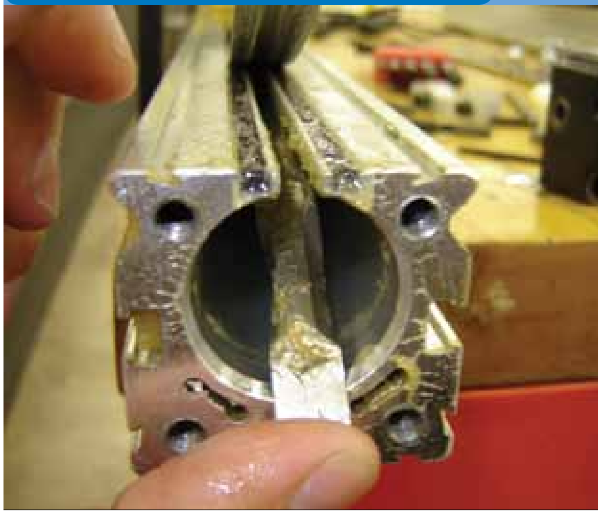
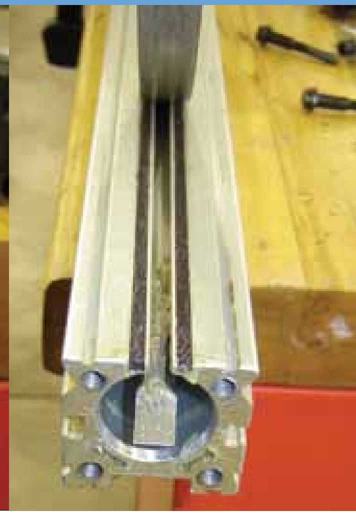
APPLICATION TIP

Product category: **Pneumatic Actuators**

Industry: Paper and Plastics





Problem:
Inoperable cushion seals and damaged sealing bands on band-type cylinder

Cause:
Inertia spikes and final velocity speeds exceeding actuator cushion capacities

Solution:
Application of external shock absorbers

Actuator internal cushions vs. external shock absorbers: Knowing when and how to use them is crucial for maximum actuator life.

Exceeding the capacity of the actuator's internal cushions can cause irreparable damage to the cushion seals and sealing bands.

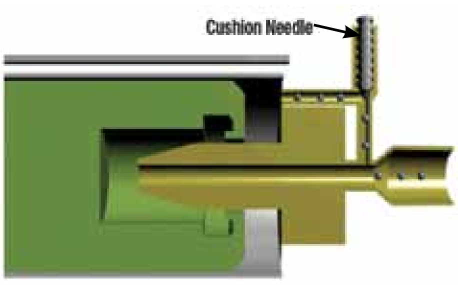
Tolomatic pneumatic band-type cylinders have been proven industry workhorses since they were first introduced back in 1985. It is an unusual circumstance to find an actuator that fails prematurely, particularly after an initial installation. Tolomatic went to the customer's facility to find out why.

A plastics container manufacturer was using a Tolomatic internal bearing style band cylinder to move a flying knife assembly across a piece of plastic film as rolls were released from the extruding machinery. The 10-pound flying knife assembly moves the full 101-inch stroke in 1.5 seconds every 45 minutes. Flow controls were being used with an air pressure rating of 40 psi. Most of the cylinders they employed failed during the first 100 strokes or less while others would run up to 6 months before needing to be replaced. The particular cylinder being analyzed had been running for two weeks when erratic behavior was noticeable. After inspecting the cylinder, it was determined that the actuator's internal cushions were rendered inoperable due to damaged seals. Removing the head from the actuator also revealed that the sealing band was bent and "cupped", a sign that an inertia spike was causing the damage.

The actuator's sealing band experienced cupping damage caused from inertia spikes.

To explain why this was happening we need to define how the actuator's internal cushions work.

The cushion's function is to slow the actuator's load at the end-of-stroke



The illustration above shows the cushion spear engaged into the cushion seal. The resulting compressed air is released by adjusting the cushion needle.

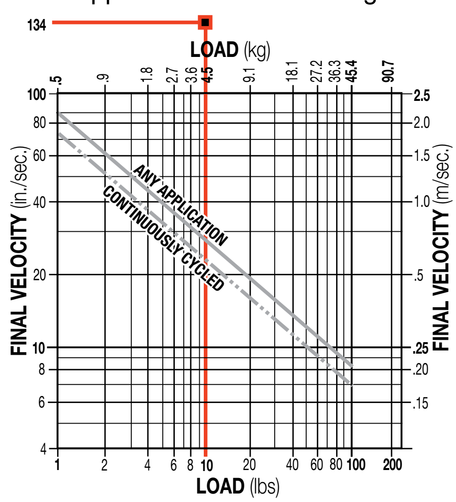
to avoid damage to the actuator seals, bearings, bands and head. The actuator's air cushions operate by trapping air at the end of the actuator stroke, when the cushion spear engages into the cushion seal. The trapped air is compressed by the inertia of the load and the rate at which it is allowed to exhaust is controlled by the actuator's cushion needle. Cushion needle adjustment should be done at installation (this is easily done with a screw driver) and cannot be preset at the factory because it is application dependant. Cushions should be adjusted so the load comes to a gradual and smooth stop at the end of stroke and there should be no "bouncing" motion present. Additional adjustments to the cushions may need to be done periodically during the life of the actuator.

In this installation, there were several factors that led to actuator failure. Although flow controls were being used, there were no initial adjustments made to the actuator's internal cushions at the time of installation. As a result, pressure built up at the end-of-stroke because the cushion needle was not allowing the pressure to exhaust. Pressure spikes resulted, causing damage to the seals and band. Once this occurs, the cushion becomes inoperable and air leaks from the sealing band.

It was also discovered that the final velocity of load in this application far exceeded the capacities of the actuator's internal cushions. When the load inertia is beyond the capability of the cushion, the resulting damage to the actuator is the same. Pressure increases at end-of-stroke and causes the same deformation to the band, breaking the seal and rendering the cushion inoperable.

The chart below shows the final velocity vs. load capacities of the actuator's internal cushions which is published in the product catalog. If the final velocity vs. load exceeds these rated values, external shock absorbers should be employed.

In this application we are moving 10



pounds, 101 inches in 1.5 sec. The distance we move and the speed at which the load is moved, creates a linear velocity. In other words, the farther the distance, the faster the speed. To determine what the final velocity is, we first have to determine the average velocity:

101 inches ÷ 1.5 sec = 67.3 in/sec.

The rule of thumb to determine final velocity is 2 times the average velocity:

67.3 x 2 = 134.6 in/sec

You can see from the chart, that 134 in/sec is off the chart for this product and will require external shock absorbers in order to stop the load properly. When employing external shock absorbers on a Tolomatic band cylinder the internal cushions must be removed and the shock should be aligned with the center of gravity of the load. Proper shock alignment eliminates additional moment loads which could cause damage to the actuator's bearing structures.

Once shocks were installed properly in this application, damage to the actuator was eliminated and the product performed flawlessly.

When designing in pneumatic actuators that are doing the work of carrying loads, don't forget to factor in how fast the load really ends up moving (final velocity) and if you have specified the right components (the actuator's internal cushions vs. external shock absorbers) in order to stop it.

Tolomatic has been a leading supplier of electric linear motion and pneumatic actuators for more than 50 years. Its product line includes electric linear and pneumatic actuators, servo-driven high-thrust actuators, servo and stepper motors, stepper drives and configured linear motion systems. Tolomatic also manufactures right-angle gear drives, caliper disc brakes and clutches.

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