Dashpots

Dashpots defined

What is a dashpot?

A dashpot is a motion damping device that reduces velocity, vibration, and oscillation in dynamic mechanisms. This is accomplished by using a piston to force ambient air through an orifice at a controlled rate to dissipate kinetic energy

Dashpots/shock absorbers:

We identify configurations in which the piston rod is attached to the load being damped as dashpots.

We identify configurations in which the piston rod is struck by, but not attached to the load, as shock absorbers.

These are motion damping devices that reduces velocity, vibration, and oscillation in dynamic mechanisms. This is accomplished by using a piston to force ambient air through an orifice at a controlled rate to dissipate kinetic energy.

The benefits of a Dashpot or shock absorber:

- It prevents damage and violent or inaccurate response caused by shock and vibration in sensitive equipment
- It reduces impact noise and wear
- It provides simple, low cost, adjustable speed control without external power
- It provides non-electrical timing capability

Why chose one of our dashpots/shock absorbers over other damping devices?

- It has unparalleled low friction, responds to forces as low as only a few grams, and its smooth
- Starting and running friction are almost identical which prevents jerky, uncontrolled starts
- It has a life span of multi-millions of cycles
- No seals are required and there are no liquids to leak
- It is made of self lubricating materials
- It's precise and accurate, easily adjustable over a 10,000 to one range, and it allows fine adjustments at installation
- They can operate at extreme temperatures
- The piston and cylinder will not rust, corrode or deteriorate over time
- It's lightweight
- They can be easily customised to suit space availability and special performance requirements

Actuators

Actuators have many of the same features of the above dashpots, but rather than damping the force, Actuators provide the force/movement in an application.

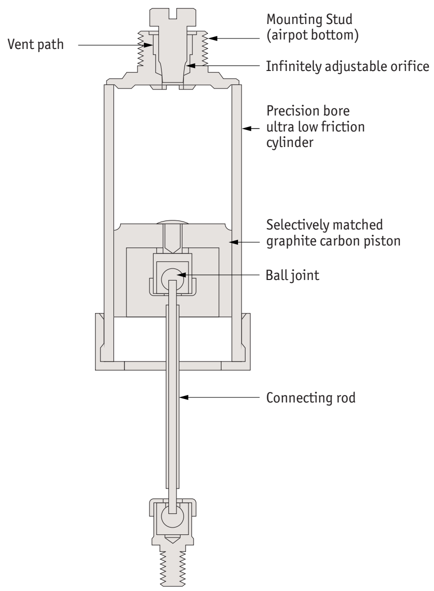
What type of applications benefit most from these special capabilities?

Any kind where these conditions are present:

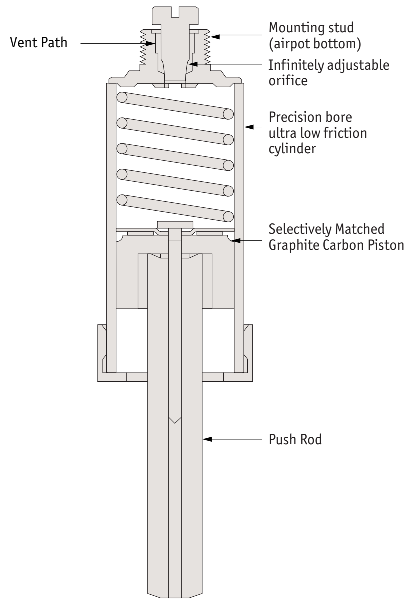
- Where smooth, near friction-free motion is critical
- Where responsiveness to low forces/ low kinetic energy levels is required
- Where equipment is sensitive and precise
- Where clean operation is important
- Where cycle rates are high or life span needs to be long
- Where reliability is critical
- Where temperatures are extreme or environments are humid
- Where high quality is a product feature
- Where non-electrical motion control is advantageous

How they work

All our damping devices are dashpots generically, but for ease of discussion, we identify configurations in which the piston rod is attached to the load being damped as dashpots. We identify configurations in which the piston rod is struck by — but not attached to the load — as shock absorbers or snubbers. Either term is acceptable.



Dashpot



Shock Absorber (snubber)

Dashpots

The materials we use

Whether it's a dashpot or a shock absorber, the materials we use are chosen for inherent lubricity, high strength-to-weight ratio, excellent stability under temperature and humidity extremes, close coefficients of thermal expansion, and non-deteriorating performance due to age or non-use.

The component parts:

- Graphitized carbon piston, precision ground to millionths of an inch TIR
- Annealed, borosilicate glass cylinder. Precision fire-polished bore

Damping direction control

One Way Damping (push or pull)

In dashpot configurations, the piston is attached to the connecting rod by a low friction ball joint or pin link. Depending on the dashpot model, the ball joint will house an internal ball check valve or it will be riveted to a flexible flap valve which is externally mounted on the piston face. Any force applied to the connecting rod which can move the piston will cause air to flow through the piston's ball check or flap valve with no appreciable restriction (no damping) in one direction and will cause the valve to close in the opposite (desired damping) direction. Damping in the compression direction is referred to as push damping. Damping in the extension direction is referred to as pull damping (see dashpot illustration).

In the shock absorber configuration, the flexible flap valve is used, and damping is only available in the push direction. Since the push rod is not connected to the load, a low force return spring is provided in the cylinder to reset the piston for the next cycle (see shock absorber illustration).

Two way damping (unit damps in both directions.)

The ball joint rod connection contains no check valve and therefore does not allow air flow through the piston. This results in approximately equal resistance to motion (damping) in both directions. Two way damping is generally not appropriate for the shock absorber configuration.

Damping rate control

Two methods are available to control the amount of damping:

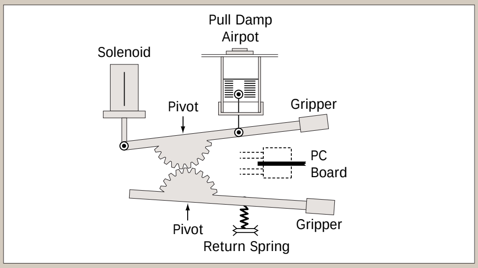
Adjustable orifice

Allows the level of damping to be controlled by hand using either a screwdriver or adjustment screw. These are the most popular type where forces or energy levels can vary or are only approximately known.

Fixed orifice

These can be set at a pre-defined dumping rate at the factory and are tamper proof.

Velocity control of solenoids



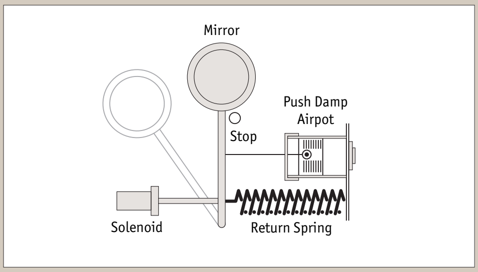
It is often desirable to slow a solenoid down to avoid a crash or high impact on closure. The dashpot tunes the solenoid to obtain the fastest motion possible without noisy impact or damage to components.

In electronics assembly equipment (as shown above) a pull damping dashpot controls a solenoid which positions the grippers. The dashpot significantly reduces gripper impact.

In automatic diagnostic equipment it controls the travel of solenoid actuated dispensers and positioners as samples move from one station to another.

In silicon wafer transport mechanisms it prevents bounce and overshoot as solenoids lift wafers into position.

Velocity control of spring loaded mechanism



Springs provide motive force to a mass at the expense of continuously increasing velocity. Dashpot damping develops an opposing force to limit this velocity to a desired value.

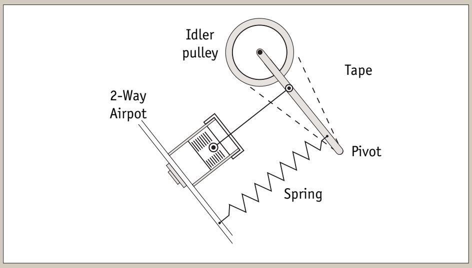
In laser equipment (as shown below left), a push damp dashpot controls a mirror as it swings into position.
The dashpot damping increases as the mirror approaches a stop, allowing rapid positive positioning without loud noise or impact damage.

In automatic mailing and addressing equipment it regulates the positioning mechanisms and feed roller pressure.

In spring loaded doors, x-y slides, and tape cartridge carriers it prevents damage on release.

Dashpots

Vibration damping

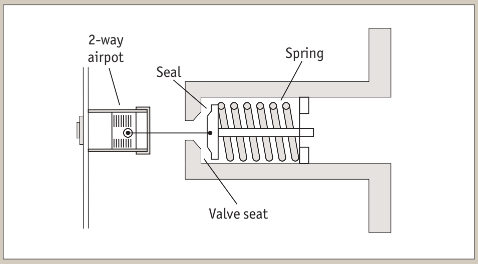


Dashpot damping is one of the simplest ways of eliminating vibration. The dashpot provides a high ratio of damping-to-friction force.

In magnetic tape duplicators (as shown above), a two-way damping dashpot significantly reduces idler arm vibration caused by stiction or take-up drive pulsation. The idler can still move freely to accommodate changes in the loop profile. Using a dashpot also improves the response during start-up acceleration.

In high speed fibre optic filament, wire, and textile winders, a dashpot is ideal where oscillation of tension idlers can cause broken filaments.

Oscillating valve damping



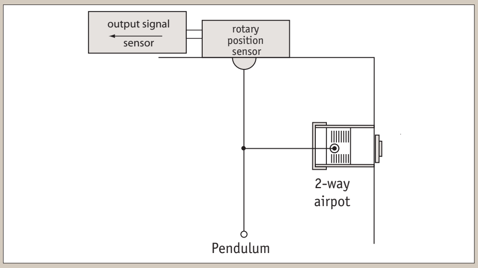
Poppet and check valves can naturally resonate, causing unwanted noise, pressure/flow fluctuations, or wear. These problems can be eliminated by precise damping.

In pneumatic valves (as shown above), a dashpot reduces the amplitude of oscillation without affecting the cracking pressure or positioning of the poppet. With dashpot's low mass, virtually frictionless motion, and minimal air spring at low forces, the steadystate positioning of the poppet is essentially unaffected by the dashpot.

In a vacuum regulator it improves regulation and eliminates noise caused by the oscillating poppet striking the valve seat.

In a patient ventilator it damps the check valve to eliminate downstream pressure fluctuations.

Limiting overaction

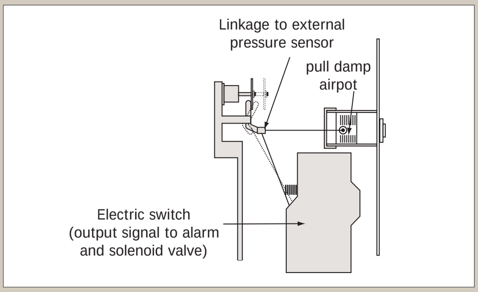


Many instruments are susceptible to random pulses and surges, which can lead to harmful, over-range conditions. The dashpot is velocity sensitive and resists these surges, providing more consistent operating conditions and preventing damage.

In sensitive, tilt-sensing instruments, a two-way damping dashpot prevents the pendulum from reacting violently to sudden changes, stabilising it but allowing it to move smoothly with angular change. In sensitive scales, dashpots protect against loading shock without interfering with measurement.

In magnetic tape handling equipment, dubbers, motion picture projectors, and film duplicators dashpots provide protection where high speed stop and start can lead to overshoot, fouling, and backlash.

Creating time delay



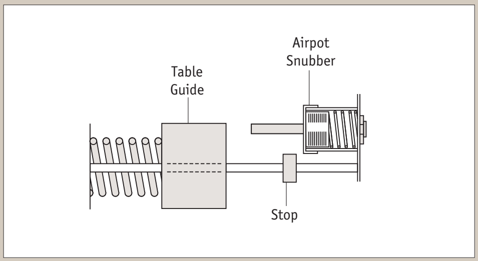
Dashpot offers reliable timing control for non-electrical systems and for electrical systems requiring non-electrical backup. In a commercial sprinkler system a pull damping dashpot times a switch (as shown above) which actuates a solenoid valve in response to ambient conditions. The time delay prevents short term, non-threatening signals from actuating the sprinklers, while allowing actuation if the signal persists beyond the desired time.

In refrigerator ice dispensers an dashpot slows closure of the spring loaded ice chute doors. In beverage vending machines it controls descent of filling compartment access doors.

Dashpots

Basic principles and applications

Cushioning impact

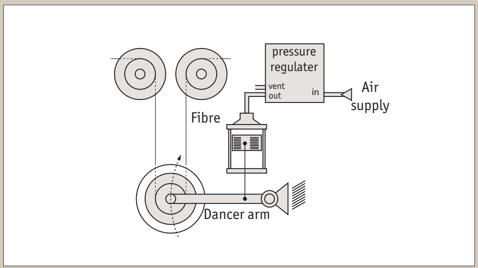


When controlled deceleration is required at the end of the stroke of your mechanism, the Springfix shock absorber configuration is particularly useful. It performs push damping only and the push rod is not connected to the work.

In office copiers (as above), an Springfix shock absorber damps the lens carriage at the end of its return stroke. Because of this controlled deceleration, impact noise and bounce are prevented, permitting faster machine operation. The shock absorber return spring quickly resets the piston for the next cycle.

In semi-conductor wafer transport mechanisms, it dampens firm positioning against hard stops.

Pneumatic actuation – pressure or vacuum

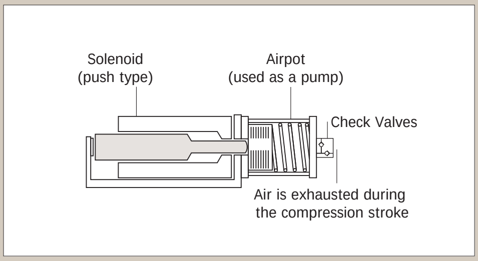


Using a threaded port in place of the adjustable oriface, the dashpot is capable of acting as a pneumatic actuator, providing smooth precise positioning.

In high speed filament winders (as shown above), Springfix actuators are part of a force control system to maintain proper filament tension. The ultra-low friction actuators provide precise, hysteresis-free force control in response to small pressure or vacuum changes directed by the controller.

In automatic assembly and semiconductor equipment, it smoothly dispenses and positions parts.

Designing your own pumping, pressure sensing, and flow measurement devices



Innovative customers have taken advantage of the special properties provided by the Springfix piston and cylinder combination to produce pumping and pressure handling devices of their own design.

For example, fitted with a hose barb, the Springfix cylinder/piston assembly can be connected to a motor or solenoid (as shown above) and used to pump air. Its low friction and inherent lubricity reduce power requirements and concerns about contamination from lubricants.

Used as a pressure sensor or flow indicator, the inherently low friction allows response to extremely low pressures and small pressure changes. The piston can provide a mechanical output, and the glass cylinder allows visible indication of piston position changes. Piston/cylinder sets can be purchased for these purposes and Springfix application engineers are available to assist customers who have these special needs.

Model selection is based on the following criteria:

Force

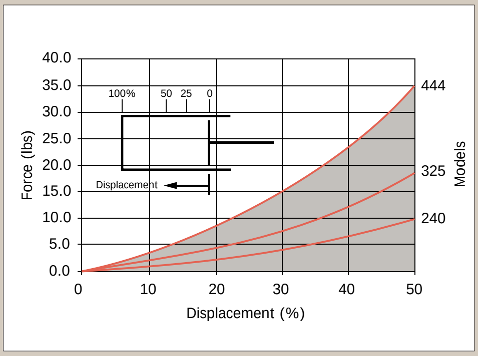
The primary consideration for dashpot configurations and all applications involving vibration, time delay, and velocity control.

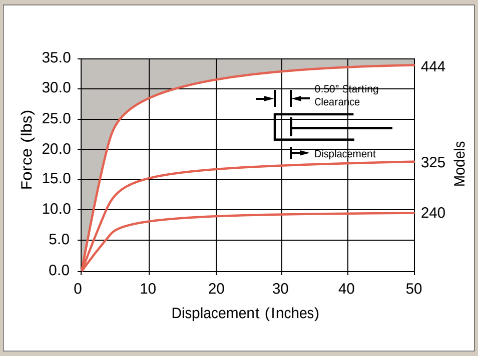
Limits based on damping direction. Force always relates to the net load which is pushing or pulling on the dashpot. Typically, force will dictate the unit's size when the dashpot is used in the configuration.

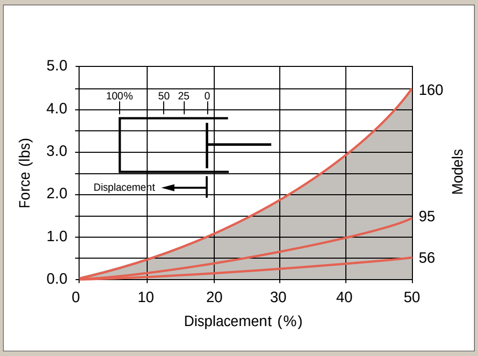
At rest, the dashpot is a passive device and has no force output. In motion, the dashpot offers a resisting force which rises to equal the force of the input load, achieving a zero net force. This results in zero acceleration and constant velocity.

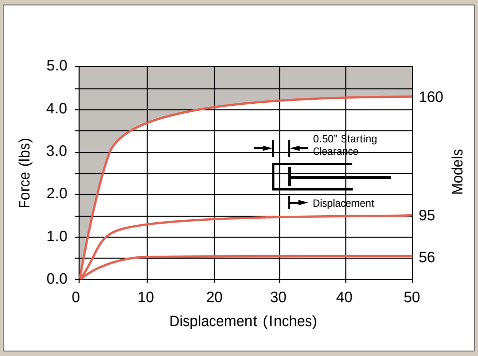
Force limits of Springfix dashpots are determined by the direction of damping and the diameter of the piston.

In pull damping units, a vacuum is being created in the dashpot as the piston moves outward. Thus, the maximum resisting force limit of the unit is a direct function of atmospheric pressure and the area of the piston (F=PA).









Dashpots

Selection guidelines

Energy

The main consideration for shock absorber configurations

Kinetic energy dictates the size requirement when the dashpot unit is to be used in the shock absorber (snubber) configuration.

Maximum energy handling capability is simply a function of the volume of air that is forced out of the dashpot on each cycle. Equal volumes of expelled air will handle equal amounts of energy. Therefore, small diameters with long strokes can equal the energy capability of larger diameters with short strokes. The only difference is the rate at which the energy is dissipated relative to each increment of stroke.

Damping coefficient

Use for time delay applications

Damping coefficient is almost always the primary determinant for applications where a specific time delay is required.

This is because the coefficient expresses time as it relates to stroke and force:

$$\text{Required Damping Coefficient} = \frac{\text{Force x Time}}{\text{Distance}}$$

Force equals the input to the dashpot, *Time* is the time delay desired of the dashpot, and *Distance* is the stroke used by the dashpot.

In the English system of units, the damping coefficient is expressed as:

$$\frac{\text{lbs} \bullet \text{s}}{\text{in}}$$

Often, it is written as:

$$\frac{\text{lbss}}{\text{in/s}}$$

We typically express this as “pounds per inch per second”.

This ratio expresses the dashpot’s resistance to motion, given the rate of air leak inherent in the dashpot. With a closed orifice, the dashpot’s leak becomes a function of clearance around the piston.

It is important to understand that the damping coefficient is a ratio, and the rating of any dashpot does not imply an absolute amount of force which the dashpot is capable of resisting.

For example, a rating of 50 lbs/in/sec does not mean that the dashpot can resist a 50 lb load. It only means that a one pound load would take 50 seconds to travel one inch, and a 5 pound load would take 10 seconds, and so forth. All computations must be scaled to accommodate the maximum force and stroke limitations of the dashpot model selected.

Damping direction

The choice of damping direction depends on several variables:

1. **Force or energy to be applied to the unit**
   Select a model whose diameter can provide the required force in the desired direction of damping. If this is a shock absorption application, determine the stroke/diameter combination that will provide the required energy capability.
2. **Space available for mounting the unit**
3. **Rate of force rise in the damping unit**
   Can the application tolerate some gradual force buildup (as in the compression direction), or must the resisting force be immediate (as in the pull direction)?
4. **Partial stroke damping**
   If damping is desired only at the beginning of the stroke, a pull damping unit with a port in the side of the cylinder will provide damping until the piston passes the port.

   If damping is needed only near the end of the stroke and the stroke is long, a push damping dashpot with a port in the side of the cylinder will provide damping only after the piston passes the port.

   If the stroke is long but damping is required only near the end, a shock absorber (snubber) configuration might be more suitable than the dashpot, since it does not have to be connected throughout the entire stroke of the mechanism being damped.

Orifice

Adjustable or non-adjustable

Non-adjustable units are more economical and less vulnerable to tampering than adjustable units. However, for a non-adjustable unit to be used, the application must be able to tolerate a range of damping variation from unit to unit. The degree of variation experienced will depend on the specific damping values required by the application and the diameter of the dashpot unit selected.

To evaluate the possibility of using a fixed orifice unit, the damping variation range acceptable in the application must first be determined empirically in functional tests.

Samples and specials

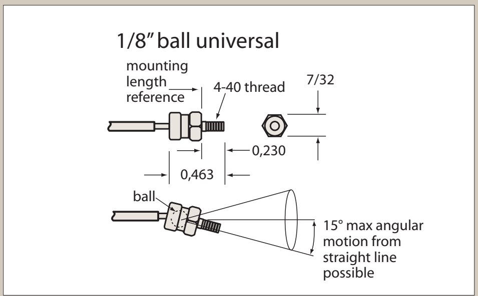
We can also supply just the cylinder/piston combinations should you wish to use the same technology but designed into your own application. We have a range of stock sizes but often design and produce specials to your individual requirements. Contact us with details of your application and we will advise you of the best solution.

The precision and response of our products are difficult to appreciate until you actually hold one in your hands, so we are offering a free sample. Contact us by either fax or email to request your free sample.

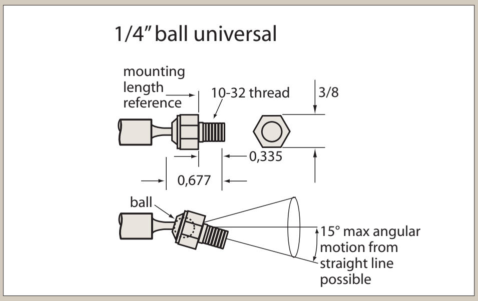
Dashpot rod end linkages

Linkages

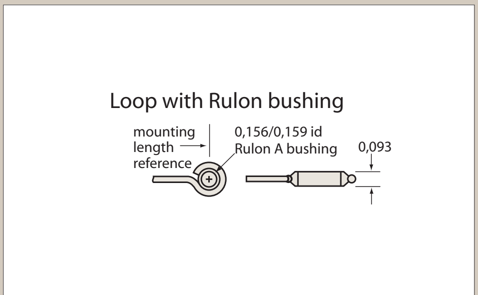
Technical drawings for the end linkages used on dashpots are on the following pages. Only certain end linkage options are available for each dashpot. Please check the product page for information as to which linkages are available.



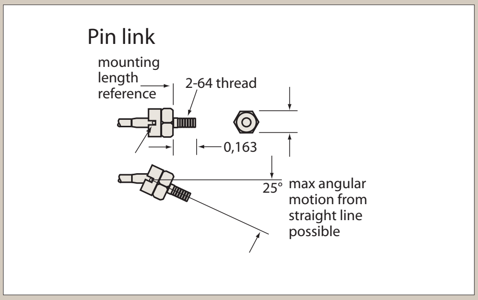
$^1/_8$ ball universal
with 4 - 40 thread.



$^1/_4$ ball universal
with 10 - 32 thread.



Loop with 0,156 id
removable rulon bushing.



Pin link with 2 - 64 thread

Not all rod end linkages are available on all dashpots. Rod end linkage available as stated on each individual product.