

Excerpts from NS 8178:2014. Optimum values of reverberation time for various types of music for a given size hall.

### Reverberation Time - what is the optimum value?

In a given size venue the so called reverberation time has to be able to be lowered by 50% in the crucial frequency bands in order for the hall to sound equally optimal whether for chamber music, a brass orchestra or a rock band. This is a fact and is stated by for instance the Norwegian standardization organization, Standard Norge, in the standard NS 8178:2014\*).

This has never been remotely possible before due to at least 3 reasons:

- 1) The reverberation time range has not been wide enough
- 2) The reverberation time has been modified at the incorrect frequencies (much more so at high frequencies than at low)
- 3) Former variable acoustics technologies have been challenging to incorporate into the interior design.

The present technology makes up for all of these shortcomings.

\*) It should be noted that the NS 8178:2014 is too limiting regarding larger halls for amplified music according to research. This has been compensated for in the above figure.

The product complies with relevant building regulations  
The technology is patented

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**Flex Acoustics™**

One hall - all musical genres





4 modules side by side. The steel modules can be mounted both on wall and ceiling surfaces. Here the modules are seen in their closed state.

## One hall - all musical genres

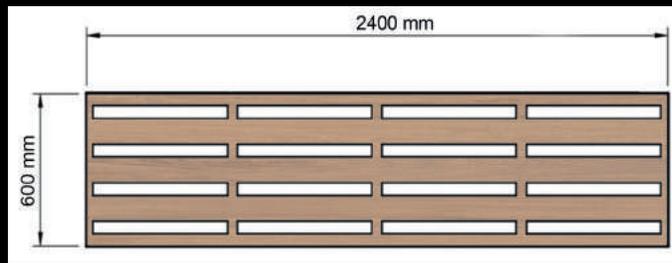
With a brand new technology from Flex Acoustics as of 2019, music halls can now for the first time, present any style of music as well as theater and even cinema, with optimal acoustics and sound. The technology is not visible, but rather, embedded in the interior architecture.

The technology consists of numerous modules mounted on ceiling and wall areas, in a large enough quantity to reach the acoustic variability desired by the hall management. Each module measures 240 x 60 cm and can be mounted on both wall and ceiling surfaces. Various surface materials, such as wood, can then be mounted onto the modules.

They are either opened to let sound enter to be absorbed, or closed to reflect sound - with the flick of a switch. These modules, when in the open state, have a high absorption coefficient at lower frequencies but not at high. This has been proven to be essential for an ideal sound at pop and rock concerts. When closed, the hall will present a long reverberation time essential for classical music genres.

Typically, a large share of the ceiling area must be covered as well as a portion of wall areas. The modules are connected in a number of circuits, for instance three or four, as recommended by an acoustic consultant. Each preset fits one specific musical genre.

Ventilation ducts, fire-sprinkler systems, lighting, etc are hidden in the cavity behind the Flex Acoustics variable modules.



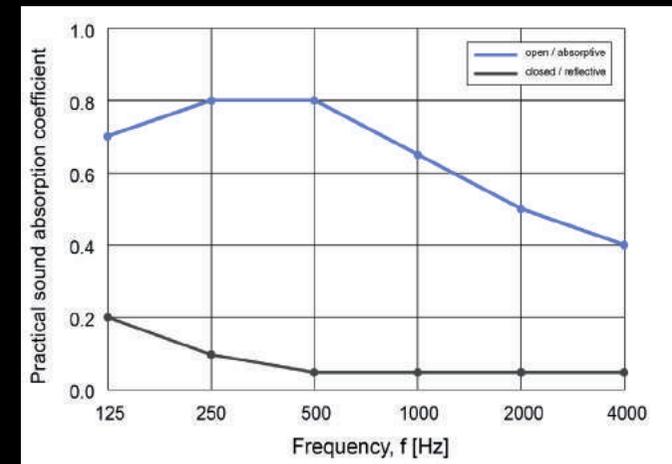
Surface panels of any finish can be mounted flush onto the variable steel modules. Hence the design possibilities are endless.

## Chose any surface finish for the interior design

Surface panels with various finishes can be mounted flush onto the variable modules. The modules are thereby embedded in the interior architecture. The architect as well as the hall executives can thus decide which design finish they want in the hall. Panels can be lacquered or have finishes of any type of wood veneer. The surface panels are appropriately perforated in front of the opening parts of the variable modules and comply with normal building regulations.

The surface panels can attain various perforation patterns. An acoustician and an architect confirm that panels are perforated correctly. They will advise where to mount the variable Flex Acoustics modules in order to achieve the variability sought after by the hall management. The modules can be connected into circuits, of for instance, 4 presets each of which fits one musical genre.

The hall appears visually exactly the same regardless of which preset is chosen. The variable modules themselves are painted in matte black, or any other desired color and can be left without surface panels.



Certified measurement of absorption coefficients of the steel modules in their opened and closed states. Please contact Flex Acoustics for full report.

## Certified measurements by Delta Acoustics, Denmark

- According to the test method EN ISO 354:2003
- 7 modules side by side - total surface area: 10,1 m<sup>2</sup>
- Total depth of construction: 400 mm
- Sound absorption material: 90 mm mineral wool with acoustic lining on both sides
- Air cavity behind mineral wool: approx. 200 mm
- The specimen was mounted as Type E-400 mounting on the concrete floor of the reverberation room
- Each panel measures 2400 x 600 mm and weighs approx 50 kg all included.

With the 0,2 absorption coefficient at 125 Hz in the closed state the hall will be naturally tamed and will not need significant other permanent absorption at this frequency.

It is evident that with air cavities greater than 200 mm, low frequency absorption can attain higher values than what is seen in the diagram above. Acousticians can order other types and thicknesses of absorption material than used in the test and chose the depth of the air cavity.

The variable modules can be mounted in a zigzag pattern to obtain a better sound-diffused room and can be mounted horizontally.