ACOUSTIC AND THERMAL INSULATION IN BUILDINGS

L'ISOLANTE K-FLEX

K-FLEX INDEX

OVERVIEW AIRBORNE SOUND INSULATION REQUIREMENTS IN 24 EUROPEAN COUNTRIES

Airborne sound insulation between houses
Main requirements in 24 European countries

Country *with indication of concept for formulation of requirements*		**Multi-storey housing**		**Terraced housing**	
		Req. [dB]	Eq. L'n,w (1), (2) [dB]	Req. [dB]	Eq. L'n,w (1), (2) [dB]
Denmark	R'_w	≥ 52	52	≥ 55	55
Norway	R'_w	≥ 55	55	≥ 55	55
Sweden	$R'_w + C_{50\text{-}3150}$	≥ 53	~55	≥ 53	~55
Finland	R'_w	≥ 55	55	≥ 55	55
Iceland	R'_w	≥ 52	~52	≥ 55	~55
Germany	R'_w	≥ 53	53	≥ 57	57
UK	$D_{nT,w} + C_{tr}$	≥ 45	~49-52	≥ 45	~49-52
France	$D_{nT,w} + C$	≥ 53	~53-56	≥ 53	~53-56
Switzerland	$D_{nT,w} + C$	≥ 54	~54-57	≥ 54	~54-57
Austria	$D_{nT,w}$	≥ 55	~54-57	≥ 60	~59-62
Netherlands	$I_{lu;k}$	≥ 0	~55	≥ 0	~55
Belgium	$D_{nT,w}$	≥ 54	~53-56	≥ 58	~57-60
Italy	R'_w	≥ 50	50	≥ 50	50
Spain	$D_{nT,w} + C_{100\text{-}5000}$	≥ 50	~50-53	≥ 50	~50-53
Portugal	$D_{n,w}$	≥ 50	~50-52	≥ 50	~50-52
Poland	$R'_w + C$	≥ 50	~51	≥ 52	~53
Czech Rep.	R'_w	≥ 52	52	≥ 57	57
Slovakia	R'_w	≥ 52	52	≥ 52	52
Hungary	R'_w	≥ 52	52	≥ 57	57
Slovenia	R'_w	≥ 52	52	≥ 52	52
Estonia	R'_w	≥ 55	55	≥ 55	55
Latvia	R'_w	≥ 54	54	≥ 54	54
Lithuania	$D_{nT,w}$ or R'_w	≥ 55	~55	≥ 55	~55
Russia	I_b	≥ 50	52	(8)	(8)

SOUND INSULATION REQUIREMENTS FOR RESIDENTIAL BUILDINGS IN EUROPE

To begin with we need to distinguish both between the units to describe the sound insulation of a building element and the units to describe the sound insulation between rooms in a building which is determined by a combination of various building elements.
As far as buildings are concerned one has to consider the diffusion of airborne sound, pressure vibrations in the air produced by elements such as loudspeakers, musical instruments, people talking, etc.), as well as of impact sound, caused by peolple walking on floors, the moving of elements such as chairs etc., and sound caused by using sanitary installations and its propagating as airborne and as structure-borne sound.

Airborne sound insulation
The sound reduction index R versus frequency is used to describe the airborne sound insulation of building elements. It is also called transmission loss (TL). From the sound reduction index versus frequency, the single number quantity, the weighted sound reduction index Rw is calculated by comparing the values with a reference curve according to ISO 717-1.
Two supplementary spectrum adaptation terms have been introduced in a new edition of ISO 717-1, C for pink noise (equal levels over the whole frequency range which represents activities like talking, music, TV and medium and high speed railway traffic) and Ctr for noise with mainly low frequencies (representing city traffic, factories, disco music etc.. With the sum of Rw and the relevant spectrum adaptation term (according to the relevant spectrum) the difference of A-weighted levels can be calculated. The spectrum adaptation terms may be stated for the frequency range 100-3150 Hz (used for decades) as well as for the enlarged frequency ranges of 50-3150 Hz or 100-5000 Hz; the relevant frequency range has then to be stated as an index, e.g. $C_{50-5000}$ or $C_{tr,50-5000}$.
Different countries have different units to describe the airborne sound insulation between two rooms. If one considers that sound is transmitted in buildings only through separating structures, the sound reduction index is also used to describe the sound insulation between two rooms; to take into account the fact that the sound is generally transmitted in a building via the separating element and the flanking elements, the sound reduction index in the building is called the apparent sound reduction index R'1. The single number quantities, weighted apparent sound reduction index R'w, and C and Ctr, are calculated and stated as described above.

[1] pronounced R-dash; the dash represents the fact that that the given sound reduction index is measured in the building.

The sound level difference D between two rooms is stated to differentiate between the sound insulation of building elements and the sound insulation between two different rooms in a building. Since sound levels in receiving rooms are also determined by the sound absorption in the room, this means that the higher the sound absorption, the lower the sound level, this sound level difference has to be referred to as standardized absorption; two units are standardized: the normalized sound level difference Dn, referred to 10 m^2 of sound absorption area in the receiving room and the standardized sound level difference DnT, referred to 0.5 seconds of reverberation time in the receiving room. Numerous measurements have shown that the reverberation time in living rooms is independent of the volume over 0.5 seconds and therefore the standardized sound level difference is better in practice at representing the acoustic conditions in rooms 2.
Supplementing apparent sound reduction index, normalized sound level difference and standardized sound level difference, the spectrum adaptation terms are stated.
As far as building acoustics are concerned, one may draw a clear differentiation to describe acoustic quality:
The sound insulation of a building element is characterized by the sound reduction index; this can only be measured in a normalized test facility; the single number stated is the weighted sound reduction index Rw, and additionally the spectrum adaptation terms C and Ctr.
In a building, the sound insulation between two rooms, whether adjacent or one on top of the other or not directly connected to each other, is characterized by the standardized sound level difference; the single number stated is the weighted standardized sound level difference DnT,w, and additionally the spectrum adaptation terms C and Ctr.

[2] The sound absorption area A results from the volume V and the reverberation time T by A = 0.16.V/T; evidently the sound absorption area grows with rising volume while the reverberation time remains constant independent of volume.

AIRBORNE SOUND INSULATION

Impact sound insulation

The impact sound insulation of floors is described by the normalized impact sound level, i.e. the sound level which is measured in a test environment in the room beneath the floor (receiving room), which is excited by a tapping machine. This sound level refers to a 10 m^2 sound absorption area in the receiving room. From the sound level measured in third-octave or octave bands, a single number is calculated according to ISO 717-2, the weighted normalized impact sound level Ln,w.
In a new edition of ISO717-2 a supplementary spectrum adaptation term CI was defined. This spectrum adaptation term may be determined for the frequency range of 100-3150 Hz, which has been used for decades, and also for the enlarged frequency range of 50-3150 Hz or 50- 2500 Hz; the frequency range has to be specified as an index, e.g. CI,50-2500. The sum of Ln,w and CI characterizes the linear impact sound level and corresponds better to the A-weighted sound level, produced by walking on the floor.
In residential buildings nearly all floors mainly consist of a bare floor with a floor covering. However, a single bare floor does not guarantee an effective impact sound insulation. An additional floor covering needs to be added to ensure the required impact sound insulation.
Therefore the planner must know the impact sound level of the bare floor and the reduction in impact sound pressure level from the floor covering to be able to calculate the impact sound level of the entire floor. Single number quantities have been defined for the bare floor and the floor covering for this purpose: the equivalent weighted normalized impact sound pressure level Ln,eq,0,w of bare massive floors and the weighted reduction in impact sound pressure level ΔLw for the floor covering. The weighted impact sound pressure level of a floor with covering is the equivalent weighted normalized impact sound pressure level Ln,eq,0,w of the bare massive floor less the weighted reduction in impact sound pressure level ΔLw for the floor covering.
For wooden floors it is not possible to use the weighted reduction in impact sound pressure level ΔLw. However, a special quantity for the reduction in impact sound pressure level by floor coverings on wooden floors has been defined in a new edition of ISO 717-2; this has to be determined separately by measurement on a normalized timber joist floor and stated with the single number ΔLt,w for the impact sound pressure level on timber joist floors and ΔLtv,w for the impact sound pressure level on vertically laminated wooden floors 5. In an investigation the basis for the determination of these quantities and ΔLt,w und ΔLtv,w for a great number of usual types of floor covering on wooden floors was measured (Lang, 2004). The airborne and impact sound insulation of a series of timber joist floors with different floor coverings was also measured in this investigation; furthermore, a connection between impact sound insulation measured by the tapping machine and given for walking was determined by comparison with the noise of persons walking on the floors (see Figure 7).
The impact sound insulation of floors in a building is measured with the tapping machine in the same way as in test facilities. However, the sound level does not refer to 10 m^2 sound absorption area but to the reverberation time of 0.5 seconds (which is usual in living rooms in practice regardless of their volume) and the result is called the standardized impact sound level
L'nT and the single number weighted standardized impact sound level L'nT,w .
However, in the standards in several countries, requirements for the impact sound insulation inbuildings are laid down based on the weighted normalized impact sound level L'n,w or on the weighted standardized impact sound level L'nT,w6, in some countries with the additional adaptation term C_I.

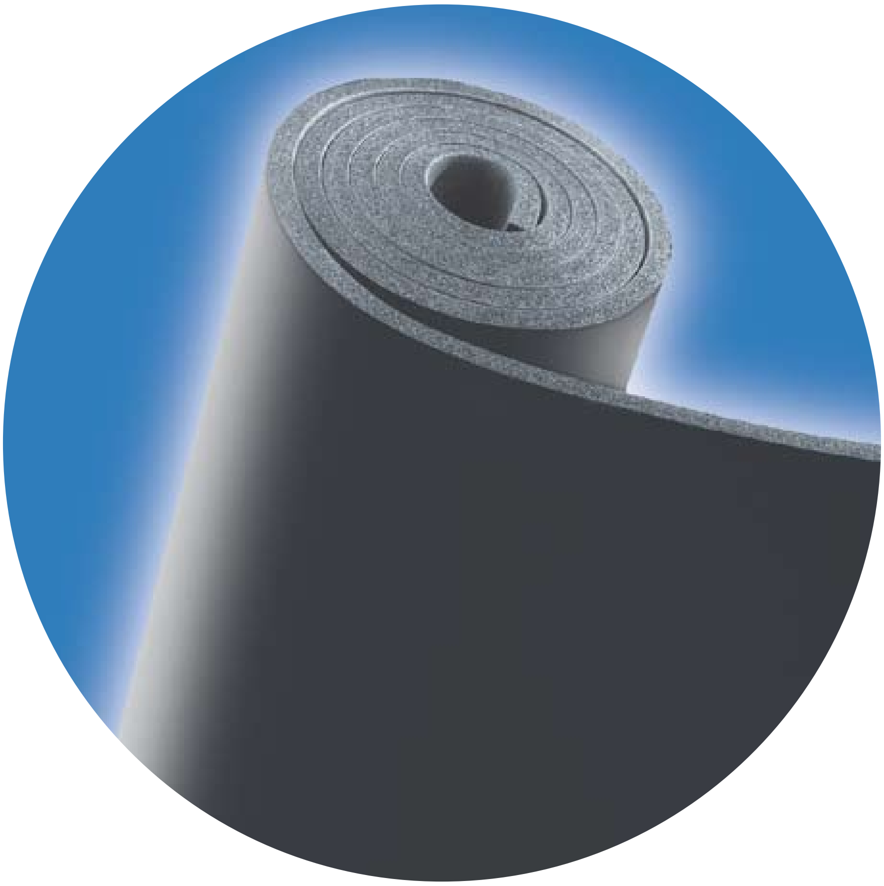
Impact sound insulation between houses
Main requirements in 24 European countries

Country *with indication of concept for formulation of requirements*		Multi-storey housing		Terraced housing	
		Req. [dB]	Eq. L'n,w (1), (2) [dB]	Req. [dB]	Eq. L'n,w (1), (2) [dB]
Denmark	L'n,w	≤ 58	58	≤ 53	53
Norway	L'n,w	≤ 53	53	≤ 53	53
Sweden	L'n,w + CI,50-2500	≤ 56	~56	≤ 56	~56
Finland	L'n,w	≤ 53	53	≤ 53	53
Iceland	L'n,w	≤ 58	58	≤ 53	53
Germany	L'n,w	≤ 53	53	≤ 48	48
UK	L'nT,w	≤ 62	~62-57	None	N/A
France	L'nT,w	≤ 58	~60-53	≤ 58	~60-53
Switzerland	L'nT,w + C	≤ 50	~52-45	≤ 50	~52-45
Austria	L'nT,w	≤ 48	~50-43	≤ 46	~48-41
Netherlands	Ico	≥ +5	~61-54	≥ +5	~61-54
Belgium	L'nT,w	≤ 58	~60-53	≤ 50	~52-45
Italy	L'n,w	≤ 63	63	≤ 63	63
Spain	L'nT,w	≤ 65	~67-60	≤ 65	~67-60
Portugal	L'n,w	≤ 60	60	≤ 60	60
Poland	L'n,w	≤ 58	58	≤ 53	53
Czech Rep.	L'n,w	≤ 58	58	≤ 53	53
Slovakia	L'n,w	≤ 58	58	≤ 58	58
Hungary	L'n,w	≤ 55	55	≤ 47	47
Slovenia	L'n,w	≤ 58	58	≤ 58	58
Estonia	L'n,w	≤ 53	53	≤ 53	53
Latvia	L'n,w	≤ 54	54	≤ 54	54
Lithuania	L'n,w	≤ 53	53	≤ 53	53
Russia	Iy	≤ 67	60	(7)	(7)

IMPACT SOUND INSULATION

ACOUSTIC INSULATION OF HORIZONTAL STRUCTURES

K-FLEX ST SHEET 6 mm in thickness

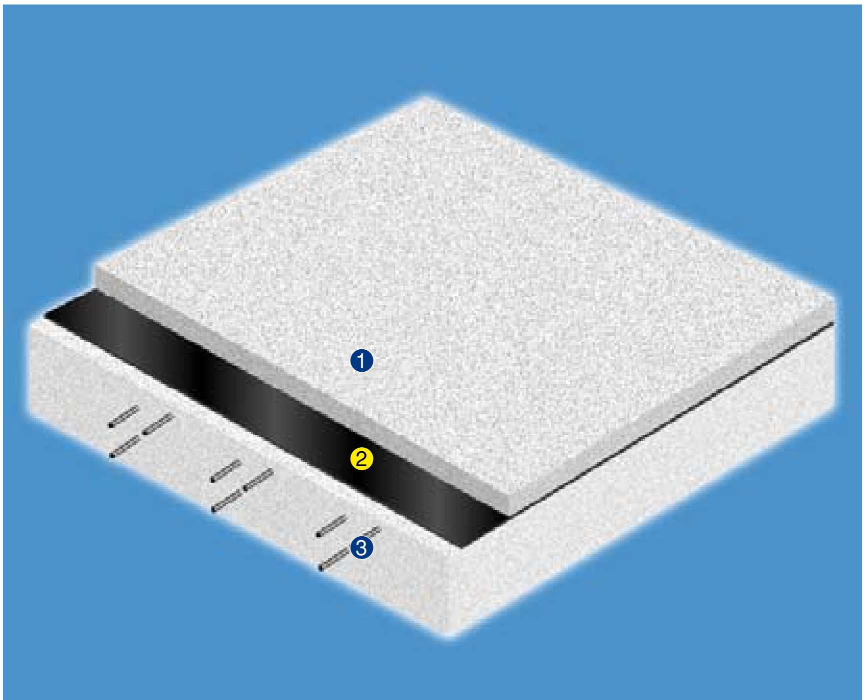


K-FLEX HORIZONTAL PARTITIONS

Where horizontal partitians are concerned, we can group them into two definite types of structures:

- Predalles floors, used for fire prevention if there are garages situated below;
- Reinforced cement tile floors

The references regarding sound absorption characteristics are related to the laboratory tests in conformaty with UNI EN ISO 140-8 and UNI EN ISO 717-2.
A wooded floor covering instead of ceramic tiles improves performance. In both cases the insulation must be layed creating an overlap of at least 10 cm. The systems must never puncture the insulation. On the outer edges, in contact with the walls, the insulation must be turned up in such a way that it rises above the height of the finished floor. The concrete slab must come into contact with the outer walls.
If necessary, to make the job of laying the floor and the skirting board easier, one could avoid turning back the insulation along the walls, applying a K-FLEX ST adhesive strip around the edges of the walls.



CEMENT TILE FLOOR

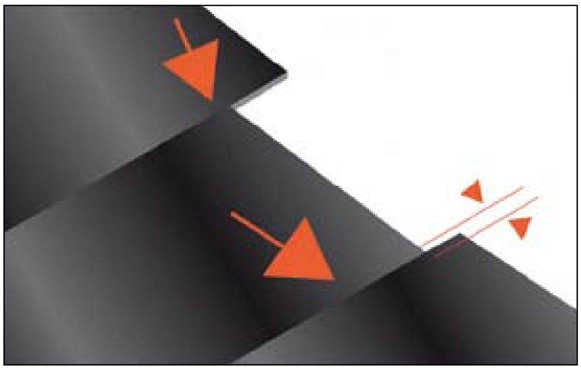
CEMENT TILES FLOOR

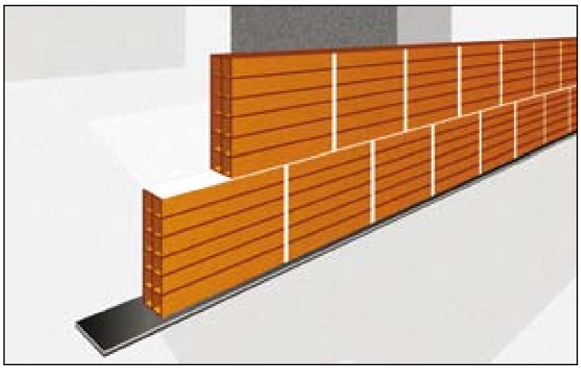
LEVEL OF IMPACT SOUND ABSORPTION
ΔLw=25dB

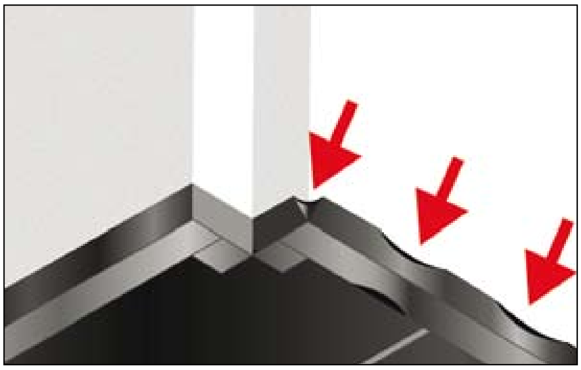
	Description of components	Thickness (mm)
1	Concrete slab	50
2	K-FLEX ST	6
3	Floor in cement tiles	140

INSTALLATION PROCEDURE

Dry installation of the K-FLEX ST acoustic sheet directly onto the floor.







Overlap the sheets by at least 10 cm, taking care not to tear or perforate the material. The covering must be continuous and without imperfections.

Lay the floor slabs directly over the covering taking care not to damage it.

Apply the K-FLEX ST Perimeter Strips laterally and turned up against the wall, in order to guarantee continuity of the screed floating tank of the slab also towards the vertical structures.

Build a supporting slab with the same thickness as the system coverings and the final floor covering (above the products of the K-FLEX ST 6 mm thickness range, slabs of at least 5 cm are advisable; for lesser thicknesses it is advisable to continue reinforcing with fibers or suitable slab grids). The slab should be made following indications specified by the normative (ISO 13813).

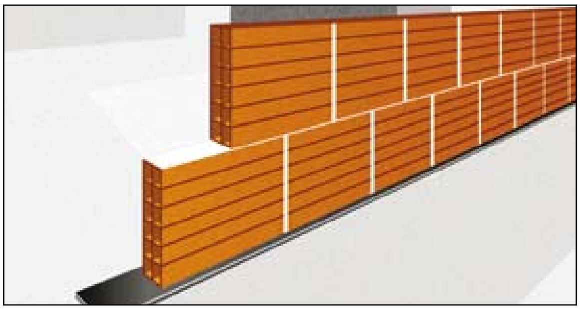
The vertical excess of the acoustic Perimeter strips should be removed with a cutter only after having laid the final floor and before laying the skirting board.

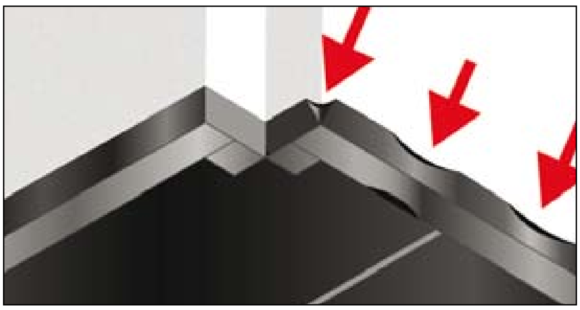
It is important to note that laying the “Wall cutting strip” under the internal partition walls is extremely important to obtain the correct required impact noise insulation values.

ACOUSTIC INSULATION UNDER WOODEN FLOORS

K-FLEX ST is the ideal product to directly apply under wooden floors. K-FLEX ST has all the essential requirements to ensure a perfect installation since:

1. It guarantees high acoustic dampening qualities.
2. It ensures a complete and safe vapour and humidity barrier.
3. Preserves all its characteristics in time.
4. It will act as a cushion to allow for any expansion between the concrete and the wooden floor.
5. It is completely atoxic and self-extinguishing (Reaction to fire: Class 0 BS 476 PT 6/7).



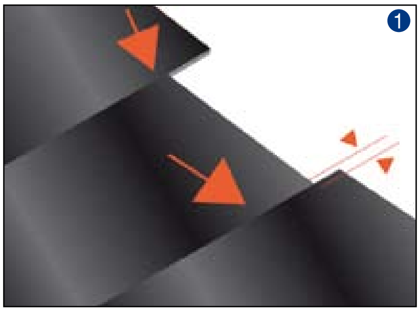


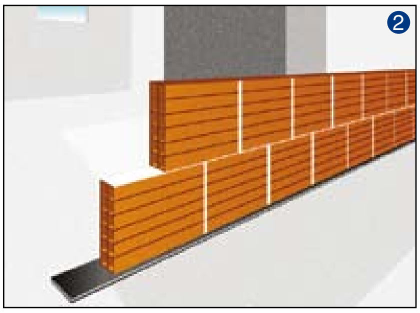
APPLICATION ADVICE

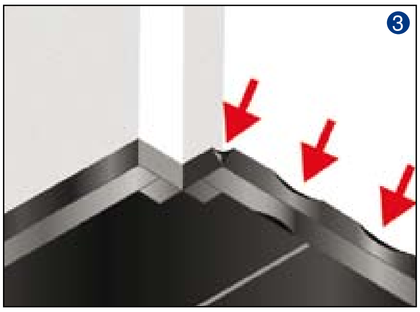
K-FLEX ST can be positioned directly onto existing floors without using adhesives.

- The surface to cover must be clean and completely smooth.
- Apply 3 mm thick K-FLEX ST tape between the K-FLEX ST sheet joints.
- Carefully lift K-FLEX ST onto the walls, tubes etc., to avoid acoustic conduction of the floor.
- Lay the wood tiles with care to avoid damaging the K-FLEX ST.

APPLICATION ADVICE







CREATING A HORIZONTAL ACOUSTIC INSULATION

When laying products for acoustic and thermal insulations on horizontal structures, it is important to acheive continuity in order to create a tank, made by following the instructions below:

◆ Always create an overlay of at least 10 cm.
The floating floor must always allow the concrete slab to “float” inside it. (fig. 1)

◆ Apply K-FLEX ST Perimeter Strips securely onto the masonry in order to avoid rigid joints between the horizontal and vertical structures. It would be better if the strips were attached starting from the height of the floor and cover the whole surrounding edge of the floor insulation as shown in figure 3. Avoid air bubbles when applying the strips and position them so that they are folded vertically onto the walls with a length equal to the thickness of the concrete slab and that of the floor.
The excess of the strips should be cut away only after the flooring has been layed. (fig. 3)

◆ Start to lay the slabs in the direction of the overlapped sheets.

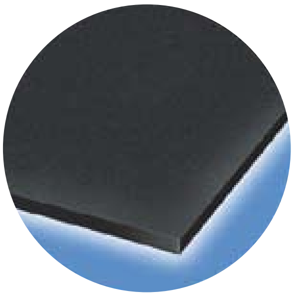
◆ For ceramic or marble skirting boards and coverings in kitchen or bathroom tiles, take care to leave a few milimeters between them and the glued floor in order to avoid loss of sound insulation performance through rigid joints between the floor, the skirting board and the wall. (fig. 2).

◆ In order to improve acoustic impedance and the strengthening of the horizontal structures, apply K-FLEX ST Perimeter Strips under each block to stop sound transmission to the underlying room through the vertical structure.

◆ With a collar made out of K-FONIK ST GK 072, insulate all pillars (if present) or whatever obstacle that could cause vibrations to spread (acoustic bridge) between both the horizontal and the other structures. (fig. 4)

ACOUSTIC AND THERMAL INSULATION OF THE VERTICAL STRUCTURES

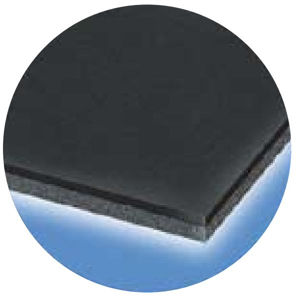
K-FLEX K-FONIK GK



Sheet of 3 mm thickness, high density elastomer.

Sheet dimensions:
1200 x 1000 mm and 5000 x 1000 mm

K-FLEX K-FONIK ST GK

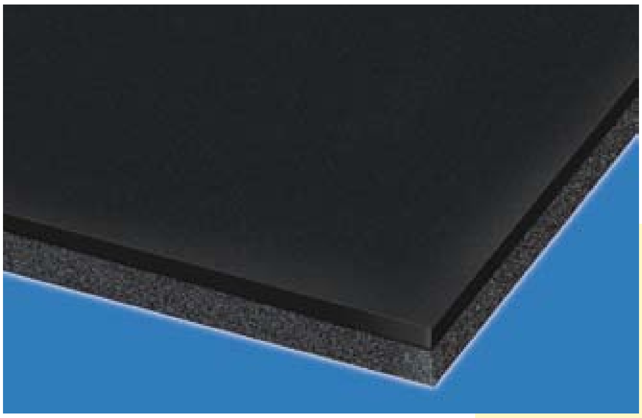


Multilayer, smooth elastomer sheets, in various thicknesses, coupled with high density elastomer.

Sheet dimensions:
15000 x 1000 mm and 3000 x 1000 mm

THE INSULATION MATERIAL: PERFORMANCE

For vertical structures, the various soundproofing solutions normally consist of a combination of masonry and insulating material.
In the middle of a two-wall structure, a material that can act as a mechanical agent should be inserted.
K-FONIK ST GK combines a high density elastomeric material in various thicknesses (from 3 to 5 mm) with a soft material that has excellent thermal insulation properties.
The combined effect of the two materials ensures excellent acoustic and thermal insulation results.



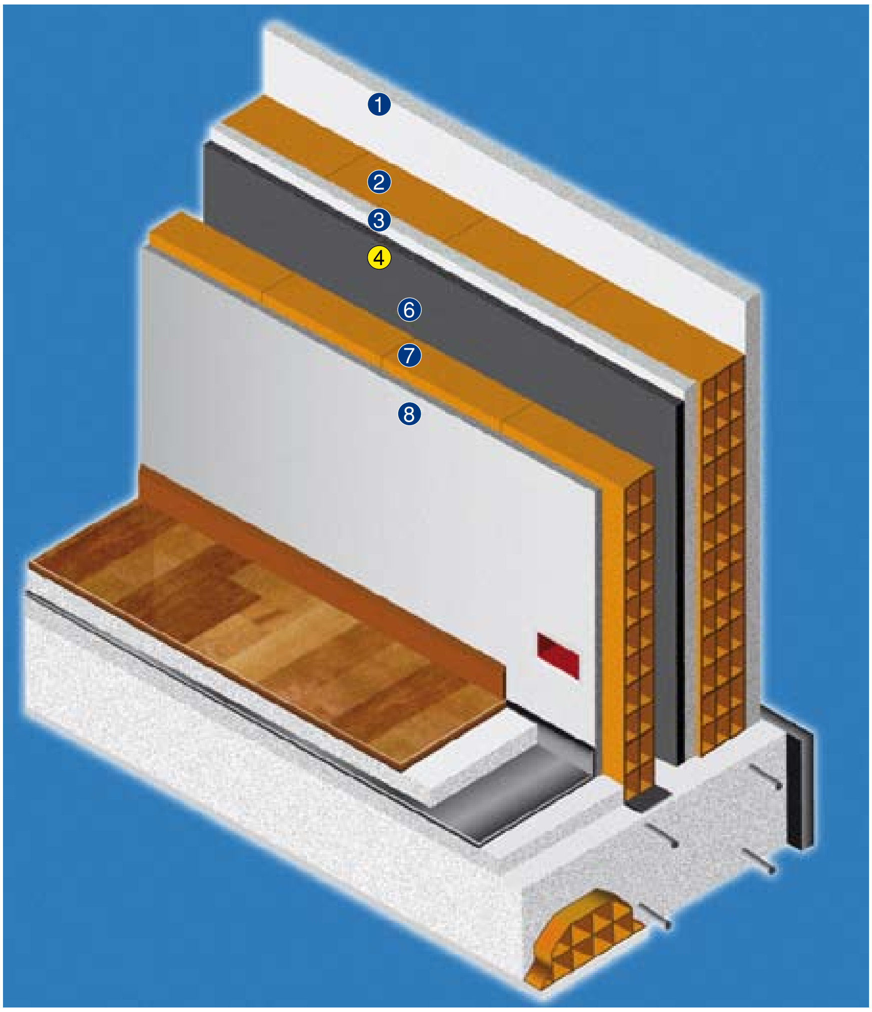
K-FONIK ST GK 072

NYLON FIXING PLUG

K-FLEX ST PERIMETER STRIPS

K-FLEX PERIMETER STRUCTURES AND WALL PARTITIONS

The most effective system for walls consists of a K-FONIK ST GK 072 sheet applied with nylon fixing plugs.
With K-FONIK ST GK 072, a sound insulation value equal to Rw= 56dB can be obtained with only 3 mm of high density rubber and 10 mm of elastomeric foam. The thermal conductivity of K-FONIK ST GK 072 is 0,037 W/(m·k).
To further improve thermal and acoustic insulation it is possible to use a 32 mm thick K-FLEX ST sheet in the combination.



DOUBLE WALL 120-13-80

WEIGHTED SOUND REDUCTION INDEX Rw= 56 dB

Correction terms: C= -1dB; Ctr= -5dB

A	Description of components	Thickness (mm)
1	Cement lime mortar	15
2	Double Brick	120
3	Cement lime mortar	10
4	K-FONIK ST GK 072	13
5	K-FLEX ST Perimeter Strips	6
6	Wall cavity	20
7	Brick	80
8	Lime and gypsum plaster	15

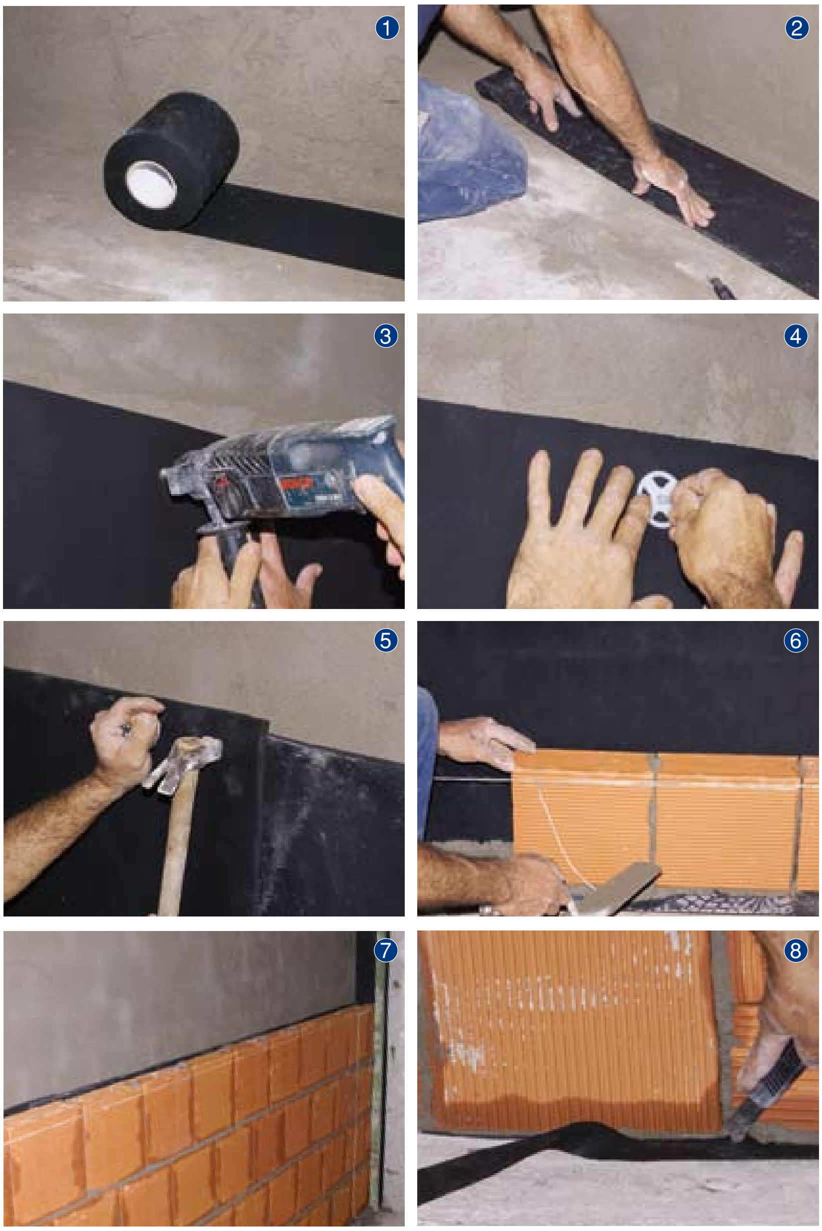
DOUBLE WALL 120-45-80

WEIGHTED SOUND REDUCTION INDEX Rw= 57 dB

Correction terms: C= -2dB; Ctr= -6dB

B	Description of components	Thickness (mm)
1	Cement lime mortar	15
2	Double Brick	120
3	Cement lime mortar	10
4	K-FONIK ST GK 072 + K-FLEX ST 32mm	45
5	K-FLEX ST Perimeter Strips	6
6	Wall cavity	20
7	Brick	80
8	Lime and gypsum plaster	15

INSTALLATION PROCEDURE



Build the first partition taking care to also apply the masonry mortar vertically to close the acoustic bridge (please note that it is advisable to use heavy, semi-filled or double bricks instead of the traditional hollow type).

To acheive the desired acoustic performance it is necessary to place a K-FLEX ST Perimeter Strip at the foot of the partitions. (figs. 1 and 2)

If the second brick partitioning wall is identically the same weight as the first one, apply a layer of mortar on the inside of at least 1 cm in thickness.

Place the insulation material in the wall cavity:

Apply K-FONIK ST GK 072 starting from the top of the wall with nylon fixing plugs, fixing them about every 50 cm. (figs. 3 and 4).
The K-FONIK sheet should be layed over the next one leaving an overlap of about 5 cm (fig. 5)

Proceed by building the second wall, making sure to leave an air cavity of 2 cm between the wall and the insulation material.(figs. 6 and 7)

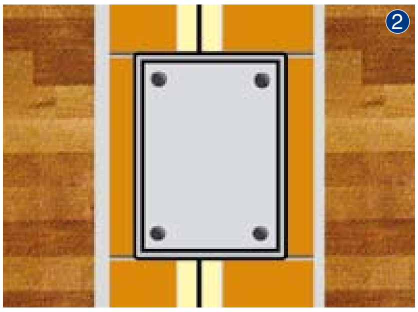
All weak areas in the wall could potentially create an acoustic bridge. It is therefore wise to cover all breakages, cracks etc., with mortar.

Remove any K-FLEX ST Perimeter Strip excess with a cutter. (fig. 8)

Apply plaster to the walls.

APPLICATION ADVICE


1


2

VERTICAL ACOUSTIC INSULATION

Always apply a K-FLEX ST Perimeter Strip at the foot of the partitions. (fig. 1)

Wrap any pillars etc. with K-FLEX K-FONIK ST GK and re-cover them with hollow tiles, with special curved bricks or with a special plaster supporting mesh. (fig. 2)

To guarantee an effective soundproofing it is important to build the walls with care, avoiding flaws between bricks and applying mortar both horizontaly and vertically. (fig. 3)

Fix K-FONIK ST GK with nylon fixing plugs. (figs. 4, 5 and 6)

When applying K-FONIK ST GK make sure to overlap the following sheet by about 5 cm. (figs.7 and 8)


3


4


5


6


7


8

LIGHTWEIGHT PLASTERBOARD WALLS ON METAL FRAMES

Acoustic insulation of lightweight plasterboard walls on metal frames can be achieved by laying plasterboard coupled with K-FLEX K-FONIK GK high density elastomer. The cavity of the metal structure should be empty in order to create an air chamber. If however one should wish to combine acoustic with thermal performance it is advisable to insert a K-FLEX ST sheet into the cavity.

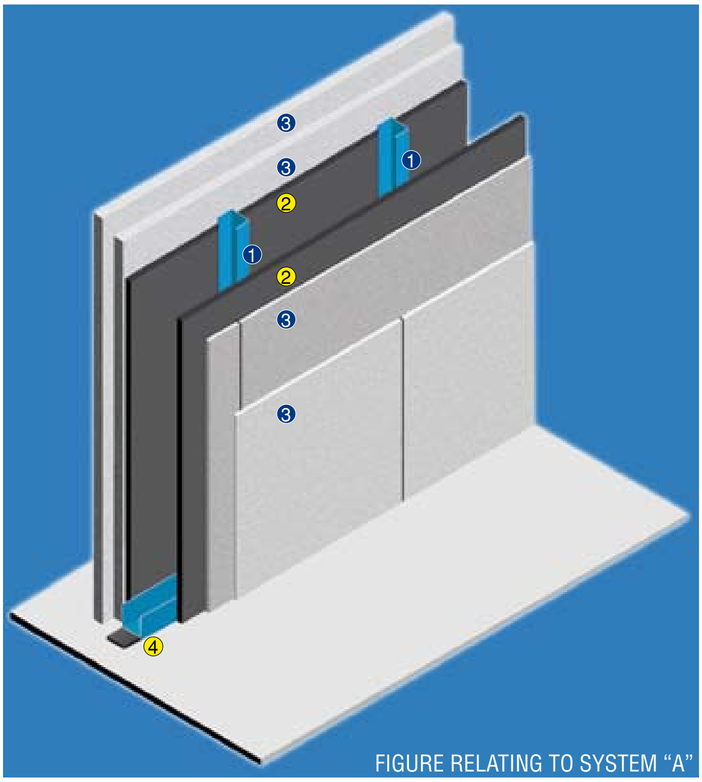


FIGURE RELATING TO SYSTEM "A"

APPLICATION ADVICE

Build the metal frame with a thickness of 75/100 mm which should be separated from the masonry, floors and coverings, with K-FONIK GK sheets, thickness 3 mm, 4 Kg/m^2, width 75/100 mm. Place a K-FLEX ST Perimeter Strip under the metal frame.

Apply the plasterboard sheets, (precoupled with K-FONIK GK, 3, 4 or 5 mm) directly in contact with the metal frame on both the sides. Then apply the second layer of plasterboard, staggering the joints.
Seal all joints with silicone putty.

In order to obtain an effective acoustic insulation, place a K-FLEX ST sheet in the cavity.

HOW TO IMPROVE RESULTS

In order to improve low frequency acoustic resistence, increase the total mass of the wall system by applying a thicker K-FONIK GK sheet, available in thicknesses of 3, 4 and 5 mm.
For further improvements it is possible to build a double cavity structure with 5 or 7 plaster boards.

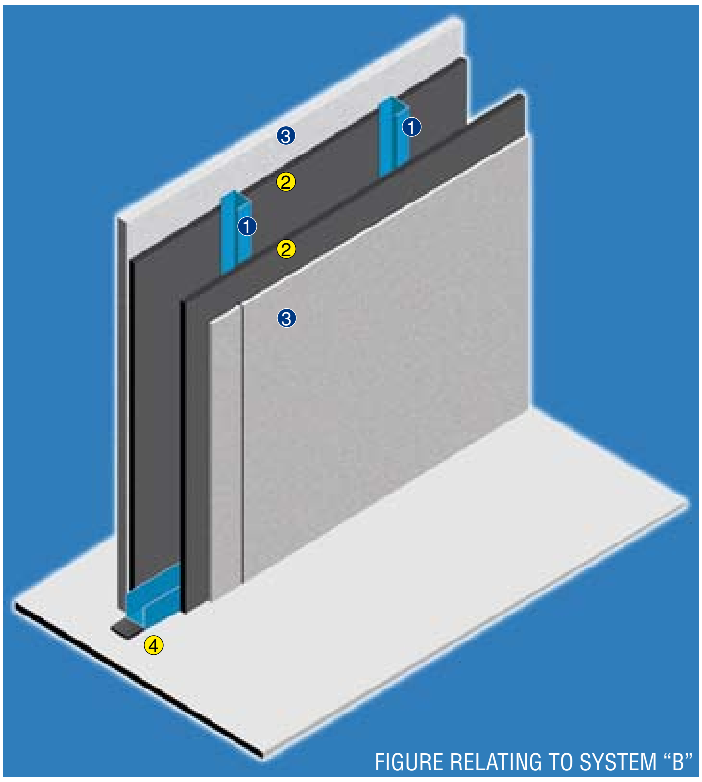


FIGURE RELATING TO SYSTEM "B"

LIGHTWEIGHT WALLS

WEIGHTED SOUND REDUCTION INDEX Rw= 48 dB

Correction terms: C= -1dB; Ctr= -6dB

A	Description of components	Thickness (mm)
1	Metal frame	75
2	K-FONIK GK	3
3	Plaster board	12,5
4	Perimeter Strip	6

LIGHTWEIGHT WALLS

WEIGHTED SOUND REDUCTION INDEX Rw= 42 dB

Correction terms: C= -2dB; Ctr= -7dB

B	Description of components	Thickness (mm)
1	Metal frame	75
2	K-FONIK GK	3
3	Plaster board	12,5
4	Perimeter Strip	6

RESTORATION INTERVENTIONS ON VERTICAL STRUCTURES

FALSE PLASTERBOARD WALLS

The application of the panels internally can be carried out in two ways: by gluing the panels to the existing masonry or fixing them mechanically to the metal frame. This type of intervention is fundamental to improve the performance of already existing walls. For both solutions, K-FONIK ST GK 072 insulation coupled with a 12,5 mm plaster board in the single and double sheet configuration should be used.

HOW TO IMPROVE RESULTS

In order to improve low frequency acoustic resistence, increase the total mass of the wall system by applying a thicker K-FONIK GK sheet, available in thicknesses of 3, 4 and 5 mm. For further improvements it is possible to build a double cavity structure with 5 or 7 plaster boards.

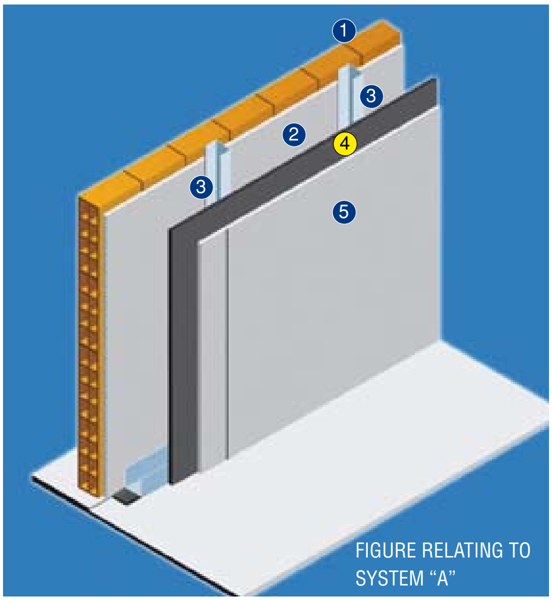


FIGURE RELATING TO SYSTEM "A"

FALSE WALLS ON A METAL FRAME

WEIGHTED SOUND REDUCTION INDEX Rw= 48 dB

Correction terms: C= -2dB; Ctr= -8dB

A	Description of components	Thickness (mm)
1	Hollow brick	80
2	Cement lime mortar	15
3	Metal sustaining frame	75
4	K-FONIK ST GK 072	13
5	Plaster board	12,5

GLUED FALSE WALLS

WEIGHTED SOUND REDUCTION INDEX Rw= 45 dB

Correction terms: C= -1dB; Ctr= -6dB

B	Description of components	Thickness (mm)
1	Hollow brick	80
2	Cement lime mortar	15
3	K-FONIK ST GK 072	13
4	Plaster board	12,5

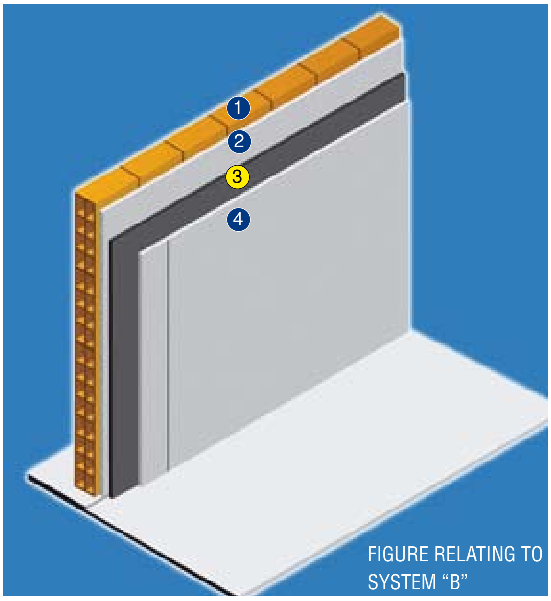


FIGURE RELATING TO SYSTEM "B"

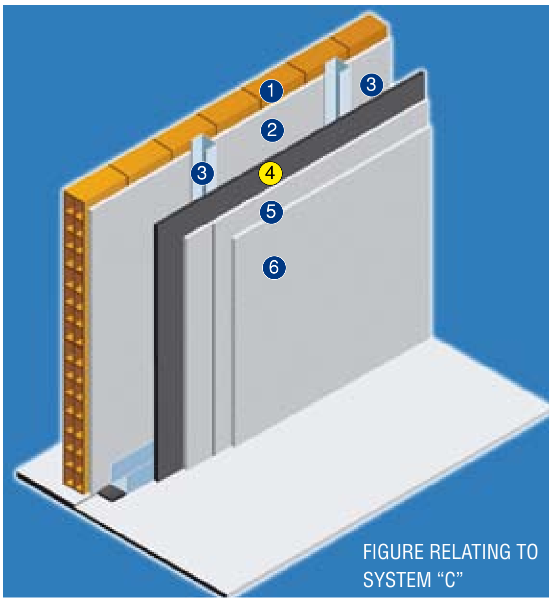


FIGURE RELATING TO SYSTEM "C"

GLUED FALSE WALLS

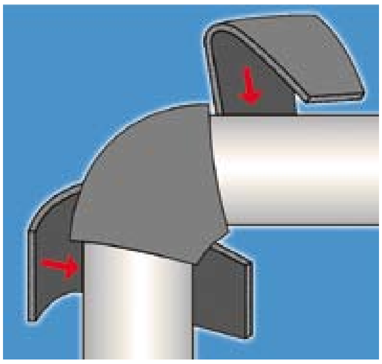
WEIGHTED SOUND REDUCTION INDEX Rw= 49 dB

Correction terms: C= -2dB; Ctr= -7dB

C	Description of components	Thickness (mm)
1	Hollow brick	80
2	Cement lime mortar	15
3	Metal sustaining frame	75
4	K-FONIK ST GK 072	13
5	Plaster board	12,5
6	Plaster board	12,5

ACOUSTIC INSULATION OF WATERWORKS, SANITARY AND RAIN PIPES

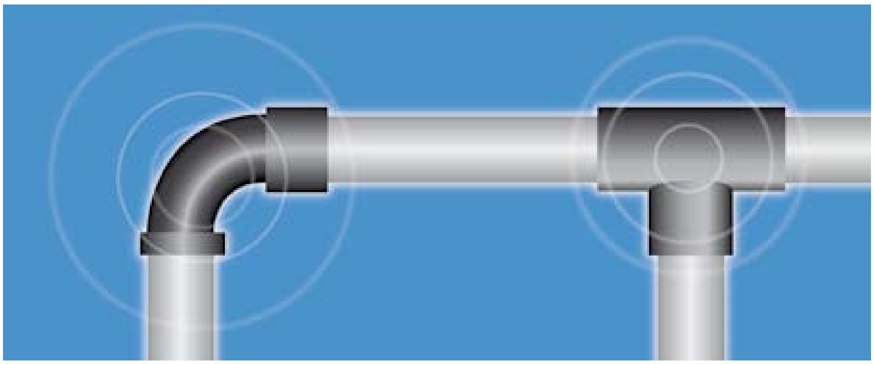
Sanitary systems, rain pipes and waste pipes conform to the D.P.C.M. 5/12/97 normative in the category of discontinuous sound systems.
L'ISOLANTE K-FLEX offers an easy solution to prevent the relevant problems, by wrapping K-FONIK ST GK 072 around the pipes. This prevents sound and vibration from spreading through the pipes.

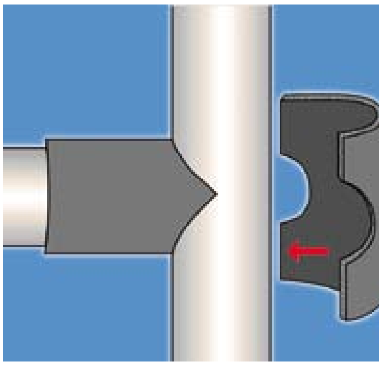


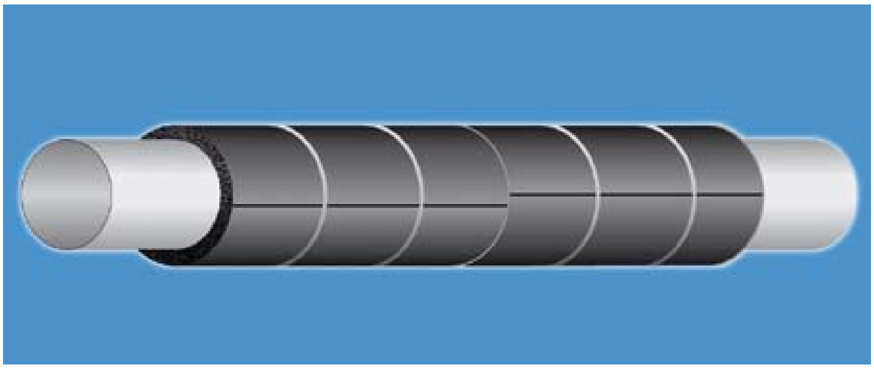
*** Sound insulation strength measured on drainage pipes (DIN EN 14366 and DIN 52 219: 1993-07)**

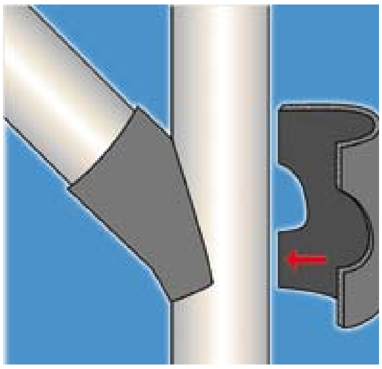
Water capacity [l/s]	0,5	1,0	2,0	4,0
Sound in the proximity of pipes without insulation	48 dB	52 dB	55 dB	57 dB
Sound in the proximity of pipes with K-FONIK ST GK 072	35 dB	39 dB	42 dB	45 dB
With K-FONIK ST GK 072 and 220 Kg/m^2 masonry (adjacent room)	4 dB	9 dB	14 dB	19 dB

**Refers to ST GK 072*









THERMAL INSULATION OF ROOF COVERINGS, FLAT ROOFS AND USABLE TERRACES

K-FLEX K-FONIK can be effectively used for thermal and acoustic insulation of flat roofs or usable terraces.

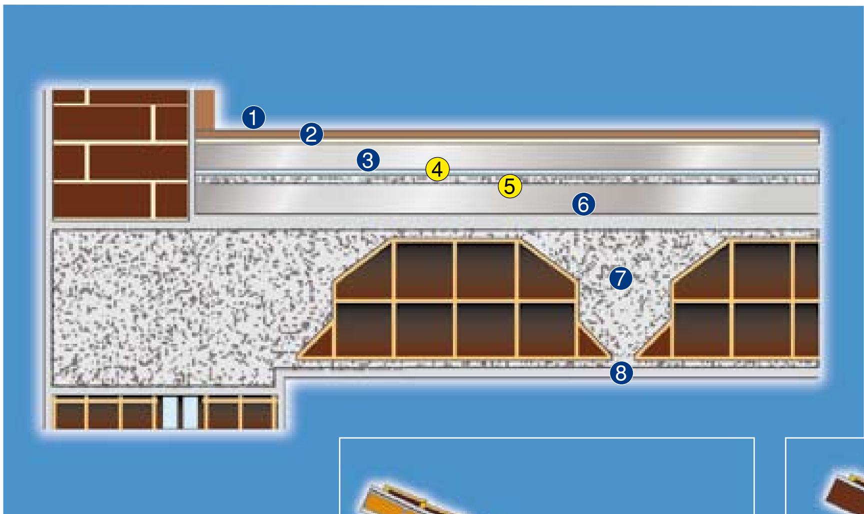
APPLICATION ADVICE

Position K-FONIK ST GK with a thickness of 10 or 15 mm, depending on the required thermal properties, above the bitumous layer.
K-FONIK ST GK can be easily layed directly onto the bitumous sheath.

PITCHED ROOFS

Thermal insulation of a pitched roof can be made on the extrados (under the tiles) or on the intrados of the pitch, especially in the case of wooden roofs. Obviously the most common solution is to insulate the covering using thermal insulation on the last floor (loft).

For these purposes, the most effective products are K-FLEX ST or K-FLEX ST DUCT, depending on the specific needs. Information regarding material characteristics can be found on page 27.



Description of components	
1	Covering
2	Tile adhesive
3	Ground bearing floor slab
4	K-FLEX ST GK
5	Bituminous layer
6	Slope screed
7	Floor
8	Plaster

Description of components	
1	K-FLEX ST
2	Tiles

Description of components	
1	K-FLEX ST
2	Floor

TECHNICAL CONSIDERATIONS

THERMAL BRIDGES

The following are considered to be thermal bridges:

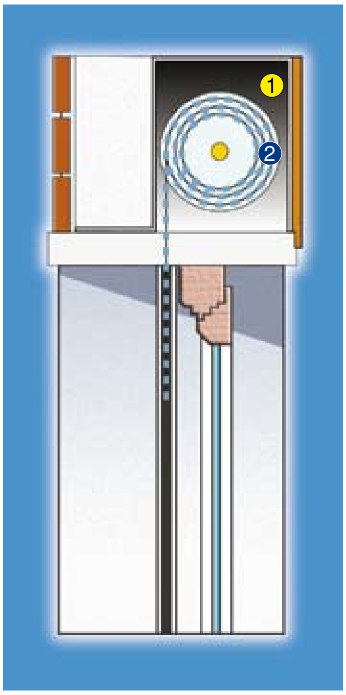
- Morphological bridges, these are caused by discontinuity of wall shapes such as corners, edges, trihedrons etc.
- Structural bridges, these are caused by the insertion of high conductivity material inside the insulation masonry (for example, reveals, pillars, edge beams, metal elements, etc.).
- Widespread bidges, these are caused by widespread heterogeneity in the structure such as traditional mortar joints inside walls made of insulating blocks.

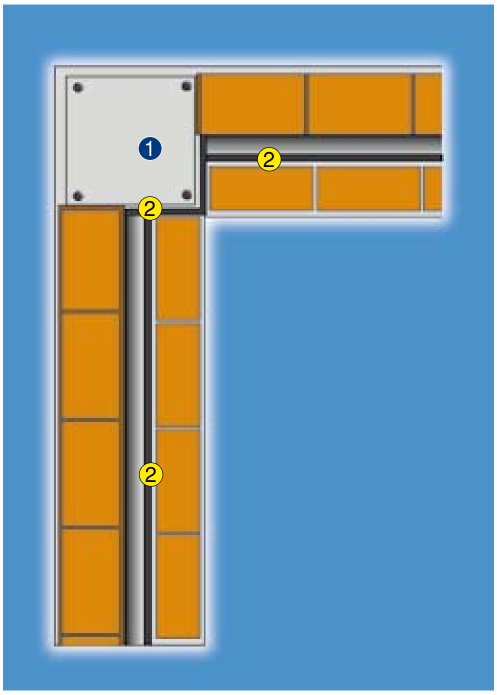
TIPS FOR SOLVING PROBLEMS

Thermal bridges must be repaired in compliance with the law 1O/91, which stipulates a minimum wall surface temperature to prevent damages caused by the effects of condensation which would be extremely difficult to correct at a later stage.

In this case K-FLEX ST proves to be extremely effective for solving these problems and thanks to its high thermal resistant cellular structure, it makes an extremely effective vapour barrier.

Technical characteristics can be found on page 27.





Description of components	
1	K-FLEX ST
2	Roller

Description of components	
1	Pillar
2	K-FLEX ST with thermal insulation and vapour barrier function

TECHNICAL SHEETS

K-FLEX K-FONIK SYSTEM

Special products for acoustic insulation

Product description:

K-FONIK ST GK is a viscoelastic acoustic insulation product, made with partially reticolated polymers and mineral fillers.
The product is made with the following structures:

-K-FONIK ST GK 072 (3 mm high-density elastomer with 10 mm nitrilic rubber).

-K-FONIK GK (3 mm high-density elastomer).

Their special sound insulation characteristics make this an excellent product for traditional applications in the construction sector, eg. acoustic insulation of floors, brick walls and plasterboards.

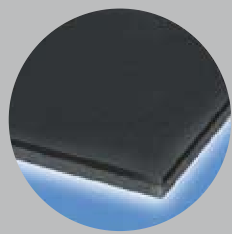
Technical Characteristics	K-FONIK ST GK 072	K-FONIK GK
Thickness	3 mm + 10 mm	3 mm
Width	1.000 mm	1.000 mm
Length	1.500 mm	1.200 mm
Temperature range	-30 °C + 116° C	-30 °C + 116 °C
Precise weight	1.300 – 1.400 Kg/m³	1.300 – 1.400 Kg/m³
Mechanical resistance to pressure (High-density elastomer)	10% - 4 Kg/cm² 25% - 15 Kg/cm² 50% - 44 Kg/cm²	
Ultimate elongation % Breaking load N/mm²	>100 >1,5	> 100 >1,5
Corrosion risk	DIN 1988/7, ph neutral	DIN 1988/7, ph neutral
Fire	BS 476 Pt. 6 1989 Cl. 0 (UK)	
Ecological data	CFC and HCFC free	CFC and HCFC free
Thermal conductivity λ EN 12667 (DIN 52612) – EN ISO 8497 (DIN 52613)	– 20°C = 0,034 W/(m•K) 0°C = 0,036 W/(m•K) +20°C = 0,038 W/(m•K)	Non Applicabile
Sound reduction index UNI EN ISO 140-3 UNI EN ISO 717-7	RW 26 dB	RW 25 dB
Weighted sound reduction index for lightweight plasterboard walls on a metal frame	RW 48 dB	
Weighted sound reduction index for false plasterboard walls on a metal frame	RW 49 dB	
Weighted sound reduction index for partitioning walls	RW 57 dB	

***Weighted sound reduction index measured on drainage pipes (DIN EN 14366 and DIN 52 219: 1993-07)**

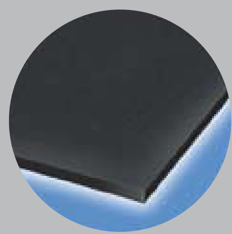
Water capacity [l/s]	0,5	1,0	2,0	4,0
Sound in the proximity of pipes without insulation	48 dB	52 dB	55 dB	57 dB
Sound in the proximity of pipes with K-FONIK ST GK 072	35 dB	39 dB	42 dB	45 dB
With K-FONIK ST GK 072 and 220 Kg/m² masonry (adjacent room)	4 dB	9 dB	14 dB	19 dB

**Refers to ST GK 072*

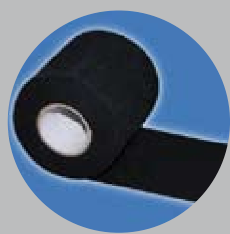
ST GK 072



GK



K-FONIK ST PERIMETER STRIPS



thickness 6 mm
lengths 50-75-100 mm

K-FLEX ST INSULATION SHEETS

K-FLEX ST offers all the requirements to meet the many needs of the construction sector. Excellent thermal insulating properties and high vapour resistence make this product the ideal solution, offering exceptional long term high performance.

Rolls: 1000 mm width		Rolls: 1500 mm width	
STANDARD	ADHESIVE WITH NET *	STANDARD	ADHESIVE WITH NET*
Thickness mm	Thickness mm	Thickness mm	Thickness mm
6	6	6	6
10	10	10	10
13	13	13	13
16	16	16	16
19	19	19	19
25	25	25	25
32	32	32	32
40	40	40	40
50	50	50	50
60			

*NET= reinforcing mesh

Coverings:
- ALU
(alluminium and polyester foil)

SHEETS AND ROLLS
with or without adhesive

TECHNICAL DATA

TECHNICAL DATA

Temperature range	-200 °C max +116 °C**
Thermal conductivity λ W/(m·K) EN 12667 (DIN 52612) - EN ISO 8497 (DIN 52613)	-20 °C = 0,034 0 °C = 0,036* +20 °C = 0,038
Thermal conductivity λ W/(m·K) L10 EN 12667 (DIN 52612) - EN ISO 8497 (DIN 52613)	+40 °C = 0,040 W/(m·K)
Corrosion risk	DIN 1988/7*; pH neutral
Permeability μ EN 12086 (DIN 52615)	**≥ 7000***
Fire	Cl. “0” BS 476 P 6/7 1989

* Supervised by an independent Institute **For applications at a temperature lower than –50 °C, please contact our Technical Office.

K-FLEX ST INSULATION SHEETS

K-FLEX ST DUCT

A system developed to meet the needs of todays contracting industry.

K-FLEX DUCT

K-FLEX DUCT
Self-adhesive with reinforced mesh

Width: 1500/1800 mm

K-FLEX DUCT AL CLAD SYSTEM

K-FLEX DUCT self-adhesive with AL CLAD SYSTEM covering (thickness 300 μ) and reinforced mesh
UV protection

Width: 1500 mm

INDOOR / OUTDOOR · UV RESISTANT

K-FLEX DUCT ALU

K-FLEX DUCT self-adhesive sheet finished with smooth aluminium foil (thickness 80 μ) and with reinforced mesh.

Width: 1500 mm

K-FLEX DUCT NET COLOR SYSTEM

K-FLEX DUCT self-adhesive sheet with COLOR coating and with reinforced mesh.
UV protection

Width: 1500 mm

INDOOR / OUTDOOR · UV RESISTANT

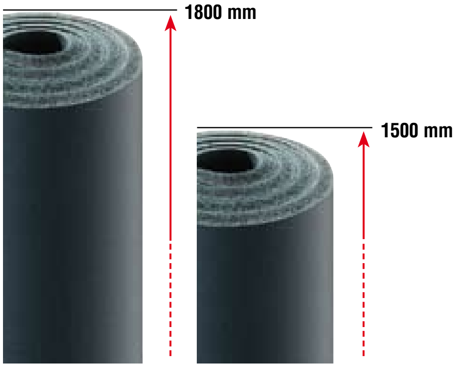
Color range in stock:

- RAL 5012 Blue
- English Green
- RAL7035 Grey
- RAL 9002 White
- Red
- RAL 9011 Black
- RAL1019 Sand
- RAL 3015 Pink

Thicknesses/mm
6 - 8 - 10 - 12 - 15 - 20 - 30

NEW

ELASTOMERIC SHEET
available in widths up to
1800 mm



K-FLEX DUCT:

EASILY INSTALLED: *flexible and easy to handle, the 1500/1800 mm width is the ideally suited for ducts.*
QUALITY*: designed to improve the adhesion on metal surfaces.*
ECONOMICAL: *reduces the installation time and consequently the final cost of pre-fabricated ducts.*

K-FLEX DUCT is packaged in a heavy blue PE bags which clearly distinguishes it from other insulations.
K-FLEX DUCT is distributed on pallets.

TECHNICAL DATA

Temperature range	-40 °C to +105 °C
Thermal conductivity λ W/(m·K) EN 12667 (DIN 52612)	-20 °C = 0,034 0 °C = 0,036* +20 °C = 0,038
Thermal conductivity λ W/(m·K) L10 EN 12667 (DIN 52612)	+40 °C = 0,040 W/(m·K)
Corrosion risk	DIN 1988/7*; pH neutral
Permeability μ EN 12086 (DIN 52615)	≥ **5000**
Fire	Class “O” BS 476 P 6/7 1989

Supervised by an independent Institute

L'ISOLANTE K- FLEX reserve the right to change data and technical requirements without notice.

ACOUSTIC CERTIFICATES

REDUCTION OF THE IMPACT SOUND LEVEL

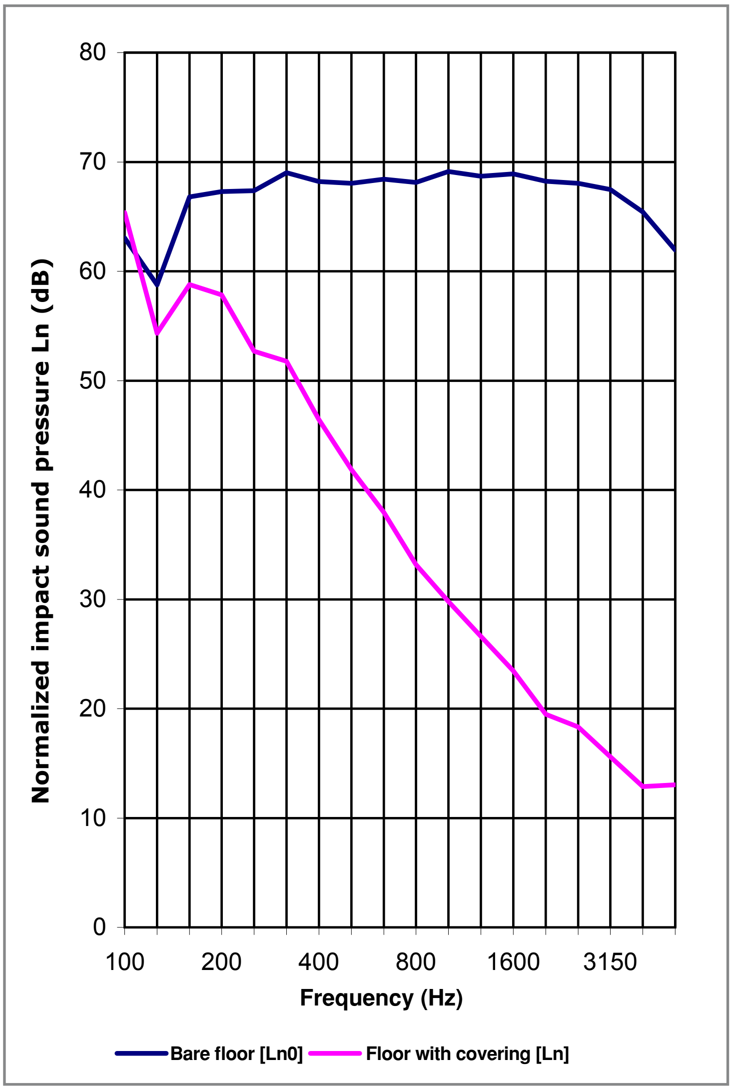
UNI EN ISO 140-8   UNI EN ISO 717-2

Client: L'ISOLANTE K-FLEX
Tested element: K-FLEX ST 6 mm
Date of test: 31/7/2007

Ln0 = Normalized impact sound pressure of the bare floor
Ln = Normalized impact sound pressure of the floor with tested covering
ΔL = Ln0-Ln = Weighted impact noise level attenuation

Ambient conditions: 27 °C 40% UR
Area of absorption equiv. Ao = 10 m^2
Volume of the receiving room V = 52 m^3

FREQ. (Hz)	Ln0 (dB)	Ln (dB)	ΔL (dB)
100	63,0	65,4	-2,3
125	58,8	54,3	4,4
160	66,8	58,8	8,0
200	67,3	57,8	9,4
250	67,4	52,7	14,7
315	69,0	51,8	17,2
400	68,2	46,4	21,8
500	68,0	41,9	26,2
630	68,4	37,9	30,5
800	68,1	33,2	34,9
1000	69,1	29,8	39,3
1250	68,7	26,6	42,1
1600	68,9	23,5	45,5
2000	68,2	19,5	48,7
2500	68,0	18,3	49,7
3150	67,5	15,6	51,9
4000	65,4	12,9	52,6
5000	61,9	13,0	48,9



Evaluation according to ISO 717-2 between 100 and 3150 Hz based on measurements obtained in the laboratory with an artificial source.

Ln0,w	=	74	dB
Ln,w	=	50	dB
Lnr0,w	=	78	dB
Lnr,w	=	53	dB
ΔLw	=	25	dB

CI,r,0	=	-11	dB
CI,r	=	3	dB
CI,Δ	=	-14	dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3   UNI EN ISO 717-1

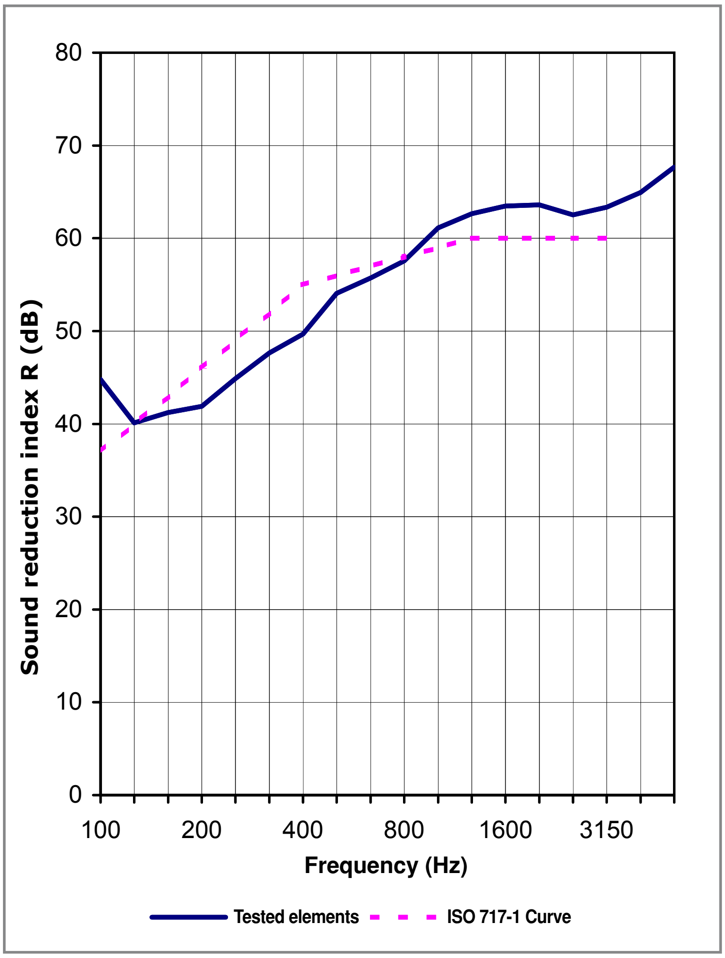
Client: L'ISOLANTE K-FLEX
Tested element: Hollow brick (12 cm) + K-FONIK ST GK 072 (13 mm) + 8 cm hollow brick
Date of test: 10/7/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of sound pressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))
Tested sound: white noise

Ambient conditions: 23 °C 60% UR
Area of sample S = 13,4 m^2
Volume of the receiving room V = 98 m^3
Volume of the emitting room 85 m^3

FREQ. (Hz)	R (dB)
100	44,8
125	40,1
160	41,2
200	41,9
250	44,9
315	47,6
400	49,7
500	54,1
630	55,7
800	57,6
1000	61,1
1250	62,7
1600	63,5
2000	63,6
2500	62,5
3150	63,3
4000	64,9
5000	67,7

Evaluation according to ISO 717-1 (100 ÷3150 Hz) based on measurements obtained in the laboratory.



Rw = 56 dB
C = -1 dB
Ctr = -5 dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3 UNI EN ISO 717-1

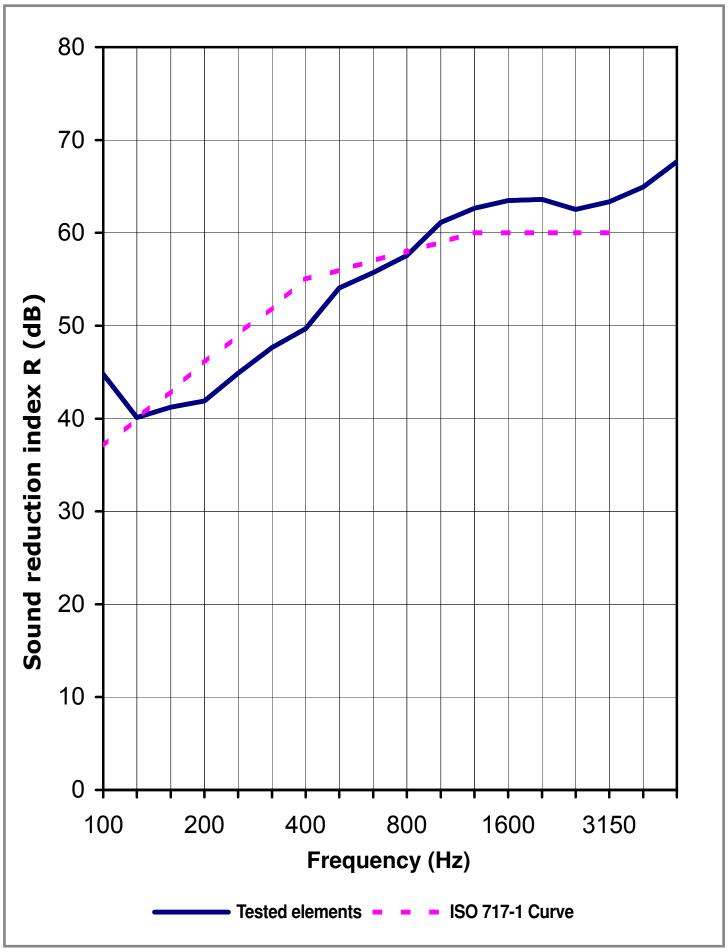
Client:	L'ISOLANTE K-FLEX
Tested element:	hollow brick (12 cm) + K-FONIK ST GK 072 + K-FLEX ST 32 mm + 8 cm hollow brick
Date of test:	12/7/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of sound pressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))

Tested sound: white noise

Ambient conditions: 23 °C 60% UR
Area of sample S = 13,4 m^2
Volume of the receiving room V = 97 m^3
Volume of the emitting room 85 m^3

FREQ. (Hz)	R (dB)
100	43,4
125	40,4
160	37,8
200	42,5
250	44,6
315	48,3
400	50,9
500	55,0
630	57,0
800	59,3
1000	61,7
1250	63,4
1600	64,4
2000	63,8
2500	62,5
3150	63,6
4000	65,4
5000	68,2



Evaluation according to ISO 717-1 (100 ÷3150 Hz) based on measurements obtained in the laboratory.

Rw = 57 dB
C = -2 dB
Ctr = -6 dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3 UNI EN ISO 717-1

Client: L'ISOLANTE K-FLEX

Tested element: Double 12,5 mm plasterboard + K-FONIK GK 3 mm + 75 mm hollowmetal frame + K-FONIK GK 3 mm + double 12,5 mm plasterboard

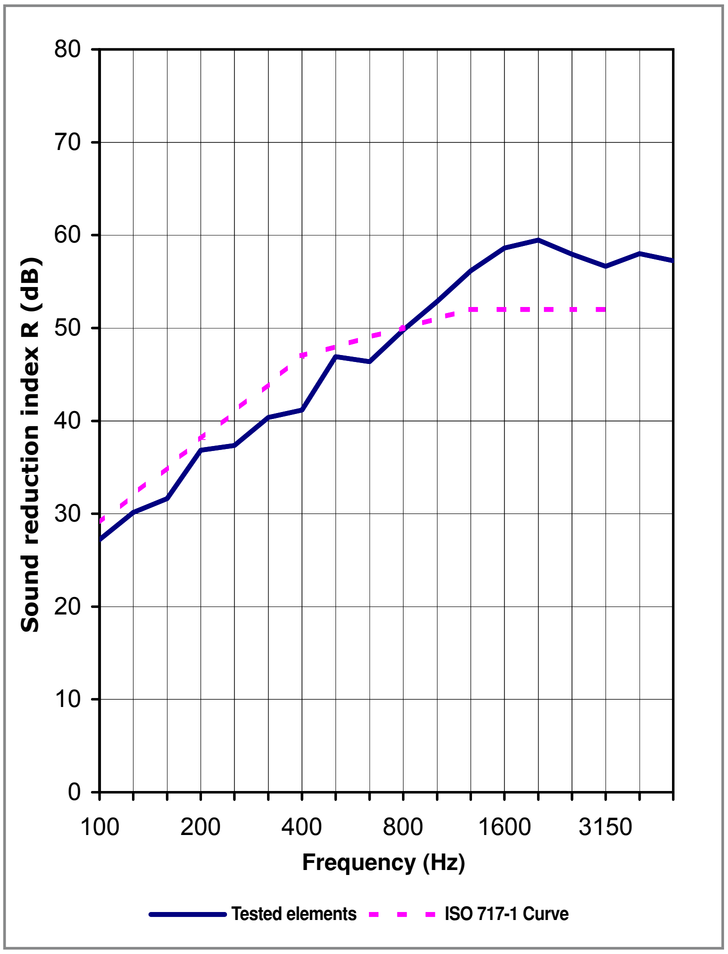
Date of test: 6/9/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of sound pressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))

Tested sound: white noise

Ambient conditions: 23 °C 50% UR
Area of sample S = 13,4 m²
Volume of the receiving room V = 100 m³
Volume of the emitting room 85 m³

FREQ. (Hz)	R (dB)
100	27,2
125	30,1
160	31,6
200	36,8
250	37,3
315	40,4
400	41,2
500	46,9
630	46,4
800	49,8
1000	52,9
1250	56,2
1600	58,6
2000	59,5
2500	57,9
3150	56,6
4000	58,0
5000	57,3



Evaluation according to ISO 717-1 (100 ÷ 3150 Hz) based on measurements obtained in the laboratory.

Rw = 48 dB
C = -1 dB
Ctr = -6 dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3 UNI EN ISO 717-1

Client: L'ISOLANTE K-FLEX

Tested element: Single plasterboard (12.5 mm) + K-FONIK GK 3 mm + 75 mm hollowmetal frame + K-FONIK GK 3 mm + Single 12,5 mm plasterboard

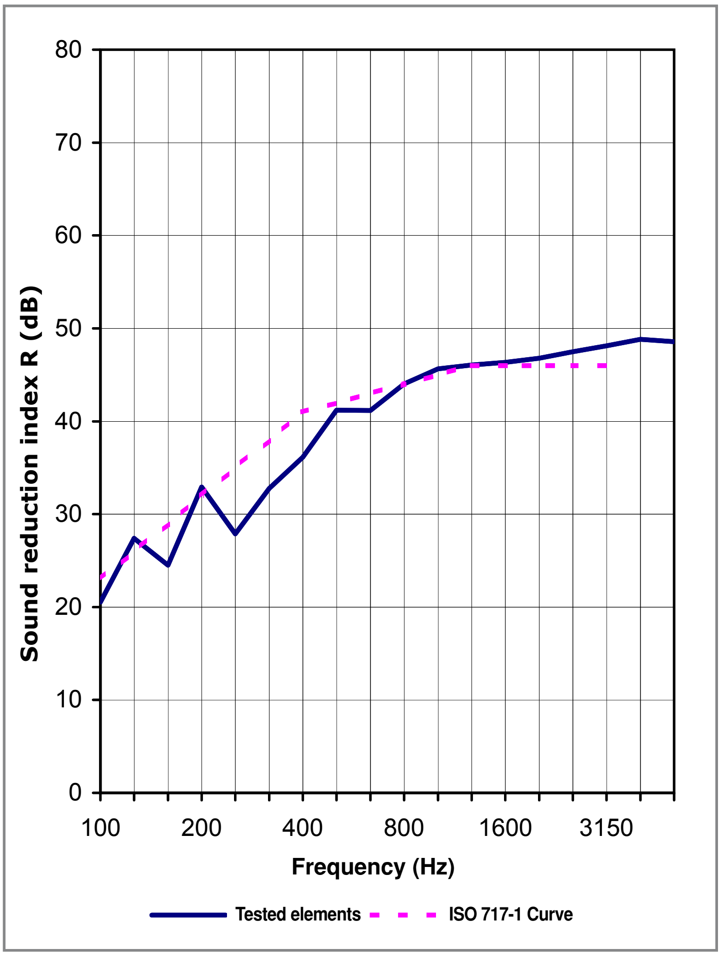
Date of test: 5/9/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of sound pressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))

Tested sound: white noise

Ambient conditions: 23 °C 50% UR
Area of sample S = 13,4 m²
Volume of the receiving room V = 100 m³
Volume of the emitting room 85 m³

FREQ. (Hz)	R (dB)
100	20,5
125	27,4
160	24,5
200	32,9
250	27,9
315	32,8
400	36,1
500	41,2
630	41,1
800	44,0
1000	45,6
1250	46,0
1600	46,3
2000	46,8
2500	47,5
3150	48,1
4000	48,8
5000	48,6



Evaluation according to ISO 717-1 (100 ÷ 3150 Hz) based on measurements obtained in the laboratory.

Rw = 42 dB
C = -2 dB
Ctr = -7 dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3 UNI EN ISO 717-1

Client: L'ISOLANTE K-FLEX

Tested element: hollow 8 cm brick + K-FONIK ST GK 072 + 75 mm hollowmetal frame + 12.5 mm plasterboard

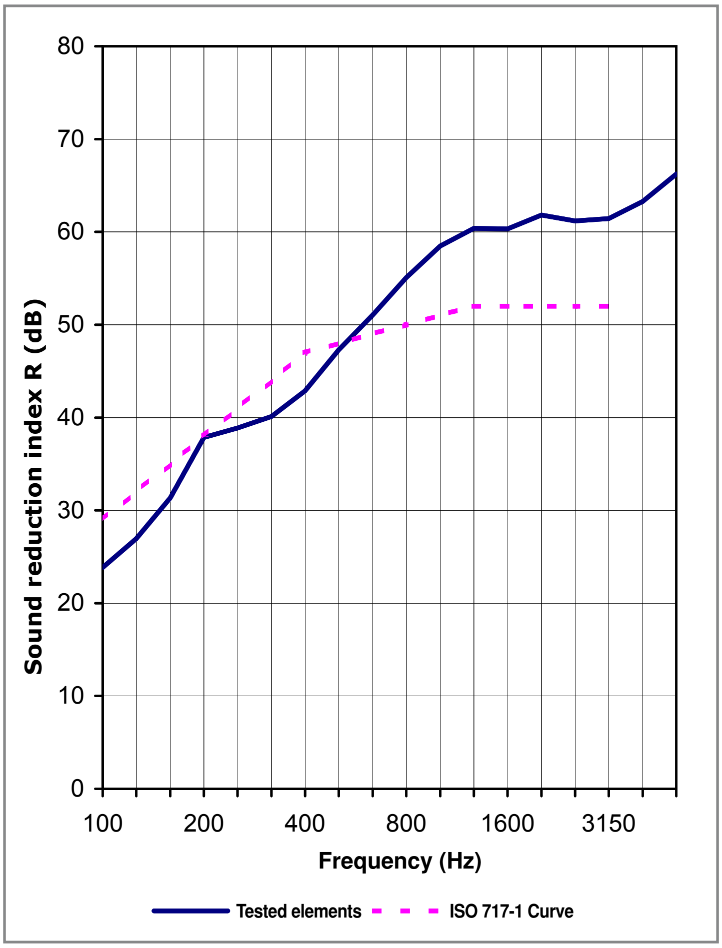
Date of test: 16/7/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of sound pressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))

Tested sound: white noise

Ambient conditions: 23 °C 60% UR
Area of sample S = 13,4 m^2
Volume of the receiving room V = 100 m^3
Volume of the emitting room 85 m^3

FREQ. (Hz)	R (dB)
100	23,8
125	26,9
160	31,3
200	37,9
250	38,9
315	40,1
400	42,9
500	47,3
630	51,0
800	55,1
1000	58,5
1250	60,4
1600	60,3
2000	61,8
2500	61,2
3150	61,4
4000	63,3
5000	66,2



Evaluation according to ISO 717-1 (100 ÷ 3150 Hz) based on measurements obtained in the laboratory.

Rw = 48 dB
C = -2 dB
Ctr = -8 dB

SOUND REDUCTION INDEX R

UNI EN ISO 140-3 UNI EN ISO 717-1

Client: L'ISOLANTE K-FLEX

Tested element: hollow 8 cm brick + K-FONIK ST GK 072 + 1 glued plasterboard 12,5 mm

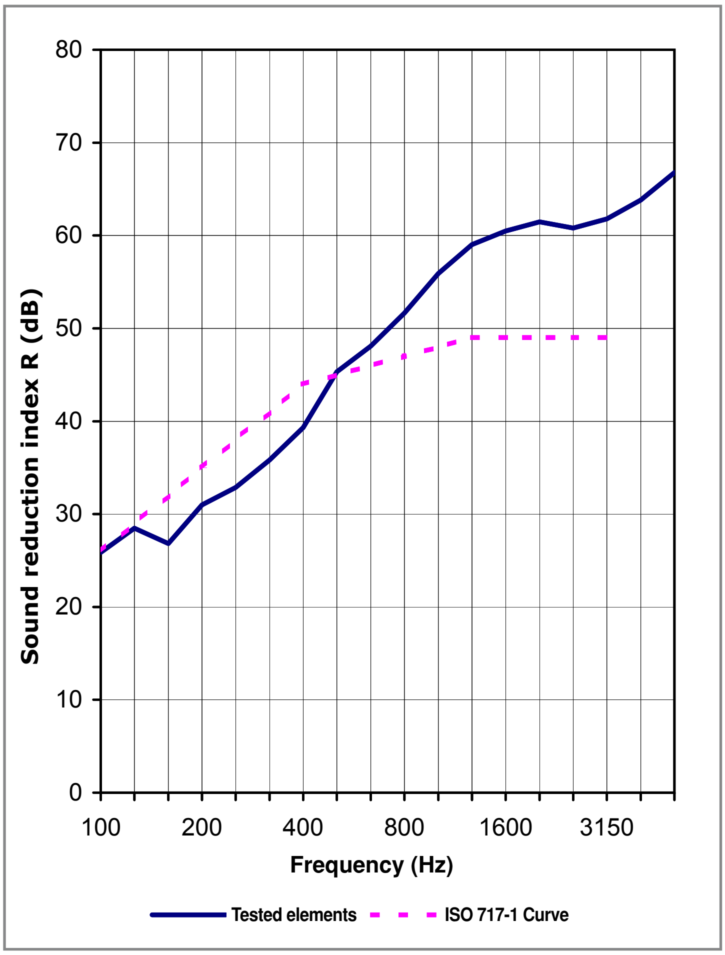
Date of test: 17/7/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of soundpressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))

Tested sound: white noise

Ambient conditions: 23 °C 60% UR
Area of sample S = 13,4 m^2
Volume of the receiving room V = 100 m^3
Volume of the emitting room 85 m^3

FREQ. (Hz)	R (dB)
100	25,9
125	28,5
160	26,8
200	31,0
250	32,9
315	35,8
400	39,3
500	45,3
630	48,1
800	51,6
1000	55,9
1250	59,0
1600	60,5
2000	61,5
2500	60,8
3150	61,8
4000	63,8
5000	66,8



Evaluation according to ISO 717-1 (100 ÷ 3150 Hz) based on measurements obtained in the laboratory.

Rw = 45 dB
C = -1 dB
Ctr = -6 dB

SOUND REDUCTION INDEX R

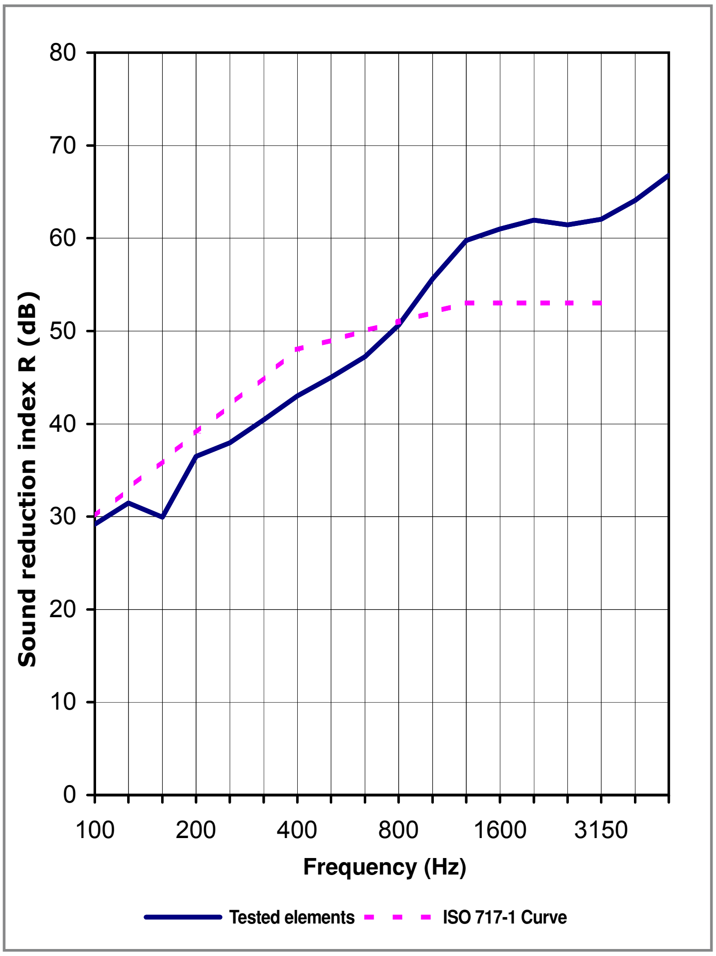
UNI EN ISO 140-3 UNI EN ISO 717-1

Client: L'ISOLANTE K-FLEX
Tested element: hollow 8 cm brick + K-FONIK ST GK 072 + 2 glued plasterboard 12,5 mm
Date of test: 17/7/2007

L1 = Medium level of sound pressure in the emitting room
L2 = Medium level of soundpressure in the receiving room
T = Mean reverberation time in the receiving room
R = Sound reduction index = L1 - L2 + 10 LOG ((S x T)/(0,16 x V))
Tested sound: white noise

Ambient conditions: 23 °C 60% UR
Area of sample S = 13,4 m^2
Volume of the receiving room V = 100 m^3
Volume of the emitting room 85 m^3

FREQ. (Hz)	R (dB)
100	29,2
125	31,5
160	29,9
200	36,5
250	37,9
315	40,4
400	43,0
500	45,0
630	47,2
800	50,6
1000	55,6
1250	59,7
1600	61,0
2000	62,0
2500	61,4
3150	62,1
4000	64,1
5000	66,8



Evaluation according to ISO 717-1 (100 ÷ 3150 Hz) based on measurements obtained in the laboratory.

Rw = 49 dB
C = -2 dB
Ctr = -7 dB

ACOUSTIC INSULATION

The tests fulfill the requirements of the DIN 4109 normative (Germany) which takes into consideration more restrictive standards compared to the DPCM 31/12/97 normative (Italy) which requires a maximum sound pressure level = 35dB

DIN 4109/A1: 2001-01 normative for residential buildings

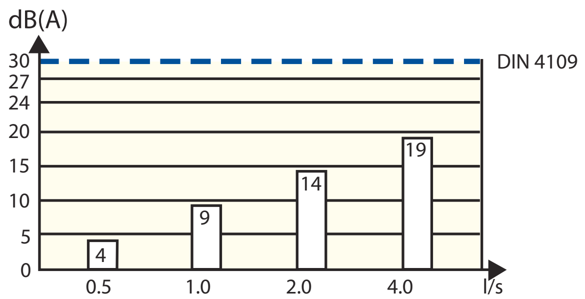
The maximum sound pressure level for discontinuous working systems of Lin ≤ 30dB is the maximum permitted for sanitary installations in residential buildings in Germany.

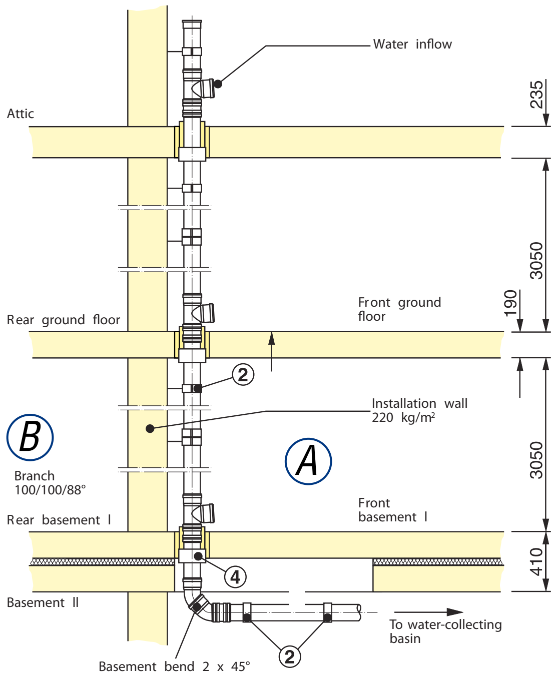
DIN 4109 normative

For other types of buildings, non residential, the maximum sound pressure level is ≤ 35dB.

Sound pressure level L_{In} [dB(A)]				
Water capacity[l/s]	*0,5*	*1,0*	*2,0*	*4,0*
Area:	***First floor Area A***			
Without K-FONIK GK 072	*48*	*52*	*55*	*57*
With K-FONIK GK 072	*35*	*39*	*42*	*45*
Area:	***First floor Area B***			
Without K-FONIK GK 072	*14*	*18*	*24*	*27*
With K-FONIK GK 072	*4*	*9*	*14*	*19*

Extract of the Fraunhofer Institute No. P-BA 247/2006 certificate





Graphic representation of the Fraunhofer institute test method for drainage systems
(DIN EN 14366 - DIN EN 52219)