Camloc
Motion Control

Understanding The Basics:

How do gas struts work?

Summary

An explanation of what a gas strut is, it's component parts, how they are constructed and operate. It gives the reader a understanding of the fundamental workings and terminology used when specifying gas springs. This paper provides the knowledge that is useful in later technical papers that deal with guidelines for different mounting positions on applications. This further helps with understanding the differences in orientation and damping effects that are to be expected based upon the chosen mounting position.

1.0 Introduction to Gas Struts

1.01 What is a Gas Spring?

The basic principle of a gas spring (or strut) is the same as for a mechanical coil spring; it is a device for storing energy. However, rather than straining the material that makes up the coil spring, a gas spring stores energy by compressing the Nitrogen gas contained inside.

1.02 How Does a Gas Spring Operate?

Although it looks similar to a pneumatic or hydraulic cylinder a gas spring differs in that it does not require an external energy source to create movement. A gas spring is a closed system and once manufactured and charged with inert Nitrogen gas no further gas is introduced to the system for it to operate.

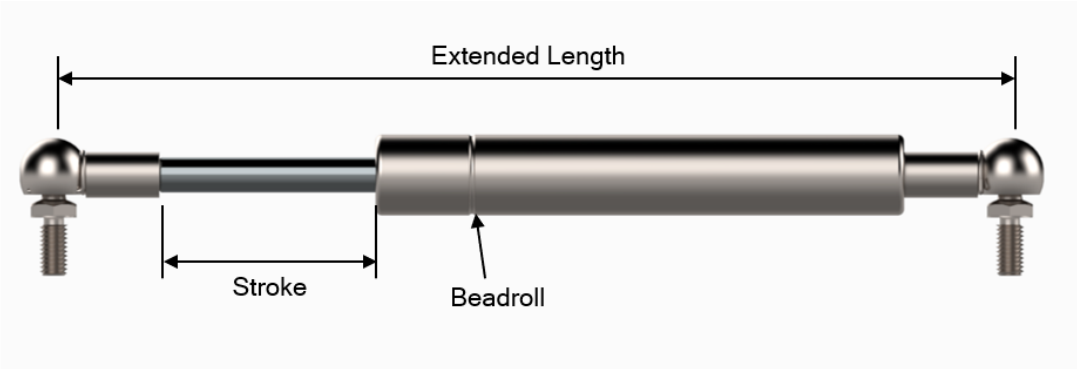
With a gas spring the pressure on either side of the piston remains equal whether it's fully extended or fully closed, this again is different to a hydraulic or pneumatic cylinder that requires a pressure differential across the piston in order to move.

So, how does it work if no further gas is introduced, and the internal pressure remains equal? The reason the gas strut extends is due to the difference in cross-sectional area of the rod where the gas is unable to exert any pressure. It is the difference between the Nitrogen gas pressure acting on the internal face of the rod, and the atmospheric pressure acting on the external end of the rod that causes it to extend.

As the rod is pushed into the tube the available volume is reduced, the gas is further compressed, and the internal pressure increases. This compression creates the spring like behaviour. An orifice in the piston attached to the rod allows the flow of gas across the piston and controls the extension speed.

2.0 Gas Spring Terminology

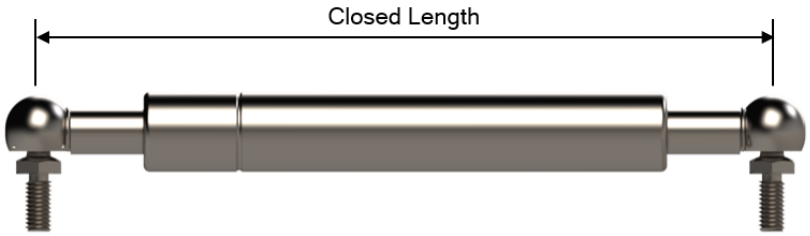
Stroke - The maximum amount of distance the rod can travel from closed length to extended length.



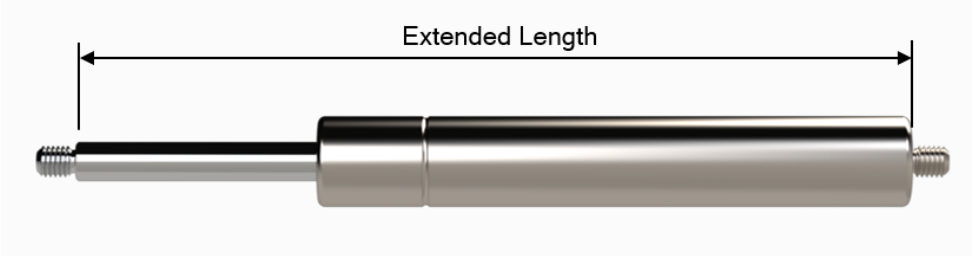
Extended length – The total length of the gas spring measured from the centre to centre of the end fits when the spring is fully extended.

Beadroll – The beadroll is the grooved section of the tube. This feature is used to retain the sealing components and to provide a physical stop at maximum extension preventing damage to the seals.

Closed Length – The total closed length measured from the centre to centre of the end fits when the spring is fully compressed.



Where no end fits are used - The measurements for closed and extended length will refer to the length from rod end to tube end (excluding threads).



3.0 Construction of a Gas Spring

Gas springs consist of multiple components, each with a dependency on the other. To ensure maximum longevity and safe operation the interaction of all these components must be understood and considered by the manufacturer.

3.01 Rod

Rods are manufactured from either precision ground carbon or stainless steel and the surface is treated to improve wear and corrosion resistance. As a rule, the rod will always be longer than the stroke of the spring and shorter than the length of the tube.

Carbon steel can be treated using chrome-plating or nitriding. Camloc carbon steel rods use a nitrided surface treatment as this has several advantages including:

- Better wear resistance
- Lower frictional characteristics
- Corrosion resistance equivalent to some stainless steels

3.02 Tube

The gas spring tube is manufactured from high-integrity, powder coated, carbon or stainless steel seamless welded tube suitable for high pressures.

The internal surface finish and tensile strength of the tube are critical for the gas struts longevity and burst pressure performance.

3.03 Guide and Seal Package

The guide and seal package provides a bearing surface for the rod and prevents the escape of gas and ingress of contamination.

Although typically manufactured from plastic composite, guides can be manufactured from zinc, brass or other materials where a suitable bearing sleeve has been incorporated. Rubber is used as standard for the sealing components.

3.04 Piston Assembly

Manufactured from zinc, aluminium or plastic the piston assembly controls the velocity of the spring as it extends and compresses throughout it's stroke, it also prevents the rod from being expelled from the spring. For safety reasons the attachment strength of the piston to rod is a critical consideration.

3.05 End Plug

The end plug is used to seal the tube end of the gas spring and is where the tube end fitting attaches. In the case of Camloc Gas Springs the end plug is also where the Vari-Lift valve can be incorporated. The Vari-Lift valve allows the release of the Nitrogen gas from the spring, which reduces the gas spring force. This feature is useful in allowing the gas springs to be fine-tuned to the application.

3.06 Nitrogen Gas Charge

Nitrogen is used inside gas springs as it is inert and non-flammable and therefore does not react with any of the internal components. Gas struts can be charged with pressures up to 200 bar.

3.07 Oil

The oil provides lubrication for the seals and internal components, it also provides the damping effect at the end of the struts stroke.

4.0 Force Terminology

Two terms that are frequently used when referring to gas struts are the static P1 force and the spring rate.

4.01 Static Force (P1)

The P1 static force is the industry standard term used to describe the force output of a gas spring, it should be clearly marked on the strut in Newtons (for example 300N). It is measured by compressing the spring 10mm, allowing it to extend to 5mm from full extension and taken after a 5 second dwell.

4.02 Spring Rate

This term is often used in the same way it'd be used to describe a coil spring, it is the rate of change of force as the spring is extended and compressed. It is variously described as progression rate, P2/P1 ratio or k-factor.

5.0 De-gassing a Vari-Lift

When gas springs are used, hinge friction, perceived speed of action, the weight of the application and where the gas spring is positioned on the application will vary and have a bearing on calculations; this can lead to forces predicted prior to testing (theoretical forces) differing to those in reality.

Camloc's Vari-Lift valve allows the end-user to save time and effort by offering the ability to de-gas the strut whilst in position.

Gas springs fitted with the Vari-Lift valve are charged to their maximum force during manufacture. Using a standard 2mm Allen key, gas can be gradually released through the valve. To do this; insert the Allen key into the Vari-Lift valve found at the end of the tube and make a quarter-turn. Once gas can be heard, make a quarter-turn back to close the valve then check whether the application is running smoothly. If not, repeat the process.

Release of gas must be done on a gradual basis, to ensure too much is not released from the gas spring.

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Camloc Motion Control Ltd, design and manufacture engineered gas spring and damper solutions to the latest ISO 9001 industry standards.

We work closely with customers at every stage. From initial design through to product testing, manufacture and distribution, to ensure our products deliver precise movement control solutions to suit individual requirements.

Continuous investment in staff and the latest hardware keeps it at the forefront of the industry, ensuring we continuously adopt the latest manufacturing processes and successfully problem solve for our customers.

Utilising over 30 years of industry experience, Camloc delivers high quality products that cover a wide range of industry sectors.

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