10/2008

PERFORMANCE CEILINGS

More scope for innovation

EDUCATION

MADE IN GERMANY

NEW SOLUTIONS FOR EDUCATIONAL BUILDINGS

INDEX

AMF product literature has been redesigned.
The Education brochure is Part 1 of the application series.
Programmes 1 to 6 provide detailed information on product performance.
Receive all the new AMF brochures by completing the fax reply card, or download at www.amfceilings.co.uk

Acoustics in classrooms and lecture theatres

Acoustics in classrooms are a subject of considerable interest to both education and construction sectors.

Poor acoustic conditions are often found in these rooms. Designers and acousticians realise that rules of acoustic design - which have been known for many years - are being ignored. Teachers are frustrated that education authorities and contractors have the wrong priorities.

Exposure to noise has an immediate effect on the mental state of both pupils and teachers. Consequences include poor speech comprehension, reduced attention and concentration and greater psychological instability. Short term memory suffers and noise also promotes aggressive behaviour.

The main requirements for classrooms and lecture theatres are:

- Very good speech comprehension
- Correct transmission of speech
- Restricted noise from outside the building and from adjacent spaces
- Good acoustic conditions generally within the room itself

A major survey has been carried out in both occupied and unoccupied classrooms. These areas were further differentiated between those with and without any acoustic treatment. Measured speech comprehension was significantly worse in the untreated rooms, with several black spots found. Problems were increased in rooms occupied by children due to the higher noise levels caused by general activity within the rooms.

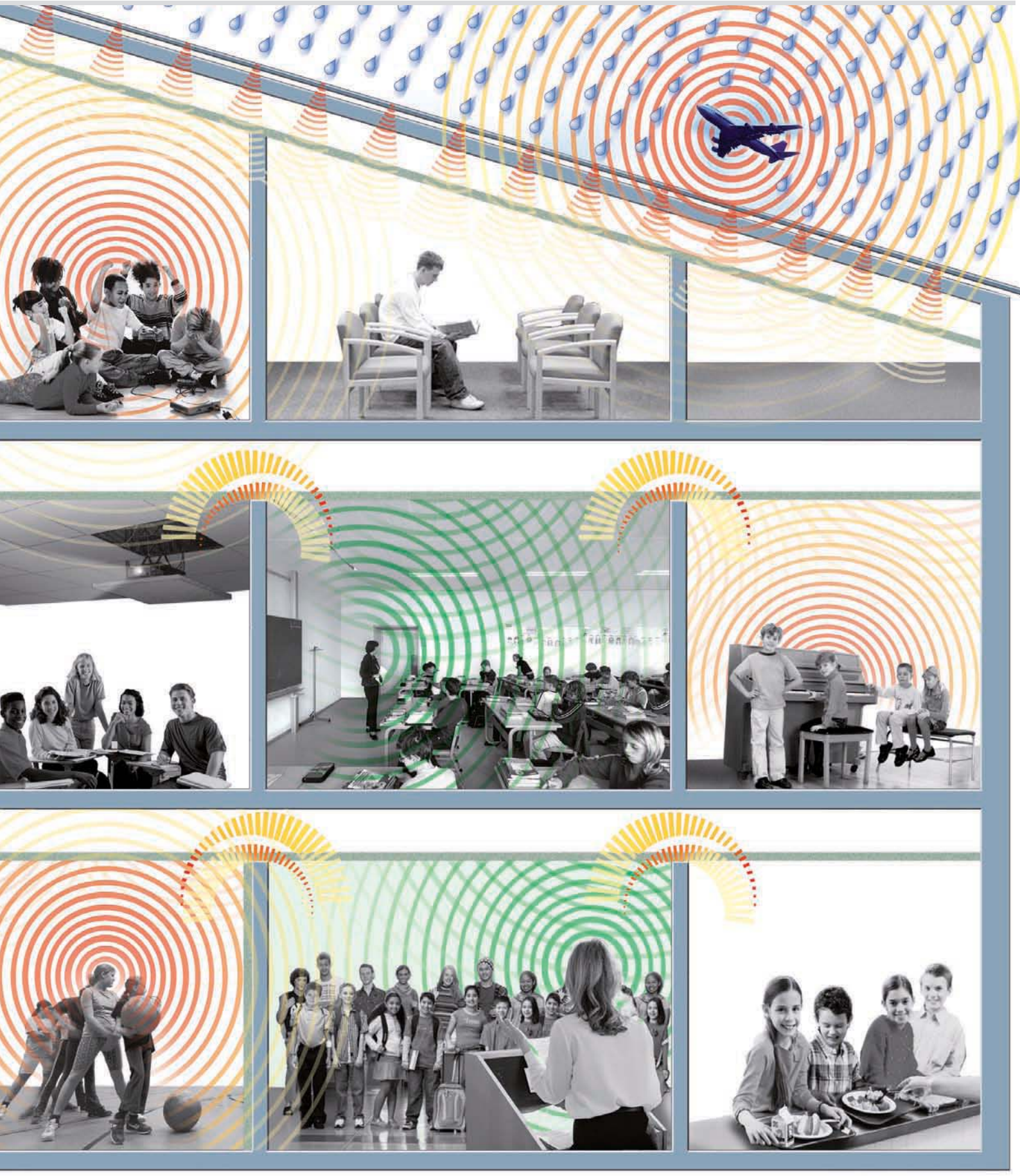
Results of a teachers‘ questionnaire revealed interesting facts:

Teachers who consider their classrooms to be noisy tend to
- suffer from regular headaches
- connect sore throats with their work
- are sick more often with throat problems

Teachers who consider their classrooms to be too reverberant tend to
- believe that acoustics influence their performance
- are convinced that pupils‘ performance and behaviour are influenced by the acoustics
- are absent through illness more often than other colleagues

This survey demonstrates that, when designing class rooms, acoustic considerations are important.

COMPLEX ACOUSTICS IN SCHOOLS



Reflection

An acoustic source produces acoustic waves, similar to the effect of a stone being dropped in a smooth pool of water. The waves spread evenly from the source and reach everywhere in the space. This acoustic signal provides information when it arrives at the listener. Sound waves which are blurred or absorbed by objects within the space have a major impact on intelligibility.

The human evolution of the ear and the brain - the users of sound information - has become accustomed to reflections and echoes from acoustic signals.

The crucial aspect is the length of delay in reflected sound reaching the listener‘s ear. If the time difference between the original sound and reflected sound is too long, the brain cannot establish the relationship between the sounds but treats them as separate signals. An example of this is the echo from a shout in the mountains.

If the time difference between the two sound elements is too short, this results in a space with ˝dead˝ acoustics, where reflected sounds are missed by the brain.
The result is a poor acoustical environment, disorientation and reduced speech comprehension.

Sound absorption

Characteristics of reflection and absorption are measured by the degree of sound absorption in a space. Every surface in a room has a sound absorption factor that affects the room acoustics. The sum of these factors produces an acoustic stored mental picture of the particular space. Take for example a church. Our mind visualises a number of impressions - resonating sounds, classical music, a high volume and long reverberation times. This is created by the geometry of the room and reflective materials such as marble floors and stone walls. By contrast a domestic living room creates the impression of warmth and peace. A small space and multiple use of absorbent materials such as carpets and soft furnishings create this mental image.

SOUND ABSORPTION

Reverberation time

Speech intelligibility depends on two factors: the ambient noise within the room and the reverberation time of the space.
The latter is the time, in seconds, required for reverberant sound in an enclosed space to reduce to a millionth (i.e. to drop by 60 dB) of its original energy level after the source of the sound is stopped. Reverberation times normally vary across the spectrum.

Ultimately the reverberation time is created by the size and number of reflections and absorbing materials within a given space. The planned application of the room defines within certain tolerances what reverberation times should be achieved. Recommendations for such reverberation times differ from country to country, as can be seen below:

Ideal reverberation times
For unoccupied classrooms (volume volume less then to 250 m^3)

- USA 0.4 – 0.6 s
- D 0.5 – 0.6 s
- I 0.6 – 0.8 s
- F 0.4 – 0.8 s
- CH 0.5 – 0.7 s
- S 0.5 – 0.6 s

Maximum for frequency range 250 - 4000 Hz.
For 125 Hz a 20 % higher value is allowed

Ideal reverberation times
For unoccupied **lecture theatres** (volume up to 250 m^3)

- USA 1.0 – 1.5 s
- I 0.6 – 0.8 s
- CH 0.6 – 1.0 s
- F 0.6 – 1.2 s

For the **aurally handicapped** there are naturally more severe requirements

- CH 0.3 – 0.4 s

The stated figures refer to **mid-range sound***
***Mid-range** = median of octave bands 500 - 1000 Hz
Reverberation time figures for the UK are summarised in BB93 and these can be found on page I of this brochure.

Reverberation time

To achieve a good acoustic environment the whole room needs to have the correct reverberation time. Particular areas such as classrooms have individual requirements and cannot be governed by universal guidelines.

Lecture rooms should be designed to ensure that the speaker's voice is clearly projected to the audience. Immediate reflection of sound waves carries the voice into the room. Unwanted noise, however, must be absorbed. The correct application of reflection and absorbing fields in the ceiling can create this balance.

To create a uniform ceiling that includes both absorbent and reflective tiles, AMF offers products that embrace these criteria.
Those are **THERMATEX Fine Stratos and Laguna in plain and micro-perforated versions and THERMATEX Acoustic.**

Visual contact - speaker to listener

A floor plan and the location of the audience must be designed in such a way as to maximise the link between speakers and listeners.
For the aurally handicapped good lighting is essential to aid lip-reading.

SOUND INSULATION

Sound insulation

Acoustic considerations for schools are often only concerned with sound absorption or reflection within classrooms.
However all rooms in schools are affected by external sound sources. These can be a variety of influences including noise from adjacent music rooms or sports halls: impact and airborne sound from rooms or corridors above: mechanical equipment within the building; and road or aircraft noise from outside.

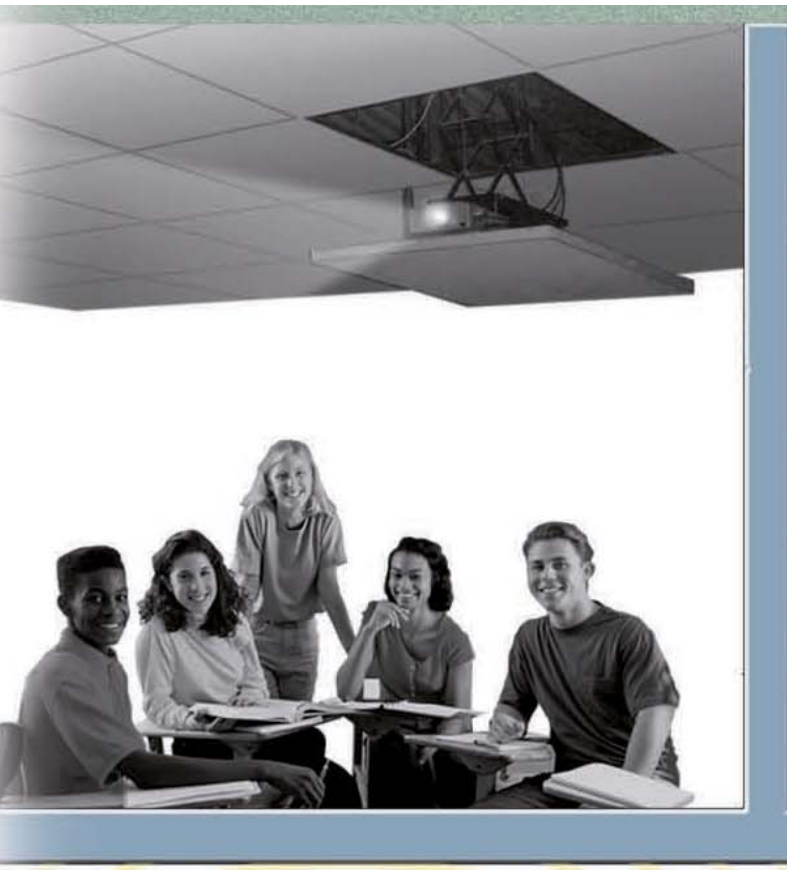
Speech Intelligibility is also governed by such intrusive noise so these effects have a substantial influence on the efficacy of a room and require detailed consideration.

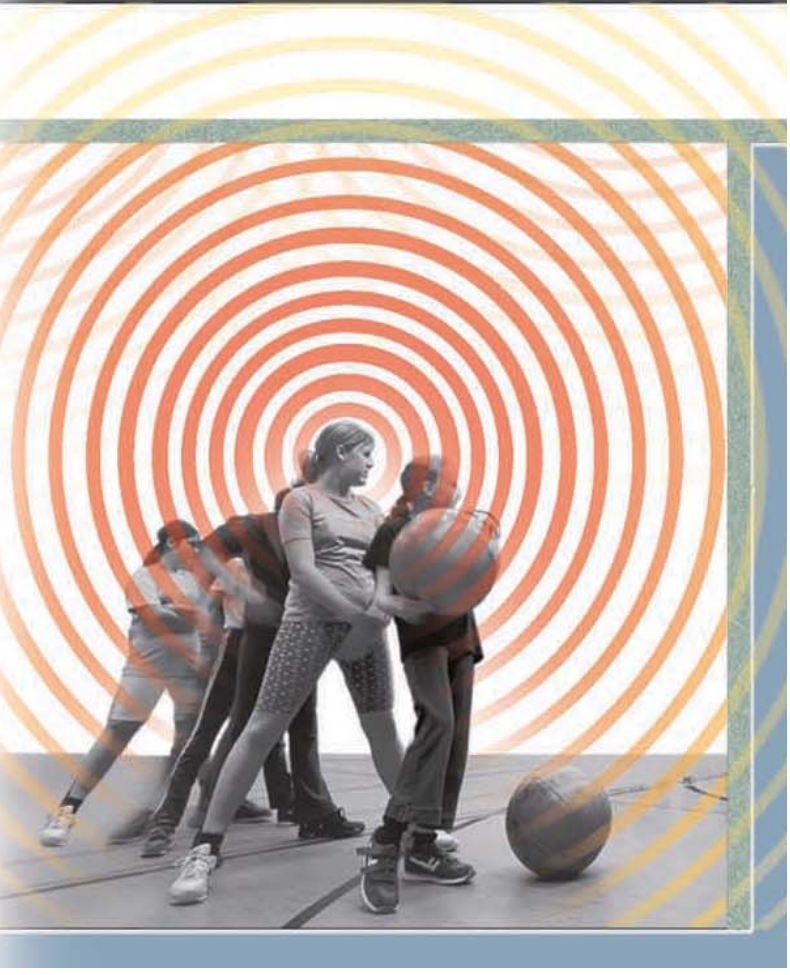
The process of isolating a room from external sound sources is called sound insulation. This reduces airborne and impact noise from the external sources and maintains a good acoustic ambience within the room.

Analysis of individual construction materials that applies to sound absorption is much less relevant for sound insulation. The latter requires the space as a whole to be considered, as a single weak element will create a negative effect. Sound leakage through a solitary point will spoil the sound insulation for the whole room. As a result national requirements such as DIN 4109 and British Building Regulations Approved Document E pay greater attention to sound attenuation factors to achieve optimal acoustic solutions.

Sound attenuation can be illustrated by the example of a water dam.
To raise the water in the dam to a higher level, the entire dam wall must be increased in height. If however there is a small leak in the dam wall, no amount of new construction will let the water level rise.

For high sound insulation requirements, such as in schools, the appropriate selections and adequate installation of building materials and systems is crucial.





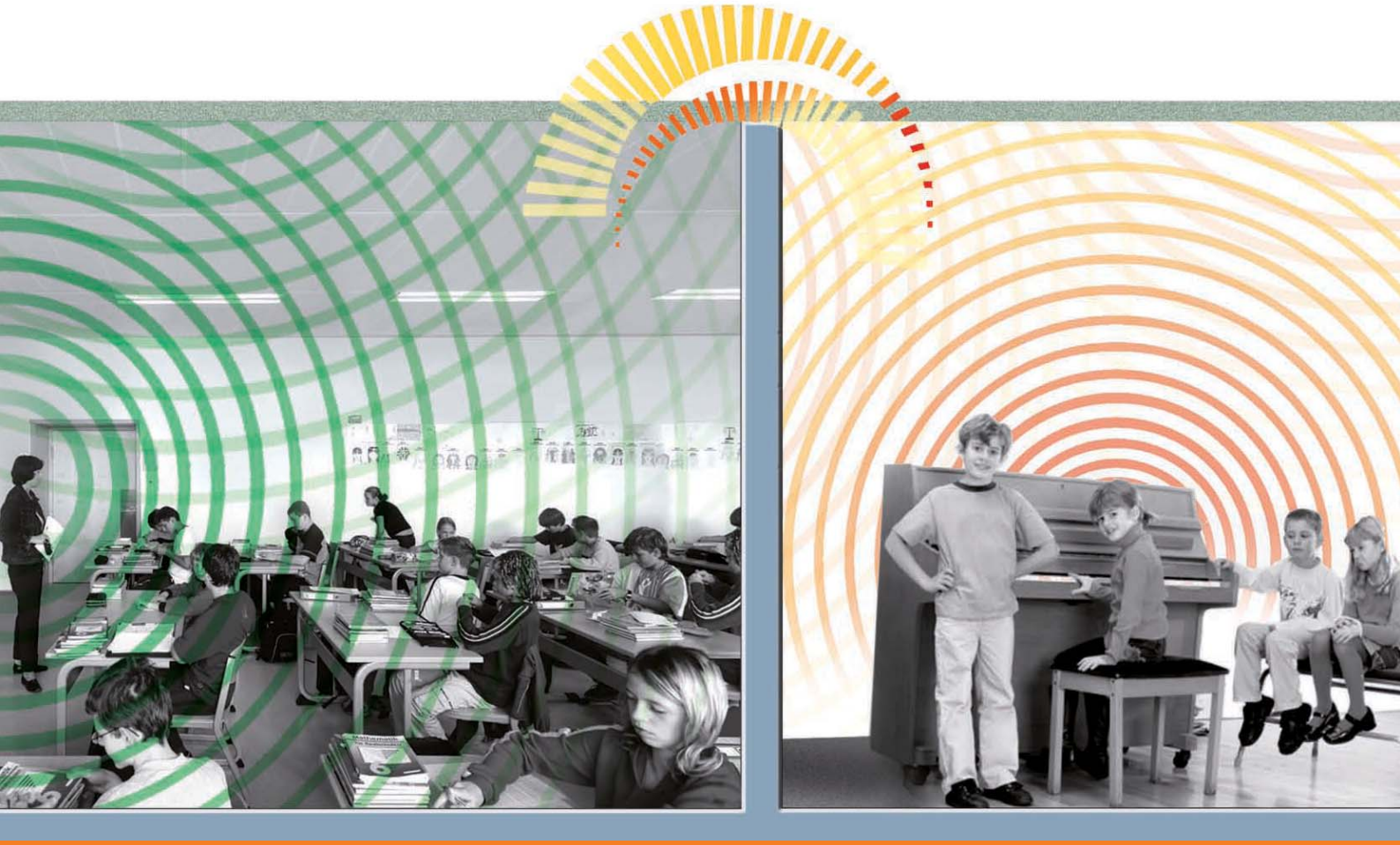
Sound attenuation between rooms

Sound attenuation controls the amount of noise transferring through a wall or ceiling into a neighbouring space. AMF ceiling products are tested to BS EN ISO 20140-3.

Materials such as suspended ceilings work in conjunction with the wall or soffit, providing an additional sound barrier and thus a means for improving the sound attenuation.

AMF Sound Insulating ceiling systems - such as THERMATEX Fine Stratos micro 600 x 600 x 40 mm (SK) in an exposed grid system - can achieve an R_W value of up to 31 dB without any added insulation. Such performances mean good levels of noise control from above to below can be achieved, which is ideal for lightweight roofs (noise break in and rain noise control) and also for enhancing thin concrete slabs.

SOUND INSULATION

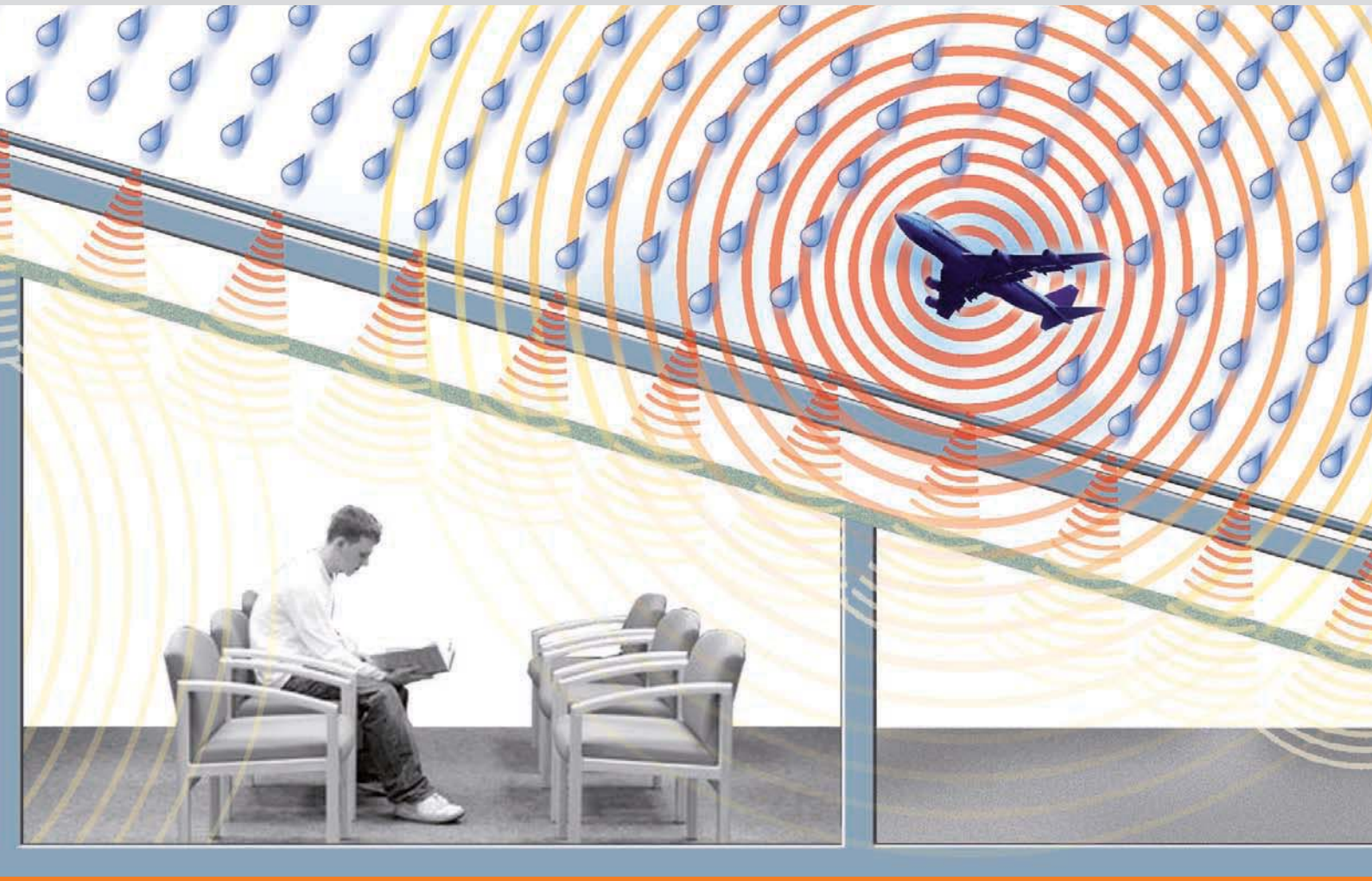


Sound attenuation

The standard test for suspended ceiling systems is to measure the room-to-room sound insulation in accordance with EN 20140-9. With a defined void depth of 650 - 760 mm and a common ceiling plenum above adjacent rooms, the sound passes from one room through the ceiling twice and into the receiving room. The result is the normalised level difference measured as a D_{nc} value.

This is a laboratory test under controlled conditions. Practical performance on a building site is substantially affected by flanking sound, the structure borne transmission of sound along walls, floor and ceiling slabs, and also noise via service channels and other integrated systems.

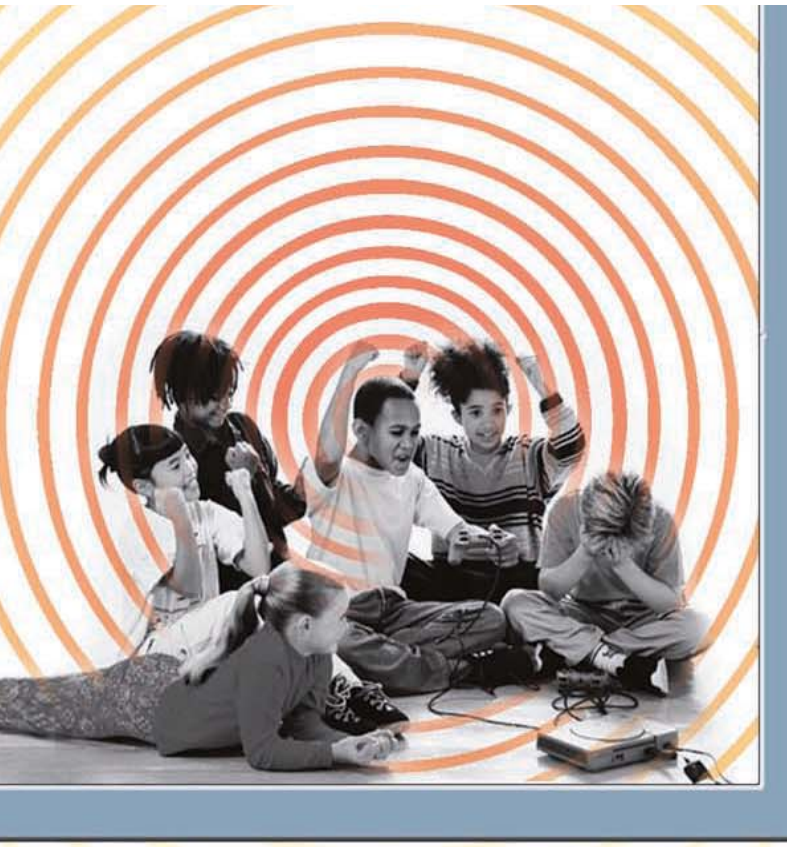
THERMATEX Silence dB and THERMATEX dB Acoustic ceiling tiles provide exceptional sound attenuation with room-to-room insulation values of up to 43 dB. With the addition of low density mineral wool on the back, these values can be increased further. This means that it is possible to meet the horizontal room to room requirements even in circumstances where it is impracticable to build the partition up to the floor slab or roof due to either services in the ceiling void or by use of a profiled composite slabs or roof liner tray.

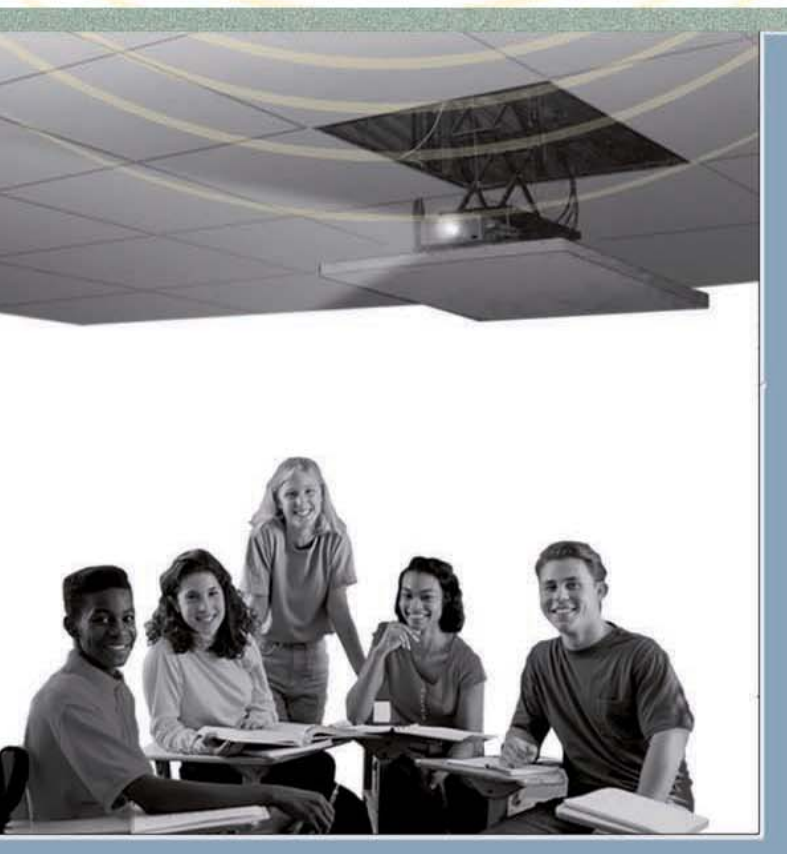


External sound insulation

Environmental noise sources have recently been given greater consideration and new test methods are being developed to deal with specific concerns.
Draft international standard ISO/CD 140-18 is the laboratory measurement of sound generated by rainfall on building elements.
With rain noise levels in buildings as high as 70 to 80 dB, this can have a dramatic effect on speech intelligibility.
Tests have been made with and without an AMF suspended ceiling system under a metal roof system. 19 mm THERMATEX and THERMATEX dB Acoustic ceiling tiles have reduced rain noise by up to 16 dB which is subjectively three times quieter.

SOUND INSULATION

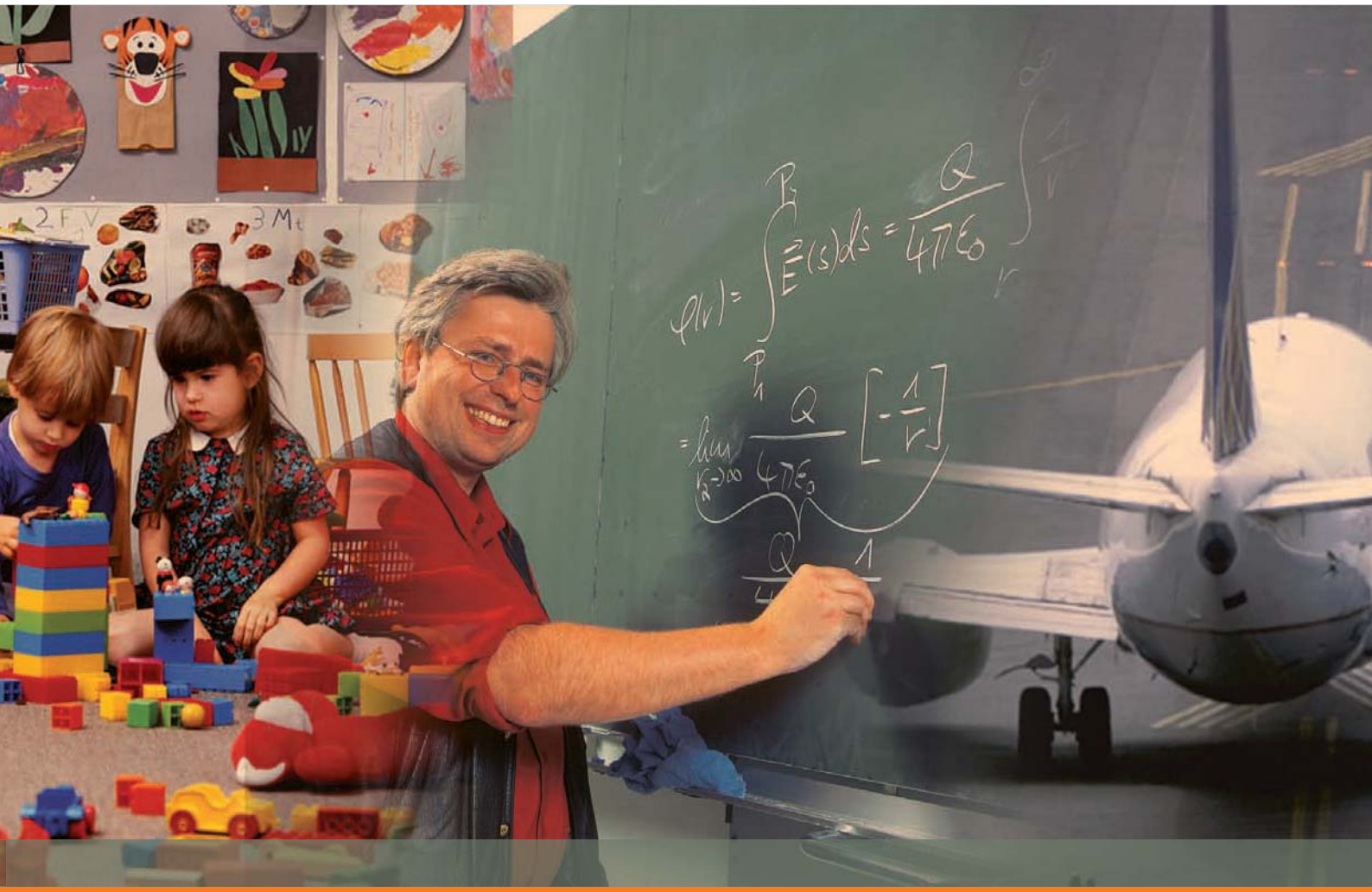




Impact sound insulation

Impact sound can be created by the noise of footsteps from the floor above travelling down through the void and the suspended ceiling. This is tested by measuring the sound pressure levels in the receiving room from noise created by a tapping machine placed on the floor in the room above. Field measurements are in accordance with ISO 140-7 and evaluated as per ISO 717-2.

Very good test results have been achieved with THERMATEX Acoustic and THERMATEX dB Acoustic ceiling tiles. These results can be further improved by the use of anti-resonation suspension hangers.



Requirements

Recent studies have shown that in a room there should be a maximum noise level of 38 dB (A) - at least 5 dB below speech volumes.
Assuming that a percentage of students will always have hearing problems (in Germany 15 to 20 per cent of all pupils have aural difficulties), then ideally, external noise levels should be reduced to 35 dB (A).
According to a U.S. study over 11 per cent of students have hearing problems, affects their speech comprehension and learning ability.
As a result every third child with impaired hearing repeats at least one year during schooldays. Bad classroom acoustics are in part responsible. Even students with perfect hearing can struggle to understand a teacher's voice that is compromised by background noise.
Within a teaching room there can be significant noise elements including overhead projection equipment and ventilations systems. These noise sources must be considered in terms of the above requirements.
External noise from traffic or aircraft as well as from other rooms within the same building must be evaluated to meet the minimum requirements of regulations such as BB93.

Maximal levels of external noise

UK	35 dB for normal teaching spaces and 30 dB in rooms for the aurally impaired.
D	40 dB, 35 dB in certain cases
F	40 - 50 dB for schools other than nursery.
	43 - 55 dB for nursery schools.

At design stage it is important that specifications incorporate the right acoustic options. AMF can give advice on the performance characteristics of the acoustic tile range, including free reverberation time calculations.

CEILING SOLUTIONS

AMF Acoustic ceilings

THERMATEX Alpha, THERMATEX Acoustic and THERMATEX dB Acoustic, THERMATEX Comfort and Kombimetall ceilings offer excellent noise protection characteristics. The special products combine high sound absorption with exceptional sound insulation.
Within the room sound is absorbed while external noise - from adjacent spaces or outside the building - is reduced.

THERMATEX Alpha

THERMATEX Alpha is a newly developed mineral acoustic ceiling tile with a tissue facing. In addition to its Class A sound absorption THERMATEX Alpha also offers both fire protection and the options of hygienic treatment. As a wet-felt mineral tile it has excellent physical properties, assisting handling and installation.

α_w = 0,90 as per DIN EN ISO 11654 / NRC = 0,90 as per ASTM C 423
$D_{n,c,w}$ = 26 dB as per DIN EN 20140-9 (19 mm thickness)

Further information on our products can be found in AMF Parts 1-6.

THERMATEX Acoustic

THERMATEX Acoustic is a 19 mm thick ceiling tile made from a specially perforated mineral board and an acoustic fleece facing. The perforations provide excellent sound absorption while the fleece offers a smooth, elegant surface finish. The combination of high density, bio-soluble mineral wool with clay and starch provides excellent physical characteristics, particularly for acoustic performance.

α_w = 0,65 (H) as per DIN EN ISO 11654 / NRC = 0,70 as per ASTM C 423
$D_{n,c,w}$ = 38 dB as per EN 20140-9
($D_{n,c,w}$ = 40 dB for semi-concealed planks)

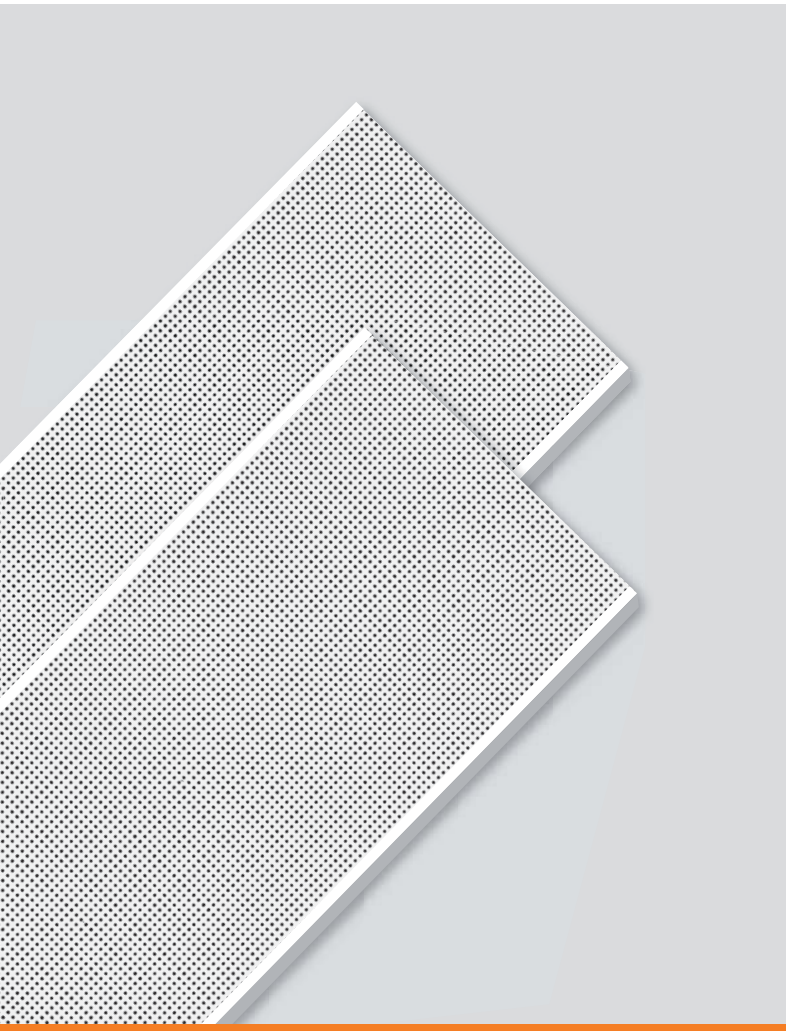
THERMATEX dB Acoustic

THERMATEX dB Acoustic is the ideal solution for high sound attenuation requirements.
Additionally good levels of sound absorption are achieved and the white unperforated surface creates an excellent appearance.
The combination of high density, bio-soluble mineral wool with clay and starch provides excellent physical characteristics, particularly for acoustic performance.

THERMATEX dB Acoustic (24 mm thickness)
α_w =0,65 (H) s per DIN EN ISO 11654 / NRC=0,70 as per ASTM C 423
$D_{n,c,w}$ = 41 dB as per EN 20140-9
($D_{n,c,w}$ = 43 dB for semi-concealed planks)

THERMATEX dB Acoustic (30 mm thickness)
α_w =0,65 (H) s per DIN EN ISO 11654 / NRC=0,70 as per ASTM C 423
$D_{n,c,w}$ = 43 dB as per EN 20140-9

CEILING SOLUTIONS



THERMATEX Kombimetall

AMF THERMATEX Kombimetall, a metal ceiling plank with a mineral core, meets high performance requirements for both acoustics and fire protection.

THERMATEX Kombimetall is a composite product, used without the need for further sound insulation materials. THERMATEX Kombimetall can be installed as a free-span corridor plank (System F) or as a modular panel in a fixed grid ceiling (System I). Downlighters and sprinklers can be easily integrated into the plank. THERMATEX Kombimetall combines the appearance of a metal ceiling with the fire resistance, acoustic performance and easy installation of all AMF ceiling systems.

α_w = 0.65 (H) as per DIN EN ISO 11654 / NRC = 0.70 as per ASTM C 423

$D_{n,c,w}$ = 42 dB as per EN 20140-9

The absorption performance of this system comfortably meets the UK's BB93 requirement for ceilings if used throughout corridors and circulation spaces.

THERMATEX Comfort

AMF THERMATEX Comfort offers excellent fire protection and enhanced acoustic performance.

THERMATEX

- Fine Stratos
- Fine Stratos micro
- Star
- Mercure

$D_{n,c,w}$= 38 dB as per EN 20140-9 (19 mm thickness)

$D_{n,c,w}$= 40 dB as per EN 20140-9 (planks)

Further information on our products can be found in AMF Parts 1-6.

Exposed System C

System C utilises the popular exposed suspension grid as a proactive element in ceiling design. Square edged (SK) ceiling panels are laid into the grid and give a flush visual appearance. Tiles with recessed edges (VT) allow greater creative design options with both 24 and 15 mm wide tee sections. All tiles are independently demountable, giving access to the ceiling void at all points.

Exposed System F

System F is a free span ceiling system that is ideal for corridors. Spanning from wall to wall without intermediate fixings, AMF System F planks are available with both demountable and non-accessible edge details.
A wide range of THERMATEX face patterns are available, as well as THERMATEX Acoustic and THERMATEX Kombimetall.

SPECIAL REQUIREMENTS

Fire protection

Fire safety in schools and educational buildings is paramount. Fire resistant ceilings can help to protect escape routes and provide fire compartmentation.

Die selbstständigen Brandschutzdecken

- F30 Uno / + Metall
- F30 Dual + Metall
- F30 Mono

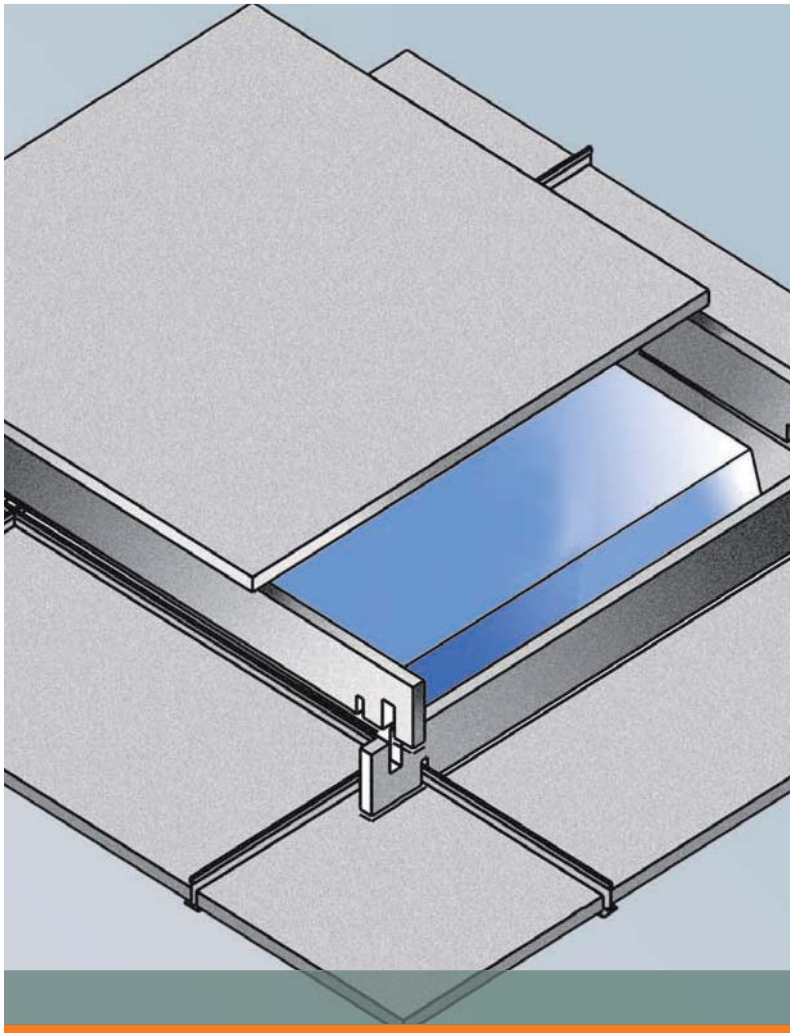
bieten sehr hohe Sicherheit, hohe Funktionalität durch Revisionierbarkeit, guten Schallschutz und schöne Optik.

All AMF products meet Class 0 and Class 1 for reaction to fire requirements and many AMF systems provide structural fire resistance.

AMF THERMATEX Acoustic and THERMATEX Kombimetall tiles give up to 60 minutes fire protection to both steel beams - BS 476: Part 23 - and timber joists for the BS 476: Part 21 test.

Specialist panel and plank products are an important part of the AMF fire safety range, providing fire protection from above and below. Escape routes such as corridors are protected from fire above the ceiling while services in the void are safeguarded from fire in the space below.

AMF THERMATEX Uno, Mono and Dual panels all offer this specialist level of fire protection together with demountability and acoustic performance.



Light box

Providing fire protection for fittings such as luminaires and downlighters as well as ensuring room-to-room sound attenuation values are maintained.

Further information on our products can be found in AMF Parts 1-6.

Hygiene

In **kitchens, canteens** and other areas where food is handled, hygiene and cleanliness are key issues. AMF THERMATEX Thermaclean S and Kombimetall ceilings can be wiped down and cleaned with standard cleaning agents. In addition these products meet the Clean Room classifications 4 to 6 of European standard ISO 14644-1.

THERMATEX Thermaclean S

AMF THERMATEX Thermaclean S consists of a white vinyl foil laminated to a THERMATEX mineral board. A durable washable finish means THERMATEX Thermaclean S is ideal for applications where high hygiene levels are required.
$D_{n,c,w}$ = Up to 40 dB

SPECIAL REQUIREMENTS

Durability and humidity resistance

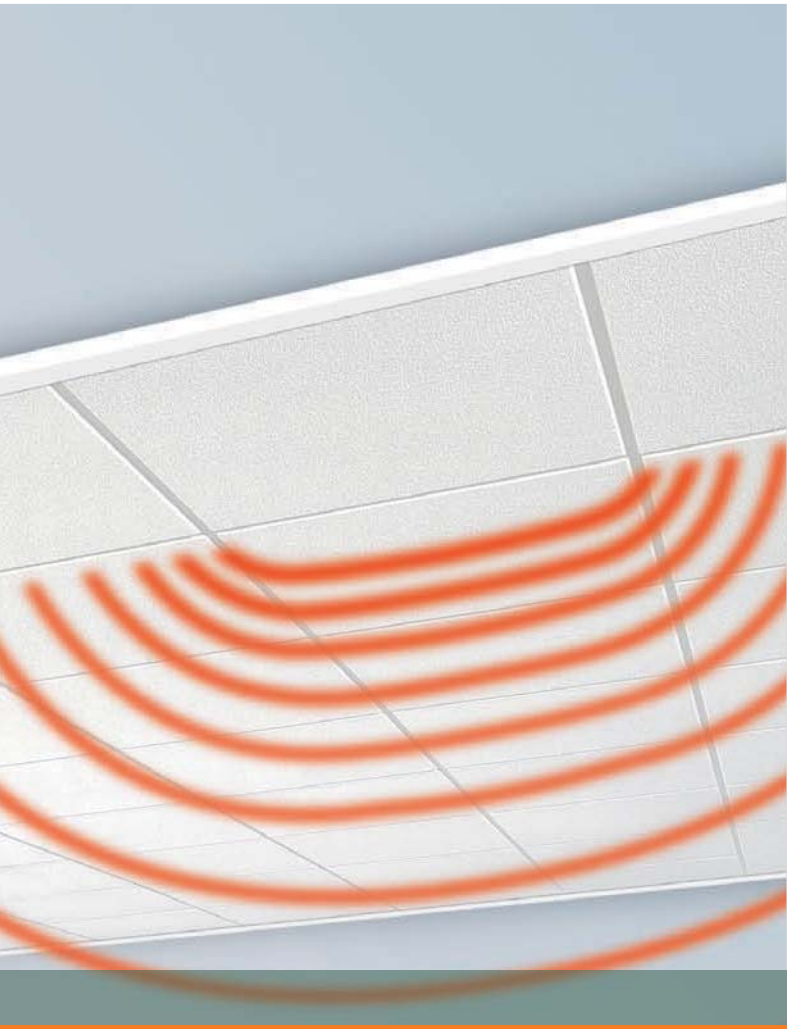
For a tough physical environment AMF FIBRAFUTURA ceilings offer excellent technical characteristics. Special installation systems for impact resistance make these tiles ideal for use in sports halls, swimming pools and outdoor areas.

Fibrafutura

AMF FIBRAFUTURA lightweight wooden ceiling tiles are made from wood fibres bound together with white cement. Available in different colours and with an attractive natural finish, FIBRAFUTURA offers good design options.

The excellent physical characteristics of FIBRAFUTURA include sound absorption and attenuation as well as resistance to high humidity levels and impact. For AMF FIBRAPHON is a Class A absorber, offering exceptional sound absorption ideal for Sports Halls and other large spaces.

Further information on our products can be found in AMF Parts 1-6.



AMF Soundmosaic

The AMF Soundmosaic is a flat panel loudspeaker for a modular ceiling. The Soundmosaic works on the principle of wave conversion, this means the mineral fibre ceiling tile is the loudspeaker itself and looks identical to the rest of the AMF ceiling.
The result offers a higher quality for both speech and music.

Beamex System

Modern technology is now an integrated part of the education process. Video and computer projectors as well as projection screens can be integrated into AMF suspended ceilings, controlled remotely, and given protection against theft and vandalism.
When required the panel is easily lowered and the projectors used immediately.

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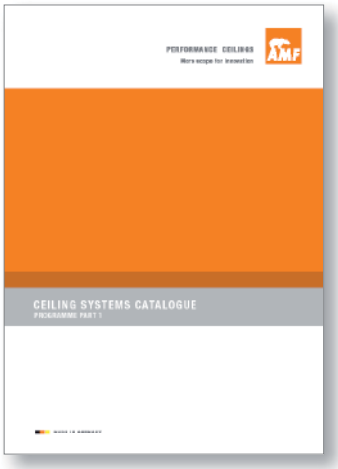

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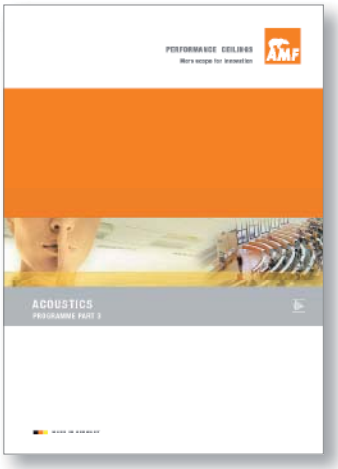

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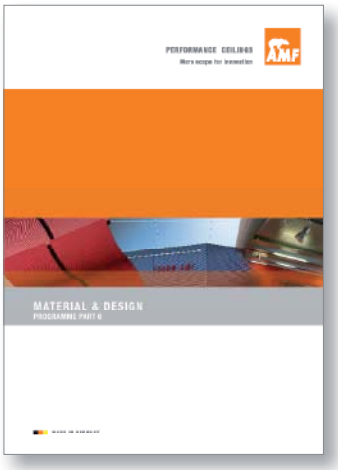

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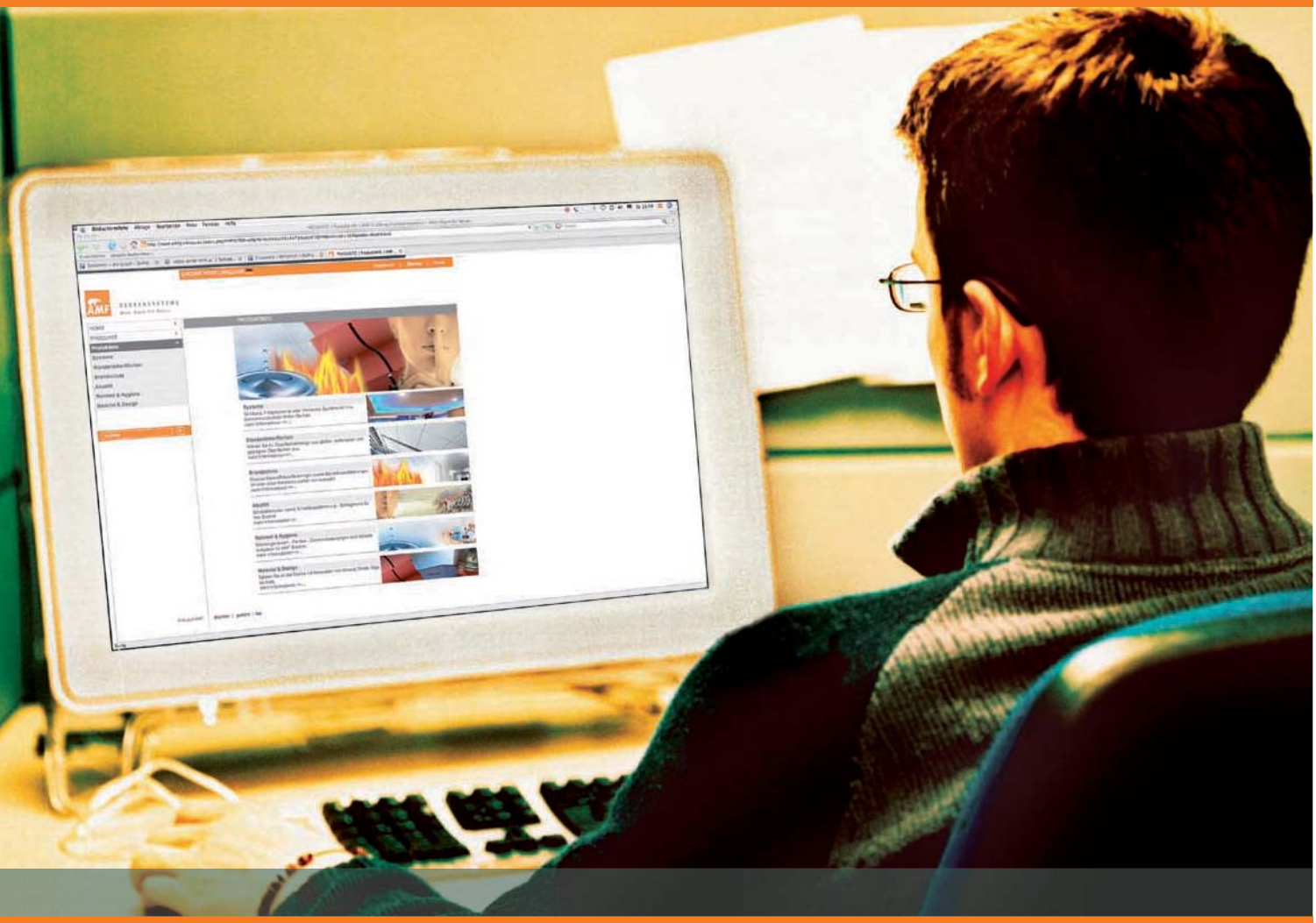

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