High Pressure-Sensitive Tapes for Light Weight Damping Applications

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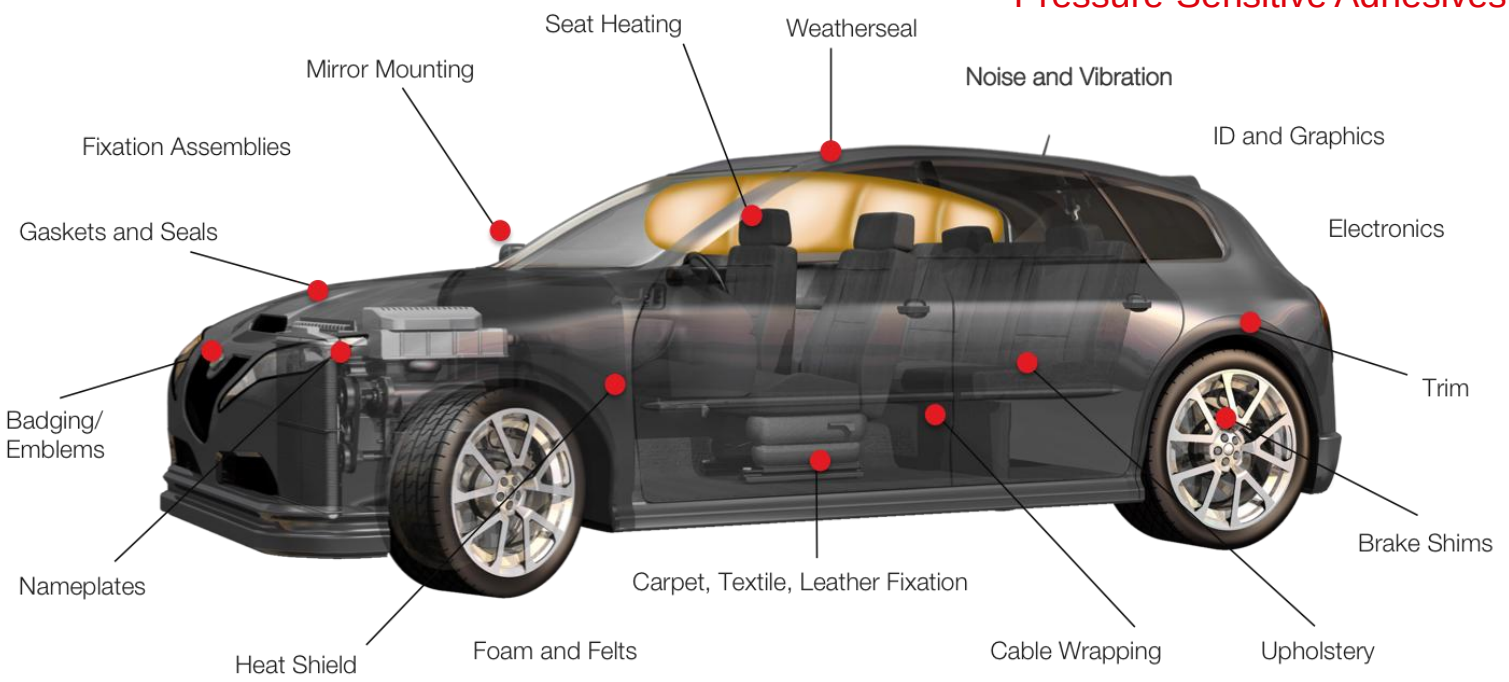
Overview

- Introduction
- Vibration Damping
- Constraint Layer Damping
- Construction Measurements
- Applications and Conclusion

Introduction

- For the automotive industry lightweight damping solutions become more and more important, in order to increase passenger comfort and safety.

Pressure-Sensitive Adhesives



Introduction

- The damping of materials in combination with light weight becomes also in general transportation business important.
- Avery Dennison Performance Tapes developed pressure-sensitive adhesives tapes for use in a constraint layer damping construction.

Vibration Damping

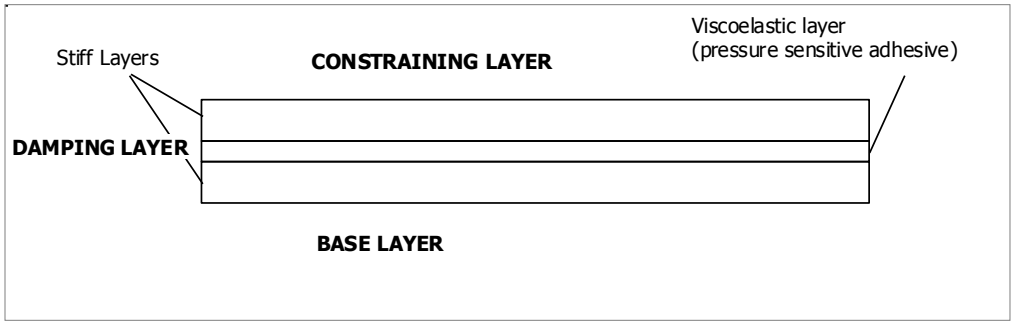
- Tackle Noise and Vibration: different ways to deal with noise.
  - Post-treatment (kill the noise).
    - Airborne noise at medium to high frequencies will often be attacked by open cell foams, pressed fibres, felts and nonwoven materials: Used in the passenger compartment.
    - Isolating airborne noise by encapsulating the source with structured foams and stiffeners: e.g. Isolating motor compartment.
  - Pre-treatment (avoid dissipation of noise) resulting in reduced dBA.
    - For low frequencies (<200Hz) heavy metal layers and mastics (bitumen) will give effective noise and vibration reduction.
    - A different technique is to use the principle of **constraint layer damping**, resulting in lightweight.

Vibration Damping

- How to treat vibration damping.
  - The challenge is to tune pressure-sensitive adhesives for damping properties while still keeping their PSA function.
  - A portfolio and/or formulation window was established to optimise damping at different temperatures and peak or broad damping behaviour at several frequency areas.

Constraint Layer Damping

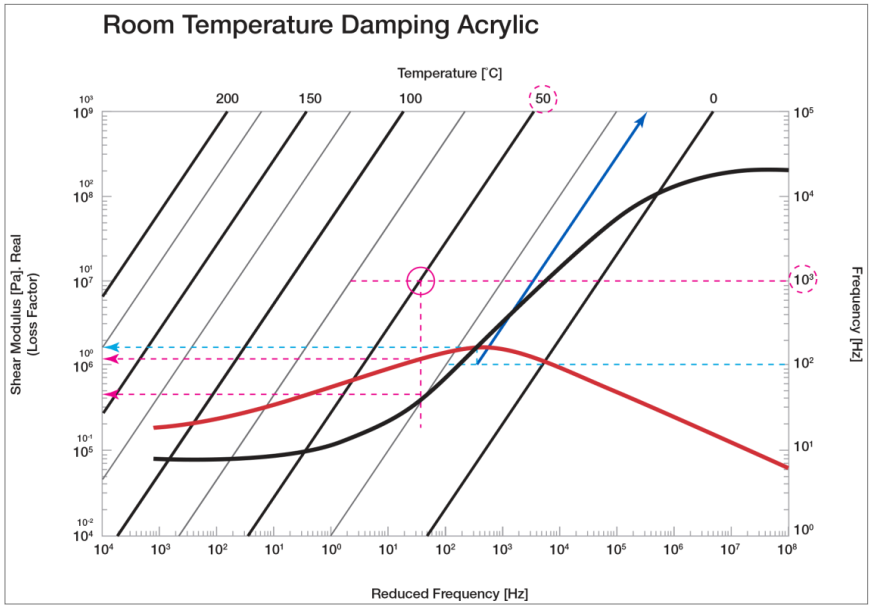
- Constraint layer damping:
  - Constraint layer damping is a solution whereby a visco-elastic damping layer is positioned between 2 stiff layers (stiffness above Aluminium).



- Calculating the damping efficiency in a constraint layer:
  - Is proposed by Ross Ungar and Kerwin (RUK theory).
  - Loss factor is depending on the dimensions (thickness), the stiffness and the visco-elastic properties.

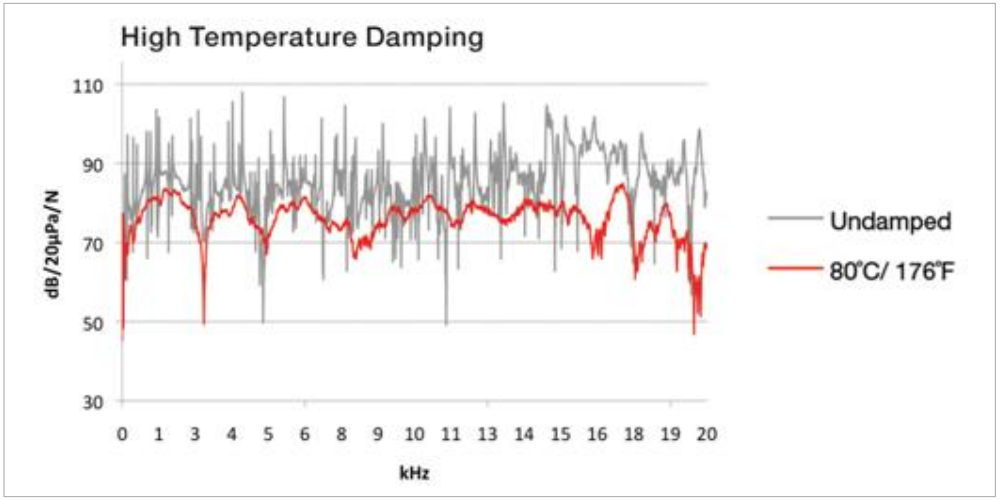
Constraint Layer Damping

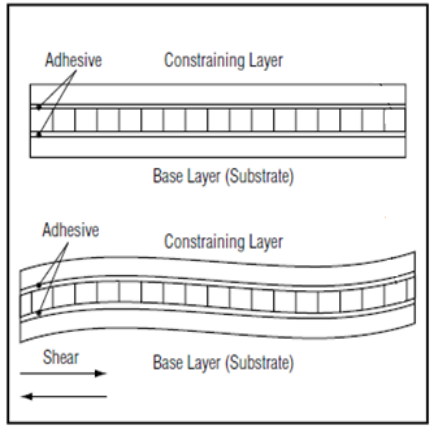
- Adhesive measurements: nomogram.
  - Measuring the visco-elastic properties quantify the time temperature dependent behaviour of pressure sensitive tapes and show shear modulus and loss factor are T and frequency dependent.
  - Typical visualisation is a nomogram.



Construction Measurements

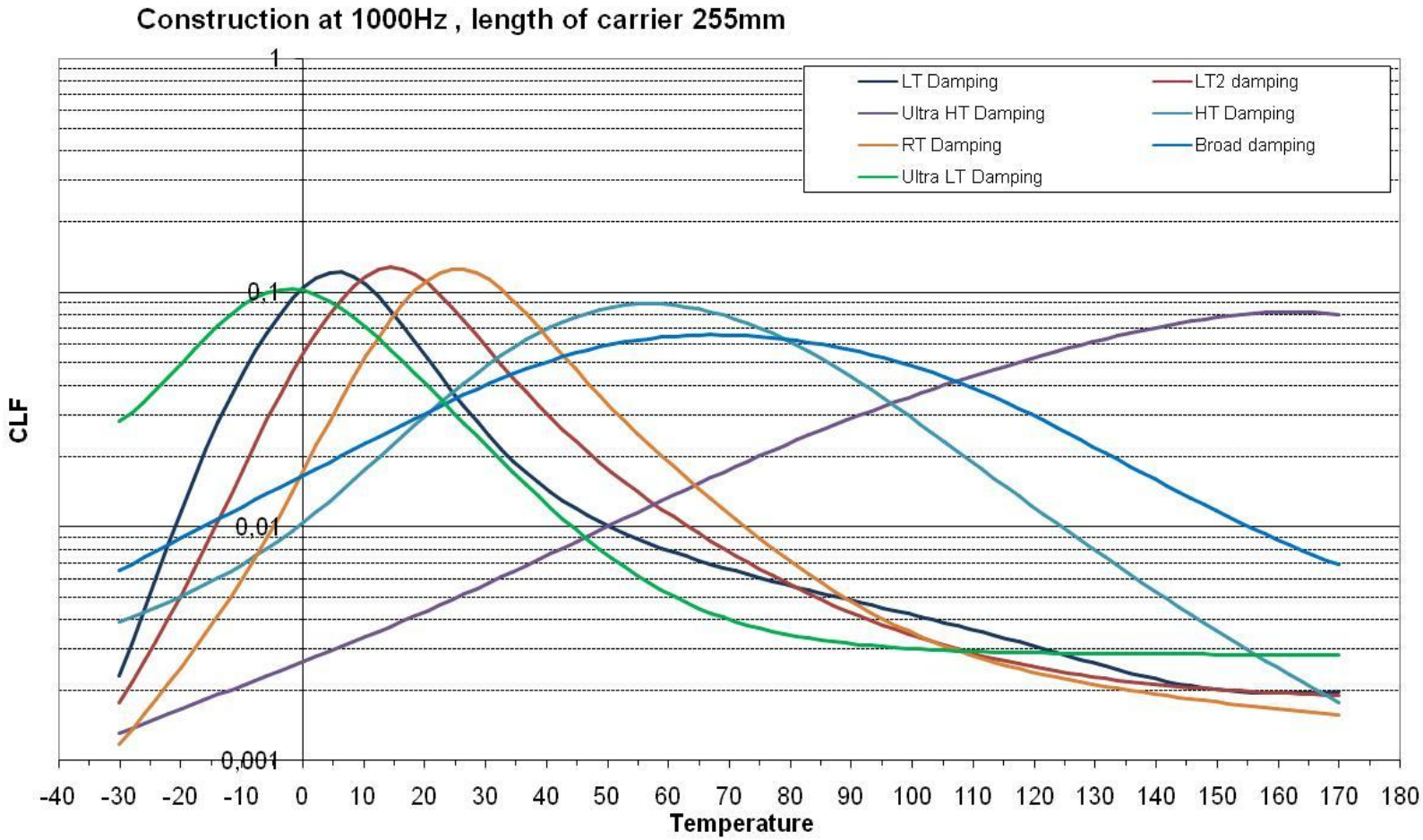
- Vibrating beam testing.
  - Rather than measuring the visco-elastic behaviour of the adhesive the preferred technique used is VBT (vibrating beam testing).
  - Measuring composite loss factor of adhesives in a sandwiched beam will generate more accurate data (specially in high frequencies) and will predict more the final application performance.



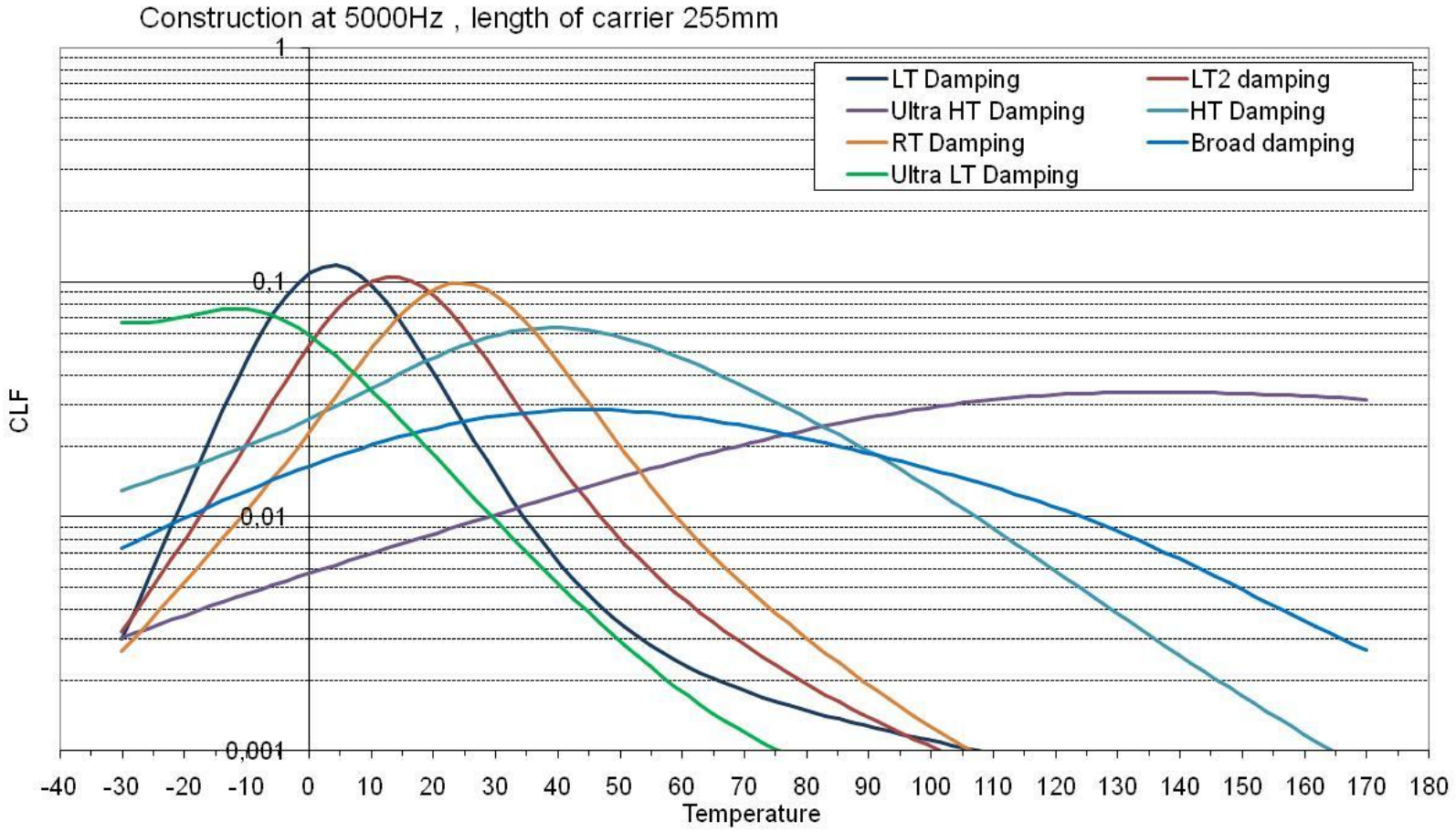


Shear impact to the visco-elastic layer in the vibration set-up

Construction Measurements

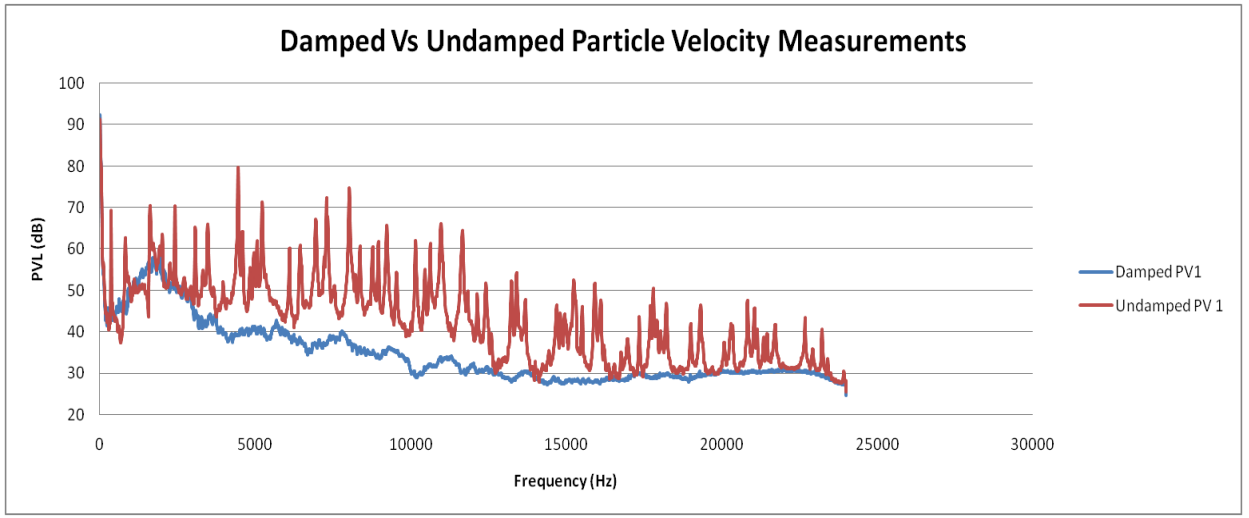


Construction Measurements



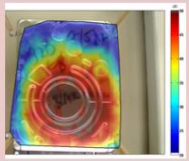
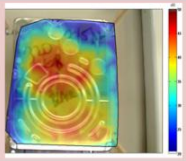
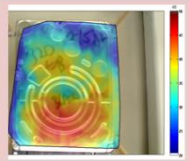
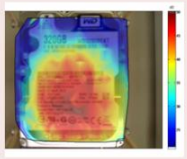
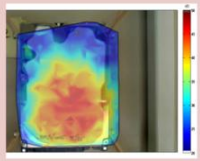
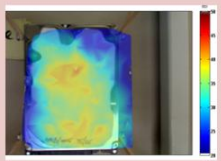
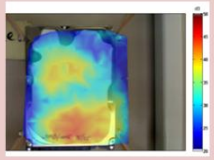
Construction Measurements

- Sound before and after damping.
  - Another way of measurement.
  - Easy to compare effects.



Construction Measurements

- Examples of vibration measurements and effects in the applications.

	800-1200 Hz	1200-1600 Hz	1600-2000 Hz
Bare Drive			
Standard Product Label			
Avery Development Adhesive			

Conclusion

- Tapes have the added advantage of functioning as an **in-design solution**, a capability made possible by the availability of rapid prototyping software.
- The resulting products offer a complete portfolio of damping adhesives meeting transportation industry needs for harnessing noise vibration, requirements for temperature and frequency, bonding performance and internal strength and durability.

Thank You

For additional information contact:

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