NORGREN

M/31000, M/32000
Air bellows, single acting
Ø 6 ... 26 inch (152 ... 660 mm)

Allmost frictionless operation
No maintenance or lubrication
Ideal for short stroke, high-force applications
High isolation level for vibration applications
Very easy to install – no alignment problems
Weather resistance



Technical features

Medium:
Compressed air (also containing oil), Nitrogen, water (also with glycol) for air springs with corrosion-resistant metal parts
Operation:
Single acting
Operating pressure:
5,5 bar recommanded dynamic pressure
8 bar max.

Operating temperature:
-40 ... (+70°C) "Static"
-30 ... +50°C "Dynamic"
for M/31000 (Standard)
Butyl for TM/31000
-25°C ... (+ 90°C) "Static";
-20°C ... + 70°C "Dynamic"
Epichlore for EMP/31000
-20°C ... (+130°C) "Static";
-15°C ... +115°C "Dynamic"
The numbers in brackets represent the maximum permissible operating temperature.
When operated at this temperature, the air bellow may have a reduced life time.
Nominal diameters:
6, 8, 10, 12, 14 1/2,
16, 21, 26 inches
Strokes:
From 50 ... 430 mm max., depending on diameters and number of convolutions

Materials:
End plates: steel, chromated
Studs: steel, zinc plated
Central ring: aluminium or steel, chromated, partly moulded in
Bellow: M/31000, M/32000: NR/BR, SBR compound rubber
TM/31000, TM/32000: Butyl
EM/31000, EM/32000: Epichlore

Technical data

Nominal Ø (inch)	6	6	8	8	10	10	10	12	12	12	14 1/2	14 1/2	14 1/2	16	16	21	26
Air ports	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2	-	-
Nominal Ø (inch) x convolutions	6 x 1	6 x 2	8 x 1	8 x 2	10 x 1	10 x 2	10 x 3	12 x 1	12 x 2	12 x 3	14 1/2 x 1	14 1/2 x 2	14 1/2 x 3	16 x 2	16 x 3	21 x 2	26 x 2
Recommended max stroke (mm)	45	95	65	145	85	170	250	85	170	250	100	215	320	275	355	200	325
Stroke (mm)	50	115	75	175	100	225	330	100	225	330	125	265	380	315	430	251	400
Installation height min (mm)	50	75	50	75	50	75	100	50	75	100	50	75	100	75	120	84	100
Installation height max (mm)	105	190	125	250	150	300	430	150	300	430	175	340	480	390	550	335	500
Recommended max working height (mm)	95	170	115	220	135	245	350	135	245	350	150	290	420	350	475	284	425
Retracting force to reach min height (N) *1)	140	170	120	130	150	150	100	200	250	250	230	280	330	250	100	311	400
Clearance around the air bellow (mm)	190	190	245	245	300	300	300	350	350	350	425	425	425	460	460	620	750
Weight (kg)	2,4	2,7	3	3,75	4,1	4,7	5,3	5,4	6,2	6,9	7,1	8,3	9,6	8,8	10,4	12	33,2
Theor. thrust at 6 bar (N) at installation height min	11400	10400	18300	18000	25000	26000	26500	39000	39700	41000	59000	59500	58900	62000	635000	140000	186000
Theor. thrust at 6 bar (N) at installation height max	2100	2400	6000	4500	8000	6000	7000	14000	10100	10500	17000	17500	15400	17000	20000	41000	84000
Vibration height [mm]	85	150	100	200	120	220	*	120	240	*	130	250	*	300	*	240	400
Volume [l] at vibration height	5,9	1,25	1,55	4	3,4	7,2	*	5,5	12	*	9,8	20,4	*	27,3	*	46	106
Stiffness at 4 bar [N/mm]	760	249	560	200	257	123,5	*	372	190	*	558	252	*	216,5	*	682	750
Airspring natural "fn" frequency at 4 bar [Hz]	3,2	2,8	3	2,2	2,6	1,8	*	2,5	1,9	*	2,4	1,6	*	1,5	*	1,6	1,2
Isolation rate "I" at 10 Hz and 4 bar [%]	86,6	94,3	91,1	95,8	92,6	96,5	*	93,3	96,7	*	93,9	97,4	*	97,7	*	97,4	98,5
Max. torque for mounting studs or holes (Nm)	28	28	28	28	25	25	25	25	25	25	25	25	25	25	25	40	100
Models	M/31061	M/31062	M/31081	M/31082	M/31101	M/31102	M/31103	M/31121	M/31122	M/31123	M/31141	M/31142	M/31143	M/31162	M/31163	M/32212	M/32262

***) Must not be used for vibration or isolators application**
***1) only valid for M/31000/ M/32000**

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Alternative air bellows

Symbol	Model	Material	Description	Dimension see page
	M/31000	Standard	Ø 6 ... 16 inches (125 ...406 mm)	3
	M/32000	Standard	Ø21 ... 26 inches (533 ... 660 mm)	4
	TM/31000	Butyl	Ø 6 ... 16 inches (125 ...406 mm)	3
	TM/32000	Butyl	Ø21 inches (533 mm)	4
	EM/31000	Epichlore	Ø 6 ... 16 inches (125 ...406 mm)	3
	EM/32000	Epichlore	Ø21 inches (533 mm)	4

Options selector

★M/3★★★★

Air bellow materials	Substitute
NR/BR, SBR compound rubber	None
High temperature (Butyl)	T
Extreme temperature (Epichlore)	E
Variants	**Substitute**
Standard with bead rind and plate	1
only with bead ring (21" & 26")	2

Number of convolutions	Substitute
1	1
2	2
3	3
Nominal diameters (inches)	**Substitute**
6	06
8	08
10	10
12	12
14 1/2	14
16	16
21	21
26	26

Note: Please fill in only the numbers of digits required, e.g. M/31023

Ordering example

To order a compact air bellow in standard rubber material, a nominal diameter of 8 inches and 2 convolutions
quote: M/31082

Important instructions:

Thrust:
The thrust depends on the height of the bellow. When height increases - the thrust decreases.

- Before installing the air bellow, check it carefully for any damage it may have suffered from transport or improper storage.

- Do not inflate the air bellow until it has been secured properly.

Stops: To avoid damage when the bellow is compressed or extended mechanical stops at both end positions have to be used.

Clearance:
There must be enough clearance around the air bellow.

- The full surface of the metal parts is to be used to bear the forces.

- Air bellows must be equipped with lateral guides.

- Deflate the air bellows fully before removing.

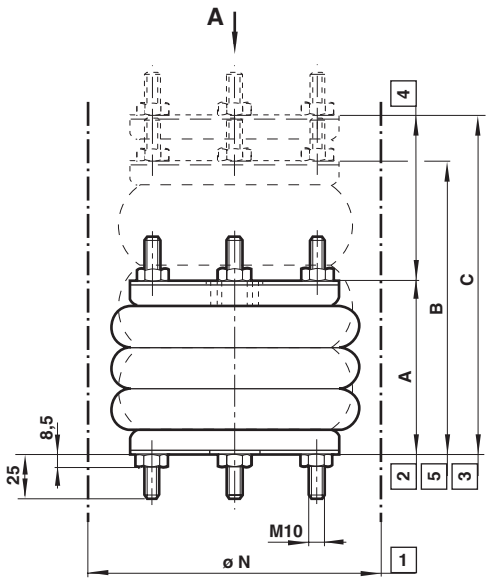
- Ensure that the bellows is not constantly in contact with hydraulic oil, lubricants, solvents, metal cuttings and welding sparks.

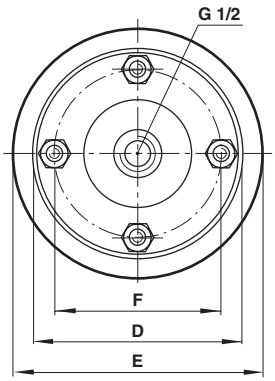
- Should the air bellow be subjected to special media in an application, ask Norgren for further information, specifying the medium, temperature and concentration

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Basic dimensions

M/31061 ... M/31163



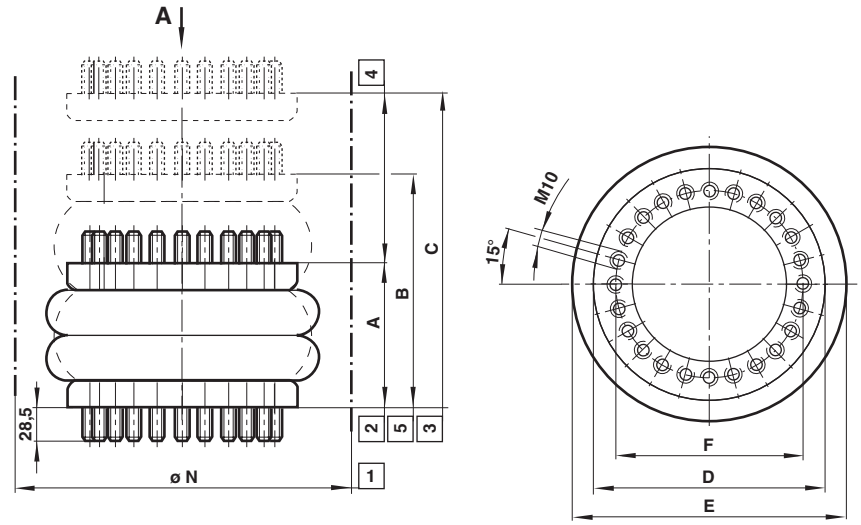


1 Installation diameter min.
2 Installation height min.
3 Installation height max.
4 Stroke
5 Recommended max. working hight

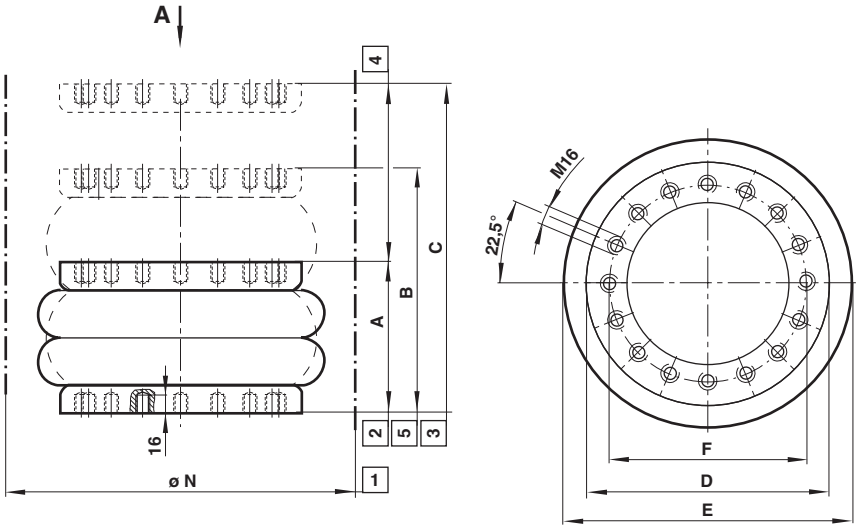
Norminal Ø (inch) x convolutions	Recommended max. stroke (mm)	Recommended max. working height B (mm)	Stroke (mm)	Installation height A min. (mm)	Installation height C max. (mm)	Max. torque for mounting studs (Nm)	Ø E	Ø D	Ø F	Ø N	Weight (kg)	Models
6 x 1	45	95	50	50	105	28	175	155	127	190	2,4	M/31061
6 x 2	95	170	115	75	190	28	175	155	127	190	2,7	M/31062
8 x 1	65	115	75	50	125	28	230	184	155,5	245	3	M/31081
8 x 2	145	220	175	75	250	28	230	184	155,5	245	3,75	M/31082
10 x 1	85	135	100	50	150	25	270	210	181	300	4,1	M/31101
10 x 2	170	245	225	75	300	25	270	210	181	300	4,7	M/31102
10 x 3	250	350	330	100	430	25	270	210	181	300	5,3	M/31103
12 x 1	85	135	100	50	150	25	330	260	232	350	5,4	M/31121
12 x 2	170	245	225	75	300	25	330	260	232	350	6,2	M/31122
12 x 3	250	350	330	100	430	25	330	260	232	350	6,9	M/31123
14 1/2 x 1	100	150	125	50	175	25	400	310	282,5	425	7,1	M/31141
14 1/2 x 2	215	290	265	75	340	25	400	310	282,5	425	8,3	M/31142
14 1/2 x 3	320	420	380	100	480	25	400	310	282,5	425	9,6	M/31143
16 x 2	275	350	315	75	390	25	435	310	282,5	460	8,8	M/31162
16 x 3	355	475	430	120	550	25	435	310	282,5	460	10,4	M/31163

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M/32212



M/32262



1 Installation diameter min.
2 Installation height min.
3 Installation height max.
4 Stroke
5 Recommended max. working hight

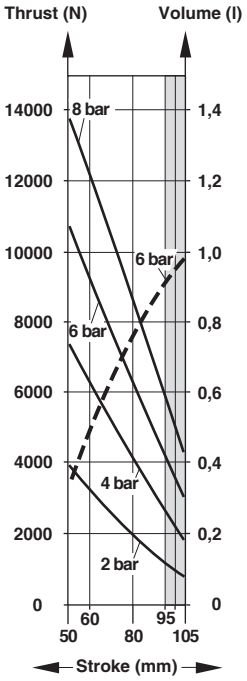
Norminal Ø (inch) x convolutions	Recommended max. stroke (mm)	Recommended max. working height B (mm)	Stroke (mm)	Installation height A min. (mm)	Installation height C max. (mm)	Max. torque for mounting studs (Nm)	Ø E	Ø D	Ø F	Ø N	Weight (kg)	Models
21 x 2	200	284	251	84	335	40	577	517	482	620	12	M/32212
26 x 2	325	425	400	100	500	100	710	530	495	750	33,2	M/32262

Coution: End plates aren't included as standard in scope of supply of air bellows. Consult our technical service for details of end plates.

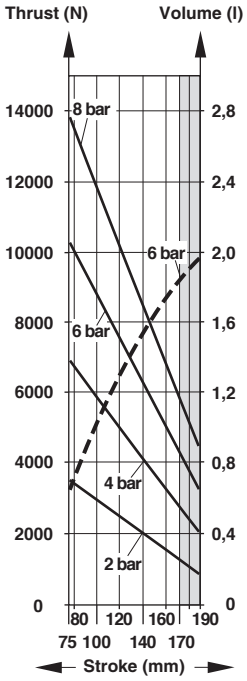
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Thrust (at 2, 4, 6, 8 bar), volume (at 6 bar)

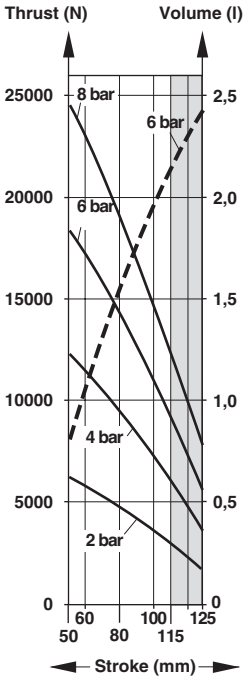
M/31061



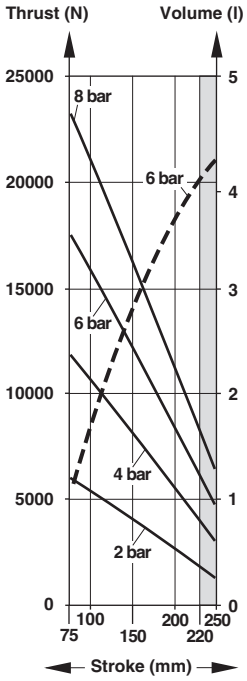
M/31062



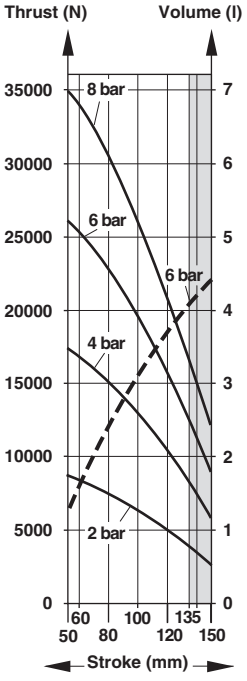
M/31081



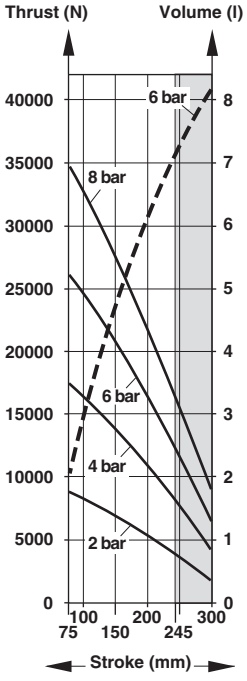
M/31082



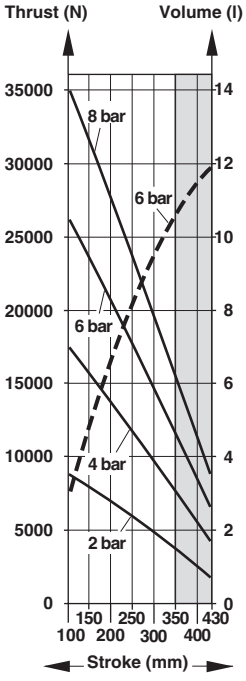
M/31101



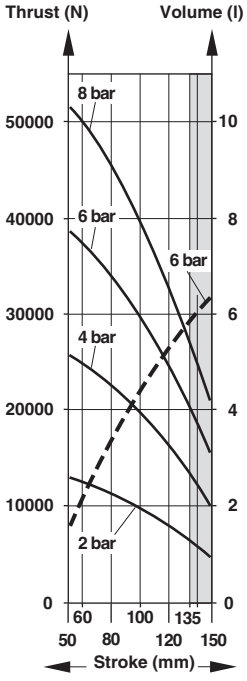
M/31102



M/31103



M/31121



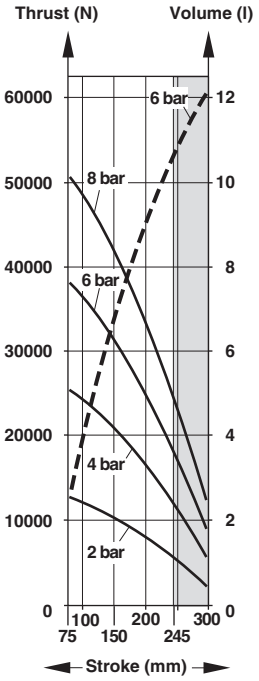
-- Thrust (N) - - Volume (l)

Caution!
In any cases you have to be belove the max. installation height. For application in the grey zone please contact Norgren.

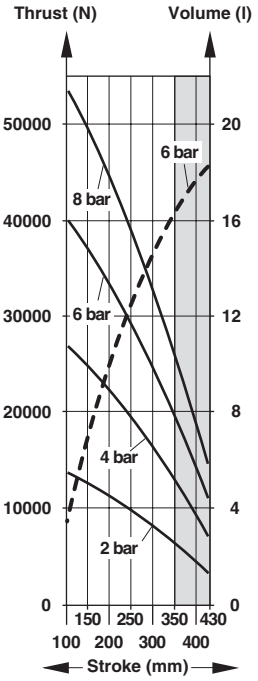
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Thrust (at 2, 4, 6, 8 bar), volume (at 6 bar)

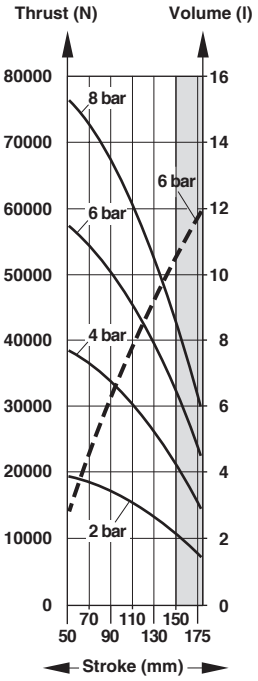
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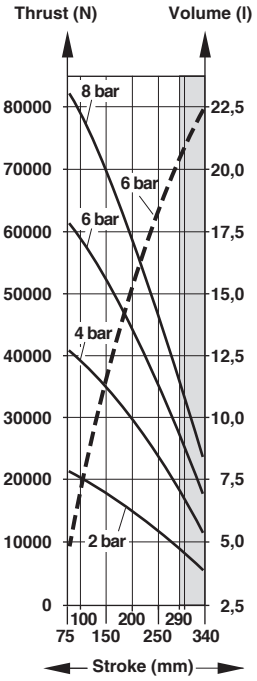
M/31123



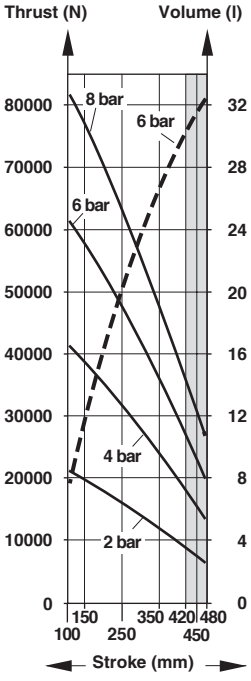
M/31141



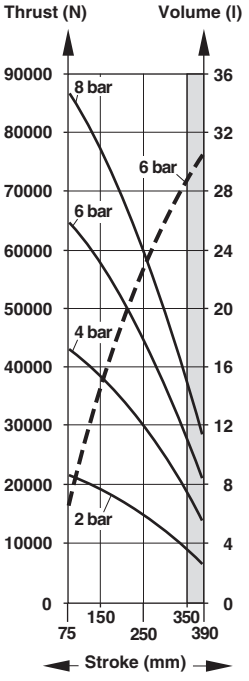
M/31142



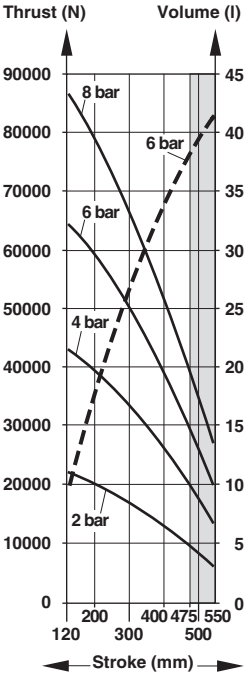
M/31143



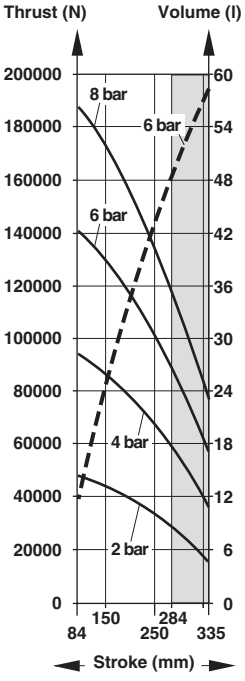
M/31162



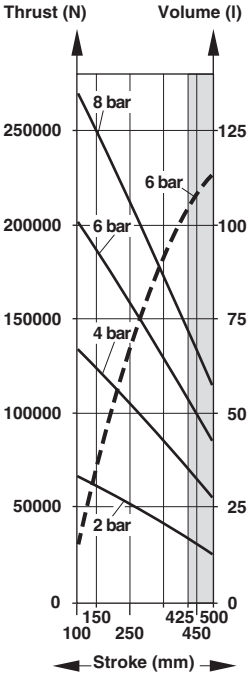
M/31163



M/32212



M/32262

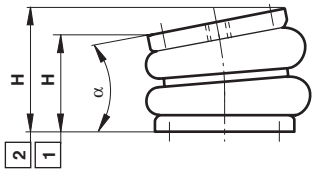


-- Thrust (N) - - Volume (l)

Caution!
In any cases you have to be below the max. installation height. For application in the grey zone please contact Norgren.

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Operation angle



Out of alignment

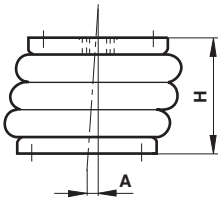


Table 3

Norminal Ø (inch) x convolutions	max. α °	max. A	Models
6 x 1	10	10	M/31061
6 x 2	15	10	M/31062
8 x 1	10	10	M/31081
8 x 2	15	10	M/31082
10 x 1	20	10	M/31101
10 x 2	25	20	M/31102
10 x 3	30	30	M/31103
12 x 1	20	10	M/31121
12 x 2	25	20	M/31122
12 x 3	30	30	M/31123
14 1/2 x 1	20	10	M/31141
14 1/2 x 2	25	20	M/31142
14 1/2 x 3	30	30	M/31143
16 x 2	25	20	M/31162
16 x 3	30	30	M/31163
21 x 2	25	20	M/32212
26 x 2	25	20	M/32262

[1] Installation height min

[2] Installation height max

Operation angle

Tilt angles from 10 ... 30° are possible, depending on the air bellow design. Don't go below the minimum installation height or exeed the maximum installation height.

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Example for selecting air bellow as actuators

A 1000 kg conveyor carrying a 550 kg pallet needs to be lifted by 90 mm (stroke) in order to transfer the pallet to another level. Four (4) air bellows should be used. The available operating pressure is 5 bar.
The operating temperature is 45°C. There is a 270 mm square space to house each air bellow. Compression and extension stops are provided. The air bellows have to be mounted in a space which is 85 mm apart. During the lifting operation the conveyor may tilt in the second half of the stroke by a max. of 9°.

Step 1: Fill in and complete the datasheet

a)	Total weight to be lifted:	F	=	(1000 kg + 550 kg) • 10 m/s² = 15500 N
b)	Number of air bellows:	n	=	4
c)	Thrust per air bellow:	f	=	$\frac{15500\ N}{4}$ = 3875 N
d)	Operating pressure:	P	=	5 bar
e)	Required stroke:	S	=	90 mm
f)	Vertical space:	Xv	=	85 mm
g)	Horzontal space:	Xh	=	270 mm
h)	Operating temperature:	T	=	45°C
i)	Operation angle:	a	=	9°
j)	Out of alignment:	A	=	0 mm
k)	Chemical resistance:			normal environment

Step 2:

From table (technical data) air bellows have to be selected, that have a min. 90 mm stroke and clearance around the air bellows smaller than Xh = 270 mm.
We select: M/31082

Step 3:

Calculate the total height at which the air bellow should be used, see step 1:

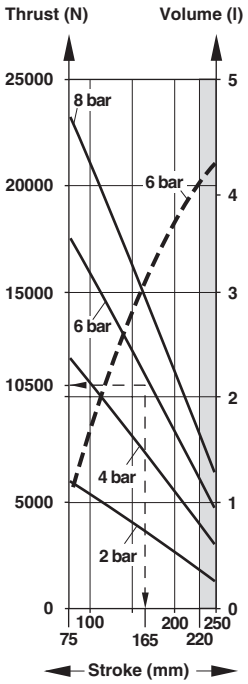
Vertical space	Xv 85 mm
Stroke	S 90 mm
Total height	175 mm

By refering to the total height of 175 mm and the vertical space of 85 mm, only M/31082 (installation height min. 75 to recommended max. working height 220 mm) can be used from table (technical data).

The max installation height is 165 mm. 75 mm installation height min. of M/31083 plus 90 mm stroke.

Step 4:

Check the thrust at 6 bar at a height of 165 mm.
From the charts in the datasheet we can see that:



M/31082 will provide 10500 N at 6 bar. To get the figure for 5 bar, we have to calculate:

$$\frac{105060\ N \bullet 5}{6} = 8750\ N \text{ at } 5\ bar$$

Result:

The air bellow M/31082 can provide the required thrust of 3875 N.

Step 5:

Check the operation angel and the out of alignment when the selected air bellow can tilt.
i) max. operation angle 15° is higher as existing operating angel 9°.
j) max out of alignment is 10 mm is higher as existing alignment 0 mm.

Result:

M/31082 can be used.

Step 6:

Check all remaining parameters
h) At 45°C Standard rubber material
-40°C ... (+ 70°C) "Static";
-30°C ... + 50°C "Dynamic"
k) No special chemical resistance is required

Result:

M/31082 is the chosen air bellow, because it meets all requirements.

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Example for selecting air bellow used as vibration isolator

A hydraulic power unit with an excitation frequency (fe) between 1200 and 3000 cycles/min (= 20 to 50 Hz) must be vibration isolated. The total weight of the power unit is 3800 kg. The supporting area under the unit is 1,2 m x 0,8 m. The operating temperature is 50°C. The space for the installation is 240 mm high. Four air bellows will be used. The max. operating pressure is 4 bar. A minimum of 97% vibration isolation has to be reached.

Step 1: Fill in and complete the datasheet

a)	Total weight to be isolated:	F	=	3800 kg • 10 m/s^2 = 38000 N
b)	Number of air bellows:	n	=	4
c)	Thrust per air bellow:	f	=	$\frac{38000\ N}{4}$ = 9500 N
d)	Operating pressure:	P	=	4 bar
f)	Vertical space:	Xv	=	240 mm
g)	Horizontal space:	Xh	=	400 mm (0,8 m /2)
h)	Operating temperature:	T	=	50°C
k)	Chemical resistance:			normal environment
m)	Isolation rate:	I	=	97%
p)	Excitation frequency	fe	=	min. 20 Hz, max. 50 Hz

Two types of air bellows are chosen. Each one has to work with a vibration height lower than 240 mm and fit in a horizontal space samler than 400 mm. From table (technical data) we select:
1. M/31102 - Vibration height 220 mm - Clearance around the air bellow 300 [mm] - Airspring natural frequency "fn" at 4 bar 1,8 [Hz]
2. M/31122 - Vibration height 240 mm - Clearance around the air bellow 350 [mm]- Airspring natural frequency "fn" at 4 bar 1,9 [Hz]

Step 2:

Take the air bellow with the lowest airspring natural frequency fn = 1,8 Hz in order to get the highest isolation rate refering to fe min. = 20 Hz. Air bellow M/31102 is chosen.

Step 3:

Calculate the isolation rate (I) of the M/31102 by using the formula:

Formula:

$$I = 1 - \frac{1}{\left(\frac{fe}{fn}\right)^2 - 1}$$

Example:

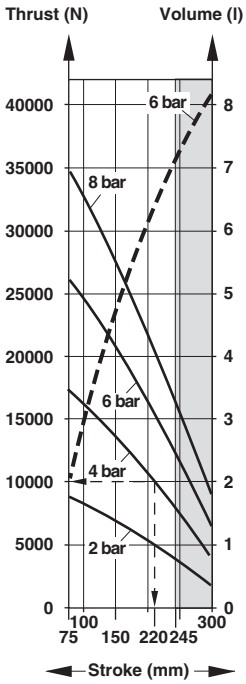
$$I = 1 - \frac{1}{\left(\frac{20}{1,8}\right)^2 - 1}$$

$$= 1 - \frac{1}{122,4} = 0,991$$

I = 99,1%

Step 4:

Check the thrust at 4 bar at a height of 220 mm. From the charts in the datasheet we can see that.



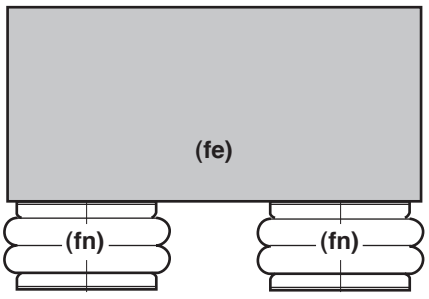
M/31102 will provide 10000 N as a vibration height of 220 mm at 4 bar.

Step 5:

Check all remaining parameters
h) At 50°C Standard rubber material (-40 to +70°C) can be used.
g) No special chemical resistance is required.

Result:

4 x M/31102 air bellows are chosen. They will provide 99,1% vibration isolation and lift the 3800 kg weight at 4 bar.



fe = Excitation frequency of load
fn = Airspring natural frequency

Warning

These products are intended for use in industrial compressed air systems only. Do not use these products where pressures and temperatures can exceed those listed under 'Technical features'.

Before using these products with fluids other than those specified, for non-industrial applications, life-support systems, or other applications not within published specifications, consult NORGREN.

Through misuse, age, or malfunction, components used in fluid power systems can fail in various modes.

The system designer is warned to consider the failure modes of all component parts used in fluid power systems and to provide adequate safeguards to prevent personal injury or damage to equipment in the event of such failure.
System designers must provide a warning to end users in the system instructional manual if protection against a failure mode cannot be adequately provided.
System designers and end users are cautioned to review specific warnings found in instruction sheets packed and shipped with these products.

Our policy is one of continued research and development. We therefore reserve the right to amend, without notice, the specifications given in this document.