About gas springs

KALLER®

Contents

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All dimensions are stated in mm.
All dimensions are nominal unless tolerance is stated.

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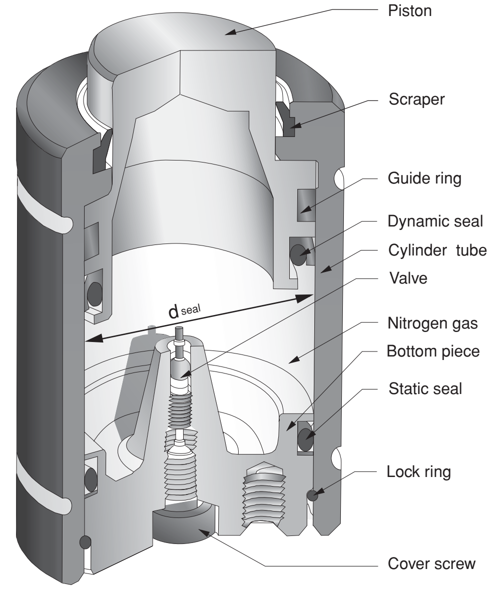
GENERAL

KALLER gas springs are designed to meet customer expectations for reliability, safety and service lifetime.

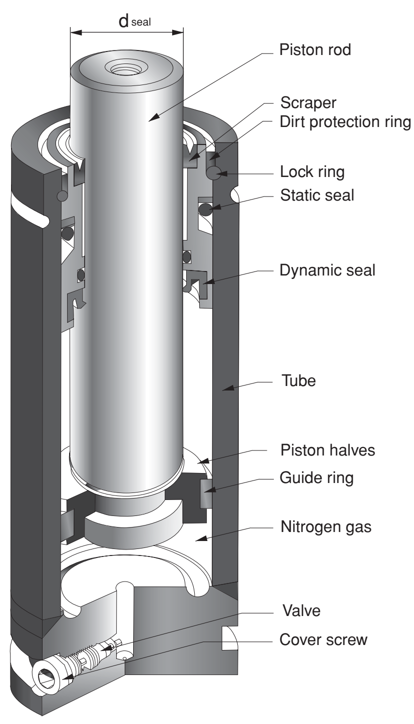
Strömsholmen AB, the designers and manufacturers of KALLER gas springs, has been ISO 9001 approved since 1994 and ISO 9001:2000 and PED (97/23/EC) approved since 2002 and is the world's first and leading manufacturer of nitrogen gas springs for the metal stamping industry.

Main groups of gas springs

Kaller gas springs can be split into two main groups: piston rod sealed and bore sealed.



Bore sealed gas spring



Piston rod sealed gas spring

Overview of Models

CU Series:

These super-compact gas springs provide a high amount of force while having small outer body diameters.

Forces:	950 lbF to 41150 lbF
Strokes:	6 mm to 50 mm
Max. strokes/min.:	~100 (at 20°C)

Powerline X Series:

The world's shortest and strongest rod sealed gas spring with tapped base mounting holes and side charging port for hose system connection.

Forces:	380 lbF to 21360 lbF
Strokes:	10 mm to 125 mm
Max. strokes/min.:	~20-100 (at 20°C)

EP Series:

These ejector pin gas springs are color-coded and fully adjustable with either an M16 or M24 threaded body.

Forces:	11 lbF to 380 lbF
Strokes:	10 mm to 100 mm
Max. strokes/min.:	~100 (at 20°C)

R Series:

Non-repairable, color-coded and fully adjustable gas springs with a Ø12 or 19mm outer body diameter.

Forces:	29 lbF to 202 lbF
Strokes:	7 mm to 80 mm
Max. strokes/min.:	~100-150 (at 20°C)

Mini Series:

Repairable, color-coded and fully adjustable gas springs with small outer body diameters.

Forces:	112 lbF to 450 lbF
Strokes:	7 mm to 125 mm
Max. strokes/min.:	~80-100 (at 20°C)

TU Series:

Kaller's standard series. Dimensions correspond to the ISO 11 901 standard for gas springs.

Forces:	562 lbF to 23830 lbF
Strokes:	10 mm to 300 mm
Max. strokes/min.:	~15-40 (at 20°C)

CPF Series:

A shorter version of the TU Series

Forces:	2070 lbF to 23830 lbF
Strokes:	13 mm to 300 mm
Max. strokes/min.:	~15-100 (at 20°C)

TB Series:

Low force increase version of the TU Series, sharing the same total lengths but with larger body diameters. As a result, it has a longer service lifetime and can be run at faster press frequencies.

Forces:	1686 lbF to 11240 lbF
Strokes:	12.7 mm to 300 mm
Max. strokes/min.:	~40-80 (at 20°C)

SL Series:

Similar to the TU Series, these gas springs have "inch based" total lengths and stroke lengths.

Forces:	1686 lbF to 11240 lbF
Strokes:	½" to 8"
Max. strokes/min.:	~15-40 (at 20°C)

K Series:

Short height version of the TU Series with tapped base mounting holes and side charging port for hose system connection.

Forces:	1124 lbF to 6744 lbF
Strokes:	6 mm to 125 mm
Max. strokes/min.	~30 (at 20°C)

KS Series:

Shorter height version of the TU Series with charging port located in the piston rod and without tapped base mounting holes.

Forces:	250 daN to 750 daN
Strokes:	12.7 mm to 125 mm
Max. strokes/min.:	~30 (at 20°C)

Being phased out & replaced by the Powerline X Series

LCF (Low Contact Force) Gas Spring Information

The LCF Series is the next generation of nitrogen gas springs. This innovative series is engineered to address the major problems facing metal stampers today: excessive shock loads, high noise levels and extreme pad/blank-holder bounce, all factors that lead to high press maintenance costs and noise pollution.

The LCF Series reduces shock load by as much as 50% compared to traditional gas springs. They deliver a gradual force build-up and smooth acceleration so there's less impact on gear and bearings and less wear on drive components.
The payoff is reduced press maintenance.

The LCF Series lowers noise levels significantly, with a higher reduction in sound pressure level compared to standard gas springs. Its lesser impact force results in these lower noise levels and makes these springs a cost effective alternative to building noise enclosures.
The payoff is a quieter, safer and healthier working environment.

The LCF Series decreases pad/blank-holder bounce, allowing improved part transfer efficiency, increased production rates and reduced scrap. A gradual force increase and return results in smoother pad/blank-holder operation.
The payoff is higher production rates.

Because LCF gas springs mount directly to the die and are independent from the press, all benefits travel with the tool.

Standard features:

- 100% interchangeable with standard, ISO gas springs (i.e. our TU Series)
- Retrofits in existing dies
- Charged and rebuilt like standard gas springs
- Drop in, flange mount, or base plate mounting
- Can be hosed together
- Can be incorporated into press cushions

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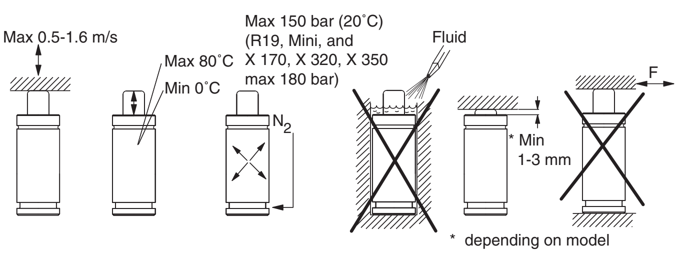
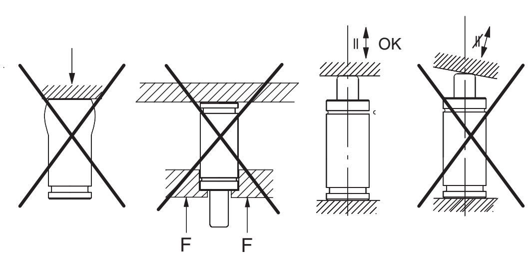
USER INFORMATION

Mounting Instructions

To achieve the best possible service-life and safety from the gas spring, follow these instructions. The gas spring is intended for use in tool and machine applications.

- Secure the gas spring to the tool/machine whenever possible, using the threaded hole(s) in the base of the gas spring or a suitable flange.
- The threaded hole in the piston rod top should not be used for mounting purposes. It is only to be used when servicing the gas spring.
- Do not use the gas spring in such a way that the piston rod is released freely from its compressed position, as this could cause internal damage to the gas spring.
- The maximum allowed stroke speed is from 0.5 to 1.6 m/s, depending on model.
- Make sure the gas spring is mounted parallel to the direction of the compression stroke.
- Ensure the contact surface of the piston rod top is perpendicular to the direction of the compression stroke and is sufficiently hardened.
- The gas spring should not be subjected to side loads.
- Protect the piston rod against mechanical damage and contact with fluids.





Stroke length

The nominal stroke (defined as S in the catalog tables) may be used fully in all KALLER gas springs.

However, the recommendation is not to use the full stroke in normal operation. This is to prevent the spring from being “over-stroked” as a result of changes to the tool or problems in the tool.

We do not recommend the last 5 mm or 10% of the nominal stroke be used.

Maximum charging pressure

The maximum charging pressure (at 20°C) stated for the different gas springs may not be exceeded as it may affect the safety of the product.

Operating temperature

Exceeding the gas spring’s recommended max. operating temperature will shorten the service-life of the gas spring.

Recommended maximum strokes/minute

The values given for each gas spring in the catalog are valid for “normal” applications in press tools. The lower limits given are valid for the longer stroke lengths and the higher values for short stroke springs. These values are based on a fully used stroke. If only a portion of the stroke is used, the number of strokes per minute could be increased.

Maximum piston rod velocity

The maximum piston rod velocity is not to be exceeded because it may infringe on safety, as well as the performance of the gas spring.

Service interval

If correctly installed and used, the following minimum service-interval of the KALLER Gas Springs is expected.

Stroke lengths up to and including 50 mm, after 1 million strokes.

Stroke lengths above 50 mm, after 100,000 stroke meters.

The number of stroke meters is calculated as:
Used stroke (in meters) x 2 x number of strokes.

It is our recommendation that the gas spring is replaced after 2 million strokes or after 10 years of service.

Service information

All KALLER gas springs except the R12, EP2 16, EP2 24, EPS2 24, R19, CU 420 series and X 170, X 320, X 2400-016 can be serviced. For the service, repair kits and tool kits are available. Service instructions are included in the repair kits.

⚠ **Caution! Only specially trained personnel with good knowledge about the products should carry out the maintenance. Mistakes made during assembly and charging may affect safety and/or have a detrimental effect on the service-life of the product.**

CAD-files

To make it easier for tool designers to design in our gas springs, KALLER products are available as both 2D and 3D CAD files/models. These are available for download from our web-site (www.kaller.com).

BASIC GAS SPRING THEORY

CALCULATION OF THE INITIAL FORCE

The initial force of the gas spring can be calculated as the sealed area of the piston rod or the piston (depending on design) times the pressure in the gas spring.

The larger the effective cross sectional area of the piston rod or the piston, the more “powerful” the gas spring will be. This explains why a bore sealed spring, like the CU spring, is more powerful than a piston rod sealed spring, like the TU spring, with the same outer body diameter. Derived from the figures above, the gas spring force can be written as:

Formula ❶

$$F_{gas\ spring}\ (lbF) = p \cdot r_{seal}^2 \cdot \pi$$

p (psi)

r_{seal} (in)

CHANGING THE INITIAL FORCE

As seen in the above formula ❶ the force from a given gas spring can be changed by changing the gas pressure. In cases where a non-standard initial force is required, the following formula should be applied:

Formula ❷

$$p_{filling} = p_{standard} \cdot \frac{F_{required}}{F_{standard}}$$

$F_{required}$ (lbF) = The required initial force

$F_{standard}$ (lbF) = Standard initial force (at $p_{standard}$)

$p_{standard}$ (psi) = Standard filling pressure

Example 1

A TU 1500 spring (see page 2.8/2) should be modified to give an initial force of 2700 lbF (at 20°C).

$$P_{filling} = P_{standard} \cdot \frac{F_{required}}{F_{standard}}$$

$$F_{required} = 2700 \text{ lbF}$$

In the table for the TU 1500 the following values can be found:

$$P_{standard} = 2175 \text{ psi}$$
$$F_{standard} = 3370 \text{ lbF}$$

The filling pressure that should be used will then be:

$$P_{filling} = 2175 \cdot \left[\frac{2700}{3370}\right] = 1750 \text{ psi}$$

A gas pressure of 1750 psi will give the desired initial force of 2700 lbF.

The standard initial force, $F_{standard}$ and the standard filling pressure at 20°C are given for each model in the catalog.

ISOTHERMIC FORCE INCREASE

As the gas spring is compressed, the gas pressure in the spring will rise, resulting in an increased gas spring force. The gas pressure increase (and force increase) is determined by the gas laws.

THE IDEAL GAS LAW

Formula 3

$$p \cdot V = n \cdot R \cdot T$$

p (bar) **= gas pressure**
V (l) **= gas volume**
R (Nm/°K) **= constant = 8,314**
T (°K) **= temperature**
n (mole) **= molecular quantity**

For a closed system, as the gas spring, where the temperature is kept constant (isothermic process), this formula can be simplified to:

Formula 4

$$p \cdot V = \text{constant} \quad \text{(Boyle's law)}$$

Calculation of the gas pressure at a certain point of the stroke (S) can be done in the following way:

Formula 5

$$p_o \cdot V_o = p_s \cdot V_s$$

p_o (bar) **= initial pressure**
V_o (l) **= initial volume**
p_s (bar) **= pressure at stroke S**
V_s (l) **= volume at stroke S**

By combining this Formula 5 with Formula 1 the following Formula 6 can be derived to calculate the force at any position of the stroke.

Formula 6

$$F_s = F_{init,\ actual} \cdot \left[\frac{S_{nom}}{S_{nom} - S_{used} \cdot \left[1 - \frac{F_{init,\ nom}}{F_{end,\ nom}} \right]} \right]$$

F_s (lbF) = force at the used stroke S
$F_{init,actual}$ (lbF) = initial force at current filling pressure
S_{used} (mm) = used stroke
S_{nom} (mm) = nominal stroke for the spring
$F_{init,nom}$ (lbF) = nominal initial force of the spring
F_{end} (lbF) = force at full nominal stroke

$S_{nom,}$ $F_{init,nom}$ and $F_{end,nom}$ are given for each model in the catalog. If the force has not been changed (the filling pressure has not been modified), $F_{init,\ actual}$ will be the same as the $F_{init,\ nom}$ which is the value given in the catalog.

Note! All end forces stated in the catalog are the isothermic end forces.

Example 2

What is the spring force of a TU 1500-100 when compressing the spring 80 mm?

$$F_s = F_{init,\ nom} \cdot \left[\frac{S_{nom}}{S_{nom} - S_{used} \cdot \left[1 - \frac{F_{init,\ nom}}{F_{end,\ nom}} \right]} \right]$$

S_{used} = 80 mm

The table for the TU 1500 (see page 2.8/2) will give the following values:

$F_{init,\ actual}$ = 3370 lbF
S_{nom} = 100 mm
$F_{init,\ nom}$ = 3370 lbF
$F_{end,\ nom}$ = 5170 lbF

$$F_s = 3370 \cdot \left[\frac{100}{100 - 80 \cdot \left[- \frac{3370}{5170} \right]} \right]$$

F_s (80mm) = 4680 lbF

If the temperature of the gas spring is kept constant (isothermic process), the spring will give a force of 20800 N when compressed 80 mm.

POLYTROPHIC FORCE INCREASE

For most applications the temperature inside the gas spring will not stay constant during the stroke. For these applications the following formula should be used to calculate the "true" force increase (polytrophic).

Formula 7

$$F_s = F_{init,\ actual} \cdot \left[\frac{S_{nom}}{S_{nom} - S_{used} \cdot \left[- \frac{F_{init,\ nom}}{F_{end,\ nom}} \right]} \right]^n$$

Where **n** is called polytropic exponent.

Depending on how fast the gas spring is compressed and the initial gas pressure, the n-value will be between 1 and 1.55. For a normal application in a press tool and a filling pressure of 150 bar a n-value of 1.4 could be used.

$S_{nom,}$ $F_{init,nom}$ and $F_{end,nom}$ are given for each model in the catalog. If the force has not been changed (the filling pressure has not been modified), $F_{init,\ actual}$ will be the same as the $F_{init,\ nom}$ which is the value given in the catalog.

Note! All end forces stated in the catalog are the isothermic end forces.

Example 3

What is the "polytrophic" end force of a TU 1500-100, when using a stroke of 80 mm in a "normal" press application?

Formula 7

$$F_{s,\ polytrophic} = F_{init,\ actual} \cdot \left[\frac{S_{nom}}{S_{nom} - S_{used} \cdot \left[1 - \frac{F_{init,nom}}{F_{end,\ nom}} \right]} \right]^n$$

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$F_{init, actual}$ = 3370 N
S_{nom} = 100 mm
S_{used} = 80 mm
$F_{end,nom}$ = 5170 lbF
$F_{init,nom}$ = 3370 lbF
n = 1.4 ("normal press application")

$$F_{s, polytrophic}(80\ mm) = 3370 \cdot \left[\frac{100}{100 - 80 \cdot \left[1 - \frac{3370}{5170}\right]}\right]^{1.4}$$

= 5330 lbF

INITIAL FORCE DEPENDING ON TEMPERATURE

The temperature in the gas affects the pressure in, and the force of the gas spring. The forces given in the catalog are based on a temperature of 20°C. Using the same basic Formula 3 as above, the pressure and force at other temperatures can be calculated as follows:

Formula 8

$$\frac{p_0}{T_0} = \frac{p_1}{T_1}$$

T_0 (°K) = Reference temperature

T_1 (°K) = Gas spring temperature

Formula 9

$$p_1 = p_0 \cdot \frac{T_1}{T_0}$$

As the force is proportional to the pressure, it can also be written as:

Formula 10

$$F_1 = F_0 \cdot \frac{T_1}{T_0}$$

Example 4

A gas spring with a initial force of 3370 lbF at 20°C is used in such a way that the gas spring temperature is increased to 60°C. What initial force will the spring have at 60°C?

Solution using Formula 10

$$F_1 = F_0 \cdot \frac{T_1}{T_0}$$

F_0 = 3370 lbF
T_1 = 273 + 60°C = 333°K
T_0 = 273 + 20°C = 293°K

$$F_1 = 3370 \cdot \frac{333}{293} = 3820\ lbF$$