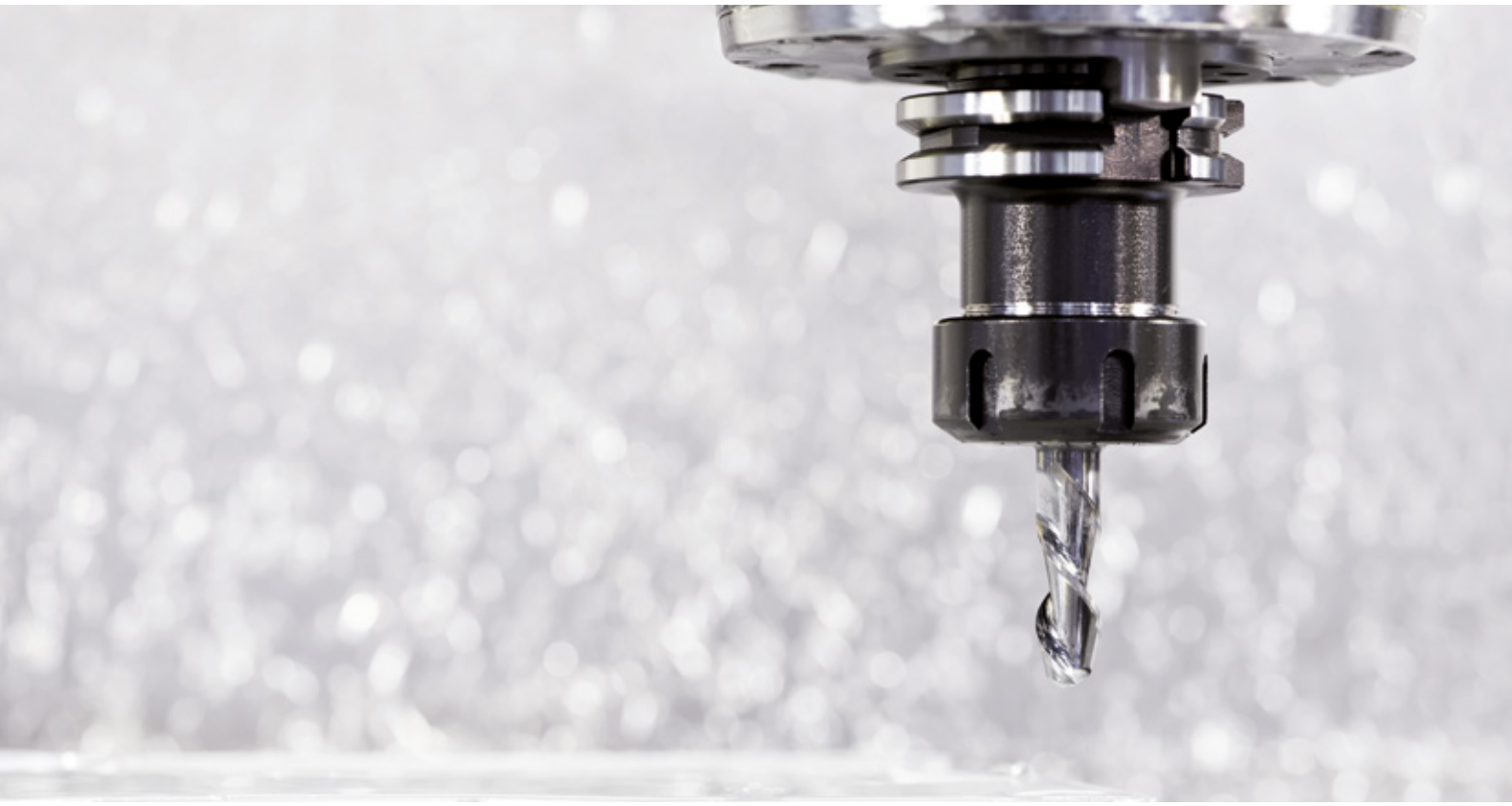
Strong lightweight
www.havel-mf.de

Havel metal foam



Innovative solutions made from aluminium foam for the mechanical engineering sector

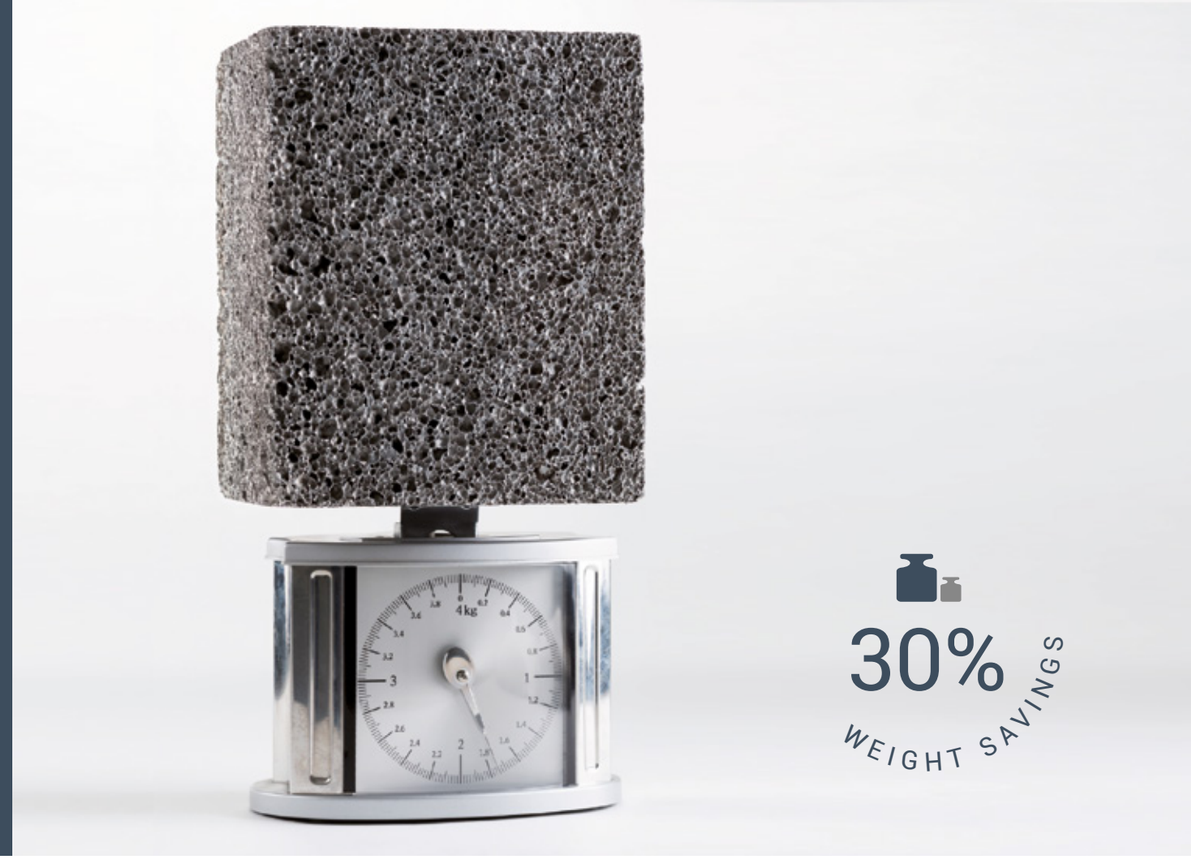
Sandwiches | Panels | Foam filled profiles | 3D shaped elements

Strong lightweight

With our Havel Lite ® series, Havel metal foam has specialised in the development and production of aluminium foam and aluminium foam sandwiches – a highly innovative lightweight material.

We have worked together with the Fraunhofer Institute for Machine Tools and Forming Technology to develop unique production technology that uses this modern material on an industrial scale.

Innovative lightweight construction solutions can be realised for various sectors using the versatile Havel Lite ® range.



Advantages of aluminium foam

Our 2+1 advantages

Low weight

+

Excellent mechanical durability

The product has a number of advantages

- Non-flammable, fulfils the fire protection standard (DIN EN 45545-2)
- Can be welded
- 100% recyclable
- Excellent vibration-damping behaviour
- Noise-absorbing
- Good electromagnetic shielding
- Further mechanical processing is easy to carry out (drilling, sawing, milling, welding)
- Can be repaired
- Various alloys possible
- Foam-filling possible for components (SAS only)
- Noise protection and insulation
- Energy absorption / good crash behaviour
- Vibration reduction
- Metallic bonding
- Radiation-shielding

Innovative solutions made from aluminium foam for the mechanical engineering sector

The use of lightweight composite materials allows for a considerable reduction in the weight of the parts that have to be moved in mechanical engineering. A lower mass and good vibration-damping behaviour are major advantages for moving components, as this allows for smaller drives and designs have to accommodate lower forces.

Sample application for a sandwich

X, Y, Z travel paths of a double-spindle machining centre

Application areas

- Machine tools
- Laser applications
- Solar module production
- Electronics production
- Microproduction
- Packing machines
- Wood processing
- Handling and assembly technology
- Optics production
- Food technology
- Pick & place applications

The following advantages result from the use of vibration-damping lightweight composite materials, depending on the specific application:

Higher machining accuracy

Structural vibrations result from drives, reaction forces during machining, or overshooting during acceleration and braking procedures, for example. These vibrations spread out over large distances and reduce machining accuracy, particularly on light and highly rigid structures. Vibration-damping lightweight composite materials allow for the elimination of vibrations in cases where this is necessary and, at the same time, facilitate higher machining accuracy.

Longer service life

The structural vibrations result in long-term alternating stresses. These can lead to fatigue failure – particularly at notches and under corrosive conditions – that can drastically reduce the service lives of machines and components.

The damping of structural vibrations below the fatigue limit significantly increases service lives.

Higher machining speed

The structural vibrations of components caused by motion can be damped by selecting a suitable material. This allows for higher speeds and accelerations at a constant level of machining accuracy.

Extremely lightweight construction

Thanks to their cellular structure, aluminium foams are excellent energy-absorbers for vibrations, impacts and noise.

- **30% weight savings compared to pure aluminium**

Wide range of products

Havel Lite® sandwiches

Low weight and high mechanical stability facilitate the development of innovative lightweight construction solutions. Pioneering cost-effective solutions can be created for various sectors by taking advantage of at least one of aluminium foam's other unique advantages.

The aluminium foam is combined in composite structures with steel (Havel Lite® SAS) or aluminium (Havel Lite® AAS) in the form of sandwiches. The material joints consist solely of metal, with no adhesive bonding. As a result, no toxic gases are formed in the event of a fire **(DIN EN 45545-2)**.

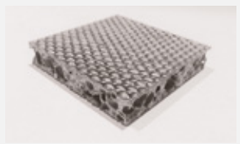
Havel Lite® pure foam & 3D shaped elements

Aluminium foam panels with steel mesh inserts have particularly good tensile strength and are less brittle. However, they are even lighter than sandwiches and are also less expensive than carbon, for example.

In principle, almost any geometrical shape can be produced using the powder metallurgy process, just as with moulding processes.

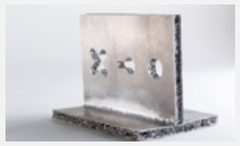
SAS manufacturing technology: directly foamed-bolts and nuts

Manufacturing ability: curved sandwich

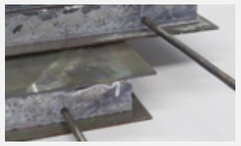


Aluminum foam panels with steel mesh

3D molding (aluminum foam crash absorber on the luggage rack of a Audi Q7)



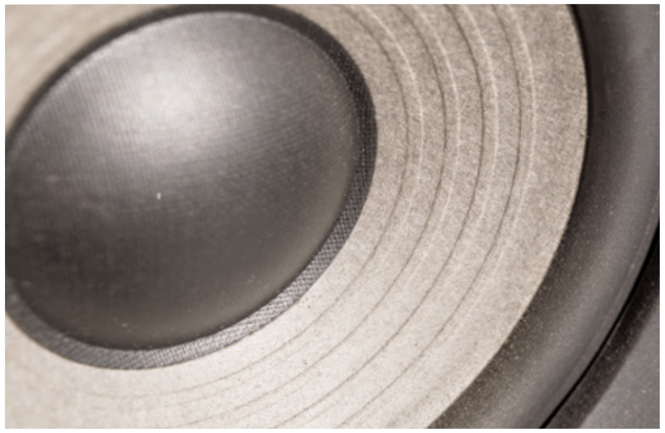
Further processing options: drilling, welding, milling

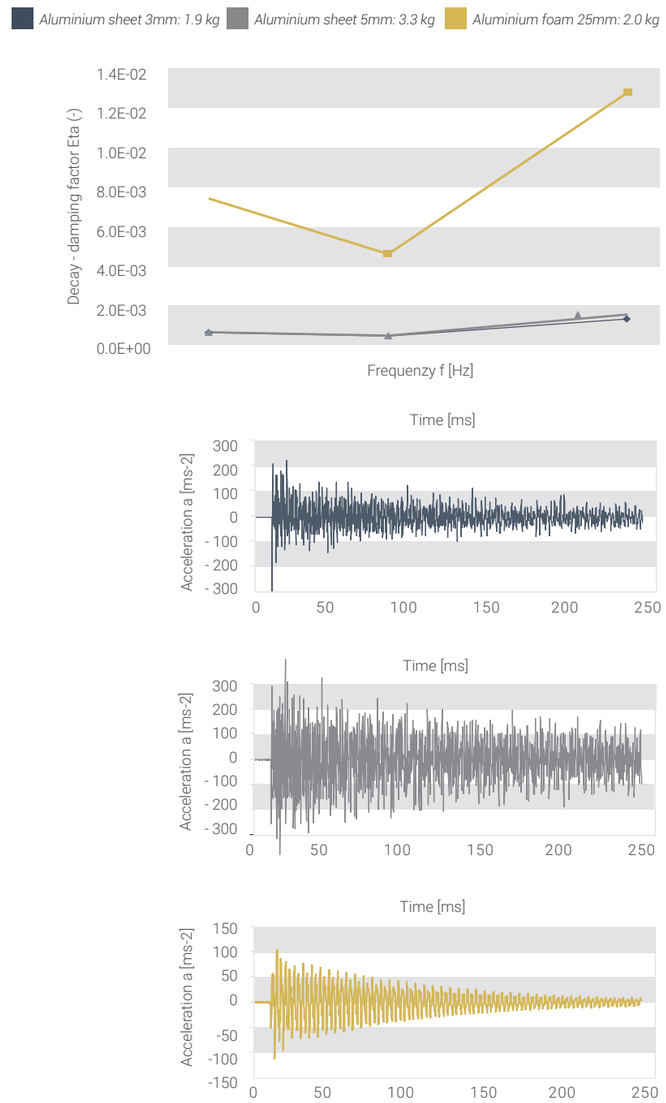


Steel-aluminum foam sandwiches with steel pipe

3D molding (sill for a Bugatti)

Foam filled profiles





Resonance reduction

Structure-borne noise damping refers to the ability of a material to convert mechanical vibration energy into thermal energy by means of internal friction within a body. This property reduces undesired noise and vibrations and passes them on to the surroundings in the form of heat.

The cellular structure allows for the dissipation of vibration energy by means of very small plastic deformations of the thin cell walls. Additional reduction of vibration is achieved due to friction between crack surfaces in the pore walls.

Damping factor of 25 mm aluminium foam panel, 5 mm aluminium sheet and 3 mm aluminium sheet.

Test object

Aluminium sheet:
500 x 500 x 3 mm; 1.9 kg

Aluminium sheet:
500 x 500 x 5 mm; 3.3 kg

Aluminium foam:
500 x 500 x 25 mm; 2 kg

Test method

Longitudinal vibrations were initiated in the test objects using the “impact hammer” method. An acceleration sensor and frequency sensor were used to measure the amplitude.

Results

- The loss factor for aluminium foam is significantly higher than that of solid aluminium. The damping of aluminium foam depends only weakly on the resonance frequency.
- The loss factor of the tested material (AlSiMg, AlSi12) has its maximum at a density of around 0.63 g/m³.

Main areas of application

- Components (gearboxes or covers) that are exposed to mechanical vibrations
- Filling material for hollow parts or profiles

Sample applications

Gear-cutting machine Tool holder*

Problem: · Vibrations in the main spindle

Cause: · Long centre on tailstock

Solution: · Aluminium foam ring

Requirements

· Very low concentricity deviation

· High degree of homogeneity and great damping ability of metal foam

· „Permanent" bonding of metal foam and flange rings

1 *Intermediate flange*
2 *Tool*
3 *Workpiece*
4 *Workpiece holder*

Intermediate flange with stuck-in metal foam ring

HPM 1850U milling machine from NILES-SIMMONS Industrie-anlagen GmbH with foamfilled Z slider*

Advantages:

· **28% lighter than grey cast iron structures with the same rigidity**

· Improved vibration-damping

28% LIGHTER THAN GRAY CAST STRUCTURES

11 aluminium foam sandwiches with solid parts added; Series production of approx. 15 units/year since 12/2014

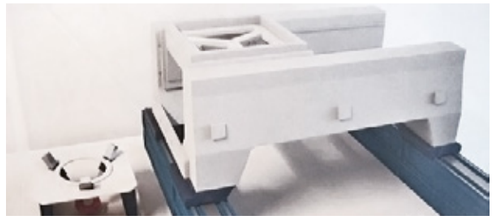
Aluminium foam sandwich

Transverse gantries for a milling machine*

0.5% MAX. DAMPING STEEL STRUCTURE

Comparison	Conventional	New
Mass [t]	6.3	6.6
Bending [mm]	34	14

Comparison	Frequency	Damping
1st bending vibration along x	37.9 Hz	2.3 %
1st bending vibration along z	75.5 Hz	2.9 %



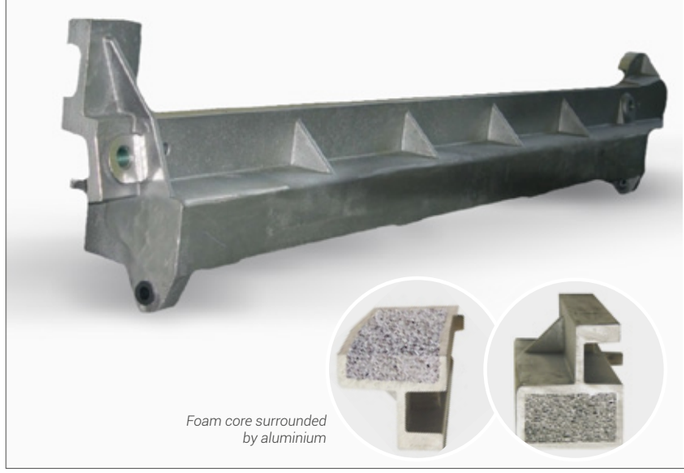
Dynapod project

Gantry dimensions:
5900 x 1400 x 940 mm

Steel-aluminium foam sandwiches:
1178 x 1182 x 35 mm

Sandwich thickness:
Steel / foam / steel = 3 / 29 / 3 mm

2500 units have been produced since 2004



Foam core surrounded by aluminium

Supporting beam for spools on a textile machine*

Composite of aluminium foam + aluminium grey cast iron (sand casting) after design change

· Weight constant at approx. 21.0 kg

· **Vibration reduction of 60%**

· Increase in critical frequency from 310 to 370 Hz

60% VIBRATION REDUCTION

* *Source: Fraunhofer Institute for Machine Tools and Forming Technology*

Research & development

FEM calculations

Product solutions

Series production

Further processing

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