

USE AN ENGINEERED APPROACH TO TAILOR A PERFECT STANDARD GAS SPRING FOR YOUR DESIGN

A GUIDE TO GAS SPRING DESIGN AND CUSTOMIZATION

When your machine design calls for an industrial gas spring, you'll find a wide range of standard, off-the-shelf products available from various manufacturers. But ordering a gas spring from a catalog comes with a lot of risks. Depending on your application, some degree of customization is necessary to ensure you have just the right gas spring for your assembly. There is a better way to optimize your selection. We recommend taking an engineered approach to adding gas springs to your design, using standard industrial gas springs as a starting point.

GOOD DATA DRIVES GAS SPRING SPECIFICATION AND PREVENTS UNINTENDED RESULTS

Standard gas springs are quick and easy to order. They're also relatively inexpensive provided they don't need troubleshooting upon receipt. However, customers may underestimate the amount of data they need to specify a gas spring. Furthermore, off-the-shelf gas springs commonly offer one of three choices of output force. Will one of those three forces be exactly right? Either way, customers may get unintended results.

If the factory-supplied output forces don't succeed, hoods or lids may open unexpectedly, or the spring might not support the mass it needs to move. Another concern with off-the-shelf gas springs: customer drawings fail to allow enough room in the installation for the spring. Or, the spring comes with the wrong end fittings. These situations often cause customers to spend unnecessary time trying different forces and modifying the assembly — and they still may not have the right gas spring for the job. All this trial-and-error inflates labor expenses, and the project suffers needless delays.

Unlike most standard gas springs, an engineered solution is, in essence, a premium custom part that the manufacturer typically adjusts to the specifications of the application. The added investment typically pays off via the time and labor cost savings that result when

the gas spring works to perfection. ACE Controls' customer support combines online tools and an attentive application engineering staff to assist in making the modifications necessary to ensure the standard gas spring works perfectly, including recommending the correct end fittings to make installation easier.

The following sections present an overview of industrial gas springs and the important factors to consider when creating the perfect design:

UNDERSTAND GAS SPRING OPERATION AND IDENTIFY ESSENTIAL APPLICATION PARAMETERS

Gas springs are a self-contained, force generating, maintenance-free cylinder. The body is pre-charged with nitrogen gas to provide a specific output force. The pressure is applied to the net piston and diameter area, which provides the output force in push-type gas springs. Except for a small increase in progression force as the piston rod is compressed, the piston provides a constant output force and controls the velocity by metering the gas through its orifice. Gas springs contain a small volume of oil to dampen, or cushion, the movement at the extreme end of travel when mounted with the piston rod facing downward. ACE industrial gas springs also include a field-accessible vent valve for the occasional custom installations where there may be a need to further reduce the force of a stock unit.



ACE stainless-steel locking gas springs enable this hygiene and toileting system for disabled children to reach 15-degree inclination angles to the front and rear.

LOOK AT THE DIFFERENT GAS SPRING TYPES

Depending on the application, designers can choose from many types of gas springs. Some common gas spring types and examples of typical uses include:

- **Push-type gas springs to lift and lower loads for diverse applications.** There's a wide range of push-type gas springs to suit devices that lift or lower loads with easy control and minimal exertion. Push-type gas springs support covers and lids in a broad range of industries like automation and machine building, medical technology, electronics, automotive and furniture.
- **Pull-type gas springs to fit constrained spaces.** This type of gas spring is compact and can mount in any orientation and position. Unlike standard push-type gas springs, the gas pressure in the cylinder retracts the piston rod. ACE Controls offers pull-type gas springs with a very low progression rate and an adjustment valve to control the traction force. Pull-type gas springs are used in various industrial applications as well as medical devices, electronics and furniture.
- **Locking gas springs to hold a position.** Chair-type applications often need to maintain a certain position to support the end user. For example, when a person triggers a chair into motion by pressing a button or lever, a piston valve opens to extend the spring to move the seat to a desired position. When the user triggers the seat again, the valve closes to lock the piston rod, and thus the chair, into position. ACE Controls locking gas springs have been successfully customized, for example, to create lockable inclination angles for mobility systems for disabled children and young adults.
- **Rust-inhibiting gas springs protect against corrosion.** Gas spring vendors can offer rust-inhibiting versions of their standard models to protect against corrosion in food or hygienically sensitive areas like clean rooms. ACE Controls offers standard gas springs with an advanced UV coating or 303 or 316 VA stainless steel outer bodies that can also be filled with food-grade oil, conforming to FDA 21 CFR 178.3570 which regulates incidental food contact.

ESSENTIAL DATA FOR SPECIFYING A GAS SPRING

To obtain the optimum operation from an off-the-shelf gas spring, it's important to identify the following parameters as you begin the selection process. Sometimes mistakes happen here, but the right gas spring manufacturer can provide the tools and engineering support to help designers get started.

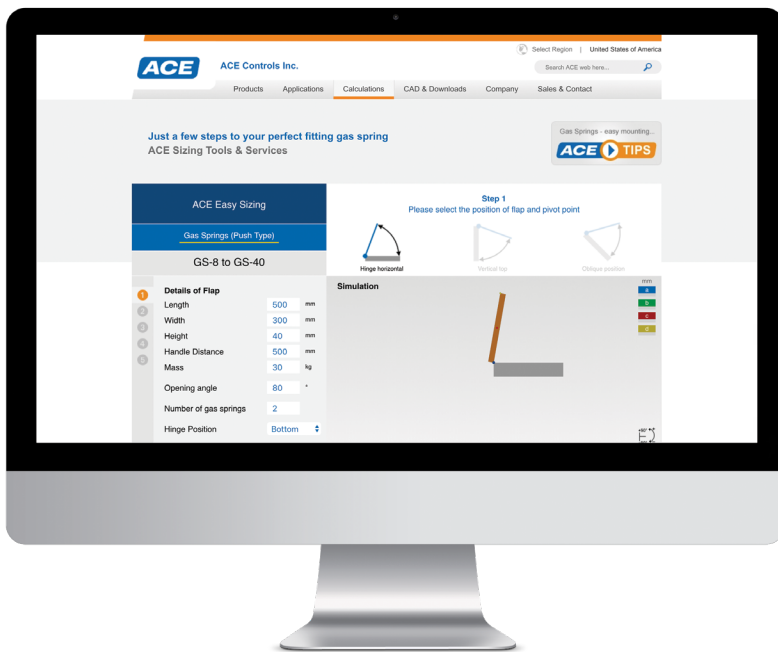
- **Size and weight.** Know the dimensions and weight of the object being moved. For best results, use a spring scale to determine its weight.
- **Orientation.** The body of the gas spring must fit within the confines of the assembly without constraining its motion.
- **Pivot point.** Top, middle or bottom.
- **Point of lifting.** The point where the user will push or pull to move the load.
- **Starting angle and finishing angle.** The angle of the load before the spring initiates its travel and the angle of the load when the spring ends its travel, respectively.
- **Hand force.** The amount of force the user needs to apply to move the mass. An application engineer can help determine the necessary hand force for different angles of movement throughout the complete motion of the load.
- **Extension force.** Gas springs apply forces to counterbalance the weight of the load or hood being moved. Designers can choose the amount of pure nitrogen inside the spring that pushes the piston head and gives it the necessary extension force to move the load. ACE Controls' Online Calculation software can help customers find a good balance of the forces the gas spring will need to apply in relation to its load.
- **Center of gravity.** Understanding how the geometry and weight of the load are all affected by gravity is critical when determining: where to mount the gas spring, how much force is needed to counterbalance the weight of the load and where to reach that perfect balance. When gas springs are mounted with their center of gravity close to the pivot, their operation is easier to predict.

- **Stroke length.** This refers to the distance the load must move. Make sure the gas spring can manage the overall force in the installation. Gas spring vendors' product data can show how different forces interact with stroke and how much force a specific stroke length can handle.
- **Mounting.** How the gas spring is mounted will determine the degree of the load's opening angle and the distance the gas spring will need to move the load, which is commonly known as stroke. For example, linear applications will have a straight stroke. You will need to know the dimensions of the load and account for any equipment or obstructions nearby that could otherwise affect the mounting location.
- **Materials.** Since most gas springs will find use in relatively benign indoor environments, standard gas springs are usually made of carbon steel. However, there may be situations where customers may opt for rust-inhibiting materials or UV coatings such as for use in saltwater environments or food and medical industry applications.
- **Ambient Temperature.** This refers to the gas spring's operating environment.

PROTOTYPING AND ADJUSTING GAS SPRINGS TO PRECISE REQUIREMENTS

Depending on how much data you know about the intended installation to determine the right gas spring design, partnering with a gas spring vendor that can offer various resources to work on a prototype can save you time, money and effort. Designers who choose ACE Controls can take advantage of a multi-pronged approach to achieve an optimal gas spring installation every time:

- **Video tips.** ACE Controls' YouTube channel is an excellent resource for gas spring information. In addition to application examples and product information, the channel includes several ACE TIPS videos that provide gas spring selection and installation tips like sizing a gas spring, correct mounting techniques, and how to use an ACE Controls DE-GAS adjustment valve to ensure you have just the right amount of nitrogen gas in the chamber.
- **Online Calculation software.** Before buying an ACE Industrial gas spring, customers use ACE's Online Calculation software. (www.acecontrols.com/us/calculations/motion-control/gasspring-online-calculation.html). Simply input the dimensions of the object you're moving, along with its weight, handle distance, opening angle, hinge position and pivot point. 2D and 3D modeling simulates the assembly. After a customer chooses the right gas spring, the tool estimates the amount of nitrogen needed to fill it.



ACE Controls' Online Calculation software uses 3D simulation to help customers select the perfect gas spring in just a few steps.

Based on the drawing you calculated in the online software, you can test the gas spring's performance in your own facility. If the gas spring does not perform as expected, an ACE Controls application engineer can help calculate the right force for the assembly or make any change to the spring to achieve the ideal performance. ACE Controls is also one of just a few gas spring manufacturers that includes adjustment valves on the back end of the body so customers can bleed off some of the nitrogen gas. If the spring is already installed, simply remove one of the end fittings to bleed the gas if necessary. Or, if the spring has too much extension force, send it back for additional nitrogen.

- **Talk to an application engineer.** Sometimes customers do not have all the information available to properly size the gas spring. ACE application engineers can estimate the stroke the customer needs in order to help them select from the wide range of standard body sizes and stroke lengths. The customer quickly receives a fully charged gas spring with an ACE DE-GAS actuating valve to bleed off the nitrogen to the desired performance.

Regardless of where a customer begins the process, ACE Controls application engineers will help them get the performance they want. When the spring functions exactly as desired, ACE will test the gas spring, measure it and record the proper nitrogen pressure and other specifications. This comprehensive prototyping support takes all the complications out of specifying the gas spring for the design, eliminating the guesswork and headaches like moving mounting points around — factors that can hold up a project or production run. Designers will be sure they'll have the exact gas spring every time they place an order for that application in the future, thereby saving time and labor costs to improve the bottom line.

PROPER MOUNTING ENSURES OPTIMAL OPERATION

The first thing to remember when mounting a gas spring is to make sure the spring fits within the system. The general tolerance for fitting the gas spring is ± 0.08 inches, but it may vary depending on the spring's size and extension force. Therefore, make sure this data complies to the spring manufacturer's tolerance criteria before installation. If your application places very high demands on the durability and stability of the gas spring, ACE Controls does not recommend combining a small diameter body with long stroke length and a high force.



ACE Controls' DE-GAS NEWTONLINE gas springs include an adjustment valve so users can turn an adjuster knob to bleed nitrogen gas at their facility and achieve the right amount of pressure.

Proper alignment is also crucial for preventing side loads that can damage gas spring elements like the seal or piston rod. In addition to following these mounting practices, consider end fittings with a swivel eyelet or an angle ball joint, which help address minor side loads. An application engineer can recommend the best mounting strategy and end fitting option to alleviate side load risks.

Finally, gas springs should be installed with the piston rod downwards. As a gas spring nears full extension and the piston rod reaches the bottom, it travels through a small oil chamber which provides some end damping to soften the motion. The chamber helps keep the seal lubricated to extend the life of the gas spring, and it allows for alternative mounting opportunities.

CUSTOMIZING GAS SPRINGS

ACE Controls can help you adjust a standard gas spring to suit almost any assembly, and our application engineers can also provide the following modifications to optimize a custom unit, depending on the application:

- **When you need to adjust the force resistance.** Sometimes, modifications are necessary to ensure the user experiences smooth, even motion throughout the stroke. Often, changing to a different-size piston rod can provide greater or lesser force resistance. For instance, adding a larger piston rod to a cylinder with a smaller body volume can raise the progression value — the force difference between two different rod positions — while using a slightly smaller rod than offered in the standard size may help to lower it.
- **When you need to change the extension speed.** Manufacturers can adjust the orifice and piston head.
- **When you need to change the stroke length.** If a required stroke length is in between those provided by the off-the-shelf gas spring, the rod can be cut to an ideal length.
- **When you need a gas spring to operate in extreme temperatures.** Gas spring vendors can manufacture springs from certain grades of steel capable of enduring harsh temperatures.

MAXIMIZE AND PROTECT YOUR GAS SPRING INVESTMENT

Because gas springs function in demanding applications across various industries, consider the following accessories to maximize your investment.

- **To maintain cleanliness.** Rod wipers attach to the rod to keep it clean as well as protect it from debris or caustic fluids.
- **Where safety is a concern.** Locking tubes prevent your lids, gates or covers from closing accidentally. These devices lock in the spring's extended position and eliminate the need for a support rod.
- **To make mounting easy and versatile.** ACE Controls is one of just a few gas spring manufacturers that offer interchangeable end fittings made of steel.

FROM OFF-THE-SHELF TO PERFECT MATCH

Selecting and installing an off-the-shelf gas spring is often an inexact and time consuming process. While standard gas springs can provide an initially quick and inexpensive purchase, a lot can go wrong during sizing and, ultimately, implementation. That's why it pays to choose your standard gas spring from a manufacturer that provides a multifaceted, engineered approach that includes online selection and implementation resources along with application engineers that can work through the data requirements and provide the tools, adjustments and accessories to match it perfectly. An engineered approach means you'll only need to drill four holes, place the order and install the springs. You'll also have the right calculations for future orders, so you'll always save time, effort and money.

To begin sizing the perfect gas spring for your application, check out ACE Controls' Online Calculation software at www.acecontrols.com/us/calculations/motion-control/gasspring-online-calculation.html.