EMBELTON
NOISE AND VIBRATION ISOLATION

# Back to basics: Acoustics

## HVAC installations for vibration reduction

Presented by Clem Sturgess

## Causes of vibration

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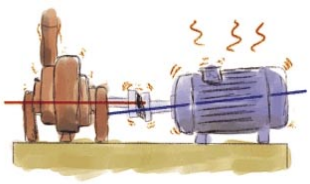
Vibration is generally transferred into the structure from out of balance or misaligned rotating equipment



## Effect of vibration on equipment

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Constant vibration forces from misaligned or out of balance forces act on the system like bending a piece of wire backwards and forwards



## Vibration noise

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Vibration can travel easily through structures and is reradiated from walls and ceilings as noise, many floors away from the source of the noise.

# Effect of vibration on humans

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**Table 2.2** Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration ($m/s^2$) 1–80 Hz

| Location | Assessment period[1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z-axis | x- and y-axes | z-axis | x- and y-axes |
| **Continuous vibration** | | | | | |
| Critical areas[2] | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |
| | Night-time | 0.007 | 0.005 | 0.014 | 0.010 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.020 | 0.014 | 0.040 | 0.028 |
| Workshops | Day- or night-time | 0.04 | 0.029 | 0.080 | 0.058 |
| **Impulsive vibration** | | | | | |
| Critical areas[2] | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Workshops | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |



# Pipework Support

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It is important to isolate pipework that is connected to sources of vibration.

Generally the pipes should be supported up to 100 pipe diameters from the source of the vibration.

## Pipework Support

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The spacing of pipework hangers is dependant on the size of the pipework, however, the pipework should be supported at all changes of direction.



## Pipework Support

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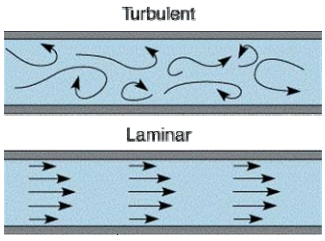
Pipework should still be isolated even if a flexible connection is used. Water can take a large distance to settle into even laminar flow in pipework. Also under high pressures, the flexible connection may be not that flexible




## Seismic vibration mount
## •How they work

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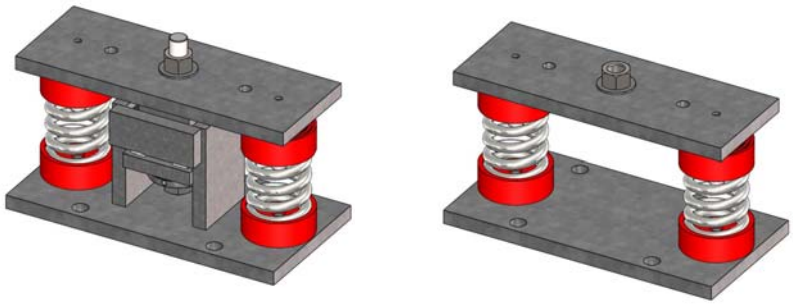
Under normal operation, seismic mounts act like standard open springs





## Seismic vibration mount
## •How they work

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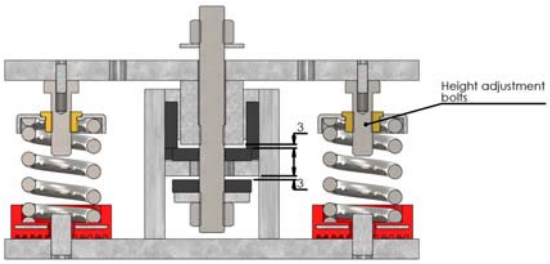
3mm gaps between central block and rubber provide support in the event of seismic activity



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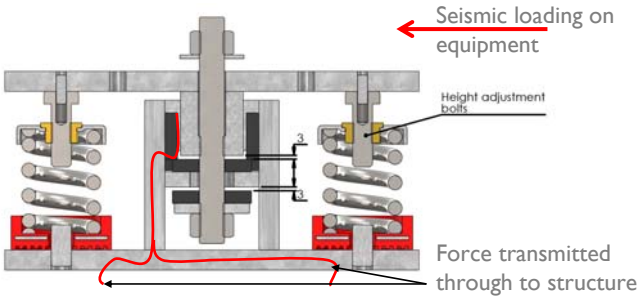




## Isolation Sleeves

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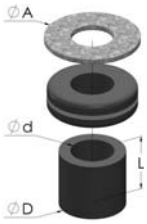
Prevents bridging the rubber on the base of the mount




# How Vibration Isolation Works

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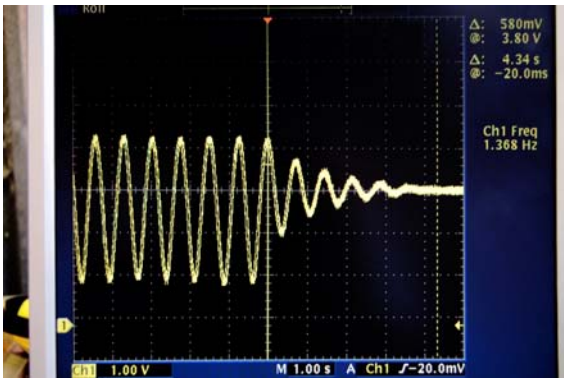




# Natural Frequency

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When an object is struck. It will vibrate at its natural frequency.

## Static deflection

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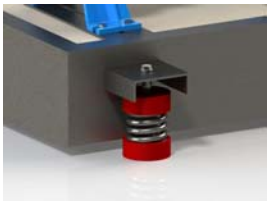
The more a spring or rubber deflects under load, without compressing to solid, the lower the natural frequency of the mount.

This is called the **static deflection**.





## Resonance

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If an object is given repeated pushes at its natural frequency it will go into resonance. It will move slightly more each time until it gets out of control.

## Startup Issues

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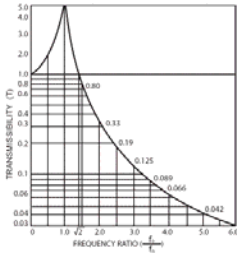
As a motor ramps up from stopped to operating speed, it must pass through the resonant frequency.




The equipment may require some restraint



## Effect of height

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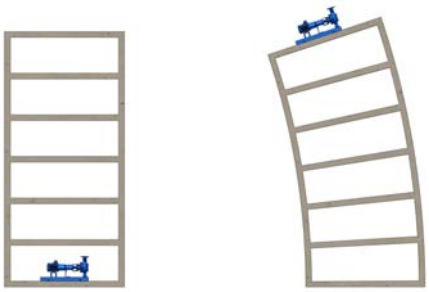
The higher storeys are inherently less stable than lower storeys. So the higher in the building, the more isolation is required.



## Important factors in vibration isolation selection

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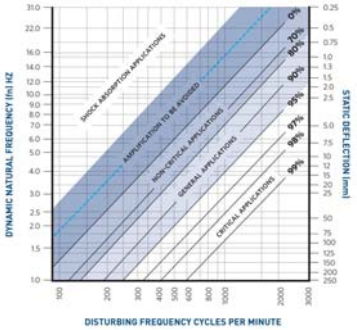
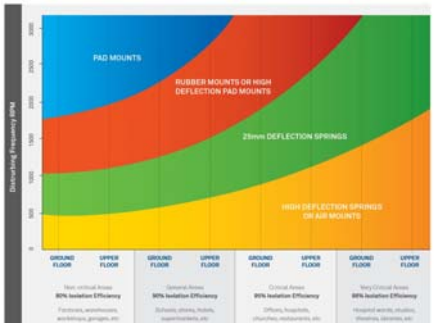



Isolation Efficiency Chart




Static Deflection Guide



## The 6 most common vibration problems

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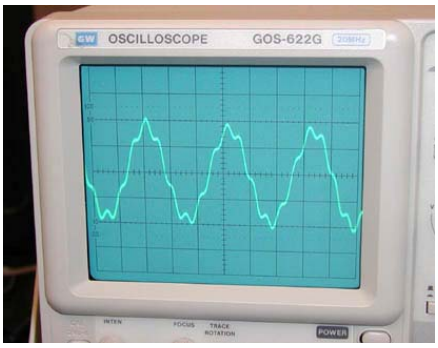


# 1: Fixed Pipe Stands

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Problem:

Well isolated pumps or chillers connected to pipes with fixed stands



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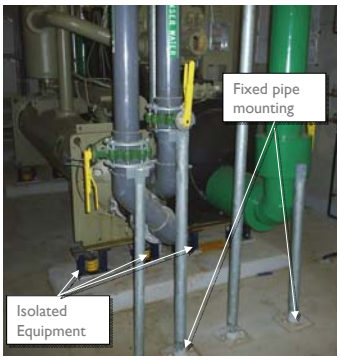


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# 1: Fixed Pipe Stands

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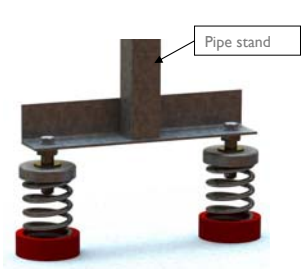
Solution:

Install spring mounts on the pipe stand base so that they match pump spring deflection

or

Support the top of the pipework using isolation hangers and remove pipe stand







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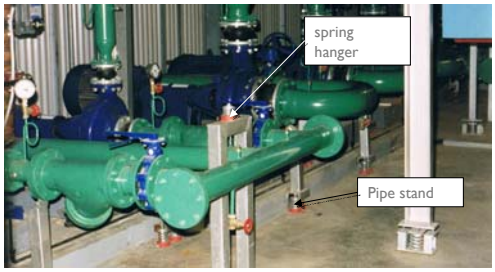

## 2: Noise transmitted from isolated pumps

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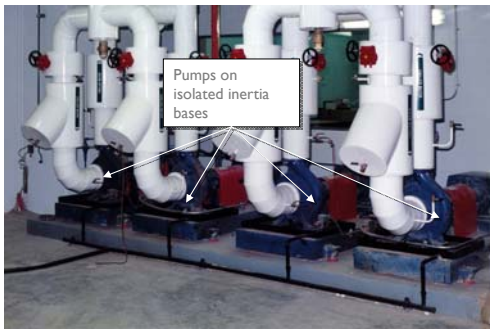
Problem:

Noise transmitted from isolated pumps






## 2: Noise transmitted from isolated pumps

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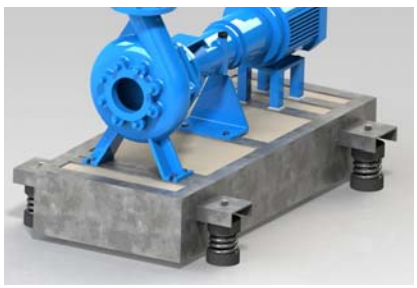
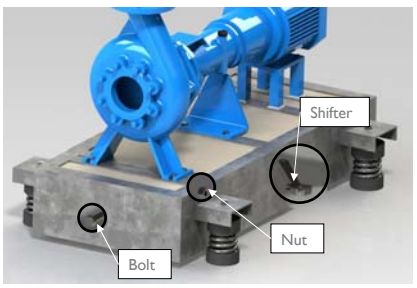
Solution:

Check under inertia base for nuts, bolts or other debris or adjust springs to raise pumps





# 3: Pipework hard fixed into wall or ceiling

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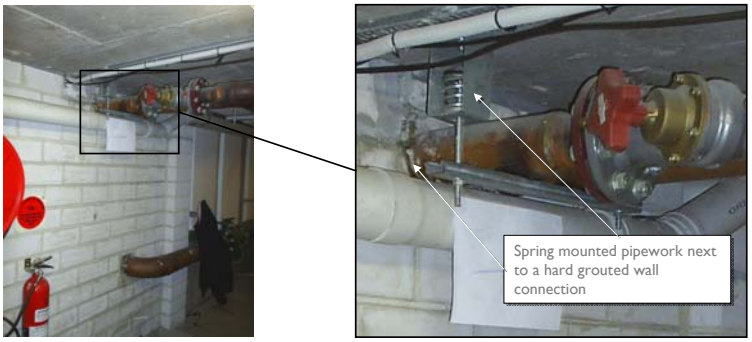
Problem:

Noise transmitted from pipework passing through a wall or ceiling






# 3: Pipework hard fixed into wall or ceiling

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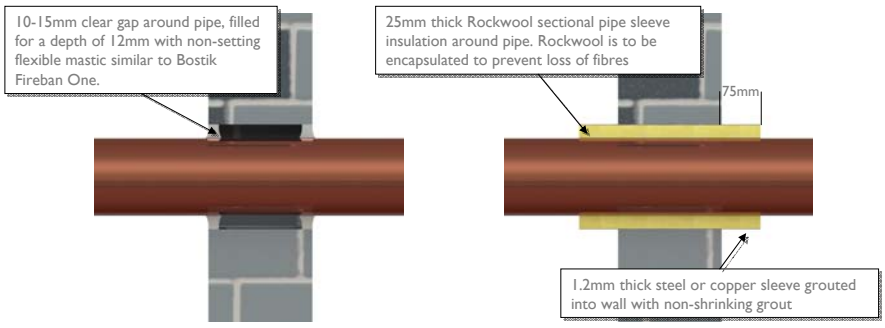
Solution:

Seal around openings for pipework with flexible mastic or insulation



# 4: Bridging of spring hangers

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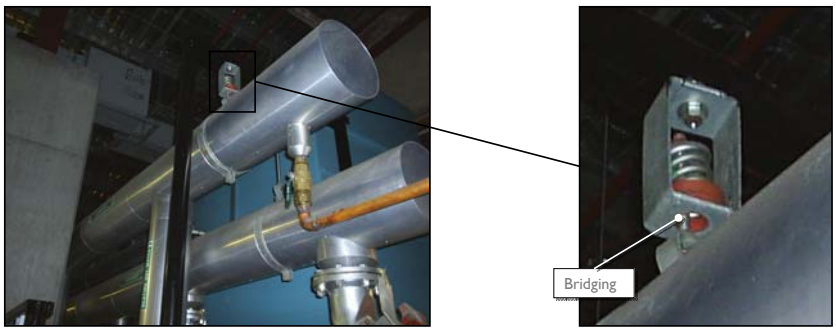
Problem:

Rod is touching the side of the hanger cage, causing bridging of isolation element






# 4: Bridging of spring hangers

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Solution:

Realign pipe clip or hanger cage so rod is central to the hole in the hanger cage

# 5: Hard bolted pipework

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Problem:
Condenser pipework hard bolted to floor or walls



# 5: Hard bolted pipework

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Solution:
Suspend pipework from raised frame

## 5: Hard bolted pipework

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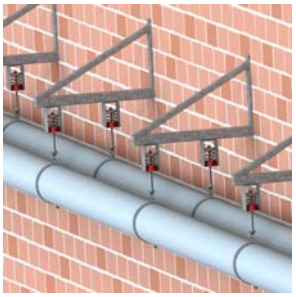
Solution:

Install new wall bracket and suspend pipes from the bracket.





## 6: Generator vibration transmission

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Problem:

Incorrectly adjusted spring mounting

## 6: Generator vibration transmission

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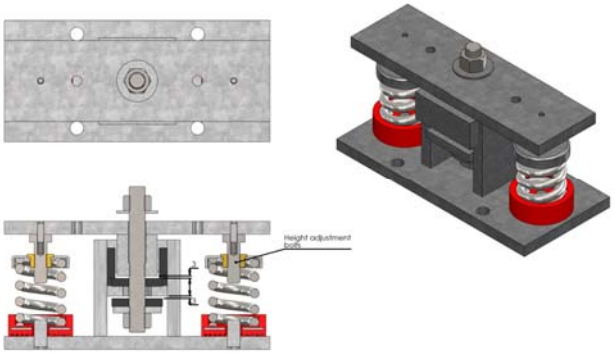
Solution:

Adjust the height adjustment bolts until the generator is supported by the springs only



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## Thank you for your time

**If you have any further questions or noise problems then please contact us on:**

**Phone: 3359 7100**
**0408 409 168**

**Email:**
**c.sturgess@embelton.com**