KM/31000 (Stainless steel end plates)
Air bellows, single acting

> Ø 8 ... 14 1/2 inch (203 ... 368 mm)
> Very easy to install – no alignment problems
> Almost frictionless operation
> Typical applications; actuator, air spring, or vibration isolation
> No maintenance or lubrication
> High isolation level for vibration applications

Technical features

Medium:
Compressed air lubricated or un lubricated, Nitrogen, water (with glycol)

Operation:
Single acting

Operating pressure:
5,5 bar (79 psi) recommended
8 bar (116 psi) max.

Nominal diameters:
8, 10, 12, 14 1/2 inches

Strokes:
From 75 ... 380 mm max., depending on diameters and number of convolutions

Operating temperature:
for KM/31000 (Standard)
-30° ... +50°C (-22° ... +122°F)
-40° ... +70°C (-40° ... +188°F)

IR for TKM/31000
-20° ... +70°C (-4° ... 158°F)
-25° ... +90°C (-13° ... 194°F)*

ECO for EKM/31000
+50° ... +115°C (+122° ... 239°F)
+20° ... +130°C (+4° ... +266°F)*

* The number represent the maximum permissible operating temperature. It is suitable to operated with restriction at this temperature, the air bellow may have a reduced life time!

Materials:
End plates, Studs and central ring:
Stainless steel (1.4305)

Bellow:
KM/31000:
NR/BR, SBR compound rubber

TKM/31000: IR

EKM/31000: ECO

Technical data

<table>
<thead>
<tr>
<th>Model</th>
<th>KM/31081</th>
<th>KM/31082</th>
<th>KM/31101</th>
<th>KM/31102</th>
<th>KM/31103</th>
<th>KM/31121</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder Ø (inch)</td>
<td>8&quot;</td>
<td>8&quot;</td>
<td>10&quot;</td>
<td>10&quot;</td>
<td>10&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>Port size</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
</tr>
<tr>
<td>Nominal Ø (inch) x convolutions</td>
<td>8&quot; x 1</td>
<td>8&quot; x 2</td>
<td>10&quot; x 1</td>
<td>10&quot; x 2</td>
<td>10&quot; x 3</td>
<td>12&quot; x 1</td>
</tr>
<tr>
<td>Stroke (mm)</td>
<td>75</td>
<td>175</td>
<td>100</td>
<td>225</td>
<td>330</td>
<td>100</td>
</tr>
<tr>
<td>Installation height min (mm)</td>
<td>50</td>
<td>75</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Recommended max working height (mm)</td>
<td>115</td>
<td>220</td>
<td>135</td>
<td>245</td>
<td>350</td>
<td>135</td>
</tr>
<tr>
<td>Installation height max (mm)</td>
<td>130</td>
<td>250</td>
<td>150</td>
<td>300</td>
<td>430</td>
<td>150</td>
</tr>
<tr>
<td>Retracting force to reach min height (N)</td>
<td>220</td>
<td>350</td>
<td>150</td>
<td>250</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

Force at 6 bar (N) depending from the stroke

Model     | KM/31122 | KM/31123 | KM/31141 | KM/31142 | KM/31143 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder Ø (inch)</td>
<td>12&quot;</td>
<td>12&quot;</td>
<td>14 1/2&quot;</td>
<td>14 1/2&quot;</td>
<td>14 1/2&quot;</td>
</tr>
<tr>
<td>Port size</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
<td>G1/2</td>
</tr>
<tr>
<td>Nominal Ø (inch) x convolutions</td>
<td>12&quot; x 2</td>
<td>12 x 3</td>
<td>14 1/2&quot; x 1</td>
<td>14 1/2&quot; x 2</td>
<td>14 1/2&quot; x 3</td>
</tr>
<tr>
<td>Stroke (mm)</td>
<td>225</td>
<td>330</td>
<td>100</td>
<td>265</td>
<td>380</td>
</tr>
<tr>
<td>Installation height min (mm)</td>
<td>75</td>
<td>100</td>
<td>50</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Recommended max working height (mm)</td>
<td>245</td>
<td>350</td>
<td>135</td>
<td>290</td>
<td>420</td>
</tr>
<tr>
<td>Installation height max (mm)</td>
<td>300</td>
<td>430</td>
<td>150</td>
<td>340</td>
<td>480</td>
</tr>
<tr>
<td>Retracting force to reach min height (N)</td>
<td>250</td>
<td>250</td>
<td>200</td>
<td>280</td>
<td>330</td>
</tr>
</tbody>
</table>

Force at 6 bar (N) depending from the stroke

See graph on page 4 & 5
KM/31000 (Stainless steel end plates)
Air bellows, single acting

Alternative air bellows

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Model</th>
<th>Material</th>
<th>Description</th>
<th>Dimension see page</th>
</tr>
</thead>
<tbody>
<tr>
<td>KM/31000</td>
<td>Standard</td>
<td>Ø 8 ... 14 1/2 inches (152 ... 368 mm)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>TKM/31000</td>
<td>Butyl</td>
<td>Ø 8 ... 14 1/2 inches (152 ... 368 mm)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EKM/31000</td>
<td>Epichlore</td>
<td>Ø 8 ... 14 1/2 inches (152 ... 368 mm)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

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.

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.

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

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.
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Stops:
To avoid damage when the bellow is compressed or extended mechanical stops at both end positions have to be used.
**KM/31000 (Stainless steel end plates)**  
**Air bellows, single acting**

---

### Basic dimensions

**KM/31081 ... KM/31143**

**Operation angle**

**Table 1**

<table>
<thead>
<tr>
<th>Nominal Ø (inch) x convolutions</th>
<th>Stroke [mm]</th>
<th>Installation height [A] [mm]</th>
<th>Recommended working height [B] [mm]</th>
<th>Installation height [C] max. [mm]</th>
<th>Max. torque for mounting studs [Nm]</th>
<th>Natural frequency [fn] at 4 bar [Hz]</th>
<th>Siffness at 4 bar [N/mm]</th>
<th>Recommended vibration height [mm]</th>
<th>Ø E</th>
<th>Ø D</th>
<th>Ø F</th>
<th>Ø N</th>
<th>Weight [kg]</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot; x 1</td>
<td>75</td>
<td>50</td>
<td>115</td>
<td>130</td>
<td>25</td>
<td>2.72</td>
<td>250</td>
<td>100</td>
<td>230</td>
<td>184</td>
<td>155,5</td>
<td>245</td>
<td>3.0</td>
<td>KM31081</td>
</tr>
<tr>
<td>8&quot; x 2</td>
<td>175</td>
<td>75</td>
<td>220</td>
<td>250</td>
<td>25</td>
<td>1.86</td>
<td>105</td>
<td>200</td>
<td>230</td>
<td>184</td>
<td>155,5</td>
<td>245</td>
<td>3.7</td>
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<tr>
<td>10&quot; x 1</td>
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<td>50</td>
<td>135</td>
<td>150</td>
<td>25</td>
<td>2.6</td>
<td>257</td>
<td>120</td>
<td>270</td>
<td>210</td>
<td>181</td>
<td>300</td>
<td>4,1</td>
<td>KM31101</td>
</tr>
<tr>
<td>10&quot; x 2</td>
<td>225</td>
<td>75</td>
<td>245</td>
<td>300</td>
<td>25</td>
<td>1.8</td>
<td>123</td>
<td>220</td>
<td>270</td>
<td>210</td>
<td>181</td>
<td>300</td>
<td>4,7</td>
<td>KM31102</td>
</tr>
<tr>
<td>10&quot; x 3</td>
<td>330</td>
<td>100</td>
<td>350</td>
<td>430</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>270</td>
<td>210</td>
<td>181</td>
<td>300</td>
<td>5,2</td>
<td>KM31103</td>
</tr>
<tr>
<td>12&quot; x 1</td>
<td>100</td>
<td>50</td>
<td>135</td>
<td>150</td>
<td>25</td>
<td>2.5</td>
<td>372</td>
<td>120</td>
<td>330</td>
<td>260</td>
<td>232</td>
<td>350</td>
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<tr>
<td>12&quot; x 2</td>
<td>225</td>
<td>75</td>
<td>245</td>
<td>300</td>
<td>25</td>
<td>1.8</td>
<td>200</td>
<td>220</td>
<td>330</td>
<td>260</td>
<td>232</td>
<td>350</td>
<td>6,2</td>
<td>KM31122</td>
</tr>
<tr>
<td>12&quot; x 3</td>
<td>330</td>
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<td>350</td>
<td>430</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>330</td>
<td>260</td>
<td>232</td>
<td>350</td>
<td>6,9</td>
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</tr>
<tr>
<td>14 1/2&quot; x 1</td>
<td>100</td>
<td>50</td>
<td>135</td>
<td>150</td>
<td>25</td>
<td>2.4</td>
<td>558</td>
<td>130</td>
<td>400</td>
<td>310</td>
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<td>425</td>
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<tr>
<td>14 1/2&quot; x 2</td>
<td>265</td>
<td>75</td>
<td>290</td>
<td>340</td>
<td>25</td>
<td>1.6</td>
<td>252</td>
<td>250</td>
<td>400</td>
<td>310</td>
<td>282,5</td>
<td>425</td>
<td>8,3</td>
<td>KM31142</td>
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<tr>
<td>14 1/2&quot; x 3</td>
<td>380</td>
<td>100</td>
<td>420</td>
<td>480</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>310</td>
<td>282,5</td>
<td>425</td>
<td>9,6</td>
<td>KM31143</td>
</tr>
</tbody>
</table>

---

### Operation angle

**Table 2**

<table>
<thead>
<tr>
<th>Nominal Ø (inch) x convolutions</th>
<th>Operating angel [α] max. [°]</th>
<th>Out of alignment [Z] [mm]</th>
<th>Installation height [A] [mm] min.</th>
<th>Installation height [C] max. [mm]</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot; x 1</td>
<td>10</td>
<td>10</td>
<td>50</td>
<td>130</td>
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</tr>
<tr>
<td>8&quot; x 2</td>
<td>10°</td>
<td>10</td>
<td>75</td>
<td>250</td>
<td>KM31082</td>
</tr>
<tr>
<td>10&quot; x 1</td>
<td>10 ... 20</td>
<td>10</td>
<td>50</td>
<td>150</td>
<td>KM31101</td>
</tr>
<tr>
<td>10&quot; x 2</td>
<td>15 ... 25</td>
<td>20</td>
<td>75</td>
<td>300</td>
<td>KM31102</td>
</tr>
<tr>
<td>10&quot; x 3</td>
<td>15 ... 30</td>
<td>30</td>
<td>100</td>
<td>430</td>
<td>KM31103</td>
</tr>
<tr>
<td>12&quot; x 1</td>
<td>10 ... 20</td>
<td>10</td>
<td>50</td>
<td>150</td>
<td>KM31121</td>
</tr>
<tr>
<td>12&quot; x 2</td>
<td>15 ... 25</td>
<td>20</td>
<td>75</td>
<td>300</td>
<td>KM31122</td>
</tr>
<tr>
<td>12&quot; x 3</td>
<td>15 ... 30</td>
<td>30</td>
<td>100</td>
<td>430</td>
<td>KM31123</td>
</tr>
<tr>
<td>14 1/2&quot; x 1</td>
<td>10 ... 20</td>
<td>10</td>
<td>50</td>
<td>150</td>
<td>KM31141</td>
</tr>
<tr>
<td>14 1/2&quot; x 2</td>
<td>15 ... 25</td>
<td>20</td>
<td>75</td>
<td>340</td>
<td>KM31142</td>
</tr>
<tr>
<td>14 1/2&quot; x 3</td>
<td>15 ... 30</td>
<td>30</td>
<td>100</td>
<td>480</td>
<td>KM31143</td>
</tr>
</tbody>
</table>

**Operation angle**

Tilt angles from 10 ... 30° are possible, depending on the air bellow design. Ensure application is within minimum and maximum installation heights.

---

*Our policy is one of continued research and development. We therefore reserve the right to amend, without notice, the specifications given in this document. (1999 - 1274d) © 2015 Norgren GmbH*

en 1.8.007.03
Thrust (at 2, 4, 6, 8 bar), volume (at 6 bar)

Caution!
Ensure that all applications are within the max. installation height. For applications in the grey area please contact Norgren technical service.
Thrust (at 2, 4, 6, 8 bar), volume (at 6 bar)

KM/31141

KM/31142

KM/31143

Caution!
Ensure that all applications are within the max. installation height. For applications in the grey area please contact Norgren technical service.
Application example - Air bellow as an actuator

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

<table>
<thead>
<tr>
<th>Step 1: Fill in and complete the datasheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Total weight to be lifted: $F = (1000 \text{ kg} + 550 \text{ kg}) \cdot \frac{10 \text{ m}}{\text{s}^2} = 15500 \text{ N}$</td>
</tr>
<tr>
<td>b) Number of air bellows: $n = 4$</td>
</tr>
<tr>
<td>c) Thrust per air bellow: $f = \frac{15500 \text{ N}}{4} = 3875 \text{ N}$</td>
</tr>
<tr>
<td>d) Operating pressure: $P = 5 \text{ bar}$</td>
</tr>
<tr>
<td>e) Required stroke: $S = 90 \text{ mm}$</td>
</tr>
<tr>
<td>f) Vertical space: $X_v = 85 \text{ mm}$</td>
</tr>
<tr>
<td>g) Horizontal space: $X_h = 270 \text{ mm}$</td>
</tr>
<tr>
<td>h) Operating temperature: $T = 45^\circ \text{C}$</td>
</tr>
<tr>
<td>i) Operation angle: $\alpha = 9^\circ$</td>
</tr>
<tr>
<td>j) Out of alignment: $A = 0 \text{ mm}$</td>
</tr>
<tr>
<td>k) Chemical resistance: normal environment</td>
</tr>
</tbody>
</table>

Step 2:

From table 1 air bellows have to be selected, that have a min. 90 mm stroke and clearance around the air bellows smaller than $X_h = 270 \text{ mm}$. We select: KM/31082

Step 3:

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

Vertical space $X_v = 85 \text{ mm}$
Stroke $S = 90 \text{ mm}$
Total height $175 \text{ mm}$

By referring to the total height of 175 mm and the vertical space of 85 mm, only KM/31082 (installation height min. 75 to recommended max. working height 220 mm) can be used from table 1.

Step 4:

Check the thrust at 5 bar at a height of 175 mm.

From the charts in the datasheet page 4 we can see that:

![Thrust vs. Stroke Chart](chart.png)

**KM/31082**

<table>
<thead>
<tr>
<th>Thrust (N)</th>
<th>Volume (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25000</td>
<td>5</td>
</tr>
<tr>
<td>20000</td>
<td>4</td>
</tr>
<tr>
<td>15000</td>
<td>3</td>
</tr>
<tr>
<td>10500</td>
<td>2</td>
</tr>
<tr>
<td>6000</td>
<td>1</td>
</tr>
</tbody>
</table>

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

$$\frac{10500 \text{ N} \cdot 5}{6} = 8750 \text{ N} \text{ at 5 bar}$$

**Result:**
The air bellow KM/31082 can provide the required thrust of 3875 N.

Step 5:

Check the operation angle and the out of alignment when the selected air bellow can tilt, see table 2.

i) max. operation angle $10^\circ$ is higher as existing operating angle $9^\circ$.

j) max. out of alignment is $10 \text{ mm}$ is higher as existing alignment $0 \text{ mm}$.

**Result:**
KM/31082 can be used.

Step 6:

Check all remaining parameters

h) At $45^\circ \text{C}$ Standard rubber material
   -30 ... + 50°C

k) No special chemical resistance is required

**Result:**
KM/31082 is the chosen air bellow, because it meets all requirements.
Application example - Air bellow as a 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: \( F = 3800 \text{ kg} \times 10 \text{ m}^2 = 38000 \text{ N} \)
b) Number of air bellows: \( n = 4 \)
c) Thrust per air bellow: \( f = \frac{38000 \text{ N}}{4} = 9500 \text{ N} \)
d) Operating pressure: \( P = 4 \text{ bar} \)
e) Vertical space: \( X_v = 240 \text{ mm} \)
f) Horizontal space: \( X_h = 400 \text{ mm} \times (0.8 \text{ m}) \)
g) Operating temperature: \( T = 50°C \)
h) Chemical resistance: Normal environment
i) Minimum isolation rate: \( I = 97\% \)
j) Excitation frequency \( f_e \)

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 smaller than 400 mm.

From table 1 we select:
1. KM/31102 - Vibration height = 220 mm - Clearance around the air bellow = 300 mm - Airspring natural frequency “fn” at 4 bar = 1.8 Hz - Stiffness at 4 bar = 123 N/mm
2. KM/31122 - Vibration height = 220 mm - Clearance around the air bellow = 350 mm - Airspring natural frequency “fn” at 4 bar = 1.8 Hz - Stiffness at 4 bar = 200 N/mm

Step 2:
Take the air bellow with the lowest airspring natural frequency \( fn \) at 4 bar = 1.8 Hz.
Do to the fact that both air bellows constater the same natural frequency. Please use the lowest stiffness at 123 N/mm in order to get the highest isolation rate referring to fe min. = 20 Hz.

Air bellow KM/31102 is chosen.

Step 3:
Calculate the isolation rate (I) of the KM/31102 by using the formula:

**Formula:**

\[
I = 1 - \left( \frac{1}{f_e} \right)^{\frac{1}{fn}} - 1
\]

**Example:**

\[
I = 1 - \left( \frac{20}{1.8} \right)^2 - 1
\]

\[
= 1 - \frac{1}{122.4} = 0.991
\]

\[
I = 99.1\%
\]

**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/data».

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 IMI Precision Engineering, Norgren GmbH.

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

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

**Step 5:**
Check all remaining parameters

- At 50°C Standard rubber material (-30 ... +50°C) can be used.
- No special chemical resistance is required.

**Result:**

4 x KM/31102 air bellows are chosen. They will provide 99.1% vibration isolation and lift the 3800 kg weight at 4 bar.