

# Education environments

Building Solutions for Active Spaces

## SpecSure™ lifetime system warranty

All of the British Gypsum system solutions listed in this guide are covered by **SpecSure**, a lifetime system warranty designed to protect the integrity of drywall system specifications and deliver reliable performance, unrivalled technical support and peace of mind for everyone involved in the construction team.

Unique to British Gypsum, the UK's leading specialists in drywall system design, development and supply, the **SpecSure** lifetime warranty is provided with every British Gypsum proprietary system designed and installed in accordance with the company's recommendations, as specified in the White Book and associated literature.

**SpecSure** is your guarantee that the system you have chosen:

- Comprises only the highest quality components, designed to work individually and in unison to deliver the quoted level of performance.
- Has the technical expertise and experience of the UK's leading drywall specialists behind it.
- Has been fully tested in the company's UKAS approved fire, acoustic, and structural test laboratories.
- Has been site tested to prove installation integrity and simplicity.
- Will be supported at every stage by the UK's leading on- and off-site technical support personnel.
- Will give trouble free performance throughout the life of your building.

### Qualifying for SpecSure™

All you need to do to qualify for the unique **SpecSure** lifetime system warranty for your project is to specify and install British Gypsum systems in line with the recommendations contained in the latest edition of the British Gypsum White Book and associated literature. The systems must comprise only branded British Gypsum components, as we are unable to guarantee that other manufacturers' components will meet our rigorous system performance and quality standards when installed in our tested systems. If you are unsure whether a particular system qualifies for **SpecSure** lifetime warranty, contact our Drywall Academy Advice Centre on 08705 456123, or email [bgtechnical.enquiries@bpb.com](mailto:bgtechnical.enquiries@bpb.com).

**SpecSure™** - system performance warranted for life



*More than 10,000 actual test and substantiation reports already available to underpin the performance of our systems.*



*Full technical support throughout the design and installation process.*



*Training support through our three purpose built Drywall Academy training centres.*



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# SchoolSpec

*SchoolSpec* is part of British Gypsum's *Building Solutions for Active Spaces* series, a portfolio of publications developed to provide

architects, specifiers and builders with leading-edge solutions and technical information. We are committed to market leading

innovation in support of our customers' needs.

*SchoolSpec* makes specifying for educational facilities easier and introduces a range of specifications which have been extensively tested and proven for use in schools.



**GYPROC**  
PLASTERBOARD PRODUCTS

**THISTLE**  
PLASTER PRODUCTS

**GYPFRAME**  
METAL PRODUCTS

**GLASROC**  
SPECIALIST BOARD PRODUCTS

**ARTECO**  
CEILING PRODUCTS

## Our approach

*SchoolSpec* is part of a portfolio of British Gypsum *Building Solutions for Active Spaces* publications. It is intended to assist specifiers, architects, building control, clients, contractors and acousticians involved in the design / development of educational buildings. The guide details the internal elements – partitions,

separating walls, linings, encasements and suspended ceilings – which can be used in specific end-use areas and which impact on the safety and lifetime performance of the school.

*SchoolSpec* considers the legislative and key design drivers which need to be taken into account in order to specify the appropriate internal element. The requirements for individual elements are fully assessed and specification solutions offered which will match the performance criteria.

**NB** The system solutions and specifications presented in *SchoolSpec* are intended for guidance purposes and are British Gypsum's interpretation of Building Bulletin 93 requirements.

British Gypsum products and systems have been fully tested against relevant British and European standards, measuring parameters such as structural performance, fire resistance, acoustics, thermal insulation, impact resistance, moisture resistance and condensation control. Our total solutions approach ensures that all performance criteria can be met. British Gypsum systems also perform well in terms of environmental impact of

manufacture, installation, service life and ultimate disposal of products used, which collectively result in reduced whole-life building costs. All systems are site-proven and engineered to meet legislative and design criteria in the most cost effective way. They are built from established branded products and components – *GYPROC*, *THISTLE*, *GYPFRAME*, *GLASROC* and *ARTECO*.

As market leader and innovator in the industry, British Gypsum has an unrivalled wealth of knowledge and technical know-how. Leading-edge technical resources enable the company to provide quality systems backed up by technical support services, system warranties, training and NBS specification clauses. Everything that you need in fact to meet the regulatory performance requirements.

## Specifying for schools

**SchoolSpec** covers aspects of educational building design that affect the interior environment. It addresses issues such as noise control between activity rooms, classroom acoustics and speech intelligibility, durability of interior linings, and fire protection for both life safety and asset protection.

Within the lifetime of a school building, different educational strategies and programmes will be developed and the building plan needs to allow for flexibility in use and future adaptability. British Gypsum solutions are highly versatile. **GypWall** partitions, for instance, can achieve all the specific levels of sound insulation and fire protection performance required for different activity areas within a school building. Certain areas of a school can be subject to greater wear and tear because of high foot traffic or intense use. These areas include corridors, lobbies, halls, common rooms, changing rooms and other public areas. By recommending the specification of Heavy and Severe Duty partitions and the use of high performance plasterboards such as Gyproc DuraLine, **SchoolSpec** solutions provide highly durable, fast to install alternatives to traditional masonry systems.

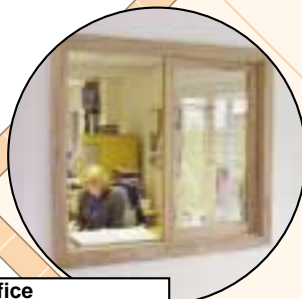
Many areas within a school are naturally high in moisture and humidity. The materials used in areas such as kitchens and gymnasium changing rooms need to be tolerant to this environment in order to avoid system failures or increased maintenance costs. Moisture resistant (MR) grades of

Gyproc WallBoard, FireLine and SoundBloc allow all the necessary acoustic and fire specifications to be met, whilst also providing tolerance to high moisture and humidity environments. MR grade boards also provide a suitable base for ceramic tiling in wet use areas, such as shower rooms and sink splash-back areas.

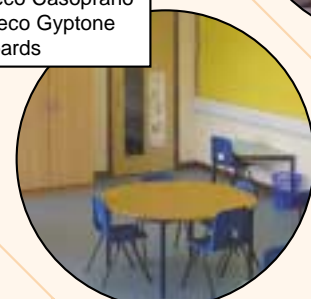
For suspended ceilings, British Gypsum Artec ceiling tiles can be used to provide the perfect room acoustics for optimum speech intelligibility. For ceilings used within gymnasiums and multi-purpose halls, the robustness of the lining should be considered, as often these ceilings are required to be sound absorbing – Artec Rigitone boards provide a solution.



**Main structure**  
● Fire protection to structural frame  
**Products** - Glasroc FireCase s



**School office**  
● Fire protection  
**Products** - Gyproc FireLine boards



**Classroom**  
● Speech intelligibility  
**Products** - Artec Casoprano ceiling tiles; Artec Gyptone ceiling tiles / boards



**Entrance hall**  
● Aesthetics ● Acoustic absorption  
● Impact resistant walls  
**Products** - Gyproc DuraLine boards; Artec Rigitone ceiling boards; Artec Gyptone ceiling tiles / boards



**IT room**  
● Fire protection  
**Products** - Gyproc FireLine boards

**Laboratory**

- Fire protection

**Products** - Gyproc FireLine boards



**Main hall**

- Acoustic absorption / insulation
- Speech intelligibility

**Products** - Arteco Casoprano ceiling tiles; Arteco Gyptone ceiling tiles / board



**Kitchen**

- Fire protection
- Moisture resistance
- Hygiene

**Products** - Gyproc FireLine boards; Gyproc moisture resistant boards



**Music room**

- Sound insulation / absorption

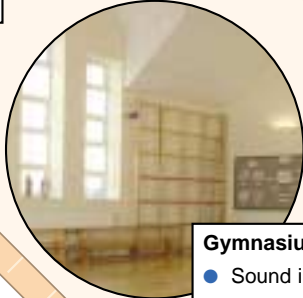
**Products** - Arteco Casoprano ceiling tiles; Arteco Gyptone ceiling tiles / boards



**Gymnasium / Sports hall**

- Sound insulation / absorption
- Impact resistance

**Products** - Arteco Rigitone ceiling boards; Gyproc DuraLine boards



**Corridor / Stairwell**

- Sound insulation
- Impact resistance

**Products** - Arteco Gyptone ceiling tiles; Arteco Casoprano ceiling tiles; Gyproc DuraLine boards



**Library**

- Sound absorption

**Products** - Arteco Casoprano ceiling tiles



Care should be taken when specifying ceilings within high humidity environments. Specification of gypsum based Arteco ceiling tiles such as Casoprano, Gyptone, or Rigitone, which are five times more tolerant

to free moisture than mineral fibre, will reduce aesthetic damage and whole-life maintenance costs.

In very severe environments such as changing rooms, kitchens and shower rooms, Gyproc tiles provide protection to relative humidity levels up to 90%. Gyproc Bio tiles combine biocidal protection with an

easy maintenance wipe clean PVC hygiene surface.

The comprehensive range of ceiling tiles and boards, combined with high performance plasterboard partitions, walls, and encasements allow a total specification to be prepared.

## Enhanced learning environments

It's time to think differently about our school buildings. Our physical environment can motivate us or discourage us. In schools this means that we need designs which will inspire good teaching, support productive learning, enhance pupils' wellbeing and prompt feelings of security.

With the increasing recognition of the role of good acoustics in optimising learning potential, best practice acoustic design is

becoming as important in schools today as books and equipment. For the school designer it creates a whole new set of challenges. From the initial design stage, the performance and inter-relationships between individual elements of the building need to be considered along with such issues as room size and shape, internal finishes, and the relative locations of the various quiet and noisy activities which are an essential part of everyday school life. Careful early planning in the location of activity areas such as gyms and libraries, for instance, can save serious problems occurring later in the project.

## The legislation

To ensure good acoustic design, the Department for Education and Skills produces recommendations for performance standards in schools, and guidelines on appropriate levels of sound insulation between different activity spaces, through their Building Bulletin series of publications. These recommendations are being enhanced to bring schools in line with the new Building Regulations Part E acoustic standards. From July 2003, Building Bulletin 93 (BB93) will come into force resulting in more demanding acoustic

requirements across a wider range of educational properties, more site performance testing, and the involvement of Building Control inspectors to ensure compliance with Building Regulation requirements.

The new Bulletin gives guidance on increased sound insulation levels with specific changes to benefit hearing and visually impaired pupils. The scope of the guidelines is extended to cover nursery schools and ancillary spaces adjacent to teaching areas. Sound absorption requirements are given for corridors, entrance halls and stairwells, designed to control the overall noise levels between common spaces and teaching / learning areas. The importance of speech clarity between teachers and students is acknowledged with the introduction of specific speech intelligibility standards for open plan spaces in schools.

The necessity for fire safe building design is governed by national Building Regulations, Approved Document B.





## Choosing the right system to meet the acoustic requirements

Good acoustic design enables people to hear clearly without distraction. This is achieved by:

- determining appropriate background noise levels and reverberation times for the various activities and room types

- planning the disposition of 'quiet' and 'noisy' spaces and separating them wherever possible by distance, external areas or neutral 'buffer' spaces such as storerooms or corridors

- using walls, floors and partitions to provide sound insulation

- optimising speech intelligibility by considering the room volume, room shape and the acoustic properties of the room surfaces.

## Planning activity areas

**Table 1 Performance requirements for adjacent activity areas**

	ACTIVITY ROOM			
	Nursery quiet room, Library quiet study area, Interviewing or counselling room	Primary / Secondary classroom / teaching area, Open plan teaching or resource area, Science lab, Library resource area, Office, Staff room, Audio visual, Classroom for hearing impaired	Swimming pool, Noisy corridor / stairwell, Toilet, Kitchen, Changing room, Metal / woodworking area, Indoor sports hall, Dance or drama studio, Gym, Music control room, Nursery playroom, Assembly hall	Music classroom, Performance or ensemble room, Recording studio
RECEIVING ROOM				
Swimming pool	G	F	D	A
Toilet, Kitchen, Changing room	G	F	D	A
Open plan teaching or resource area, Science lab, Metal / woodworking area	F	F	C	B
Library resource area, Office, Staff room	F	E	C	B
Indoor sports hall, Dance studio, Gym, Music control room	F	D	C	B
Nursery quiet room or playroom, Primary school classroom / teaching area	F	D	C	C
Music classroom, Library-quiet study area, Assembly hall, small music practice room	E	D	B	B
Interviewing or counselling room, Secondary school classroom / teaching area, Audio visual rooms	F	D	B	B
Classroom for hearing impaired	E	D	C	B
Drama studio	C	C	B	A
Music performance room	C	C	A	A
Performance or ensemble room, recording studio	D	C	A	A

**Notes:**

In using Table 1, it is a requirement of Building Bulletin 93 to consider both rooms as the 'receiving room' and take the most onerous performance solution e.g

Activity room	Receiving room	Performance required
Toilet	Classroom	C
Classroom	Toilet	D
<b>Solution:</b>		<b>C</b>

**A B C D E F G** Go directly to Table 1 (pages 25/26) for partition solutions  
Decreasing performance

**Table 2 Performance requirements for corridors, atria, stairwells and other circulation spaces**

Type of space used by pupils	Performance zone for wall including glazing
All spaces except music rooms	<b>G</b>
Music rooms <sup>†</sup>	<b>F</b>

Notes:

<sup>†</sup> Specialist design advice should be sought in respect of music rooms.

**Acoustic zoning for the right solution**

Requirement E4 within the Building Regulations 2000 states that, ‘Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use’. The normal way to satisfy this requirement is to comply with the guidance given in DfES Building Bulletin 93 (BB93). Building Bulletin 93 gives recommendations on the noise levels that an activity room will generate, its tolerance to background noise levels and the maximum background levels from adjacent areas, ventilation and traffic noise. These guidelines are then used to determine the minimum levels of sound insulation required between spaces. Refer to Tables 1.1 - 1.4 in ‘BB 93’, the data from which has been used to compile **Table 1** – Performance requirements for adjacent activity areas.

**Table 1** assists in determining the layout of the school and should be considered during the early planning stage of a project. The table vastly simplifies the specification of internal walls

between adjacent activity areas. The letters **A** - **G** refer to acceptable performance specifications e.g. if a secondary teaching room is next to a drama studio, the internal dividing wall element should meet performance classification **B**. Refer to the tables in ‘5. Specification solutions’, to find the options available.

To account for the intermittent use of corridor areas, and the inclusion of doors within partitions, a reduced performance level is set as given in **Table 2**.

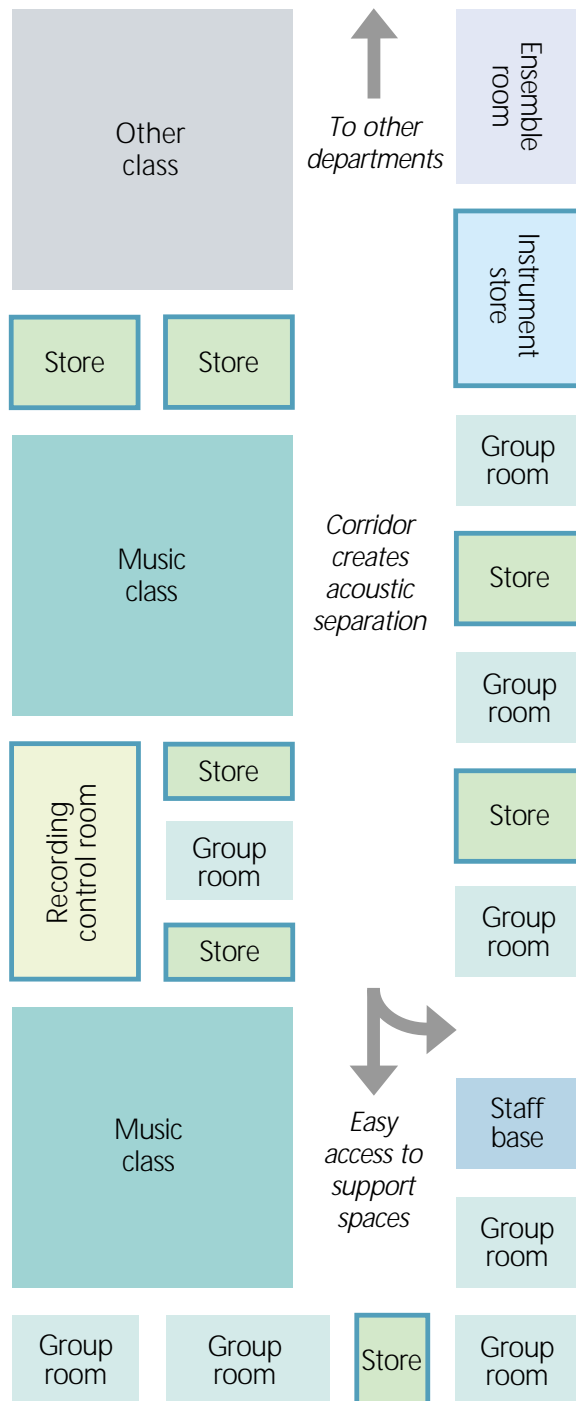
Impact sound insulation is required to control the noise level created by impact e.g. footsteps transmitted into the receiving room. **Table 3** shows the *SchoolSpec* solutions to meet the performance levels for floors set out in BB93.

**Table 3 Performance requirements for floors**

RECEIVING ROOM	Floor Type
Music - performance, ensemble, Recording studio, music classroom, Lecture room for more than 50, Drama studio, small music practice room	<b>A</b>
Music - control room for recording, Classroom for hearing impaired, Assembly halls, multi-purpose halls, Dance studio	<b>B</b>
Primary and Secondary classroom / teaching areas, Open plan teaching, Lecture room for less than 50, Study room, Science labs, Audio visual, Nursery quiet rooms, Primary teaching areas, Swimming pool, Atria circulation spaces, Kitchens, Indoor sports hall, Toilets and changing areas	<b>C</b>
Dining room, Offices, Staff room, Metalwork and light craft, Nursery playroom, Corridors and stairwells	<b>D</b>



**Fig 1 Use of acoustic buffer zones**



## Layout of rooms

It will usually be possible to achieve the necessary degree of sound insulation between two activities by interposing a suitable wall or floor. However, if spaces are very diverse in their acoustic requirements, for example a sports hall and music room, it is seldom practical to provide the degree of sound insulation necessary by a single wall. Such spaces are better positioned well apart, separated by either an external space or a neutral area such as a store or circulation space to act as a buffer between the two. **Fig. 1**, adapted from Building Bulletin 93, shows part of a school layout with noise sensitive areas separated from classrooms and other more noisy areas.

The  $D_{nT (T_{mf,max})_{w}}$  term used in Building Bulletin 93 is a design value for sound insulation which takes account of the recommended reverberation time of the space. It is more suited to school design than  $D_{nTW}$ , a term mainly used in residential building design, which makes a correction to a standard 0.5 second reverberation time. It should be stressed, however, that regardless of the measurement terms used, the required sound insulation performance will only be achieved in practice if the building designer fully takes account of flanking sound transmission.

KEY  Acoustic buffer zones

## Improving speech intelligibility in classrooms

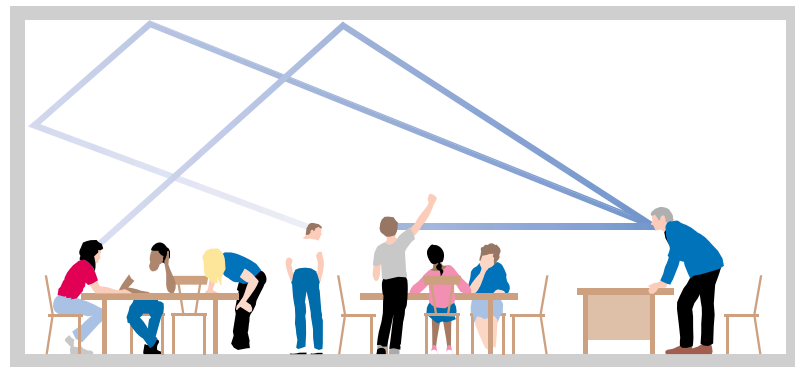
### Speech intelligibility - key issues

Speech intelligibility is now recognised as essential in helping pupils to achieve their learning potential. Research has shown that pupils who cannot understand clearly what the teacher is saying have a tendency to 'switch-off' - effectively short-changing their own educational opportunities and creating additional stress for teachers.

In a typical classroom, with the teacher at one end, sound reaches the pupils both directly from the teacher and via reflections from the ceiling, walls and floor (see Fig 2). Because of this, pupils at the front

will generally be able to understand what the teacher is saying, whilst pupils at the back and sides of the room are receiving a mixture of both speech and reflected sound - making it difficult to identify the teacher's words.

Fig 2 Sound transmission in a typical classroom



### The research - good acoustics pays for itself

**1** Children at school are exposed to noise levels averaging 72 decibels - more than ten times the maximum exposure level for classrooms recommended by World Health Organisation guidelines.

A two-year survey of over 2,000 children aged 7 - 10 years in London schools looked at the effect of different types of noise on the results obtained in Standard Assessment Tests (SATs). The survey showed that both internal and external noise levels were associated with lower SATs results. It was found that language based tasks were particularly affected by background 'babble' and with the most vulnerable children being those with special educational needs.

The extent of the problem became clear in a spelling test of 20 words. Under conditions of classroom noise, the number of correct spellings was reduced on average by 15-20%. The research team stressed that appropriate acoustic design reduces noise levels in schools, and should be given a high priority when schools are being built or refurbished.

Source: South Bank University/London University Institute of Education

**2** A research study in the US found that good acoustic design can create high levels of financial return from only a modest increase in investment. The main findings were as follows:

- The cost difference between providing a mediocre and a good

acoustic ceiling is less than \$1 per student over a 20 year period.

- Higher performing acoustic ceilings improve recognition of sentences by about 3-4%. If this is set against the annual cost for educating a child, the economic value will exceed the cost of upgrading the ceiling by a factor of around 200.

- In the US teachers lose an average 2 days/year due to vocal fatigue, caused by having to shout over classroom noise. Paying for substitute teachers for this period would cost each school around \$7500 a year.

Source: 'Good classroom acoustics is a good investment' by David Lubman and Louis C Sutherland



## Controlling reverberation

Reverberation is measured in seconds. It is the time taken for the sound pressure level to drop by 60dB after the sound source is turned off.

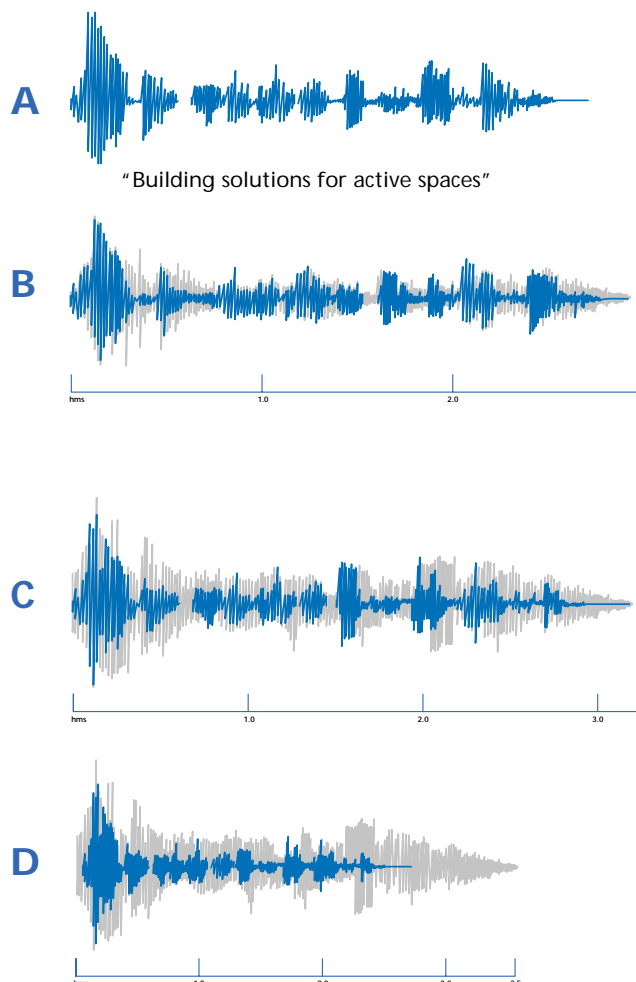
Diagrams A - D show how reverberation progressively masks the intelligibility of speech waveforms.

**Diagram A** represents a waveform of the phrase: "Building solutions for active spaces". You can see each distinct syllable of the words. The sharp spikes are the consonants which contain the speech information.

**Diagram B** shows the waveform if the same phrase is spoken in a room with a 0.8 second reverberation time. The waveform is now blurred. The original speech syllables are in blue with the reverberant sound field in grey. The reverberant sound is stretching out between the syllables to fill in the gaps with noise. The sharp spikes of the consonants are still distinct and have not been masked by the reverberant sound.

**Diagram C** shows the same waveform in a room with a 1.5 second reverberation time. The reverberant sound level is now stretching out between the syllables and is starting to mask some of the sharp spikes of the consonants. This means that some of the syllables are being masked by the reverberant 'noise', leaving the listener with varying degrees of comprehension.

**Diagram D** shows the waveform in a 2.0 second reverberant room. The waveform is very indistinct - many syllables are completely masked in the reverberant field.



There is no single reverberation time that is suitable for all environments. For example, a secondary school classroom is recommended to have a maximum reverberation time of 0.8 seconds. This compares with a swimming pool that is recommended to have a higher maximum reverberation time of 2 seconds.

**Measuring speech intelligibility**

Achieving the target reverberation time for a specific room (classroom, hall, dining room, etc) will help to provide a good acoustic environment but will not necessarily produce a room with excellent speech intelligibility. To assess the level of speech intelligibility in a room, two approaches have been used; the **subjective** method and the **objective** method.

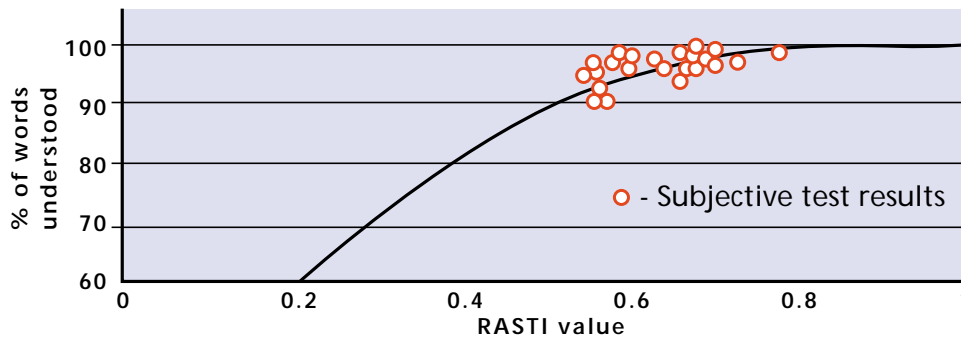
In the subjective method, a man and a woman read out a list of paired words that rhyme, so that the initial consonants of the words differ only slightly. People in the classroom listen to the words that are read out and have to tick the boxes for the words they believe they have heard. The results are assessed and a percentage figure derived for the number of words that have been correctly heard.

In the objective method, a test signal is produced electronically which creates a sound source with properties that are inherent in the spoken word. In place of people assessing the sounds, microphones are used. The information gained from this test is used to produce a room rating known as the Rapid

Speech Transmission Index, or RASTI for short.

Comparative work has shown that there is a very close correlation between the tests. This means that the less expensive and more easily controlled RASTI test can be used as a good predictor of speech intelligibility in a room. **Fig 3** plots the results of the subjective test with the RASTI values derived from the objective test. **Table 4** gives a measure of speech intelligibility against the RASTI values together with an assessment of performance.

**Fig 3 Speech intelligibility tests**



**Table 4 Comparison of speech intelligibility methods**

RASTI	Intelligibility	Performance assessment
<0.3	50%	Very poor
0.3-0.4	60%	Poor
0.4-0.5	70%	Acceptable
0.5-0.6	80%	Good
0.6-0.7	90%	Very good
0.7-0.8	99%	Excellent



## Achieving speech intelligibility in practice

After extensive speech intelligibility testing in France using these methods, BPB Placoplatre (a sister company of British Gypsum) has developed a patented computer program to aid the specifier in the selection of products required to provide speech intelligibility in rooms. The program requires the following details to be entered; size and shape of the room, what materials are being used for the floor and walls, the size and shape of windows and doors, together with the location of the teacher and pupils.

Once the information has been entered, the program automatically works out the type and location of ceiling and wall materials required to meet the recommended reverberation times, and to provide the best speech intelligibility.

Outputs from the computer program include a layout drawing of where Arteco Casoprano VOICE, FORTE, NOVA or

ALTO ceiling tiles, along with Gyptone boards, should be installed. An example of outputs is shown in Fig 4 (opposite). Sound absorbing Casoprano VOICE / NOVA is combined with the sound reflecting Casoprano FORTE / ALTO to provide a ceiling layout that achieves optimum speech intelligibility levels. Casoprano FORTE / ALTO assists with projecting the teacher's voice, whilst Casoprano VOICE / NOVA controls the overall reverberation time within the classroom. Arteco Gyptone boards are included as a partial wall lining to further enhance the acoustic environment by reducing noise reflections off the back wall. A further benefit of Casoprano VOICE / NOVA ceiling tiles is their ability to control low frequency reverberation. Bass sounds mask high pitched sounds. Thus strong bass sound reverberation not only affects the intelligibility of the bass sounds, but also the intelligibility of the high pitched sounds.

The spectrum for speech falls within the frequency range 250Hz - 4000Hz.

For good intelligibility, low frequency (250Hz - 500Hz) should not exceed the reverberation time obtained at higher frequency ranges. Lining materials should therefore be selected which have good absorption levels at these low frequencies. Arteco Casoprano VOICE / NOVA ceiling tiles have a flat absorption curve and Fig 5 (opposite) illustrates how their performance compares with a typical curve of a mineral fibre ceiling tile. The superior sound absorbing performance of Casoprano VOICE / NOVA tiles at low frequency results in improved speech intelligibility.

## Our pioneering approach

There are therefore two elements to the British Gypsum solution - purpose designed acoustic ceiling tiles and boards which allow the acoustics of a room to be manipulated, and a unique computer program that predicts the pattern of tiles and boards for optimum speech intelligibility in the room or space.

The benefits to the client are two-fold. Firstly, for upgrading a tiled suspended ceiling (an everyday construction in educational buildings), ceiling tiles can be readily substituted without changes to detailing or installation techniques, making the solution affordable in the context of ever tighter maintenance / build budgets. Secondly, Arteco Casoprano ceiling tiles have been developed to provide either sound absorption or sound reflection, but they are identical in appearance. It is therefore possible to retain a uniform ceiling appearance whilst at the same time achieving an optimised performance layout.

Fig 4. Example output

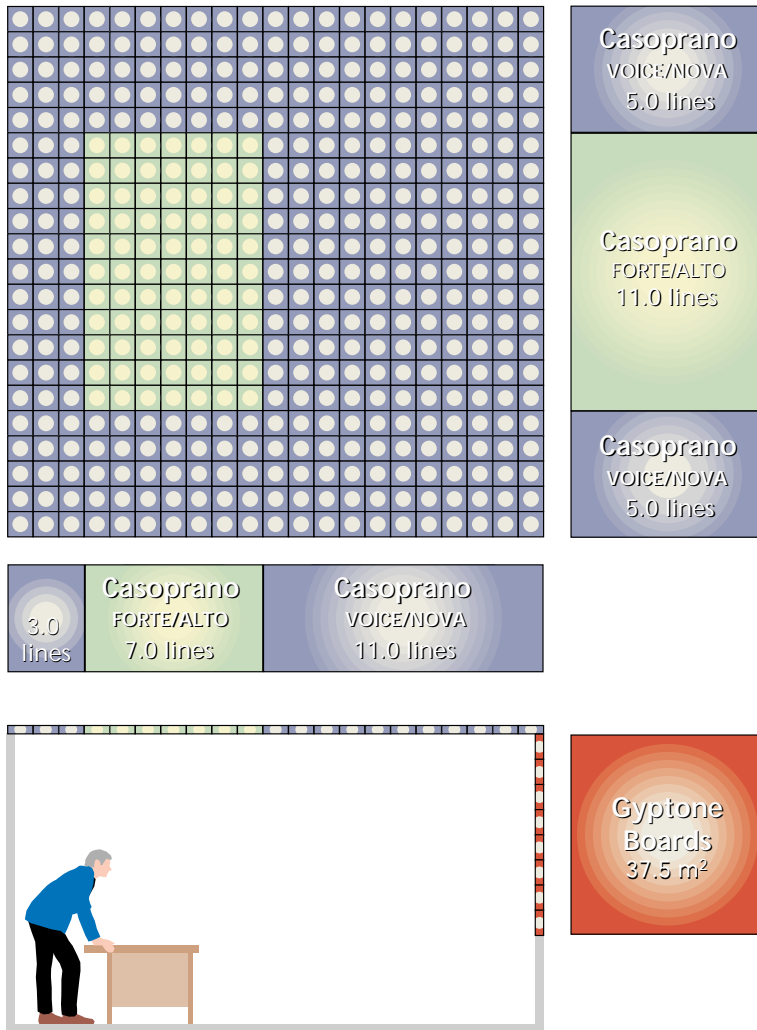
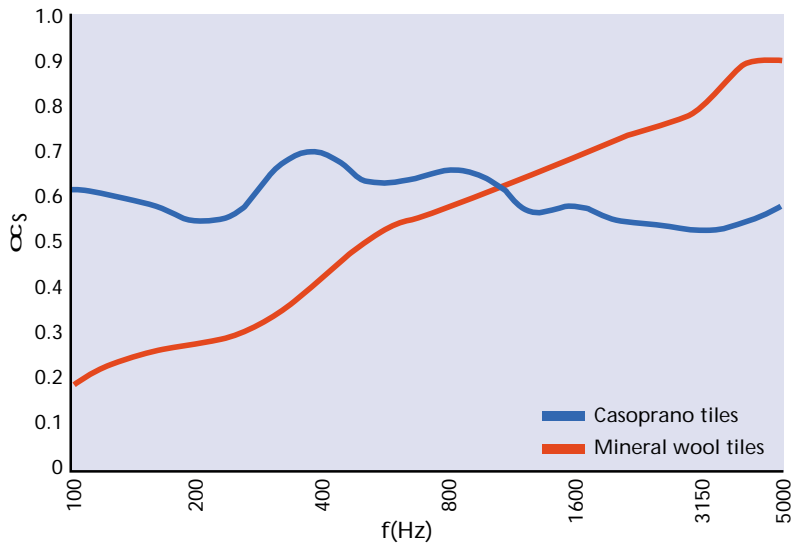


Fig 5. Comparative sound absorption data



## Guidance on specific activity areas

### Reverberation times for different room types

Table 5, taken from Building Bulletin 93, gives recommended reverberation times for different types of space.

### Lecture theatres

In lecture theatres a raked floor and/or raised dais will have to be used. Also, an angled reflector over the platform will be useful for reinforcement of sound to the rear, and conversely to reflect sound from the rear to platform occupants. For larger halls, a mid-frequency reverberation time of  $\leq 1.0$  sec is recommended, whereas a lower figure of  $\leq 0.8$  seconds is appropriate for smaller halls with fewer than 50 people.

### Music suites

The quality of sound in a music room should be an appropriate balance between fullness of tone and clarity. A long reverberation time (RT) promotes fullness of tone but at the expense of clarity (individual sounds start to overlap). A short RT tends to provide clarity but at the expense of fullness of tone. Thus spaces with a very short RT can have a 'dead' quality.

Room volume is critical to the quality of sound in a music room and a higher than average ceiling is desirable. An increase in room volume affects the quality of the sound (the liveliness) and modifies the loudness. It is therefore desirable to have a ceiling height of at least 3m in all music rooms, including group rooms. Additional sound absorption may be provided to reduce loudness but this will have to be carefully balanced with the need to preserve a quality of liveliness which could be compromised by excessive sound absorption.

Table 5 Recommended reverberation times, taken from Building Bulletin 93, published by the DfES

Type of room/activity (receiving room)	$T_{mf}$ <sup>1</sup> (seconds)
Nursery school playrooms	$\leq 0.6$
Nursery school quiet rooms	$\leq 0.6$
<i>Primary school:</i> classrooms, class bases, general teaching areas, small group rooms	$\leq 0.6$
<i>Secondary school:</i> classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories	$\leq 0.8$
<i>Open-plan</i>	
Teaching areas	$\leq 0.8$
Resource areas	$\leq 1.0$
<i>Music</i>	
Music classroom	$\leq 1.0$
Small practice / group room	$\leq 0.8$
Ensemble room	0.6 - 1.2
Performance / recital room	1.0 - 1.5
Recording studio	0.6 - 1.2
Control room for recording	$\leq 0.5$
<i>Lecture rooms</i>	
Small (fewer than 50 people)	$\leq 0.8$
Large (more than 50 people)	$\leq 1.0$
Classrooms designed specifically for use by hearing impaired pupils	$\leq 0.4$
Study room (individual study, withdrawal, remedial work, teacher preparation)	$\leq 0.8$
Libraries	$\leq 1.0$
Science laboratories	$\leq 0.8$
Drama studio	$\leq 1.0$
Metal / woodwork classrooms, resource / light craft and practical work	$\leq 0.8$
Assembly halls <sup>3</sup> , multi-purpose <sup>3</sup> halls (drama, PE, audio/visual presentations, assembly, occasional music)	0.8 - 1.2
Audio-visual, video conference rooms	$\leq 0.8$
Atria, circulation spaces used by pupils	$\leq 1.5$
Indoor sports hall	$\leq 1.2$
Gymnasium	$\leq 1.2$
Dance studio	$\leq 1.2$
Swimming pool	$\leq 2.0$
Interviewing / counselling rooms, medical rooms	$\leq 0.8$
Dining rooms	$\leq 1.0$
<i>Ancillary spaces<sup>2</sup></i>	
Kitchens	$\leq 1.5$
Offices, staff rooms	$\leq 1.0$
Corridors, stairwells <sup>4</sup>	-
Coats and changing areas	$\leq 1.5$
Toilets	$\leq 1.5$

<sup>1</sup> Mid-frequency reverberation time,  $T_{mf}$  in finished but unoccupied and unfurnished rooms. Common materials often absorb most sound at high frequencies. Therefore reverberation times will tend to be longer at low frequencies than at high frequencies. In rooms used primarily for speech, the reverberation times in the 125Hz and 250Hz octave bands may gradually increase with decreasing frequency to values not more than 30% above  $T_{mf}$ .

<sup>2</sup> The extension of Part E of Schedule 1 to the Building Regulations 2000 (as amended by SI 2002/2871) to schools, applies to teaching and learning spaces and is not intended to cover administration and ancillary spaces. For these areas the values are for guidance only.

<sup>3</sup> For very large halls and auditoria, and for halls designed primarily for unamplified music rather than speech, designing solely in terms of reverberation time may not be appropriate and specialist advice should be sought. In large rooms used primarily for music, it may be appropriate for the reverberation times in the 125Hz and 250Hz octave bands to gradually increase with decreasing frequency to values up to 50% above  $T_{mf}$ .

<sup>4</sup> Refer to 'Corridors, entrance halls and stairwells', later.

The level of sound, and possible disturbance from other music spaces, will vary depending on the instruments being played (e.g. drum kit would be hard to ignore) but it is difficult to organise the use of space to take this fully into account without loss of flexibility. At the design stage, careful planning can minimise disturbance from external and internal sounds, for example by:

- locating the music department to minimise disturbance from noise sources outside and inside the school – possibly to a separate building or a contained area away from the main school building. Although locating these spaces adjacent to each other is not recommended in DfES Building Bulletin 93, it is possible to provide an adequate level of sound insulation by specifying **GypWall AUDIO**. This is a twin frame wall with **A** performance category. Refer to '5. Specification Solutions'.
- using sound insensitive spaces such as storerooms, 'dead' spaces or low traffic thoroughfares as sound buffers between music making spaces (refer to Fig 1, on page 10).

When designing a space for good sound insulation it is important to remember that the resultant level achieved will depend not only on the specified wall or floor, but also on the surrounding structure and any penetrating elements such as doors or services. The construction detailing in Fig 6, should be considered.

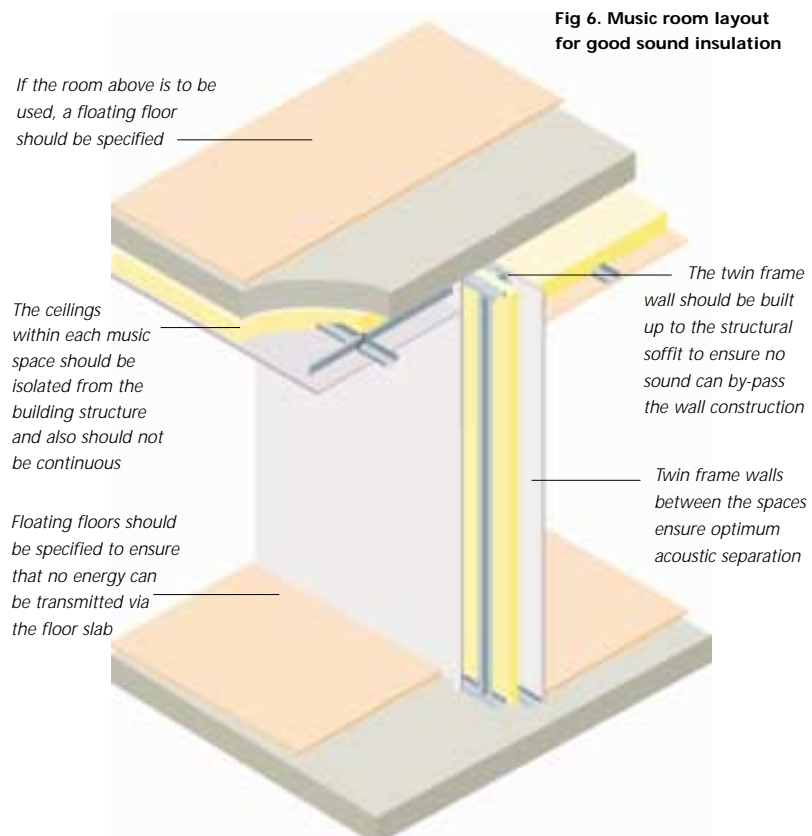
- **Twin-framed wall construction** – this form of construction is commonly used within multi-screen cinema complexes to achieve very high levels of isolation. This wall may be suitable where noise sensitive areas have to be adjacent to each other due to layout constraints.

Refer to '5. Specification solutions', Partitions and walls Table 1.

- **Floating floors** – by floating the floor within the music room this will reduce noise transmission into or out of the room.
- **Resilient ceiling** – by hanging the ceiling from an independent frame, a greater degree of isolation is achieved between the music room and the surrounding spaces. The performance of this ceiling can be enhanced further by using acoustic ceiling hangers.
- **Windows** – should, if possible, be avoided as they introduce a weakness to the structure. If windows are essential they should be double glazed with a cavity ideally of at least 50mm.

- **Doors** – the use of a sound lobby is highly recommended, with the doors being offset. If this design cannot be accommodated then the doors should be as heavy as possible and should feature acoustic seals on all edges.

For further guidance on the specification of music suites, refer to Building Bulletin – Music Accommodation in Secondary Schools – A Design Guide, published by the Department for Education and Skills (DfES) and also Building Bulletin 93, Section 5 - The design of rooms for music.



**Fig 6. Music room layout for good sound insulation**

## Art, design and technology areas



These activity areas are often combined with insufficient consideration given to direct and indirect noise transfer problems. Where there is noisy machinery, in woodwork and metalwork areas for example, it is advisable to locate these in spaces separated from quieter activities such as class tuition in art and design. Sound absorbing ceilings will help to control the high activity noise levels.

## Drama rooms

These generally fall into three categories - rooms for small scale drama teaching/practical work; studios for rehearsal, teaching and small-scale performance; and theatres/flexible spaces for performance. Typically, they will be fitted with heavy curtains on some or all walls, which provide some control of reverberation time. Acoustically absorbent ceilings are often installed to give further sound absorption. Theatres and spaces primarily for performance vary considerably in form and size - from the conventional assembly hall to adaptable theatres used for drama, lectures, films, meetings and music - which all have different acoustic requirements. Building Bulletin 93 recommends that the advice both of an acoustician and a theatre consultant should be sought. Deep balconies are to be avoided as the space under these can be acoustically 'dead' and reflections from the ceilings and walls need to

compensate for the lack of direct sound in such areas.

## Dining areas

High activity noise often interferes with conversation leading to excessive noise levels. Dining areas therefore benefit from sound absorption measures to control early reflections. The best place for acoustic absorption is the ceiling followed by the walls. Barrel vaulted roofs and circular walls should be avoided unless sound absorbent materials are installed.



## Multi-purpose halls

In large schools, multi-purpose halls are less popular as it is difficult for a single hall to fulfil all functions well. Where a single flexible hall is required it presents specific problems due to the conflicting acoustic requirements of the various activities - the main conflict being between speech and unamplified music. Where regular performances of music are expected, reverberation time can be modified using moveable areas of absorption, such as heavy curtains, without changing the volume of the space. This has little effect at low frequencies however, which results in acoustics suited to neither speech nor music. The provision of Arteco sound absorbing tiles / wall linings can help in this respect.

### Sports facilities

The need for hard and robust materials, combined with low occupation, creates highly reverberant conditions and poor speech intelligibility, making communication tiring and difficult. Built-in absorption in the finishes will be helpful and the ceiling provides the principal means of absorption control.

Building Bulletin 93 recommends a specification of  $\leq 1.2$  seconds in school applications.

For ceilings used within gymnasiums and multi-purpose halls, the robustness of the lining should be considered, as often these ceilings are required to be sound absorbing. Ceiling systems using Artec Rigitone boards offer a robust and durable solution, whilst providing the levels of absorption required.

### Open plan areas

It is a requirement of Building Bulletin 93 that open plan areas achieve a measured Speech Transmission Index (STI) between 0.60 and 1.0, corresponding to a rating of good to excellent. If this cannot be met within the scope of the activity plan, the need for the open plan area should be reassessed. In open plan areas it is essential to provide good speech intelligibility at short distances (up to 5m) and to secure freedom from aural distraction by more distant sound sources and by background noise. Some degree of privacy is also desirable.

Specific measures as indicated by computer prediction models will be necessary in order to realise the limited acoustic potential of open plan areas. These include carpeted

floors, acoustically absorbent ceilings, and acoustically absorbent screens (typical height 1.7m) between class groups.



## Specialist provision for pupils with hearing impairments

In rooms for teaching the hearing impaired, good speech intelligibility is essential. Long reverberation times can lead to poor speech intelligibility and high reverberant ambient noise levels, which make speech discrimination difficult. Long reverberation times should therefore be avoided.

It is recommended in DfES Building Bulletin 93, that the unoccupied mid-frequency reverberation time in classrooms for teaching the hearing impaired is less than or equal to 0.4 seconds.

In order to achieve good speech signal / noise level ratios and thus increase the pupils' ability to make the most of their residual hearing, the maximum ambient noise level in classrooms for teaching hearing impaired pupils should be LAeq, 30mins = 30dB, which is 5dB lower than the value recommended in Building Bulletin 93 for general classrooms in mainstream schools.

Low frequency ambient noise should be minimised as hearing impaired pupils make use of low frequencies (below 500Hz) to obtain information from speech. British Gypsum Artec ceiling tiles are effective at absorbing low frequency sound, particularly when compared to mineral fibre tiles. Refer to 'Improving sound intelligibility in classrooms' earlier.

## Corridors, entrance halls and stairwells

The Building Regulations 2000 require that sound absorptive treatments be applied within corridors, hallways, stairwells and entrance halls, to reduce the reverberant noise and avoid interference with teaching and study activities in adjacent rooms. The



easiest way of providing sound absorption is to install an acoustic tile or board ceiling. Other methods include lining the walls with sound absorbent materials or providing a soft floor covering. Approved Document E provides two methods of calculating the amount of sound absorbing material needed to meet the regulations; these are termed Method A and Method B.

### Method A

#### Entrance halls, corridors or hallways.

Cover an area at least equal to or greater than the floor area with a Class C absorber or better. It will normally be convenient to cover the ceiling area with additional absorption. Refer to Tables 3 and 4 in '5. Specification solutions' for Artec ceiling tiles and boards that have a Class C rating.

#### Stairwells or stair enclosures.

Calculate the combined area of the stair treads, the upper surface of the intermediate landings, the upper surface of the landings (excluding ground floor) and the ceiling area of the top floor.

Either cover at least an area equal to this calculated area with a Class D absorber, or cover an area equal to at least 50% of this calculated area with a Class C absorber or better. British Gypsum Artec ceiling tiles and boards have either a Class C or D rating - refer to Tables 3 and 4 in '5. Specification Solutions'.

The absorption material should be equally distributed between floor levels. It will normally be convenient to cover the underside of intermediate landings, and the ceiling on the top floor. However, where there is insufficient ceiling area available, the absorptive materials can be applied to any surface. In this case the use of Artec Gyptone boards as wall linings would be a suitable solution.

**Method B**

This method is intended for use in entrance halls, corridors and hallways as it is not suited to stairwells or stair enclosures.

In comparison with Method A, Method B takes into account existing absorption provided by all surfaces and should allow greater flexibility in meeting the requirements. However, the method is more complex and requires knowledge of all the materials to be used for lining the area and their sound absorption coefficients.

For entrance halls, Method B requires a minimum of 0.20m<sup>2</sup> of total absorption area per cubic metre of volume, distributed over the available surfaces.

For corridors and hallways, Method B requires a minimum of 0.25m<sup>2</sup> of total absorption area per cubic metre of volume, distributed over one or more of the surfaces.

Sound absorption data for Artec ceiling tiles and boards is available, refer to tables in '5. Specification solutions'.

The following example demonstrates the application of Method A within School layouts:

**Example - method A**

Total floor area = 31.72m<sup>2</sup>

**Option 1**

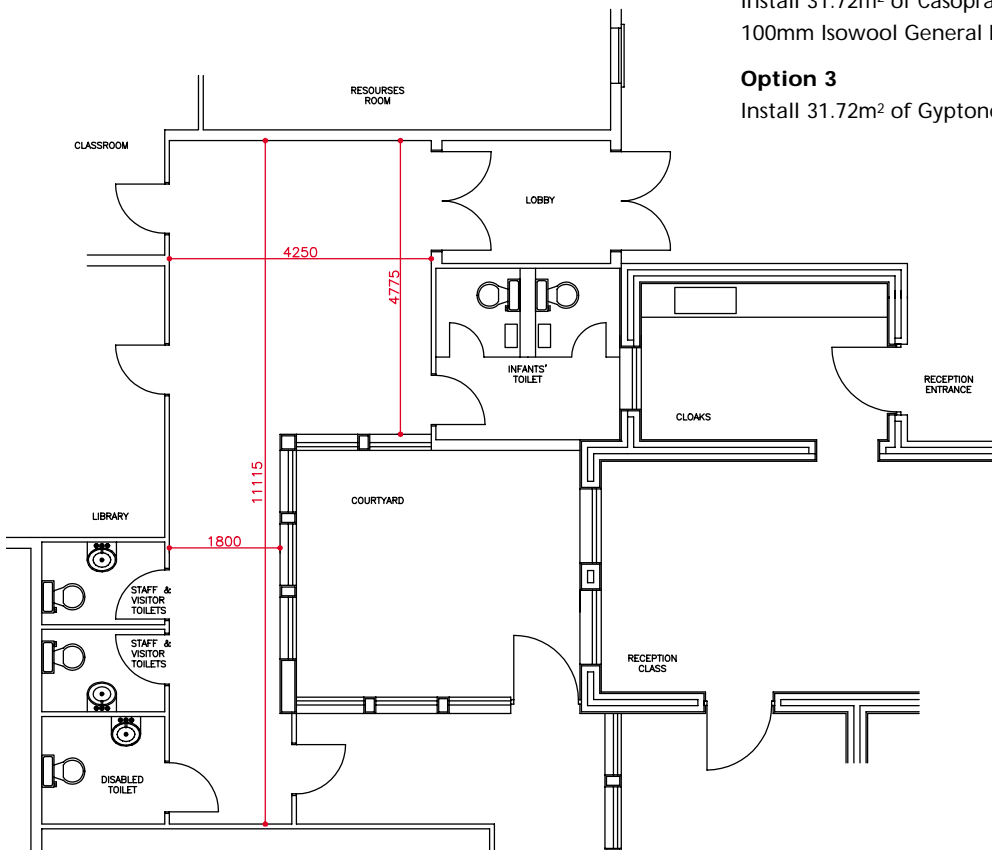
Install 31.72m<sup>2</sup> of Casoprano nova, Gyptone LINE 4, LINE 8 OR POINT 15

**Option 2**

Install 31.72m<sup>2</sup> of Casoprano nova backed with 100mm Isowool General Purpose Roll

**Option 3**

Install 31.72m<sup>2</sup> of Gyptone QUATTRO 41 boards





## Meeting onerous fire and life-safety requirements

■ A large school fire devastates property and puts lives at risk. The long term disruption that follows puts staff and pupils under stress and results in large financial, educational and administrative costs.

■ Each year more than 2,000 schools in the UK suffer fires large enough to need action by local fire brigades. In 2003 the cost of these is predicted to reach £87 million - almost three times

the cost in 1995.

■ A recent report by Zurich Municipal ('The design and protection of new schools') highlighted a number of factors responsible for the increase in fire related costs:

- youngsters are attracted by the familiarity of school sites yet levels of intruder protection and detection are poor
- resistance to fire spread is compromised by the use of

combustible materials of construction

- fires are not detected early enough

The report recommends that non-combustible material is used in construction and Class 0 materials of limited combustibility (e.g. plasterboard) used for internal linings.

## Fire safe building design

### New buildings

Since April 2001, any new schools in England have had to obtain planning approval in the usual manner through Building Control procedures. The specifier thus needs to refer to Approved Document B within current Building Regulations. This change is a result of the Education Regulations, which repeal Regulation 8 of the Education (Schools and Further and Higher Education) Regulations 1989 (SI 1989/351). Regulation 8 was the means by which the Secretary of State for Education and Employment approved particulars of new schools, thus making them exempt from approval under the Building Regulations.

### Compartmentation

The spread of fire within a building can be restricted by sub-dividing it into compartments separated from one another by walls and/or floors of fire-resisting construction.

Sub-division is achieved using compartment walls and floors. In schools, these floors and walls should provide a full 60 minutes fire resistance. However, if the school has



a basement storey more than 10m below ground level, or an upper floor greater than 18m above ground level, 90 minutes fire resistance is required. Note that if the upper floor is more than 30m above ground level special provisions apply ie. sprinklers must be fitted and fire resistance increased to 120 minutes.

In schools, compartment walls and floors are required in the following circumstances:

- the compartment or floor area of any one storey in the building exceeds 800m<sup>2</sup>
- to every floor of the building if it has a floor at a height of more than 18m above ground level
- to the floor of the ground storey if the building has one or more basements
- to the floor of every basement storey except the lowest floor if the basement depth is greater than 10m
- to walls common to two or more buildings
- to walls dividing buildings into separated parts
- to construction enclosing places of special fire hazard.

**Note:** Refer to Approved Document B of current Building Regulations for full details.

Further guidance on compartmentation is given in the Building Regulations 2000 and in the DfES Building Bulletin 7. It should be noted, however, that the guidance is in respect of minimum standards. It is often desirable to design smaller or more fire resistant compartments in order to confine any fire outbreak more effectively.

### Structural fire protection

Structural frames, beams, columns, loadbearing walls (internal and external), floor structures and gallery structures, should have at least 60 minutes loadbearing capacity. 90 minutes loadbearing capacity is required where the building has a floor at a height above 18m or a basement 10m below ground level. This requirement can be reduced to 60 minutes if sprinklers are specified. Note that if the upper floor is more than 30m above ground level, special provisions apply ie. sprinklers must be fitted and fire resistance increased to 120 minutes.

### Fire-stopping

Services can act as a mechanism of fire spread in buildings. It is therefore essential that adequate provision is made for fire-stopping to maintain the fire integrity of the separating element.

The measures detailed in Building Regulations Approved Document B3, Section 10: Protection of Openings and Fire Stopping, are intended to delay the passage of fire and retard the spread of smoke. Paragraph 10.2 states that "if an element that is intended to provide fire separation (and therefore has fire resistance in terms of integrity and insulation) is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire-stopping so that the fire resistance is not impaired".

By designing service zones through which all services pass, the number of individual service penetrations can be minimised. Service zones can be sealed after installation of the services using approved fire-stopping materials.



### **Additional protection**

Whilst constructing buildings to meet current Building Regulations and Department of Education and Skills (DfES) codes makes provision for adequate life-safety, passive fire protection can also be used to provide protection to valuable assets and resources.

Specifying fire-rated constructions around areas within a school building such as the library, science labs, IT & media rooms, administrative offices, along with building service areas such as boiler rooms, will minimise damage and costs of replacement. Most importantly, the disruption to the operation of the school and the pupils' education will be minimised.

Where fire protection is being specified, it is important to consider all aspects alongside the main construction. It is important to ensure that all gaps are sealed to avoid smoke damage. All services passing through the element should be fire-stopped and all doors fire-rated.

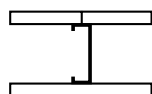
Where overhanging roof eaves occur, provision should be made for an adequate fire barrier inserted to prevent an external fire entering the roof-space through the eaves. A suitable barrier can be located in the roof-space where the roof abuts the wall. It is preferable, however, that the fabric of the overhang itself forms a barrier by virtue of being constructed from non-combustible materials throughout.

### **Existing buildings**

Although little can be done to alter the basic construction of an existing building, the wall and ceiling surfaces on escape routes can be upgraded to comply with current standards. Also, additional fire barriers and fire doors can be introduced to upgrade existing constructions, and fire resistant partitions and ceilings installed to provide new escape routes and fire compartmentation.

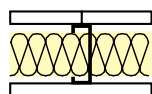
# SchoolSpec 5. Specification solutions

**Table 1 - Partitions and walls - performance data**  
Partitions conform to NBS Clause K10



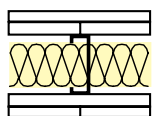
**Specification:** GypWall ROBUST system: one layer of board each side of Gypframe 70 S 60 'C' Studs

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
DuraLine	-	13	98	24	3800	30	<b>G</b>	Heavy	Q606025



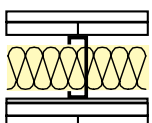
**Specification:** GypWall ROBUST system: one layer of board each side of Gypframe 70 S 60 'C' Studs with Isowool Acoustic Partition Roll (1200) in cavity

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
DuraLine	25	13	98	25	3800	60	<b>F</b>	Heavy	Q606026
DuraLine	50	13	98	26	3800	60	<b>E</b>	Heavy	Q606027



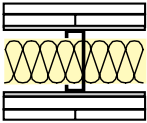
**Specification:** GypWall ROBUST system: two layers of board each side of Gypframe 70 S 60 'C' Studs with Isowool Acoustic Partition Roll (1200) in cavity

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
Inner layer of 15mm SoundBloc and outer layer of 13mm DuraLine	50	28	128	50	4800	90	<b>D</b>	Severe	Q606039



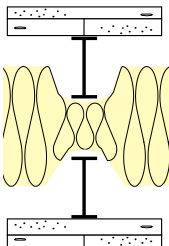
**Specification:** GypWall QUIET SF system: two layers of board each side of Gypframe 70 S 60 'C' Studs with Gypframe RB1 Resilient Bar on one side with Isowool Acoustic Partition Roll (1200) in cavity.

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
Inner layer of 15mm SoundBloc and an outer layer of 13mm DuraLine	50	28	144	51	4200	90	<b>C</b>	Severe	Q606041



**Specification:** GypWall QUIET SF system: two layers of board each side of Gypframe 70S60 Studs with Gypframe RB1 Resilient Bar both sides with Isowool Acoustic Partition Roll (1200) in cavity.

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
Inner layer of 15mm SoundBloc and an outer layer of 13mm DuraLine	50	28	160	52	3400	90	<b>B</b>	Severe	Q606042



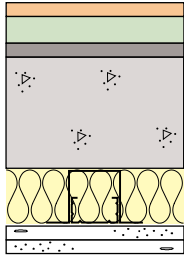
**Specification:** GypWall AUDIO system: Gypframe stud framework, section specification depends on height requirement, with Isowool General Purpose Roll in cavity.

Gyproc board type	Isowool quilt mm	Lining thickness mm	Nominal thickness mm	Approx weight kg/m <sup>2</sup>	Max height mm	Fire resistance minutes	Acoustic zone	Partition duty	Performance substantiation report
Inner layer of 19mm Plank and an outer layer of 12.5mm SoundBloc	200	31.5	300	56	7800	90	<b>A</b>	Severe	A326015

**Notes to all tables:**

- 1 For elements to achieve their optimum performance levels, it is important that the surrounding structure is designed to a good standard and that flanking sound transmission is avoided.
- 2 The performances quoted relate to imperforate constructions and particular care should be taken to ensure that there are no air leakage paths at wall perimeters and that suspended ceilings are properly detailed at wall junctions.
- 3 To meet specified levels of fire resistance all constructional gaps and penetration of services must be adequately fire-stopped.
- 4 Solutions are available giving 90 or 120 minutes fire resistance to suit specific project requirements. Contact British Gypsum for guidance.
- 5 The stated performances are achieved using British Gypsum components fixed as per current system recommendations. Any variations should be checked with British Gypsum.

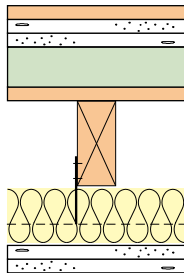
## Table 2 - Floors - sound insulation



Acoustic Zone: **A**

Floors within Acoustic Zone **A** demand exceptionally high impact sound insulation and as such every effort should be made to design out the need for installation through layout planning.

However where an Acoustic Zone **A** floor is required proprietary<sup>1</sup> systems are available.

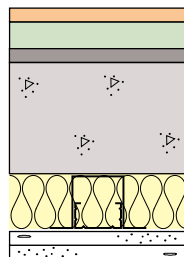


Acoustic Zone: **B**

Platform comprising one layer of 18mm t & g chipboard bonded to two layers of 19mm Gyproc Plank. Fixed to a proprietary<sup>1</sup> batten floor system installed on 15mm OSB board to top of joists.

**Ceiling solution:** CasoLine MF framing suspended from Gypframe Acoustic Hangers and lined with inner layer of 19mm Gyproc Plank and outer layer of 15mm Gyproc WallBoard (alternatively two layers of 15mm Gyproc SoundBloc). 100mm Isowool General Purpose Roll in the floor cavity.

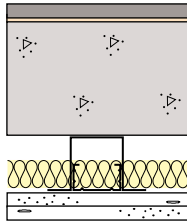
Proprietary systems are available for concrete base floors that achieve Acoustic Zone performance. Contact British Gypsum Drywall Academy Advice Centre for further information.



Acoustic Zone: **B**

Proprietary<sup>1</sup> systems are available for concrete base floors that achieve Acoustic Zone **B** performance. Contact British Gypsum Drywall Academy Advice Centre for further information.

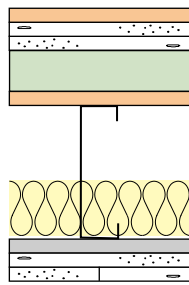
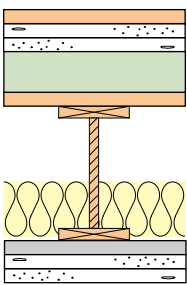
<sup>1</sup> For details of proprietary floors please contact the British Gypsum Drywall Academy.



Acoustic Zone: **C**

Concrete base 300kg/m<sup>2</sup>, with floating layer comprising 65mm sand / cement screed over mineral fibre slab.

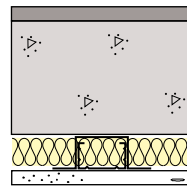
**Ceiling solution:** GypLyner, with lining of double layer 12.5mm Gyproc SoundBloc. Minimum cavity depth 50mm and 25mm Isowool Acoustic Partition Roll (1200) in the cavity. If preferred, a **CasoLine MF** suspended ceiling can be installed.



Acoustic Zone: **C**

Timber joist, engineered I beam or steel joist (nominally 200mm depth). Platform floor comprising one layer of 18mm t and g chipboard bonded to two layers of 19mm Gyproc Plank fixed to proprietary<sup>1</sup> batten floor system installed on 15mm OSB board on top of joists.

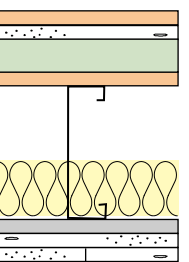
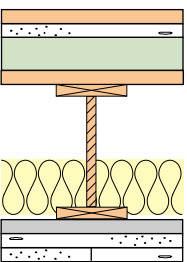
**Ceiling solution:** Gypframe RB1 Resilient Bars or GypLyner fixed to the underside of the joists and lined with an inner layer of 19mm Gyproc Plank and an outer layer of 15mm Gyproc WallBoard (or alternatively two layers of 15mm Gyproc SoundBloc), 100mm Isowool General Purpose Roll in the floor cavity.



Acoustic Zone: **D**

Concrete base 365kg/m<sup>2</sup>, with appropriate soft covering comprising any resilient material, or material with a resilient base, with an overall uncompressed thickness of at least 4.5mm.

**Ceiling solution:** GypLyner, with 25mm Isowool Acoustic Partition Roll (1200) in cavity and lining of single layer 12.5mm Gyproc SoundBloc.



Acoustic Zone: **D**

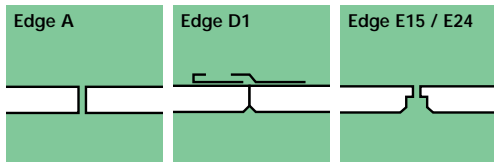
Timber joist, engineered I beam or steel joist (nominally 200mm minimum depth) platform floor comprising one layer of 18mm t and g chipboard bonded to 19mm Gyproc Plank fixed to proprietary<sup>1</sup> batten floor system installed on 15mm OSB board to top of joists.

**Ceiling solution:** Gypframe RB1 Resilient Bars fixed to the underside of the joists and lined with an inner layer of 19mm Gyproc Plank and an outer layer of 15mm Gyproc WallBoard, (or alternatively two layers of 15mm Gyproc SoundBloc), 100mm Isowool General Purpose Roll in the floor cavity.

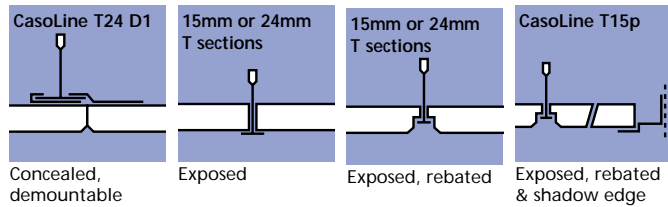
<sup>1</sup> For details of proprietary floors please contact the British Gypsum Drywall Academy.

**Table 3 - Lay-in grid suspended ceilings**

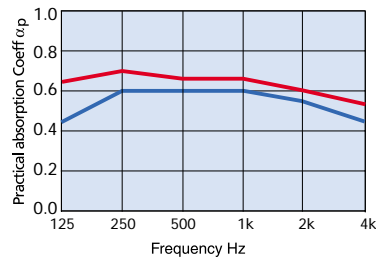
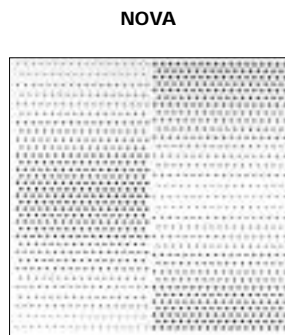
**Edge profiles**



**Grid systems**



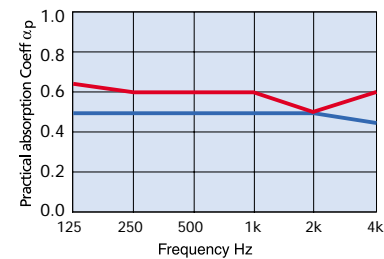
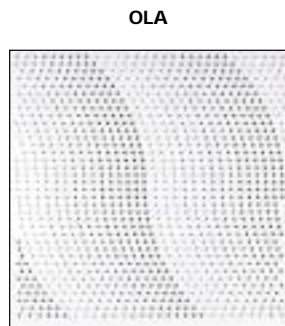
**Data for Casoprano tiles**



■ 400mm plenum - 100mm Isowool General Purpose Roll  
 ■ 400mm plenum - no quilt

Practical absorption coefficient $\alpha_p$									
125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class	
0.65	0.70	0.65	0.65	0.60	0.55	0.65(L)	0.65	C	
0.45	0.60	0.60	0.60	0.55	0.45	0.60	0.60	C	

Size	600 x 600mm
Tile edges	A, E15
Light reflectance	75%
Thickness	Edge A = 8mm Edge E15 = 9.5mm
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 = 7.2kg/m <sup>2</sup>
Grid system	15mm T sections <sup>1</sup>
Performance substantiation report	C10A081 C10A082
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B



■ 400mm plenum - 100mm Isowool General Purpose Roll  
 ■ 400mm plenum - no quilt

Practical absorption coefficient $\alpha_p$									
125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class	
0.65	0.60	0.60	0.60	0.50	0.50	0.60	0.65	C	
0.50	0.50	0.50	0.50	0.50	0.45	0.50(L)	0.50	D	

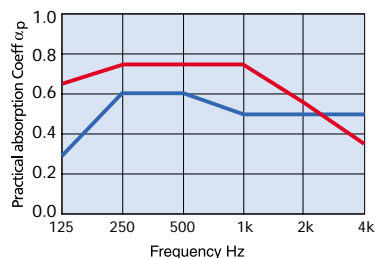
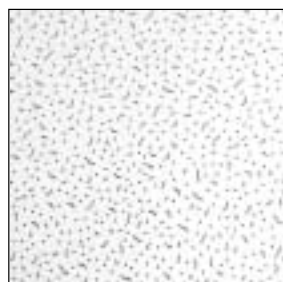
Size	600 x 600mm
Tile edges	A, E15
Light reflectance	75%
Thickness	Edge A = 8mm Edge E15 = 9.5mm
Grid system	15mm T sections <sup>1</sup>
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 = 7.2kg/m <sup>2</sup>
Performance substantiation report	C10A085 C10A086
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup> Tiles should be installed in a suitable grid system; the designer should ensure the system used is capable of supporting the tile load.

## Table 3 - Lay-in grid suspended ceilings - continued

### Data for Casoprano tiles

#### VOICE



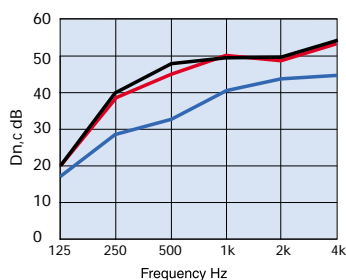
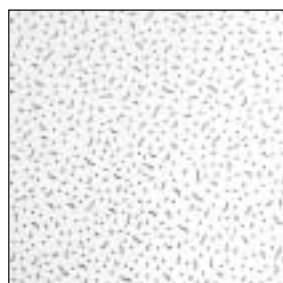
■ 400mm plenum - 100mm Isowool General Purpose Roll  
■ 400mm plenum - no quilt

#### Practical absorption coefficient $\alpha_p$

125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.65	0.75	0.75	0.75	0.55	0.35	0.55(L)	0.70	D
0.30	0.60	0.60	0.50	0.50	0.50	0.55(L)	0.55	D

Size	600 x 600mm
Tile edges	A, E15, E24
Light reflectance	75%
Thickness	Edge A = 8mm Edge E15 & E24 = 9.5mm
Grid system	15mm T sections <sup>1</sup>
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 & E24 = 7.2kg/m <sup>2</sup>
Performance substantiation report	C10A031 C10A078
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B

#### FORTE



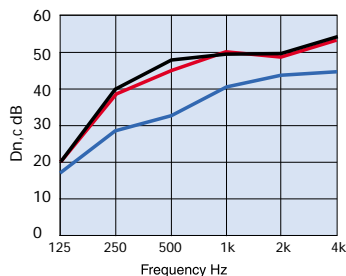
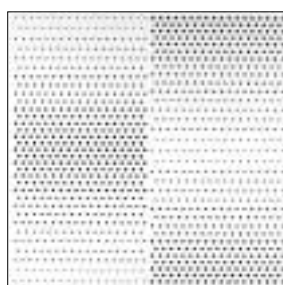
■ 100mm Isowool General Purpose Roll  
■ 75mm Isowool TS48  
■ No quilt

#### Room to room sound insulation - $D_{n,c}$

125	250	500	1k	2k	4k	$D_{n,c,w}$
20.3	38.7	45.5	50.2	49.1	53.1	46
20.1	40	48.4	49.7	49.7	54.5	47
17.8	28.5	33.3	41.2	44.2	45.6	38

Size	600 x 600mm
Tile edges	A, E15, E24
Light reflectance	75%
Thickness	Edge A = 8mm Edge E15 & E24 = 9.5mm
Grid system	15mm T sections <sup>1</sup>
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 & E24 = 7.2kg/m <sup>2</sup>
Performance substantiation report	C10A032 C10A079 C10A080
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B

#### ALTO



■ 100mm Isowool General Purpose Roll  
■ 75mm Isowool TS48  
■ No quilt

#### Room to room sound insulation - $D_{n,c}$

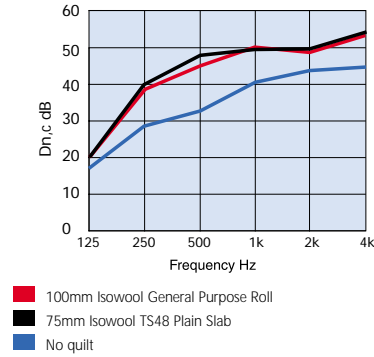
125	250	500	1k	2k	4k	$D_{n,c,w}$
20.3	38.7	45.5	50.2	49.1	53.1	46
20.1	40	48.4	49.7	49.7	54.5	47
17.8	28.5	33.3	41.2	44.2	45.6	38

Size	600 x 600mm
Tile edges	A, E15
Light reflectance	75%
Thickness	Edge A = 8mm Edge E15 = 9.5mm
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 = 7.2kg/m <sup>2</sup>
Grid system	15mm T sections <sup>1</sup>
Performance substantiation report	C10A087 C10A088 C10A089
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup> Tiles should be installed in a suitable grid system, the designer should ensure the system used is capable of supporting the tile load.

## Table 3 - Lay-in grid suspended ceilings - continued

### Data for Casoprano tiles



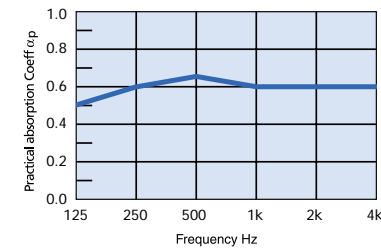
Room to room sound insulation - Dn,c						
125	250	500	1k	2k	4k	Dn,c,w
20.3	38.7	45.5	50.2	49.1	53.1	46
20.1	40	48.4	49.7	49.7	54.5	47
17.8	28.5	33.3	41.2	44.2	45.6	38

Size	600 x 600mm
Tile edges	A, E15, E24
Light reflectance	80%
Thickness	Edge A = 8mm Edge E15 & E24 = 9.5mm
Grid system	15mm T sections <sup>1</sup>
Tile weight	Edge A = 6.5kg/m <sup>2</sup> Edge E15 & E24 = 7.2kg/m <sup>2</sup>
Performance substantiation report	C10A027 C10A070 C10A071
Max. RH	90%
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup> Tiles should be installed in a suitable grid system, the designer should ensure the system used is capable of supporting the tile load.

### Data for Gyptone planks and tiles

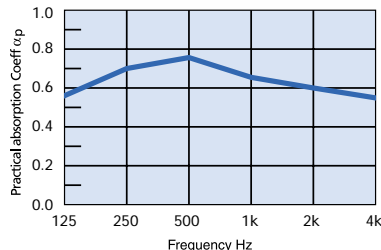
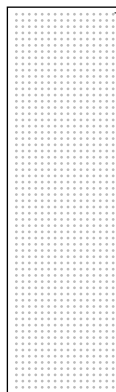
#### Plank LINE 8



Practical absorption coefficient αp							
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC
0.50	0.60	0.65	0.60	0.60	0.60	0.65	0.60

Size	300 x 1800mm 300 x 2100mm
Thickness	12.5mm
Long Edge	E15
Short Edge	A
Grid system	CasoLine T15p
Weight	8kg/m <sup>2</sup>
Perforated area	15%
Light reflectance	70%
Performance substantiation report	C10A009
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

#### Plank POINT 15



Practical absorption coefficient αp							
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC
0.55	0.70	0.75	0.65	0.60	0.55	0.65(L)	0.65

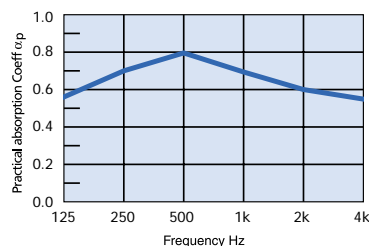
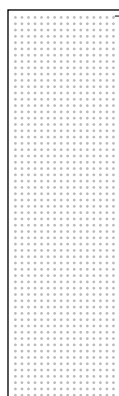
Size	300 x 1800mm 300 x 2100mm
Thickness	12.5mm
Long Edge	E15
Short Edge	A
Grid system	CasoLine T15p
Weight	8kg/m <sup>2</sup>
Perforated area	11%
Light reflectance	75%
Performance substantiation report	C10A010
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

<sup>2</sup> Absorption data is available for plenum depths less than 200mm, contact British Gypsum Drywall Academy Advice Centre.

## Table 3 - Lay-in grid suspended ceilings - continued

Data for Gyptone planks and tiles - continued

### Plank QUATTRO 55



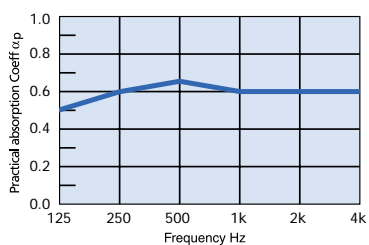
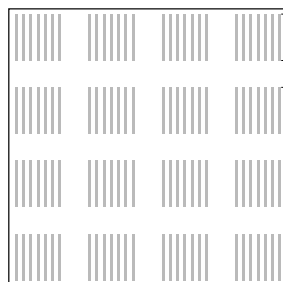
■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α<sub>p</sub>

125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.50	0.70	0.80	0.70	0.60	0.55	0.65	0.70	C

Size	1800 x 300mm 2100 x 300mm
Thickness	12.5mm
Long Edge	E15
Short Edge	A
Grid system	CasoLine T15P
Weight	8kg/m <sup>2</sup>
Perforated area	15%
Light reflectance	73%
Performance substantiation report	C10A034
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

### LINE 4



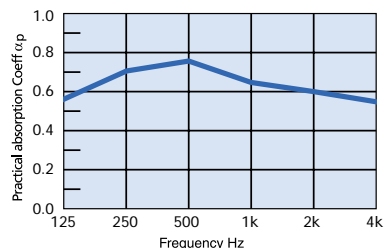
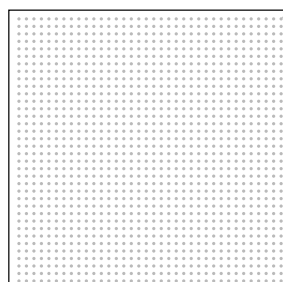
■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α<sub>p</sub>

125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.50	0.60	0.65	0.60	0.60	0.60	0.65	0.60	C

Size	600 x 600mm
Thickness	12.5mm
Edge	E15
Grid system	15mm T section <sup>2</sup>
Weight	8kg/m <sup>2</sup>
Perforated area	15%
Light reflectance	70%
Performance substantiation report	C10A004
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

### POINT 11



■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α<sub>p</sub>

125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.55	0.70	0.75	0.65	0.60	0.55	0.65(L)	0.65	C

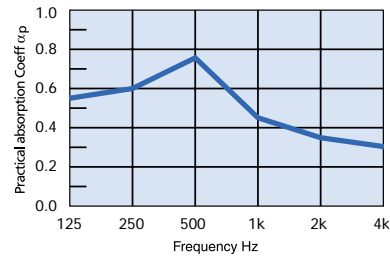
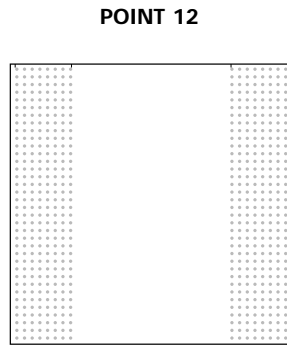
Size	600 x 600mm
Thickness	12.5mm
Edge	E15
Grid system	15mm T section <sup>2</sup>
Weight	8kg/m <sup>2</sup>
Perforated area	12%
Light reflectance	75%
Performance substantiation report	C10A005
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

<sup>1</sup> Absorption data is available for plenum depths less than 200mm, contact British Gypsum Drywall Academy Advice Centre.

<sup>2</sup> Tiles should be installed in a suitable grid system; the designer should ensure the system used is capable of supporting the tile load.

## Table 3 - Lay-in grid suspended ceilings - continued

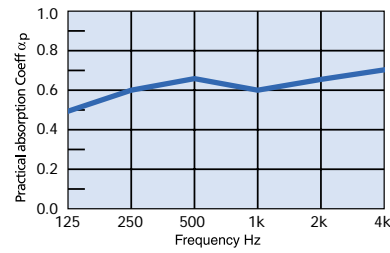
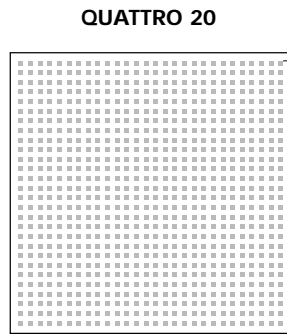
### Data for Gyptone planks and tiles - continued



■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α <sub>p</sub>								
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.55	0.65	0.75	0.45	0.35	0.30	0.40(LM)	0.55	D

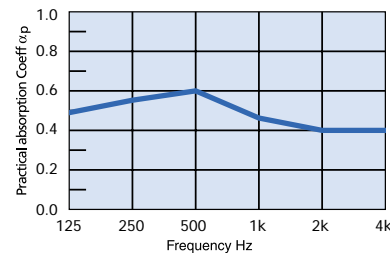
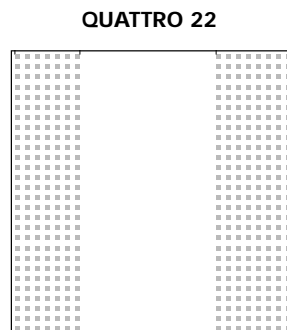
Size	600 x 600mm
Thickness	12.5mm
Edge	E15
Grid system	15mm T section <sup>2</sup>
Weight	8kg/m <sup>2</sup>
Perforated area	5%
Light reflectance	75%
Performance substantiation report	C10A006
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%



■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α <sub>p</sub>								
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.50	0.60	0.65	0.60	0.65	0.70	0.65	0.60	C

Size	600 x 600mm
Thickness	12.5mm
Edge	E15 & D1
Grid system	15mm T section <sup>2</sup> and CasoLine T24 D1
Weight	8kg/m <sup>2</sup>
Perforated area	18%
Light reflectance	73%
Performance substantiation report	C10A003
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%



■ 200mm plenum - no quilt<sup>1</sup>

Practical absorption coefficient α <sub>p</sub>								
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.50	0.55	0.60	0.45	0.40	0.40	0.45(L)	0.50	D

Size	600 x 600mm
Thickness	12.5mm
Edge	E15 & D1
Grid system	15mm T section <sup>2</sup> and CasoLine T24 D1
Weight	8kg/m <sup>2</sup>
Perforated area	9%
Light reflectance	73%
Performance substantiation report	C10A007
Reaction to fire	Class 0 / Euroclass B
Max. RH	70%

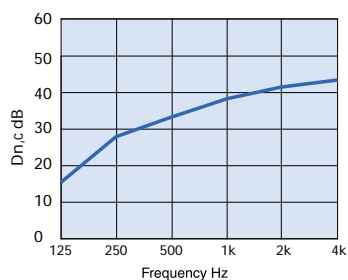
<sup>1</sup> Absorption data is available for plenum depths less than 200mm, contact British Gypsum Drywall Academy Advice Centre.

<sup>2</sup> Tiles should be installed in a suitable grid system; the designer should ensure the system used is capable of supporting the tile load.

## Table 3 - Lay-in grid suspended ceilings - continued

### Data for Gyprex tiles

#### Gyprex BIO



■ No quilt<sup>1</sup>

#### Room to room sound insulation - Dn,c

125	250	500	1k	2k	4k	Dn,c,w
16.5	27.4	33.1	38.8	41.9	43.8	37

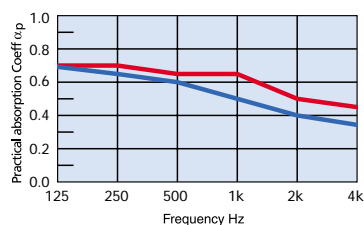
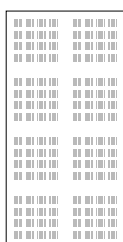
Size	600 x 600mm
Thickness	8mm
Edge	A
Grid system	15mm T Section <sup>1</sup>
Weight	6.2kg/m <sup>2</sup>
Light reflectance	83%
Performance substantiation report	C10A021
Reaction to fire	Class 0 / Euroclass B
Max RH	90%

<sup>1</sup> Tiles should be installed in a suitable grid system; the designer should ensure the system used is capable of supporting the tile load.

## Table 4 - CasoLine MF suspended ceilings

### Data for Gyptone boards

#### LINE 6



■ 400mm plenum - plus 100mm Isowool General Purpose Roll<sup>1</sup>

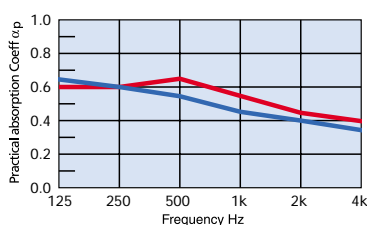
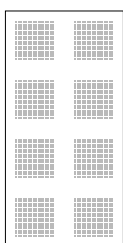
■ 400mm plenum - no quilt<sup>1</sup>

#### Practical absorption coefficient $\alpha_p$

125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.70	0.70	0.65	0.65	0.50	0.45	0.55(L)	0.65	D
0.70	0.65	0.60	0.50	0.40	0.35	0.45(L)	0.55	D

Size	1200 x 2400mm
Board edges	Long edge - Tapered Butt end - Square
Thickness	12.5mm
Weight	8kg/m <sup>2</sup>
Performance substantiation report	C10A001 C10A002
Perforated area	13%
Perforation size	6 x 80mm
Reaction to fire	Class 0 / Euroclass B

#### QUATTRO 46



■ 400mm plenum - plus 100mm Isowool General Purpose Roll<sup>1</sup>

■ 400mm plenum - no quilt<sup>1</sup>

#### Practical absorption coefficient $\alpha_p$

125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.60	0.60	0.65	0.55	0.45	0.40	0.50(L)	0.55	D
0.65	0.60	0.55	0.45	0.40	0.35	0.45(L)	0.50	D

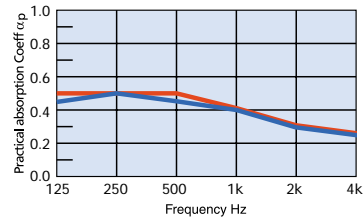
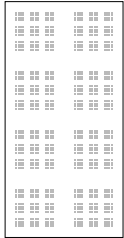
Size	1200 x 2400mm
Board edges	Long edge - Tapered Butt end - Square
Thickness	12.5mm
Weight	8kg/m <sup>2</sup>
Performance substantiation report	C10A014 C10A015
Perforated area	10%
Perforation size	12 x 12mm @ 25mm centres
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup> Absorption data is available for plenum depths less than 400mm, contact British Gypsum Drywall Academy Advice Centre.

## Table 4 - CasoLine MF suspended ceilings - continued

### Data for Gyptone boards - continued

#### QUATTRO 47



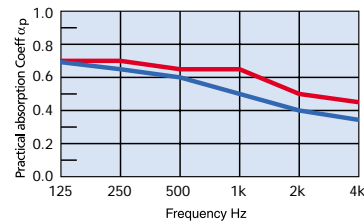
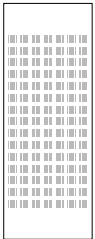
■ 400mm plenum - plus 100mm Isowool General Purpose Roll<sup>1</sup>  
 ■ 400mm plenum - no quilt<sup>1</sup>

#### Practical absorption coefficient $\alpha_p$

125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.50	0.55	0.50	0.40	0.30	0.30	0.40(L)	0.45	D
0.45	0.50	0.45	0.40	0.30	0.25	0.35(L)	0.40	D

Size	1200 x 2400mm
Board edges	Long edge - Tapered Butt end - Square
Thickness	12.5mm
Weight	8kg/m <sup>2</sup>
Performance substantiation report	C10A016 C10A017
Perforated area	14%
Perforation size	12 x 12mm @ 25mm centres
Reaction to fire	Class 0 / Euroclass B

#### Curve LINE 7



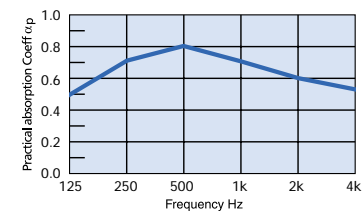
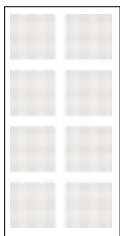
■ 400mm plenum - plus 100mm Isowool General Purpose Roll<sup>1</sup>  
 ■ 400mm plenum - no quilt<sup>1</sup>

#### Practical absorption coefficient $\alpha_p$

125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.70	0.70	0.65	0.65	0.50	0.45	0.55(L)	0.65	D
0.70	0.65	0.60	0.50	0.40	0.35	0.45(L)	0.55	D

Size	900 x 2400mm
Board edges	Long edge - Tapered Butt end - Square
Thickness	6.5mm
Weight	5kg/m <sup>2</sup>
Performance substantiation report	C10A018 C10A019
Perforated area	14%
Perforation size	6 x 80mm
Reaction to fire	Class 0 / Euroclass B

#### QUATTRO 41



■ 200mm plenum - no quilt

#### Practical absorption coefficient $\alpha_p$

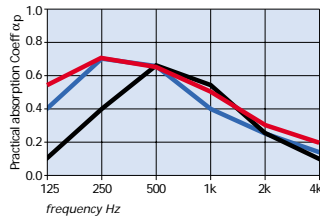
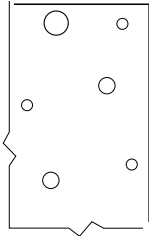
125	250	500	1k	2k	4k	$\alpha_w$	NRC	Class
0.50	0.70	0.80	0.70	0.60	0.55	0.65	0.70	C

Size	1200 x 2400mm
Board edges	Long edge - Tapered Butt end - Square
Thickness	12.5mm
Weight	8kg/m <sup>2</sup>
Performance substantiation report	C10A091
Perforated area	16%
Perforation size	12 x 12mm @ 25mm centres
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup>Absorption data is available for plenum depths less than 400mm, contact British Gypsum Drywall Academy Advice Centre.

**Table 4 - CasoLine MF suspended ceilings - continued**  
**Sound absorption data for Rigitone boards<sup>1</sup>**

**8-15-20<sup>2</sup>**



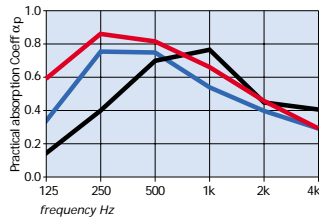
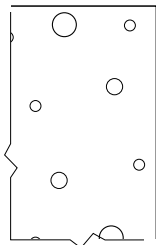
- 200mm plenum - plus 75mm Isowool TS48 Plain Slab
- 200mm plenum - no quilt
- 50mm plenum - no quilt

*Practical absorption coefficient α<sub>p</sub>*

125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.55	0.70	0.65	0.50	0.30	0.20	0.35(LM)	0.55	D
0.40	0.70	0.65	0.40	0.25	0.15	0.30(LM)	0.50	D
0.10	0.40	0.65	0.55	0.25	0.10	0.25(LM)	0.45	E

Size	2000 x 1200mm
Board edges	Square
Thickness	12.5mm
Weight	10kg/m <sup>2</sup>
Performance substantiation report	C10A056 C10A057 C10A068
Perforated area	6%
Hole diameter	8mm, 15mm & 20mm
Reaction to fire	Class 0 / Euroclass B

**8-15-20 SUPER<sup>2</sup>**



- 200mm plenum - plus 75mm Isowool TS48 Plain Slab
- 200mm plenum - no quilt
- 50mm plenum - no quilt

*Practical absorption coefficient α<sub>p</sub>*

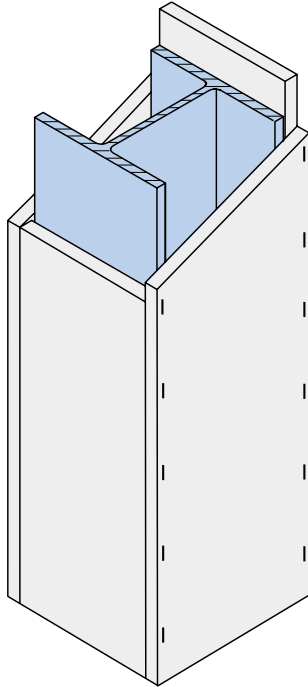
125	250	500	1k	2k	4k	α <sub>w</sub>	NRC	Class
0.60	0.85	0.80	0.65	0.45	0.30	0.45(LM)	0.70	D
0.35	0.75	0.75	0.55	0.40	0.30	0.45(LM)	0.60	D
0.15	0.40	0.70	0.75	0.45	0.40	0.50(M)	0.55	D

Size	1960 x 1200mm
Board edges	Square
Thickness	12.5mm
Weight	10kg/m <sup>2</sup>
Performance substantiation report	C10A069 C10A059 C10A058
Perforated area	10%
Hole diameter	8mm, 15mm & 20mm
Reaction to fire	Class 0 / Euroclass B

<sup>1</sup> Additional designs of Rigitone boards are available, contact the British Gypsum Drywall Academy Advice Centre.

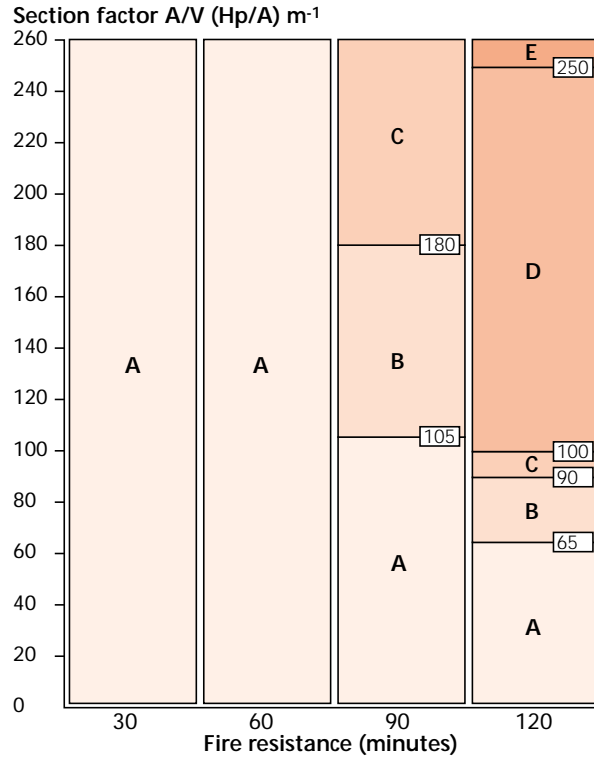
<sup>2</sup> Rigitone 8-15-20 and 8-15-20 SUPER are suitable for use in indoor sports halls.

**Table 5 - Encasements to structural steel - fire protection**



The British Gypsum FireCase frameless encasement system provides a high quality cladding to structural steel, and offers up to 120 minutes fire protection. The system affords protection to universal steel columns and beams, together with many joists and castellated beam sections. It can be used in any type of educational building where an encasement is required to structural steelwork. The completed lining is robust and offers a high degree of impact resistance combined with moisture resistance. A joint treatment or gypsum plaster can be applied to give a smooth seamless finish.

The designer will need to ascertain the level of fire resistance required and whether protection is needed to 3 or 4 sides. The appropriate A/V factor can be found from tables in The British Gypsum 'White Book', Section **d01**, or from other sources.



<b>A</b>	15mm	<b>D</b>	30mm
<b>B</b>	20mm	<b>E</b>	35mm
<b>C</b>	25mm		

**Thickness of Glasroc FireCase s board required**