Using the Firestone Airstroke® actuator/Airmount® isolator in shock impact applications

General Discussion

Air springs are frequently used in shock impact isolation applications. This air spring application is commonly found in saw mills as the means to both absorb the shock of a falling log, and then, by actuating the air spring, to lift the log onto a conveyor. Because of the properties of both air and rubber, the air spring is an ideal solution to this problem. Without it, the mechanism and surrounding structure would suffer fatigue and fail prematurely due to the intensity of the shock from the falling logs.

Sizing the air spring

To size the proper air spring, we need to know the amount of energy that will need to be absorbed. There are several ways to go about this calculation:

For a free falling mass without an initial velocity:

(Potential) Energy, PE = mgh (mass • gravity • height)

where the mg (mass • gravity) = the weight of the object in N
and h = the height in meters

This will provide you with the amount of energy that needs to be absorbed for a free falling mass with no initial velocity.

For a free falling mass with an initial velocity:

Add the amount of energy from the free fall and the energy from the initial energy:

(Potential + Kinetic) Energy, in lbs = mgh (mass • gravity • height) + $\frac{1}{2}mv^2$ ($\frac{1}{2}$ • mass • velocity^2)

where the mg (mass • gravity) = the weight of the object in N
and h = the height in meters

and where mass = in kg
and the velocity = v in meters per second

This will provide you with the amount of energy that needs to be absorbed for a free falling mass with an initial velocity.

Or if the velocity before impact is known:

Kinetic Energy, in lbs = $\frac{1}{2}mv^2$ ($\frac{1}{2}$ • mass • velocity^2)

and where mass = in kg
an the velocity = v in meters per second

This will provide you with the amount of energy that needs to be absorbed for a moving mass.

All of the above calculations will provide the same required information: the amount of energy needed to be absorbed.

The following configuration is recommended.

1. Use the air spring at 5.5 BAR restricted to a starting, or extended, height at, or close to, the air spring's maximum usable height. Refer to the design page for the particular style selection.
2. Relieve the build-up of internal air pressure at 8.3 BAR. The internal volume of air decreases, which increases the pressure as the air spring is compressed.
3. Make sure that the kinetic energy has been absorbed before the minimum height of the air spring has been reached.
4. An air spring will act as a "spring". The stored energy from compression will be returned in the form of rebound.

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The kinetic energy calculated on page one needs to be compared to the table below.

Style Number	Starting Height@ (mm)	Compressed Height (mm)	Total Stroke (mm)	Height Where Internal Pressure equals 8.3 BAR (mm)	Kinetic Energy Absorbed (Joules)
16	81	51	30	66	203
131	107	56	51	85	395
25	152	76	76	132	587
110	127	64	64	89	689
116	127	64	64	86	858
115	127	64	64	94	1185
26	229	102	127	165	1626
20	229	102	127	165	2314
19	140	64	76	102	2653
113	140	64	76	104	4132
22	254	102	152	185	5453
21	254	102	152	188	8862
28	254	102	152	191	12034
313	381	127	254	279	13558
203	254	102	152	191	17012
312	381	127	254	279	20264
138-1.5	178	76	102	135	22928
29	279	102	178	206	25705
323	381	127	254	279	28154
215	305	102	203	229	47007
321	432	127	305	274	64550
348-3	483	152	330	330	129822

Since the air spring has virtually no damping characteristics, there will be bounce back or rebound motion. Relieving the air pressure build-up acts to reduce this rebound.