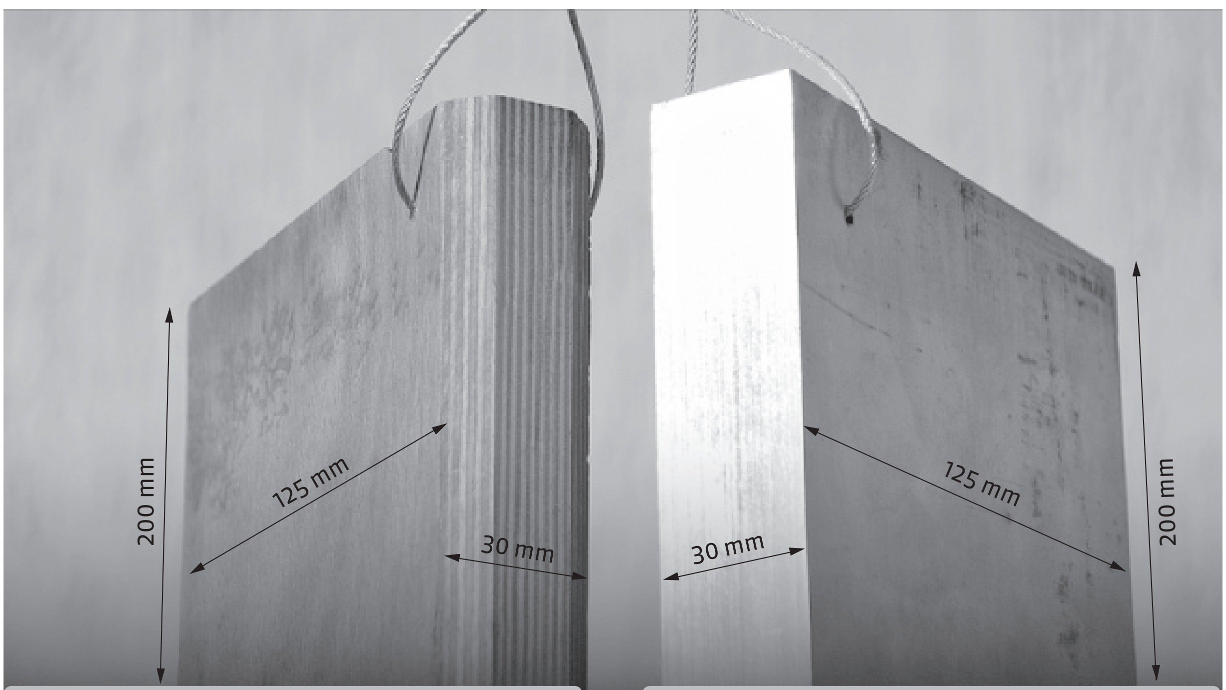
The Virtues of Panzerholz

An Investigation into the Acoustical Properties of Aluminum and Panzerholz

Quite often in audiophile literature, one finds euphoric accolades about the 'virtues of aluminum' regarding its vibration control attributes. Or, that aluminum contributes to a beautiful tone quality in some way or another. In this test, we set out to see if we could quantify this phenomenon, to see whether we could put some numbers on what seemed mostly opinionated argument.

The heavyweight fight With defending champion

We took two samples of material, both of the same size. The newcomer was Panzerholz, defending champion was aluminum. We drilled a small hole through one corner of each so that we could investigate both materials under the same conditions of free suspension.



PANZERHOLZ

Panzerholz is a high tech natural wood product manufactured in Germany. Under extreme heat, pressure and moisture, the wood is compressed to half of its original dimensions. The cellulose fibers bond on a molecular level, creating an engineered wood substance not found in nature.

ALUMINUM

Aluminum, in pure form, is about three times as dense as water. It is used always in alloy form. Famous for its machinability, stability and resistance to corrosion, it has made its way into more and more audiophile gear.

Audio Or aviation?

If you have seen the term "aircraft grade aluminum," you should know that such a term has no officially recognized meaning, and is not used to depict any specific alloy. If a specific alloy is nevertheless given, in the field of aviation, these alloys must adhere to standards regarding qualities of high strength and light weight. "Aircraft grade aluminum alloy" is not any specific alloy, nor is it an acoustical performance description. The exact aluminum alloy used by us in this test is known under many names, according to the varying terminology used by the standard it is filed under.

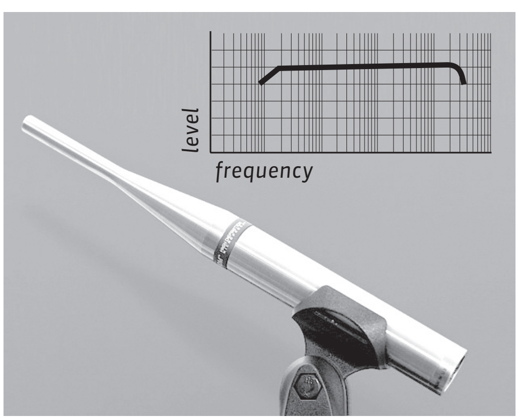
VARIOUS NAMES FOR THE ALLOY SPECIMEN USED HERE

Standard	Code Name
ISO R209	Al-Si1Mg
Alcan Abbreviation	B51S
NF A02-004	A-SGM0,7
DIN 1700	AlMgSi1
DIN 17007	3.2315
BS-L, DTD	H30
UNI	P-AlMgSi
USA Spec	6082

Wood may be good But for what?

Panzerholz is known for its extremely high density (it sinks in water), its high strength (is used as a metal substitute), and that it is bulletproof. Furthermore, its acoustical resonance damping characteristics are said to be among the very best available. We want to see if we can pinpoint what comprises these good acoustical characteristics, and whether they can be shown clearly.

The setup Equipment used



MICROPHONE

Earthworks M30 omnidirectional
measurement microphone
Distance to source: 30 cm. Angle to source: 0 degrees on axis

ROOM AMBIENCE

Studio Recording Semi-Dead Room
approx. 10 m x 12 m x 6 m

PROCESSING

Steinberg WaveLab
Waveform display, Spectrum analysis: block size 262144,
0.2 Hz resolution, 99% analysis overlapping,
Smoothing Window: Hamming
SIA-Smaart Acoustic Tools Analysis
Spectrograph magnitude range –54 dB to 0 dB, 24-bit / 48 kHz,
Logarithmic Banding

Take one Quiet on the set

First, we acquire the data. To excite the samples acoustically, we strike them with a hammer. A strike equates to acoustical energy of all frequencies at once. What we need for direct comparison purposes are two strikes which are of the same loudness, into each sample of material. Listen first to a sample of how each block sounds when struck several times.

We positioned and suspended the blocks one after the other into the same place in front of the microphone. We measured for accuracy. We let the acoustic tail ring as long as it would naturally fade out without being artificially damped via contact with any other object other than the wire suspending each block.

In the Panzerholz sample above, you can make out a slight metallic sound coming from the hammer resonating in my clenched fist as I strike the block repeatedly. An attempt was made to hold the hammer tightly to reduce its own metallic sound's contribution to our microphone signal. No amount of clenching was completely successful, but, as you will see, for these tests, it was clearly enough and it did not interfere with the interpretation of the results.

In the Aluminum sample, one cannot hear this metallic sound at all because of the sound of the Aluminum itself. Of course it is there, just as in the Panzerholz example, for it is the same hammer being held in the same way. But you can't hear it. This already provides us with our first piece of valuable information about the acoustic damping properties of Aluminum vs. Panzerholz. The Aluminum sample does not allow us to hear the hammer's own resonation contribution, whereas the Panzerholz sample does.

The two contenders Step into the ring

These are the two exact files we investigated:

ALUMINUM **mp3 | 48 kHz / 24 bit**

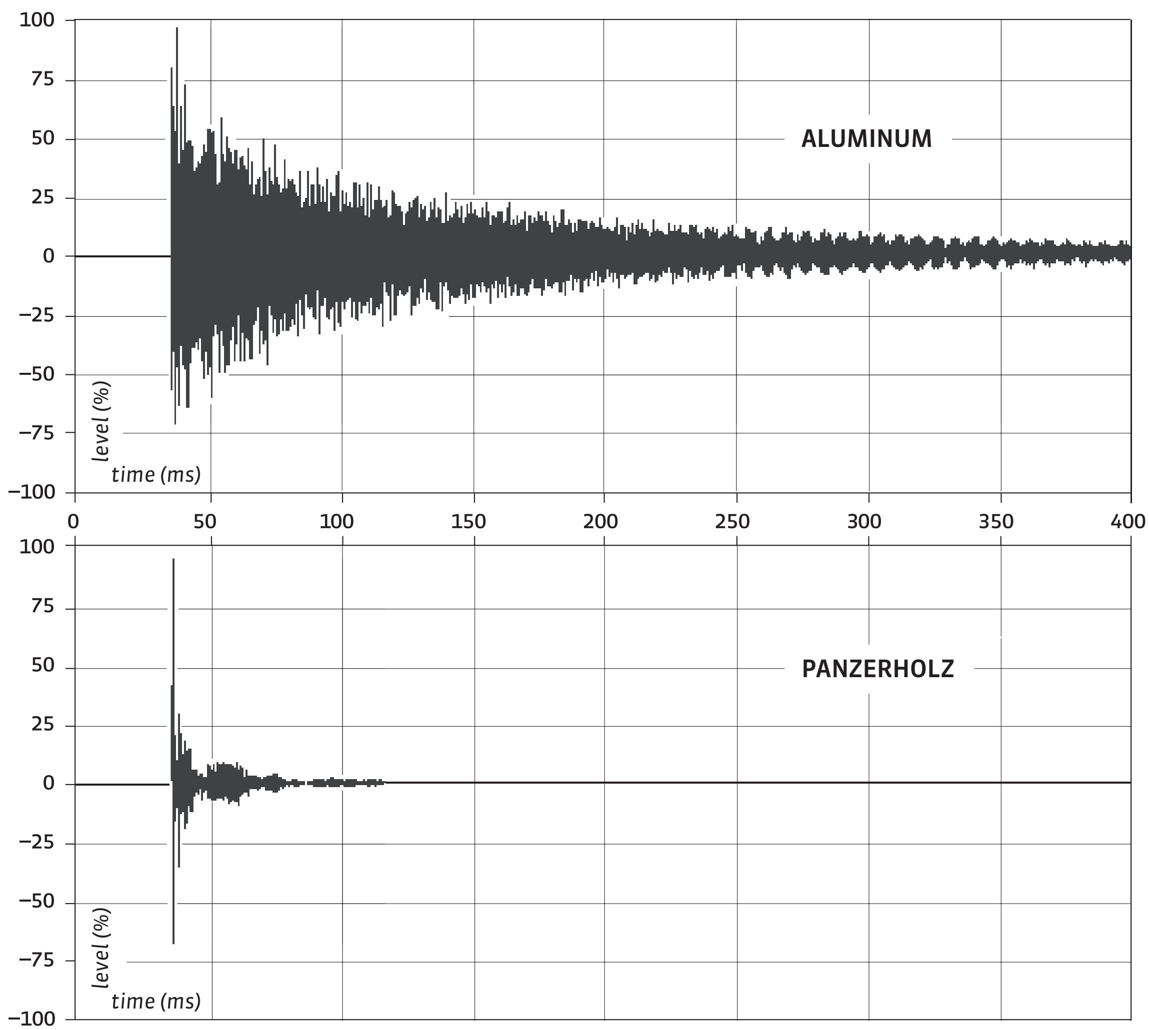
PANZERHOLZ **mp3 | 48 kHz / 24 bit**

They are both exactly the same level (0 dB on the digital scale) and both are exactly the same length in time, so they can be compared directly to reveal useful, informative data. The original full-resolution files are provided as well, so that you may run your own analysis with your own equipment under any aspect you deem important to investigate further.

Round one The first knockout

Using these two samples' strikes, we now run the first test. What you see here are two waveforms which depict the amplitude of each wave (vertical axis) over time (horizontal axis).

ALUMINUM AND PANZERHOLZ WAVEFORMS



Aluminum and **Panzerholz** test blocks in direct calibrated comparison, struck once each, with acoustical energy decaying over time.

In both cases, the image scaling settings of time and level are identical. Both strikes occur after 35 milliseconds of silence. Panzerholz is silent again at about the 120ms mark, whereas the Aluminum test block continues to ring even well after a half of a second (beyond visible window).

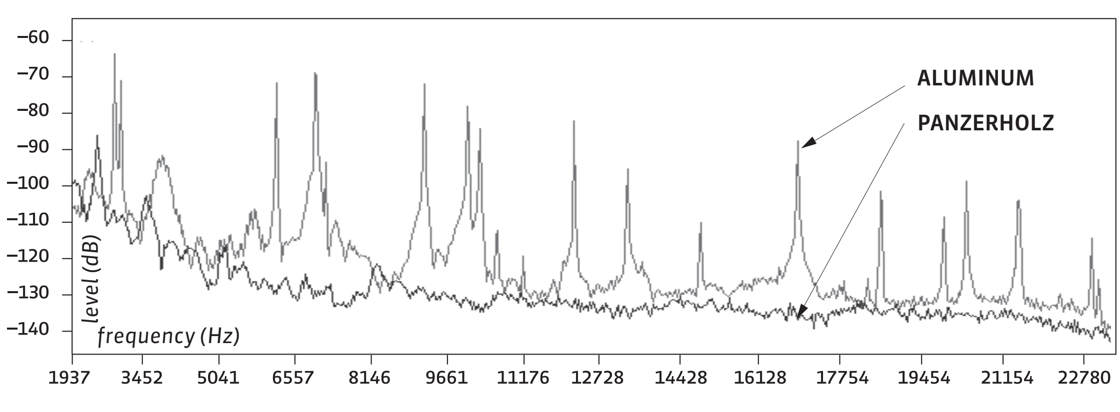
What we see here What it means

The above results are calibrated. This means that the peak level (0 dB, or 100% amplitude) that the microphone registered are identically large in both the Aluminum and Panzerholz strikes. But be aware of the following logic, please. This doesn't necessarily mean that the two strikes were of the same physical velocity. It means only that the first acoustical wavefront's peak hitting the microphone's membrane moved it the exact same distance in both cases. The hammer was on the far side of material, when viewed from the microphone. Who's to say that the Panzerholz material didn't first absorb much of the acoustical enegry from the initial strike of the hammer before this acoustical energy left the Panzerholz and reached the microphone? So what we are seeing here is a calibrated comparison, not of two strikes' equal initial impact, nor of their equal velocities upon impact, but of equal initial acoustical energy transmission from object to microphone. Hence, our test is clearly not about the hammer. It is about the intrinsic acoustical damping properties of these two materials, when left uninhibited by any other influences except their own ability to dissipate acoustical energy which began in both instances at the same calibrated, known level.

Round two The second knockout

We see clearly by comparing the two curves that the Aluminum test block displays pronounced and clearly definable frequency resonance characteristics, whereas the Panzerholz block appears to show almost no such resonant behavior.

ALUMINUM AND PANZERHOLZ FREQUENCY SPECTRUM

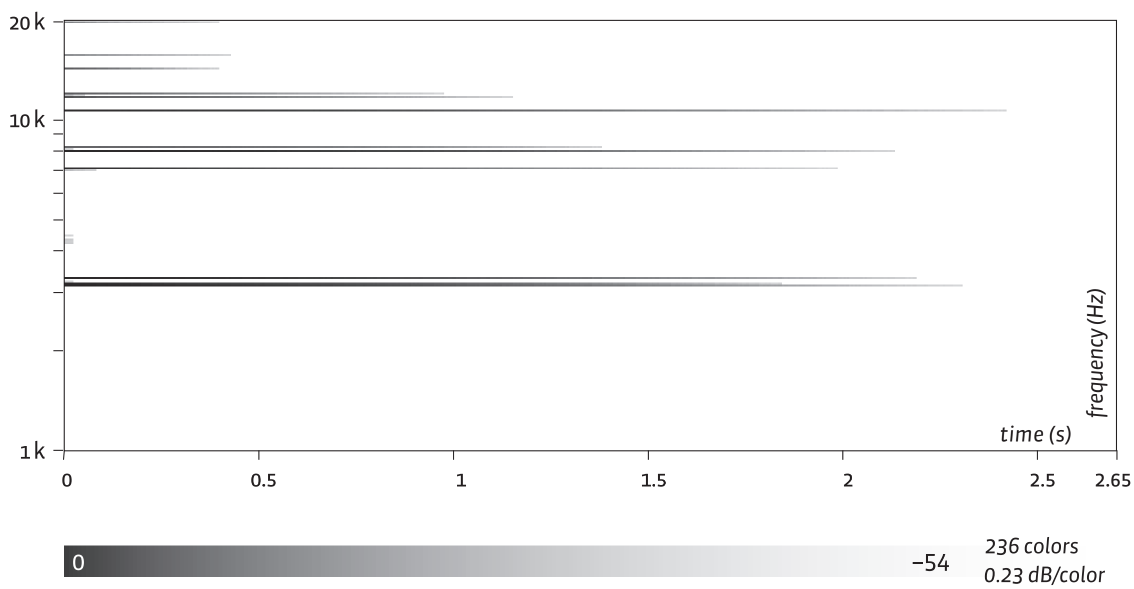


The Aluminum sample's resonant peaks are extremely pronounced and clearly discernable as frequency resonations, whereas **the Panzerholz sample** displays no such obvious tendency.

Round three The third knockout

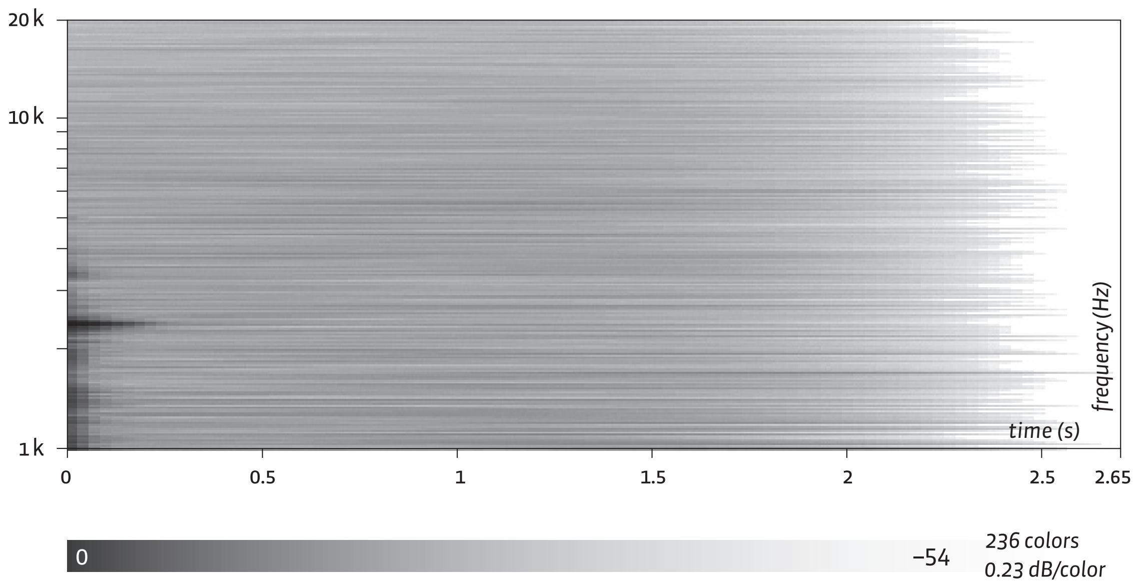
Now, taking our analysis a step further, we combine the acoustical frequency response data for each material under test with the time it takes for these frequencies to dissipate. We see how each frequency (on the left) fades out in intensity (color heat gradation) over time (horizontally). See how clearly these 2 and a half seconds describe the behavior of both equally suspended materials. Here we see not only how long they ring (which we saw above in the wave form graphs); now we see which frequencies ring for how long, selectively.

ALUMINUM SPECTROGRAPH OVER TIME



Aluminum spectrograph over time. We see the obvious spectrum of resonances of only a few select frequencies. The energy from the single strike immediately excites the block's resonant frequencies, and these pronounced resonations remain for different periods of time as the acoustic energy dissipates out of the block and disperses into the air.

PANZERHOLZ SPECTROGRAPH OVER TIME



Panzerholz spectrograph over the same amount of time. Note the almost perfect homogeneity and synchronicity of the fading out of all frequencies. As time passes towards the right, all of the individual frequencies behave in almost exactly the same way, dispersing the initial strike into an immediate all-frequency "noise" instead of into clear and long-lasting resonantions of select frequencies. It seems that the brighter areas in the first 0.1 second interval coincide with the sound of the metal hammer used to strike the Panzerholz block. If one listens closely, there is clearly an audible metallic type sound at only the very beginning of each strike.

The new champion Bring on the fireworks

In terms of acoustical damping properties, it is in two aspects, namely, the spectral homogeneity, as well as in the short-livedness of the resonation, where all the quality lies.

This immediate dispersal of the energy from the strike into an amorphous dissipation of acoustic energy without displaying a definite sonic signature means that Panzerholz is miles ahead of Aluminum at performing spectrumless, neutral vibration absorption. Aluminum has shown to portray characteristic "tones" which ring like a bell at certain pronounced frequencies, and does not dissipate acoustic energy in a neutral, even manner.

Aluminum's great for soda pop cans, though. Cool-looking hub caps, too!