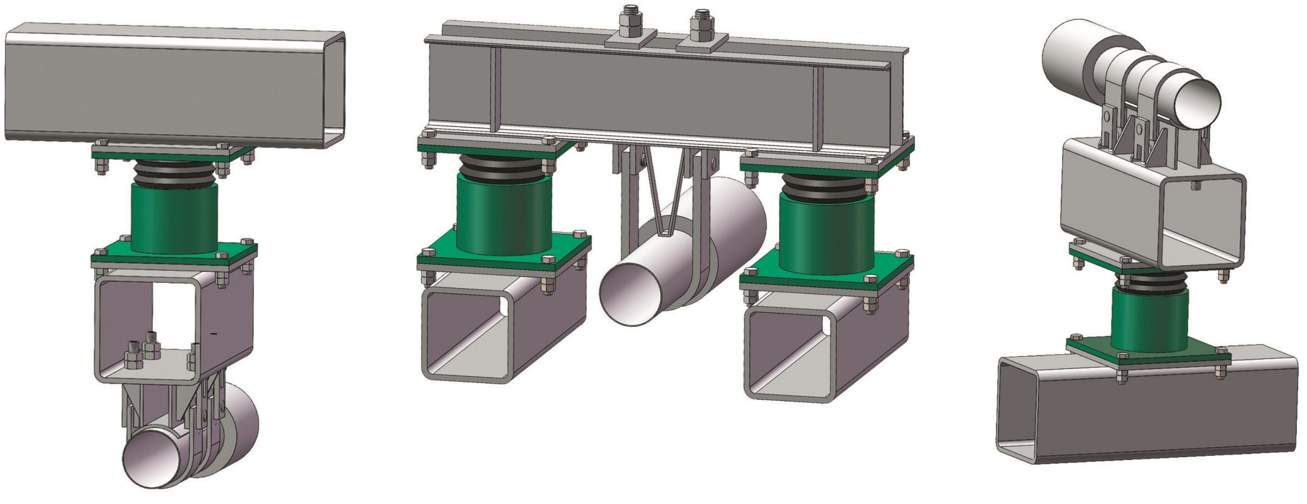
VISCOELASTIC DAMPERS



VISCOELASTIC DAMPERS

INTRODUCTION:

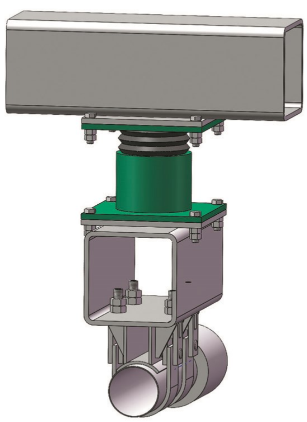
A Viscoelastic Damper is a passive damping device designed to effectively reduce vibrations of the structure onto which it is installed.

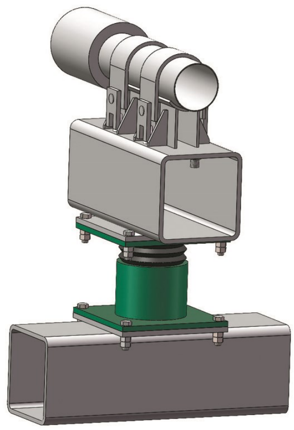
Whilst it does not support static load, the viscoelastic damper has both elastic and viscous properties. As a result, the device is able to dampen and dissipate energy by converting it from kinetic energy to heat.

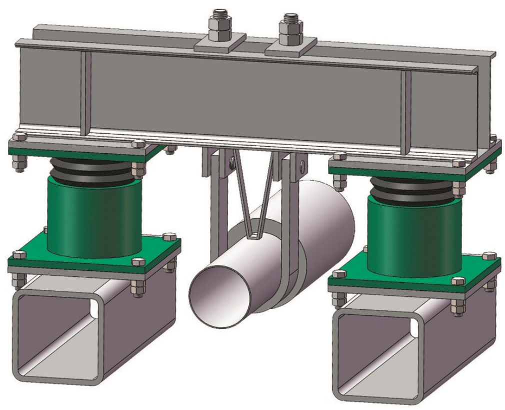
Viscoelastic Dampers are often used across a wide range of industries, such as the oil & gas, power generation and petrochemical industries, where vibration control is vital.

In power plants, for example, excessive deflections caused by dynamic events (such as rapid valve closure, two phase flow or even earthquakes) can potentially cause significant damage to piping systems and other components. Furthermore, even small vibration displacements can result in fatigue and damage to the piping systems and other components over the long-term operation of a plant.

However, the use of CPA viscoelastic dampers protects piping systems and other components from such issues by achieving excellent vibration control.







KEY BENEFITS OF THE CPA VISCOELASTIC DAMPER:

1. Operating vibration and dynamic vibration can be significantly reduced and controlled along the complete piping system at all angles.

2. The damping effects of all vibration are immediate. There is a high damping effect on excessive dynamic vibration (e.g. earthquake or rapid valve closure).

3. The damping force is proportional to the vibration speed, and the proportional coefficient is the damping coefficient, which is always measured and monitored by our in-house testing machine.

4. Simple structure, cost-saving and maintenance-free.

VISCOELASTIC DAMPERS

DESIGN FEATURES & WORKING PRINCIPLE:

1. The metal housing of the damper is comprised of a top plate, an outer cylindrical shell and a bottom plate.

2. Either the top or bottom plate is connected to the rigid structure, whilst the opposite plate is connected to the vibrating structure (e.g. the piping system).

3. A piston is connected to the top plate and sits within the outer cylindrical shell. The space within the shell and around the piston is filled with a viscous damping fluid.

4. As the piston compresses into the damping fluid, a damping force is generated in order to slow down the vibration frequency. The damping force is achieved by converting kinetic energy into heat. The piston is free to move all in directions within the fluid.

5. The force of the damper is directly proportional to the vibration speed, and the proportional coefficient is called the damping coefficient. This damping coefficient is directly measured and monitored by our in-house testing machine.

6. In order to achieve adequate vibration control, a well-designed viscoelastic damper must take into consideration the vibration frequency of the pipeline, the total mass of the pipeline (including the medium inside the pipeline) and the damping coefficient value calculated from the optimal damping ratio of 0.4. The formula is outlined below:

$\xi = \dfrac{C}{2m\omega}$	ξ :	Damping ratio, the optimal damping ratio for industrial pipelines is 0.4
	C :	Damping coefficient kNs/m
	m :	Total weight of pipeline system t
	ω :	Angular velocity of pipeline vibration 1/s, $\omega = 2\pi f$;

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KEY PARAMETERS REQUIRED FOR DESIGN & SELECTION OF DAMPERS:

In order to accurately design and select the appropriate damper, please provide the following information:

i) Rated load (kN)

ii) Vertical and horizontal damping coefficients (kNs/m)

iii) Vertical and horizontal equivalent stiffness (kN/mm)

iv) Vertical and horizontal allowable displacement (mm)

v) Damper operating temperature (°C)

Rated load (kN):

The rated load refers to the maximum damping force that a damper can provide at the relevant operating temperature.

Damping Coefficient (kNs/m):

The ratio of maximum damping force to the maximum vibration speed.

The damping coefficient value is related to the vibration frequency and decreases as the vibration frequency increases. It is the most intuitive parameter to describe the energy dissipation characteristics of viscoelastic dampers.

Equivalent Stiffness (kN/mm):

The ratio of the maximum damping force to the maximum vibration displacement.

The equivalent stiffness value is also related to frequency and increases with the increase of vibration frequency. In programs that cannot input damping coefficients directly proportional to vibration velocity, equivalent stiffness can be used for calculation.

The maximum allowable displacement is the sum limit of thermal expansion displacement, impact load response displacement, and operating vibration response displacement.

Usually, the allowable displacement in both vertical and horizontal directions is ±40mm. When the thermal expansion exceeds 40mm displacement, the damper is still usable, but it needs to be offset during cold installation to compensate for excessive thermal expansion.

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INSTALLATION INSTRUCTIONS / DESIGN RECOMMENDATIONS:

i) The viscoelastic damper is typically supplied preset/pre-locked to the 'cold load' using positioning rods. The positioning rods should only be removed once the top plate and bottom plate are bolted to the supporting structure and pipeline.

ii) Viscoelastic dampers can be installed above, beside, or below the pipeline. However, the damper should always be transported and installed in the vertical direction in order to avoid leakage of the damping fluid.

iii) Viscoelastic dampers should generally be installed in the area of the pipeline with the maximum deflection, known as the antinode point, in order to obtain the maximum possible damper load.

iv) The design temperature is an important parameter when designing/selecting the appropriate viscoelastic damper. Therefore, it is important that the operating temperature of the pipeline does not exceed the stated design temperature for a long time. This is especially important on high temperature pipelines so that the dampers do not experience:

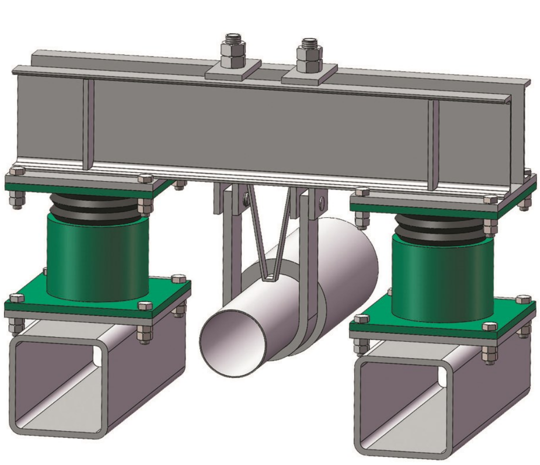
  a) thermal radiation and convection from adjacent pipelines and components
  b) heat conduction from supporting pipelines.

  In order to minimise the risk of such issues occurring, protective plates can be added around the damper and/or a special insulation can be applied.

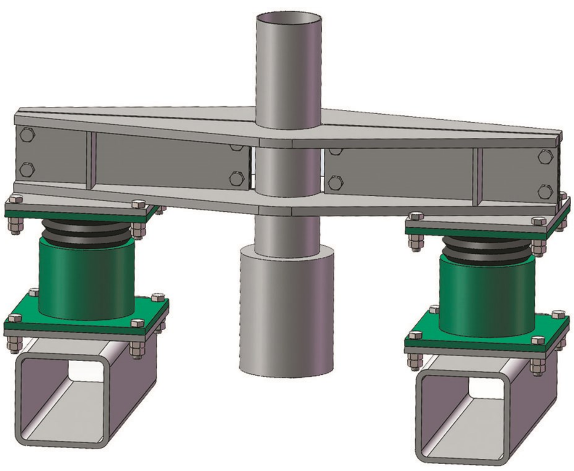
v) Sufficient distance should be maintained between the supporting pipeline and the damper in order to limit direct heat conduction.

VISCOELASTIC DAMPER LAYOUTS:

Horizontal piping symmetrical layout:



Vertical piping symmetrical layout:



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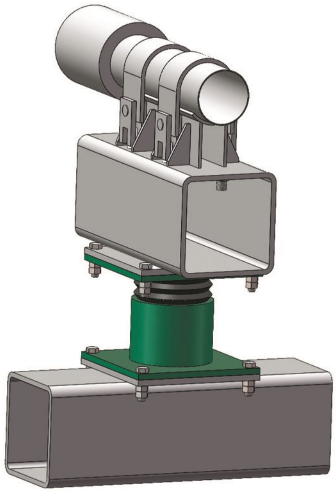
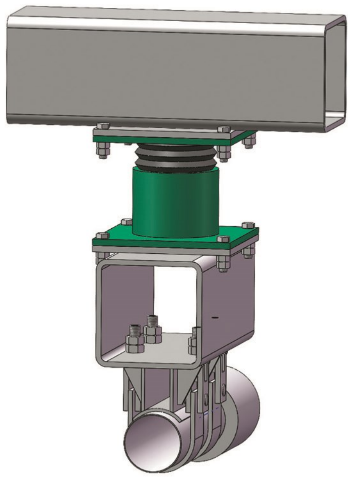
Lower support layout:



Upper suspension layout:



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