.0	97.7	99.4	99.8

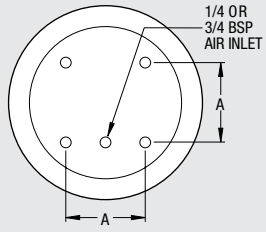
CONSULT FIRESTONE FOR USE AS AN AIRMOUNT†

END CLOSURES

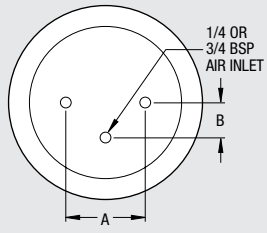
TYPE 1 bead plate



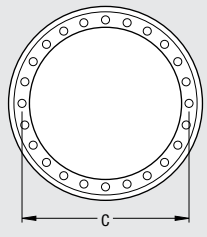
TYPE 2 bead plate



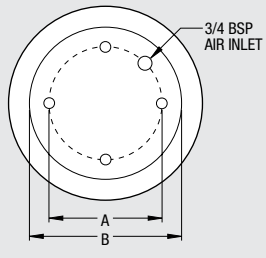
TYPE 3 bead plate



TYPE 4 bead ring



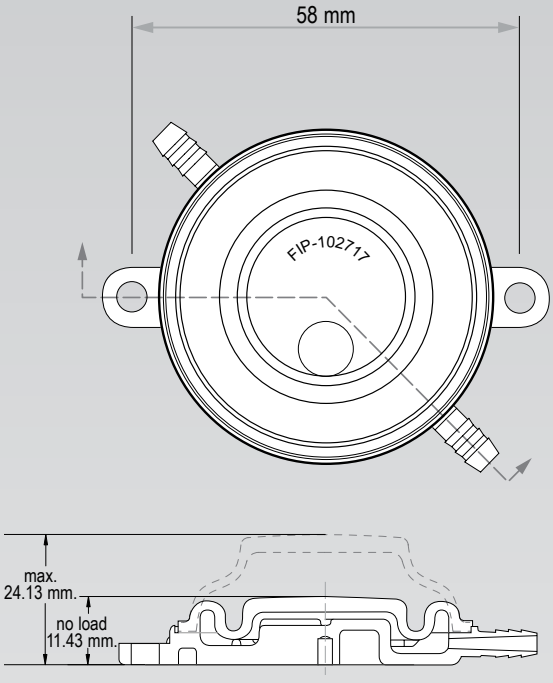
TYPE 5 bead plate

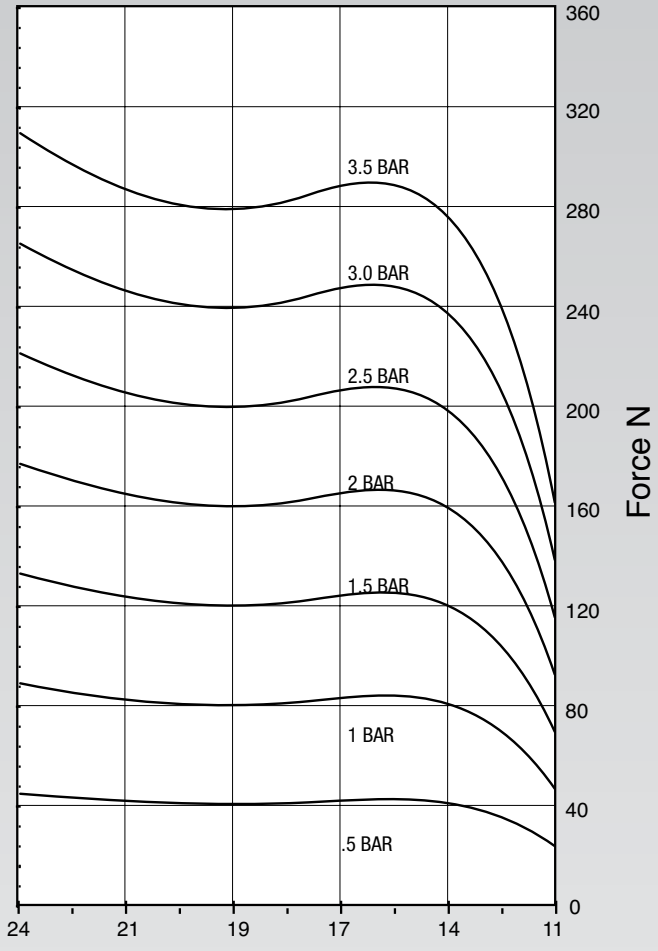


Note: Threads conform to ISO 228-1; gauge to ISO 228-2.

••Airmount isolator air pressures below 3 bar should be reviewed with Firestone.
†Except for 1M1A.

Description	Assembly Order No.
50-P-10	WA1-358-5676





Use #8 or 4mm screws to mount through tabs.

Use .18 [4.6] ID nylon or equivalent tubing.

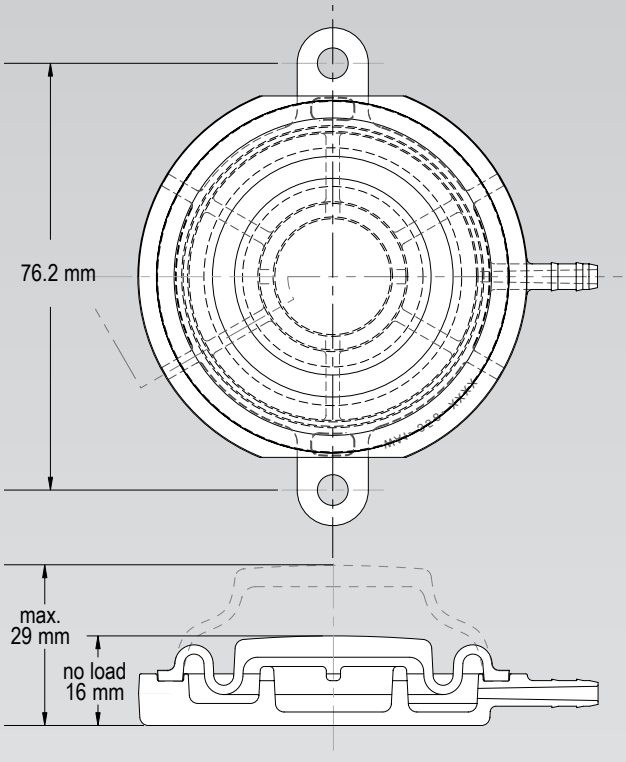
NOTE:

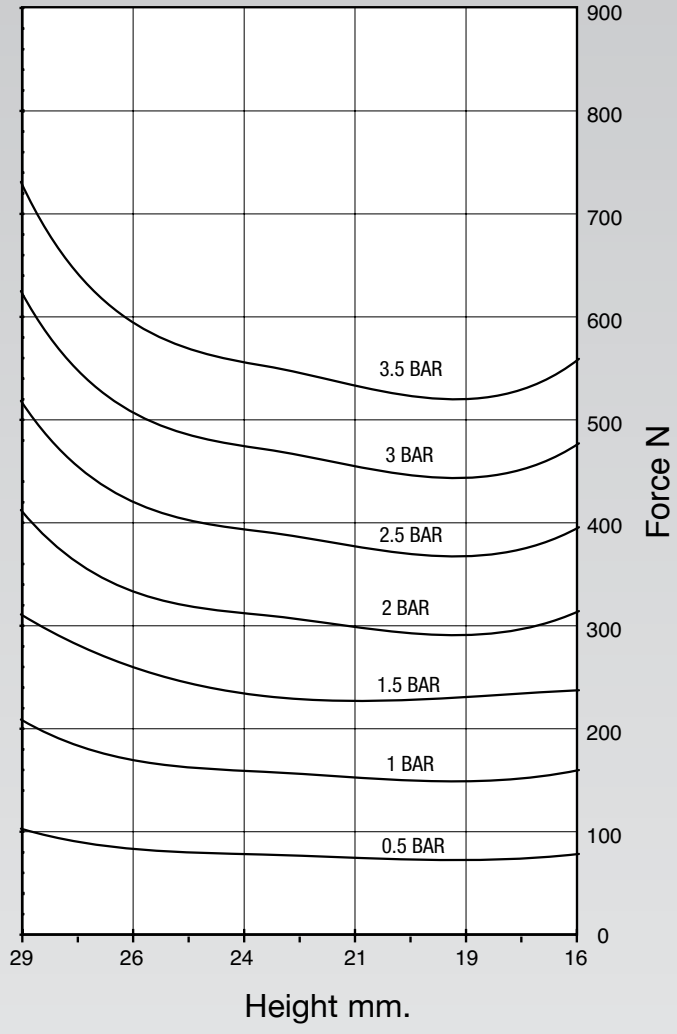
Do not use as an Airmount isolator.

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	kN Force .5 BAR	1 BAR	1.5 BAR	2 BAR	2.5 BAR	3 BAR	3.5 BAR
11		22.6	45.2	67.8	90.4	113.0	135.6	158.2
14		40.6	81.1	121.7	162.2	202.8	243.3	283.9
17		39.4	78.8	118.1	157.5	196.9	236.3	275.5
19		40.4	80.8	121.1	161.6	202.0	242.4	282.8
21		39.1	78.1	117.2	156.2	195.3	234.3	273.4
24		43.9	87.7	131.6	175.5	219.3	263.2	307.1

Description	Assembly Order No.
70-P-13	WA1-358-5674





Use #8 or 4mm screws to mount through tabs.

Use .18 [4.6] ID nylon or equivalent tubing.

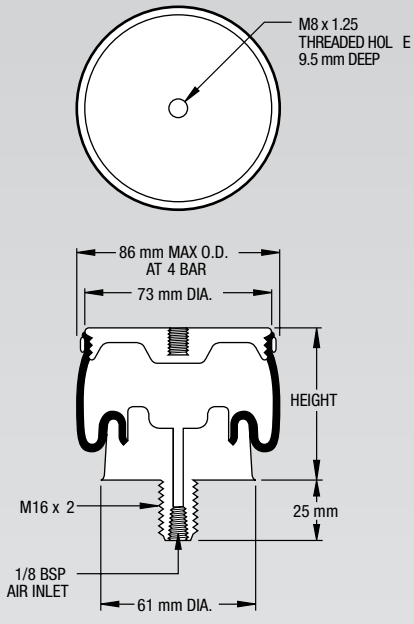
NOTE:

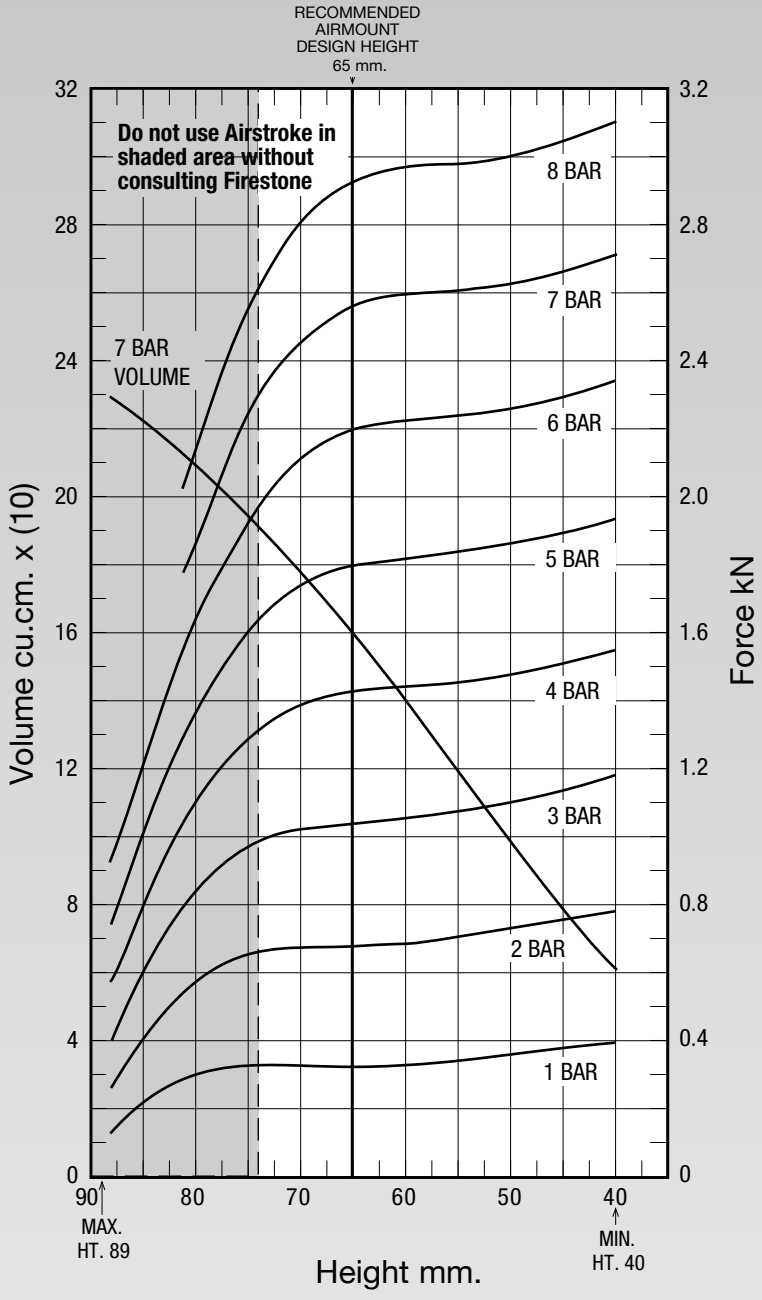
Do not use as an Airmount isolator.

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	kN Force .5 BAR	1 BAR	1.5 BAR	2 BAR	2.5 BAR	3 BAR	3.5 BAR
16		78.4	156.9	235.4	313.8	392.3	470.8	549.2
19		74.2	148.4	222.6	296.9	371.1	445.3	519.6
21		75.3	150.6	225.9	301.2	376.5	451.8	527.1
24		78.5	157.0	235.6	314.1	392.6	471.2	549.7
26		82.8	165.6	248.5	331.3	414.1	497.0	579.8
29		102.2	204.4	306.6	408.8	511.0	613.2	715.4

	Description	Assembly Order No.
Style 1M1A-0 Two Ply Bellows	Blind nuts, 1/8 BSP, Plastic stud	W02-M58-3000
	Blind nuts, 1/8 BSP, Brass stud	W02-M58-3001
Assembly weight ..... .23 kg.		
Force to collapse to minimum height (@ 0 BAR) ..... 89 N.		





See page 12 for instructions on how to use chart.

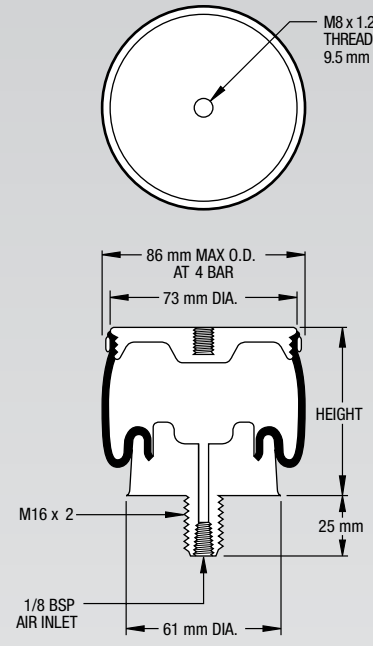
Dynamic Characteristics at 65 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	1.04	53	3.58
4	1.42	70	3.49
5	1.79	86	3.45
6	2.19	103	3.42
7	2.55	118	3.40

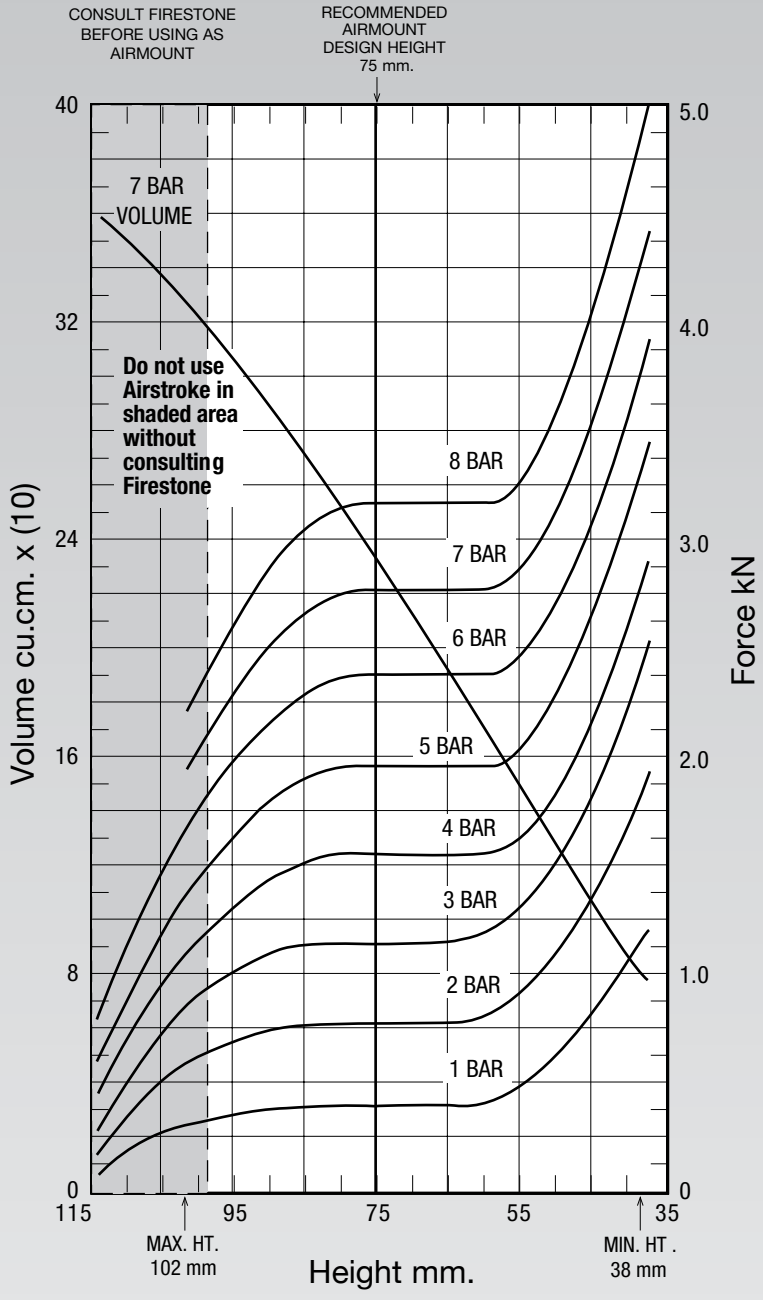
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
70	180	35	1.02	1.38	1.72	2.09	2.42
65	161	36	1.04	1.42	1.79	2.19	2.55
60	144	37	1.05	1.44	1.82	2.22	2.59
55	123	37	1.07	1.45	1.83	2.23	2.60
50	103	37	1.10	1.47	1.85	2.25	2.62
45	81	38	1.13	1.50	1.89	2.29	2.65
40	64	39	1.17	1.54	1.93	2.33	2.70

	Description	Assembly Order No.
Style 1M1A-1 Two Ply Bellows	Blind nuts, 1/8 BSP, Plastic stud	W02-M58-3006
Assembly weight ..... .23 kg.		
Force to collapse to minimum height (@ 0 BAR) ..... 89 N.		



NOTE: The dotted line on the static data chart shows the force capabilities of the 1M1A-1 when attaching an additional 12 mm pedestal, provided by the customer, to the base of the air spring. If an additional pedestal is not used, the air spring will behave as the solid line depicts. Without a pedestal the rubber part will contact the ground at the height of 53 mm and could cause the rubber part to wear prematurely.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 75 mm Design Height
(Required for Airmount isolator design only)

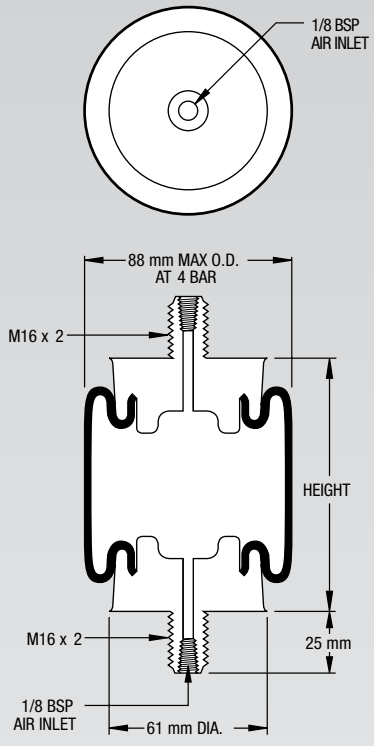
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	1.16	38.66	2.88
4	1.57	49.85	2.81
5	1.97	60.30	2.76
6	2.39	71.66	2.73
7	2.78	81.97	2.71

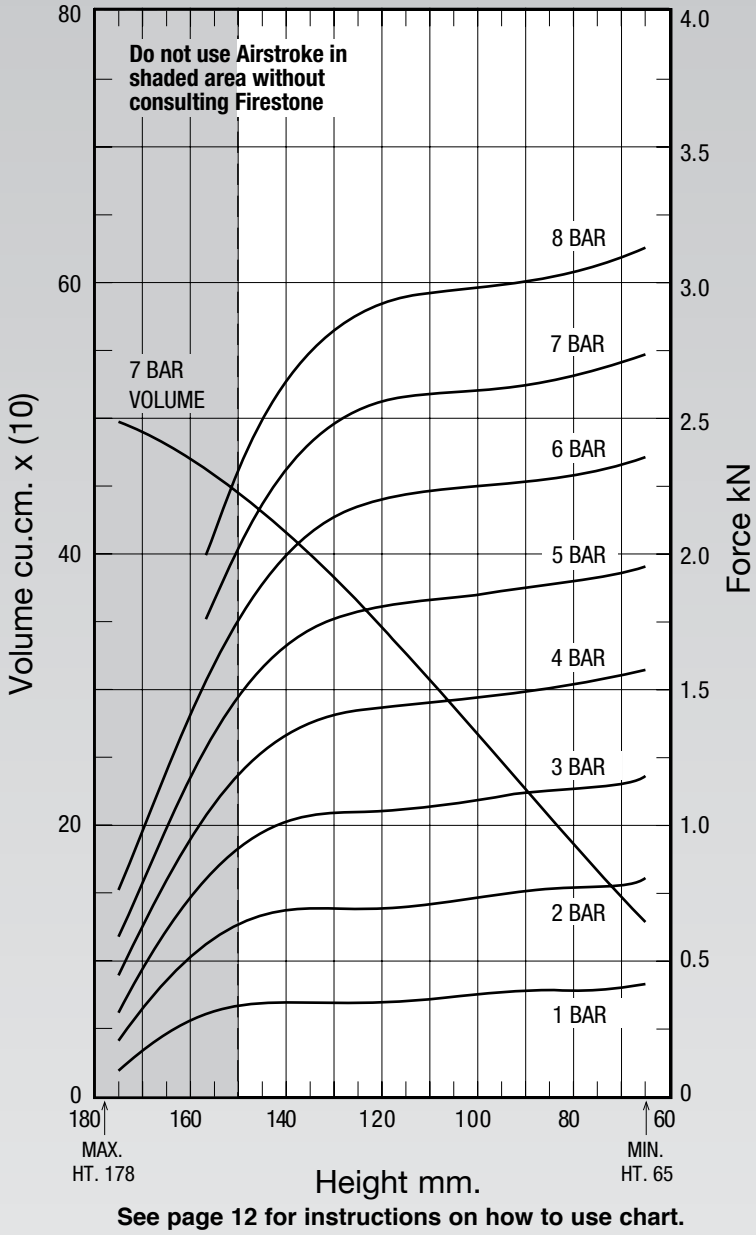
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
85	272	38.07	1.14	1.52	1.95	2.30	2.66
75	235	39.67	1.16	1.57	1.97	2.39	2.78
65	194	39.67	1.16	1.57	1.97	2.39	2.78
55	152	40.83	1.31	1.63	2.04	2.46	2.86
45	110	50.25	1.79	2.17	2.63	3.06	3.52

AIRSTROKE ACTUATOR ONLY

	Description	Assembly Order No.
Style 2M1A Two Ply Bellows	1/8 BSP, each end	W02-M58-3002
Assembly weight ..... .27 kg.		
Force to collapse to minimum height (@ 0 BAR).. 133.5 N.		





See page 12 for instructions on how to use chart.

NOTE: This Airstroke actuator must be guided throughout the stroke.

NOTE: Do not use as an Airmount isolator.

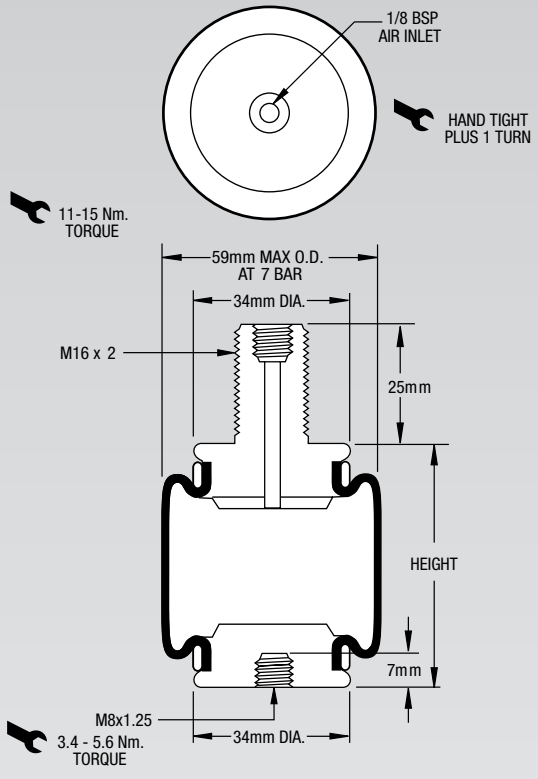
NOTE: Plug off one end. (This part is single acting)

NOTE:
Do not use as an Airmount isolator

Force Table (Use for Airstroke™ actuator design)

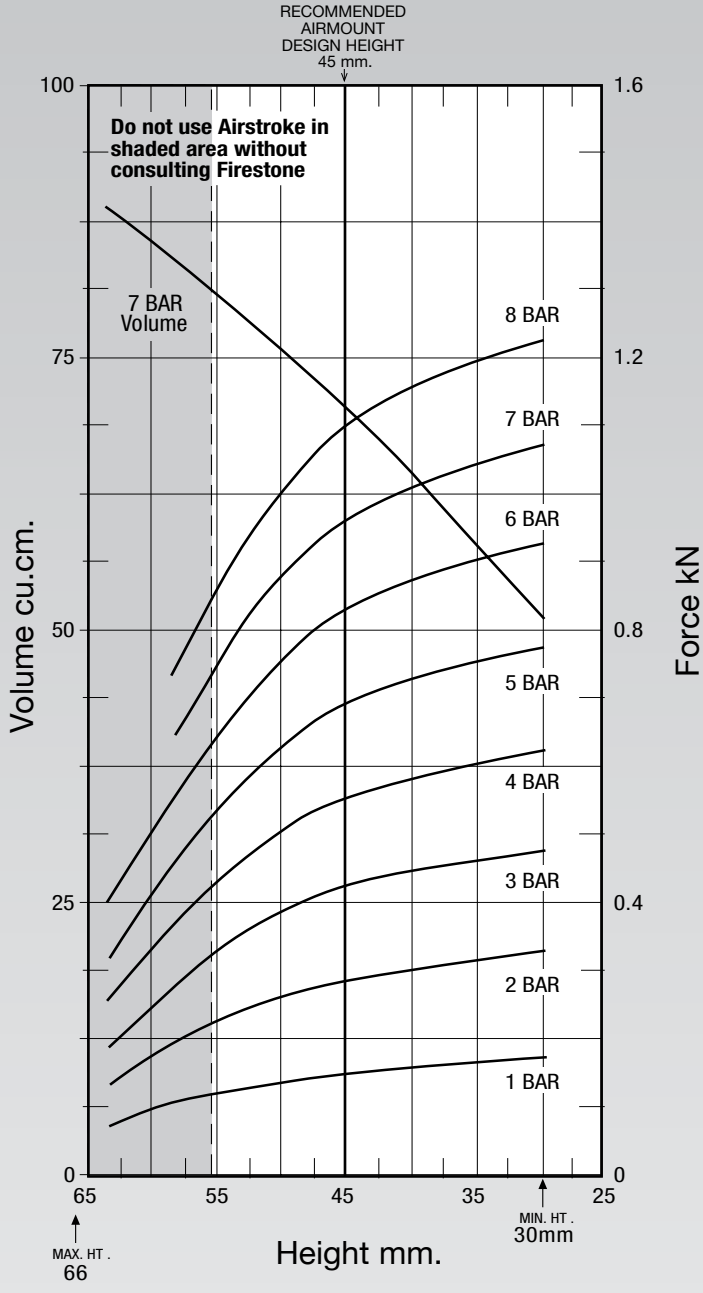
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
140	413	33	1.01	1.33	1.65	1.98	2.29
130	379	35	1.04	1.41	1.76	2.13	2.47
120	344	37	1.05	1.44	1.81	2.20	2.56
110	306	37	1.07	1.45	1.83	2.23	2.60
100	268	37	1.09	1.48	1.85	2.25	2.61
90	227	38	1.12	1.50	1.87	2.27	2.63
80	189	38	1.13	1.52	1.90	2.30	2.66
70	150	39	1.15	1.54	1.93	2.33	2.71

	Description	Assembly Order No.
Style 2M2A Two Ply Bellows	Blind Nut, 1/8 BSP, plastic studs	W02-M58-3019
Assembly weight ..... 0.07 kg.		
Force to collapse to minimum height (@ 0 BAR)..... 22 N.		



NOTE: This Airstroke actuator must be guided throughout the stroke.

NOTE: The 2M2A must be supported laterally when used as an isolator. Contact Firestone for use in isolation applications.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 45 mm Design Height
(Required for Airmount isolator design only)

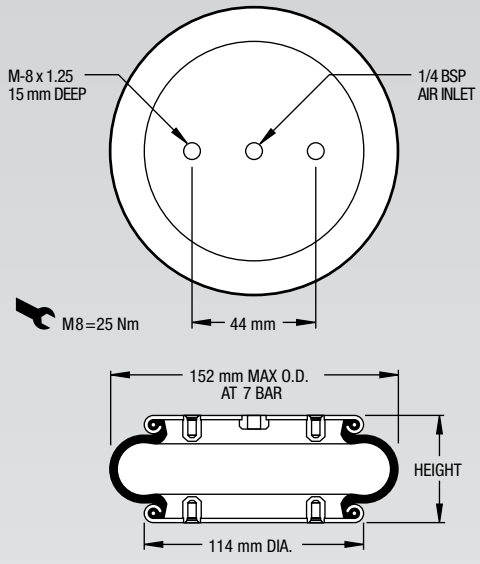
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	0.42	18	3.27
4	0.55	23	3.23
5	0.68	29	3.25
6	0.82	34	3.22
7	0.95	39	3.20

Force Table (Use for Airstroke™ actuator design)

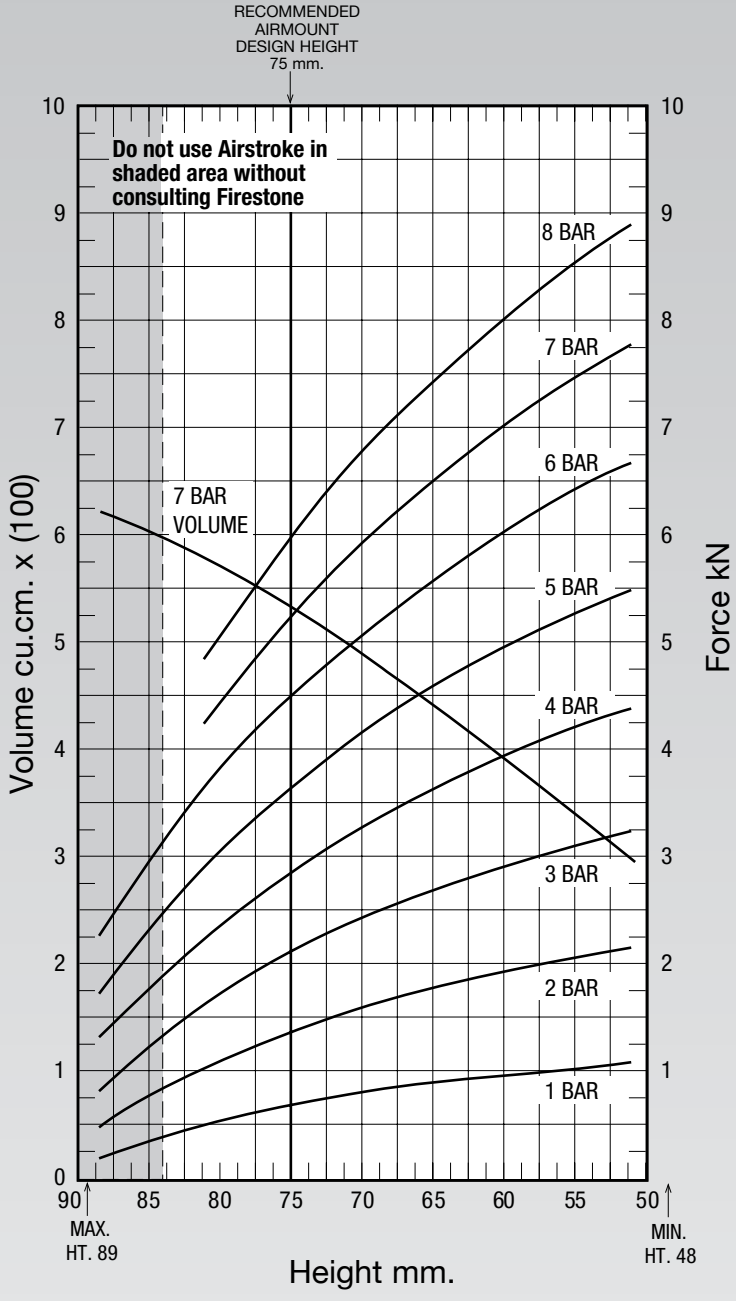
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
55	80.30	10.4	0.32	0.41	0.52	0.62	0.73
45	70.46	13.6	0.42	0.55	0.68	0.82	0.95
35	58.99	14.8	0.45	0.60	0.75	0.90	1.04
25	40.56	15.6	0.49	0.64	0.79	0.94	1.09

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 16 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6140
	Socket head aluminum bead rings (bolts, nuts, washers not included–use M6 cap screws)	W01-358-0017
	Rubber bellows only	W01-358-0010
Assembly weight.....1.13 kg.		
Force to collapse to minimum height (@ 0 BAR) 133 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 75 mm Design Height
(Required for Airmount isolator design only)

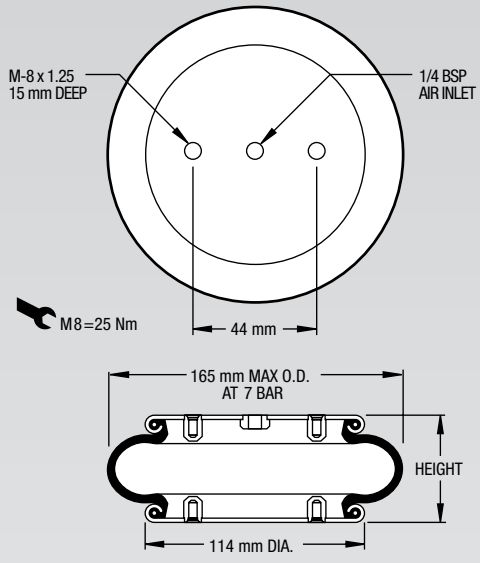
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	2.04	140	4.13
4	2.76	177	3.99
5	3.52	217	3.91
6	4.36	256	3.82
7	5.10	293	3.78

Force Table (Use for Airstroke™ actuator design)

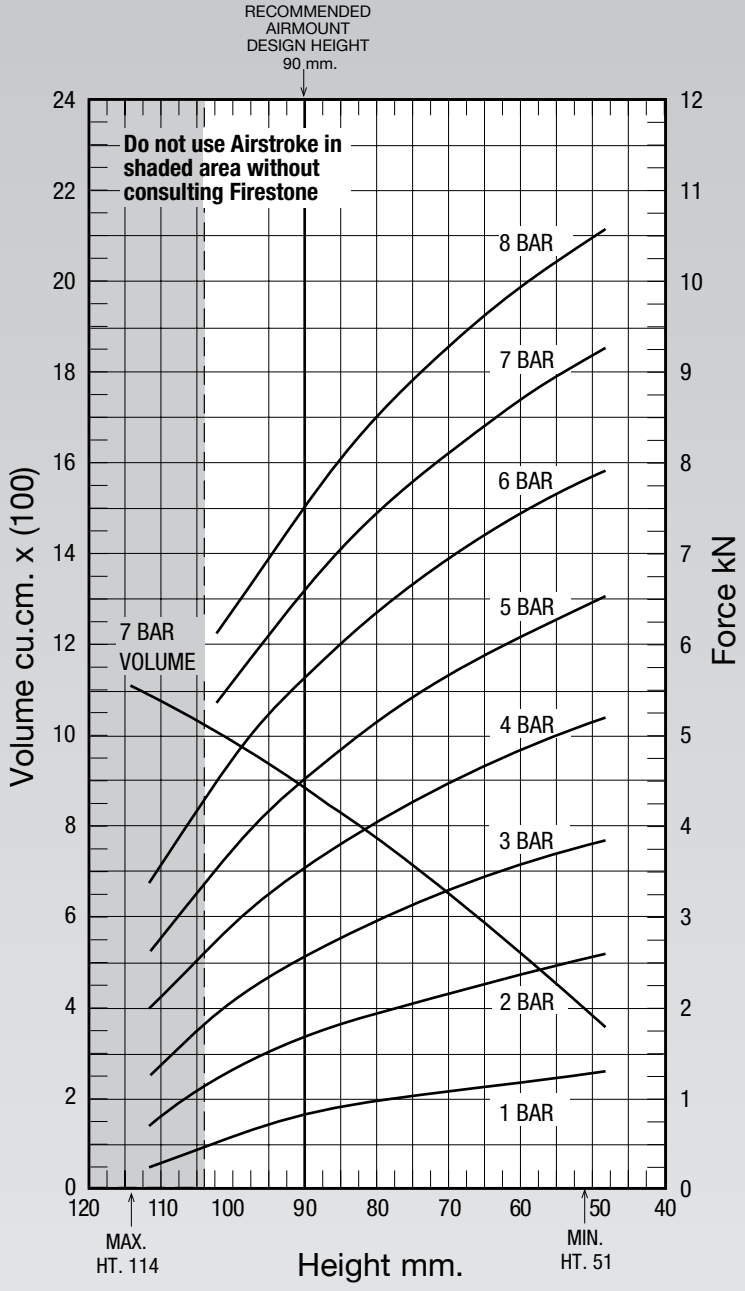
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
80	575	61	1.61	2.25	2.89	3.62	4.26
70	492	83	2.37	3.20	4.06	4.98	5.81
60	390	99	2.85	3.88	4.89	5.95	6.93

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 131 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6155
	Socket head aluminum bead rings (bolts, nuts, washers not included–use M6 cap screws)	W01-358-0127
	Rubber bellows only	W01-358-0131
Assembly weight.....1.2 kg.		
Force to collapse to minimum height (@ 0 BAR) 142 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 90 mm Design Height
(Required for Airmount isolator design only)

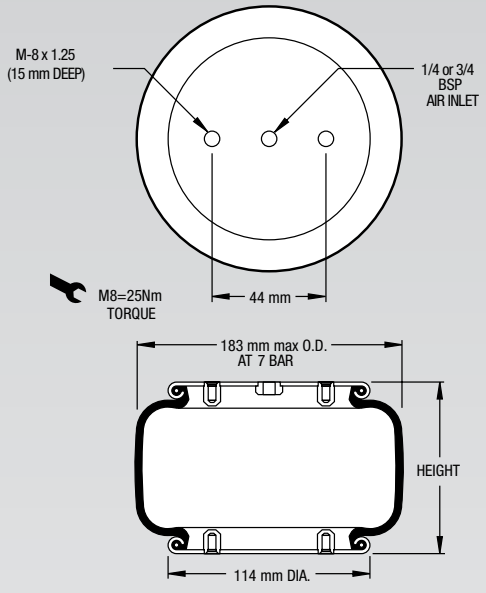
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	2.50	103	3.20
4	3.51	133	3.07
5	4.48	162	3.00
6	5.57	193	2.93
7	6.54	221	2.90

Force Table (Use for Airstroke™ actuator design)

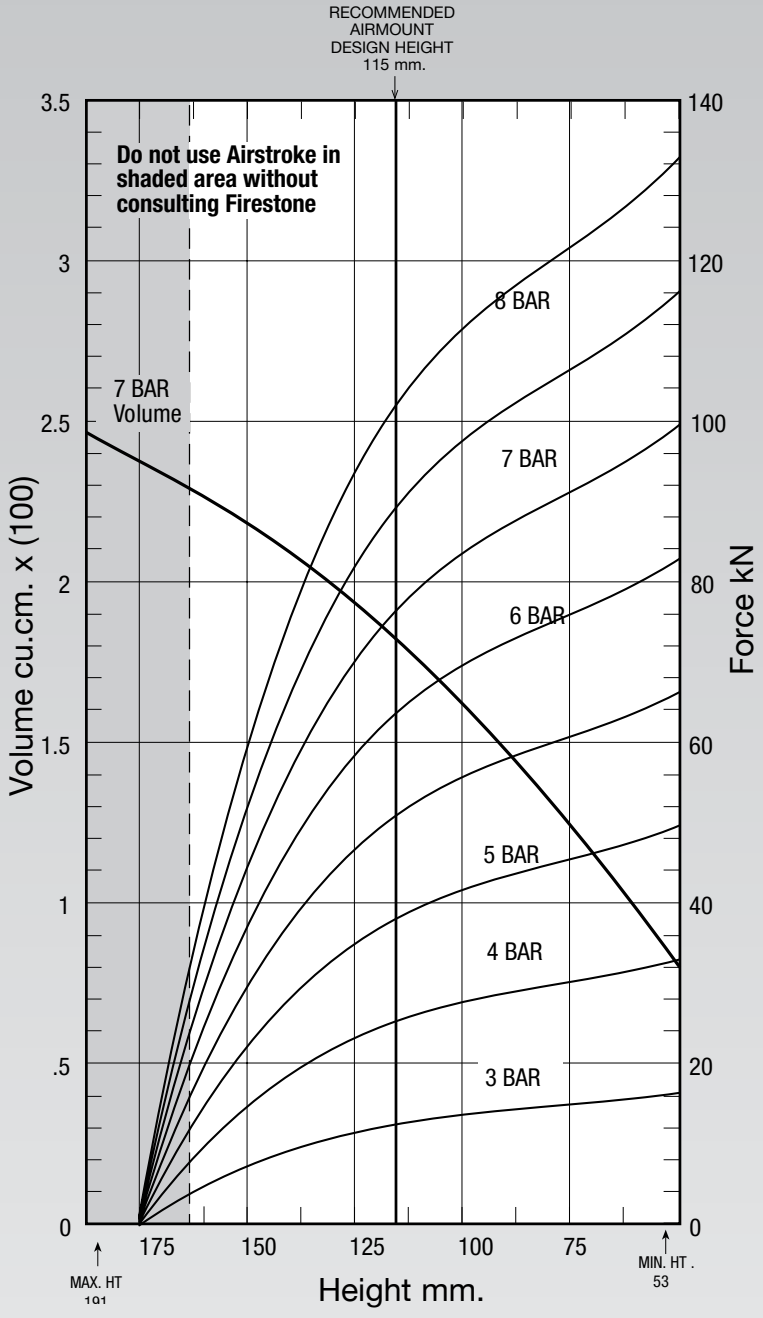
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
100	982	78	1.96	2.83	3.65	4.63	5.48
90	880	93	2.50	3.51	4.48	5.57	6.54
80	774	105	2.90	4.01	5.10	6.30	7.38
70	652	115	3.23	4.44	5.61	6.91	8.08
60	529	124	3.51	4.79	6.05	7.41	8.65

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 160 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-7751
	Socket head aluminum bead rings (bolts, nuts, washers not included–use M6 cap screws)	W01-358-7592
	Blind nuts, 3/4 NPT	W01-358-7752
Assembly weight.....1.36 kg.		
Force to collapse to minimum height (@ 0 BAR) 623 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 115 mm Design Height
(Required for Airmount isolator design only)

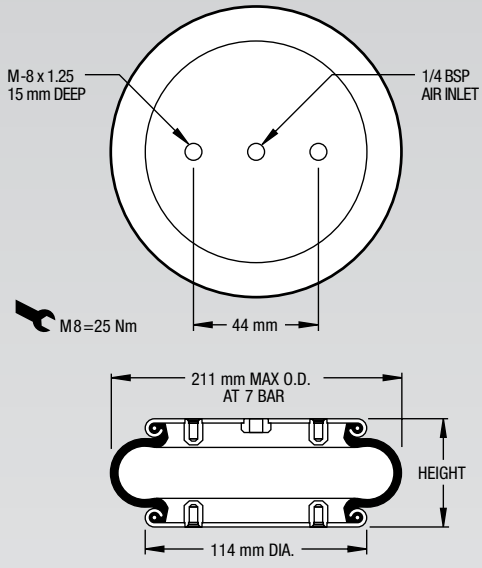
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
4	4.8	57.26	2.22
5	6.0	81.25	2.12
6	7.1	105.25	2.07
7	8.3	129	2.02

Force Table (Use for Airstroke™ actuator design)

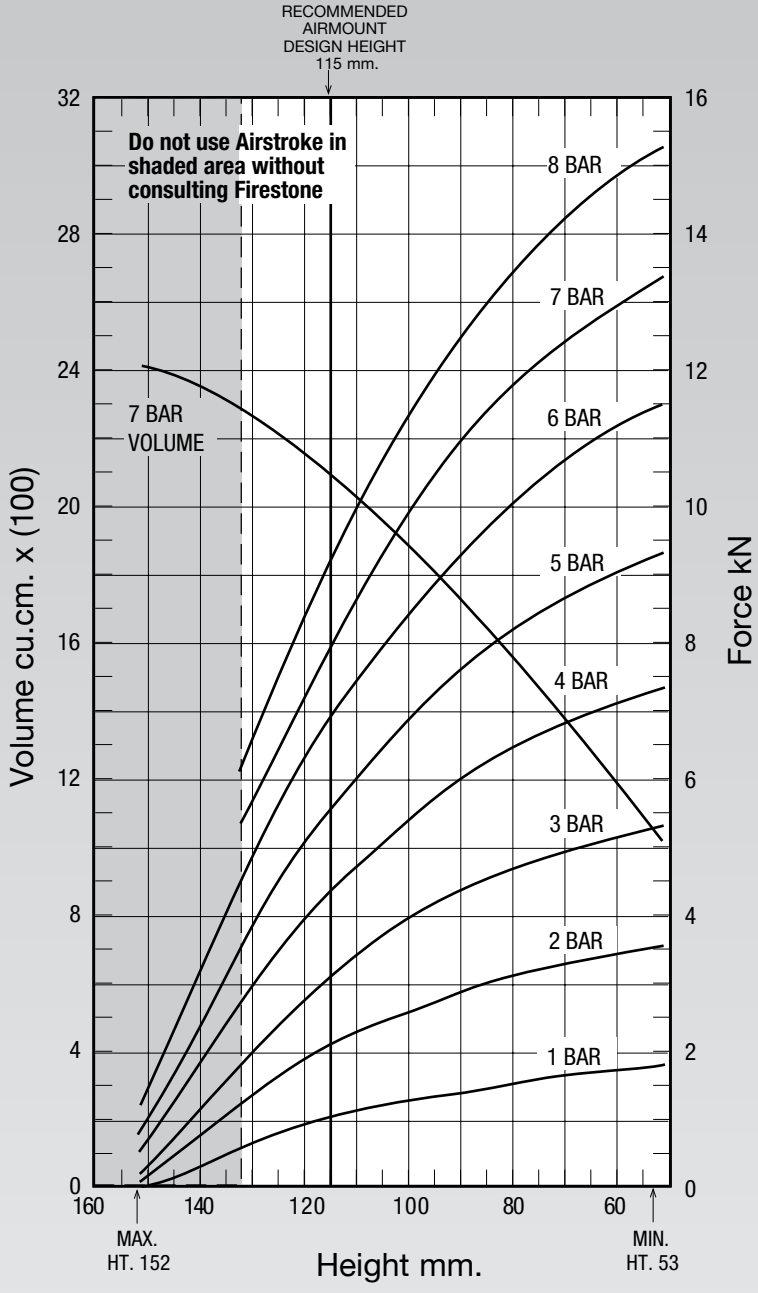
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	2268	80	2.03	2.90	3.75	4.74	5.58
120	2167	103	2.76	3.86	4.95	6.14	7.18
110	2037	123	3.41	4.68	5.96	7.36	8.61
100	1898	140	3.92	5.34	6.78	8.36	9.78
90	1733	154	4.33	5.92	7.49	9.23	10.80
80	1568	166	4.64	6.39	8.08	9.94	11.62
70	1379	176	4.89	6.77	8.58	10.55	12.30
60	1198	184	5.09	7.05	8.97	11.03	12.85

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 110 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6145
	Socket head aluminum bead rings (bolts, nuts, washers not included–use M6 cap screws)	W01-358-0112
	Rubber bellows only	W01-358-0100
Assembly weight.....1.36 kg.		
Force to collapse to minimum height (@ 0 BAR) 36 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 115 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	3.10	99	2.82
4	4.29	127	2.72
5	5.48	157	2.67
6	6.78	189	2.63
7	7.92	218	2.62

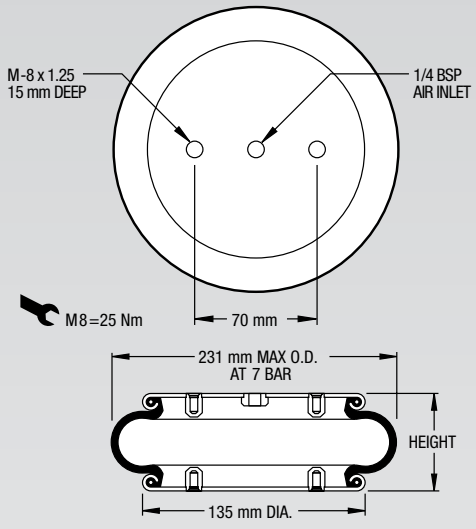
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	2268	80	2.03	2.90	3.75	4.74	5.58
120	2167	103	2.76	3.86	4.95	6.14	7.18
110	2037	123	3.41	4.68	5.96	7.36	8.61
100	1898	140	3.92	5.34	6.78	8.36	9.78
90	1733	154	4.33	5.92	7.49	9.23	10.80
80	1568	166	4.64	6.39	8.08	9.94	11.62
70	1379	176	4.89	6.77	8.58	10.55	12.30
60	1198	184	5.09	7.05	8.97	11.03	12.85

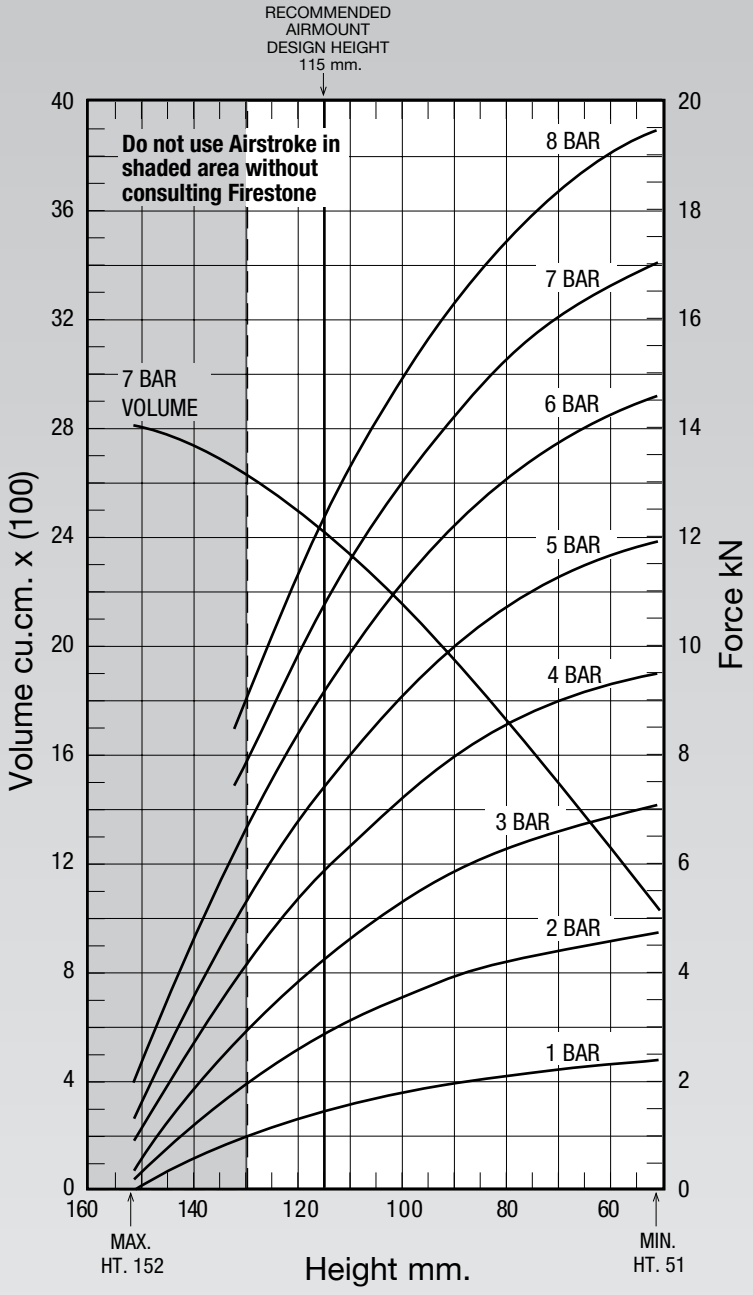
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 116 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6166
	Blind nuts, 3/4 BSP	W01-M58-6165
	Countersunk steel bead rings, 40 mm bolts, nuts & washers	W01-358-7568
	Rubber bellows only	W01-358-0133
Assembly weight.....1.95 kg.		
Force to collapse to minimum height (@ 0 BAR) 36 N.		

Style 117 High Strength Con-struction	Blind nuts, 1/4 BSP	W01-M58-6176
	Blind nuts, 3/4 BSP	W01-M58-6175
	Countersunk steel bead rings, 40 mm bolts, nuts & washers	W01-358-7606



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 115 mm Design Height
(Required for Airmount isolator design only)

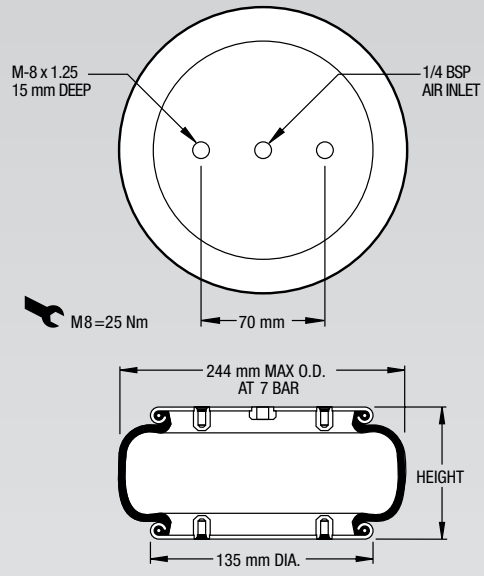
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	4.16	132	2.80
4	5.73	169	2.71
5	7.26	207	2.67
6	8.98	247	2.62
7	10.55	285	2.59

Force Table (Use for Airstroke™ actuator design)

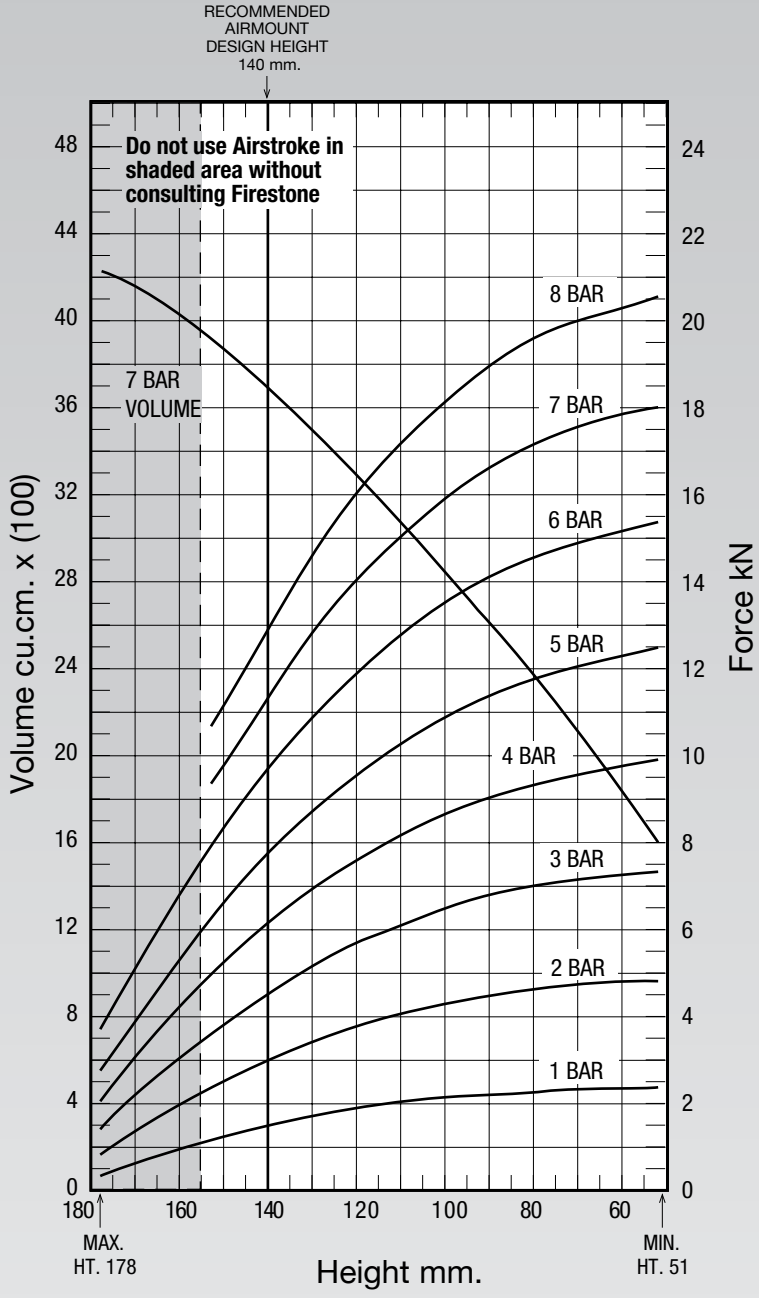
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	2635	110	2.86	4.04	5.17	6.51	7.71
120	2506	138	3.75	5.20	6.60	8.20	9.65
110	2341	163	4.54	6.22	7.86	9.70	11.38
100	2164	183	5.20	7.07	8.92	10.95	12.82
90	1956	201	5.75	7.84	9.84	12.04	14.07
80	1745	215	6.19	8.45	10.59	12.91	15.08
70	1509	228	6.54	8.91	11.18	13.64	15.92
60	1280	236	6.82	9.20	11.58	14.17	16.55

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 116-1 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6170
Assembly weight.....2.04 kg.		
Force to collapse to minimum height (@ 0 BAR) 165 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

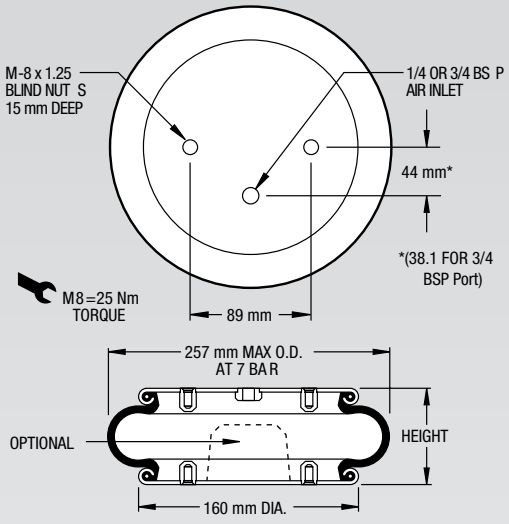
Dynamic Characteristics at 140 mm Design Height (Required for Airmount isolator design only)			
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	4.45	108	2.46
4	5.94	138	2.41
5	7.52	170	2.37
6	9.42	205	2.33
7	11.18	237	2.30

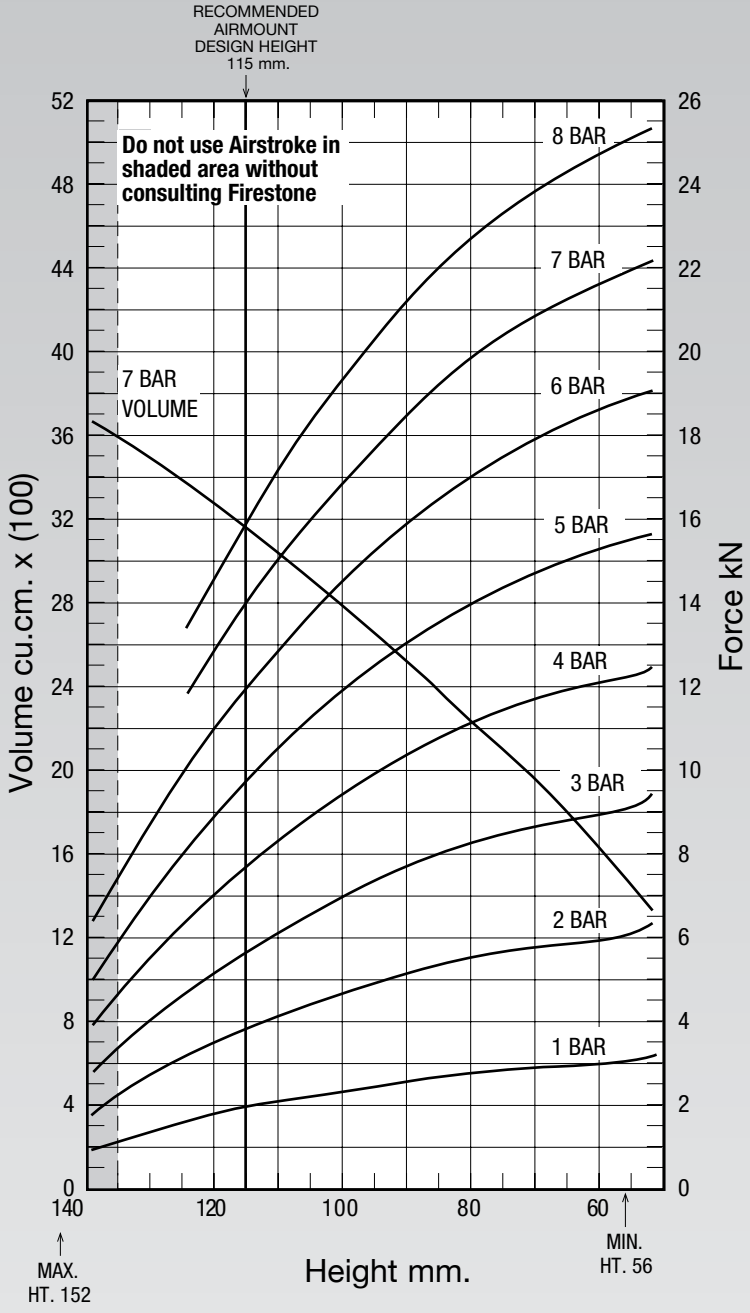
Force Table (Use for Airstroke™ actuator design)							
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm**2)	kN Force				
			@ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
140	3678	160	4.45	5.94	7.52	9.42	11.18
130	3491	180	5.08	6.77	8.55	10.66	12.61
120	3301	197	5.61	7.47	9.42	11.71	13.82
110	3085	213	6.07	8.06	10.18	12.63	14.89
100	2869	225	6.44	8.54	10.79	13.38	15.75
90	2628	236	6.76	8.94	11.31	14.02	16.49
80	2391	244	7.00	9.25	11.72	14.51	17.05
70	2130	250	7.19	9.51	12.05	14.91	17.50

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 115 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6375
	Blind nuts, 1/4 BSP rubber bumper	W01-M58-6376
	Blind nuts, 3/4 BSP	W01-M58-6374
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-6977
	Rubber bellows only	W01-358-0118
Assembly weight.....2.49 kg.		
Force to collapse to minimum height (@ 0 BAR) 36 N.		

Style 124 High Strength Con-struction	Blind nuts, 1/4 BSP	W01-M58-6181
	Blind nuts, 3/4 BSP	W01-M58-6182





See page 12 for instructions on how to use chart.

NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.

Dynamic Characteristics at 115mm Design Height
(Required for Airmount isolator design only)

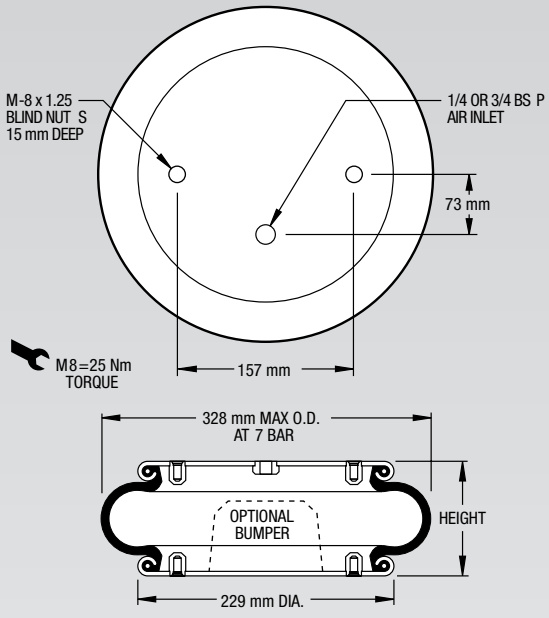
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	5.64	175	2.78
4	7.63	229	2.73
5	9.62	282	2.70
6	11.81	336	2.66
7	13.81	385	2.63

Force Table (Use for Airstroke™ actuator design)

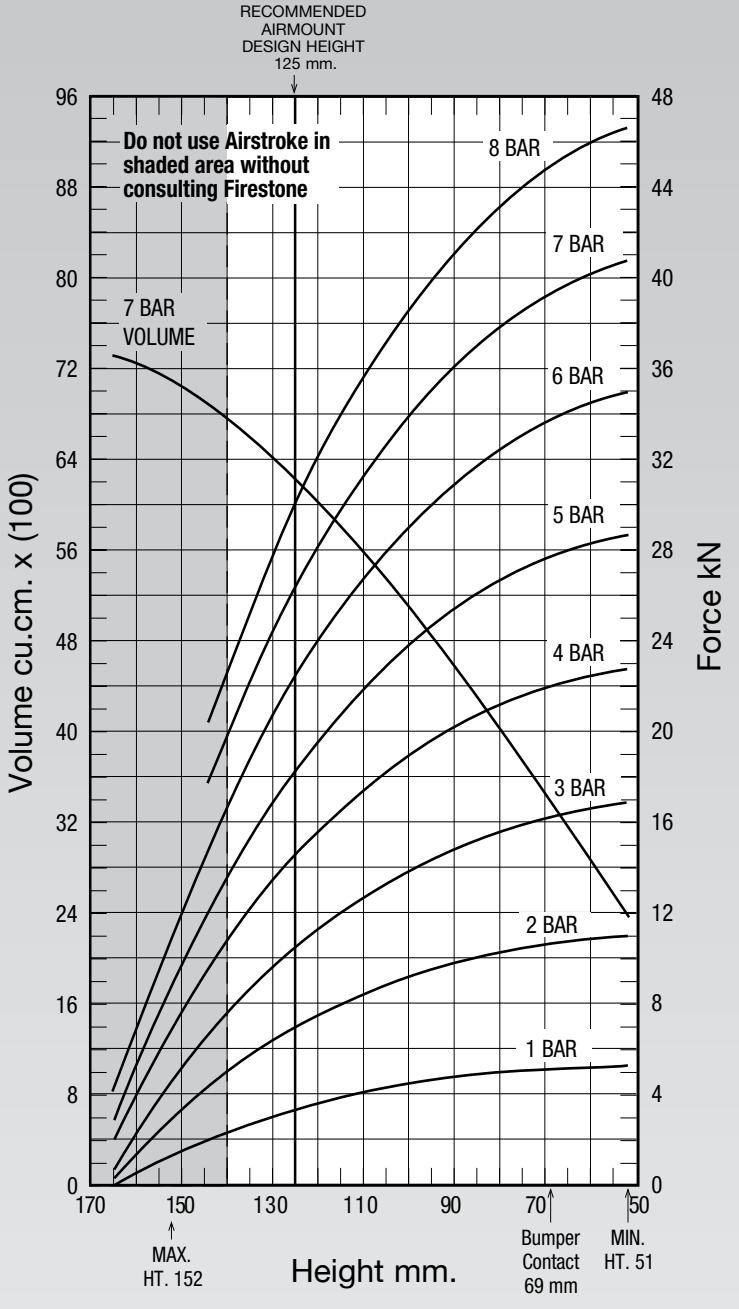
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	3467	144	3.95	5.37	6.81	8.51	10.05
120	3265	180	5.13	6.93	8.75	10.78	12.63
110	3030	213	6.11	8.25	10.40	12.74	14.88
100	2794	239	6.92	9.33	11.74	14.34	16.73
90	2525	263	7.66	10.30	12.93	15.75	18.37
80	2256	282	8.24	11.08	13.89	16.91	19.70
70	1951	297	8.62	11.65	14.64	17.82	20.76
60	1650	307	8.88	12.01	15.14	18.46	21.49

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 19 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6008
	Blind nuts, 1/4 BSP, bumper	W01-M58-6373
	Blind nuts, 3/4 BSP	W01-M58-6011
	Blind nuts, 3/4 BSP, bumper	W01-M58-6372
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-6975
	Rubber bellows only	W01-358-0134
Assembly weight (bead plate version, no bumper) 4.45 kg.		
Force to collapse to minimum height (@ 0 BAR) 40 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 125 mm Design Height
(Required for Airmount isolator design only)

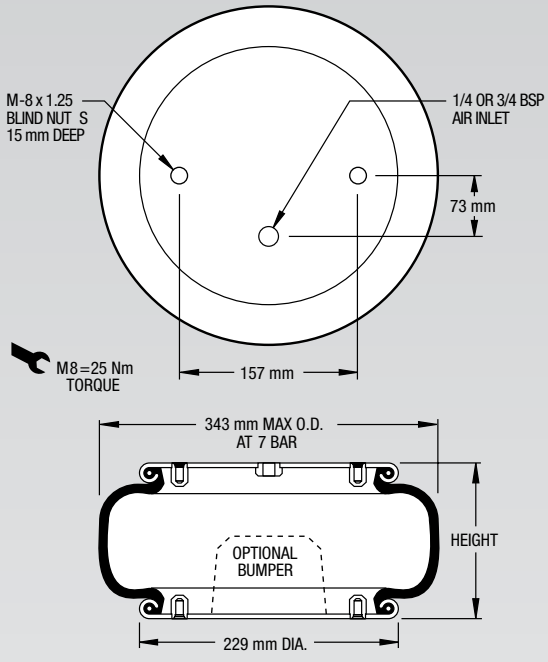
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	10.49	290	2.62
4	14.46	383	2.57
5	18.21	471	2.54
6	22.34	559	2.49
7	26.15	641	2.47

Force Table (Use for Airstroke™ actuator design)

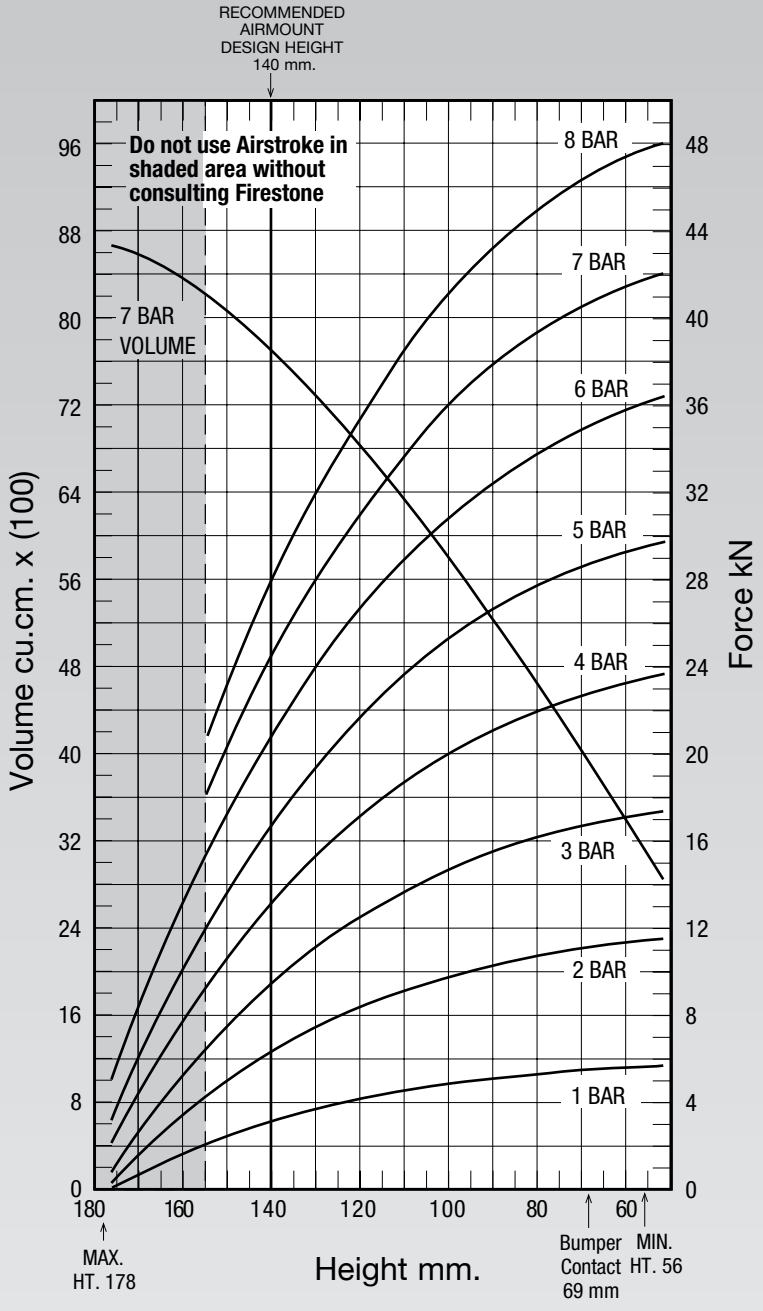
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	6379	345	9.61	13.28	16.74	20.60	24.15
120	6004	398	11.24	15.49	19.48	23.85	27.87
110	5555	444	12.67	17.39	21.84	26.65	31.10
100	5093	482	13.85	18.90	23.74	28.92	33.71
90	4566	513	14.87	20.18	25.35	30.86	35.94
80	4048	539	15.67	21.16	26.59	32.38	37.69
70	3474	559	16.27	21.93	27.58	33.60	39.13
60	2923	574	16.68	22.48	28.26	34.45	40.15

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 19-.75 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6040
Assembly weight (bead plate version, no bumper)		4.53 kg.
Force to collapse to minimum height (@ 0 BAR)		67 N.



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 140 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	9.30	272	2.70
4	12.89	356	2.62
5	16.44	435	2.57
6	20.49	514	2.50
7	24.11	589	2.46

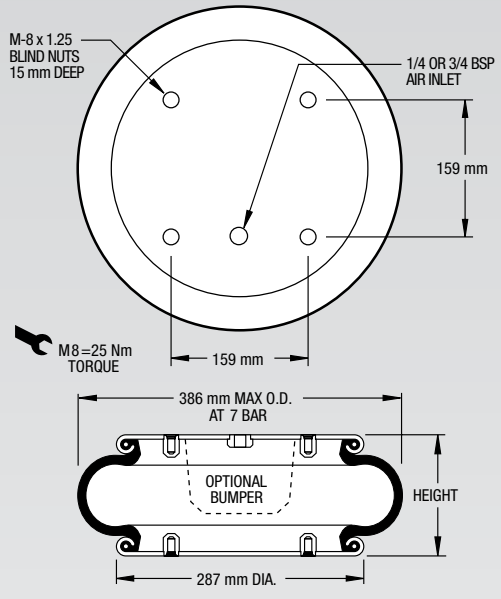
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
140	7705	345	9.30	12.89	16.44	20.49	24.11
130	7286	397	11.01	15.15	19.21	23.73	27.81
120	6846	441	12.41	17.00	21.52	26.44	30.89
110	6335	480	13.64	18.63	23.55	28.84	33.62
100	5822	512	14.65	19.94	25.19	30.79	35.86
90	5243	540	15.50	21.06	26.57	32.45	37.80
80	4681	562	16.18	21.93	27.65	33.77	39.34
70	4063	580	16.73	22.65	28.54	34.84	40.60

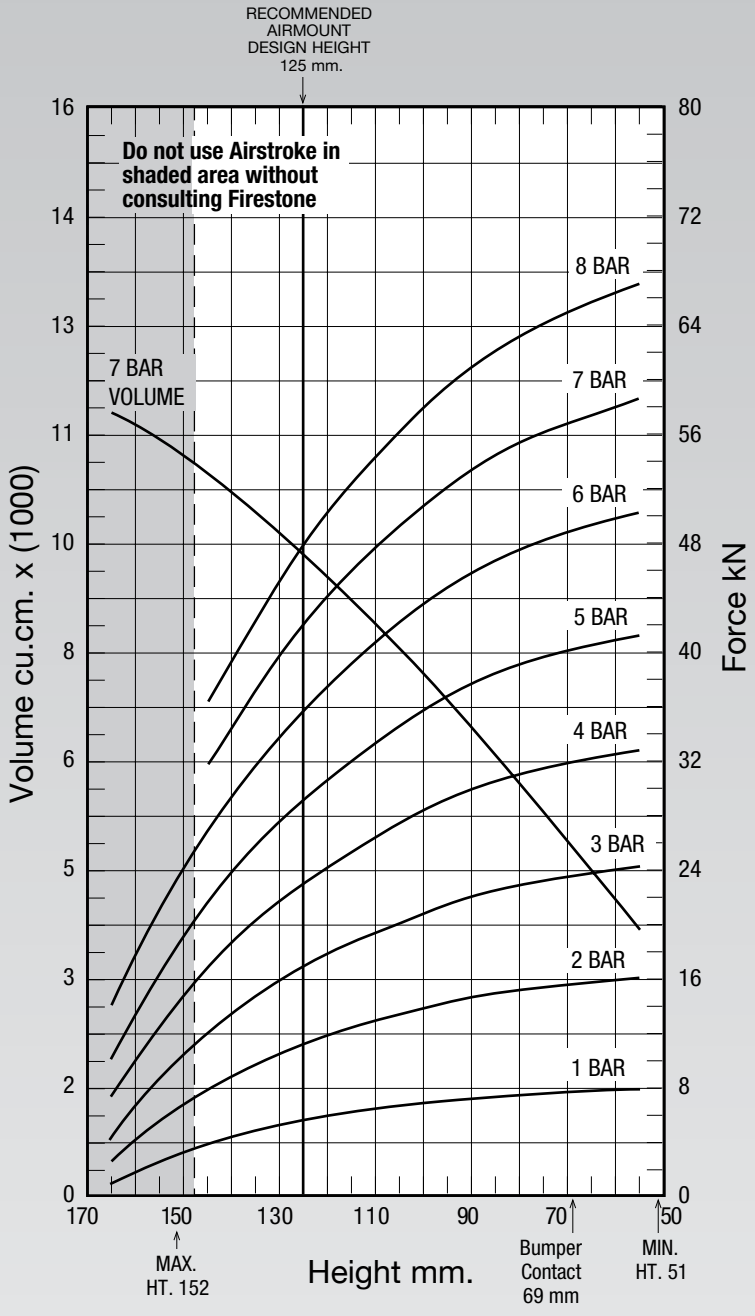
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 113 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6101
	Blind nuts, 1/4 BSP, bumper	W01-M58-6103
	Blind nuts, 3/4 BSP	W01-M58-6100
	Blind nuts, 3/4 BSP, bumper	W01-M58-6102
	Countersunk steel bead rings, 40 mm bolts, nuts washers	W01-M58-7538
	Rubber bellows only	W01-358-0135
Assembly weight.....6.58 kg.		
Force to collapse to minimum height (@ 0 BAR) 76 N.		

Style 128 High Strength Con-struction	Blind nuts, 1/4 BSP	W01-M58-6071
	Blind nuts, 3/4 BSP	W01-M58-6070
	Rubber bellows only	W01-358-0231



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 125 mm Design Height
(Required for Airmount isolator design only)

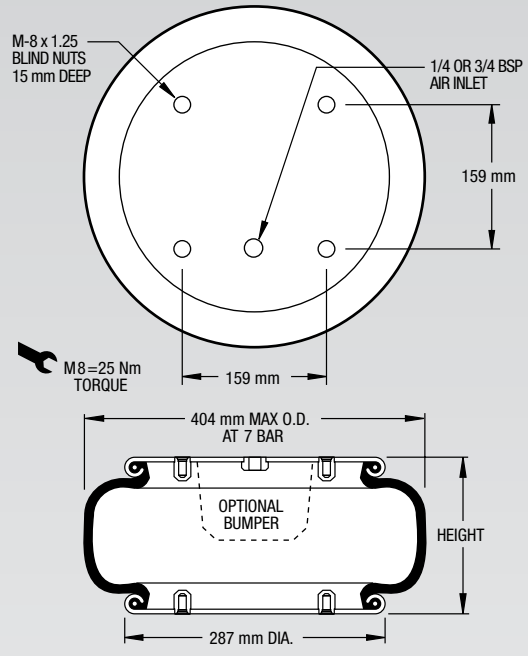
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	16.72	416	2.49
4	22.90	534	2.41
5	28.97	651	2.36
6	35.62	774	2.32
7	41.65	890	2.31

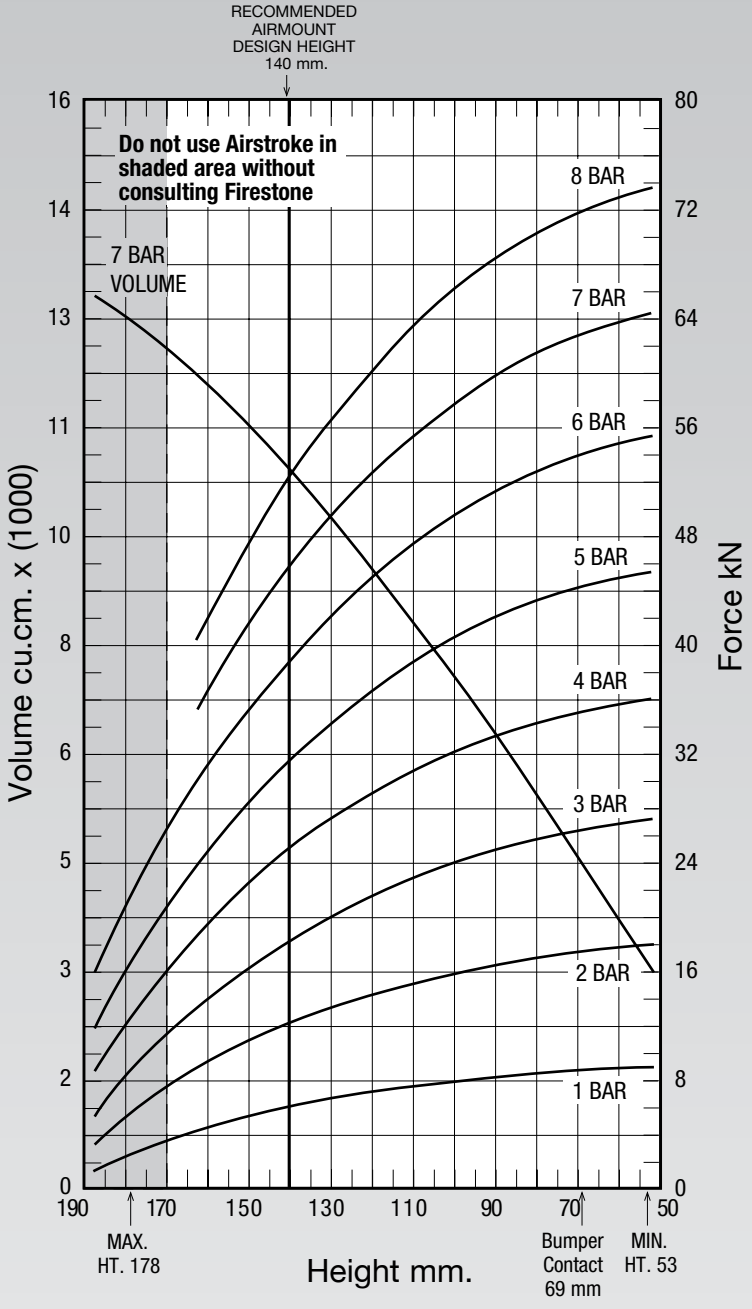
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq.)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
140	10316	486	13.02	18.16	23.20	28.93	34.00
130	9720	562	15.62	21.49	27.24	33.59	39.30
120	9110	624	17.66	24.10	30.44	37.37	43.68
110	8411	679	19.40	26.36	33.22	40.69	47.53
100	7714	724	20.81	28.23	35.53	43.42	50.66
90	6929	762	22.00	29.85	37.54	45.76	53.31
80	6159	790	22.89	31.08	39.05	47.53	55.33
70	5306	813	23.54	31.96	40.13	48.87	56.93

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 113-1 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6371
	Blind nuts, 3/4 BSP	W01-M58-6369
	Rubber bellows only	W01-358-0150
Assembly weight.....6.89 kg.		
Force to collapse to minimum height (@ 0 BAR) 111 N.		
Style 128-1 High Strength Con-struction	Blind nuts, 3/4 BSP	W01-M58-6066





NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 140mm Design Height
(Required for Airmount isolator design only)

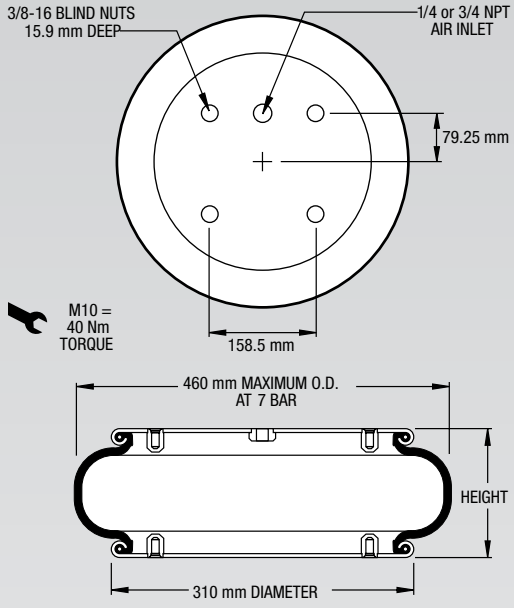
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	18.07	416	2.39
4	24.76	529	2.31
5	31.33	646	2.27
6	38.72	771	2.23
7	45.44	887	2.20

Force Table (Use for Airstroke™ actuator design)

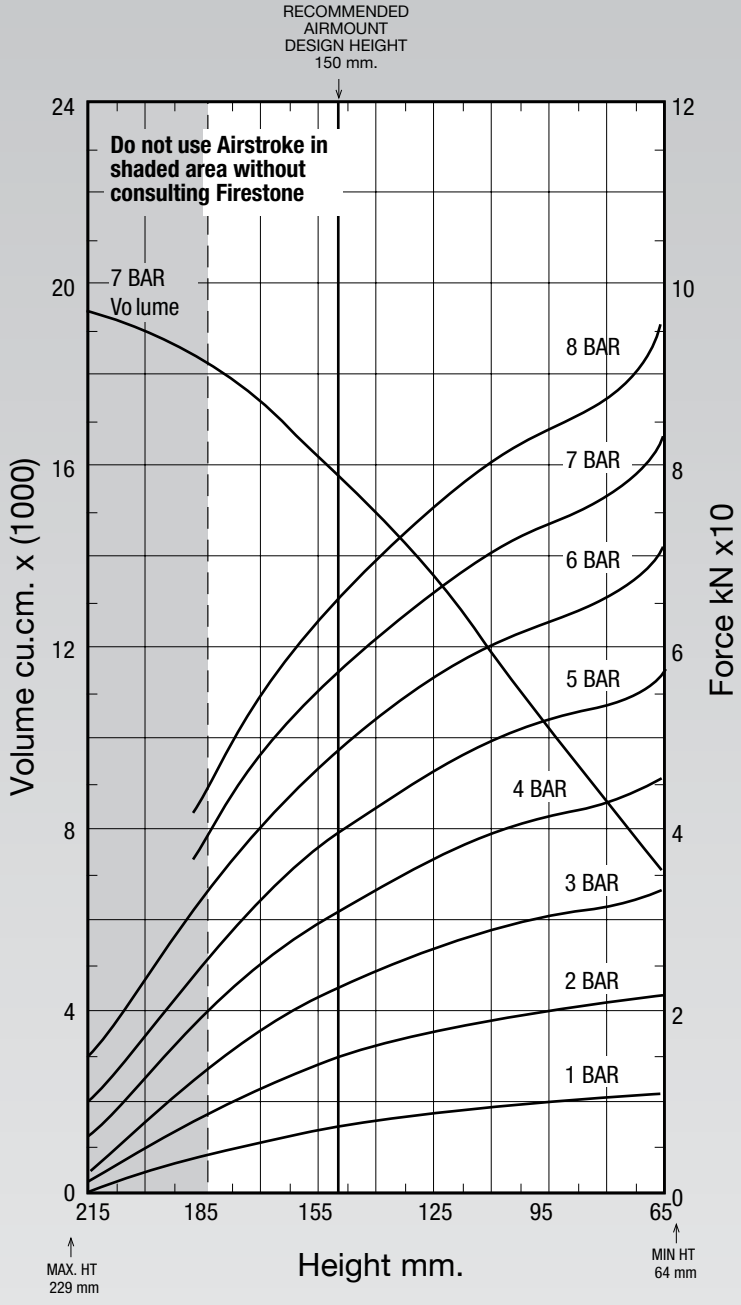
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq.)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
160	11771	516	13.58	19.08	24.39	30.59	36.10
140	10492	649	18.07	24.76	31.33	38.72	45.44
120	9061	750	21.39	28.92	36.48	44.84	52.49
100	7479	825	23.91	32.03	40.34	49.41	57.72
80	5781	878	25.75	34.28	43.15	52.69	61.43
60	4002	911	26.85	35.69	44.94	54.78	63.79

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 153-2 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-8158
Assembly weight.....7.86 kg		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 150 mm Design Height
(Required for Airmount isolator design only)

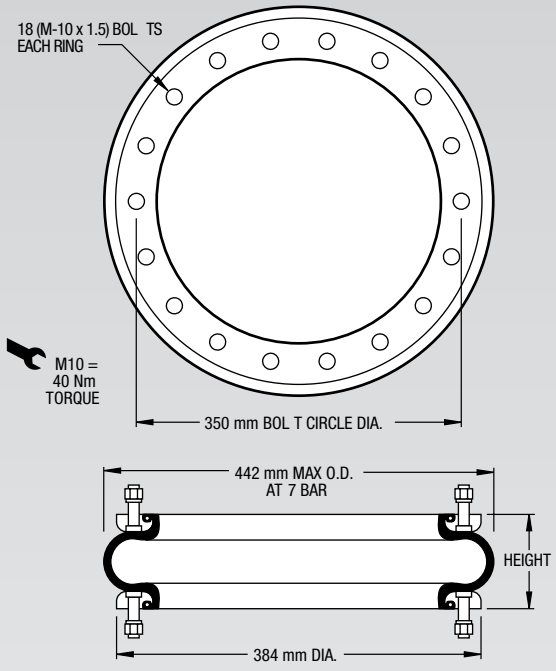
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	22.39	428.74	2.18
4	30.72	555.60	2.12
5	39.04	673.69	2.07
6	48.29	794.88	2.02
7	56.58	911.22	2.00

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
180	18085	586	14.48	21.09	27.34	34.71	41.03
165	17075	710	19.02	26.49	33.92	42.34	49.74
150	15865	808	22.39	30.72	39.04	48.29	56.58
135	14493	890	25.09	34.38	43.44	53.33	62.31
120	13057	960	27.37	37.61	47.34	57.70	67.20
105	11469	1016	29.32	40.21	50.50	61.28	71.18
90	9891	1054	30.76	41.86	52.56	63.81	74.18
75	8291	1112	32.00	43.34	54.47	66.62	77.85

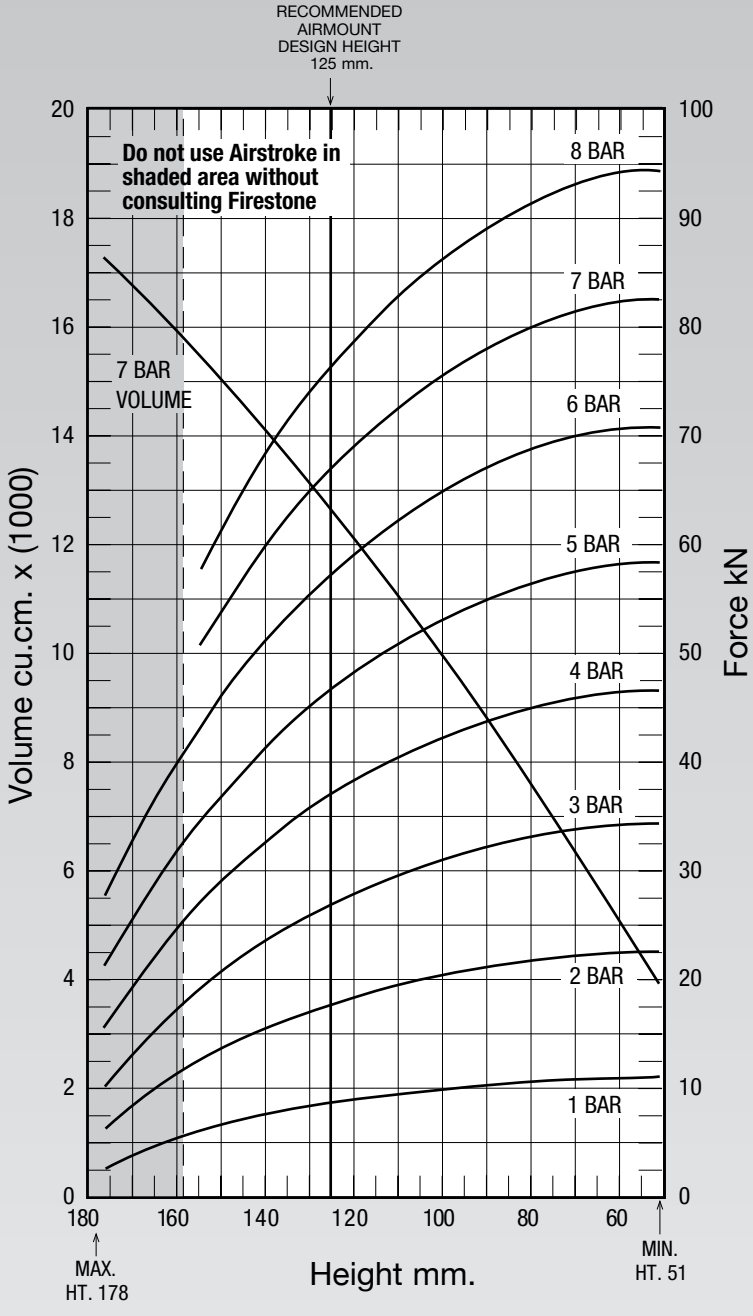
NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 119	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6974
Two Ply Bellows	Rubber bellows only	W01-358-0119
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7477
Assembly weight.....5.98 kg.		
Force to collapse to minimum height (@ 0 BAR) 76 N.		



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 125 mm Design Height
(Required for Airmount isolator design only)

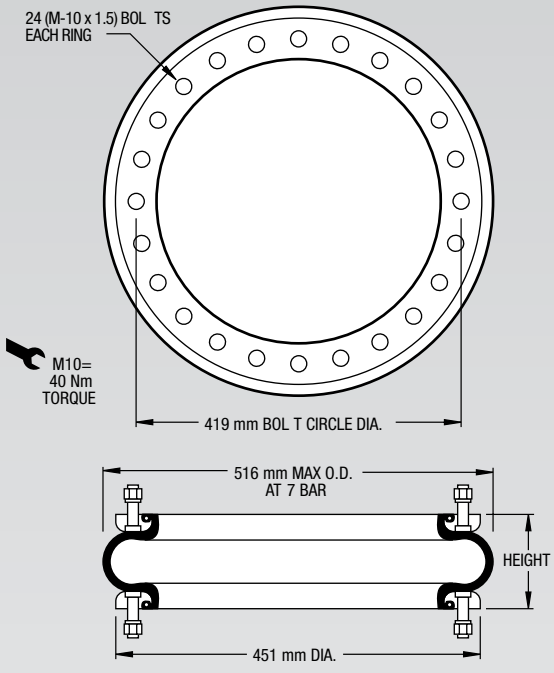
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	26.86	599	2.35
4	36.82	766	2.27
5	46.53	934	2.23
6	57.15	1109	2.20
7	66.80	1269	2.17

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
140	14081	847	23.26	32.31	40.96	50.59	59.29
130	13097	922	25.78	35.46	44.84	55.17	64.52
120	12133	982	27.78	37.99	47.98	58.85	68.74
110	11058	1033	29.48	40.18	50.67	62.00	72.34
100	10008	1075	30.83	41.97	52.85	64.53	75.23
90	8840	1110	31.99	43.53	54.73	66.70	77.72
80	7704	1139	32.96	44.81	56.25	68.45	79.72
70	6445	1162	33.79	45.85	57.48	69.86	81.34

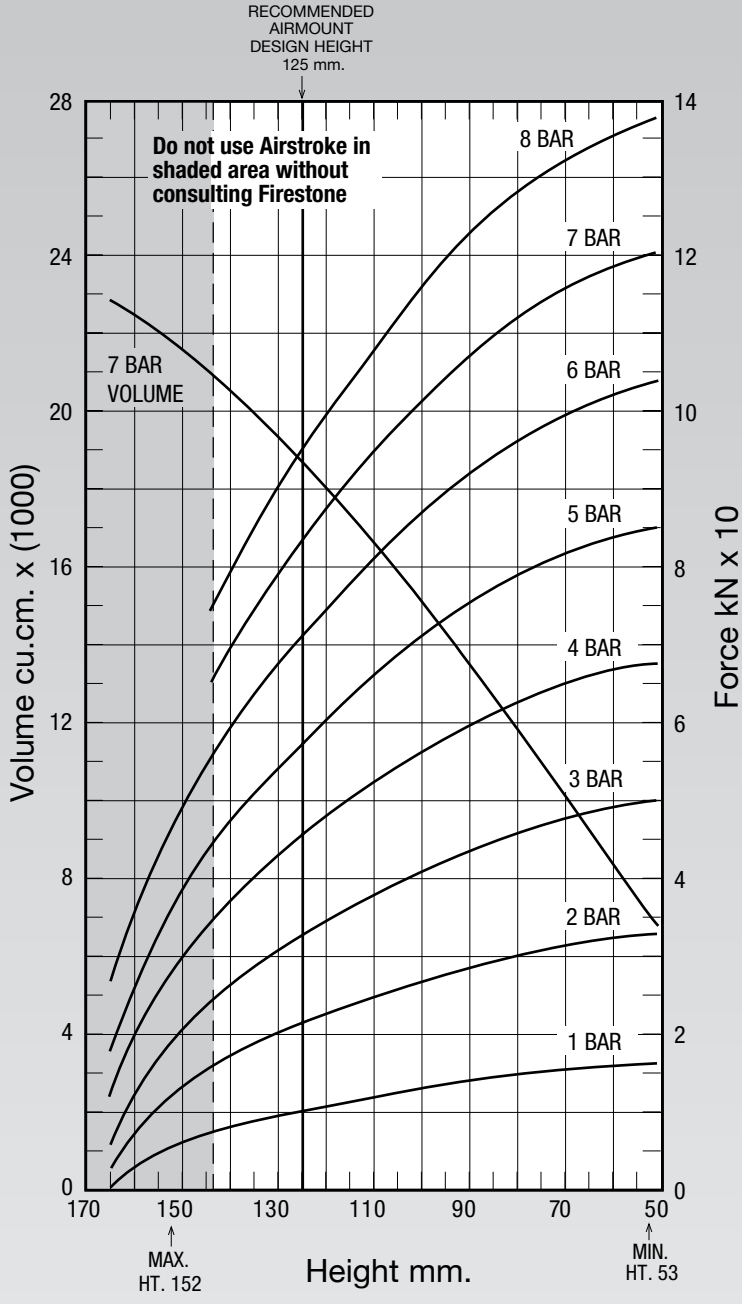
NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 121 Two Ply Bellows	Ribbed neck aluminum bead rings, 45 mm bolts, nuts, washers	W01-M58-6966
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7272
	Rubber bellows only	W01-358-5135
Assembly weight.....7.26 kg.		
Force to collapse to minimum height (@ 0 BAR) 89 N.		



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 125 mm Design Height
(Required for Airmount isolator design only)

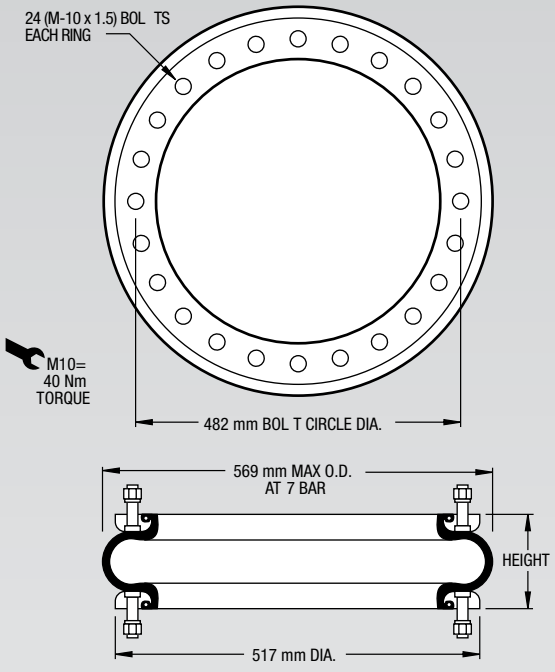
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	32.46	812	2.49
4	45.13	1058	2.41
5	57.13	1298	2.38
6	70.61	1535	2.33
7	82.85	1750	2.29

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
130	19228	1122	30.41	42.47	53.82	66.78	78.52
120	17985	1239	34.26	47.49	60.07	74.04	86.72
110	16552	1350	37.72	52.13	65.82	80.82	94.46
100	15121	1446	40.64	56.07	70.70	86.63	101.20
90	13511	1531	43.26	59.58	74.98	91.75	107.17
80	11939	1599	45.55	62.46	78.47	95.84	111.88
70	10205	1653	47.72	64.98	81.51	99.23	115.66

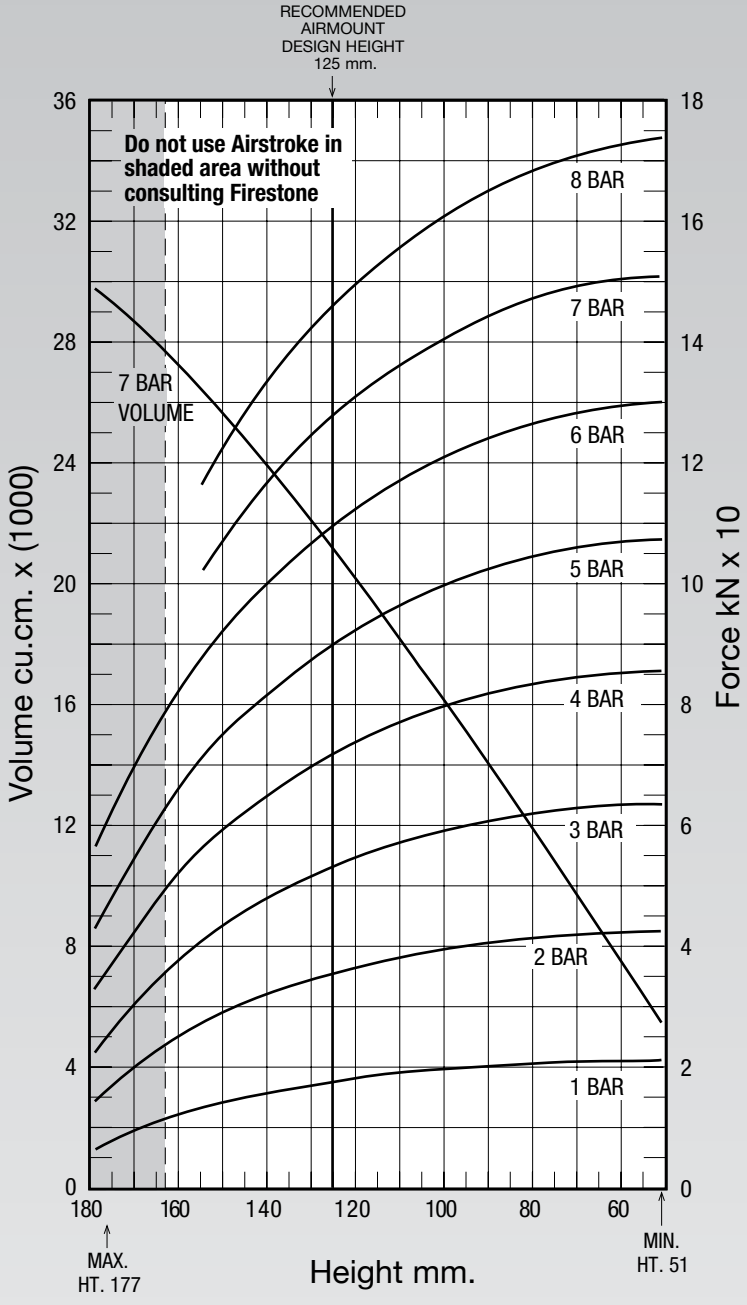
NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 126 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6973
	Rolled plate assembly, 1/2 blind nuts, 3/4 BSP	W01-M58-7718
	Rubber bellows only	W01-358-1026
Assembly weight.....9.66 kg.		
Force to collapse to minimum height (@ 0 BAR) 111 N.		



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 125 mm Design Height
(Required for Airmount isolator design only)

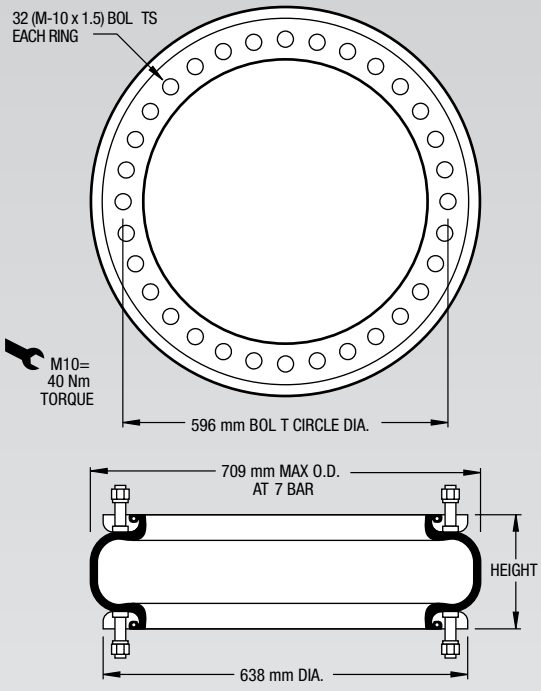
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	53.10	1184	2.35
4	71.42	1512	2.29
5	89.75	1828	2.25
6	109.40	2154	2.21
7	127.49	2458	2.19

Force Table (Use for Airstroke™ actuator design)

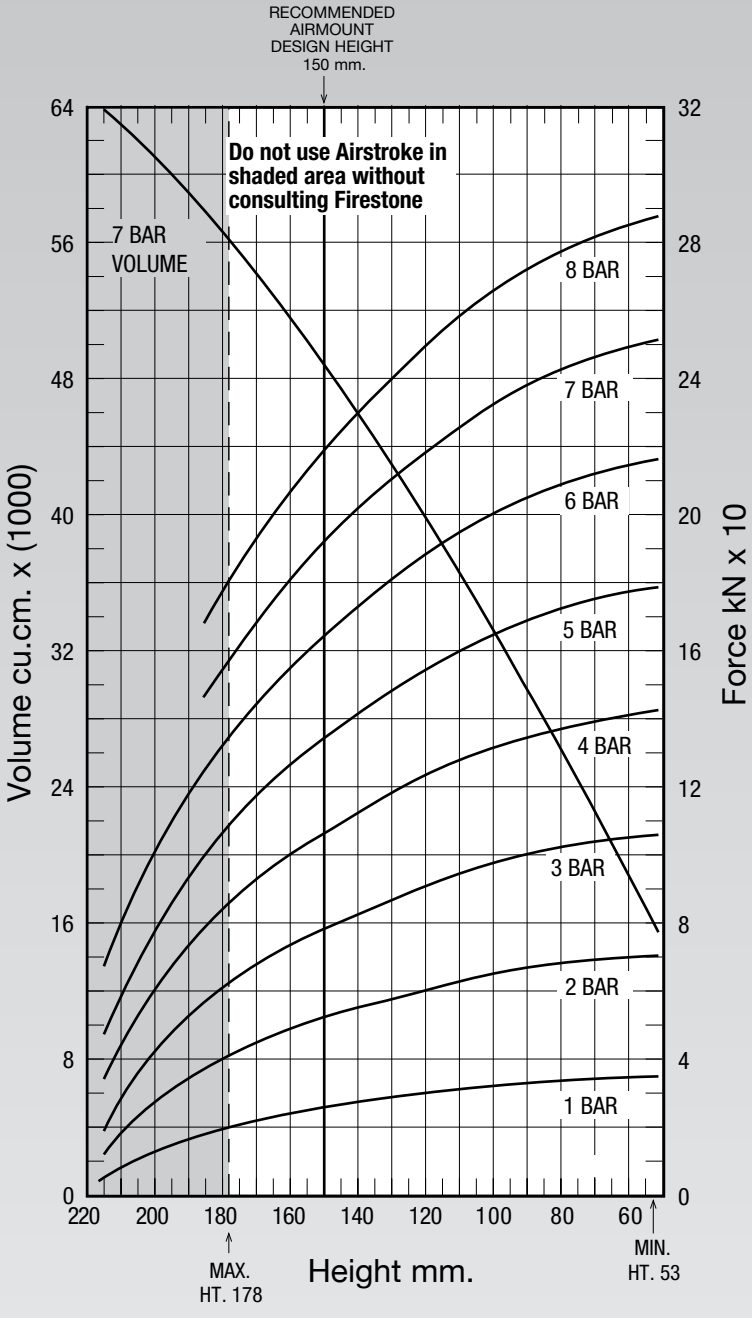
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
160	27186	1355	37.05	51.09	64.81	80.58	94.86
140	23871	1660	47.71	64.48	81.24	99.48	116.20
120	20206	1863	54.46	73.23	91.96	111.95	130.41
100	16216	2006	58.95	79.48	99.52	120.68	140.38
80	12022	2101	62.03	83.35	104.45	126.58	147.09
60	7743	2153	63.76	85.23	106.86	129.60	150.66

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 138-1.5	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6972
High Strength Con-struction	Rubber bellows only	W01-358-0147
Assembly weight.....11.11 kg.		
Force to collapse to minimum height (@ 0 BAR) 667 N.		



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 150 mm Design Height
(Required for Airmount isolator design only)

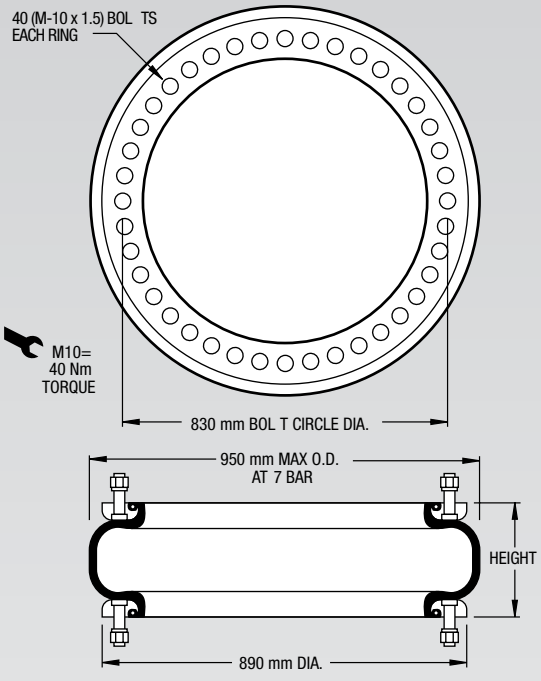
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	78.40	1361	2.08
4	106.51	1742	2.02
5	134.29	2111	1.98
6	164.07	2488	1.94
7	191.19	2844	1.92

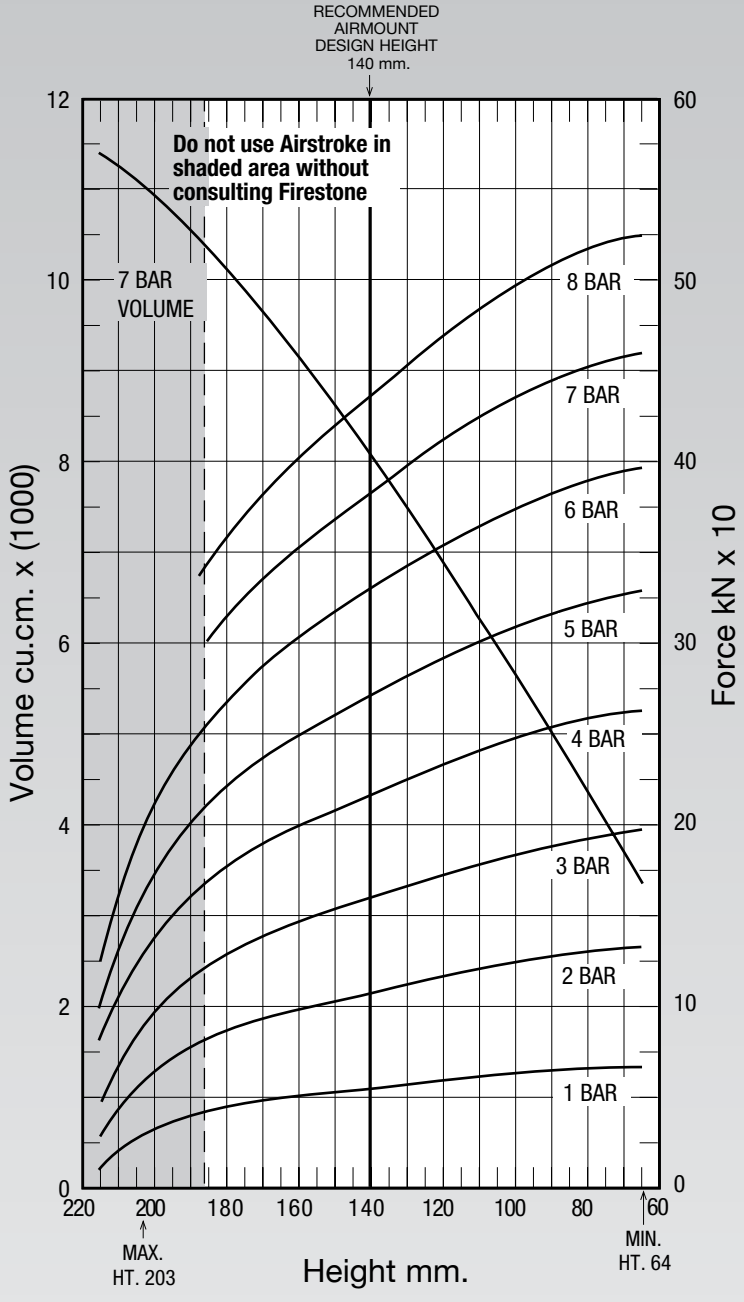
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
180	56558	2200	60.35	83.40	106.09	131.40	153.99
160	51417	2573	73.03	99.66	125.96	154.37	180.09
140	45680	2871	83.06	112.54	141.62	172.60	200.97
120	39615	3120	91.25	123.17	154.62	187.80	218.40
100	33114	3322	97.72	131.55	165.06	200.15	232.53
80	26237	3471	102.53	137.62	172.72	209.27	242.92
60	19043	3567	105.89	141.79	177.80	215.18	249.69

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 148-1	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6969
High Strength Con-struction	Rubber bellows only	W01-358-1021
Assembly weight.....21.00 kg.		
Force to collapse to minimum height (@ 0 BAR) 1378 N.		





NOTE: The effective length of the 45 mm bolt is 23 mm in this bead ring.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 140 mm Design Height
(Required for Airmount isolator design only)

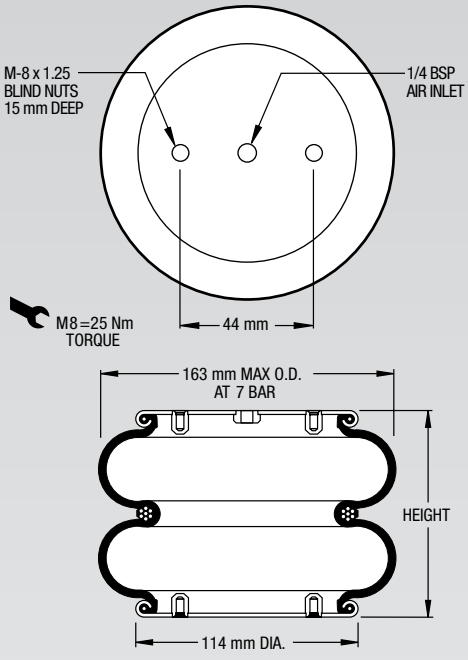
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	159.12	2747	2.07
4	214.60	3485	2.01
5	268.86	4248	1.98
6	327.14	5077	1.96
7	381.44	5830	1.95

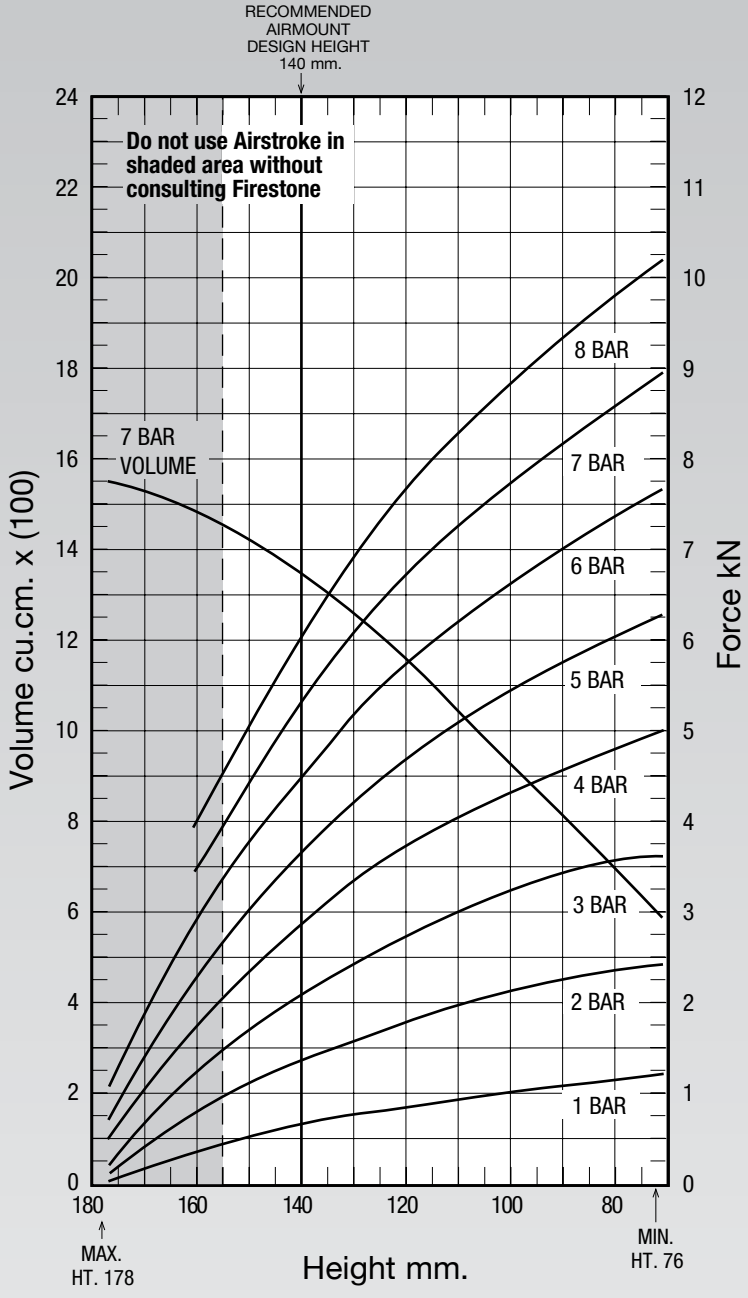
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
180	100532	4456	126.24	174.51	218.75	266.95	311.89
160	90826	4998	144.99	197.24	247.10	300.31	349.83
140	79989	5450	159.12	214.60	268.86	327.14	381.44
120	68618	5857	170.91	230.51	289.23	351.92	409.95
100	56587	6199	181.41	245.45	307.57	373.08	433.88
80	44091	6455	191.45	257.88	321.60	388.59	451.81

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 25 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6160
	Socket head aluminum bead rings (bolts, nuts, washers not included–use M6 cap screws)	W01-358-0030
	Rubber bellows only (no girdle hoop)	W01-358-0025
Assembly weight .....1.72 kg.		
Force to collapse to minimum height (@ 0 BAR) 85 N.		





See page 12 for instructions on how to use chart.

NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.

Dynamic Characteristics at 140 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	2.03	62	2.75
4	2.81	80	2.67
5	3.63	98	2.60
6	4.50	117	2.55
7	5.30	135	2.52

Force Table (Use for Airstroke™ actuator design)

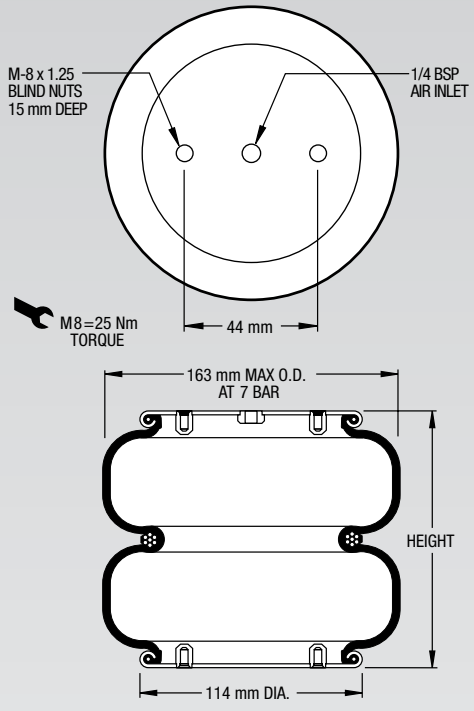
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
150	1421	62	1.64	2.29	2.92	3.66	4.32
140	1344	74	2.03	2.81	3.63	4.50	5.30
130	1253	85	2.39	3.27	4.13	5.09	5.96
120	1159	95	2.69	3.66	4.61	5.66	6.62
110	1049	103	2.97	4.00	5.04	6.16	7.18
100	939	109	3.21	4.27	5.38	6.57	7.65
90	817	116	3.41	4.52	5.69	6.95	8.10
80	698	122	3.55	4.76	5.98	7.31	8.52

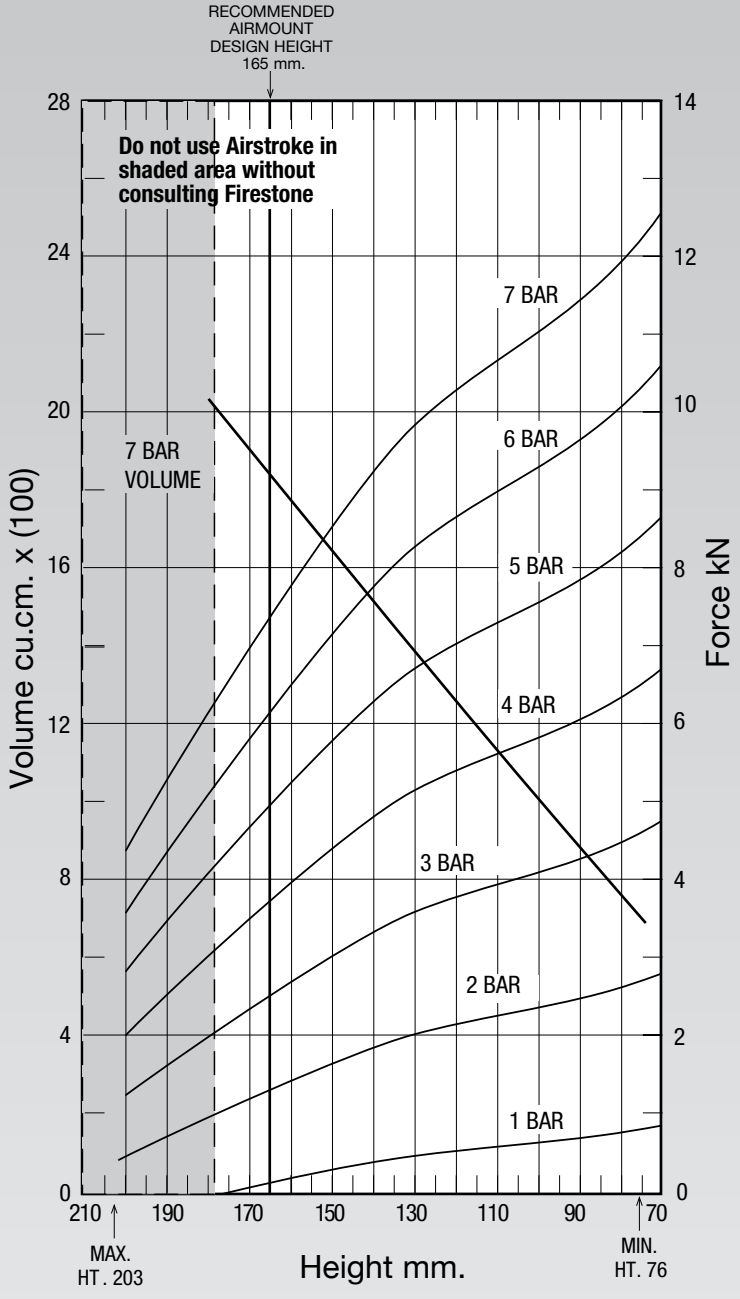
NOTE: Replacement for Style 255-1.5

267-1.5 Firestone AIRSTROKE ACTUATORS AIRMOUNT ISOLATORS

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 255-1.5 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6105
	Socket head aluminum bead rings (bolts, nuts, washers not included, use cap screws)	W01-358-6833
	Rubber bellows only	W01-358-0048
Assembly weight .....1.7 kg.		
Force to collapse to minimum height (@ 0 BAR) 190 N.		





NOTE: A bead plate part is shown. This part is also available with bead rings. Bolts are not included. See pages 8-10 for explanation.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 165 mm Design Height
(Required for Airmount isolator design only)

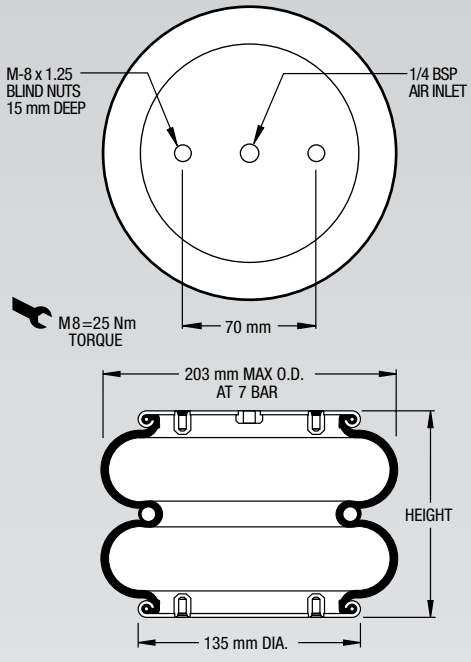
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	3.2	59	2.30
4	4.3	73	2.21
5	5.3	90	2.16
6	6.5	106	2.11
7	7.5	121	2.08

Force Table (Use for Airstroke™ actuator design)

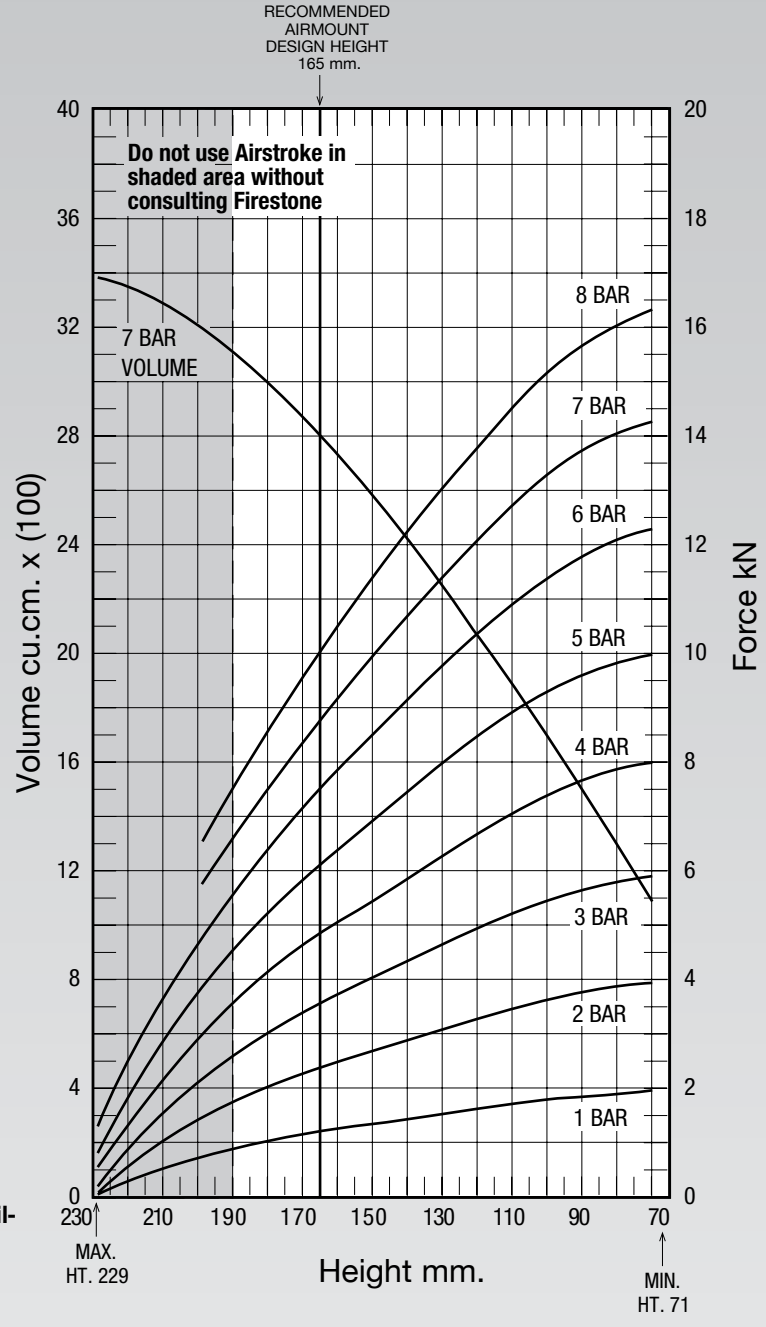
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
175	2048	86	2.5	3.4	4.3	5.2	6.0
150	1786	107	3.2	4.3	5.3	6.4	7.5
125	1491	123	3.6	4.9	6.1	7.3	8.6
100	1163	134	4.0	5.3	6.7	8.0	9.4
75	803	143	4.2	5.7	7.1	8.5	10.0
60	623	156	4.7	6.2	7.8	9.4	10.9

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 224 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6400
	Rubber Bellows only	W01-358-5101
	Countersunk steel bead ring	W01-358-3407
Assembly weight.....2.27 kg.		
Force to collapse to minimum height (@ 0 BAR) 62 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 165 mm Design Height
(Required for Airmount isolator design only)

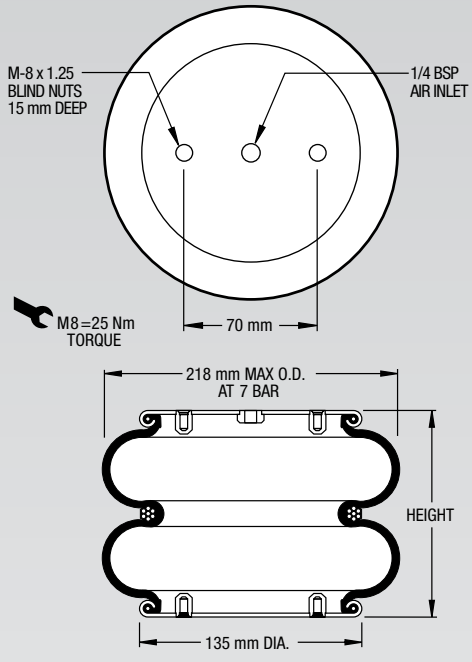
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	3.48	69	2.21
4	4.74	88	2.15
5	6.01	109	2.13
6	7.40	132	2.11
7	8.65	152	2.09

Force Table (Use for Airstroke™ actuator design)

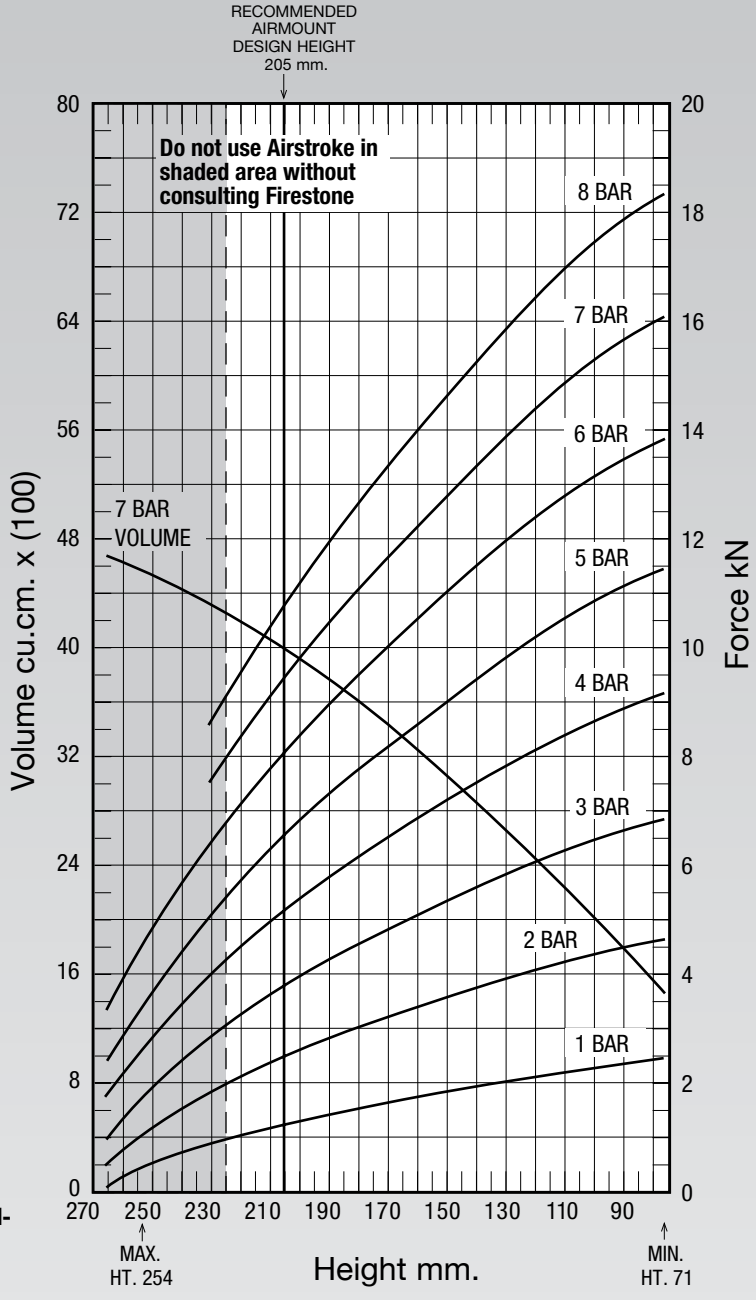
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
180	3002	105	2.90	4.00	5.08	6.28	7.37
160	2730	129	3.64	4.95	6.28	7.73	9.03
140	2411	151	4.29	5.80	7.35	9.05	10.58
120	2063	172	4.87	6.61	8.35	10.27	12.02
100	1690	189	5.37	7.34	9.24	11.32	13.23
80	1300	201	5.76	7.85	9.88	12.05	14.04

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 26 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6353
	Blind nuts, 3/4 BSP	W01-M58-6387
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-6988
	Rubber bellows only	W01-358-0142
Assembly weight.....2.40 kg.		
Force to collapse to minimum height (@ 0 BAR) 102 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 205 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	3.74	59	1.99
4	5.15	76	1.92
5	6.52	93	1.88
6	8.03	109	1.83
7	9.41	124	1.81

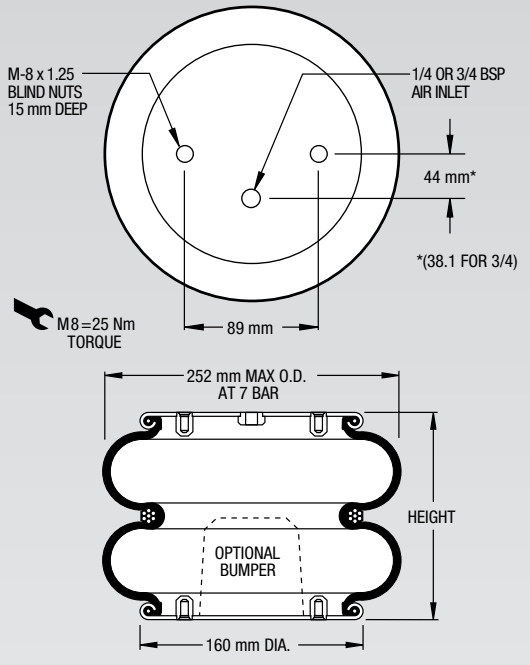
Force Table (Use for Airstroke™ actuator design)

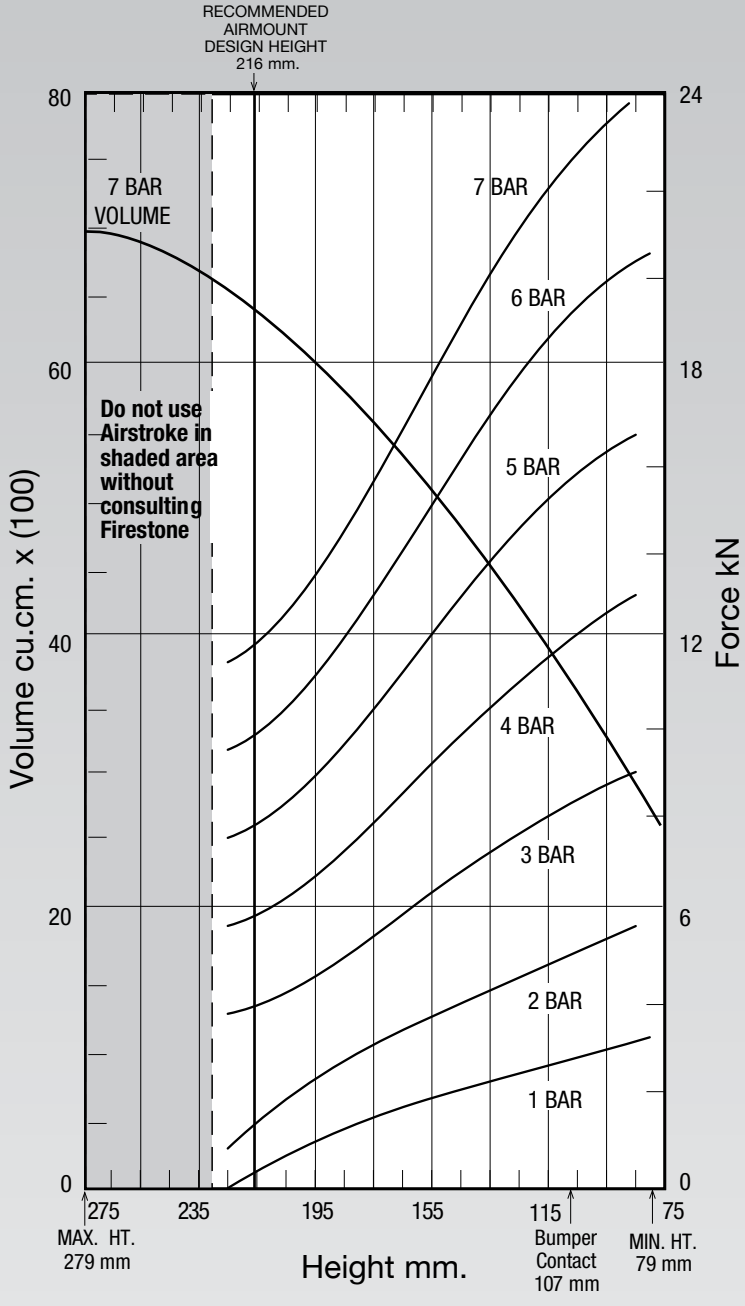
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
220	4202	118	3.19	4.44	5.66	7.06	8.29
200	3918	139	3.90	5.35	6.76	8.32	9.73
180	3594	157	4.51	6.12	7.70	9.43	11.00
160	3233	174	5.08	6.82	8.57	10.46	12.20
140	2840	191	5.60	7.48	9.40	11.46	13.35
120	2434	206	6.05	8.09	10.16	12.36	14.38
100	2007	218	6.42	8.63	10.81	13.11	15.25
80	1564	228	6.76	9.08	11.34	13.72	15.94

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 274 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6187
	Blind nuts, 1/4 BSP, bumper	W01-M58-6188
	Blind nuts, 3/4 BSP	W01-M58-6185
	Blind nuts, 3/4 BSP, bumper	W01-M58-6186
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-6990
	Rubber bellows only	W01-358-0297
Assembly weight.....3.40 kg.		
Force to collapse to minimum height (@ 0 BAR) 62 N.		

Style 202 High Strength Con-struction	Blind nuts, 1/4 BSP	W01-M58-6192
	Blind nuts, 3/4 BSP	W01-M58-6190





See page 12 for instructions on how to use chart.

NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.

Dynamic Characteristics at 216 mm Design Height
(Required for Airmount isolator design only)

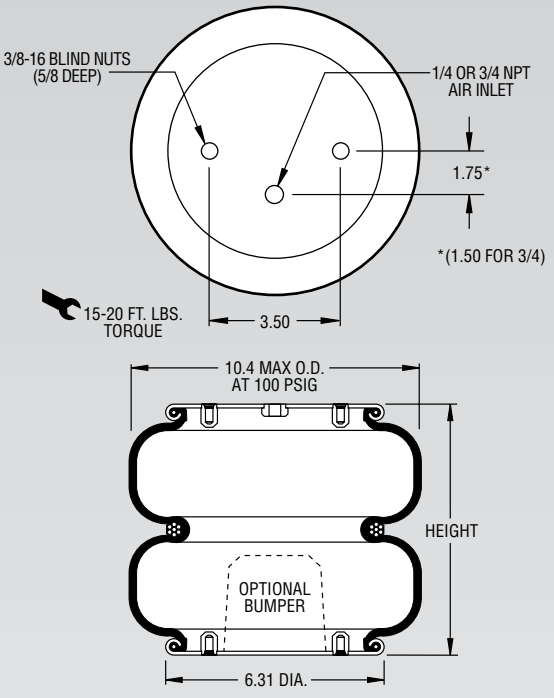
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	5.6	77.93	2.01
4	7.5	98.23	1.96
5	9.3	122.17	1.89
6	11.2	146.53	1.87
7	13.1	168.24	1.85

Force Table (Use for Airstroke™ actuator design)

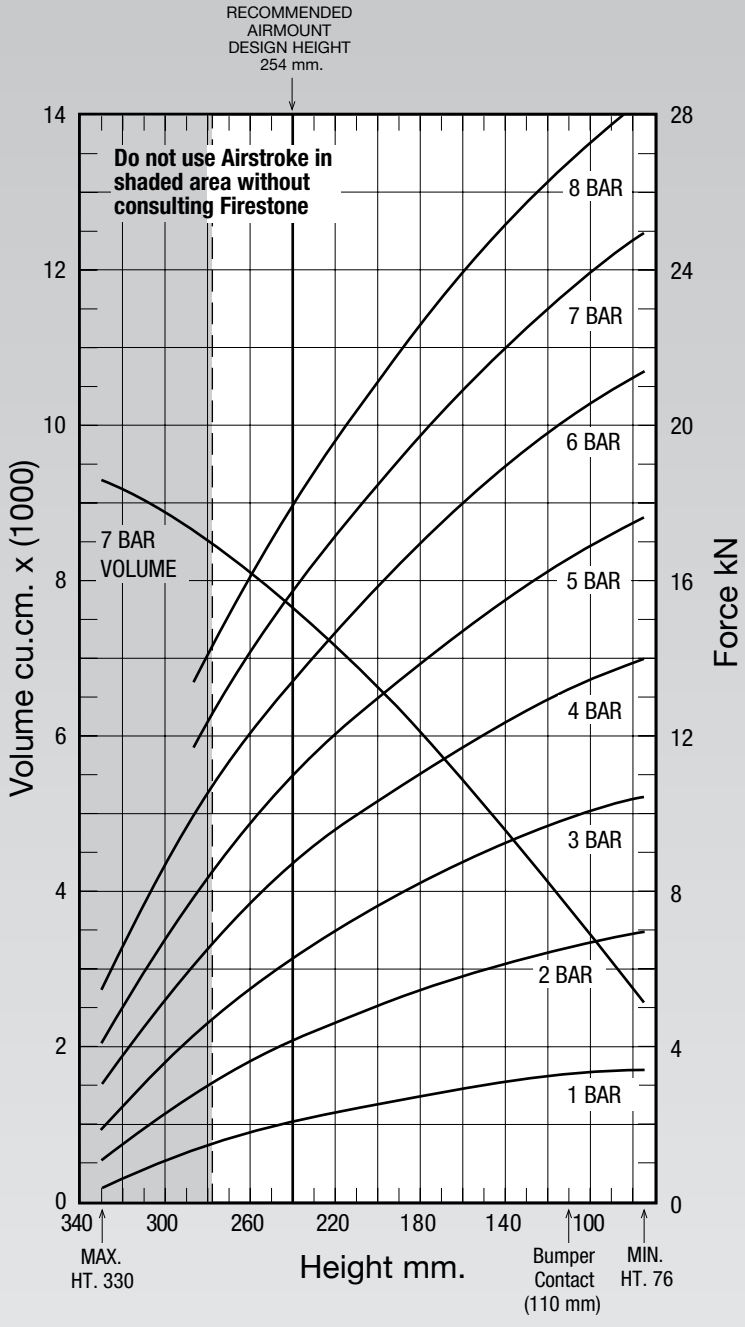
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
225	6424	174	5.2	6.9	8.7	10.4	12.2
200	5981	186	5.5	7.4	9.2	11.1	13.0
175	5424	228	6.8	9.1	11.4	13.6	15.9
150	4769	260	7.8	10.4	13.0	15.6	18.2
125	4048	291	8.7	11.6	14.5	17.4	20.3
100	3228	320	9.6	12.8	16.0	19.2	22.4

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 20-2 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6183
	Blind nuts, 3/4 BSP	W01-M58-6194
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-6880
	Rubber bellows only	W01-358-0305
Assembly weight.....3.50 kg.		
Force to collapse to minimum height (@ 0 BAR) 75 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 254 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	5.71	71	1.76
4	8.12	91	1.67
5	10.15	108	1.63
6	12.45	126	1.59
7	14.58	144	1.57

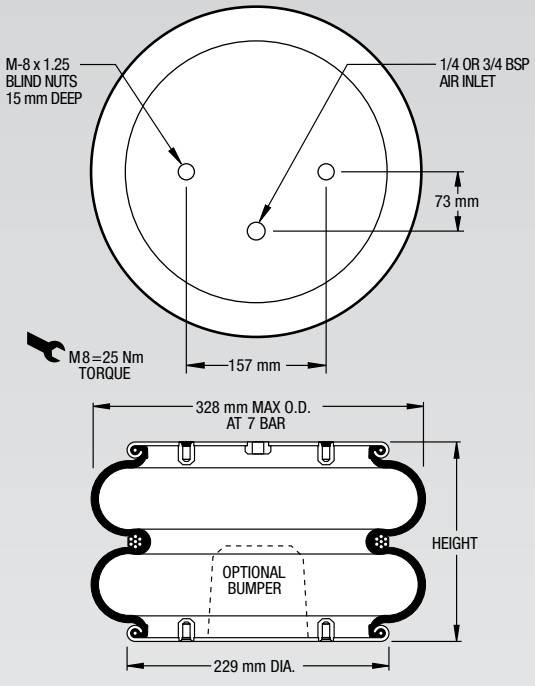
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
280	8531	175	4.52	6.43	8.27	10.41	12.28
260	8130	201	5.43	7.58	9.65	11.97	14.05
240	7682	223	6.24	8.60	10.86	13.36	15.63
220	7189	244	6.96	9.51	11.95	14.61	17.07
200	6637	263	7.58	10.31	12.94	15.79	18.43
180	6048	282	8.16	11.03	13.85	16.91	19.73
160	5424	299	8.70	11.70	14.71	17.96	20.96
140	4770	315	9.23	12.33	15.49	18.89	22.02

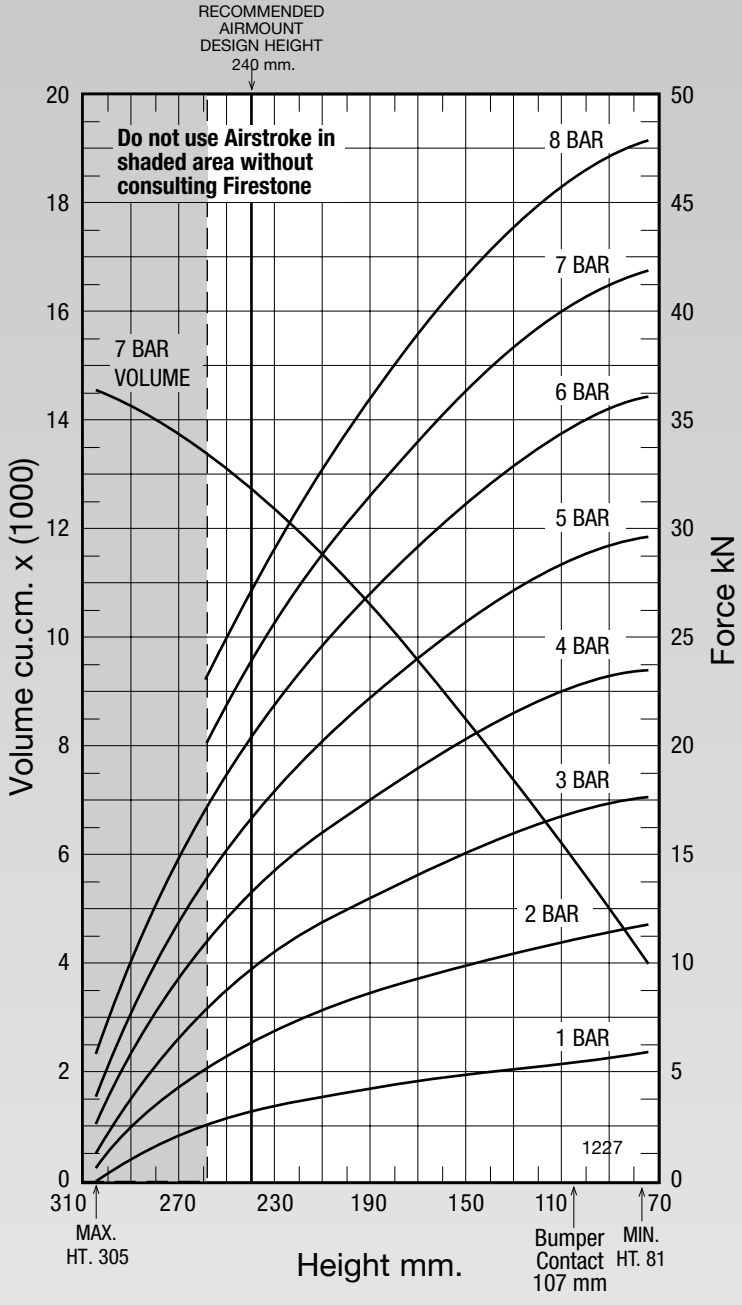
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 22 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6381
	Blind nuts, 1/4 BSP, bumper	W01-M58-6382
	Blind nuts, 3/4 BSP	W01-M58-6200
	Blind nuts, 3/4 BSP, bumper	W01-M58-6201
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-7524
	Rubber bellows only	W01-358-0226
Assembly weight (bead plate version, no bumper) 5.8 kg.		
Force to collapse to minimum height (@ 0 BAR) 88.9 N.		

Style 210 High Strength Con-struction	Blind nuts, 1/4 BSP	W01-M58-6212
	Blind nuts, 3/4 BSP	W01-M58-6210
	Countersunk steel bead rings, bolts, nuts, washers	W01-M58-6976
	Rubber bellows only	W01-358-7928



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

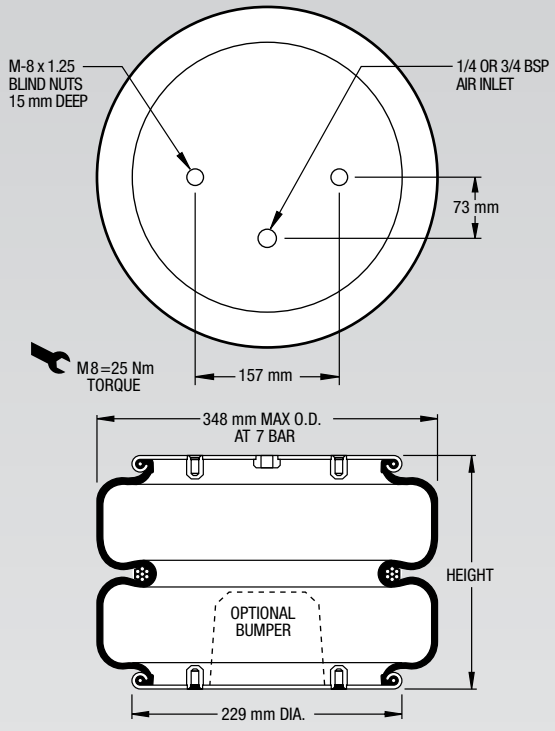
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	9.68	137	1.88
4	13.12	175	1.82
5	16.56	215	1.80
6	20.35	255	1.77
7	23.81	294	1.75

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
240	12776	340	9.68	13.12	16.56	20.35	23.81
220	12002	389	11.22	15.11	19.05	23.31	27.21
200	11107	431	12.49	16.79	21.19	25.89	30.16
180	10127	469	13.60	18.28	23.10	28.21	32.81
160	9072	504	14.61	19.64	24.85	30.32	35.24
140	7952	535	15.56	20.90	26.42	32.23	37.44
120	6815	562	16.42	22.03	27.80	33.85	39.32
100	5637	583	17.15	22.94	28.90	35.12	40.78

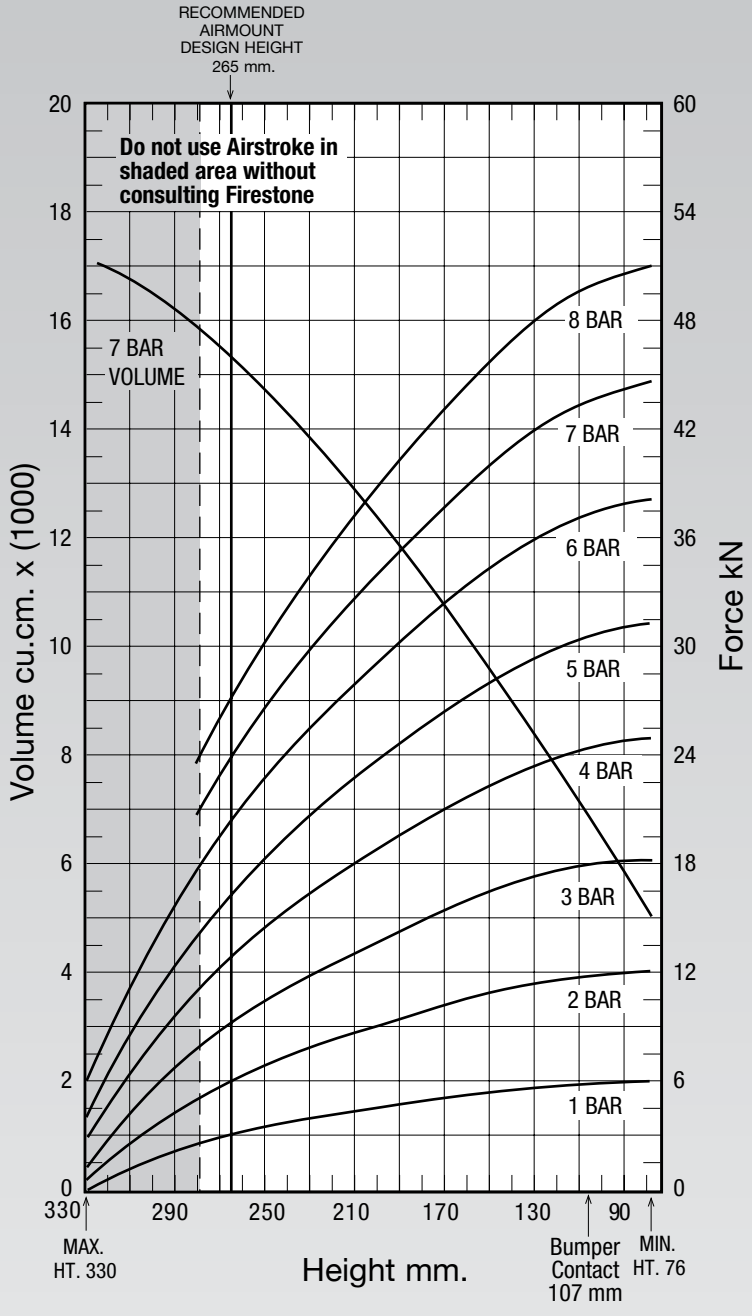
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 22-1.5 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6384
	Blind nuts, 3/4 BSP	W01-M58-6383
	Rubber bellows only	W01-358-0259
Assembly weight (bead plate version, no bumper) 5.85 kg.		
Force to collapse to minimum height (@ 0 BAR) 116 N.		



NOTE: The bellows extends beyond the bead plates at minimum height.

NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 265 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	9.12	129	1.87
4	12.82	170	1.82
5	16.30	208	1.78
6	20.28	246	1.74
7	23.86	282	1.71

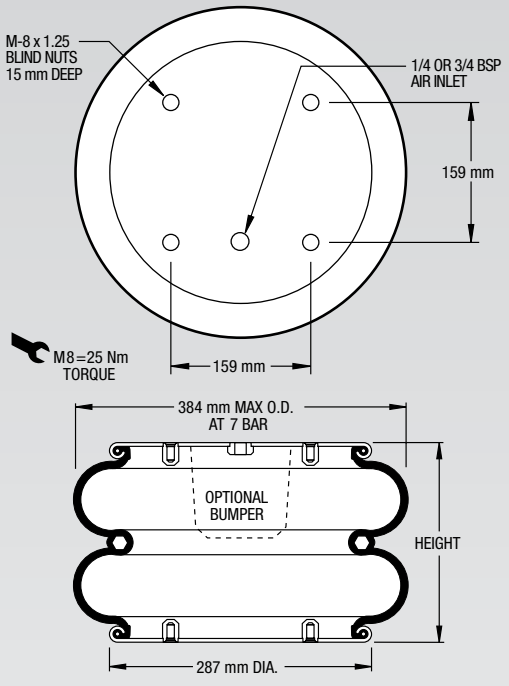
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
270	15435	327	8.67	12.21	15.55	19.41	22.87
230	13823	424	11.73	16.31	20.58	25.32	29.64
190	11833	502	14.16	19.45	24.50	30.04	35.13
150	9521	571	16.31	22.17	27.91	34.20	39.97
110	7032	619	17.73	24.18	30.37	37.11	43.34
80	4521	635	18.21	24.84	31.20	38.10	44.48

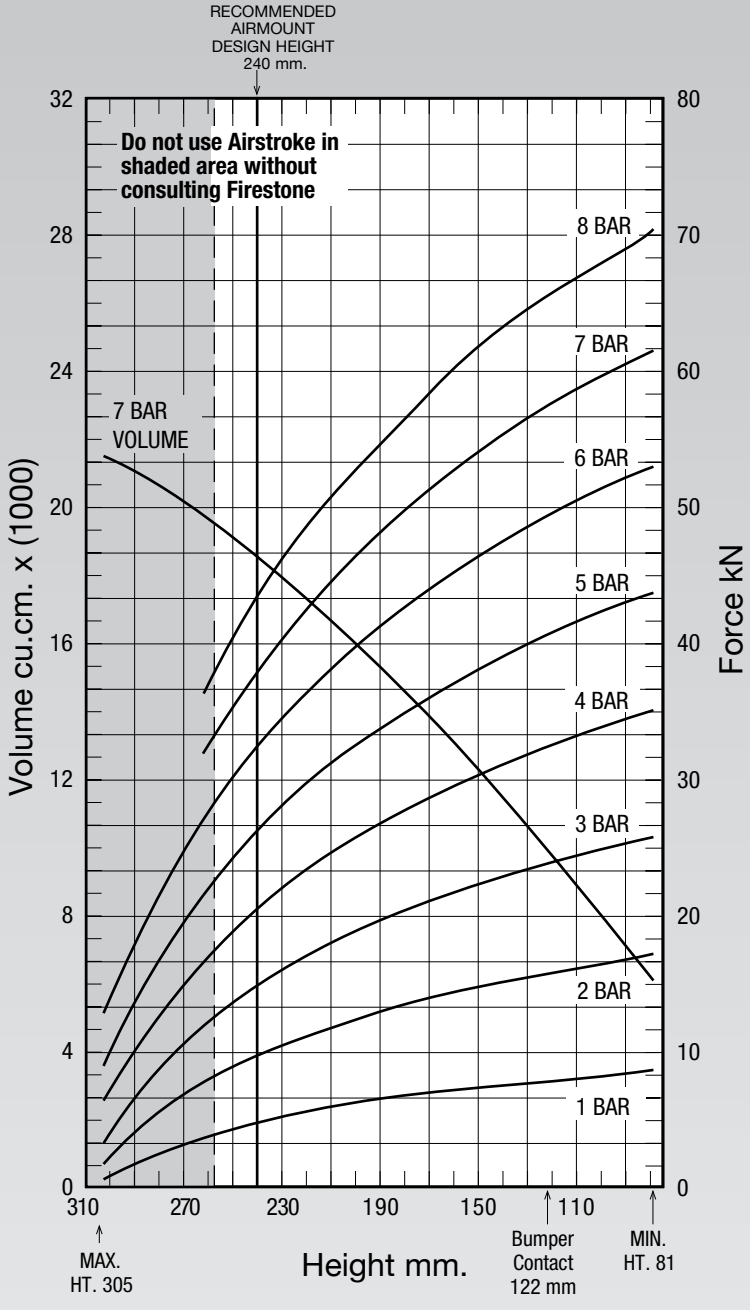
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 21 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6114
	Blind nuts, 1/4 BSP, bumper	W01-M58-6115
	Blind nuts, 3/4 BSP	W01-M58-6112
	Blind nuts, 3/4 BSP, bumper	W01-M58-6113
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-7710
	Rubber bellows only	W01-358-0213
Assembly weight.....7.85 kg.		
Force to collapse to minimum height (@ 0 BAR) 98 N.		

Style 205 Four Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6079
	Blind nuts, 3/4 BSP	W01-M58-6077
	Rubber bellows only	W01-358-7929



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

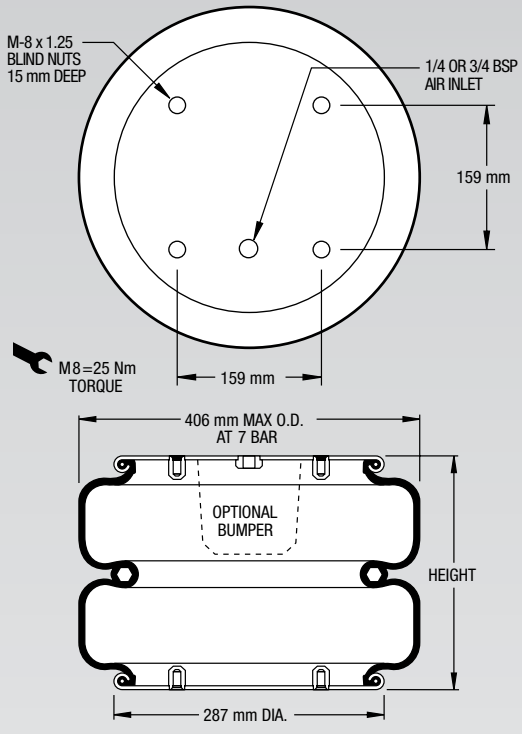
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	14.67	200	1.84
4	20.23	262	1.79
5	25.85	318	1.75
6	31.99	375	1.71
7	37.38	430	1.69

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
240	18574	534	14.67	20.23	25.85	31.99	37.38
220	17382	598	16.77	23.02	29.19	35.86	41.84
200	16033	651	18.51	25.33	31.96	39.08	45.56
180	14575	698	20.01	27.29	34.36	41.93	48.87
160	13022	741	21.33	29.01	36.53	44.56	51.90
140	11385	780	22.48	30.56	38.50	46.92	54.61
120	9732	813	23.47	31.96	40.21	48.91	56.88
100	8023	839	24.34	33.24	41.65	50.51	58.72

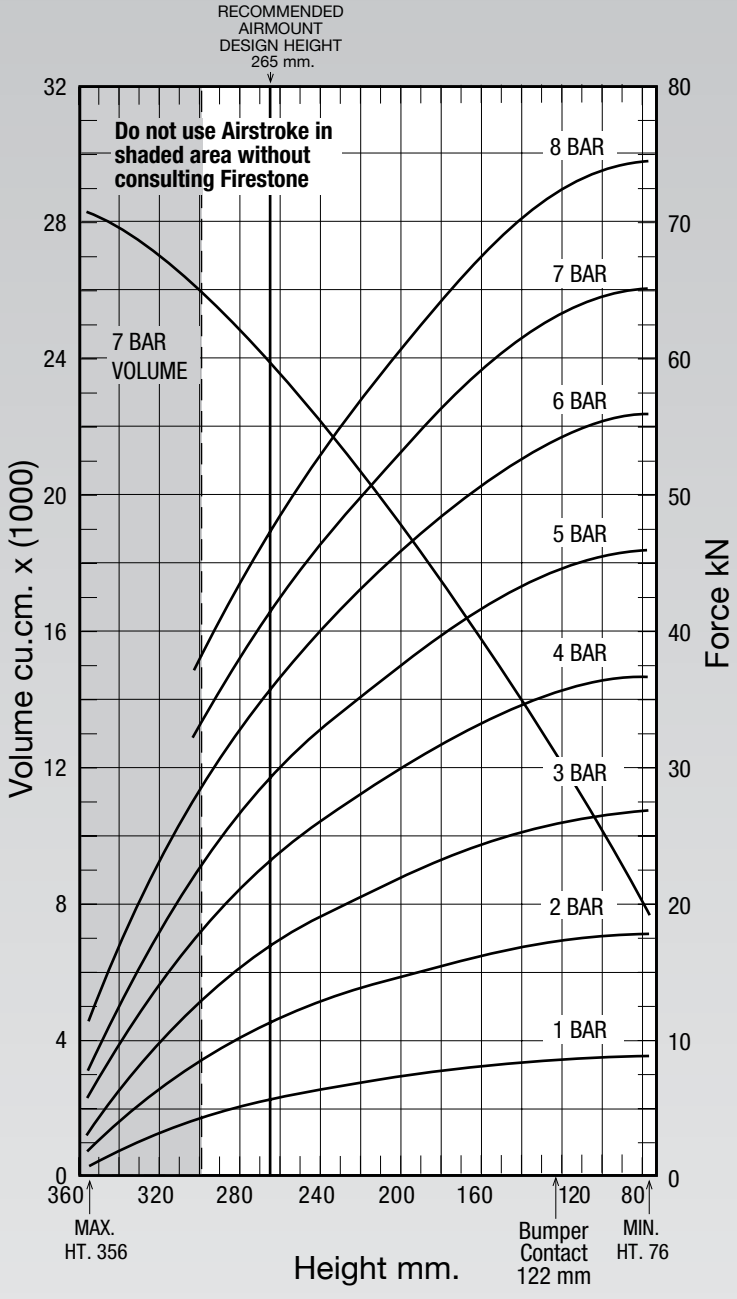
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 21-2 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6377
	Blind nuts, 1/4 BSP, rubber bumper	W01-M58-6379
	Blind nuts, 3/4 BSP	W01-M58-6378
	Rubber bellows only	W01-358-0140
Assembly weight (bead plate version, no bumper) 8.26kg.		
Force to collapse to minimum height (@ 0 BAR) 156 N.		



NOTE: The bellows extends beyond the bead plates at minimum height.

NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 265 mm Design Height
(Required for Airmount isolator design only)

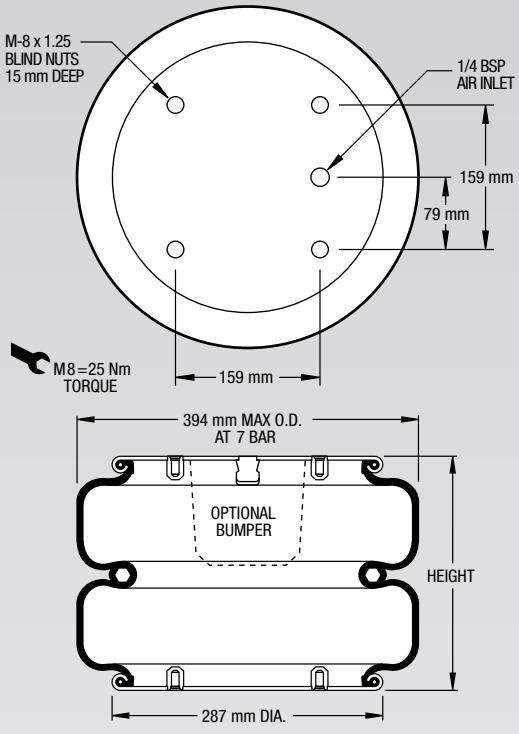
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	16.48	183	1.66
4	22.69	238	1.62
5	28.70	289	1.58
6	35.33	340	1.55
7	41.34	390	1.53

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
280	24758	541	14.81	20.52	26.07	32.28	37.85
240	22165	661	18.76	25.69	32.37	39.60	46.23
200	19084	758	21.74	29.70	37.34	45.53	53.06
160	15583	844	24.15	33.09	41.57	50.69	59.10
120	11862	906	25.90	35.57	44.61	54.37	63.44
80	8016	930	26.79	36.66	45.89	55.82	65.11

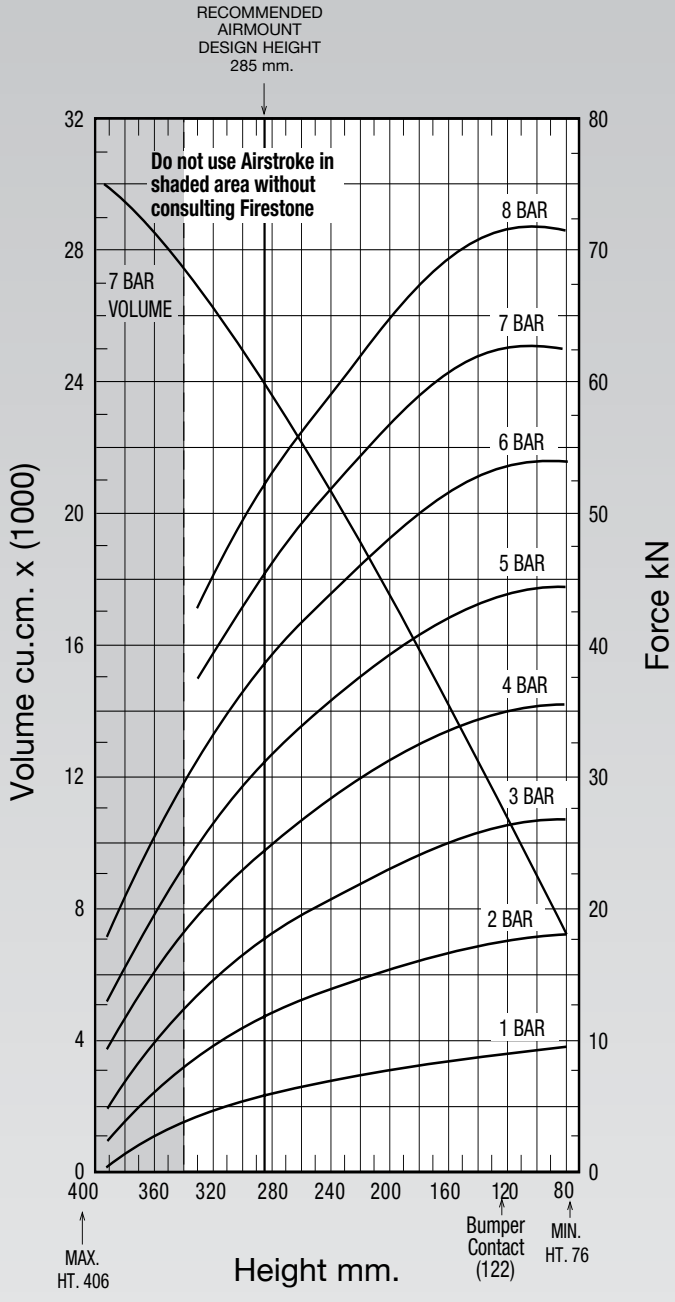
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 233-2 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6107
	Blind nuts, 3/4 BSP	W01-M58-6109
Assembly weight.....8.89 kg.		
Force to collapse to minimum height (@ 0 BAR) 455 N.		



NOTE: The bellows extends beyond the bead plates at minimum height.

NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 285 mm Design Height
(Required for Airmount isolator design only)

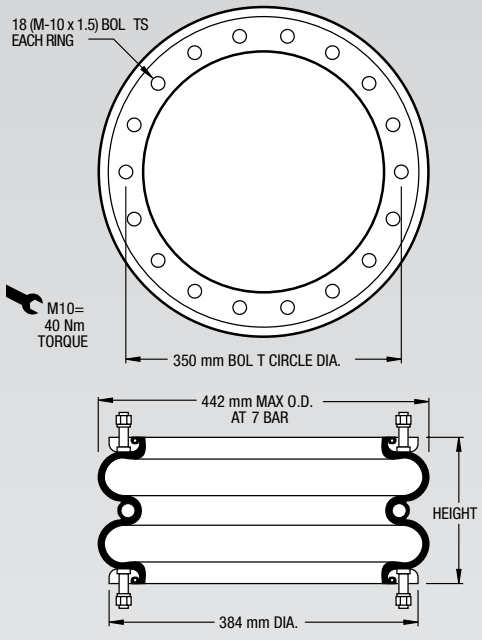
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	17.48	164	1.53
4	24.14	208	1.46
5	30.73	251	1.43
6	38.28	299	1.39
7	45.04	345	1.38

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
320	26309	560	14.44	20.52	26.35	33.20	39.23
280	23714	653	17.82	24.56	31.24	38.87	45.73
240	20846	729	20.39	27.85	35.13	43.41	51.04
200	17673	799	22.69	30.81	38.73	47.65	55.94
160	14250	859	24.68	33.30	41.87	51.34	60.11
120	10748	892	25.94	34.86	43.76	53.44	62.41
80	6382	889	26.62	35.40	44.31	53.60	62.25

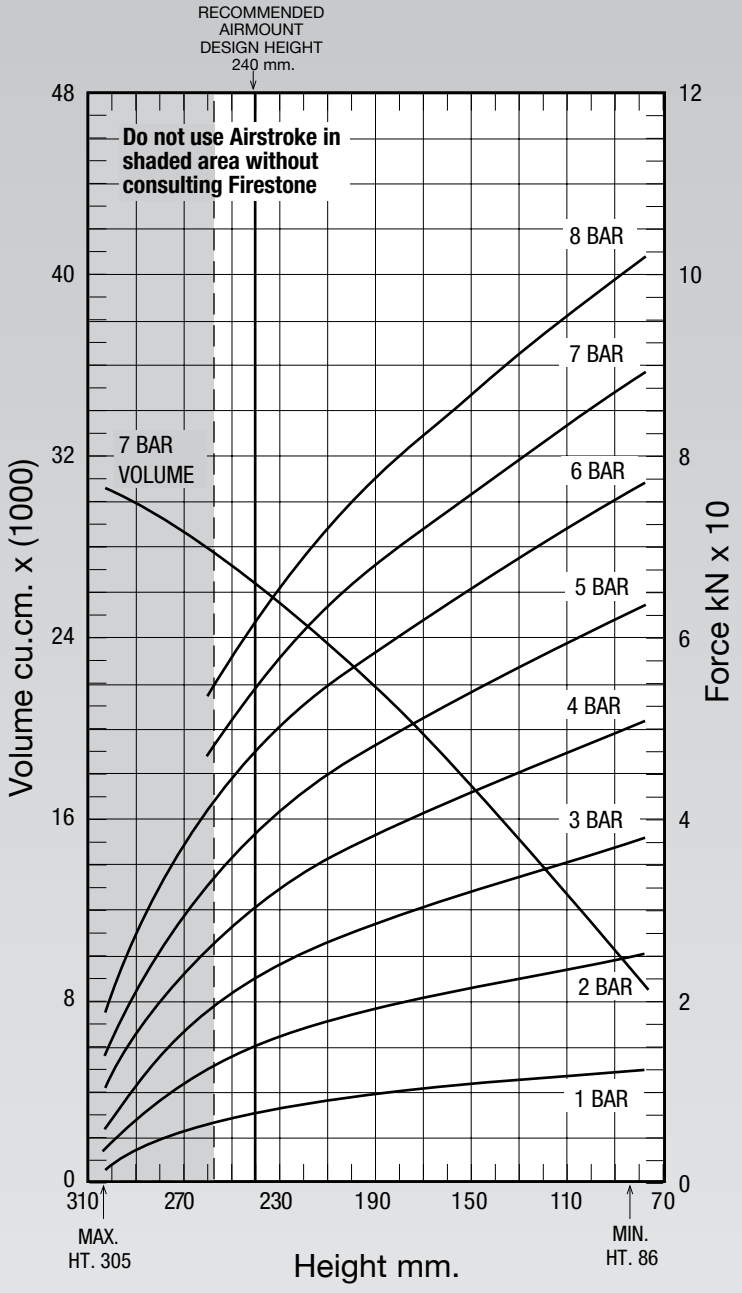
NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 28 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-7531
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7271
	Rubber bellows only	W01-358-7925
Assembly weight.....8.62 kg.		
Force to collapse to minimum height (@ 0 BAR) 169 N.		
Style 201 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 50 mm bolts, nuts, washers	W01-358-7244
	Rubber bellows only	W01-358-0201



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	22.15	295	1.82
4	30.14	376	1.76
5	38.05	460	1.73
6	46.65	542	1.70
7	54.48	618	1.68

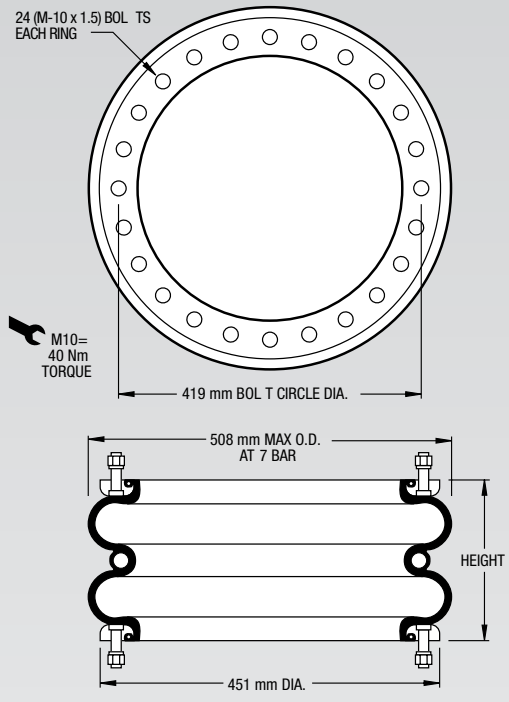
Force Table (Use for Airstroke™ actuator design)

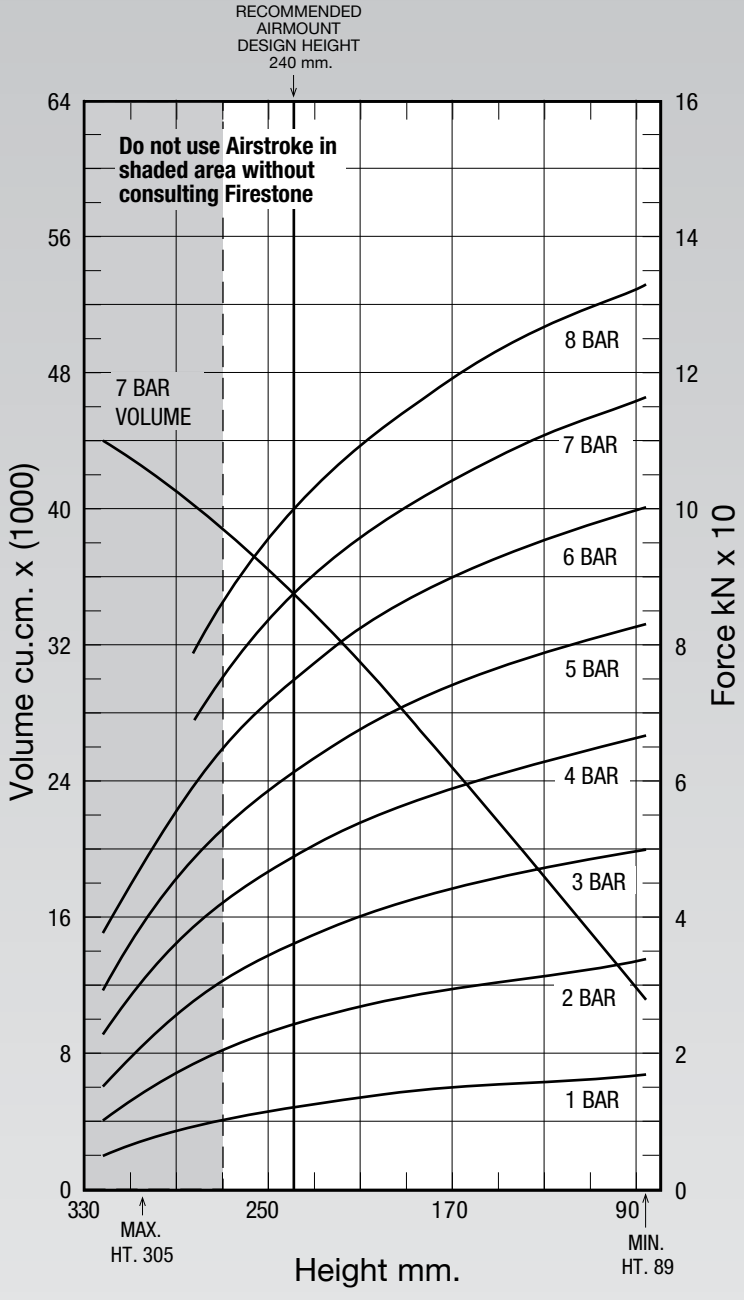
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
240	26073	778	22.15	30.14	38.05	46.65	54.48
220	24364	868	25.13	33.95	42.75	52.16	60.76
200	22432	942	27.57	37.08	46.61	56.69	65.96
180	20346	1006	29.58	39.70	49.85	60.54	70.38
160	18120	1062	31.33	42.02	52.74	63.99	74.36
140	15772	1118	32.97	44.25	55.56	67.37	78.24
120	13395	1175	34.68	46.56	58.50	70.87	82.21
100	10932	1231	36.48	48.90	61.43	74.35	86.18

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 203 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6985
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7767
	Rubber bellows only	W01-358-0205
Assembly weight.....10.80 kg.		
Force to collapse to minimum height (@ 0 BAR) 178 N.		

Style 218 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6986
	Rubber bellows only	W01-358-0219





See page 12 for instructions on how to use chart.

NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	35.98	409	1.68
4	48.73	516	1.62
5	61.33	627	1.60
6	74.72	745	1.57
7	86.97	856	1.56

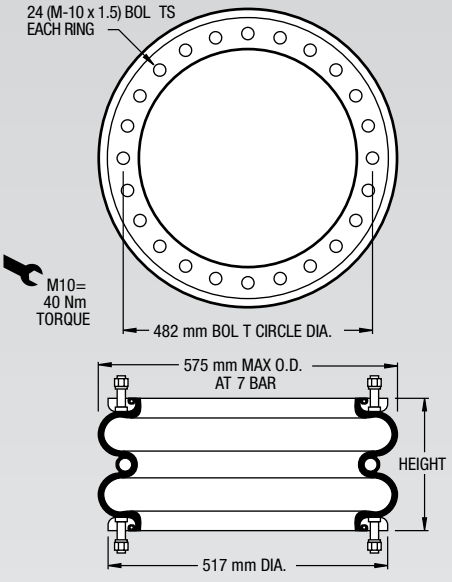
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
260	37836	1132	32.38	44.21	55.77	68.08	79.26
240	35328	1243	35.98	48.73	61.33	74.72	86.97
220	32638	1331	38.91	52.40	65.84	80.08	93.18
200	29694	1404	41.34	55.43	69.58	84.51	98.30
180	26610	1467	43.38	57.99	72.78	88.32	102.65
160	23416	1520	45.15	60.21	75.56	91.62	106.42
140	20139	1567	46.72	62.20	77.99	94.46	109.68
120	16912	1607	48.13	64.04	80.11	96.86	112.48

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

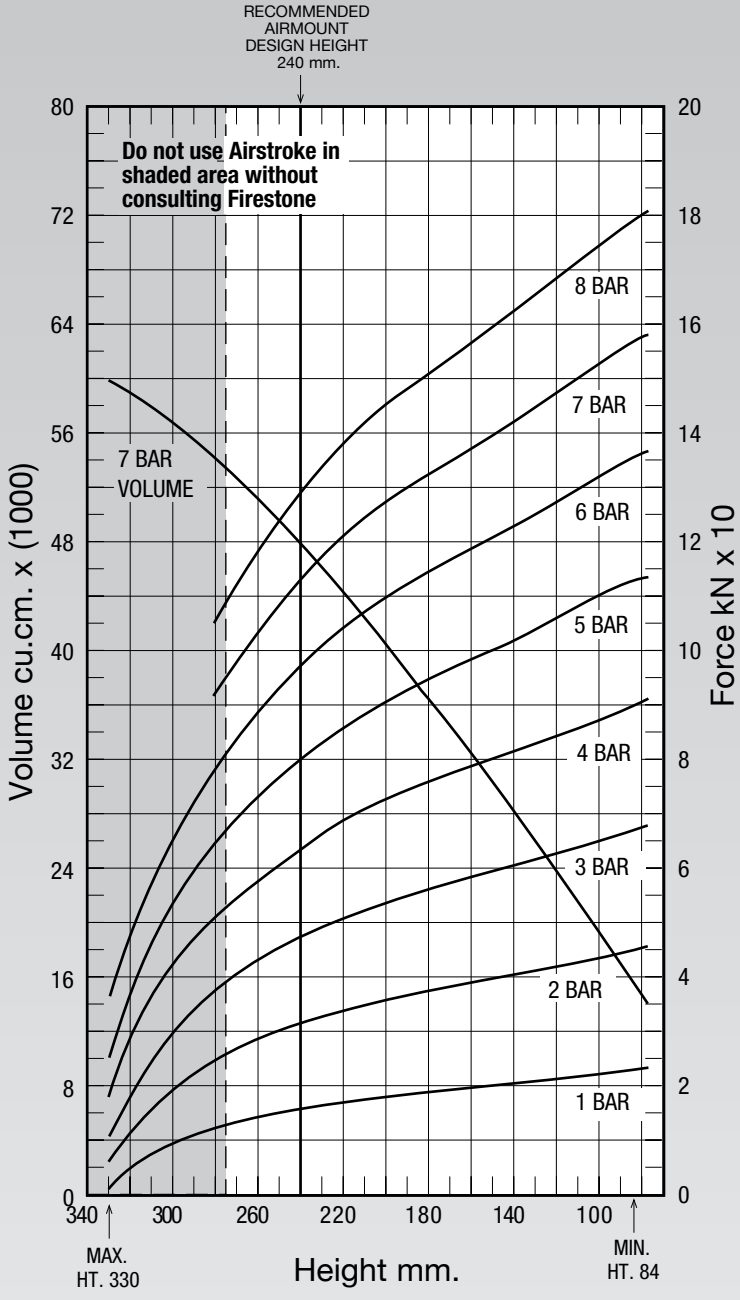
	Description	Assembly Order No.
Style 29 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-7532
	Rolled plate assembly, 1/2 blind nuts, 3/4 BSP	W01-358-7275
	Rubber bellows only	W01-358-7902
Assembly weight.....13.06 kg.		
Force to collapse to minimum height (@ 0 BAR) 311 N.		

Style 207 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6987
	Rubber bellows only	W01-358-0207



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

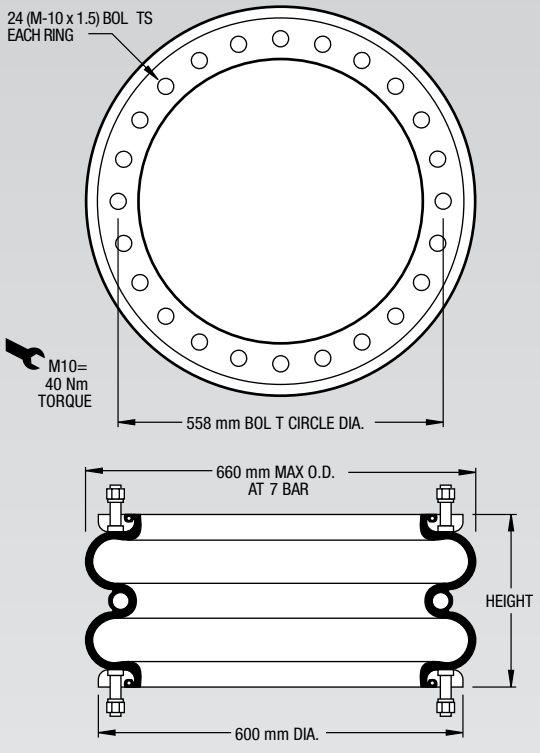
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	47.12	497	1.62
4	63.62	663	1.61
5	80.06	795	1.57
6	97.40	923	1.54
7	113.25	1050	1.52

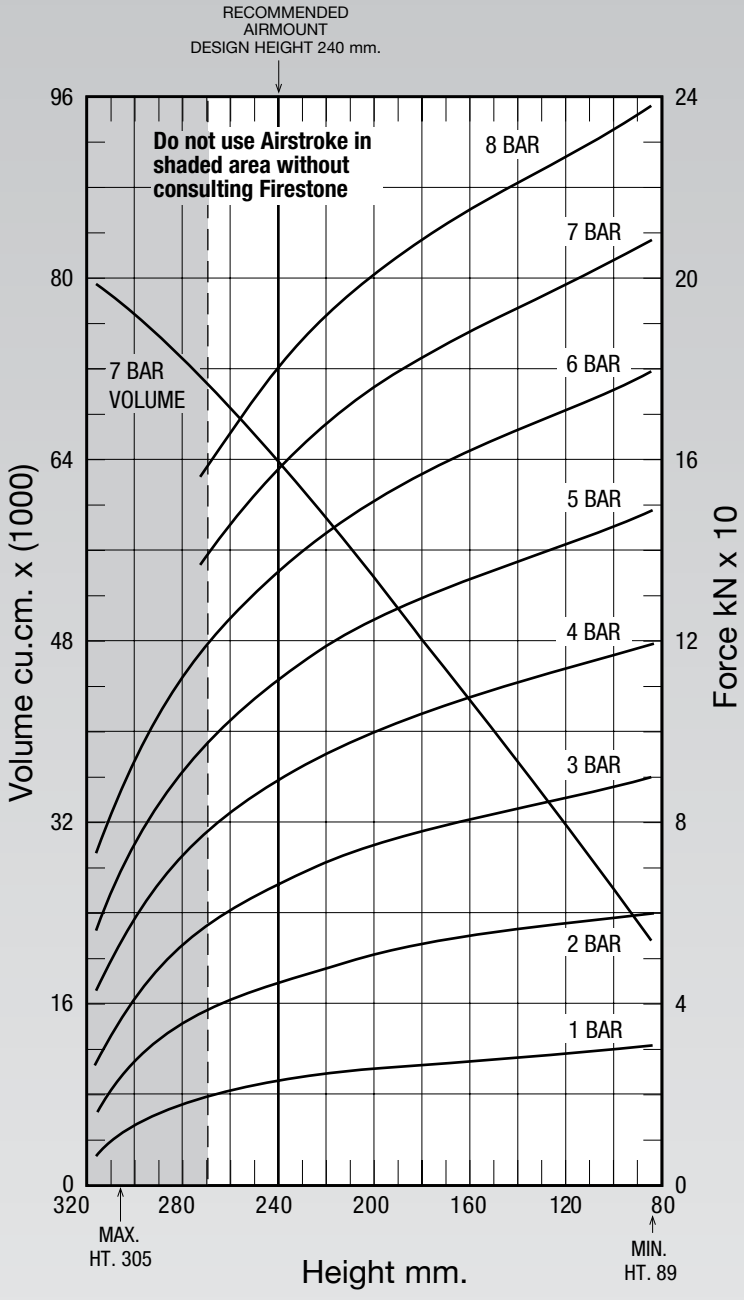
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
280	53863	1317	37.03	50.72	64.11	78.82	92.17
240	47704	1618	47.12	63.62	80.06	97.40	113.25
200	40443	1814	53.26	72.74	90.77	109.45	127.00
160	32306	1962	57.95	78.61	98.18	118.39	137.31
120	23824	2110	62.84	84.57	105.81	127.52	147.69
80	15280	2255	67.74	90.95	113.48	136.38	157.84

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 200 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6979
	Rubber bellows only	W01-358-5126
Assembly weight.....15.83 kg.		
Force to collapse to minimum height (@ 0 BAR) 445 N.		





See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

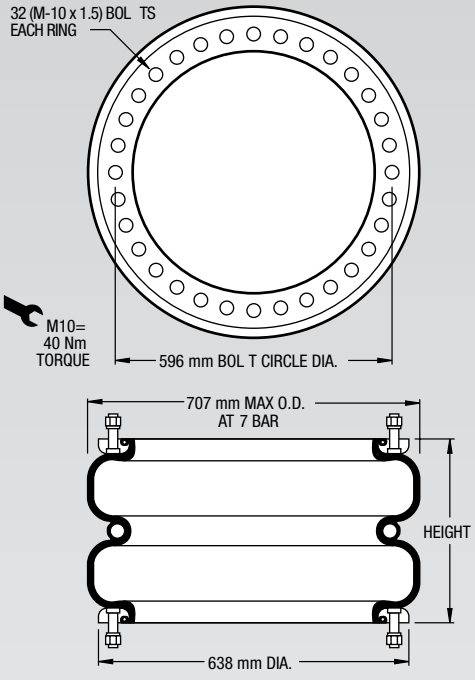
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	65.60	710	1.64
4	88.20	903	1.60
5	110.53	1091	1.57
6	134.38	1290	1.54
7	156.56	1480	1.53

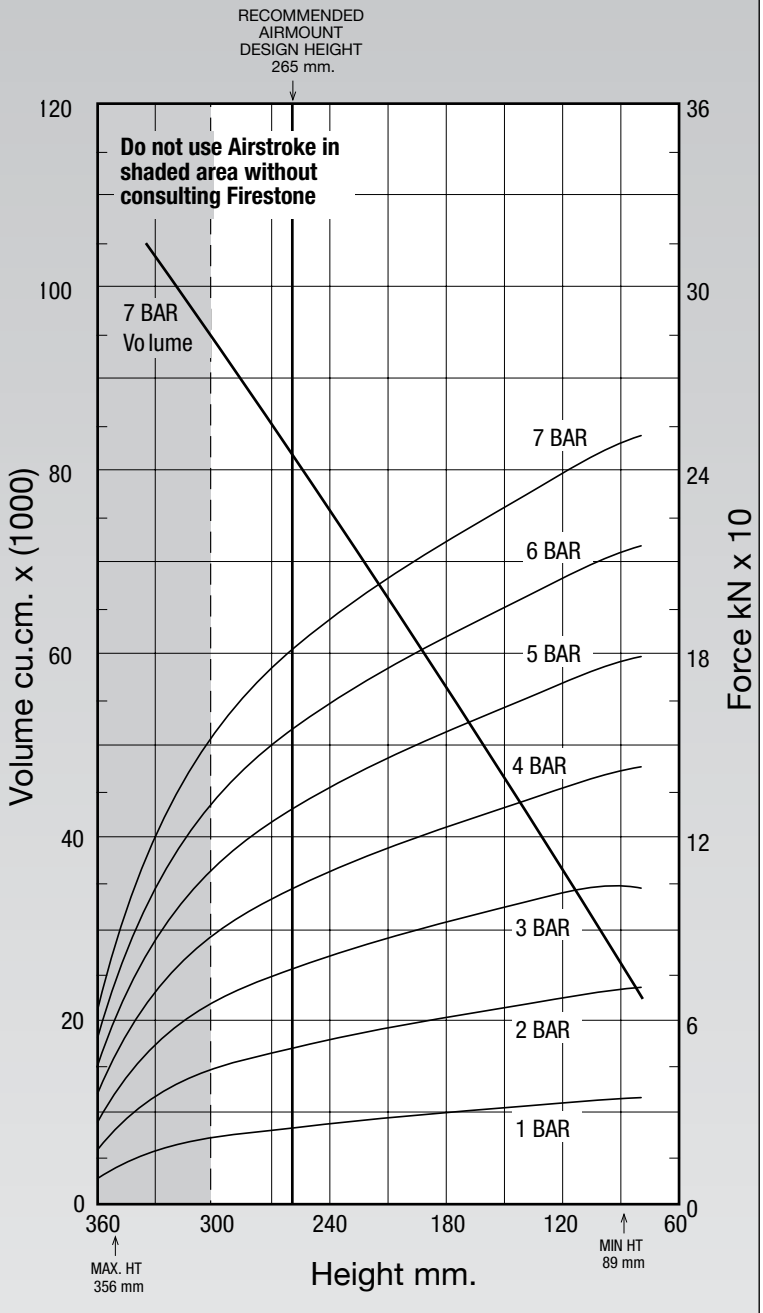
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
260	68626	2057	59.56	80.57	101.22	123.62	143.98
240	64100	2237	65.60	88.20	110.53	134.38	156.56
220	59270	2384	70.27	94.34	117.99	143.23	166.86
200	54018	2503	74.03	99.30	124.00	150.38	175.20
180	48552	2599	77.11	103.27	128.85	156.12	181.87
160	42927	2678	79.74	106.59	132.92	160.96	187.47
140	37197	2754	82.19	109.71	136.77	165.54	192.76
120	31597	2835	84.73	113.02	140.90	170.45	198.42

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 215	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6978
High Strength Con-struction	Rubber bellows only	W01-358-7912
Assembly weight.....17.42 kg.		
Force to collapse to minimum height (@ 0 BAR) 712 N.		





See page 12 for instructions on how to use chart.

Dynamic Characteristics at 265 mm Design Height
(Required for Airmount isolator design only)

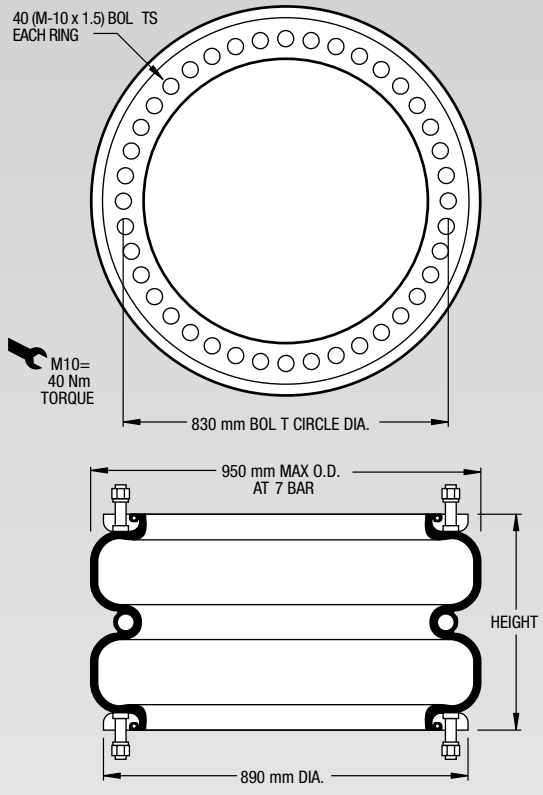
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	75.98	710	1.52
4	103.39	879	1.45
5	130.16	1077	1.43
6	158.58	1277	1.42
7	184.57	1458	1.40

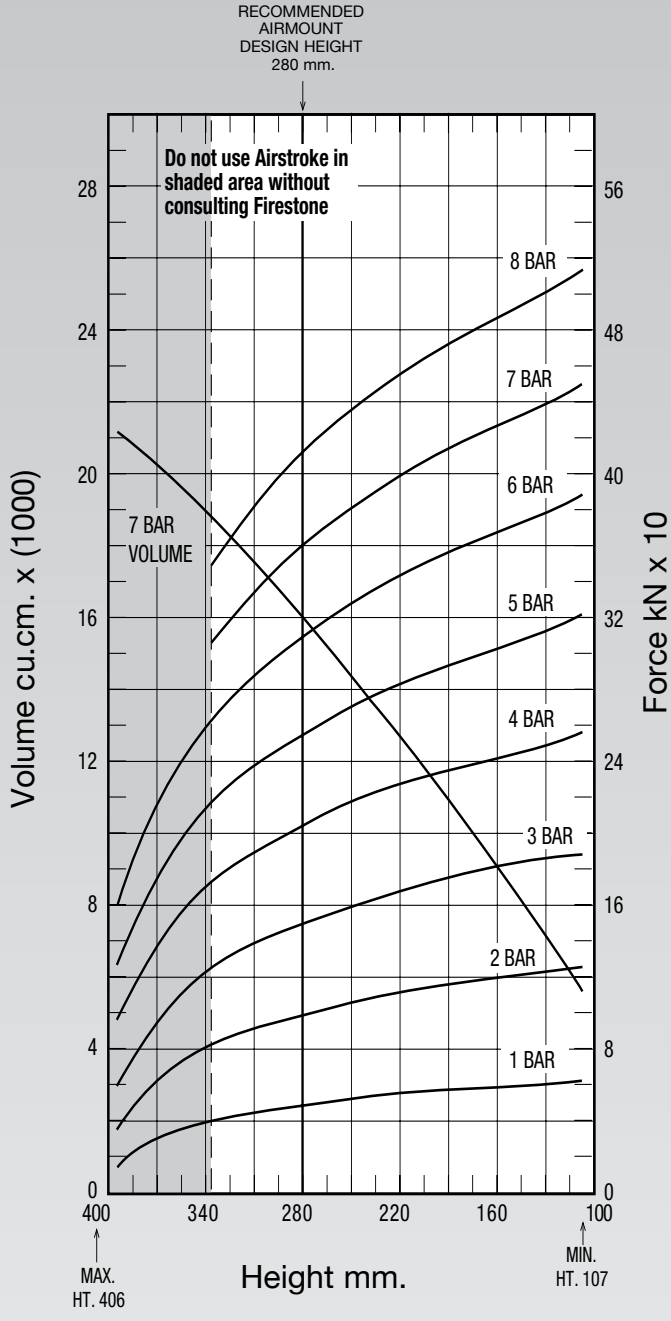
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
280	87025	2517	71.76	98.42	123.96	151.24	176.18
240	76206	2804	81.69	110.16	138.72	168.82	196.27
200	64214	3026	88.70	119.39	150.17	182.38	211.83
160	51165	3225	94.30	127.88	160.34	194.31	225.73
120	37635	3424	100.33	135.61	169.95	206.11	239.66
80	23815	3558	105.77	141.44	177.04	214.33	249.02

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 248-2	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6970
High Strength Con-struction	Rubber bellows only	W01-358-1022
Assembly weight.....32.88 kg.		
Force to collapse to minimum height (@ 0 BAR) 1556 N.		





NOTE: The effective length of the 45 mm bolt is 30 mm in this bead ring.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 280 mm Design Height
(Required for Airmount isolator design only)

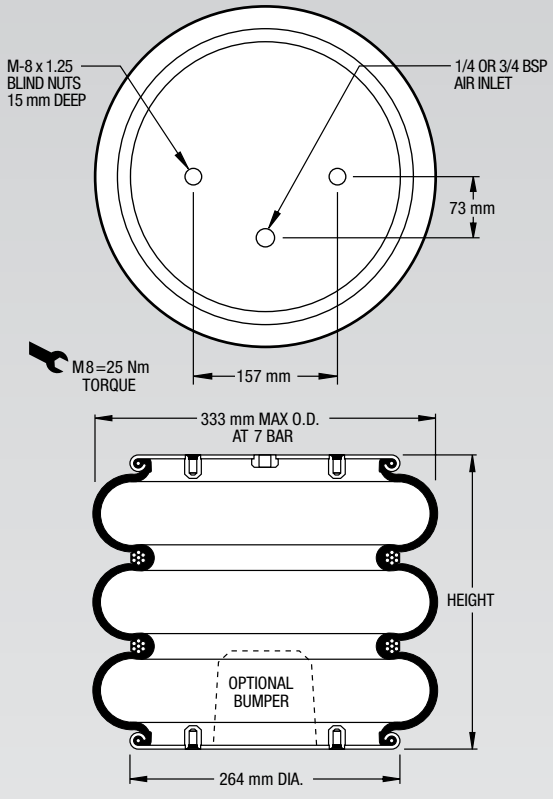
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	150.00	1245	1.44
4	204.75	1600	1.39
5	255.83	1923	1.37
6	309.73	2281	1.35
7	360.26	2628	1.35

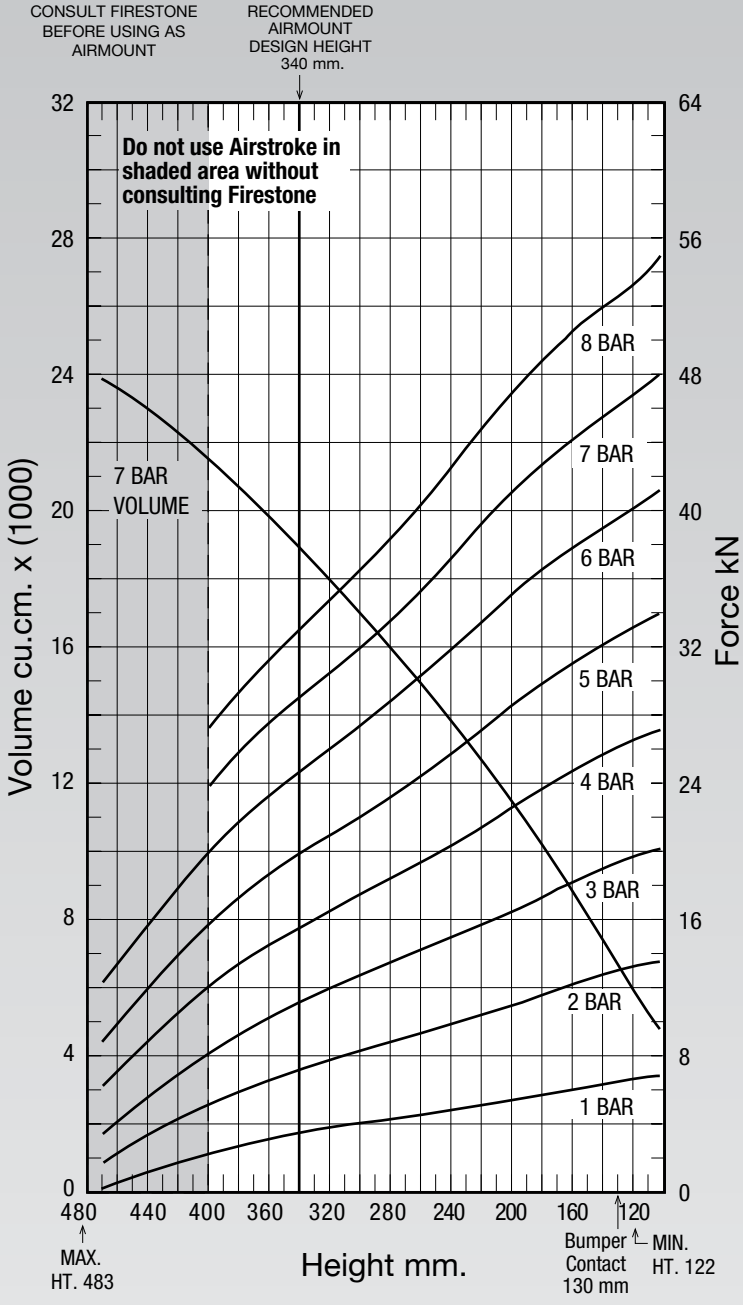
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
320	180105	4643	133.77	183.62	230.28	279.45	324.96
280	160037	5147	150.00	204.75	255.83	309.73	360.26
240	138633	5549	162.94	220.93	275.60	333.61	388.39
200	115452	5858	174.20	233.51	291.87	352.93	410.04
160	90693	6106	182.57	242.51	304.68	368.72	427.34
120	65396	6367	188.40	252.37	317.21	384.29	445.66

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 352 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6129
	Blind nuts, 3/4 BSP	W01-M58-6128
Assembly weight.....8.84 kg.		
Force to collapse to minimum height (@ 0 BAR) 900 N.		





NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 340 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	11.29	94	1.44
4	15.70	115	1.35
5	20.02	140	1.32
6	24.85	165	1.28
7	29.14	188	1.27

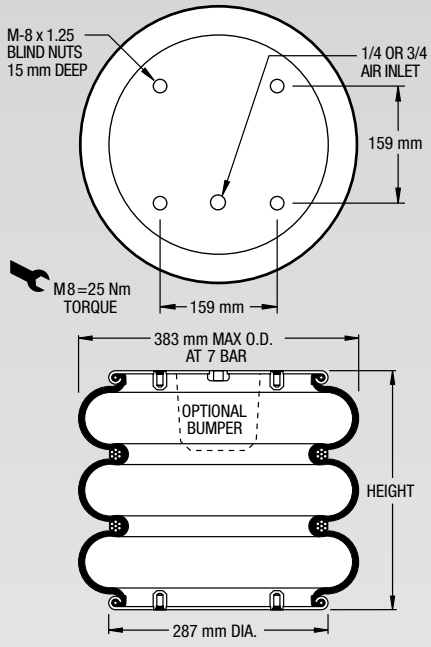
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
380	20777	370	9.42	13.56	17.44	21.95	25.89
340	19038	416	11.29	15.70	20.02	24.85	29.14
300	17069	459	12.88	17.53	22.29	27.49	32.13
260	14972	508	14.35	19.46	24.70	30.43	35.55
220	12695	563	15.87	21.65	27.37	33.68	39.40
180	10161	614	17.50	23.87	30.03	36.76	42.96
140	7445	652	19.13	25.76	32.28	39.20	45.65

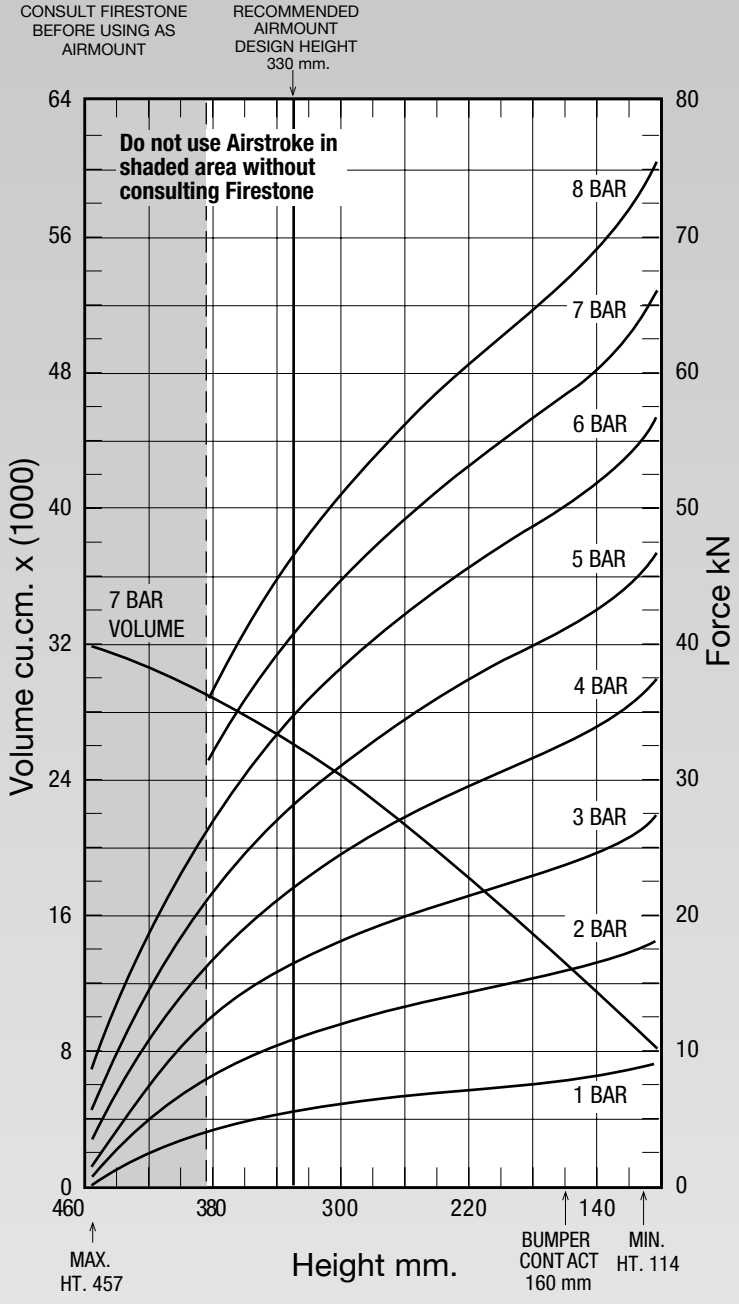
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 313 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6120
	Blind nuts, 1/4 BSP, bumper	W01-M58-6121
	Blind nuts, 3/4 BSP	W01-M58-6122
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-7526
	Rubber bellows only	W01-358-7900
Assembly weight.....8.84 kg.		
Force to collapse to minimum height (@ 0 BAR) 205 N.		

Style 39 High Strength Bellows	Blind nuts, 3/4 BSP	W01-M58-6130
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-7534



NOTE: This part is also available with bead rings (rather than bead plates.) SEE PAGE 8.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 330 mm Design Height
(Required for Airmount isolator design only)

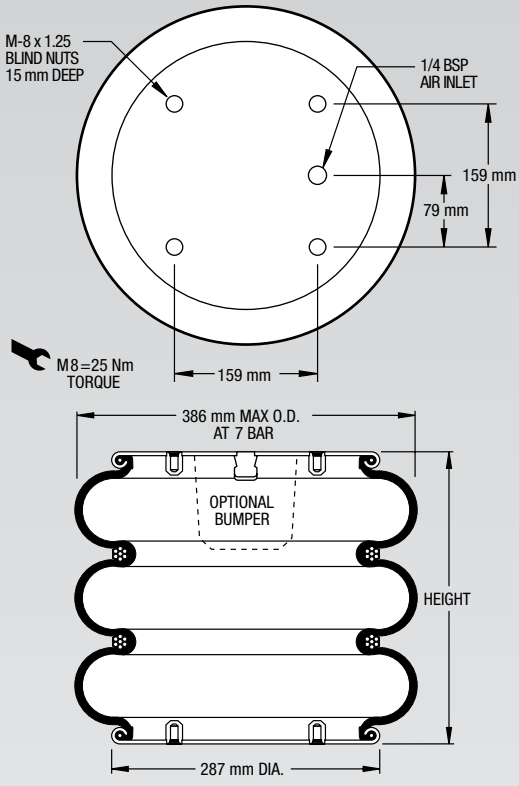
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	16.03	137	1.46
4	21.87	177	1.42
5	27.79	216	1.39
6	34.37	258	1.37
7	40.27	296	1.35

Force Table (Use for Airstroke™ actuator design)

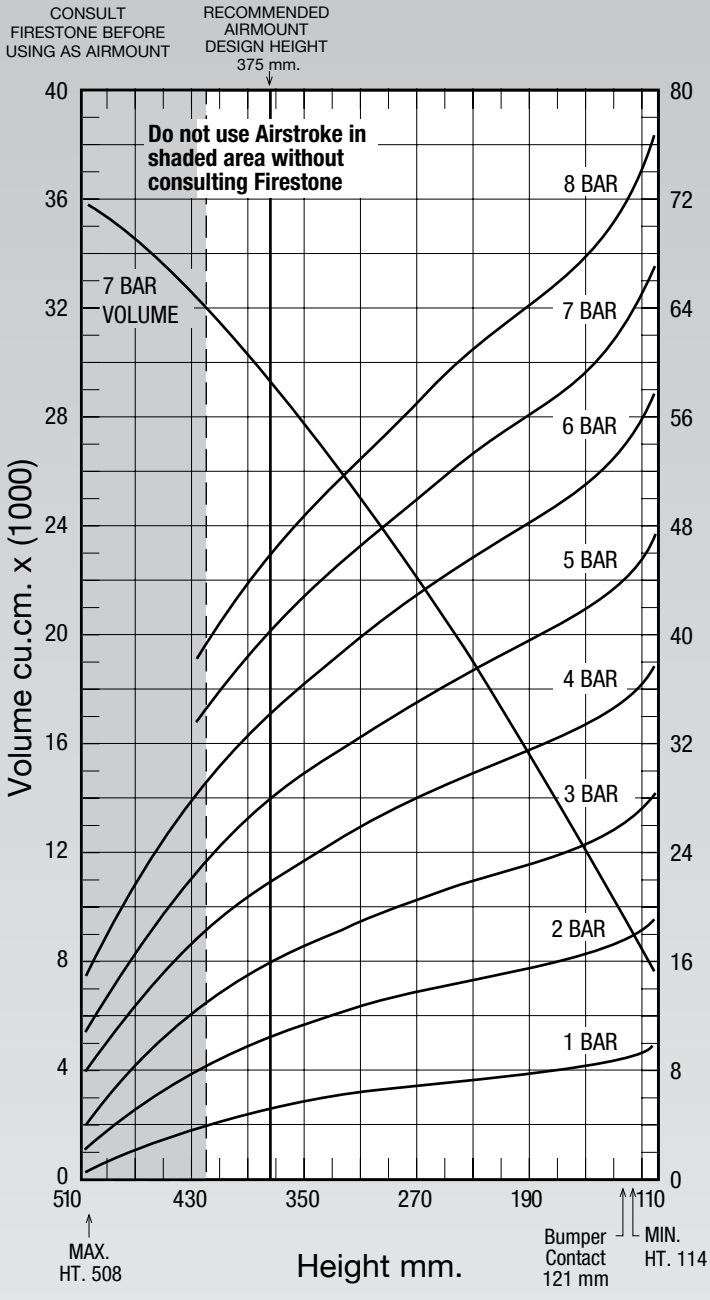
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
360	27730	507	13.81	18.98	24.25	30.20	35.45
320	25348	595	16.66	22.70	28.81	35.57	41.64
280	22676	666	18.89	25.65	32.47	39.90	46.59
240	19773	726	20.71	28.15	35.61	43.60	50.79
200	16583	778	22.22	30.33	38.33	46.80	54.44
160	13143	827	23.59	32.39	40.82	49.74	57.85
120	9602	890	25.58	35.07	44.05	53.55	62.29

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 333 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6136
	Blind nuts, 1/4 BSP, rubber bumper	W01-M58-6138
	Blind nuts, 3/4 BSP	W01-M58-6137
	Countersunk steel bead rings, 40 mm bolts, nuts, washers	W01-M58-7535
	Rubber bellows only	W01-358-7019
Assembly weight.....11.16 kg.		
Force to collapse to minimum height (@ 0 BAR) 289 N.		



NOTE: A bead plate part is shown. This part is also available with bead rings. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 375 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	15.75	115	1.35
4	21.81	148	1.30
5	27.65	179	1.27
6	34.16	210	1.24
7	40.04	239	1.22

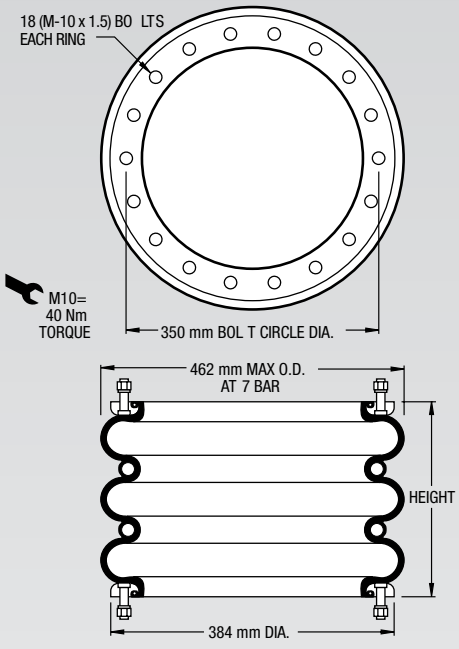
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
420	31923	492	12.82	18.18	23.24	29.16	34.43
380	29684	565	15.48	21.47	27.24	33.69	39.51
340	27147	623	17.53	24.08	30.38	37.29	43.60
300	24321	676	19.30	26.37	33.16	40.53	47.32
260	21367	727	20.90	28.46	35.74	43.60	50.87
220	18224	773	22.32	30.31	38.06	46.41	54.12
180	14802	815	23.58	31.93	40.12	48.91	57.03
140	11225	864	25.14	33.87	42.56	51.89	60.49

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

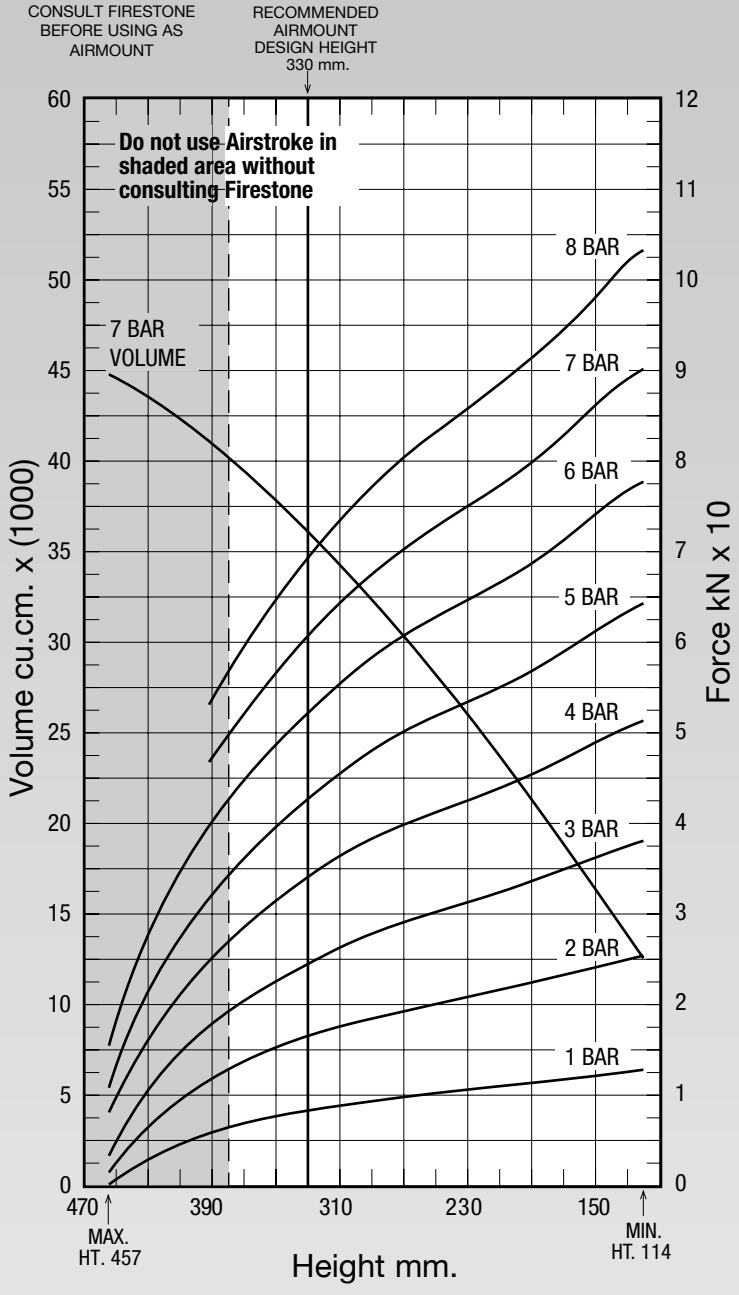
	Description	Assembly Order No.
Style 312	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-7530
Two Ply Bellows	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7286
	Rubber bellows only	W01-358-7914
Assembly weight.....11.25 kg.		
Force to collapse to minimum height (@ 0 BAR) 600 N.		

Style 314	Aluminum ribbed neck bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6981
High Strength Con-struction	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-8009
	Rubber bellows only	W01-358-7926



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 330 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	24.56	204	1.44
4	33.97	270	1.40
5	42.68	328	1.38
6	51.90	385	1.36
7	60.40	438	1.34

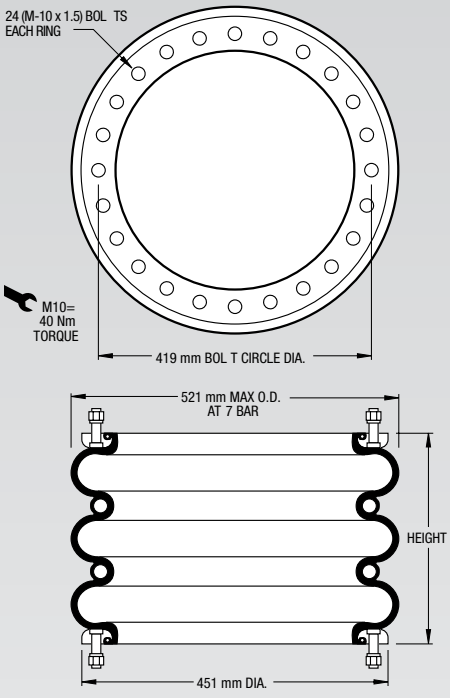
Force Table (Use for Airstroke™ actuator design)

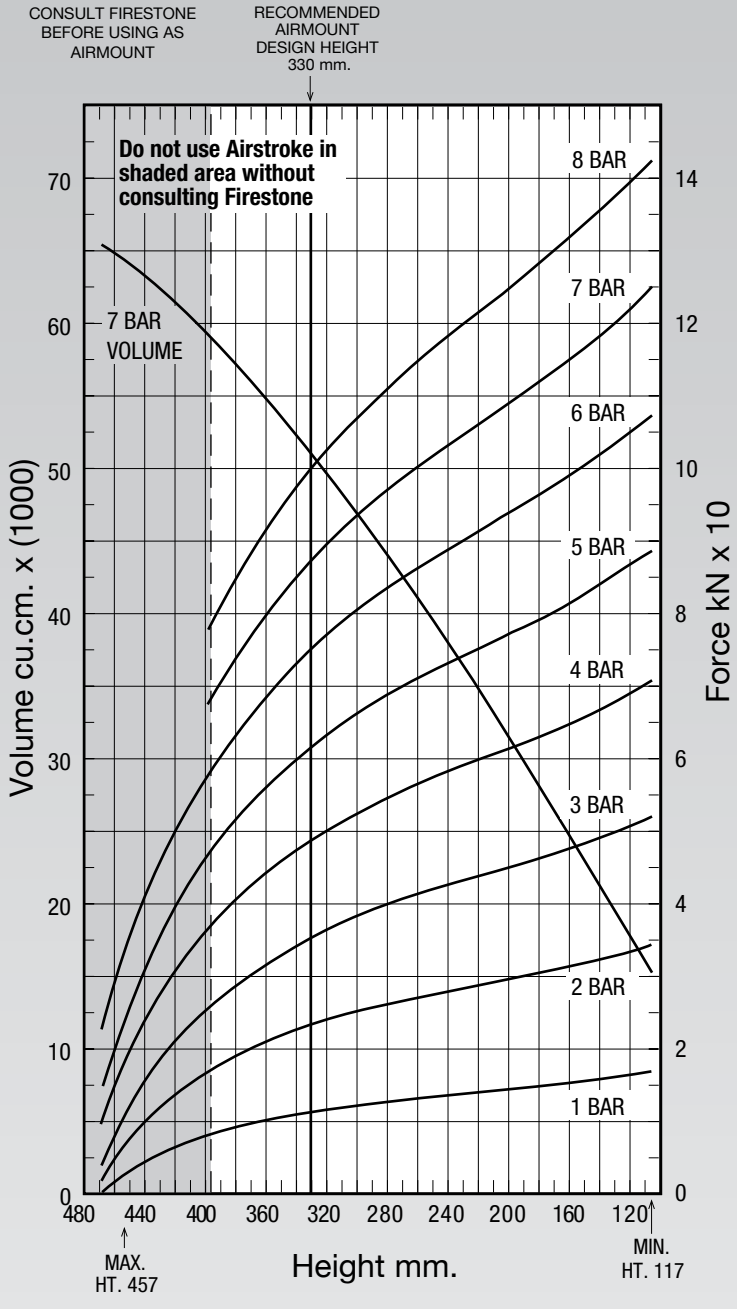
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
360	38788	772	21.55	29.90	37.73	46.24	54.00
320	35273	890	25.42	35.13	44.10	53.57	62.30
280	31368	984	28.40	39.00	48.94	59.32	68.90
240	27154	1056	30.78	41.90	52.50	63.61	73.91
200	22558	1123	33.01	44.63	55.85	67.62	78.58
160	17629	1207	35.55	47.98	60.10	72.74	84.47
120	8017	1290	38.09	51.39	64.29	77.75	90.31

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 323 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6980
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-7274
	Rubber bellows only	W01-358-7921
Assembly weight .....14.11 kg.		
Force to collapse to minimum height (@ 0 BAR) 311 N.		

Style 324 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6968
	Rubber bellows only	W01-358-0324





NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.

See page 12 for instructions on how to use chart.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*

Dynamic Characteristics at 330 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	35.44	282	1.41
4	48.94	359	1.35
5	61.63	439	1.33
6	75.25	519	1.31
7	87.73	591	1.29

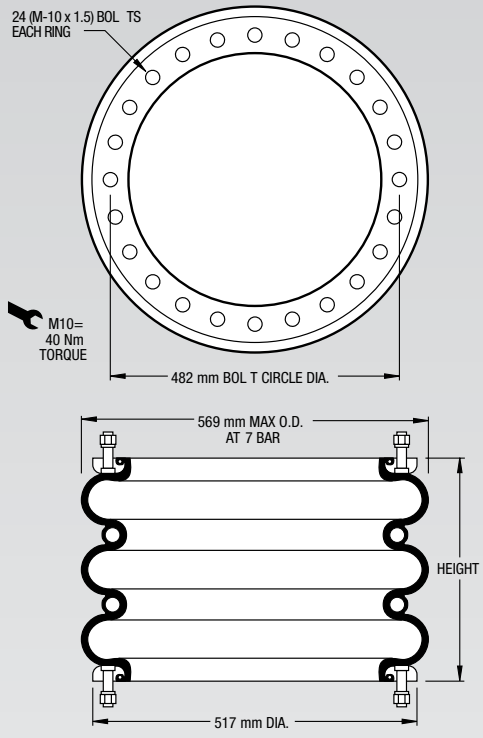
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
390	58273	1014	27.34	38.66	49.98	60.53	70.98
350	53588	1185	33.11	46.04	58.01	71.01	82.92
310	48222	1314	37.50	51.49	64.81	79.00	91.98
270	42438	1416	40.88	55.72	70.14	85.30	99.14
230	36340	1503	43.49	59.18	74.48	90.52	105.18
190	29824	1585	45.86	62.40	78.51	95.46	110.96
150	22961	1676	48.67	66.06	83.04	100.93	117.33

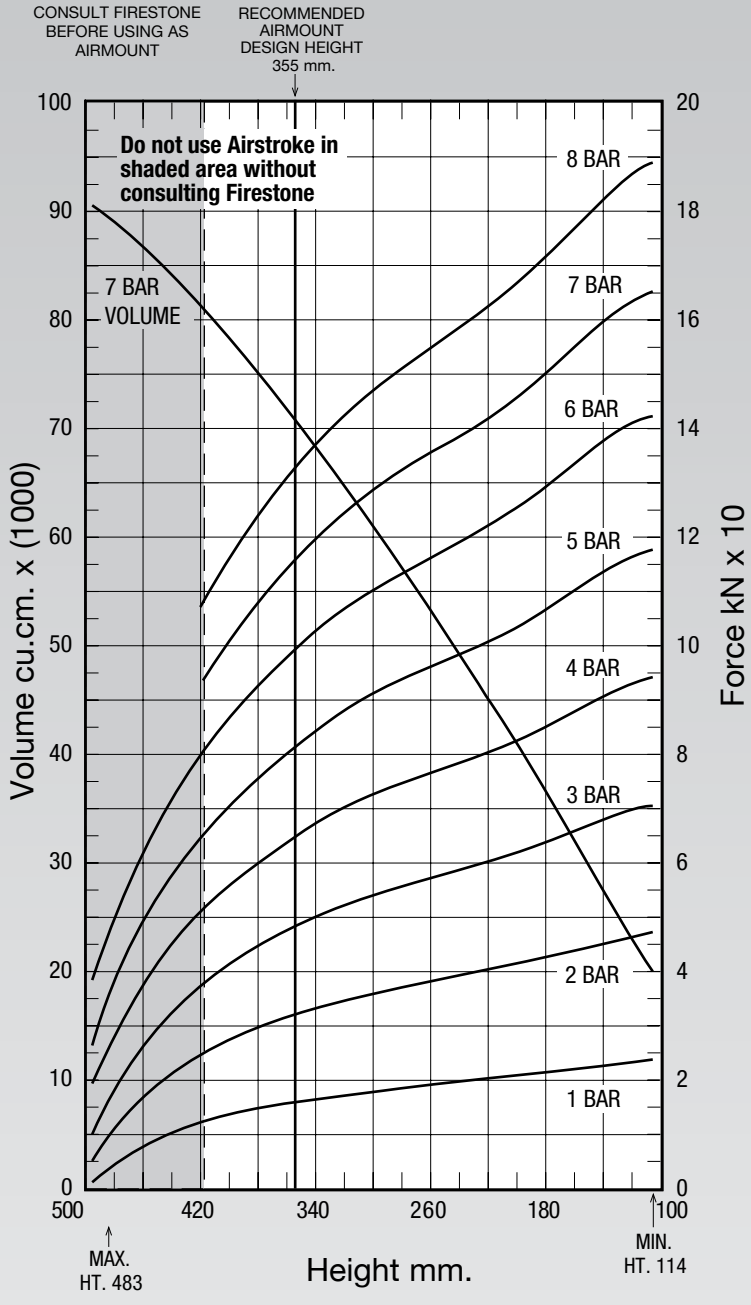
NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 320 Two Ply Bellows	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6983
	Rolled plate assembly, 1/2 blind nuts, 3/4 NPT	W01-358-0987
	Rubber bellows only	W01-358-7276
Assembly weight.....16.47 kg.		
Force to collapse to minimum height (@ 0 BAR) 400 N.		

Style 328 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6967
	Rubber bellows only	W01-358-1002



NOTE: A bead ring part is shown. This part is also available with rolled plates. See page 11 for explanation.



See page 12 for instructions on how to use chart.

**Increase the minimum height by 18 mm. Add 18 mm to the height (bottom axis) before reading loads.*

Dynamic Characteristics at 355 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	48.24	346	1.34
4	64.83	443	1.30
5	81.41	537	1.28
6	99.02	630	1.26
7	115.27	717	1.24

Force Table (Use for Airstroke™ actuator design)

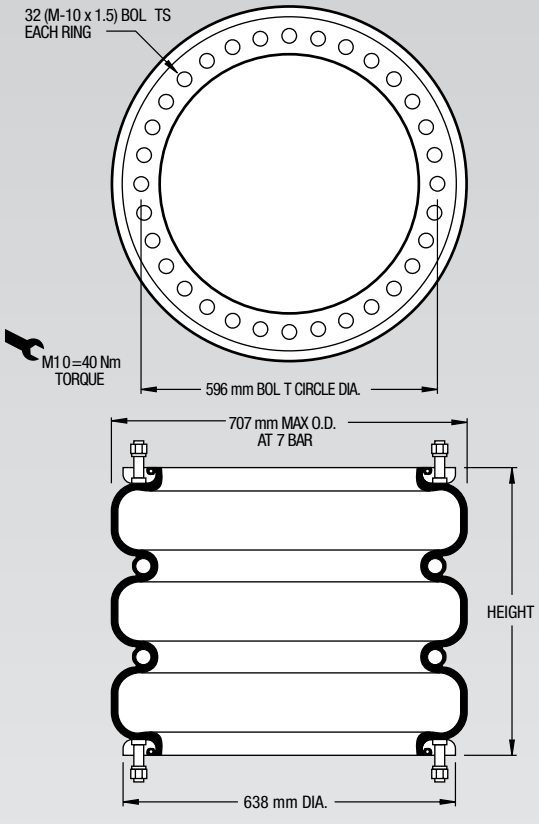
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
390	76680	1494	43.07	58.16	73.24	89.57	104.53
350	70136	1667	48.89	65.68	82.46	100.23	116.64
310	62881	1800	53.25	71.41	89.51	108.46	126.01
270	55222	1905	56.54	75.68	94.82	114.81	133.36
230	47253	2001	59.44	79.34	99.42	120.50	140.03
190	38794	2109	62.84	83.60	104.80	127.04	147.64
150	29903	2239	67.09	89.06	111.57	135.01	156.73

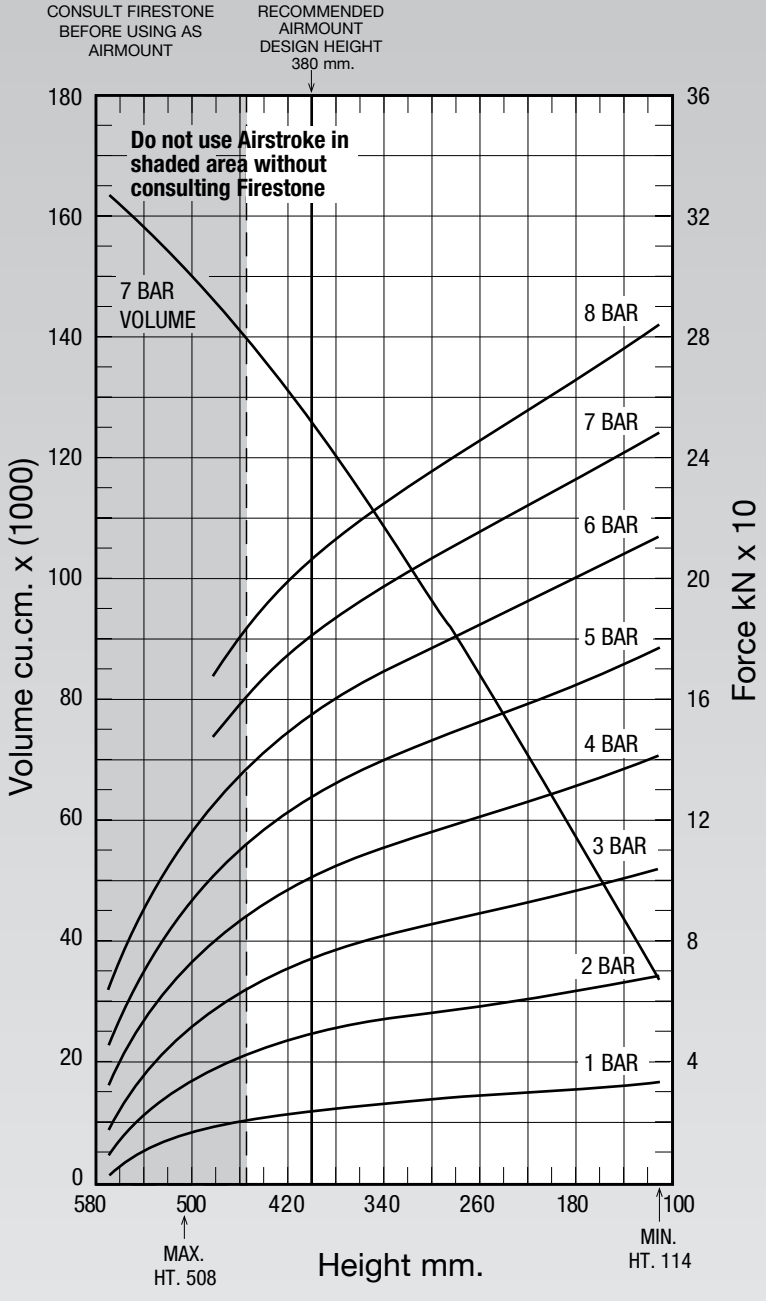
NOTE: Replacement for Style 319

321 Firestone AIRSTROKE™ ACTUATORS AIRMOUNT™ ISOLATORS

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 321	Aluminum ribbed neck bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6984
High Strength Con-struction	Rubber bellows only	W01-358-7919
Assembly weight.....23.2 kg.		
Force to collapse to minimum height (@ 0 BAR) 800 N.		





See page 12 for instructions on how to use chart.

Dynamic Characteristics at 380 mm Design Height
(Required for Airmount isolator design only)

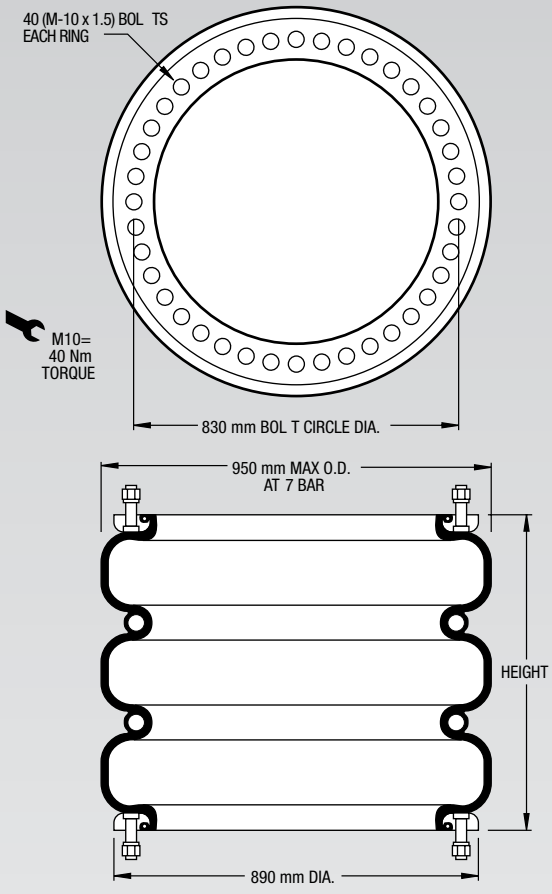
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	77.48	465	1.22
4	104.95	592	1.18
5	132.00	716	1.16
6	160.98	839	1.14
7	187.60	954	1.12

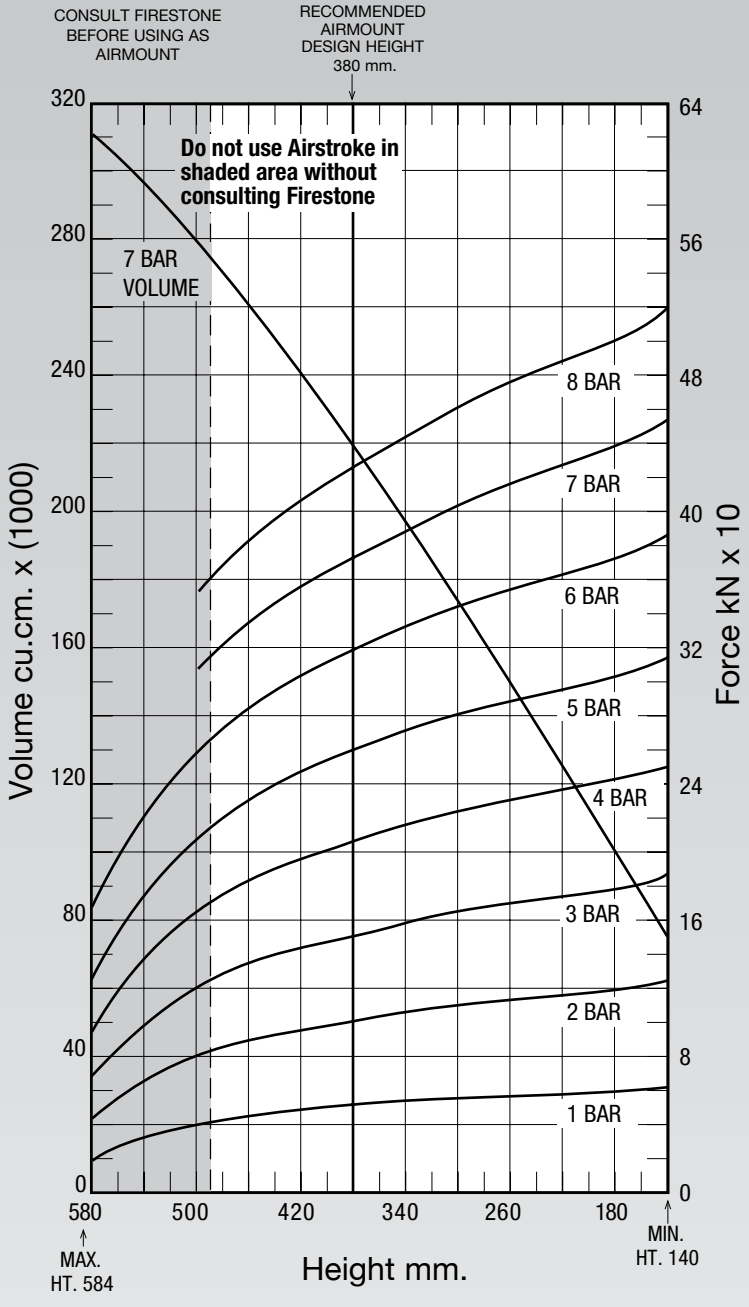
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq.)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
440	135784	2394	67.39	92.19	116.52	143.26	167.54
400	125615	2596	74.50	101.14	127.36	155.70	181.66
360	114722	2757	80.12	108.37	136.16	165.72	192.94
320	102796	2897	84.65	114.48	143.61	174.35	202.76
280	90465	3026	88.33	119.71	150.09	182.12	211.80
240	77839	3151	91.63	124.49	156.08	189.54	220.56
200	64589	3277	95.16	129.35	162.19	197.05	229.36
160	50778	3407	99.35	134.85	168.98	204.99	238.43

NOTE: All Assembly Order Numbers are for bead ring parts unless noted otherwise.

	Description	Assembly Order No.
Style 348-3 High Strength Con-struction	Ribbed neck aluminum bead rings (equal spacing), 45 mm bolts, nuts, washers	W01-M58-6971
	Rubber bellows only	W01-358-1023
Assembly weight.....47.13 kg.		
Force to collapse to minimum height (@ 0 BAR).....1690 N.		





See page 12 for instructions on how to use chart.

NOTE: The effective length of the 45 mm bolt is 23 mm in this bead ring.

Dynamic Characteristics at 380 mm Design Height
(Required for Airmount isolator design only)

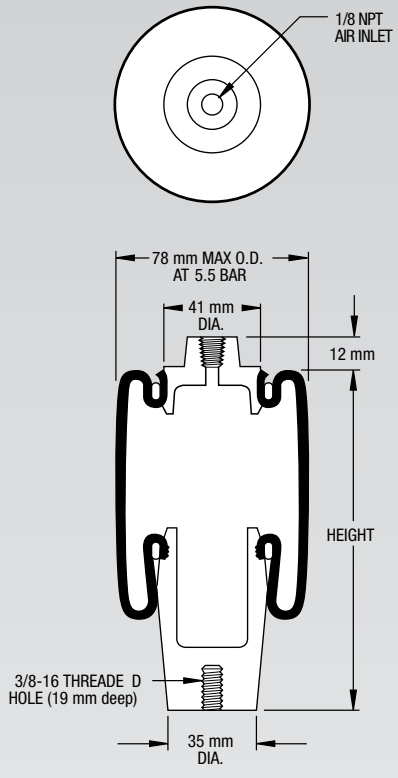
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	150.16	853	1.19
4	204.95	1110	1.16
5	258.67	1358	1.14
6	317.66	1614	1.12
7	371.47	1839	1.11

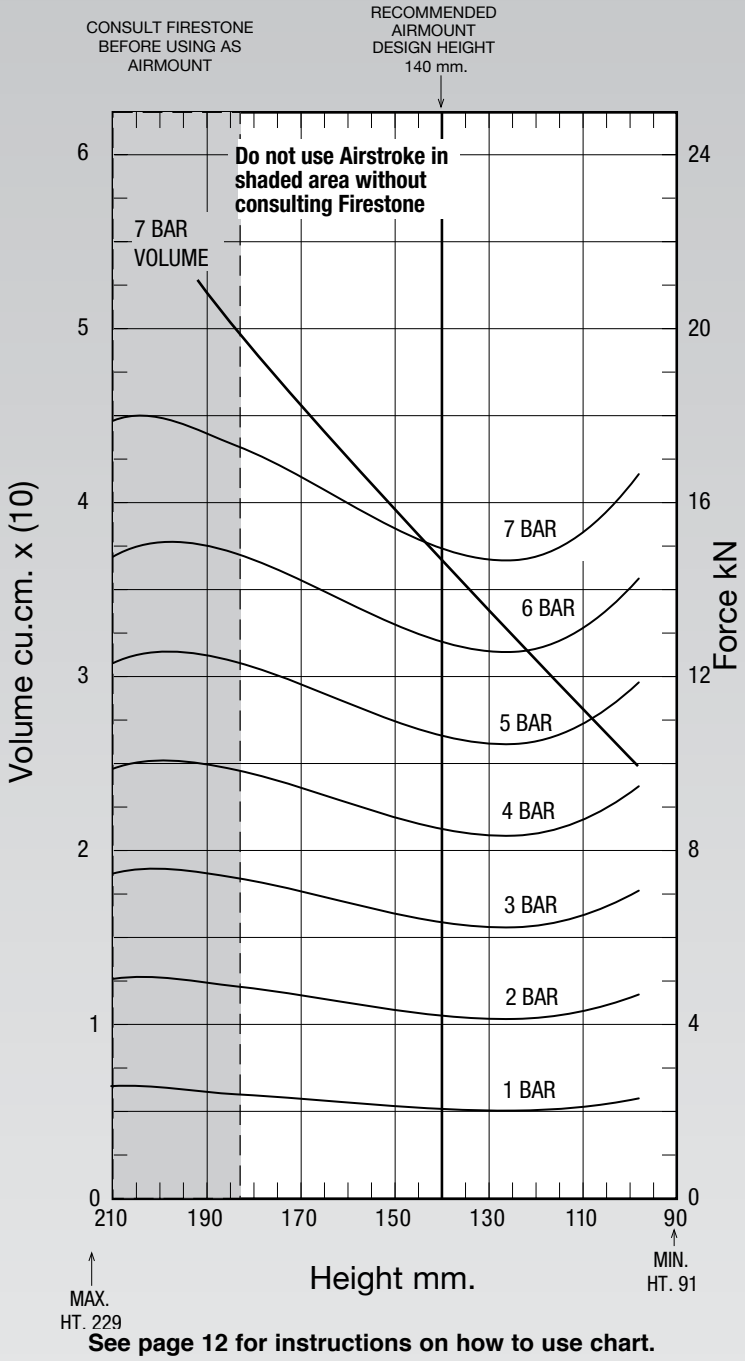
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
480	270750	4561	127.37	173.02	217.83	270.35	319.21
440	250951	4919	138.66	188.24	237.29	292.98	344.32
400	230507	5189	146.63	199.91	252.25	310.21	363.21
360	208945	5418	153.57	209.53	264.45	324.50	379.23
320	185692	5635	160.48	217.86	274.75	337.23	394.37
280	161999	5837	166.81	225.16	283.33	348.39	408.53
240	138075	6014	171.63	231.86	290.68	357.85	420.92
200	113324	6165	175.04	238.45	297.89	366.36	431.46
160	87906	6334	180.41	245.13	306.87	377.11	443.32

	Description	Assembly Order No.
Style 4004 Two Ply Bellows	Blind nuts, 1/8 NPT	W02-358-4004
Assembly weight . . . . . .45 kg.		

NOTE: Standard assembly is imperial.





NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 140 mm Design Height
(Required for Airmount isolator design only)

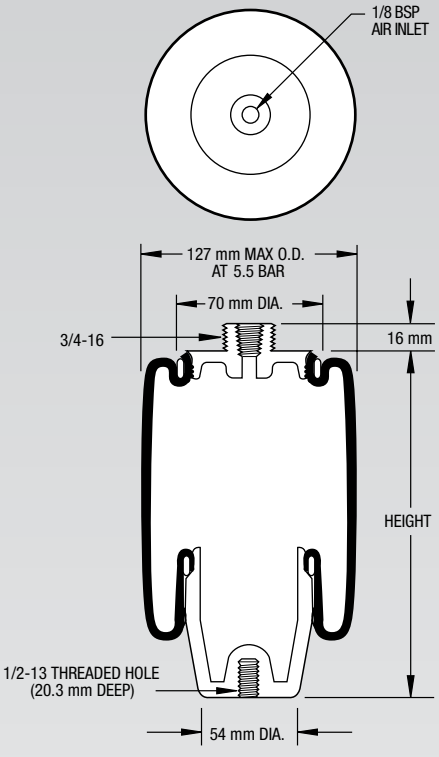
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
4	9.1	9.63	1.88
5	11.1	12.25	1.78
6	13.4	15.93	1.74
7	15.6	17.3	1.59

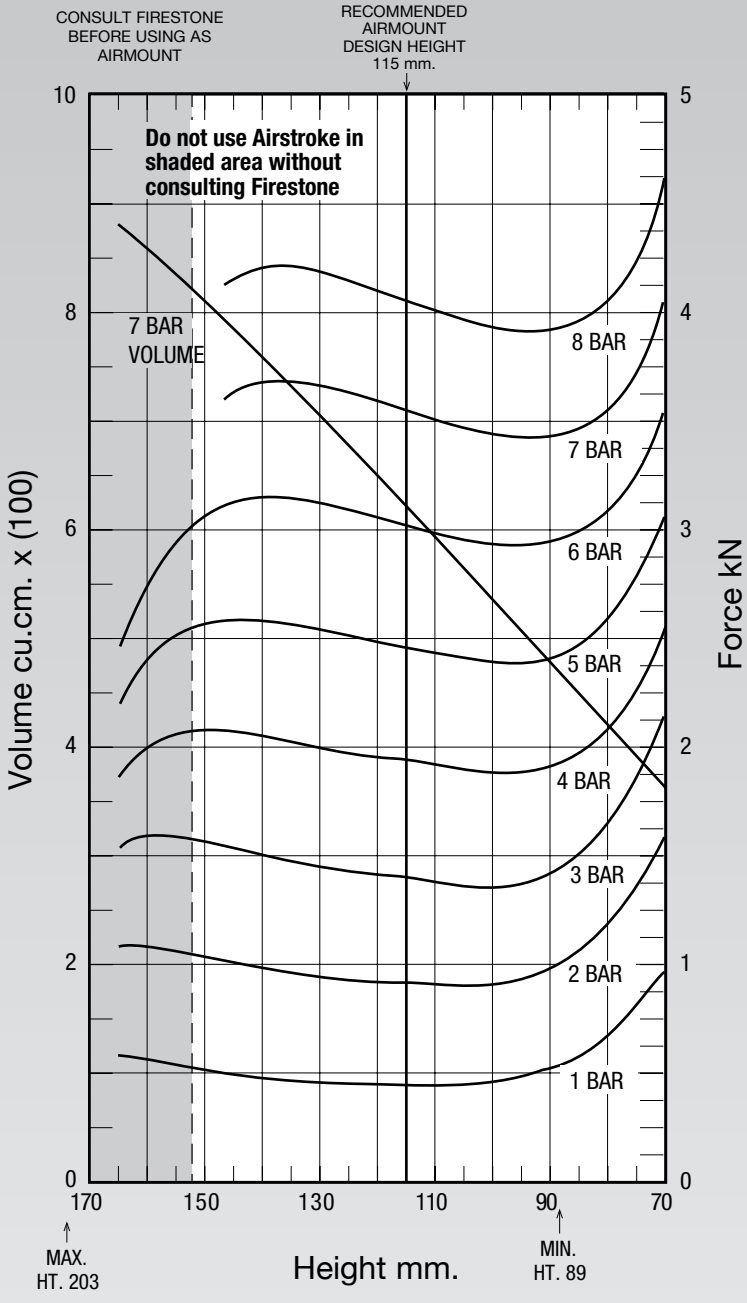
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
180	438	25	.74	1.01	1.26	1.53	1.78
170	411	26	.74	1.01	1.28	1.58	1.84
160	383	26	.72	1.00	1.27	1.58	1.85
150	355	26	.70	.98	1.25	1.55	1.82
140	325	25	.68	.95	1.21	1.51	1.78
130	297	24	.66	.92	1.17	1.45	1.71
120	272	24	.65	.90	1.13	1.40	1.65
110	246	23	.64	.88	1.11	1.36	1.59
100	225	22	.63	.86	1.09	1.33	1.55

	Description	Assembly Order No.
Style 7012 Two Ply Bellows	Blind nut, 1/8 NPT	W02-358-7002
Assembly weight ..... .82 kg.		

NOTE: Standard assembly is imperial.





See page 12 for instructions on how to use chart.

NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

Dynamic Characteristics at 115 mm Design Height
(Required for Airmount isolator design only)

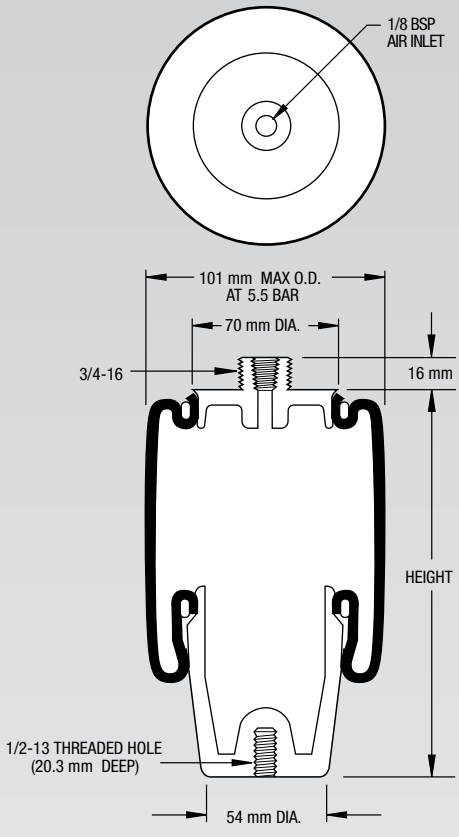
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	1.81	13	1.31
4	2.51	18	1.33
5	3.18	23	1.33
6	3.85	33	1.47
7	4.44	43	1.55

Force Table (Use for Airstroke™ actuator design)

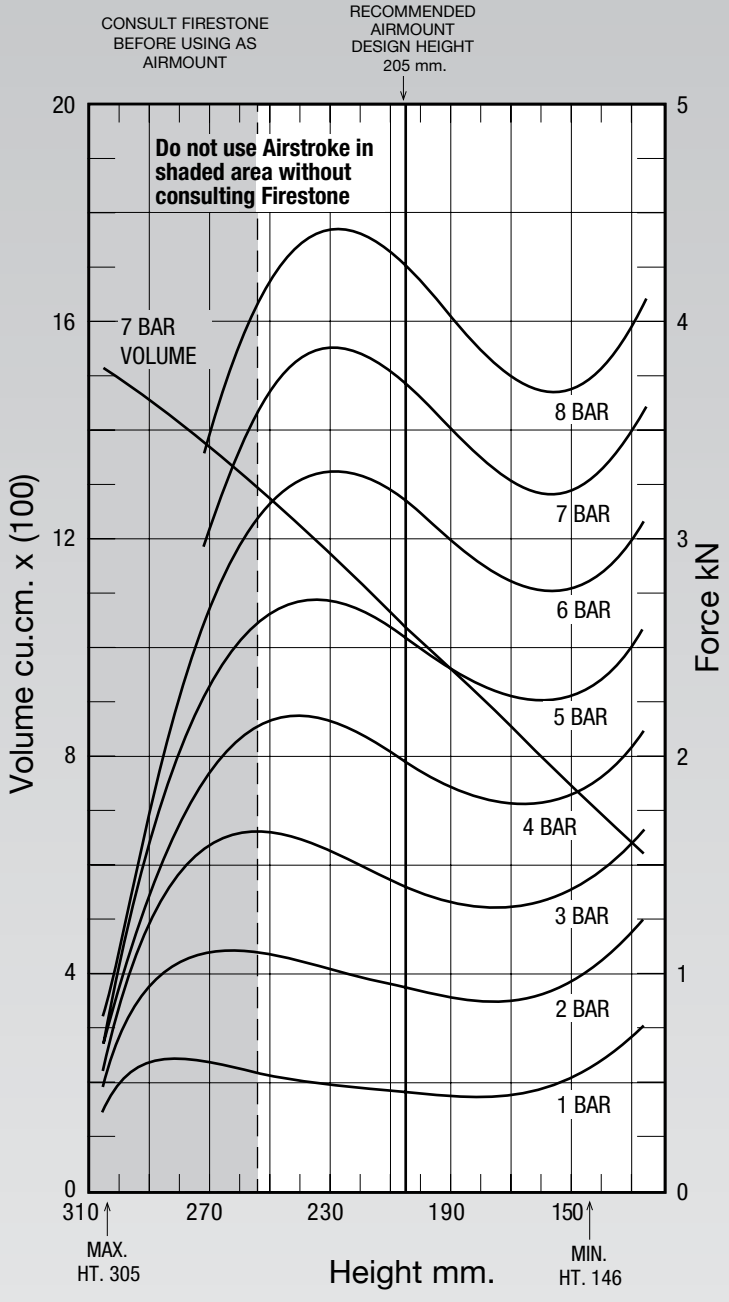
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
240	1676	56	1.83	2.45	3.06	3.52	3.94
220	1547	62	1.82	2.52	3.18	3.81	4.37
200	1409	65	1.77	2.48	3.15	3.89	4.56
180	1271	65	1.71	2.42	3.07	3.83	4.51
160	1134	61	1.65	2.33	2.97	3.67	4.30
140	1000	58	1.63	2.22	2.83	3.48	4.06

	Description	Assembly Order No.
Style 7010 Two Ply Bellows	Blind nuts, 1/8 NPT	W02-358-7010
Assembly weight ..... .73 kg.		

NOTE: Standard assembly is imperial.



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 205 mm Design Height
(Required for Airmount isolator design only)

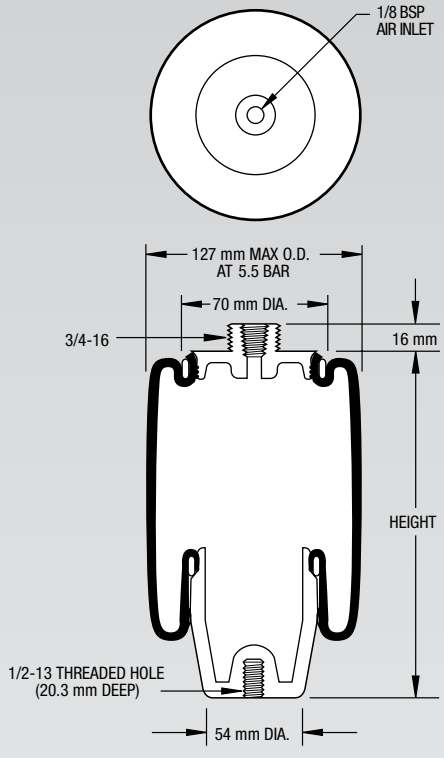
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	1.41	8	1.18
4	1.99	10	1.11
5	2.55	13	1.14
6	3.17	17	1.14
7	3.72	18.5	1.11

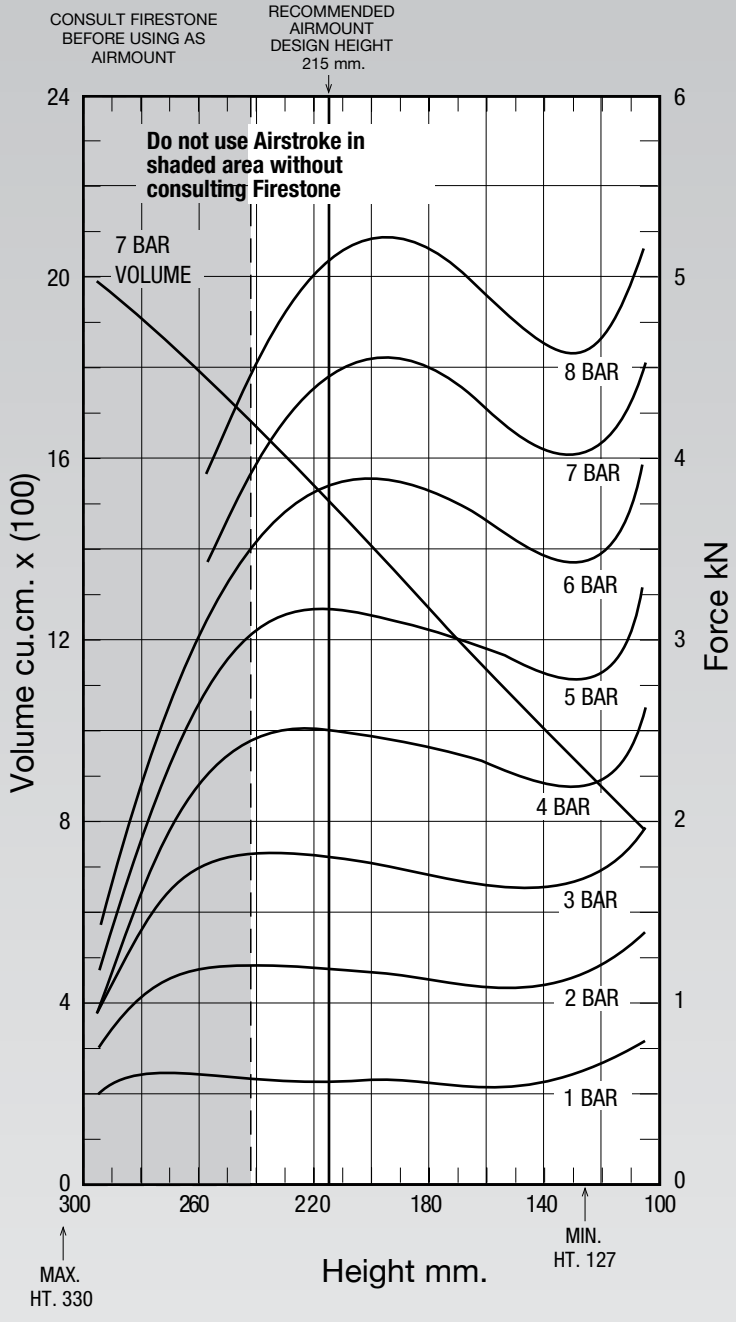
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
260	1321	48	1.65	2.08	2.52	2.95	3.39
240	1224	55	1.63	2.18	2.71	3.27	3.82
220	1123	55	1.51	2.10	2.66	3.29	3.86
200	1016	52	1.39	1.95	2.50	3.12	3.66
180	906	48	1.31	1.81	2.33	2.90	3.38
160	798	46	1.33	1.78	2.25	2.76	3.21

	Description	Assembly Order No.
Style 7012 Two Ply Bellows	Blind nut, 1/8 NPT	W02-358-7012
Assembly weight ..... .82 kg.		

NOTE: Standard assembly is imperial.





See page 12 for instructions on how to use chart.

NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

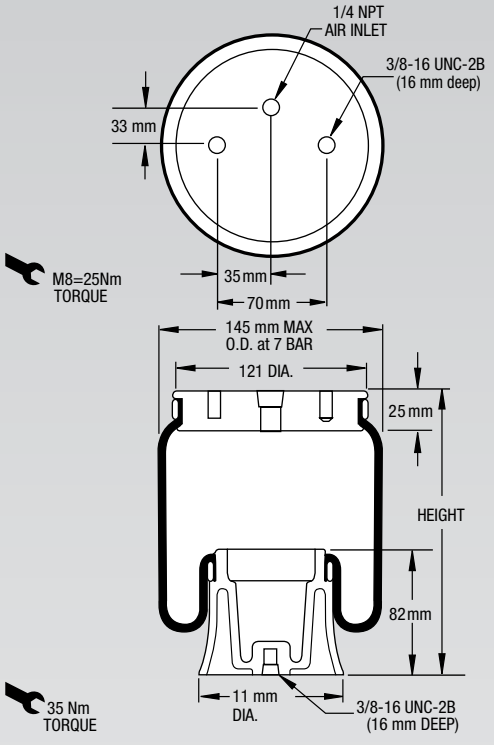
Dynamic Characteristics at 215 mm Design Height
(Required for Airmount isolator design only)

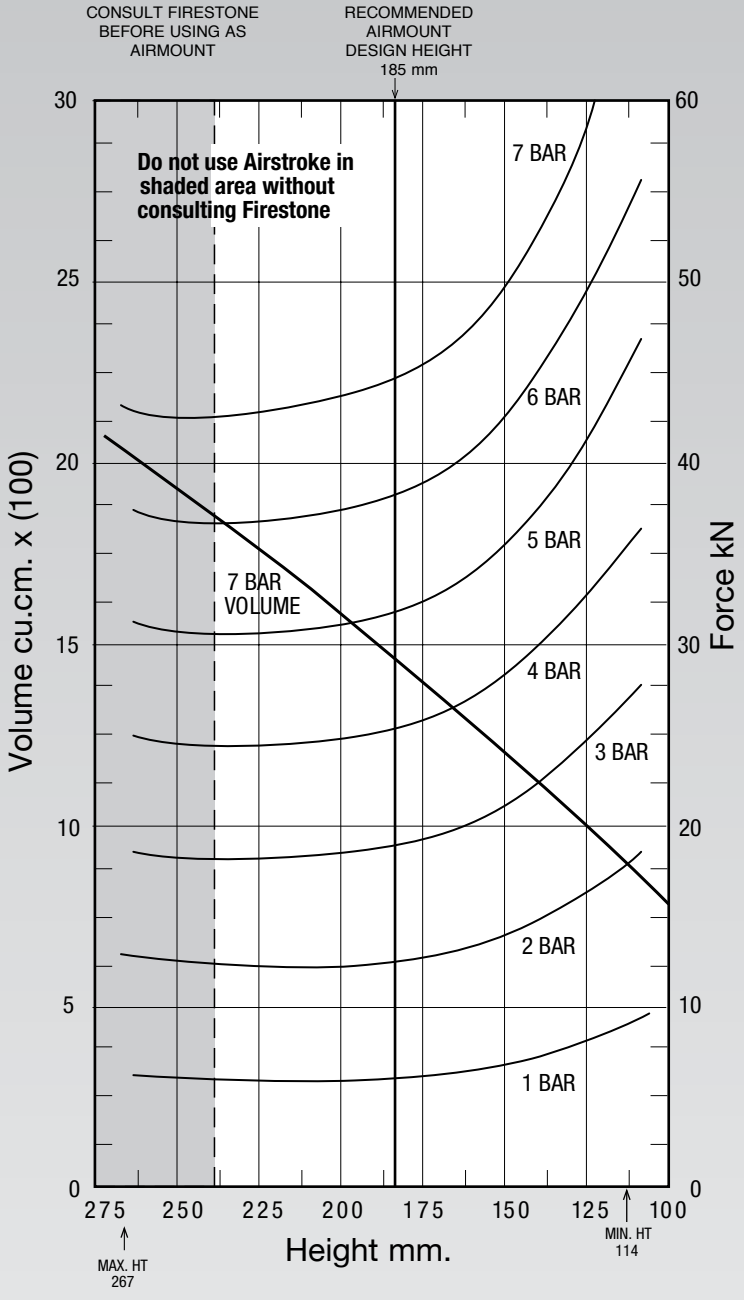
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	1.81	13	1.31
4	2.51	18	1.33
5	3.18	23	1.33
6	3.85	33	1.47
7	4.44	43	1.55

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
240	1676	56	1.83	2.45	3.06	3.52	3.94
220	1547	62	1.82	2.52	3.18	3.81	4.37
200	1409	65	1.77	2.48	3.15	3.89	4.56
180	1271	65	1.71	2.42	3.07	3.83	4.51
160	1134	61	1.65	2.33	2.97	3.67	4.30
140	1000	58	1.63	2.22	2.83	3.48	4.06

	Description	Assembly Order No.
Style 100/70 Two Ply Bellows	Blind nuts, 1/4 NPT	W02-358-9025
Assembly weight ..... 1.3 kg.		





NOTE: Recommended operating pressure not to exceed 100 psig.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 185 mm Design Height
(Required for Airmount isolator design only)

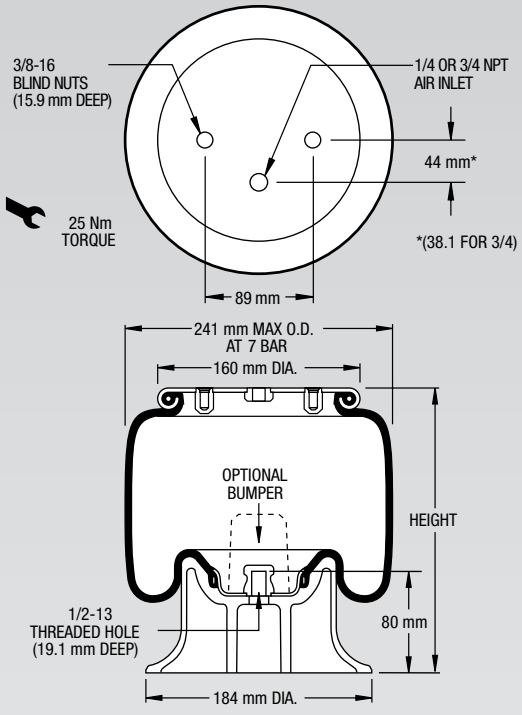
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
4	2.6	23	1.73
5	3.3	31	1.63
6	3.9	40	1.57
7	4.5	48	1.53

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
250	1940.9	61.5	1846	2462	3077	3693	4308
225	1757.8	60.9	1827	2436	3045	3654	4263
200	1565.0	62.3	1868	2490	3113	3735	4358
175	1373.9	64.2	1926	2568	3210	3852	4494
150	1180.8	70.5	2114	2818	3523	4227	4932
125	976.0	82.6	2479	3306	4132	4959	5785

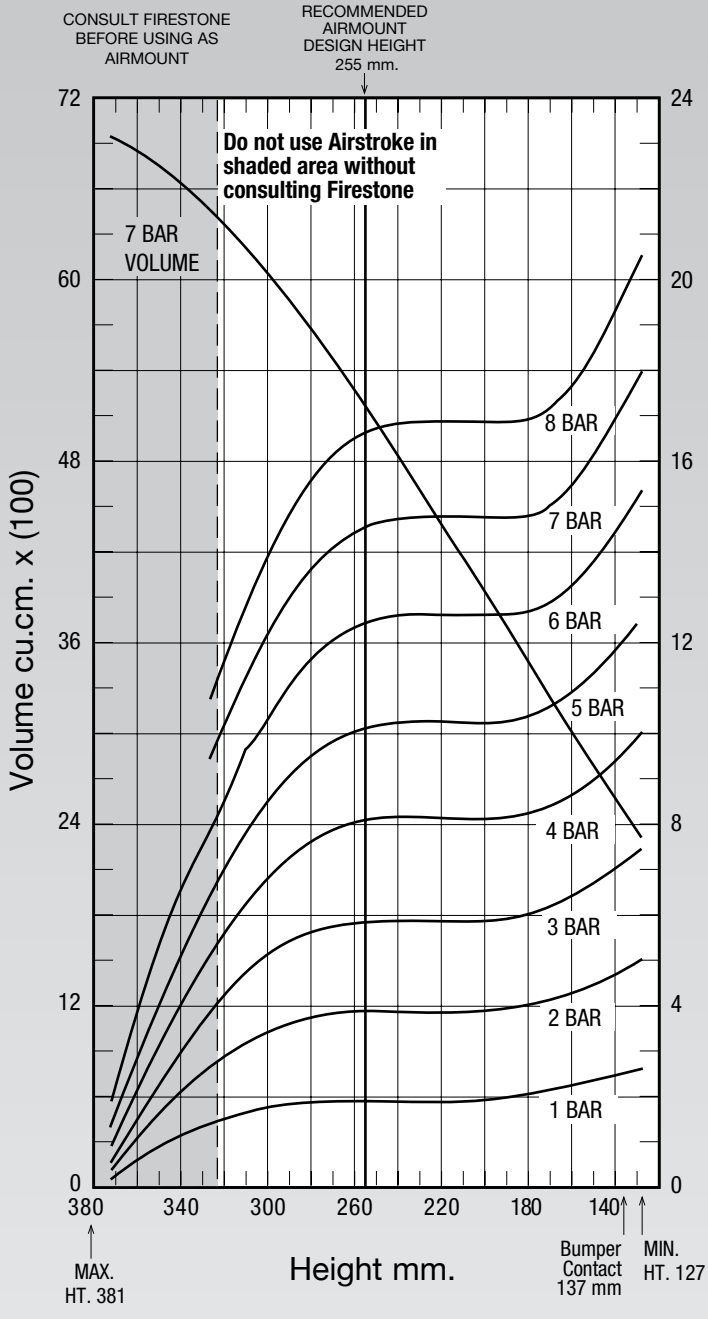
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T14C-1 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-5310
	Blind nuts, 1/4 NPT, bumper	W01-358-5311
	Blind nuts, 3/4 NPT	W01-358-5305
	Blind nuts, 3/4 NPT, bumper	W01-358-5306
	Countersunk steel bead ring 1¾ bolts, nuts, washers	W01-358-5307
Assembly weight ..... 2.95 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 255 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	5.88	47	1.41
4	8.06	67	1.44
5	10.14	83	1.43
6	12.41	102	1.43
7	14.50	117	1.42

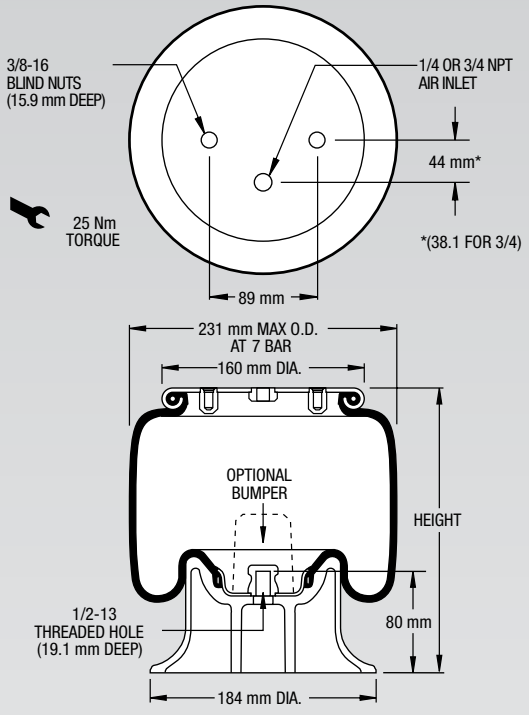
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
300	6065	171	5.05	6.70	8.39	10.23	11.94
280	5704	192	5.62	7.45	9.45	11.52	13.45
260	5306	205	5.86	8.00	10.06	12.30	14.36
240	4881	210	5.89	8.15	10.28	12.60	14.73
220	4438	211	5.89	8.15	10.29	12.63	14.76
200	3967	211	5.89	8.15	10.29	12.63	14.76
180	3494	211	5.98	8.19	10.32	12.63	14.76
160	3027	220	6.39	8.59	10.80	13.18	15.37

1T14C-3 Firestone AIRSTROKE ACTUATORS AIRMOUNT ISOLATORS

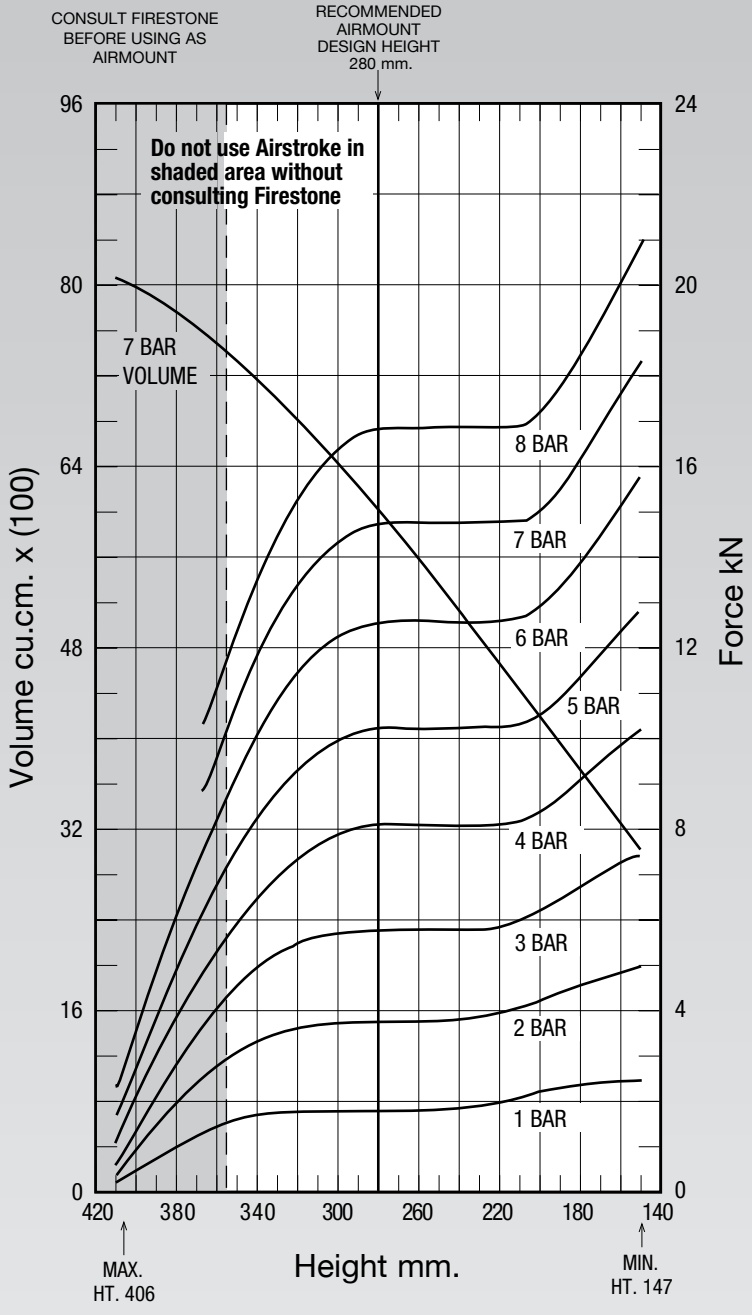
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T14C-3 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-5405
Assembly weight ..... 3.08 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 280 mm Design Height
(Required for Airmount isolator design only)

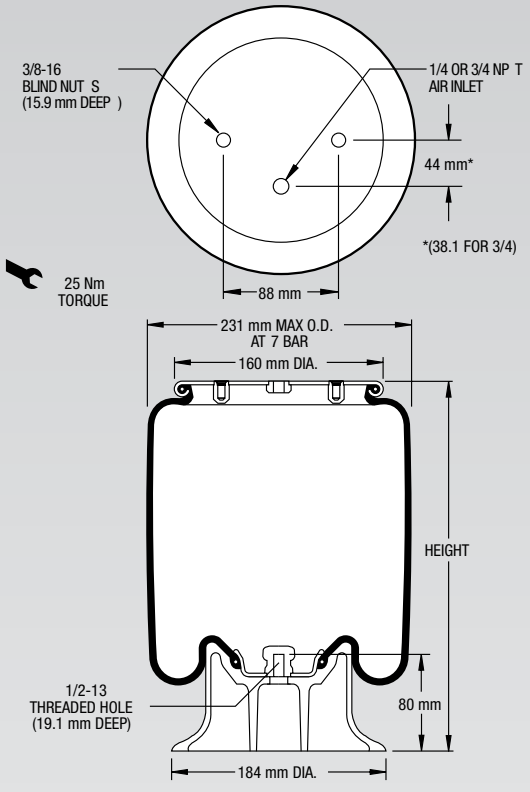
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	5.80	38	1.27
4	8.10	53	1.28
5	10.19	64	1.25
6	12.55	78	1.24
7	14.72	90	1.23

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
320	6836	190	5.47	7.34	9.26	11.37	13.30
300	6447	204	5.74	7.88	9.92	12.20	14.30
280	6041	210	5.80	8.10	10.19	12.55	14.72
260	5612	211	5.80	8.11	10.22	12.58	14.75
240	5165	211	5.80	8.11	10.22	12.58	14.75
220	4705	211	5.85	8.11	10.23	12.59	14.75
200	4221	214	6.17	8.36	10.54	12.86	14.98
180	3735	229	6.68	8.99	11.31	13.78	16.04

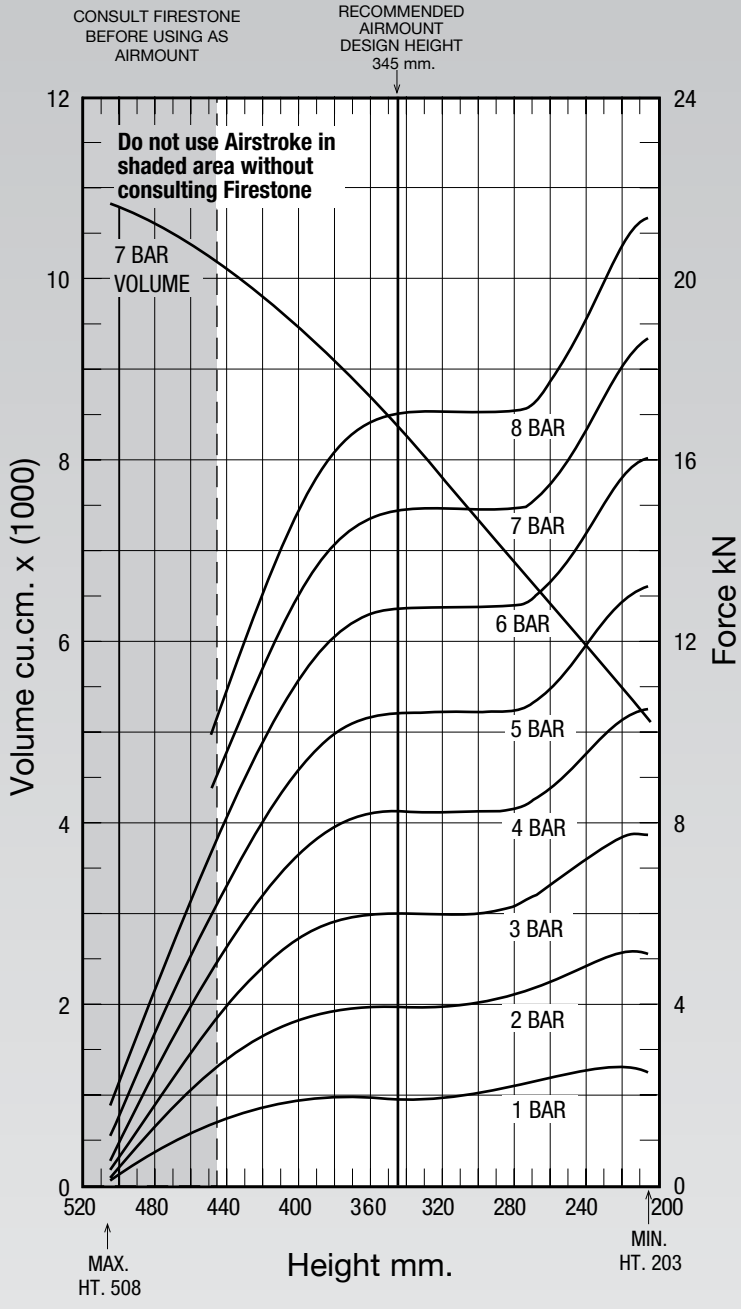
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style	Blind nuts, 1/4 NPT	W01-358-5712
1T14C-7	Blind nuts, 3/4 NPT	W01-358-5708
Two Ply		
Bellows		
Assembly weight..... 3.17 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 345 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	6.02	30	1.11
4	8.27	39	1.09
5	10.44	48	1.07
6	12.79	59	1.07
7	14.92	68	1.06

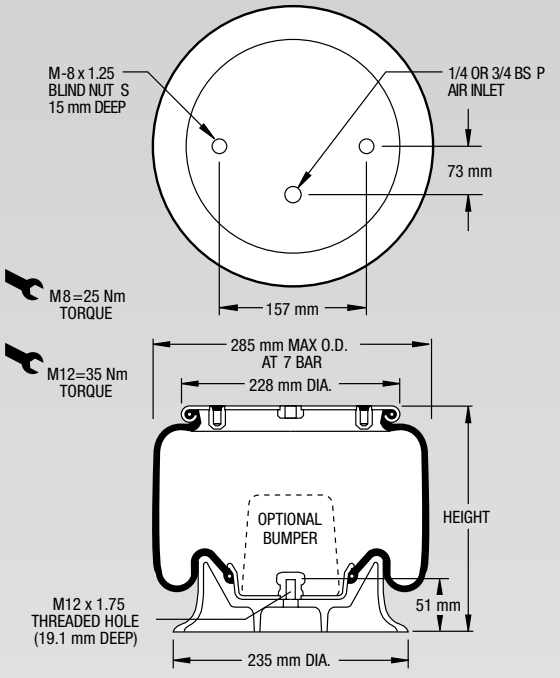
Force Table (Use for Airstroke™ actuator design)

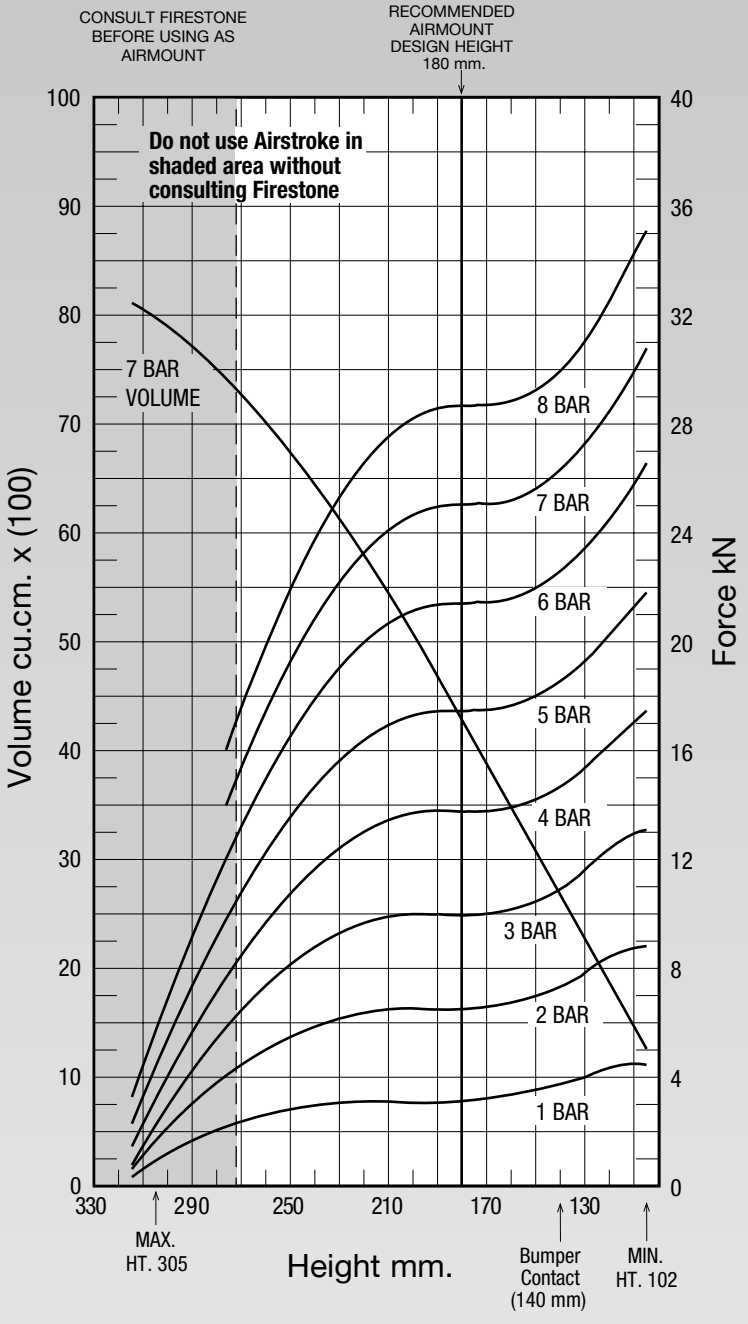
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
440	10160	134	3.90	5.17	6.54	8.02	9.37
400	9509	184	5.43	7.25	9.11	11.07	12.87
360	8729	210	6.00	8.20	10.34	12.63	14.72
320	7832	213	6.02	8.27	10.44	12.79	14.93
280	6898	213	6.17	8.30	10.46	12.79	14.93
240	5973	238	7.15	9.49	11.85	14.33	16.65

1T15T-1 Firestone AIRSTROKE™ ACTUATORS AIRMOUNT™ ISOLATORS

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15T-1 Two Ply Bellows	Blind nuts, 1/4 BSP, bumper	W01-M58-6322
	Blind nuts, 3/4 BSP	W01-M58-6325
Assembly weight ..... 5 kg.		





NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 180 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	9.93	175	2.09
4	13.77	229	2.03
5	17.43	279	1.99
6	21.43	334	1.97
7	25.04	384	1.95

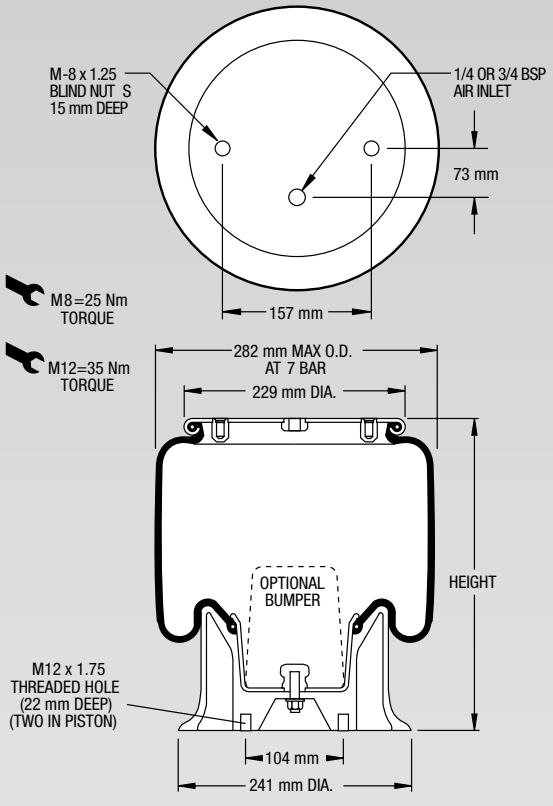
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
260	7000	247	7.32	9.59	12.10	14.80	17.26
240	6423	298	8.81	11.67	14.69	17.91	20.85
220	5773	334	9.66	13.04	16.43	20.07	23.38
200	5041	353	9.92	13.65	17.25	21.14	24.67
180	4262	358	9.93	13.77	17.43	21.43	25.04
160	3450	361	10.10	13.93	17.61	21.62	25.26
140	2623	375	10.94	14.70	18.48	22.54	26.27
120	1820	408	12.35	16.26	20.32	24.59	28.59

AIRSTROKE™ ACTUATORS AIRMOUNT™ ISOLATORS Firestone 1T15LP-3

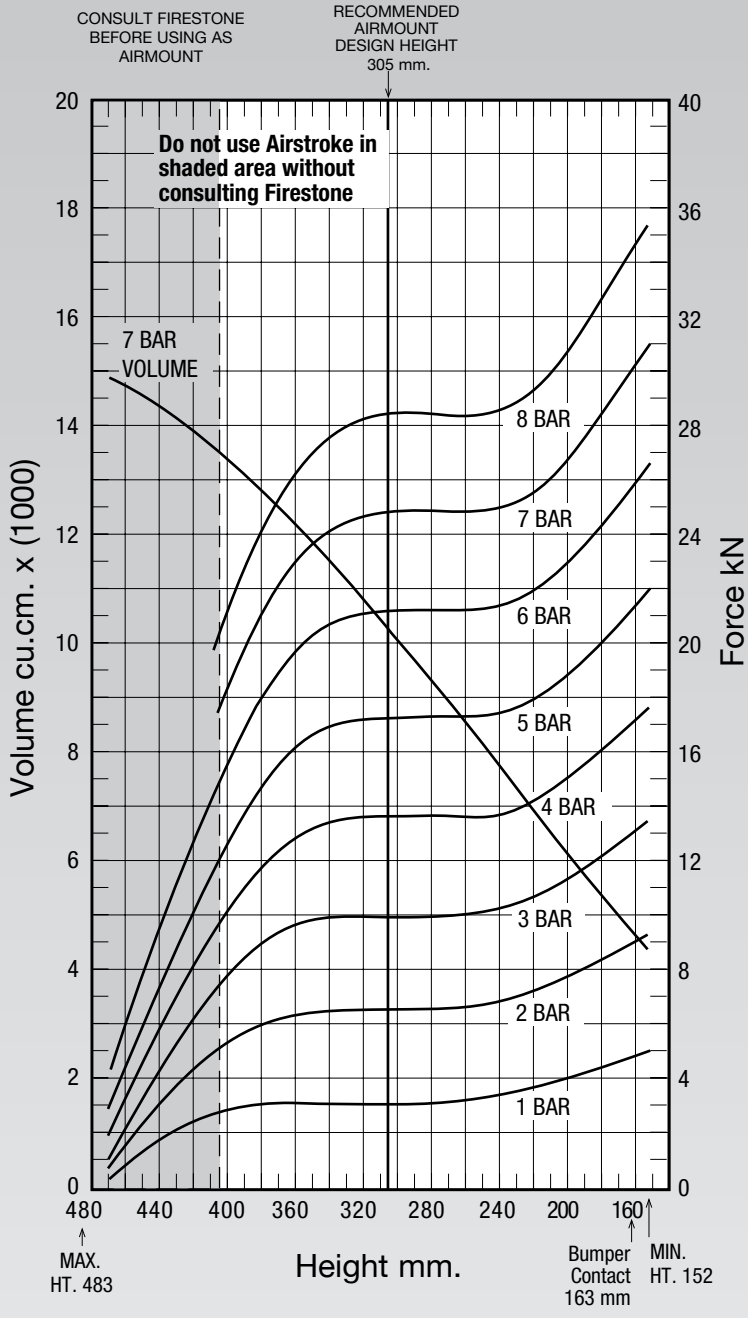
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15LP-3	Blind nuts, 1/4 BSP, bumper	W01-358-9049
Two Ply Bellows	Blind nuts, 3/4 BSP	W01-358-9051
Assembly weight ..... 6 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 305 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	10.05	68	1.30
4	13.74	88	1.26
5	17.32	107	1.24
6	21.26	130	1.23
7	24.88	149	1.22

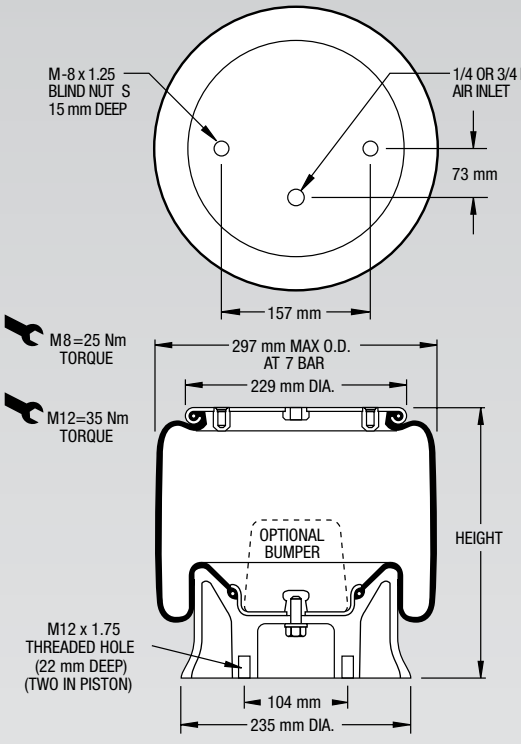
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
400	13435	262	7.86	10.23	12.82	15.66	18.31
360	12261	327	9.66	12.86	16.12	19.63	22.90
320	10863	353	10.05	13.72	17.26	21.15	24.73
280	9362	356	10.05	13.74	17.32	21.27	24.89
240	7818	357	10.29	13.80	17.43	21.39	24.99
200	6240	383	11.38	15.06	18.88	22.99	26.81
160	4688	432	13.08	17.25	21.46	25.96	30.26

1T15L-4 Firestone AIRSTROKE ACTUATORS AIRMOUNT ISOLATORS

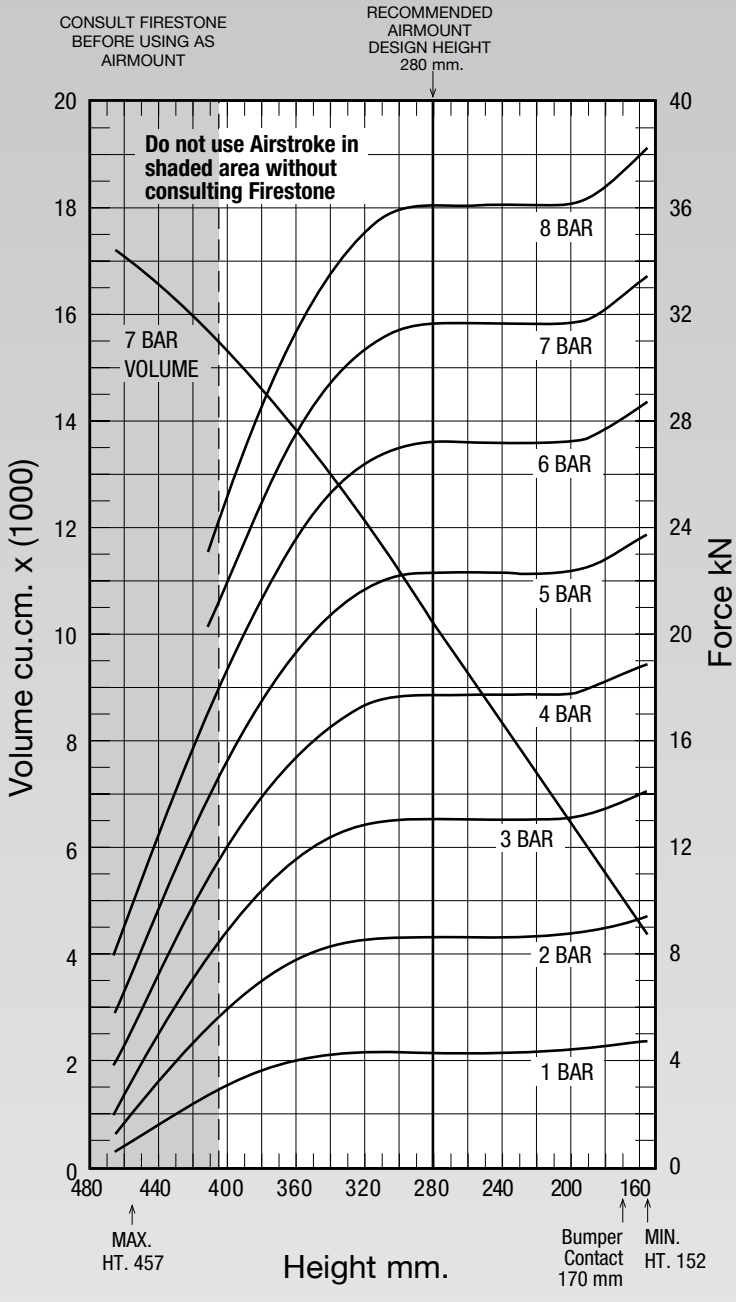
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style	Blind nuts, 1/4 BSP	W01-M58-6255
1T15L-4	Blind nuts, 1/4 BSP, bumper	W01-M58-6256
Two Ply Bellows		
Assembly weight ..... 7.03 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 280 mm Design Height
(Required for Airmount isolator design only)

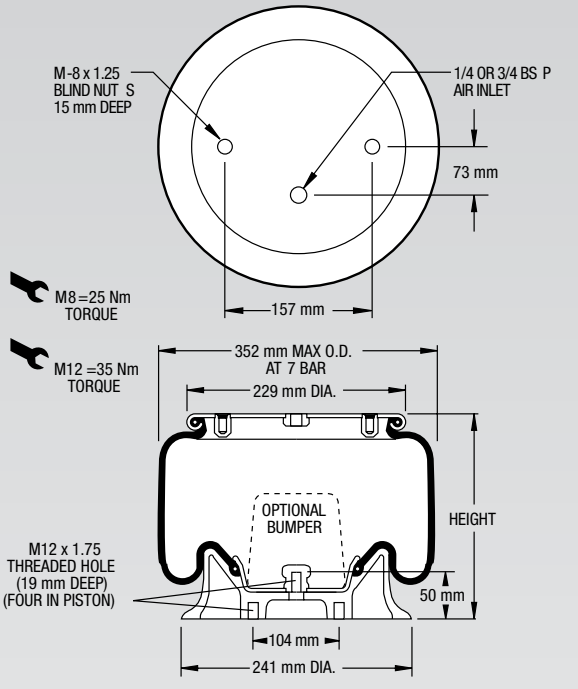
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	13.03	110	1.45
4	17.73	140	1.40
5	22.31	170	1.38
6	27.14	202	1.36
7	31.57	230	1.35

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
400	15364	309	8.65	11.78	14.94	18.45	21.61
360	13880	389	11.44	15.27	19.18	23.35	27.19
320	12139	437	12.81	17.24	17.65	26.30	30.58
280	10291	451	13.03	17.73	22.31	27.14	31.57
240	8407	451	13.03	17.73	22.31	27.14	31.57
200	6496	451	13.06	17.73	22.31	27.14	31.57
160	4628	472	13.96	18.72	23.46	28.45	33.06

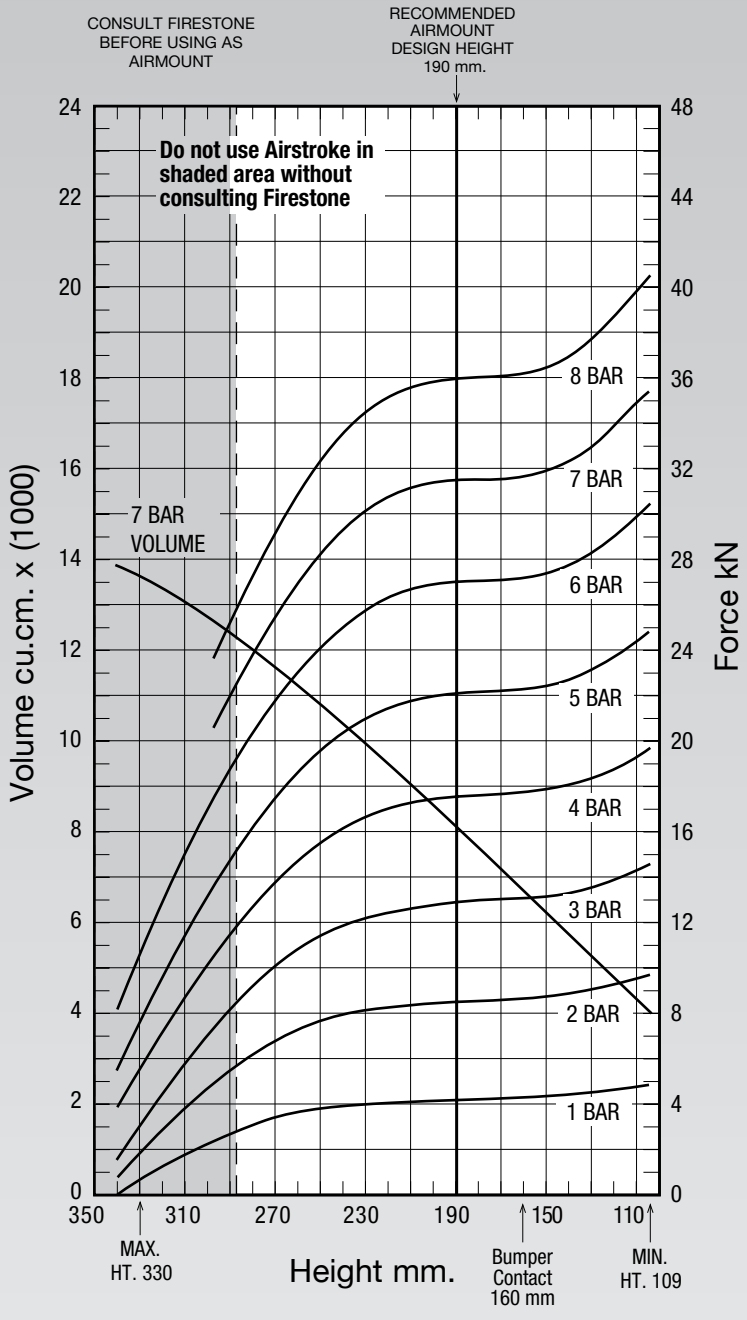
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15M-0 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-9030
	Blind nuts, 1/4 NPT, rubber bumper	W01-358-9031
	Blind nuts, 3/4 NPT	W01-358-9034
	Blind nuts, 3/4 NPT, rubber bumper	W01-358-9036
	Countersunk steel bead ring, 40 mm bolts, nuts, washers	W01-358-9038
Assembly weight ..... 5.22 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 190 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	12.85	149	1.70
4	17.59	189	1.63
5	22.14	228	1.60
6	27.03	270	1.58
7	31.53	307	1.56

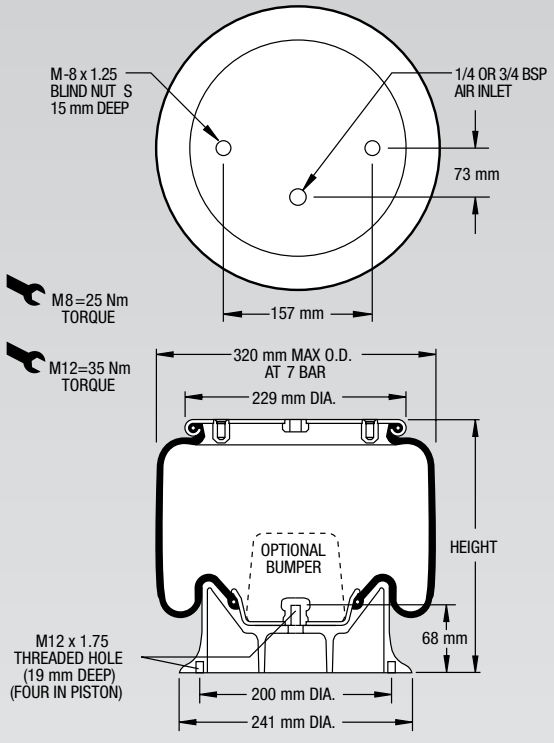
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
280	12080	337	9.10	12.52	15.98	19.99	23.58
260	11314	382	10.70	14.55	18.42	22.79	26.76
240	10488	417	11.79	16.07	20.26	24.90	29.16
220	9611	438	12.44	17.03	21.44	26.26	30.68
200	8667	449	12.76	17.50	22.01	26.90	31.39
180	7694	451	12.90	17.64	22.19	27.09	31.59
160	6704	453	13.02	17.73	22.31	27.22	31.73
140	5712	462	13.29	18.05	22.72	27.74	32.34

1T15M-2 Firestone AIRSTROKE™ ACTUATORS AIRMOUNT™ ISOLATORS

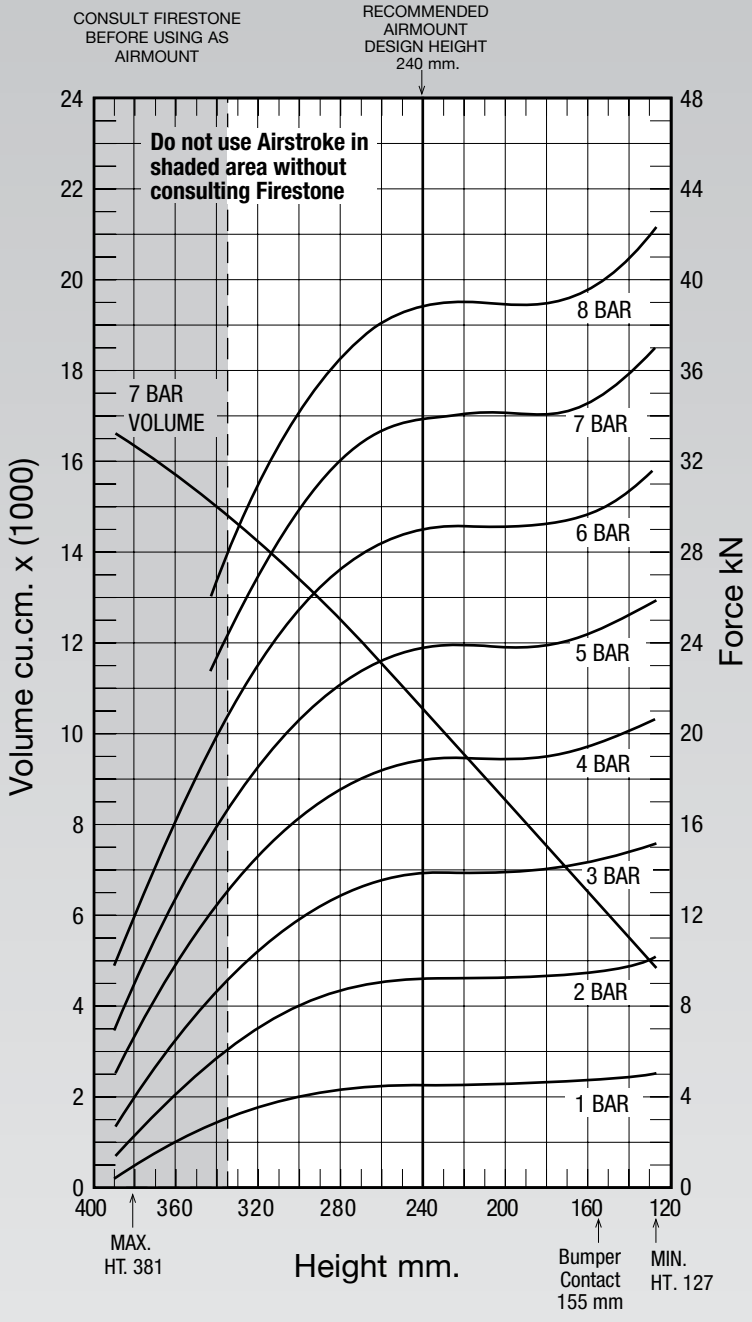
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15M-2 Two Ply Bellows	Blind nuts, 1/4 BSP, bumper	W01-M58-6273
	Blind nuts, 3/4 BSP	W01-M58-6270
	Blind nuts, 3/4 BSP, bumper	W01-M58-6271
Assembly weight ..... 5.99 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 240 mm Design Height
(Required for Airmount isolator design only)

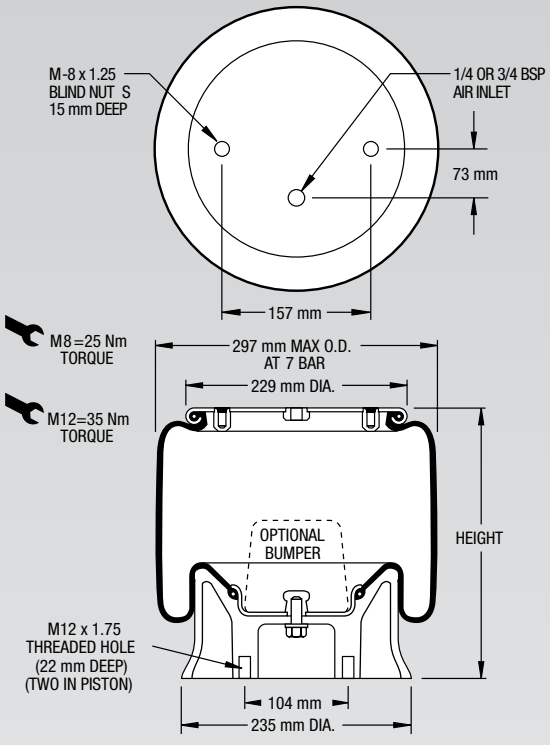
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	13.74	128	1.52
4	18.78	166	1.48
5	23.70	201	1.45
6	29.05	238	1.43
7	33.91	271	1.41

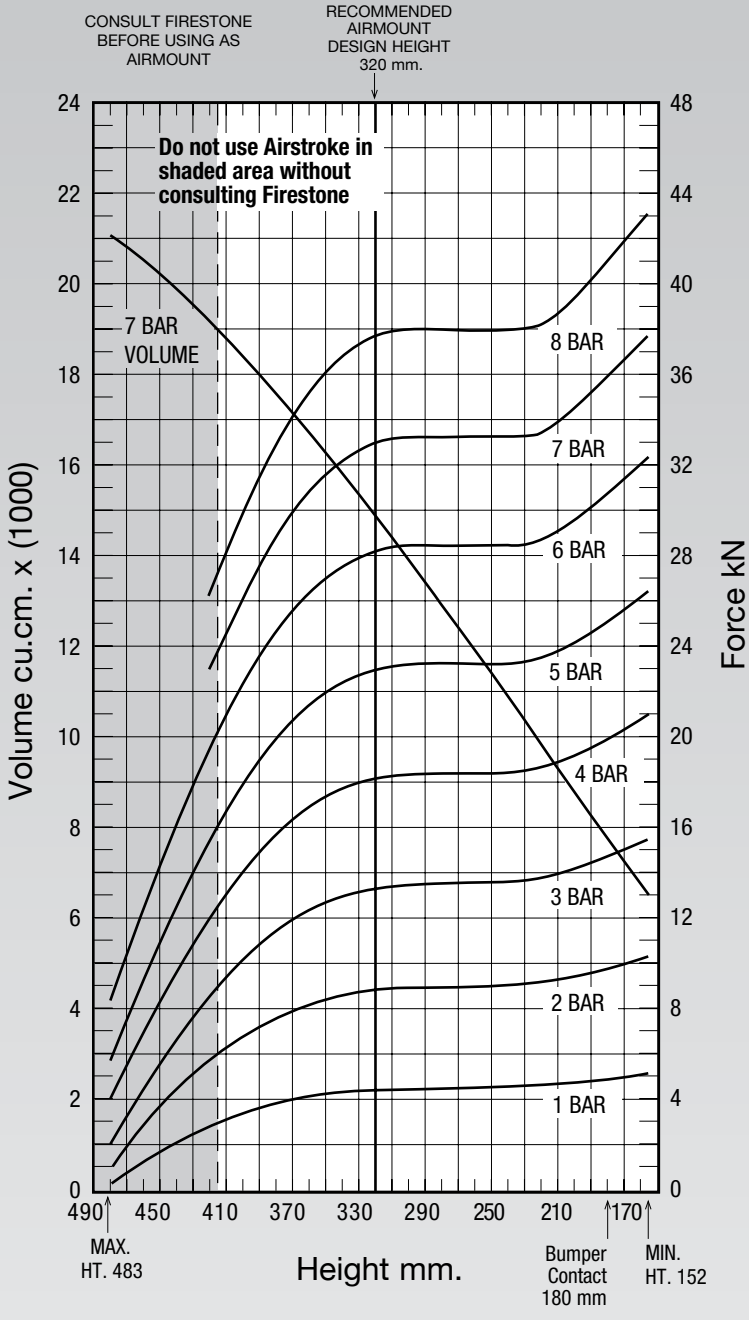
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
300	13442	423	11.82	16.18	20.46	25.24	29.59
280	12542	454	12.83	17.51	22.11	27.18	31.80
260	11597	475	13.45	18.36	23.17	28.43	33.22
240	10616	485	13.74	18.78	23.70	29.05	33.91
220	9613	486	13.82	18.90	23.85	29.19	34.05
200	8562	486	13.83	18.90	23.85	29.19	34.05
180	7512	486	13.90	18.97	23.90	29.20	34.05
160	6473	492	14.15	19.30	24.27	29.59	34.46

NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15M-4 Two Ply Bellows	Blind nuts, 1/4 BSP	W01-M58-6284
	Blind nuts, 1/4 BSP, bumper	W01-M58-6283
	Blind nuts, 3/4 BSP	W01-M58-6280
Assembly weight ..... 6.49 kg.		





NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.

See page 12 for instructions on how to use chart.

Dynamic Characteristics at 320 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	13.30	94	1.33
4	18.18	121	1.29
5	22.97	147	1.26
6	28.21	173	1.24
7	32.97	198	1.22

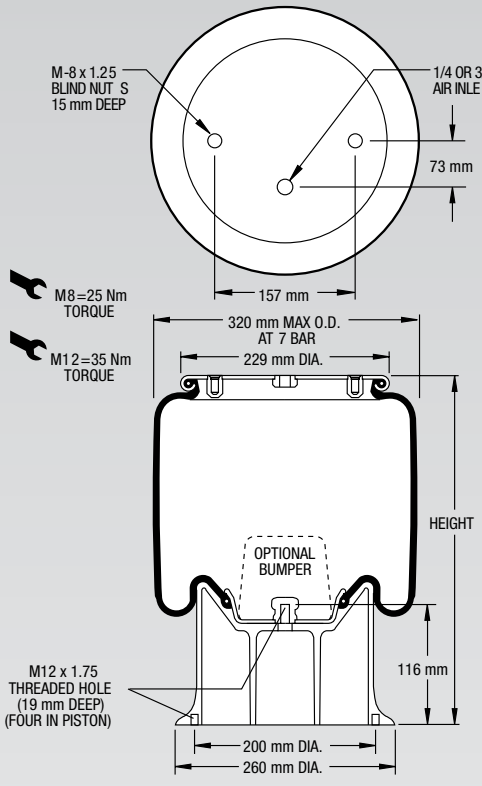
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
400	18412	371	10.00	13.84	17.67	22.06	25.95
360	16746	439	12.25	16.79	21.27	26.24	30.73
320	14853	471	13.30	18.18	22.97	28.21	32.97
280	12874	475	13.48	18.41	23.23	28.47	33.24
240	10870	475	13.53	18.41	23.23	28.47	33.24
200	8827	491	14.11	19.11	24.09	29.47	34.39
160	6803	533	15.26	20.70	26.12	32.00	37.34

1T15M-6 Firestone AIRSTROKE ACTUATORS AIRMOUNT ISOLATORS

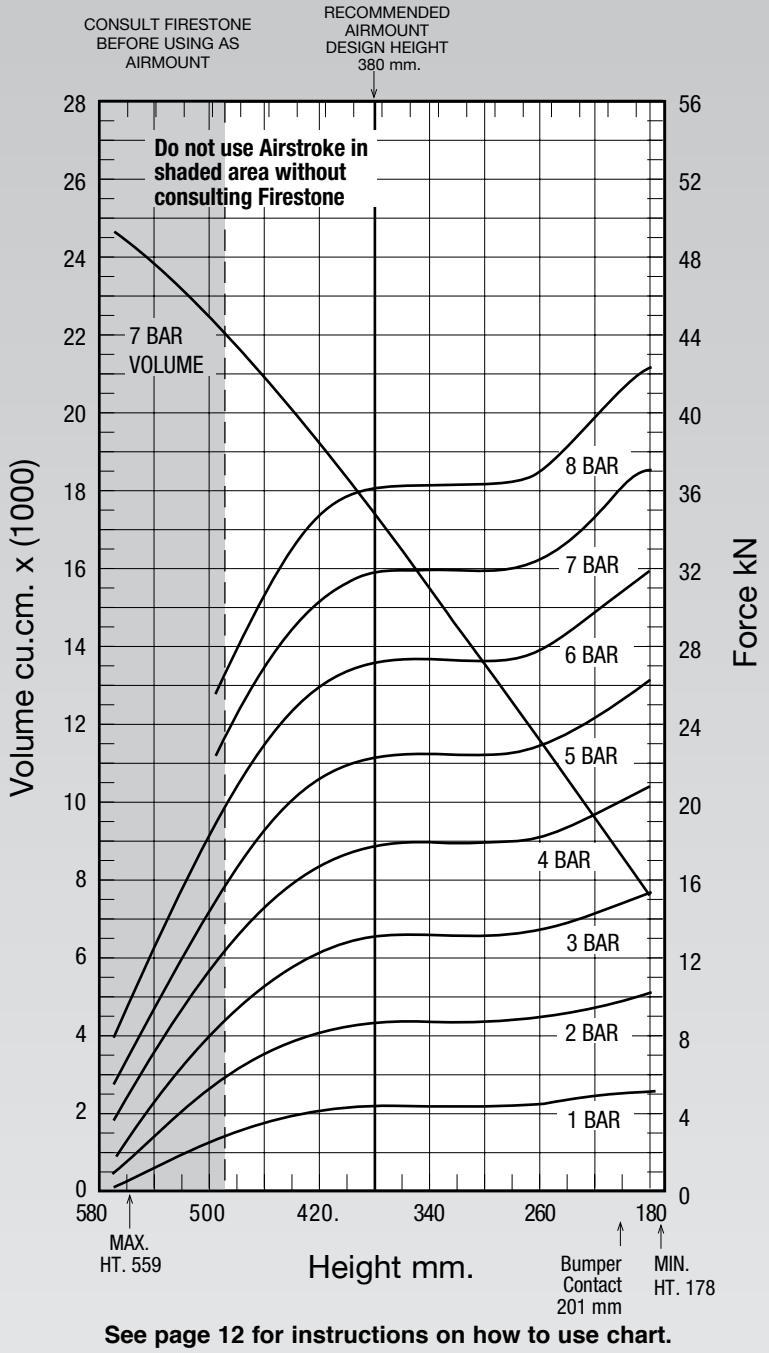
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15M-6	Blind nuts, 1/4 BSP	W01-M58-6290
Two Ply Bellows	Blind nuts, 3/4 BSP	W01-M58-6292
Assembly weight ..... 7.12 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 380 mm Design Height
(Required for Airmount isolator design only)

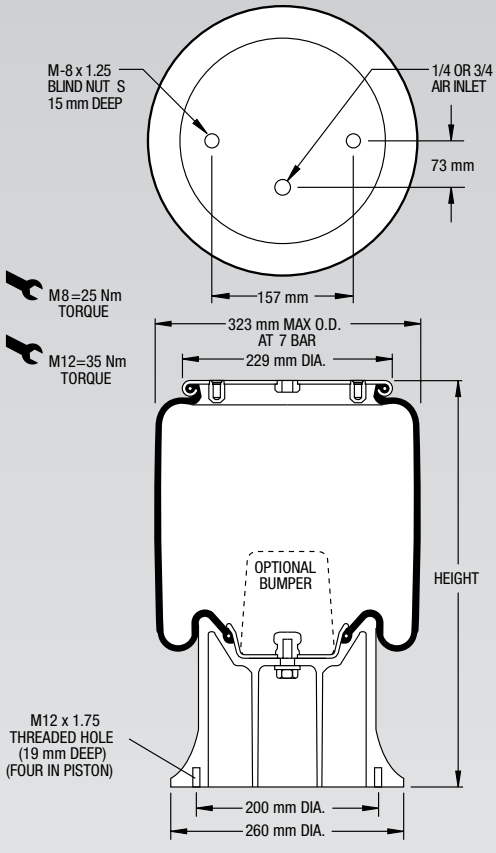
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	13.01	72	1.18
4	17.68	93	1.14
5	22.25	111	1.11
6	27.16	129	1.09
7	31.66	147	1.07

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
480	21723	347	9.30	12.91	16.49	20.60	24.25
440	20080	410	11.50	15.70	19.88	24.52	28.70
400	18349	445	12.73	17.31	21.82	26.70	31.16
360	16512	454	13.11	17.82	22.40	27.29	31.79
320	14536	454	13.12	17.83	22.40	27.29	31.79
280	12544	454	13.12	17.83	22.40	27.29	31.79
240	10569	476	13.72	18.54	23.35	28.53	33.28
200	8579	515	14.81	20.02	25.24	30.88	36.02

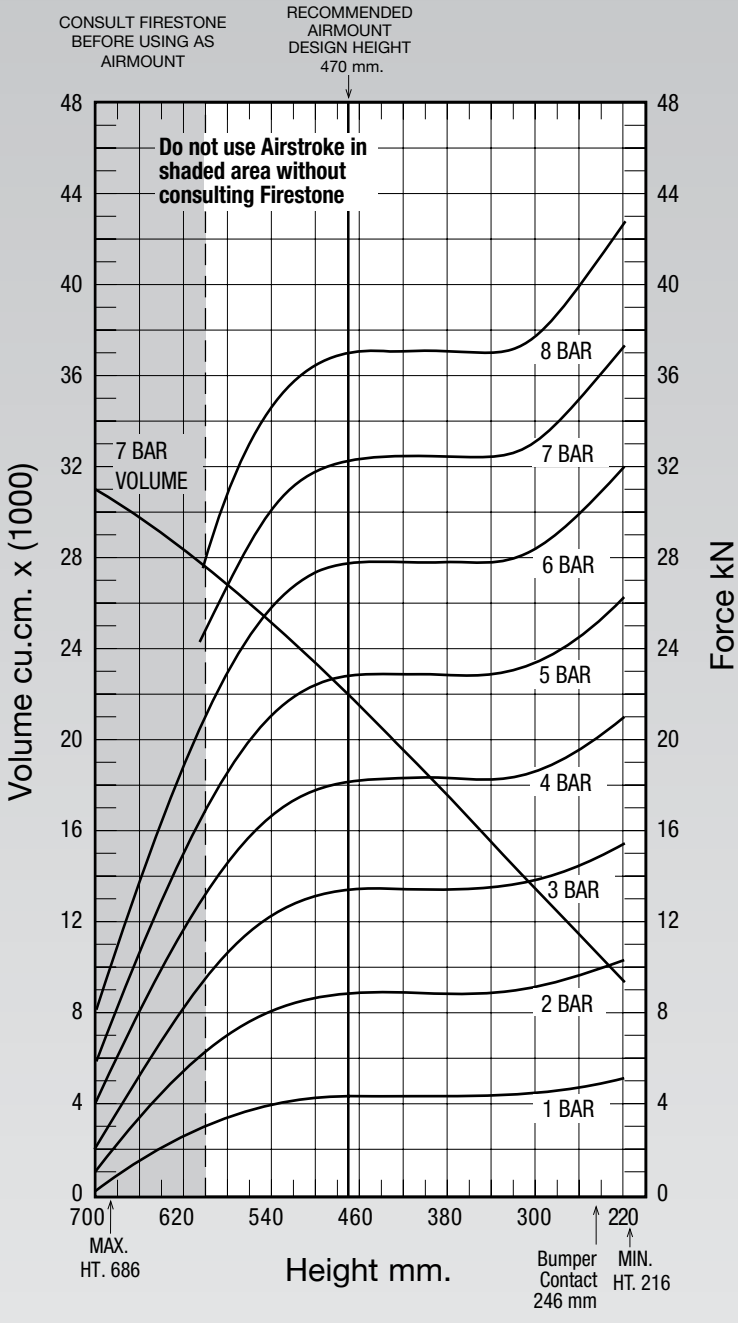
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T15M-9 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-9108
	Blind nuts, 1/4 NPT, bumper	W01-M58-6305
	Blind nuts, 3/4 NPT	W01-M58-6300
	Blind nuts, 3/4 NPT, bumper	W01-M58-6301
Assembly weight ..... 8.16 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 470 mm Design Height
(Required for Airmount isolator design only)

Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	13.36	60	1.05
4	18.21	78	1.03
5	22.82	92	1.00
6	27.76	107	.98
7	32.35	121	.96

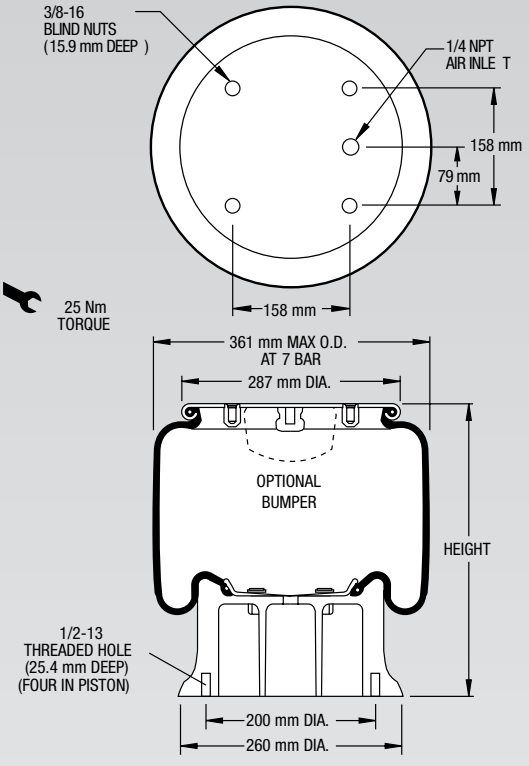
Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
560	26024	411	11.50	15.68	19.84	24.50	28.73
520	24282	446	12.75	17.33	21.81	26.70	31.20
480	22386	461	13.30	18.12	22.72	27.67	32.25
440	20414	463	13.41	18.29	22.90	27.81	32.40
400	18453	463	13.41	18.29	22.90	27.81	32.40
360	16464	463	13.41	18.29	22.90	27.81	32.40
320	14405	465	13.59	18.33	22.99	27.94	32.52
280	12395	485	14.10	19.06	23.94	29.14	33.94

1T19L-7 Firestone AIRSTROKE™ ACTUATORS AIRMOUNT™ ISOLATORS

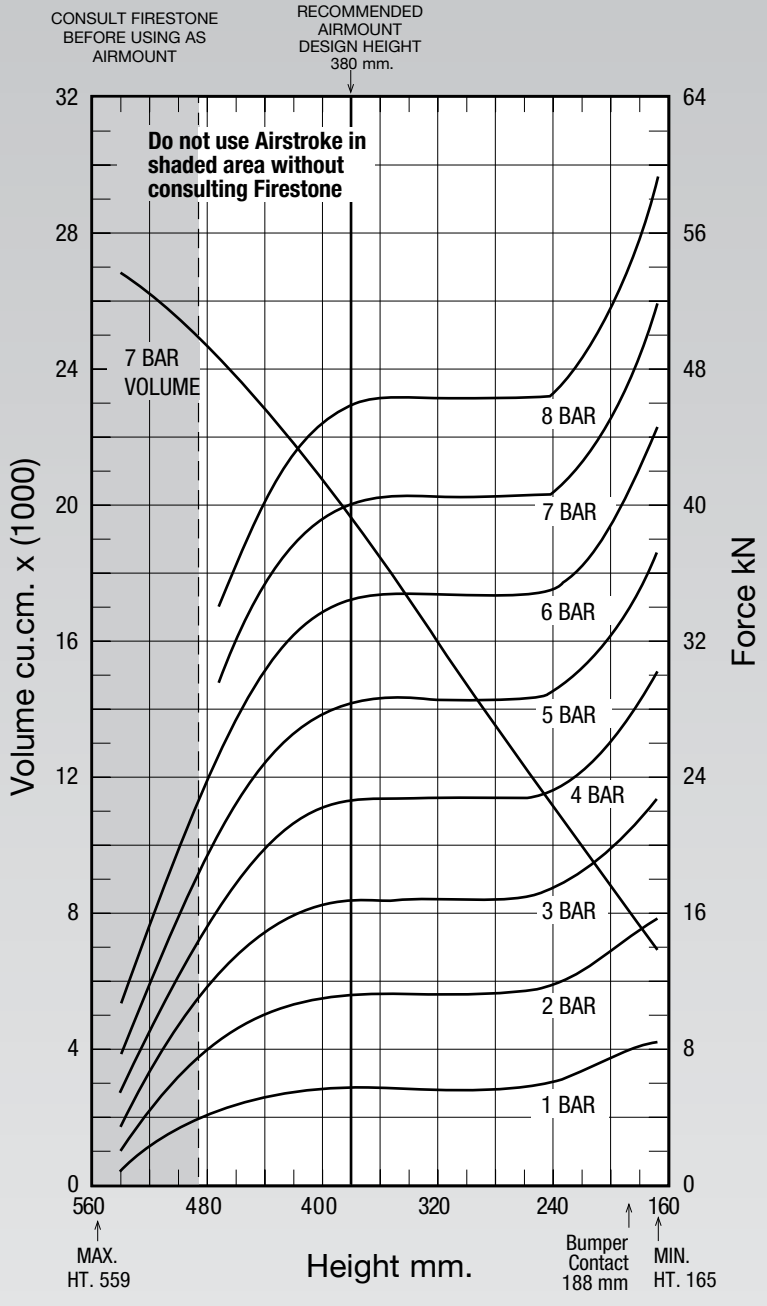
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T19L-7 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-9148
	Blind nuts, 1/4 NPT, bumper	W01-358-9149
	Blind nuts, 3/4 NPT	W01-358-9172
	Blind nuts, 3/4 NPT, bumper	W01-358-9160
	Countersunk steel bead ring 1¾ bolts, nuts, washers	W01-358-9165
Assembly weight ..... 11.16 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 380 mm Design Height
(Required for Airmount isolator design only)

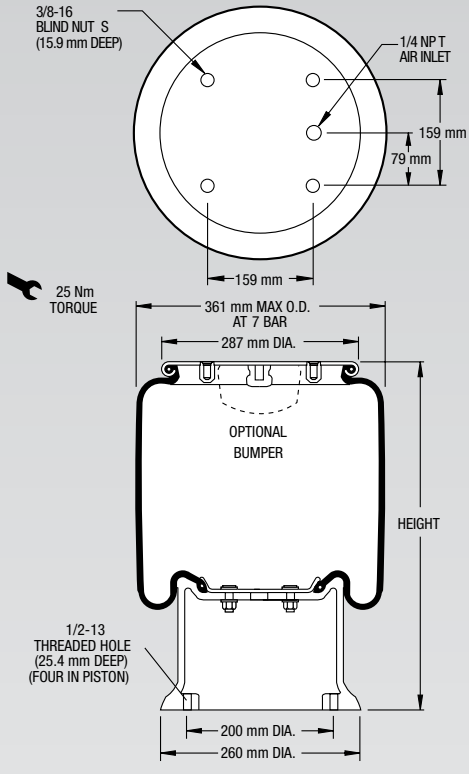
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	16.82	98	1.20
4	22.64	128	1.18
5	28.37	155	1.17
6	34.49	186	1.16
7	40.18	215	1.15

Force Table (Use for Airstroke™ actuator design)

Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force @ 3 BAR	@ 4 BAR	@ 5 BAR	@6 BAR	@7 BAR
460	23795	454	13.44	17.70	22.22	27.17	31.77
420	21800	536	15.94	21.20	26.54	32.23	37.53
380	19624	574	16.82	22.64	28.37	34.49	40.18
340	17263	580	16.84	22.78	28.56	34.78	40.56
300	14779	580	16.84	22.78	28.56	34.78	40.56
260	12355	580	16.85	22.78	28.56	34.78	40.56
220	9981	606	18.44	24.34	30.28	36.48	42.38
180	7648	698	21.43	28.27	35.08	42.10	48.84

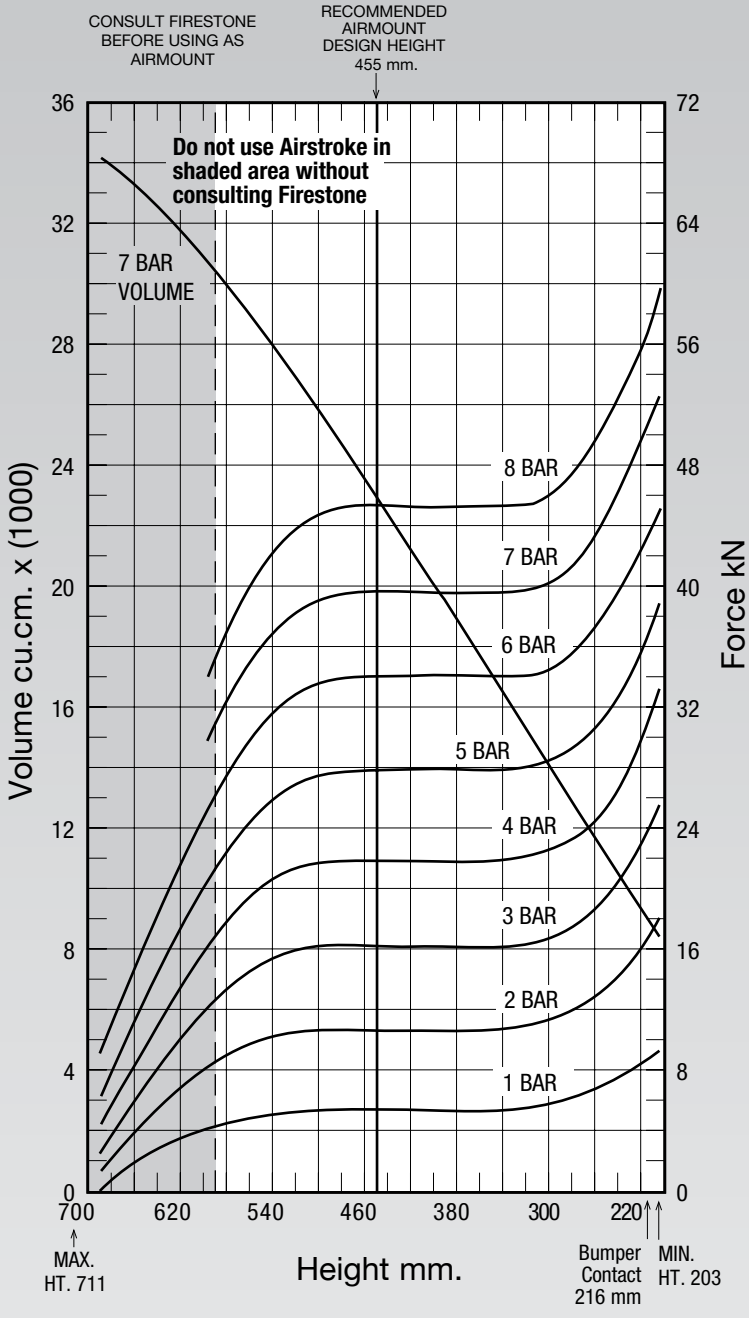
NOTE: All Assembly Order Numbers are for bead plate parts unless noted otherwise.

	Description	Assembly Order No.
Style 1T19L-11 Two Ply Bellows	Blind nuts, 1/4 NPT	W01-358-9155
	Blind nuts, 1/4 NPT, bumper	W01-358-9156
	Blind nuts, 3/4 NPT	W01-358-9153
	Blind nuts, 3/4 NPT, bumper	W01-358-2132
	Countersunk steel bead ring, 1 3/4 bolts, nuts, washers	W01-358-9162
Assembly weight ..... 10.25 kg.		



NOTE: Bellows will not compress properly with less than .7 BAR internal pressure.

NOTE: A bead plate part is shown. This part is also available with a bead ring. Bolts are not included. See pages 8-10 for explanation.



See page 12 for instructions on how to use chart.

Dynamic Characteristics at 455 mm Design Height (Required for Airmount isolator design only)			
Gauge Pressure (BAR)	Load (kN)	Spring Rate (kN/m)	Natural Frequency Hz
3	16.22	76	1.08
4	21.90	96	1.04
5	27.77	117	1.02
6	34.04	140	1.01
7	39.63	160	1.00

Force Table (Use for Airstroke™ actuator design)							
Assembly Height (mm)	Volume @ 7 BAR (cu cm)	EFF Area @ 7 BAR (cm sq)	kN Force				
			@ 3 BAR	@ 4 BAR	@ 5 BAR	@ 6 BAR	@ 7 BAR
580	29938	462	13.45	18.02	22.57	27.62	32.34
540	28011	525	15.32	20.56	25.83	31.49	36.72
500	25891	557	16.09	21.66	27.35	33.44	38.95
460	23607	566	16.22	21.90	27.77	34.03	39.62
420	21262	566	16.22	21.90	27.77	34.04	39.63
380	18895	566	16.22	21.90	27.77	34.04	39.63
340	16461	566	16.22	21.94	27.80	34.04	39.63
300	13995	575	16.79	22.58	28.40	34.58	40.25

NOTES

NOTES

INDEX

ORDER NUMBER TO STYLE NUMBER TO PAGE NUMBER

ORDER NUMBER	STYLE NUMBER	SEE PAGE
w01-358-0010	16	40
w01-358-0017	16	40
W01-358-0025	268 *(formerly 25)*	57
W01-358-0030	268 *(formerly 25)*	57
W01-358-0048	267-1.5 *(formerly 255-1.5)*	58
W01-358-0100	110	43
W01-358-0112	110	43
W01-358-0118	115	46
W01-358-0119	119	52
W01-358-0122	248-2	73
w01-358-0127	131	41
w01-358-0131	131	41
W01-358-0133	116	44
W01-358-0134	19	47
W01-358-0135	113	49
W01-358-0140	21-2	66
W01-358-0142	26	60
W01-358-0147	138-1.5	55
W01-358-0150	113-1	50
W01-358-0205	203	69
W01-358-0207	207	70
W01-358-0213	21	65
W01-358-0219	218	69
W01-358-0226	22	63
W01-358-0231	128	49
W01-358-0259	22-1.5	64
W01-358-0297	274 *(formerly 20)*	61
W01-358-0305	20-2	62
W01-358-0324	324	78
W01-358-0987	320	79
W01-358-1002	328	79
W01-358-1021	148-1	56
W01-358-1023	348-3	81
W01-358-1026	126	54
W01-358-2132	1T19L-11	99
W01-358-3407	224	59
W01-358-5101	224	59
W01-358-5126	200	71
W01-358-5135	121	53
W01-358-5305	1T14C-1	87
W01-358-5306	1T14C-1	87
W01-358-5307	1T14C-1	87
W01-358-5310	1T14C-1	87
W01-358-5311	1T14C-1	87
W01-358-5405	1T14C-3	88
W01-358-5708	1T14C-7	89
W01-358-5712	1T14C-7	89
W01-358-6155	131	41
W01-358-6833	267-1.5 *(formerly 255-1.5)*	58
W01-358-7019	333	76
W01-358-7244	201	68
W01-358-7266	312	77
W01-358-7271	28	68
W01-358-7272	121	53
W01-358-7274	323	78
W01-358-7275	29	70

ORDER NUMBER	STYLE NUMBER	SEE PAGE
W01-358-7276	320	79
W01-358-7477	119	52
W01-358-7568	116	44
W01-358-7606	117	44
W01-358-7592	160	42
W01-358-7751	160	42
W01-358-7752	160	42
W01-358-7767	203	69
W01-358-7900	313	75
W01-358-7902	29	70
W01-358-7912	215 *(formerly 211)*	72
W01-358-7914	312	77
W01-358-7919	321 *(formerly 319)*	80
W01-358-7921	323	78
W01-358-7925	28	68
W01-358-7926	314	77
W01-358-7928	210	63
W01-358-7929	205	65
W01-358-8009	314	77
W01-358-8158	153-2	51
W01-358-9030	1T15M-0	93
W01-358-9031	1T15M-0	93
W01-358-9034	1T15M-0	93
W01-358-9036	1T15M-0	93
W01-358-9038	1T15M-0	93
W01-358-9049	1T15LP-3 *(formerly 1T15S-6)*	91
W01-358-9051	1T15LP-3 *(formerly 1T15S-6)*	91
W01-358-9108	1T15M-9	97
W01-358-9148	1T19L-7	98
W01-358-9149	1T19L-7	98
W01-358-9153	1T19L-11	99
W01-358-9155	1T19L-11	99
W01-358-9156	1T19L-11	99
W01-358-9160	1T19L-7	98
W01-358-9162	1T19L-11	99
W01-358-9165	1T19L-7	98
W01-358-9172	1T19L-7	98
W01-M58-6008	19	47
W01-M58-6011	19	47
W01-M58-6040	19-.75	48
W01-M58-6066	128-1	50
W01-M58-6070	128	49
W01-M58-6071	128	49
W01-M58-6077	205	65
W01-M58-6079	205	65
W01-M58-6100	113	49
W01-M58-6101	113	49
W01-M58-6102	113	49
W01-M58-6103	113	49
W01-M58-6105	267-1.5 *(formerly 255-1.5)*	58
W01-M58-6107	233-2	67
W01-M58-6109	233-2	67
W01-M58-6112	21	65
W01-M58-6113	21	65
W01-M58-6114	21	65
W01-M58-6115	21	65

INDEX

ORDER NUMBER TO STYLE NUMBER TO PAGE NUMBER

AIRSTROKE™ ACTUATOR DESIGN PARAMETER SHEET

1. FORCE REQUIRED:

2. STROKE REQUIRED:

3. AVAILABLE AIR PRESSURE:

4. ANGLE OF MOTION (PLEASE SKETCH):

5. LATERAL SPACE AVAILABLE FOR AIRSTROKE ACTUATOR(S):

6. ENVIRONMENTAL CONDITIONS:

7. CYCLE RATE:

8. RESPONSE TIME REQUIRED:

SPECIAL REQUIREMENTS:

DATE

PLEASE SKETCH WITH DIMENSIONS

REMARKS

NAME

COMPANY

ADDRESS

CITY/COUNTRY/CODE

TELEPHONE

Please return to your local stocking distributor, or send directly to:

Firestone Industrial Products Company, 250 W. 96th St. • Indianapolis, Indiana 46260 U.S.A.
Phone: 1-800-888-0650

PLEASE CUT ALONG DOTTED LINE

AIRMOUNT™ ISOLATOR DESIGN PARAMETER SHEET

FOR VIBRATION ISOLATION

A) TO PREVENT OUTGOING VIBRATION TRANSMISSION (INTO THE SURROUNDING AREA), OR

B) FOR ISOLATING DELICATE EQUIPMENT FROM INCOMING VIBRATIONS, PLEASE COMPLETE THE FOLLOWING:

1. DESCRIPTION OF EQUIPMENT:

_____

_____

_____

2. TYPE OF DISTURBANCE TO BE ISOLATED (FORCED FREQUENCY OF VIBRATION):

_____

_____

3. MAXIMUM WEIGHT (Kg) _____
4. WEIGHT DISTRIBUTION (PLEASE SKETCH ON GRAPH).
5. DESIRED NUMBER OF MOUNTING POINTS: ____
6. POSITION OF MOUNTING POINTS (PLEASE SKETCH ON GRAPH).
7. SPACE (DIAMETER) AVAILABLE FOR AIRMOUNT ISOLATORS (mm): _____
8. AIR PRESSURE AVAILABLE: _____
9. DIMENSIONS: HEIGHT (mm) _____
   LENGTH (mm) _____
   WIDTH (mm) _____
10. POSITION OF CENTER OF GRAVITY (C.G., ⊗, mm UP FROM BASE) _____
11. DISTURBING FREQUENCY(f_f)
    a) FOR A) ABOVE, MACHINE SPEED, (rpm) ____
    b) FOR B) ABOVE, FREQUENCY OF INCOMING VIBRATION (H_z) _____
12. PERCENT ISOLATION DESIRED (%): _____

FOR ISOLATING AN UNBALANCED MASS

13. PLEASE COMPLETE 1 THROUGH 12, AND ALSO INCLUDE:
14. TYPE OF MOVING COMPONENTS (UNBALANCED MASS):

_____

15. WEIGHT OF UNBALANCED MOVING MASS (Kg):

_____

16. RADIUS OF MOVEMENT (mm): _____
17. DIRECTION OF MOVEMENT (PLEASE SKETCH ON GRAPH).

FOR SHOCK IMPACT ISOLATION

18. PLEASE COMPLETE 1, AND ALSO INCLUDE:
19. WEIGHT OF MOVING OBJECT (Kg): _____
20. SPEED OF MOVING OBJECT (m/sec): _____
21. DISTANCE OF FREE FALL (mm): _____
22. DESIRED STOPPING DISTANCE (mm): _____
23. SPACE (DIAMETER) AVAILABLE FOR SHOCK IMPACT ISOLATOR(S) (mm): _____

DATE _____

NAME _____

COMPANY _____

ADDRESS _____

CITY/ COUNTRY/CODE _____

PHONE _____

Please return to your local stocking distributor, or send directly to:

Firestone Industrial Products Company, 250 W. 96th St. • Indianapolis, Indiana 46260 U.S.A.
Phone: 1-800-888-0650

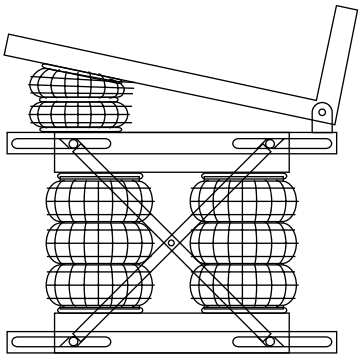
PLEASE CUT ALONG DOTTED LINE

INDEX

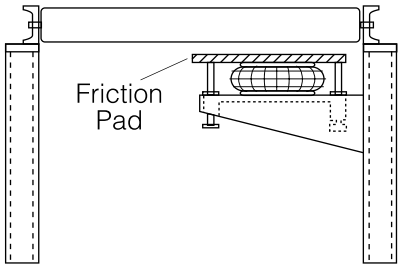
STYLE NUMBER TO PAGE NUMBER

METRIC

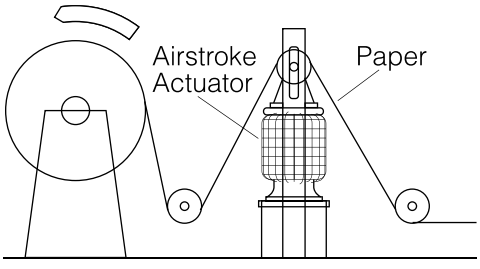
TYPICAL APPLICATIONS



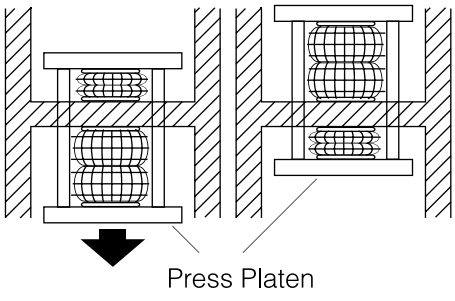
SCISSORS LIFT AND TILT TABLE



ROLLER FRICTION BRAKE



WEB TENSIONING DEVICE



FORMING PRESS

DISTRIBUTED BY

Firestone

World's Number 1 Air Spring.

FIRESTONE INDUSTRIAL PRODUCTS COMPANY

www.firestoneip.com 800.888.0650

MEMDG0414