Advice for Calculating and Selecting the Right Gas Spring

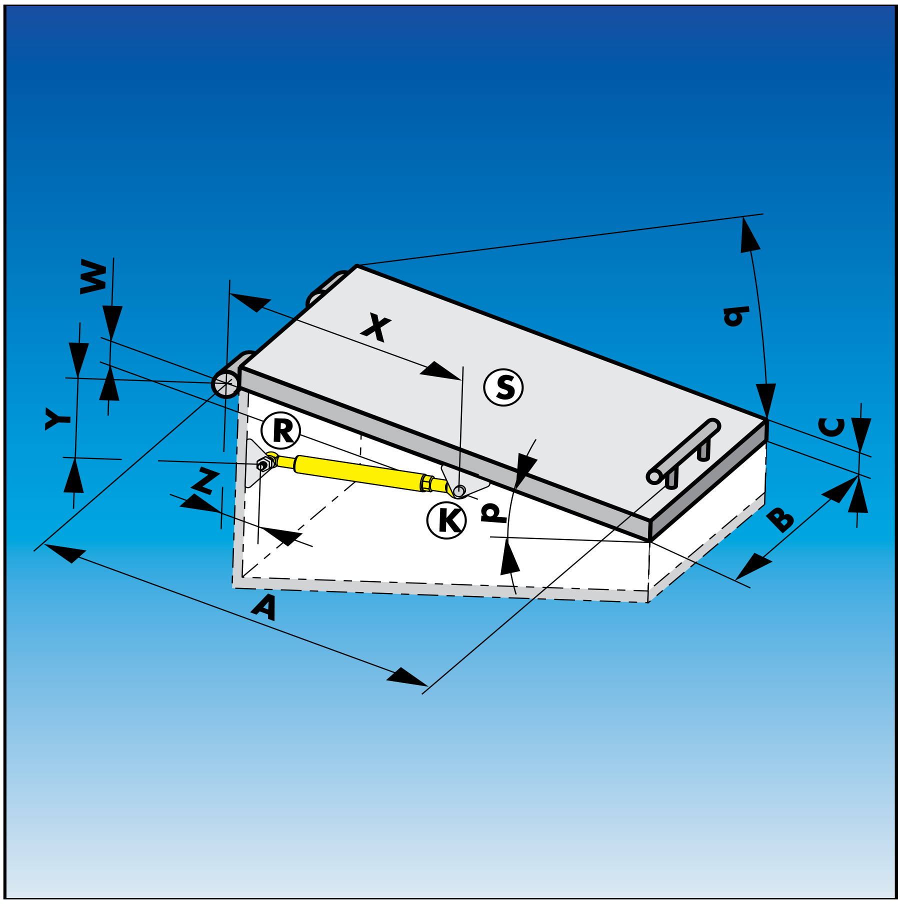
DICTATOR can offer you the perfect gas spring for every application, because there are endless variations.

After reading the following descriptions you will be able to:

- choose the type of **gas spring** required,
- clarify the **function** of the gas spring - to keep open, keep closed, or automatically open,
- find the optimum **fixing points** and the stroke,
- calculate the required **spring force,**
- determine the technical **qualities.**

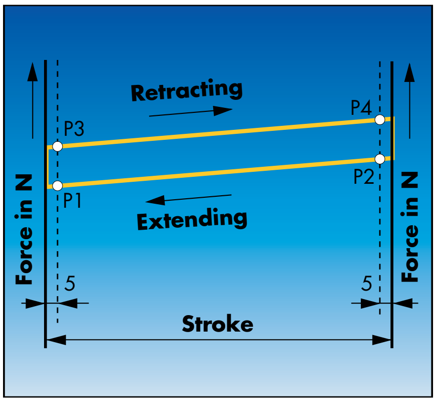
With these values you will then be able to quickly find the right gas spring on the previous pages.

Our highly experienced DICTATOR advisors will be glad to help you should you have any queries. You will find check lists on pages 06.085.00 - 06.088.00.



Details Required

Function	should it open with no assistance, assist or hold open
Requirements	speed and frequency of movement
Flap measurements	length A, width B, thickness C
Flap position	closed or open
Flap weight	in Newtons (1 N = 0.1 kp), centre of gravity
Fixing possibilities	on the flap and on the frame/housing
Fittings	suitable means of fixing
Environmental conditions	temperature, dirt, dampness etc.



A. Choosing the Right Type of Gas Spring

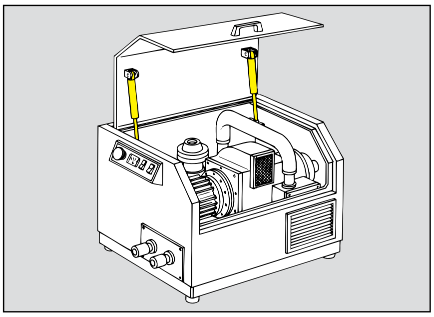
Depending on the application, firstly choose the type of gas spring which best fulfills the required functions of your application: pushing, pullling, damping, holding etc.

Detailed descriptions of all varieties of gas springs can be found on pages 06.003.00 - 06.012.00. Technical data can be found on pages 06.017.00 - 06.058.00.

Push Type Gas Springs

Push type gas springs are most commonly used as a counterweight or for supporting moveable components e.g. on hatches, flaps, windows, swivel arms and various other swinging or pushable elements.

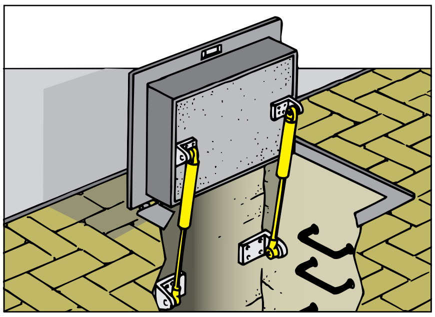
The basic function is explained on page 06.005.00 and technical data can be found on pages 06.017.00 - 06.027.00.



Progressive Gas Springs

Progressive gas springs are always used when particularly heavy hatchways need to be opened by hand.

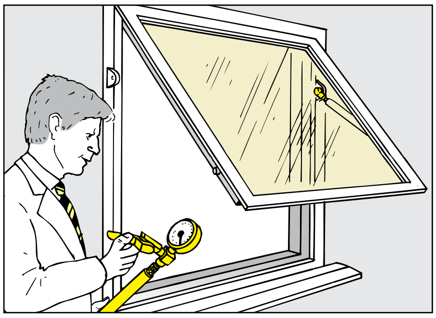
The basic function is explained on page 06.009.00 and technical data for push-type gas springs can be found on pages 06.017.00 - 06.027.00. You should also indicate the required progressivity when ordering. We recommend you contact our Advisory Service before ordering.



Gas Springs with Floating Piston

Gas springs fitted with a floating piston are used when the piston must extend and retract very slowly e.g. on sensitive window applications.

The basic function is explained on page 06.006.00 and technical data can be found on pages 06.029.00 - 06.032.00.



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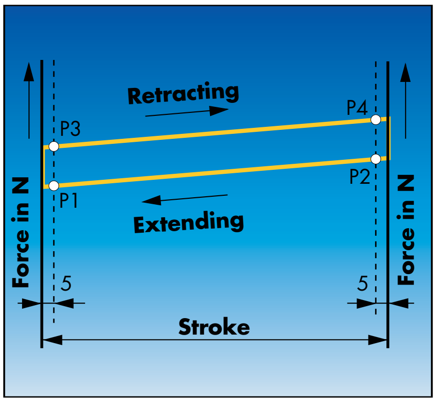


Choosing the Right Type of Gas Spring, cont.

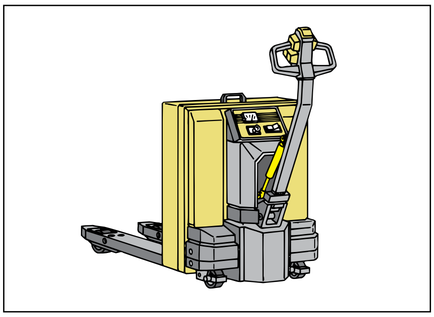
For every type of DICTATOR gas spring you will find a number of accessories available. Our competent advisors specialise in producing the exact gas spring your application requires.

Should you need a gas spring which you cannot find here, we will select the correct model from our large selection and modify it if necessary.

Pull Type Gas Springs

Pull type gas springs are mainly used in cases where a counterweight can only be achieved by a gas spring which is fitted above the moving element e.g. on a fork lift truck shaft.

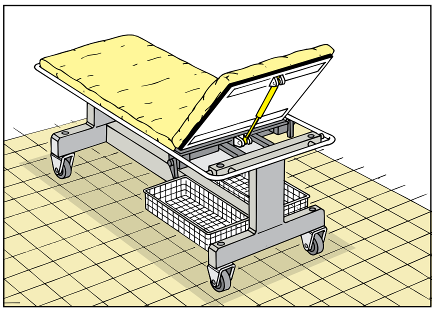
The basic function is explained on page 06.006.00 and technical data can be found on pages 06.033.00 - 06.038.00.



Locking Gas Springs

Locking gas springs are used when an object must be held or locked in any possible position. Rigid locking is used when an exact position is necessary. Cushioned locking compresses slightly when loaded e.g. in comfortable office chairs.

The basic function is explained on page 06.007.00 and technical data can be found on pages 06.039.00 - 06.044.00.

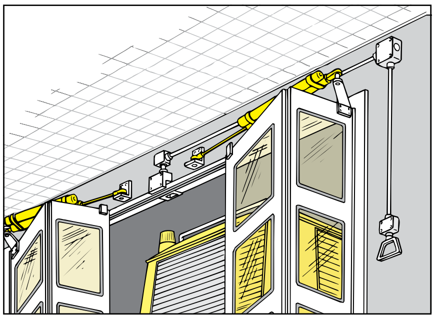


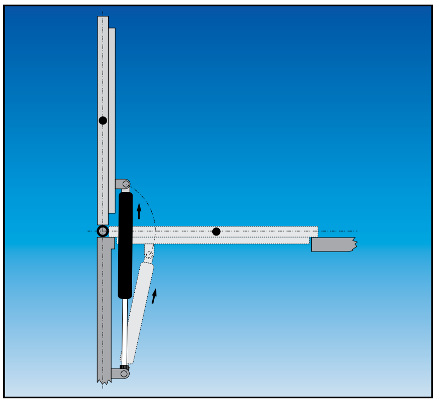
Variable Speed Gas Springs

Variable speed gas springs are used when the pushing speed needs to be adjustable. They can for example open folding doors smoothly and safely.

The final damping feature prevents the door leaves from bumping against each other loudly.

The basic function is explained on page 06.008.00 and technical data can be found on pages 06.059.00 - 06.060.00.





B. Function and Task of Your Gas Spring

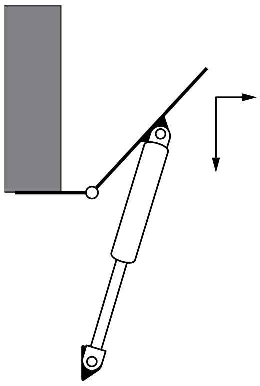
According to the function you require you will obtain different results relating to the installation and the following calculations concerning gas spring forces.

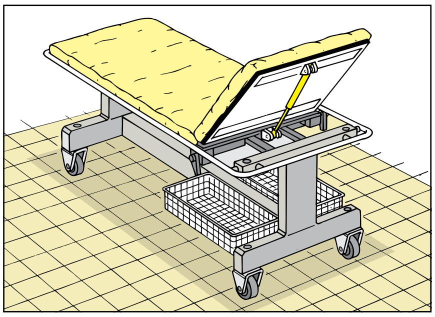
Firstly you should decide whether the gas spring needs to open a flap or hatch automatically **or** just support a manual opening. Depending on the weight of the flap or hatch you need to calculate the horizontal position and several further positions. The gas spring might even close actively.

1. Opening-Assistance

1. The panel is lifted against the force of gravity (indicated by the arrows) with help of the gas spring.

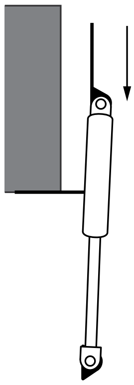
Warning: We recommend you install a final stopping device on the panel so that the gas spring cannot totally extend; the gas spring must never serve as the final stopping device.





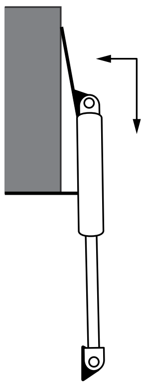
2. When the panel is vertical, gravity no longer works in the direction of closing. The gas spring force should not be too large at this point as this would make it impossible to close by hand.

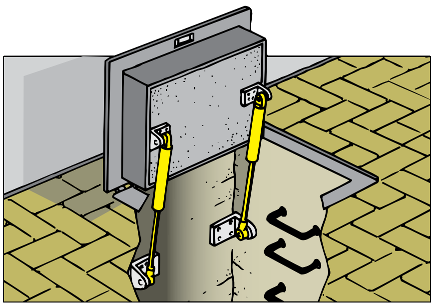
   When choosing the fixing points it is important that neither the cylinder nor the piston rod hits the frame. The panel must have a separate end stop.



3. The force of gravity now even works in the opposite direction (opening). In this position the gas spring probably would touch the frame anyway.

Warning: Please contact our Advisory Service if you want (and are able) to choose the fixing points so that the dead centre can be crossed (and the gas spring does not touch the frame). You must then install the gas spring (with long holes in the fixing bracket if necessary) so that the dead centre of the flap **never** exerts a pulling force on the gas spring as this would destroy the cylinder. The high pressure inside may cause serious injury!





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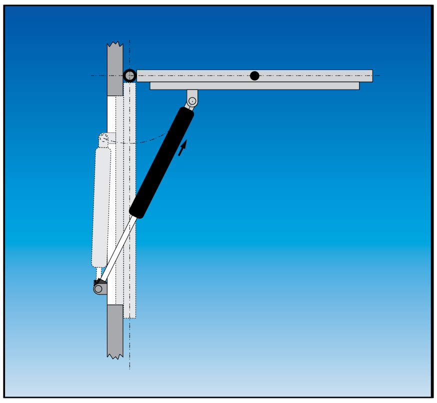
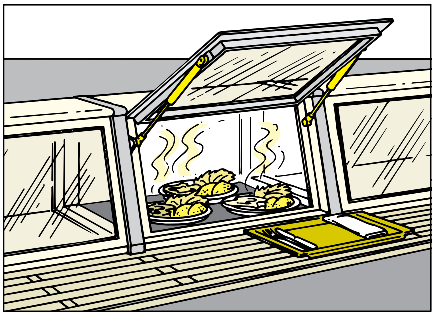


Function and Task of Your Gas Spring, cont.

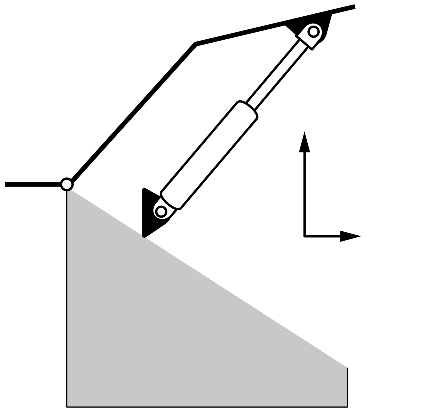
Gas springs are ideal for holding flaps and hoods. They can be dimensioned and positioned so that the gravity forces are completely equalised in the required opening position.

Depending on how the fixing points are chosen the gas spring can either support the closing of the flap from a certain position on (see centre diagram). This means the hood is actively closed. Or the gas spring opens the flap automatically once it has been unlocked.

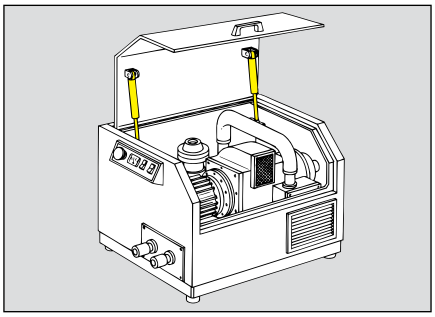
2. Keeping Open/Closed



A lid should not lift by itself but should be opened by hand with as little force as possible. Therefore the operating force of the gas spring in the closed position has to be slightly lower than the weight of the hatch. In the opened position the gas spring must have enough force to bear the weight of the flap - or you use a locking gas spring (e.g. in hospital beds).

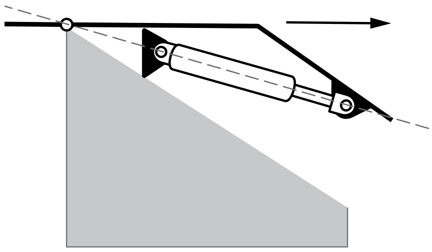


The hood is opened and kept open by the gas spring.

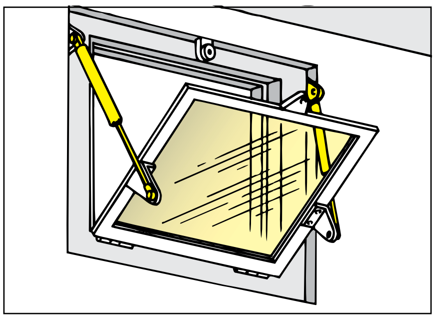


An alternative would be to choose the fixing points so that the gas spring operates in the closed position even in closing direction.

Please observe the motion of the hood in the diagram on the right. The centre diagram shows the position when the dead centre is crossed in the closing direction. From that point the gas spring operates downwards in closing direction.

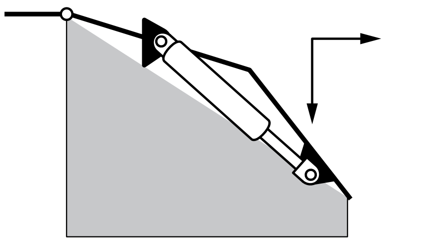


The hood is closed against the force of the spring and reaches the dead centre in this position (smallest stroke).



A window (e.g for smoke evacuation or emergency exit) should open itself and remain open without an additional force.

The fixing points should be chosen so that the operating force of the gas spring is larger than the weight of the window (in the closed position of the window).



The vertical operating direction has reversed so that the hood is now kept closed by the gas spring.

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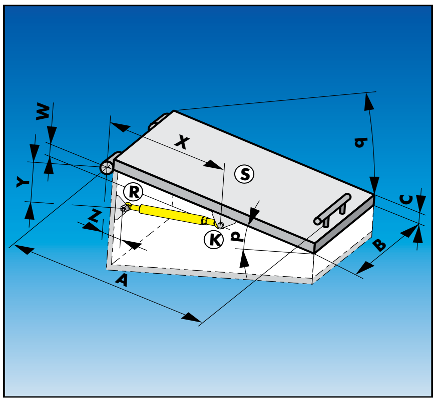


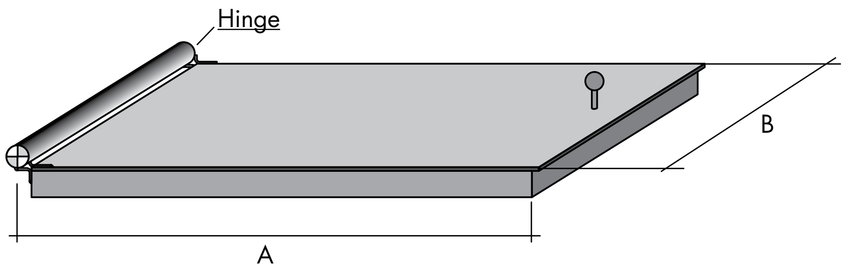
C. Fixing Points and Length of Gas Spring

Correct fixing points are most important for an effectively working gas spring. When the gas spring is correctly measured and fitted in its optimum position, the gas spring will operate correctly.

By following the instructions below you will be able to find the suitable fixing points, the length of the gas spring, as well as the **direction of the effective force**. The latter will allow the gas spring to function in the way you selected on the previous pages.

1. Panel Measurements

The first step when identifying the fixing points is to measure the panel. This example shows a panel in its closed position.



Please make a note of

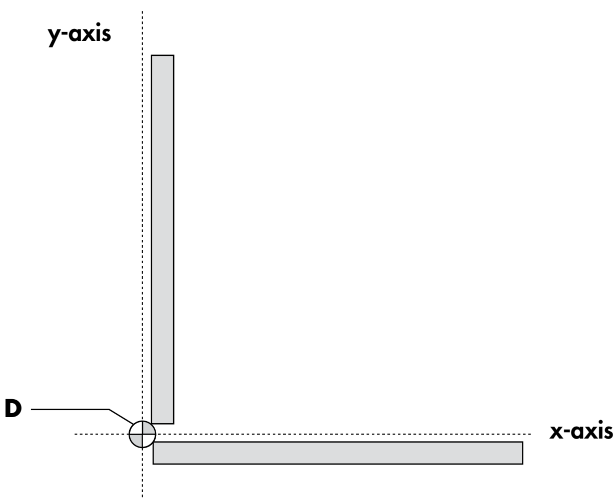
Measurement A ________________

Measurement B ________________

2. Coordinate Axis

Firstly draw the flap to scale, schematically in the open and closed position. **Pivot point D** on the flap always serves as the reference point for all following measurements. This is usually the centre of the hinge.

Draw a coordinate axis through the centre of pivot point D. The axis are labelled **x-axis** and **y-axis**. They always run parallel to the closed or open flap.



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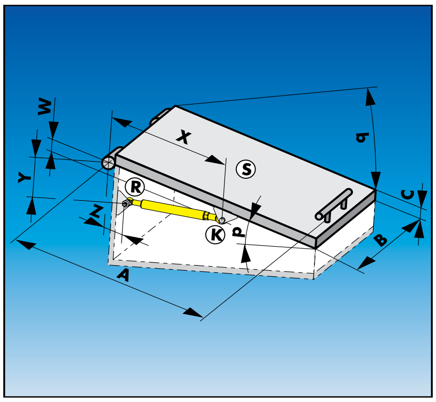


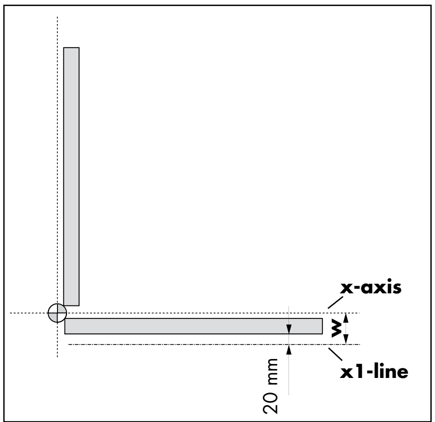
Fixing Points and Length of Gas Spring, cont.

By now following these steps you will firstly locate fixing point **R** on the frame, and then the fixing to the flap. You must then check whether we are able to manufacture the resulting lengths (gas spring compressed - gas spring extended) (see table on page 06.077.00).

It may be necessary to move points R and K. If this is the case, you must begin with step C.3 again. By following our advice you should easily manage to do this - possibly even on the first attempt.

3. Fixing point R

Fixing point **R** on the frame is determined by both distances Y and Z . Measurement **w** is the first estimate which you need to calculate. This is particularly important when the flap is very thick or it has an angled shape, or when there is a large distance between the hinge and flap.

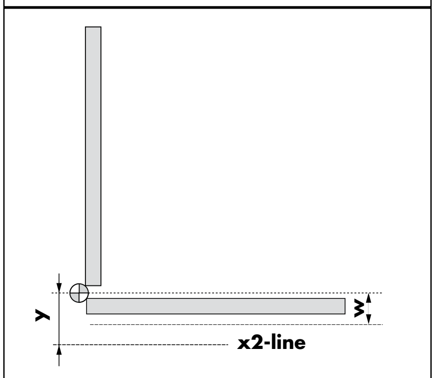


Draw a line (x1) parallel to the flap 20 mm from the bottom edge of the flap. The distance between this line and the x-axis is measurement **w**.

The distance between the bottom edge of the flap and the x1-line is determined by the mounting bracket you want to fix to the flap.

The most frequently used mounting device (order no. 205244) requires the 20 mm mentioned above. Measurements are always given to the middle of the pin. Please see page 06.065.00 et sqq. for further details and other mounting brackets.

Please make a note of **measurement w:** ______________________ **mm**

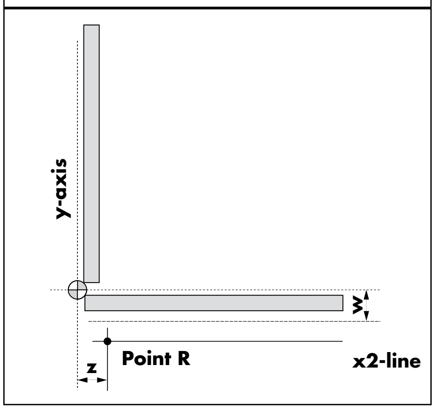


Now draw another line parallel to the x-axis, line **x2**.

The distance between the **x2** line and the x-axis is **y**. Distance **y** can be determined by the following criteria:

- Measurement **y** should be between 0 and 100 mm <u>longer</u> than measurement **w**.
- On a lighter flap (up to 20 kp) **y** can be equal to **w**.
- On a heavier flap **y** should be as long as possible (w +100).

Please make a note of **measurement y :** ______________________**mm**



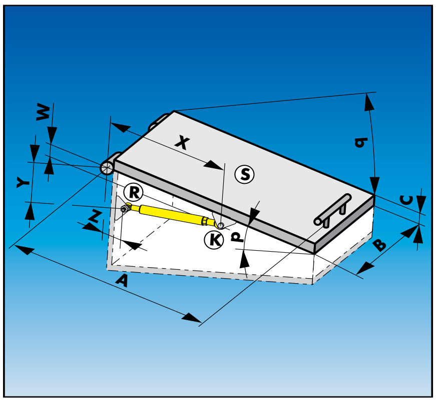
Fixing point R can be found on line **x2** at a distance **z** from the **y-axis**.

Distance **z** can be determined by the following criteria:

- Measurement **z** should be at least as long as measurement **w**.
  However **z** *should <u>not</u> be any longer than three times the length w.*
- **z** should not be longer than **w**, particularly on heavy flaps over 20 kg
- Opening greater than 90° is allowed on lighter flaps with a large measurement **z**.

WARNING: If **z** is smaller than **w** there is a danger that once it is fitted the gas spring could touch the open flap and get bent.

Please make a note of **measurement z :** ______________________**mm**



Fixing Points and Length of Gas Spring, cont.

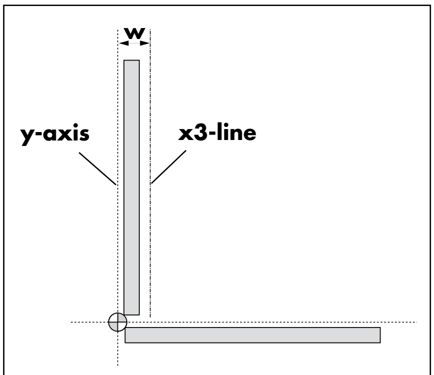
Once you have worked out where to fix the gas spring to the frame (**point R)** according to the instructions on the previous page, you must then find a suitable **point K** on the **flap**. This should cause no problem if you follow the advice given below.

We are always ready to answer any questions you may have, and advise you if your application does not look the way it should. Our motto: ***Making it easy for you!***

4. Helping Point K_{open}

Firstly you need to establish point **K** on the **opened flap**: $\mathbf{K_{open}}$

To do this you need the **scale drawing** and the established x- and y-axis, as well as the **flap size A** and measurement **w**.



Firstly draw a line (**x-3**) parallel to the flap in its open position at a distance **w** to the y-axis (see page 06.075.00 for measurement **w**).

The flap can be drawn at any opening angle - it does not have to be completely open as in the diagram. The **y-axis** always runs parallel to the flap and the **x3**-line at distance **w**.

On bent or angled-shaped flaps and bonnets always draw the **y-axis** parallel to the surface of the flap onto which the mounting bracket will be fixed.

Extended length:	200	[mm]
	300	[mm]
	400	[mm]
	500	[mm]
	600	[mm]
	700	[mm]
	800	[mm]
	900	[mm]
	1000	[mm]
	1100	[mm]
	1200	[mm]

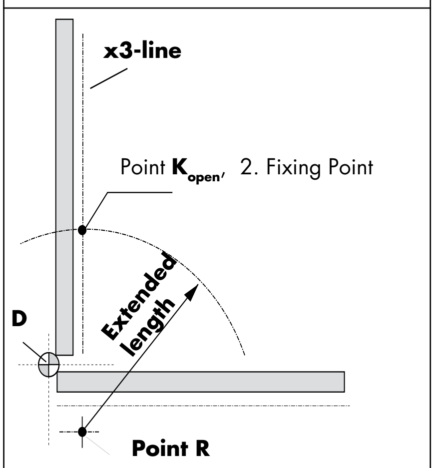
Now choose a gas spring length from the table on the left, taking into account:

- The extended length of the gas spring should correspond to approx. $^2/_3$ of the flap measurement **A** (see page 06.074.00 for measurement **A**).

  Example: If flap measurement A is 1200 mm, choose a gas spring whose extended length is approx. 800 mm.

If the value is between two values in the table, choose the higher one. Please contact our Advisory Service if your flap is over 1800 mm. This table can be used for the following gas spring ranges: 8 - 19, 10 - 23, 14 - 28, 20 - 40.

Please make a note of the chosen **extended length:** _____________ **mm**



Now draw a circle around point **R** determined by measurements y and z.

The radius of this circle is the extended length you have chosen above. The point where the circle cuts across the **x3-line** is point $\mathbf{K_{open}}$.

You have now worked out **where to fix the gas spring to the flap**.

By following the instructions on the next page you will be able to label point K when the flap is closed. With the help of another table you will then be able to work out whether the resulting compressed length of the gas spring is possible with the extended length of the gas spring you have chosen above. With a very short cylinder only a short compressed length is possible, but not a larger stroke.

Even if this may sound complicated, you will find you have no problems working anything out if you follow our advice step by step.

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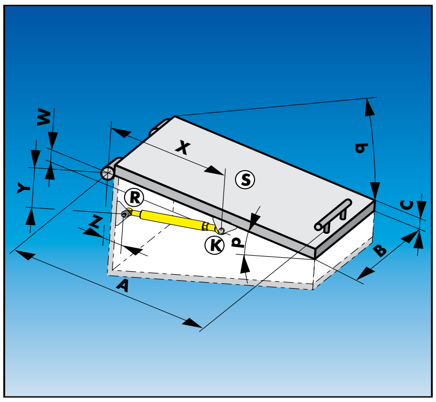


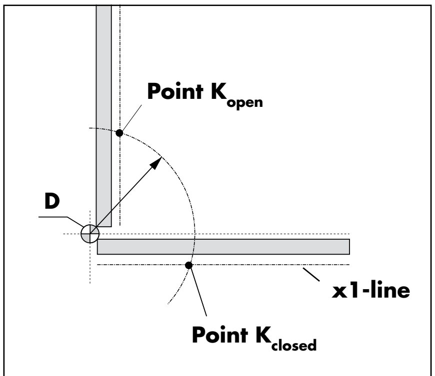
Fixing Points and Length of Gas Spring, cont.

Now check whether your chosen gas spring length is also correct for your application. This gas spring must fit in both open (distance **R-K$_{open}$**) and closed positions of the flap.

In the following steps you will work out and check whether your chosen gas spring is possible even when compressed i.e. when the flap is completely closed.

5. Fixing Point K$_{closed}$

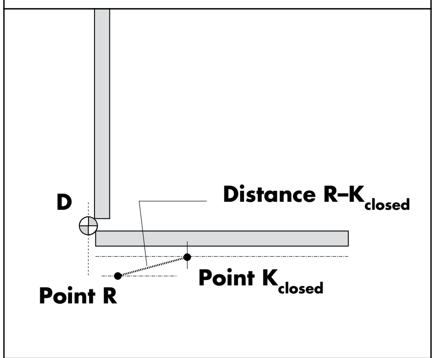
Fixing point (**K**) on the flap always experiences the same circle as the flap itself experiences when it is opened or closed. You have already worked out the position of the fixing point in the open position: **K$_{open}$**.



Now work out point **K$_{closed}$**. This is the point on the flap where the gas spring fitting is located when the flap is closed.

Firstly take the radius from pivot point **D** to point **K$_{open}$** with the compasses. Now draw a circle around pivot point **D** (in the middle of the hinge).

The point where the arc crosses line „**x1**" is point **K$_{closed}$**. This is where the gas spring fitting is located at the flap when it is completely closed.



Checking the Gas Spring Length

Measure the distance between both fixing points **R** and **K$_{closed}$**. This is the length of the gas spring when the flap is completely closed.

Please make a note of distance **R - K$_{closed}$**:________________ **mm**

Compare this value in the table on the left with the extended length of the gas spring you chose on the previous page.

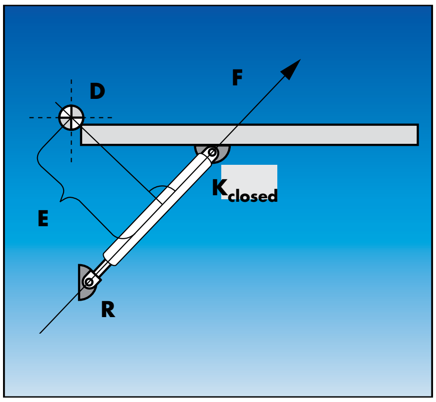
Example: on the previous page (06.076.00) you chose a gas spring whose extended length was 800 mm on a flap with a measurement A of 1200 mm. The table on the left shows that measurement **R-K$_{closed}$** must not be smaller than 450 mm (Le).

La	Le	Stroke
200	150	50
300	200	100
400	250	150
500	300	200
600	350	250
700	400	300
800	450	350
900	500	400
1000	550	450
1100	600	500

La = Extended length ž R-K$_{open}$
Le = Compressed length R-K$_{closed}$

Analysing the Checking

- If measurement **R–K$_{closed}$** is **longer** than the compressed length of your chosen gas spring, this gas spring is suitable for your application. You can now continue to the next page and calculate the necessary gas spring force.
- If measurement **R–K$_{closed}$** is **shorter** than the compressed length of your chosen gas spring, you need to choose a gas spring from the table which has a longer stroke. If this is the case, you need to begin the calculations again, starting with establishing fixing point **K$_{open}$** (see page 06.076.00).
- If the gas spring is **too long** (extended length over 1200 mm) there is a danger that it will snap under load. In this case measurement **y** must be reduced. Mark point **R** nearer the bottom of the flap (see page 06.075.00) and re-calculate the fixing point.



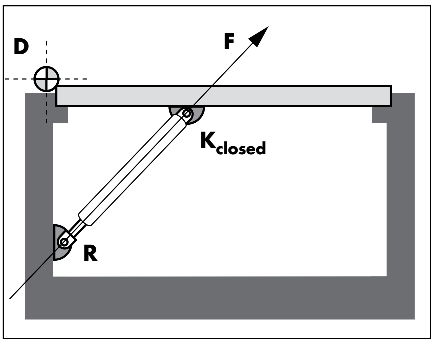
D. Calculating the Gas Spring Force

Every gas spring exerts a particular force on the piston rod. The part of this force which is effective after installation depends on the fixing points. These decide the direction in which the gas spring operates on the flap.

The more accurately you calculate the necessary force, the more your desired function can be guaranteed as DICTATOR will adjust the force exactly according to your order (see page 06.016.00 for tolerances).

1. Direction of Operation

For calculating the force relations you need another scale drawing. As you did in the previous section, insert axis **x** and **y** as well as points **R** and **K$_{closed}$**. Your gas spring will be fixed to these two points so that the **direction of operation** of the gas spring runs through both these points. Now draw the direction of operation of the gas spring **F** in your diagram.

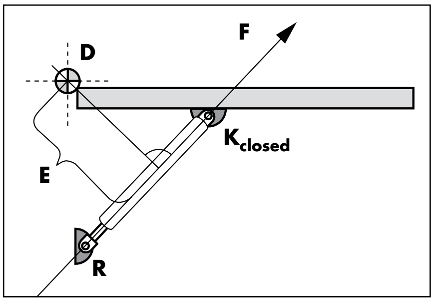


2. Operating Arm

Now draw a perpendicular line, vertical to the operation line, starting from the pivot point of the flap **D**.

The length of the perpendicular line is operating arm **E**.

With the operating arm **E** and gas spring force **F** (see page 06.077.00) calculate the **effective moment** of the gas spring: **F x E**.



In this and following calculations, use **m** (1 meter =1000 mm) as a measurement unit for the length and **N** (1 Newton = 0,1 kp = 0.2248 lbf) for the force.

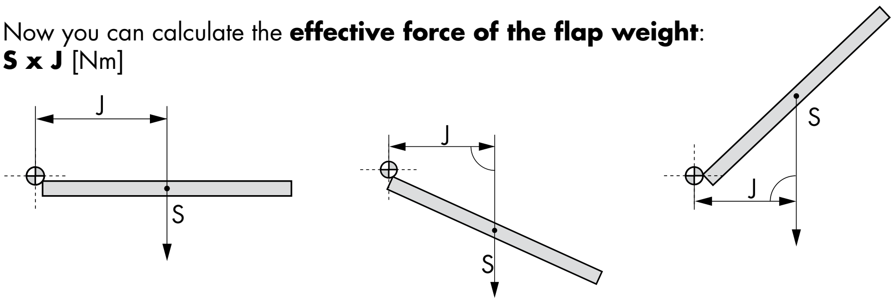
Please make a note of the **effective moment** of the gas spring:___________ **Nm**

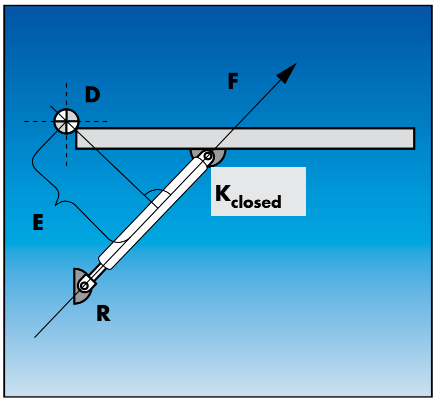
3. Weight

Now calculate the effective force of the weight of the flap. Draw the force direction of the centre of gravity of the flap (weight of the flap vertical to the centre of the earth). To make it easier to calculate the weight you can take **1 kg weight** to mean **approx. 1 kp (= 10 N) of gravity**.

Starting from the gravitational line draw a perpendicular line at right angles to pivot point D. The length of the perpendicular line is **operating arm J**.

Now you can calculate the **effective force of the flap weight**:
S x J [Nm]





Calculating the Gas Spring Force, cont.

Now you need to decide on the function of your gas spring: the gas spring should either simply support the opening or automatically open the flap (please see advice given on page 06.072.00).

In the first case the flap is usually lifted to an upwards opening or a vertical position, where it remains open without assistance.

In the second case the flap must be locked in the closed position. When released it is opened automatically by the gas spring - e.g. on smoke ventilator skylights or windows.

4. Force Relation

The relation of the effective moments determines how the flap will operate:

- When the gas spring moment is equal to the gravity moment, the flap should theoretically stay in this position.

F • E = S • J the corresponding gas spring force is : $F = \frac{S \cdot J}{E}$

In reality there are two variations to the above:

- Gas spring assists with opening, flap closes slowly by its own weight: $F < \frac{S \cdot J}{E}$
- Gas spring opens the flap automatically (after being unlocked): $F > \frac{S \cdot J}{E}$

5. Gas Spring Force

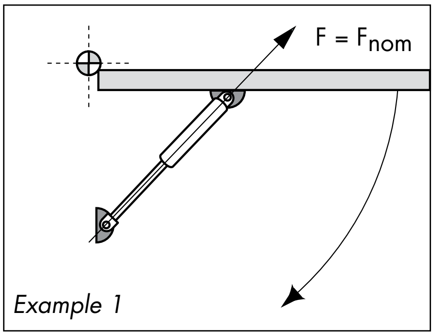
The gas spring force which has to be included in your order is always measured in its extended position (Fa). This means you need to consider the gas spring progressivity when you have calculated its force in the compressed position.

Progressivity is explained on page 06.009.00. It accounts for approx. 30 % in normal push type gas springs: **Fe = Fnom • 1.33**

Two examples make this connection clearer. It is taken that weight S in a horizontal position is balanced out by the gas spring.

1) With an extended gas spring the flap is kept in a horizontal position.

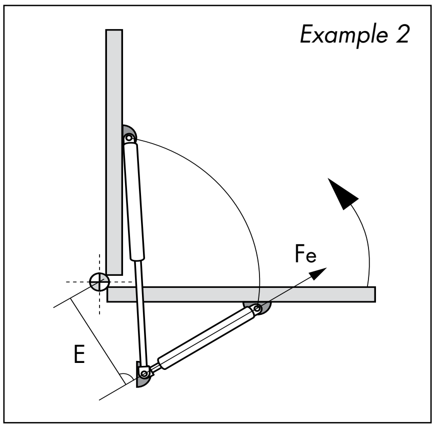
The spring force Fnom to be ordered can be found directly from your calculation results: **Fnom = F**



Example 1

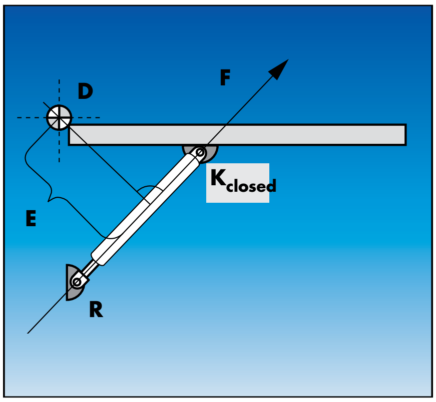
2) With a compressed gas spring the flap weight in a horizontal position is balanced out by the gas spring force: **F = S • J / E**.
This is however the force Fe, that is 30 % higher than Fnom.

The spring force Fnom which you need to order must be 30 % less than the calculated force F: **Fnom = F / 1.33**



Example 2

Warning: The calculation only takes into account one gas spring force. You must always divide the result **F** by the number of gas springs you want to use per flap in order to obtain the gas spring force you need to order.



Calculating the Gas Spring Force, cont.

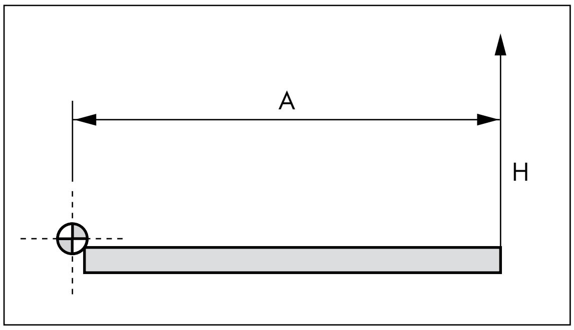
To enable your calculations to lead to a satisfactory function and easy handling of the flap, you need to work out the hand force: you need to either support the gas spring whilst the flap is opening, or, if the gas spring automatically opens it, you should be able to push the flap down by hand with an acceptable hand force.

These hand forces vary depending on the position of the flap and must therefore be calculated for all opening angles (e.g. every 10°).

5. Hand Force

The hand force needed to open the flap effects - just like the gas spring force and the gravitational force - a pivot moment.

This can be calculated from the hand force **H** and distance **A** from the position of the handle and flap pivot point D:



$$\mathbf{H \cdot A}$$

6. Relation of all Forces

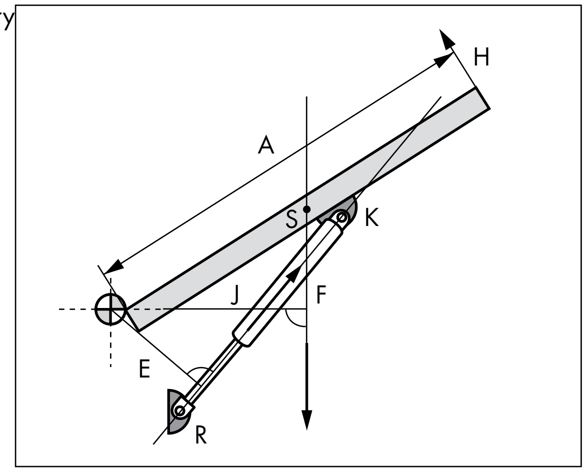
The flap remains where it is when all forces are equal: the forces which work above (gas spring force and hand force) and the gravitational force which always works below. All forces must be multiplied by their respective operating arm (distance from flap pivot).

By re-arranging the basic formula you can calculate the necessary hand force **H**:

$$(H \cdot A) + (F \cdot E) = S \cdot J$$

$$H \cdot A = (S \cdot J) - (F \cdot E)$$

$$H = \frac{(S \cdot J) - (F \cdot E)}{A}$$



The result of this calculation can either be positive (+) or negative (-):

- positive **H** †⇧ flap must be lifted by hand
- negative **H** †⇧ flap must be pushed down by hand

It is particularly important with <u>heavy</u> flaps to work out the hand force for <u>different</u> positions of the flap, even if the gas spring force is equal to the weight of the flap in a horizontal position (**F • E = S • J**).

In some situations the force relations are so unsuitable that with certain opening angles the hand forces are too large. Our Advisory Service can help you with this.

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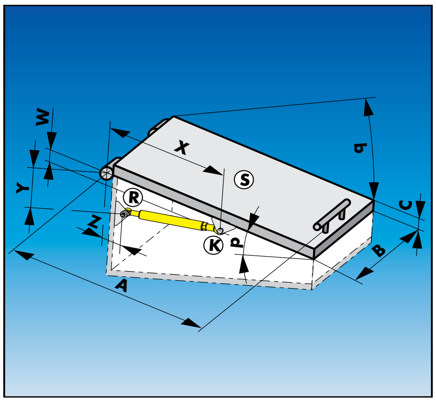


Calculating the Gas Spring Force, cont.

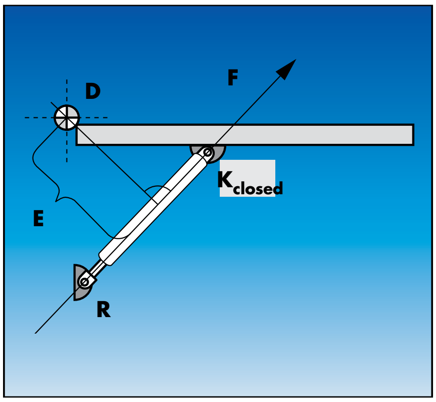
The following table gives you a summary of all the symbols and terms used in the previous pages (also see diagram on left).

Please be aware that in all formulae the length must be given in **meters** [m]. If you have measured this in mm you need to divide this value by 1000: 1000 mm = 1 m (**1 mm = 0.001 m**)

The force in **Newton** [N] can be calculated from the common weight (mostly in kg): 1 kg = approx. 1 kp = approx. 10 N (**1 N = 0.1 kp**)

7. Key

A	=	Flap length	[m]
B	=	Flap width	[m]
C	=	Flap thickness	[m]
D	=	Pivot point	
E	=	Gas spring operating arm	[m]
F	=	Gas spring force	[N]
G	=	Weight	[N]
H	=	Hand force	[N]
I	=	–	
J	=	Gravitational operating arm	[m]
K	=	Position where gas spring is fixed to flap	
L	=	La / Le (gas spring lengths)	[mm]
M	=	–	
N	=	Newton (1 kp = ca. 10 N)	[N]
O	=	–	
P	=	Diagram points P1, P2, P3, P4	
p	=	Angle of closed flap	[°]
q	=	Opening angle	[°]
R	=	Position where gas spring is fixed to frame	
S	=	Gravity	[N]
T	=	Distance of gravitational force - pivot	[m]
U	=	–	
V	=	–	
W	=	Distance D to Kclosed vertical	[m]
X	=	Distance D to Kclosed horizontal	[m]
Y	=	Distance D to R vertical	[m]
Z	=	Distance D to R horizontal	[m]



E. Determining the Gas Spring's Characteristics

Before ordering **your** gas spring(s) you should once more check all details according to the following points.

The order in which the following points are listed also corresponds to the special DICTATOR **part number** and the details on the technical information pages (pages 06.019.00 - 06.058.00).

To make it easier for you to order your gas spring you simply need to insert the values of your chosen **gas spring model** in the empty boxes on the **information page** (pages 06.019.00 - 06.058.00) and fax the page to us.

1. Piston Rod (Ø)

The correct diameter of the gas spring piston rod is calculated from the necessary gas spring force. The force $\mathbf{F_{nom}}$ (= force with extended piston) which you calculated on page 06.079.00 should be approximately in the **middle of the force range** for that gas spring range. These force ranges are given on every information page (pages 06.019.00 - 06.058.00) directly below the description for each gas spring range.

Please also make sure that very thin piston rods only allow for short stroke movements to prevent them from snapping. Please order a gas spring from a larger range if you require a larger stroke movement. The first number in the range description is also the piston rod diameter in mm.

2. Cylinder (Ø)

The cylinder diameter is usually given for each gas spring range (found on pages 06.019.00 - 06.058.00). It follows automatically from the piston rod diameter selected above. The cylinder diameter is the second number in the range description.

If you require a gas spring with as little progressivity as possible (increase of the force when piston rod is compressed), an larger (longer or thicker) cylinder can be used. Please ask our Advisory Service if you have such an application.

3. Stroke

On pages 06.076.00 and 06.077.00 you calculated both the extended and compressed lengths. From this you can work out the necessary stroke **H**:

$$\mathbf{H = L_a - L_e}$$

$\mathbf{L_a}$ = Length extended = Distance **R** to $\mathbf{K_{open}}$

$\mathbf{L_e}$ = Length compressed = Distance **R** to $\mathbf{K_{closed}}$

If possible you should optimise the fixing points so there are <u>no very short</u> and <u>no very long</u> stroke movements:

- the **shorter** the stroke, the larger the gas spring force needs to be i.e you need to select a larger (more expensive) range;
- the **longer** the stroke, the greater the danger of the piston rod bending. In extreme cases the fixing on the piston rod (and sometimes also the front end of the cylinder) needs an additional external guide to prevent lateral yielding.

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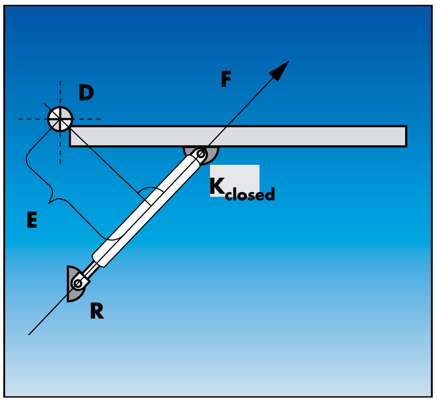


Determining the Gas Spring's Characteristics, cont.

An advantage gas springs have over other springs is that along with the low increase in force, the **movement** can also be successfully **controlled** (by being damped). For this you need to choose a suitable type of damping.

The stroke lengths do not need to and should not always be completely used.

Please take note that when installing gas springs the fixing points should lie so far apart from each other that the gas spring can easily be installed and removed whith the gas spring completely extended. The spring should never be pulled apart by force.

4. Type of Damping

The movement of the piston rod can be controlled by the integrated damping. The gas then flows through a small **port** in the rod (see diagram on page 06.004.00).

The different types of damping available are: on compression, on extending, on compression and extending stroke, and without damping. Each type of damping has its own number which appears in the **part number**. The information pages (pages 06.019.00 - 06.058.00) indicate which type of damping is possible for the corresponding series.

0 = without damping
1 = damping on extending stroke
2 = damping on compression stroke
3 = damping on both extending and compression strokes

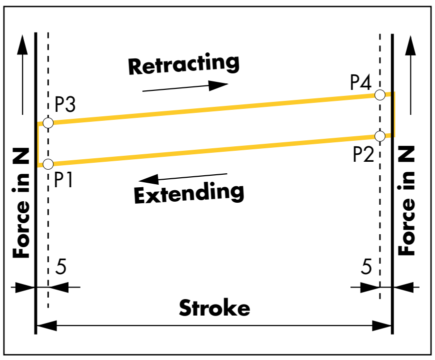
Towards the end of the extending movement (only if the piston rod is underneath) the oil must move through the piston port, through which the extending speed is slowed down once again - approx. 1 - 2 cm before the piston rod is fully extended. This **final damping** can also be adjusted for a longer final damping by additional quantities of oil. However, due to the fact that this causes the progressivity to change, you should consult our Advisory Service if you prefer that feature.

5. Gas Spring - Force Rating

DICTATOR can produce all gas springs with the force that you may require for your application. Please check your results on page 06.079.00 with the formulae for the hand force on page 06.080.00 and write down the force rating $\mathbf{F_{nom}}$ on the order form.

The range of forces for each range can be found on the information pages.

Although DICTATOR gas springs are manufactured with a special particularly low friction durable seal, a certain amount of friction cannot be avoided. The diagram on the left shows the force range:

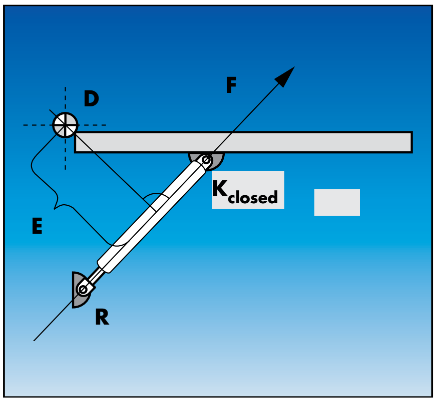


P1 The force ($\mathbf{F_{nom}}$) given on the label and order description is the **extending force**, reached approx. 5 mm before full extension.

P2 When the piston rod is completely compressed, the gas spring force is greater due to the progressivity value (normally approx. 30 %) because the gas volume in the cylinder is less when the piston rod is compressed (see page 06.009.00).

P3 The force needed to **compress** the piston rod is greater than the extending force due to friction caused by the seal.

P4 The further the piston rod retracts, the more the gas is compressed and the more the extending force increases. For safety reasons separate stopping devices need to be placed approx. 5 mm from the final stroke position (once the gas spring has beed installed).



Determining the Gas Spring's Characteristics, cont.

The **lengths** calculated on page 06.077.00 represent the distances between the fixing points. These lengths include the end fittings and should be written on the order information on the information pages 06.019.00 - 06.058.00.

When checking whether the lengths you have worked out are possible, you should take into consideration the minimum length of the **internal parts** and **measurement D** of both end fittings: D_K (on piston rod), D_Z (on cylinder)

Measurements D can be found on the gas spring information pages and on pages 06.062.00 - 06.064.00.

6. Compressed Length

The compressed length Le is the distance between point **R** and point K_{closed} in your calculations on page 06.077.00. This length must be long enough for the stroke and other components (including end fittings):

$$L_e \geq \text{stroke} + \text{length of all components}$$

7. Extended Length

The extended length La is the distance between point **R** and K_{open} in your calculations on page 06.076.00. This length must be long enough to include two strokes and all parts (including end fittings):

$$L_a \geq (2 \times \text{stroke}) + \text{length of all components}$$

The lengths of the internal components can be found in point 7 on the information pages concerning each individual gas spring range (pages 06.019.00 - 06.058.00).

8. Piston Rod End Fittings

In order to fix the piston rod, choose an end fitting which is most suitable for the intended swinging movement. Please see gas spring information pages (pages 06.019.00 - 06.058.00) for available end fittings. It is important that no lateral forces act on the piston rod as these could cause the piston rod to snap.

Although rose bearings are slightly more expensive and longer than simple eyelets, they can however prevent a lateral load on the piston rod if the pins are slightly slanted.

9. Cylinder End Fittings

The above recommendations can also be used when choosing components to connect the cylinder.

10. Additional Options

All additional options available for each gas spring range are listed in the information pages (pages 06.018.00 - 06.058.00) They are labelled with order codes 4 to 8. Technical details can be found on pages 06.010.00 - 06.012.00.

- **4** An **oil chamber** is necessary when push type gas springs cannot be installed with the piston rod vertically underneath (max. difference of 35°). An oil chamber prevents the seal from drying out, increases the life of the gas spring and reduces friction.
- **5** A **valve** can be an advantage when the necessary pressure cannot be determined in advance e.g. in a sample or individual piece. The valve can be found axially in the bottom part of the cylinder and is secured with a hexagon socket screw with o-ring. Protective glasses must be worn when releasing gas.
- **6** A **protective tube** should be ordered if the gas spring is to be exposed to dirt, paint and other such hazards. It also protects the piston rod from mechanical damages and increases its life.
- **7** An additional **helical spring** (in the cylinder or on the piston rod) ensures that smoke vents on windows open automatically, even after long rest periods.
- **8** Environmentally friendly **biological oil** enables gas springs to be used in areas containing food.

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