NEW
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GOODYEAR

Super Cushion
Air Springs

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Partners In Automation Since 1964

PNEUMATIC • ELECTRICAL • RESISTANCE WELDING

Phone: 616-538-1111 Watts: 800-632-1857 Fax: 616-538-6847
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INTRODUCTION

The air spring has long been a superior alternative to air cylinders, hydraulic cylinders, and steel spring springs in a wide variety of industrial actuation and vibration isolation application.

Goodyear's leading role in the development of air springs over the past 45 years is reflected in the development of the rolling lobe air spring and sleeve type air spring for truck seat suspensions, air-adjustable shock absorbers, industrial equipment actuators, and industrial vibration isolators

The Goodyear air springs plant in Green, Ohio is dedicated to having world-class product quality. In recognition of our efforts, we have been presented with many awards, including the Ford Q-1 and Freightliner Masters of Quality award. The plant has also been ISO 9001 certified as a further commitment to customer satisfaction and product quality.

AIR SPRING CONCEPT

Super-Cushion air springs are high strength rubber/ fabric flexible air containers sealed by retainers at each end. In operation, air pressure inside the flexible member exerts internal force in an axial direction to produce a stroke for lifting, pushing, gripping, compacting or tensioning a variety of materials or objects. The air pressure in Super-Cushion air springs also serves as an energy absorbing medium to provide superior vibration isolation, load leveling, and height control.

In air actuation, a single Super-cushion air spring can provide up to 17,000 pounds of linear force and a stroke up to 20 inches. Super-Cushion air springs can be operated vertically, horizontally or at an angle. They are capable of rapid actuation, and can be applied to produce rotary motion.

In vibration isolation, Super-Cushion air springs can isolate more than 99% of unwanted vibration. They are also highly recommended for shock absorption and load height control. They have a proven record of long life and ease of maintenance.

Super-Cushion air spring can also be used to perform dual functions as in a case where a vibrating table must be raised or lowered (actuated) and the vibration of the table isolated from the rest of the equipment.

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AIR SPRING COMPONENTS

The rubber flex member is built with a tough rubber lining and outer cover reinforced by high strength synthetic fabric. This flex member is fitted with rust-resistant retainers at each end.

The upper retainer is equipped with an air fitting, and both retainers have recessed blind taps or protruding bolts for mounting to machinery.

FLEX MEMBERS: Super-Cushion air spring flex members are built of two plies of either nylon or polyester fabric, coated with rubber. They are designed to withstand over 100 psi inflation pressure, frequent flexing and misalignment. The rubber cover protects against abrasion, aging and the external environment. A rubber liner protects against the interior environment and loss of air.

The majority of industrial Super-Cushion air springs are made of natural rubber. The operational temperature range of natural rubber is –67°F to +158°F.

RETAINERS: The flexible member of the Super-Cushion air spring is attached to the upper and lower end retainers by either mechanically crimping the retainer around the built-in bead, or by swaging the flex member between a metal ring and the end retainer, thus providing an air tight seal.

All retainers and pistons are made of an engineered thermoplastic or thermo set composite material, or corrosion resistant aluminum, zinc or steel. The upper retainer has a tap to accommodate a 1/8", 1/4", 1/2" or 3/4" air fitting or valve. Although it is called the upper retainer for reference, it need not be in the up position to function properly; the attitude of the air spring does not affect its function.

Upper and lower retainers are made with blind taps, or protruding bolts to facilitate attachment to equipment and machinery. All standard bellows type Super-Cushion air springs have 3/8" blind taps that will accommodate 3/8" studs. The fastener installation torque should not exceed 25 foot pounds.

BUMPERS: A rubber bumper inside the air spring assembly helps protect the flexible member and the end retainers in those applications where external compression stops are not practical. Internal bumpers are recommended when:

1. The assembly will frequently reach the "bumper contact height"
2. The assembly will occasionally reach the "bumper contact height", but with a significant load and impact.
3. A machine may have to operate on a deflated air spring assembly.

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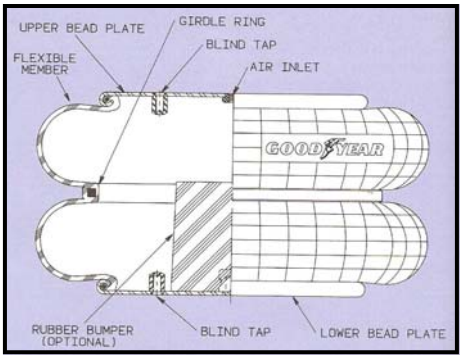
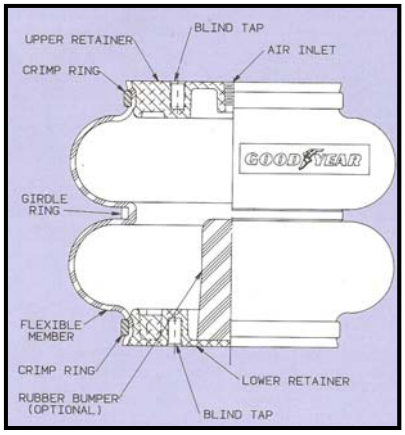
PRODUCT DESCRIPTION

Bellows Type Air Spring

(2B12-309 Shown)

Bellows air springs have one, two or three convolutions in the flexible member. There are two styles of bellows; crimped design (shown here) and sleeve type (see below). With the crimped design, the end retainers are permanently attached by mechanically crimping the retainer around the built-in bead wire of the flexible member.





Sleeve Type Air Spring

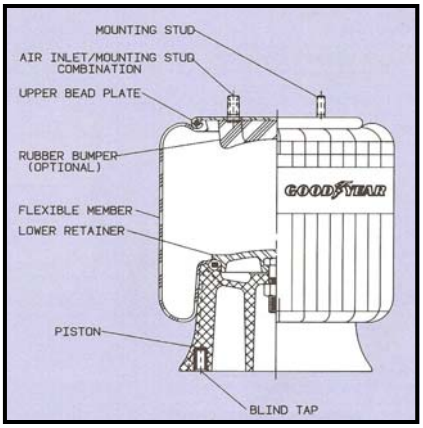
(2B7-542 Shown)

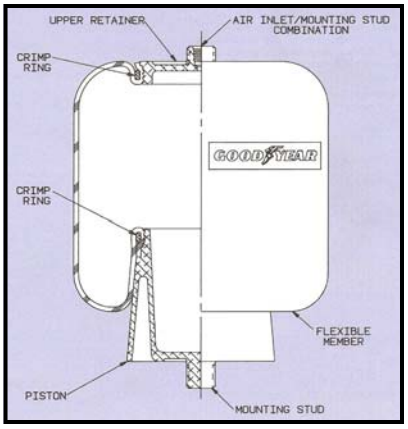
Sleeve type bellows offer similar characteristics to the crimped design bellows, but, as with the sleeve type rolling lobe, the flexible member is constructed without internally molded bead wires. The end retainers are permanently attached by pinching the flexible member between the end retainers and external crimp rings which are than swaged to the proper diameter. Sleeve type bellows offer the lowest force to compress of any type of air spring.

Rolling Lobe Air Spring

(1R12-092 Shown)

Rolling lobe air springs incorporate a piston which allows the flexible member to roll along the piston's surface as the forces change





Sleeve Type Rolling Lobe

(1S6-023 Shown)

Sleeve type air spring are similar to the rolling lobe air springs except that the sleeve type assemblies employ a flexible member without an internally molded bead. The flexible member is attached to the end retainers by pinching the material between the end retainers and exterior crimp rings which are than swaged to the proper diameter.

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DESIGN CONSIDERATIONS AIR ACTUATION

Super-Cushion air springs are actuated by increasing and decreasing air pressure. They can replace hydraulic and air cylinders in countless applications at a much lower cost.

Super-Cushion air springs generally have a shorter, more compact height (length) than air or hydraulic cylinders. This offers many design advantages over air and hydraulic cylinders. The maximum recommended inflation pressure is 100 psi for Super-Cushion air springs. This limit of pressure may require a larger O.D. air spring, when compared to a cylinder, to lift an equivalent load.

Super-Cushion air springs have no sliding seals, thus negligible break away and sliding friction compared to cylinders. Also, Super-Cushion air springs have a greater effective area in the compressed position than in the extended position. This results in a much more rapid actuation response possible with Super-Cushion air springs than with air or hydraulic cylinders.

Super-Cushion air springs provide a force in one direction, i.e., they are single acting. Air or hydraulic cylinders can be of the single or double acting types. To replace a double acting cylinder, two air springs may be used, one for extension and the other for return.

The equation, force = pressure x effective area ($F = P \times A_e$) is applicable to both air springs and cylinders. Unlike cylinders, the effective area of the air spring can vary to a small degree with pressure and to a large degree over stroke. With the bellows air springs, the effective area decreases with increasing stroke. It is important to choose an air spring that will produce the desired force at the top end of the stroke. In the rolling lobe and sleeve types, the piston contour influences the effective area. Most rolling lobe and sleeve types have a relatively constant effective area over a substantial portion of their stroke.

In many actuator applications, the mass can move only in the desired path regardless of the actuator used.

Air springs follow the path of least resistance, which accounts for their ability to function with misalignment of approximately ten degrees. If the path of least resistance is not within ten degrees of desired path, a means to guide the actuated mass must be employed.

The useable stroke of an air spring is the difference between the recommended actuator height limit and the compressed height. If an internal bumper is included in an assembly, the compressed height is greater than that same assembly without a bumper. Therefore, there is less stroke available in a Super-Cushion air spring with an internal bumper.

The height limit (actuator) is recommended for optimum life in actuator applications and the extension of the assembly should be limited here. Each assembly must be limited in extension to the maximum extended height (isolator) shown in the Engineering Data to prevent air spring failure. When the air spring is extended beyond the actuator height limit, highly concentrated stress develop. Life of the air spring above this height limit depends on pressure, extension and repetition of these concentrated stresses, but will most likely be reduced.

SAFETY CONSIDERATIONS

Safety locking devices are commonly used in jacking and lifting applications. This is also an important design consideration with the use of compressed air actuators. If a sudden depressurization occurred, the load could fall.

To prevent possible bodily injury, design and installation of safety lock devices should be in these applications where air spring actuators lift a load or object.

INSTALLATION

All air spring applications require adequate support of both upper and lower end components. Although it is recommended to fully support the air springs to the diameter of attaching end metals, it is not always required. If your application does not allow for full support, contact Rapid Control Service for design assistance.

In case of arcuate motion, the best results occur when the upper and lower components are parallel at the air spring's bumper contact height. A small reverse angle at this position may be designed in to reduce the angle at maximum spring extension. For bellows, the convolutions must separate as the air spring approaches maximum extension to prevent excessive abrasion. Do Not exceed the Maximum Extended Height of the spring as measured on the outside of the arcuate path.

When designing for the use of air springs, care must be taken to ensure that no sharp edges will contact the flexible member throughout the full travel of the air spring. This must be verified for both maximum inflation and zero pressure operation, especially for rolling lobe and sleeve type rolling lobe springs where clearance between the meniscus and the piston support surface decreases as the pressure decreases. The space envelope around the air spring must clear the maximum outside diameter of the air spring by two inches (one inch on all sides) to allow for normal growth as well as deformity caused by misalignment.

DESIGN CONSIDERATIONS AIR ACTUATION

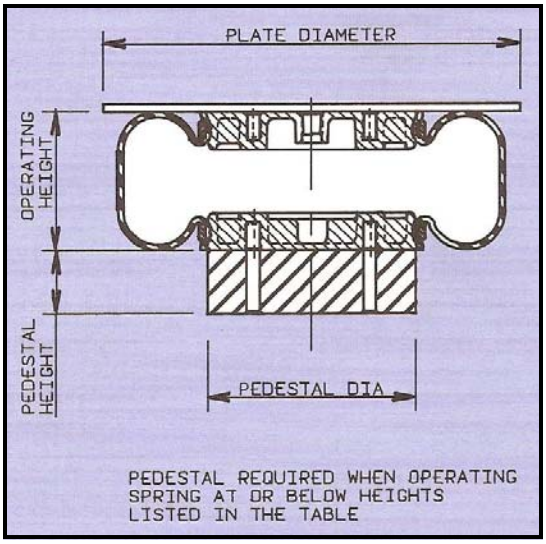
Excessive loading may occur on the air spring assembly when adequate height clearance is not maintained with external stops. Built-in compression stops (rubber bumpers) are available with various load vs. deflection characteristics. However, external mechanical stops are recommended whenever possible to prevent end metal deformation.

Special cases occur with the triple convolution bellows (3B) air springs under certain load and deflection conditions. In order to maintain stability over the entire stroke of a (3B) air spring, it must be fully supported to the maximum outside diameter of the air spring. Also, the end retainers must either be recessed approximately 0.75" into the supporting surfaces, or attached with special rubber rings that fit around the outside diameter of the retainers.

Special Consideration for Sleeve Type Bellows:

When operating the following air springs at or below the heights listed in the table, caution must be taken to avoid flexible member contact with obstructions. The air springs should either be mounted with a flat plate on both the upper and lower retainers, or on a pedestal. Dimensions for the plates and pedestals are specified in the table

	1B5-520	1B6-535	1B8-560
Operating Height	2.8"	3.5"	3.3"
Plate Diameter	6.75"	7.25"	9.65"
Pedestal Height	1.8"	1.7"	1.5"
Pedestal Diameter	3.25"	4.00"	5.00"



DO & DON'T OF DESIGN AND APPLICATION

DO

1. Allow clearance around the maximum diameter of the air spring assembly to prevent abrasion of the flex member on the other structures. Where misalignment is not intended, a one inch clearance is generally sufficient.
2. Limit the extension of the Super Cushion actuator to the "actuator height limit" for increased life by installing external stops.
3. Specify air spring assemblies with internal bumpers and/ or install external stops to avoid:
   a. Compression below the "compressed height without a bumper" for the bellows air springs. For the rolling lobe and sleeve type springs, limit the compression to 0.1" above the "compressed height without a bumper".
   b. Severe impacting to the "compressed height without a bumper" for the bellows air springs. For the rolling lobe and sleeve type springs, limit the compression to 0.1" above the "compressed height without a bumper".
4. The desired path of the actuated mass must be guided if not already provided for in the equipment design
5. Consider environmental conditions such as temperature range chemicals, ect. When choosing a Super Cushion air spring for actuation.
6. For applications using rolling lobe or sleeve type super cushion air springs, a minimum of approximately 10 psi inflation pressure should be maintained. This insures that the flexible member will roll over the piston without buckling. Bellows air springs will maintain their operational configuration at zero pressure.
7. Use pipe dope or Teflon tape around air fittings to insure against air leaks.
8. Inflate with air, water, bottled nitrogen, or anti-freeze solution.
9. Design in adequate safety locking devices to support the load and prevent bodily injury in case of sudden depressurization.

For design data sheets, go to the following address

http://www.goodyearep.com/resourcecenter.aspx?folderid=292

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DESIGN CONSIDERATIONS AIR ACTUATION

DO & DON'T OF DESIGN AND APPLICATION

DON'T

1. Do not put Super Cushion air spring in torsion. To do so may cause the air spring assembly to fail
2. Do not exceed the maximum extended height shown for isolators under any conditions. To do so may cause structural damage to the assembly. Travel should be limited to the actuator height limit for optimum life.
3. Do not exceed the 100 psi maximum inflation pressure.
4. Do not exceed 200 psi internal pressure in compression, or in other condition.
5. Do not permit the Super Cushion air spring to be compressed below its compressed height with no bumper in any application.
6. Do not exhaust all air from a rollong lobe or sleeve type air spring while attempting to compress it. A minimum of approximately 10 psi should be maintained internally to allow the flex member to roll down over the piston
7. Do not use oil to actuate unless a sample of oil is approved by the Goodyear Tire & Rubber Company

PRODUCT INDENTIFICATION SYSTEM

Assembly Number

2 B 12 — 425

These three numbers identify the specific end retainer, air fittings size, flex member and bumper

This could be a single or double digit number. It is the nominal outside working diameter of the air spring assembly, in inches. (it is NOT the maximum diameter)

This letter refers to the type of air spring
- B — Bellows
- R — Rolling Lobe
- S — Sleeve (beadless rolling lobe type)

Number of convolutions in the assembly
- 1 = Single Convolute
- 2 = Double Convolute
- 3 = Triple Convolute

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GOODYEAR

Single Convoluted Type Air Spring

Part Number	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	Force Available At Actuator Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Force Available At Compressed Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
1B5-500	2.0	5.7	1.8	3.8	NO	570	425	290	175	1525	1210	900	595	1/4
1B5-502	2.0	5.7	1.8	3.8	NO	570	425	290	175	1525	1210	900	595	3/4
1B5-503	2.0	5.7	1.8	3.8	NO	570	425	290	175	1525	1210	900	595	1/4 TV
IB5-510	3.0	6.0	1.8	4.8	NO	530	390	260	145	1620	1290	955	635	1/4
IB5-512	3.0	6.0	1.8	4.8	NO	530	390	260	145	1620	1290	955	635	3/4
1B5-520	4.0	6.5	1.8	5.8	NO	445	305	180	80	2100	1660	1230	850	1/4
1B5-521	4.0	6.5	1.8	5.8	NO	445	305	180	80	2100	1660	1230	850	3/4
1B6-530	3.0	6.5	1.8	4.8	NO	880	635	440	235	2115	1655	1240	840	1/4
1B6-531	3.0	6.5	1.8	4.8	NO	880	635	440	235	2115	1655	1240	840	1/4 OS
1B6-532	2.5	6.5	2.3	4.8	YES	880	635	440	235	2065	1640	1230	810	1/4 OS
1B6-535	5.3	7.0	1.8	7.1	NO	780	510	320	165	3020	2380	1815	1290	1/4
1B6-536	5.3	7.0	1.8	7.1	NO	780	510	320	165	3020	2380	1815	1290	1/4OS
1B6-538	4.8	7.0	2.3	7.1	YES	780	510	320	165	2715	2110	1585	1085	1/4 OS
1B7-540	3.8	7.7	1.8	5.6	NO	445	290	130	30	2635	2095	1540	1015	1/4
1B7-541	3.8	7.7	1.8	5.6	NO	445	290	130	30	2635	2095	1540	1015	1/4 OS
1B7-542	3.3	7.7	2.3	5.6	YES	445	290	130	30	2580	2055	1505	990	1/4 OS
1B8-550	3.8	8.7	1.8	5.6	NO	815	525	315	110	3650	2895	2155	1405	1/4
1B8-551	3.8	8.7	1.8	5.6	NO	815	525	315	110	3650	2895	2155	1405	1/2
1B8-552	3.8	8.7	1.8	5.6	NO	815	525	315	110	3650	2895	2155	1405	3/4
1B8-553	3.8	8.7	1.8	5.6	NO	815	525	315	110	3650	2895	2155	1405	1/4 OS
1B8-554	3.3	8.7	2.3	5.6	YES	815	525	315	110	3590	2830	2105	1370	1/4 OS
1B8-560	5.5	9.4	1.8	7.3	NO	1105	750	750	130	4720	3650	2625	1755	1/4
1B8-562	5.5	9.4	1.8	7.3	NO	1105	750	750	130	4720	3650	2625	1755	3/4
1B8-563	5.5	9.4	1.8	7.3	NO	1105	750	750	130	4720	3650	2625	1755	1/4 OS
1B8-564	5.0	9.4	2.3	7.3	YES	1105	750	750	130	4160	3200	2270	1500	1/4 OS
1B9-201	2.7	11.0	3.2	5.9	YES	1575	1215	875	560	5130	4090	3045	2010	1/4 OS
1B9-202	3.6	11.0	2.3	5.9	N0	1575	1215	875	560	5625	4500	3350	2225	1/4 OS
1B9-204	3.6	11.0	2.3	5.9	N0	1575	1215	875	560	5625	4500	3350	2225	1/2 OS
1B9-205	2.7	11.0	3.2	5.9	YES	1575	1215	875	560	5130	4090	3045	2010	1/2 OS
1B9-207	3.6	11.0	2.3	5.9	N0	1575	1215	875	560	5625	4500	3350	2225	3/4 OS
1B9-208	2.7	11.0	3.2	5.9	YES	1575	1215	875	560	5130	4090	3045	2010	3/4 OS
1B12-301	13.2	4.6	2.6	7.2	YES	3640	2710	1840	1095	9035	7110	5250	3480	1/4 OS
1B12-304	13.2	4.9	2.3	7.2	NO	3640	2710	1840	1095	9195	7185	5305	3520	3/4 OS

NOTE: OS = OFFSET AIR FITTING

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Single Convoluted Type Air Spring

Part Number	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	Force Available At Actuator Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Force Available At Compressed Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
1B12-305	4.6	13.2	2.6	7.2	YES	3640	2710	1840	1095	9035	7110	5250	3480	3/4 OS
1B12-313	4.9	13.2	2.3	7.2	NO	3640	2710	1840	1095	9195	7185	5305	3520	1/4 OS
1B14-350	4.9	15.2	2.3	7.2	NO	4910	3705	2625	1605	13320	10585	7975	5290	1/4 OS
1B14-351	3.0	15.2	4.2	7.2	YES	4910	3705	2625	1605	11760	9345	7000	4630	1/4 OS
1B14-352	4.9	15.2	2.3	7.2	NO	4910	3705	2625	1605	13320	10585	7975	5290	3/4 OS
1B14-353	3.0	15.2	4.2	7.2	YES	4910	3705	2625	1605	11760	9345	7000	4630	3/4 OS
1B14-362	6.0	15.9	2.3	8.3	NO	4865	3625	2530	1520	14870	11705	8730	5795	3/4 OS
1B14-364	6.0	15.9	2.3	8.3	NO	4865	3625	2530	1520	14870	11705	8730	5795	1/4 OS
1B15-375	5.6	17.5	2.3	7.9	NO	4980	3775	2470	1490	16750	13450	9665	6510	1/4 OS
1B15-376	3.7	17.5	4.2	7.9	YES	4980	3775	2470	1490	13960	11140	8295	54656	1/4 OS
1B15-377	5.6	17.5	2.3	7.9	NO	4980	3775	2470	1490	16750	13450	9665	6510	3/4 OS
1B15-378	3.7	17.5	4.2	7.9	YES	4980	3775	2470	1490	13960	11140	8295	5465	3/4 OS

Double Convoluted Type Air Spring

Part Number	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	Force Available At Actuator Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Force Available At Compressed Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
2B6-530	4.5	6.5	2.8	7.7	NO	595	405	235	95	2865	2320	1800	1255	1/4
2B6-531	4.5	6.5	2.8	7.7	NO	595	405	235	95	2865	2320	1800	1255	1/4
2B6-532	4.3	6.5	3.4	7.7	TES	595	405	235	95	2465	1940	1455	970	1/4
2B6-535	5..9	7.0	2.8	9.1	NO	585	400	215	90	3395	2790	2170	1505	1/4
2B6-536	5.7	7.0	3.4	9.1	YES	585	400	215	90	3000	2420	1820	1270	1/4
2B7-540	6.5	8.0	2.5	9.0	NO	835	550	295	110	3220	2535	1860	1240	1/4
2B7-541	6.5	8.0	2.5	9.0	NO	835	550	295	110	3220	2535	1860	1240	1/4 OS
2B7-542	5.7	8.0	3.3	9.0	YES	835	550	295	110	3115	2460	1810	1240	1/4 OS
2B7-545	6.5	8.0	2.5	9.0	NO	835	550	295	110	3220	2535	1860	1240	1/2
2B7-546	6.5	8.0	2.5	9.0	NO	835	550	295	110	3220	2535	1860	1240	3/4
2B8-550	7.1	8.6	2.8	10.3	NO	850	600	350	100	5150	4150	3100	2150	1/4
2B8-552	7.1	8.6	2.8	10.3	NO	850	600	350	100	5150	4150	3100	2150	3/4
2B8-553	7.1	8.6	2.8	10.3	NO	850	600	350	100	5150	4150	3100	2150	1/4
2B8-554	6.8	8.6	3.5	10.3	YES	850	600	350	100	4650	3700	2800	1900	1/4

NOTE: OS = OFFSET AIR FITTING

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Double Convoluted Type Air Spring

Part Number	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	Force Available At Actuator Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Force Available At Compressed Height Limit (Pounds) 100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
2B9-200	8.0	10.3	3.5	11.5	NO	540	330	100	30	5435	4320	3160	2020	1/4 OS
2B9-201	7.7	10.3	3.8	11.5	YES	540	330	100	30	5320	4225	3095	1980	1/4 OS
2B9-204	8.0	10.3	3.5	11.5	NO	540	330	100	30	5435	4320	3160	2020	1/2 OS
2B9-205	7.7	10.3	3.8	11.5	YES	540	330	100	30	5320	4225	3095	1980	1/2 OS
2B9-208	7.7	10.3	3.8	11.5	YES	540	330	100	30	5320	4225	3095	1980	3/4 OS
2B9-216	8.0	10.3	3.5	11.5	NO	540	330	100	30	5435	4320	3160	2020	3/4 OS
2B9-250	9.3	10.3	3.5	12.8	NO	1495	1105	750	415	6105	4860	3640	2475	1/4 OS
2B9-251	9.0	10.3	3.8	12.8	YES	1495	1105	750	415	5880	4575	3500	2370	1/4 OS
2B9-253	9.0	10.3	3.8	12.8	YES	1495	1105	750	415	5880	4675	3500	2370	1/4 OS
2B12-309	6.9	13.0	4.2	11.1	YES	2905	2185	1390	770	9150	7255	5345	3505	1/4 OS
2B12-318	6.9	13.0	4.2	11.1	YES	2905	2185	1390	770	9150	7255	5345	3505	3/4 OS
2B12-425	7.6	13.0	3.5	11.1	NO	2905	2185	1390	770	9480	7470	5500	3580	1/4 OS
2B12-429	7.6	13.0	3.5	11.1	NO	2905	2185	1390	770	9480	7470	5500	3580	3/4 OS
2B12-437	7.6	13.0	3.5	11.1	NO	2905	2185	1390	770	9480	7470	5500	3580	1/4
2B12-416	10.9	13.7	3.5	14.4	NO	2650	1750	1175	480	11015	8600	6430	4210	1/4 OS
2B12-419	10.9	13.7	3.5	14.4	NO	2650	1750	1175	480	11015	8600	6430	4210	3/4 OS
2B14-352	7.8	15.1	3.5	11.3	NO	3485	2715	2000	1240	13915	11070	8280	5480	3/4 OS
2B14-353	6.4	15.1	4.9	11.3	YES	3485	2715	2000	1240	13100	10555	7880	5275	3/4 OS
2B14-354	7.8	15.1	3.5	11.3	NO	3485	2715	2000	1240	13915	11070	8280	5480	1/4 OS
2B14-355	6.4	15.1	4.9	11.3	YES	3485	2715	2000	1240	13100	10555	7880	5275	1/4 OS
2B14-362	11.7	16.0	3.5	15.2	NO	4310	3150	2065	1120	16265	12965	9665	9345	1/4 OS
2B14-363	11.7	16.0	3.5	15.2	NO	4310	3150	2065	1120	16265	12965	9665	9345	3/4 OS
2B14-452	11.0	16.0	4.2	15.2	YES	4310	3150	2065	1120	15385	12235	9090	5970	1/4 OS
2B15-375	9.3	16.7	3.5	12.8	NO	4105	2970	2090	1270	15675	12510	9350	6210	1/4 OS
2B15-376	7.9	16.7	4.9	12.8	YES	4105	2970	2090	1270	14230	11375	8490	5075	1/4 OS
2B15-377	9.3	16.7	3.5	12.8	NO	4105	2970	2090	1270	15675	12510	9350	6210	3/4 OS
2B15-378	7.9	16.7	4.9	12.8	YES	4105	2970	2090	1270	14230	11375	8490	5075	3/4 OS
2B19-8433	6.75	20.0	3.25	10.0	NO	17680	14000	10340	6710	27240	21750	16260	10760	—
2B22-8539	6.75	22.75	3.25	10.0	NO	24190	19110	14130	9320	34100	27140	20150	13320	—

NOTE: OS = OFFSET AIR FITTING

Triple Convoluted Type Air Spring

						Force Available At Actuator Height Limit (Pounds)				Force Available At Compressed Height Limit (Pounds)				
Part Number	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	100 psi	80 psi	60 psi	40 psi	100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
3B12-304	13.3	13.0	4.7	18.0	NO	29.25	2165	1370	735	10165	7915	5855	3960	1/4 OS
3B12-305	13.3	13.0	4.7	18.0	NO	29.25	2165	1370	735	10165	7915	5855	3960	3/4 OS
3B14-351	10.9	15.5	7.3	18.2	YES	4770	3385	1935	940	13885	10550	7810	5220	1/4 OS
3B14-353	10.9	15.5	7.3	18.2	NO	4770	3385	1935	940	13885	10550	7810	5220	3/4 OS
3B14-354	13.5	15.5	4.7	18.2	NO	4770	3385	1935	940	15200	11080	8240	5220	1/4 OS
3B14-361	13.5	15.5	4.7	18.2	NO	4770	3385	1935	940	15200	11080	8240	5220	3/4 OS
3B15-375	12.3	16.5	4.7	17.0	NO	6165	4775	3470	2225	16650	13275	9765	6555	1/4 OS
3B15-376	9.7	16.5	7.3	17.0	YES	6165	4775	3470	2225	14925	11865	8905	5945	1/4 OS
3B15-377	12.3	16.5	4.7	17.0	NO	6165	4775	3470	2225	16650	13275	9765	6555	3/4 OS
3B15-378	9.7	16.5	7.3	17.0	YES	6165	4775	3470	2225	14925	11865	8905	5945	3/4 OS

Sleeve Lobe Type Air Spring

						Force Available At Actuator Height Limit (Pounds)				Force Available At Compressed Height Limit (Pounds)				
Part Num-ber	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	100 psi	80 psi	60 psi	40 psi	100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
1S3-013	2.1	3.6	1.5	3.6	NO	140	85	45	30	620	485	365	245	1/8
1S3-011	4.4	3.25	3.6	8.0	NO	110	85	65	55	370	290	205	135	1/8
1S4-007	4.9	4.6	2.2	7.1	NO	330	255	190	145	1160	940	740	535	1/8
1S4-008	6.5	4.6	4.0	10.5	NO	565	445	345	255	890	705	530	350	1/8
1S5-010	4.05	5.6	2.2	6.25	NO	575	445	335	240	1270	970	710	475	1/8
1S5-005	5.5	5.6	4.0	9.5	NO	840	660	500	350	970	755	545	360	1/8
1S5-006	6.5	5.6	4.0	10.5	NO	780	615	470	330	1135	890	660	425	1/8

Rolling Lobe Type Air Spring

						Force Available At Actuator Height Limit (Pounds)				Force Available At Compressed Height Limit (Pounds)				
Part Num-ber	Usable Stroke	Max Dia @ 100 psi In	Min Ext Height Inches	Max Ext Height Inches	Bumper	100 psi	80 psi	60 psi	40 psi	100 psi	80 psi	60 psi	40 psi	Air Fitting Size (in)
1R8-005	13.0	8.7	5.6	18.6	NO	—	950	650	400	5015	4125	3235	2410	1/4
1R8-009	11.8	8.7	6.8	18.6	YES	—	895	605	400	4200	3420	2625	1910	1/4
1R9-009	8.6	9.5	3.2	11.8	NO	915	705	510	300	5380	4405	3400	2690	1/4
1R9-003	12.3	9.5	5.6	17.9	NO	1315	975	670	430	4970	3955	2985	2090	1/4
1R10-086	14.1	11.0	6.0	20.1	NO	2560	1905	1240	690	8235	6695	5175	3710	1/4
1R11-028	9.3	11.5	3.7	13.0	NO	2335	1875	1145	475	8370	6740	5180	3610	1/4
1R11-039	11.0	11.7	6.1	17.1	YES	2365	1820	1365	945	7940	6390	4900	3330	1/4
1R12-095	9.1	12.7	4.4	13.5	YES	2410	1750	1005	405	8610	6845	5140	3390	1/4
1R12-132	10.8	12.9	6.1	16.9	YES	2740	1925	1230	630	8480	6715	5015	3305	1/4
1R12-092	13.4	12.6	7.7	21.1	YES	2780	1705	1210	620	8295	6550	4840	3200	1/4
1R12-274	14.7	12.8	8.1	22.8	YES	3015	2285	1465	795	9060	7295	5260	3525	1/4

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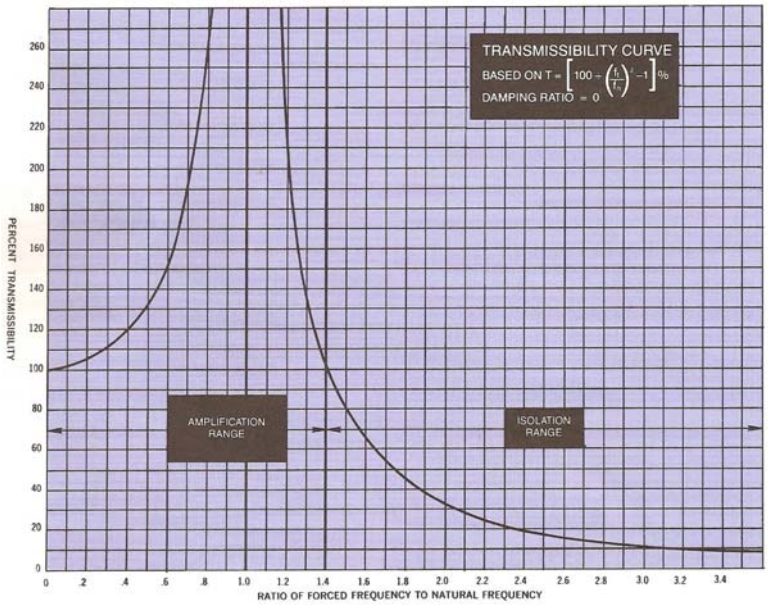
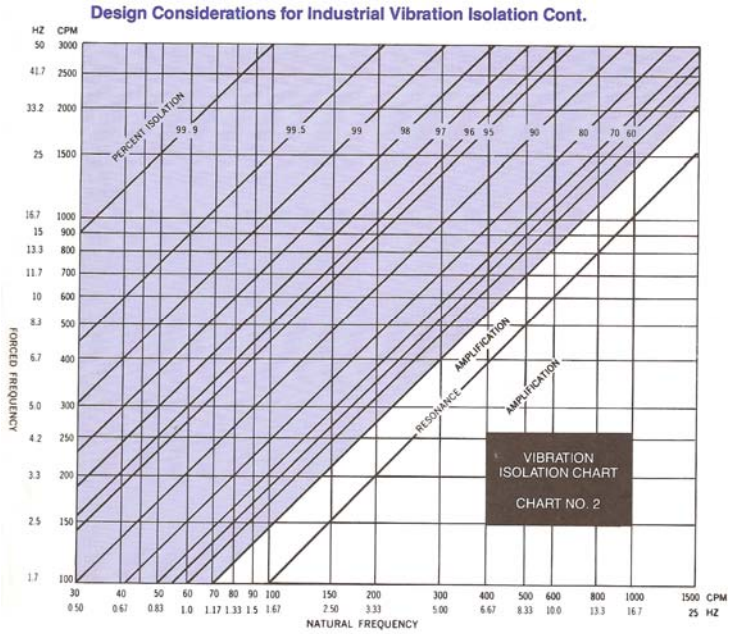
DESIGN CONSIDERATIONS VIBRATION ISOLATION

All moving machinery vibrates to some extent at some forced frequency (f_f). These vibrations are transmitted into and through the supporting structure of the machine, and into any masses attached to it.
Vibrations cause flex fatigue to all objects wich they disturb. They also increase noise level by the "drum effect", especially when the vibrating equipment is on a floor other than the one at ground level.
Transmissibility is the ratio of the transmitted force to the exciting force. When the ratio of force fequency of a machine to natural frequency of vibration isolator is greater than three, 10 percent or less of the force vibration is transmitted through the vibration isolator. Theoretically, 90 percent or more of the vibration is isolated.



The vibration isolation chart is shown above in the second column. The force or exciting freuency is plotted on the vertical ordinate and the natural frequency of the air spring is plotted on the horizontal ordinate. The diagonal lines represent percentage of vibrating at 1500 cpm and is mounted on any type vibration isolator with a natural frequency of 300 cpm, vibration isolation is theoretically 96.1 percent.
The above theoretical 96.1 percent vibration isolation assumes that the deflection of the floor under the pump is small compared to the deflection of the vibration isolator, and that the moving mass fo the isolated



Equipment is extremely small compared to the floor mass. The assumption is most accurate when the equipment is mounted on the ground floor. On other floors, greated deflection may yield a lower percentage of vibration isolation. In newer, lighter weight building with large floor spans, floors are designed with allowable deflection of as much as 1/360 of free span. If machinery were to be mounted in a 20 foot bay, the floor deflection might be as much as 1/360 x 240" or 666".

STABLITY GUIDELINES

When a mass is mounted on three or four air springs in a vibration isolation application, the distance between any two air springs should be greater than the height of the center of gravity of the mass. This height would be measured from the floor to the center of gravity when the mass is at the mounted operating position. If using more than four air springs, the spacing of the outermost air spring should be greater than the height of the center gravity of the mounted mass.
For a mass with a high center of gravity and narrow base, stability may be improved by increasing the width of the base , adding an inertia base which lowers the center of gravity of the system, or by raising the mounting points of the air springs above the plane of the floor without increasing the height of the center of gravity.

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DESIGN CONSIDERATIONS VIBRATION ISOLATION

In a vibration isolation application where the mounted mass is the source of the forced vibration, the amplitude of the vibration is dependent upon the forced freqency and the ratio of unbalanced mass in motion to the total mounted mass. The greater this ratio is, the greater will be the amplitude of vibration.
Where amplitudes are larger than desired, they can be reduced by adding damping through the use of shock absorbers. Another approach to reducing the amplitude is to add weight (an inertial base) to the mounted mass, thus reducing the ratio of the unbalanced mass to the mounted mass.

DO & DON'T OF DESIGN AND APPLICATION

DO

1. Allow clearance around the maximum diameter of the air spring assembly to prevent abrasion of the flex member on the other structures. Where misalignment is not intended, a one inch clearance is generally sufficient..
2. Specify air spring assemblies with internal bumpers and/ or install external stops to avoid:
   a. Compression below the "compressed height without a bumper" for bellows. For rolling lobe & sleeve types, limit the compression to 0.1" above the "compressed height without bumper".
   b. Severe impacting at the "compressed height with no bumper".
   c. Operation of vibrating equipment on the air spring assembly when it is deflated.
3. Install extension stops to limit the extension of the air spring to the maximum extended height.
4. When using an internal bumper, check the load vs. deflection curve for bumper deflection height to insure compatibility of the air spring bumper and compressed height limits with application.
5. Choose an air spring assembly for which the desired operating height and load are in the design height and design load range at inflation pressures between 20 and 100 psi.
6. Where possible, use design heights in the center of the design height range
7. For increased lateral rate (stability) use (1B) type bellows or use restraining cylinders with the rolling lobe and sleeve type assemblies
8. Use pipe dope or teflon tape around air fittings in insure against air leaks.
9. Install sir springs with air port on the isolated end whenever possible.

DON'T

1. Do not exceed 200 psi internal pressure in compression or in any other condition.
2. Do not exceed the 100 psi maximum inflation pressure.
3. Do not exceed the maximum extended height. To do so may cause structural damage to the air spring assembly.
4. Do not put the air spring assembly in torsion.
5. Do not permit the Super Cushion air spring to be compressed below it's "compressed height with no bumper" in operation.
6. Do not allow a machine to continue to operate on a deflated air spring assembly. If deflation can occur, an internal bumper will help to protect the air spring assembly.
7. Do not mount a mass on a rolling lobe or sleeve type air spring without providing proper means of lateral stability.
8. Do not exhaust all the air from a rolling lobe or sleeve type air spring while attempting to compress it. A minimum of approximately 10 psi air pressure should be maintained internally. Not doing so may cause the flex member to buckle instead of rolling over the piston.

For design data sheets, go to the following address

http://www.goodyearep.com/resourcecenter.aspx?folderid=292

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Single Convoluted Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
1B5-500	5.7	220-1370	2.5-3.0	2.0	1.8	3.8	NO	72.0	94.0	96.3	98.3	1/4
1B5-502	5.7	220-1370	2.5-3.0	2.0	1.8	3.8	NO	72.0	94.0	96.3	98.3	3/4
1B5-503	5.7	220-1370	2.5-3.0	2.0	1.8	3.8	NO	72.0	94.0	96.3	98.3	1/4 TV
IB5-510	6.0	195-1560	2.5-4.0	3.0	1.8	4.8	NO	82.0	96.0	97.5	99.0	1/4
IB5-512	6.0	195-1560	2.5-4.0	3.0	1.8	4.8	NO	82.0	96.0	97.5	99.0	3/4
1B5-520	6.5	190-1555	3.5-5.0	4.0	1.8	5.8	NO	83.0	96.2	97.6	99.0	1/4
1B5-521	6.5	190-1555	3.5-5.0	4.0	1.8	5.8	NO	83.0	96.2	97.6	99.0	3/4
1B6-530	6.5	290-1960	3.0-4.0	3.0	1.8	4.8	NO	78.0	95.0	97.0	98.6	1/4
1B6-531	6.5	290-1960	3.0-4.0	3.0	1.8	4.8	NO	78.0	95.0	97.0	98.6	1/4 OS
1B6-532	6.5	290-1960	3.0-4.0	2.5	2.3	4.8	YES	78.0	95.0	97.0	98.6	1/4 OS
1B6-535	7.0	250-2210	4.0-6.0	5.3	1.8	7.1	NO	90.0	97.4	98.4	99.3	1/4
1B6-536	7.0	250-2210	4.0-6.0	5.3	1.8	7.1	NO	90.0	97.4	98.4	99.3	1/4OS
1B6-538	7.0	250-2210	4.0-6.0	4.8	2.3	7.1	YES	90.0	97.4	98.4	99.3	1/4 OS
1B7-540	7.7	260-2225	4.0-5.0	3.8	1.8	5.6	NO	83.0	96.1	97.6	99.0	1/4
1B7-541	7.7	260-2225	4.0-5.0	3.8	1.8	5.6	NO	83.0	96.1	97.6	99.0	1/4 OS
1B7-542	7.7	260-225	4.0-5.0	3.3	2.3	5.6	YES	83.0	96.1	97.6	99.0	1/4 OS
1B8-550	8.7	330-2965	3.75-4.75	3.8	1.8	5.6	NO	83.0	96.3	97.6	99.0	1/4
1B8-551	8.7	330-2965	3.75-4.75	3.8	1.8	5.6	NO	83.0	96.3	97.6	99.0	1/2
1B8-552	8.7	330-2965	3.75-4.75	3.8	1.8	5.6	NO	83.0	96.3	97.6	99.0	3/4
1B8-553	8.7	330-2965	3.75-4.75	3.8	1.8	5.6	NO	83.0	96.3	97.6	99.0	1/4 OS
1B8-554	8.7	330-2965	3.75-4.75	3.3	2.3	5.6	YES	83.0	96.3	97.6	99.0	1/4 OS
1B8-560	9.4	180-3340	4.0-6.5	5.5	1.8	7.3	NO	85.0	96.6	97.9	99.1	1/4
1B8-562	9.4	180-3340	4.0-6.5	5.5	1.8	7.3	NO	85.0	96.6	97.9	99.1	3/4
1B8-563	9.4	180-3340	4.0-6.5	5.5	1.8	7.3	NO	85.0	96.6	97.9	99.1	1/4 OS
1B8-564	9.4	180-3340	4.0-6.5	5.0	2.3	7.3	YES	85.0	96.6	97.9	99.1	1/4 OS
1B9-201	11.0	645-3905	4.5-5.0	2.7	3.2	5.9	YES	84.0	96.6	97.8	99.0	1/4 OS
1B9-202	11.0	645-3905	4.5-5.0	3.6	2.3	5.9	N0	84.0	96.6	97.8	99.0	1/4 OS
1B9-204	11.0	645-3905	4.5-5.0	3.6	2.3	5.9	N0	84.0	96.6	97.8	99.0	1/2 OS
1B9-205	11.0	645-3905	4.5-5.0	2.7	3.2	5.9	YES	84.0	96.6	97.8	99.0	1/2 OS
1B9-207	11.0	645-3905	4.5-5.0	3.6	2.3	5.9	N0	84.0	96.6	97.8	99.0	3/4 OS
1B9-208	11.0	645-3905	4.5-5.0	2.7	3.2	5.9	YES	84.0	96.6	97.8	99.0	3/4 OS
1B12-301	13.2	1380-8820	3.0-5.0	4.6	2.6	7.2	YES	89.0	97.3	98.4	99.3	1/4 OS
1B12-304	13.2	1380-8820	3.5-5.0	4.9	2.3	7.2	NO	89.0	97.3	98.4	99.3	3/4 OS

NOTE: OS = OFFSET AIR FITTING

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GOODYEAR

Single Convoluted Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
1B12-305	13.2	1380-8820	3.0-5.0	4.9	2.6	7.2	YES	89.0	97.3	98.4	99.3	3/4 OS
1B12-313	13.2	1380-8820	3.0-5.0	4.9	2.3	7.2	NO	89.0	97.3	98.4	99.3	1/4 OS
1B14-350	15.2	1935-11,985	4.0-5.25	4.9	2.3	7.2	NO	86.0	96.8	98.0	99.2	1/4 OS
1B14-351	15.2	1935-11,985	4.0-5.25	3.0	4.2	7.2	YES	86.0	98.8	98.0	99.2	1/4 OS
1B14-352	15.2	1935-11,985	4.0-5.25	4.9	2.3	7.2	NO	86.0	96.8	98.0	99.2	3/4 OS
1B14-353	15.2	1935-11,985	4.0-5.25	3.0	4.2	7.2	YES	86.0	96.8	98.0	99.2	3/4 OS
1B14-362	15.9	2250-13,560	3.25-5.25	6.0	2.3	8.3	NO	87.0	97.0	98.1	99.2	3/4 OS
1B14-364	15.9	2250-13560	3.25-5.25	6.0	2.3	8.3	NO	87.0	97.0	98.1	99.2	1/4 OS
1B15-375	17.5	2295-13,740	4.4-5.4	5.6	2.3	7.9	NO	91.0	97.5	98.6	99.4	1/4 OS
1B15-376	17.5	2295-13,740	4.4-5.4	3.7	4.2	7.9	YES	91.0	97.5	98.6	99.4	1/4 OS
1B15-377	17.5	2295-13,740	4.4-5.4	5.6	2.3	7.9	NO	91.0	97.5	98.6	99.4	3/4 OS
1B15-378	17.5	2295-13,740	4.4-5.4	3.7	4.2	7.9	YES	91.0	97.5	98.6	99.4	3/4 OS

Double Convoluted Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
2B6-530	6.5	215-2025	4.5-6.5	4.5	2.8	7.7	NO	85.0	96.0	97.5	99.2	1/4
2B6-531	6.5	215-2025	4.5-6.5	4.5	2.8	7.7	NO	85.0	96.0	97.5	99.2	1/4
2B6-532	6.5	215-2025	4.5-6.5	4.3	3.4	7.7	YES	85.0	96.0	97.5	99.2	1/4
2B6-535	7.0	300-2270	5.0-7.0	5.9	2.8	9.1	NO	92.0	97.5	98.3	99.3	1/4
2B6-536	7.0	300-2270	5.0-7.0	5.7	3.4	9.1	YES	92.0	97.5	98.3	99.3	1/4
2B7-540	8.0	235-2585	6.0-8.0	6.5	2.5	9.0	NO	91.0	97.8	98.7	99.5	1/4
2B7-541	8.0	235-2585	6.0-8.0	6.5	2.5	9.0	NO	91.0	97.8	98.7	99.5	1/4 OS
2B7-542	8.0	235-2585	6.0-8.0	5.7	3.3	9.0	YES	91.0	97.8	98.7	99.5	1/4 OS
2B7-545	8.0	235-2585	6.0-8.0	6.5	2.5	9.0	NO	91.0	97.8	98.7	99.5	1/2
2B7-546	8.0	235-2585	6.0-8.0	6.5	2.5	9.0	NO	91.0	97.8	98.7	99.5	3/4
2B8-550	8.6	450-2700	7.0-8.0	7.1	2.8	10.3	NO	93.5	97.9	98.8	99.6	1/4
2B8-552	8.6	450-2700	7.0-8.0	7.1	2.8	10.3	NO	93.5	97.9	98.8	99.6	3/4
2B8-553	8.6	450-2700	7.0-8.0	7.1	2.8	10.3	NO	93.5	97.9	98.8	99.6	1/4
2B8-554	8.6	450-2700	7.0-8.0	6.8	3.5	10.3	YES	93.5	97.9	98.8	99.6	1/4

NOTE: OS = OFFSET AIR FITTING

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Double Convoluted Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
2B9-200	10.3	520-3615	8.0-9.0	8.0	3.5	11.5	NO	92.0	97.8	98.7	99.5	1/4 OS
2B9-201	10.3	520-3615	8.0-9.0	7.7	3.8	11.5	YES	92.0	97.8	98.7	99.5	1/4 OS
2B9-204	10.3	520-3615	8.0-9.0	8.0	3.5	11.5	NO	92.0	97.8	98.7	99.5	1/2 OS
2B9-205	10.3	520-3615	8.0-9.0	7.7	3.8	11.5	YES	92.0	97.8	98.7	99.5	1/2 OS
2B9-208	10.3	520-3615	8.0-9.0	7.7	3.8	11.5	YES	92.0	97.8	98.7	99.5	3/4 OS
2B9-216	10.3	520-3615	8.0-9.0	8.0	3.5	11.5	NO	92.0	97.8	98.7	99.5	3/4 OS
2B9-250	10.3	1450-4035	8.0-9.0	9.3	3.5	12.8	NO	93.3	98.1	99.0	99.5	1/4 OS
2B9-251	10.3	1450-4035	8.0-9.0	9.3	3.5	12.8	NO	93.3	98.1	99.0	99.5	1/4 OS
2B9-253	10.3	1450-4035	8.0-9.0	9.3	3.5	12.8	NO	93.3	98.1	99.0	99.5	1/4 OS
2B12-309	13.0	915-7205	7.5-9.5	6.9	4.2	11.1	YES	92.0	98.0	98.9	99.5	1/4 OS
2B12-318	13.0	915-7205	7.5-9.5	6.9	4.2	11.1	YES	92.0	98.0	98.9	99.5	3/4 OS
2B12-425	13.0	915-7205	7.5-9.5	7.6	3.5	11.1	NO	92.0	98.0	98.9	99.5	1/4 OS
2B12-429	13.0	915-7205	7.5-9.5	7.6	3.5	11.1	NO	92.0	98.0	98.9	99.5	3/4 OS
2B12-437	13.0	915-7205	7.5-9.5	7.6	3.5	11.1	NO	92.0	98.0	98.9	99.5	1/4
2B12-416	13.7	1315-8175	7.5-9.5	10.9	3.5	14.4	NO	92.5	98.1	99.0	99.5	1/4 OS
2B12-419	13.7	1315-8175	7.5-9.5	10.9	3.5	14.4	NO	92.5	98.1	99.0	99.5	3/4 OS
2B14-352	15.1	1595-11,255	7.5-9.5	7.8	3.5	11.3	NO	93.0	98.1	99.0	99.5	3/4 OS
2B14-353	15.1	1595-11,255	7.5-9.5	6.4	4.9	11.3	YES	93.0	98.1	99.0	99.5	3/4 OS
2B14-354	15.1	1595-11,255	7.5-9.5	7.8	3.5	11.3	NO	93.0	98.1	99.0	99.5	1/4 OS
2B14-355	15.1	1595-11,255	7.5-9.5	6.4	4.9	11.3	YES	93.0	98.1	99.0	99.5	1/4 OS
2B14-362	16.0	2255-13,075	7.5-9.5	11.7	3.5	15.2	NO	93.0	98.2	99.0	99.5	1/4 OS
2B14-363	16.0	2255-13,075	7.5-9.5	11.7	3.5	15.2	NO	93.0	98.2	99.0	99.5	3/4 OS
2B14-452	16.0	2255-13,075	7.5-9.5	11.0	4.2	15.2	YES	93.0	98.2	99.0	99.5	1/4 OS
2B15-375	16.7	2040-12,590	7.5-9.5	9.3	3.5	12.8	NO	93.0	98.2	99.2	99.5	1/4 OS
2B15-376	16.7	2040-12,590	7.5-9.5	7.9	4.9	12.8	YES	93.0	98.2	99.2	99.5	1/4 OS
2B15-377	16.7	2040-12,590	7.5-9.5	9.3	3.5	12.8	NO	93.0	98.2	99.2	99.5	3/4 OS
2B15-378	16.7	2040-12,590	7.5-9.5	7.9	4.9	12.8	YES	93.0	98.2	99.2	99.5	3/4 OS
2B19-8433	20.0	3330-27,240	9.5	6.75	3.25	10.0	NO	95.0	98.6	99.1	99.6	—
2B22-8539	22.7	4480-34,100	9.5	6.75	3.25	10.0	NO	96.0	98.8	99.2	99.7	—

NOTE: OS = OFFSET AIR FITTING

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Triple Convoluted Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
3B12-304	13.0	860-7305	11.0-15.0	13.3	4.7	18.0	NO	94.0	99.1	99.6	99.6	1/4 OS
3B12-305	13.0	860-7305	11.0-15.0	13.3	4.7	18.0	NO	94.0	99.1	99.6	99.6	3/4 OS
3B14-351	15.5	1945-12,100	10.5-12.5	10.9	7.3	18.2	YES	95.0	98.5	99.2	99.6	1/4 OS
3B14-353	15.5	1945-12,100	10.5-12.5	10.9	7.3	18.2	YES	95.0	98.5	99.2	99.6	3/4 OS
3B14-354	15.5	1945-12,100	10.5-12.5	13.5	4.7	18.2	NO	95.0	98.5	99.2	99.6	1/4 OS
3B14-361	15.5	1945-12,100	10.5-12.5	13.5	4.7	18.2	NO	95.0	98.5	99.2	99.6	3/4 OS
3B15-375	16.5	2215-12,830	10.5-12.5	12.3	4.7	17.0	NO	95.5	98.8	99.3	99.6	1/4 OS
3B15-376	16.5	2215-12,830	10.5-12.5	9.7	7.3	17.0	YES	95.5	98.8	99.3	99.6	1/4 OS
3B15-377	16.5	2215-12,830	10.5-12.5	12.3	4.7	17.0	NO	95.5	98.8	99.3	99.6	3/4 OS
3B15-378	16.5	2215-12,830	10.5-12.5	9.7	7.3	17.0	YES	95.5	98.8	99.3	99.6	3/4 OS

Sleeve Lobe Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
1S3-013	3.6	90-600	2.0-3.0	2.1	1.5	3.6	NO	71.0	93.0	96.3	98.2	1/8
1S3-011	3.25	70-415	5.0-6.0	4.4	3.6	8.0	NO	92.0	97.8	98.7	99.5	1/8
1S4-007	4.6	160-880	3.8-4.4	4.9	2.2	7.1	NO	90.0	97.4	98.4	98.3	1/8
1S4-008	4.6	140-900	6.5-7.5	6.5	4.0	10.5	NO	95.0	98.5	99.2	99.6	1/8
1S5-010	5.6	185-1140	3.8-4.3	4.0	2.2	6.25	NO	90.0	97.5	98.5	99.4	1/8
1S5-005	5.6	165-1130	6.2-7.2	5.5	4.0	9.5	NO	95.0	98.6	99.2	99.6	1/8
1S5-006	5.6	170-1175	7.0-9.0	6.5	4.0	10.5	NO	96.1	99.0	99.3	99.7	1/8

Rolling Lobe Type Air Spring

Part Number	Max OD @ 100 psi (Inches)	Design Load Range (Pounds)	Design Load Range (Inches)	Useable Stroke (Inches)	Min Comp Height (Inches)	Max Ext Height (Inches)	Bumper	Approximate Isolation Percent For A Disturbing Frequency Of: 435 CPM	870 CPM	1160 CPM	1750 CPM	Air Fitting Size (in)
1R8-005	8.7	5.60-3140	10.5-13.0	13.0	5.6	18.6	NO	95.3	98.7	99.2	99.6	1/4
1R8-009	8.7	530-3085	10.5-13.0	11.8	6.8	18.6	YES	96.0	98.9	99.3	99.6	1/4
1R9-009	9.5	740-4460	6.0-7.5	11.8	3.2	11.8	NO	91.0	97.8	98.6	99.4	1/4
1R9-003	9.5	590-3825	8.0-12.0	12.3	5.6	17.9	NO	93.0	98.2	99.0	99.5	1/4
1R10-086	11.0	1045-5970	9.5-13.5	14.1	6.0	20.1	NO	96.1	99.0	99.3	99.7	1/4
1R11-028	11.5	1115-6795	6.0-10.0	9.3	3.7	13.0	NO	95.0	98.7	99.2	99.6	1/4
1R11-039	11.7	1300-7055	8.0-12.0	11.0	6.1	17.1	YES	94.0	98.6	99.1	99.5	1/4
1R12-095	12.7	1360-7340	7.0-9.0	9.1	4.4	13.5	YES	94.0	98.4	99.1	99.6	1/4
1R12-132	12.9	1400-78.18	8.0-10.0	10.8	6.1	16.9	YES	93.0	98.2	99.0	99.5	1/4
1R12-092	12.6	1320-7710	10.5-16.5	13.4	7.7	21.1	YES	96.0	99.0	99.3	99.7	1/4
1R12-274	12.8	1435-8055	11.3-14.3	14.7	8.1	22.8	YES	96.8	99.1	99.5	99.7	1/4